

Hydrogen The Netherlands - Gulf Region

Scaling-up clean hydrogen together



Netherlands

The Gulf and the Netherlands: Joining forces for creating a hydrogen-powered economy

As we face the same challenges in finding a zero pathway, we all want to contribute to a smooth transition to renewable energy. In support of decarbonising global production and energy use, hydrogen has been identified as an essential component and part of the solution to reduce greenhouse gas emissions and their impact on global warming. Hydrogen is an energy carrier that can be stored and eliminates the imbalance between the supply and demand of renewable energy like solar and wind. As hydrogen is a relatively new product to use at scale, a whole new value chain is being developed to support the production, transport, storage, distribution and usage of (low carbon) hydrogen and its derivatives.

The Integrated Value Chain for Green Molecules

Currently, 80% of the energy used worldwide is in molecules, and only 20% is in the form of electrons. This will shift in a future energy system as we can electrify part of the energy use, but molecules will continue to be needed for many reasons.



Integrated value chain for green molecules

Hydrogen is a fundamental building block for green molecules, including hydrogen, ammonia, and e-fuels or synthetic fuels. Clean hydrogen is made with renewable energy or from fossil fuels while capturing carbon dioxide. Clean hydrogen or clean ammonia (clean hydrogen combined with nitrogen from the air) are green molecules; Clean hydrogen combined with carbon dioxide from direct air capture, biogenic CO₂ or industrial CO₂ kept in a close loop also create green molecules. In an Integrated Value Chain approach, we include, apart from hydrogen, the source (fossil fuels with CO₂ capture or renewables), the end product and derivatives (hydrogen, ammonia and

e-fuels), and any other carriers used. Another element to include is the role of energy storage in bridging the intermittency of renewable power.

Opportunities for the Gulf states

The hydrogen sector is an upcoming industry with high potential for growth both in the Netherlands and the Gulf states. Innovations follow one another quickly, and as the broad range of available applications widens, development in this sector is moving rapidly. According to a study by Roland Berger - one of the world's leading strategy consultancies with a wide-ranging service portfolio and renowned for its expertise in transformation and innovation - the Gulf region will be able to capture up to 100M tons of clean energy, generating an annual revenue of approximately \$200Bn. The Gulf region is well-positioned to become a net exporter of clean hydrogen and its derivatives at globally competitive costs. The region has the fundamentals, such as good climate conditions, vast areas of uninhabited land to develop new projects to produce renewable energy cost-efficiently, and the capital and investment climate to create such large-scale projects. The Kingdom of Saudi Arabia, United Arab Emirates, and Oman have each developed a hydrogen strategy to capture a significant proportion of the international clean hydrogen market. Their ability to scale up clean hydrogen production makes these Gulf states an ideal breeding ground for developing clean hydrogen value chain-related technology from pilot to commercial scale.

The Gulf and the Netherlands: unlocking hydrogen opportunities together!

Sustainable growth and development can only be achieved through joint efforts. The Netherlands and the Gulf states have an extended history of trusting collaboration, contributing to their aims to solve challenges together. The Netherlands has embraced the development of clean hydrogen as an essential energy carrier and wants to play a significant role in implementing and operating this new value chain. The UAE, Saudi Arabia, and Oman are dedicated to leading the global sustainable transition in the clean hydrogen sector. By bonding to meet mutual goals, a Dutch private-public partnership (PIB) is initiated to offer a comprehensive, innovative, and transformative strategy that addresses all aspects of the clean hydrogen value chain. The PIB allows Dutch and Gulf companies in the hydrogen chain to exchange knowledge and share innovative ideas. This includes know-how on clean hydrogen development from supply chain to usage and applications. The PIB will help to enable business opportunities related to developing the clean hydrogen value chain, including creating required corridors to transport clean hydrogen or derivatives from the Middle East to Europe.

Why work with us?

The Netherlands is firmly committed to achieving international climate agreements, but we cannot do it alone. International collaboration and strong partnerships are essential for a more sustainable future. Clean hydrogen is one of the many prospects within our reach. Not only does it contribute significantly to the energy transition, but it also offers promising economic growth and employment opportunities. Building a sustainable and clean energy system in the Netherlands that is fundamentally clean-hydrogen-based is built on several distinctive characteristics:

1. Our climate commitments and policies ensure our drive forward
2. Our scope considers the entire integrated value chain rather than seeing production, applications, storage and other aspects as separate issues
3. Researchers work with businesses and government to address safety issues, ensuring regulation and standards are correctly developed and implemented
4. The outlook on clean hydrogen is decidedly global.

The focus is not only on the Dutch clean hydrogen ecosystem but also on accelerating the global adoption of clean hydrogen as a carbon-neutral fuel and energy source. This makes the Netherlands an excellent facilitator and accelerator in using clean hydrogen. Also, with a long history of working with natural gas and being the second largest user of Hydrogen in Europe, the Netherlands can translate years of knowledge and experience into developing the entire clean hydrogen value chain. The country's extensive gas grid is being converted to transport hydrogen, and with the many wind farms and established naval connections, the Netherlands serves as the ideal hub for the distribution and transport of clean hydrogen. With all this experience in hydrogen, switching to clean hydrogen becomes easier.

Towards a long-term partnership

Unique to this partnership is the ability to provide each other with knowledge and experience at every step of the Clean Hydrogen Integrated Value Chain. Opportunities lie in innovative solutions and companies that can provide potential solutions supporting production, handling (conversion, storage, transport), and using clean hydrogen and derivatives. Furthermore, regulation and certification, engineering, financing and, where necessary, subsidising the growing sector are implemented to ensure maximum efficiency.

Together, we can prove that clean hydrogen is a powerful solution to accelerate the transition and achieve our climate goals.

Partners



Advario is a leading provider of tank storage and logistics services, that operates a global network of terminals, strategically located in the US, Singapore, the Middle East, Europe and China, handling a broad range of products, from chemicals to gases and new energy products (like ammonia, methanol, CO₂). Our vision is to be a frontrunner in the energy transition: we design, build and operate storage infrastructure to provide our customers with the highest reliability, while ensuring that safety and sustainability are embedded into every aspect of our business. www.advario.com



Air Products is the world's largest hydrogen producer, with over 60 years of experience in hydrogen technology. As the world's largest hydrogen supplier, Air Products is taking major steps to accelerate the energy transition. Air Products develops, engineers, builds, owns and operates some of the world's largest clean hydrogen projects, supporting the transition to low- and renewable energy in the heavy-duty transportation and industrial sectors. <https://www.airproducts.nl>



Battolyser systems is an innovative electrolyser producer enabling 100% green hydrogen at the lowest LCOH. The Battolyser[®], with 100% flexibility unlocks new ways to significantly reduce your LCOH by producing hydrogen when cheap renewable power is available and shutting off when not. Its integrated battery allows electricity trading, lowering investments in off-grid renewables for the lowest LCOH. <https://www.battolysersystems.com/>



Bosal is a leading manufacturer in the fields of mobility and energy, with 17 industrial sites, 12 distribution centres, 7 R&D centers and 2,500 employees around the world. BOSAL's mission is to contribute to a cleaner world by consistently innovating, and offering tailor made solutions for future generations. BOSAL Energy provides specific heat exchanger solutions for all emerging Hydrogen production and application technologies such as Solid Oxide Fuel Cell Technology (SOFC) or Solid Oxide Electrolysers (SOEC). <https://www.bosal.com/en>



Boskalis is a global leader in dredging, offshore contracting, and maritime services. With over 100 years of experience, we are a total solutions provider for ports, offshore energy, and inland infrastructure markets. Our unique combination of expertise, vessels and activities allows us to provide innovative and sustainable solutions in coastal and delta regions worldwide. We create new horizons. <https://boskalis.com>



Demaco has been the expert in liquid hydrogen and cryogenic infrastructure for more than 35 years. The core competencies are design, construction, testing and installation of systems around the globe. Loading and unloading systems for trailers, ships or aviation as well as vacuum-insulated pipelines for hydrogen production have been built for Europe, Asia and America. Demaco is the partner for outstanding performance and the lowest operating costs for your liquid hydrogen infrastructure. <https://demaco-cryogenics.com/hydrogen/>



Delft Offshore Turbine (DOT) is a spin-off company of TU Delft. The AquaDOT turbine uses a seawater pump instead of a generator, making the turbine 50% lighter. The first unit can produce 600m³/day and is destined for Namibia. The company is finishing its 2.5MW equivalent pump and turbine in 2024 delivering 10,000m³/day fresh water from sea water. www.dotpower.nl www.aquadot.nl

Desolenator

Desolenator provides the world-first solar thermal desalination solution harnessing the photons of the sun to turn seawater or brackish water into high quality, ultra-pure water. Desolenator can be coupled with Zero Liquid Discharge to eliminate the challenge of brine and provide a fully circular solution. www.desolenator.com



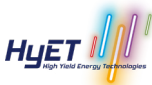
Elestor develops large scale electricity storage using Hydrogen and Bromine based on the flow battery principle. The Elestor HBr flow battery has the unique technology where already hydrogen is used as one of the active components. This enables combination of the flow battery with hydrogen storage and integration with electrolysers for maximum utilization. www.elestor.com



Gasunie is an energy network operator. In the Netherlands and the northern part of Germany, we manage and maintain the infrastructure for large-scale transport and storage of gas. At the moment, this is mainly natural gas, but the energy transition will increasingly bring about a shift towards green gas and hydrogen. We also collaborate in the construction and management of heat and CO₂ grids. We ensure that this part of the energy supply is safe, reliable and as sustainable as possible, ensuring that everyone has access to energy, always. www.gasunie.nl/en



H2Fuel is hydrogen bound to a salt and has the highest energy density compared to all other hydrogen alternatives. The release of hydrogen is achieved using a patented process that requires no additional energy and doubles the amount of hydrogen stored in the salt. After hydrogen release, the residual product - or spent fuel - can be recycled and reused as a hydrogen carrier. www.h2-fuel.nl



The **HyET Group** companies are active across the renewable energy supply chain. Their core focus is on technology development and commercialization of solutions for low-cost, energy-efficient production, transport, and storage of clean energy. Currently, the HyET Group consists of five technology companies – HyET Solar (thin-film solar foils), HyET Lithium (solid state lithium-ion batteries), HyET E-Trol (PCEC and high-pressure AEM electrolysis technologies), HyET Hydrogen (electrochemical hydrogen compression and separation technologies) and HyET NoCarbon (carbon capture / utilization and ammonia processing technologies). <https://www.hyetgroup.com/>



HYGRO offers a scalable, cost-competitive green hydrogen production and distribution solution. Leveraging wind/solar power synergy with integrated electrolysis. HYGRO was the first company in the world to launch the 'hydrogen mill' concept; a wind turbine with integrated electrolysis to produce hydrogen directly at the mill. Utilizing hydrogen as the primary energy carrier, our technology ensures efficient delivery across the value chain, providing green hydrogen precisely when and where needed. www.hygro.nl



J.de Jonge is a family company who manufactures loading and piping systems for clean energy such as Marine loading arms and mechanical infrastructure for (liquid) hydrogen and ammonia. They also provide wider tank storage services to support clean energy operations. The company is opening a new plant in Jubail in April 2024 to be able to manufacture locally in the Gulf region. www.jdejonge.com



Nes Fircroft is the world's leading engineering staffing provider spanning the Energy sector. We offer a full range of staffing solutions: Contract, Permanent (Direct) Hire, Managed Solutions, or Employer of Record (Expatriate Visa/Payroll). These services are complemented by an industry-leading support solution and global mobility package, to ensure our clients keep hold of the top talent in a compliant manner for as long as they need it. We work across the hydrogen value chain around the world with strong client relationships in Europe, the Middle East, and APAC. www.nesfircroft.com



NONOX B.V., founded in 1996 and based in The Netherlands, started with the development of dedicated gas engines with superior environmental and fuel economy properties. Nowadays, NONOX has worldwide patented technology which can be applied to natural gas, methanol, petrol and hydrogen engines. www.nonox.nl



Plug Power offers plug-and-play electrolyzer products, as well as custom-engineered, built-to-order integrated solutions to meet any type of demand. Plug's output instantaneously adjusts based on electrical input, creating a perfect pairing with intermittent renewable resources. www.plugpower.com



Port of Amsterdam aims to be a leading European seaport at the forefront of the transition to a sustainable society. The port is a logistics hub for international and national trade flows, as well as local urban distribution. Western Europe's fourth largest port delivers added value by focusing on the growth of bio- and synthetic fuels, hydrogen activities, circular industry and manufacturing. Port of Amsterdam works intensively with clients and partners to make the port operate faster, smarter and cleaner. www.portofamsterdam.com



Port of Rotterdam is Europe's largest seaport and energy port. The company manages, operates and supports the smooth and safe flow of shipping to and from Europe and across the oceans. Through digitalisation and innovation, the Port of Rotterdam is transforming into a cleaner and greener port. Rotterdam wants to become an important hydrogen hub for Europe, aiming to import 18Mton of hydrogen and derivatives in 2050 to facilitate the decarbonisation of industrial clusters in North-West Europe, mainly Germany. www.portofrotterdam.com



Proton Ventures delivers innovative engineering and design solutions for world-scale storage terminals, ammonia production & decomposition units and other ammonia related process applications (e.g. deNOX). Proton Ventures' capabilities in these fields include:

- Consultancy Support
- Conceptual and Feasibility studies
- Owners Engineering
- (Pre-) FEED Packages
- EPC(M) Works (limited scale)
- Operations & Maintenance

www.protonventures.com



Royal HaskoningDHV is a global leading engineering consultancy firm active in mobility & transport, industry & buildings, environment and water & maritime sectors. In the green energy sector, it supports their clients from project inception and feasibility, construction and operations in marine facilities (ports, berths) for liquid cargoes, marine support bases, energy islands, offshore wind installations, logistic modelling, ESIA services and water management consultancy. www.royalhaskoningdhv.com



SoluForce offers a safe, sustainable, cost-efficient and quickly deployable infrastructure for local hydrogen distribution. The non-metallic and flexible pipelines are pivotal in various hydrogen projects, ensuring minimal TCO and CO2 emissions. With over 4000 km installed, the SoluForce system is trusted for reliable energy infrastructure worldwide. Certified and based on proven technologies, it can be the perfect accelerator to achieve local hydrogen distribution in a fast, flexible and cost-efficient manner.

<https://www.soluforce.com/>



Stirling Cryogenics is a 70-year existing company in the field of Stirling Cryogenerators, producing on-site cooling power for o.a. the liquefaction of combustible gases such as (bio-)LNG and hydrogen.

Our systems for liquefaction of hydrogen as well as for BOG re-liquefaction can be completely containerized for easy installation and mobility.

Size can range for lab-scale of 5 kg/day up to 400 kg/day for industrial sites.

www.stirlingcryogenics.com



Thomassen Energy helps Gas Turbines power plants achieve their business and profitability objectives while reducing their carbon footprint to meet decarbonization goals. Thomassen Energy retrofit gas turbine technologies reduce carbon intensity with neutral solutions for power generation.

Our cutting-edge solutions enable existing gas turbines to utilize clean alternative fuels, like hydrogen, paving the way towards carbon-free power generation.

www.thomassen.energy



TNO is an independent research organisation. More than 15 research departments spread over 6 units are collectively working on innovations along the entire hydrogen value chain from production to infrastructure, storage and final applications. TNO is involved in over 50 hydrogen related projects. From developing new materials in its Faraday lab to work on prefeasibility and engineering studies for large scale deployment in project such as NorthH2 and the Gigawatt project.
www.tno.nl/en



As a clean-tech engineering OEM company **Urban Mobility Systems** develops and manufactures battery electric and hybrid (fuel cell) drive-trains to replace the diesel engine traditionally used in construction equipment. This way UMS enables the zero emission building site, greatly reducing both air and noise pollution on-site. All UMS conversion kits are made with a specific focus on economic safety viability, scalability and excellent build quality.
<https://urbanmobilitysystems.nl/en/>



At ports around the world, **Vopak** provides storage and infrastructure solutions for vital products that enrich everyday life. Together with partners and customers, Vopak is accelerating the development of infrastructure solutions for hydrogen, ammonia, CO₂, long-duration energy storage, and low-carbon fuels & feedstocks – paving the way to a more sustainable future
www.vopak.com



Voyex Liquid Organic Hydrogen Carrier (LOHC) technology is safe, easy to handle and cost efficient. Useable as both storage and transport medium and replacement fuel for heavy duty and industrial ICE applications. The LOHC is circular, is characterized by a 'safer-than-diesel' hazard level, has a high hydrogen storage content of 60 kg H₂/m³ and a usage at atmospheric pressures and room temperatures also supporting the continuing use of already in place diesel infrastructure.
www.voyex.nl



Witteveen+Bos is an engineering and consultancy firm that advises and helps clients all over the world in resolving today's complex challenges. With a network of 23 offices in 10 countries and some 1,400 engineers and consultants, we work on improving the human environment for everyone, today and for future generations. In regard to hydrogen, Witteveen+Bos offers the following services: system integration, engineering, risk assessments (QRA), safety (HAZID/HAZOP), permits, technoeconomic feasibility, roadmaps (vision and strategy), innovation, stakeholder management, grant support, project management and consortium formation.
www.witteveenbos.com

Cooperation partners



IRO: The Association of Dutch Suppliers in the offshore energy industry is an independent non-profit organisation that supports and promotes the interests of its 360 member companies.

“Embracing the energy transition” is our motto, actively supported by our members.

We strongly believe that the offshore energy industry plays a vital role in achieving the climate targets for 2050. From fossil to wind, from hydrogen to floating solar, from marine energy to CCS, from geothermal to ecology.

www.iro.nl



Invest International is a financing organization, majority owned by the Dutch Government. In the field of Green Hydrogen, it develops and finances projects in emerging markets, to contribute to local sustainable development and support the energy transition in Northwestern Europe. While deploying its funds, Invest International makes efforts to engage the expertise of Dutch businesses, demonstrate strong environmental and social commitment and strive for local impact and inclusive growth.

www.investinternational.nl



Government of the Netherlands

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Expectation is that by 2035 40-60% (70% by 2040) of hydrogen volume will be imported and it is essential to build a diversified supply system and to develop relations with countries and regions who can export hydrogen.

In support of this, MOU's for collaboration at government level and to develop public private partnerships have been signed with respectively the UAE, Oman and the Kingdom of Saudi Arabia.

The objective of the PIB for the Netherlands Government is to have Dutch companies involved in developing the local hydrogen value chain in the target countries as well as in developing the corridor of green hydrogen and derivatives such as green ammonia and methanol between the Gulf region and Europe using Netherlands ports as gateway.

Curious to learn more? Get in touch!

H3 (Holland Hydrogen Hub) Business Hub is the go-to link between companies in the Netherlands and the Middle East. Experts in hydrogen technology, they believe hydrogen is vital for the energy transition. H3's primary objective is to facilitate partnerships and joint ventures between companies and organizations in the Middle East and the Netherlands. Through collaboration and innovation, they aim to drive the adoption of sustainable energy solutions and contribute to a greener future.

www.hollandhydrogenhub.org



You can contact the coordinators of this partnership via the following details:



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