

For a sustainable turnaround, you need to make a U-turn – we're paving the way to hydrogen.

Expert consultation for scaling up the hydrogen economy

An initiative of **TUVNORDGROUP** companies

Once the infrastructure is in place, hydrogen knows no bounds...

The global climate goals are ambitious. It will primarily be the responsibility of businesses to make them achievable. In particular, hydrogen technology will play a central role in achieving greenhouse gas neutrality and minimizing raw material consumption. Moreover, the new geopolitical situation has given fresh impetus to the energy transition. Wait and see is no strategy – hydrogen now!

In Europe and also in Germany, extensive funding such as the IPCEI projects is being offered for this purpose. International hydrogen strategies foresee significant investments in research, development, and manufacturing to enable rapid decarbonization while ensuring resource security. Germany has set itself the goal of becoming one of the world's leading providers in this future field.

It is assumed that by 2050, the market ramp-up of water electrolysis in Germany alone will account for between 60 and 80 GW in the power grid. The National Hydrogen Strategy predicts that Germany will need about 90–130 TWh of hydrogen by 2030. To speak of successful market penetration by 2030, a large number of MW electrolyzers and growth rates of around 1 GW per year by the end of the decade are necessary. The challenges to achieving this volume are complex and require seamless supply chains and a correspondingly competitive electrolysis industry. This calls for smart exit strategies from existing production processes and the expansion of manufacturing capacities towards increasingly renewable hydrogen. This is precisely where HydroHub is engaged with extensive consulting, engineering, and training services.

Moreover, much research and development work is still needed to enable industrial companies, as the most important consumers, to make relevant use of hydrogen across the board. The National Hydrogen Strategy emphasizes the need to create reliable political frameworks and ensure the technical reliability of stable plant operations with varying feedstocks and volume flows. This includes the development of technologies for using renewable hydrogen in various industries, including steel and cement production, to significantly reduce emissions.

The optimal expansion of the hydrogen pipeline network naturally forms the basis for industrial use. The German hydrogen core network, as part of the European Backbone, is considered crucial to unlocking the full potential of the molecule. To bring hydrogen to its true potential, an absolutely process-secure infrastructure quality is required. To enable and ultimately ensure this, HydroHub has embarked on its 360° service package. Starting with conversion strategies from natural gas to hydrogen, through route and pipeline engineering, to the flexibilization and operational optimization of energy networks.

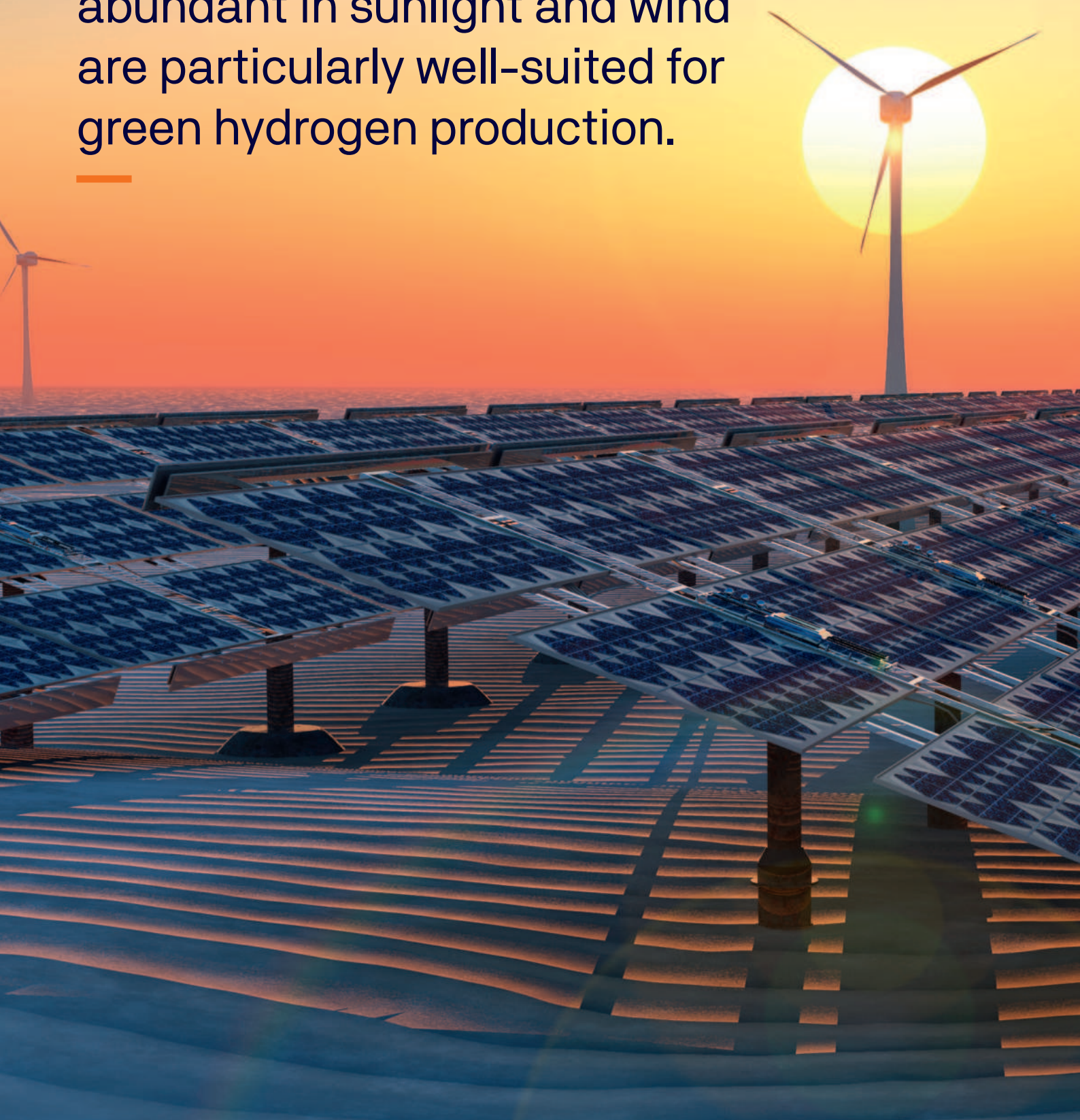
We can handle pressure.

Both the time constraints and the challenges in the details along the value chain put all market participants under pressure to enter new territory flawlessly. We offer comprehensive consulting and engineering expertise for hybrid energy supply, networking, distribution, storage, and reconversion systems. Starting from research projects, feasibility studies, strategy development, or regulatory engineering, through pre-, basic, and detailed engineering to EPC/M. With versatile services in consulting, engineering, and training, we support the ramp-up of the hydrogen economy with an open approach to technology.

Even though the capacities for intra-European hydrogen production will experience enormous expansion in the medium term, the demand from the industrial, mobility, and also heat/power sectors can only be secured in the long term through the import of hydrogen – especially under the changed political conditions. The National Import Strategy assumes an import requirement of 50–70% for Germany and views the German hydrogen core network as part of the European Backbone, thereby emphasizing the necessity of international cooperation.

For our clients, it pays off that we have been working since the beginning of industrialization to ensure that everything flows and develops. Safety is our core business, even where technologies are yet to establish themselves.

Electrolysis powered by renewable energy: Countries abundant in sunlight and wind are particularly well-suited for green hydrogen production.



...until then, the focus of the hydrogen economy rests on import.

The demand for hydrogen will be enormous in the near future – not only in Germany. The National Hydrogen Strategy predicts that Germany will need about 90–130 TWh of hydrogen by 2030. Once hydrogen has comprehensively replaced other energies, it will become a commodity product, as production is significantly ramped up and manufacturing and transport costs are optimized in the long term. Until then, the best strategies for import, transport, storage, and application need to be defined.

Typically, the sun- and wind-rich countries, which are particularly suitable for the production of sustainable hydrogen, have an energy surplus, while countries like Germany, with a corresponding energy deficit, have a very high demand for hydrogen.

Let us first consider the future molecule in terms of import strategies. Hydrogen can be transported over long distances, making the import of green energy possible. But what are the most urgent tasks for manufacturers, importers, and users? Companies and municipalities must ensure the supply of the energy carrier hydrogen



The repurposing of existing infrastructure offers immense advantages in scaling-up of the hydrogen economy and is already in full swing.

at an early stage. This means that potential imports via pipeline or ship must be evaluated technically, economically, and in terms of safety. This concerns, for example, the various storage and transport options depending on the respective carrier substance such

as ammonia, methanol, or LOHC (Liquid Organic Hydrogen Carriers). And what does the most efficient supply chain system look like that closes the loop to the exporting countries? HydroHub is ready to contribute with its years of expertise in consulting, engineering, and training to sustainably support the energy transition in the hydrogen market. HydroHub helps manufacturers, network and storage operators, importers, the public sector, investors, and users to develop strategies early on to ensure the successful supply of hydrogen. This involves identifying ideal export countries, conducting technical, economic, and safety assessments in feasibility studies and reports, and exploring storage and transport options.

Looking at Germany, one must ask what the biggest challenges in hydrogen import will be. By 2050, about 250 TWh/year will need to be imported. This corresponds to 7.5 million tons, which make up about 2/3 of the total demand in Germany. Germany will thus remain a hydrogen-importing country in the long term. In the import process itself, we see challenges along the entire value chain: To achieve a global CO₂ saving effect through renewable hydrogen, one must already consider production in the exporting country. The renewable energies needed for hydrogen production there must be provided in addition to already existing sustainable energy sources. Digital certificates of origin are crucial to verify the sustainability and origin of the hydrogen and to ensure that it meets the criteria of the Renewable Energy Directive (RED II/RED III) or the CBAM requirements. The sustainable transport of renewable hydrogen also plays a major role in ultimately being able to look at a truly green energy carrier. Hydrogen has an extremely low energy density. Therefore, it is difficult to store it in a gaseous state during transport, making it uneconomical in this form. Technical solutions are needed here to improve the efficiency and economy of transport through H₂ derivatives.

In the demand countries, the emerging development of the hydrogen market, in turn, influences import strategies, especially for renewable hydrogen. It must be ensured that the imported hydrogen truly meets technical standards and achieves a consistently positive climate impact. However, not only ecological and economic standards are considered, but also social prerequisites in the exporting countries must be met to act sustainably in all aspects. Digital certificates of origin provide trust and transparency to all stakeholders, and parts of the TÜV NORD GROUP are involved in their development.

The most cost-effective form of hydrogen transport, as with many gases, is the pipeline. This is, of course, not always feasible. But for a distance of up to 1,500 kilometers and mostly overland, pipelines are the preferred solution even for gaseous hydrogen. This is not always possible when considering renewable hydrogen. Not all exporting sun- and wind-rich regions are close enough to Germany to develop the necessary infrastructure. This brings ship transport into focus. There are also various technologies available for this. For example, the energy density can be increased by liquefying the hydrogen through cooling to -250 degrees Celsius. This is quite energy-intensive and loss-prone, but it is an option. Furthermore, there are various carrier substances such as ammonia, methanol, or LOHC, where hydrogen is transported in a bound form rather than in its elemental form. Methanol and ammonia also become interesting as sustainable ship fuels, making the import more environmentally friendly and are therefore increasingly discussed. Which of these carrier substances

is most suitable depends on the conditions in both the exporting and, to some extent, the importing country. By 2024, around 40 ships worldwide will already be running on methanol fuel. In addition to extensive groundwork and conducting large-scale transport pilot projects, other relevant steps must also be considered, such as regulation, promotion, on-site storage, reconversion, further transport, expansion, and connection to the national hydrogen infrastructure, among others. Port locations must therefore develop strategies early on to determine which trade cooperations and technologies are most sensible for them.

It also involves repurposing existing facilities and adapting standards and regulations. Topics such as H2 Readiness link import issues with storage and further transport in the destination country. Here, HydroHub has many years of expertise as a technology consultant."

Port locations are aligning themselves with import strategies: On behalf of the City of Hamburg, HydroHub produced a report outlining the economic, technical, safety, and sustainability-related requirements for the necessary hydrogen infrastructure.



The key themes of the hydrogen market are those of HydroHub.

In addition to the key topic of **H2 import/export** just discussed, HydroHub has also dedicated itself to areas that play a central role for the energy industry and industrial locations in Germany: Firstly, the field of sustainability, which must be supported from the outset in the ramp-up of the hydrogen economy with digital certificates of origin to successfully achieve the decarbonization of sectors (**H2 Sustainability**). Furthermore, we summarize the status quo analysis of affected sectors and markets, as well as a comprehensive and efficient infrastructure, including the repurposing of existing facilities and infrastructures for hydrogen use, under **H2 Readiness** and **H2 Second Life**. This completes the thematic circle of the hydrogen economy for HydroHub, which will determine the local market in the next 5–10 years.

Let's look at the key topics in detail. **Sustainability:** The rapid development of a European/global hydrogen economy is seen as one of the main instruments to slow down climate change. The basis for establishing a hydrogen-centered economy is a sustainable and as greenhouse gas-neutral as possible implementation of necessary technologies and processes. Systems for classification and certification along the entire value chain will be established to classify and assess the greenhouse gas intensity/neutrality and sustainability of hydrogen. This also includes considering the ecological and social impacts of production, including precursors, as well as storage and transport up to the application of hydrogen. Therefore, HydroHub offers a corresponding topic-specific service offering around sustainability.

In **H2 Readiness** and **H2 Second Life**, the focus is on existing and convertible infrastructure: A successful market ramp-up of the hydrogen economy requires a comprehensive and efficient infrastructure and confronts companies along the value chain with demanding, partly new strategic topics. The central questions relate to economic and safety planning, realization, and operation, both for newly constructed and repurposed


infrastructures and facilities specialized in hydrogen. The focus is thus on the economic and safety planning, realization, and operation of existing facilities, which were originally intended for the use of other process gases and are only suitable for hydrogen through repurposing. This is complemented by considering infrastructures or facilities that were already designed for the use of hydrogen at the beginning of the project.

Guided with safety, assured excellence.

Along these central key topics, the specialists at HydroHub confidently accompany clients in any type of development project. From feasibility studies to analyses, evaluations, consulting, and engineering in the fields of plant, process, and procedural technology, to the complete conversion of production sites. For example, we accompany the planning and construction of plants for hydrogen production. We design industry-specific hydrogen concepts as well as concrete hydrogen application strategies for companies and evaluate them technically and economically.

Our engineers also develop comprehensive hydrogen location strategies, including hydrogen roadmaps and technology introduction strategies, for municipalities, states, the federal government, and downstream authorities. We always operate with a special focus on the safety of products and projects, climate protection and sustainability, as well as economic aspects, and address legal issues.

Finally, we bring market participants together through our trust-based approach, thus securing the necessary investments in sustainable hydrogen concepts. We assess their value, conduct due diligence, and develop business models along with their financial engineering. Because ideally, new technologies meet 360° solutions, which can of course be utilized individually, but are always considered holistically.

A photograph of three wind turbines standing on a rolling green hill under a cloudy sky. The turbines are white with three blades each. The hill is covered in lush green grass with some shadows. In the background, there are more hills and mountains under a blue sky with white clouds.

Sustainability at the 360°
center of HydroHub services:
Renewable hydrogen should
encompass social standards
in producing countries and be
transported sustainably.

HydroHub – Consultation and engineering experts



HydroHub organizes itself on a project basis in response to dynamic requirements.

As the head of HydroHub, Alexander Holle sees the commitment to this exciting technology as the most important field for the future: “One of the central visions of HydroHub is to contribute to the secure, efficient, and sustainable energy supply of tomorrow. We are now at a point where the potential applications of hydrogen technology are becoming apparent, whether as a storage medium, a driver of clean mobility, or for power and heat supply.” What drives us in the field of hydrogen is the prospect of making a significant contribution to decarbonization – which will only successfully establish itself in the future if it can be used strategically and safely. Here, we want to make every possible contribution to quickly securing sustainable infrastructure and applications alongside innovative companies and institutions.

Our goal is clear. To achieve it, we have defined an unusual offering with HydroHub. This enables us to pragmatically, flexibly, and solution-orientedly complement

the entire hydrogen value chain with any service that can be helpful at various stages of development. With a broad and well-trained network of specialists, all requirement scenarios are covered. Our aim is to enable market players to move from thinking to action as quickly as possible, and thus from ambitious plans to safe operational capability.

**360° Consultation expertise
alongside the value chain.**

Dr. Andreas Ziolk, Managing Director of EE ENERGY ENGINEERS GmbH, a company within the TÜV NORD GROUP and part of the HydroHub network, states: “Whatever your requirement may be – you will always meet the best experts for the task from an excellently specialized team. This team then organizes everything necessary to ensure optimal project progress.

Hyexperts Osterholz: Public & Freight Transport on the Right Path

“HyLand – Hydrogen Regions in Germany” is a competition initiated by the Federal Ministry for Digital and Transport (BMDV), which has already progressed to further rounds. HyLand motivates stakeholders in all regions of Germany to initiate, plan, and implement hydrogen-related concepts. The aim of the competition is to identify and promote the most innovative and promising regional concepts, while ensuring that the hydrogen is produced locally from renewable energies and then consumed within the region.

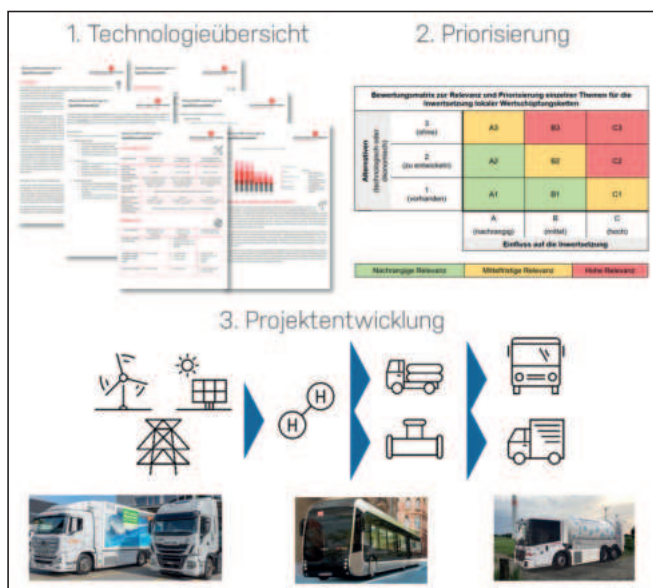
One of the HyLand sub-projects is “HyExperts – Freight Traffic with Renewable Hydrogen – Future Mobility,” in which EE Energy Engineers GmbH, a company of the TÜV NORD GROUP and part of the HydroHub, participated. The potentials of the rural region of Northeast Lower Saxony for the use of renewable hydrogen in the mobility sectors of regional freight transport, public transport, and waste collection were identified, calculated, and conceptualized into concrete projects. The project was divided into three areas, covering the entire value chain from decentralized hydrogen production from regional renewable energies, through logistics with storage, transport, and provision, to application, examined under technical, economic, and legal aspects. The focus was on committed companies in the region: The network partners have around 1,600 trucks, 700 buses, 110 filling stations, and 175 MW of renewable generation capacity (approximately 450,000 MWh/a).



Hydrogen for heavy-duty transport and large vehicles – a clean solution.

The result was a comprehensive concept, presented as a guideline, describing the best possible strategy for introducing hydrogen technology into regional freight traffic. The results enabled the region of Northeast Lower Saxony to apply for the subsequent “HyPerformer” call for proposals.

In addition to EE Energy Engineers GmbH, BBH Consulting GmbH and BBH GmbH were involved in the project, which had a volume of 1.46 million euros.



Services provided by HydroHub in the project:

- Market overview of technical options and cost depression potential of relevant components along the H₂ value chain
- Presentation of tax and legal framework conditions
- Overview of funding opportunities and relevant networks
- Economic evaluations
- Recommendations and implementation concepts
- Overall project coordination
- Organization of meetings with local stakeholders

Services of HydroHub with Hydrogen Expertise

Our services cover the entire value chain of the hydrogen economy – from production through transport and storage to utilization in various application areas. We provide comprehensive support for hydrogen projects and offer a wide range of services tailored to different application areas in the phases of concept/planning, production, operation, and decommissioning/disposal. This includes, among other things, strategy development, feasibility studies, regulatory engineering, as well as pre, basic, and detailed engineering, up to EPC/M.



Energy generation

Renewables
(e.g. wind, solar)

Conventional
power plants

Geothermal



H₂ generation

Electrolysis
Seawater
desalination plants

Reforming processes
Bio gas

Methane pyrolysis



Distribution/transport

Electrical grid
Pipelines
District heating

Intelligent networks
Refuelling stations/
filling systems

Tankers
(lorry, train, ship)



Storage

Battery storage
Gas tanks

Cavern storage
(H₂ and CO₂ [CCS])

Pressure vessels
H₂ hydride storage



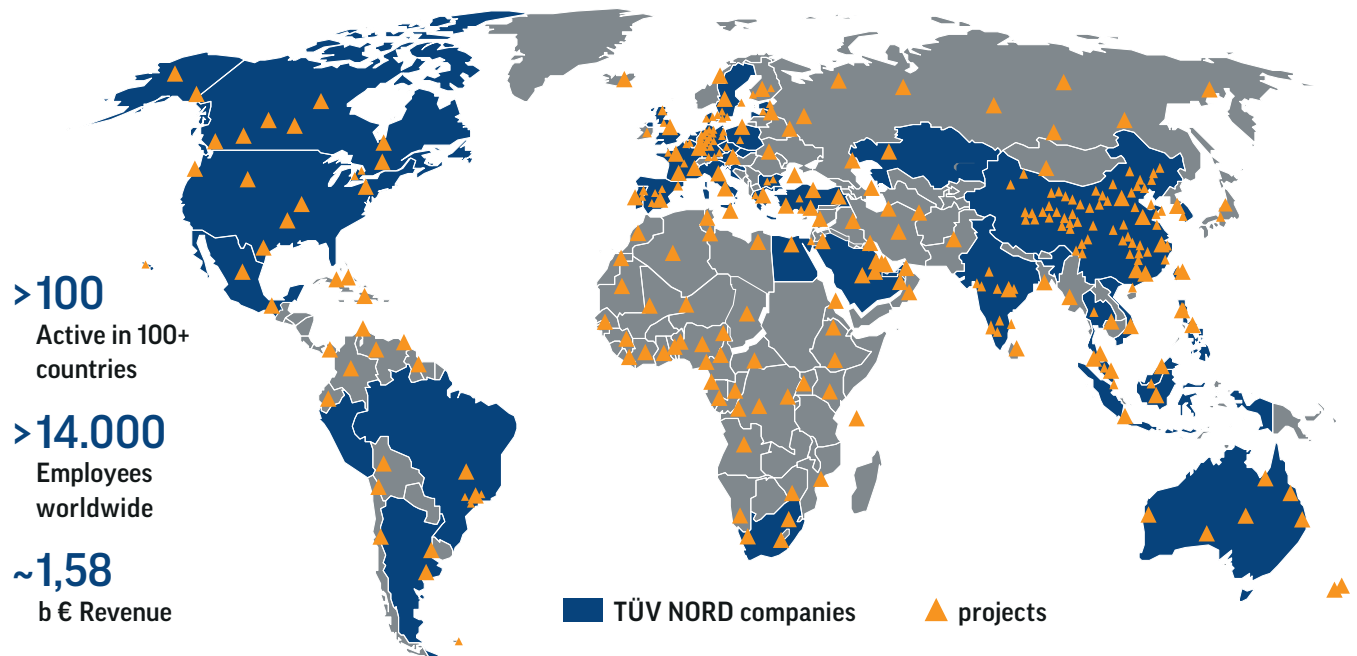
Consumption/use

Fuel cell system
Methanol synthesis unit

Carbon management
Mobility (e.g. e-fuels)
Reconversion to electricity

Power-to-X
(gas, heat, liquid)
Industrial applications
(e.g. refinery)

HydroHub – An Initiative by Companies of TÜV Nord Group



As a recognized technology service provider, the TÜV NORD GROUP stands worldwide for safety and trust, neutrality, and quality. In all aspects, we have a firm focus on the digital future. Independent engineers and IT security experts provide excellent solutions for safety, quality, and a strong competitive position. With a presence in 50 countries and activities in more than 100 countries, we empower companies with over 14,000 employees to fulfill their responsibilities towards people, technology, and the environment. We have accompanied all industrial revolutions, develop globally recognized safety standards, and contribute to a safer world, especially in the digitally interconnected era.

Our services along the hydrogen value chain have been compiled into 16 detailed PDFs for you. You can easily access these through the QR code. Alternatively, visit: hydrohub.de/en/downloads/



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