



HYDROGEN IN THE FLANDERS - NETHERLANDS REGION

WaterstofNet

Catalyst for sustainable
hydrogen projects

Development, coordination, realisation, evaluation and communication



WaterstofNet

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Introduction

At WaterstofNet, we are seeing increasing interest in hydrogen technology from companies and governments and in its possible applications in various areas. This attention is the result of the increased demand for zero-emission transportation and the growing commitment to green electricity, whereby energy storage and the sustainable valorisation of renewable energy are posing new challenges.

Together we will make our hydrogen region a leader in Europe

Since 2009, demonstration projects have been developed within the framework of the Interreg project Hydrogen Region Flanders-South Netherlands, with Belgium and Netherlands working closely together in a cross-border collaboration. This project has seen the construction of the first hydrogen stations with electrolysis in Flanders and the Netherlands and the development, construction and demonstration of innovative means of hydrogen-based transport (refuse trucks, barges, buses). Plus, based on this Interreg project, the region has become a partner in various European projects through WaterstofNet (see overview p. 6-7) with a number of technology experts from Flanders and the Netherlands becoming involved.

WaterstofNet is active with regional partners in a number of hydrogen projects. This portfolio is continuing to expand in scope and diversity. The Hydrogen Region 1.0 project has

proven to be essential in putting hydrogen technology developed in the region on the European map.

This collaboration between the Netherlands and Flanders has been further consolidated with the approval of the Interreg project Hydrogen Region 2.0. It includes the realisation of additional demonstration projects, some of which are unique in Europe. Plus, the Power to Gas cluster has been established within the framework of the Flemish initiative Innovative Business Networks (also known as IBNs, they're an initiative of the Flemish Agency for Innovation and Entrepreneurship). There are now 30 companies working together around the theme of power to gas, with the first concrete projects now in development. One of the aims is to further consolidate cross-border collaborations.

The feasibility of cross-border collaborations focused on hydrogen projects has been clearly demonstrated. In Europe, the Flanders-Netherlands region has become very active in hydrogen. With possibilities and ambitions that extend even further ...

We invite companies, knowledge centres and governments to work together to help establish us as one of the European leaders in hydrogen by 2020!

Adwin Martens
Director of WaterstofNet vzw



Why hydrogen?



Environmental Goal 20 20 20

Europe is striving for a drastic reduction in greenhouse gases by 2050 (reduction of 80%). To achieve this reduction, various goals have been set for 2020, 2030 and 2050. This includes the 20 20 20 goal, which is for:

- a 20% reduction in greenhouse gases (compared to 1990);
- 20% less energy consumption;
- a 20% share of renewable energy in total energy consumption;
- 10% of the energy consumed in the transport industry must be renewable.

Hydrogen can play an important role in the area of zero-emission transport and energy storage.

Zero-emission transport

Vehicles running on hydrogen are silent and have zero emissions. The action radius and refuelling are comparable to vehicles running on traditional fuels. Hydrogen is used in buses, forklifts, refuse trucks, watercraft and cars.

Energy storage

Hydrogen is perfect for the storage of large amounts of energy due to its relatively low weight and high-energy density. Peak production and sustainable forms of obtaining energy, such as sun and wind energy, pose problems for the function and stability of the electricity network. By converting surplus sustainable energy to hydrogen, we create an energy buffer and a network stabiliser. The resulting hydrogen can be used in transport applications or, during periods of scarcity, transformed into electricity. The hydrogen can also be injected into the natural-gas network (power-to-gas) or serve as a basis for chemical products (power-to-chemicals).

Hydrogen = a powerful lightweight element

- The most prevalent element on earth.
- The lightest element on earth, 14 times lighter than air. 1 Nm³ of hydrogen gas weighs 90 grams.
- A colourless, odourless, non-toxic gas.
- Not a source of energy, but a carrier of energy.
- Able to be produced from a broad range of sources.
- A large capacity for storing energy.
- Stored in vehicles as a pressurised gas (350/700 bar).

Hydrogen = a sustainable energy carrier

The sustainability of hydrogen depends on the production method. In industry, 500 billion m³ of hydrogen is used every year as a raw material in various industrial processes. This hydrogen is mainly produced from natural gas (reforming). Sustainably produced hydrogen is created via electrolysis from green electricity (sun or wind energy) and water, as a by-product of the chemical industry. The re-use of hydrogen as an industrial waste product from industry can be considered sustainable.



What does WaterstofNet do?

Working together with industry and government, WaterstofNet develops and realises projects and road maps dedicated to the sustainable creation of hydrogen for zero-emission transport and energy storage. The focus is on Flanders and the Netherlands.

The core tasks of WaterstofNet



develops and realises
sustainable hydrogen projects



develops and coordinates
industrial ecosystems for
hydrogen, such as the Power to
Gas corporate cluster



is a part of **international
hydrogen development networks**
(IEA, Hydrogen Europe, etc.)

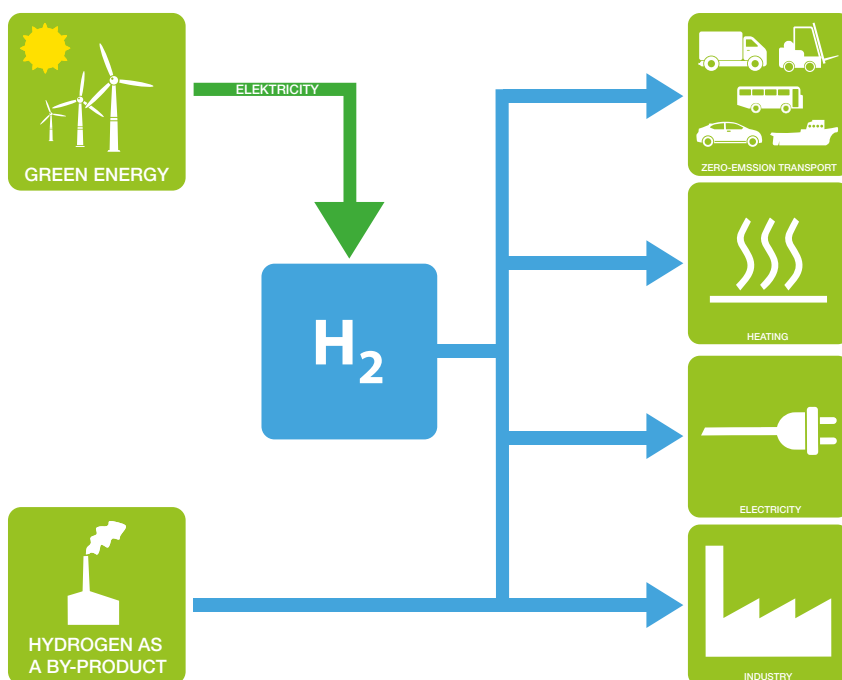


creates **road maps** for hydrogen
infrastructure and applications

In addition it...

- facilitates cooperation between industry, policy, research and education,
- communicates with policy-makers, stakeholders and the broader public about hydrogen,
- is a partner in European projects on hydrogen, such as HighVLOcity, Don Quichote, 3Emotion, H2ME, H2-Share, H2BeNeLux, Revive, etc.,
- works together with other European hydrogen regions (Bolzano, Cologne, etc.).

Sustainable hydrogen projects



WaterstofNet Projects

2009 - 2012



Construction of refuelling station in Halle
> [P 8](#)



Demonstration of hydrogen-fuelled forklifts
> [P 19](#)



Conversion of refuse trucks to hydrogen
> [P 20](#)



1 MW fuel cell plant running on residual hydrogen
> [P 30](#)

2012



Wind energy, hydrogen, forklifts and smart grid
> [P 9 & 31](#)

Strategic vision for opportunities for hydrogen in the North Sea region
> [P 32](#)

2013



Demonstration of four buses with fuel cells in four European cities
> [P 26](#)



Construction of refuelling station in Helmond
> [P 11](#)



Bus with hydrogen-powered range extender
> [P 25](#)



Hydrogen-fuelled watercraft
> [P 29](#)

2014



Hydrogen-fuelled car at WaterstofNet
> [P 16](#)

Road map for hydrogen infrastructure in Belgium
> [P 33](#)

Road map study for Power-to-gas
> [P 34](#)

2015



Large-scale implementation of hydrogen fuelled vehicles and hydrogen refuelling stations
> P 17



Demonstration of two refuse trucks running on hydrogen in 10 European cities
> P 21



Demonstration of 29 hydrogen-fuelled buses in 5 European cities
> P 27

2016

Indoor refuelling for a large fleet of forklifts and expansion of refuelling station to public refuelling station
> P 10

Expansion of refuelling station in Helmond
> P 12



Mobile hydrogen refuelling station
> P 13



Development and construction of two hydrogen refuelling stations in Wilrijk and Breda
> P 14



Conversion of 44 ton trucks to hydrogen
> P 23



Demonstration of two articulated buses running on hydrogen
> P 28



Flemish industry cluster on green electricity and hydrogen
> P 42

2017

8 hydrogen refuelling stations in Benelux
> P 15



80 hydrogen-fuelled cars in Benelux
> P 18



Conversion of 28 ton trucks to hydrogen
> P 24



Analysing the barriers to large-scale implementation of hydrogen
> P 36

Potential study for green hydrogen
> P 37

Green hydrogen certification
> P 38



Smart battery and hydrogen-integrated energy-storage system for solar energy
> P 40

2018 - 2020



Demonstration of 15 refuse trucks running on hydrogen in 8 European cities
> P 22



Large-scale hydrogen production in a port environment
> P 39



Project achievements

Infrastructure



HYDROGEN REFUELLING STATION FOR
LOGISTIC APPLICATIONS IN FLANDERS



www.waterstofnet.eu

DURATION

2009 - 2013

PARTNERS



HYDROGENICS
Advanced Hydrogen Solutions



PROGRAMME



Construction of refuelling station

Hydrogen region Flanders - South Netherlands

Within the framework of the Interreg project Hydrogen Region Flanders-South Netherlands, Hydrogenics, on behalf of WaterstofNet, has built the first 350-bar hydrogen refuelling station in Flanders. Based on the Colruyt Group logistics site in Halle, it converts green electricity (wind and sun) to hydrogen using electrolysis.

The hydrogen refuelling station was opened in February 2012 and a test programme for forklifts running on hydrogen was started.

The role of WaterstofNet

WaterstofNet was the originator for the construction of the hydrogen refuelling station and ran it until 2017. Since then it has been run by the Colruyt Group.





HYDROGEN REFUELLING STATION FOR
LOGISTIC APPLICATIONS IN FLANDERS

Wind energy, hydrogen, forklifts and smart grid

Don Quichote

As part of the European project Don Quichote, the hydrogen refuelling station at the Colruyt Group site in Halle has been expanded to serve as a unique test location for the combination of wind-hydrogen forklifts and a smart grid.

The expansion includes the:

- installation of PEM electrolysis (30 Nm³/h), through which the benchmark with alkaline electrolysis is feasible;
- expansion with extra storage and compressor capacity;
- expansion with fuel cells, so that stored hydrogen makes electricity via the fuel cell which is then fed into the electricity network.

The complete Don Quichote installation was officially commissioned on 9 March 2016 with various business operating strategies tested (hydrogen production for refuelling forklifts or for conversion to electricity with fuel cells to be put back on the network).

The role of WaterstofNet

WaterstofNet developed, wrote and submitted the initial project idea. After approval, WaterstofNet was responsible for part of the project coordination, the coordination of the expansion of the refuelling station and the linked safety study and communication.



www.don-quichote.eu

DURATION

2012 - 2017

PARTNERS



PROGRAMME





HYDROGEN REFUELLING STATION FOR LOGISTIC APPLICATIONS IN FLANDERS

- › Indoor refuelling for a large fleet of forklifts
- › Expansion of refuelling station to public refuelling station for 700-bar

Hydrogen Region 2.0

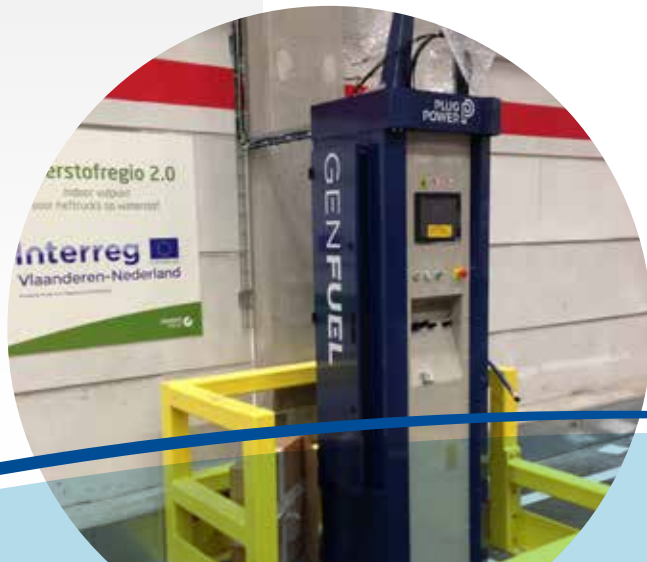
In 2016, as an extension to the existing infrastructure, indoor dispensers were installed for refuelling hydrogen-powered forklifts. This allowed the forklifts to be refuelled more rapidly.

In addition, the logistics site refuelling station was expanded to 700-bar, meaning that regular passenger vehicles could also be refuelled there. The DATS 24 refuelling station next to the logistics site will be opened in the second half of 2018 and will be the second public refuelling station in Flanders to offer hydrogen fuel.

Since opening in 2012, there have been approximately 5000 refuellings (March 2018).

The role of WaterstofNet

As the project coordinator of Hydrogen Region 2.0, WaterstofNet has supported the process in cooperation with the partners and Interreg.





HYDROGEN REFUELLING STATION FOR
AUTOMOTIVE APPLICATIONS IN THE NETHERLANDS

Construction of refuelling station

Hydrogen Region Flanders - South Netherlands

Within the Interreg project Hydrogen Region Flanders-South Netherlands, PitPoint, on behalf of WaterstofNet, has developed the first electrolysis refuelling station in the Netherlands, with construction taking place on the grounds of the Automotive Campus in Helmond.

This is the first hydrogen refuelling station in Benelux to be equipped with an electrolysis system, serving vehicles that refuel at 350 bar (buses, refuse trucks, etc.) and at 700 bar (cars).

The refuelling station has been operational since 2013 and is being used as a test platform for various types of hydrogen vehicles from other hydrogen projects. In addition, it is used by drivers whose cars run on hydrogen.

The role of WaterstofNet

WaterstofNet is the owner and operator of the refuelling station.



www.waterstofnet.eu

DURATION

2009 - 2013

PARTNERS



PROGRAMME



DURATION

2016 - 2019

PARTNERS



PROGRAMME



HYDROGEN REFUELLING STATION FOR AUTOMOTIVE APPLICATIONS IN THE NETHERLANDS

Expansion of refuelling station

Hydrogen Region 2.0

Due to the increasing demand for hydrogen for various vehicle applications, the hydrogen refuelling station on the Automotive Campus in Helmond has been expanded in 2018 within the Hydrogen Region 2.0 project, with increases to production (60 Nm³/h) and compression capacity.

Since it opened in 2013, approximately 1100 (250 x 350 bar, 850 x 700 bar) vehicles have been fuelled (March 2018).

The role of WaterstofNet

WaterstofNet is the owner and operator of the refuelling station.





Mobile hydrogen refuelling station

Hydrogen Region 2.0

From discussions with them, it became apparent that end-users of vehicles running on hydrogen wanted to have a hands-on experience with the use of hydrogen.

To respond, WaterstofNet has purchased a mobile hydrogen refuelling point within the framework of the Hydrogen Region 2.0 project. This allows interested end-users access to short demonstrations.

The role of WaterstofNet

WaterstofNet organises demonstration projects based on location, instruction of end-users, permits, reporting and communication.

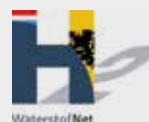


www.grensregio.eu

DURATION

2016 - 2019

PARTNERS



PROGRAMME





PLANNED HYDROGEN REFUELLING STATIONS

Development and construction of 2 hydrogen refuelling stations in Wilrijk and Breda

Hydrogen Region 2.0

As part of the Hydrogen Region 2.0 project, two hydrogen refuelling stations will be developed and built in Wilrijk and Breda, both providing 350-bar and 700-bar installations.

In Wilrijk, the refuelling station will be linked to the ISVAG waste energy plant. The hydrogen refuelling station in Breda will also deliver green hydrogen.

These stations will refuel cars and refuse trucks. Buses will also be able to refuel in Breda. Both refuelling stations will be completed and opened in 2019.

The role of WaterstofNet

As the project coordinator of Hydrogen Region 2.0, WaterstofNet has supported the process in cooperation with the partners and Interreg.





PLANNED HYDROGEN REFUELLING STATIONS

8 hydrogen refuelling stations in Benelux

H2BeNeLux

H2Benelux has been approved as part of the European programme Connecting Europe Facility (CEF) – Transport Sector.

Co-financing has been provided by:

- the Dutch government (Ministry of Economic Affairs and the Ministry of Infrastructure & Environment);
- the Flemish Government;
- the Walloon Government;
- the Luxembourg Government.

As part of the H2Benelux project, Benelux governments are working together with a number of partners (companies) to start the development of hydrogen refuelling stations for passenger vehicles. This will allow Benelux to connect to developments in Germany and France.

A total of 8 hydrogen refuelling stations will be built within the H2BeNeLux project: 4 in the Netherlands, 3 in Belgium (2 in Flanders and 1 in Wallonia), and 1 in Luxembourg. For each hydrogen refuelling station, there will be 10 hydrogen-powered vehicles deployed, allowing the locations to serve as test centres for the provision of hydrogen fuel.

The performance of these eight test centres will be translated into a road map for the development of hydrogen infrastructure in Benelux for 2020 - 2025 - 2030.

The role of WaterstofNet

WaterstofNet has developed the H2Benelux project idea and submitted it to Europe.

During the implementation of H2Benelux, WaterstofNet is the coordinator of the project and WaterstofNet organises the content and financial reporting and communication for the projects.

 Co-financed by the European Union
Connecting Europe Facility

www.H2Benelux.eu


DURATION

2017 - 2020

PARTNERS



PROGRAMME

 Co-financed by the European Union
Connecting Europe Facility





WaterstofNet

www.waterstofnet.eu

Project achievements

Zero-emission transport



HYDROGEN-FUELLED CARS

Hydrogen-fuelled car at WaterstofNet



WaterstofNet has been using a hydrogen-fuelled car since October 2014: the Hyundai ix 35.

The car, which is powered by a fuel cell, releases zero emissions and has an action radius of more than 500 km. It can be fully refuelled within 5 minutes (5 kg of hydrogen at 700 bar).

Refuelling primarily takes place at the hydrogen refuelling station of WaterstofNet on the Automotive Campus in Helmond.

Over the last three years, the car has covered 67,000 km without problems. Many interested parties have driven the car; their reviews have been all been positive.

As part of the HyTrec project, WaterstofNet has shown that it is possible to drive a hydrogen-fuelled car from Brussels to Vejle (Denmark), a total distance of 800 km. Refuelling was available in Halle (Belgium), Helmond (Netherlands), Düsseldorf, Hamburg (Germany) and Vejle (Denmark).

Furthermore, WaterstofNet has also driven the car to Bolzano (Italy) and to London (UK) as part of the Dutch International Hydrogen Challenge.

The role of WaterstofNet

WaterstofNet has introduced the wider public in Flanders and the Netherlands to the possibilities of hydrogen-fuelled cars.





Large-scale implementation of hydrogen fuelled vehicles and hydrogen refuelling stations

WaterstofNet is the contact partner for the project for Benelux, providing communication on the progress and the state of affairs to and from Benelux.

Hydrogen
Mobility Europe

AGA



AREVA H₂Gen



Member of The Linde Group



Communauté
d'Agglomération
Sarreguemines
Confluences

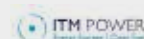
Danish Hydrogen Fuel

elementenergy



Medica Invest. Medica for the Future.

HONDA
The Spirit of Freedom



 THE LINDE GROUP



NISSAN



TOYOTA

nel





HYDROGEN-FUELLED CARS

80 hydrogen-fuelled cars in Benelux

H2BeNeLux

H2Benelux has been approved as part of the Connecting Europe Facility (CEF) – Transport Sector programme.

It has been co-financed by:

- the Dutch government (Ministry of Economic Affairs and the Ministry of Infrastructure & Environment);
- the Flemish Government;
- the Walloon Government;
- the Luxembourg Government.

In H2Benelux, 8 hydrogen refuelling stations will be built: 4 in the Netherlands, 3 in Belgium (2 in Flanders and 1 in Wallonia), and 1 in Luxembourg (see page 15). 10 hydrogen-fuelled cars will be deployed for each hydrogen refuelling station, allowing the eight Benelux locations to serve as test centres.

The role of WaterstofNet

WaterstofNet developed the H2Benelux project concept and submitted it. During the implementation of H2Benelux, WaterstofNet was the project coordinator, reporting on content and financials, and organising communication for the project.



Co-financed by the European Union
Connecting Europe Facility

www.H2Benelux.eu

DURATION

2017 - 2020

PARTNERS



PROGRAMME

Co-financed by the European Union
Connecting Europe Facility



HYDROGEN-FUELLED FORKLIFTS

Demonstration of hydrogen-fuelled forklifts

Hydrogen Region Flanders - South Netherlands and Hydrogen Region 2.0

Based on the experience of testing forklifts running on hydrogen within the Hydrogen Region Flanders-South Netherlands project, the Colruyt Group has decided to pursue a larger project. The Colruyt Group is switching a fleet of 75 forklifts to hydrogen. A fleet this large is unique in Flanders and the Netherlands and will provide additional insight into operational experience in a logistics centre. An indoor refuelling station has been built to serve the fleet efficiently (see also page 10).

The role of WaterstofNet

As the Hydrogen Region project coordinator, WaterstofNet has supported the process in cooperation with the partners and Interreg.



www.waterstofnet.eu

DURATION

2009 - 2013

2016 - 2019

PARTNERS



PROGRAMME





www.waterstofnet.eu

DURATION

2009 - 2013

PARTNERS



PROGRAMME



HEAVY-DUTY

Conversion of refuse trucks to hydrogen

Hydrogen Region Flanders - South Netherlands

If an electrically driven refuse truck only makes use of battery power, the action radius is limited - depending on the total energy consumption.

E-trucks, within the framework of the Interreg project Hydrogen Region Flanders-South Netherlands, has extended the electrical reach of refuse trucks running on batteries with a fuel cell and hydrogen tank. This increases the action radius so that their day-to-day implementation on different routes is possible.

The refuse truck was first used by Cure in Eindhoven in 2013.

The role of WaterstofNet

During the project, the refuse truck refuelled at the WaterstofNet refuelling station in Helmond. Furthermore, in response to the positive experiences, WaterstofNet has initiated follow-up trajectories for refuse trucks running on hydrogen in additional European programmes.





HEAVY-DUTY

Demonstration of 2 refuse trucks running on hydrogen in 10 European cities

Life 'N Grab Hy!

As part of the Life 'n Grab Hy! project, two refuse trucks were converted to hydrogen power and put to work in 10 European cities.

The refuse trucks were first used by the Cure waste management organisation (Eindhoven) and the Baetsen Groep (Veldhoven) to pick up trash in and around Eindhoven.

After a test phase, they will be employed in 10 cities in Europe (including Rotterdam, Cologne, Antwerp, Bolzano, Merano and Aberdeen). Locations were chosen based on the availability of existing hydrogen refuelling stations.

The role of WaterstofNet

WaterstofNet coordinates the project, organises collaborations with the European cities, makes inventories of available and usable hydrogen refuelling stations and is responsible for project communication.

Life 'N Grab Hy
clean cities, clean air



www.lifeandgrabhy.eu

DURATION

2015 - 2020

PARTNERS



PROGRAMME





www.h2revive.eu

DURATION

2018 - 2021

PARTNERS



Gemeente Breda



PROGRAMME



HEAVY-DUTY

Demonstration of 15 refuse trucks running on hydrogen in 8 European cities

REVIVE

As part of the REVIVE (Refuse Vehicle Innovation and Validation in Europe) project, 15 vehicles will be built and used in seven locations in Europe: Antwerp, Amsterdam, Breda, Groningen, Helmond and Roosendaal and Bolzano.

The role of WaterstofNet

WaterstofNet coordinates the use of the trucks in the European cities and is responsible for part of the communication of the project.





HEAVY-DUTY

Conversion of 44 ton truck to hydrogen

Hydrogen Region 2.0

There is increasing interest in making freight transport more sustainable. Although they are emission-free and drive silently, the use of battery-operated electrical trucks is not a solution for long-distance trajectories. However, pairing the batteries with the use of a hydrogen range-extender tells a different story.

Within the Hydrogen Region 2.0 project, the first large (44 ton) truck running on hydrogen will be developed and demonstrated by VDL.

The role of WaterstofNet

As the project coordinator for Hydrogen Region, WaterstofNet has supported the process in collaboration with the different partners and Interreg.



www.waterstofnet.eu

DURATION

2016 - 2019

PARTNERS



PROGRAMME



DURATION

2017 - 2020

PARTNERS



PROGRAMME



HEAVY-DUTY

Conversion of 28 ton truck to hydrogen

H2-Share

As part of the H2-Share project, a 28-ton hydrogen truck and a mobile hydrogen refuelling station will be built and demonstrated.

The truck will be tested at 6 locations in Belgium, the Netherlands, Germany and France. Based on the performance and the strong collaboration with all partners, a road map will be created for the implementation of hydrogen in heavy-duty vehicles.

The role of WaterstofNet

WaterstofNet coordinates the project and is responsible for communication.





HYDROGEN-FUELLED PUBLIC TRANSPORT

Bus with hydrogen-powered range extender

Hydrogen Region Flanders - South Netherlands

As part of the Hydrogen Region Flanders-South Netherlands project, VDL equipped a bus with a hydrogen range-extender. The bus fuelled at the hydrogen refuelling station in Helmond and was put to work in that region. Based on the results of these tests, the range-extender concept is to be further developed by VDL.

The role of WaterstofNet

During the project, the bus refuelled at the WaterstofNet refuelling station in Helmond.



www.waterstofnet.eu

DURATION

2009 - 2013

PARTNERS



PROGRAMME





HYDROGEN-FUELLED PUBLIC TRANSPORT

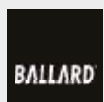


www.fuelcellbuses.eu

DURATION

2013 - 2018

PARTNERS



PROGRAMME



Demonstration of 14 buses with fuel cells in 4 European cities

HighVLOCity

The European project HighVLOCity included the use of 14 fuel-cell buses in 4 European cities. Following on from HyTransit, HighVLOCity is the second of the FCH-JU's bus projects to accelerate the implementation of hydrogen-fuelled buses in public transport.

Buses will be employed in Antwerp (De Lijn), San Remo (Riviera Transport), Groningen and Aberdeen.

The Antwerp buses, built by Van Hool, are run by De Lijn. They use residual hydrogen, refuelling at the Port of Antwerp.

The role of WaterstofNet

As part of the project, WaterstofNet created a website where available information about the buses running on hydrogen in Europe has been collected, including monthly performance figures. The website www.fuelcellbuses.eu has been online since December 2016, providing a total overview of the hydrogen-bus projects in Europe.





HYDROGEN-FUELLED PUBLIC TRANSPORT

Demonstration of 29 hydrogen-fuelled buses in 5 European cities

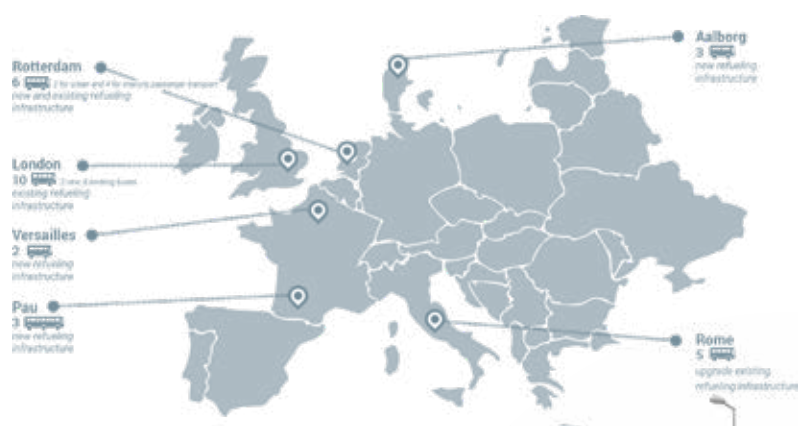
3Emotion

The European project 3Emotion (Environmentally friendly, Efficient, Electric Motion) is a logical successor to the HighVLOCity project; it aims to incorporate fuel cell buses on a larger scale, at lower costs and with higher reliability.

Within the project, 21 new and 8 existing buses will be put to work in 6 European cities.

The role of WaterstofNet

WaterstofNet is responsible for the communication of the project.



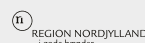
3Emotion
environmentally friendly, efficient, electric motion

www.3Emotion.eu

DURATION

2015 - 2019

PARTNERS



PROGRAMME



www.waterstofnet.eu

DURATION

2016 - 2018

PARTNERS



BUS & COACH



PROGRAMME



Ministerie van Infrastructuur en Milieu

Provincie Noord-Brabant



HYDROGEN-FUELLED PUBLIC TRANSPORT

Demonstration of 2 articulated buses running on hydrogen Eindhoven

The Dutch government has approved five demonstration projects, each with two hydrogen-fuelled buses, as a preparation for the greater implementation of hydrogen-fuelled buses in the Netherlands.

The demonstration project in Eindhoven involves the development of two 18-metre buses that run on hydrogen. These two buses are included in a full-service schedule. The buses fuel at the Automotive Campus in Helmond.

The role of WaterstofNet

WaterstofNet has extended the hydrogen refuelling capacity in Helmond with an increased storage capacity and exploits the refuelling station in Helmond throughout the demonstration project.





HYDROGEN-FUELLED MARITIME TRANSPORT

Hydrogen-fuelled watercraft

Hydrogen Region Flanders - South Netherlands

As part of the Interreg Hydrogen Region Flanders-South Netherlands project, a barge - which was initially equipped with a battery-powered electric transmission - has had its fuel sources expanded with a fuel cell and hydrogen tanks.

A small hydrogen refuelling point has been installed to allow the barge to refuel with hydrogen.

The zero-emission barge was used from 2013 to 2017 during barging seasons on Lake Veere.

The role of WaterstofNet

WaterstofNet supported the project and was the sponsor and operator of the hydrogen refuelling point.



www.waterstof.eu

DURATION

2009 - 2013

PARTNERS



PROGRAMME





Project achievements

Electricity

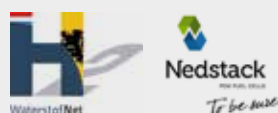


www.waterstofnet.eu

DURATION

2013

PARTNERS



1 MW fuel cell plant running on residual hydrogen

Hydrogen Region Flanders - South Netherlands

In 2013, in the Port of Antwerp, at the site of chlorine producer Solvin, what was then the world's largest fuel cell plant to run on residual hydrogen was built. It was put together solely out of European technology. The plant converted residual hydrogen - a by-product of chlorine production - into 1 MW of electricity. During the test programme, various components were tested over a period of more than 10,000 hours. Based on this experience, the Dutch company Nedstack was able to deliver a follow-up project: a 2 MW fuel cell plant in China.

The role of WaterstofNet

As the project coordinator of the Interreg project Hydrogen Region, WaterstofNet has supported the process in collaboration with partners and Interreg.



Hydrogen in a smart grid environment

Don Quichote

The refuelling station at the Colruyt Group in Halle has been expanded as part of the Don Quichote project. A fuel cell has been added; hydrogen stored in the fuel cell is turned into electricity. This is then fed into the electricity network (see also page 9).

The role of WaterstofNet

WaterstofNet developed, wrote and submitted the initial project idea. After approval, WaterstofNet was co-responsible for the project coordination, the coordination of the expansion of the refuelling station and the related safety study and communication.

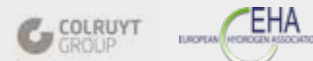


www.don-quichote.eu

DURATION

2012 - 2017

PARTNERS



PROGRAMME





Road maps and studies

Road maps

HyTrEc

Hydrogen Transport Economy
for the North Sea Region

www.hytrec.eu

DURATION

2012 - 2015

PARTNERS



PROGRAMME



Strategic vision for opportunities for hydrogen in the North Sea region

HyTrEc

As part of the HyTrEc project, a number of regions (Flanders, South Netherlands, Bremen, Vejle in Denmark, Scotland, Southwest Sweden and Narvik in Norway) have started a collaboration focused on the use of hydrogen as an energy carrier. In addition to exchanging experiences with hydrogen-refuelling infrastructure and vehicles, a vision and strategy for a collaboration focused on hydrogen has been developed in the North Sea region.

This strategy, laid out in the brochure 'A Joint Hydrogen Strategy Framework for the North Sea Region', includes a SWOT analysis, targets for 2020 and an action plan for using hydrogen as an energy carrier in the North Sea region.

The role of WaterstofNet

WaterstofNet created the strategy document 'A Joint Hydrogen Strategy Framework for the North Sea Region'.



Road map for hydrogen infrastructure in Belgium

H2Mobility Belgium

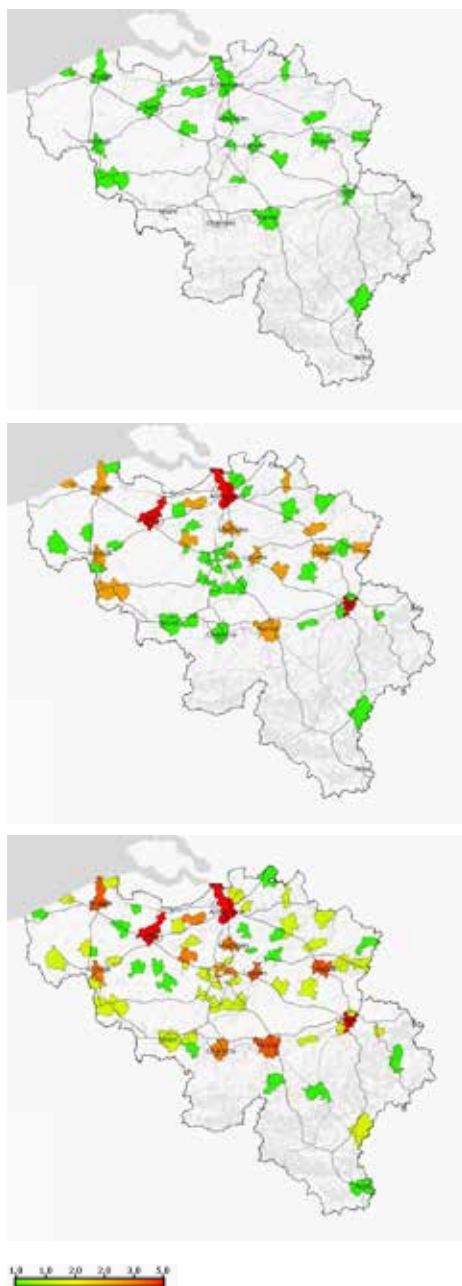
As part of the European project HIT-2-Corridors, some hydrogen refuelling stations were built (in countries including Sweden and Finland), with a number of regions working together to set up a programme for the roll-out of hydrogen infrastructure.

WaterstofNet, with the cooperation of the Université Catholique de Louvain, has set up a plan for the development of hydrogen refuelling stations and hydrogen-fuelled vehicles for Belgium in the period 2020–2030. The results of this H2-Mobility-Plan are being used by the Flemish government as input for the implementation of the European directive Clean Power for Transport.

The role of WaterstofNet

WaterstofNet developed the road map H2Mobility Belgium for hydrogen refuelling infrastructure in Belgium.

Roll-out of hydrogen refuelling stations in Belgium



www.waterstofnet.eu

DURATION

2014 - 2015

PARTNERS



A Member of The Linde Group | AGA



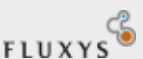
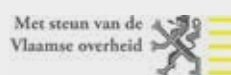
PROGRAMME



Co-financed by the European Union
Trans-European Transport Network (TEN-T)

DURATION

2014 - 2015

PARTNERS**PROGRAMME**

Road map

Power-to-gas

In the Power-to-gas project road map for Flanders, various Flemish partners have been involved in highlighting the diverse technology and valorisation courses on power-to-gas in Flanders.

The term 'power-to-gas' refers to 'the conversion of renewable energy to hydrogen'.

As part of the road map, analyses have been made of the technical and economic feasibility of the following power-to-gas valorisation paths:

- delivery to hydrogen refuelling stations for vehicles;
- injection into the existing natural gas network;
- generate electricity via a fuel cell;
- with CO₂ conversion to synthetic methane.

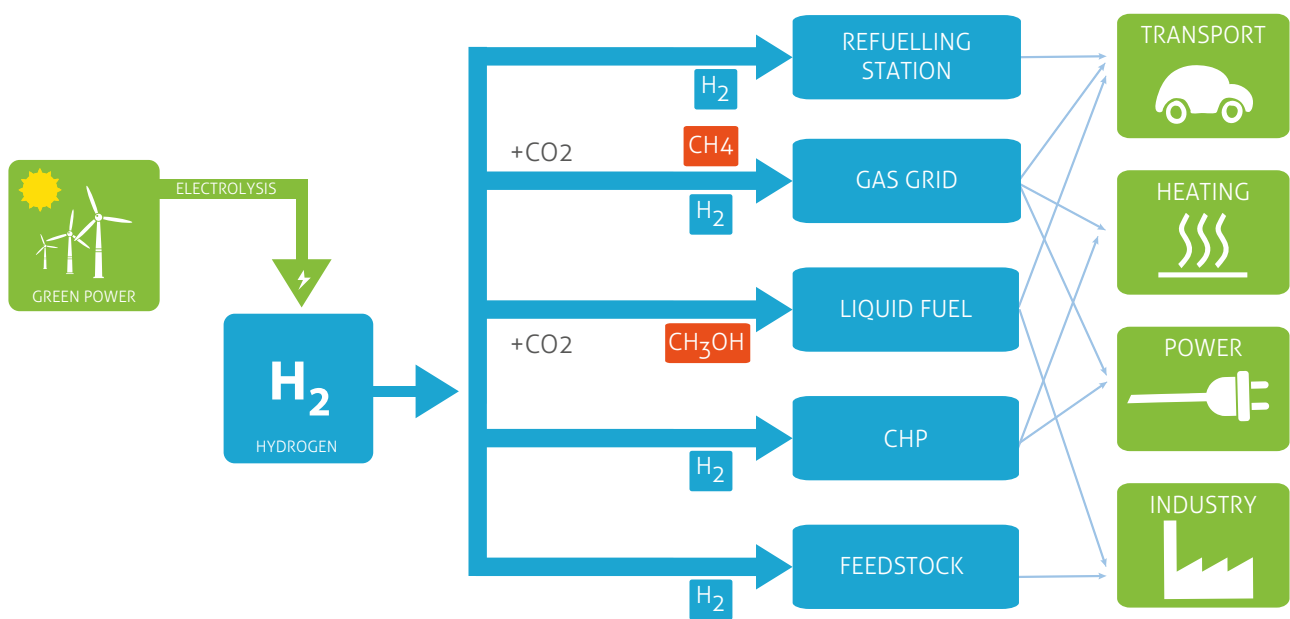
The results for Flanders are presented in the road map, available for download at www.waterstofnet.eu or www.power-to-gas.be.

The Flemish industry cluster Power to Gas was established as a follow-up to the study (see page 42).

The role of WaterstofNet

WaterstofNet developed the project idea and wrote the project proposal. WaterstofNet cooperated in the development of the business cases and coordinates the IBN cluster Power-to-Gas, which was set up to develop concrete projects based on the road map.







Road maps and studies

Studies



www.hylaw.eu

DURATION

2017 - 2018

PARTNERS



PROGRAMME



Analysing the barriers to large-scale implementation of hydrogen

HyLaw

The European project HyLaw is focused on the regional analyses of barriers that hinder the large-scale implementation of hydrogen as an energy carrier. The analyses are focused on technical-economic and legal considerations. Working together allows the regions to search for mutual solutions that can then be communicated on the European level for easier implementation.

The role of WaterstofNet

WaterstofNet is responsible for the analyses for Belgium.



Potential study for green hydrogen

On behalf of VEA (Flemish Energy Agency), WaterstofNet and Hincio have worked together to devise a potential study for green hydrogen in the Flemish energy landscape.

This study estimates the opportunities for green hydrogen in Flanders, starting with the results and insights derived from foreign studies. The study includes both the technical potential (e.g. how much hydrogen can be used to decarbonise the transport, heat and industry sectors?) and the economic impact (e.g. what are the costs of implementation). In order to facilitate the implementation of hydrogen, a number of policy proposals have been formulated.

The results have been translated into a road map outlining green hydrogen in Flanders up to the year 2030, with a global estimation for 2050.

The study can be downloaded on the website www.waterstofnet.eu.

The role of WaterstofNet

WaterstofNet coordinated this study.

www.waterstofnet.eu

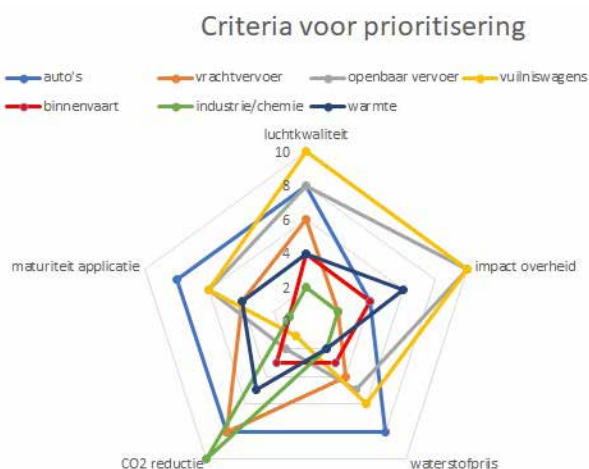
DURATION

2017 - 2018

PARTNERS



PROGRAMME



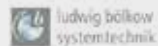


www.certifhy.eu

DURATION

2017 - 2018

PARTNERS



PROGRAMME



Green hydrogen certification

CertifHy

The goal of the CertifHy project is the implementation of Guarantees of Origin (GOs) to prepare for green and low-carbon hydrogen. The certification of green character of hydrogen made from renewable energy is important for its further valorisation. Guarantees of Origin are essential for demonstrating to consumers and companies how environmentally friendly - or green - hydrogen is. This enables them to make a contribution to energy transition.

As part of the project, a schematic for GOs for hydrogen will be developed. It will be valid throughout Europe. As part of the CertifHy project, there have been three pilot projects selected in Europe, including the Don Quichote project at Colruyt in Halle (see page 9). The process for the granting of GOs to green hydrogen production will be tested.

The role of WaterstofNet

As part of the stakeholders' platform, WaterstofNet is the chair of the work group: Guarantees of Origin: Commercialisation and Use. This work group will examine the conditions and possibilities of the Guarantees of Origin from the perspective of the user. In this role, WaterstofNet is also a member of the project steering committee.



Large-scale hydrogen production in a port environment

Greenports

The Greenports study project is supported by VLAIO within the call for transition priorities. It examines the optimal technical solutions, market economy boundary conditions and the necessary legal framework for converting large amounts of onshore and offshore wind energy available in port environments via electrolysis into hydrogen (power-to-gas). The resulting hydrogen can be used in various valorisation paths:

- Injection of the H_2 into the natural gas network as a carbon-free source of heating or mobility (CNG);
- Use of the H_2 for zero-emission mobility;
- Use of the H_2 in industry.

The goal of the project is to deliver optimal technical solutions as well as to sketch out the economic boundary conditions and the legal framework, and to make the integration of large-scale power-to-gas installations possible in an economically feasible manner in the energy system in Flanders/Belgium.

The study focuses specifically on the port in Zeebrugge but is open to translation to other confluence points of green electricity and gas.

The role of WaterstofNet

WaterstofNet has created this project proposal within the Power-to-Gas cluster and is coordinating the implementation of the study.

www.power-to-gas.be

DURATION

2018 - 2020

PARTNERS



PROGRAMME



www.waterstofnet.eu

DURATION

2017

PARTNERS



PROGRAMME



Smart battery and hydrogen-integrated energy-storage system for solar energy

Sunshine

Sunshine stands for SUN-based Smart battery and Hydrogen Integrated Novel Energy-concept.

This feasibility study, supported by VLAIO and facilitated by the spearhead cluster Energie Flux50, examined the technical and economic feasibility of 'hybrid' energy storage (battery and hydrogen) at the Terranova Solar solar park in Zelzate. The goal was to create added value for the electricity produced.

Possible valorisation paths include producing and selling hydrogen for zero-emission transport applications, support services for the electricity network, and other applications.

The follow-up of this feasibility study is the construction of a demonstration on the Terranova Site. A consortium will be formed for this.

The role of WaterstofNet

WaterstofNet created this project proposal within the Power-to-Gas cluster and coordinated the market exploration for the hydrogen.





DURATION

2016 - 2018

PARTNERS



PROGRAMME



Flemish industry cluster on green electricity and hydrogen

Cluster Power-to-Gas

About thirty Flemish companies have united in an Innovative Business Network (IBN) and are actively working together on power-to-gas.

The corporate cluster was set up as a successor to the 'Power-to-gas road map study' for Flanders (see page 34).

In Flanders, a number of companies are present across the entire ‘power-to-gas’ value chain (from energy production to hydrogen end-users). By working together intensively as a cluster on concrete projects, Flemish industry can take a strong position in this future market.

The activities of the cluster are:

- to perform ‘power-to-gas’ feasibility studies at specific locations in Flanders (including Greenport – see page 39 and Sunshine, see page 40);
- to develop and realise demonstration projects focused on ‘power-to-gas’ in Flanders;
- to develop creative business models that can lead to an interesting profit-making ‘power-to-gas’ market in the future;
- to exchange knowledge and communal knowledge-building about ‘power-to-gas’ concepts;
- to profile the Flemish industry within the European ‘power-to-gas’ market;
- to act as the contact on the Flemish-Belgian level for the role of ‘power-to-gas’ in the future energy strategy.

The role of WaterstofNet

WaterstofNet is initiator and coordinates the work of the cluster.





Industrial ecosystem regarding hydrogen in Flanders - South Netherlands

Hydrogen Region Flanders - South Netherlands and Hydrogen Region 2.0

Since 2009, Flemish and Dutch technology developers, end-users, governments and research institutions, under the coordination of WaterstofNet, have been working together on various hydrogen projects.

The first projects, as shown in this brochure, are framed within the Hydrogen Region Flanders-South Netherlands project, and are based on the first hydrogen refuelling stations with electrolysis and the development, building and demonstration of innovative modes of transport based on hydrogen (forklifts, refuse trucks, buses, etc.).

From the results, the region created a unique ecosystem based on hydrogen and has become involved in various European hydrogen projects.

The Hydrogen Region 2.0 project started in April 2016, also financed by Interreg Flanders-Netherlands. This project reinforces the structural cooperation between the Flemish and Dutch players, by the development of more and unique demonstrations, also described in this brochure.

In addition to the realisation of demonstration projects, within Hydrogen Region 1.0, workshops on hydrogen were organised in the various provinces of the region. With more than 500 participants, we can say that the interest in hydrogen has grown, and that the ecosystem around hydrogen has expanded enormously since 2009.

From this ecosystem, WaterstofNet wants to structurally extend its trailblazing role: regionally, nationally and internationally.



www.waterstofnet.eu

DURATION

2009 - ...

PARTNERS



PROGRAMME





International cooperation

There is a strong international dimension to the expansion of the concept of hydrogen as a fuel. WaterstofNet believes it is crucial to work closely with other hydrogen regions and to be active in the trend-setting international networks involving hydrogen.



Dutch hydrogen platform

WaterstofNet participates in the activities of the Dutch hydrogen platform and cooperates in the introduction of hydrogen in the Netherlands.



WaterstofNet works together with other hydrogen regions

WaterstofNet has entered into a 'Memorandum of Understanding' with HyCologne (Cologne) and H2 South Tyrol (Bolzano). Both hydrogen regions have pursued hydrogen activities similar to those in our region. The collaboration, including the exchange of knowledge and experience, has proven to be highly educational and has resulted in added value for all parties.



WaterstofNet represents Flanders within the 'Region' programme of the Fuel Cell and Hydrogen Joint Undertaking (FCH-JU)

The FCH-JU project started with about 90 regions in Europe collaborating to develop a vision for the implementation of hydrogen in the regions. Flanders entered this project via a 'Memorandum of Understanding', with WaterstofNet designated as the representative for Flanders for the project.



WaterstofNet is a member of Hydrogen Europe as the representative of the Belgian association

WaterstofNet represents Belgium as a member of Hydrogen Europe. In the FCH-JU, Hydrogen Europe is the glue that binds European industries and associations together. As such, WaterstofNet is able to further develop European initiatives regarding hydrogen.



WaterstofNet represents Belgium within the International Energy Agency (IEA)

On a global level, within the Hydrogen Implementing Agreement of the International Energy Agency (IEA), there is an active exchange of hydrogen-related knowledge and experience organised among countries including Japan, China, South Korea, Germany, the United Kingdom, France, Denmark, the Netherlands and Italy. WaterstofNet represents Belgium in the network, acting as an intermediary between the agency and the Flanders-Netherlands region.



Thesis or dissertation on hydrogen?

WaterstofNet is looking for students interested in hydrogen

Are you a student or researcher with an interest in performing a study on hydrogen?

WaterstofNet would love to help you on your way. WaterstofNet has already worked with students.

Students at the University of Antwerp are performing an analysis of the technical-economic possibilities of hydrogen-powered refuse trucks within the framework of Socially Responsible Companies.

And students of Group T (KU Leuven) are developing a calculation programme for establishing the dimensions of a hydrogen installation on a production site of

green power (solar and/or wind), with various customers for the hydrogen (industrial customers and mobility applications). The Philips Turnhout site is serving as an example.

In addition, a student of the Karel de Grote College is working on the creation of the demand for hydrogen applications for a possible hydrogen refuelling station in Turnhout.

Are you a student and have an idea for a thesis or dissertation or internship? Then contact WaterstofNet!



Collaboration?

Hydrogen provides opportunities for companies

Are you and/or your company interested in working with WaterstofNet on new hydrogen projects? Would you like to take part in the Power to Gas cluster? Do you have project ideas? Then contact WaterstofNet!



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