WEBINAR CONCLUSIONS

LARGE GREEN HYDROGEN PROJECTS IN THE NORTH SEA REGION

Tuesday 25 May 2021: Virtual

NS HyMaP and the Webinar

Over 180 participants registered for the first NS HyMaP webinar on 25 May 2021. Jon Jordan started the webinar with a welcome and introduction. He outlined the work of the North Sea Hydrogen Ports and Maritime Community (NS HyMaP) which began as an Information Exchange in April 2020 and is now a membership-based association that promotes the increased use of hydrogen in the ports and maritime sector as an effective and efficient way of achieving climate neutrality in one of the EU's most important maritime regions.

Background to the Webinar

The EU and national governments have ambitious targets for green hydrogen production in their strategies. For instance, the EU Hydrogen Strategy has a target of 6 GW by 2024 and Germany has a target of 5GW by 2030. Large green hydrogen projects will play a key role in achieving these targets. In December 2020, the magazine Recharge published a list of the thirteen largest World green hydrogen production projects. The largest project in the list was in Western Australia, and the next two projects were based in the North Sea Region. These were the NortH2 project and the AquaVentus initiative. The NS HyMap Secretariat invited the project leader of NortH2 and the program manager of the AquaVentus initiative to make presentations at the webinar. The aim of the presentations was to outline the way in which NortH2 and AquaVentus had been put together, the progress that had been made and the plans to achieve their targets.

The Hydrogen Fuel Cell Joint Undertaking (FCH-JU) has made an extremely strong contribution to the development of large hydrogen projects in the EU and the webinar featured the important work of the FCH-JU in developing large and integrated projects like the BIG HIT and Heavenn Hydrogen Valley project.

The presentations

Enrique Giron, Project Manager, Hydrogen Fuel Cell-Joint Undertaking (FCH JU.)

The Hydrogen Fuel Cell Undertaking (FCH JU) is a public-private partnership based in Brussels. Enrique Giron began his presentation by outlining its work. The FCH JU has supported 285 projects at just over €1 billion to bring hydrogen to market readiness.

Enrique demonstrated the growing size of projects with the following examples:

- Bringing hydrogen mobility projects under one framework through H2ME project (2015-2022.) This will develop a 'working framework' which will "identify optimal commercialisation strategies and synergies between countries" and "develop European strategies for commercialisation."
- Increasing the size of hydrogen bus projects from tens of buses per project to the JIVE and JIVE2 projects which has seen orders placed for 306 buses.
- The size of fuel cells in shipping has been increasing from 0.16 MW in 2017 to a 2MW fuel cell in 2020 powered by liquid hydrogen.

The size of **electrolysers** has also been increasing from 10 MW in 2017 to a Call for a 100MW electrolyser in Green Deal Call which closed in January 2021. There were 16 applications under this Call and a decision on the successful projects will be made shortly. An increase in the size of electrolysers is a key component in the scaling up of green hydrogen production and GW scale electrolysers are expected to be operational by 2030.

The FCH JU has already funded some large projects including the BIG HIT, Heavenn and the recently launched Green HYsland projects. The aim of the **Heavenn project** is to create a Hydrogen Valley in the Northern Netherlands. It has 31 public and private sector partners and will produce large amounts of green hydrogen for a wide variety of applications. These include the construction of hydrogen refuelling stations for buses, cars and trucks. It will include an inland waterway barge powered by a hydrogen fuel cell. Hydrogen will also be used in domestic heating and e-kerosine will be developed for aviation. The opportunities for hydrogen storage in the Northern Netherlands will also be exploited.

The European Commission published its hydrogen strategy in July 2020 and it included an ambitious target of 40 GW of green hydrogen from electrolysers by 2030. A new Budget for the period 2021 to 2027 has been agreed and new legislation will create a Clean Hydrogen Partnership to take over from the FCH JU. The new Partnership will have a Budget of around €1 billion. Much of this Budget will be devoted to annual calls as part of the Horizon Europe Programme and there will also be opportunities for significant hydrogen projects under the EU Innovation Fund and Important Projects of Common European Interest (IPCEI.) A Clean Hydrogen Alliance has also been established to support the EU Investment Agenda. This involves all stakeholders in the clean hydrogen ecosystem and its mission is to create a pipeline of projects.

Jasper Rigter, RWE Project Lead, NortH2 project

The NortH2 project has the aim of "kickstarting the green hydrogen economy" in Northwest Europe. It has a broad partnership that includes Shell, Equinor, RWE, Groningen Seaports, Gasunie and the Province of Groningen. It is a cross-border consortium working together on the large scale production, transport and storage of green hydrogen for use in industrial sectors that are hard to abate in terms of their emissions. It is planned to produce 1GW by 2027; 4 GW by 2030 and 10+ GW by 2040.

The Northern Netherlands has been chosen for this project because of its:

- Proximity to resources (e.g. possibilities of offshore wind and North Sea location.)
- Transport and storage capacity

- Access to knowledge, suppliers and markets

A number of studies are involved in the development of the project. A **pre-feasibility study** concluded that it was:

- Technically feasible – wind farm development and the development of green hydrogen production and infrastructure can be realised in the time frame.
- Market potential for hydrogen as a feedstock; large future market for industrial heating from natural gas to hydrogen.
- Potential to reduce costs with large projects- The main cost components are windfarms, power infrastructure and electrolysis. A large project will allow lower component costs and an optimisation of the whole value chain. The cost savings for a large project could be as much as 20 per cent. Commercial optimisation will enable further reduction in the Levilised Cost of Hydrogen (LCOH.)

A further feasibility study is being carried out to demonstrate the realistic and balanced development of green hydrogen for targeted market segments. The Study will also develop a technically feasible and investible business case.

It is expected that NorthH2 will generate the first 1 GW by 2027. The hydrogen generated will be from new windfarms.

There are key policy areas to be addressed to ensure the success of GreenH2 and other large green hydrogen projects. These include:

- Reimbursement of offshore transport infrastructure costs to create a level playing field.
- Robust commercial, financial and policy frameworks for the supply and demand of green hydrogen.
- Policies enabling green hydrogen purchases e.g. Contracts for Difference.

Christine Partmann, Project Manager, AquaVentus Initiative

AquaVentus is the umbrella term for a group on interconnected projects which was designed to be closely linked to the EU and German hydrogen strategies. AquaVentus envisages a 10 GW generation capacity for green hydrogen from offshore wind energy by the year 2035 as well as its transport via pipeline on land. The pipeline is considered to be a more cost-efficient method to use wind energy up to 300 km from the shore as if it would take five HVDC transmission lines to transport similar amounts.

When fully implemented, AquaVentus would produce one million tons of green hydrogen per year in the German Bight between Heligoland and the Dogger Bank. In addition to expanding renewable energies to generate electricity, AquaVentus opens up development opportunities for emission free energy providing energy for plant construction, the maritime sector, mobility and logistics and heavy industry such as chemicals and steel.

The initiative is driven by a strong project family. The AquaVentus Development Association consists of more than sixty organisations including well-known international companies and research institutions.

An examination of the proposed timetable gives a strong indication of the ways in which the projects complement each other:

2023 AquaPrimus 1: First Prototype at the port of Mukran/ island of Rügen (Baltic Sea)

Development and one year trial run of a 14 MW prototype of a decentralized hydrogen generation unit ready for series production. Advantages for optimizing the configuration from easy access via the edge of the quay. Regular operation on site with integration into the power grid. Ensuring of the resulting demand for green electricity by an on-site photovoltaic park.

2024 AquaPortus: Preparation of Heligoland's South Harbour

Gradual expansion of the port facilities in the outer port of the island of Heligoland into a central hydrogen hub in the North Sea. Construction of an LOHC (liquid organic hydrogen carrier) infrastructure to receive and further process the AquaPrimus production volume. Conversion of the island heat supply from heating oil to climate neutral LOHC waste heat. Usage of the first H2 mobility solutions, such as the dune ferry or service ships for the existing offshore wind farms off Heligoland

2025 AquaPrimus 2: Construction of two Offshore Pilot Plants

Construction of two 14 MW pilot plants in the sea off Heligoland and a connection via the Heligoland test field to the southern port. Regular commercial operations for the decarbonization of Heligoland after one-year trial run in preparation for series production.

2026 AquaPortus: Heligoland Goes Green

Further expansion of the hydrogen infrastructure on Heligoland including parts of the power supply converted to fuel cells and introduction of hydrogen storage. Dismantling of the fossil fuel infrastructure.

2028 AquaSector: Construction of Large Offshore Wind Farm

Construction of the World's largest offshore hydrogen windfarm at 290 MW with 25,000 tonnes of hydrogen transported to Heligoland by second smaller pipeline. Contract for this work let by 2022

2029 AquaPortus: The North Sea Hydrogen Hub

Heligoland becomes "the central hydrogen hub in the North Sea" and ships calling at Heligoland are carbon neutral. Hydrogen and LOHC ships will bunker on the island and surplus hydrogen will be sent to the North Sea coastal region.

2030 AquaDuctus: Extension of Hydrogen Pipeline

Hydrogen pipeline extends to all parts of Heligoland and to the Hamburg/ Brunsbuttel area of Germany. Up to 100.000 tonnes of green hydrogen available for industry and mobility.

2035+ AquaDuctus: 10 GW Hydrogen Achieved

Offshore generation capacity of 10 GW will be created. The replacement of five HVDC connections will offer significant economic benefits and protect the natural habitat of the Wadden Sea. There will be long term integration into the European Hydrogen Network and connections into the Netherlands and Denmark.

Concluding Remarks

The Webinar demonstrated the need for large green hydrogen projects and initiatives. They will play a key role in achieving the targets in both the EU and national hydrogen strategies. As the technology has been proven, FCH JU funded projects have followed a trend towards larger projects which have created a pathway to commercialisation. This is demonstrated through Hydrogen Valley projects such as Heavenn and the Green Deal Call for larger 100 MW electrolysers.

The two large green hydrogen projects showcased have much in common and the formation of large public private partnerships across the hydrogen value chain are critical for project success. However, one project has a centralised approach to hydrogen production and the other initiative favours offshore hydrogen production with a family of inter-related projects. Both NorthH2 and AquaVentus will benefit from economies of scale and lower component costs.

The approach of both projects is a gradual one. Both NorthH2 and AquaVentus have a target of 10 GW hydrogen generation but these targets will not be reached until the 2030s with targets being set as they progresses and feasibility studies playing a critical role in the early stages of their development. Both will develop into cross-border projects and this co-operation is an important feature of national hydrogen strategies. Both projects/initiatives emphasise the need to match hydrogen supply with demand as the hydrogen market grows with more end-user commercial applications. However, by the 2030s they will form part of a European Hydrogen Network and this network will be joined with equally ambitious projects across the North Sea Region.

Jon Jordan, NS HyMaP

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