TKI NIEUW GAS
Topsector Energie

Overview of Hydrogen Projects in the Netherlands

Peter de Laat for TKI Nieuw Gas

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Introduction

Globally hydrogen projects are developing at a great speed. New projects are announced on a weekly basis. Dutch industry, research institutions, consultants, NGOs and governments actively take part in these developments and are jointly working on a large range of projects, aimed at realizing the potential role that hydrogen can play in the energy transition to carbon neutrality in 2050. These projects not only focus on The Netherlands, but also seek to connect to our neighboring countries, stakeholders in the North Sea region and to the global arena.

In this slide deck we present an overview of Dutch research, pilot and demonstration projects on hydrogen which are ready to be shared in the public domain. We hope that this overview of projects inspires everyone to continue working on the realization of these projects and start new ones. Of course, this overview is not complete, it is just a picture of what is happening at this moment. We have also filtered out projects which are only a first idea at this stage. Hopefully, these projects, once more information is available, can be included in a next version.

If your project is not yet listed in this overview, or if the information presented is not accurate, please let us know so we can keep this overview up-to-date. Please contact us at office@tki-gas.nl.

Enjoy reading!

Jörg Gigler, managing director TKI New Gas | Topsector Energy

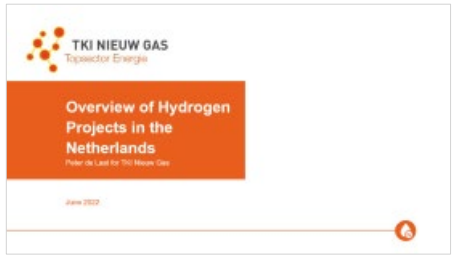
Explanation of the information box

- Category — What is the main subject of the project in the hydrogen chain?
- Capacity — What is the size of the project in MW, tons H_2/hour or trucks build?
- Process phase — In which phase is the project:

concept	(idea development)
feasibility study	(first design)
FEED-study	(business case)
FID	(investment decision)
execution	(implementation, building)
commissioning	(test run)

- Project costs — The amount of subsidy or investment involved.
- Contact — Here, more information on the project or initiative is given.

Overview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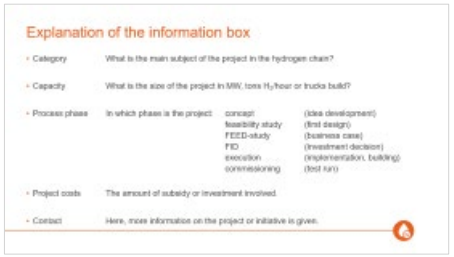
Introduction


Explanation of the information box


Production


Storage


Import


Offshore


Transportation


End use: Energy Supply


End use: Industry


End use: Mobility & Transport

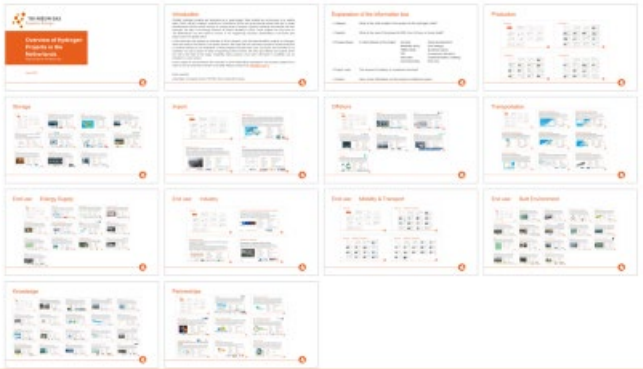

End use: Built Environment


Knowledge


Partnerships

Production

Overview

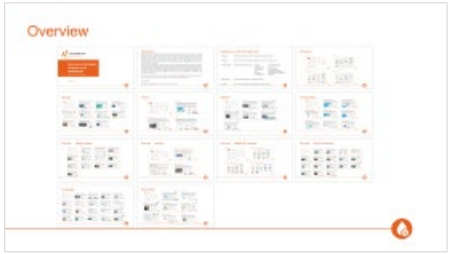


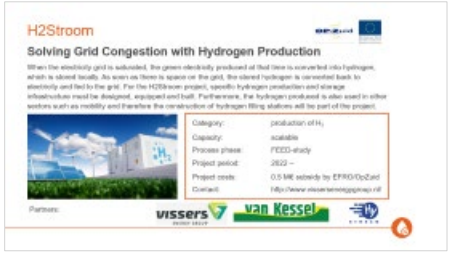
Production I

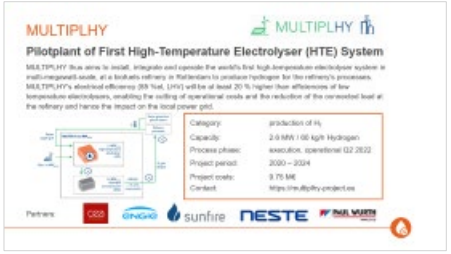
Production II

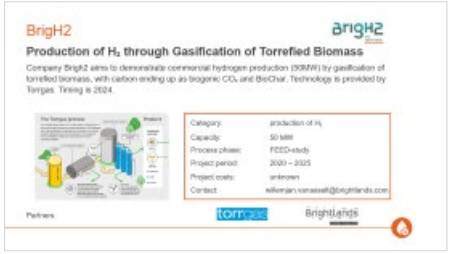
Production III

Production I









Production II

Overview

Production I

Production III

Haddock

Building a 100 MW Electrolysis Plant on Yara-site in Sluiskil

Partners: Ørsted

SeaH2Land

Linking GW-scale Electrolysis to Large Industrial Demand in the Dutch-Flemish North Sea Port Cluster Through an Envisaged Regional Cross-Border Pipeline.

Partners: Ørsted

H2Agro

Two Agricultural Companies Work Together Towards a Sustainable Future with Hydrogen

Partners: ACCIONA

CurtHyl

Building a 200 MW Electrolyser to Avoid Curtailment of Windpark

Partners: Port of Rotterdam, Air Liquide

VoltH2 - Vlissingen

Hydrogen Production in Vlissingen with Dedicated Storage

Partners: VOLT H2

Uniper

Building a 100 MW Electrolysis Plant on the Maasvlakte

Partners: uniper

Shell Hydrogen Holland I

Realisation of a 200 MW Electrolyser in Rotterdam

Partners: Shell, Port of Rotterdam

Hydrohub GW

The Hydrohub GigaWatt Scale Electrolyser

Partners: TenneT, Gasunie, HyCC, BioMCN, McPhy, DE NORA

GROHW

Accelerating with decentralized hydrogen ecosystem

Partners: GROHW, hve, HAN, VOS

H2ARVESTER

Harvesting Extra Hydrogen on Agricultural Land in Use

Partners: LTO noord

Bio-TecH2

Production of Bio-Hydrogen

Partners: Bio-energie cluster Oude Maasvlakte, PlanET

Djewels-1

Realisation of a 20 MW Electrolyser in Delfzijl

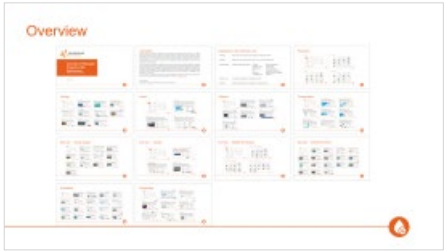
Partners: HyCC, Gasunie, BioMCN, McPhy, DE NORA

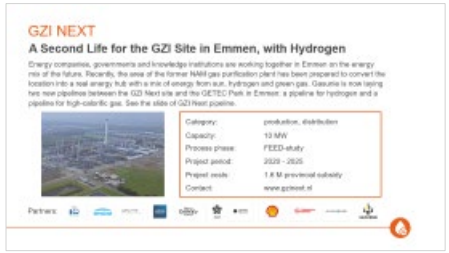
H2-Fifty

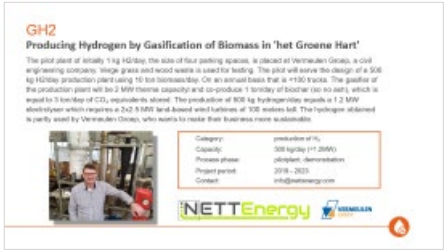
Building a 250 MW Electrolysis Plant in Port of Rotterdam

Partners: Port of Rotterdam, HyCC

Production III







Hynoca Alkmaar

Decentral Green Hydrogen Production for Local Application

Hynoca is the first of more to follow hydrogen production facilities where certified biomass residues will be converted into green hydrogen and biochar (certified carbon sink). To cut the hydrogen price and CO2 footprint associated with biomass and hydrogen transportation, the decentral production facility is located near biomass availability sites and hydrogen offtakers. Hynoca conducted a LCA that determined to avoid at least 12 kg CO2 emission per kg of H2 produced. The project will start operations in 2023.

Category:	decentral production of H_2
Capacity:	240t – 1.300t H_2 /year
Process phase:	demonstration preparation
Project period:	end 2023 (test & demonstration)
Project costs:	7 M€
Contact:	info@hydevco.eu

Partners:

H2Stroom

Solving Grid Congestion with Hydrogen Production

When the electricity grid is saturated, the green electricity produced at that time is converted into hydrogen, which is stored locally. As soon as there is space on the grid, the stored hydrogen is converted back to electricity and fed to the grid. For the H2Stroom project, specific hydrogen production and storage infrastructure must be designed, equipped and built. Furthermore, the hydrogen produced is also used in other sectors such as mobility and therefore the construction of hydrogen filling stations will be part of the project.

Category:	production of H_2
Capacity:	scalable
Process phase:	FEED-study
Project period:	2022 –
Project costs:	0.5 M€ subsidy by EFRO/OpZuid
Contact:	http://www.vissersenergygroup.nl/

Partners:

H2UB Laren

Joint Hydrogen Production from Mono-manure Fermentation

12 Livestock farmers in Laren have the ambition to make an important social contribution to the nitrogen problem, the Climate Agreement and the energy transition. For this, central green hydrogen production from biogas by SMR or Plasmolysis was investigated with very promising results. The biogas will be transported to the Hub by a local pipe system. Based on the results of the H2UB Laren study, the working group intends to launch a pilot to start producing green hydrogen from biogas.

Category:	production of H_2
Capacity:	15 kg H_2 /uur
Process phase:	Feasibility-study
Project period:	2021 – 2025
Project costs:	10 M€
Contact:	www.lochemenergie.net

Partners:

LochemEnergie

CCS

Wakker Laorne

Green Chemistry Consultancy

Djewels-2

Realisation of a 40 MW Electrolyser in Delfzijl

Operated by HyCC, it will provide 6 ktpa hydrogen per year to be used by DSL-01 to produce sustainable aviation fuel. Part of the "Hydrogen Valley“, a broad coalition of public and private parties to realize large-scale production, storage, and distribution of green hydrogen, as a raw material for industry, the built environment and mobility.

Category:	production of hydrogen
Capacity:	40 MW
Process phase:	FID in 2023
Project period:	2020 -
Project costs:	1.5 mln EUR subsidy
Contact:	www.hyCC.com

Partners:

VoltH2 - Terneuzen

Hydrogen Production in Terneuzen with Dedicated Storage

In collaboration with Virya Energy, VoltH2 is developing a 25 MW green H_2 production plant on the Axelse Vlakte in Terneuzen, using electrolysers powered only by renewable energy. The permit for the facility is awarded in April 2022, and it will have a dedicated H_2 storage, access to pipeline infrastructure as well as multimodal transport systems in support of H_2 distribution further afield. The feasibility of installing an onsite HRS for the supply of H_2 for heavy road, utility and light duty vehicles as well as inland waterway transport is being considered. The project is scalable in phases, up to 80 MW capacity by 2030.

Category:	production of H_2
Capacity:	25 MW
Process phase:	FEED / Tendering
Project period:	2021 – 2025
Project costs:	50-60M
Contact:	www.volth2.com

VOLT H2

North Sea Port

virya energy

Cleanup Gas

Hydrogen from Supercritical Water Gasification Technology

This technology uses high temperature and high pressure to convert organic waste into green hydrogen and green gas – a sustainable alternative to natural gas. At its demo location, SCW and its partner Gasunie are currently constructing an industrial installation with initial capacity of 18.6 MW. This will be the world's first supercritical water gasification plant and upscaling to 100 MW is possible in the future.

Category:	production of H_2
Capacity:	18.6 MW
Process phase:	demonstration
Project period:	2020 –
Project costs:	Invest-NL investment 15 M€
Contact:	www.scwsystems.com

Partners:

SCW systems

gasunie crossing borders in energy

Energiepark Eemshaven-West

Combining Technologies to Produce Renewable Hydrogen

Vattenfall aims to produce 100% renewable hydrogen in the area of Eemshaven-West, in Northern Netherlands, by connecting wind and solar electricity production directly to an electrolyser and a battery, in order to decarbonize the mobility and industry sector. The electrolyser will be built in a phased approach, starting with 10 MW, after which a ramp-up will take place towards 100 MW.

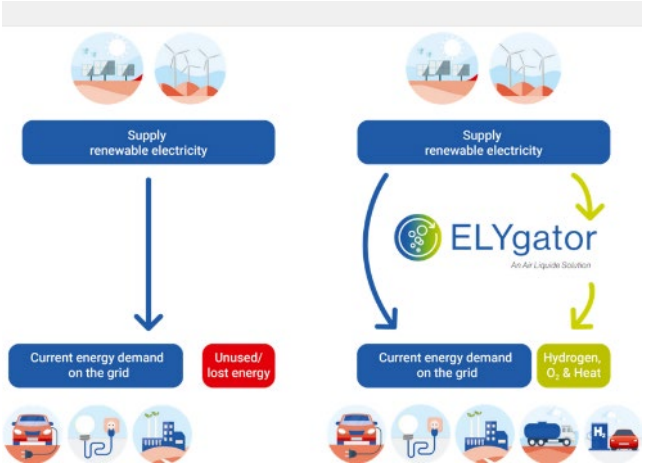
Category:	production of H_2
Capacity:	10-100 MW (phased)
Process phase:	FEED-study (permitting phase)
Project period:	2020 – 2027, FID 2023 / 2024
Contact:	www.vattenfall.com/nl

VATTENFALL

ELYgator

Building a 200 MW Electrolyser in Terneuzen

Air Liquide is developing the ELYgator project, a large-scale 200 MW water electrolyser project that will be entirely sourced from renewable power sources and will enable avoidance of 3M tons of CO_2 over the first 10 years of the plant's operation. The unit is planned to become operational in 2026 and produce over 15,5 ktons of renewable hydrogen per year which will be injected into Air Liquide's European cross-border hydrogen network and dedicated to both mobility applications as well as industrial applications.



Category:	production of H_2
Capacity:	200 MW
Process phase:	FEED-study
Project period:	2020 – 2026
Project costs:	€ 270 - 290M
Contact:	robert.haffner@airliquide.com

Partners:

H2 Conversion Park

Building First 2 GW Conversion Park for Large Scale Hydrogen Production on the Maasvlakte in Rotterdam

Several large-scale hydrogen factories will produce hydrogen on this central location and share at least electricity and hydrogen infrastructure. From this central location hydrogen will be transported via the open-access Hydrogen Network Rotterdam towards companies in the Port area of Rotterdam. The first electrolysers announced in the conversion park are the 200 MW of Shell (2024) and 250MW of H2-Fifty (BP and HyCC; 2025).

Category:	production of H_2
Capacity:	1-2 GW
Process phase:	FEED-study and FID
Project period:	2020 – 2050
Project costs:	unknown
Contact:	rfm.weterings@portofrotterdam.com

Partners: Deltalinqs, Air Liquide, Shell, bp, HyCC, Port of Rotterdam

H_2ero

Hydrogen out of Energy of Renewable Origin for Zeeland

The project comprises the development of a 150 MW electrolyser on the site of Zeeland Refinery in Vlissingen. This location is particularly suitable given its location in an already highly hydrogen-intensive region with many opportunities for setting up and scaling up a ‘low-carbon’ hydrogen value chain. An annual production of 21 kT of green hydrogen can be expected with the installation, which is equivalent to an avoided CO_2-emission of approximately 200 kTa compared to H_2 production through the conventional fossil route.

Category:	production of H_2
Capacity:	150 MW
Process phase:	Pre-FEED
Project period:	2021 – 2026
Project costs:	unknown
Contact:	koen.van-leuven@zrefinery.nl

Partners:

Zeeland Refinery

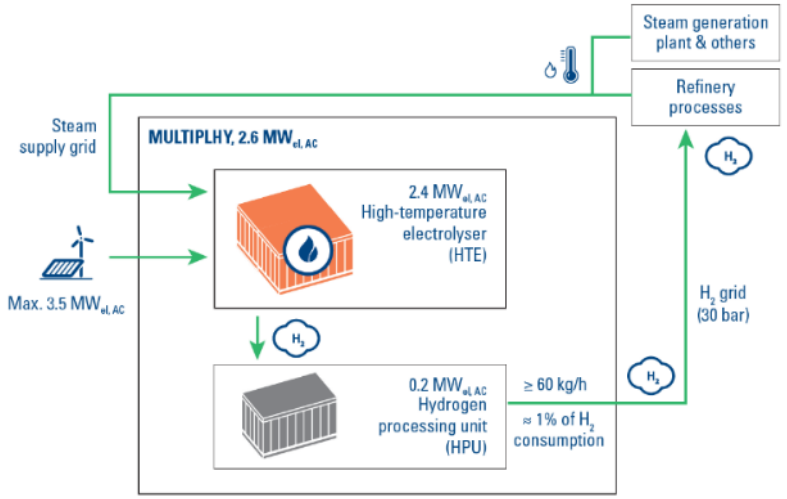
TotalEnergies

LITASCO GROUP
TRADING AND SUPPLY COMPANY

MULTIPLHY

Pilotplant of First High-Temperature Electrolyser (HTE) System

MULTIPLHY thus aims to install, integrate and operate the world's first high-temperature electrolyser system in multi-megawatt-scale, at a biofuels refinery in Rotterdam to produce hydrogen for the refinery's processes. MULTIPLHY's electrical efficiency (85 %el, LHV) will be at least 20 % higher than efficiencies of low temperature electrolysers, enabling the cutting of operational costs and the reduction of the connected load at the refinery and hence the impact on the local power grid.



Category:	production of H_2
Capacity:	2.6 MW / 60 kg/h Hydrogen
Process phase:	execution, operational Q2 2022
Project period:	2020 – 2024
Project costs:	9.75 M€
Contact:	https://multiplhy-project.eu

Partners:

FUREC

Hydrogen Production Plant by ‘waste-to-chemicals’ on Chemelot

The project plans to transform residual waste into raw material pellets, which are then converted into hydrogen at industrial park Chemelot. FUREC (Fuse Reuse Recycle) uses existing waste streams, partly of biogenic origin, so that they do not have to be landfilled or incinerated. FUREC saves the equivalent of 140.000 households of natural gas use. In addition to local sales at Chemelot, the hydrogen can eventually be transported to industry in Rotterdam and the German Ruhr area. The CO_2 released during the production of hydrogen can be either captured and stored or used as a raw material in the future.

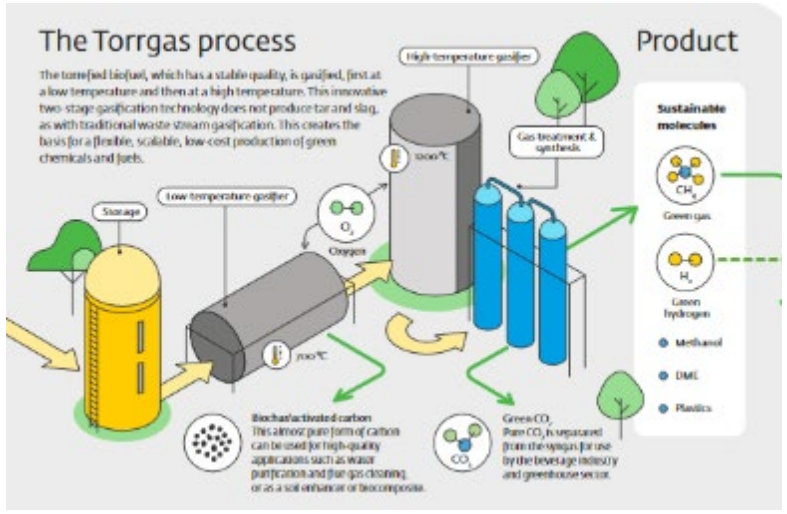
Category:	production of H_2
Capacity:	600 Mio m³ H_2
Process phase:	Feasibility-study
Project period:	2021 – 2025
Contact:	Jacob.Rookmaaker@rwe.com

OCI RWE chemelot for today's future provincie limburg

BrigH2

Production of H_2 through Gasification of Torrefied Biomass

Company Brigh2 aims to demonstrate commercial hydrogen production (50MW) by gasification of torrefied biomass, with carbon ending up as biogenic CO_2 and BioChar. Technology is provided by Torrgas. Timing is 2024.



Category:	production of H_2
Capacity:	50 MW
Process phase:	FEED-study
Project period:	2020 – 2025
Project costs:	unknown
Contact:	willemjan.vanasselt@brightlands.com

Partners:

Haddock

Building a 100 MW Electrolysis Plant on Yara-site in Sluiskil

The aim of the project is to replace fossil hydrogen with renewable hydrogen, for both on-site consumption and to link to the regional hydrogen backbone. The on-site hydrogen is intended to be used in the production of carbon neutral fertilizer products, decarbonizing the food value chain, and also has potential as a future climate neutral shipping fuel. The installation is powered by dedicated renewable energy supply from Ørsted's offshore wind farms.

Category:	production of green H_2
Capacity:	100 MW
Process phase:	concept select
Project period:	2020-2026
Project costs:	unknown
Contact:	https://orsted.nl/contact

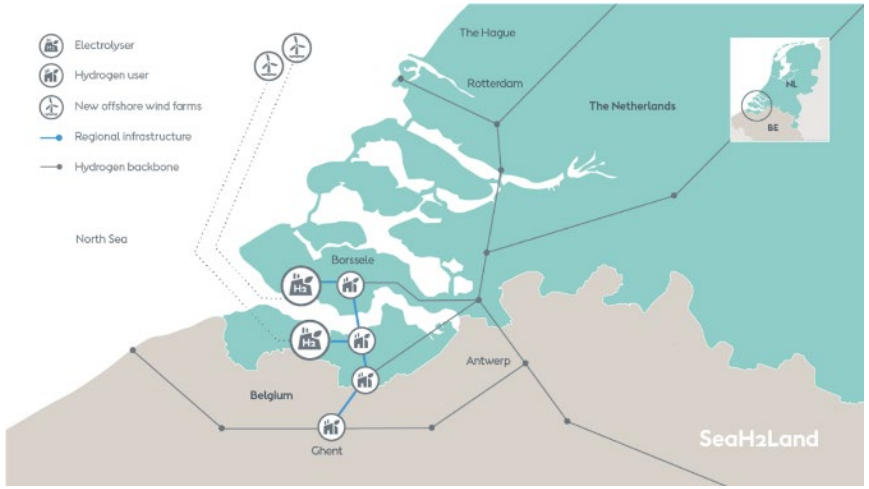
Partners:

Ørsted

SeaH2Land

Linking GW-scale Electrolysis to Large Industrial Demand in the Dutch-Flemish North Sea Port Cluster Through an Envisaged Regional Cross-Border Pipeline.

SeaH2Land is a vision for gigawatt-scale electrolysis and offshore wind landing points on both sides of the river Scheldt after extension of the 380kV grid, turning the cluster into a true hydrogen hub. Containing a 1 GW electrolyser to produce renewable hydrogen and 2 GW of new offshore wind capacity linked to the electrolyser and the regional and national hydrogen pipelines. This includes the cross-border connection between the Netherlands and Belgium to exchange hydrogen between industrial players in the region.



Category:	production of green H_2
Capacity:	1 GW
Process phase:	Feasibility-study
Project period:	2020 – 2028/2030
Project costs:	unknown
Contact:	https://seah2land.nl/

Partners:

Ørsted

YARA Knowledge grows

zeeland refinery A TOTAL AND LUKOIL COMPANY

DOW

North Sea Port

H2Agro

Two Agricultural Companies Work Together Towards a Sustainable Future with Hydrogen

Arable and flower bulb company Vof Dogterom on Goeree-Overflakkee and arable farming company Vof van den Hoek in Hoeksche Waard started their own research in 2018 into making the farm more sustainable using hydrogen. Now Accenda B.V. is simulating and designing an optimized energy system for each company. With a simulation, the available production of sustainable energy is mapped out over time, including the own energy consumption. The required capacity of the electrolyser is calculated based on the available sustainable energy for hydrogen production.

Category:	production of H_2, storage, use
Capacity:	under study
Process phase:	FEED-study
Project period:	2018 – 2023
Contact:	ehaveman@ltonoord.nl

Partners:

CurtHyl

Building a 200 MW Electrolyser to Avoid Curtailment of Windpark

In the CurtHyl project on the Maasvlakte II in the port of Rotterdam, renewable electricity from offshore wind on the North Sea is converted into renewable hydrogen via electrolysis. This renewable hydrogen will be supplied to customers in industry and the mobility sector. Due to its favorable location on the Maasvlakte II, close to the landfall of the offshore power cables, optimum use is made of the available electricity infrastructure and grid reinforcements further inland can be avoided. The 200 MW electrolyser will follow the production of renewable generation as closely as possible and thus contributes to the stability of the Dutch electricity grid.

Category:	production of H_2
Capacity:	200 MW
Process phase:	FEED-study
Project period:	2020 – 2026,
Project costs:	270 – 290 M€
Contact:	robert.haffner@airliquide.com

Partners:

Port of Rotterdam

Air Liquide

VoltH2 - Vlissingen

Hydrogen Production in Vlissingen with Dedicated Storage

VoltH2 is developing a 25 MW green hydrogen production plan in Vlissingen-Oost, for which it has obtained all permits (a first in The Netherlands). Situated next to the Sloecentrale Powerplant, the plant will produce green hydrogen using renewable energy only. The facility will have its own dedicated hydrogen storage as well as access to pipeline and multimodal transport infrastructure to enable H_2 distribution beyond the immediate locality. VoltH2 is assessing the feasibility of installing a local HRS for the supply of H_2 directly to trucks and other vehicles. The project is designed to be scalable in phases, up to a 100 MW by 2030.

Category:	production of H_2
Capacity:	25 MW
Process phase:	FEED / Tendering
Project period:	2021 – 2025
Project costs:	50-60M
Contact:	www.volth2.com

VOLT H2

North Sea Port

Uniper

Building a 100 MW Electrolysis Plant on the Maasvlakte

Energy company Uniper is developing large-scale production of green hydrogen on the Maasvlakte. The first phase comprises the realization of a 100 MW elektrolyser plant on Uniper site by 2025 followed by a phased expansion to 500 MW by 2030. The Maasvlakte is an excellent location to produce green hydrogen. Renewable electricity from offshore wind farms will soon be landed here and various important facilities (e.g. utilities) are already present on the Uniper site.

Category:	production of H_2
Capacity:	100 MW
Process phase:	FEED-study
Project period:	2021 – 2025
Project costs:	unknown
Contact:	fred.hage@uniper.energy

Partners:

Shell Hydrogen Holland I

Realisation of a 200 MW Electrolyser in Rotterdam

The green hydrogen produced will initially be used at the Shell refinery in Pernis to partially decarbonise the production of fossil fuels. This saves a minimum of 200,000 tonnes of CO_2 per year. This hydrogen can later be used to decarbonise trucks in the transport sector.

Category:	production of hydrogen
Capacity:	200 MW / 50,000 kg H_2/day
Process phase:	FEED-study, FID 2022
Project period:	2020 - 2024
Project costs:	unknown
Contact:	www.shell.nl

Partners:

Hydrohub GW

The Hydrohub GigaWatt Scale Electrolyser

Conceptual design of an electrolyser system of gigawatt size, the size that bridges large-scale renewable power production in offshore wind parks and industrial-scale use of hydrogen for feedstock and energy purposes.

Category:	production of H_2
Capacity:	1 GW
Process phase:	FEED-study completed with report
Project period:	2018 - 2022
Project costs:	TKI subsidy
Contact:	carol.xiao@ispt.eu

Partners:

GROHW

Accelerating with decentralized hydrogen ecosystem

GROHW captures the shared ambition of a group of partners to move the energy transition towards zero emissions by joint development of a decentralized hydrogen ecosystem. From locally produced green power and on-premises production of green hydrogen to end-user applications as an asphalt factory and -in combination with an innovative heat pump- for the built environment. Including a local elektrolyser supplier and an energy trading platform, GROHW provides a complete hydrogen ecosystem that counters grid congestion. The total system is ready for demonstration by the fall of 2022 at a 50-kW scale; the full scale (MW level) is the next step. A sophisticated blueprint is available to enable replication anywhere else.

Category:	production of green hydrogen
Capacity:	MW
Process phase:	execution, demonstration
Project period:	2020 - 2023
Project costs:	3-4 million
Contact:	raphael.van.der.velde@witteveenbos.com

Partners:

H2ARVESTER

Harvesting Extra Hydrogen on Agricultural Land in Use

The mobile H2ARVESTER can be seen as an "extra crop" in the rotational cultivation of arable farmers. The yield of the solar panels can be processed into hydrogen (H_2) and stored, to balance the production and use of the generated energy.

Category:	production of green hydrogen
Capacity:	scalable
Process phase:	FEED-studies
Project period:	2017 - 2025
Project costs:	non-disclosed
Contact:	mvroom@npk.nl

Partners:

LTO noord

npk | design

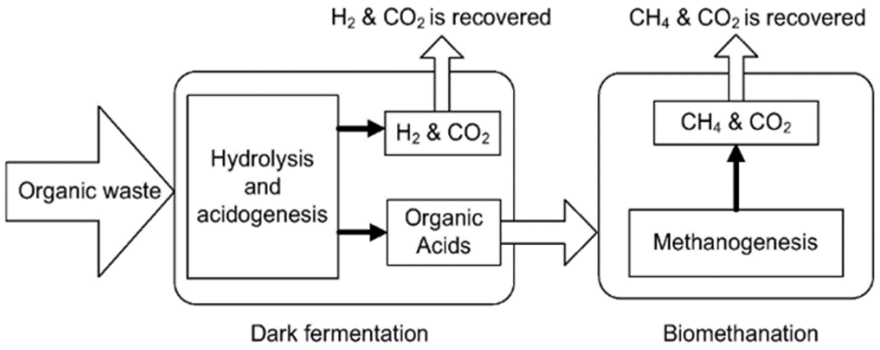
L'Orèl Consultancy B.V.

CLEAN TECH REGIO

Bio-TecH2

Production of Bio-Hydrogen

Creating the basis for an implementation of biohydrogen production from biogenic waste streams and wastewater with smart bacteria in fermentation tanks. Upscaling to large-scale technology to realize the development step of a market-ready establishment.



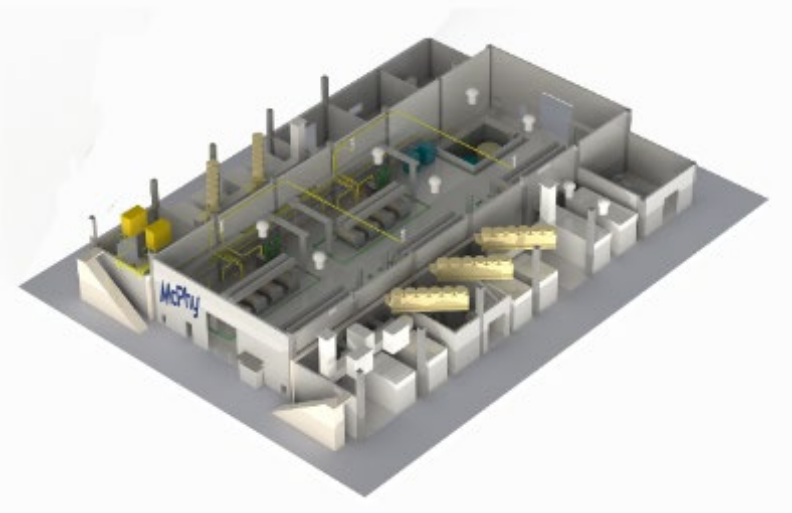
Category:	production of biohydrogen
Capacity:	scalable
Process phase:	project completed with report
Project period:	2019 – june 2022
Project costs:	350 k Interreg subsidy
Contact:	www.biohydrogen.eu

Partners: FH MÜNSTER University of Applied Sciences; bio-energie cluster Oost-Nederland; PlanET; H2 bv hydrogen solutions

Djewels-1

Realisation of a 20 MW Electrolyser in Delfzijl

Operated by HyCC and Gasunie, it will provide 3,000 tons of green hydrogen per year, reducing CO_2 emissions by 27,000 tons per year. The produced hydrogen will be used for green methanol production for transport fuel at BioMCN. This plant also must validate the technical integrity and operating principles, stability and safety of a large-scale water electrolysis plant.



Category:	production of hydrogen
Capacity:	20 MW
Process phase:	FID in 2022
Project period:	2020 -
Project costs:	16 M€ subsidy
Contact:	www.djewels.eu

Partners: HyCC, gasunie crossing borders in energy, BioMCN, McPhy Driving clean energy forward, Hinicio, DE NORA

H2-Fifty

Building a 250 MW Electrolysis Plant in Port of Rotterdam

The new factory will be able to produce 45,000 tons of green hydrogen annually. Because the hydrogen is produced from water with sustainable electricity, CO_2 emissions can decrease by 350,000 tons annually. BP will use the green hydrogen to desulphurise products and for mobility projects. The H2-Fifty project will be in the so-called Conversion Park, a special site that the Port Authority is building on the Maasvlakte for electrolysers from various companies.

Category:	production of H_2
Capacity:	250 MW
Process phase:	FEED-study
Project period:	2019 – 2023 (FID)
Project costs:	225 - 300 M
Contact:	hgj.regeer@portofrotterdam.com

Partners:

Eemshydrogen

Building a 50 MW Hydrogen Plant for Westereems Wind Farm

The Eemshydrogen project demonstrates at scale (50MW) that electrolyzers can flexibly follow intermittent power production from a directly connected wind farm. The electrolyser supports development of a larger hydrogen infrastructure and targets CO_2-reduction in hard to abate industrial sectors. Depending on market conditions and regulations, the electrolysis capacity will be scaled up further.

Category:	production of green H_2
Capacity:	50 MW
Process phase:	FEED-study, FID in 2022
Project period:	COD in 2024
Contact:	ron.hoogsteen@rwe.com

Partners:

RWE

Hy4Am

Building a 10 MW Electrolyser at Hemweg Location

The goal is to supply approximately 200 kg/hour green hydrogen to mobility and industry in the Amsterdam region from 2026. The technical feasibility study has been successfully completed and the focus is currently on developing market demand and optimizing the business case. This plant is a first step to larger electrolysis capacities and an integral part of a fossil free hub (production, storage and distribution) for providing green electricity, heating and fuels for Amsterdam Metropole Region.

Category:	production of H_2
Capacity:	10 MW, 200 kg/h
Process phase:	FEED-study
Project period:	2020-2025; FID in 2023
Contact:	www.vattenfall.com/nl

Partners:

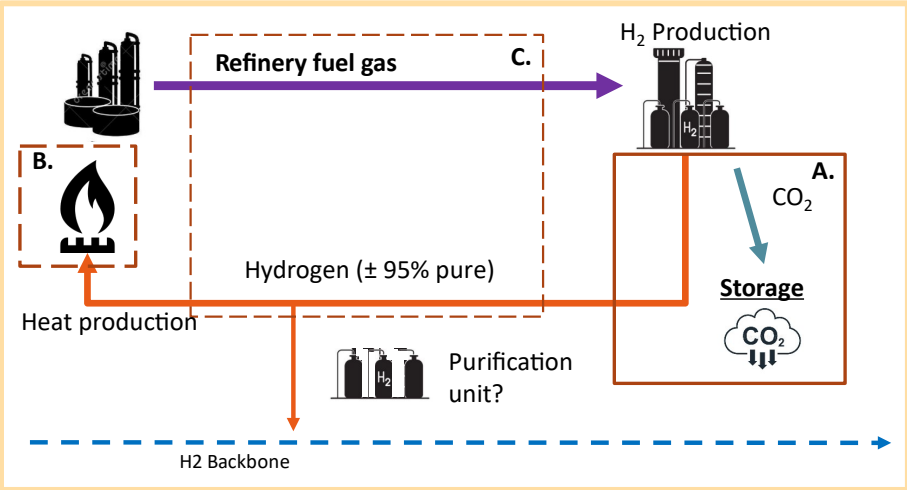
VATTENFALL

Port of Amsterdam

H-vision

A Unique Approach for Industry to Achieve its Climate Targets with Low Carbon Hydrogen

Bringing together the full hydrogen value chain, to deliver 2,7 Mton of CO_2 emissions reductions for the Rotterdam industry by 2032. With two world-scale hydrogen plants, capturing over 95% of the CO_2 emissions. The unique process uses refinery fuel gas as its primary feedstock. The low-carbon hydrogen will have a purity of over 95%.



Category:	production of low-carbon Hydrogen
Capacity:	2 plants of 750 MW
Process phase:	concept
Project period:	2020 - 2032
Project costs:	1-2 Billion investment
Contact:	projectmanagement-hvision@deltalinqs.nl

GreenH2UB

Creating a Green Hydrogen Ecosystem in North-Brabant

GreenH2UB is a 5-10 MW green hydrogen plant based on PEM electrolysis. Application and deployment in industry, mobility and built environment. The realization of the first GreenH2UB is set for the Kempisch Bedrijvenpark in the Metropol Region Eindhoven. The GreenH2UB will be connected directly to wind farm de Pals and solar farms. Finished the Concept Design and obtained a positive Feasibility Study.

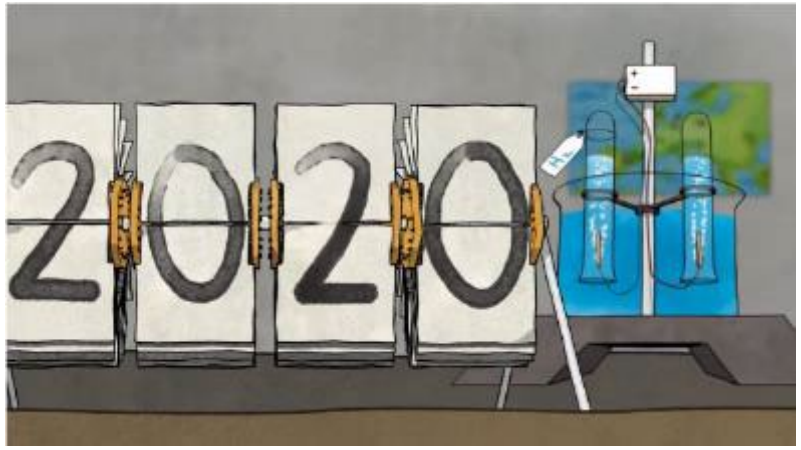
Category:	production of green H_2
Capacity:	5-10MW (330k-1m kg/y)
Process phase:	FEED-study
Project period:	FID 2023, COD 2024
Project costs:	12 M€ CAPEX
Contact:	www.greenh2ub.nl

Partners: FORCE RENEWABLE ENERGY, BOM, BRAINPORT EINDHOVEN, ennatuurlijk, Berenschot, TNO innovation for life, WATT INFRA, DOEN, Interreg Vlaanderen-Nederland, ENEXIS NETBEHEER, WaterstofNet, HyMatters

HEAVENN

H_2 Energy Applications in Valley Environments for Northern NL

The projects support focus on sectoral integration: the large-scale production of green hydrogen as a raw material for industry, the storage, transport and distribution of hydrogen and its application for energy supply for industry and the built environment and in mobility.



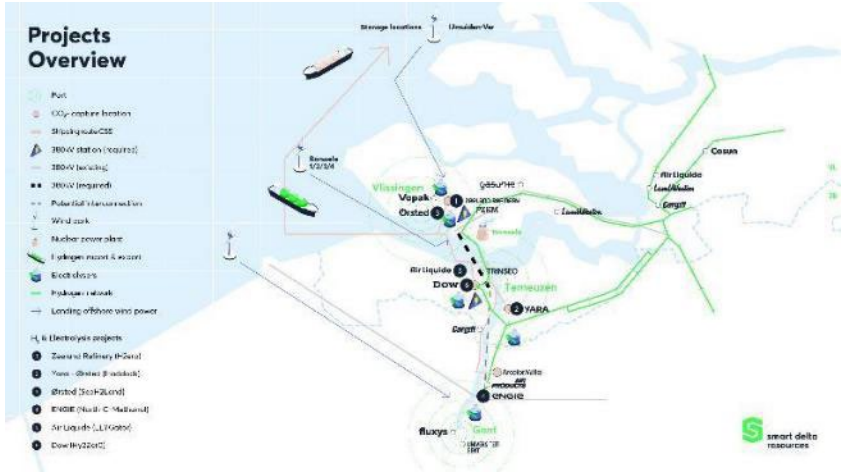
Category:	production H_2 in Energy Valley
Capacity:	30 subprojects
Process phase:	execution
Project period:	2020 - 2025
Project costs:	90 M€
Contact:	https://heavenn.org/

Partners:

Hydrogen Delta

Shift of the Largest Hydrogen Producer (580kta) and Consumer in the Benelux to a Sustainable Hydrogen Cluster.

The ambitious Hydrogen Delta Program aims to make the industry more sustainable by phasing out gray hydrogen through clean hydrogen investments. This by producing green hydrogen on a large scale, consuming it locally and importing and exporting it. The next step is to flesh out the kick-start of green hydrogen pilots and realization of the Hydrogen Delta Network.



Category:	production, distribution
Capacity:	>1 GW in projects
Process phase:	FEED-study
Project period:	2020 - 2030
Project costs:	>1 B€
Contact:	www.smartdeltaresources.com

Partners:

GZI NEXT

A Second Life for the GZI Site in Emmen, with Hydrogen

Energy companies, governments and knowledge institutions are working together in Emmen on the energy mix of the future. Recently, the area of the former NAM gas purification plant has been prepared to convert the location into a real energy hub with a mix of energy from sun, hydrogen and green gas. Gasunie is now laying two new pipelines between the GZI Next site and the GETEC Park in Emmen: a pipeline for hydrogen and a pipeline for high-calorific gas. See the slide of GZI Next pipeline.

Category:	production, distribution
Capacity:	10 MW
Process phase:	FEED-study
Project period:	2020 - 2025
Project costs:	1.6 M provincial subsidy
Contact:	www.gzinext.nl

Partners:

Hydrogen Wind Turbine

Building a Wind Turbine that Produces Hydrogen

TheA 4 MW ENERCON wind turbine has been built in 2021 and a 2,3 MW electrolyser will be integrated in 2023. The goal of this project is to create synergy between the wind turbine, electrolyser and pipeline & storage. The demonstrator hybrid turbine will be built on the ECN test location in the Wieringermeer.

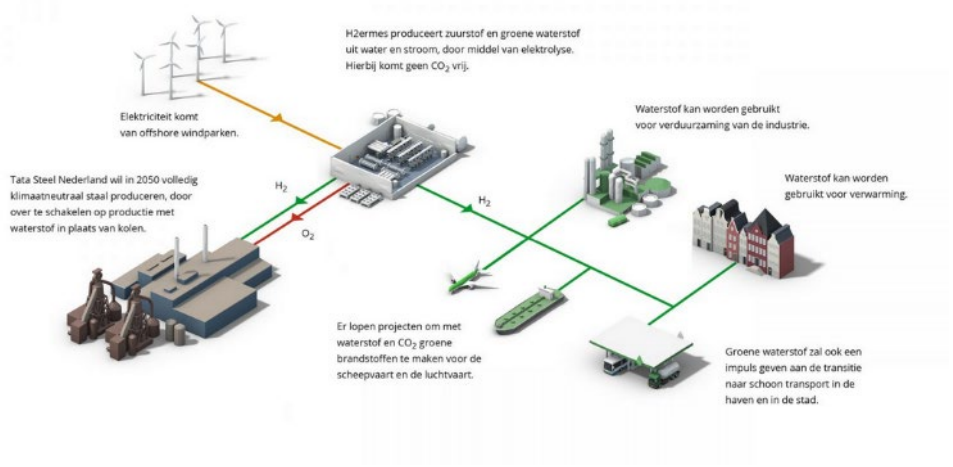
Category:	production, storage, distribution
Capacity:	2,5 MW
Process phase:	execution
Project period:	2021 - 2023
Project costs:	unknown
Contact:	adegoeij@hy-gro.nl

Partners: ENERCON ENERGY FOR THE WORLD, nhn, New Energy Coalition, HYGRO enabling hydrogen from wind to wheel, TNO innovation for life

H2ermes

Building a 100 MW Hydrogen Plant in Amsterdam for Tata Steel

Deployment of hydrogen delivered by a 100 MW electrolysis plant to produce fuels and / or basic chemicals with the carbon monoxide (CO) and carbon dioxide (CO_2) in the residual gases from the steel production at Tata Steel.



Category:	production of green hydrogen
Capacity:	100 MW
Process phase:	FEED-study
Project period:	2021 - 2025
Project costs:	150 M€
Contact:	https://h2ermes.nl

Partners:

Port of Amsterdam
Port of partnerships

TATA STEEL

HyCC

GH2

Producing Hydrogen by Gasification of Biomass in 'het Groene Hart'

The pilot plant of initially 1 kg H2/day, the size of four parking spaces, is placed at Vermeulen Groep, a civil engineering company. Verge grass and wood waste is used for testing. The pilot will serve the design of a 500 kg H2/day production plant using 10 ton biomass/day. On an annual basis that is <100 trucks. The gasifier of the production plant will be 2 MW therma capacityl and co-produce 1 ton/day of biochar (so no ash), which is equal to 3 ton/day of CO_2 equivalents stored. The production of 500 kg hydrogen/day equals a 1.2 MW electrolyser which requires a 2x2.5 MW land-based wind turbines of 100 meters tall. The hydrogen obtained is partly used by Vermeulen Groep, who wants to make their business more sustainable.

Category:	production of H_2
Capacity:	500 kg/day (=1.2MW)
Process phase:	pilotplant, demonstration
Project period:	2019 - 2023
Contact:	info@nettenergy.com

NETTEnergy

VERMEULEN GROEP

NortH2

The Production of Green Hydrogen from a GW Windfarm in the North Sea

The objective is to generate up to 4 GW of wind energy for hydrogen production by 2030, and possibly 10 GW in 2040. Green hydrogen production of 300,000 tons prevents around 2,7 megatons of CO_2 emissions per year. The final concept will be adopted at the end of 2023 and then further developed towards an investment decision.

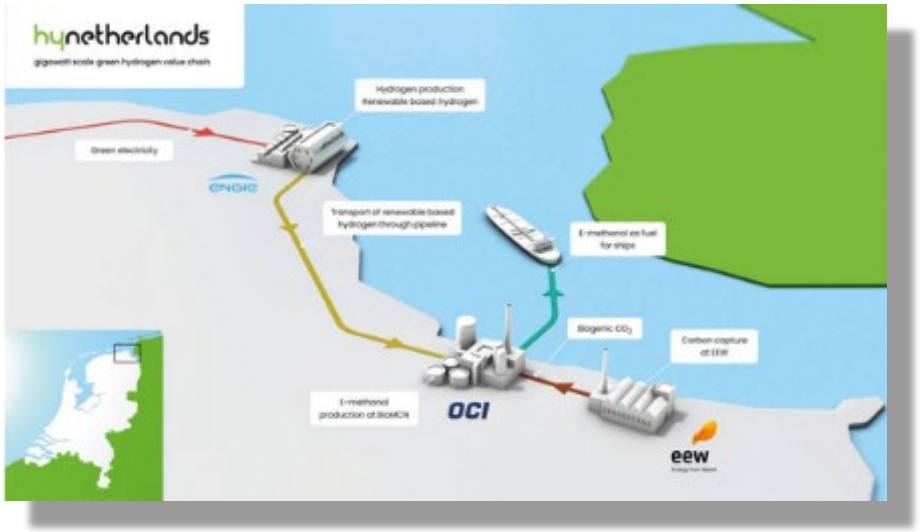
Category:	production of H_2
Capacity:	4 GW wind – 0,3 Mt H_2/y
Process phase:	Feasibility-study
Project period:	2020 - 2050
Project costs:	unknown
Contact:	https://www.north2.eu/

Partners: RWE, equinor, gasunie crossing borders in energy, Shell, Eneco, GRONINGEN SEAPORTS, provincie groningen

HyNetherlands

Building a 100 MW Electrolyser in the Eemshaven

The factory will have an important function for balancing the electricity system. If the wind farms supply more electricity than is currently needed, it can be converted into hydrogen and stored. If necessary, the hydrogen can be converted back into electricity. ENGIE is now engaged in the preparatory activities for taking the final investment decision for the 100MW electrolyser early 2023. Commissioning is scheduled for mid 2025.



Category:	production of Hydrogen
Capacity:	100 MW to 1 GW
Process phase:	FEED-study
Project period:	FID 2023
Project costs:	220 M€
Contact:	https://hynetherlands.nl/

Partners:

GldH2

A Hydrogen Value-Chain with Multi Purpose in Zutphen

Integral use of locally generated green hydrogen in Zutphen, among others for industrial and mobility use, including heavy transport and public transport. Another focus is heating current homes in the city center, using existing gas pipelines and hydrogen-fired central heating boilers.

Category:	production and deployment
Capacity:	2 MW electrolyser
Process phase:	execution
Project period:	2020 - 2023
Project costs:	unknown
Contact:	info@gldh2.nll

Partners

Storage

Overview

H2 Bunkerstation

Development of a Liquid Hydrogen Bunkerstation in Den Helder

Liquid Hydrogen will become one of the key energy carriers for the seagoing vessels. Aim of the project is to realize a bunkerstation with a storage capacity of 200 m³ liquid hydrogen. The first users of the bunkerstation will be the shortsea freight vessels and local working boats or dredgers/offshore support ships.

The focus of the LH2 bunkerstation is realizing a bunkerfacility and not the production of LH2.

Category:	storage
Capacity:	200 m³
Process phase:	FEED-study / execution
Project period:	2022 - 2023
Project costs:	3.5 M€
Contact:	www.newenergycoalition.org

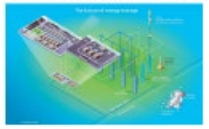
Partners: PORT OF DEN HELDER · TOTAL · TUDelft · New Energy Coalition

HyStock

Development of An Underground Hydrogen Storage

There is a need for large-scale, underground storage of hydrogen because hydrogen supply and demand are not constant. That is why Gasunie subsidiary HyStock is developing hydrogen storage in a salt cavern in Zuidwending, near Veendam.

The installation in the first cavern (≈ 200GWh) is expected to be operational in 2027. It is estimated that four caverns will be needed for hydrogen storage by 2030 in order to meet market demand for hydrogen. The hydrogen storage will be accessible to all parties who want to store hydrogen, for the short or long term. Initially, this will run through a connection to the Hydrogen Network Noord-Nederland, and soon after through a connection with the Hydrogen Network Netherlands.



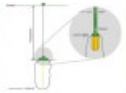
Category:	storage
Capacity:	scalable
Process phase:	FEED-study
Project period:	2019 – 2030
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie

A8 - HyStock Demonstration project

Insights into Hydrogen Storage in Salt Caverns

In 2021 and 2022, Gasunie subsidiary HyStock is using borehole A8 at Zuidwending as a demonstration project of hydrogen storage in salt caverns. The project will provide valuable insights into safety, mechanical integrity, pressure, working methods and microbiology. These insights will be used to develop the first full-scale hydrogen storage in the Netherlands: cavern A5 at the Zuidwending site. The existing A8 borehole will also eventually become a salt cavern and will then be used for hydrogen storage.



Category:	storage
Capacity:	scalable
Process phase:	Construction
Project period:	2020 – 2022
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie

FODEO

Flexible Storage, with Local Energy Exchange, of Sustainable Energy in Almere Oosterwold

The goal of FODEO is to contribute to optimizing the self-sufficiency of energy at the neighborhood level. This offers opportunities for a new market for local trading and storage of sustainably generated energy. Within the project we also look at organizational and legal issues. For example, we look at which amendments to legislation and regulations are necessary to make local energy communities possible.

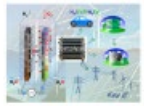
Category:	storage
Capacity:	scalable
Process phase:	Feasibility-study
Project period:	2021 – 2023
Project costs:	450 k€ TKI subsidy
Contact:	leovanbemmel@villaville.nl

Partners: ideate · Villa Ville · ABB · J-OB

Battolyser

A Nickel-iron Battery Combined with an Electrolyser

For the first time a short-term-energy-storage-system (battery) is combined with a long-term-energy-storage-system (electrolyser). When the battery is full, the surplus of energy produces hydrogen and oxygen for energy storage. This makes the battolyser flexible with respect to energy insertion. The device can be operational around the clock: either a surplus of energy is used to fill up storage capacity or energy is provided to consumers. A pilot development on the Magnum site in Eemshaven is being carried out.



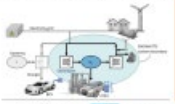
Category:	storage
Capacity:	scalable
Process phase:	demonstration
Project period:	2019 – 2022
Project costs:	TSE + Waddenfonds subsidy
Contact:	www.battolyser.com

Partners: battolyser · PROTON VENTURES · TNO · Ørsted · VATTENFALL

Enowatts

Hydrogen Technology on Industrial Park de Kleefse Waard

Enowatts focusses on storage of excess wind energy in hydrogen, as well as local hydrogen applications at industrial park Industriepark Kleefse Waard (IPKW) in Arnhem, by means of systems modelling, development and testing.



Category:	storage
Capacity:	scalable
Process phase:	Feasibility and FEED-studies
Project period:	2020 - 2022
Project costs:	700 k€ (300k€ grant)
Contact:	sustainable.energy@han.nl

Partners: HYGEAR · HAN · XINTC

Sinnewetterstof

A 1.4 MW Electrolyser Placed near a Solarpark for Gridbalancing

Instead of reducing the generation at peak times, an electrolyser is used to convert electricity from the adjacent 50 MW Oosterwolde solar park and water into hydrogen. In this way a peak load in the grid is prevented. The hydrogen produced is compressed to 300 bar and stored in tube trailers that can then be used later in hydrogen vehicles. The plant in Oosterwolde is operational since March 2022.

Category:	storage, knowledge
Capacity:	1.4 MW
Process phase:	commissioning
Project period:	2019 - 2023
Project costs:	0.9 M€ DEI-subsidy
Contact:	https://sinnewetterstof.nl/

Partners: GroenLeven

H2Fuel

A Technique for the Production, Storage and Release of H_2

The storage takes place under atmospheric conditions in a powder and the release takes place without added energy with very clean water. Hereby not only 100% of the hydrogen stored in this powder is released, but also the same amount of hydrogen from the water is harvested. Plant One Rotterdam is currently running a proof-of-concept project for extracting (unpacking) hydrogen from sodium borohydride ($NaBH_4$).

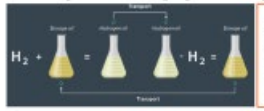
Category:	storage
Capacity:	scale up
Process phase:	FEED-study/proof of concept
Project period:	2019 - 2030
Project costs:	unknown
Contact:	https://h2-fuel.nl

Partners: H2FUEL-SYSTEMS · Solid Hydro Re Gen

Hydrogen Oil

Liquid Organic Hydrogen Carriers as a Maritime Fuel

The fuel is produced through a process where Hydrogen and a liquid that we call Storage Oil are combined by applying heat and pressure in a patented process. Being a liquid, the Hydrogen Oil can easily be transported and refueled into a maritime vessel. Onboard of the vessel, the Hydrogen is released from the Hydrogen Oil by applying heat and pressure in the reverse process. When we release hydrogen, the liquid becomes Storage Oil which can be charged again for its next usage. This is tested in this pilot in Uzendoorn.



Category:	storage
Capacity:	scalable
Process phase:	execution
Project period:	2020 - 2023
Project costs:	1 M€
Contact:	www.voyex.nl

Partners: VOYEX · Dekker · SOLARDUCK

Cyrus Smith 2.0

Creating a Mobile 20 KW Electrolyser for Local Energy Storage

The fluctuating nature of renewable energy sources necessitates flexibility in our energy infrastructure. Thanks to the result of a technical validation project (the Cyrus Smith 1.0 project) of grid interaction, basic control strategies have become available with corresponding grid interface. The current project aims to demonstrate full technical grid support (proof-of-principle) and is now being built and tested.

Category:	storage, knowledge
Capacity:	20 KW
Process phase:	execution
Project period:	2020 - 2022
Project costs:	TSE 290 k€
Contact:	info@hymatters.com

Partners: HyMatters · H2Consultancy

H2 Bunkerstation

Development of a Liquid Hydrogen Bunkerstation in Den Helder

Liquid Hydrogen will become one of the key energy carriers for the seagoing vessels. Aim of the project is to realize a bunkerstation with a storage capacity of 200 m³ liquid hydrogen. The first users of the bunkerstation will be the shortsea freight vessels and local working boats or dredgers/offshore support ships.

The focus of the LH2 bunkerstation is realizing a bunkerfacility and not the production of LH2.

Category:	storage
Capacity:	200 m³
Process phase:	FEED-study / execution
Project period:	2022 - 2023
Project costs:	3.5 M€
Contact:	www.newenergycoalition.org

Partners: PORT OF DEN HELDER, Scheepvaartbedrijf van Dam, SPAANSEN Grondstoffen en Logistiek, TOTAL, TU Delft, New Energy Coalition

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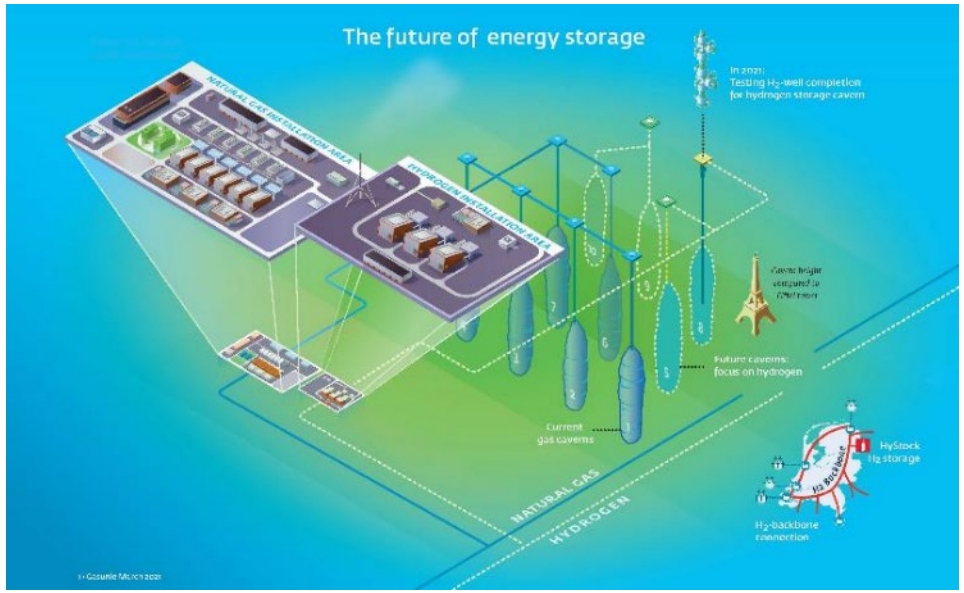

Category:	storage
Capacity:	scalable
Process phase:	FEED-study
Project period:	2018 – 2030
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie
crossing borders in energy

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Insights into Hydrogen Storage in Salt Caverns

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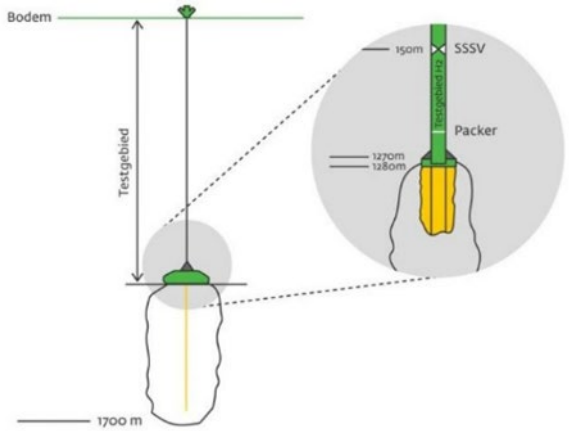

Category:	storage
Capacity:	scalable
Process phase:	Construction
Project period:	2020 – 2022
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie
crossing borders in energy

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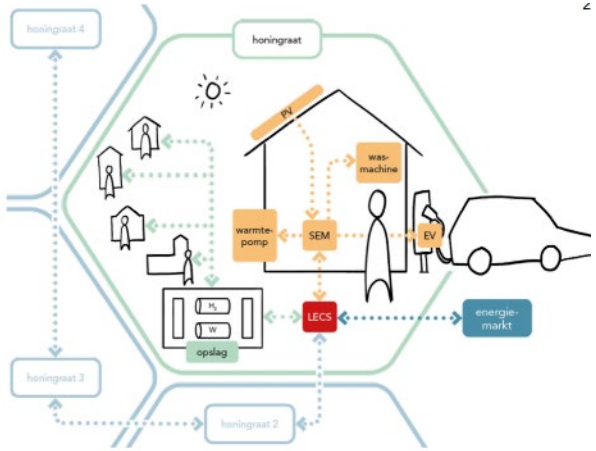

Category:	storage
Capacity:	scalable
Process phase:	Feasibility-study
Project period:	2021 – 2023
Project costs:	450 k€ TKI subsidy
Contact:	leovanbemmel@villaville.nl

Partners: HUYGEN, ideate, Villa Ville, ABB, Poinselot, SPECTRAL, J-OB, Nedstack

Battolyser

A Nickel-Iron Battery combined with an Electrolyser

For the first time the functionality of a short-term-energy-storage-system (battery) is combined with the functionality of an electrolyser in one device. As the battery fills up, the production of hydrogen kicks in which can be used for industrial applications or long-term energy storage. This makes the battolyser very flexible and suitable to deal with intermittency of renewables output. When there is a surplus of power, hydrogen is produced and where there is a shortage, electricity is sold. An industrial demonstration has been developed for operation at the Magnum power plant in the Eemshaven.

Category:	storage of power and production of H_2
Capacity:	scalable
Process phase:	industrial demonstration
Project period:	2019 – 2022
Project costs:	Partner funds + Waddenfonds subsidy
Contact:	www.battolysersystems.com

Partners: Battolyser Systems, waddenfonds, PROTON VENTURES, Ørsted, YARA, VATTENFALL

Enowatts

Hydrogen Technology on Industrial Park de Kleefse Waard

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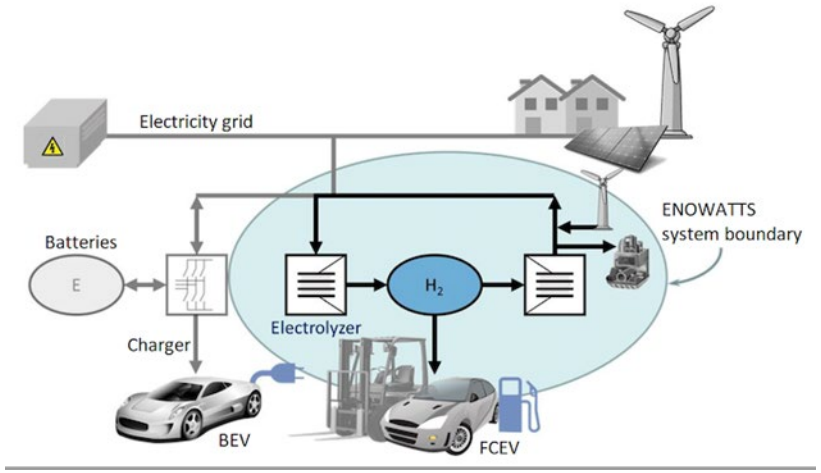

Category:	storage
Capacity:	scalable
Process phase:	Feasibility and FEED-studies
Project period:	2020 - 2022
Project costs:	700 k€ (300k€ grant)
Contact:	sustainable.energy@han.nl

Partners:

Sinnewetterstof

SINNEWETTERSTOF
POWERED BY ALLIANDER & GROENLEVEN

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Instead of reducing the generation at peak times, an electrolyser is used to convert electricity from the adjacent 50 MW Oosterwolde solar park and water into hydrogen. In this way a peak load in the grid is prevented. The hydrogen produced is compressed to 300 bar and stored in tube trailers that can then be used later in hydrogen vehicles. The plant in Oosterwolde is operational since March 2022.

Category:	storage, knowledge
Capacity:	1.4 MW
Process phase:	commisisoning
Project period:	2019 - 2023
Project costs:	0.9 M€ DEI-subsidy
Contact:	https://sinnewetterstof.nl/

Partners: alliander GroenLeven zonne-energie og gemeente oostelingwerf ecomunitypark

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A Technique for the Production, Storage and Release of H_2

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Category:	storage
Capacity:	scale up
Process phase:	FEED-study/proof of concept
Project period:	2019 - 2030
Project costs:	unknown
Contact:	https://h2-fuel.nl

Partners:

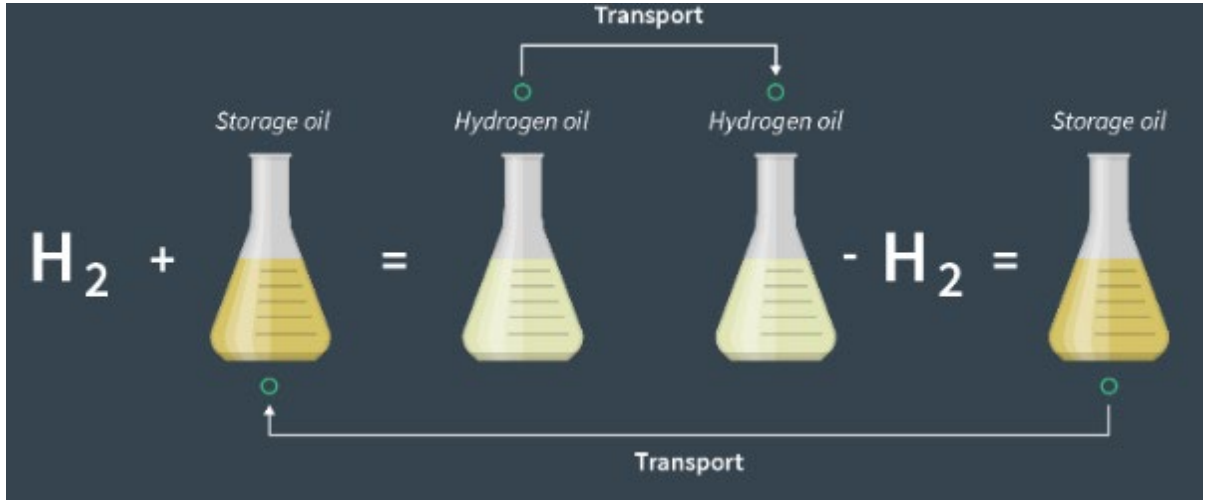
H2FUEL-SYSTEMS
Making Hydrogen work

Solid Hydro. Re.Gen

Hydrogen Oil

Liquid Organic Hydrogen Carriers as a Maritime Fuel

The fuel is produced through a process where Hydrogen and a liquid that we call Storage Oil are combined by applying heat and pressure in a patented process. Being a liquid, the Hydrogen Oil can easily be transported and refueled into a maritime vessel. Onboard of the vessel, the Hydrogen is released from the Hydrogen Oil by applying heat and pressure in the reverse process. When we release hydrogen, the liquid becomes Storage Oil which can be charged again for its next usage. This is tested in this pilot in IJzendoorn.



Category:	storage
Capacity:	scalable
Process phase:	execution
Project period:	2020 - 2023
Project costs:	1 M€
Contact:	www.voyex.nl

Partners:

Cyrus Smith 2.0

Creating a Mobile 20 KW Electrolyser for Local Energy Storage

The fluctuating nature of renewable energy sources necessitates flexibility in our energy infrastructure. Thanks to the result of a technical validation project (the Cyrus Smith 1.0 project) of grid interaction, basic control strategies have become available with corresponding grid interface. The current project aims to demonstrate full technical grid support (proof-of-principle) and is now being built and tested.

Picture: McPhy.com

Category:	storage, knowledge
Capacity:	20 KW
Process phase:	execution
Project period:	2020 - 2022
Project costs:	TSE 290 k€
Contact:	info@hymatters.com

Partners:

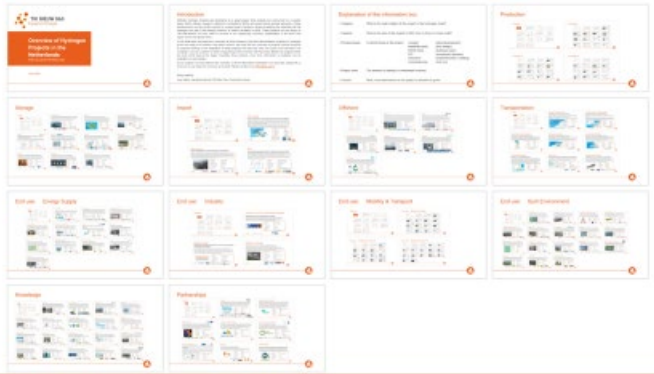
HAN_UNIVERSITY OF APPLIED SCIENCES

HyMatters

H2Consultancy
Making Fuelcell Systems

Import

Overview



ACE Terminal

Green Ammonia as a Hydrogen Import Carrier in Rotterdam

Green ammonia as a hydrogen carrier will play a vital role in the import of green hydrogen to meet future demand. After hydrogen bonds with nitrogen in the form of ammonia, it can be transported simply and safely in large volumes, and then stored and reconverted into green hydrogen. Green ammonia is also immediately usable as CO2-free fuel, for example, for shipping or as a raw material for the production of fertiliser.

In addition to the ACE import terminal for green ammonia at the Maasvlakte (2026), import terminals for other hydrogen carriers like Liquid Hydrogen (LH2) and LOHC (Liquid Organic Hydrogen Carriers) are anticipated in northwest Europe. Expected future import terminal locations are in Rotterdam, Eemshaven, Zeeland, Amsterdam, and Brunsbüttel.

Category:	import
Capacity:	scalable
Process phase:	Feasability-study
Project period:	2021 – 2026
Project costs:	confidential
Contact:	info@gasunie.nl

Partners: gasunie crossing borders in energy, HES, Vopak

H2A [formerly H2Gate]

Import of Megatons of Green Hydrogen in Amsterdam

H2Gate focuses on the development of large-scale hydrogen imports to the Amsterdam port region (1 million ton per year). The project focuses on several hydrogen carriers that match the infrastructure in the port. The consortium has started a new phase where the partners develop and proof safe and cost-effective hydrogen carriers technologies, supported by clear pilot projects in hard-to-abate transport and industry sectors. The aim for the realization of the combined import terminal is around 2030.

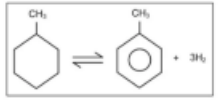
Category:	import, storage
Capacity:	1 Mton/year
Process phase:	demonstration
Project period:	2022 – 2030
Project costs:	unknown
Contact:	Eduard.de.Visser@portofamsterdam.com

Partners: Port of Amsterdam, EVOS, hydrogenious LOHC TECHNOLOGIES, HYSILABS

MCH

Transporting Hydrogen Based on Methylcyclohexane (MCH)

The Port of Rotterdam Authority will look at how it can import hydrogen for commercial purposes on a large scale. The technology under investigation is the transport of hydrogen based on the substance methylcyclohexane (MCH). That is easier than other options such as transporting hydrogen at a temperature of minus 253 degrees or form ammonia. The ambient temperature is less important when using MCH and existing ships and infrastructure can be used.



Category:	import, transport of H_2
Capacity:	400 kton a year in 2030
Process phase:	Feasibility-study
Project period:	2022-2023
Project costs:	unknown
Contact:	hgj.regeer@portofrotterdam.com

Partners: Port of Rotterdam, MITSUBISHI POWER, koole TERMINALS, CHIYODA CORPORATION

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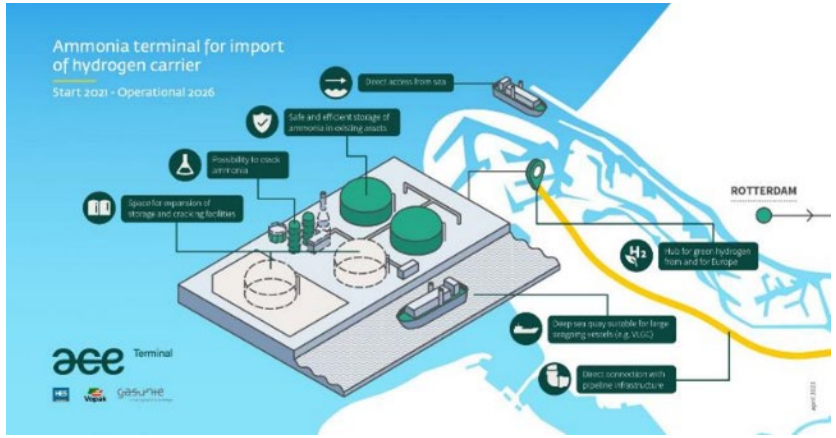

Category:	import
Capacity:	scalable
Process phase:	Feasability-study
Project period:	2021 – 2026
Project costs:	confidential
Contact:	info@gasunie.nl

Partners:

gasunie crossing borders in energy

HES International

Vopak

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Import of Megatons of Green Hydrogen in Amsterdam

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Category:	import, storage
Capacity:	1 Mton/year
Process phase:	demonstration
Project period:	2022 – 2030
Project costs:	unknown
Contact:	Eduard.de.Visser@portofamsterdam.com

Partners: Port of Amsterdam, EVOS, Electriq Global, hydrogenious LOHC TECHNOLOGIES, HYSILABS

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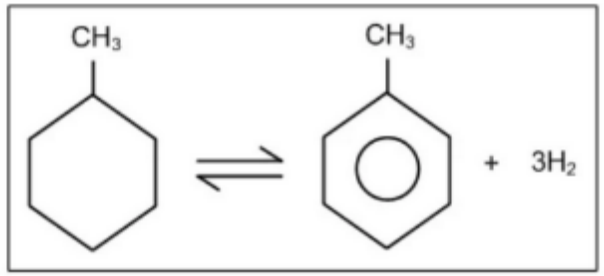

Category:	import, transport of H_2
Capacity:	400 kton a year in 2030
Process phase:	Feasibility-study
Project period:	2022-2023
Project costs:	unknown
Contact:	hgj.regeer@portofrotterdam.com

Partners:

Port of Rotterdam

MITSUBISHI POWER

koole TERMINALS

CHIYODA CORPORATION

Offshore

Overview

SEA2H2

Improve Hydrogen from Seawater to Boost Offshore Production

The challenge for the use described lies in the treatment of seawater to make it suitable for membrane electrolysis. Electrolyzers require the use of ultra-pure water as a prerequisite. Seawater must be desalinated for this purpose, as well as elaborately purified and filtered. The solution developed together with WFBR is as innovative as it is illuminating: The waste heat from the electrolysis process is used to desalinate the seawater. This technology allows green hydrogen to be produced with energy from offshore wind farms and transported onshore via pipelines.

Category:	offshore, knowledge
Capacity:	scalable
Process phase:	demonstration
Project period:	2019 – 2022
Project costs:	415 k€ TSE subsidy
Contact:	https://hydron-energy.com/

Partners: SCHAEFFLER hydron energy WAGENINGEN UNIVERSITY & RESEARCH

FlexH2

grow

Flexible Offshore Wind Hydrogen Power Plant Module

The goal is to develop and demonstrate technology that will accelerate the scale-up of offshore wind, green hydrogen production and its integration in the energy system. The proposed wind-to-hydrogen solution, which will be tested in laboratories at a Medium Voltage kW-scale, enables direct sourcing of renewable electricity to green hydrogen production. The results of this research project could provide the basis for the accelerated development of Power-to-H2 projects in the Netherlands.

Category:	offshore, knowledge
Capacity:	scalable
Process phase:	concept
Project period:	2022 – 2026
Project costs:	4 M€ MOOI-SIGOHE grant
Contact:	www.shell.com

Partners: vonk TNO TU/e TU Delft ABB Van Oord

North Sea Wind Power Hub

North Sea Wind Power Hub Programme

A Transnational and Cross-sector Approach to Harness the Power of the North Sea

The North Sea Wind Power Hub is developing a solid knowledge base to ensure that countries choose the right solution to unlock the offshore wind potential of the North Sea. The consortium's work is based on research, stakeholder interaction and experience from earlier projects. Its cross-sector approach includes system integration between the power system and future green hydrogen solutions.

The current insight is that 'Power to Gas' will play a crucial role in integrating vast amounts of offshore wind into the European energy system. This role is at least threefold: it will provide flexible options for the RES-based power system, decarbonise industry, transport and dispatchable power, and optimise infrastructure investments on- and offshore.

Category:	offshore, knowledge
Capacity:	scalable
Process phase:	Programme execution
Project period:	2018 – 2030
Project costs:	€28 million < 2024
Contact:	https://northseawindpowerhub.eu/

Partners: TenneT gasunie ENERGINET

H2OpZee

Large Scale Hydrogen Production on the North Sea

H2opZee is a demonstration project aimed at the construction of 300-500 megawatts (MW) electrolyser capacity far out in the North Sea, to produce green hydrogen with offshore wind. This hydrogen will then be transported to land through an (existing) pipeline. The pipeline has a capacity of 10-12 gigawatts (GW) and is therefore already suitable for the further roll-out of green hydrogen production to a gigawatt scale in the North Sea. The intention is to start the feasibility study in the second quarter of this year. This project is an initiative of TKI Wind op Zee.

Category:	Offshore, production of H_2
Capacity:	300 - 500 MW
Process phase:	concept
Project period:	2022 -
Project costs:	3 Billion euro
Contact:	patrice.hijsterborg@neptuneenergy.com

Partners: NEPTUNE ENERGY RWE

PosHYdon

POSHYDON

Hydrogen Production from North Sea Water on an Offshore Platform

PosHYdon seeks to validate the integration of three energy systems in the Dutch North Sea: offshore wind, offshore gas and offshore hydrogen and will involve the installation of hydrogen-producing plant on the Neptune Energy-operated Q13a-A platform. The Q13a-A is the first fully electrified platform in the Dutch North Sea, located approximately 13 kilometres off the coast of Scheveningen (The Hague). The green hydrogen will be mixed with the gas and transported via the existing gas pipeline to the coast. The 1 MW electrolyser will produce a maximum of 400 kilogrammes of green hydrogen per day.

Category:	Offshore, production of H_2
Capacity:	1 MW
Process phase:	pilotplant, demonstration
Project period:	2019 - 2025
Project costs:	DEI+ subsidy 3.6 M€
Contact:	patrice.hijsterborg@neptuneenergy.com

Partners: nel NGT NOGAT TAQA TNO

H2-Gateway

H2 Gateway

Empty Gas Fields Play a Role for Blue Hydrogen Production

The hydrogen gas can be produced with green energy from the (large) offshore wind farms that will be built in the coming decades. But even now hydrogen can be produced from natural gas. The released CO_2 can be captured and stored in the empty gas fields below the North Sea.

Category:	offshore, storage
Capacity:	> 0,2 Mt/year
Process phase:	FEED-study
Project period:	2020 - 2027
Project costs:	600 – 1,000 M€
Contact:	Esther Zijl, info@nhn.nl

Partners: eon gasunie NOGAT NH Provincie Noord-Holland DEN HELDER PORT OF DEN HELDER nhn New Energy Coalition

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Category:	offshore, knowledge
Capacity:	scalable
Process phase:	demonstration
Project period:	2019 – 2022
Project costs:	415 k€ TSE subsidy
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Category:	Offshore, production of H_2
Capacity:	300 - 500 MW
Process phase:	concept
Project period:	2022 -
Project costs:	3 Billion euro
Contact:	patrice.hijsterborg@neptuneenergy.com

Partners:

NEPTUNE ENERGY

RWE

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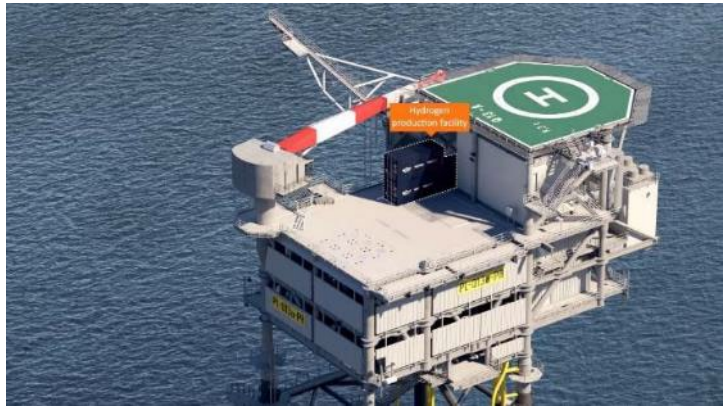

Category:	Offshore, production of H_2
Capacity:	1 MW
Process phase:	pilotplant, demonstration
Project period:	2019 - 2025
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Partners:

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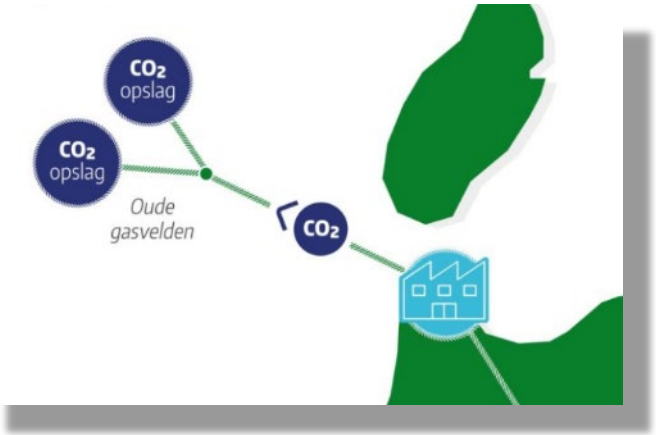

Category:	offshore, storage
Capacity:	> 0,2 Mt/year
Process phase:	FEED-study
Project period:	2020 - 2027
Project costs:	600 – 1,000 M€
Contact:	Esther Zijl, info@nhn.nl

Partners: ebn, gasunie crossing borders in energy, NAM, Provincie Noord-Holland, gemeente DEN HELDER, PORT OF DEN HELDER, nhn, New Energy Coalition

Transportation

Overview

Hydrogen Network Netherlands

Development of a National Hydrogen Network

The availability of hydrogen infrastructure is crucial for the development of the hydrogen economy and hence for making the Netherlands more sustainable. Large-scale use and production of hydrogen require a reliable, open access, non-discriminatory national network. Gasunie is developing a national hydrogen network in the Netherlands.

By 2030, the Hydrogen Network Netherlands will link the Regional Hydrogen Networks (facilitating all large industrial clusters in the Netherlands) to each other and to foreign countries and hydrogen storage facilities. This will be done mainly with existing infrastructure (80%) and partly with new infrastructure.

Category:	transportation
Capacity:	10+GW, scalable further
Process phase:	Pre-FEED
Project period:	2021 – 2030
Project costs:	€1.5 billion
Contact:	info@gasunie.nl

gasunie

Hydrogen Network Noordzeekanaalgebied

Development of a Regional Hydrogen Network

Gasunie and the Port of Amsterdam have joined forces and drafted joint plans to accelerate the energy transition in the North Sea Canal area (Noordzeekanaalgebied) through the creation of an open access, non-discriminatory regional hydrogen infrastructure.

Via this hydrogen network users and producers of hydrogen in the IJmond region will be connected to those in the port area of Amsterdam. The development of this regional infrastructure is a precondition for setting up and scaling up hydrogen projects over the next few years. The Hydrogen Network is currently planned to be operational in the second half of 2026. In a subsequent step, this regional network will be connected to the Hydrogen Network Netherlands.

Category:	transportation
Capacity:	Scalable
Process phase:	Pre-FEED
Project period:	2021 – 2026
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie

Hydrogen Network Noord-Nederland

Development of a Regional Hydrogen Network

Gasunie plans to built an open access, non-discriminatory hydrogen network in the Northern Netherlands, a leading 'hydrogen valley'. This network will connect to HyStock (the first underground hydrogen storage facility in the Netherlands) and to the future German hydrogen infrastructure from Gasunie Deutschland at Oude Statenzijl (HyPerLink) and Thyssengas / OGE at Vlieghuis. The first phase of this hydrogen network is expected to be operational in 2026. This connection to Emmen and Germany/ Ruhr area (second phase) is also planned for 2026. The route to Germany in the direction of Hamburg/ Bremen will follow shortly afterwards, just as the connection of this regional network to the Hydrogen Network Netherlands.

Category:	transportation
Capacity:	scalable
Process phase:	FEED-study
Project period:	2021 – 2026
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie

Hydrogen Network Zeeland

Development of a Regional Hydrogen Network

In Zeeland the sustainability of business processes is tackled via various transition paths. This includes the hydrogen path: system integration issues for large-scale electrolysis, stimulating hydrogen import and export, and developing regional hydrogen infrastructure with connections to the national networks in the Netherlands and Belgium.

Gasunie and the North Sea Port have an agreement to develop an open access, non-discriminatory regional hydrogen infrastructure: Hydrogen Network Zeeland. This network will link supply and demand for hydrogen in the Delta region with a connection to the system in Belgium (2030) and, later, to the Hydrogen Network Netherlands (2027).

Category:	transportation
Capacity:	scalable
Process phase:	Pre-FEED
Project period:	2021 – 2026
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie

Hydrogen Network Rotterdam

Development of a Regional Hydrogen Network

In the Rijnmond region, Gasunie and the Port of Rotterdam Authority are constructing the Hydrogen Network Rotterdam. This network will soon form the regional hydrogen infrastructure in Rotterdam, running from the Maasvlakte to Pernis. Hydrogen Network Rotterdam will connect the conversion park on the Maasvlakte with the heavy and (petro)chemical industries and import terminals in the port. In the future it will be linked to the Hydrogen Network Netherlands.

Hydrogen Network Rotterdam will be an open access, non-discriminatory network operational by 2025 and accessible to all companies that want to transport hydrogen. The main transport pipeline will be large enough to carry not only the green hydrogen generated in the port, but also the expected hydrogen imports.

Category:	transportation
Capacity:	scalable, starts at 200MW
Process phase:	FEED-study
Project period:	2020 – 2025
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie

GZI Next Hydrogen Pipeline

Realisation of a Local Hydrogen Pipeline

Emmen is working hard on sustainability, and green hydrogen plays an important role in that effort. It is a building block of the green energy hub GZI Next. Gasunie, NAM, Shell and Engie are working here – along with the province of Drenthe, the municipality of Emmen and educational institutions – to create a green hydrogen chain that will link the production, transport and purchase of green hydrogen. GZI Next contributes to a future-proof economy and the preservation of employment in the region.

In 2022, Gasunie started laying a new natural gas pipeline. At the same time, a second pipeline will be laid to transport hydrogen in the future. The pipelines will be laid between the GETEC Park Emmen and the GZI Next site in Emmen. Construction work on the hydrogen pipeline is expected to be completed by the end of 2022, and hydrogen is expected to be transported by the beginning of 2024. The hydrogen pipeline in Emmen will become part of the Hydrogen Network Netherlands.

Category:	transportation
Capacity:	scalable
Process phase:	construction
Project period:	2018 – 2024
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie

Delta Corridor

New Infrastructure Meets the Hydrogen Needs of the Industry

At present Rotterdam supplies a large part of the NW-European industry (including North Rhine-Westphalia) with fossil energy and raw materials. To provide this industry with sustainable energy and raw materials, a new infrastructure is needed, such as the Delta Corridor. With the HyTransPort, RTM and de national H-grid it connected; the whole NW-Europe industrial area will be supplied with Hydrogen.

Category:	transport of H_2
Capacity:	scalable
Process phase:	Feasibility-study
Project period:	2022 – 2025 (FID)
Project costs:	>50 M€, with 7 M€ subsidy
Contact:	hgj.regeer@portofrotterdam.com

Partners: RRP Port of Rotterdam

Hydrogen Sensor Technology

Developing Better Sensors for Natural Gas / Hydrogen Mixtures

The project aims to develop a technology that allows the cost-effective and sufficiently accurate measurement of the composition of natural gas / hydrogen mixtures, wherein high concentrations of hydrogen are mixed (typically up to 90%). The HyDeploy (UK) project is a follow-up project, in which the developed sensor technology is put into a field test. In this project, up to 20% hydrogen is mixed in the natural gas. Duration until end 2022.

Category:	transportation
Process phase:	commissioning
Project period:	2018 – 2022
Project costs:	TBE 225 k€
Contact:	huib.blokland@tno.nl

Partners: TNO innovation for life, Cadent, ENEXIS, gasunie, HyDeploy

Hydrogen Network Netherlands

Development of a National Hydrogen Network

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By 2030, the Hydrogen Network Netherlands will link the Regional Hydrogen Networks (facilitating all large industrial clusters in the Netherlands) to each other and to foreign countries and hydrogen storage facilities. This will be done mainly with existing infrastructure (85%) and partly with new infrastructure.

Category:	transportation
Capacity:	10+GW, scalable further
Process phase:	Pre-FEED
Project period:	2021 – 2030
Project costs:	€1.5 billion
Contact:	info@gasunie.nl

gasunie
crossing borders in energy

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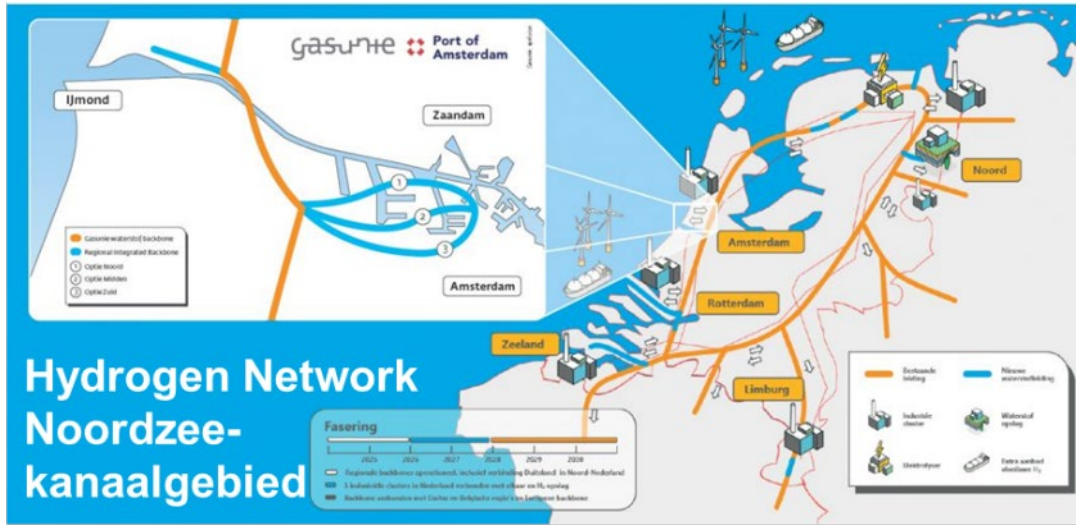

Category:	transportation
Capacity:	Scalable
Process phase:	Pre-FEED
Project period:	2021 – 2026
Project costs:	confidential
Contact:	info@gasunie.nl

gasunie
crossing borders in energy

Hydrogen Network Noord-Nederland

Development of a Regional Hydrogen Network

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Category:	transportation
Capacity:	scalable
Process phase:	FEED-study
Project period:	2021 – 2026
Project costs:	confidential
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gasunie
crossing borders in energy

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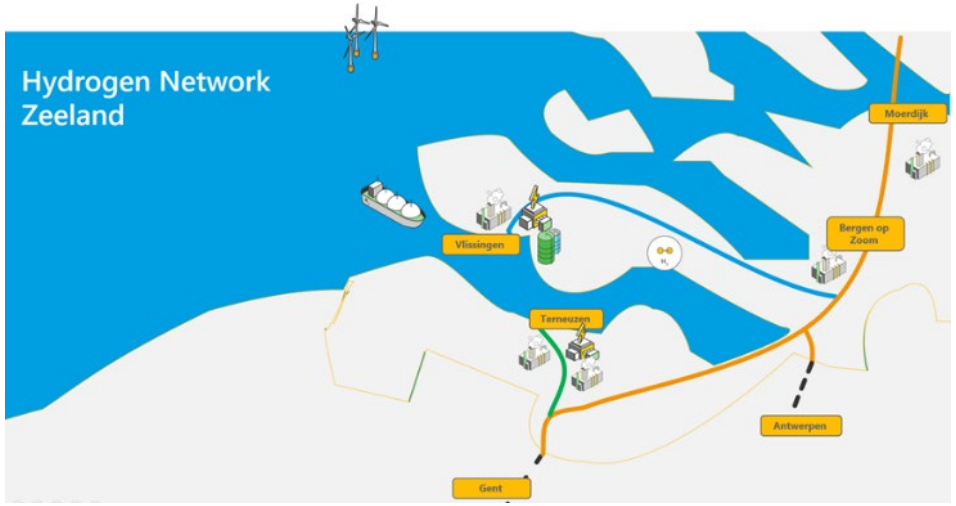
In Zeeland the sustainability of business processes is tackeled via various transition paths. This includes the hydrogen path: system integration issues for large-scale electrolysis, stimulating hydrogen import and export, and developing regional hydrogen infrastructure with connections to the national networks in the Netherlands and Belgium.

Gasunie and the North Sea Port have an agreement to develop an open access, non-discriminatory regional hydrogen infrastructure: Hydrogen Network Zeeland. This network will link supply and demand for hydrogen in the Delta region with a connection to the system in Belgium (2026) and, later, to the Hydrogen Network Netherlands (2027).



Category:	transportation
Capacity:	scalable
Process phase:	Pre-FEED
Project period:	2021 – 2026
Project costs:	confidential
Contact:	info@gasunie.nl

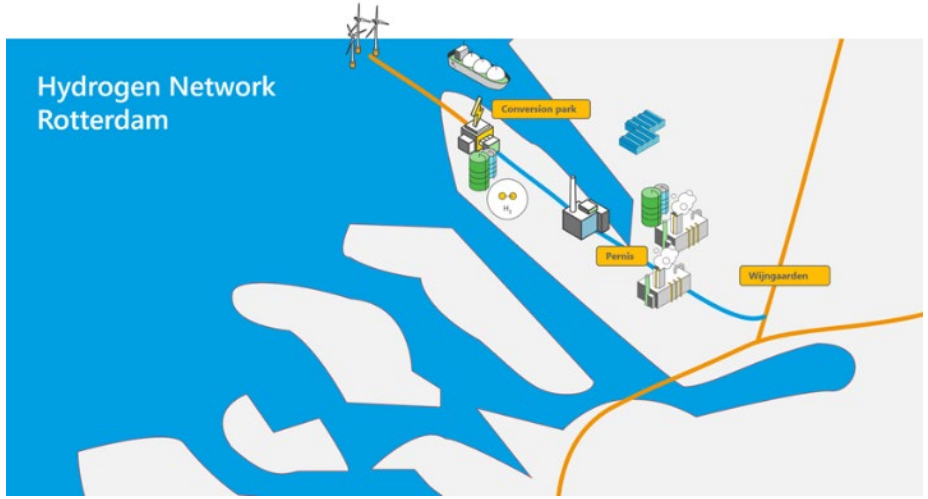
gasunie
crossing borders in energy

Hydrogen Network Rotterdam

Development of a Regional Hydrogen Network

In the Rijnmond region, Gasunie and the Port of Rotterdam Authority are constructing the Hydrogen Network Rotterdam. This network will soon form the regional hydrogen infrastructure in Rotterdam, running from the Maasvlakte to Pernis. Hydrogen Network Rotterdam will connect the conversion park on the Maasvlakte with the heavy and (petro)chemical industries and import terminals in the port. In the future it will be linked to the Hydrogen Network Netherlands.

Hydrogen Network Rotterdam will be an open access, non-discriminatory network operational by 2025 and accessible to all companies that want to transport hydrogen. The main transport pipeline will be large enough to carry not only the green hydrogen generated in the port, but also the expected hydrogen imports.



Category:	transportation
Capacity:	scalable, starts at 200MW
Process phase:	FEED-study
Project period:	2020 – 2025
Project costs:	confidential
Contact:	info@gasunie.nl

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GZI Next Hydrogen Pipeline

Realisation of a Local Hydrogen Pipeline

Emmen is working hard on sustainability, and green hydrogen plays an important role in that effort. It is a building block of the green energy hub GZI Next. Gasunie, NAM, Shell and Engie are working here – along with the province of Drenthe, the municipality of Emmen and educational institutions – to create a green hydrogen chain that will link the production, transport and purchase of green hydrogen. GZI Next contributes to a future-proof economy and the preservation of employment in the region.

In 2022, Gasunie started laying a new natural gas pipeline. At the same time, a second pipeline will be laid to transport hydrogen in the future. The pipelines will be laid between the GETEC Park Emmen and the GZI Next site in Emmen. Construction work on the hydrogen pipeline is expected to be completed by the end of 2022, and hydrogen is expected to be transported by the beginning of 2024. The hydrogen pipeline in Emmen will become part of the Hydrogen Network Netherlands.

Category:	transportation
Capacity:	scalable
Process phase:	construction
Project period:	2018 – 2024
Project costs:	confidential
Contact:	info@gasunie.nl

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Delta Corridor

New Infrastructure Meets the Hydrogen Needs of the Industry

At present Rotterdam supplies a large part of the NW-European industry (including North Rhine-Westphalia) with fossil energy and raw materials. To provide this industry with sustainable energy and raw materials, a new infrastructure is needed, such as the Delta Corridor. With the HyTransPort.RTM and de national H-grid it connected; the whole NW-Europe industrial area will be supplied with Hydrogen.

Category:	transport of H_2
Capacity:	scalable
Process phase:	Feasibility-study
Project period:	2022 – 2025 (FID)
Project costs:	>50 M€, with 7 M€ subsidy
Contact:	hgj.regeer@portofrotterdam.com

Partners:

RRP Rotterdam-Rijn Pijpleiding

Port of Rotterdam

Hydrogen Sensor Technology

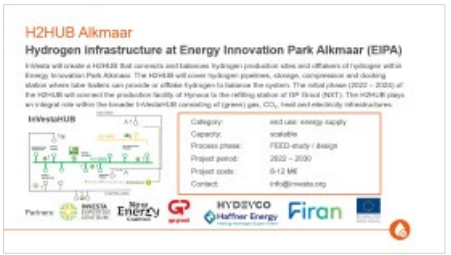
Developing Better Sensors for Natural Gas / Hydrogen Mixtures

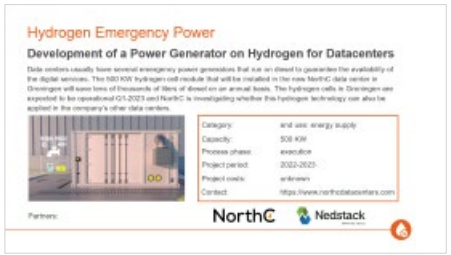
The project aims to develop a technology that allows the cost-effective and sufficiently accurate measurement of the composition of natural gas / hydrogen mixtures, wherein high concentrations of hydrogen are mixed (typically up to 90%). The HyDeploy (UK) project is a follow-up project, in which the developed sensor technology is put into a field test. In this project, up to 20% hydrogen is mixed in the natural gas. Duration until end 2022.

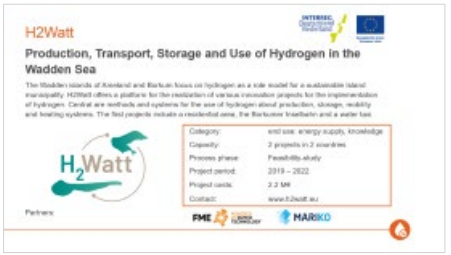
Category:	transportation
Process phase:	commissioning
Project period:	2018 – 2022
Project costs:	TSE 225 k€
Contact:	huib.blokland@tno.nl

Partners: TNO innovation for life, Liander, ENEXIS NETBEHEER, Gasunie, HyDeploy

End use: Energy Supply



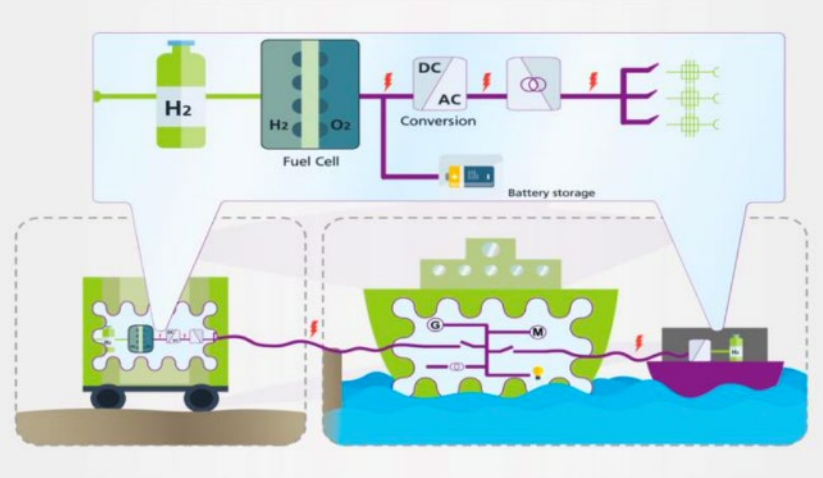




H2 Walstroom

Hydrogen for Green Shorepower in the Three Northern Harbours

The project focuses on the design, development, testing and realization of a mobile fuelcell/genset, which will be deployed to provide clean shorepower to docket vessels in Groningen Seaport, Port of Den Helder and Port of Harlingen.



Category:	end use: energy supply
Capacity:	335kW
Process phase:	FID/execution
Project period:	2020 - 2023
Project costs:	3.9 M€
Contact:	www.eekels.com

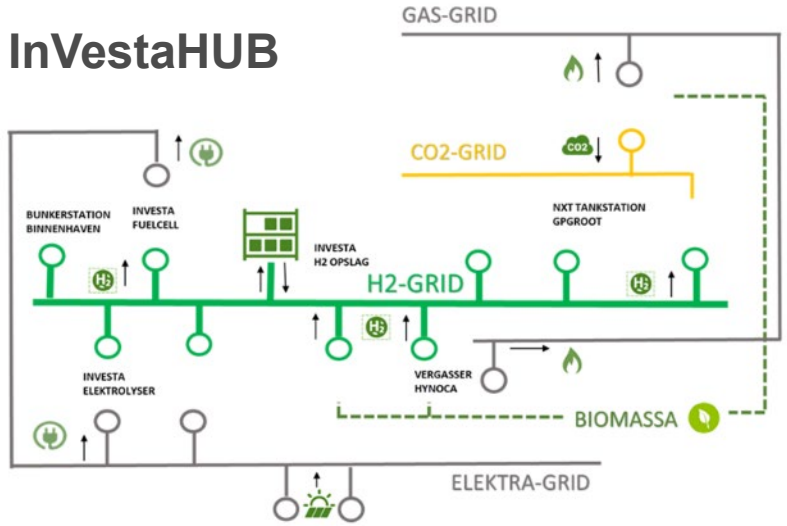
Partners: GRONINGEN SEAPORTS, PORT OF DEN HELDER, PORT OF HARLINGEN, Bredenoord, eekels | TBI, Nedstack PEM FUEL CELLS

H2HUB Alkmaar

Hydrogen infrastructure at Energy Innovation Park Alkmaar (EIPA)

InVesta will create a H2HUB that connects and balances hydrogen production sites and offtakers of hydrogen within Energy Innovation Park Alkmaar. The H2HUB will cover hydrogen pipelines, storage, compression and docking station where tube trailers can provide or offtake hydrogen to balance the system. The initial phase (2022 – 2024) of the H2HUB will connect the production facility of Hynoca to the refilling station of GP Groot (NXT). The H2HUB plays an integral role within the broader InVestaHUB consisting of (green) gas, CO_2, heat and electricity infrastructures.

InVestaHUB



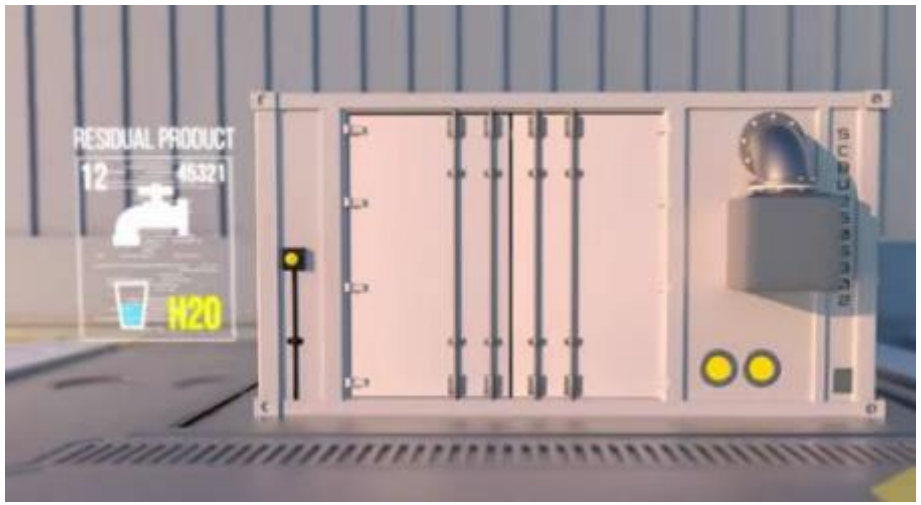
Category:	end use: energy supply
Capacity:	scalable
Process phase:	FEED-study / design
Project period:	2022 – 2030
Project costs:	8-12 M€
Contact:	info@investa.org

Partners: INVESTA EXPERTISE CENTRUM, New Energy Coalition, gp groot, HYDEVCO, Haffner Energy Making Hydrogen Super Green, Firan, Europese Unie Europees Fonds voor Regionale Ontwikkeling

Hydrogen Emergency Power

Development of a Power Generator on Hydrogen for Datacenters

Data centers usually have several emergency power generators that run on diesel to guarantee the availability of the digital services. The 500 KW hydrogen cell module that will be installed in the new NorthC data center in Groningen will save tens of thousands of liters of diesel on an annual basis. The hydrogen cells in Groningen are expected to be operational Q1-2023 and NorthC is investigating whether this hydrogen technology can also be applied in the company's other data centers.



Category:	end use: energy supply
Capacity:	500 KW
Process phase:	execution
Project period:	2022-2023
Project costs:	unknown
Contact:	https://www.northcdatacenters.com

Partners:

NorthC

Nedstack
PEM FUEL CELLS

Solarparc Spiesberg

Local Solarparc as Source of Hydrogen for Local Mobility

At Grashoek, directly along the A67 and the 380 kV high-voltage power line, a new 15 MW solarparc is developed. Since the local electricity grid is not always available for the return of the here generated electricity, we will convert the green electricity, on site, into green hydrogen. We intend to extract green electricity from the electricity grid at times when no sustainable energy is generated at the solar park. The hydrogen produced is compressed and stored in tube trailers that will be used later in hydrogen vehicles.

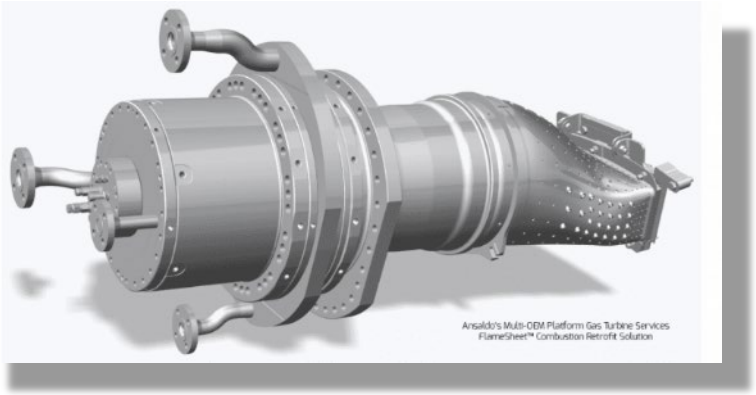
Category:	end use: energy supply
Capacity:	5 MW
Process phase:	FEED-study
Project period:	2021 – 2023
Project costs:	unknown
Contact:	www.morgenzon.nu

Partners:

High Hydrogen Retrofit Partnership

Hydrogen Gas Turbine Retrofit to Eliminate Carbon Emissions

To develop a cost-effective ultralow emissions (sub 9ppm NOx and CO) combustion system retrofit for existing installed gas turbines in the output range of 1 MW to 300 MW.
Fuel flexibility and stable operation is required from 100% natural gas to 100% hydrogen.



Category:	end use: energy supply
Capacity:	scalable
Process phase:	FEED-study
Project period:	2e phase 2021 - 2023
Project costs:	unknown
Contact:	www.ansaldoenergia.com/ansaldo-thomassen

Partners: ANSALDO ENERGIA, OPRA TURBINES An Energas Group Company, AkzoNobel, GETEC PARK.EMMEN, TU Delft, VATTENFALL Nouryon

H2Watt

Production, Transport, Storage and Use of Hydrogen in the Wadden Sea

The Wadden islands of Ameland and Borkum focus on hydrogen as a role model for a sustainable Island municipality. H2Watt offers a platform for the realization of various innovation projects for the implementation of hydrogen. Central are methods and systems for the use of hydrogen about production, storage, mobility and heating systems. The first projects include a residential area, the Borkumer Inselbahn and a water taxi.

Category:	end use: energy supply, knowledge
Capacity:	2 projects in 2 countries
Process phase:	Feasibility-study
Project period:	2019 – 2022
Project costs:	2.2 M€
Contact:	www.h2watt.eu

Partners:

H2Milk Run

Mobile Hydrogen Refuelling Station

Daily delivery of hydrogen via a small truck with a full functional HRS at multiple sites a day (a "Milk Run"). This initiative enables to start with fuel cell forklift trucks without the need to invest in infrastructure, in order to accelerate the use of hydrogen in logistics in a region. In spring 2022 the new GINAF truck will start to distribute hydrogen in the region of Ede.

Category:	end use: energy supply
Capacity:	1 truck
Process phase:	execution, demonstration
Project period:	2021 - 2024
Project costs:	1.25 M€
Contact:	j.w.gosseling@mobihy.com

Partners: GINAF, MOBIHY, provincie Gelderland, ede, TOYOTA MATERIAL HANDLING, BOSCH BETON, bruil, VETH, Bidfood

H2GO

Towards Hydrogen Energy Island Goeree Overflakkee

H2GO is working on scalable sub-projects concerning production, distribution and demand for green hydrogen in various domains of society. The program has four main objectives: contributing to a reliable energy supply with hydrogen; replacing fossil fuels with hydrogen; reusing the existing natural gas infrastructure for hydrogen; and sharing our expertise and experiences so that it can be duplicated. H2GO applies a directed roll-out strategy. This gives us room to adapt the strategy as we go, if required.

Category:	end use: energy supply
Capacity:	8 projects
Process phase:	concept to execution
Project period:	2017 - 2030
Contact:	www.h2goeree-overflakkee.nl

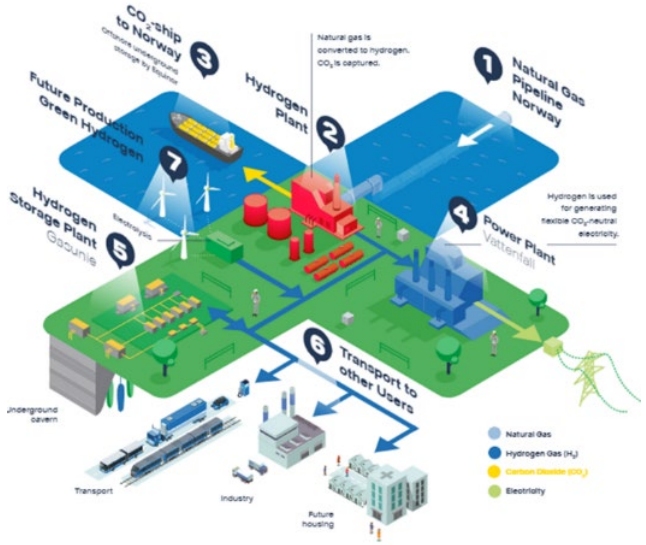
Partners:

DELTAWIND · RGO · Hylife Innovations · gasunie crossing borders in energy · Port of Rotterdam · TU Delft · Gemeente Goeree-Overflakkee · TNO innovation for life · Provincie Zuid Holland · WETEC · TKI Nieuw Gas Topsector Energie

H2M: Hydrogen-to-Magnum

Conversion of 1,320 MW Magnum Natural Gas Power Plant at Eemshaven to Hydrogen including Storage of Hydrogen in Salt Caverns

Vattenfall, Equinor and Gasunie aimed to develop large-scale production and off-take of low-carbon hydrogen in the Northern Netherlands, using ATR and CCS and production of CO_2-free flexible power. The H2M project can potentially reduce CO_2-emissions with 1.2 million tons per year if hydrogen is used for power production and in industry. The project can be realized in 6-7 years provided there is a concrete outlook on required financial support. In June 2022 RWE has acquired the gas-fired power plant 'Magnum' at Eemshaven from Vattenfall and it will participate into the Eemshydrogen project in the future.



Category:	deployment in energy supply
Capacity:	3 x 440 MW
Process phase:	Pre-FEED ready
Project period:	2020 - 2030
Contact:	A. Jongenburger; alion@equinor.com

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RWE VATTENFALL

equinor

H_2 Air Base Leeuwarden

Leeuwarden Air Base Focuses on Hydrogen

The feasibility-study in 2020 showed potential to produce and store green hydrogen. First the 10 ha. solarpark is estimated to be built in 2023, potentially in combination with hydrogen production. We want to use hydrogen for transport purposes: heavy duty transport, fleet and ground equipment. At a later stage we may scale up our demand for back-up power, heating and in the long term biokerosene.

Category:	end use: energy supply
Capacity:	18 MW solar power
Process phase:	FEED-study
Project period:	2021 - 2030
Project costs:	unknown
Contact:	TR.v.wonderen@mindef.nl

Partners:

Koninklijke Luchtmacht

Hysolar

The Production and Supply of Green Hydrogen in Nieuwegein

Hysolar / Greenpoint operates a public hydrogen refueling station since the summer of 2021. The main hydrogen demand is generated by heavy duty machines (e.g., tractors, holders, cranes), trucks, buses, and by passenger cars. Further, in Q2 2023 a 2,5 MW electrolyser will be installed that is supplied with green electricity. To increase the efficiency of the electrolyser, the waste heat will be utilized by a nearby industrial customer.

Category:	end use: energy supply
Capacity:	2,5 MW / 250 ton H_2 / year
Process phase:	execution
Project period:	2021 - 2036
Project costs:	DKTI/ EU LIFE subsidy
Contact:	www.hysolar.nl

Partners:

ALLIED WATERS

SCHOLTenergy

van Kessel

Zephyros

Development of a Maritime Hydrogen Hub in Den Helder

The aim is to demonstrate and stimulate green hydrogen as a maritime fuel on and around the Wadden Sea. The project aims to realize a local solar park, an electrolyser, a pipeline from the electrolyser to an inland port and a public refueling facility, and a hydrogen-electric vessel for use by a pool of maritime service providers and knowledge institutions. The electrolyser is used for flexibility services and congestion management to reduce the hydrogen price with revenues. The aim is to have the hub operational by the beginning of 2022.

Category:	end use: energy supply
Capacity:	2 refilling stations/ 400 kg H_2
Process phase:	FID/execution
Project period:	2019 - 2024
Project costs:	6.4 M€ DKTI/ Waddenfonds
Contact:	p.cnubben@newenergycoalition.org

Partners: PORT OF DEN HELDER, DAMEN, TOTAL, alliander, New Energy Coalition, nholland hogeschool, ENGIE, TU Delft

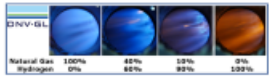
End use: Industry

Overview

Hydrogen as a Fuel for Industrial Heating Processes

Development of Fuel Flexible Burner Concept

This projects aims to prepare energy-intensive industrial production processes (e.g. glass, food and ceramic sector) for a gradual transition from natural gas to hydrogen. The fuel flexible burner concept can handle any mix of natural gas and hydrogen.



Category:	end use: industry
Capacity:	100 kW – 200 MW
Process phase:	execution
Project period:	2020 – 2022
Project costs:	TSE 670 k€
Contact:	Sander.Gersen@dnv.com

Partners: Industry consortium of 35 partners

DNV

Brightsite Hydrogen

Development of a Plasma Process for the CO_2-free Production of Hydrogen and Ethylene

Using electricity as energy source a plasma process is being developed for the CO_2-free production of hydrogen, acetylene and ethylene using methane from the electrified naphtha crackers as feedstock. The products are the building blocks for the production of fertilizers and plastics. The aim is to construct a demo plant in 2025-2027 producing 10 kt / yr hydrogen and a production plant in 2030-2040 producing 0.2 Mt / yr hydrogen. This work is performed in collaboration with the chemical industry.

Brightsite
Transforming industry

Category:	end use: industry
Capacity:	10 – 200 kt H_2 / yr
Process phase:	concept – pilot
Project period:	2021 – 2030
Contact:	hans.linden@tno.nl

Partners: sitech services, TNO innovation for life, Maastricht University, Brightlands Chemelot Campus

NEDMAG on Hydrogen

Demonstration of H_2 Heating a 2 MW Oil Furnace

In this demonstration project the furnace of the industrial magnesium salt mining site of NEDMAG in Veendam will be fueled by varying natural gas/ hydrogen blends. To assure safe and reliable furnace operation, a Fuel Adaptive Control System is installed

Category:	end use: industry
Capacity:	2 MW
Process phase:	execution/commissioning
Project period:	2020 - 2022
Project costs:	unknown
Contact:	H.Hamstra@Nedmag.nl

Partners: NEDMAG, DNV, tempco

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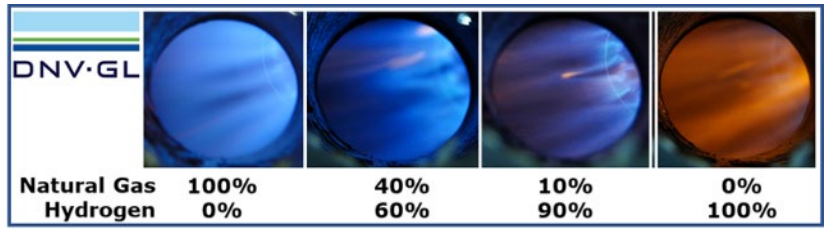
This projects aims to prepare energy-intensive industrial production processes (e.g. glass, food and ceramic sector) for a gradual transition from natural gas to hydrogen. The fuel flexible burner concept can handle any mix of natural gas and hydrogen.



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Brightsite
Transforming industry

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Capacity:	10 – 200 kt H_2 / yr
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Contact:	hans.linden@tno.nl

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Category:	end use: industry
Capacity:	2 MW
Process phase:	execution/commissioning
Project period:	2020 - 2022
Project costs:	unknown
Contact:	H.Hamstra@Nedmag.nl

Partners:

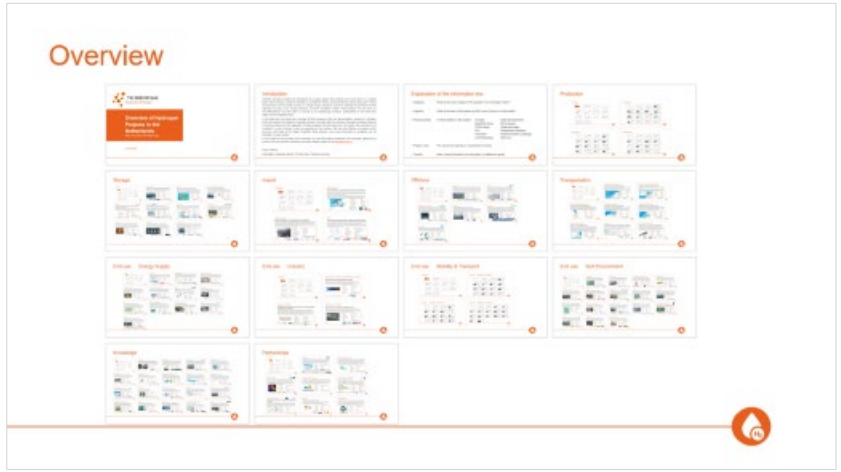
NEDMAG

DNV

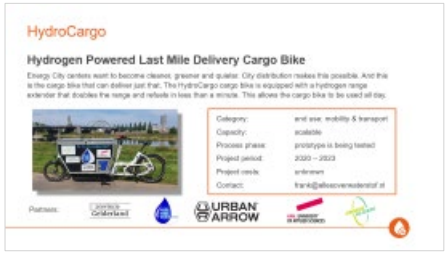
tempco Systems Sensors Service Member of RÖSSEL Group

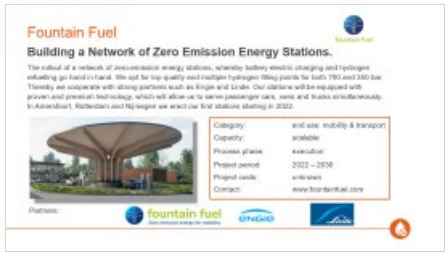
LAMTEC Partner of Tempco

End use: Mobility & Transport

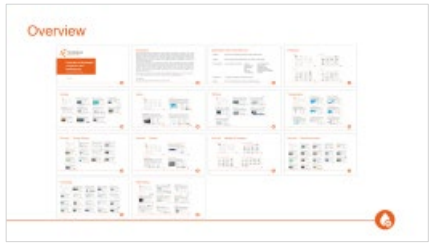


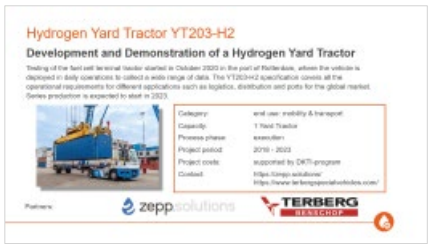
End use: Mobility & Transport I



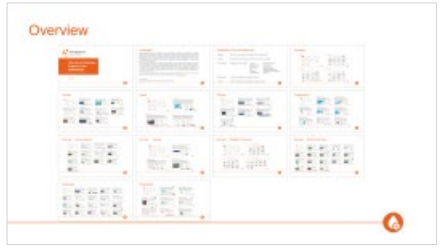


End use: Mobility & Transport II





End use: Mobility & Transport III



HydroCargo

Hydrogen Powered Last Mile Delivery Cargo Bike

Energy City centers want to become cleaner, greener and quieter. City distribution makes this possible. And this is the cargo bike that can deliver just that. The HydroCargo cargo bike is equipped with a hydrogen range extender that doubles the range and refuels in less than a minute. This allows the cargo bike to be used all day.

Category:	end use: mobility & transport
Capacity:	scalable
Process phase:	prototype is being tested
Project period:	2020 – 2023
Project costs:	unknown
Contact:	frank@allesoverwaterstof.nl

Partners:

provincie Gelderland

ALLES OVER WATERSTOF

URBAN ARROW

HAN_UNIVERSITY OF APPLIED SCIENCES

GROENE RIJDERS

Fountain Fuel

Building a Network of Zero Emission Energy Stations.

The rollout of a network of zero-emission energy stations, whereby battery electric charging and hydrogen refuelling go hand in hand. We opt for top quality and multiple hydrogen filling points for both 700 and 350 bar. Thereby we cooperate with strong partners such as Engie and Linde. Our stations will be equipped with proven and premium technology, which will allow us to serve passenger cars, vans and trucks simultaneously. In Amersfoort, Rotterdam and Nijmegen we erect our first stations starting in 2022.

Category:	end use: mobility & transport
Capacity:	scalable
Process phase:	execution
Project period:	2022 – 2030
Project costs:	unknown
Contact:	www.fountainfuel.com

Partners:

Project Phoenix

Building the World's First Liquid Hydrogen-Powered Aircraft

The 1:3 scale prototype is powered by a 1500 W fuel cell coupled with a battery pack for take-off power and safety. Hydrogen is kept in a cryogenic tank at -253°C and warmed to 0°C using a complex tubing system. Phoenix is able to fly for 7h with just 1kg of liquid hydrogen, covering a distance of more than 500 km. These endurance and range values are unmatched by batteries and conventional fuels. Our work can be used to have the first hydrogen-powered passenger aircraft flying by 2030, potentially by a spin-off start-up.

Category:	end use: mobility & transport
Capacity:	prototype
Process phase:	demonstration
Project period:	2021 – 2023
Project costs:	unknown
Contact:	www.aerodelft.nl

Partners: o.a.

Hydrogen Excavator

Building a Zero Emission Excavator on Hydrogen

It is a converted Liebherr R926 Generation 8 that, thanks to our adjustments, emits no CO_2 and NOx at all. The machine can run for a full working day without the need to replace the batteries or top up the hydrogen. “It looks exactly like a traditional excavator. Only it is so clean that we can even work with it in Nature conservation areas. In addition, the hydrogen version is more powerful than the regular one. We have developed a blueprint for how you can convert construction machines quickly and efficiently.”

Category:	end use: mobility & transport
Capacity:	1 excavator
Process phase:	commissioning
Project period:	2020 – 2022
Project costs:	unknown
Contact:	bbierens@mourik.com

Partners:

Hydrogen Zuiderzeehaven

Green Shipping with Hydrogen Port Facilities

The plan includes local production of green hydrogen at the IJDT terminal, in the Kampense Zuiderzeehaven - a joint venture of shipping company MCS and green energy supplier Windkracht. Wind turbines and solar panels provide the electricity needed to produce green hydrogen. Ships will be supplied from the terminal. In addition, the hydrogen will also be available for road transport, especially for freight transport.

Category:	end use: mobility & tranpsport
Capacity:	scalable
Process phase:	Feasibility-study
Project period:	2022 – 2025
Project costs:	unknown
Contact:	www.portofzwolle.nl

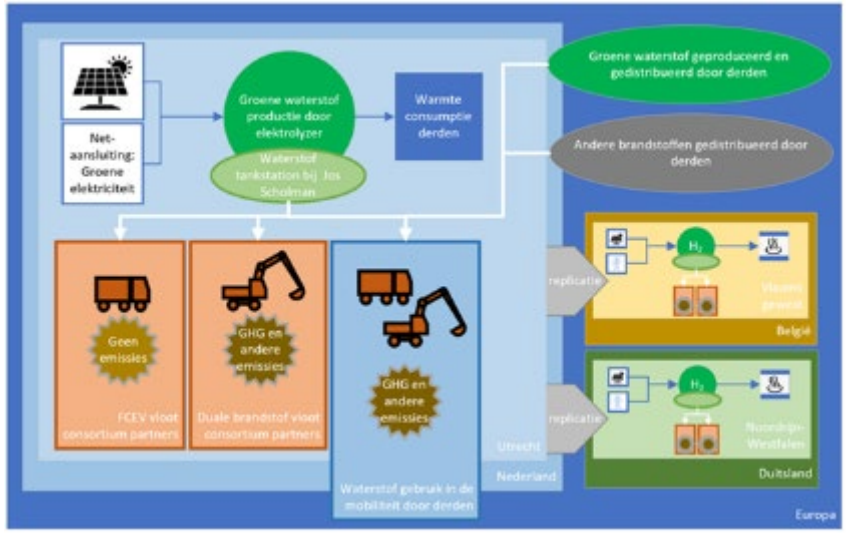
Partners:

PORT OF ZWOLLE PORT OF OPPORTUNITIES

LIFE NEW HYTS

reNEWable green HYdrogen for TranSport

The project will demonstrate the opportunities and feasibility for local production, distribution, and application of green hydrogen in road transport. It aims to create the right conditions for rapid uptake of green hydrogen-fueled heavy-duty vehicles in local transport. To stimulate this, the Provincie Utrecht has developed a Hydrogen Covenant, which aims to boost hydrogen mobility in the region. Knowledge and experience will be shared with Belgium and Germany.



Category:	end use: mobility & transport
Capacity:	2 MW electrolyser, 6 FCEVs for transport, 8 dual fuel machines
Process phase:	execution
Project period:	2021 - 2026
Project costs:	8.4 M€
Contact:	Nellie.Slaats@kwrwater.nl

Partners: hysolar, STAMHUIS, CvHEEZIK, v.d. HEERIK b.v. LOGISTICS - WAREHOUSING, josscholman.nl, KWR, PROVINCIE UTRECHT

DreamH2aul

2 Hydrogen-Electric N3 Trucks and a Hydrogen Filling Point

Development and production of two hydrogen-powered zero-emission semi-trucks that are able to tow any trailer, can drive more than 600 km on a single tank and offer the driver the necessary sleeping place. In Deventer a public hydrogen filling station at 350 bar is realized to promote sustainable logistics and the use of the two hydrogen-electric tractors developed in the DreamH2aul project. This filling station will supply exclusively green hydrogen.

Category:	end use: mobility & transport
Capacity:	2 trucks and 1 H_2 filling station
Process phase:	FEED-study / execution
Project period:	2021 – 2024
Project costs:	supported by DKTI program
Contact:	https://www.dreamh2aul.com/en/

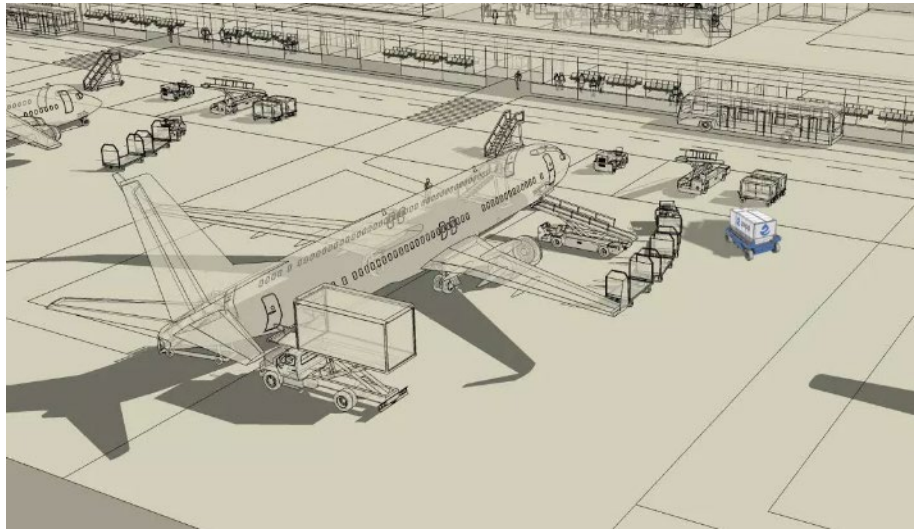
Partners: zepp.solutions, TotalEnergies, VOS 75 JAAR, YOUR GREEN WAY TO SHIP BCTN

H2GPU

TULIPS

Development of a Hydrogen Ground Power Unit at Schiphol

A GPU is used to provide electric power to an aircraft when it is stationary on the ground. In the HGPU that will be developed by zepp.solutions, the conventional diesel engine in the GPU is replaced by a hydrogen powertrain. The first unit will be demonstrated at Schiphol airport by KLM equipment services in 2023.



Category:	end use: mobility & transport
Capacity:	1 H_2 Ground Power Unit (GPU)
Process phase:	FEED-study / execution
Project period:	2022 – 2025 (demo in 2023)
Project costs:	Horizon 2020 subsidy
Contact:	https://tulips-greenairports.eu/ https://zepp.solutions/tulips-gpu/

Partners:

zepp.solutions

KLM Equipment Services

Ab Initio

A Hybrid Hydrogen-Electric Powertrain for an Inland Vessel

The aim is to develop a new fuel cell system and hydrogen storage system for the new training vessel for the STC Group in Rotterdam. The 67-meter-long ship will be used for the practical training of students of maritime courses. The ‘Ab Initio’ is expected to enter service in September 2022.

Category:	end use: mobility & transport
Capacity:	1 (inland) training vessel
Process phase:	execution
Project period:	2022 – 2023
Project costs:	Not disclosed
Contact:	https://abinitio.stc-group.nl/ https://zepp.solutions/ab-initio

Partners:

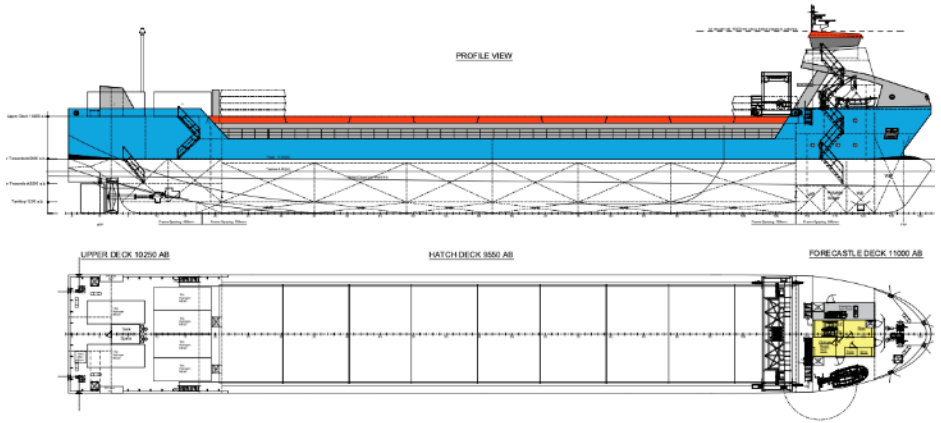
zepp.solutions

STC GROUP
LEADING IN LEARNING

LH2 Vessel

Construction of a New Build Shortsea Vessel on Hydrogen

Tata Steel Ijmuiden and van Dam Shipping has entered into an agreement to realize a new-build shortsea vessel based on 100% Liquid Hydrogen propulsion. The shipping industry is at the start of a large energy transition process. The newbuild LH2 vessel will be the first “commercial” vessel based on 100% zero emission. The project is supported by the partners in the SH2IPDRIVE R&D program of which van Dam Shipping is one of the lead partners.



Category:	end use: mobility & transport
Capacity:	1 newbuild shortsea vessel
Process phase:	FEED and realization
Project period:	2022 - 2023
Project costs:	15 M€
Contact:	www.vandamshipping.com

Partners: Scheepvaartbedrijf van Dam, CONOSHIP INTERNATIONAL, TNO innovation for life, TATA, MARINE SERVICE NOORD Taking care of maritime piping., TU Delft, New Energy Coalition

Green Transport Delta - Hydrogen

The Development of three Hydrogen Mobility Technologies

The main aim of this project is to developing three hydrogen technologies: hydrogen combustion engines, hydrogen fuel cells and a next generation technology for hydrogen refueling infrastructure. These three main developments in this project are related to cross-sectoral mobility applications for the automotive, marine, and non-road mobile machinery sectors, and the resulting technical requirements of the products from the end-user's perspective.

Category:	end use: mobility & transport
Capacity:	scalable
Process phase:	concept
Project period:	2022 –
Project costs:	24 M€ EZK subsidy
Contact:	marc.horsten@daftrucks.com

Partners:

WAviatER

Building Hydrogen Production Technology for the Aviation Sector and Energy Applications at a Regional Level.

The first concrete application is at Groningen Airport Eelde: Hydrogen Valley Airport. An electrolyzer will be developed here to produce green hydrogen as an emission-free energy carrier for light airplanes, drones and ground material. “In the Northern Netherlands this is the first step towards an ecosystem of companies that develop their own products for the green hydrogen economy.”

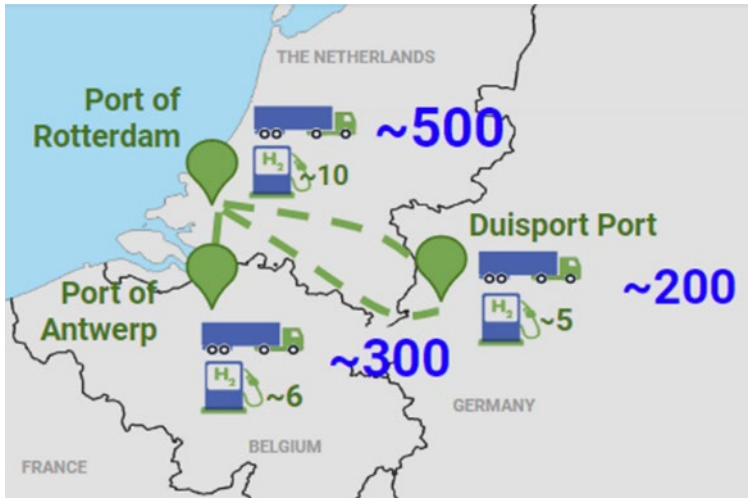
Category:	end use: mobility & transport
Capacity:	scalable
Process phase:	FEED-study
Project period:	2022- 2023
Project costs:	(ERDF) – REACT-EU fund 3.5 M€
Contact:	p.cnubben@newenergycoalition.org

Partners: DEMCON, douna, rijksuniversiteit groningen, vonk, JB, Groningen Airport Eelde Luchthaven van het Noorden, REDSTACK, TNO, New Energy Coalition

HyTrucks

A concerted market approach for H2 growth acceleration Port of Rotterdam - Port of Antwerp - Port of Duisburg

HyTrucks aims to kickstart the zero-emission major heavy duty transportation vehicle value chain in the Port of Rotterdam with corridors to and in the Port of Antwerp and the Port of Duisburg. The HyTrucks ambition is to have 1,000 hydrogen fuelled trucks on the road as well as the corresponding low carbon hydrogen production and refuelling infrastructure by 2025.



Category:	end use: mobility & transport
Capacity:	1,000 trucks, 20-25 refuelling stations
Process phase:	FEED-study
Project period:	2020 – 2025
Project costs:	TBD
Contact:	robert@gcnl.eu

Partners(NL): Port of Rotterdam, Air Liquide, Air Products, VDL, Hyzon/Holthausen, Total Gas Mobility, Cummins/Hydrogenics, Vattenfall, Toyota Motor Europe, Vos Logistics, HN Post, Jongeneel Transport, Peter Appel, Simon Loos, Cornelissen Groep, Containerships, Waterstofnet

Green Planet

Building a Hydrogen Filling Station and Regional Transport Hub

Hydrogen is also called the fuel of the future. That is why we want to offer hydrogen for passenger cars at Green Planet in Pesse. To this end, we are working within the innovative TSO2020 project with many partners, including Gasunie and TenneT. At this moment hydrogen for passenger cars is available In addition to refueling with hydrogen, we are also working with partners on a hydrogen transport hub in the Northern Netherlands: a place where green hydrogen is compressed in trailers that can distribute the hydrogen.

Category:	end use: mobility & transport
Capacity:	1 filling station, H_2 transport hub
Process phase:	commissioning
Project period:	2020 – 2023
Project costs:	4 M€
Contact:	https://greenplanet.nl/

Partners:

Hydrogen fuel cell sweeper

Sweeping of Inner Cities Without Emissions

The fuel cell uses hydrogen and oxygen to generate energy to drive and sweep the roads, after which only a small amount of water vapor comes out of the exhaust. With the new sweeper we immediately introduce a hydrogen exchange bottle system (H2 pod). This saves us the purchase of an expensive refueling system, because the H2 pod is flexible and offers the possibility to quickly and safely exchange the empty hydrogen exchange bottle for a full one, wherever and whenever we want.

Category:	end use: mobility & transport
Capacity:	500H2 sweeper
Process phase:	execution, demonstration
Project period:	2019 - 2023
Project costs:	DKTI-subsidy
Contact:	www.greenmachines.com

Partners: GREEN MACHINES, VAN CAMPEN ECOTECHNIEK BV, CLEANMAT TRUCKS, HOLTHAUSEN CLEAN TECHNOLOGY, HAN UNIVERSITY OF APPLIED SCIENCES

Hyzon Motors Europe

Building Heavy Duty Hydrogen Trucks in Winschoten

Holthausen Clean Technology and the American Hyzon Motors will build heavy duty hydrogen trucks in Winschoten that run on green hydrogen. The factory will initially make 500 trucks per year. Production will eventually be increased to 2,000 trucks annually. This means that the number of direct and indirect jobs generated by the factory will grow from the first hundred to a thousand jobs in the next years.

Category:	end use: mobility & transport
Capacity:	2,000 trucks/year
Process phase:	execution
Project period:	2021 – 2025
Project costs:	unknown
Contact:	Carl@holthausen.nl

Partners:

HOLTHAUSEN CLEAN TECHNOLOGY

HYZON

WEVA

Building Hydrogen Electric Cargo Ship Antonie

The use of hydrogen in inland shipping is still in its infancy. By developing a new ship now that runs on green hydrogen, it will soon be possible to experiment further in practice with the production, storage and transport of hydrogen applications. In this way, hydrogen can develop as an important sustainable propulsion system for inland vessels in addition to, for example, battery-electrically powered ships. The ship will be 135 meters long, 3,700 tons and will transport salt from the Nouryon factory in Delfzijl to the Botlek in Rotterdam.

Category:	end use: mobility & transport
Capacity:	1 cargo ship
Process phase:	execution
Project period:	2021 – 2023
Project costs:	4 M€ Green Deal subsidy
Contact:	www.nprc.eu

Partners: KOEDOOD DIESELSERVICE B.V. H. Lenten Scheepvaart Nedstack Nouryon NPRC EST. 1935

GREEN SHIPPING WADDENZEE

World Heritage Site as an Inspiration for Sustainable Shipping with Hydrogen on the Wadden Sea

The Green Shipping Waddenzee program aims to accelerate innovations in the field of CO_2-neutral and fossil-free shipping for the Wadden fleet and to develop the associated port facilities and infrastructure. All this to support the ambition of a 60% CO_2-reduction in 2030 for the Wadden region. There are 11 projects, of which 6 have already started, such as the design and the operational implementation of a shore power installation and design & development of a 2,5 MW elektrolyser, hydrogen refueling and a operational testing files with pilot vessels in the Port of Den Helder.

GREEN SHIPPING
Waddenzee

Category:	end use: mobility & transport
Capacity:	11 hydrogen projects
Process phase:	design&development of pilots
Project period:	2020 – 2024
Project costs:	25.8 M€
Contact:	https://greenshippingwaddenzee.nl/

Partners:

FME POWERED BY DUTCH TECHNOLOGY

waddenfonds

H2Trac

Developing a 175 HP Tractor on Hydrogen

H2Trac's vision is that land is farmers' best friend, something that must be nurtured. That's why H2Trac's mission is to help farmers with innovative tractors to keep the soil healthy and improve yields. Machines that run on clean hydrogen and enable controlled traffic farming. For Infra-structure companies H2Trac builds a Zero-Emission tractor for all purposes. The EOX175 is built and tested and ready for sales. The first hydrogen version is built in spring 2022 and can be ordered for next year.

EOX

MAKING THE SOIL DO THE WORK

Category:	end use: mobility & transport
Capacity:	5 tractors in 2022
Process phase:	producing
Project period:	2022 - 2023
Project costs:	unknown
Contact:	www.h2trac.com

Green Hydrogen Chain Terneuzen

The Use of Hydrogen at Companies with Heavy Equipment

Different companies in region Terneuzen want to make a leap in the sustainability of their companies and see hydrogen as the perfect solution. The Canal Zone Energy Consortium wants to have a hydrogen filling station ready by 2023. A location is also foreseen, the site of De Pooter Olie on the Beneluxweg in Terneuzen. This project is also part of WP2 of Zero Emission Transport Zeeland, which investigates green hydrogen in road transport. In 2022 a study on the connection with the VoltH2-Terneuzen project is started.

Category:	end use: mobility & transport
Capacity:	filling station and vihicles
Process phase:	Feasiblity-study
Project period:	2022 - 2025
Contact:	m.verschuren@h4a.nl

Hydrogen Yard Tractor YT203-H2

Development and Demonstration of a Hydrogen Yard Tractor

Testing of the fuel cell terminal tractor started in October 2020 in the port of Rotterdam, where the vehicle is deployed in daily operations to collect a wide range of data. The YT203-H2 specification covers all the operational requirements for different applications such as logistics, distribution and ports for the global market. Series production is expected to start in 2023.

Category:	end use: mobility & transport
Capacity:	1 Yard Tractor
Process phase:	execution
Project period:	2018 - 2023
Project costs:	supported by DKTI-program
Contact:	https://zepp.solutions/ https://www.terbergspecialvehicles.com/

Partners:

zepp.solutions

TERBERG BENSCHOP

ISHY

Implementation of Ship Hybridisation

Part of the project is the development of a hydrogen fuel cell system module suitable for medium scale maritime applications. Zepp.solutions will develop and produce this module, which will be ready for implementation in 2023.

Category:	end use: mobility & transport
Capacity:	1 prototype
Process phase:	FEED- engeneering
Project period:	2019 – 2023 (prototype ready)
Project costs:	9 M Interrreg 2 Seas grant
Contact:	https://www.interreg2seas.eu/en/ISHY

H2Benelux

Co-financed by the European Union Connecting Europe Facility

DKTI transport

A real-life Trial Preparing Hydrogen Mobility in the BeNeLux

The roll out of a basic network of hydrogen refuelling stations in the BeNeLux through the deployment of 8 HRS and 80 FCEV along the BeNeLux sections of the TEN-T Network Corridors, to enable the creation of a sufficiently covered European wide network of HRS.

Category:	end use: mobility & transport
Capacity:	70 MPa HRS, FCEV
Process phase:	execution
Project period:	2017 - 2022
Project costs:	17.5 M€ CEF + DKTI transport
Contact:	michel.honselaar@waterstofnet.eu

Partners:

WaterstofNet

COLRUYT GROUP

TOTAL

Rijkswaterstaat
Ministry of Infrastructure and the Environment

Hydrogen Heavy Truck

H2TRUCK
vooruit op waterstof

Development of 50 Ton Bulk Truck on Hydrogen

Bosch's Beton logistics department is increasingly faced with restrictions on construction projects within the environmental zones of large cities. The efficient delivery of concrete retaining walls (photo) is seriously disrupted by this. Hydrogen can be the solution in this case.

Category:	end use: mobility & transport
Capacity:	2 trucks and a HRS (400kg/d)
Process phase:	FEED-study
Project period:	2020 - 2024
Project costs:	unknown
Contact:	brandjan@energeion.nl

Partners:

ENERGEION geeft alles energie

BOSCH BETON

HyET Hydrogen Efficient purification & compression

HAN_UNIVERSITY OF APPLIED SCIENCES

H2RenT

Building 6 Hydrogen-powered Garbage Trucks

The trucks will be operating in different locations, so that municipalities and collection companies can become acquainted with hydrogen technology. A unique aspect is that service companies are also involved in the demonstration project.

Category:	end use: mobility & transport
Capacity:	6 trucks
Process phase:	execution
Project period:	2019 - 2024
Project costs:	unknown
Contact:	stefan.neis@waterstofnet.eu

Partners:

RH2INE

Rhine Hydrogen Integration Network of Excellence

RH2INE will stimulate a targeted structural demand for hydrogen in the mobility sector, aligned with a sustainable hydrogen supply network. The RH2INE Kickstart Study shows that implementation from a value-chain approach is within reach, provided that facilitating policy is there to support workable business cases for zero emission technology. The recommendations offer an excellent basis for further steps in developing the H2 waterborne infrastructure, potentially increasing the willingness for further investments in the whole ecosystem from shipbuilding and maintenance to hydrogen production and distribution.

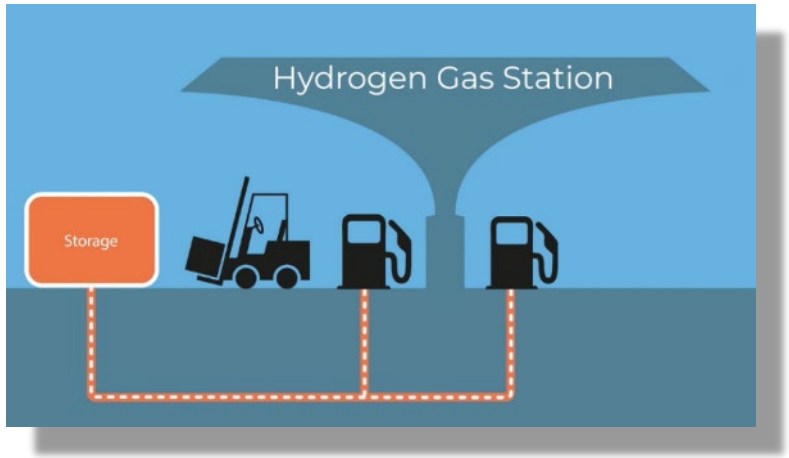
Category:	end use: mobility & transport
Capacity:	12 ships and 4 filling stations
Process phase:	FEED-study
Project period:	2020 – 2030
Project costs:	1.25 B€
Contact:	www.rh2ine.eu

Partners: the Province of South Holland, the State of North Rhine-Westphalia, Ministry of Infrastructure and Water Management, Province of Gelderland, Port of Rotterdam Authority, Duisburg Port Authority RhineCargo, BCTN, EICB, HyCC, Covestro, Air Products, Future Proof Shipping, HTS Group, NPRC, AirLiquide and Koedood.

DUWAAL

Development of a Green Hydrogen Economy in the Northwestern NL

The realization of a first hydrogen gas station in Alkmaar, two hydrogen trucks, a hydrogen sweeper, the development of an integrated storage, transport and distribution system for hydrogen. It will be combined with a 4 MW hydrogen turbine.



Category:	end use: mobility & transport
Capacity:	2,5 MW
Process phase:	FEED-study
Project period:	2020 -
Project costs:	DKTI 2 M€
Contact:	elunborg@hy-gro.nl

Partners:

HYGRO
enabling hydrogen from wind to wheel

H2SHIPS

System-Based Solutions for H_2-Fueled Water Transport in NW Europe

Development of a hydrogen supply chain for shipping (retrofit) inland vessels. A new hydrogen powered port vessel will be built in Amsterdam. In Belgium, a H_2 refueling system suitable for open sea operation, will be developed and tested.

Category:	end use: mobility & transport
Capacity:	1 port vessel
Process phase:	FEED-study
Project period:	2019 - 2023
Project costs:	7.2 M€ total EU project
Contact:	Jan.Egbertsen@portofamsterdam.com

Partners:

eifer European Institute for Energy Research

Port of Amsterdam Port of partnerships

TU Delft Delft University of Technology

TATA STEEL

REVIVE

Refuse Vehicle Innovation and Validation in Europe

Integrating fuel cell powertrains into 15 vehicles and deploying them in 8 sites across Europe. An additional task will explore the potential for ‘Waste-to-Wheel’ business models where the fuel cell trucks are combined with more affordable green hydrogen sourced from waste plants.

Category:	end use: mobility & transport
Capacity:	15 waste trucks
Process phase:	execution
Project period:	2019 - 2024
Project costs:	8.7 M€ total EU project
Contact:	stefan.neis@waterstofnet.eu

Partners:

H_2 Filling Stations by OG Clean Fuels

Designing and Building a Hydrogen Filling Point at Existing Gas Stations

At the locations it will be possible to refuel hydrogen with both 700 bars (passenger cars) and 350 bars (trucks/buses). Three hydrogen filling stations of OG Clean Fuels are operational in Assen (FOS), The Hague (HRS) and Amsterdam (HRS). In the next two years, subject to permits and subsidies, 10 fast-fill stations will be added in The Netherlands.

Category:	end use: mobility & transport
Capacity:	350/700 bars filling stations
Process phase:	execution
Project period:	2019 - 2023
Project costs:	DKTI + BENEFIC subsidy
Contact:	info@orangegas.nl

Partners:

60 Fuel Cell Electric Buses

Towards Clean Public Transport with Hydrogen in the Netherlands

Demonstration of 60 hydrogen buses on Dutch public transportation. This is part of JIVE 2 subsidies and part of a greater European project. The hydrogen buses will run in the provinces of Zuid-Holland, Groningen, Drenthe and Gelderland.

Category:	end use: mobility & transport
Capacity:	60 buses
Process phase:	execution
Project period:	2018 - 2024
Project costs:	25 M total EU project
Contact:	marc.vandersteen@rebelgroup.com

Partners o.a. :

H2-SHARE

Hydrogen Solutions for Heavy-duty (27 tons) Transport in NW Europe.

For large heavy-duty vehicles which travel longer distances, electric trucks with a hydrogen fuel cell range extender are possible zero-emission solutions. In the EU, such vehicles are not yet commercially available but have enormous potential. ‘H2-Share’ aims to unlock this potential.

Category:	end use: mobility & transport
Capacity:	1 truck, 1 mobile filling station
Process phase:	closing phase (15 maart final conference)
Project period:	2018-2022
Project costs:	1.7 M Interreg subsidy
Contact:	stefan.neis@waterstofnet.eu

Partners:

VDL, Wystrach GmbH, Rai Automotive NL, BREYTNER, Colruyt Group, Cure, DHL, e-mobil BW, Hydrogen Europe, Dutch Ministry of Infrastructure and Water Management, TNO, WaterstofNet. The city of Helmond and VIL

Hydrogen Train

Hydrogen Trains as a Sustainable Alternative for Diesel Trains

The province of Groningen wants to make rail transport in the north of the Netherlands more sustainable, which is currently still largely carried out by diesel trains. A pilot in 2020 with the Coradia iLint-hydrogen train, showed that the hydrogen train can be a fully-fledged alternative to the current diesel trains. The province has the ambition to run new trains on hydrogen from 2025.

Category:	end use: mobility & transport
Capacity:	1,000 km per filling
Process phase:	commissioning
Project period:	2020 - 2025
Contact:	https://www.hivemobility.nl/project/pilot-waterstoftrein/

Partners: ProRail, arriva a DB company, ENGIE, ALSTOM · mobility by nature ·, DEKRA On the safe side.

Energy Points

Refueling Stations with Hydrogen From and For the Future

Energy Points are modern hydrogen fueling stations with groundbreaking design. The hydrogen fillingstation in Groningen is 24/7 open and the station in Amsterdam is under construction. Holthausen Energy Points is also helping other hydrogen filling stations with hydrogen supply.

Category:	end use: mobility & transport
Capacity:	2 refilling stations
Process phase:	execution
Project period:	2020-2023
Project costs:	DKTI-subsidy + 500 k€ A'dam
Contact:	www.energypoints.nl

Partners:

Hydrogen Region 2.0

A Hydrogen Filling Station in Breda and Helmond

The filling stations will supply green hydrogen to both passenger vehicles (700 bar) and heavy-duty vehicles (350 bar). In Breda, the waste service Breda can fill its garbage trucks, and now passenger cars are welcome at the Mobility Hub. In Helmond, the existing station is commercialized.

Category:	end use: mobility & transport
Capacity:	2 refilling stations
Process phase:	commissioning
Project period:	2020 - 2023
Project costs:	Interreg and DKTI-subsidy
Contact:	info@totalgasmobility.com

Partners: TOTAL, VDL, Gemeente Breda, WaterstofNet

H2point

Developing a Hydrogen Filling Station in Roosendaal.

This project is localised near the Rotterdam-Antwerp hydrogen pipeline adjacent to the A17 highway. The next project of H2Point will be a hydrogen refilling station in Oosterhout. The project is subsidised by DTKI and BENEFIC.

Category:	end use: mobility & transport
Capacity:	2 refilling stations
Process phase:	execution
Project period:	Q3 2022 Roosendaal ready
Project costs:	2.5 M€ per station
Contact:	www.h2point.nl

Partners:

6 H_2 Filling Stations by Greenpoint Fuels

To Develop and Construct 6 Hydrogen Filling Stations in NL

In July 2021 we started using our first Greenpoint hydrogen filling station in Nieuwegein. A second hydrogen filling point in Oude-Tonge will follow in mid-2022. The other Greenpoint stations are set up in such a way that it is possible to quickly switch to hydrogen. Our Greenpoints in Haps and Zeewolde have already been licensed for hydrogen and 3 new locations will follow later this year. Talks with installation companies, governments and frontrunners are at an advanced stage.

Category:	end use: mobility & transport
Capacity:	6 H_2 filling stations
Process phase:	execution
Project period:	2019 - 2025
Project costs:	unknown
Contact:	info@greenpointfuels.nl

Partners: GREENPOINT Pure fuels and energy; van Kessel; MEIJER & VAN EERDEN

80 Hydrogen Taxi’s

Use of 80 Hydrogen Taxi's for Special Care (WMO) Transportation.

This is the first hydrogen taxi fleet in the Netherlands. Since 2019 35 Toyota Mirai’s are driving in The Hague and 10 in Ede/Arnhem. In 2020 23, and in 2021 12 more hydrogen cars where added. *“The client requires us to be available 24/7 with our fleet. Due to the large range of the hydrogen car and the fast refueling, Noot Personenvervoer can offer this.”*

Category:	end use: mobility & transport
Capacity:	80 H_2 taxi’s
Process phase:	commissioning
Project period:	2019 - 2022
Project costs:	unknown
Contact:	info@noot.nl

Partners:

NOOT voor het hele koor

Den Haag

LOUWMAN DEALERBEDRIJVEN

SWIM

Hydrogen Watertaxi

Development of a water taxi running entirely on hydrogen. The first passengers are expected to be able to board in 2022. This project is developed within the zero-emission shipping program called THRUST. All hydrogen-related components are to be developed by zepp.solutions.

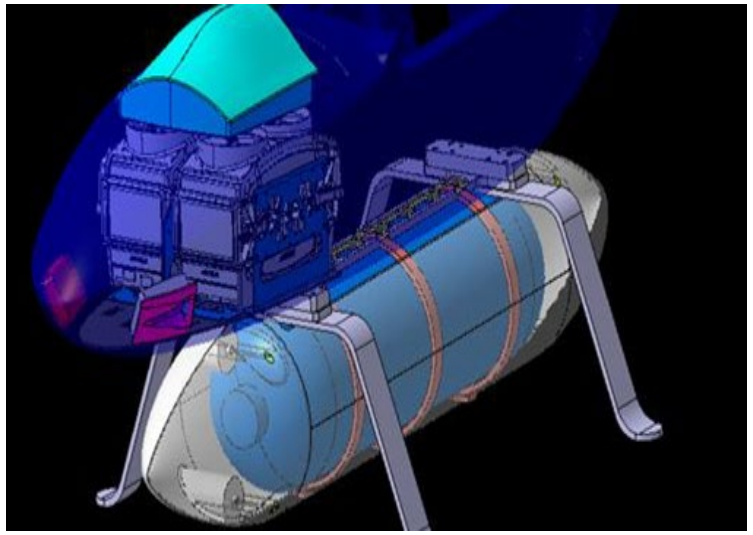
Category:	end use: mobility & transport
Capacity:	12 passengers
Process phase:	execution
Project period:	2020 - 2023
Project costs:	IDB (EICB) grant
Contact:	http://swimh2.com/

Partners o.a.: flyingfish boosting maritime innovations, zepp.solutions, envi we build world changing companies, WATERTAXI ROTTERDAM

HYDRA-2

Safe Flying with Liquid Hydrogen

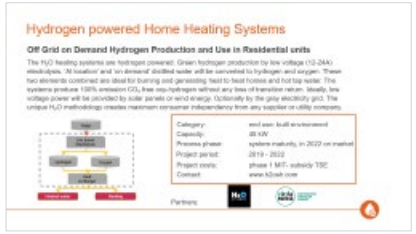
With flight demonstrations using hydrogen powered drone's NLR takes a new and safe step towards climate-neutral aviation contributing to the ambitions of the Sustainable Aviation Agreement and the Hybrid Electric Flying Action Program. In spring 2022, NLR expects to perform drone (HYDRA-2) test flights using compressed hydrogen as an energy carrier in a fully composite tank. Additionally, fuel cell technology will be demonstrated producing electric power for the propellers. In autumn 2022, NLR aims to perform a maiden test flight with a drone powered by liquid hydrogen stored in a metal tank.

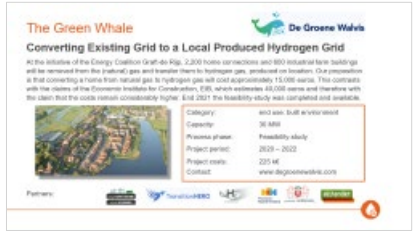


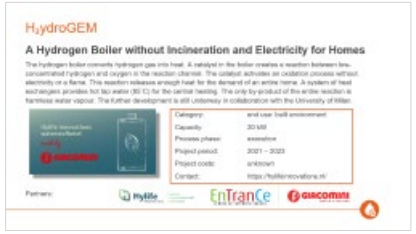
Category:	end use: mobility & transport, knowledge
Capacity:	1 drone
Process phase:	FEED-study, demonstration
Project period:	2021 - 2022
Contact:	roel.van.benthem@nlr.nl

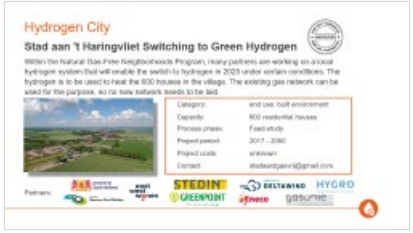
nlr Dedicated to innovation in aerospace

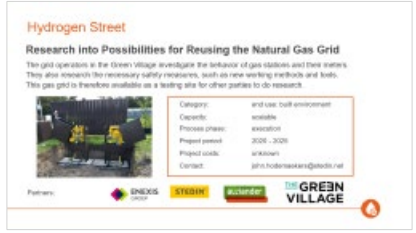
End use: Built Environment







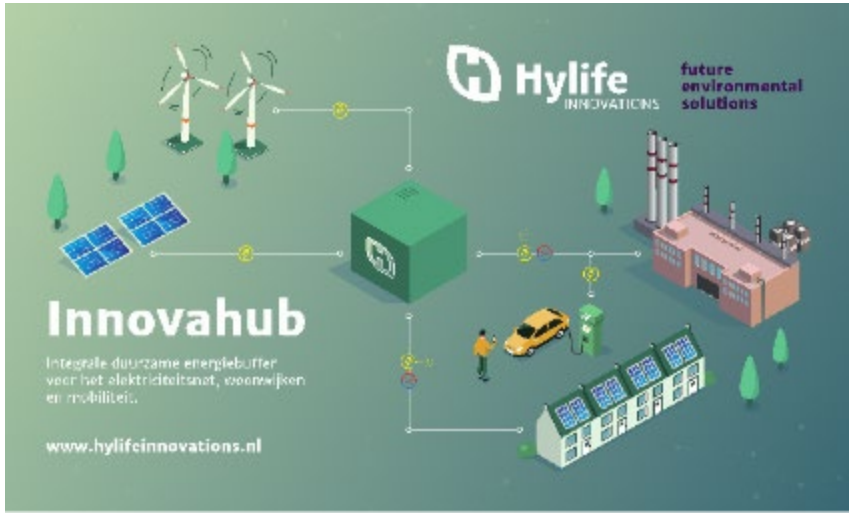




InnovaHub District

A Sustainable Power Station for the Built Environment

Hylife Innovations is developing a neighbourhood of 70-100 homes where circularity, biodiversity and climate adaptation are key, together with InnovaHub. The Hub functions as a decentralized energy buffer, unburdening the electricity grid. State-of-the-art technologies like green hydrogen are leveraged to achieve significant capacities while minimizing footprint. All these features will give the neighbourhood a very different look, compared with a traditional housing development. We expect to complete this in 2024/2025.



Category:	end use: built environment
Capacity:	70-100 homes
Process phase:	execution
Project period:	2022 – 2025
Contact:	https://hylifeinnovations.nl/

Partners: Hylife INNOVATIONS, Future environmental solutions, VAN DORP, ABB, GIACOMINI, Esselink BOUWCENTER, DE VOGEL, DCMR milieudienst Rijnmond, STOUT, Goeree-Overflakkee, vhe Industrial automation, Veiligheidsregio Rotterdam-Rijnmond, Witteveen+Bos

Hydrogen Hospital

Development of a Sustainable Hydrogen Smart Grid in Elst

The hospital's energy needs will be partly met by the electricity generated from the solar panels on the site. The surplus of solar energy produced is converted into green hydrogen. The hydrogen produced is stored at day level, but also across the seasons. A so-called "smart grid" at the location in Elst determines when it is efficient to convert the hydrogen into electricity and heat. In this way, the local electricity grid is not overloaded, and a maximum CO2 reduction is achieved at our own new location.

Category:	end use: built environment
Capacity:	scalable
Process phase:	FEED-study
Project period:	2021 – 2023
Project costs:	unknown
Contact:	www.hymatters.com

Partners:

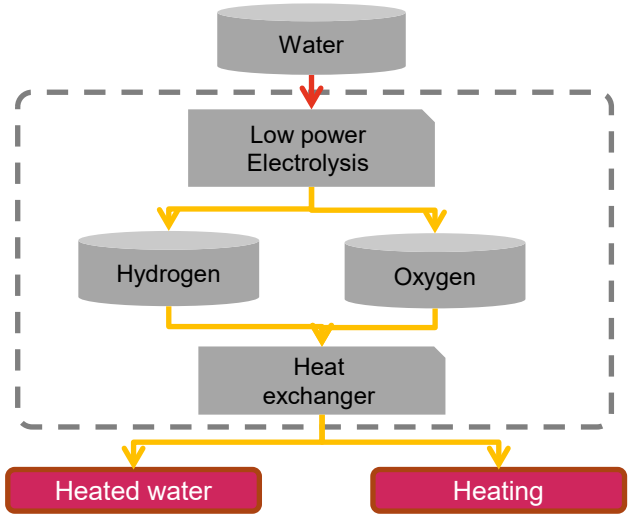
HyMatters

Rijnstate

Hydrogen powered Home Heating Systems

Off Grid on Demand Hydrogen Production and Use in Residential units

The H_2O heating systems are hydrogen powered. Green hydrogen production by low voltage (12-24A) electrolysis. ‘At location’ and ‘on demand’ distilled water will be converted to hydrogen and oxygen. These two elements combined are ideal for burning and generating heat to heat homes and hot tap water. The systems produce 100% emission CO_2 free oxy-hydrogen without any loss of transition return. Ideally, low voltage power will be provided by solar panels or wind energy. Optionally by the gray electricity grid. The unique H_2O methodology creates maximum consumer independency from any supplier or utility company.



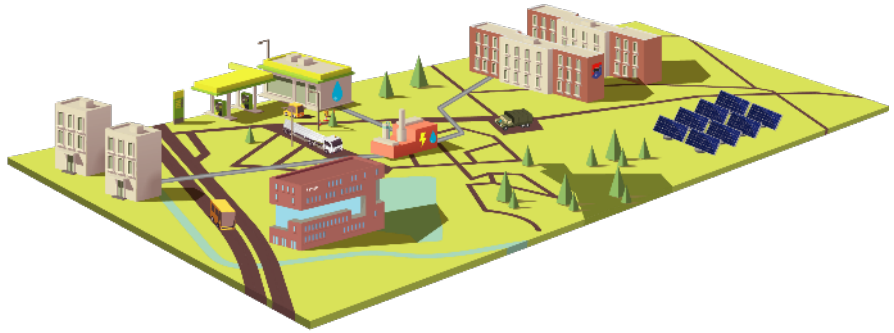
Category:	end use: built environment
Capacity:	45 kW
Process phase:	system maturity, in 2022 on market
Project period:	2019 - 2022
Project costs:	phase 1 MIT- subsidy TSE
Contact:	www.h2osh.com

Partners:

Hydrogen Eeserwold

Development of a Business Park with a Hydrogen Energy Hub

Hydrogen Eeserwold is being developed at a geographically central location north of Steenwijk. The nearby A32 and a central gas network provide the ideal infrastructure. The presence of the companies in the Eeserwold business park and the built environment provide opportunities. Research topics are possibilities to store and transport electricity from wind and sun from the surrounding area in gaseous form. A hydrogen filling station is planned at the same business park for 2022.



Category:	end use: built environment
Capacity:	4 – 30 MW electrolyser + filling station
Process phase:	Feasibility-study
Project period:	2020 – 2025
Project costs:	9 to 45 M€
Contact:	www.waterstofeeserwold.nl

Hydrogen District Wagenborgen

Connecting 33 Homes to the Local Hydrogen Network

The hydrogen is used to heat the houses. The homes will receive a hybrid heat pump that runs on sustainably generated electricity as much as possible. At cold moments, a boiler running on hydrogen switches on. The houses will be insulated and will receive solar panels and gas stoves will be replaced by induction hobs. The hydrogen that is needed is made by a farmer in Siddeburen. The gas is partly transported to the homes via existing gas pipes, and partly via a new network to be built.

Category:	end use: built environment
Capacity:	33 homes
Process phase:	execution
Project period:	2021 – 2023
Project costs:	unknown
Contact:	www.enexisgroep.nl

Partners: Eelshuis Energie

H2@Home

Research of In-house Installations with Hydrogen

A consortium of companies, lead by Flamco and gAvilar, are doing research on in-house installations with hydrogen. They research a new reducer, gasmeter and behavior of in-house piping systems for gas (including house connection). Target is also to find out which measurements/safety systems are needed when using hydrogen instead of natural gas to heat residential houses and how to change over existing systems used for natural gas.

Category:	end use: built environment, knowledge
Process phase:	commissioning
Project period:	2020 - 2022
Project costs:	350k TSE subsidy
Contact:	Lianne Mostert, gAvilar Ben Mureau, Aalberts hydronic flow control

Partners: gAvilar, PIA Automation, Beutech Kunststoffen & Bewerking, Het Internet Huis, Flamco Flow of Innovation, Enexis Netbeheer, COMAP, hsf Flow of Innovation, VSH, Henco, Freman, remeha, The Green Village

The Green Whale

Converting Existing Grid to a Local Produced Hydrogen Grid

At the initiative of the Energy Coalition Graft-de Rijp, 2,200 home connections and 600 industrial farm buildings will be removed from the (natural) gas and transfer them to hydrogen gas, produced on location. Our proposition is that converting a home from natural gas to hydrogen gas will cost approximately 15,000 euros. This contrasts with the claims of the Economic Institute for Construction, EIB, which estimates 40,000 euros and therefore with the claim that the costs remain considerably higher. End 2021 the feasibility-study was completed and available.

Category:	end use: built environment
Capacity:	30 MW
Process phase:	Feasibility-study
Project period:	2020 – 2022
Project costs:	225 k€
Contact:	www.degroenewalvis.com

Partners:

InnovaHub

A Sustainable Power Station for the Built Environment in GO

InnovaHub provides energy in the form of electricity, heating and cooling for the residential district in a sustainable manner without emissions. The supply of energy is provided by wind turbines and solar parks in the immediate surroundings. The Hub functions as a decentralised energy buffer, unburdening the electricity grid. State-of-the-art technologies like green hydrogen are leveraged to achieve significant capacities while minimizing footprint. The first installation will be linked to 17 homes. We expect to complete this in 2023.

Category:	end use: built environment
Capacity:	17 homes
Process phase:	execution
Project period:	2021 – 2024
Contact:	https://hylifeinnovations.nl/

Partners: Hylife INNOVATIONS, Future environmental solutions, VAN DORP, ABB, GIACOMINI WATER E-MOTION, Esselink BOUWCENTER, DE VOGEL, DCMR milieudienst Rijnmond, STOUT VAN HERK GROEP, Veiligheidsregio Rotterdam-Rijnmond, Goeree-Overflakkee, vhe Industrial automation, Witteveen+Bos

H_2ydroGEM

A Hydrogen Boiler without Incineration and Electricity for Homes

The hydrogen boiler converts hydrogen gas into heat. A catalyst in the boiler creates a reaction between low-concentrated hydrogen and oxygen in the reaction channel. The catalyst activates an oxidation process without electricity or a flame. This reaction releases enough heat for the demand of an entire home. A system of heat exchangers provides hot tap water (85˚C) for the central heating. The only by-product of the entire reaction is harmless water vapour. The further development is still underway in collaboration with the University of Milan.

Category:	end use: built environment
Capacity:	20 kW
Process phase:	execution
Project period:	2021 – 2023
Project costs:	unknown
Contact:	https://hylifeinnovations.nl/

Partners:

Hylife INNOVATIONS Future environmental solutions

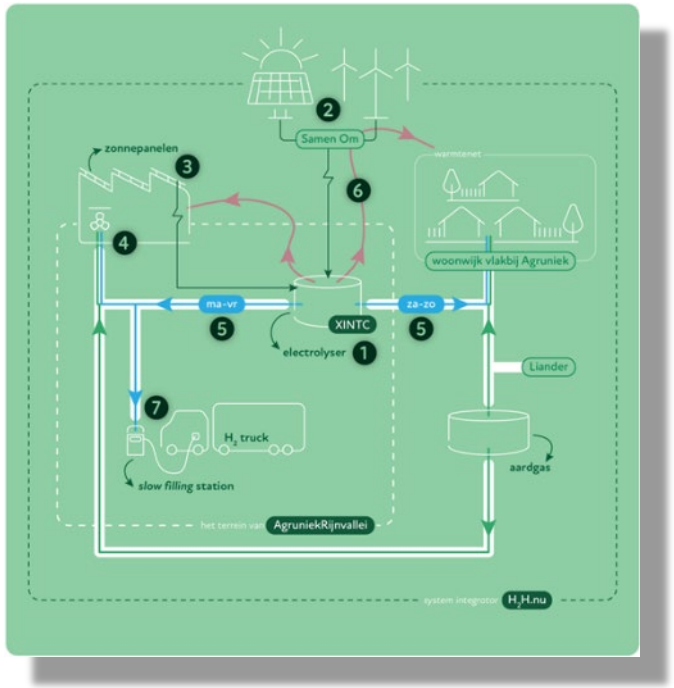
EnTranCe CENTRE OF EXPERTISE ENERGY

GIACOMINI WATER E-MOTION

H2H.nu

Application of Hydrogen as an Energy Carrier in Wageningen

Operated use of Hydrogen gas as replacement for natural gas in local housing schemes (heating) by generating Hydrogen at the location with an innovative electrolyser concept and using local solar production for energy. There are **10** households virtually connected in a smart grid system and excess solar power is used as energy input for the electrolyser. Households will get a separate hydrogen grid in order to safeguard the energy supply. 2022 plans will be put into action in the second half of this year.



Category:	end use: built environment
Capacity:	residential area level
Process phase:	Proof of Concept
Project period:	2022 -
Project costs:	unknown
Contact:	https://h2h.nu/

Retrofit Hydrogen Condensed Boiler

Towards the Introduction of H_2 in the Built Environment

The new developed boiler is a retrofit of an existing domestic natural boiler in which several components, such as the burner and flame guarding system, are replaced. The boiler will be tested in a field demo in 2021-2022.

Category:	end use: built environment
Capacity:	20 kW
Process phase:	POC
Project period:	2020 - 2022
Project costs:	unknown
Contact:	Sander.Gersen@dnv.com

Partners:

GasTerra

DNV

Power-To-Gas (P2G) Phase II

Power to Hydrogen for Residential Heating of Apartments in Rozenburg

Decentralized integration of wind and solar energy via hydrogen from electrolysis for the heat supply of the built environment. The hydrogen is delivered by regular natural gas pipelines to the boiler house of the apartment complex where the first hydrogen boilers are tested.

Category:	end use: built environment
Capacity:	3 residential houses
Process phase:	execution
Project period:	2018 - 2023
Project costs:	unknown
Contact:	albert.vandermolen@stedin.net

Partners: STEDIN.NET, Ressort Wonen, Gemeente Rotterdam, remeha, DNV, GasTerra, BEKAERT better together

Hydrogen Church

Heating the Monumental Eusebius Church with Hydrogen

Using hydrogen from a sustainable source to heat a monumental church is new and offers an opportunity to reduce the natural gas consumption of monuments. The possibilities were examined in a feasibility study. And with success! A step-by-step route is proposed, starting with heaters on 50% green hydrogen. You can then continue to grow to have all heaters burn on 100% green hydrogen.

Category:	end use: built environment
Capacity:	several heaters
Process phase:	FID
Project period:	2019 - 2023
Project costs:	unknown
Contact:	Dick.Breteler@HyMatters.com

Partners: Gemeente Arnhem, HyMatters, HAN University of Applied Sciences, DEKRA, Eusebius historisch en eigentijds, Sustainable Electrical Energy Centre Expertise

Hydrogen Neighbourhood Hoogeveen

100 Newly Built Houses and 430 Existing Houses Connected to Hydrogen

The newly built Nijstad-Oost residential area has been designated as a demonstration project for the application of hydrogen in newly-built houses. The destination plan will soon be brought into execution. Construction is expected to start in 2023. Other houses will be connected later.

Category:	end use: built environment
Capacity:	530 houses
Process phase:	execution, final call in 2022
Project period:	2020 - 2030
Project costs:	TSE 400 k€
Contact:	www.waterstofhoogeveen.nl

Partners: Stork Nederland BV, Nederlandse Gasunie NV, GasTerra BV, Nederlandse Aardolie Maatschappij N.V., Bekaert Combustion Technology BV, N-TRA BV (onderdeel netwerkbedrijf RENDO), Instituut Fysieke Veiligheid (IFV), Cogas Innovatie & Ontwikkeling B.V, Nedstack B., JP-Energiesystemen B.V, Hanze University of Applied Sciences, Provincie Drenthe, Stichting New Energy, Visser & Smit Hanab Distributie B.V, Green Planet Pesse B.V, DNV-GL Netherlands B.V., Arcadis Nederland B.V, BAM Infra Energie & Water B.V, Haskoning BV, DHV Nederland B.V, Enexis Netbeheer B.V en Liander N.V en gemeente Hoogeveen.

Hydrogen City

Stad aan 't Haringvliet Switching to Green Hydrogen

Within the Natural Gas-Free Neighborhoods Program, many partners are working on a local hydrogen system that will enable the switch to hydrogen in 2025 under certain conditions. The hydrogen is to be used to heat the 600 houses in the village. The existing gas network can be used for the purpose, so no new network needs to be laid.

Category:	end use: built environment
Capacity:	600 residential houses
Process phase:	Feed-study
Project period:	2017 - 2050
Project costs:	unknown
Contact:	stadaardgasvrij@gmail.com

Partners:

Hydrogen Street

Research into Possibilities for Reusing the Natural Gas Grid

The grid operators in the Green Village investigate the behavior of gas stations and their meters. They also research the necessary safety measures, such as new working methods and tools. This gas grid is therefore available as a testing site for other parties to do research.

Category:	end use: built environment
Capacity:	scalable
Process phase:	execution
Project period:	2020 - 2025
Project costs:	unknown
Contact:	john.hodemaekers@stedin.net

Partners:

ENEXIS GROEP

STEDIN NET

alliander

THE GREEN VILLAGE

Hydrogen Neighbourhood

Pilot Heating with Hydrogen in Neighbourhood Berkeloord, Lochem

At Berkeloord there are relatively old, sometimes even monumental buildings. The project consist of two subjects; reduction of energy consumption and heating with hydrogen. Since cooking cannot yet be done with hydrogen; induction would be the most obvious option. Before winter 2022/2023 the first house will use hydrogen.

Category:	end use: built environment
Capacity:	9 - 15 residential houses
Process phase:	execution, construction
Project period:	2020 - 2025
Project costs:	unknown
Contact:	info@lochemenergie.net

Partners:

LochemEnergie Je eigen energie

alliander

remeha

Knowledge

Overview

Faraday Lab
Research Facility for Optimizing and Scaling Up Electrolysis

GroenvermogenNL
Green Hydrogen and Chemistry for a Sustainable Netherlands

Energy Demo Field
Development of Connectr Shared Facilities for Hydrogen

SH2IPDRIVE
Sustainable Hydrogen Integrated Propulsion Drives

Hydrohub Safety
Green Hydrogen Inherent Safety Practices on Large Industrial Scale

Hydrohub SOE
Next Level Solid Oxide Electrolysis

Hydrogen GoOs by Vertogas
Issuing Guarantees of Origin for Green Hydrogen

HyXchange
Development of a Hydrogen Exchange in the Netherlands

WaterstofLab
HydrogenLab for the Built Environment

Hydrohub Hyscaling
Hyscaling: Green Hydrogen as an Economic Perspective

Hydrohub MW
The Hydrohub MegaWatt Test Centre

Hydrohub HyChain
Energy Carriers and Hydrogen Supply Chain

HYREADY
Database on Consequences of Adding H_2 to NG Networks

H2 Hub Twente
A Hub for Research, Training and Application of Hydrogen Technology

NG>H_2 District Network [Phase II]
Temporary Conversion from Natural Gas to Hydrogen

Alkaliboost
Developing Better Alkaline Electrolyser Stacks

HyDelta 2
Research on Obstacles on Hydrogen Deployment

Hydrogen Experience Centre Apeldoorn
Demonstration and Training Location

SWITCH
Experimenting with Small-scale Generation of Hydrogen on Farms

Faraday Lab

Research Facility for Optimizing and Scaling Up Electrolysis

Faraday is an open innovation lab that focuses on optimizing existing electrolysis technologies such as PEM, alkaline, SOEC and AEM. Future electrolysers must work more efficiently, produce more, consist of cheaper materials and therefore be attractive to use. In the coming period, TNO will greatly expand the Faraday lab in Petten with facilities to work on innovative solutions together with industrial partners.

Category:	knowledge, research
Capacity:	scalable
Process phase:	concepts
Project period:	2021 -
Project costs:	unknown
Contact:	marcel.weeda@tno.nl

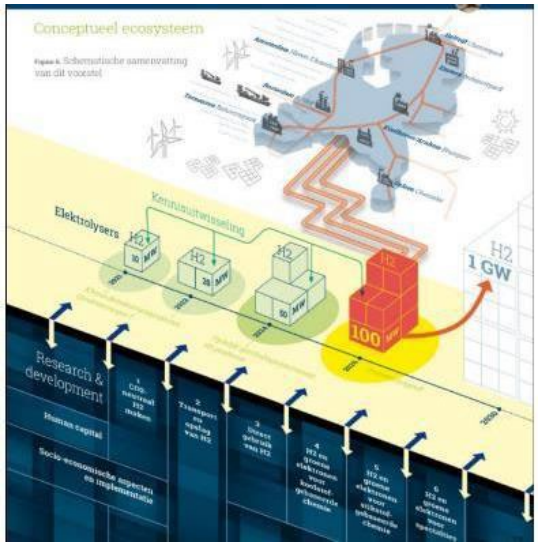
Partners:

TNO innovation for life

GroenvermogenNL

Green Hydrogen and Chemistry for a Sustainable Netherlands

Working on green hydrogen and chemistry in The Netherlands as a driving force for the energy transition. GroenvermogenNL is the investment program for green energy for the Dutch economy. This will enable the Netherlands to build up a new industry and to create an attractive business climate. To make this transition possible, well-trained people and a strong structure of knowledge sharing are necessary. That is what GroenvermogenNL does: upscaling & innovating, converting & rebuilding, retraining & training. In 2022 an additional subsidy of 500 M€ was awarded to demonstrate electrolysis at a scale at least 100 MW together with application in green chemicals, green steel and green SAF.



Category:	knowledge, investing
Process phase:	execution/R&D
Project period:	2021 – 2028
Project costs:	838 M€ (public share)
Contact:	secretariaat@groenvermogennl.org

groen vermogennl | Groene waterstof en chemie voor een duurzaam Nederland

Energy Demo Field

SHARED FACILITIES

Development of Connectr Shared Facilities for Hydrogen

At the Energy Demo Field at IPKW in Arnhem we show what is already happening in the region on a technological level, the importance of learning in practice, and the importance of bringing the right facilities and the right parties together. Nedstack is the first user of this Connectr Shared Facility on IPKW. Nedstack researches and develops PEM fuel cells. Connectr offers companies access to a range of special facilities. Such as workplaces in which consortia of companies and knowledge institutions can work together on new products and solutions.

Category:	knowledge, research
Capacity:	scalable
Process phase:	execution
Project period:	2020-2030
Project costs:	variable
Contact:	www.connectr.nu

Partners:

CONNECTR energy innovation

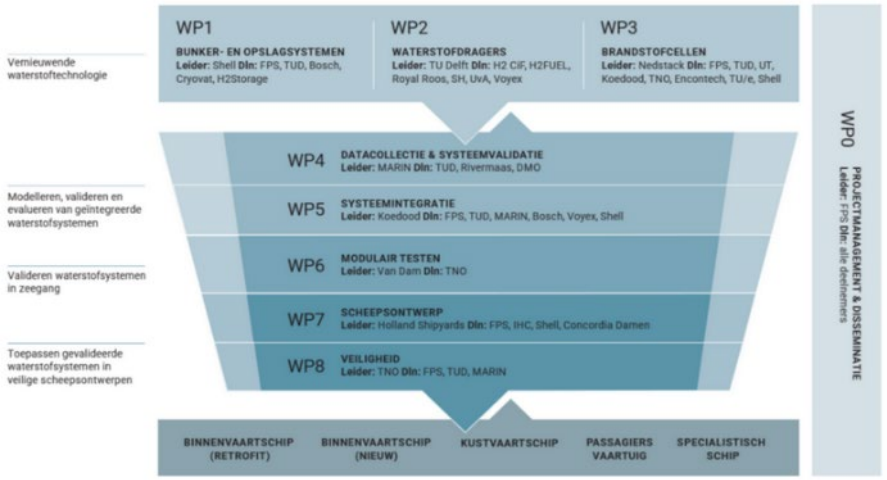
Nedstack PEM FUEL CELLS

Industriepark Kleefse Waard

SH2IPDRIVE

Sustainable Hydrogen Integrated Propulsion Drives

SH2IPDRIVE aims for the development of reliable, safe, standardized, scalable and cost-effective solutions for zero-emission propulsion and energy systems for hydrogen-powered ships. Research on the development of safe technologies for hydrogen in four different forms: compressed hydrogen gas, liquid hydrogen, liquid organic hydrogen carriers and borohydrides. Another important area of research are fuel cell systems with a higher power density and longer life, the use of waste heat and the upscaling of fuel cells.



Category:	knowledge, mobility & transport
Capacity:	scalable
Process phase:	concepts, Feasibility studies
Project period:	2021 – 2025
Project costs:	34M€ (RDM 24M€ grant)
Contact:	L.vanBiert@tudelft.nl

Partners:

Future Proof Shipping B.V. | Technische Universiteit Delft | Nedstack Fuel Cell Technology B.V. | Maritiem Research Instituut Nederland MARIN | Koedood Dieselservice B.V. | Scheepvaartonderneming Van Dam | Holland Shipyards B.V. | Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO |Bosch Rexroth B.V. | Cryovat Internationaal B.V. | H2Storage B.V. | H2 Circular Fuel B.V. | H2FUEL | Royal Roos B.V. | Solid Hydrogen B.V. | Universiteit van Amsterdam | Voyex B.V. | Encontech B.V. | Technische Universiteit Eindhoven | Universiteit Twente | Rivermaas B.V.| IHC Holland B.V. | Royal Dutch Shell | Concordia Damen Shipbuilding B.V.| Defensie Materieel Organisatie

Hydrohub Safety

Green Hydrogen Inherent Safety Practices on Large Industrial Scale

Today electrolyser suppliers, operators and owners have limited operating experience with safety aspects related to large scale water electrolysis installations. Only small-scale installations exist whereas these large-scale installations are becoming reality soon. Therefore, all partners wish to further advance all related safety aspects and develop a uniform safety approach for large-scale water electrolysis plants.

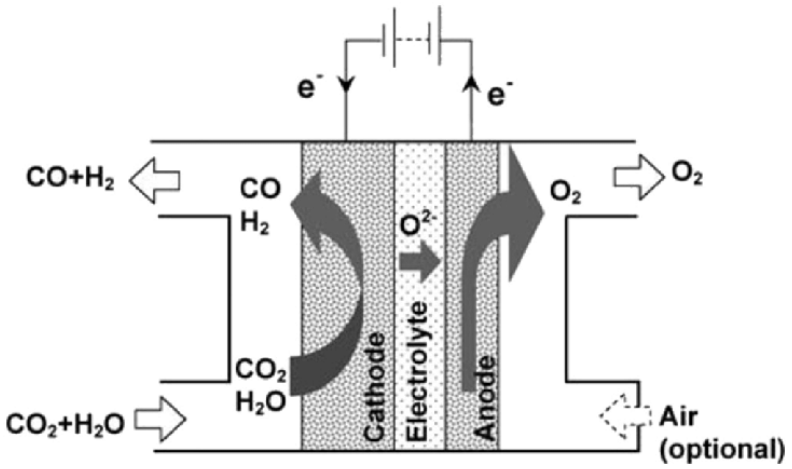
Category:	knowledge
Capacity:	> 100 GW
Process phase:	concept
Project period:	2022
Project costs:	energy studies, TKI subsidy
Contact:	carol.xiao@ispt.eu

Partners: Institute for Sustainable Process Technology, HyCC, YARA, Shell, Ørsted, Royal HaskoningDHV, TNO innovation for life, DNV

Hydrohub SOE

Next Level Solid Oxide Electrolysis

To explore the upscaling potential of SOEC for the Dutch process industry, the Institute for Sustainable Process Technology (ISPT), TNO / Voltachem, and industrial partners Air Liquide, BP, and OCI initiated a new project together to explore the upscaling potential of SOEC in the process industry. Through this project, the feasibility of SOEC-technology in the chemical and fuels industry will be evaluated.



Category:	knowledge
Capacity:	> 100 GW
Process phase:	concept
Project period:	2022-2023
Project costs:	energy studies, TKI subsidy
Contact:	carol.xiao@ispt.eu

Partners:

Institute for Sustainable Process Technology

TNO innovation for life

Air Liquide

bp

OCI

Hydrogen GoOs by Vertogas

Issuing Guarantees of Origin for Green Hydrogen

A comprehensive system for guarantees of origin (GoOs) is needed to facilitate the market for CO_2-free hydrogen. Under the Renewable Energy Directive (RED-II), the development of a GoO system is mandatory. Vertogas received a legal mandate to issues GoOs. The project to issue GoOs for green hydrogen began in 2022, in cooperation with HyExchange .

Phase 1 provides for the implementation of the H2 GoO process, based on the platform that is now used to issue GoOs for green gas. Phase 2, pending FID, will provide for the further development of the new processes in terms of IT support to further automate the issuance of H2 GoOs. The scope and timetable will be determined after the pilot.

Category:	knowledge, legal
Capacity:	not applicable
Process phase:	execution
Project period:	2022 onward
Project costs:	N/A
Contact:	info@vertogas.nl

Vertogas

HyXchange

Development of a Hydrogen Exchange in the Netherlands

In 2022 the certificate pilot is started as an important first step of the HyXchange development plan, which has 3 pillars. The first pillar is the pilot in the certification of hydrogen. The second pillar is a simulation of a hydrogen spot market and will be launched shortly. The last pillar is the start of an international hydrogen price index. The HyXchange hydrogen exchange initiative is now being followed with great interest by a circle of 45 market parties active in energy and industry. The ultimate goal is an exchange on the Dutch hydrogen infrastructure as a central trading point and price indicator, nationally and internationally.

Category:	knowledge, legal
Capacity:	scalable
Process phase:	pilot
Project period:	2022 – 2030
Contact:	b.denouden@berenschot.nl

Partners: gasunie crossing borders in energy · Port of Rotterdam · Port of Amsterdam · North Sea Port · GRONINGEN SEAPORTS

WaterstofLab

HydrogenLab for the Built Environment

The HydrogenLab is a so-called social lab which brings together stakeholders to conduct an open dialogue process about the main question: “How do we create clarity about the role of hydrogen in the energy mix to deliver green heat to the built environment?” The common challenge is to make the built environment CO_2 neutral, at the lowest possible social costs and the greatest possible added value. This requires choices that are made here and now. Anyone wanting to contribute to more nuance in the debate about hydrogen in the built environment, and is open to a constructive dialogue, is more than welcome to participate in this (online) hydrogen community. Several documents have been delivered discussing this issue.

Waterstof LAB

Category:	knowledge, societal acceptance
Capacity:	100+ members
Process phase:	open for contribution
Project period:	2020 - 2022
Contact:	https://waterstoflab.nl

Partners (initiators):

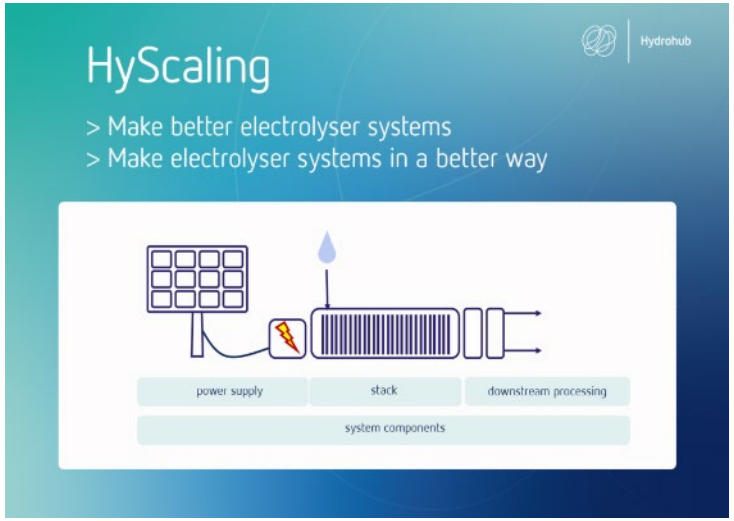
TOPSECTOR ENERGIE
Empowering the new economy

Perspectivity
For the love of complexity

Hydrohub Hyscaling

Hyscaling: Green Hydrogen as an Economic Perspective

To develop and promote hydrogen technology with Dutch companies, electrolysers have to be developed that perform better to produce green hydrogen. In addition, the production must also be more efficient and cheaper. The consortium wants to develop a good production chain for this.



Category:	knowledge, partnerships
Capacity:	10 MW
Process phase:	FEED-study
Project period:	2021-2024
Project costs:	energy studies, TKI subsidy
Contact:	carol.xiao@ispt.eu

Partners:

Hydrohub MW

The Hydrohub MegaWatt Test Centre

Development of an open-innovation infrastructure for stress testing of water electrolysis technology at an industrially relevant scale.

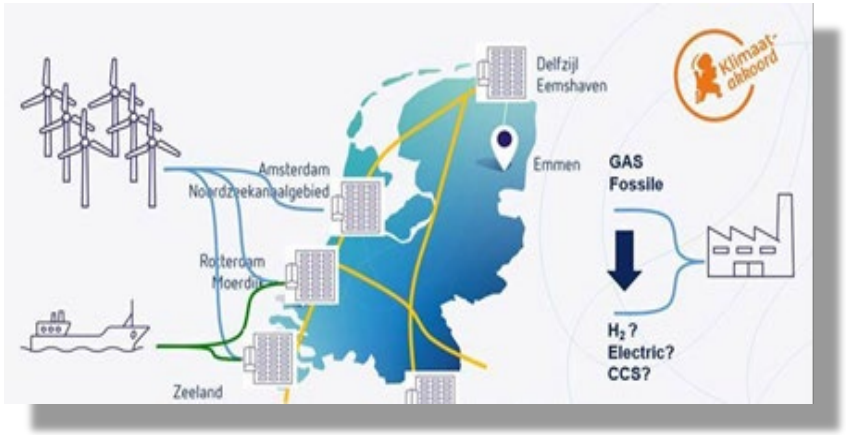
Category:	knowledge, research
Capacity:	500 kW (2 x 250 kW)
Process phase:	execution
Project period:	2018 - 2023
Project costs:	TKI subsidy
Contact:	carol.xiao@ispt.eu

Partners: Institute for Sustainable Process Technology, university of groningen, YARA, YOKOGAWA, TNO innovation for life, NOBIAN A Nouryon company, Gasunie, FRAMES, GRONINGEN SEAPORTS, Hanzehogeschool Groningen University of Applied Sciences

Hydrohub HyChain

Energy Carriers and Hydrogen Supply Chain

A series of exploratory studies focused on a strategic understanding of the drivers behind global emergence of hydrogen value chains, covering aspects such as sources of supply, demand, transport, costs, environmental impact and public engagement.



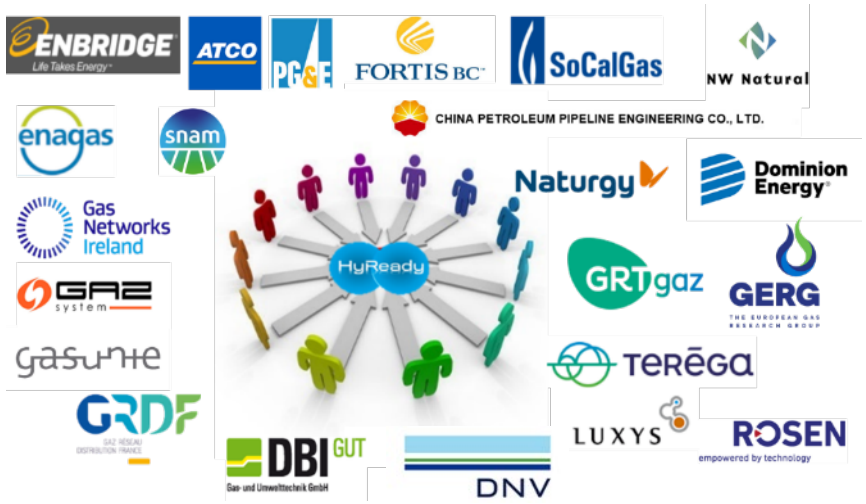
Category:	knowledge
Capacity:	> 100 GW
Process phase:	concept
Project period:	2018 - 2022
Project costs:	energy studies, TKI subsidy
Contact:	carol.xiao@ispt.eu

Partners: Institute for Sustainable Process Technology, TU Delft, OCI, Vopak, TNO innovation for life, STEDIN, Gasunie, NOBIAN A Nouryon company, YARA, DOW, Deltalinqs

HYREADY

Database on Consequences of Adding H_2 to NG Networks

This HyReady project aims to encourage the industry to “Be ready for Hydrogen”. Practical and uniform engineering guidelines are being developed to support the introduction of hydrogen to the gas grid (from transmission systems to end-users). Results are easily available from a Wiki site.



Category:	knowledge
Capacity:	scalable
Process phase:	execution
Project period:	ongoing since 2017
Project costs:	unknown
Contact:	Albert.vandenNoort@dnv.com

H2 Hub Twente

A Hub for Research, Training and Application of Hydrogen Technology

The H2 Hub Twente is a physical place where entrepreneurs, knowledge institutes and governments work together on technical applications for hydrogen technology. With this initiative, H2Hub Twente wants to make it possible for SMEs to get started with and realize concrete hydrogen projects. The focus of the Hub is on testing and application of hydrogen technology. The added value of the Hub is to support the energy transition by facilitating breakthroughs through applied research.

Category:	knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2020 - 2023
Project costs:	1.2 M€
Contact:	info@h2hubtwente.nl

Partners:

NG>H_2 District Network [Phase II]

Temporary Conversion from Natural Gas to Hydrogen

It is important to gain knowledge and experience what it takes to convert an existing gas network and homes into hydrogen. In order to bring hydrogen closer to people in Stad aan ‘t Haringvliet and to gain extra experience, a regular home is converted from natural gas to hydrogen in Stad aan ‘t Haringvliet. Phase I was carried out in Uithoorn in 2020.

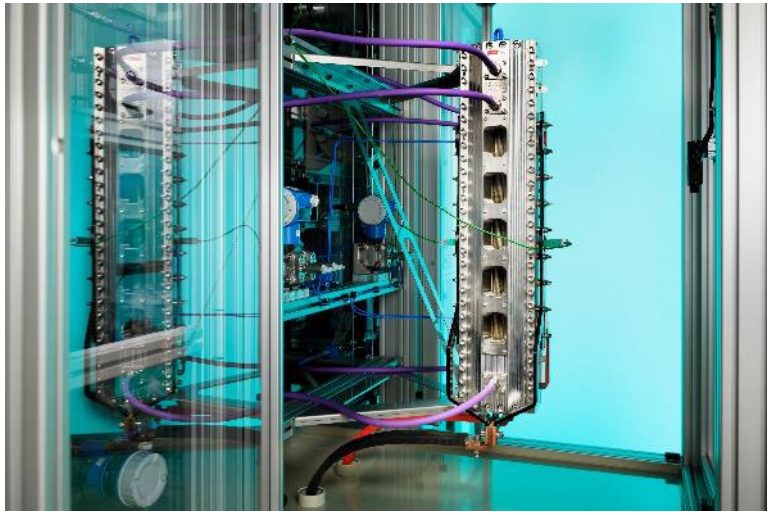
Category:	knowledge
Capacity:	district network 1 home
Process phase:	execution
Project period:	2022 - 2022
Project costs:	unknown
Contact:	tjebbe.vroon@stedin.net

Partners: STEDIN VOOR DE NIEUWE ENERGIEGENERATIE, gemeente Goeree-Overflakkee, kievit warmte, GasTerra, NEFIT, BOSCH, remeha, DNV

Alkaliboost

Developing Better Alkaline Electrolyser Stacks

The power of alkaline technology is that the electrochemical stacks are relatively cheap, because no expensive or noble metals are used. The committed parties are developing and testing new alkaline stack designs that make it possible to operate at a much higher current density.



Category:	knowledge, research
Capacity:	scalable
Process phase:	concept
Project period:	2018 - 2023
Project costs:	TSE 500 k
Contact:	thijs.degroot@hycc.com

Partners:

HyCC

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

HyDelta 2

Research on Obstacles on Hydrogen Deployment

HyDelta 2 is a continuation of HyDelta 1, which is a Dutch national research programme aimed at removing barriers towards a large-scale implementation of hydrogen in the Netherlands and in particular the safe integration of hydrogen into the existing gas transport and distribution infrastructure. After completion, the aim is to start HyDelta 3, a similar program.

Category:	knowledge, research
Process phase:	execution
Project period:	01/05/ 2022 – 30/04/ 2023
Project costs:	2.3 M€
Contact:	j.garcia@newenergycoalition.org

Partners: gasunie, DNV·GL, TNO, TKI NIEUW GAS Topsector Energie, kiwa, New Energy Coalition

Hydrogen Experience Centre Apeldoorn

Demonstration and Training Location

The HEC was officially opened on May 27, 2021, and since then, about four hundred interested parties have visited the demo location, ranging from mechanics, municipal councillors and installers to students and residents. The HEC is also rented out as a meeting location.

Category:	knowledge, human capital
Capacity:	1 residential home
Process phase:	finished
Project period:	2020 - 2022
Project costs:	240 k€
Contact:	technology@kiwa.com

Partners:

SWITCH

Experimenting with Small-scale Generation of Hydrogen on Farms

TNO and WUR operate a hydrogen pilot project in the Fieldlab in Lelystad. Here experiments are being conducted with hydrogen generation on a relatively weak grid that includes wind turbines, solar parks and a battery with the aim to optimize energy management systems and controllers. Aim is to provide highest flexibility while maintaining long lifetime of the components.

Category:	knowledge
Capacity:	small-scale
Process phase:	execution
Project period:	from summer 2022 - 2026
Project costs:	1 M€
Contact:	peter.eecen@tno.nl

Partners:

Partnerships

Overview

HyNorth

Connecting Initiatives, Projects and Knowledge on Hydrogen

HyNorth is the result of the Hydrogen North Netherlands Investment Plan from 2020. "We want to look at the dependencies between projects and identify where projects are missing that are necessary for the hydrogen ecosystem. At HyNorth, we want to join forces in the North by bringing governments, businesses and knowledge centers together. We want to connect supply and demand by seeking out collaboration. The challenge is to grow this to gigawatt scale."

Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2021 –
Contact:	https://hynorth.nl/

Brabant Hydrogen Coalition

Stimulate Hydrogen Projects in the Province of North Brabant

The Brabant Hydrogen Coalition wants to help raise hydrogen policy in Brabant to a higher level of ambition. Hydrogen must be given a more prominent place in the Brabant energy transition agenda. The renowned innovative strength of Brabant can and must also become visible in this area. Brabant is becoming a frontrunner instead of lagging behind and a clear player in the national agenda. The members of the Brabant Hydrogen Coalition want to take their responsibility by jointly developing business cases. With this we want to give an impulse to the acceleration and upscaling of the use of hydrogen in Brabant.

Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2019 -
Project costs:	unknown
Contact:	https://www.brabantsewaterstofcoalitie.nl/

EMR H2 Booster

Boosting Hydrogen Economy in the Euregio Meuse-Rhine

A consortium of nine partners is joining forces to boost the development of clean hydrogen innovation, demonstration and knowledge sharing in the Euregio Meuse-Rhine, as a first step towards the large-scale roll-out of a clean hydrogen economy. The intention is to develop new hydrogen applications where it makes sense, for example in the field of transport or industrial processes. The parties involved draw up plans and visions, but also organize inspiration and demonstration sessions.

Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2022 – 2023
Project costs:	6 ME, 0.5 ME Interreg subsidy
Contact:	www.waterstofnet.eu

Partners:

Hydrogen Coalition Limburg

A Catalyst for Hydrogen Within the Energy Transition in Limburg

WCL is an independent network and knowledge group that brings together and bundles initiatives in Limburg (and beyond). WCL conducts research into hydrogen applications that are close to the market, provides training and knowledge transfer, and connects organizations so that regional projects related to hydrogen applications can arise more quickly.

Waterstof Coalitie Limburg

Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2019-
Project costs:	unknown
Contact:	www.waterstofcoalitielimburg.nl

Zero Emissie Transport Zeeland

The Use of Hydrogen in Transport

This project will encourage companies to introduce Zero Emission Transport into their own business cases. In one of the working packages the role for green hydrogen in heavy transport will be investigated. The feasibility is being investigated at sector level and company level. At sector level, feasibility focuses on the availability of alternative fuels, infrastructure and the effect on total CO_2 emissions. At a company level, feasibility focuses on the availability of equipment, applicability in logistics processes and business case.

ZERO EMISSION

Category:	partnerships, knowledge
Capacity:	business case development
Process phase:	FEED-study
Project period:	2020 - 2023
Project costs:	OPZuid Subsidy
Contact:	www.zero-emissiezeeland.nl

Groene Waterstof Booster

Developing the hydrogen value chain in the Northern Netherlands and beyond

Connecting parties and initiatives, accelerating innovation in the hydrogen chain and making it more sustainable through green hydrogen, and achieving sustainable growth and employment. Create an open innovation climate and promote hydrogen to enable the region to develop into an innovation ecosystem for the transition to green hydrogen. Provide an environment of knowledge and technology for (vocational) education. We provide a testing, demonstration and learning environment in the field of hydrogen.

Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2019 – 30 mei 2023
Project costs:	3.1 ME
Contact:	www.groenewaterstofbooster.nl

Missie H2

The Netherlands, a Hydrogen Country

Water is our source of energy. It gives us new possibilities. That is why we choose course and introduce the Netherlands to the splashing energy of hydrogen. That is our mission, with the athletes of TeamNL as the driving force to the Paris 2024 Olympic Games.

Category:	partnerships, communication
Capacity:	scalable
Process phase:	execution
Project period:	2020 - 2024
Project costs:	unknown
Contact:	www.missieh2.nl

Partners:

HYDROGREENN

HYDROGen Regional Energy Economy Network Northern NL

Promoting business development of hydrogen applications and sharing hydrogen developments and information in or from the northern Netherlands. The hydrogen applications are used to contribute to the green innovation of energy management, mobility, industry and chemistry, with special attention fort he development of education.. There are now 450+ members involved.

Category:	partnerships, knowledge
Capacity:	-
Process phase:	execution
Project period:	2019 - 2023
Project costs	-
Contact:	info@vnonoe-mkbnoord.nl

HyNorth

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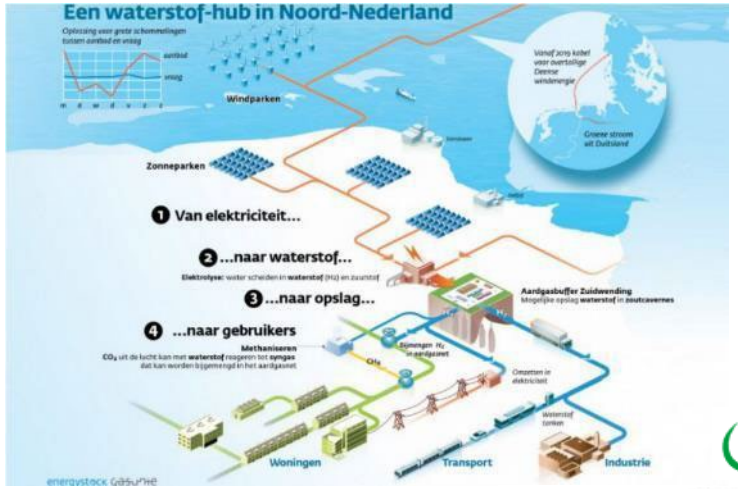

Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2021 –
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H2 Brabant
Brabantse Waterstof Coalitie

Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2019 -
Project costs:	unknown
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Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2022 – 2023
Project costs:	1 M€, 0.5 M€ Interreg subsidy
Contact:	www.waterstofnet.eu

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Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2019-
Project costs:	unknown
Contact:	www.waterstofcoalitielimburg.nl

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ZERO EMISSION

Category:	partnerships, knowledge
Capacity:	business case development
Process phase:	FEED-study
Project period:	2020 - 2023
Project costs:	OPZuid Subsidy
Contact:	www.zero-emissiezeeland.nl

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Category:	partnerships, knowledge
Capacity:	scalable
Process phase:	execution
Project period:	2019 – 30 mei 2023
Project costs:	3.1 M€
Contact:	www.groenewaterstofbooster.nl

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TeamNL

missieH2.nl

partner van TeamNL

Category:	partnerships, communication
Capacity:	scalable
Process phase:	execution
Project period:	2020 - 2024
Project costs:	unknown
Contact:	www.missieh2.nl

Partners:

Port of Amsterdam

GRONINGEN SEAPORTS

gasunie crossing borders in energy

remeha

TOYOTA

HYDROGREENN

HYDROGen Regional Energy Economy Network Northern NL

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Category:	partnerships, knowledge
Capacity:	-
Process phase:	execution
Project period:	2019 - 2023
Project costs	-
Contact:	info@vnoncw-mkbnoord.nl