

Waterstof en leidingen

Adwin Martens
WaterstofNet

> 70.000 km 2 tankstations 12 projecten

BIG-DAG, Antwerpen, 13 juni 2018

Inhoud

- WaterstofNet
- Waterstof: waarom en wie ?
- Waterstof: stand van zaken
- Waterstof en leidingen



WaterstofNet

- started in 2009
- Focus on projects and roadmaps
 - zero-emission mobility
 - energy storage (green electricity)
- Develop, realise, coordinate, communicate
- Close cooperation with industry and governments
- Representing Belgium in IEA-Hydrogen
- Member of Hydrogen Europe



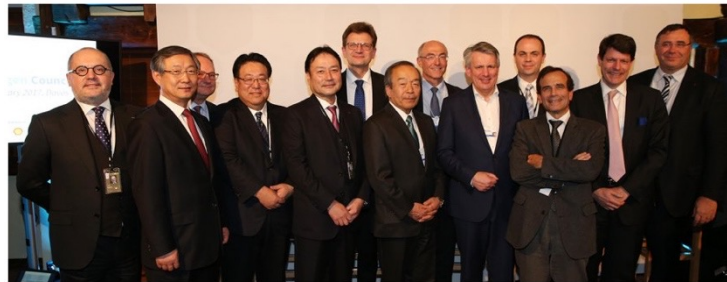
International driving forces for hydrogen



- Waterstof is al gekend in industrie (500 mld Nm³/jaar)
- Zero-emissie transport
 - infrastructure
 - vehicles > 10.000 > 1.000 > 100 > 10
- Green electricity
 - value of renewables 150 50 30 19
 - need for storage
- Europe supports hydrogen and fuel cells (> 100 M€/year, 1,4 Bln €/7 year)

Hydrogen Council:

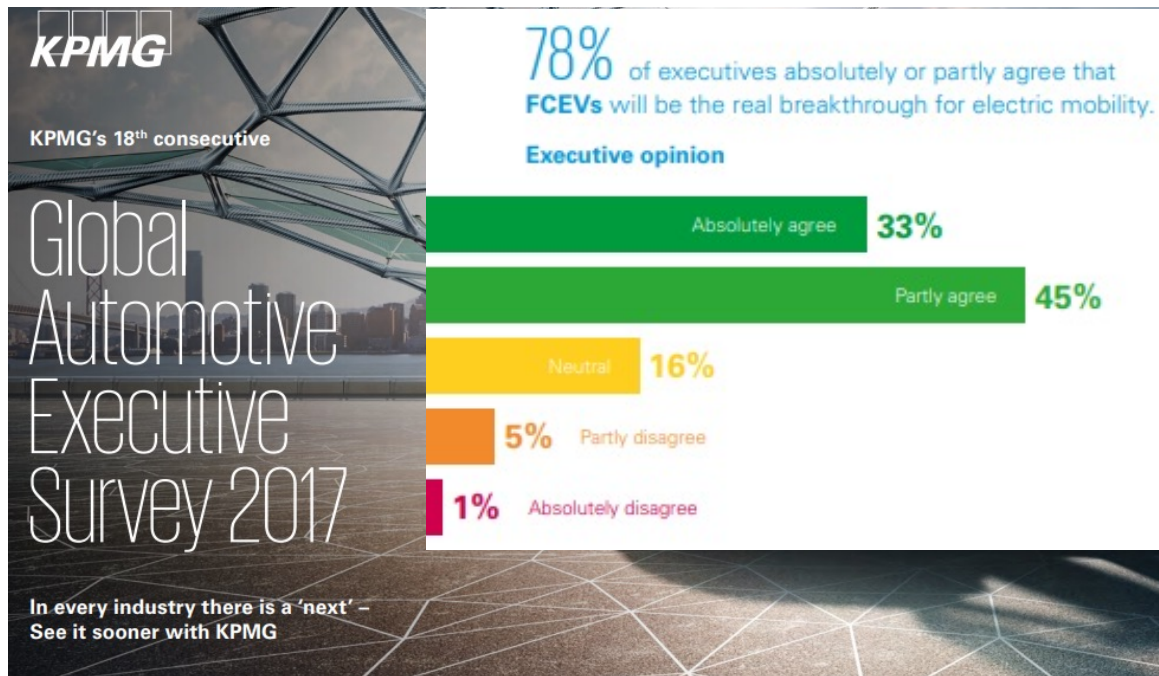
13 multinationals invest 10 billion in hydrogen



Annual analyses KPMG (> 900 executives)



WaterstofNet

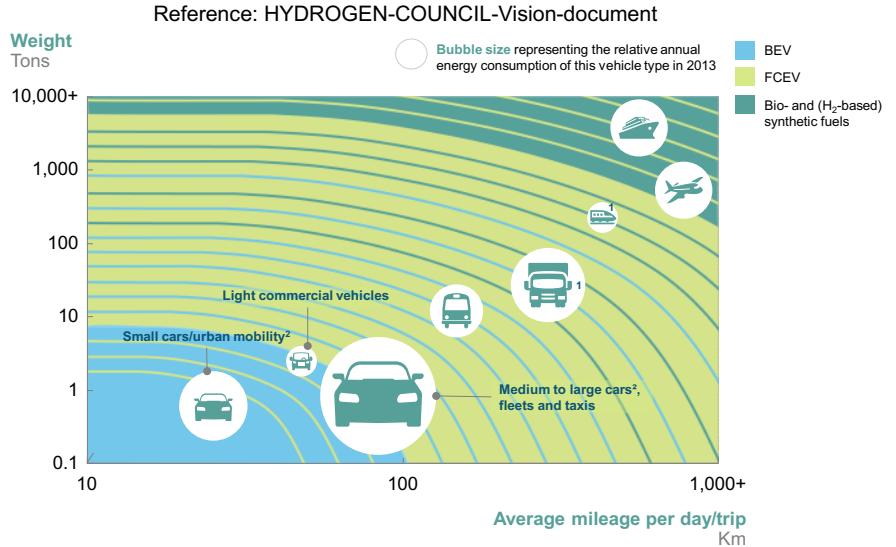


Business potential for hydrogen in mobility



Crucial advantages
 price vehicles
 price hydrogen

FCEVs will play an essential role in decarbonizing transport
 Projected economic attractiveness

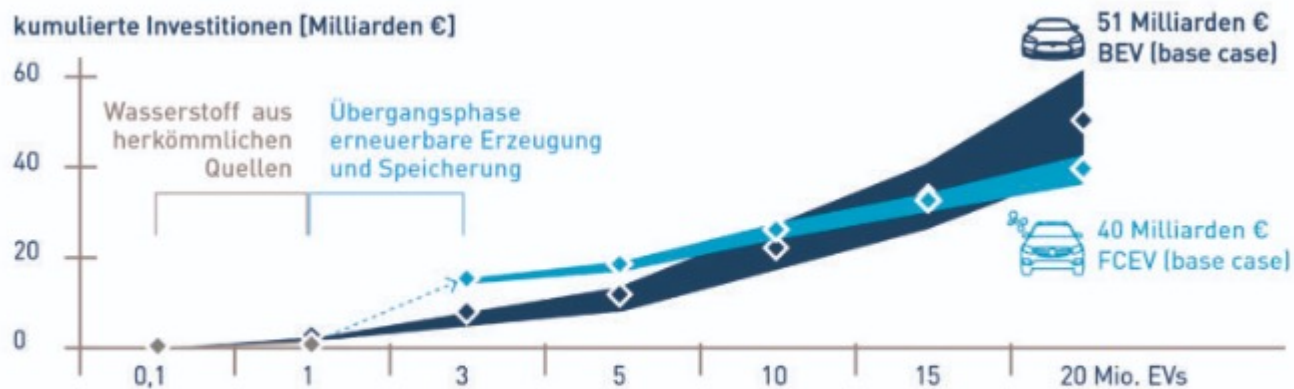


¹ Battery-hydrogen hybrid to ensure sufficient power

² Split in A- and B-segment LDVs (small cars) and C+-segment LDVs (medium to large cars) based on a 30% market share of A/B-segment cars and a 50% less energy demand

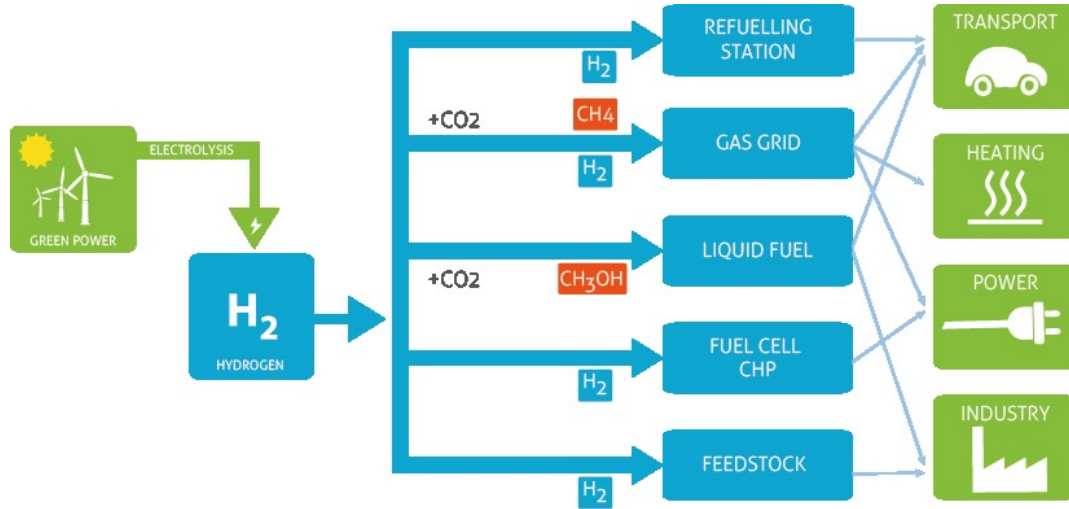
Source: Toyota, Hyundai, Daimler

Resultaten studie Jülich



Total Infrastructure Costs of Battery-Electric Vehicles (BEV) and Fuel Cell Electric Vehicles (FCEV) depending on the number of vehicles

Power to Gas



Cluster Power-to-gas





2012

2013

2014

2015

2016

2017

2020



Hydrogen Refueling Station Halle



1MW Fuel Cell plant



H2 forklift truck



Interreg Vlaanderen Nederland
Europe investeert in uw regio



Hydrogen Refueling Station Helmond



H2 garbage truck



H2 boats



H2 passenger bus



Hydrogen in smart grid environment



14 buses in 4 cities



Scenario refueling stations Belgium



Hyundai ix35 at WaterstofNet



Feasibility study Power-to-gas



29 refueling stations and 325 cars



Demonstration of 2 garbage trucks in 10 cities



29 buses in 7 cities



2 Buses Eindhoven



Bedrijvencluster Power-to-gas



Demonstrations on infrastructure and zero-emission applications in Flanders and the Netherlands



Demonstration of a hydrogen truck in 4 European Countries



Analyse regelgeving/barrières

Approved July 2017



H2Benelux

Approved July 2017



Revive

Status August 2017

2012: 1 MW fuel cell plant byproduct hydrogen

- 1MW (1,6MW Piek) elektriciteit gekoppeld aan 6kV Net
- 168 stacks
- 12 600 cellen (75 per stack)
- 70 kilo waterstof per uur



2012 : Tankinfrastructuur : tankstation bij Colruyt in Halle

- Operationeel: sinds 2012
- Locatie: Halle, België
- Groene waterstof uit zon/wind
- Vlaamse leverancier, Hydrogenics
- Drukniveau: 350 bar
- Toepassing: heftrucks, 1 – 2 -12 - 75
- 5000 tankingen
- Grootste vloot in Europa
- Start activiteiten waterstof Colruyt Group



Heftrucks op waterstof

- 2013 : 2 heftrucks
- 2016 : 20 heftrucks
- 2018 : indoor + 75 heftrucks (WR 2.0)



WaterstofNet



Tankinfrastructuur : uitbreiding tankstation bij Colruyt in Halle (Don Quichote) WaterstofNet

- Benchmark van alkalische elektrolyse en PEM-elektrolyse
- Demonstratie van gebruik van waterstof in **logistieke toepassingen** (o.a. heftrucks) en/of in een brandstofcel (120 kW) **teruglevering aan het elektriciteitsnet**
- Cost: € 4,946,134
- Europese funding FCH JU: € 2,954,846
- Partners: WaterstofNet vzw, Etablissement Franz Colruyt, HyET, TUV Rheinland, JRC, Thinkstep, Icelandic New Energy Ltd, FAST
- Opening op **9 maart 2016**
- Veel bezoekers: **EU, MIT,**



2013: Tankstation Automotive Campus Helmond

- **Operational:** since 2013, > 1000 refuellings
- **Location:** Helmond, The Netherlands
- **Production:** renewable hydrogen, electrolyses 30 Nm³/h or 2,7 kg/hr
- **Pressure level:** 350 & 700 bar
- **Storage:** 150 kg
- **Application:** passenger vehicles, buses, garbage truck
- **Extensively used for test programme by Toyota Motor Europe**



2013: vuilniswagen (E-Trucks) en bus (VDL)



2 bussen (VDL) in Helmond



Click on a location for more information about the project



Sloepen op waterstof

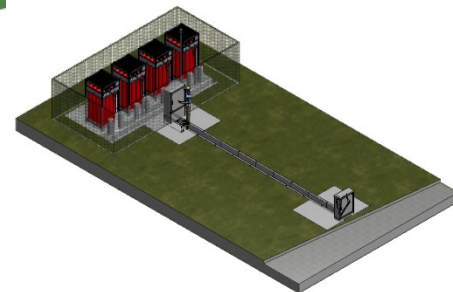
2 sloepen met fuel cell

HYDROGEN XPERIANCE

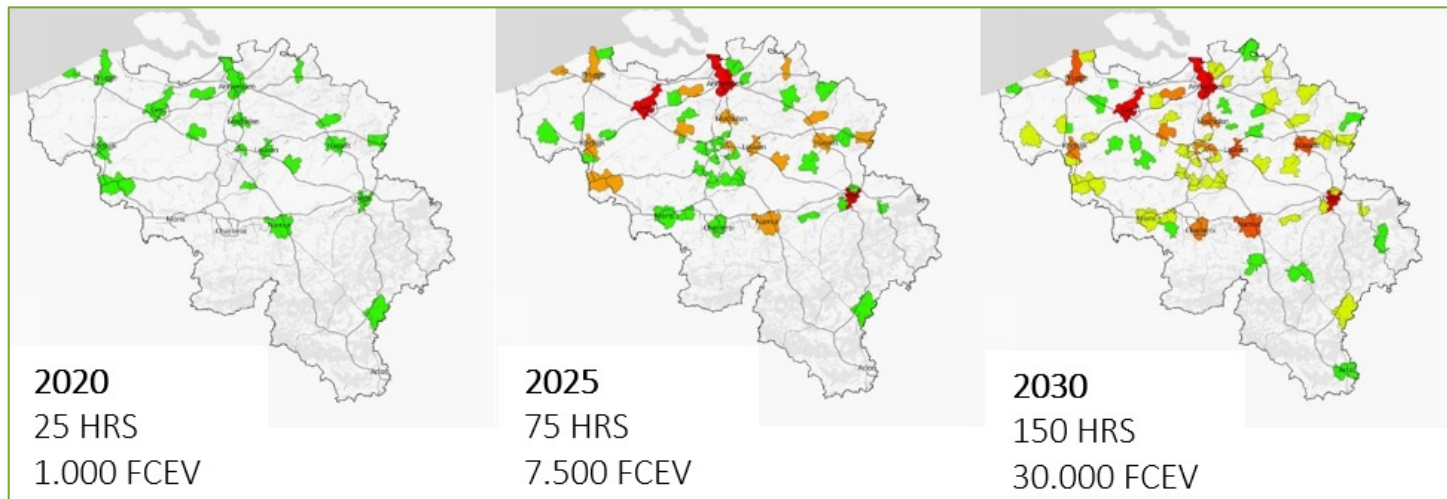
- Vaartuig: Vlet 700, 7,26 m x 2,30 m x 0,60 m (L x B x D)
- Ontwikkelde drijflijn: PEM-brandstofcel (1,2 – 2 kW), accu's (48 V, 230 Ah)
- Opslag waterstof: 200 bar, 4 flessen van 30 liter (watervolume)

WECO 635

- Vaartuig: spitgat sloep, 6,35 m x 2,30 m x 0,55 m (L x B x D)
- Klassieke drijflijn: 11 kW diesel met 2,2 elektromotor met batterij (48 V, 55 Ah)
- Ontwikkelde drijflijn: PEM-brandstofcel (2 – 5 kW)
- Opslag waterstof: 350 bar



Tankinfrastructuur : H2Mobility Belgium



Projectaanvraag: H2Benelux (TEN-T/CEF)

- 8 tankstations + 80 auto's
 - 4 Nederland
 - 3 België
 - 1 Luxemburg



Vuilniswagens op waterstof



2013: Waterstofregio 1.0 (Interreg)



2016: Life & GrabHy (Life)
(2 in 10 EU-steden)



In uitvoering ReViVe 15 vuilniswagens (JU-FCH)

Demo Sites

- Breda
- Helmond
- Groningen
- Amsterdam
- Antwerp
- Fribourg
- South Tyrol
- Roosendaal

REVIVE across Europe



Core objectives

- Develop a high performance fuel cell refuse truck that can provide the flexibility of incumbent solutions
- Trial the trucks in their operating environment
- Compile the evidence base for continued rollout of the technology
- Raise the profile of the technology as a viable option for waste collection
- Demonstrate that hydrogen fuelled refuse vehicles can have a significant impact on the utilisation of urban refuelling stations

Vrachtvervoer op waterstof

2016: Waterstofregio 2.0

Vrachtwagen 40 ton op waterstof (Interreg)



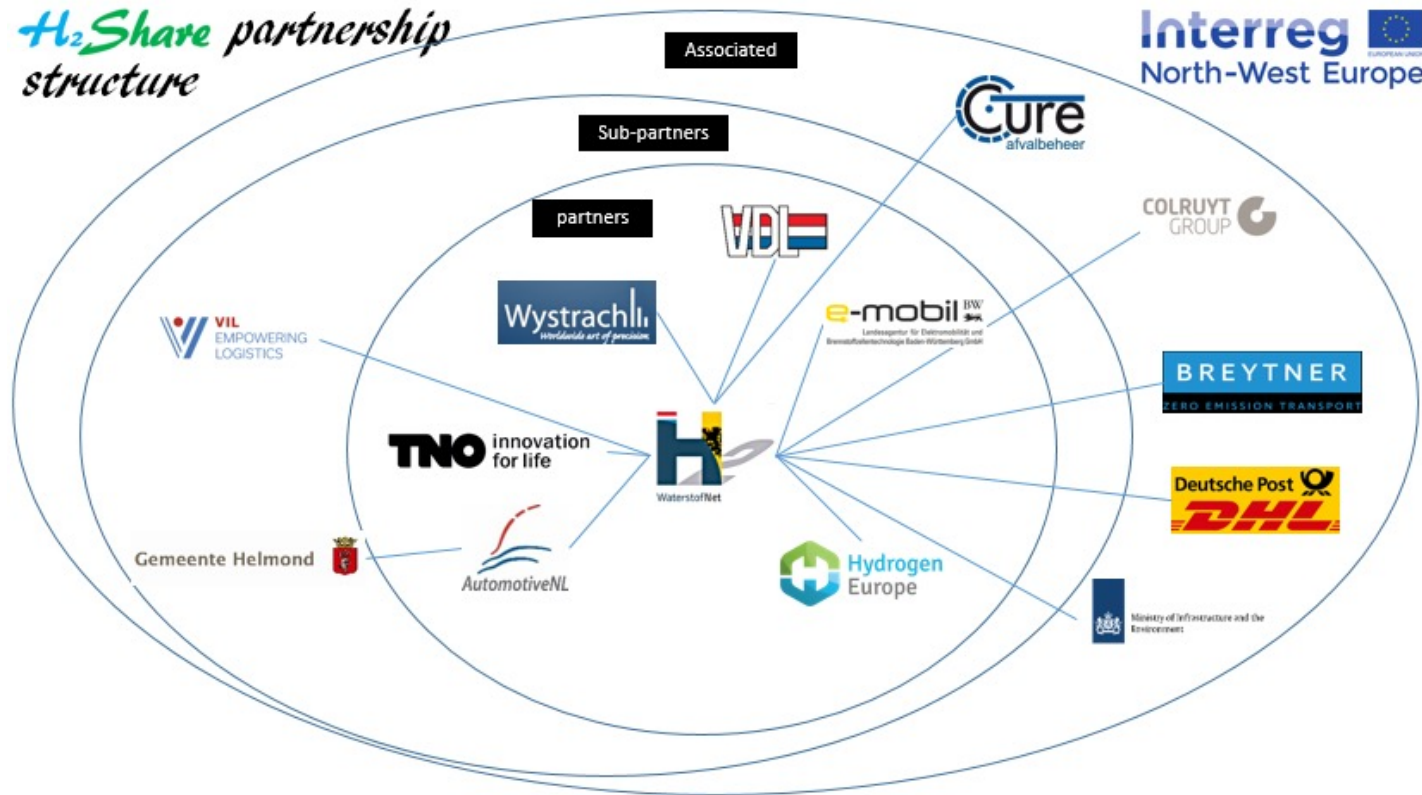
2016: H2SHare (Interreg)

Vrachtwagen 26 ton

Mobiel vulstation



H₂Share partnership structure



Interreg
North-West Europe



WaterstofNet



Waterstof en leidingen....

- “Op termijn” naar 100% groene elektriciteit
- Massief grote offshore-wind en zonneparken
- TRANSPORT ?
- Waterstof (gas in leiding, vloeibaar in schip, methanol, ammonia,...)

Cable versus pipeline cost

	Cable (BritNed)	Pipeline (BBL)
Capacity	1 GW	15 GW
Construction Cost	€ 500 mln	€ 500 mln
Volume (year)	8 TWh	120 TWh

Uniek waterstofleidingnet



WaterstofNet



Leeds: aardgas/CCS naar waterstof (H21)



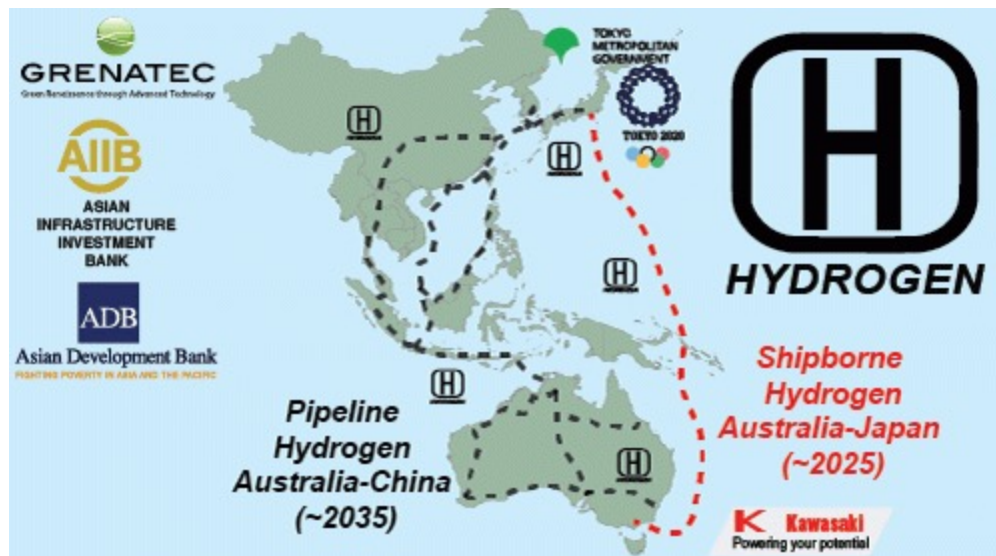
Groningen

Green Hydrogen Economy Northern Netherlands 2030



WaterstofNet

Japan



Besluit

- Na decennia “praten over waterstof” wordt het nu “gebruiken van waterstof”
- Waterstof verbindt groene elektriciteit – transport – chemie – warmte -...
- Infrastructuur (transport en opslag) is cruciaal voor waterstof
- Benelux is een sterke dimensie voor waterstof
- Hoe past dit in het toekomstverhaal van BIG ?