H2
VOR ORT

Hydrogen and climate-neutral gases can make a significant contribution to a socially compatible energy transition in the heating sector

Social compatibility will be a key factor in the success of the energy transition. However, it is clear that the energy transition will certainly have its price. This is why it is important for the energy transition to be shaped in such a way that is not only economically viable but also as affordable as possible for consumers. Action taken to combat climate change will only be accepted by the general public and implemented if it does not place an unreasonable burden on people in certain income brackets. Especially in the heating energy market, socially compatible climate protection will be extremely important. It will be necessary to make the decarbonisation of existing buildings possible without full-scale refurbishment, which would scarcely be viable. This publication by H2vorOrt explains why this is the case and why especially hydrogen can help in reducing the cost of climate protection and making it socially compatible.

High renovation requirements, low speed: in the building sector, viable alternatives are needed urgently to achieve climate protection targets

Almost half the total final energy consumption of Germany is used for generating heat and cold. Space heating for buildings and hot water production alone account for almost a third of total final energy consumption. Although Germany has already succeeded in reducing greenhouse gas emissions harmful to the climate by more than 42 percent compared with 1990, the efforts made to date will not be sufficient to reach the climate targets that have been set.[1]

Making hydrogen usable for everyone via the gas distribution networks

Among other factors, this is the result of the low annual renovation rate for existing buildings. Despite extensive incentive and subsidy programs implemented over the past few years, the renovation rate, referred to full-scale renovation equivalents, has stagnated at about one percent.[2] This is despite the fact that the German government had already set an annual renovation target of two percent in 2010. The European Union also aims for a renovation rate for existing buildings of two percent up to 2030 and beyond as part of its renovation wave strategy.[3]

Renovation requirements in Germany are very high. According to information published by BDEW, more than half the total number of 42 million residential units in Germany were built before the first Thermal Insulation Ordinance came into force in 1977.[4] A study conducted by the Federal Environment Agency finds that much of the existing housing stock is more than 44 years old and that only about 13 percent of housing meets higher energy standards.[5] This means that it would not be possible to renovate the entire existing housing stock by 2045 even with a renovation rate of two percent. However, energy-oriented renovation is a basic prerequisite for decarbonisation via the installation of heat pumps. On this basis, the two percent renovation rate set by the government is not compatible with the requirements of climate neutrality via decarbonisation through electrification.

In order to meet the ambitious decarbonisation targets for the space heating sector, another solution will need to be considered for short-term and medium-term decarbonisation. This means the use of climate-friendly alternatives to the most popular fuels used to date. With a share of 50 percent in energy consumption for the space heating sector,[6] natural gas plays a dominant role and therefore offers the greatest short-term potential for decarbonisation. By substituting zero-emission hydrogen or bio-methane for natural gas or adding hydrogen to existing natural gas networks, decarbonisation measures in the space heating sector can be implemented relatively quickly, cost effectively and at low cost. Instead of completing a comprehensive, costly renovation of the entire building envelope, it is only necessary to replace the boiler in the cellar and possibly also gas piping inside the building by hydrogen-compatible equipment in order to use climate-neutral gases. This way, decarbonisation could be made less dependent on the energy-oriented renovation rate.

In the heterogeneous building sector, there is no universal solution for decarbonisation

One of the many problems facing the heating energy transition in the building sector is the heterogeneous nature of this sector. Many different players, technologies, market mechanisms and cost structures need to be taken into consideration. The diversity of the sector is already apparent if we take a look at existing heating systems. About half of residential units in Germany are heated using natural gas, 25 percent using oil, about 15 percent by district heat and almost 5 percent using electricity via an electric heat pump or night storage radiators[7]. Decisions on decarbonisation must therefore always take into account the individual conditions of buildings and existing heating systems as well as the associated infrastructure. There are no universal solutions. The diversity of existing buildings is a result of the different conditions that applied at the time when they were built.

For example, the installation of an electric heat pump is only viable for very well-insulated buildings, which is why it may be an effective option for new buildings. For a heat pump to contribute to the decarbonisation of an existing building, the building must be fully renovated in energy terms. However, the considerable cost of this renovation is not affordable for many building owners. In the case of rented buildings, the possible transfer of renovation expenses to tenants means that renovation could contribute to a further rise in rents in towns and cities, forcing tenants out of their present districts or even their present cities.

More than half of Germany‘s residential units are privately owned. As a result of the long payback periods associated with the energy-oriented renovation of a building, a large proportion of the building stock remains unrenovated, which means that an increasingly large share of the emissions which could be saved is postponed to the future, representing an additional burden on future generations. This is a situation which the Federal Constitutional Court in Germany had already declared to be unconstitutional in its judgement on the Climate Protection Act. All the technologies which are available must therefore be used in order to reduce carbon dioxide emissions in the space heating sector rapidly in a way which is as affordable as possible for everyone concerned.

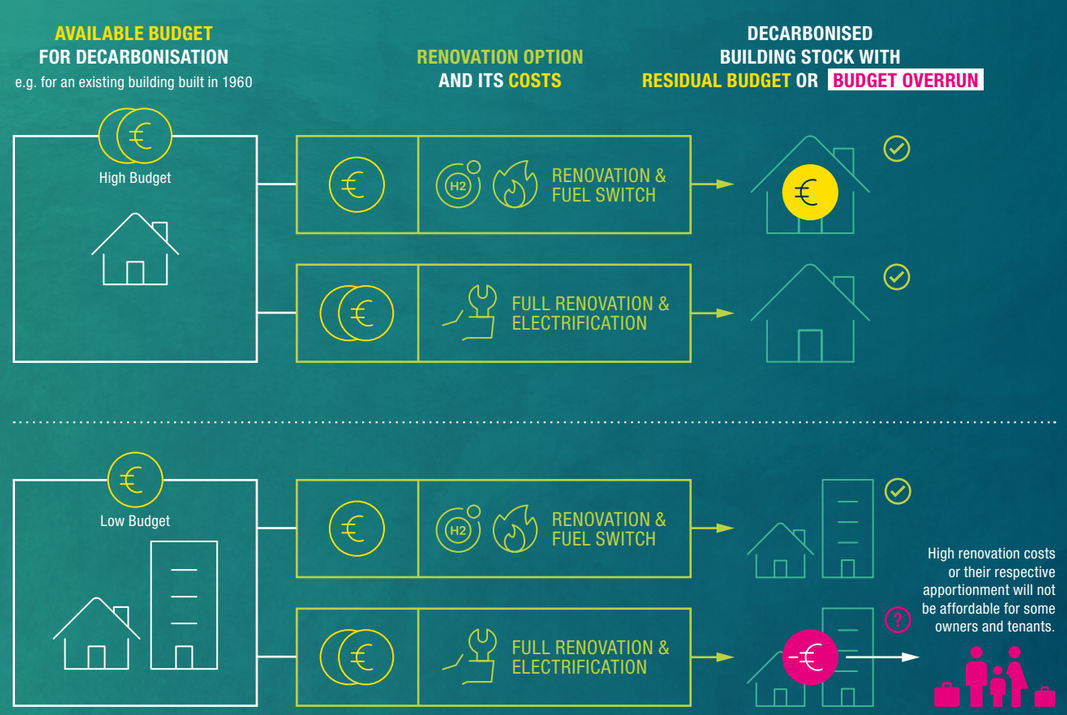
[1] Umweltbundesamt (2021): Energieverbrauch für fossile und erneuerbare Wärme.
[2] UBA (2021): Vorjahreschätzung der deutschen Treibhausgas-Emissionen für das Jahr 2020.
[3] Frontier Economics (2021): Die Rolle von Wasserstoff im Wärmemarkt.
[4] BDEW (2020): Entwicklung des Wärmeverbrauchs in Deutschland: Basisdaten und Einflussfaktoren.
[5] Umweltbundesamt (2019): Wohnen und Sanieren: Empirische Wohngebäudedaten seit 2020.
[6] BDH (2019): Politikbrief „CO_2-Senkung im Wärmemarkt mit Wasserstoff“
[7] BDEW (2020): Wie heizt Deutschland 2019?

The faster the energy transition, the more socially compatible it will be

The availability of affordable housing has already become one of the key social issues of the 21st century. Even though the cost of decarbonising the housing sector threatens to intensify this issue, the implementation of climate protection measures will still be considerably less costly than taking no action at all. It is not only for climate protection reasons but also in view of social aspects that rapid progress must be made with decarbonising the heating sector. In 2019, German greenhouse gas emissions from the heating sector resulted in cost totalling €58.4 billion[8]. If carbon pricing is introduced to make these costs part of the cost of heating, there will be significant impact on the cost of heating and therefore also of housing. This will pose a severe burden especially on low-income households. If carbon pricing is not followed by decarbonisation in the heating sector, CO_2 prices are likely to rise as certificates become increasingly scarce.

In the case of an older single-family home using 2,000 litres of oil (~20,000 kWh) for heating every year, the planned CO_2 price of €55 for 2025 will result in additional cost of almost €350. At a CO_2 price of €100, the additional cost would even be €630 if there were no change in the heat required. Households in the lower income groups already face an energy cost burden almost twice as high as that of high-income households.[9] This gap between different income brackets will become even wider with rising CO_2 prices, stagnating renovation rates and a lack of decarbonisation. The conclusion: especially low-income households will be hard-hit by CO_2 pricing. If they are tenants, they will be unable to decide on CO_2 avoidance measures themselves. If they are building owners, they will not be able to afford costly renovation.

In the existing building stock, house owners need to have a choice of **decarbonization paths with varying capital intensity**



[8] Umweltbundesamt (2021): Environmental costs due to greenhouse gases and air pollutants for electricity, heat generation and road transport, based on 2020 purchasing power
[9] Sachverständigenrat für Umweltfragen (2016): Umweltgutachten 2016.

Hydrogen enables climate neutral heating for low income households

In most cases, decarbonisation can be completed more rapidly through the use of hydrogen than with a full-scale energy performance oriented renovation because of the relative cost and complexity of the two approaches. This way, the additional cost of the CO_2 price can be avoided earlier, relieving the burden on low-income households which would otherwise be hardest-hit by costly surcharges on heating expenses. As a result, the use of hydrogen in the space heating sector not would not only represent a rapid solution for climate protection – it would also gain acceptance among the general public as a result of the socially compatible development in prices. Thanks to the integration and use of existing infrastructure, interventions in the natural environment and everyday life in the form of lengthy construction projects could also be avoided. This would also help in improving the acceptance of energy transition projects among the general public.

In this situation, we need all the technologies and solutions available to decarbonise the housing sector in good time in a way which is as economically viable and socially compatible as possible. We can no longer afford to focus solely on individual technologies as was the case in the German government's "Energy Efficiency Green Book" and its Climate Protection Plan for 2050. Every tonne of CO_2 saved will reduce the emission reduction pressure on future generations.

Digital Twin Essen: energy transition with green gas helps lower-income households

The study "Digital Twin Essen" carried out by Stadtwerke Essen and E.ON shows that hydrogen offers considerable potential for socially compatible decarbonisation of the housing sector, especially in densely populated areas. Using a "Digital Twin" of the city of Essen, the changeover to climate-neutral heat supply was digitally modelled using realistic conditions, with five different scenarios. The results were as follows: climate protection will definitely result in rising costs – also for consumers. However, one of the options considered was the most efficient in every respect – the gradual changeover to green gas in the existing natural gas system. Green gas was the best solution for reducing cost to consumers at the same time as achieving the climate targets set as efficiently as possible. With the green gas scenario, the share of heating expenses in purchasing power rose from the present figure of 2.3 percent to 3.5 percent. By comparison, the expansion of the district heating network or conversion to heat pumps boosted the share of heating expenses in purchasing power in low-income districts to more than five percent or to 4.0 percent (district heat) or 4.6 percent (heat pump) on average. The results for Essen with all five scenarios show that a solution entirely without gases is not possible and would result in a shift of the cost of the energy transition to low-income districts where inhabitants would face unreasonably high financial burdens.

Conclusion: H_2 must be part of the technology mix for heating

In addition to clear economic and strategic analyses, which support the adoption of a technology-neutral heating energy transition,[10] [11] not only time arguments but also social arguments favour the use of as wide a range of solutions as possible to the heating energy transition problems faced by consumers. Climate-neutral gases such as hydrogen will be a key tool for decarbonising the heterogeneous existing housing stock at relatively low cost and therefore boosting the acceptance and social compatibility of climate protection. The climate protection targets for the housing sector can only be reached if all households and businesses participate in the energy transition to an equal extent.

About H2vorOrt

The "H2vorOrt" initiative is a collaboration of 37 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 500,000 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.

[10] dena (2018): dena-Leitstudie Integrierte Energiewende.
[11] dena (2021): Dena-Leitstudie Aufbruch Klimaneutralität.