INTERNATIONAL PARTNERSHIP FOR
HYDROGEN AND FUEL CELLS IN THE ECONOMY

IPHE Country Update October 2019: The Netherlands

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1. New Initiatives, Programs, and Policies on Hydrogen and Fuel Cells

In June 2019, the Dutch government presented the National Climate Agreement of the Netherlands, to the House of Representatives. This Letter to the House of Representatives, accompanying the Proposal for a National Climate Agreement, contains a set of about 600 measures to reach the targets of the Climate Change policy (49% CO_2-redcution by 2030). In a multi-stakeholder process, the most important stakeholders (several business organisations, Non-Governmental-Organisation's, national, regional and local governments) have made their contribution to this National Agreement.

In this National Agreement, hydrogen is seen as a robust element in the CO2-free energy and feedstock system. The Agreement contains a separate chapter on hydrogen, composed by a cross-sectoral working group Hydrogen.

About green hydrogen, it is stated that:

> *Additional investment in green hydrogen*
> *The Netherlands is a transit country with huge front and back doors. We function as a natural hub for raw and ancillary materials. We are located on the North Sea, which is increasingly becoming a source of sustainably generated electricity. We also have a strong base and petrochemicals cluster. In other words, the Netherlands is a prime location for the development of green hydrogen, as a fuel, as a storage medium and as a feedstock. All of these applications are crucial for the transition. Moreover, the development of hydrogen could open up economic opportunities in the Netherlands. This development will not happen by itself. The government is therefore fully committed to ensuring that the Netherlands becomes a frontrunner in green hydrogen. This will include an ambitious hydrogen programme focusing on research, pilots and demonstration projects, infrastructure and the application of broad hydrogen. From the Climate Budget, the government is making additional funding available to the indicative sum of €40 million per year for pilots and demonstrations in relation to green hydrogen.*

In the mid (2030) to long (2050) term, hydrogen can and must be able to carry out a number of critical functions within the energy and raw materials management system. The principal areas of focus will be:

1. A carbon-free feedstock for the process industry. Hydrogen is already widely used (approximately 100 PJ converted to energy value) and the need for hydrogen will continue to grow as a result of new sustainable chemical processes. In time, this feedstock will have to be carbon-free hydrogen. There is no alternative;
2. Carbon-free energy carriers for high temperature heat for the process industry. There are few alternatives for temperatures above approximately 600 degrees;
3. Controllable carbon-free capacity, energy storage for prolonged periods and energy transport over longer distances. These will be necessary in an energy supply in which the share of non-controllable weather-dependent sustainable energy is increasing significantly and where the sources (offshore wind energy) are situated at

a considerable distance from the user. Those needs will chiefly begin to increase around 2030;

4. Mobility, especially with regard to passenger transport for greater distances and road transport as a focus ahead of 2025. Heavy road transport over long distances, shipping, and rail are solid options for the longer term (toward 2030). In addition to battery electric transport, we will be committing significantly to hydrogen as part of the policy that aims to achieve zero-emissions mobility. The transition from grey to green hydrogen is crucial in that regard;
5. Built environment, possibly for buildings and districts that cannot easily be made more sustainable in other ways for various reasons.

Hydrogen Programme

A substantial hydrogen programme is to be initiated under this Climate Agreement. The programme will chiefly focus on unlocking the supply of green hydrogen, the development of the necessary infrastructure and collaboration with various sectoral programmes, as well as the facilitation of ongoing initiatives and projects. This programme will also allow the synergy between infrastructure and the use of hydrogen to be advanced.
It is crucial that this programme focus on incremental scaling of the production of green hydrogen using sustainable electricity in the short term. This is due to the following:

- The necessary large-scale production of green hydrogen requires a rapid price reduction of electrolysers and the price of renewable electricity. With respect to electrolysers, a reduction of 65% on the capex of electrolysers must (and, according to the expectations of relevant market parties, can) be realised through upscaling in the lead-up to 2030, from approximately €100 million per 100 MW at present to €35 million per 100 MW, and to 3 – 4 GW of established electrolysis capacity as a result of scaling. In conjunction with the expectations regarding the costs of renewable electricity generation, green hydrogen may become competitive in time.
- A sufficient volume of renewable electricity is required in order to accommodate the demand for green hydrogen. In this regard, attention should be paid to ensure some link to the growth of electrolysis capacity and the growth of offshore wind energy. Consideration should also be given to the way in which the capacity, use and location of electrolysis plants could contribute to the integration of renewable electricity into the energy system. The impact on infrastructure should be included in the comprehensive infrastructure survey for 2030 – 2050 that GasUnie and TenneT will carry out in 2020.
- Given the Netherlands' excellent starting position regarding the production and use of hydrogen, the Netherlands will be able to take a leading position in this field if our country is able to take the lead in developments.

This programme aims to have realised 3 – 4 GW of established capacity of electrolysers by 2030, with development being in alignment with the additional growth of the share of renewable electricity.

In addition, the programme will focus on the development of an optimal hydrogen infrastructure. In the period leading up to 2025, it is expected that, within the various industrial clusters and energy clusters, a need for a regional infrastructure for hydrogen will emerge. In relation to an established capacity of 3 – 4 GW, a need will also arise for the storage of hydrogen and the connection of various clusters, which can largely be achieved using existing natural gas infrastructure, which may require modification. On that basis, preparations will be made in the coming years regarding the realization of a national basic infrastructure for hydrogen (transport and storage).

The programme does not focus on the development of demand for hydrogen directly – that responsibility is more closely related to the various sectoral programmes. However, there will be close cooperation with those sectoral programmes to review the way in which the expected demand will develop and what is required from the hydrogen programme to develop that demand further.

Up to 2030, the programme will distinguish between the following phases and objectives:

- 2019 – 2021: preparatory programme for the roll-out of hydrogen, using a considerable number of ongoing initiatives and projects as a point of departure, to be concluded with an evaluation to benefit the further specification and objectives of the following phases. At the end of 2021, a decision will be made on the final structure of the follow-up phase and on the extent of the scaling up beyond 2030;
- 2022 – 2025: based on the results of the first phase, particularly if the cost reduction of electrolysis and the commitment of the relevant parties provide a sufficient basis, scaling up to 500 MW of established electrolysis capacity will take place if possible, in conjunction with the development of the demand for hydrogen and regional infrastructure and the connection of the various clusters. In 2025, a decision will be taken on the final structure of the follow-up phase;
- 2026 – 2030: scaling up to 3 –4 GW of established electrolysis capacity, connection to storage sites and expansion of infrastructure, on the condition of additional growth of renewable electricity, among other things.

2. Hydrogen and Fuel Cell R&D Update

In February 2019, a large R&D-programme on energy innovation was launched (DEI: Demonstration Energy Innovation). Budget approximately €100M. The DEI includes several hydrogen-related topics like integration of more flexible power in the power-system and heating of building without natural gas.
https://www.rvo.nl/subsidies-regelingen/demonstratie-energie-innovatie

Several R&D- projects have been granted, including topics like:

- Hydrogen from seawater via Membrane Distillation and Polymer Electrolyte Membrane Electrolysis;
- Low-cost and fast-fill dispenser for HRS;
- Development and building proto-type electric boat with FC-stack for inland shipping.

Last year several feasibility studies were announced, concerning:

- Production of green hydrogen by electrolysers, scale: from 1 MW up to 100 MW; and,
- Use of hydrogen for heating buildings and parts of cities.

3. Demonstration, Deployments, and Workforce Developments Update

Hydrogen Valley Northern Netherlands: HEAVENN
The Northern Netherlands is on track to become one of the European hydrogen frontrunners. The Northern Netherlands grant application for a Hydrogen Valley has been selected by the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) of the European Commission to prepare the grant agreement for 20 million euros with a public-private co-financing of 70 million euros. The total project size is around 90 million euros. This subsidy is intended for the development of a fully functioning green hydrogen chain in the northern Netherlands. By January 2020, the consortium aims to be able to sign the agreement and the six-year project will start.

The grant application was made in April this year by the **HEAVENN** consortium, led by Energy Valley (part of New Energy Coalition). HEAVENN stands for H2 Energy Applications (in) Valley Environments (for) Northern Netherlands and consists of 31 public and private parties from 6 European countries. New Energy Coalition and Samenwerkingsverband Noord-Nederland were the drivers in the application, supported by more than 65 national and international parties from California to Japan and New Zealand. The HEAVENN project is unique because it encompasses and connects the entire hydrogen chain within a geographical region.

HyStock
The first 1 MW power-to-gas installation is an important step in scaling up power-to-gas technology. EnergyStock and Gasunie New Energy aim to convert sustainable electricity into hydrogen for transport and industry at the site of EnergyStock storage facility. The EnergyStock facility is ideally situated for this project thanks to buffer capacity and connection with the main gas and electricity infrastructure**.**

This pilot project, called HyStock, is the first power-to-gas facility in the Netherlands with a capacity of 1 Megawatt. The installation started end of 2018 and construction finished in May 2019. A 1 MW solar field consisting of approximately 12,500 solar panels will be installed at EnergyStock's site of which, approximately 4,500 panels will be dedicated to the HyStock project. The other 8,000 panels will be used to improve the green credentials of the energy consumption of the actual gas storage facility. The majority of the sustainable energy, e.g. 88%, will be delivered to the HyStock project via TenneT's high-voltage electricity grid, enabling energy conversion between the high voltage electricity network and the gas transmission network.

Flagship Projects in the Netherlands
Out of the 23 international Hydrogen Flagships Projects 3 of them are based in the Netherlands:

1. Hydrogen to Magnum (H_2M), Netherlands and Norway
2. HyNetherlands Project, Netherlands
3. H-Vision Project, Netherlands

4. Events and Solicitations

No new international events to report.

Webinar "Hydrogen in the Netherlands"
At TNO (former ECN is now part of TNO, Dutch knowledge institute) a number of webinars about hydrogen, each with a different scope, are being planned. One of the webinars seems ideally suited for IPHE purpose. It is a on hydrogen developments in the Netherlands in general, with a slight emphasis on developments with strong involvement of TNO (e.g. H-Vision, off-shore electrolysis and reuse and repurposing of natural gas infrastructure assets). The focus will on the Netherlands as living lab and partner for an energy transition including hydrogen.

The plan is to organize this webinar on the 12th of December. No further details yet, but the IPHE network is invited to announce the webinar so that people can participate directly.

5. Investments: Government and Collaborative Hydrogen and Fuel Cell Funding

Programme for the demonstration of low-carbon technologies and innovations in transport

multi-annual demonstration programme (financing for example Living Labs) has been published in April 2019:
Budget Call of 2019: €30M
Focus of this Call 2019:

- Acceleration of development and demonstration of low-carbon vehicles (transportation of goods and passengers small (M2) and large (M3) buses;
- The development and demonstration of mobile machines, Light Electric Vehicles and ships (inland and short sea shipping) are eligible;
- Deployment and use of infrastructure for alternative fuels; and,
- Co-financing of EU-supported infrastructure for alternative fuels (mainly hydrogen).

The preliminary results are:

- Grants for 4 new HRS. The total number of operational and planned HRS in the Netherlands will be 19, by the end of 2020;
- 5 Hydrogen-projects with medium and heavy duty FC vehicles, like garbage trucks and mobile machinery. There is also a hydrogen project in a port, including the development of an inland ship with a FC range-extender.

6. Regulations, Codes & Standards, and Safety Update

The Ministry of Infrastructure and Water Management/RWS founded an ad hoc expert group that examines all the given information about the NEL refuelling station incident that took place at Kjorbo, Norway in June 2019. The intention is to collect all peculiarities and compile conclusions and recommendations. The results will be compiled after the final report of NEL GedCom comes available. These results will be sent as an advice to the relevant working groups (such as PGS35 that deals with best-available-techniques, the Dutch safety platform WVIP, fire brigade institute IFV, national standardization committee, et cetera)

Summary Country Update October 2019: The Netherlands

Transportation	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fuel Cell Vehicles[1]	2.000 by 2020 (15.000 by 2025) (300.000 by 2030)	162 as of Oct.. 2019	• Working Group Demand Gathering, (part of the Dutch Hydrogen Platform). • Main Task: Stimulate and co-ordinate activities of fleet-owners and HRS-business. • Work in progress: Preparations for a new covenant 'Hydrogen in Mobility' (Preliminary targets between brackets.)	Some Fiscal measures: • No purchase tax (BPM) • No road tax (MRB). • Low addition of 4% (instead of 22%) per year (Income tax) • Fiscal rebate on investments in a hydrogen car (9% of investments costs)
FC Bus	100 by 2020 (300 by 2025)	12 (scheduled), 8 in operation	• National Agreement on Zero Emission Regional Public Transportation By Bus • Dutch provinces (South-Holland and Groningen) are partner in JIVE-2 (i.e. FCH JU project on scaling up Public Transport FC buses)	Fiscal rebate on investments in a hydrogen bus (9% of investments costs)
Fuel Cell Trucks[2] (LCV and HD)	500 by 2020 (3.500 by 2025)	16 as of Sept. 2019	• Green Deal Zero Emission InnerCity Logistics https://greendealzes.connekt.nl/en/the-livable-city/	
Forklifts	No target	0		

[1] Includes Fuel Cell Electric Vehicles with Range Extenders

[2] As above

H_2 Refueling Stations	**Target Number**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
70 MPa On-Site Production	20 by 2020 (50 by 2025)	1	• Fuel Vision • Covenant (Green Deal) Sustainable Hydrogen Economy • National Agreement Climate Change • (New: Covenant H2 in Mobility) • New HRS: Arnhem (only 350 bar, 700 bar coming into service in Nov. 2019)	<u>Subsidy Scheme:</u> Up to 100% Subsidy of the investments costs for a (public) HRS No Subsidy for operation
70 MPa Delivered		1		
35 MPa On-Site Production	20 by 2020 (50 by 2025)	3		
35 MPa Delivered		2		
Stationary	**Target Number[3]**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
Small[4]	No target	0		
Medium[5]	No target	0		
Large[6]	No target	0		
District Grid[7]	No target	0		

[3] Targets can be units installed and/or total installed capacity in the size range indicated
[4] <5 kW (e.g., Residential Use)
[5] 5kW – 400 kW (e.g., Distributed Residential Use)
[6] 0.3MW – 10 MW (e.g., Industrial Use)
[7] 1MW – 30 MW (e.g., Grid Stability, Ancillary Services)

Regional Grid[8]		0		
Telecom backup	No target			
H_2 Production	**Target[9]**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
Fossil Fuels[10]	Climate neutral as soon as possible (no CO2- emission well to wheel)	Large share of fossil fuelled H2-production (by SMR)	• Covenant (Green Deal) Sustainable Hydrogen Economy • National Agreement Climate Change	
Water Electrolysis[11] (PEM, Alkaline, SOEC)	500 MW by 2025 3 - 4 GW by 2030	1 MW At HyStock	https://www.energystock.com/about-energystock/the-hydrogen-project-hystock	
By-product H_2	No target	Large production facilities in Rotterdam harbour area and Groningen harbour area	• Production based on chlorine-alkali production process, H2 as by-product.	

[8] 30MW plus (e.g., Grid Storage and Systems Management)
[9] Target can be by quantity (Nm^3, kg, t) and by percentage of total production; also, reference to efficiency capabilities can be a target
[10] Hydrogen produced by reforming processes
[11] Please indicate if targets relate to a specific technology (PEM, Alkaline, SOEC)

Energy Storage from Renewables	Target[12]	Current Status	Partnership, Strategic Approach	Support Mechanism
Power to Power[13] Capacity	No target	0		
Power to Gas[14] Capacity	No target	0		

[12] Can be expressed in MW of Installed Capacity to use the electricity from renewable energy generation, and Annual MWh of stored energy capacity
[13] Operator has an obligation to return the electricity stored through the use of hydrogen back to electricity
[14] Operator has the opportunity to provide the stored energy in the form of hydrogen back to the energy system through multiple channels (e.g., merchant product, enriched natural gas, synthetic methane for transportation, heating, electricity)