H2 VOR ORT

Heating with hydrogen: easily adapted and a real plus for climate protection and energy sovereignty in Germany

The building sector in Germany accounts for 35 percent of final energy consumption and 30 percent of CO_2 emissions. Accordingly, the coming years will be decisive for the transition of this sector towards climate neutrality. In addition to energy-efficient building renovation and heating with green electricity and solar thermal energy, the use of climate-neutral gases such as green hydrogen is indispensable in order to safely achieve the climate goals in the building sector and gradually reduce dependence on fossil energy imports.

Hydrogen: Climate-neutral fuel for half of all German households & many commercial and industrial enterprises

The heat supply in Germany is currently still largely based on natural gas; almost 50 percent[1] of all German homes are heated with it. In addition to about 21 million households and the majority of public buildings, more than 1.8 million industrial and commercial customers use natural gas to heat their buildings or to carry out their processes. A distinction is made here between space heating and process heating. Across all sectors, 47 percent of net heat generation in Germany was covered by natural gas in 2020.[2]

The disadvantage: heat generated from natural gas leads to CO_2 emissions and thus harms the climate in the long term. In addition, the import of natural gas from predominantly only one source, i.e. Russia, endangers the security of supply in Germany.

Making hydrogen usable for everyone via the gas distribution networks

In order to achieve the set goal of climate neutrality in heat generation while successively reducing dependence on imports of fossil fuels, fossil fuels must be gradually replaced by climate-neutral gases, among others, in the coming years. These include biomethane and low carbon or green hydrogen. The use of both gases enables a rapid reduction of CO_2 emissions in the heating sector – with little effort and more quickly than a change in heating technology can achieve.

In the coming years, more and more green hydrogen from Germany, Europe and other regions of the world will become available here at decreasing costs. In contrast to today, we will obtain our energy from many participants in the hydrogen world market in the future. Throughout Europe and beyond, renewable energies are being expanded at an accelerated pace and electrolysers for the production of green hydrogen are being built in ever larger capacity classes. This will also make sufficient quantities available for the heating market. Furthermore, considerable additional volume potentials of biomethane and other green gases can be activated in a timely manner.

Switching to a heat supply with climate-neutral gases such as green hydrogen is worthwhile for both businesses and many households. Especially for existing buildings that currently use natural gas, the transition to hydrogen leads to quick and cost-efficient climate neutrality and creates independence from the price development of fossil fuels for households and businesses. When switching to climate neutral solutions, industry and the manufacturing sector are usually even dependent on the use of climate-neutral or green gases, because only these can generate the temperatures of over 500°C that are necessary for many production processes.

Gas grids and heating appliances are becoming H_2-ready

Hydrogen and natural gas do differ in volume, density, flow rate and calorific value. However, this is not a hurdle in practice: The blending of hydrogen up to certain quantities is already no problem for grids and heating systems and is already happening. Almost every existing heating device can handle hydrogen blends of up to 20 percent without problems. In a model region in the Fläming region of Brandenburg, around 400 older existing appliances from a wide range of manufacturers are already running on 20 percent hydrogen without any problems.

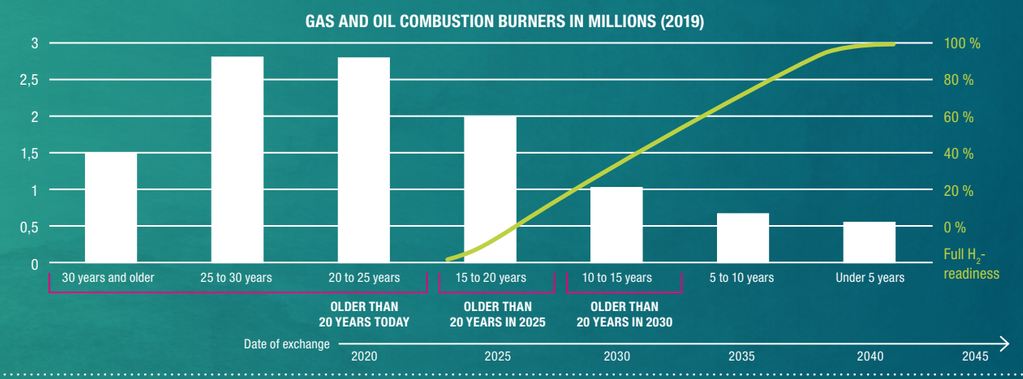
However, the transition to 100 percent hydrogen still requires action. To this end, measures must be taken in the gas grid and, in addition, the installation of heating appliances that can run on 100 percent hydrogen must begin soon. From 2025 at the latest – Viessmann is already planning a first model for 2024 – H_2-ready new appliances will be available. They burn natural gas and biomethane by default but can be converted for the operation with 100 percent hydrogen in two and a half hours and for a few hundred euros. The heating appliance industry is currently working on making these appliances available even earlier. In this way, the conversion of entire streets can take place very quickly.

H_2-ready: a new conventional gas heating system becomes fully hydrogen-compatible and thus independent of natural gas in three steps

[1] BDEW (2021): Beheizungsstruktur des Wohnungsbestandes in Deutschland 2021. https://www.bdew.de/service/daten-und-grafiken/beheizungsstruktur-wohnungsbestand-deutschland/
[2] BDEW (2022): Entwicklung der Nettowärmeerzeugung in Deutschland. https://www.bdew.de/service/daten-und-grafiken/entwicklung-der-nettowaermeerzeugung-in-deutschland/

As a general rule, a heating appliance should be replaced every 20 years. By then, at the latest, it is significantly less efficient than it was at the beginning of its service life due to wear and tear. In addition, more modern systems with significantly lower energy consumption are available on the market – a replacement therefore directly saves CO_2 and considerable heating and operating costs. Simply switching from an old gas heating system to the newer condensing technology brings energy savings of up to 30 percent. This effect is even more pronounced if an old oil-fired heating system is replaced by a modern gas-fired heating system: The emissions of a gas-fired heaters are - regardless of the increased efficiency – 10 percent lower than those of oil-fired heaters.[3] For existing heating systems without modern condensing technology, legislation requires mandatory replacement after 30 years. The relief package adopted by the coalition on 24 March 2022 stipulates that all 20-year-old heating systems are to be replaced. To this end, the gas boiler replacement programme of the federal Efficient Buildings Programme is to be optimised. In 2019, the average age of a heating system was 17 years, and only one third of all heating systems in Germany were less than 10 years old. If the natural replacement cycle of these heating systems is used in the coming years and they are replaced by modern devices, at least two thirds of all heating systems could be completely H_2-ready by 2030.

600,000 burners per year – at the end of their service life – **will be replaced by H_2-ready appliances.** By 2045, this will be the entire system stock.



Calculation of heater age based on: Annual surveys Association of Chimney Sweeps: https://www.schornsteinfeger.de/sonderdruck-2020.pdfx?forced=true
Both gas and oil-fired systems

Provided that the buildings are supplied with climate-neutral or green gases, the heat generation of every building equipped with this heating technology is CO_2-neutral and fossil-free. By using the existing gas infrastructure, large quantities of climate-neutral energy can be supplied to the building sector quickly – independent of the progress of the renovation measures.

Condensing boilers and fuel cells – efficient heat generation for the building sector

Hydrogen, or green gases, can be converted into heat using different processes. Condensing technology is an already established, modern combustion system of the heating sector; the mode of operation with hydrogen is identical to that with other gases. In the condensing boiler, circulating water in the heating system is heated by the combustion of hydrogen. This makes very efficient use of the energy content of the fuels used, which is significantly higher with hydrogen than with other gases. The heating system can additionally be supplemented by the use of solar thermal systems on the roof, which further increase the efficiency of the system. In the heating period, direct heating with hydrogen is just as efficient as heating with an electric heat pump, since the often not very efficient conversion of hydrogen into electricity is not necessary.[4]

In addition to the condensing boiler, the use of hydrogen in a fuel cell is another option for heat generation. However, the mode of operation of the fuel cell differs significantly from the classic combustion method. The principle of "cold combustion" is used, a controlled electrochemical reaction between hydrogen and oxygen, in which electricity, heat and water are generated simultaneously. Due to the dual use for heat and power generation, the fuel cell is extremely efficient and thus saves operating costs. The heat generated can be used to heat the building and operate the hot water supply. The electricity generated can either be used directly in the house or fed into the public grid. In addition, the operating costs of the heating system can be further reduced through the remuneration of this feed-in. Alternatively, if not used immediately, the electricity produced can be stored in batteries on site, for example directly in one's own electric car. In this way, fuel cell heaters function as small decentralised power plants that can help to generate electricity according to demand in a more electrified world in the future and thus relieve the burden on the electricity grids.

[3] Vaillant in accordance with BMWi: https://www.vaillant.de/heizung/heizung-verstehen/tipps-rund-um-ihre-heizung/emissionen/
[4] Study „Wasserstoff zur Dekarbonisierung des Wärmesektors" (https://www.dvgw.de/medien/dvgw/forschung/berichte/g202101-h2-waermemarkt-abschlussbericht.pdf)

Can we become worldwide technology leaders with heating appliances "Made in Germany"?

The use of H_2-ready heating appliances not only has environmental and energy policy advantages. These climate-neutral technologies have the potential to become an export hit in demand worldwide and thus to create long-term added value and skilled jobs in Germany. Numerous industrialised countries and EU member states have set ambitious climate protection targets, want to reduce their dependence on individual importing countries by reducing fossil energy imports, and are testing the blending of hydrogen in higher concentrations in the natural gas grid, as the UK is already doing. German heating manufacturers are among the technological leaders in the development of H_2-ready heating appliances and their components. In addition, the "Made in Germany" label continues to stand as a sign of high quality – especially abroad. An ambitious, rapid conversion of heating appliances and gas distribution networks to hydrogen would thus not only have enormous potential for Germany to reduce greenhouse gas emissions, but would also lead to increased value creation and more future-proof jobs. Converting heating appliances to hydrogen would thus benefit not only households and industry, but also Germany as a business location.

Germany as an industrial location: Hydrogen-capable heating systems have the potential to become the next export hit „Made in Germany"

[1] https://www.bmwk.de/Redaktion/DE/Dossier/wasserstoff.html

The conversion and inspection of all heating appliances is possible with good preparation by the gas distribution system operators and the regional trade. This is proven by the market area conversion currently underway: Since 2019, a good 10 percent of the heating appliances affected will be converted to high-calorific gas each year – in total, there will be more than five million appliances. However, this conversion only affects part of Germany. With a Germany-wide market area conversion to hydrogen, significantly higher conversions per year can therefore be achieved.

About H2vorOrt

The "H2vorOrt" initiative is a collaboration of 45 distribution grid operators of the Deutscher Verein des Gas- und Wasserfaches (DVGW) working with the Verband kommunaler Unternehmen (German Association of Local Public Utilities, VKU), whose joint objective is to turn more than 550,000 km of gas distribution infrastructure into a net zero system. The project partners have joined forces to investigate the issue of how to implement a regional, reliable supply of net zero gases across the Federal Republic of Germany in concrete terms. Hydrogen in particular can play a crucial role in achieving all climate goals without compromising economic efficiency.

Further information at: **www.h2vorort.de**

H2 VOR ORT

WITH CONSULTATION OF THE FEDERAL ASSOCIATION OF THE GERMAN HEATING INDUSTRY (BDH)