

H2 VOR ORT

Paving the way for the local energy transition: how hydrogen protects the climate and strengthens local communities

Local authorities will play a key role in achieving national climate protection targets in good time.

The goal of climate neutrality by 2045 has been defined at the national level but the real energy transition is actually taking place in towns and cities. If the climate protection targets are to be achieved with secure energy supplies and in a way which is as so-

cially compatible as possible, the use of climate-neutral hydrogen will play a key role in the individual communities. The use of hydrogen via the existing gas distribution networks will allow a continuous reduction in greenhouse gas emissions, generate additional added value on a local basis and help in keeping the rise in the cost of climate-neutral living accommodation as low as possible. This brochure from H2vorOrt explains how this will be possible.

With sector coupling and climate-neutral gases, local authorities can become the enablers of the energy transition

Many mayors now face the same challenge: "How can we achieve decarbonisation in our area and how can we shape the process to achieve this goal?" CO₂ is emitted everywhere, and everyone causes between 6 and 13 tonnes of CO₂¹ emissions every year. Wherever greenhouse gases are now released, these

emissions must be reduced to zero over the next 24 years. This process will call for strategic planning based both on renewable energy sources and a changeover from the fossil fuels used to date to climate-neutral alternatives. Energy from renewable sources such as photovoltaic and wind power plants will need to be used in all

Making hydrogen usable for everyone via the gas distribution networks

¹ Amt für Stadtgrün, Umwelt und Klima (2020): Energie- und CO₂-Bilanz der Stadt Neuss.

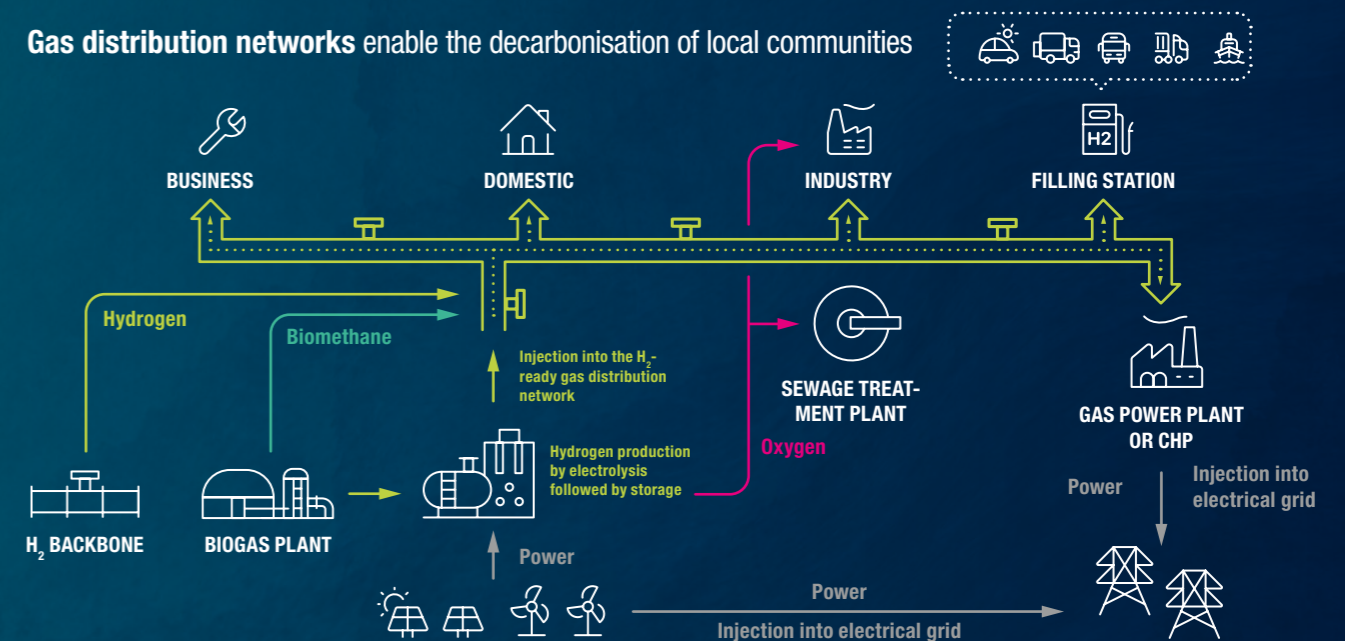
sectors both locally and regionally and appropriate infrastructure will be required. However, most communities will not be able to generate enough energy to meet local demand at all times. The electricity generated by wind and solar power depends to a large extent on the time of the day, the season and actual weather conditions. These fluctuations in energy generated by renewable sources mean that considerably more power is often generated on sunny or windy days than can actually be absorbed by the electricity grid. It is also not possible or very costly to store large quantities of power within the electricity grid. This means that alternative infrastructure will be essential to ensure a secure supply of climate-neutral energy. Apart from high energy import requirements, this storage problem is one of the main reasons why electricity only accounts for 20 percent of final energy consumption throughout Germany.

Hydrogen can store large quantities of renewable energy for a considerable period of time irrespective of the time and place of generation. With hydrogen, renewable energy can also be made available to all sectors. This way, hydrogen will allow a secure supplies of climate-neutral energy for 365 days per year. For this purpose, electricity from renewable sources is converted into hydrogen by an electrolysis plant and can then be distributed to customers in the various sectors via the existing gas distribution systems. It can then be used for heating homes and offices, in industrial plants

and commercial facilities and also for local and regional transport. In order to ensure that the large quantities required can be transported to the centres of consumption, 21 countries are currently cooperating to establish an international hydrogen network. Over the next two decades, this European Hydrogen Backbone will ensure that all towns and cities in Germany will be able to receive adequate quantities of climate-neutral hydrogen. But even in 2045, Germany will likely still need large quantities of imported energy as many communities will not be in a position to generate sufficient quantities of energy, or hydrogen, from renewable sources on a local or regional basis.

Where hydrogen production is already possible, this offers local communities considerable advantages and potential. For example, the by-products of hydrogen production can also be used. The waste heat from electrolysis processes can be used to heat homes via district heating systems and the oxygen produced by electrolysis can be used, for example, for biological treatment at wastewater treatment plants. This will reduce the energy requirements of the plants concerned. Chemical or raw material plants may also be able to use this oxygen for their processes. This approach will open up new possibilities of keeping the rise in energy costs for households, companies and public facilities on the way to climate neutrality as low as possible.

Gas distribution networks enable the decarbonisation of local communities



Today's gas distribution systems are tomorrow's hydrogen distribution systems

After they have been upgraded, existing gas distribution systems or storage facilities can also be used for hydrogen distribution. Via these systems, it will be possible to distribute growing volumes of climate-neutral energy throughout Germany and to ensure secure supplies to households, companies and public

facilities at all times. All the members of H2vorOrt are already working intensively to upgrade their distribution systems to carry up to 100 percent hydrogen and will be developing a plan for the establishment of H₂ readiness by 2025 at the latest, taking into consideration the long-term goal of climate-neutral local energy

supplies. The individual plans of distribution system operators will then be compiled and condensed to form a national gas network area transformation plan.

It will therefore be possible to use existing gas infrastructure for climate-neutral energy supplies and the energy transition with only minor technical modifications. Public bodies and companies in the private sector developed this infrastructure on a nationwide basis over the course of many years. This development was financed by the network tariffs paid by customers and extensive investments by the companies concerned. The further use of this infrastructure can help in relieving the burden on power networks and reducing the need for further expansion of the

power grid. This would also mean fewer roadworks in towns and cities. Almost all of Germany's towns, cities and villages are now connected to an extremely high-performance gas distribution system. In 2019, gas distribution systems served a total of 1.7 million industrial and commercial customers as well as more than 19.8 million homes². This means that gas distribution systems provided heating energy to more than 41 million people, or almost half the population of Germany. In total, companies, public bodies and households received almost 730 terawatt-hours (TWh) of gas. This quantity would be sufficient to meet the entire energy demand of Switzerland and Austria for a year³.

Hydrogen can be added to natural gas or used as a pure fuel – the gas systems will allow both approaches

In future, hydrogen may be used as a pure fuel or may be mixed with natural gas in a steadily growing ratio. This mixing approach has been tried and tested in practice and is already approved up to a concentration of 10 percent hydrogen by volume. The hydrogen share can be increased to 20 percent by volume with only minor modifications. After the gas systems have been upgraded, the transportation of pure hydrogen will also be possible. This way, household, industrial and commercial customers can receive 100 percent climate-neutral energy.

Irrespective of whether hydrogen is used in pure or mixed form, it is almost always more economically viable to use existing gas infrastructure and to convert it to 100 percent hydrogen in

the future than to build entirely new infrastructure. Up to 2045, the cost of upgrading gas infrastructure, including transmission systems and gas storage facilities, for 100 percent hydrogen will be about €45 billion⁴. The gas distribution systems in towns and cities will only account for about one third of this figure. It will therefore only be necessary to slightly increase network tariffs and the value of gas systems as major assets of local authorities will be maintained. Local authorities and system operators have already demonstrated that existing gas networks can be changed over to other gases efficiently, quickly and safely – for example during the changeover from coke oven gas to natural gas.

High potential: decentralised production of climate-neutral gases

There is significant potential for the decentralised production and use of hydrogen in Germany. A study by DVGW has shown that more than half of Germany's 11,000 communities have a medium or high potential for the construction and operation of power-to-gas (electrolysis) plants. The total installation potential for the connection of electrolysis plants to existing gas distribution systems indicated by the study amounted to as much as 40 GW. This quantity is eight times as high as the current target of the German government for the construction of electrolysis plants up to 2030. If these plants were operated at full capacity for only 40 percent of the hours in the year, they could produce 140 TWh of green hydrogen. This corresponds to about 14 percent of current natural gas consumption in Germany. However, in order to tap this potential, it will be necessary to rapidly and comprehensively expand renewable energies so that adequate electricity from renewable sources is available for electrolysis plants at low prices.

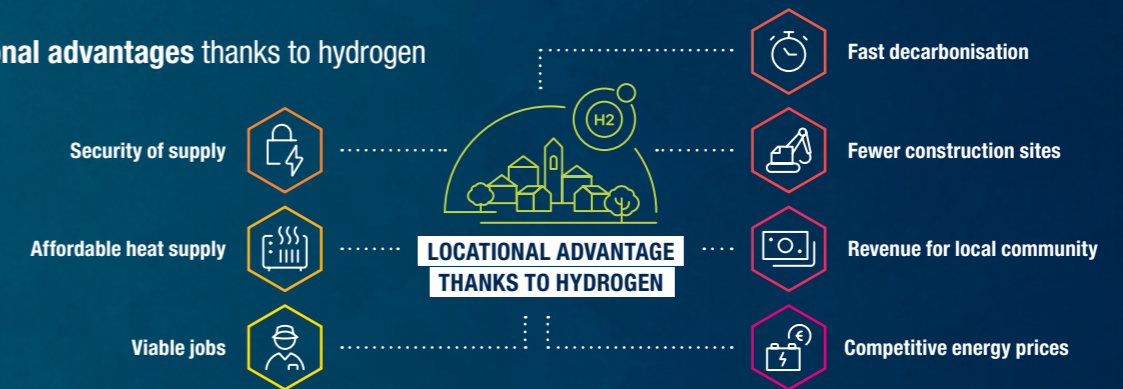
The expansion of photovoltaic and wind power facilities by local authorities will generate a secure source of income, for example in the form of rentals or the direct participation of local authorities in the revenue of new wind farms and free-standing photovoltaic plants which has been provided for by law since 2021. The synergy effects associated with the operation of an electrolysis plant such as the utilization of waste heat in local heat networks, the use of the green hydrogen produced in fuel cell buses for local transport, or the use of the oxygen produced by electrolysis in local sewage treatment plants will help in developing a value stream in the community. The existing gas distribution network will function as the infrastructure backbone and enable the development of such successful models on a local basis.

² BDEW (2020): Wie heizt Deutschland 2019?; Statistisches Bundesamt (2021): Wohngebäude, Wohnungen, Wohnfläche; Statistisches Bundesamt (2021): Statistisches Jahrbuch.

³ BP (2021): Statistical Review of World Energy.

⁴ DVGW (2018): Abschlussbericht Transformationspfade zur Treibhausgasneutralität der Gasnetze und der Gasspeicher nach COP 21.

Locational advantages thanks to hydrogen



Creating acceptance for climate protection – utilization of H₂ and gas infrastructure

The use of climate-neutral gases and existing gas infrastructure can make a considerable contribution to improving the acceptance of climate protection and the energy transition in towns and cities. The expansion of extra high voltage and high voltage power systems is a very slow process not only as a result of lengthy approval procedures but also as a result of the lack of acceptance of such projects among the general public. However, these

problems should not and indeed must not restrict the pace of transformation of the energy system on the way to climate neutrality. Large quantities of renewable energy can be transported through the buried pipelines of existing gas systems in the form of climate-neutral gases, boosting the pace of the energy transition. A gas pipeline can carry almost six times as much climate-neutral energy as a power line along the same route.

The local job creator: growth prospects for local industry and businesses

Recent studies have shown that the production of green hydrogen in Germany opens up considerable potentials and growth opportunities – especially with respect to job creation. Many experts are convinced that the hydrogen economy will be Germany's next major job creator. According to their predictions, up to one million⁵ additional jobs connected directly or indirectly with the production

of green hydrogen are likely to be created by 2050. The conversion of existing industrial and commercial processes to hydrogen can also create future-oriented jobs with a positive impact on the climate in local communities, which will also make rural areas more attractive for highly qualified employees. Hydrogen will therefore be a key element in the future of our communities.

Successful practical examples of the energy transition with climate-neutral gases

The local projects implemented by many local authorities throughout Germany are proving that sector coupling and decarbonisation are already possible in practice through the use of climate-neutral hydrogen. For example, the "Westküste 100" project in Schleswig-Holstein represents an industrial-scale regional hydrogen economy. Hydrogen produced using energy from renewable sources is stored in a salt cavern and then distributed in line with demand for use in the production of carbon-neutral fuel or for heating residential buildings. In the town of Öhringen

in Baden-Württemberg, the "Hydrogen Island Öhringen" converts power from renewable sources into green hydrogen in an electrolysis plant. This hydrogen is then injected into the existing natural gas system with a concentration of up to 30 percent by volume and used in the heat energy market. The special feature of this project is that the project area is isolated from the surrounding natural gas network and receives independent supplies, like an island within the overall network. These examples show that the local energy transition is already well underway.

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.

⁵ Ludwig Bölkow Systemtechnik (2019): Wasserstoffstudie Nordrhein-Westfalen.