Ports

Paving the way for the hydrogen sector

October 2020

www.hinicio.com

Colossal projects for the production of decarbonized hydrogen are emerging in large European ports and vying with ambition to become the strongholds of this sector of the future. Beyond economic impact, the European political, industrial and energy sovereignty are being decided today.

Transition of the Maritime Economy: Driving Force for the Development of Port Activities

By 2030, the global maritime economy could be worth $3 trillion, up from $1.5 trillion in 2015. The intensification of trade flows as well as the maritimization of the economy – whose vast potential for innovation and resources remains undervalued, are key development opportunities for ports.

In order to take advantage of the transition of the maritime economy, ports are trying to increase their attractiveness to operators in order to capture the flow of goods, passengers, services, as well as investments. From a historical positioning of 'a development port', responsible for the construction and maintenance of infrastructure, they evolve towards the model of the 'entrepreneurial port', coordinating and stimulating the development of their ecosystem, notably through the intermodality of hinterland connections or by the development of industrial clusters.

Ports are strategic assets for two reasons: First as vectors of industrial, military, energy, food, commercial and geopolitical sovereignty, they concentrate activities critical to the functioning of the economy. Moreover, they are major economic hubs in which industrial, fishing, tourism and logistics activities are concentrated. The first-rate industrial-port complexes often go hand in hand with economic power.

The transition of the maritime economy is also accompanied by new environmental and social challenges to which ports can offer a direct and indirect response:

- **By acting within their own boundaries:** reducing CO_2 emissions and polluting particles from traditional port activities or ships entering urban areas; building sustainable and resource-efficient infrastructure (energy, raw materials, etc.); strengthening the hygiene and safety of activities, while facilitating city-port interfaces, or organizing the sharing of the sea between its various uses (e.g. fishing, boating, defense, offshore wind, freight, etc.),
- **By influencing the activity of other players:** Coordinating industrial dynamics to catalyze the development of new sectors such as marine energy, green navigation, responsible fishing, or hydrogen.

Little known until recently, hydrogen in a few short years has become a top priority for ports..

Hydrogen headed for scale

Hydrogen will play a key role in the energy transition, notably by allowing for the valorization of low-carbon and renewable energy for the replacement of natural gas, goal, and oil in numerous industrial, energy, and mobility applications.

After a decade of demonstrations and initial deployments in niche markets, recent years have seen the development of the first electrolysis projects: producing hydrogen from water on scales ranging from a few megawatts to tens of megawatts in many European member states and ports in particular.

Nevertheless, a major acceleration is now in the works and the beginnings of the transition to scale are now clearly visible. As a result, numerous initiatives at the scale of several hundred megawatts or even several gigawatts are now in development. These projects are being spearheaded by major industry leaders through **a new vision of the energy system where hydrogen will play a key role in diverting massive quantities of renewable energy towards difficult to decarbonize sectors** (industry, mobility, buildings...).

In addition, hydrogen is an energy carrier that connects low-cost, sometimes disperse renewable energy resources (North Africa, Gulf Countries, Chile, Australia, etc.) with major consumption centers. Hydrogen is thus paving the way for an international renewable energy market linking regions with surplus resources to those in deficit with ports acting as hubs as they have for fossil fuels.

From this perspective, the challenge will be to valorize the best energy resources and to design an efficiency and competitive long-distance transport chain for hydrogen and its derivatives (liquid hydrogen, synthetic methanol, ammonia, organic liquids, etc.) towards the principle demand clusters. To this end, the use of pipeline networks or long-distance maritime transport will be preferred options.

Hydrogen is at the heart of Europe's energy strategy

The European Commission has deemed the molecule a pillar of the energy transition and as one of the priorities of the « Green Deal ». For example, in its hydrogen strategy published in 2020, the EU aims to double the hydrogen market by 2030 with 80 GW of electrolysis production capacity, half of which being outside the Union (North Africa, Eastern Europe) and develop an equivalent amount of natural gas reforming capacity with CO2 sequestration. 400 billion euros of investment are expected by 2030, ultimately aiming to make Europe a leader in Hydrogen against the US and China.

European regulations are opening space for the development large-scale of hydrogen production projects with viable economic models, although the start-up period will often require public support. The 'RED2' directive is the best example of this. RED2 sets the renewable energy in transport fuels target at 14%, justifying massive investments in green hydrogen in refineries or the production of synthetic fuels such as renewable methanol.

Public funding instruments are also being developed to support energy transition projects at scale such as: the innovation fund, funded by carbon market revenues of 1 billion euros per year over the next 10 years, **calls for projects arising from the Green Deal**, established by the EU and reducing the risk of the first projects by covering all or part of the initial project funding gap. There is also the ongoing development of a dedicated Hydrogen **IPCEI** (Important Project of Common European Interest) that with the Commission's approval, will enable exemptions to state aid ceilings to finance major integrated projects at the European level, thus promoting the re-industrialization of the continent.

Ports will be the hubs of the industry

At the G20 in Tokyo, the International Energy Agency issues a first recommendation to world leaders to make ports the nerve center for the production and consumption of decarbonized hydrogen. It also emphasized the development of hydrogen import-export networks through shipping by capitalizing on existing liquefied natural gas infrastructure.

If ports can eventually become the future centers of the hydrogen market, they may in the short term be strategic places for the transition to the scale of the sector. They are often first-rate industrial and logistical centers and hold the current demand opportunities (refineries, ammonia, chemistry, etc.) The presence of cement plants can also be a distinctive feature as emitted Co2 can be captured and recombined with green hydrogen to produce synthetic fuels or methane – hydrogen could also intervene upstream of these energy intensive processes.

Natural gas networks, often present in ports, are also potential opportunities for hydrogen injection and blending. This would allow for a supply to gas-intensive industries in a targeted manner, or more diffusely, to all consumers downstream from the injection site. Injecting synthetic methane also remains an opportunity, although the time horizon for a viable business case is further out.

Thermal power plants, some of which still burn coal in Europe, are often located in port areas. **Their conversion to hydrogen is also possible** (some experiments are on-going at the European-level). They could become an avenue for the development of pilot-scale green electricity generation projects provided that the cost of green hydrogen falls below 1.5€/kg – in line with European targets. Each thermal power plant could also generate a hydrogen demand on its own, requiring the installation of several GW of electrolysis.

Hydrogen also can decarbonize freight transport transiting through ports: port equipment (transport – handling), road freight, or ships and boats (propulsion, on-board electricity, dockside connections, etc.)/ In the latter case, it is also an opportunity to valorize the industrial base through the synergy of existing skillsets in engines, building/repairing of ships, and composite materials.

Finally, hydrogen can also contribute to **the integration of marine energies in the energy system**, specifically offshore wind, the costs of which are in rapid decline. For example, the offshore production of hydrogen and its transport to shore via pipeline could be competitive compared to investments in under-sea cables.

The first large-scale projects emerge

In the global context of the rapid acceleration in the deployment of the hydrogen sector, the first major initiatives are emerging today in ports across Europe and around the world. Example include H-Vision (massive production of hydrogen from natural gas with CO_2 capture for use in the Port of Rotterdam), HyNetherlands led by ENGIE (100MW – 1GW in the Port of Eems), North Sea Wind Power Hub (offshore energy hub centralizing multi-GW wind production off the Port of Rotterdam for the connection to terrestrial uses via electric cables and hydrogen pipelines), Hydrogen Delta (1 GW for industrial uses in the Port of Zeeland), and Wesk-ste100 (700 MW in the Port of Hamburg).

Projects to export hydrogen (or its derivatives) by sea are also being prepared in areas where renewable energy is abundant and competitive: North Africa, Australia, Chile, Gulf Countries, etc.) but also in Europe, notably Portugal, where the project H2 Sines, led by GALP, the Portuguese national oil company, in partnership with EDP, REN, Vestas and Martifer, aims to develop 1 GW of electrolysis capacity by 2030 to supply local markets as well as Northern Europe through the Port of Rotterdam. A Memorandum of Understanding was signed in September 2020 between the Portuguese and Dutch governments for the implementation of a green hydrogen value chain between the two countries. Similarly, Germany signed a cooperation agreement with Morocco this year to promote the import of green hydrogen, taking advantage of the competitive solar resources of morocco while providing opportunities for local industry.

Rivers also have a role to play in the hydrogen sector, like the Blue Danube project which aims to link the renewable energy resources of Eastern Europe with the consumption centers of the west via inland waterway transport. On the other hand, large river ports can also be suitable ecosystems for the sector's transition to scale. Hamburg and Paris, the top two river ports respectively in terms of freight and passenger transport, host fleets of boats that can offer substantial opportunities for hydrogen despite technical and regulatory hurdles still to be overcome. In this context, the H2 Ships project, which is designed to prepare the structuring of such an ecosystem on the River Seine, is an excellent example. Finally, in terms of innovation, river shipyards could also take advantage of the situation by becoming a gateway of innovation for applications at sea.

What are the challenges for ports?

The future dominant positions of ports in a carbon-neutral world are being determined today by their ability to anticipate and support industrialization and the scale-up of the hydrogen sector.

The top priority must be to develop large-scale hydrogen production projects that can generate the economies of scale necessary for economic viability. The opportunities in the short-term to focus on are those in industries covered by the RED2 directive (refineries, synthetic methanol for blending with traditional fuels, etc.). Ammonia and steel are also promising avenues, although regulatory incentives remain inadequate, making the economic equation more difficult due to lower market premiums for green hydrogen. However, this must be balanced with issues pertaining to industrial sovereignty.

The aggregation of several large industrial consumers, in the same port, or in the same region (sometimes including several ports such as in BENELUX) is an opportunity to worth exploring. This would achieve even greater economies of scale and allow the production ecosystem to be integrated with the future European hydrogen transport/storage networks, in line with the vision recently stated by several gas network managers.

As a result, the provision of electrolysis capacity on this scale alone is an industrial challenge for a sector where most OEMs are SMEs and where annual global production volumes do not exceed 100 MW. To realize this ambition, **several Gigafactory projects are underway in Europe**.

Massive hydrogen production for industry must form the backbone of port projects, around which other more disperse uses, such as mobility (handling, trucks, etc.) can lean on and thus benefit from competitively priced hydrogen.

> **"Port authorities have a key role to play in the facilitation and development of projects"**

To this end, given the complexity of the ecosystem of players in each port, port authorities have a key role to play in the facilitation and development of projects and can contribute in particular to the mutualization of infrastructure in optimized schemes. Their role will be decisive in the governance of the local hydrogen sector, at the interface between the public and private spheres, as well as in the convergence of infrastructure, urban planning and energy policies with industrial interests.

From a more forward-looking view, ports will be the hubs of future international exchanged of hydrogen and its derivatives, either as an importer or exporter. In this context, one off the main determinants will be the cost of producing renewable energy.: the areas benefiting from the most competitive renewable energy will be destined to become net exporters. Conversely, regions of the world where energy will be more expensive, are more likely to become importers. In this configuration, areas with the highest irradiation rates (Chile, North Africa) and or the best wind profiles (Norway, etc.) and with major port infrastructures, will be able to develop comparative advantages for the export of hydrogen and its derivatives. They will be able to supply to the most energy-consuming regions, thus redrawing the geopolitics of energy.

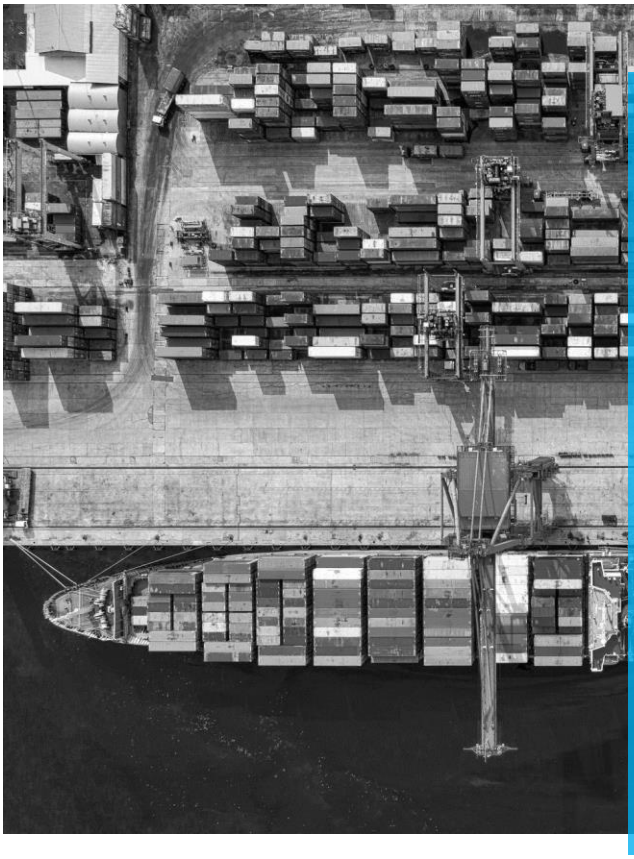
As a result, the future role of each port must then be viewed through the prism of long-term and global market, rather than one in isolation and the short term.

Hydrogen ports…vectors of sovereignty

Hydrogen ports can contribute to the sovereignty of states in multiple ways: first through the opportunity to develop of cutting-edge know-how in specific segments as close as possible to the markets (e.g. hydrogen ships) thereby securing potentially critical technologies.

Moreover, competitive hydrogen ecosystems can help maintain sectors exposed to both the constraints of the energy transition (steel industry, coal-fired power plants, etc.) and global competition: without a viable economic model, some of them might simply prefer relocation to decarbonization. Competitive hydrogen super producers could solve part of this equation, or even in the best cases, facilitate a relocation by offering green and competitive raw materials (e.g. aluminum production in Iceland attracted by cheap electricity).

Finally hydrogen ports can contribute to Europe's energy sovereignty by providing important outlets for renewable energy and especially marine-based renewable energy. A large-scale continental production capacity would then be likely to contribute substantially to the reduction of the Union's energy imports (300Bn€ in 2019).



At the crossroads of maritime, industry and energy, ports will play a strategic role in the development of the hydrogen sector both for the on-site opportunities they can bring, and for their role in a more integrated and international vision of the renewable energy market where hydrogen and its derivatives will enable the development of new energy flows.

In the context where capture of energy flows is already subject to intense competition, the major European ports are securing their positions in the hydrogen economy with large-scale projects focused on industrial uses. They rely on a favorable regulatory framework as well as on new financing tools established at both the European Union and Member State level. The transition from ambition to a tangible industrial reality that provides a concrete response to climate challenges and industrial sovereignty is a considerable challenge that awaits the hydrogen sector. To meet this challenge, ports will certainty be at the center of attention.

About Hinicio

Hinicio is a strategy consultancy specializing in sustainable energy and mobility, recognized as one of Europe's leading hydrogen companies.

Founded in 2007, the company is present in Belgium (headquarters), France, China, Chile, Colombia, Mexico, and Argentina.

We support public and private leaders in the development of their strategies and the implementation of their industrial projects around the world.

Hinicio has a pioneering position on the subject of hydrogen ports, major European hubs and large-scale projects among the most cutting-edge in the world.

Jean-Christophe LANOIX
Associate Director France
jean-christophe.lanoix@hinicio.com

Jill GALLAND
Senior Consultant
jill.galland@hinicio.com