# Havenschets

## Executive summary

## The role of seaports in the energy transition

Europe's goal is to have an almost completely carbon neutral economy by 2050. To achieve this, the entire energy system must have to turn green quickly. This means that all electricity must be generated using sustainable sources (wind, sun, hydropower, etc.), but also that processes requiring energy molecules must become carbon neutral. In the Netherlands options for massive offshore wind capacity, offshore carbon storage as well as energy imports are considered key to decarbonise in order to satisfy the mitigation targets. Such and related activity is likely to be concentrated in seaport regions.

Projections suggest that during the next few decades some 38 GW – 72 GW offshore wind capacity will be installed on the Netherlands continental shelf, that serious volumes of $CO_2$ need be stored in the North Sea subsurface, and that moreover massive volumes of carbon neutral energy will be imported from elsewhere. This rapid extension of new energy activities, however, also asks for all kind of handling activities needed to make sure that the energy produced elsewhere (e.g. offshore) is absorbed not only in the harbour areas but also in the hinterland in an efficient and cost-effective way, and that the $CO_2$ is captured and transported to offshore storage locations.

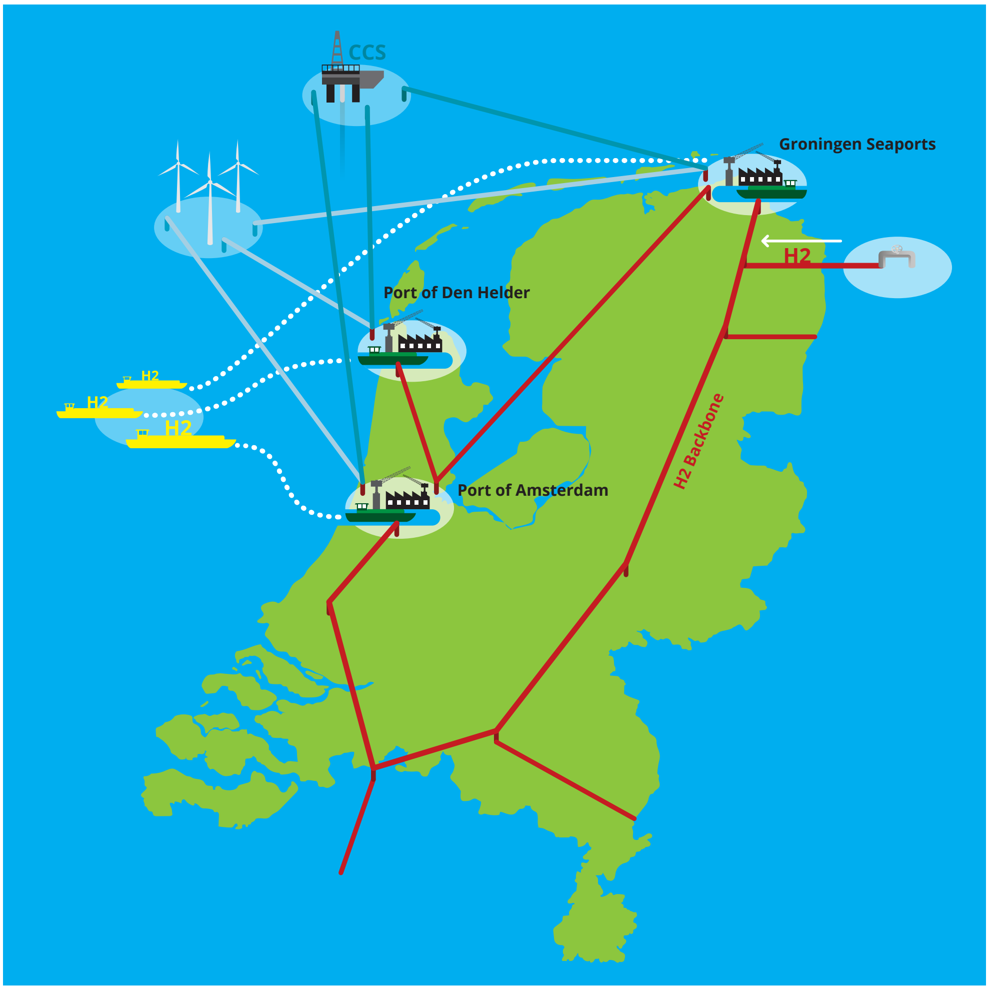
Seaports are indispensable for such handling because they need not only be the point for major future green energy imports, but also the most logical locations for related activities, including energy conversion, energy transport, and energy storage, as well as production and services based on carbon neutral energy. It is therefore crucial that seaports individually and collectively accept this future responsibility in the energy transition. It is equally important that this future energy hub role is recognised and sufficiently supported by the various public authorities.

## The role of the northern Netherlands seaports

A major part of the projected Netherlands' offshore wind capacity will be located north or north-west of the Netherlands' coast. Given their location and infrastructure connections, the Northern Netherlands' seaports are therefore a logical landing point for a serious part of future offshore energy. The aim of this study therefore is to identify what role the Northern Netherlands' seaports (Groningen Seaports, Port of Den Helder and Port of Amsterdam) can play in the transport of energy and as a marketplace for (new) energy-intensive activities.

This study shows that in the next few decades these northern seaports can collectively develop into an energy network of national or even North-Western European proportions. It also seems likely that both, nationally produced low-carbon hydrogen, green and blue, as well as hydrogen imports, cover a serious part of the hydrogen transmitted. As a result by 2050 in the combined northern seaport areas: collective electrolyser capacity may grow towards 150 $PJ_h$ (~8 GW[1]; base scenario) or even some 300 $PJ_h$ (~16 GW[1]; offensive scenario); combined blue hydrogen production capacity may rise towards 150 – 290 $PJ_h$ (~4.5 – 9 GW[2]); and hydrogen imports may develop to levels in the order of 1.2 – 2.4 Mton per year.
The base demand scenario of this study assumes that by 2050 the three northern seaports collectively handle about 25% (450 $PJ_h$) of total projected hydrogen demand from the Netherlands' and the Germany combined, of which some 120 $PJ_h$ is absorbed in the harbour areas

1 Based on 5250 operational hours.
2 Based on 8760 operational hours.




themselves. This defines the same seaports as logical hubs for energy conversion, energy import and transmission and as attractive locations for related energy-intensive industrial and servicing activity. The latter does for instance include: replacing grey hydrogen for industrial use by low carbon hydrogen; using low-carbon hydrogen for the production of synthetic fuels such as kerosene; or introducing new low-carbon chemical and other energy-intensive activities. Due to their relative proximity to offshore-depleted gas reservoirs, the same seaports are also in a good position to become serious transmission points of $CO_2$ (e.g. for offshore subsurface storage), and therefore locations of blue hydrogen production.
The benefits of working together

There is clear evidence that a close collaboration between the three seaports is likely to generate serious synergy benefits. Our modelling suggests that, depending on the hydrogen supply mix these benefits can add up to €100 – €300 million per annum designated to various actors in the value chain.

- First, by working together the three seaports are better able to further develop their unique selling points and generate economies of scale. By doing so, overall energy system expenditures decline with some 30% – 50% compared to the case of non-collaboration.

- Second, by collaborating via the backbone connection the seaports are able to act as: a flexibility provider to the energy system because hydrogen is transported back and forth; and as a provider of reliable and secure low-carbon energy, which is crucial for many energy-intensive activities.
- Finally, by operating as a collective energy hub network, the seaports' strategic position towards the national and European energy transition agenda will become stronger as well as their position in getting linked to the new energy corridors and facilities e.g. under the TEN-E and TEN-T network.

The development of a hydrogen backbone connecting the three seaports, with each other and the hinterland, such that hydrogen flows are easily be exchanged and collectively transmitted further into the hinterland is conditional for the realisation of synergy advantages The current projections of planned backbone investments suggest that only Groningen Seaports and Port of Amsterdam are connected to such a backbone. To unlock the full potential of the three Northern Netherlands harbours as an energy hub network, an extension to Port of Den Helder is crucial. Some projections in the study suggest that in the absence of a backbone the three harbours combined will only transmit ~120 $PJ_h$ of energy by 2050, whereas if the backbone and extension do exist, the energy flows can easily grow towards levels in the order of 400 – 875 $PJ_h$ per year.

## Each of the three seaports must well specialize in specific energy-related activities.

To give a broad characterization:

- Groningen Seaports is well situated to develop into a major green hydrogen production and transmission location thanks to the presence of extensive chemical industry and the proximity to large-scale storage facilities.
- Port of Den Helder is well positioned for blue and dedicated green hydrogen related activities due to its location next to feed-in points into major gas trunk lines and its relative proximity to offshore wind locations.
- Given its status in liquid bulk import activity, Port of Amsterdam has a promising profile to develop into a major hydrogen import location and a location for related fuel conversion and end-use implementation (e.g. steel production, synthetic fuels for aviation and hydrogen based bunker fuels for heavy transport, such as shipping).
- The diversity and complementarity of the unique selling points between the three harbour regions allows for the emergence of a broad range of energy services collectively covering the complete hydrogen value chain.

## Different but complementary seaport profiles

How the energy-related activities must be divided over the three seaports is hard to predict. The role of the individual seaports in transmission of hydrogen strongly depends on: the development of the hydrogen market as a whole; if the seaports collectively succeed in positioning themselves as one successful energy hub network; the degree to which blue hydrogen is part of hydrogen supply; and the share in the energy mix of imported hydrogen.

Each of the seaports' further development as a regional energy hub depends on specific conditions. For Groningen Seaports it is important that: additional connections other than the Cobra and NorNed cable are established; new nearby windfarms are developed that are well-suited for green hydrogen production; and the hydrogen value chain will fly in the region. For Port of Den Helder a connection with the hydrogen backbone is rather crucial. In addition, it is important for this area whether the existing gas pipeline connections with offshore gas fields/platforms can be used for transport of $CO_2$ and possibly hydrogen from and towards the area.

For Port of Amsterdam the growth of imports of hydrogen or hydrogen carriers supports the area to benefit from existing infrastructure. Additional further industrial development towards producing and handling low carbon bunker fuels, synthetic kerosene and steel play an important role in the further growth perspective.

## Preparing for the future role end synergies

Several organizational issues will have to be tackled timely and effectively in order for the three seaports to successfully develop into one major energy hub network. Organizing good collaboration between the various stakeholders involved is an obvious precondition as well as clear targets and strategies.

The wide variety of private and public stakeholders involved leads to an equally wide variety of stakeholder objectives, perceptions and issues that moreover are likely to change over time. Identifying the stakeholders and their roles in the development of energy-related activities in the harbour areas is therefore crucial to be able to collaborate effectively.

It is vital that the emerging role of the harbour regions as an energy hub network and as a factor of national interest in getting to a low carbon economy is acknowledged. It is important that the national government explicitly recognizes the strategic potential of the three northern seaports for the national economy. The national energy hub notion also needs to be incorporated in the various port-related development processes.

In accordance with the ESPO view, seaports need to be explicitly linked to new energy corridors under the TEN-E and TEN-T network. That way harbour clusters contribute to a swift introduction of alternative fuels by supplying hydrogen to: inland industry clusters, bunkering infrastructure for inland navigation and sea transport; and fuelling stations for road and rail (e.g. last mile shunting in the ports).

## The need for investment

To reach the climate ambitions in a cost-efficient and timely matter, the development of the three Northern Netherlands seaports into an energy hub network is indispensable. Large-scale investments (tens of billions of euros) need to be made in activities ranging from harbours facilities and connecting infrastructure to conversion, production and import capacities for the industry and mobility. All these activities need to be coordinated in order to fit together. For this to happen public-private coordination is crucial, but also a clear system of rules and regulations clarifying responsibilities, liabilities, and legal competences.

To illustrate some legal challenges, some examples can be provided. Although municipalities are currently the main shareholders in most Netherlands' ports (and therefore also responsible for long-term spatial planning), port authorities will increasingly link with private companies through Private-Public Partnership (PPP) transactions e.g. covering investment-intensive construction works. This requires additional legal guarantees. The same applies to the recent wave of privatisation with regard to port activities.

Existing regulatory frameworks do not provide the legal certainty necessary to sufficiently support the conversion of wind energy to hydrogen onshore due to e.g. uncertainties on responsibilities towards introducing direct windfarm-electrolyser connections and on repurposing existing gas pipelines. The same holds for hydrogen storage and various facilities for hydrogen application and the use of hydrogen for the production of synthetic fuels for transport.

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