

ROTTERDAM AND THE POWER OF LIQUID HYDROGEN

HYDROGEN IN ALL FORMS

Hydrogen comes in different forms and has a variety of applications. It plays a key role in the energy transition, for industry, mobility and energy storage. In this paper, we focus specifically on a 'cool' energy carrier: liquid hydrogen.

Hydrogen is liquified by cooling it to the extremely low temperature of $-253\text{ }^{\circ}\text{C}$. We first take you through the general context of hydrogen imports and infrastructure, before zooming in on the role of liquid hydrogen in the port of Rotterdam.





Presentation of Hydrogen Import Manifesto to Minister Hermans



High potential import areas

Why imported hydrogen?

The Netherlands and parts of the European Union are preparing for the import of significant quantities of renewable energy, including hydrogen, produced using sustainable electricity. Due to the high population density and high energy consumption in Northwestern Europe, it is not possible to generate sufficient renewable energy locally. That is why imports will remain necessary, even in a CO₂-neutral future. The energy Europe needs will come primarily from regions with favourable conditions for generating renewable energy, such as solar, wind or hydropower, and/or where CO₂ storage is possible. In these areas, sustainable electricity can be generated relatively cheaply and can be used to produce low-carbon hydrogen. This hydrogen can then be imported into Europe in various forms.

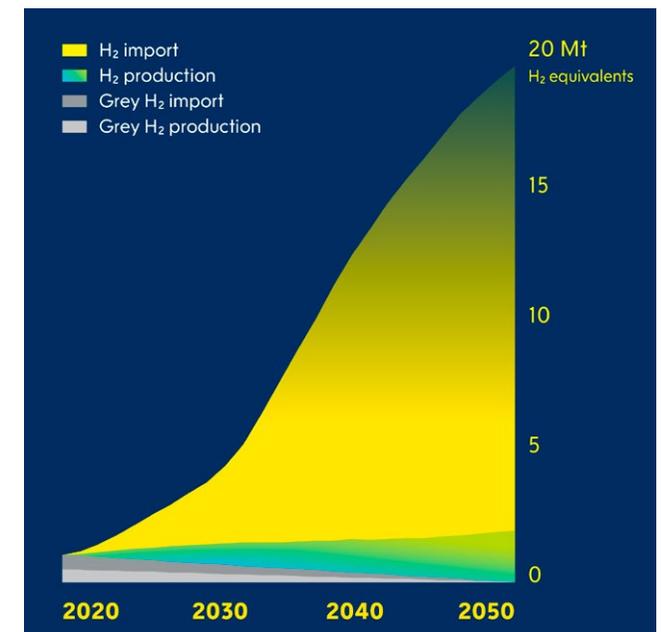
It is not yet possible to predict which form of imported hydrogen will ultimately become dominant. This depends on many factors. Therefore, it is important to explore different options and promote technologies at this stage.

Policy framework and collaboration

The import of hydrogen is an essential link in the transition to a CO₂-neutral energy supply and industry in the Netherlands and Europe. The European Commission supports the construction of import and storage infrastructure through the IPCEI programme (Important Projects of Common European Interest) and other financial instruments. In the Netherlands, the National Hydrogen Programme (NWP) is being implemented, with an important role for imports via seaports. In recent letters to the parliament, the government emphasised the importance of international hydrogen chains, infrastructure development and encouraging the use of (low-carbon) hydrogen. The business community and industry associations also recognise the crucial role of imported hydrogen. In May 2025, a broad coalition presented the Hydrogen Import Manifesto to Minister Hermans during the World Hydrogen Summit in Rotterdam. This emphasises the importance of policy on large-scale import of hydrogen and hydrogen carriers as a crucial factor for the energy transition and energy security.

Rotterdam as a hydrogen hub

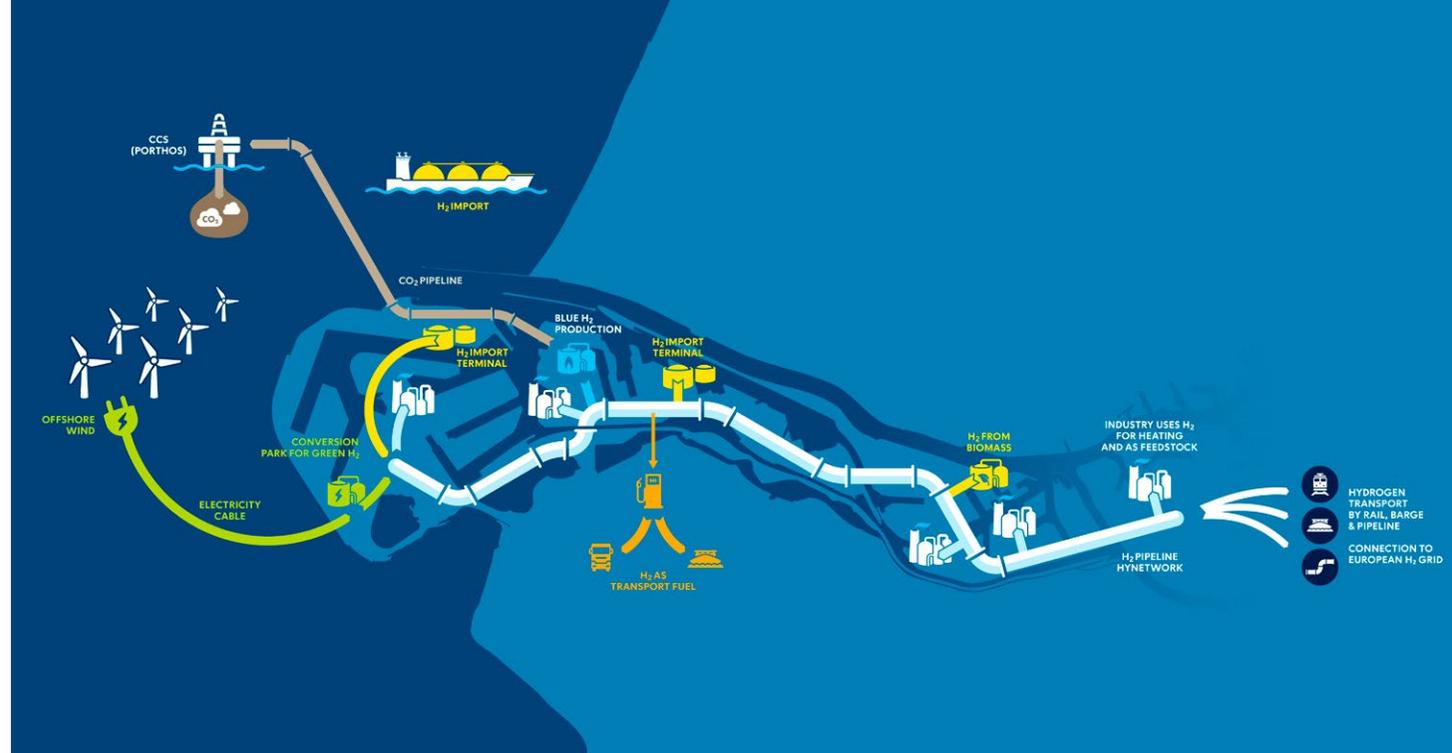
The Port of Rotterdam Authority is preparing for a future import flow of approximately 18 million tonnes of hydrogen (equivalents) per year by 2050.



Expected development of H₂ import and production



New built and existing pipeline connections



Rotterdam's hydrogen ecosystem

To realise this ambition, a robust hydrogen infrastructure is being developed in the port area. A major milestone is the construction of the Hynetwork pipeline, which is expected to be operational in 2026.

This pipeline forms the backbone for the distribution of hydrogen from import terminals to industry in the port area and marks the start of Gasunie's national hydrogen network.

In addition, work is underway on the Delta Rhine Corridor, a pipeline connection from the port of Rotterdam to Dutch industrial clusters and industry in North Rhine-Westphalia, Germany. This will expand the national network from Rotterdam to the east of the Netherlands.

Several companies in the port are preparing for the import of hydrogen in various forms. In addition to the

construction of physical infrastructure, work is underway on permit granting, technology development, supply chain collaboration and incentive policies for the use of hydrogen, for example, in (bio)refineries via the 'refinery process'.

Hydrogen carriers: different forms of transport

Hydrogen can be transported in various ways. If it is not possible to transport it via pipelines, hydrogen must be converted into another form. Unlike oil, which is liquid at normal temperatures, hydrogen must be cooled to $-253\text{ }^{\circ}\text{C}$ to liquefy. An alternative is 'packaging' hydrogen in another molecule, such as ammonia, methanol, Liquid Organic Hydrogen Carrier (LOHC), iron powder or another carrier.

Many production countries are too far from Europe to transport hydrogen in gaseous form by pipeline. The

cost of generating green electricity accounts for the largest share of the total production costs of green hydrogen, currently around 70%. In countries with plenty of sun, wind and space, these electricity costs are considerably lower than in Northwestern Europe, sometimes up to three times as low. This difference offers a major advantage for the production of green hydrogen in those regions. As a result, the lower production costs largely offset those of liquefaction, packaging and transport. For imports from Southern Europe and North Africa, pipelines could become an attractive alternative in the long term, if volumes are large enough.

Liquid hydrogen: an innovative energy carrier



Air Products Rotterdam

What is liquid hydrogen?

As explained earlier, hydrogen becomes liquid through intense cooling to $-253\text{ }^{\circ}\text{C}$. This technology has its origins in space travel but will become important for many more sectors in the future.

Currently, liquid hydrogen (LH_2) is produced in Northwest Europe by companies such as Air Products, Linde and Air Liquide. The total capacity of these facilities is approximately 25 tonnes per day.

Liquid hydrogen is suitable for transporting quantities of up to two tonnes (typical tank trailer) over distances of up to 300 kilometres. Long-term storage and long-distance transport pose technical challenges that require further innovation.

Liquid hydrogen in the port of Rotterdam: Market developments and projects

Air Products

Air Products plays an active role in the development of the European hydrogen economy. The company is developing the NEOM Green Hydrogen Complex (NGHC), the world's largest renewable hydrogen facility. With these projects, Air Products is laying the foundation for reliable and large-scale supply chains that support the energy transition.

Air Products is participating in Daimler Truck's customer trials of the Mercedes-Benz GenH2 trucks and is also deploying one of these vehicles within its own distribution fleet. In addition, there are plans for a European network of commercial hydrogen filling stations along major transport routes. To meet growing demand, Air Products is building a second liquid hydrogen facility in Rotterdam. Once operational, it will double Europe's production capacity.

Air Liquide and the ENHANCE project

As part of the ENHANCE project, Air Liquide is

developing a large-scale, innovative renewable ammonia cracking plant and an advanced liquid hydrogen production facility. ENHANCE is the first European industrial-scale project focused on the production and distribution of low-carbon and renewable hydrogen using ammonia as a raw material.

The facility supplies liquid hydrogen to the heavy mobility sector (including the maritime sector) and specific industrial applications in the Netherlands and Europe. The ENHANCE project aims to reduce more than three million tonnes of CO_2 emissions during the first ten years of operation.

Maritime sector: Samskip

The maritime sector is also pursuing sustainability, in which hydrogen plays an important role. International logistics company Samskip is developing the first short-sea container ships to run on green hydrogen. These 'SeaShuttles' will transport containers between Oslo and Rotterdam from 2027, consuming up to 1,500 tonnes of hydrogen per year. As more vessels follow, demand will continue to increase.



Samskip "SeaShuttles"



Rotterdam The Hague Airport liquid hydrogen storage facility

Aviation: Rotterdam The Hague Airport

The aviation sector also faces the challenge of becoming more sustainable. This can be achieved, for example, through the use of Sustainable Aviation Fuel (SAF), battery-electric flying or liquid hydrogen. The last two in particular are in development for shorter distances. At Rotterdam The Hague Airport (RTHA), close to the port, a small liquid hydrogen storage facility was built. This storage facility will be used to research the impact of liquid hydrogen in aviation and enable delivery to users at the airport site. RTHA is collaborating with TU Delft, AeroDelft and the Netherlands Aerospace Centre (NLR) for this purpose. These efforts are part of a broader transition within the aviation sector, in which airports, knowledge institutions and industry partners are working together to reduce the climate impact of flying. RTHA and the Port of Rotterdam Authority have jointly published a [white paper on the applications of SAF and hydrogen in aviation](#).

Future: import terminal for liquid hydrogen

The developments show that the ecosystem for liquid hydrogen is in full swing. More and more applications are becoming possible and large manufacturers are expanding their production capacities. This leads to growing interest from tank terminals. As demand for liquid hydrogen increases and the ecosystem develops, the realisation of an import terminal is becoming increasingly realistic. In recent years, several studies have been initiated into liquid hydrogen supply chains combined with storage in Rotterdam, involving parties such as Kawasaki and other international storage companies.

The port of Rotterdam is anticipating this: space has been reserved and an initial design for a possible import terminal has been drawn up. This enables the port to position itself as a future-proof link in the international hydrogen chain.

In conclusion

Hydrogen will find its way to the port of Rotterdam in various forms. Expectations are high: liquid hydrogen is increasingly seen as an indispensable link for tomorrow's energy supply. Liquid hydrogen has been part of the Rotterdam ecosystem since 1988, and current market developments indicate that liquid hydrogen will play a key role in the future of Rotterdam's hydrogen hub. The port of Rotterdam is ready!

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