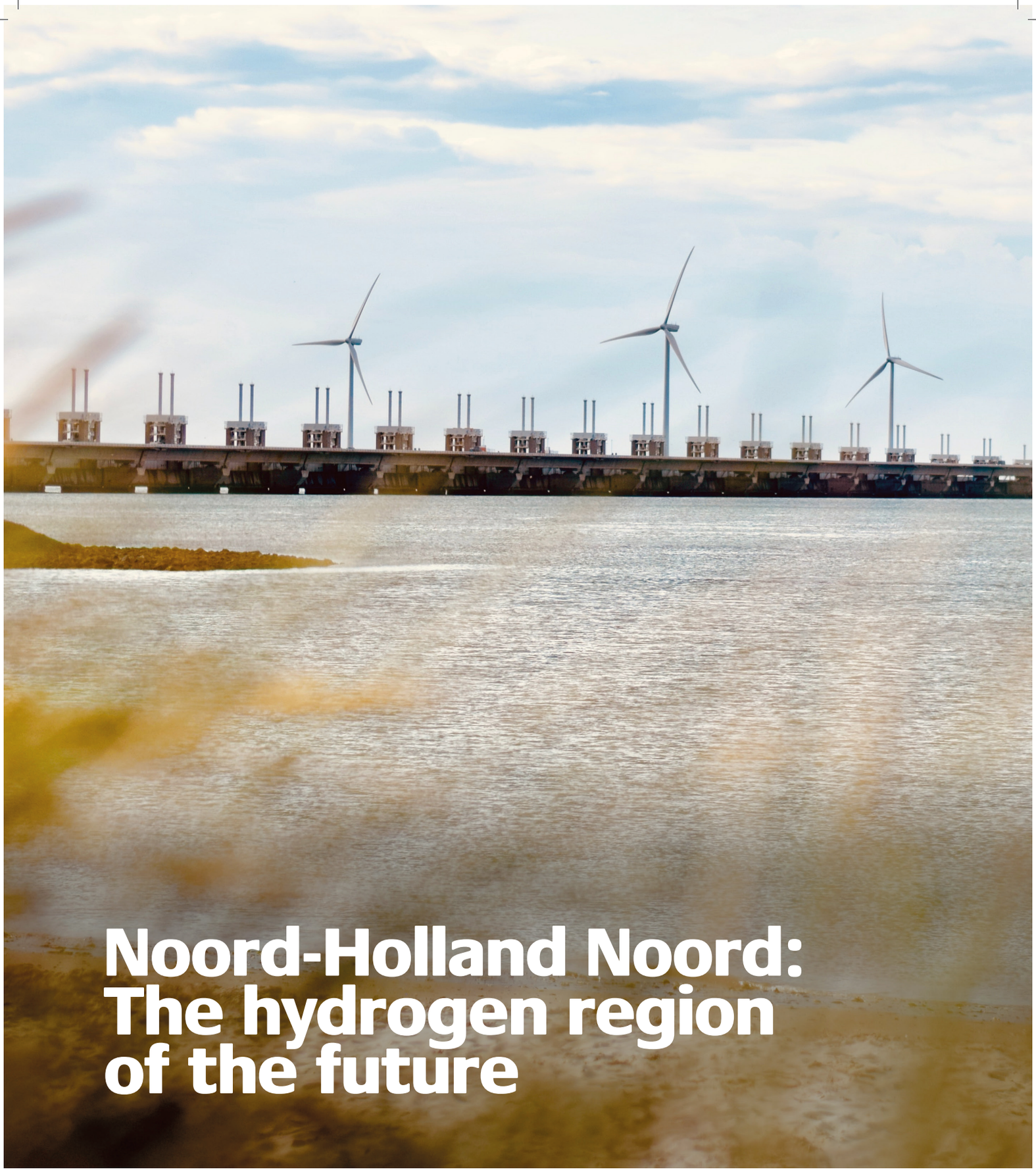

Noord-Holland Noord: The hydrogen region of the future

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Introduction

In Noord-Holland Noord we work on a sustainable future every day. A future in which we make a lasting contribution to protecting our climate with green energy and a green industry. This requires change. Change in thinking, but above all in doing. Hydrogen plays a crucial – and perhaps indispensable – role within the energy transition.

Noord-Holland Noord with the port of Den Helder has an unique starting position. The favorable location in relation to future wind farms in the North Sea, the existing gas infrastructure and high-quality knowledge make the region the future hub for the European hydrogen economy in Europe. Our hands-on mentality ensures that we not only see opportunities, but also get to work on hydrogen projects and activities. This under the motto: do not lose momentum.

Green, sustainably generated hydrogen is the ultimate goal. However, to initiate a hydrogen transition, it is important to start quickly. With the production of decarbonised hydrogen in Den Helder, we can offer the industry carbon-free hydrogen well before 2030. At the moment, the production capacity of green hydrogen is still limited and the costs are relatively high. With affordable decarbonised hydrogen – with CO2 stored in empty gas fields – we can start building a hydrogen infrastructure. In this way we pave the way for a green hydrogen future.

Noord-Holland Noord (NHN) is ready for a future energy system with hydrogen as the basis for making the Netherlands and Europe more sustainable. In this whitepaper, we take you through the story of how we are going to achieve this: starting from current hydrogen initiatives, via a realistic sketch of the situation in 2030, to our vision of the future that results from our hydrogen ambitions for 2050.


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Position Paper

Noord-Holland Noord is fully committed to hydrogen economy

In a recent report, the IPCC emphasizes once again[1]: global warming is already noticeable all over the world and greenhouse gas emissions are undeniably contributing to this. Only with drastic and large-scale measures can we limit the global temperature rise to 2 degrees. According to Climate Signal '21, in which the KNMI explains to us the significance of the IPCC report for the Netherlands, the climate is changing faster and faster and the forecast for sea level rise in the North Sea must be adjusted upwards. In the most extreme scenario, this could rise to five meters in 2150. Such a sea level rise poses a threat to the Netherlands and also to the Noord-Holland Noord (NHN) region, which is largely below the NAP[2].

Climate change is a major and urgent problem. To limit global warming as much as possible, we must rapidly replace the current fossil energy supply with sustainable alternatives. Climate neutral hydrogen is suitable for practically all sectors and can also be produced on a large scale. Moreover, it can be used not only as a fuel, but also as an indispensable raw material for various industrial processes and as a storage medium for energy. A (temporary) surplus of sustainably generated electricity can be converted into hydrogen, which is converted back into electricity if there is a shortage of electricity. Hydrogen thus acquires a function for balancing the electricity grid and can offer a solution to the growing problem of network congestion.

Challenge and opportunity

For NHN, the transition to a sustainable society represents both a challenge and an opportunity. The challenge is to make all sectors more sustainable at a rapid pace and thus to retain large economic sectors, such as shipping and the agricultural sector, for the region. The opportunity lies in making a substantial contribution to the creation of a hydrogen market, as described in the EU Strategy on Hydrogen[3]. This offers new opportunities in the fields of employment, knowledge, technology, education and science. Partly for this reason, hydrogen is one of the spearheads in the Region Deal Maritime Cluster Kop van Noord-Holland[4].

NHN is in an excellent position to play a leading role in the new hydrogen economy. The region meets all the essential conditions:

- A very favorable position in relation to the intended wind farms in the northern part of the North Sea.
- A favorable location in relation to empty gas fields, for the storage of CO2.
- The existing gas infrastructure in the North Sea. Most of this lands in Den Helder and can be used for the transport of hydrogen.
- The existing gas infrastructure in NHN, with various gas treatment installations and gas storage facilities.
- Direct connection to the hydrogen backbone that connects the region with national and international industrial customers.
- Available space for the development of the hydrogen economy.
- High-quality knowledge of hydrogen in various knowledge centers within the region.

NHN wants to get the hydrogen economy going for the whole of the Netherlands, so that our country can acquire an international position in the emerging hydrogen economy.

The hydrogen region in 2050

Due to the great urgency of the climate challenge, the transition to a sustainable society must be completed by 2050 at the latest. NHN's ambition is clear: with its favorable starting position for the production and distribution of hydrogen, the region is ideally placed to grow into one of the major hydrogen hubs for Northwestern Europe by 2050, with the port of Den Helder.

In our vision for the future, large-scale production of green hydrogen takes place at sea. Via the former gas infrastructure, this sustainably generated energy is sent via Den Helder to industrial clusters elsewhere in the Netherlands or abroad. The region also has various regional hydrogen networks, which are fed by the hydrogen backbone and regional hydrogen production facilities. Noord-Holland Noord can already be supplied with half of hydrogen that is produced regionally by 2030[5]. The demand for this hydrogen comes from various sectors, such as shipping, agriculture, logistics and the built environment.

[1]IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change
[2]https://www.rijkswaterstaat.nl/zakelijk/open-data/normaal-amsterdams-peil
[3]https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf
[4]https://www.rijksoverheid.nl/documenten/kamerstukken/2020/07/13/regio-deal-maritiem-cluster-kop-van-noord-holland

In 2050, the hydrogen economy will give a new impulse to the broad prosperity in the region, with opportunities for residents of all educational levels, ranging from maintenance technicians for wind farms at sea to researchers at international knowledge centres. In our vision for 2050, hydrogen is a crucial energy carrier for the Northwest European energy system and demand will increase exponentially in the coming years. Thanks to its favorable location and the available facilities, NHN can take on a leading role as a leading hydrogen region in meeting the demand for hydrogen.

Why the Hydrogen Valley status for NHN?

Granting the European status of 'Hydrogen Valley' to NHN will have a stimulating effect on the region. We can scale up ongoing initiatives more quickly, which means that the sustainable hydrogen infrastructure is established earlier – an essential step towards European decarbonization. Moreover, because the potential of the regional area is known, it will be easy to connect with Hydrogen Valleys elsewhere in the Netherlands and Europe. This is how we work together on an international sustainable hydrogen economy.

Towards a zero-emission economy

In anticipation of being granted the Hydrogen Valley status, NHN has already initiated a large number of initiatives. These focus, among other things, on the production of hydrogen, pilots for the further development of innovative ideas for the production and application of hydrogen and the building and sharing of knowledge.

The remainder of this position paper consists of 4 parts:

1. First we consider the current situation with a selection of current initiatives, pilots and knowledge development.
2. Next, we dive into the untapped potential of NHN and identify the steps needed to harness this potential.
3. We then discuss the 4 pillars on which NHN wants to take steps to achieve a leading position as a hydrogen region by 2030.
4. Finally, we outline the final situation as we expect to achieve this with our plans in 2050.

[5]Gezamenlijk wordt er in 2030 circa 25 petajoule aan waterstof geproduceerd, ongeveer de helft van de huidige energievraag in de regio. https://cijfers.noord-holland.nl/dashboard/energietransitie/energieverbruik

Regional cooperation brings the hydrogen economy to life

When propagating NHN's vision on the hydrogen economy in 2050, the government, the business community and knowledge institutes are working together. As a result, several initiatives have already been taken. The underlying goal here is the formation of integral chains of hydrogen production, storage, distribution and use.

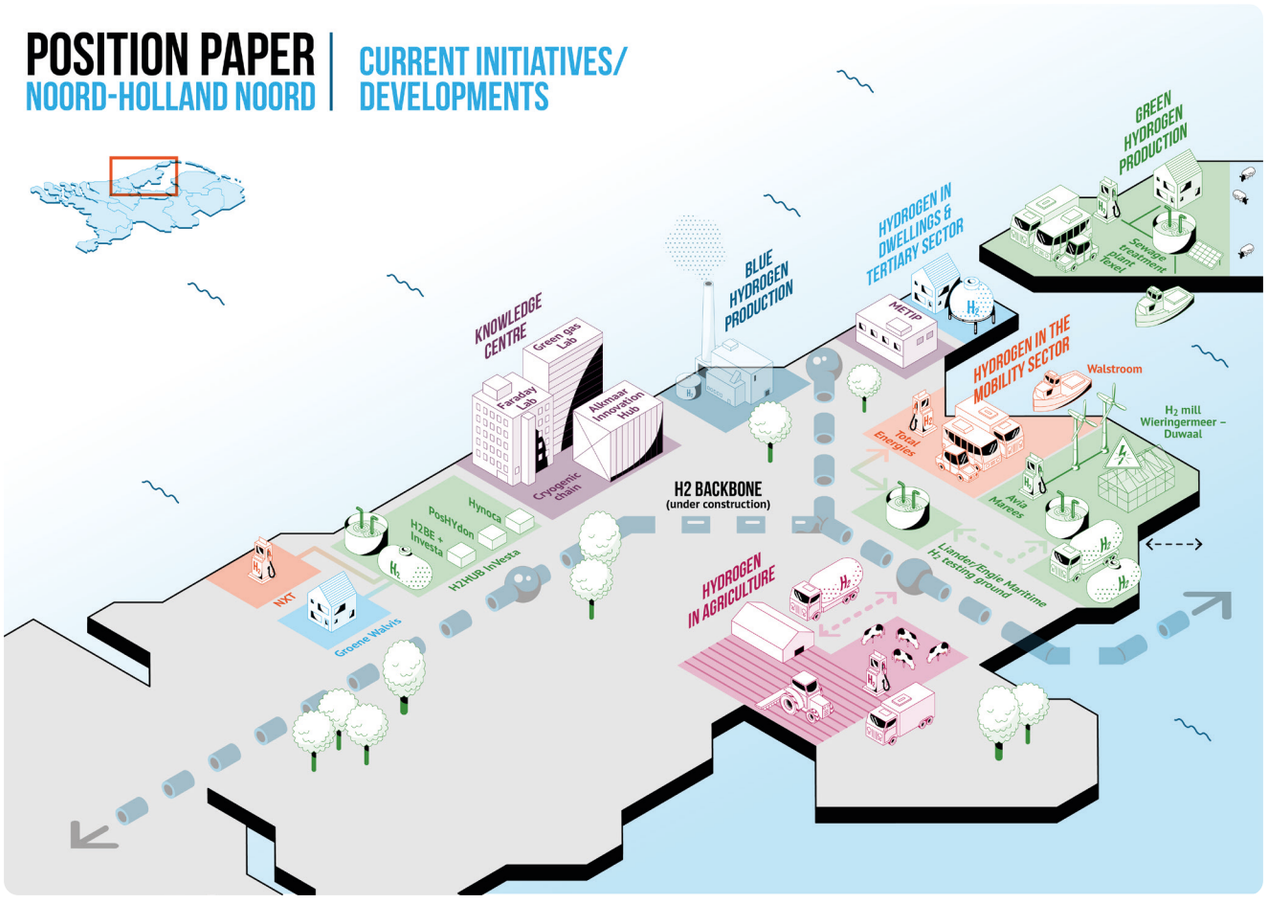
To connect these hydrogen chains, it is important to allow the supply and demand side to grow at the same time. To this end, it is necessary to develop initiatives at all levels of scale. NHN is currently actively working on innovative combinations for the production and application of hydrogen. Various stakeholders are involved in these processes. A good example is Duwaal, a program in which the electricity generated in wind turbine(s) is converted into green hydrogen on site. This green hydrogen is distributed from a high-pressure storage facility to five filling stations. Another progressive initiative in the region is the Zephyros project. A consortium including Alliander, Total and ENGIE is developing a hydrogen chain for maritime and road transport in Den Helder, with hydrogen filling points for refueling trucks and ships. At the same time, the consortium is working on the development of a fuel cell service vessel. A solar park supplies the energy for the production of green hydrogen, whereby the electrolyser installed here also plays a role in solving grid congestion.

Initiatives are also taking place at other locations with the local production of hydrogen to solve grid congestion, such as Walstroom Den Helder (see box) and in the Wieringermeer. In the Wieringermeer, efforts are being made to use hydrogen on a large scale to meet the strong growth in energy demand for agricultural activities and data centers.

Shore power in Den Helder harbor

Ships moored in the port often depend on (diesel) generators for their on-board energy supply. This can and must be more sustainable! Project Walstroom investigates whether clean alternatives can replace the polluting aggregates. One of these is a hydrogen fuel cell, which can deliver large capacities. Application of this technology also prevents grid congestion, because ships do not consume large capacities from the local electricity grid. We expect to be able to substantially scale up this project after the pilot phase, because many ships will sail hybrid or fully electric in the near future.

POSITION PAPER
NOORD-HOLLAND NOORD | CURRENT INITIATIVES/ DEVELOPMENTS



Hydrogen also has the potential to contribute to heating the built environment. In the municipality of Graft-De Rijp, this is happening with the Groene Walvis (Green Whale) project, which is investigating whether the communities of Graft and De Rijp can be stripped of natural gas and replaced with locally produced hydrogen gas. Initiatives for the development of hydrogen neighborhoods are underway in the municipality of Den Helder and on Texel.

Experiences from these projects can help other areas in their transition to a sustainable energy supply and are also reflected in the InVesta programme, where entrepreneurs and researchers jointly set up programs for the production of hydrogen from biogenic waste streams. The potential of this hydrogen production is very large. Various companies expect to be able to scale up their production to installations of 40-100 MW. In addition to solar and wind, this gives biomass an important position in the production of hydrogen.

The large number of initiatives reflects the energy that NHN puts into realizing its vision of a hydrogen economy. (See the appendix for a complete list of current projects). This energy is increasingly visible in two major projects that are being worked on, the hydrogen factory H2 Gateway in Den Helder and, by extension, the connection of Den Helder to the hydrogen backbone at the Wieringermeer. The scale of these projects is such that work is already required to realize them in 2027/2028. With H2 Gateway and the connection to the hydrogen backbone, NHN is working on a strong positioning of the region in the international hydrogen market. Both projects (H2 Gateway and H2 Backbone) are explained in the chapter on 2030, the year in which both must be completed.

Thanks to all these initiatives and experiments, innovations and explorations of existing and new hydrogen chains, NHN has the necessary knowledge to make the right choices to realize the hydrogen economy in 2050. In NHN, but also in other parts of the Netherlands and the world.

Existing and new hydrogen chains in NHN

» Clean fuels for maritime shipping
» Natural gas-free agriculture
» Green mobility
» Grid balancing
» (Inter)national export
» Built environment
» Import and transit of H2 from wind at marine parks

The untapped potential of Noord-Holland Noord

The combination of a very favorable geographical location in relation to the large wind farms, the presence of an existing gas infrastructure, a highly developed knowledge infrastructure and the space available to allow the hydrogen economy to grow, gives NHN an excellent starting position to become one of the leading hydrogen regions of Northwestern Europe. If we combine this with the expectation of a strongly growing demand for hydrogen in Northwestern Europe – as expected 20-30% of the total energy demand in 2050 – it is clear how great the potential is in the region.

Existing gas infrastructure and the H2 Backbone

Den Helder is already an important location for landing natural gas. Three large gas pipelines ensure that 90% of the North Sea gas comes ashore in Den Helder. These pipes will lose their current function in the future, but can be used for the transport of hydrogen and CO2. The facilities in the field of offshore energy production can also be used in a large-scale hydrogen infrastructure. For example, the NAM gas treatment station can be used for the central role that Den Helder will play in the landing, production and distribution of hydrogen.

The construction of the hydrogen backbone is of crucial importance for the development of Den Helder as a landing and distribution hub for hydrogen. Gasunie has announced that it must be fully operational by 2027. This will provide Den Helder with a direct connection to an enormous sales market where large volumes of hydrogen can be sold in the future. This makes the port city one of the most attractive locations for landing green molecules.

Wind farms at sea are close by

The forecasts for offshore wind are predicting an enormous growth in capacity until 2050, from a minimum of 38 to a maximum of 72 GW[6]. This energy will arrive in the form of both green molecules (hydrogen) and electrons (electricity). Because hydrogen can be transported more efficiently and economically over longer distances than electrons, the landing of molecules is preferred. With the bigger wind farms a relatively short distance off the coast and an already existing gas infrastructure at sea, the region is a logical landing place for the energy generated from wind farms with a greater distance from the coast. NHN also offers an ideal operating base for a logistics service sector, necessary for the construction and maintenance of wind farms and hydrogen infrastructure. With more than half a century of experience in logistics services in the North Sea (oil and gas extraction), Den Helder can perfectly fulfill the role of logistics service hub for sustainable energy at sea. In addition, Den Helder has one of the largest helicopter airports in Northwestern Europe, specialized in air transport for the offshore energy industry, and unique in the Netherlands. The presence of a deep-sea port and an airport offer a unique combination of possibilities.

Storage of hydrogen and CO2 at sea

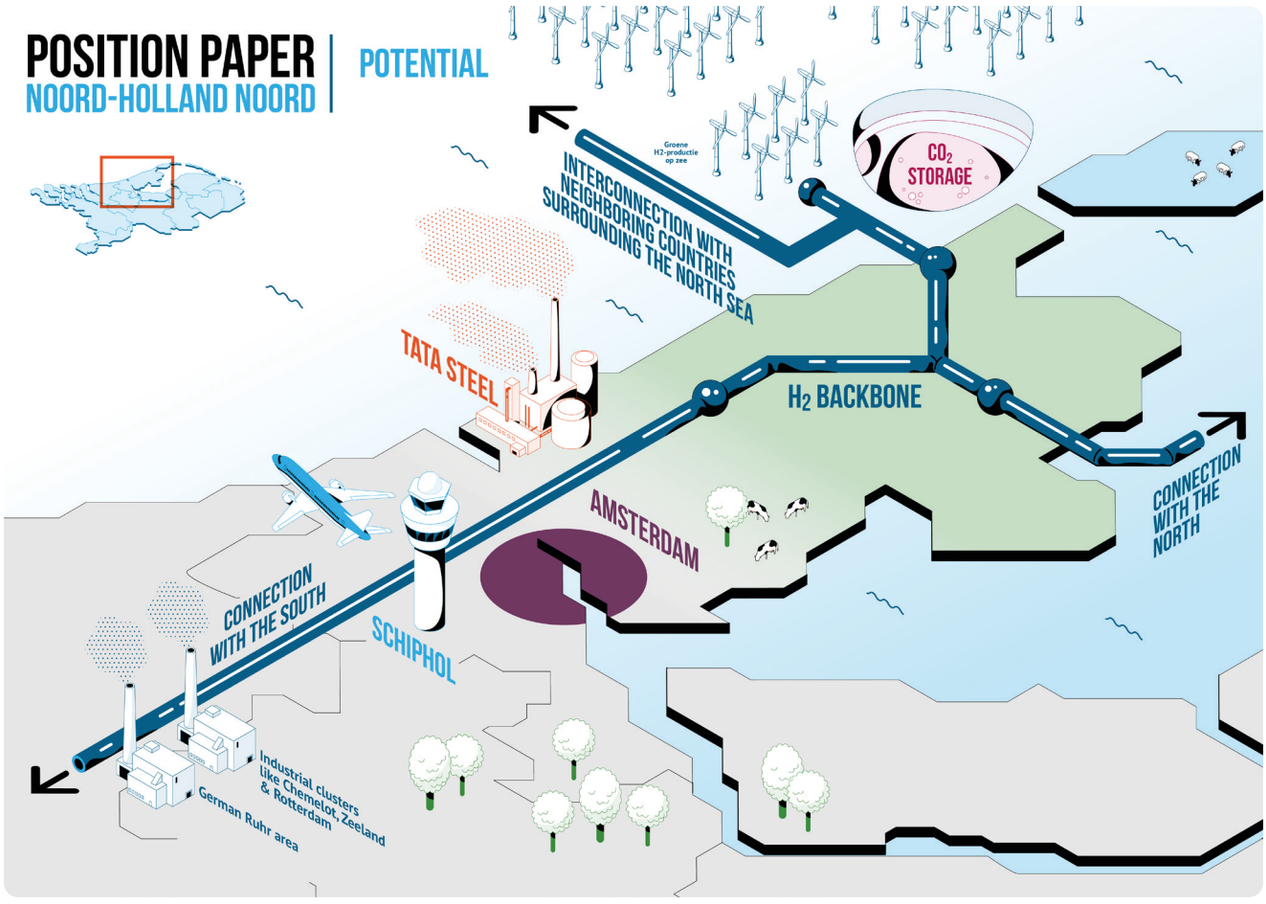
The energy transition that we all want to realize is accompanied by the need to be able to store energy for a longer period of time. In theory, hydrogen offers a solution here. Although hydrogen storage in empty salt caverns has been proven safe, it is unclear whether the capacity is sufficient to meet future storage needs[7]. A useful alternative is the storage of hydrogen in empty gas fields. Thanks to the short distance to (empty) gas fields at sea, the NHN region can also play a role in the storage of hydrogen. Storage capacity is also available in the Alkmaar region.

Green hydrogen is still available to a limited extent, but the ambitions to reduce greenhouse gas emissions in the short term are high. In order to achieve the objectives as stated in the Climate Agreement, it is urgently desirable – in anticipation of sufficient availability of (affordable) green hydrogen – to start setting up a hydrogen infrastructure now. Decarbonized hydrogen offers an important part of the solution. CO2 is captured during the production of this decarbonized hydrogen. Since storage of CO2 on land is not an issue, storage at sea offers a solution. The shorter the distance from depleted gas fields to the coast, the cheaper the transport of CO2 to these fields will be. It is also possible to use the existing gas infrastructure.

Strategic location between supply and demand

The potential for hydrogen production and distribution in NHN is great, much greater than the hydrogen demand in the region. NHN therefore sees a crucial role for itself as an international energy hub; a region that makes the connection between supply and demand of hydrogen via the hydrogen backbone. The backbone connects production and distribution with large industry clusters. Within the North Sea Canal Area (NZKG) there is a large sales market around the corner. Developments at Tata Steel and Schiphol are creating a large demand for hydrogen (derivatives), which hydrogen from NHN can (partly) provide. The hydrogen backbone also connects NHN with industrial clusters such as Chemelot and the Ruhr area, and in the long term also with other parts of Europe.

[6]DNV GL (2020). Noordzee Energie Outlook
[7]TNO. Grootschalige opslag en transport waterstof



Knowledge and innovation as a driving force

Did you know that the largest hydrogen research center in Europe is located in NHN? In the Faraday Lab in Petten, TNO works on technological innovations with a large number of industrial and academic partners, including the Joint Research Center of the European Commission. Other knowledge centers combine knowledge with practice. At InVesta in Alkmaar, for example, entrepreneurs, researchers and governments work together on sustainable hydrogen and green gas initiatives. Innovations from laboratories are also tested here in pilot and demo situations.

Another good example of practical knowledge development: the PosHYdon project, which is currently undergoing a pilot in which green hydrogen is produced on an offshore production platform (see box). And on the island of Texel, experiments are taking place with innovative developments around local chains. Texel has the ambition to continue these developments with the ultimate goal of being a climate-neutral society that serves as an example for other inhabited islands. In this context, Brussels awarded the Project Development Assistance (PDA) of the Fuel Cell and Hydrogen Joint Undertaking (FCH-JU) in June 2020. In addition to knowledge development, NHN distinguishes itself through a strong maritime cluster. The Maritime Emerging Technologies Innovation Park (METIP) stimulates collaboration between companies, knowledge institutions, startups and students for sustainable innovation in the maritime field. Research focuses on, among other things, the application of hydrogen in maritime shipping and the use of (hydrogen) drones for the inspections of wind farms at sea.

PosHYdon

PosHYdon on Neptune Energy's natural gas platform Q13a-A, off the coast of Scheveningen, integrates three energy systems in the North Sea: offshore wind, offshore gas and offshore hydrogen. By demineralizing seawater and then electrolyzing it with green electricity from offshore wind farms, PosHYdon produces green hydrogen. This will be mixed with natural gas and will be transported to the coast via existing gas pipelines. In the current pilot phase, PosHYdon is being tested at Investa in Alkmaar, before being taken to sea. The aim of the pilot is to gain experience in integrating working energy systems at sea and the production of hydrogen in an offshore environment.

NHN accelerates towards a mature hydrogen economy

The urgency of the climate goals is triggering major changes in the world, the Netherlands and NHN. Phasing out fossil energy carriers is a top priority and hydrogen plays a leading role in this. NHN has established four pillars on which it wants to take major steps towards 2030:

» Increasing the renewable energy capacity.
» Upscaling of hydrogen production.
» Hydrogen distribution and storage.
» Stimulating regional hydrogen demand.

Increasing renewable energy capacity

To realize a fully green hydrogen economy in the long term, the supply of renewable energy must grow strongly until 2050. After all, sustainable electricity is needed to produce green hydrogen. An important part of this is the realization of large offshore wind farms. At the same time, the region is increasing the supply of green energy on land by encouraging all available roofs to be fitted with solar panels. This maintains public support for the energy transition and increases the supply of renewable energy.

Scaling up hydrogen production

Sufficient supply of hydrogen is a precondition for a mature hydrogen economy. NHN encourages this from three directions.

1. Large-scale production of carbon-free hydrogen in the H2 Gateway project, primarily for the purpose of making industry more sustainable.

   Very large volumes of green hydrogen can only be expected when sufficient offshore wind and electrolysis capacity have been realised. This will take off, particularly after 2030, when sufficient offshore wind and electrolysis capacity have been realised. The energy transition however will not get underway without an adequate supply of hydrogen. Decarbonized hydrogen is therefore seen as an essential energy carrier and stepping stone for realizing the transition to green hydrogen. The H2 Gateway project in Den Helder will have an annual hydrogen production of 0.2 megatons. This volume amply exceeds the regional demand for hydrogen in 2030. This is a conscious choice, because by connecting to the hydrogen backbone, which will be operational in 2027, NHN can supply all major industrial clusters in the Netherlands and neighboring countries with sufficient hydrogen. As a result, the region also makes a significant contribution to making other regions more sustainable.

2. Scaling up the production of green hydrogen through supercritical biomass gasification.

   With the H2HUB program we must lay the foundations for a green hydrogen economy by 2030. One of the building blocks in this program is the extraction of green hydrogen from biomass. By means of supercritical biomass gasification, we convert various biological (residual) streams (and possibly waste) into green hydrogen. Thanks to the solid knowledge base of SCW Systems and InVesta, a 100 MW biomass gasifier will be operational in 2024. Other parties within InVesta also have substantial investment plans.

3. Expansion of the capacity to produce green hydrogen on a large scale by means of electrolysis.

   The PosHYdon pilot has been launched in collaboration with TNO, Neptune Energy and InVesta, among others, in which the feasibility of green hydrogen production on an operational offshore platform is being investigated. The production of hydrogen directly in the windmill. The company HYGRO has initiated this technology. The first mill (3 MW electrolysis capacity) in the Wieringermeer will be operational at the beginning of 2022. The mill will supply hydrogen directly to a filling station via a pipeline.

These different forms of hydrogen production provide a stable basis for scaling up the hydrogen infrastructure towards a mature hydrogen economy in 2050.

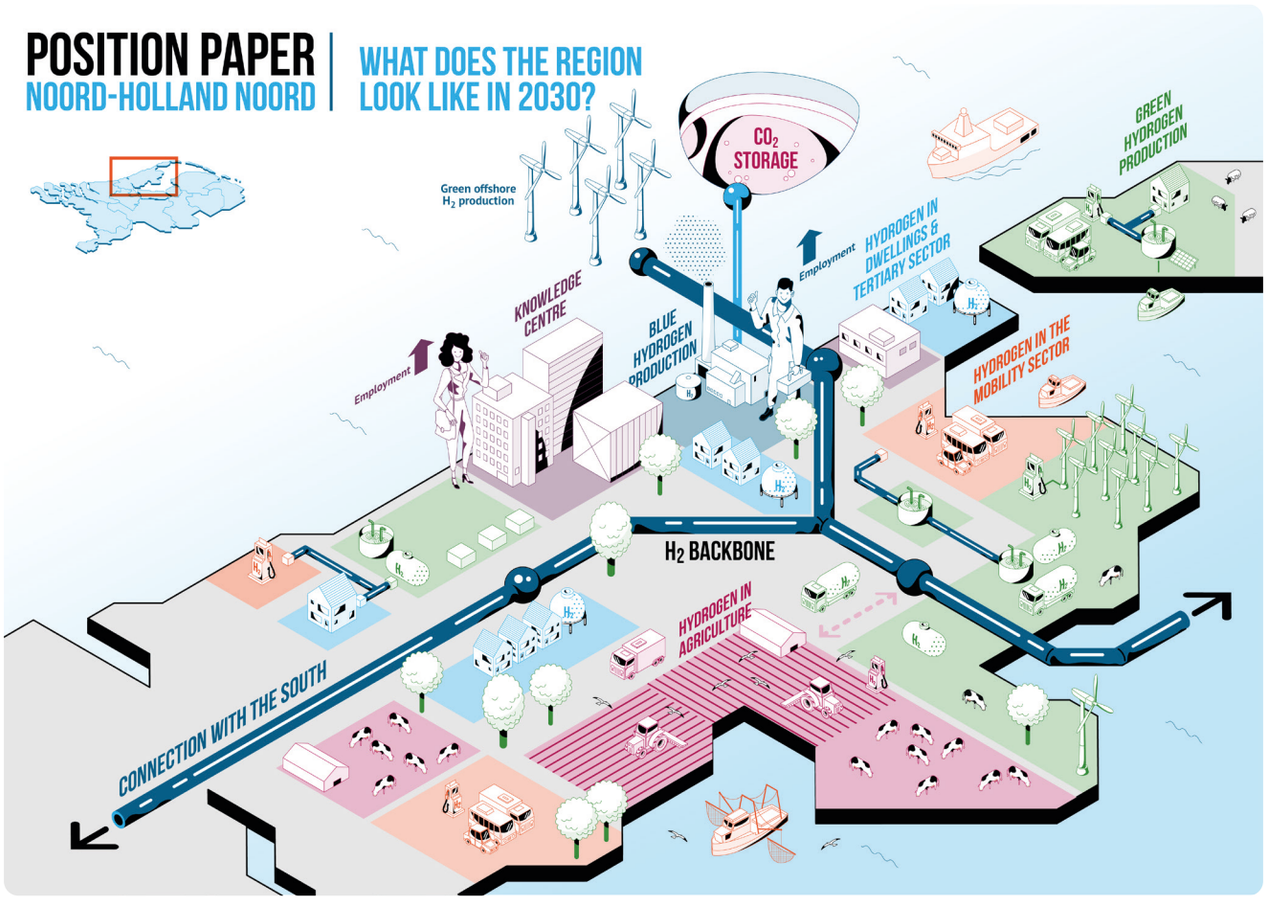
Facilitate hydrogen distribution and storage

Distribution is essential to match the supply and demand of hydrogen. In 2030, roughly two types of distribution can be distinguished.

Via the hydrogen backbone that runs right through NHN, with a direct connection to Den Helder. Approximately 100 km of hydrogen pipelines will be available in the region as early as 2027. Thanks to the H2 Gateway project, this hydrogen backbone will be fed with hydrogen well before 2030.

Via a hybrid system of hydrogen pipelines and transport by high-pressure tanker for regional transport. Hydrogen pipelines in the Wieringermeer, Den Helder and Alkmaar will be completed in 2030. Transport by high-pressure tanker provides customers who are not (yet) connected to a hydrogen pipeline in 2030. Local water storage around production locations keeps the system in balance. This creates a complete chain of hydrogen production and distribution to customers, including storage.

Figure 1. Port of Den Helder

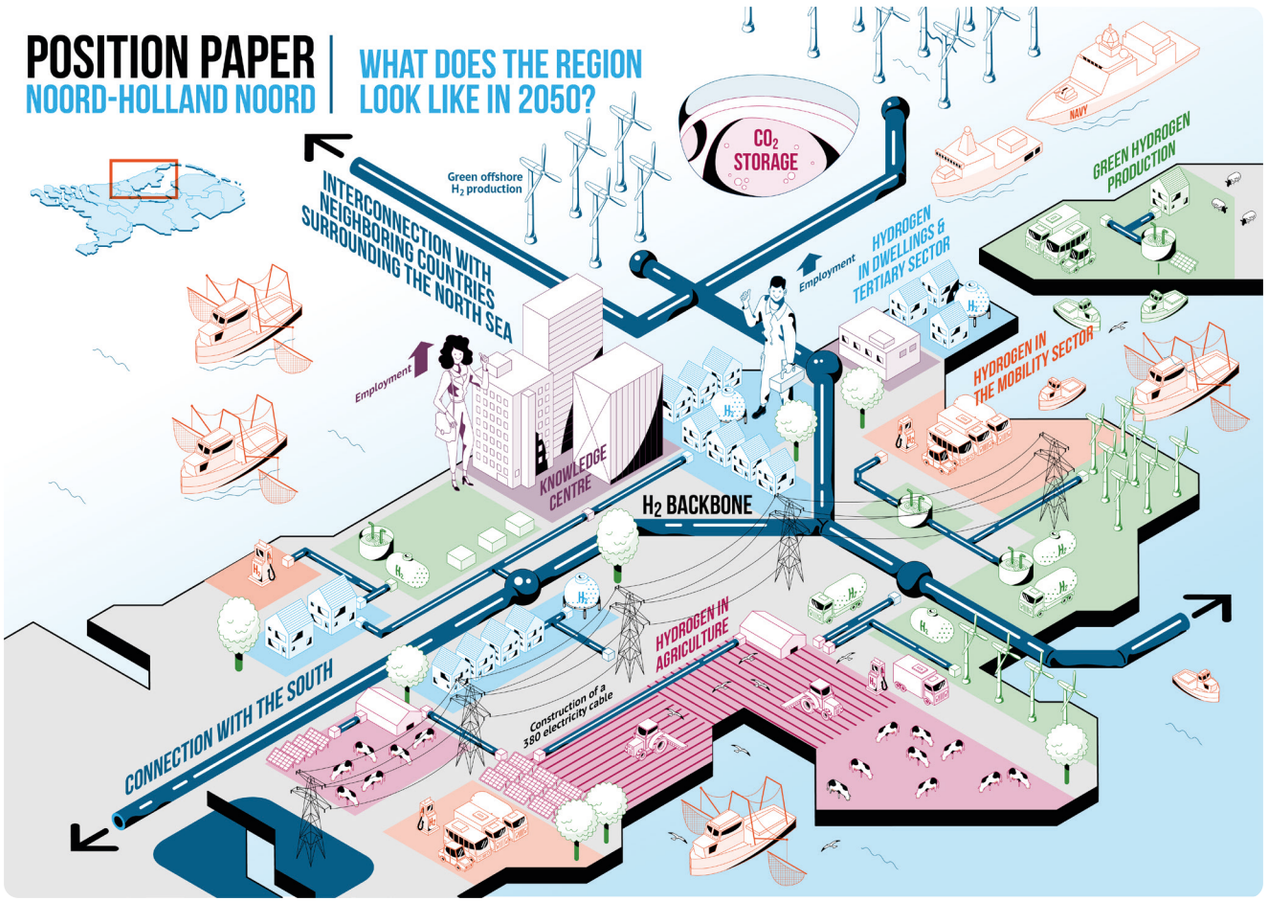


Stimulating regional hydrogen demand

Shipping is struggling with significant greenhouse gas emissions and is also difficult to make sustainable. NHN has joined the Sea Shipping, Inland Shipping and Ports Green Deal[8]. A significant part of the ships in the Port of Den Helder will make the switch to hydrogen within the next decade. This will become concrete in the realization of two filling points where ships can bunker hydrogen[9].

The agricultural sector in Noord-Holland Noord is extremely innovative and has positioned itself as a test location for hydrogen chains in the sector. The aim is to create a complete hydrogen chain in the Noord-Holland Noord agricultural sector by 2030. The basis for this is the scaling up of the current Duwaal pilot: a wind turbine with an integrated electrolyser produces green hydrogen that is distributed to several filling stations via a regional hydrogen network. At the same time, considerable efforts are being made to further develop hydrogen-powered tractors. The goal is to have at least 70 of these tractors operational by 2030.

Figure 2. Future vision for the development of a green hydrogen network within the Duwaal project



[8]https://www.greendeals.nl/green-deals/green-deal-zeevaart-binnenvaart-en-havens
[9]https://www.newenergycoalition.org/waterstoftankstation-in-kooyhaven-den-helder/

Noord-Holland Noord: the hydrogen region in 2050

The infographic on the previous page shows what the region could look like once the hydrogen economy has reached full bloom by 2050. In this vision of the future, NHN has grown into one of the leading regions in Europe in the field of hydrogen. The main engine is the enormous wind power in the North Sea. In line with the plans of the national government, at least 38 GW of offshore wind will be available by 2050. With a continuing favorable investment climate and a government that is structurally committed to offshore wind, a capacity of even 72 GW is feasible.

Energy generated at sea arrives on land in Den Helder in the form of electrons and especially molecules. At wind farms further from the coast, electrolysers are used to convert electricity into green hydrogen. Decisive factors for the choice of Den Helder as a landing site were the relatively short distance to wind farms in the North Sea and the existing gas infrastructure that is now used for hydrogen. The availability of large volumes of green hydrogen makes the production of hydrogen through carbon capture unnecessary. This ends the use of this hydrogen as a transition energy carrier.

Hydrogen Distribution and Storage

The European hydrogen backbone will be operational in 2050. From Den Helder, hydrogen generated at sea finds its way to large industrial customers at home and abroad. NHN has acquired a strong position as one of the major hubs for the distribution of hydrogen for the national and international market. The region is connected via the backbone to Northwestern European countries such as Denmark, Germany, Belgium and France. The United Kingdom, Scotland and Iceland will also be connected to this in 2050.

Parallel to the development of and connection to the European backbone, NHN has worked hard on a regional hydrogen distribution network. This regional network transports the hydrogen directly to the customer and thus optimizes the chain. Hydrogen pipelines in the Wieringermeer, Den Helder and Alkmaar have been expanded and have served as an example for other areas that are now also working on the construction of local hydrogen networks. All these networks are connected to the hydrogen backbone, creating an integrated hydrogen system.

In 2050, empty gas fields will be used for large-scale storage of hydrogen to absorb fluctuations in hydrogen supply and demand. These hydrogen storage facilities also play a role in balancing the electricity grid by feeding hydrogen power plants that produce additional electricity in the event of major shortages. The stability of the electricity grid has also been boosted by the construction of a 380 kV route. These developments mean that grid congestion in the region is a thing of the past.

Besides the fact that the production and distribution of hydrogen has matured, numerous hydrogen applications have also emerged. Hydrogen or its derivatives have become the standard in shipping and aviation. In addition, the Regional Deal Maritime Cluster Kop van Noord-Holland has given the region a strong economic boost. Investments in the hydrogen economy and the maritime sector make the region attractive for employees of all educational levels. Den Helder is one of the largest bunkering ports for hydrogen for the North Sea and Baltic Sea regions and in the Wadden Sea, all ships sail emission-neutral.

A mature regional and (inter)national hydrogen economy

At a regional and (inter)national level, NHN will have a mature hydrogen economy by 2050. All sectors are actively investing in the use of hydrogen. The Port of Den Helder has facilities where ships can bunker cryogenic hydrogen or a synthetic hydrogen derivative. Helicopters for maintenance of wind turbines and hydrogen production at sea fly on hydrogen derivatives. In addition, the region is working with Hydrogen Valley NZKG to meet the hydrogen demand from Tata Steel and Schiphol.

In 2050, Schiphol will require a large amount of hydrogen for the production of synthetic kerosene. Finally, in our vision of the future, the island of Texel is largely self-sufficient in terms of energy. This is done by generating electricity ourselves and partially converting it into hydrogen. Hydrogen and electricity are used for public transport and freight traffic, but also for heating in the built environment. Thanks to the successful transition, Texel has set an example for other islands to set up a self-sufficient energy system.

OUR OFFER

NHN can and will help the Netherlands to acquire an inter national position in the field of hydrogen and thus support the EU in achieving its hydrogen ambitions and thus contribute to achieving the climate objectives. This is thanks to the following Unique selling points of the region:

» The possibility to produce decarbonized hydrogen on a large scale before 2027 and thereby displace gray hydrogen as a kick starter for a green hydrogen economy.
» The advanced gas infrastructure that can be used in the long term for hydrogen distribution.
» The presence of an ambitious deep-sea port, good waterways to the hinterland, connection to the hydrogen backbone and facilities to become a sustainable energy hub.
» The ideal basis for an offshore logistics service on a global level, due to the unique combination of a seaport with an open connection to the sea and an offshore helicopter airport.
» The relatively short distance to the wind farms to be built in the northern North Sea.
» Presence of well-trained staff and leading knowledge institutions.
» Opportunities for CCS in the North Sea.
» Diversity and versatility in the production and applications of green hydrogen.
» High-quality knowledge of gas infrastructure and hydrogen.
» Storage of hydrogen possible in gas storage facilities in the Alkmaar region.
» Willingness to participate in pilot projects to enable electrolysis at sea.
» Intrinsic motivation of public and private parties to use hydrogen as a versatile sustainable and zero-emission energy carrier in order to make the entire Noord-Holland Noord energy value chain fossil-free and emission-free.

WHAT IS NEEDED FOR THIS?

To actually get the hydrogen economy going, the following preconditions are crucial:

» Awarding ‘Hydrogen Valley’ status, a step that recognizes the potential of this region and further flourishes the emerging hydrogen economy.
» Sufficient wind at sea to be able to produce green hydrogen in combination with hydrogen production at the energy hubs at sea.
» Landing of energy from the offshore wind fields in Den Helder.
» A hydrogen backbone that connects European industry clusters and to which Den Helder is connected.
» Collaboration between industrial clusters to accelerate hydrogen production.
» International cooperation for the development of the backbone and the sustainability of islands and ports.
» Subsidies and investments for pilots and upscaling of hydrogen production.
» Capex and Opex support measures to make hydrogen production and use in the entire energy value chain financially viable.
» Knowledge and craftsmanship clusters for a leading position in Europe in the application and use of hydrogen technology.
» Wide range of targeted education and training for all educational and professional levels from existing engineering educators across the energy and transportation value chains.
» Reskilling pathways to maintain jobs in energy, transport and technical sectors.
» Legislation and regulations for the production, transport, storage, application and safety of hydrogen.
» Stimulating the demand for hydrogen (for example by blending into the gas network and acting as a launching customer by the government).
» Standardization of hydrogen applications (including for road transport and shipping).
» Social support and acceptance among residents and companies for the application of hydrogen.

Annex

Hydrogen production

PROJECT NAME	INVOLVED PARTIES	LOCATION
DUWAAL	HYGRO, new energy coalition, Ontwikkelings-bedrijf Noord-Holland Noord	Wieringermeer
ZEPHYROS		Kooijhaven
H2 GATEWAY		Den Helder
POSHYDON		
	SCW Systems	
	Hynoca	
	Milena-Olga 2.0	
		Texel

Hydrogen demand

PROJECT NAME	INVOLVED PARTIES	LOCATION
DUWAAL	NXT, Avia	Wieringermeer
WALSTROOM		
DE GROENE WALVIS	Energie Coöperatie Graft-De Rijp	Alkmaar
		Texel

Hydrogen storage and infrastructure

PROJECT NAME	INVOLVED PARTIES	LOCATION	CAPACITY (MWH)
DUWAAL		Wieringermeer	
BUNKERSTATION BUITENHAVEN	Port of Den Helder	Den Helder	
WATERSTOFNET PORT OF DEN HELDER	Port of Den Helder	Den Helder	
ZEPHYROS		Wieringermeer	
DE GROENE WALVIS	Energie Coöperatie Graft-De Rijp	Alkmaar	
RWZI TEXEL	HHNK	Den Burg, Texel	300

Partners:

gasunie

TNO innovation for life

gemeente ALKMAAR

PORT OF DEN HELDER

GreenPort NoordHollandNoord

nhn Development Agency Noord-Holland Noord

alliander

gemeente DEN HELDER

gemeente Hollands Kroon

Provincie Noord-Holland

New Energy Coalition