

Hy4Heat | Hydrogen-Ready Wall-Mounted Gas Boilers

Worcester Bosch

www.worcester-bosch.co.uk/hydrogen

Worcester Bosch

Worcester Bosch is a leading manufacturer of energy-efficient heating and hot water solutions in the UK. Our product range includes gas and oil boilers, hot water cylinders, renewable technologies such as heat pumps and solar water heating systems, as well as controls and accessories. In 2020, Bosch became the first major global industrial concern to become scope 1 & 2 carbon neutral at all 400 of its sites. We are developing low-carbon solutions for heat and power, including both electrification and hydrogen technologies.

Worcester Bosch is a partner in two work packages of Hy4Heat; WP4 (domestic appliance development) and WP5b (commercial appliance development). Under WP4, we have developed the Greenstar 8000 Hydrogen-Ready gas condensing boiler. Under WP5b, we have developed and demonstrated the Regular appliance as a cascade solution, supporting commercial applications up to 480 kW.



Worcester Bosch manufactures at UK sites in Worcester and Clay Cross in Derbyshire

WP4 | Greenstar 8000 Hydrogen-Ready

Bosch has developed two 30 kW boiler; the Combi (which produces instantaneous hot water) and the Regular (intended to support a hot water cylinder).

The boilers are direct like-for-like replacements for existing natural gas boilers and provide heating and hot water in exactly the same way as their natural gas counterparts.

Heating with Hydrogen

In order to develop hydrogen-burning appliances, a range of technical challenges have been addressed.

Hydrogen has a lower calorific value (energy content) than natural gas, but it is also much less dense (lighter). These two differences cancel each other out, with the surprising result that hydrogen is very similar to natural gas in the way it carries energy through pipes. Most of the technical challenges come from hydrogen's much higher flame speed, although it is also difficult to detect the flame, because pre-mixed hydrogen flames can be invisible to both the naked eye, and existing boilers' electrical detection systems.

Hydrogen-Ready

Hydrogen-Ready allows consumers to install green technology ahead of gas network conversion to hydrogen. Hydrogen-Ready boilers are designed for hydrogen but can initially be configured to run on natural gas. They can be installed as direct replacements for existing natural gas boilers. They can be converted to hydrogen at the time of network switchover by changing a minimum number of components, taking no longer than an hour.

While the Prototype 1.0 appliances that have been certified



H21 HyStreet Spadeadam



Components changed in conversion

and released for demonstration trials burn 100% hydrogen only, Prototype 2.0 appliances are hydrogen-ready; capable of burning natural gas including blends of up to 20% hydrogen, and also 100% hydrogen.

Demonstration

In September 2020, the first domestic hydrogen boiler demonstration was installed and commissioned at H21's HyStreet at DNV Spadeadam. It has operated for a year heating a typically constructed end-of-terrace house.

A second appliance is being demonstrated at BEIS, NGN & Cadent's Hydrogen Home near Gateshead.

In 2020, an appliance was also demonstrated in the Netherlands in a hydrogen network demonstration conducted by Stedin in the town of Uithoorn.

Performance

The thermal output, system temperature range and speed of response of hydrogen-firing boilers are identical to those of natural gas boilers. The thermal efficiency of appliances is slightly lower while burning hydrogen, but only by a small margin that would not be noticeable an end user, and keeps the boiler in efficiency class A.

Hydrogen-burning boilers have been measured to produce very low levels of NO_x. Two demonstration appliances have been independently tested to verify NO_x emissions.



Hydrogen Home, Gateshead

Dimensions (h×w×d)	780×440×365 mm
Weight (unpacked, dry)	53.7 kg
Maximum hot water flow rate	11 l/min
Max. rated heat output	30.0 kW
Space heating efficiency class	A
Water heating efficiency class	A
NO _x emissions	< 25 mg/kWh

Performance of the Prototype 1.0 appliance

WP5b | HyLife Cascade

The HyLife cascade system provides a hydrogen-ready solution for commercial heating applications up to 512 kW. Under WP5b, the hydrogen-ready boiler has been developed and demonstrated to deliver cascade functionality with the MC400 Cascade Sequencer. The MC400 is an intelligent sequencing module for up to four boilers. Multiple sequencers can be connected together for control of up to 16 cascaded boilers. The Regular boiler now incorporates a range of physical and control features to support cascading.



Demonstrated 180 kW six boiler cascade

Demonstration

A six-boiler cascade was demonstrated incorporating two hydrogen-burning boilers (due to constraints in available fuel supply). The cascade incorporated the electronic, hydraulic and flue arrangement of a commercial cascade system. The cascade was demonstrated operating in a range of different sequencing and modulation regimes reflecting the capabilities of the MC400.

Next Steps

The Greenstar 8000 Hydrogen-Ready will be released for Community and Neighbourhood Trials in 2022. Product industrialisation depends upon significant investment, and we rely on government to provide clarity and commitment to gas network conversion. In order to benefit from economies of scale, which have the potential to deliver appliances of equivalent cost to existing natural gas boilers, a synchronised and wide-scale technology switch is needed. This could be coordinated through a regulatory mandate for hydrogen-ready boilers.

