TÜV AUSTRIA

Hydrogen.
A safe future.

Hydrogen is our reality.
Our competence. Your success.

A safe hydrogen economy

- Hydrogen production
- H_2 in transport
- Hydrogen-induced damage
- Upgrading/reusing gas networks and pipelines
- Certification of “green hydrogen”

With the growing hydrogen industry, the number of H_2 applications is increasing rapidly. As a result, many more materials are coming into contact with hydrogen.

H_2 as a raw material or (by-)product

TÜV AUSTRIA has an extensive network of material experts in its various testing and inspection companies.

Hydrogen **production**

The majority of hydrogen is still produced by the so-called steam reforming method, which converts methane (CH_4) into hydrogen (H_2) and carbon dioxide (CO_2). In order to reduce climate-damaging greenhouse gases, renewable energies such as wind, solar or hydroelectric power are increasingly being used today to split water (H_2O) into its elements hydrogen (H_2) and oxygen (O_2). This process is called electrolysis. Hydrogen produced in this way is referred to as **“green hydrogen”**.

Electrolysis plants are currently being built at spectacular speeds. Thousands of gigawatts (GW) of production capacity, electrolysers and other green H_2 production methods will be needed in order to achieve the ambitious zero emissions goal of companies, municipalities and states. And all of these will have to be built safely, soundly and reliably. TÜV AUSTRIA provides assistance during the planning, construction and initial inspection of hydrogen feed-in systems with the group’s entire range of services.

Hydrogen can be used in two ways: either directly, by feeding it into hydrogen pipelines or systems or by storing it in a liquefied or compressed state, or by mixing it into existing (natural) gas pipelines. In all cases, TÜV AUSTRIA can assist with material analyses for the H_2 compatibility as well as with overall assessments of the hydrogen production, storage and transport systems.

Safety-related services

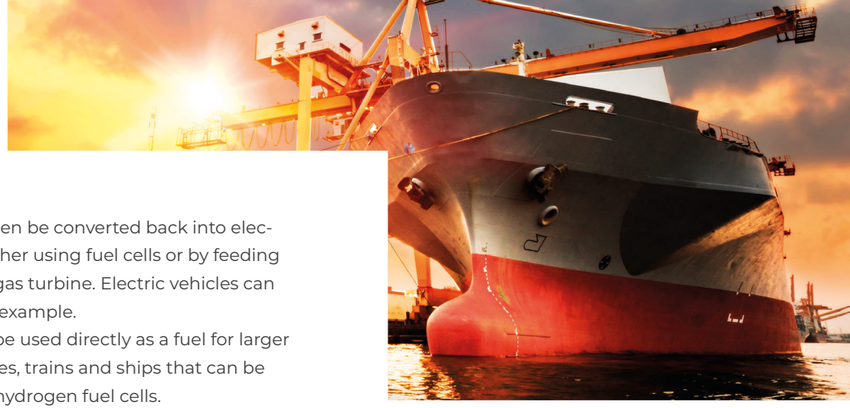
Depending on the type of system and the design parameters, explosion protection assessments have to be carried out for the hydrogen systems. In accordance with the ATEX regulations, possible risks and protective measures for employees have to be analyzed in these assessments.

In addition, TÜV AUSTRIA provides support by moderating risk analyses with regard to plant safety, fire and lightning protection, employee protection as well as during the official approval procedure for the construction and operation of the plants.

Hydrogen **in transport**

Hydrogen can be used to store energy, as an energy source (e.g. in a fuel cell) and as a direct fuel. If its combustion is controlled properly, only very few to negligible emissions are produced when H_2 is used as a fuel. Hydrogen is therefore expected to play an important role in the transport sector of the future.

For instance, hydrogen can be used to store the electricity generated by wind or solar power through electrolysis.



This hydrogen can then be converted back into electricity at any time, either using fuel cells or by feeding the hydrogen into a gas turbine. Electric vehicles can then be charged, for example.
However, it can also be used directly as a fuel for larger transportation vehicles, trains and ships that can be easily powered with hydrogen fuel cells.

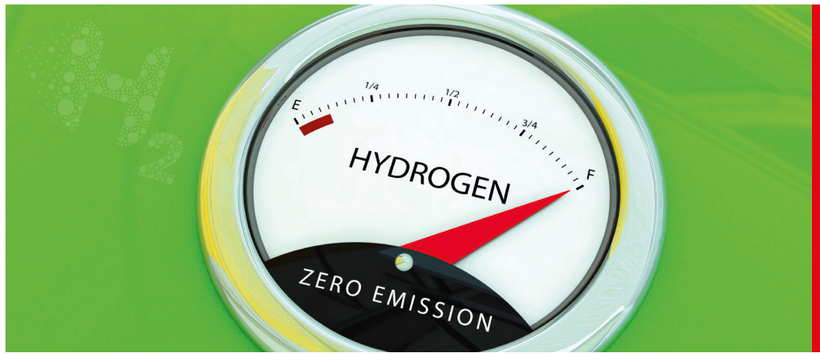
The growing hydrogen economy and the further spread of H_2-powered vehicles has led to a demand for hydrogen fueling systems. TÜV AUSTRIA accompanies customers along the entire hydrogen value chain. From an evaluation of the initial design, risk assessment, right through to the testing and certification of H_2 filling stations and vehicles:

- Safety-related review of manufacture, transport and use
- Material engineering aspects, risk analysis, certificate of origin
- Assistance during the approval procedure for the construction and operation of hydrogen fueling systems
- Evaluation, inspection and type approval of hydrogen vehicles
- Assistance during the approval procedure for hydrogen vehicles
- Electrical and electronics testing for hydrogen and hybrid vehicles

Hydrogen-induced **damage**

Hydrogen (H_2) is a relatively small molecule with specific properties, which means that its interaction with materials differs from that of many other gases and liquids.

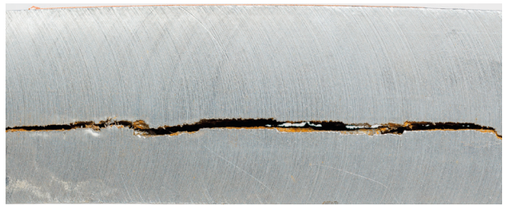
As a result, the market needs material scientists with a good understanding of and experience with hydrogen.



A small H_2 molecule with great possibilities

TÜV AUSTRIA has the know-how and experience to help you with anything you need to know about hydrogen.

- Materials in existing infrastructures
- New constructions for its transport
- Physical and chemical interaction
- Embrittlement of steel and other materials (cracking, „HIC“)
- Degradation of the mechanical properties of steel



Hydrogen and the problem of hydrogen embrittlement or the reduction of the mechanical properties are part of our daily reality. We are heavily involved in a number of hydrogen projects.

TÜV AUSTRIA has both the necessary technical know-how and the experience to help you in these matters.

Upgrading **gas networks & pipelines**

A small molecule **with great energy**

Hydrogen contains more energy per unit mass than any other fuel. The technical problems associated with the transport and storage of hydrogen primarily arise on account of its high vapor pressure and low boiling point. Hydrogen (H_2) is a much smaller molecule than natural gas (CH_4) and can therefore penetrate materials easier. Seals and gaskets can also become brittle and be permeated much easier.

Material **embrittlement**

Hydrogen can cause confined material deformations such as (hairline) cracks and small corrosion spots to spread much faster. Moreover, hydrogen can impact the strength properties of materials, such as their hardness, tensile and impact strength, and lead to hydrogen embrittlement.

Suitability of **transport networks**

Investigations and assessments determine whether existing networks are suitable for the transport of hydrogen or natural gas-hydrogen mixtures.

If no documentation is available for old pipelines, material samples are taken to analyze/categorize the material.

In certain cases, long-term material tests have to be carried out to evaluate the material resistance to hydrogen.

Certification of **“green hydrogen”**

Hydrogen has only negligible greenhouse effects and thus has the potential to make a crucial contribution to the energy transition. The “green hydrogen” certification scheme provides independent proof that hydrogen produced by regenerative methods involves much lower emissions than conventionally produced or fossil fuels.

Climate-friendly production

Green hydrogen can be traced back to clearly described, identifiable and quantifiable sources.

Certification of CO_2 emissions

The certification is based on a record of CO_2 emissions during hydrogen production in accordance with ÖNORM EN ISO 14067 (CFP for products).

Advantages of the independent certification of green hydrogen

- Reduction of greenhouse gas emissions even from the outset
- Commitment to a sustainable, future-proof energy supply
- Transparent and credible documentation of energy supplies with environmentally friendly products

This is followed by a check of the supply relationship for the electric current used to produce the hydrogen and a certificate is issued in the event of a successful outcome.

Plausibility check

Balance sheet-based check of the supply relationship for the electric current used to produce the hydrogen.

Provision by the client

The greenhouse gas report and the proof of origin of the electricity are to be provided by the client.

Certificate

A certificate is issued if it can be proven that the hydrogen is produced solely with renewable energies (“Hydrogen produced from renewable energies”).

Promising energy source

Hydrogen is one of the most promising future options for phasing out fossil energy quickly and economically.

Pioneering work

Production of green hydrogen starts at MPREIS. The Tyrolean family-run business MPREIS recently put its first proprietary electrolysis plant into operation ▷

References

at its production site in Völs near Innsbruck. The electrolyzer produced its first green hydrogen (H_2) at the end of March 2022.

“ The **certification of green hydrogen** is your contribution to our future.

Hydrogen **color spectrum**

Green hydrogen is produced through the electrolysis of water. This method uses only electricity that has been generated from renewable energy sources such as wind and solar power. Irrespective of the electrolysis technology that is used, the simple production of green hydrogen is CO_2-free because the current used for the process comes solely from renewable sources. This makes this production method climate-neutral.

Turquoise hydrogen is made from methane pyrolysis. This produces solid carbon instead of CO_2. Prerequisites for the CO_2-neutrality of the method are that the heat supplied to the high-temperature reactor comes from renewable energy sources and the permanent sequestration of the carbon produced.

Grey hydrogen is produced using fossil fuels, e.g. through steam reforming. CO_2 is hereby released into the atmosphere and contributes to the greenhouse effect. However, if the CO_2 produced is separated and permanently stored or reused (Carbon Capture, Utilisation and Storage (CCUS)), this is described as **blue hydrogen**. The CO_2 produced in this way does not enter the atmosphere and the hydrogen production is regarded as being climate-neutral.

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