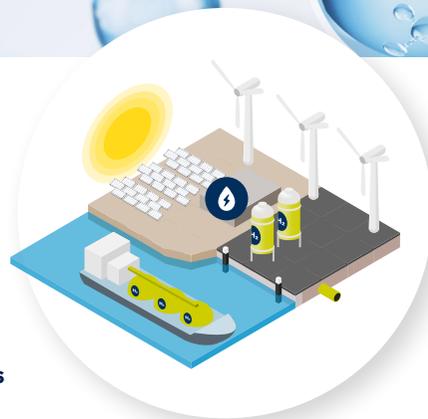


MAJOR STEPS MAKE HYDROGEN A REALITY

Hydrogen, and especially green hydrogen is increasingly being recognised and adopted as the key promise for a sustainable future. For example, not only will it be a raw material for the chemical industry, its applications are set to find their way into the steel and process industries and as a fuel for heavy transport. All this with zero emissions and a single residual product: water. It was with good reason that Allard Castelein, President and CEO of the Port of Rotterdam Authority, once labelled hydrogen as being “essential to a carbon-neutral energy supply”. Therefore, as befits the spirit of Rotterdam, the Port Authority is already fully committed to initiating and stimulating practical applications in this area.

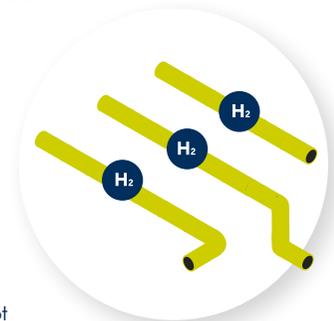


GREEN HYDROGEN

“The great thing is that in the port of Rotterdam we already have the largest hydrogen market in the Netherlands and one of the largest in Europe”, said Randolph Weterings, Programme Manager for Electrification and Hydrogen at the Port of Rotterdam Authority. For decades, Air Liquide, Air Products and Nouryon have collectively produced almost 500 kilotonnes per year. Today’s grey hydrogen is used primarily in refining to desulphurise fuels and as a building block for fertiliser. “This means we have the experience. What’s more, we have a huge amount of infrastructure already in place, and this can be partially reused to transport and use large quantities of green hydrogen.”

PIPELINE INFRASTRUCTURE

Meanwhile, the expansion of hydrogen transport from Rotterdam to users in the Netherlands, Germany and further afield in Europe is now being actively pursued. The Port of Rotterdam Authority and its partners have long been pressing for the expansion of the pipeline infrastructure so that inland industrial areas can also have safe and efficient access to the large quantities of green hydrogen needed to provide them with a new, sustainable energy carrier and raw material. Specifically, this involves establishing connections with the Chemelot industrial hub in Geleen and North Rhine-Westphalia. Moreover, thanks to the existing Spatial Vision for Pipelines, the Netherlands already has an available route along which these new pipelines can be laid between Rotterdam, Chemelot and the German border. It would then be possible to link up with one of the most important European industrial clusters in the Ruhr area.



PIPELINE INFRASTRUCTURE

In May 2021, the Ministry of Infrastructure and Water Management conducted a feasibility study in which it endorsed the expansion of the pipeline infrastructure. The study focused on four pipelines for LPG, propylene, hydrogen and carbon, and importantly, their connection to the German petrochemical and steel industries. If the quartet of pipelines, along the Rotterdam-Moerdijk-Tilburg-Venlo-Chemelot route, were to be completed in one go, it would be a considerable saving regarding to the initial investment.

INTERNATIONAL SUPPLY CHAINS

Industry is showing a lot of interest. For example, the German steel companies ThyssenKrupp Steel and HKM recently announced that they would be joining the Port of Rotterdam Authority in exploring the possibilities of international hydrogen supply chains. It would entail not only the import of green hydrogen via Rotterdam but also its transport along newly laid pipelines to Europe’s steel capital, Duisburg. Other industries have also indicated that in the mid and long term, they expect there to be a demand for green hydrogen.

Some of the hydrogen being brought to users along the pipeline would be produced in Rotterdam. However, most of it would be imported from countries where large amounts of wind and solar power can be used to produce hydrogen efficiently. Those countries are in the Middle East, Africa, South America and even Asia. Green hydrogen could be shipped in various forms from these regions to Rotterdam where it would be stored, processed and transported further.

WRAPPING HYDROGEN

As for transporting hydrogen, Rotterdam can support all forms, including as a gas. However, other ways are under development, such as “wrapping” the small hydrogen molecules in larger ones to allow it to be transported as a liquid. Liquids of this kind, e.g. lamp oil, are called Liquid Organic Hydrogen Carriers (LOHC). “This is a very promising technology”, says Marcel van de Kar, Commercial Director and Director of New Energies at Vopak. In 2019, this development led the Rotterdam tank storage company to take an interest in the German company Hydrogenious LOHC Technologies, which is developing the technology. Van de Kar: “Ammonia can also be used as a carrier. Its advantage is that you can use it at once as a semi-finished product for the chemical industry.”

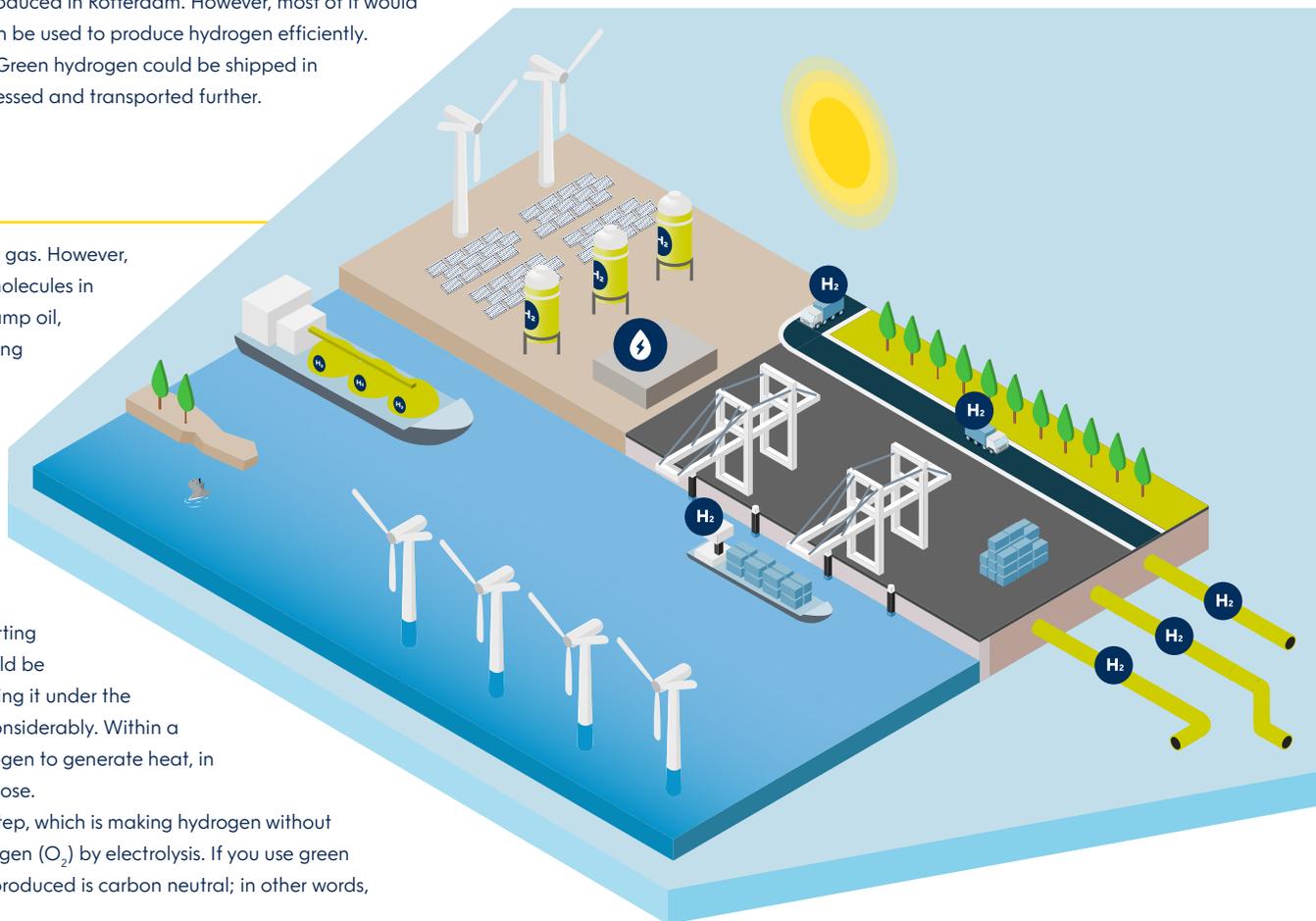
Ultimately, of course, the problem lies in the transition from grey to green hydrogen. That’s because until now, hydrogen was mainly obtained by converting natural gas at high temperatures. This “grey” hydrogen releases CO₂. This could be done differently. In the shorter term, we can keep capturing this CO₂ and storing it under the sea (so-called blue hydrogen), which already reduces the carbon footprint considerably. Within a relatively short time, it will be possible to produce large volumes of blue hydrogen to generate heat, in particular for the process industry. The H-vision project is running for this purpose.

As soon as there is sufficient green electricity available, we can take the next step, which is making hydrogen without generating CO₂. Water (H₂O) can actually be split into hydrogen (H) and oxygen (O₂) by electrolysis. If you use green energy from, say, wind or solar power for this electrolysis, then the hydrogen produced is carbon neutral; in other words, it’s “green”.

MAKING IT HAPPEN

There are many benefits to be had by developing the hydrogen hub in Rotterdam. Large-scale use of blue and green hydrogen in industry and logistics can significantly reduce CO₂ emissions and maintain the leading international position held by Rotterdam’s businesses and port. “If we’re going to be ready for this, it’s important that rather than sitting and waiting for green hydrogen to be widely available, we need to build up experience right now”, explains Port of Rotterdam Authority International Port Development Manager Edwin van Espen. “It’s a question of rolling up our sleeves and getting started. We need to set things up, try things out and make headway. We can learn from the experience and it will give us a head start.”

These initiatives are being taken across the spectrum of uses for hydrogen, from heat generation for the process industry and fuel for transport to its application as an energy storage medium and as a raw material for sustainable chemicals.



WORLD'S FIRST FLYING HYDROGEN BOAT

Innovation and the practical application of hydrogen technology are key to completing Rotterdam's transition into a hydrogen hub. For example, the Port of Rotterdam Authority is sponsoring [TU Delft's Hydro Motion project](#), which involves developing a hydrogen-flying boat to compete in the Solar & Energy Boat Challenge in Monaco this summer. There are also developments in the shipping industry. For example, the green light has been given for the construction of the first electrically propelled inland waterway vessel powered by fuel cells and hydrogen. The "Antonie" will be a 135-metre long, emissions-free barge that from April 2023 will shuttle salt between Delfzijl and Rotterdam-Botlek.

When it comes to hydrogen-fuelled road transport, Rotterdam is also making its mark. For example, in 2014 Air Liquide opened the Netherlands' first public hydrogen filling station in Rhoo, in the south of Rotterdam. As a result of this, the Port Authority has included hydrogen-powered Hyundai cars in its fleet. Furthermore, in 2020 Air Liquide was involved in the launch of one of Europe's largest projects aimed at developing hydrogen-powered trucks: HyTrucks. The goal is to have a thousand trucks, 500 of which will operate out of Rotterdam, running on hydrogen in the Netherlands, Belgium and West Germany by 2025. The consortium already counts partners such as VDL Group, Iveco/Nikola, transport companies Vos Logistics, Jongeneel Transport and HN Post, and leading fuel cell suppliers among its members.

5,000 TIMES MORE

It is clear that sustainable hydrogen will usher in a surge of new applications and therefore lead to a proliferation of uses. By 2050, the total flow of hydrogen through the port of Rotterdam is expected to reach 20 million tonnes per year. That is 5,000 times more than the amount of hydrogen that currently flows through Rotterdam's port. "Over the coming decades, demand will become so high that we will have to import most of our hydrogen", said Nico van Dooren, New Business Development Director at the Port of Rotterdam Authority. That is why the Port Authority is in talks with several parties about constructing hydrogen terminals. The port of Rotterdam is actively involved in the energy and resources transition and is ready to become Europe's Hydrogen Hub.



SAILING ON GREEN HYDROGEN

PORT OF THE FUTURE: THE IMPORTANCE OF HYDROGEN

Large scale use of hydrogen seems far on the horizon, but in Rotterdam, we've already begun, working on many different hydrogen projects with a range of companies and stakeholders. Do you want to exchange your views and ideas about hydrogen? Feel free to get in touch with us.

CONTACT

Edwin van Espen
Manager International Port Development
ejs.espen@portofrotterdam.com
portofrotterdam.com/international

