FACT SHEET

Natural gas: ready for the hydrogen economy!

The current situation

Due to the multitude of options for generating, transporting, storing and using hydrogen, it is an exceptional source of energy for decarbonisation across many sectors – particularly when its production is CO_2-neutral. For this reason, the German federal government launched the National Hydrogen Strategy (NWS) in June 2020, to create the framework for the economical and sustainable generation, transport and use of hydrogen.

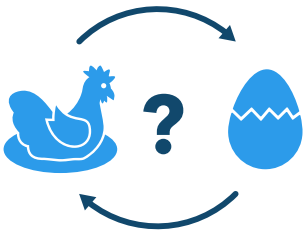
The goal

Germany will become a leading international provider of hydrogen technologies. A significant initial step is establishing a domestic hydrogen market. The estimated demand for hydrogen in Germany in 2030 is approx. 90 to 110 TWh. This corresponds to about one tenth of the energy demand that is currently met with natural gas. A sufficient hydrogen supply is critical here along with CO_2-neutral production.

Hydrogen demand in Germany in 2030[1]

The challenge

In the next ten years, only a small percentage of the foreseeable demand can be met by domestic production capabilities based on renewable energies (green hydrogen). The establishment of a purely 'green' hydrogen energy economy, which requires large amounts of electricity generated from renewable energy sources, is hampered by the sluggish development of those renewable sources. In addition, hydrogen electrolysis is in direct competition with alternative decarbonisation options such as the electrification of the industrial, transportation and heat sectors. So, there is a chicken-and-egg situation: The demand for CO_2-neutral hydrogen is still low, which means that potential hydrogen producers lack incentive to invest in hydrogen electrolysis, for example.



Chicken-and-egg situation in the hydrogen sector

Meeting needs with technological openness: hydrogen generated with natural gas

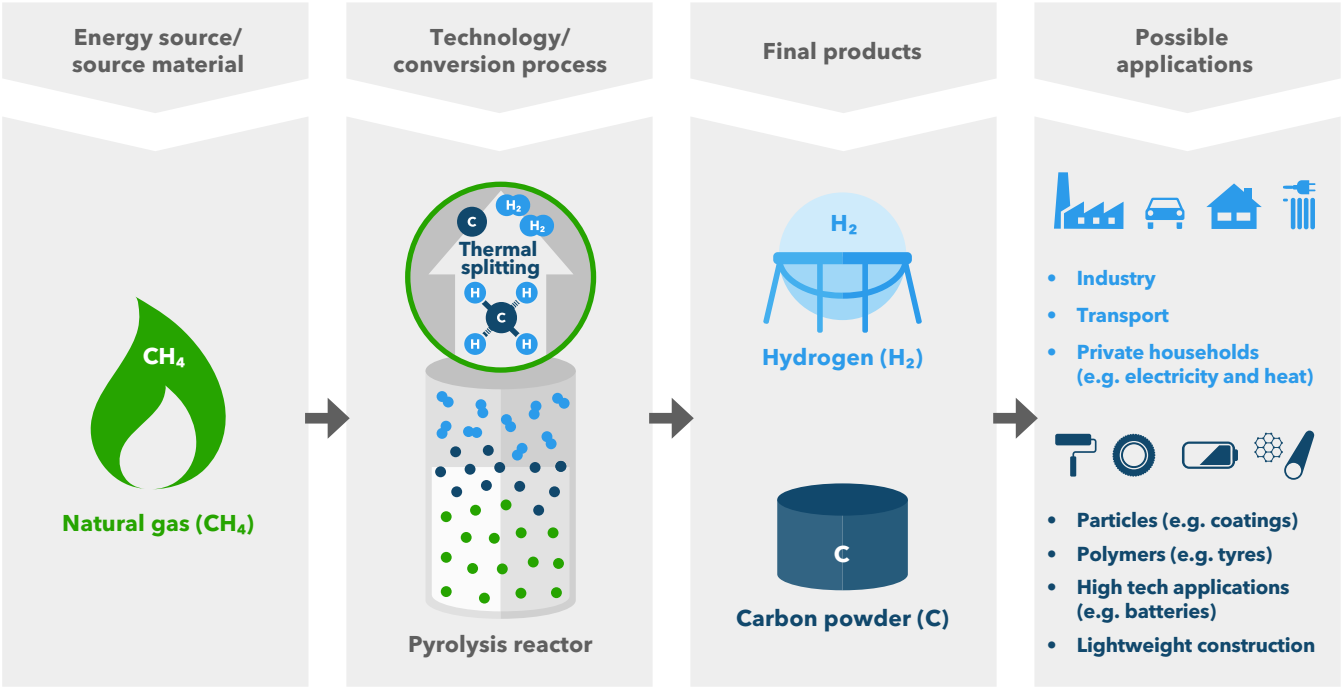
The solution

Other CO_2-neutral production processes such as pyrolysis, carbon capture and storage (CSS) and carbon capture and utilisation (CCU) are gaining attention as methods for meeting the great need for hydrogen during a transition period and thereby contributing to the establishment of a functioning hydrogen energy economy. Particularly promising are processes based on methane (blue and turquoise hydrogen). For example, methane pyrolysis can be used to generate hydrogen without CO_2 emissions. In addition to hydrogen, the process also produces solid carbon, which can be used for industrial applications.

Therefore, taking the limited production capacities for green hydrogen into account, a technological openness that also considers blue or turquoise hydrogen is crucial both for getting the market up and running quickly and for market penetration with hydrogen. Moreover, based on today's estimates, more than half of the German end-user energy demand will still need to be met by imports in 2050, particularly with regard to CO_2-neutral synthetic gases and fuels. With this in mind, technology neutrality should be implemented over the long term, with respect to producing CO_2-neutral hydrogen in order to ensure economic efficiency for achieving decarbonisation targets.

"If the 2050 carbon neutrality goal is to be reached, hydrogen technologies will also have to play an important role in Germany."[2]

Methane pyrolysis: CO_2-neutral, turquoise hydrogen generated with natural gas



During methane pyrolysis, natural gas or methane is broken down into its basic components, without CO_2 emissions. This occurs in a reactor due to heat exposure at about 800-1,200 degrees Celsius, whereby the methane molecules are split into their elementary constituents.

At the end of the pyrolysis process, hydrogen and solid carbon remain. Carbon is required in the production of steel, batteries and carbon fibres and to reinforce construction materials, for example. The generated hydrogen can be used in the industry, the transportation sector and in private households (for producing electricity and heat), among other purposes.

Conclusion: natural gas is H_2-ready!

The road to an efficient hydrogen energy economy bears many challenges – especially in the production of hydrogen. In terms of technology, solution options are already on the table. Critical here are effective incentives to get market development started so that it can generate its own momentum. The use of blue and turquoise hydrogen generated with natural gas can provide a very important contribution to meeting the high demand and to establishing a functioning hydrogen energy economy. Natural gas is H_2-ready!

Hydrogen "colour theory"[3]

Green hydrogen is produced via the electrolysis of water; the electricity used for the electrolysis must derive from renewable sources. Regardless of the chosen electrolysis technology, the production of hydrogen is CO_2-free because the electricity used comes from sources that are 100% renewable and therefore CO_2-free.

Turquoise hydrogen is produced by the thermal splitting of methane (methane pyrolysis). This process generates solid carbon rather than CO_2. To ensure that the process is CO_2-neutral, the heat supplied to the high-temperature reactor must be produced from renewable energy sources and the carbon binding must be permanent.

Grey hydrogen is sourced from fossil energy sources. In general, heat is used to convert natural gas into hydrogen and CO_2 (steam reforming process). Afterward, the CO_2 is released, unused, into the atmosphere, which reinforces the global greenhouse effect: about ten tonnes of CO_2 are generated in the production of one tonne of hydrogen.

Blue hydrogen is grey hydrogen, but the CO_2 generated in the process is precipitated and sequestered by means of a carbon capture and storage (CCS) system. Because the CO_2 produced in the process of making hydrogen does not enter the atmosphere, the hydrogen production can be considered on balance as CO_2-neutral.

Sources:
[1, 2] German Federal Ministry for Economic Affairs and Energy: The National Hydrogen Strategy, June 2020, p. 5 and p. 3.
Link: https://www.bmbf.de/files/bmwi_Nationale%20Wasserstoffstrategie_Eng_s01.pdf
[3] German Federal Ministry of Education and Research: Eine kleine Wasserstoff-Farbenlehre (A brief hydrogen 'colour theory'), June 2020.
Link: https://www.bmbf.de/de/eine-kleine-wasserstoff-farbenlehre-10879.html