Gateway to a CO2-free hydrogen economy

H2Gateway is aimed at giving a substantial boost from North Holland to the national ambition of achieving a CO2-free economy. At the heart of the concept is the centralised production of blue hydrogen for the application of feedstock and industrial heat in industry. A consortium of eight parties has conducted an exploratory analysis of the possibilities for blue hydrogen in the Netherlands. This vision paper outlines the challenges and possible solutions. It is also an appeal to potential customers, operators and policymakers to contribute ideas regarding the opportunities offered by a blue hydrogen plant to accelerate the development of a CO2-free hydrogen economy in the Netherlands.

The challenge

The industrial clusters in the Netherlands are largely dependent on fossil sources such as natural gas. This is also the case for the existing hydrogen industry. The associated CO2 emissions must be reduced rapidly. After all, the Climate Agreement formulates the objective for Dutch industry in unequivocal terms. By 2030, industry has been set a target of reducing emissions by 49% compared to 1990. In absolute terms, this amounts to a reduction of 14 megatons of CO2 per year. This quantity may even be revised upwards, with the European Union announcing in September 2020 that it wishes to refine the targets to a 55% reduction in CO2 by 2030.

The hydrogen market in the Netherlands

In the Netherlands, 0.8 megatons of hydrogen (H2) is produced annually as feedstock for process chemistry. This is done by converting natural gas to the required hydrogen. This process releases approximately 8 megatons of CO2 into the atmosphere each year. In addition to this use of hydrogen as raw material, it is being investigated whether, in a number of high-temperature processes, the combustion of natural gas can be replaced by the combustion of CO2-free hydrogen.

Hydrogen backbone

A lot of CO2 can be saved on the production of these large quantities of hydrogen. In order to exploit this reduction potential for Dutch industry, a system solution is needed. A hydrogen backbone is necessary for the development of an open market for CO2-free hydrogen. A great deal of research has been carried out into the possibility of reusing and upgrading existing national gas transport pipelines to a backbone for hydrogen transport, making it possible to link production and off-take. An important condition for the development of this national network is that sustainable production of hydrogen is scaled up and that the hydrogen is guaranteed to be delivered to customers.

Central production of blue hydrogen as an accelerator

Major projects have been announced nationwide that focus on the production of green hydrogen. However, the availability of large volumes of green hydrogen is only expected in the longer term. Moreover, this availability depends on large-scale electrolysers and sufficient installed capacity in the northern part of the North Sea. Several industrial clusters are now working to replace their local grey hydrogen production with blue and green hydrogen, tailoring generation to the local demand for hydrogen for feedstock. For the time being, these are limited volumes. These point-2-point solutions do not stimulate the construction of a hydrogen backbone, nor does the time horizon for green hydrogen. Central production of blue hydrogen, which is commercially attractive and can be provided and transported securely, can play a crucial and accelerating role in the realisation of a sustainable hydrogen economy. A nationwide infrastructure will accelerate the economic feasibility of CO2-free hydrogen and make the reduction targets for 2030 achievable.

Blue-water facility research

The consortium intends to develop a facility for the central production of approximately 0.2 megatons of blue hydrogen per year for industrial feedstock. This is between 500 and 550 tons of hydrogen per day. This means that a blue hydrogen facility will account for 25% of annual industrial hydrogen production. The effect is 2 megatons of CO2 reduction per year, which is as much as 14% of the annual industry target for 2030.

Major benefits

In the medium term, the central production of blue hydrogen has major benefits. Current production of grey hydrogen is based on steam methane reforming (SMR). By using other techniques, such as partial oxidation (POX) or auto thermal reforming (ATR), CO2 can be captured much more effectively and efficiently. The price for CO2 is expected to be between €40/ton and €60/ton in 2027. In this case, from 2027 onwards, reduced CO2 hydrogen can be offered competitively to Dutch industrial clusters that currently use natural gas to produce grey hydrogen. In addition, CCS (carbon capture and storage) is expected to be mature and socially accepted as a solution around 2027. North Holland has the shortest distance to the gas fields in the northern North Sea that are suitable for CO2 storage. As a result, a facility in North Holland has the lowest expected transport costs for the CO2 storage component. That solution does depend on the hydrogen backbone to reach the industrial clusters in the Netherlands.

Effects of central production of blue hydrogen

With the realisation of a blue-water facility, we are speeding up a number of sustainable system changes:

• Production of 0.2 megatons of hydrogen per year (25% of the current hydrogen consumption for industrial feedstock).

• Contribution of 2 megatons of CO2 reduction per year (14% of the annual industrial target for 2030).

• Earlier implementation of the open Dutch and European hydrogen network from 2027.

• An incremental sustainability step towards an open market for CO2-free hydrogen in the form of industrial clusters switching from the purchase of fossil natural gas to the purchase of CO2-free hydrogen.

• The necessary CO2 storage in the northern North Sea fields not only serves the sustainability of CO2-intensive industry up to and including 2050, but is also used as a building block for the ultimate goal: a CO2-free hydrogen economy in the Netherlands.

The continuously produced blue hydrogen and the weather-dependent green hydrogen produced can support each other (in combination with storage of hydrogen in salt caverns and existing gas fields) on the way to a CO2-free hydrogen market with a guarantee of supply for industry.

What next?

The consortium aims to conclude to conclude the exploratory phase in the course of 2020-2021 and to arrive at a successful business case with potential customers, aiming at an investment decision in 2023-2024. The plant can be put in place in 2026, after which the low CO2 hydrogen could be available for the industrial raw materials market in 2027. This initiative calls for cooperation and executive leadership within market players and government. It is necessary for these groups to assume a leading role in restructuring the CO2-free market model in the chemical industry and to encourage a switch to blue hydrogen and, in the longer term, green hydrogen. The partners in H2Gateway have taken up this challenge and would like to expand the collaboration further. Will you be joining us?