



**POWER TO GAS**

Industry Cluster Flanders

**BECOMES**



**WATERSTOF  
INDUSTRIE  
CLUSTER**

# AGENDA

**9.00 – 9.30: Arrival and reception with coffee**

**9.30 – 10.10: Presentation new cluster members: Nedstack, Berkman, Renewi, Delhaize and Storm**

**10.10 – 10.45: Presentation Agfa group and membranes for alkaline electrolysers**

**10.45 – 11.10: Presentation Nouryon about electrolysis**

**11.10 – 11.30: Short coffee break**

**11.30 – 12.00: News from the cluster**

**12.00 – 12.20: Project news from cluster members**

**12.20 – 13.00: Agfa energy management + visit energy installation**

**13.00 – 14.00: Walking sandwich lunch**

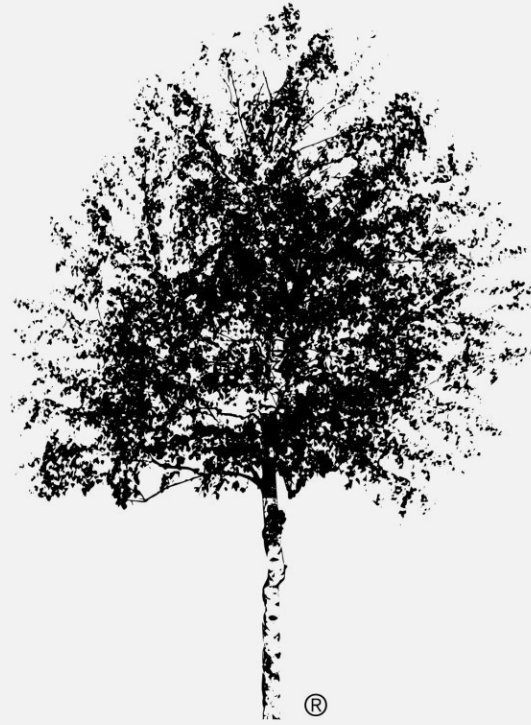
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# Presentations new cluster members



➔ **June**

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®

**B E R K M A N**

O N D E R N E M E N D S I N D S 1 9 0 3





**B E R K M A N**

O N D E R N E M E N D S I N D S 1 9 0 3



**B E R K M A N**

O N D E R N E M E N D S I N D S 1 9 0 3





**B E R K M A N**

O N D E R N E M E N D S I N D S 1 9 0 3

Slang nog in  
pomp laten  
Pompnummer  
onthouden  
Volg de  
instructies van  
de automaat op  
Slang afnemen  
en tanken  
Slang ophangen





**B E R K M A N**  
O N D E R N E M E N D S I N D S 1 9 0 3

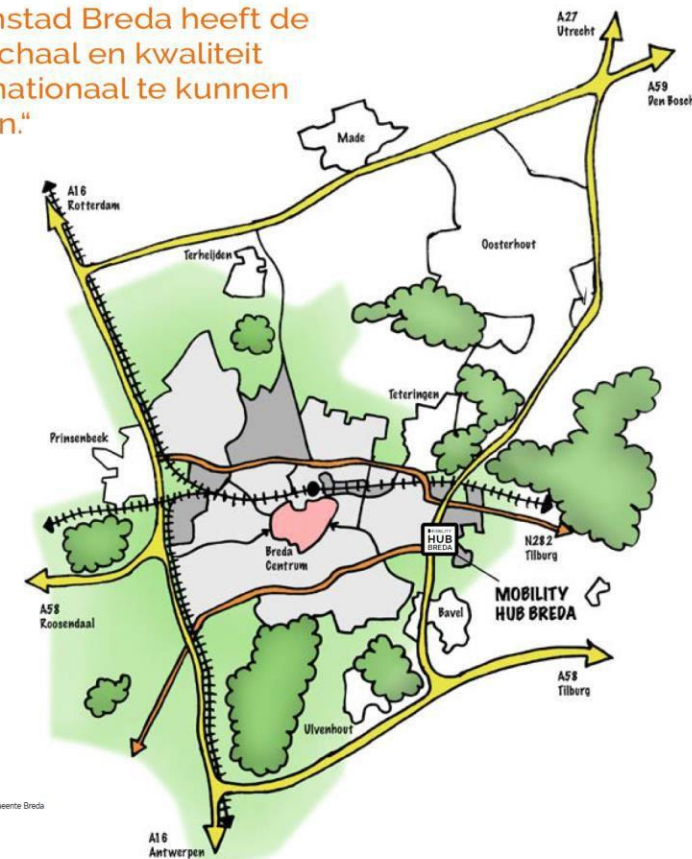


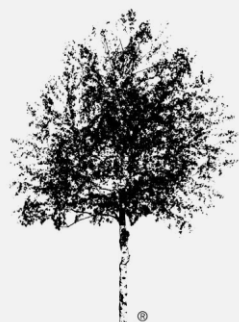
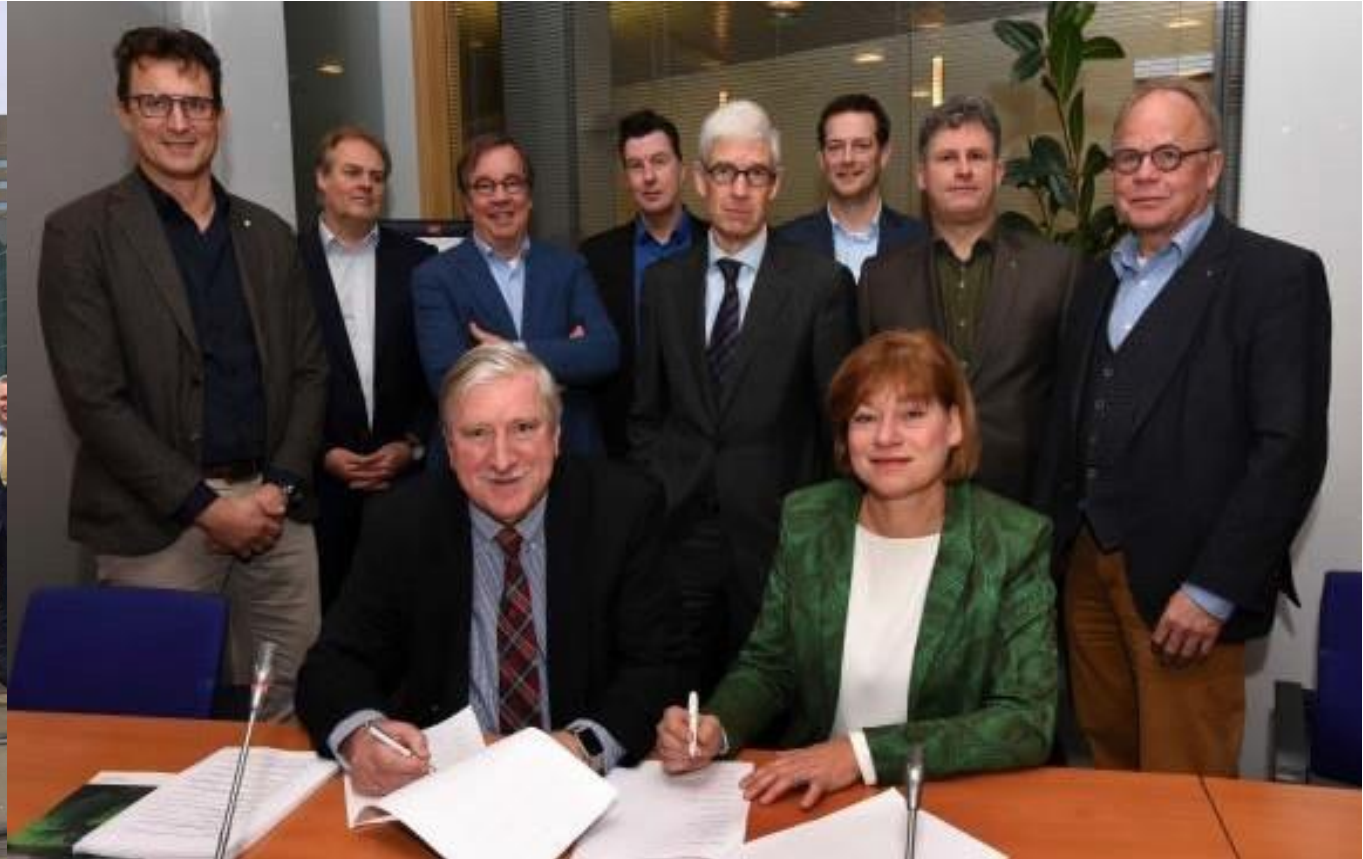


Figuur: Merkidentieit



“Centrumstad Breda heeft de ligging, schaal en kwaliteit om internationaal te kunnen schakelen.”





**B E R K M A N**  
O N D E R N E M E N D S I N D S 1 9 0 3



# Sustainability at Delhaize Belgium - Luxemburg

Luc D'Hondt  
WaterstofNet vzw  
March 5th 2020



# LUC D'HONDT

## Transport sustainability and mobility manager



°August 7<sup>th</sup> 1959

Delhaize since July 1<sup>st</sup> 1985

Bachelor Industrial Chemistry

Married

3 Children (34 - 32 - 23)

Foster Parent of A. (10)

- o Sustainable Transport and Mobility Manager
- o Manager European Transport Optimization
- o Manager External Logistics and European Transport Optimization
- o Manager External Logistics BeLux
- o Coördinator External Logistics BeLux
- o Strategic Planner
- o Store Manager DIAL
- o Assistent Store Manager DIAL







2016



# DELHAIZE, PART OF AHOLD DELHAIZE



10  
Countries



Local,  
Personal &  
Convenient

Dependable  
Value

Best  
Own Brands

Fresher & healthier

Leading in  
sustainable retailing:  
Proud member of DJSI

  
~372,000  
associates

Great  
Local  
Brands

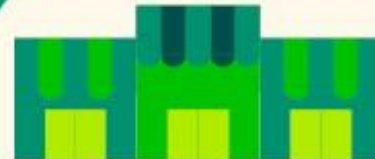
Sustainable



Leading  
in  
eCommerce



Strong  
financial  
profile



~6,769  
stores

Eat well.  
Save time.  
Live better.



top 10  
International  
food retailer



Weekly customer visits  
>50m in stores  
>20m online

150 years  
experience  
in food  
retailing

# SUSTAINABLE RETAILING STRATEGY



- Contribution to Sustainable Development Goals (SDG)
- Global strategy and local implementation
- Clear sustainability KPIs
- Part of incentive scheme

Ahold Delhaize Sustainable Retailing focus areas





Ahold  
Delhaize

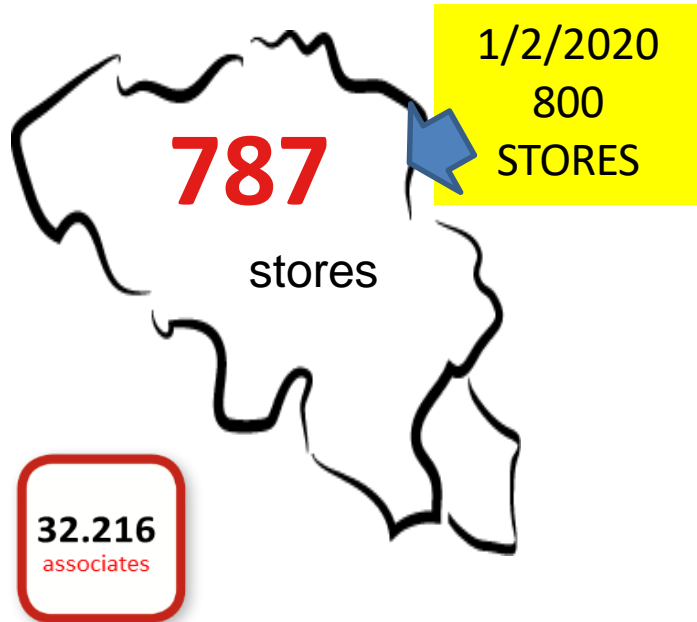
DELHAIZE LE LION  
DELHAIZE DE LEEUW

The food expert in Belgium



DU CÔTÉ DE LA VRAIE VIE  
MEE MET 'T LEVEN

# DELHAIZE BELGIUM & LUXEMBURG – KEY FIGURES



**5** million customers per week

5 billion sales (2018)

24,01 Market Share

50.000.000 Outbound km Year

	<b>12</b> 8 +8 LU	COMPANY OPERATED STORES
	<b>22</b> 0 +2LU	AFFILIATED STORES
	<b>24</b> 4 +19 LU	AFFILIATED STORES
	<b>13</b> 7 +24 LU	AFFILIATED STORES
	<b>5</b>	AFFILIATED STORES
	<b>13</b> 5	STORES WITH ONLINE SHOPPING SERVICE





**LARGE AND INNOVATIVE**

**ASSORTMENT**

**> 28.000**  
products  
= total  
assortment

**17.000**  
products  
= permanent  
assortment

**>5.000**  
products  
in fresh





A child is holding a white colander over their face, with white powder falling from it. The background is a kitchen setting. The advertisement features the Delhaize logo (a lion) and the text "DELHAIZE ZET OP TAFEL: DE SUIKER ONTDEUKERS" with a smiley face. Below this, it says "LEKKER KAN OOK MET MINDER SUIKER." and a small footnote: "\* Minder suiker in vergelijking met het gemiddelde van vergelijkbare producten van andere huismerken. Meer details op www.delhaize.nl". To the right is a box of Delhaize extra Honey balls cereal, featuring a cartoon lion and the text "Bron van vezels Source de fibres" and "32% MINDER SUIKER".

**FOCUS ON HEALTH**



UNE PASSION PARTAGÉE AVEC NOS PRODUCTEURS !



LEADER IN FRESH

AND QUALITY







**STORES FOR ALL NEEDS**





**THE TIME IS NOW**



**DU CÔTÉ DE LA VRAIE VIE  
MEE MET 'T LEVEN**



# YES IT IS ...



“Beter eten, beter leven”.  
“Mieux manger pour mieux vivre”.



 **DELHAIZE** | DU CÔTÉ DE LA VRAIE VIE  
MEE MET 'T LEVEN

# THE LION'S FOOTPRINT



Less Plastic  
Less Carbon  
Less Waste

## Delhaize's Lion FootPrint

Clear strategy

- Remove plastics and rethink packaging
- Reduce Co<sup>2</sup> emissions and be CO<sup>2</sup> neutral by 2021
- Avoid food waste and continue to give to charities
- Communicate our achievement weekly online

## THE LIONS FOOTPRINT



Ambitious from producer to customer

- Goals are ambitious but cannot be achieved in one go.
- Take various initiatives step by step.
- We are not alone in this fight for a better future.
- We have asked all Delhaize employees and customers, as well as our suppliers and producers, to participate.
- Everyone together to achieve our goal. Everyone makes the difference. Because every step counts and what we do together we do better!





**LESS CO2**



# DECREASE CARBON

 **-30%**  
ENERGY CONSUMPTION  
in new buildings

 **-44%**  
CO<sub>2</sub> EMISSION  
since 2008

Exclusive installation of  
**LED**  
LIGHTING  
EVERYWHERE  
SINCE 2014 

**BEER TRAIN**  


**5.000**  
LESS TRUCKS  
ON OUR ROADS

2 out of 3  
stores with  
NATURAL  
REFRIGERANTS  


+ 4.000 M<sup>2</sup>  
new solar panels  


**20%**  
of our (integrated)  
stores are  
**COMPLETELY FREE  
FROM FOSSIL FUELS**

**50 FREE**  
charging stations  


## Less carbon

- Already – 44% of CO<sub>2</sub> emission since 2008

## Next step: become neutral

- Calculate the carbon footprint of our stores, offices, warehouses, e-comm, logistics and fleet
- Reduce as much as possible
- Compensate what can't be reduced
- Be neutral by 2021

# RETHINK LOGISTICS : PARTNERSHIP WITH URBIKE






# A vision for a sustainable transport and mobility management @Delhaize

Luc D'Hondt  
Sustainable Transport and Mobility Manager

**DELHAIZE LE LION**  
**DELHAIZE DE LEEUW**

ANTWERP  
FEBRUARY 4<sup>TH</sup> 2020

 **DU CÔTÉ DE LA VRAIE VIE**  
**MEE MET 'T LEVEN**

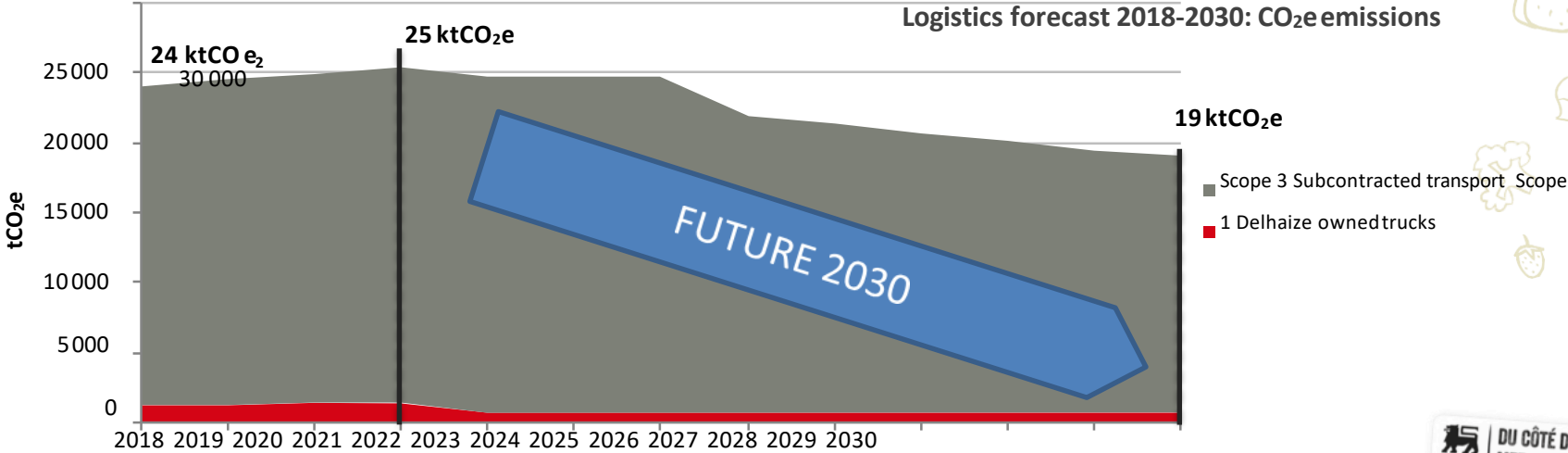
# OUTBOUND TRANSPORT

- **How CO<sub>2</sub> emissions will evolve?**

Logistics emissions are likely to increase (Delhaize expected sales growth) until new technology allows CO<sub>2</sub> reduction (hybrid, CNG, H<sub>2</sub>trucks)

Forecast on logistics results in **21% reduction** in 2030

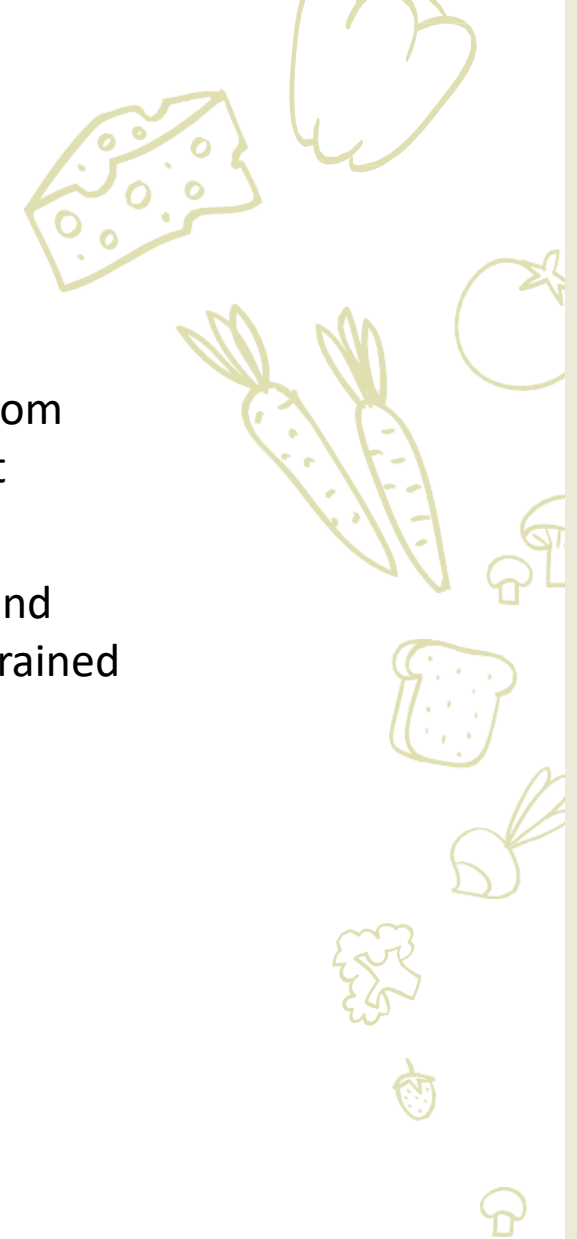
- -46% reduction on Delhaize owned trucks
- Logistics reductions relies mostly on transporters



## GLOBAL VISION

2030

- 2030: CO2 neutral transport: transport mode at the choice of carrier
- CO2: Reduction plan per cluster (micro, mini, medium, large) phased from 2021 to 2025 and then gradually until 2030 for a CO2 neutral transport  
TBC: FROM 1/1/2021: Only Euro 6 or higher in our own fleet
- Transition to a transport fleet with less carriers but with more trucks and
- more specialization (evolution of technology will lead to "differently" trained truck drivers)





THANK YOU

**Departement**

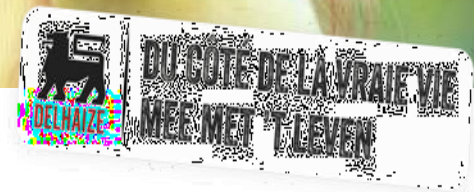
LOGISTICS  
TRANSPORT

**Name/first name**

LUC D'HONDT



[lldhondt@delhaize.be](mailto:lldhondt@delhaize.be)







# Nedstack Presentation



**Nedstack**

PEM FUEL CELLS

*To be sure.*





Nedstack

FUEL CELL

A

Company

Nedstack fuel cell technology BV



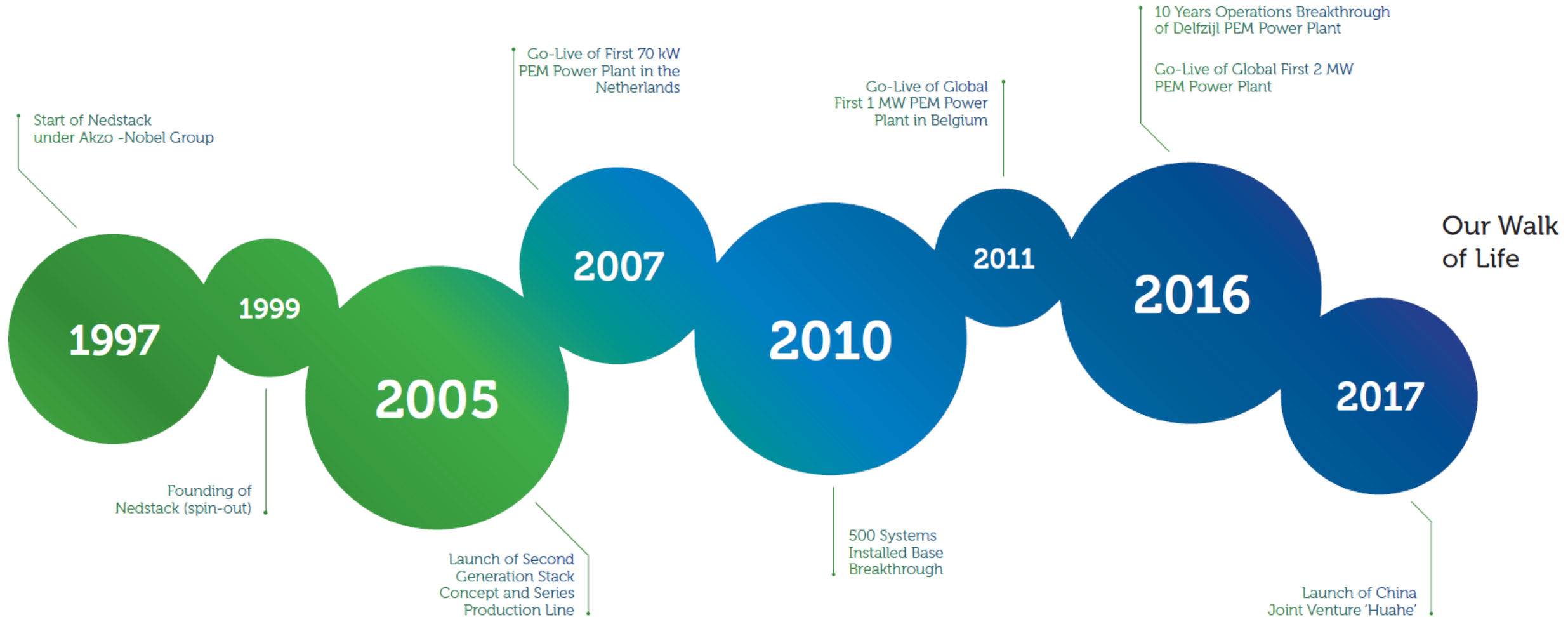
# Nedstack | Company timeline

Company

H2 economy

Markets

Solutions









## Nedstack Client and Partner selection

## Nedstack EU Funded Projects

Company

H2 economy

Markets

Solutions

			<b>FUEL CELLS AND HYDROGEN JOINT UNDERTAKING</b>
			<b>GRASSHOPPER</b> Grid Assisting Modular Hydrogen PEM Power Plant
	<b>DAMEN</b>		
			<b>IRAFC</b>
	<b>ABENGOA</b>		

# Nedstack | Owner-Group Peer-Companies

Company

H2 economy

Markets

Solutions

## Past and Present Companies under IMD-Group



Generator Rental /  
Temperature control  
Now stocklisted



PEM Fuel Cells and  
FC Solutions



Exhaust Technology  
Now standalone



UPS, Back-up Power  
and Pump solutions



Distributor NL+NO  
Now Cummins Inc.



Turn-Key Electric  
Power Generation  
Now PON Group



Diesel UPS and  
Back-up Power  
Supply systems  
Now Airwater Inc.



FPT Iveco Engines  
Distributor  
Netherlands

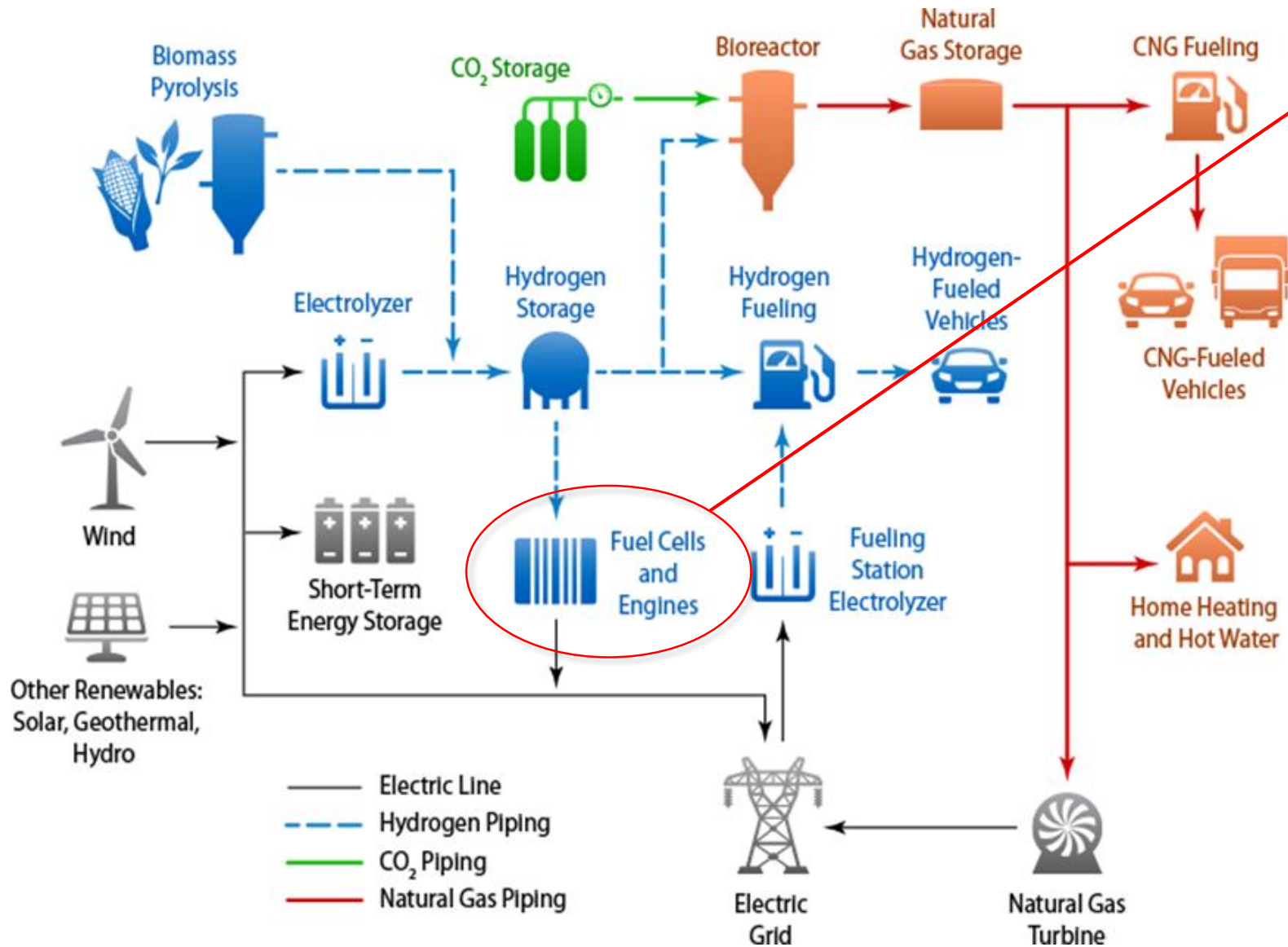
**B**

**H2 economy**





# Nedstack | A perspective on the H2 economy





Nedstack

PER RISK SELLS

C

Markets







## Maritime & Ports

- 🚢 Ferries
- 🚢 Cruise Vessels
- 🚢 Dredging
- 🚢 Inland navigation
- 🚢 Fish farming
- 🚢 Tug boats
- 🚢 Canal boats



## Built Environment

- 🚢 District heating
- 🚢 Holiday parks
- 🚢 Hotels / Conference
- 🚢 University campuses
- 🚢 Industry parks
- 🚢 Hospitals
- 🚢 Shopping malls










## Industry

- 🚢 Chlor-Alkali industry
- 🚢 Sodium-Chlorate Ind.
- 🚢 Semi-conductor
- 🚢 Data centers



## Maritime & Ports

-  Ferries
-  Cruise Vessels
-  Dredging
-  Inland navigation
-  Fish farming
-  Tug boats
-  Canal boats

### Challenge

The maritime industry is a massive contributor to global emissions and has recently embraced an enormously ambitious set of emission reductions targets at IMO level. Further local initiatives to establish 0-emission shipping zones push for vulnerable areas;

### Value Proposition








The use of hydrogen fuel cells in shipping and ports allow for achieving zero-emission operations while still maintaining endurance at sea, acceptable levels of power densities and rapid turn around times.

Market		Nedstack PemGen fit	
Market Size	Actionable	PemGen Fit	Compliancy
high	starting	high	high





## Built Environment

-  District heating
-  Holiday parks
-  Hotels / Conference
-  University campuses
-  Industry parks;
-  Hospitals;
-  Shopping malls;

### Challenge

Decarbonizing the built-environment requires moving away from fossils all together with inclusion of CNG. The Paris climate agreement has been ratified by many and will result in ambitious transition plans. The Netherlands is pursuing a built environment free of CNG in 2030.





### Value Proposition

The use of hydrogen allows for buffering between the demand for residential heat and power and the availability of heat and power from green origins. The Nedstack Energie-erf concept allows for harmonizing the energy system from both a heat and power perspective.

Market		Nedstack PemGen fit	
Market Size	Actionable	PemGen Fit	Compliancy
high	opening	high	high



## Industry and datacenters

-  Chlor-Alkali industry
-  Sodium-Chlorate Ind.
-  Semi-conductor
-  Data centers

### Challenge

Chlor-alkali plants are among the main producers of by-product hydrogen. Worldwide, 50 million tons of chlorine is produced annually, which alone would yield 3000 MW of continuous power.

### Value Proposition

Nedstack PemGen Fuel Cell Power Systems allow for capturing by-product hydrogen and converting it in useful heat and power resulting in up to 20% energy savings on electrolysis costs.

### Challenge

Data centers will take more than 10% of the world’s energy demand in just 5-10 year’s time and increasingly in microgrid environments.

### Solution

Clean energy and PEM fuel cells will be necessary to achieve this.

Market		Nedstack PemGen fit	
Market Size	Actionable	PemGen Fit	Compliancy
med	good	high	high





Nedstack

PEM FUEL CELLS

D

Solution overview


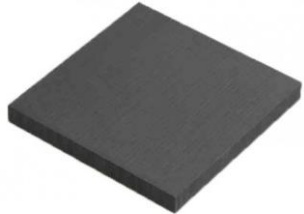
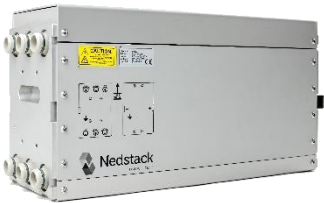


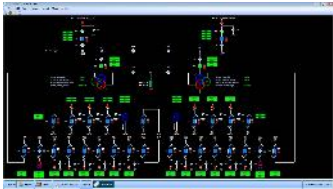


Company

H2 economy

Markets

Solutions

Fuel Cell Technology Portfolio					FC Control Solutions
Fuel Cell Parts		Fuel Cell Solutions			SCADA / CVM
BMC's	BPP's	PEM Stacks	FC Engines	Power Plants	
					
Test & Commissioning Engineering Services					Engineering Services Portfolio
Inspection and Maintenance Services					
Application Engineering & Project Management Services					





PEMGEN™  
Fuel Cell Power

## Highlights

- At Nedstack we have developed a portfolio of power systems around our extended long life (XXL) PEM-FCS stack platform.
- Rationalized over the lowest possible levelized cost of energy (LCOE) within boundaries of absolute reliability, availability and safety.
- The PemGen platform is based on the Nedstack Central BoP philosophy for extreme plant life and superior serviceability;
- Configurable to customer requirements;



1) PemGen is a Nedstack European registered trademark. Registered at EUIPO under NO. 018036949

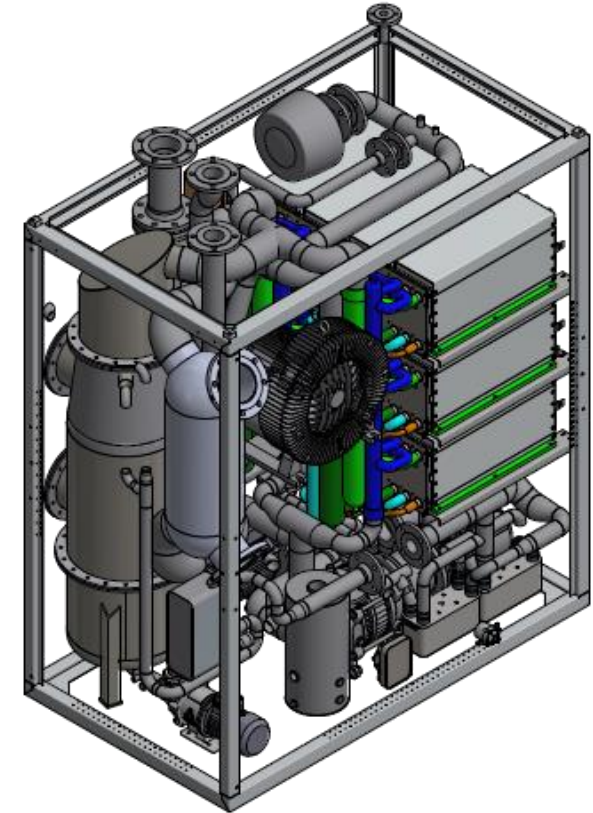
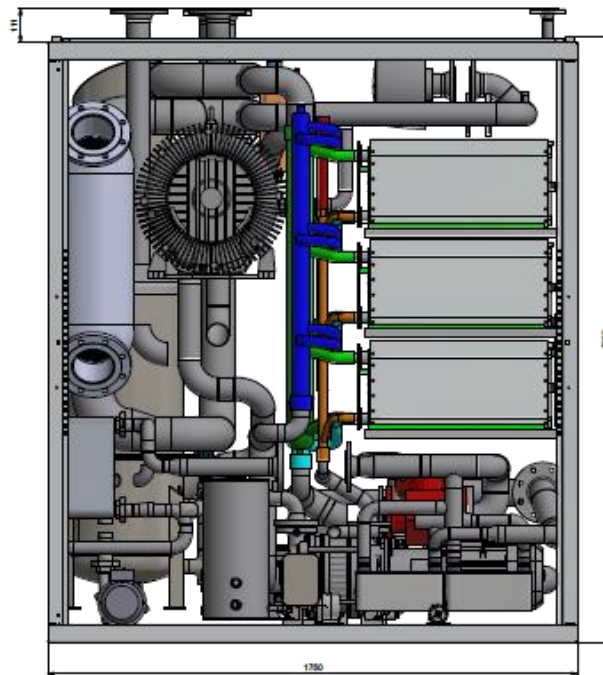
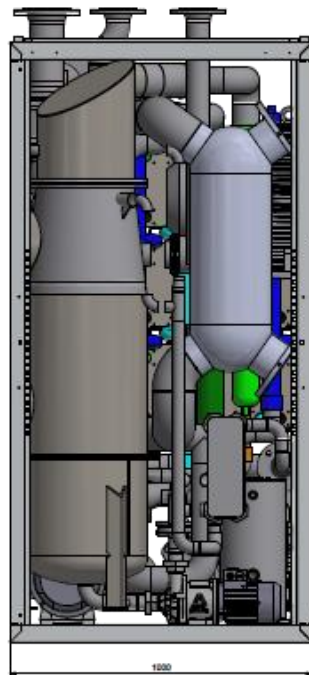
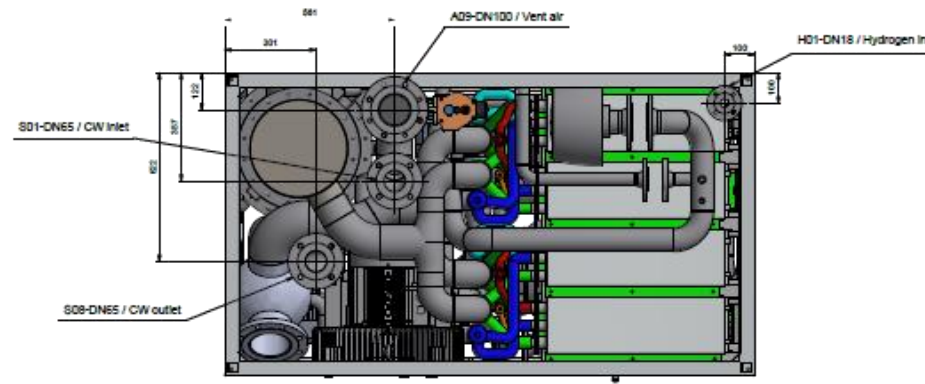
# Nedstack | PemGen MT FCPP 100 – MVP Platform

Company

H2 economy

Markets

Solutions





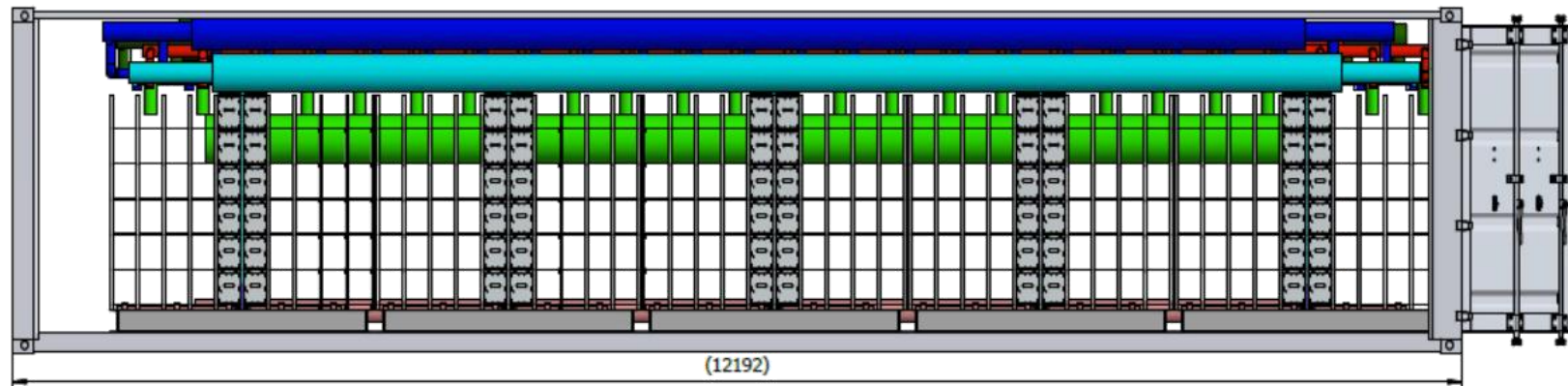
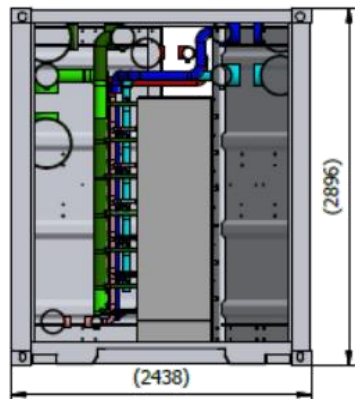
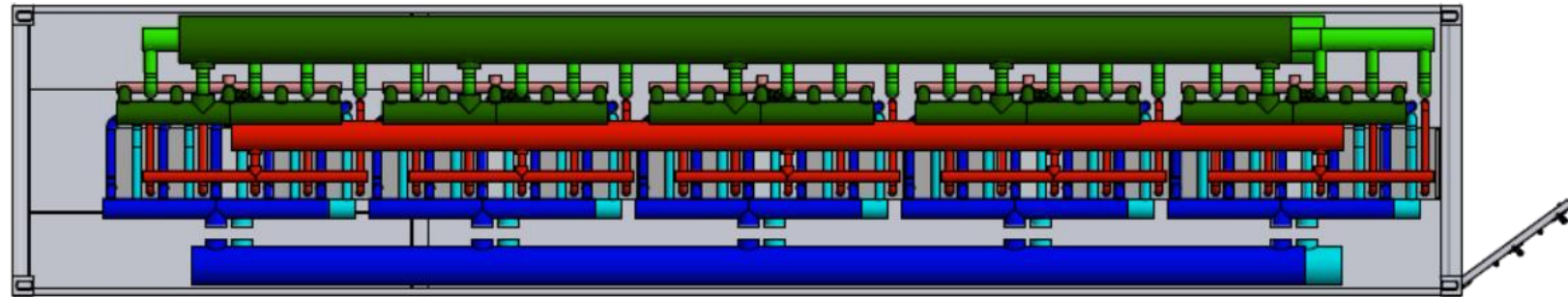
# Nedstack Appearance Impression (~3 MWe) Stack Container

Company

H2 economy

Markets

Solutions



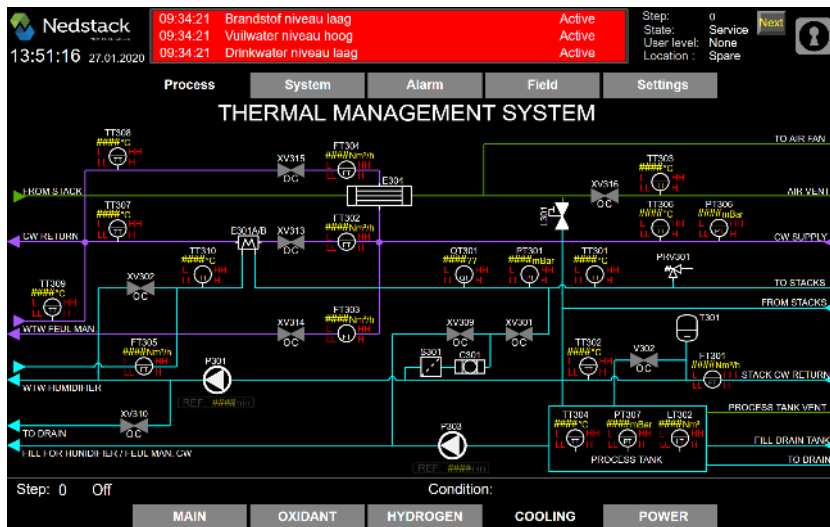
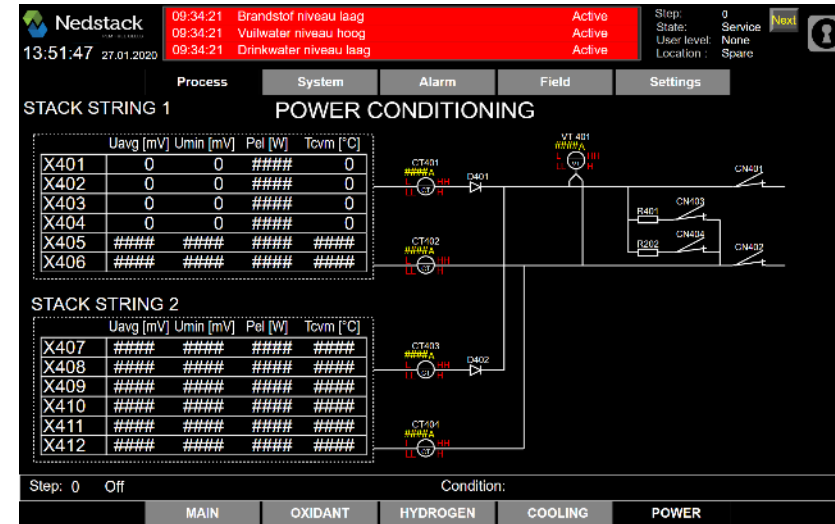
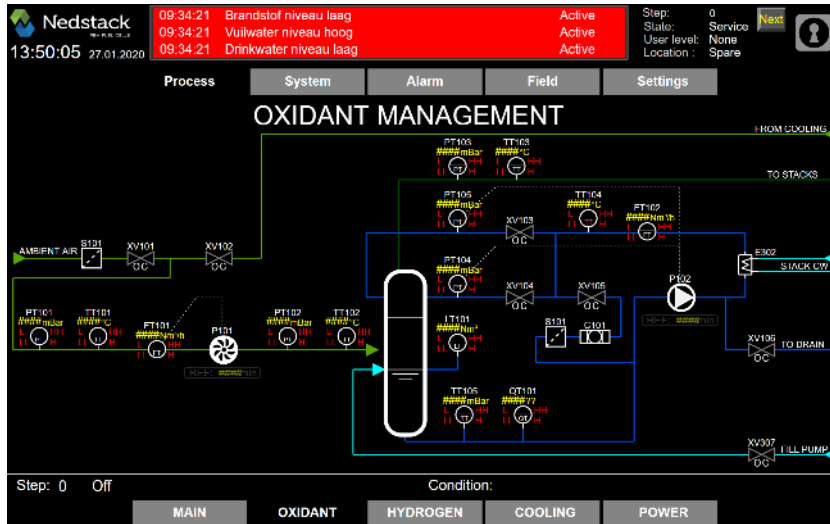
# Nedstack | Control System & SCADA

Company

H2 economy

Markets

Solutions





# Nedstack | Built Appearances

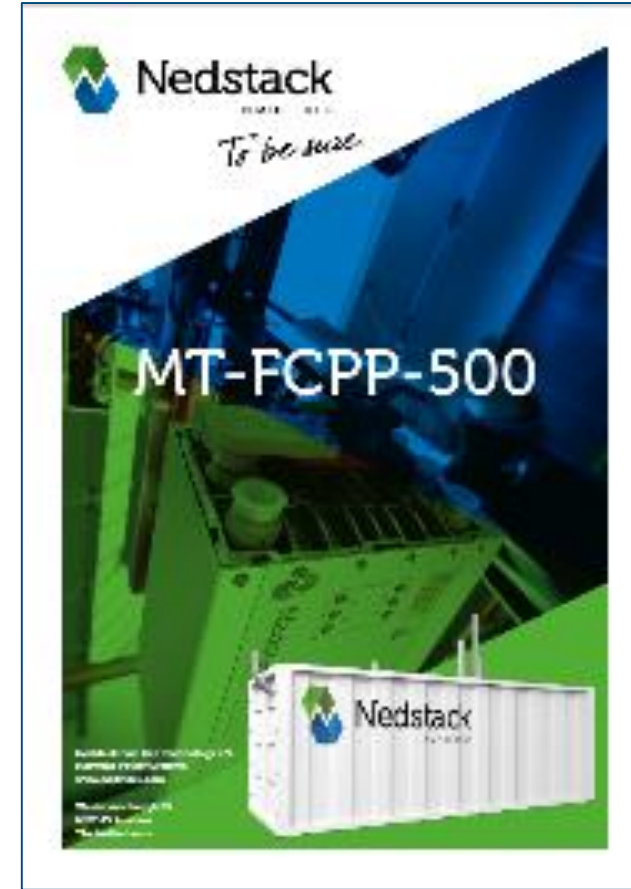
Company

H2 economy

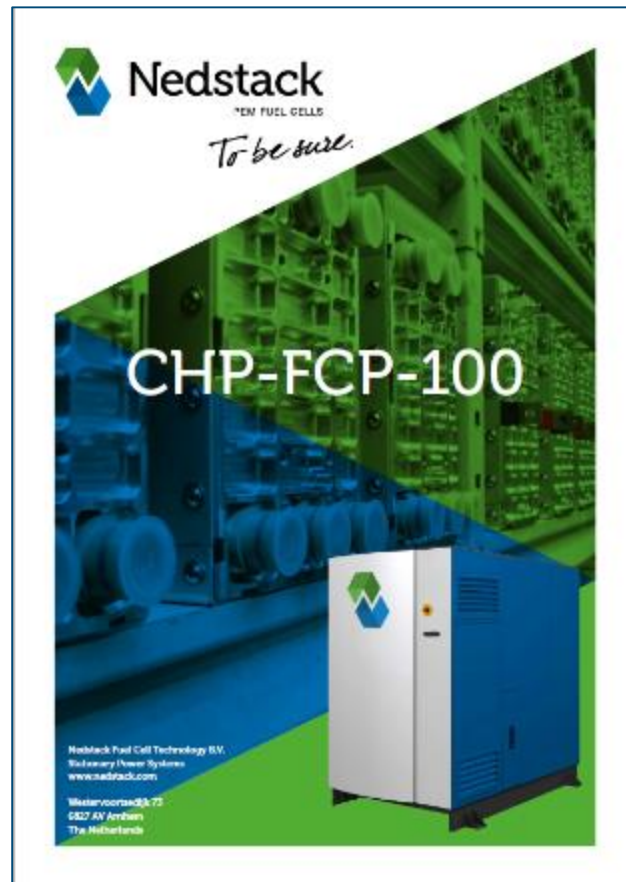
Markets

Solutions





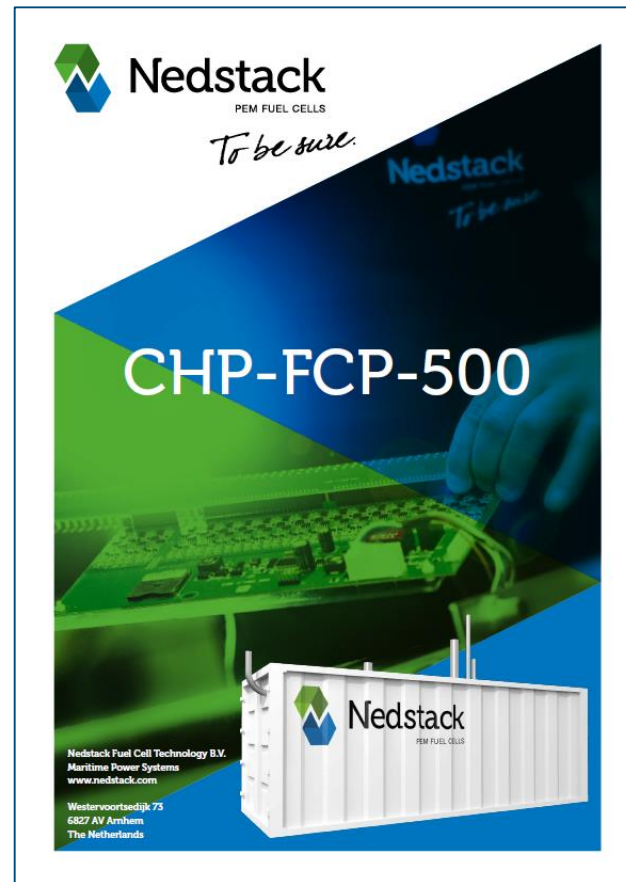




**Nedstack**  
PEM FUEL CELLS  
*To be sure.*

## CHP-FCP-100

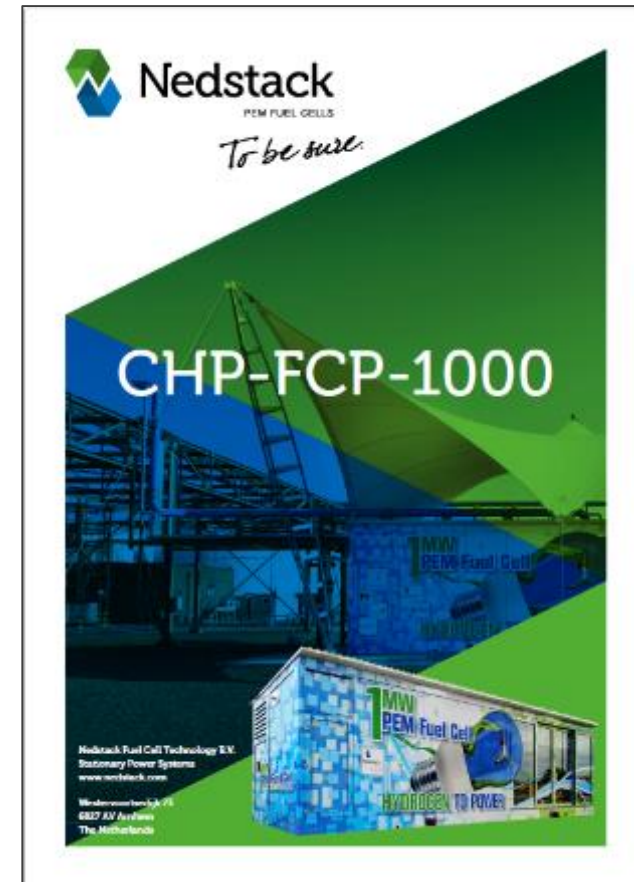
Nedstack Fuel Cell Technology B.V.  
Stationary Power Systems  
www.nedstack.com  
Westervoortdijk 73  
6827 AV Arnhem  
The Netherlands



**Nedstack**  
PEM FUEL CELLS  
*To be sure.*

## CHP-FCP-500

Nedstack Fuel Cell Technology B.V.  
Maritime Power Systems  
www.nedstack.com  
Westervoortdijk 73  
6827 AV Arnhem  
The Netherlands



**Nedstack**  
PEM FUEL CELLS  
*To be sure.*

## CHP-FCP-1000

Nedstack Fuel Cell Technology B.V.  
Stationary Power Systems  
www.nedstack.com  
Westervoortdijk 73  
6827 AV Arnhem  
The Netherlands

# Contact details

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CEO

**Phone** +31 (0) 653350450

**E-mail** [arnoud.vandebree@nedstack.com](mailto:arnoud.vandebree@nedstack.com)







# Fusie van Van Gansewinkel en Shanks

28 februari 2017



# Europees Netwerk

## Kern



Aantal operationele locaties



Aantal operationele locaties met recycling/ vernieuwing



Aantal medewerkers (FTE)



Aantal vrachtwagens

Totaal: 183

105

7.007

2.541

## Onze divisies



72

Commercial Nederland



3.037



41

Commercial België



1.892



17

Hazardous Waste



919



23

Monostreams



849



36

Municipal



649



## Wij geloven in een wereld waarin afval niet bestaat

Renewi is goed gepositioneerd om de circulaire economie te dienen. We beschouwen producten als een tijdelijke opslagplaats voor waardevolle grondstoffen die 100% kunnen worden gerecycled. Op basis van deze filosofie beschermen we de wereld tegen vervuiling, behouden we de eindige, natuurlijke grondstoffen en houden we het leefbaar voor toekomstige generaties





# ONS BEDRIJFSMODEL

Door een nieuw leven te geven aan gebruikte materialen, zitten we in het hart circulaire economie en creëren we waarde voor onze stakeholders.

## Renewi van morgen





**13,58  
miljoen**

Ton verwerkt afval  
per jaar



**90%**

Van het afval hebben we  
gerecyceld / herwonnen



**66,9%**

Ons specifieke recycling  
percentage groeide van  
0,6% tot 66,9%



**1,8%**

Door het verlagen van  
CO<sub>2</sub> emissies per ton  
verwerkt afval is onze  
CO<sub>2</sub> uitstoot verbeterd met  
1,8%



**2,2  
miljard**

We hebben genoeg glas  
gerecycled om 2,2 miljard  
flessen te produceren



**246  
zwembaden**

We hebben genoeg  
afvalwater  
schoongemaakt om 246  
olympische zwembaden  
te vullen



**22 jaar  
licht**

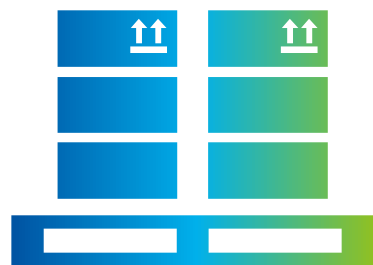
We hebben genoeg  
elektriciteit opgewekt om  
de Eiffeltoren 22 jaar te  
verlichten.



**-200  
Brandstof/jaar**

We kunnen 200 vrachtwagens  
een jaar laten rijden van de  
diesel die we hebben bespaard  
door vervanging en route  
optimalisatie





Conversie naar  
**leverancier**  
van grondstoffen





## Kattenbak- vulling

Renewi transformeert  
houtafval in kattenbakvulling.



HOUT

=



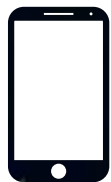
KATTENBAKVULLING





## Schaats- medailles

We namen oude mobiele telefoons en gebruikten de metalen voor de productie van medailles voor het NK Schaatsen.



MOBIELE  
TELEFOONS

=



MEDAILLES



# Onze Divisies

## Financiële kerncijfers



# Onze Divisies

## Financiële kerncijfers



**€1.194m**

Omzet

**€86.5m**

Onderliggende EBIT

Vertegenwoordigt  
**65% van de omzet  
van Renewi**



**€211m**

Omzet

**€7.0m**

Onderliggende EBIT

Vertegenwoordigt  
**12% van de omzet  
van Renewi**



**€213m**

Omzet

**€12.9m**

Onderliggende EBIT

Vertegenwoordigt  
**12% van de omzet  
van Renewi**



**€195m**

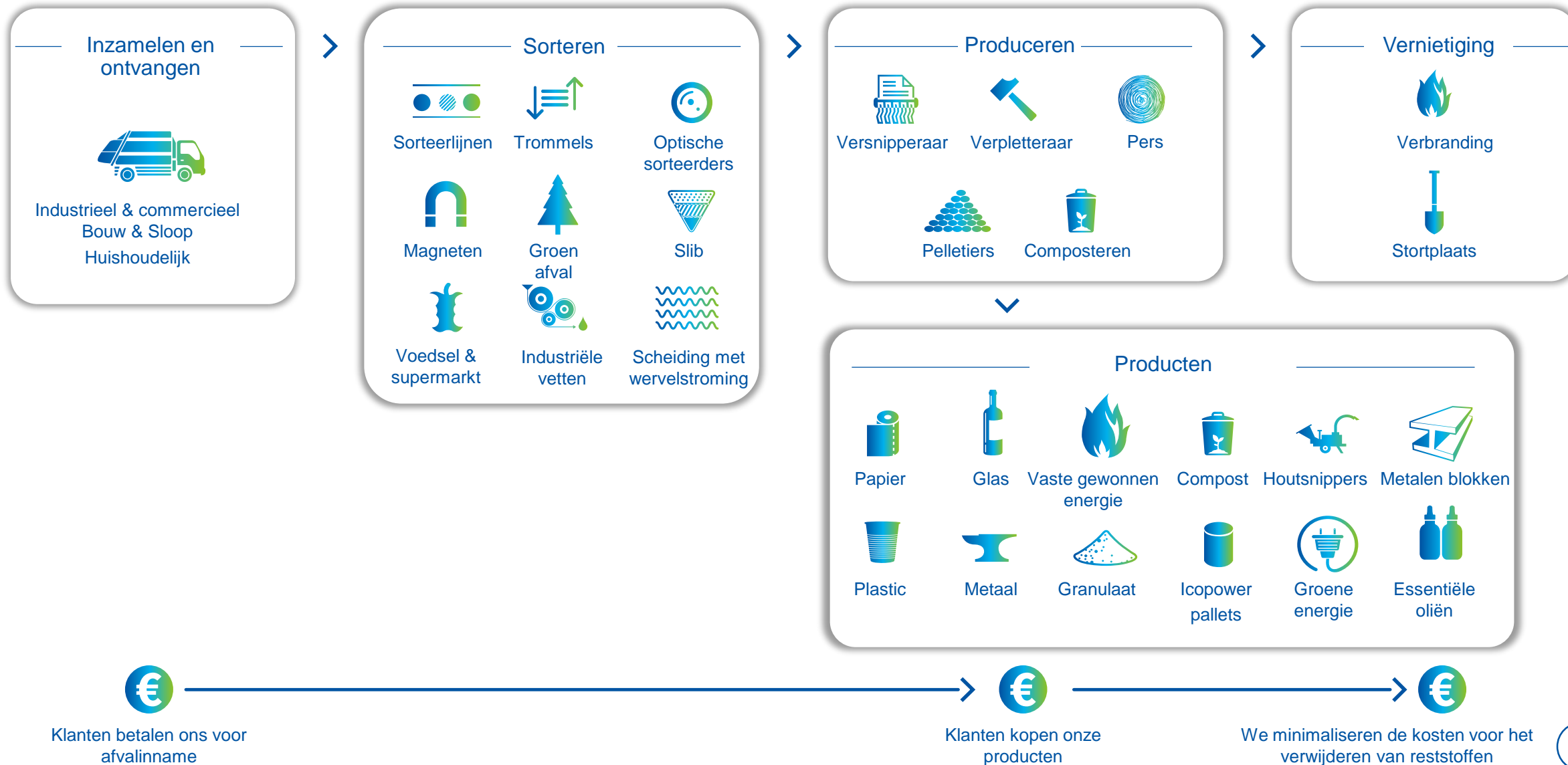
Omzet

**€0.8m**

Onderliggende EBIT

Vertegenwoordigt  
**11% van de omzet  
van Renewi**

# Commercial Waste bedrijfsmodel







**storm**  
WINDPOWER

Storm versnelt de transitie naar een  
klimaatneutrale samenleving.






## Storm: onze visie



---

Dat doen we door windparken op land te ontwikkelen, te bouwen en te exploiteren tegen een zo laag mogelijke maatschappelijke kost.




# Storm Management



---

Storm Management is gebaseerd op:

- Kleine organisatie met beperkte recurrente kost: 35 personeelsleden
  - Vaste samenwerking tussen ontwikkelaar (Storm Management) en investeerders (Storm Holding-vennootschappen)
  - Nauwe samenwerking met lokale besturen en omwonenden
- 




# Storm

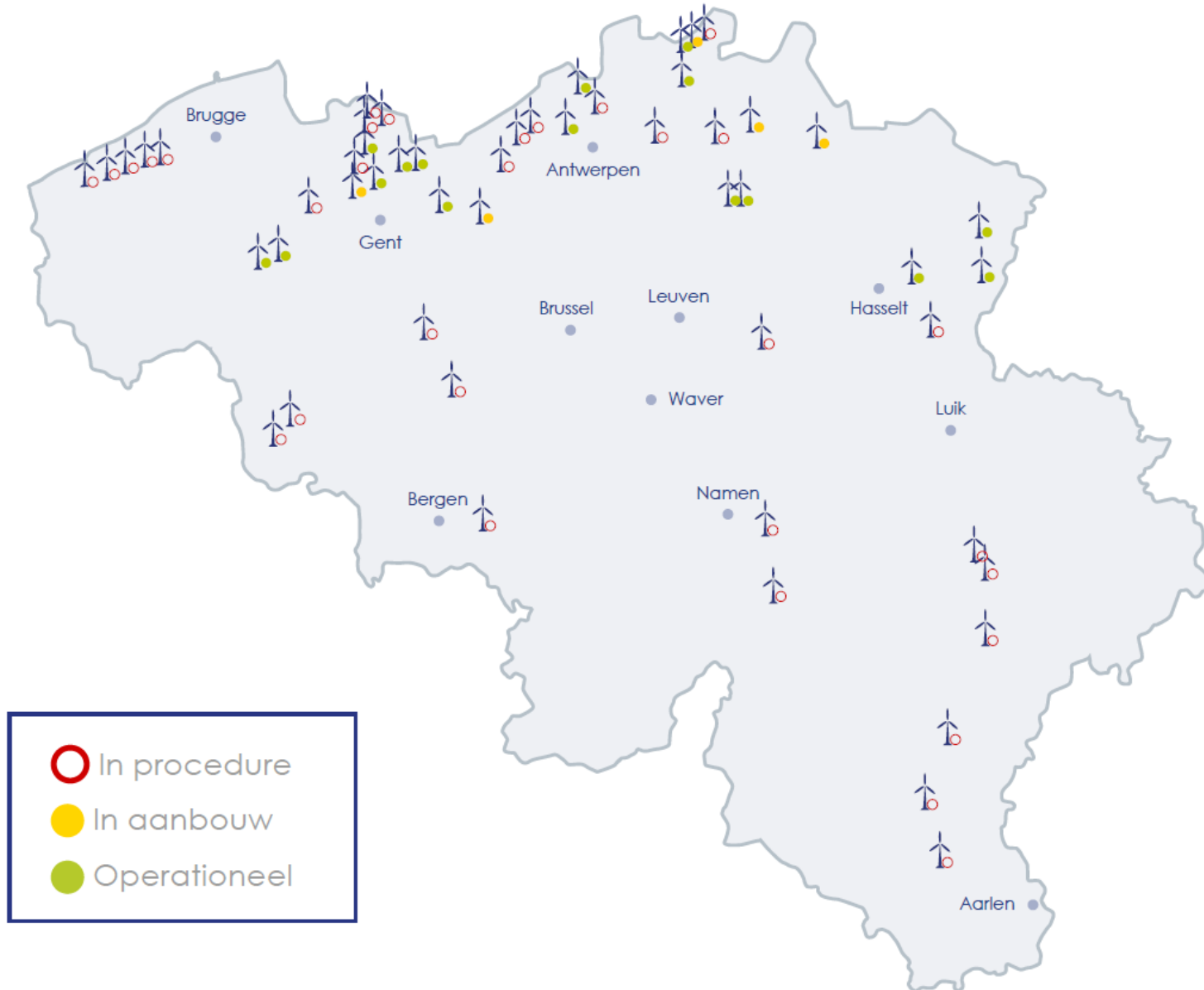


---

Storm ontwikkelt, bouwt en beheert haar windparken op een zo verantwoord mogelijke manier:

- Open en vroegtijdige **communicatie** met alle stakeholders
  - Participatie door **omwonenden** (Storm CV)
  - Participatie door **lokale besturen**
- 

# Storm Windparken





# Storm Windparken



34

Aantal operationele  
windturbines



3.209

Totaal aantal  
coöperanten



83MW

Totaal vermogen  
operationele windturbines



235.294MWh

Totale jaarlijkse  
energieproductie



66.600

Totaal aantal  
huishoudens voorzien  
van groene energie

---

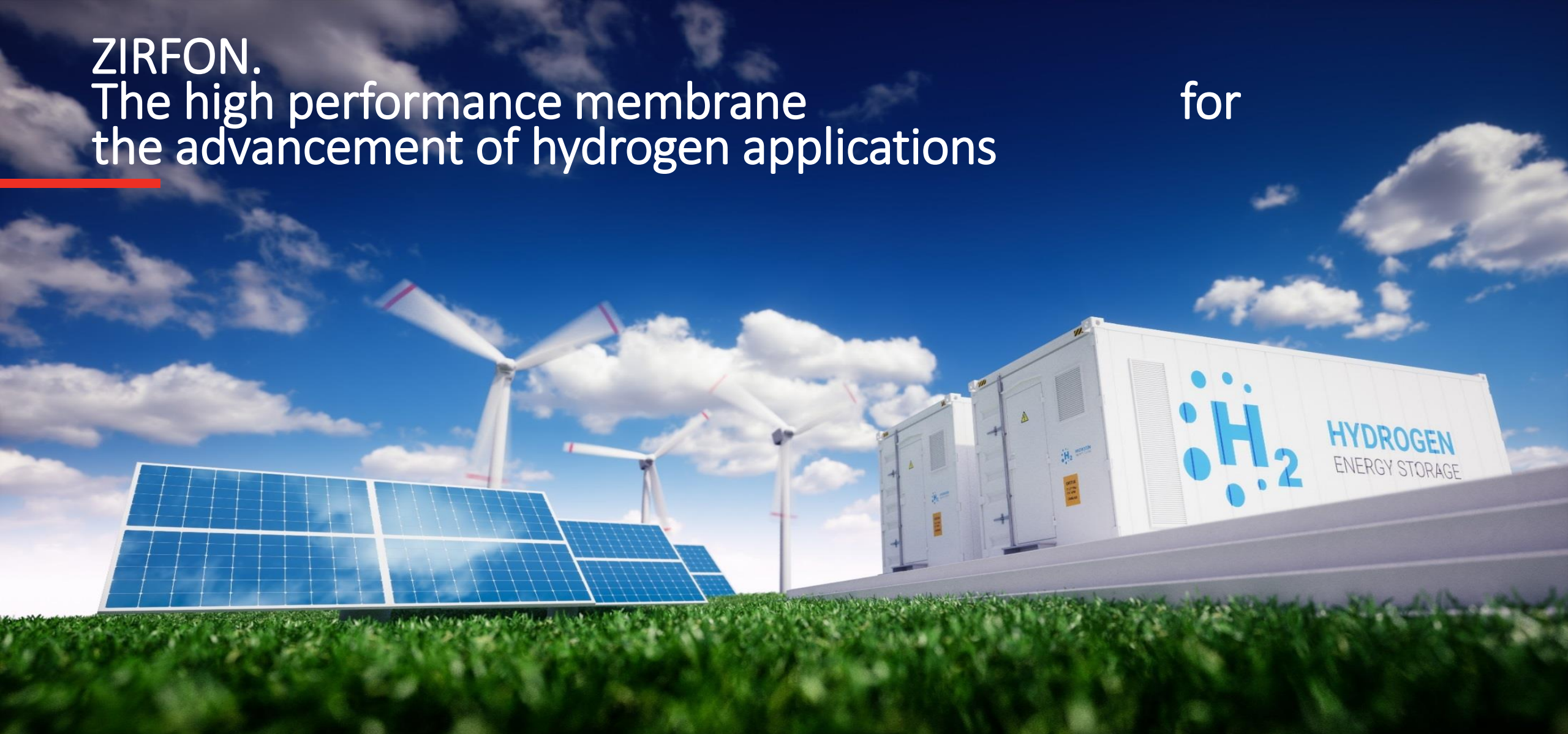
# Presentation Agfa group and membranes for alkaline electrolysers

---



# ZIRFON. The high performance membrane the advancement of hydrogen applications

for



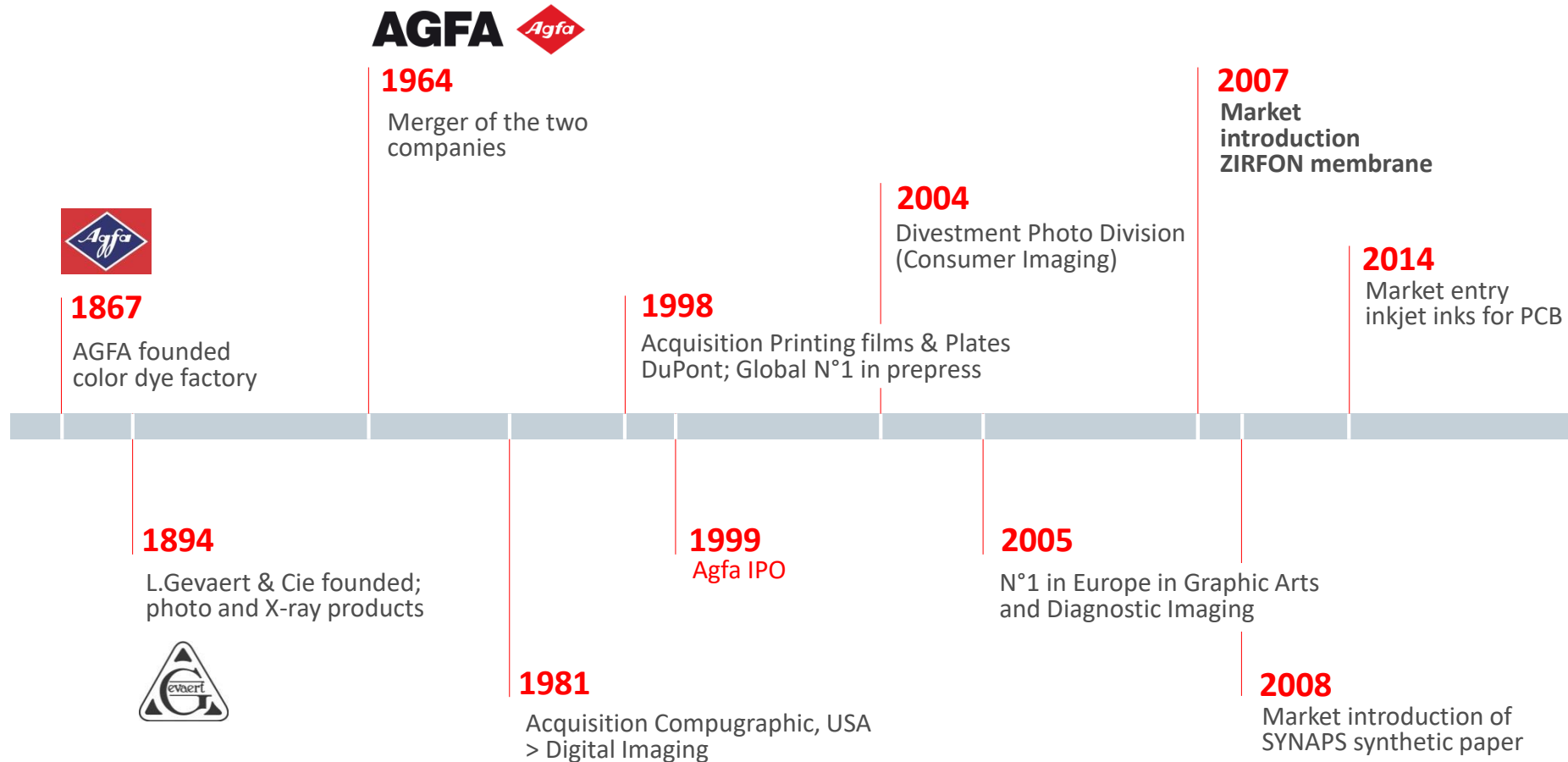
Mortsel – 12/02/2020

Nick Valckx

Business Development Manager – Zirfon/Membranes



# Agfa – Historical highlights



# Business Divisions

## OFFSET SOLUTIONS



Page make-up



Web-to-print



Workflow systems



Pressroom supplies & software



Platesetter/  
digital plates



Security Software  
(design & authentication)

## DIGITAL PRINT & CHEMICALS



Page make-up



Web-to-print



Inkjet printers



Inks



Cutting table



PCB materials



Conductive materials



Renewables



Synthetic paper



R & D Services

## RADIOLOGY SOLUTIONS



X-Ray films



Dry Imagers

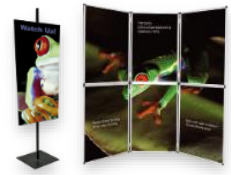


Direct radiography

## HEALTHCARE IT



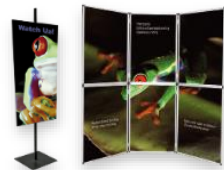
Information systems





# AGFA. PART OF DAILY LIFE

COMMUNICATION



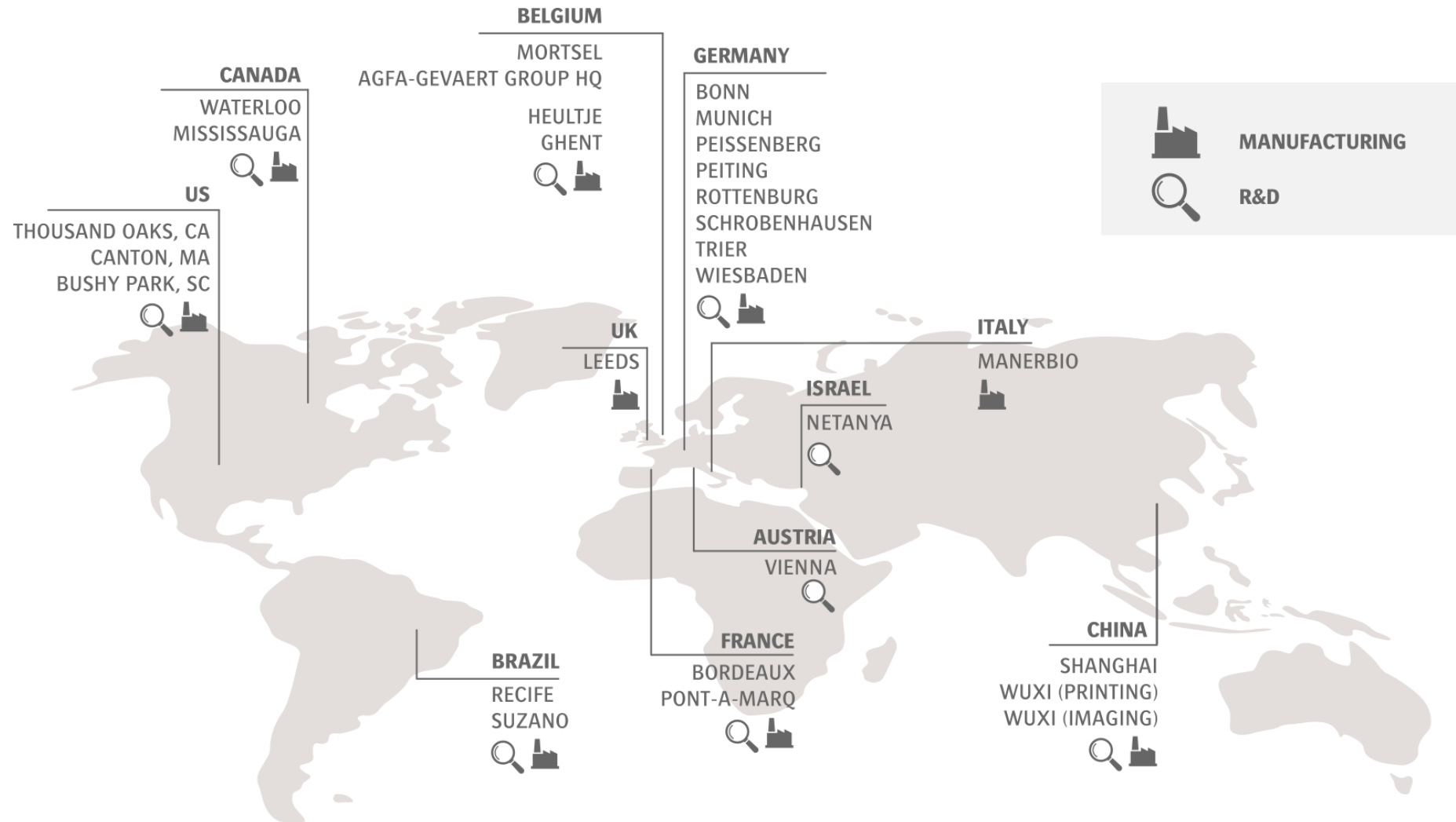
HEALTHCARE



TECHNOLOGY



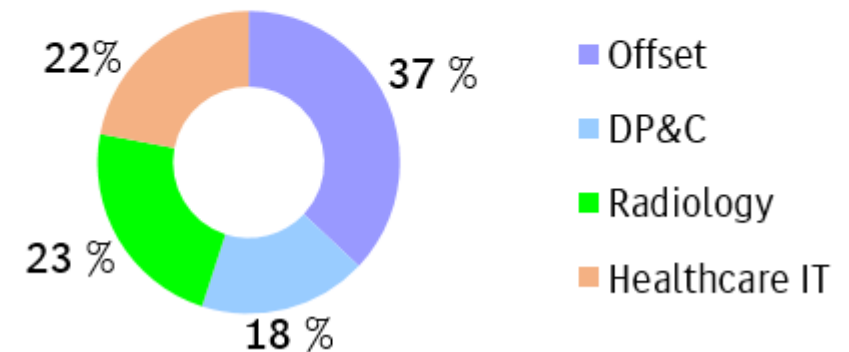
# Agfa - Global organisation



# Agfa – Key Figures

- Headquartered in Mortsel, Belgium
- Revenue 9M 2019: EUR 1.668 Million
- Agfa Worldwide: 9,962 FTE (year end 2018)
- Own Sales Organizations in ca. 40 countries
- Representations in >100 countries
- R&D Expenditures 2018: € 141 Mio (6,3 %)

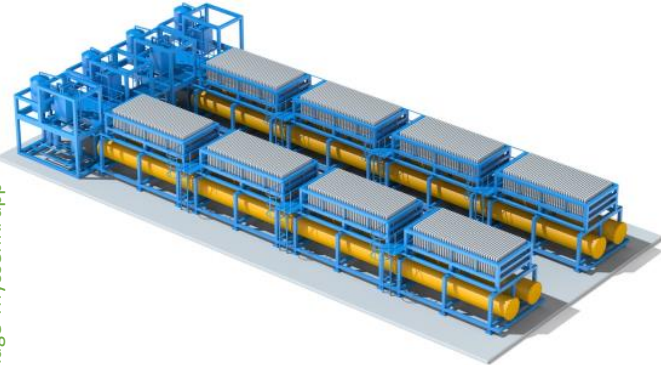
## Group Revenue 9M 2019 by Business Division





# Membranes For Alkaline electrolysis

Atmospheric

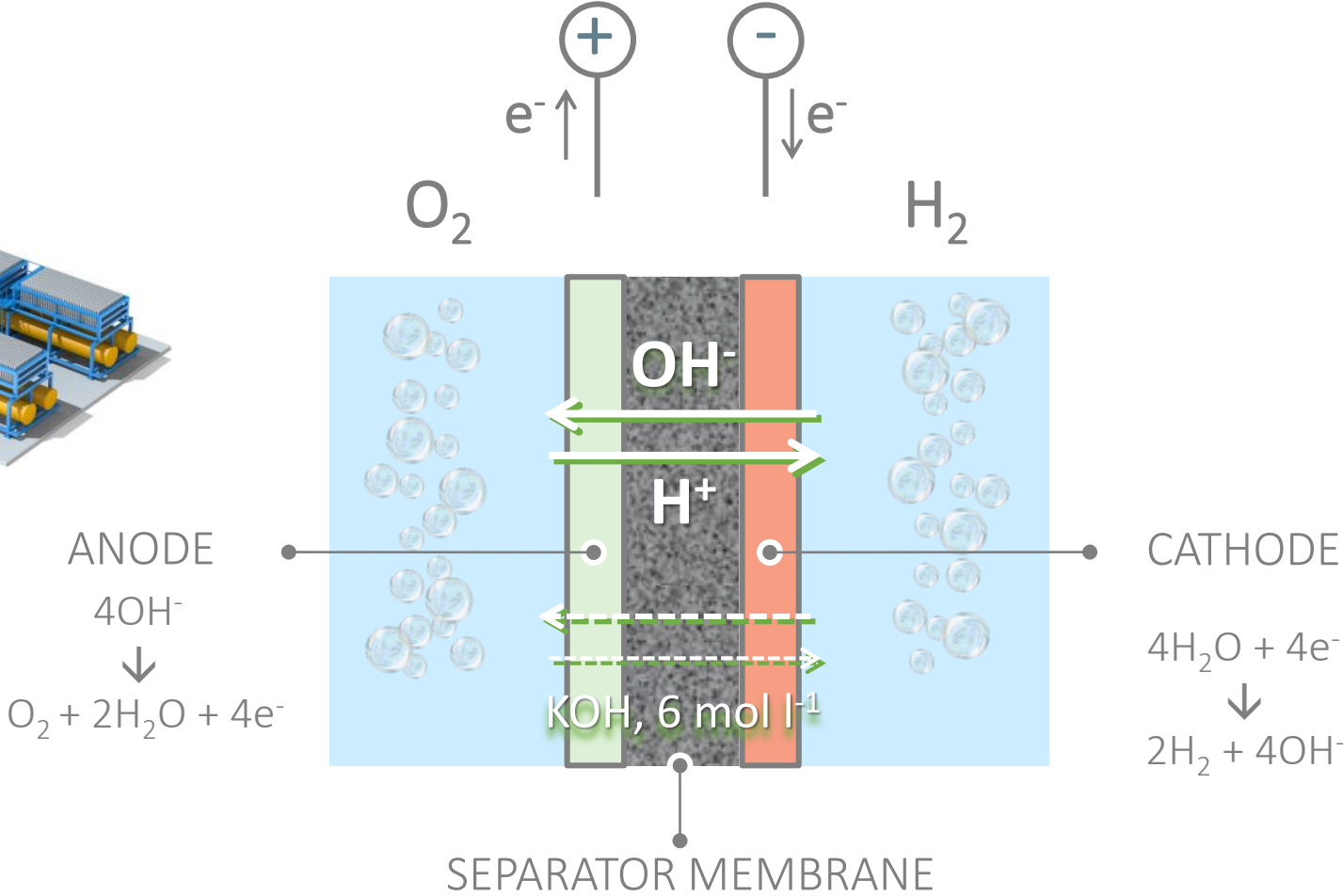


© image ThyssenKrupp

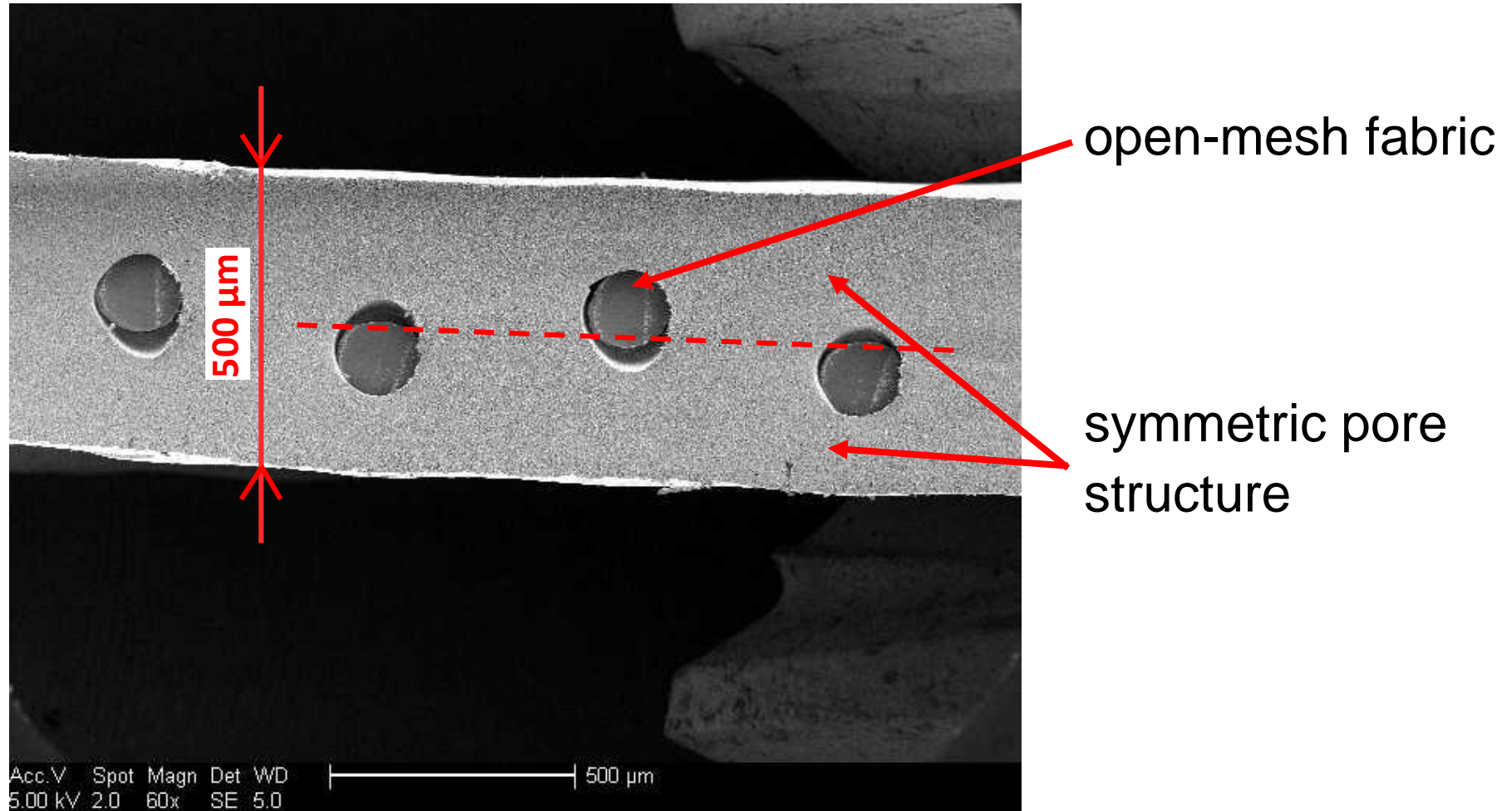
Pressurized



© image IHT



# Cross-section of ZIRFON PERL™



# The H2 Market from a membrane perspective

MOBILITY

POWER TO CHEM

BALANCING THE GRID



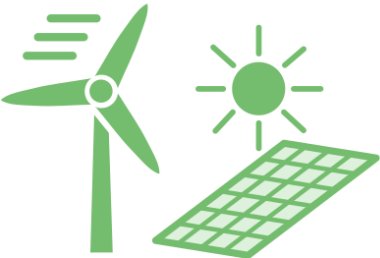


# The H2 Market from a membrane perspective

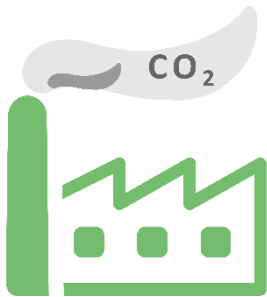
MOBILITY

POWER TO CHEM

BALANCING THE GRID



- Reduction of CO2 emission
- Contribution to circular economy



CO<sub>2</sub> & NO<sub>x</sub> CAPTURE



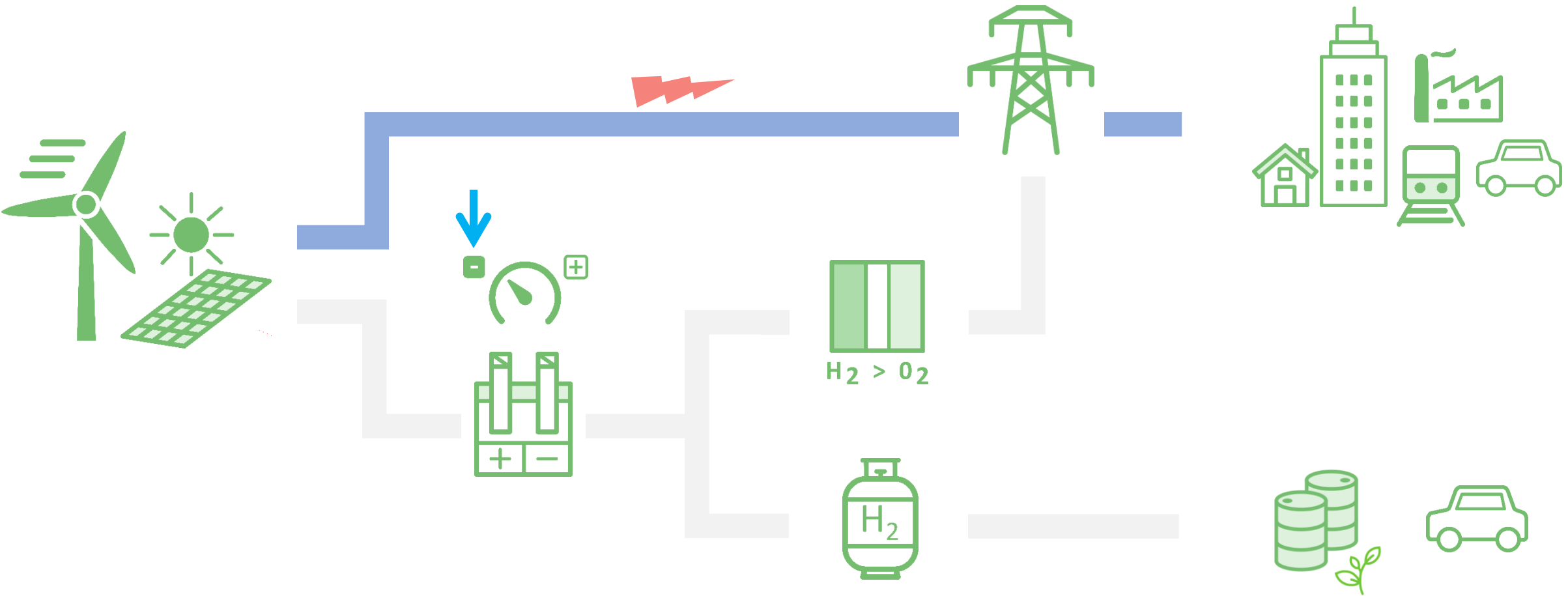
METHANOL  
AMMONIA

# The H2 Market from a membrane perspective

MOBILITY

POWER TO CHEM

BALANCING THE GRID

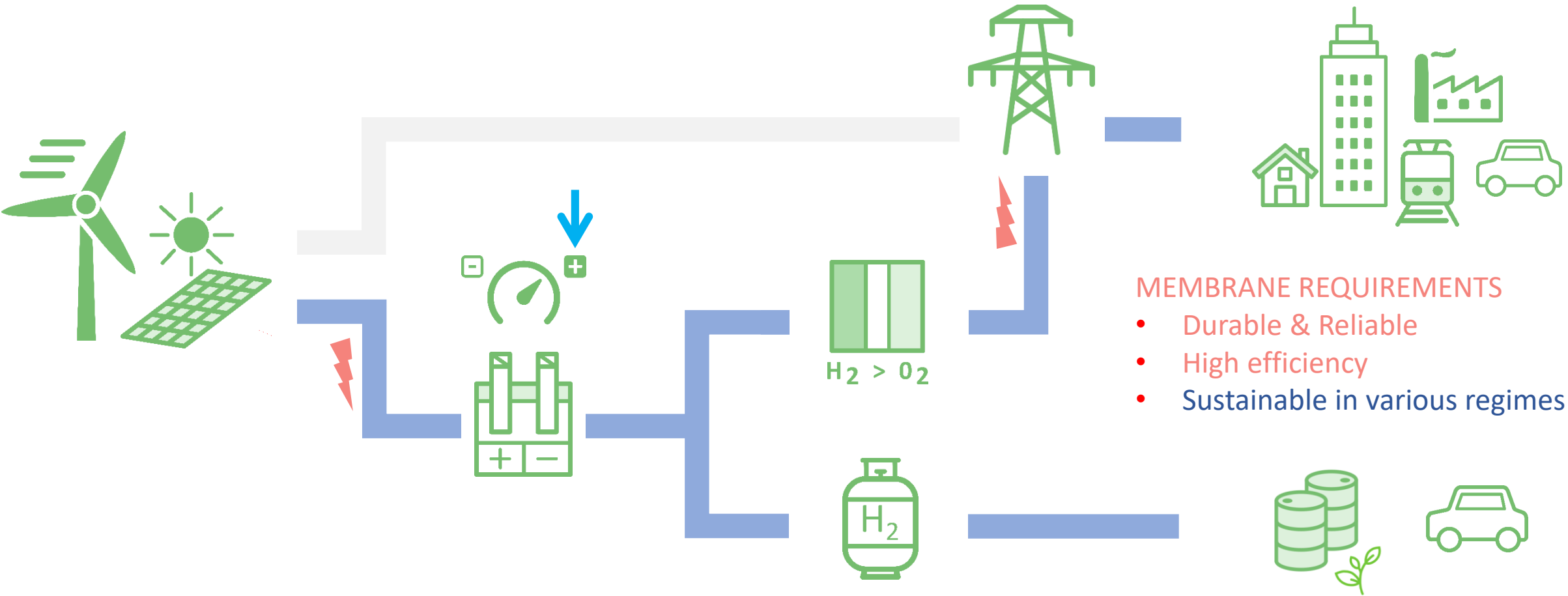


# The H2 Market from a membrane perspective

MOBILITY

POWER TO CHEM

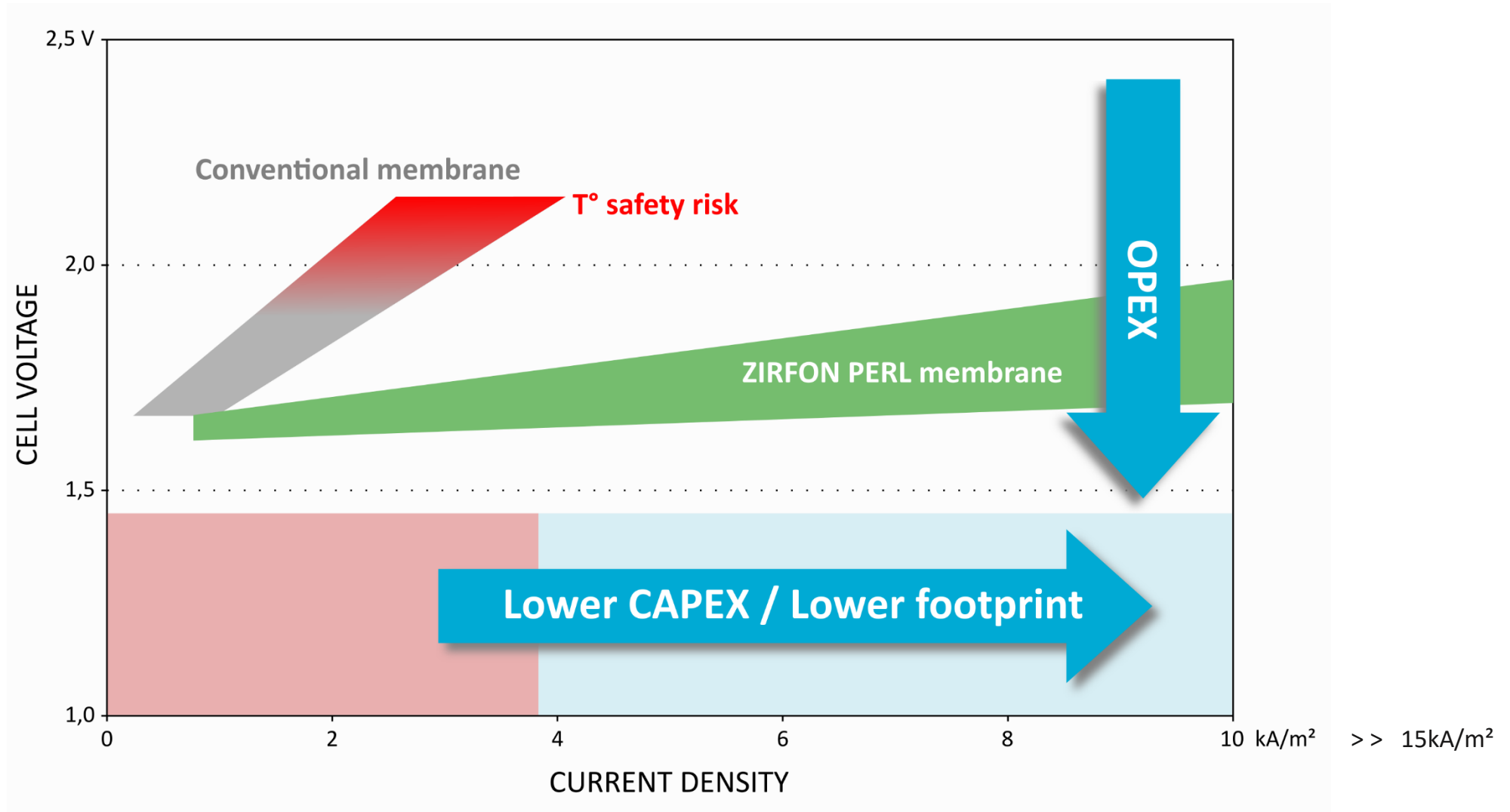
BALANCING THE GRID



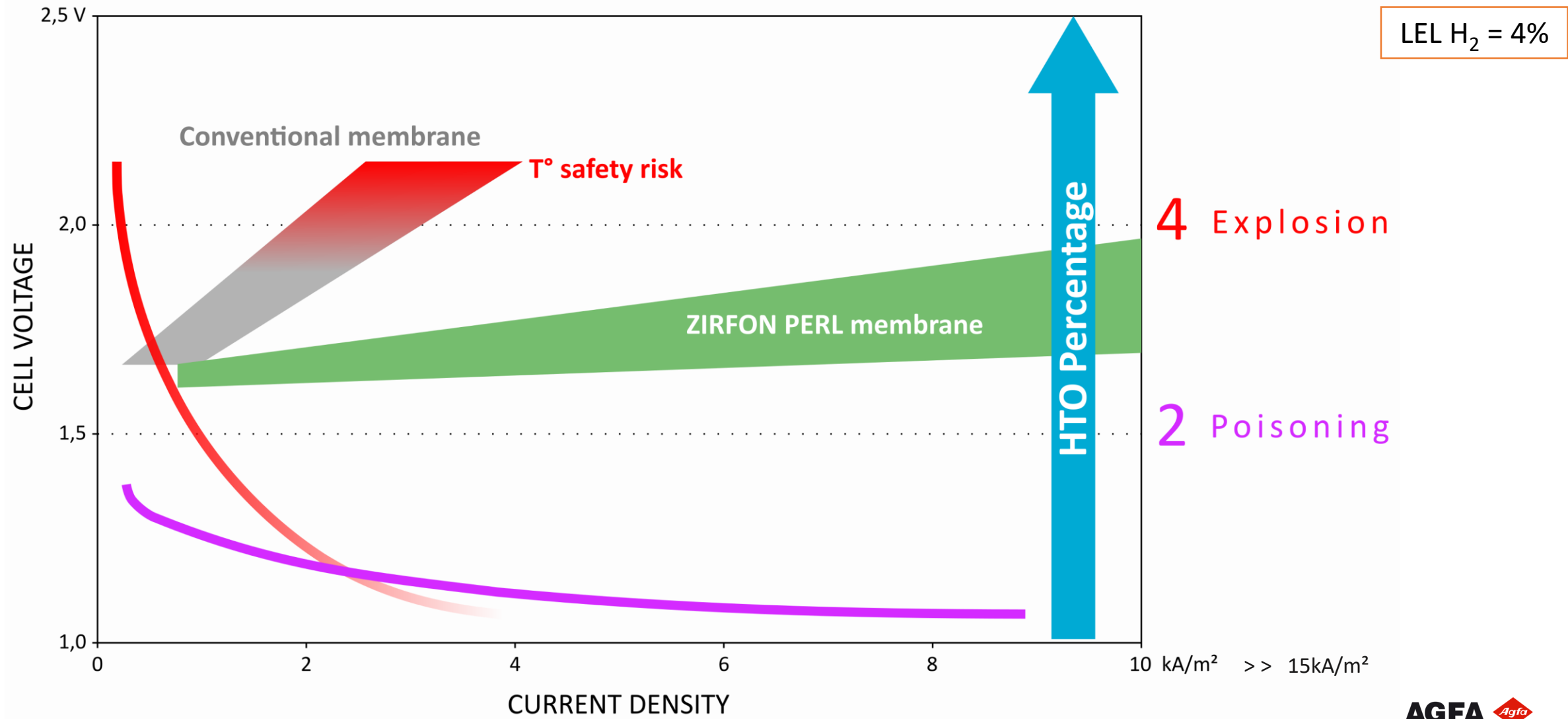
- MEMBRANE REQUIREMENTS**
- Durable & Reliable
  - High efficiency
  - Sustainable in various regimes



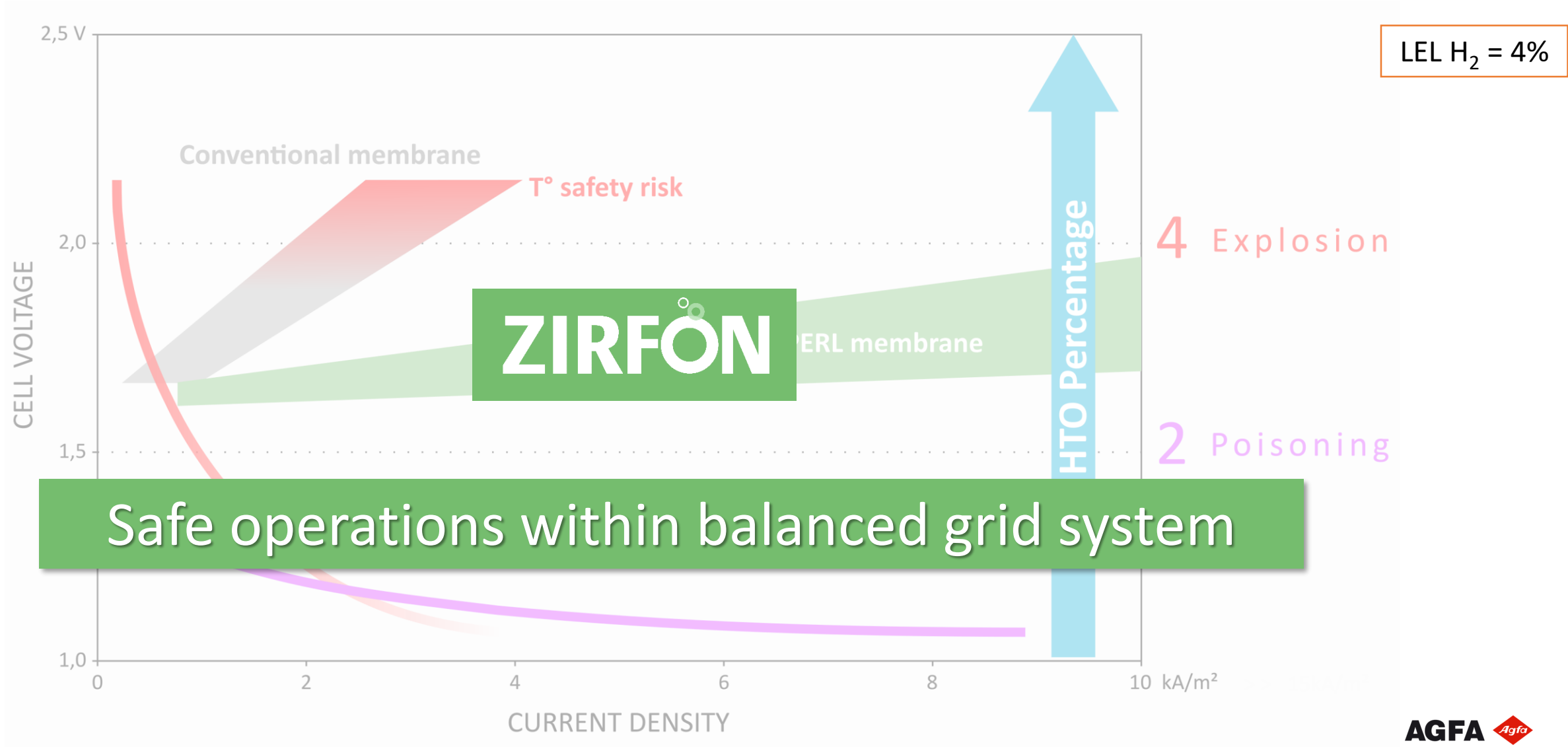
# Zirfon Performance



# Zirfon System Safety



# Zirfon System Safety



LEL H<sub>2</sub> = 4%

**ZIRFON**

ERL membrane

HTO Percentage

4 Explosion

2 Poisoning

Safe operations within balanced grid system



# Zirfon - Specifications

## ZIRFON PERL UTP 500

SEPARATOR MEMBRANE FOR ALKALINE WATER ELECTROLYSIS

### PHYSICAL PROPERTIES

<b>Weight Density</b>	1 g/cm <sup>3</sup> +/- 0,2
<b>Thickness</b>	500 µm +/- 50
<b>Maximum Operating Temperature</b>	110°C
<b>Dimensional Stability at 100°C</b>	< 1,5 %
<b>Shelf Life (unopened package)</b>	12 months

### FUNCTIONAL PROPERTIES

<b>Porosity</b>	55 % +/- 10
<b>Bubble Point</b>	2 bar +/- 1
<b>Gas Permeability at 5 bar</b>	3.2 l/min.cm <sup>2</sup> +/- 1
<b>Ionic Resistance at 21°C in 30wt% KOH</b>	< 0,3 Ohm.cm <sup>2</sup>
<b>Lifetime Expectancy std. op. conditions</b>	> 5 years

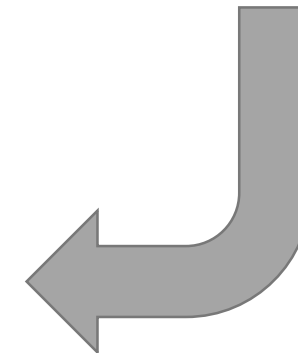
ZIRFON PERL is available in sheet size up to 1.75 m width and is fully humidified when delivered to customers.

# Electrolysis – competitive landscape

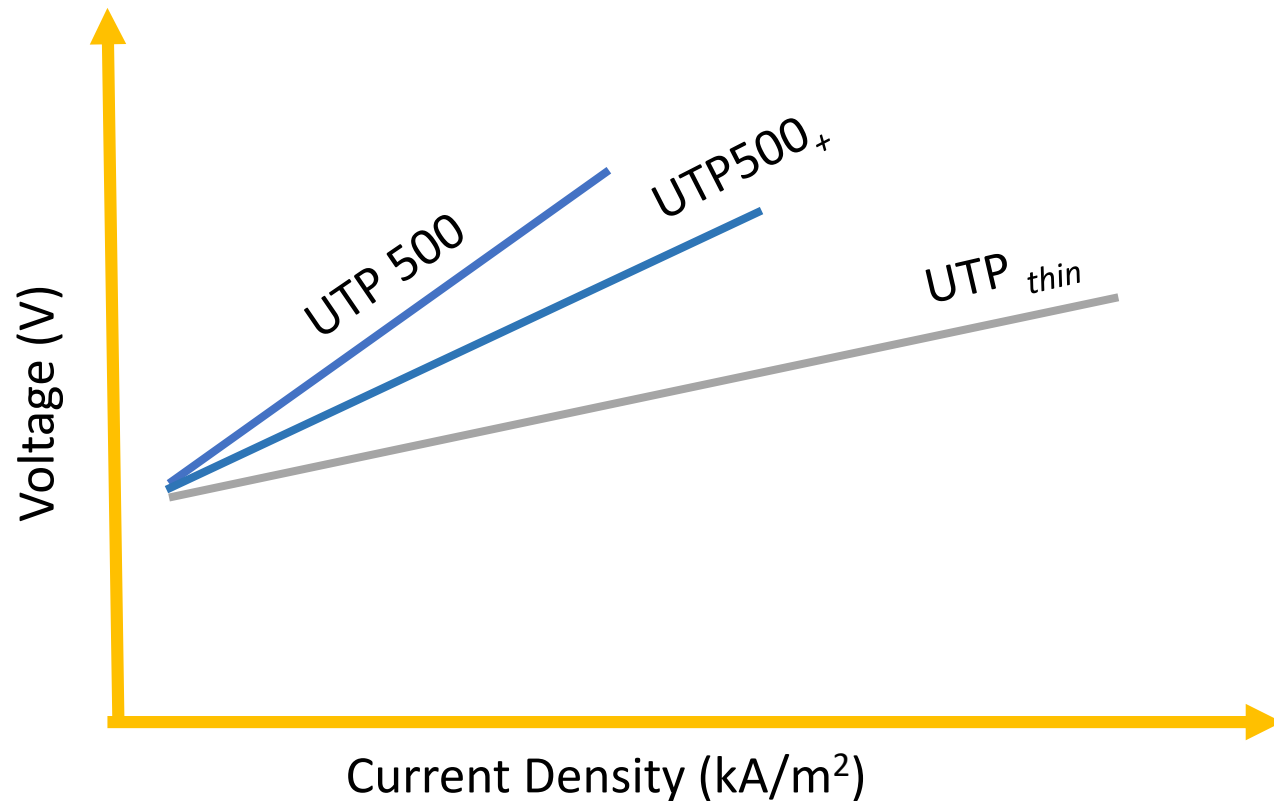
	Alkaline	
	Traditional	Zirfon
Corrosive liquid	--	--
Mature technology	++	++
Durability	++	++
Non PGM catalyst	++	++
Cost of components	++	++
Crossover of gas	--	++
Dyamic operation	-	++



Alkaline electrolysis 2.0



# Future



- UTP500 is Agfa's current standard membrane
- UTP500<sub>+</sub>
  - Improved formulation
    - ➔ 30% improved ionic conductivity
  - Launch expected in 2020
- UTP<sub>thin</sub>
  - Thinner membrane in development
  - Significant Ohmic resistance reduction



# Questions

---



# Zirfon – Proven value

**ZIRFON**  
H<sub>2</sub> ADVANCED<sup>2</sup>

UTP500

PROVEN VALUE  
FOR BOTH SYSTEM DEVELOPER AND OWNER



PROVEN DURABILITY



MINIMAL ENERGY COST



NO ASBESTOS



SUPERIOR PRODUCTIVITY



SYSTEM NEUTRAL



SUSTAINED EFFICIENCY

# Presentation Nouryon

---



# Green hydrogen for the chemical industry

Thijs de Groot



Nouryon

# Agenda



**Nouryon**



Circular chemistry and green hydrogen



Our green hydrogen projects



Making water electrolysis competitive



Key technologies and their development potential



# Nouryon

Your partner in essential chemistry  
for a sustainable future



**10,000**  
employees



**€5 billion**  
annual revenue



Almost **400 years**  
of experience



Reduced CO<sub>2</sub> emissions  
per year with  
**1.2 million tons\***



Almost  
**50% renewable**  
energy



\*Emissions reduction since 2012, while growing sales



# Leading the way in electrochemistry

Nouryon operates over 1000 MW of electrolysis capacity

In electro-chemistry since 1899

1000 MW electrolysis capacity

50% renewable energy worldwide

Chlor-alkali



Installed capacity: 380 MW  
H<sub>2</sub> production: 38 kta

Sodium chlorate



Installed capacity: 620 MW  
H<sub>2</sub> production: 62 kta

Water electrolysis



Installed capacity: 8 MW  
H<sub>2</sub> production: 1.2 kta

# Agenda



Nouryon Industrial Chemicals



**Circular chemistry and green hydrogen**



Our green hydrogen projects



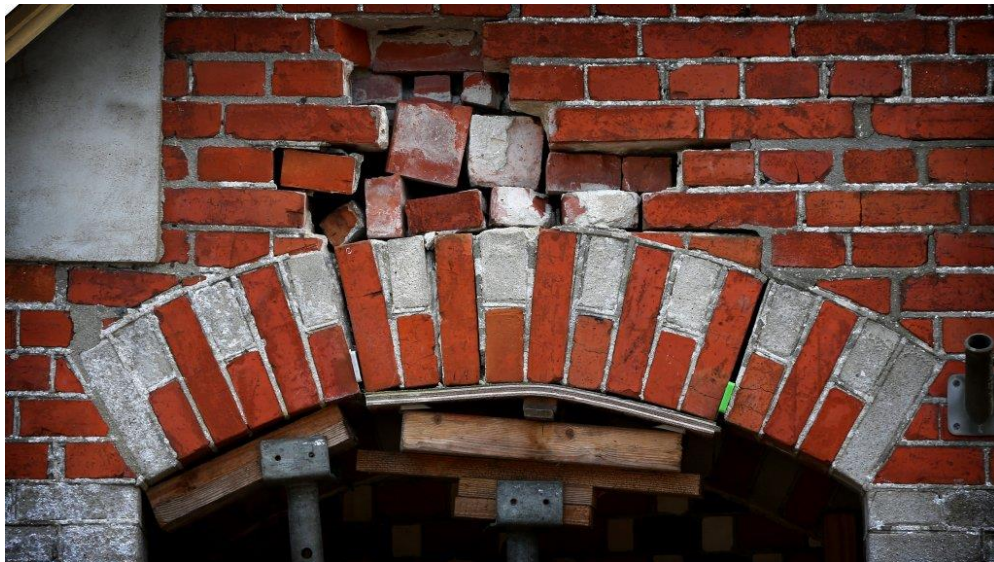
Making water electrolysis competitive



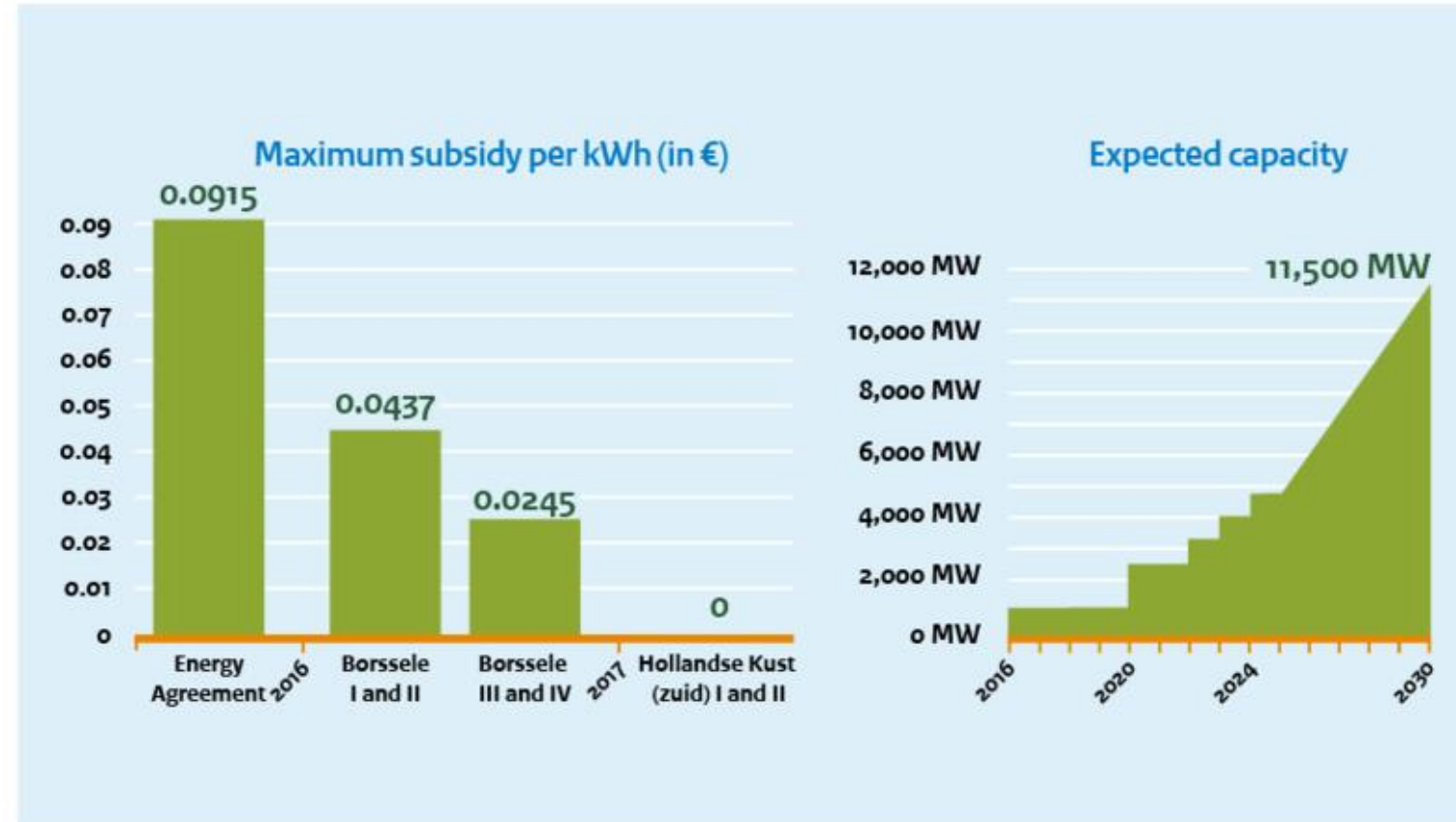
Key technologies and their development potential

# Why green hydrogen in the Netherlands?

1. Decision to stop natural gas extraction due to earthquakes

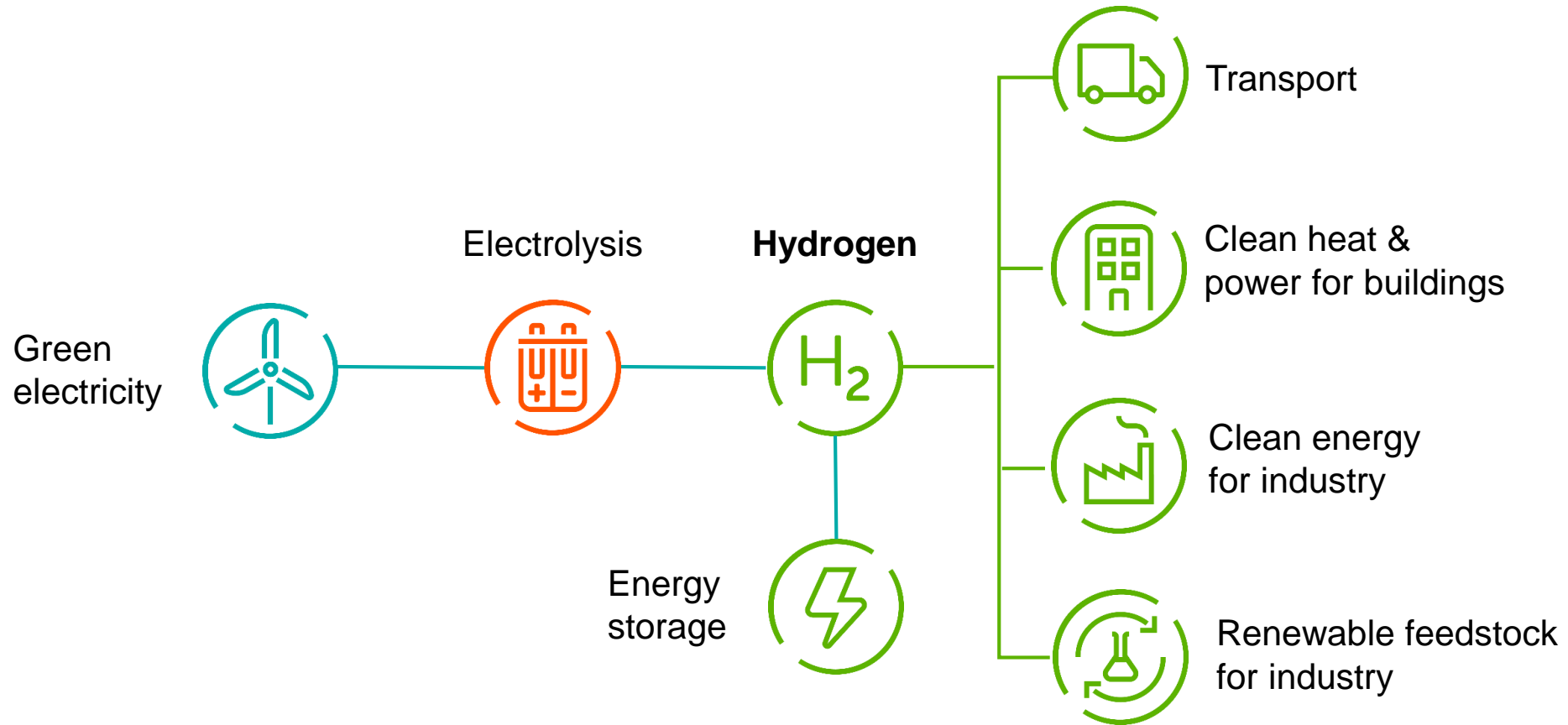


2. Developments in offshore wind energy



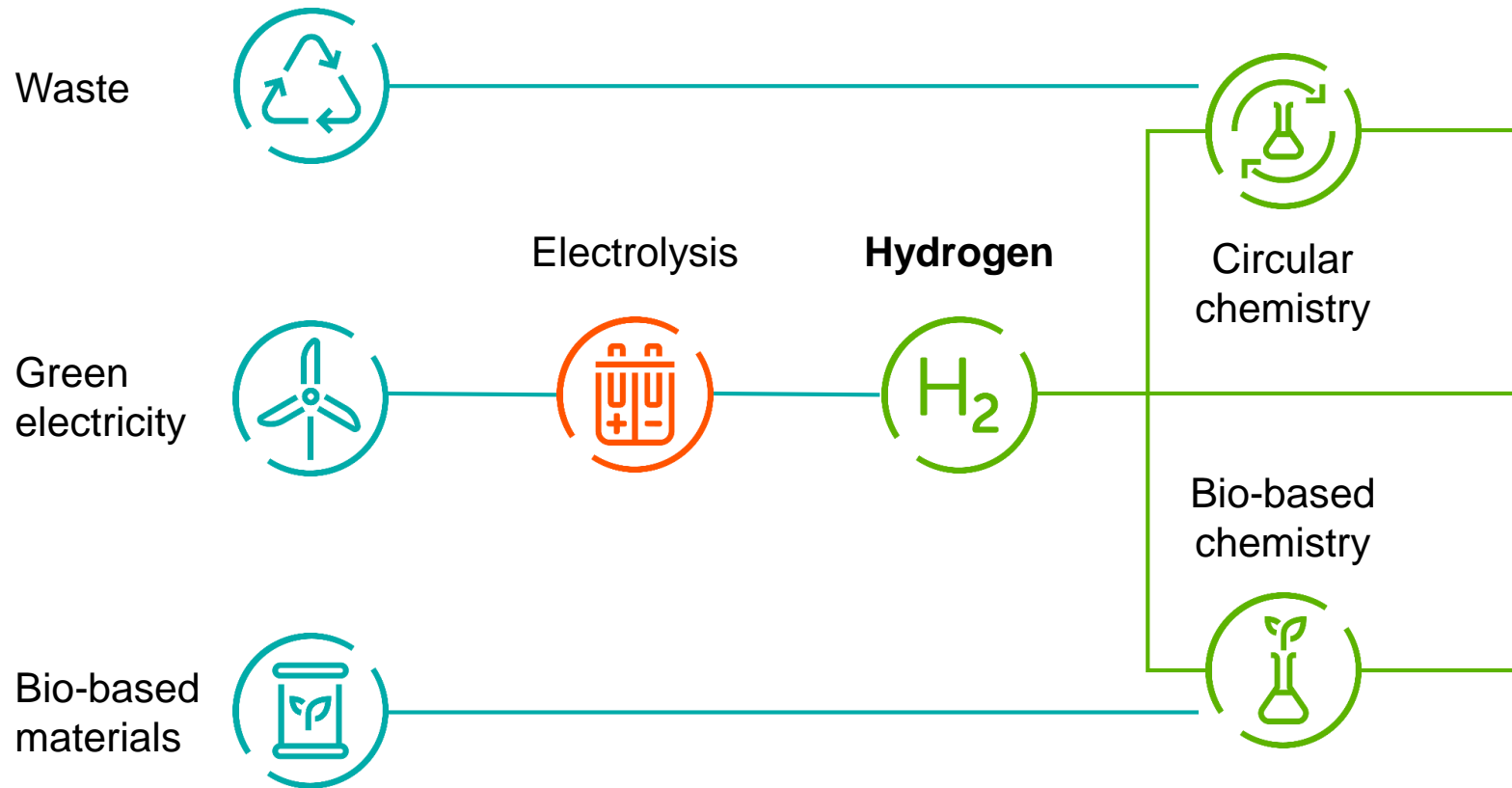


# Hydrogen plays a key role in the transition



# It's all about the chemical industry

## Zero-emission feedstock



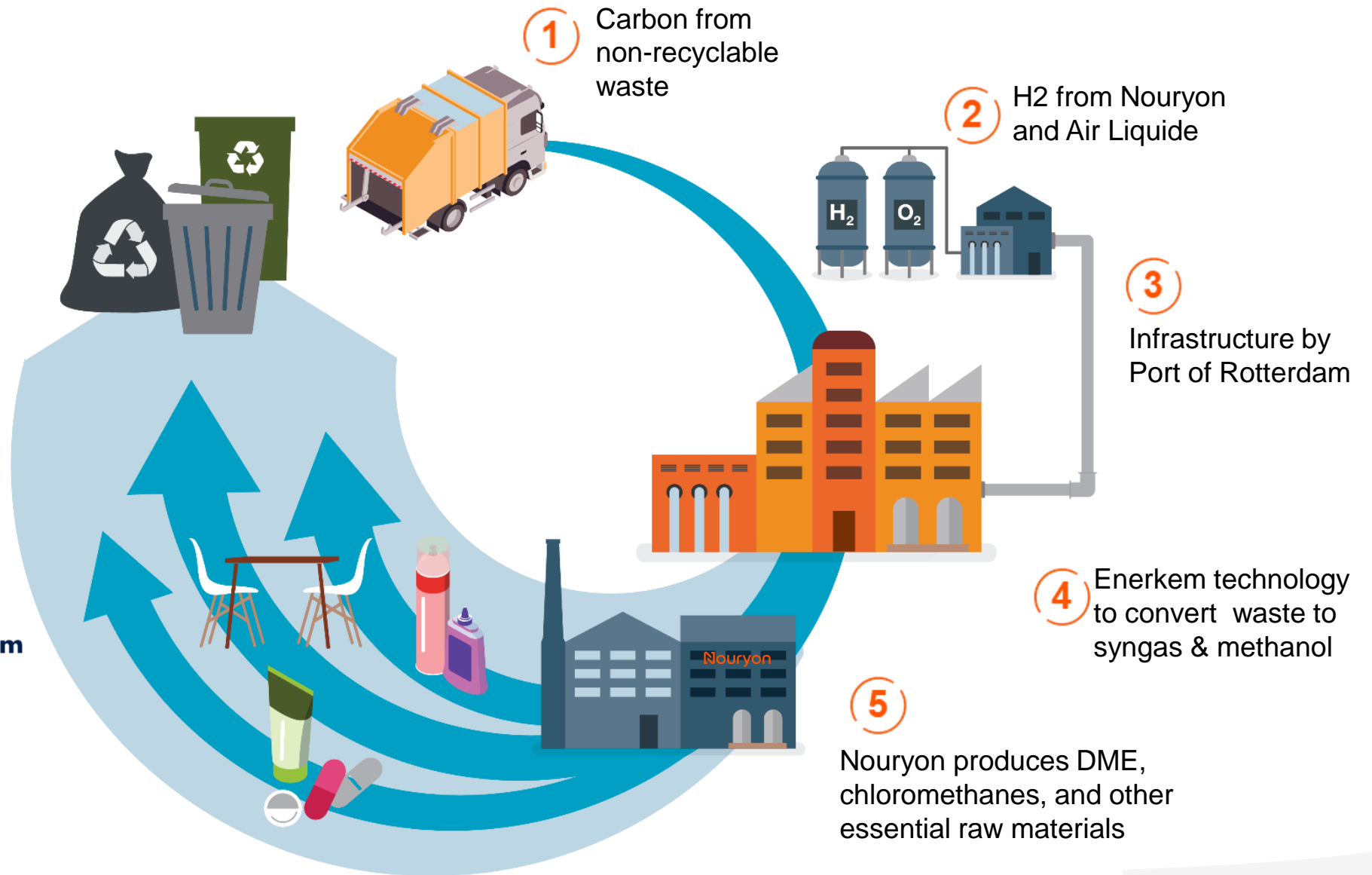
## Zero-emission materials and fuels



# Example project: Waste to Chemistry

## Production in 2020

- 309 kT waste → 220 kT/a Methanol
- CO<sub>2</sub> reduction of 300.000 tons
- Investment: € 240 mln;





# Agenda



Nouryon Industrial Chemicals



Circular chemistry and green hydrogen



**Our green hydrogen projects**



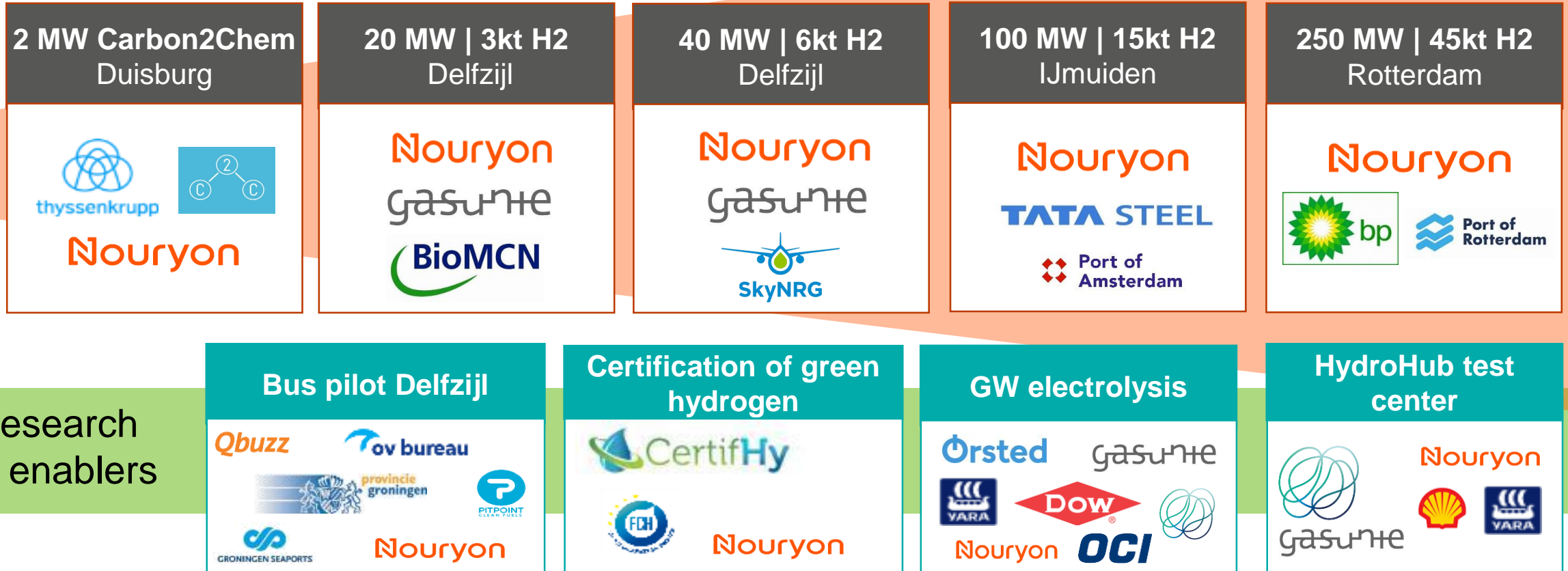
Making water electrolysis competitive



Key technologies and their development potential

## Building the circular economy

Scale-up and development of green hydrogen



Research & enablers

# First step has been announced

Delfzijl, Netherlands

1

20 MW | 3 kton H<sub>2</sub>  
Mainly bio-fuels  
FID in 2020



2

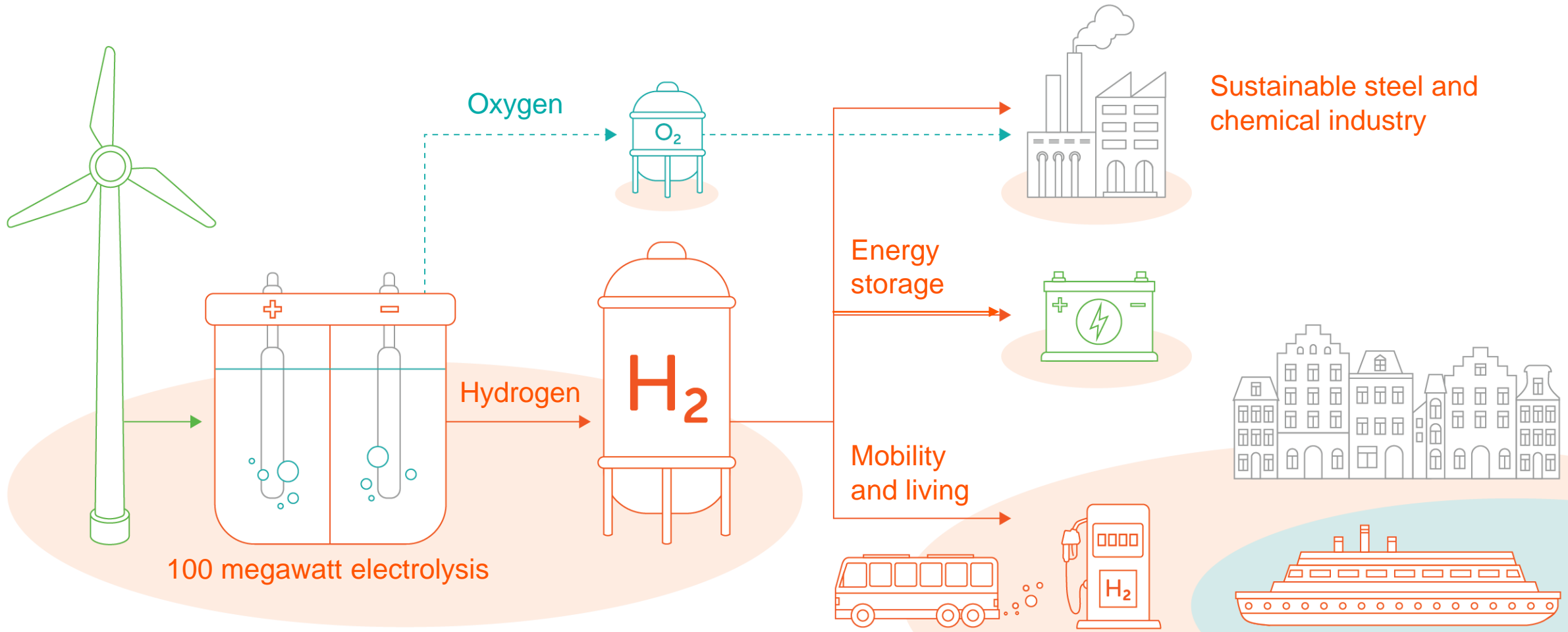
40 MW | 6 kton H<sub>2</sub>  
Bio jet fuel for KLM  
FID in 2020





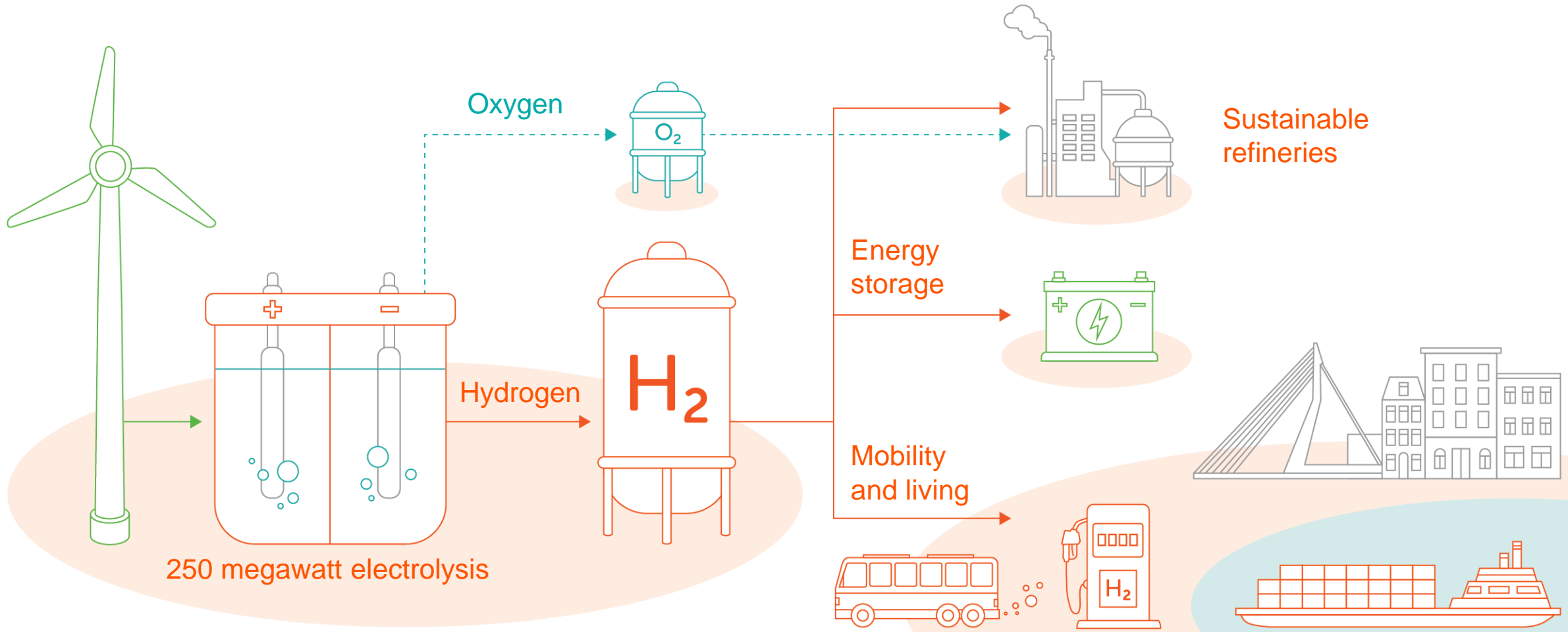
# Green hydrogen for sustainable steel

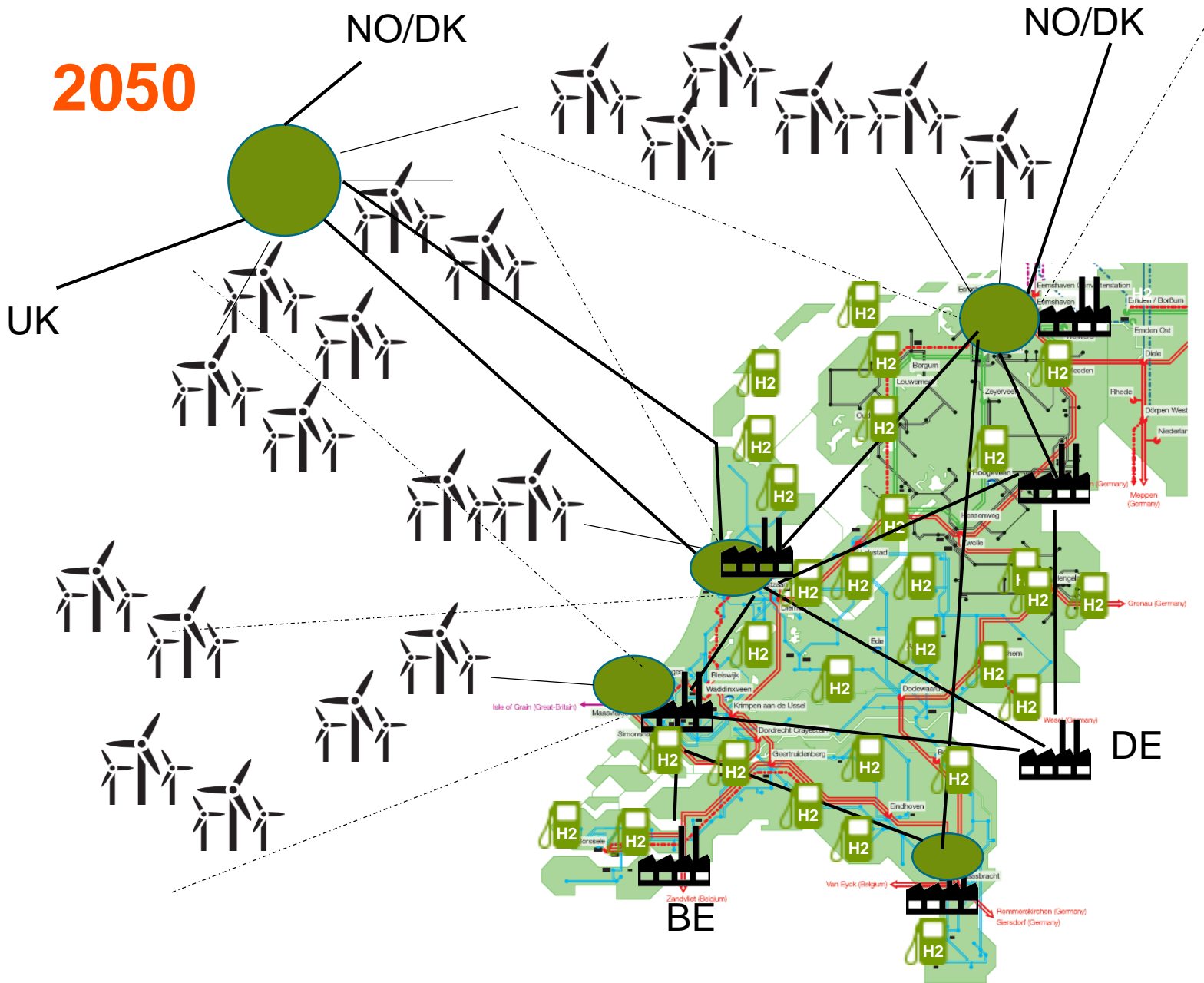
Nouryon | Tata Steel | Port of Amsterdam



# Enabling the transition in Rotterdam

Nouryon | BP | Port of Rotterdam





	Conversion
	Chemical industry
	Tanking station
	Power cable
	H2 pipeline
	Wind park

Large scale energy projects create opportunity for renewable chemical feedstock and mobility



# Agenda



Nouryon Industrial Chemicals



Circular chemistry and green hydrogen



Our green hydrogen projects

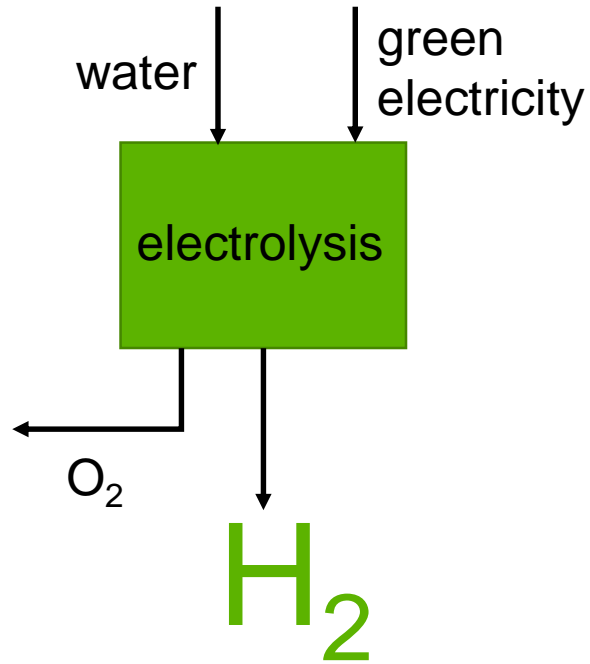


**Making water electrolysis competitive**



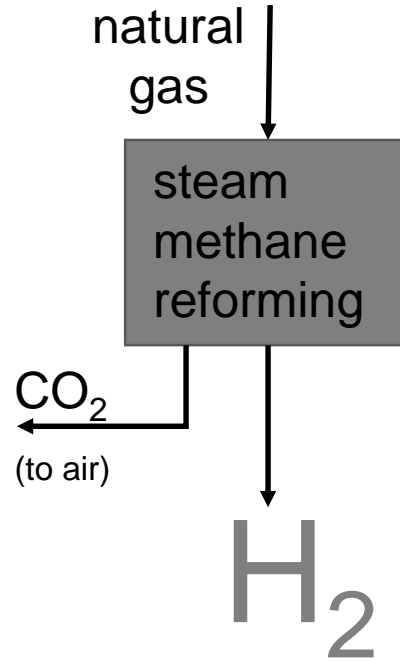
Key technologies and their development potential

# Green, grey and blue hydrogen



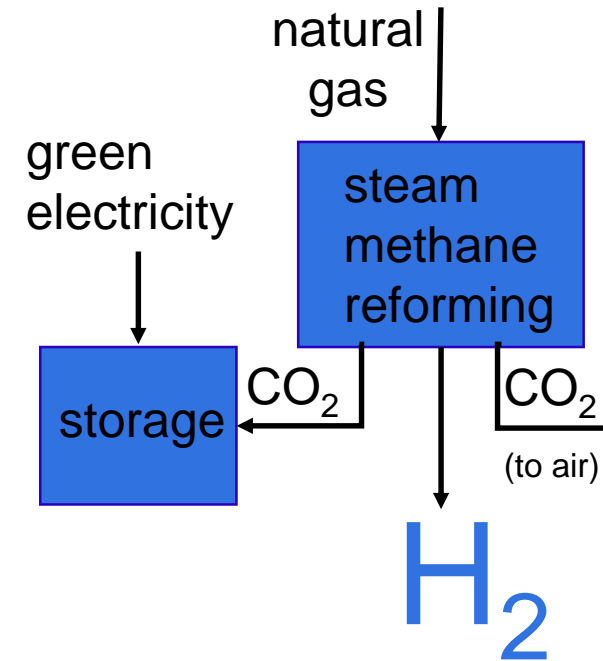
Electricity need:  
52 kWh/kg H<sub>2</sub>

0 kg CO<sub>2</sub>/kg H<sub>2</sub>



Natural gas need:  
46 kWh/kg H<sub>2</sub>

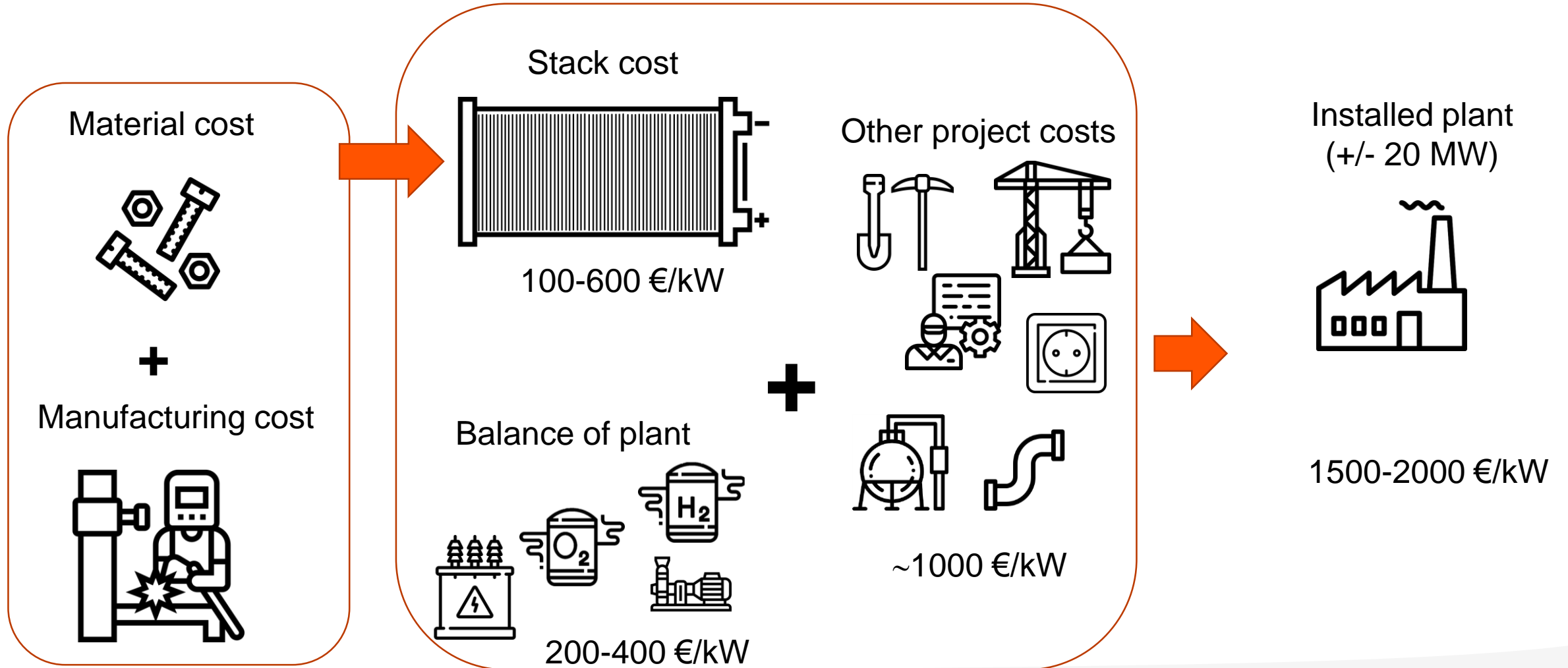
8.5 kg CO<sub>2</sub>/kg H<sub>2</sub>  
(H<sub>2</sub> now around 1.5 €/kg)



Natural gas + electricity need:  
46 + 2 kWh/kg H<sub>2</sub>

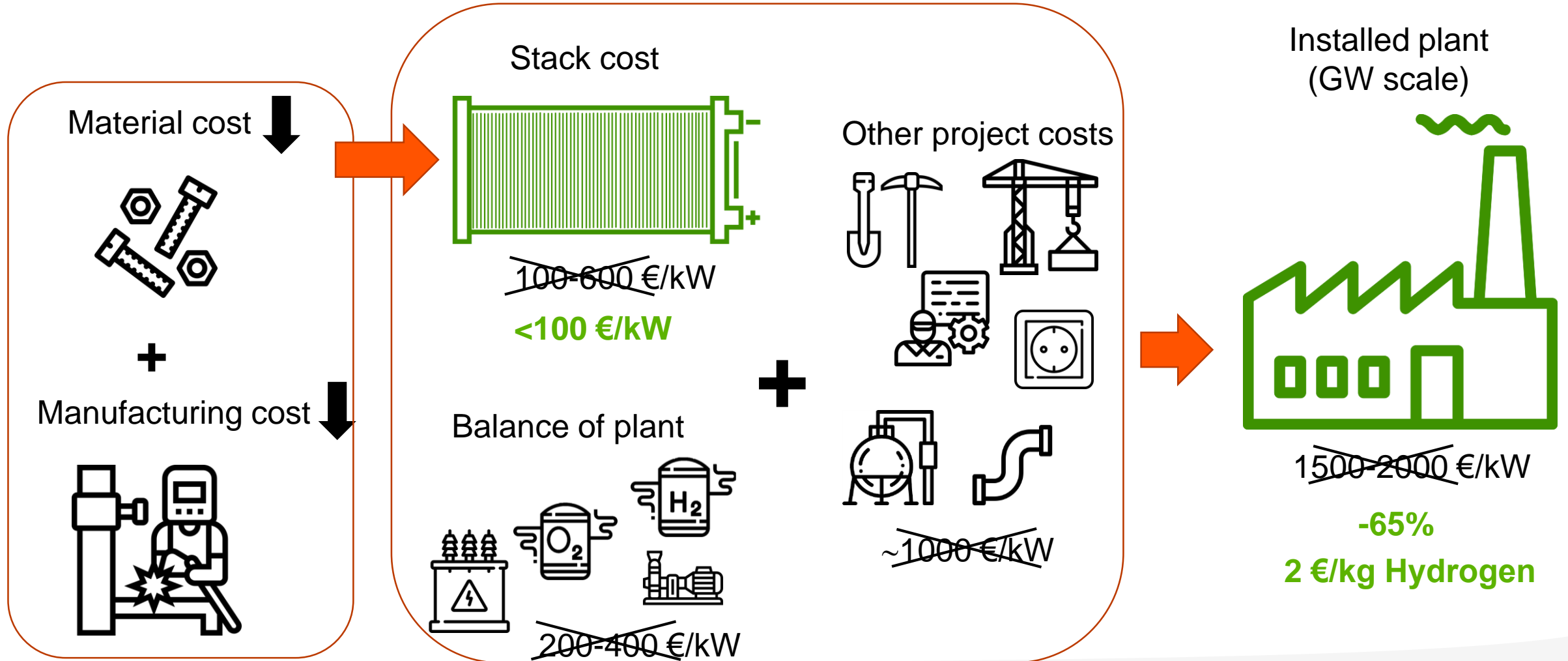
3.0 kg CO<sub>2</sub>/kg H<sub>2</sub>

# Need for GW scale: MW scale is too expensive





# Pushing down costs in GW scale



# Agenda



Nouryon Industrial Chemicals



Circular chemistry and green hydrogen



Our green hydrogen projects


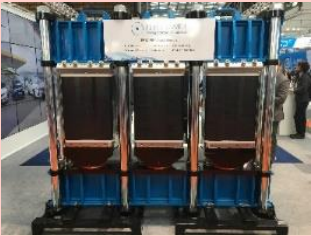




Making water electrolysis competitive



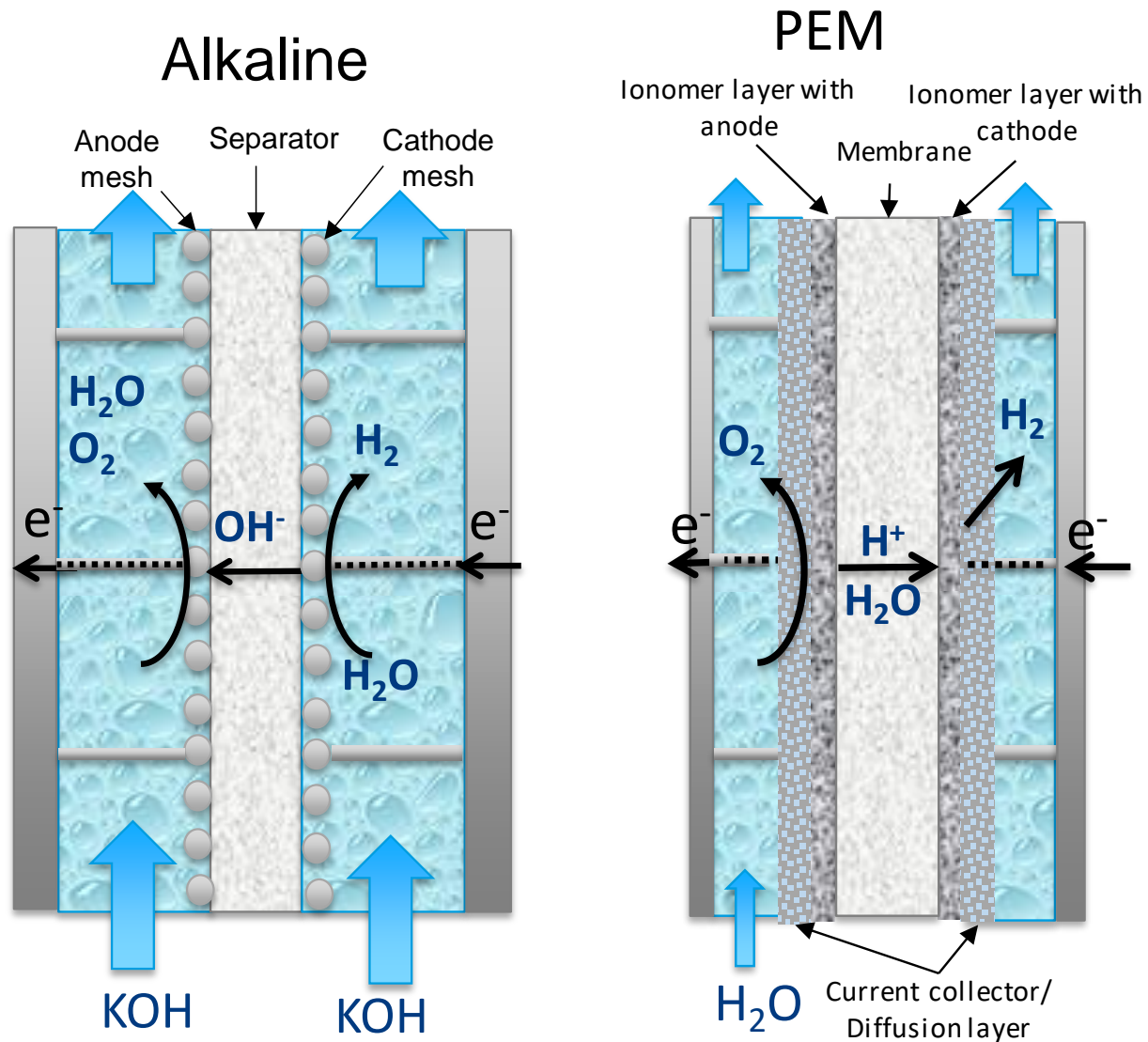
**Key technologies and their development potential**

# Key electrolysis technologies

	Alkaline	PEM	Solid oxide	AEM
				
Stack size (MW)	1 – 6	0.5 – 1.5 MW	? MW	0.0025 MW
Largest installed plant (MW)	165 / 30 Aswan / Xinjiang	10 Rheinland	0.15 Salzgitter	0.02 Rozenburg
Number of suppliers	7	5	2	1
Stack price (€/kW)	100 - 400	300 - 600	~2500	?
Stack efficiency (% of HHV)	~80%	~75%	~100%	~80%



# Key technologies



	Alkaline	PEM
Anode	Nickel	Iridium
Cathode	Nickel (activated)	Platinum
Separator	Asbestos alternative (porous)	Nafion (closed)
Cell thickness	1.5-8 cm	~0.5 cm
Current density (kA/m <sup>2</sup> )	2-9	15-30

# Commercial alkaline stacks

Current density

High  
(6-9 kA/m<sup>2</sup>)

## Atmospheric alkaline



thyssenkrupp



AKC

## Pressurized alkaline



McPhy

Low  
(2-4 kA/m<sup>2</sup>)



NEL



PERIC



Suzhou



Hydrogen-Pro



# Hydrohub MW test center @ Hanze Hogeschool

Nouryon

- The Hydrohub MW test center is a facility where research on water electrolysis is carried out at 100+ kW scale.
- The leading technologies (PEM and alkaline) are investigated
- Goal of the Hydrohub MW test center is to support innovations that can lead to cost reduction.
- Partners: Nouryon, Shell, Gasunie, Yara, Frames, Yokogawa, GSP, TNO/ECN, Hanze, RUG, ISPT
- Planned to be operational in early 2021





# Conclusions

- Green hydrogen is essential to achieve the energy transition and convert to a circular economy
- To make green hydrogen competitive we need to achieve significant cost reductions
- We believe there is still plenty of room to further improve alkaline technology



Rjukan: 165 MW, 27,900 Nm<sup>3</sup>/h  
Closed in 1971

Thank you!



[Thijs.deGroot@Nouryon.com](mailto:Thijs.deGroot@Nouryon.com)

Nouryon



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**Short coffee break**  
**See you in ten minutes!**





# News from the cluster

---

- Actual status
  - Decisions from the steering group
  - Feedback visit to Flemish cabinets
  - inventory H2 activities & expertise  
flanders
  - Hydrogen academy
  - South visits North
  - Hydrolog project
  - IPCEI Green Octopus
  - VLAIO funding instruments  
(Bart De Caesemaeker)
-

# 55 MEMBERS







# DECISIONS FROM STEERING GROUP

- Steering group meeting 24/01:



Polders Investeringsfonds nv  
Antwerpse duurzame investeringsmaatschappij



- New **name**: focus on hydrogen activities + Dutch speaking area
- New **corporate identity**
- New actions:
  - Members **portal** on website
  - H2 **status report** Flanders
  - Input for **H2 strategy** Flemish government

# VISITS TO FLEMISH CABINETS

---

- 18/12 [Hilde Crevits](#) (Economy & Innovation): H2 plan & support for demonstration projects
  - 8/01 [Matthias Diependaele](#) (taxation): ZE friendly car taxation + tax exemption for ZE trucks
  - 14/01 [Lydia Peeters](#) (mobility & De Lijn): plead for hydrogen bus projects
  - 16/01 [Zuhal Demir](#) (Energy & Climate): hydrogen in climate plans
  - 16/01 [Jan Jambon](#) (MP): collaboration with the Netherlands + initialization of Flemish H2 plan
- ➔ Follow up visits to be planned **June 2020**
-



# MAIN CONCLUSIONS VISITS TO FLEMISH CABINETS

---

- Hydrogen is generally seen as an **important topic**
  - **Cluster** recognised as representative for H2 industry
  - H2 considered as **longterm solution** for decarbonisation
    - Cabinet Energy: short term focus CO2 reduction
    - ↔ Cabinet Innovation: main discussion partner & recognised need for **H2 plan**
      - ➔ Input provided
  - Cabinet Mobility: reconsidering options for **H2 buses** (test pilots)
  - Cabinet Finance: positive towards road **tax exemption** for trucks
-

- FOD Economie is consulting several parties working on H2
- WaterstofNet invited to FOD Economie 13/02
- Analysis is running on competences federal ↔ regional regarding H2
- Hydrogen vision is being made (summer 2020)
- TBC: FOD Economie present at next meeting







# HYDROGEN ACADEMY

---

- Initiative from WaterstofNet: [Hydrogen Academy](#)
  - 5 evening [sessions](#):
    - ✓ April 20: H2 basics
    - ✓ April 27: hardware for a hydrogen economy
    - ✓ May 4: applications in transport
    - ✓ May 11: applications in industry and built environment
    - ✓ May 18: how to make a hydrogen project a success
  - Internal and external [speakers](#)
  - Strongly reduced [cost of participation](#) for cluster members!
- 



# VISIT TO NORTHERN NETHERLANDS

- Ambition: yearly [visit](#) to interesting hydrogen projects
- 2020: visit to the Northern Netherlands (Groningen) "[South visits North](#)"
- Thursday May 7 @ [Gasunie](#)
  - ✓ H2 projects Gasunie, Hydrogen Valley and WIC
  - ✓ Networkevent Gasunie, Hydrogreenn, New Energy Coalition and WIC
- Friday May 8
  - [Hystock](#)
  - Hydrogen center [Holthausen Clean Technology](#)
- Registration & more information by [mail](#)



# PROJECT HYDROLOG

- Project led by **VIL**: jan. 2020 – aug. 2021
- 15 **partners**: Aertssen, Air Liquide, Antwerp Euroterminal (AET), Brussels Airport, Delhaize, DEME, Ecosource, Engie, Fluxys, Kalmar, Motrac, MPET, POM Limburg, PSA Antwerp and STILL
- Goals:
  - Study about **internal logistics** and H2
  - **Tool** development TCO H2 logistics
  - **POC** with mobile H2 station
- **Participation** still possible: contact us **asap**





# Green Octopus and IPCEI



**WaterstofNet**

**Adwin Martens**

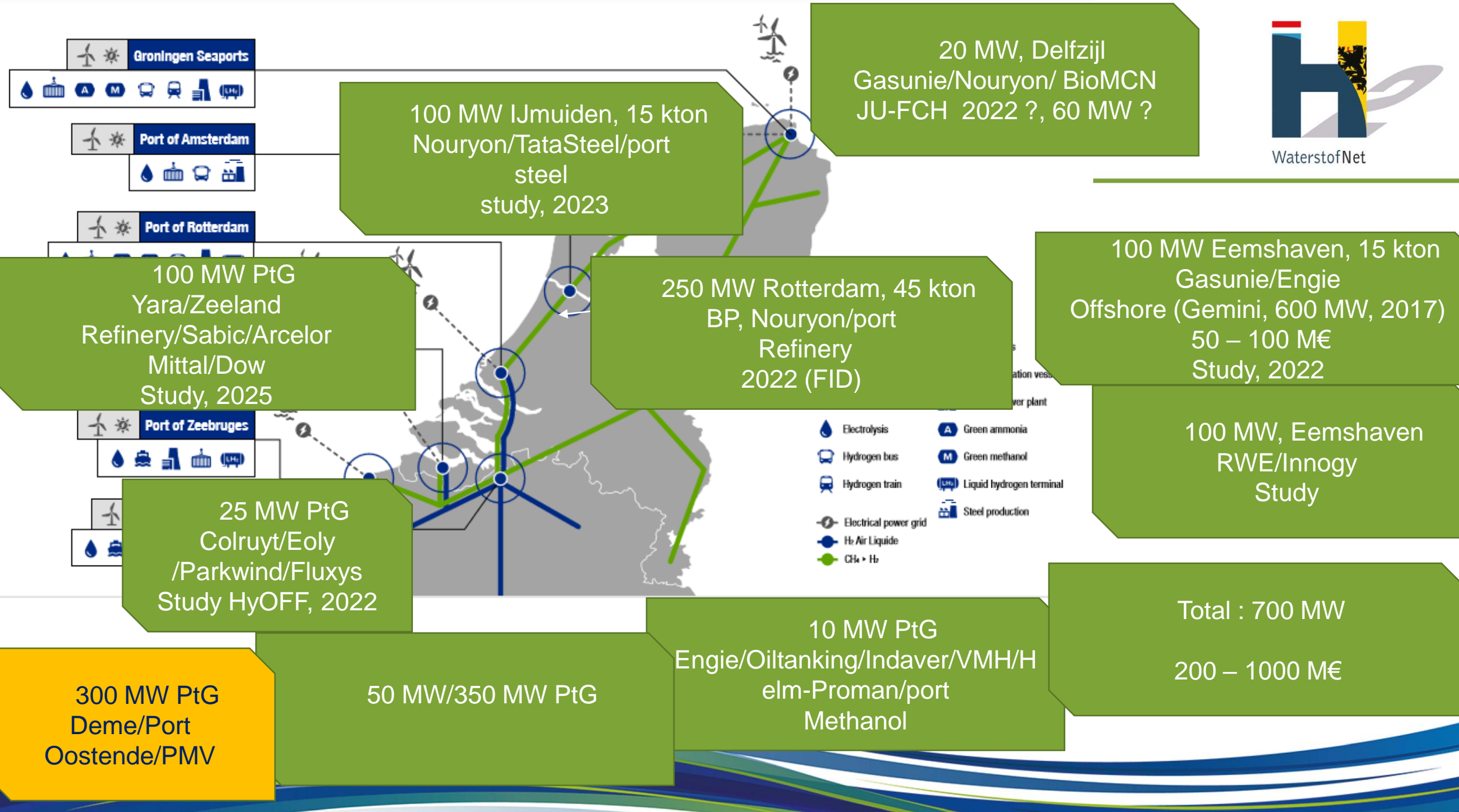
**Mortsel, 5 maart 2020**



# Green Octopus

Developing the (North) European Hydrogen backbone





Groningen Seaports

Port of Amsterdam

Port of Rotterdam

Port of Zeebruges

100 MW IJmuiden, 15 kton  
Nouryon/TataSteel/port  
steel  
study, 2023

20 MW, Delfzijl  
Gasunie/Nouryon/ BioMCN  
JU-FCH 2022 ?, 60 MW ?

100 MW PtG  
Yara/Zeeland  
Refinery/Sabic/Arcelor  
Mittal/Dow  
Study, 2025

250 MW Rotterdam, 45 kton  
BP, Nouryon/port  
Refinery  
2022 (FID)

100 MW Eemshaven, 15 kton  
Gasunie/Engie  
Offshore (Gemini, 600 MW, 2017)  
50 – 100 M€  
Study, 2022

100 MW, Eemshaven  
RWE/Innogy  
Study

25 MW PtG  
Colruyt/Eoly  
/Parkwind/Fluxys  
Study HyOFF, 2022

Total : 700 MW  
200 – 1000 M€

300 MW PtG  
Deme/Port  
Oostende/PMV

50 MW/350 MW PtG

10 MW PtG  
Engie/Oiltanking/Indaver/VMH/H  
elm-Proman/port  
Methanol

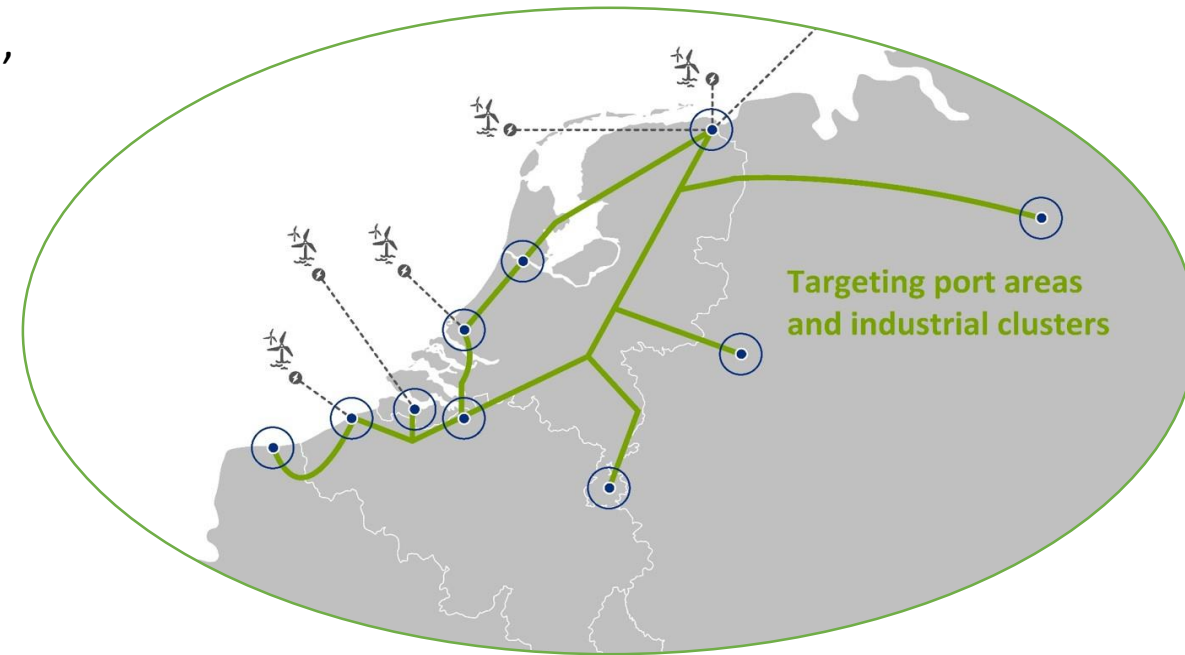


# Build a backbone and value chain to serve green hydrogen demand

Hydrogen  
for Climate Action



Large amounts of clean hydrogen will be **produced** locally or abroad,  
will be **imported** via the ports,  
will be **transported** by converted natural gas or new infrastructure  
towards large scale **endusers** of hydrogen



# Green Octopus

Hydrogen  
for Climate Action



- **Overarching** future scenario, to be realised step by step
- Cross border cooperation of **neighbouring countries**
- **Interest** from industry (10,...), governments (Flanders, Netherlands, Germany..), Europe (DGGROW, HE,..)
- Opportunities for **privat-public funding** for parts of Green Octopus

# Supporting partners

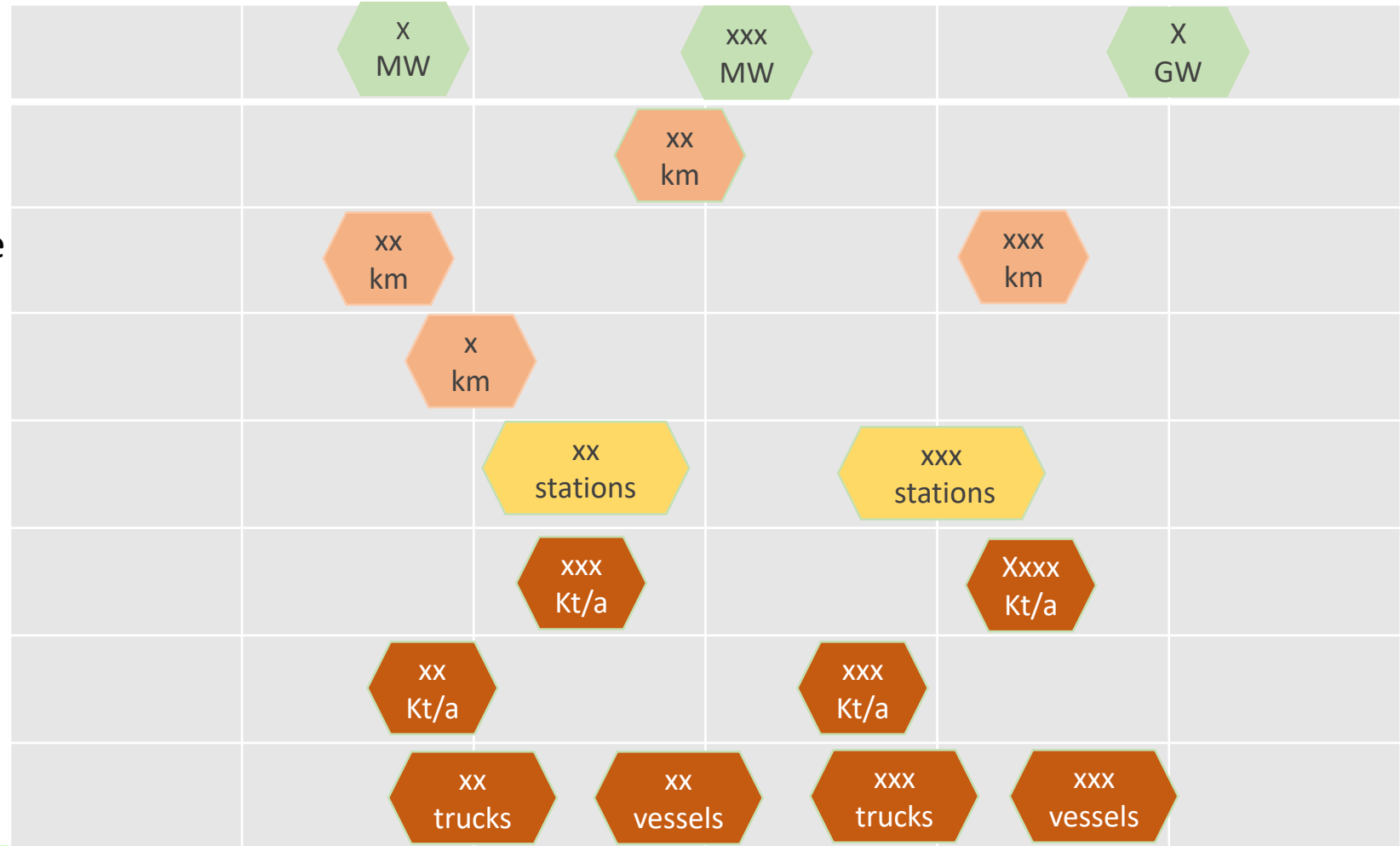
Hydrogen  
for Climate Action





# Projects examples

2020 2025 2030



# Possible funding

- Regional programmes
- National programmes
- IPCEI
- ETS- Innovation Fund
- CEF
- Interreg
- Life
- JU-FCH
- ....

Hydrogen  
for Climate Action



# 3. Characteristics of projects within Green Octopus



- Green Octopus is not equal to IPCEI-hydrogen, but is an ‘umbrella-project’
- Green Octopus can only be realised by continuous joint forces of industry/government
- Most appropriate funding schemes for individual projects must be selected



# IPCEI



- IPCEI is no European money, it is money from the member states
- IPCEI-eligibility is exemption from state aid: up to 100% funding of “funding gap”
- An IPCEI will formally be submitted by member states, not by companies
- The key-actors of the IPCEI are individual companies

# Common understanding of requirements IPCEI (1)



Three types of activities are eligible within an IPCEI (Art. 21-22 & 23 of the IPCEI guidelines)

- R&D&I projects must be of a major innovative nature or constitute an important added value in terms of R & D&I in the light of the state of the art in the sector concerned. **Battery IPCEI (Germany, Belgium,...)**
- Projects comprising of industrial deployment must allow for the development of a new product or service with high research and innovation content and/or the deployment of a fundamentally innovative production process. Regular upgrades without an innovative dimension of existing facilities and the development of newer versions of existing products do not qualify as IPCEI.
- Environmental, energy or transport projects must either be of great importance for the environmental, energy, including security of energy supply, or transport strategy of the Union or contribute significantly to the internal market, including, but not limited to those specific sectors. **“Green Octopus” IPCEI**

Within one IPCEI, companies can apply for different types of activities (R&D-FID –infrastructure)

# Common understanding of requirements IPCEI (2)



Criteria for an IPCEI are:

- It should be very important in size (> 1 B€)
- Its should be a long term project (> 5 years)
- It should consist of a long term partnership to structure strategic value chains in EU.
- The project should be risky enough (innovative in case of R&D project, considerable financial risk in case of infrastructure project).

# Timing ???

- March: Expression of Interest published by Belgium
- 12 March: Next workshop at Hydrogen Europe
- Which member state will take the lead ?
- To be followed intensively



# Conclusions

- IPCEI is a large opportunity with a lot of questions
- Guided by Hydrogen Europe and DG GROW, decided by DG COMP
- WaterstofNet is contact-point for developing Green Octopus-idea supported by governments and companies :

Coordinate the development of the Green Octopus project and prepare next steps regarding funding possibilities

Description of industrial partners willing to invest in projects with targets/timelines/budget

Description of status of interest/engagement/commitment of member states

Two-weekly telco's with feedback for and discussion with the partners

Synchronisation of activities with Hydrogen Europe/DG GROW regarding milestones

Develop status document (industry/memberstates/Europe) on Green Octopus

# SAVE THE DATES

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- Hydrogen Academy: 20/04, 27/04, 4/05, 11/05 and 18/05
- Visit to Groningen: 7-8/05
- Next cluster meeting: 3/06 @ABC
- Cluster meetings after summer:
  - 16/09
  - 2/12

*Save  
the  
Date*

---

# NEWS ABOUT VLAIO SUPPORT

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- VLAIO = **direct financial support** for R&D projects in Flanders
  - Database for types of grants
  - Support for pilot projects
  - Interesting instrument for H2: Ecologiepremie +
  - Strategische Ecologiesteun (STRES)

- “Subsidiedatabank”
- One place to find all grants and financing options
- Provincial, Flemish, federal and European support
- <https://www.vlaio.be/nl/subsidies-financiering/subsidiedatabank>





# NEW: SUPPORT FOR PILOT PROJECTS

KMO PORTEFEUILLE

KMO  
GROEISUBSIDIE

RESEARCH AND DEVELOPMENT PROJECTS

STRATEGISCHE  
TRANSFORMATIE  
STEUN

PILOT PROJECTS

ECOLOGIE  
PREMIE PLUS

STRATEGISCHE  
ECOLOGIESTEUN

IDEA

FEASIBILITY

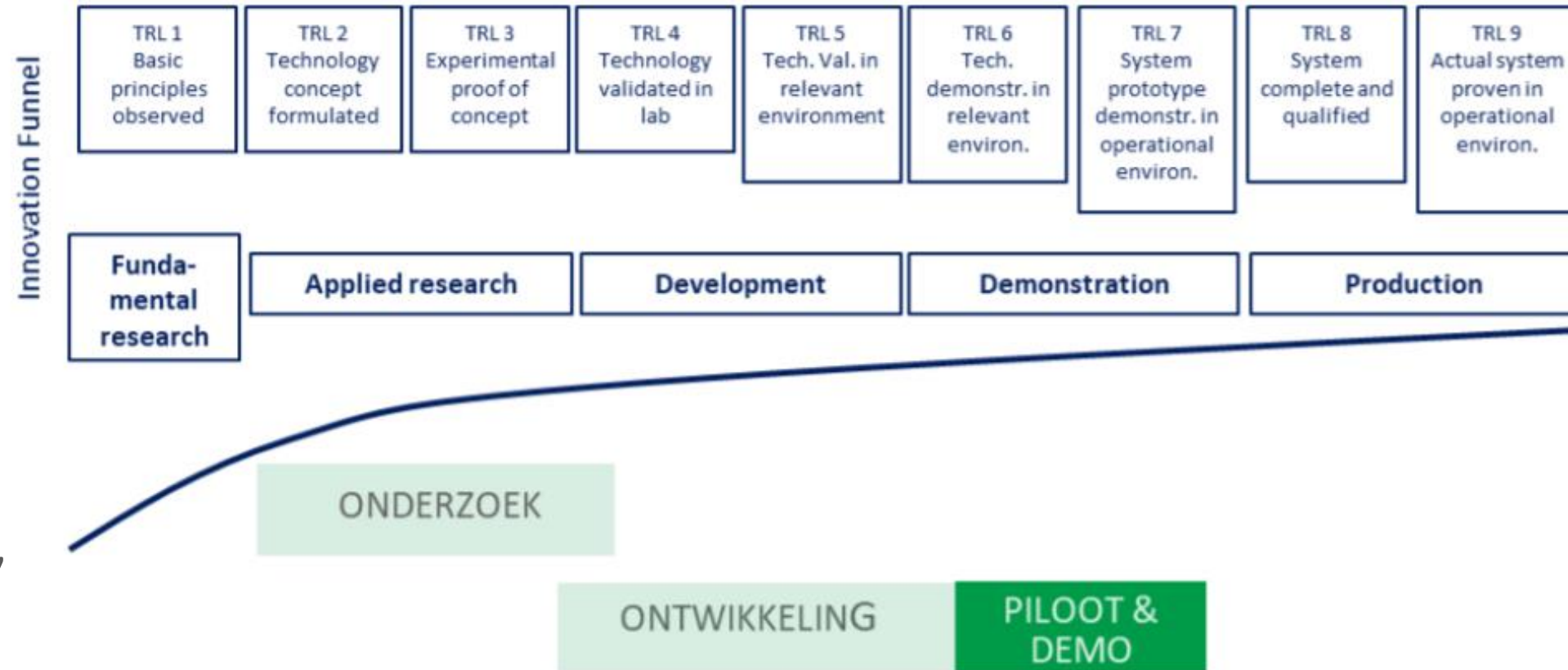
PROTOTYPE

DEMONSTRATION

WAY TO  
IMPLEMENTATION

	Development projects ( <a href="#">“Ontwikkelingsproject”</a> )	Research
	Development prototype (incl <u>pilot</u> )	Research
Support	<p><b>Basis: 25%</b></p> <p>+ 20% SE → 45%</p> <p>+ 10% ME → 35%</p> <p>+ 10% collaboration</p> <p><b>Maximum 50%</b></p>	<p><b>Basis: research: 50%</b></p> <p><b>development: 25%</b></p> <p>+ 10% ME</p> <p>+ 20% SE</p> <p>+ 10% collaboration</p> <p><b>Maximum 60%</b></p>
Maximum support	€ 3 million	€ 3 million
Minimal support	€ 25.000	€ 100.000
Duration	maximum 24 months	maximum 36 monts
Lead time	4 months	6 months

# SUPPORT FOR PILOT PROJECTS



- Pilots: TRL 6-7
- Pilot can be part of R&D project or separate
- max. €1.000.000 support for pilots
- Support for FTE's & material costs

# INTERESTING INSTRUMENT: ECOLOGIE PREMIE +

KMO PORTEFEUILLE

KMO  
GROEISUBSIDIE

RESEARCH AND DEVELOPMENT PROJECTS

STRATEGISCHE  
TRANSFORMATIE  
STEUN

PILOT PROJECTS

ECOLOGIE  
PREMIE PLUS

STRATEGISCHE  
ECOLOGIESTEUN

IDEA

FEASIBILITY

PROTOTYPE

DEMONSTRATION

WAY TO  
IMPLEMENTATION



# INTERESTING INSTRUMENT: ECOLOGIE PREMIE +

- Support for innovative, environment friendly and energy saving investments
  - Additional cost versus ‘traditional investment’ is supported
- ‘limitative technology list’
- Up to 55% support for S(M)E and up to 45% for large enterprises
- Maximum of 1 million euro support every 3 year
- [vlaio.be/ecologiepremie](http://vlaio.be/ecologiepremie)



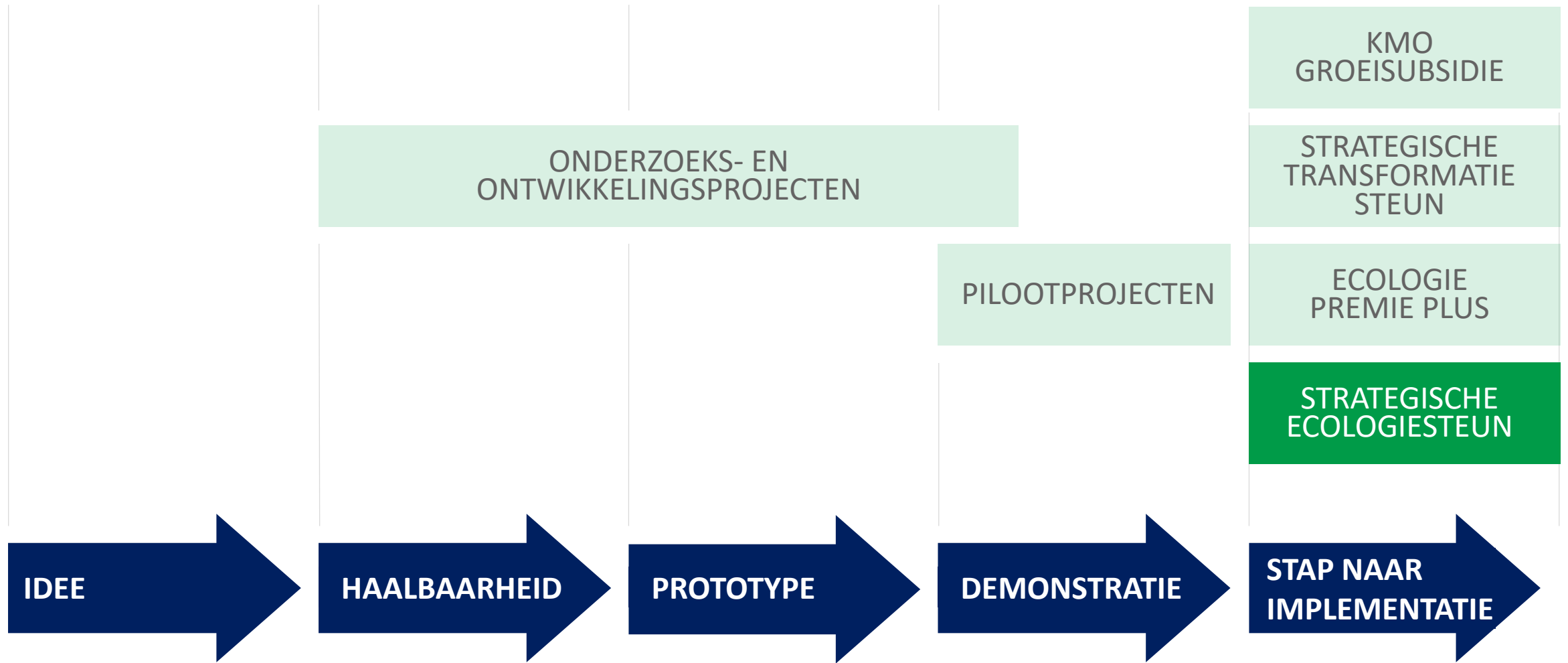
# INTERESTING INSTRUMENT: ECOLOGIE PREMIE +

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- H2 support:
    - Conversion to fuel cell for transport
      - Conversion for all types of transport
      - 30% additional investment grant for S(M)E's en 15% for large enterprises
      - Has to be present: fuel cell and H2 storage tank
    - Fuelling stations
      - Green or blue hydrogen
      - Maximum investment cost: 2 million euro
      - 30% additional investment grant for S(M)E's en 15% for large enterprises
      - Has to be present: dispenser, H2 storage and compressor, electrolysis when H2 made on site
-

- H2 support:
    - Transport using H2 fuel cell
      - All types of transport
      - 30% additional investment grant for S(M)E's en 15% for large enterprises
      - Has to be present: transport vehicle, fuel cell and H2 storage tank
    - H2 technology **not on list**? Let us know
      - Categories: cooling, transport, lighting, heating, ...
      - E.g. hydrogen as coolant, H2 shore power, H2 CHP, H2 ICE engine, ...
-

KMO PORTEFEUILLE





# STRategische EcologieSteun (STRES)

- Vlaamse investeringssteun voor ‘bedrijfseigen’ innovatieve energiebesparende en milieuvriendelijke investeringen in het Vlaams Gewest
- Investerings niet op LTL-lijst
- Voor **ecologische investeringen vanaf 3 miljoen euro** (in volgende 3 jaren)
- Enkel steun op de ecologische meerkost van de essentiële componenten

# STRES

- Ondernemingen die investeren in het Vlaamse Gewest
- Steun:

kmo

- tot 40%
- max. € 1 miljoen/3jaar

grote onderneming

- tot 30%
- max. € 1 miljoen/3jaar

- Niet voor vzw's

---

# Project news from cluster members



**KU LEUVEN**



**COLRUYT  
GROUP**

# BatHyBuild

Bottom up analysis of technologies for hydrogen in buildings

P2G meeting

5 March 2020



**KU LEUVEN**



# Main questions

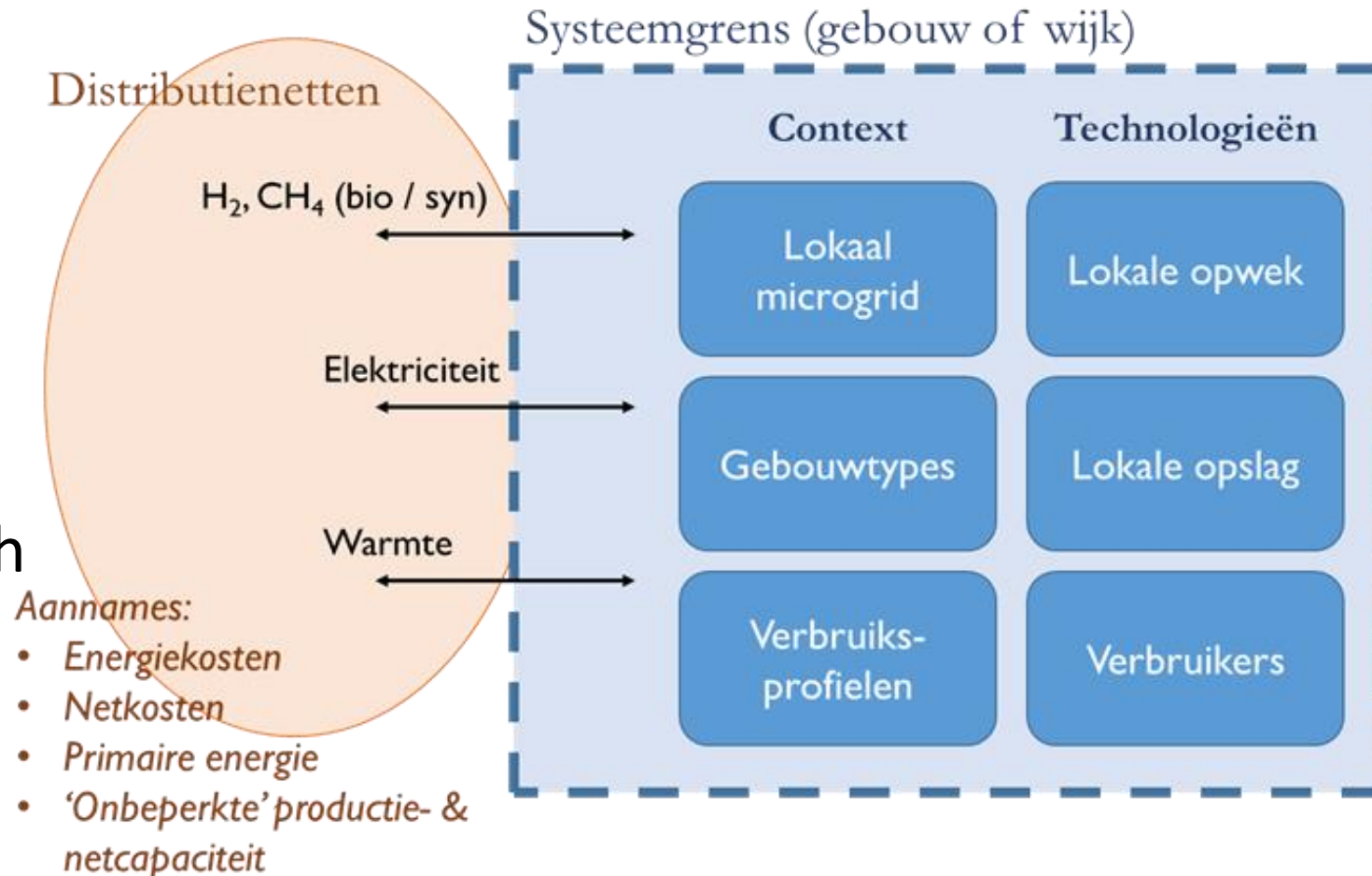
In what contexts can hydrogen be useful within the built environment?

Which technologies can be used for local production or consumption of hydrogen?

What decisions / pilots can companies pursue today which are in line with scenarios for 2050?

# Approach

- Bottom-up case analysis  
KPIs: cost, energy, grid load
- Input for policy / top down studies
- First step towards a Flemish pilot



# Practical arrangement

- Core team

- WaterstofNet
- KU Leuven
- Fluvius
- Ingenium

- Timing

- +/- March – Oct 2020
- Afterwards: feasibility / pilot project

- Budget

- Ca. 27 k€
- With support from Fluvius / VEA?

# Interested?

Isabel.Francois@waterstofnet.eu

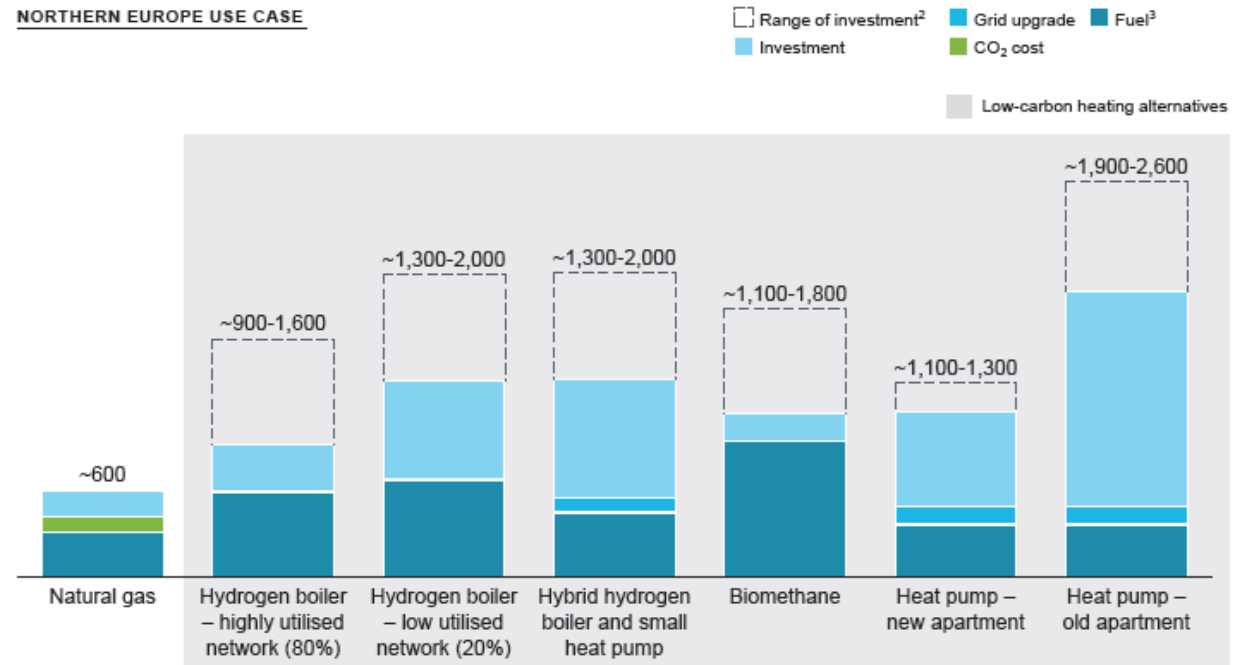
Jan.Ronge@kuleuven.be

## Exhibit 28 | Cost components of residential heating solutions in 2030

### Household heating

USD/year per household in 2030<sup>1</sup> (consumption 10 MWh/year)

NORTHERN EUROPE USE CASE





# Presentation Agfa energy management

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# Waterstof dag

Agfa-Gevaert: energieconversie



5/03/2020

Ben De Crom

Projectmanger Energy & Sustainability

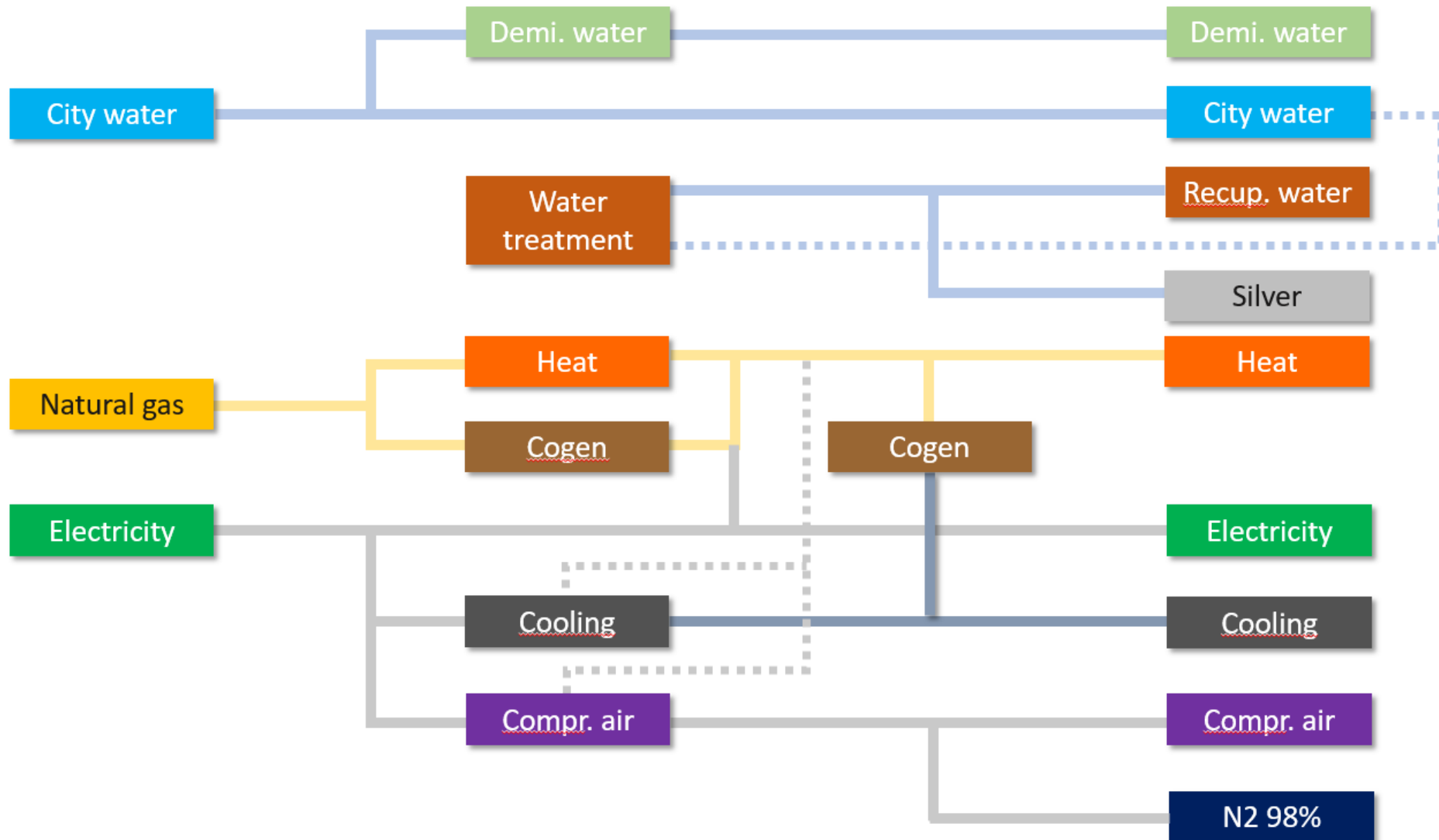


# Energie op Agfa



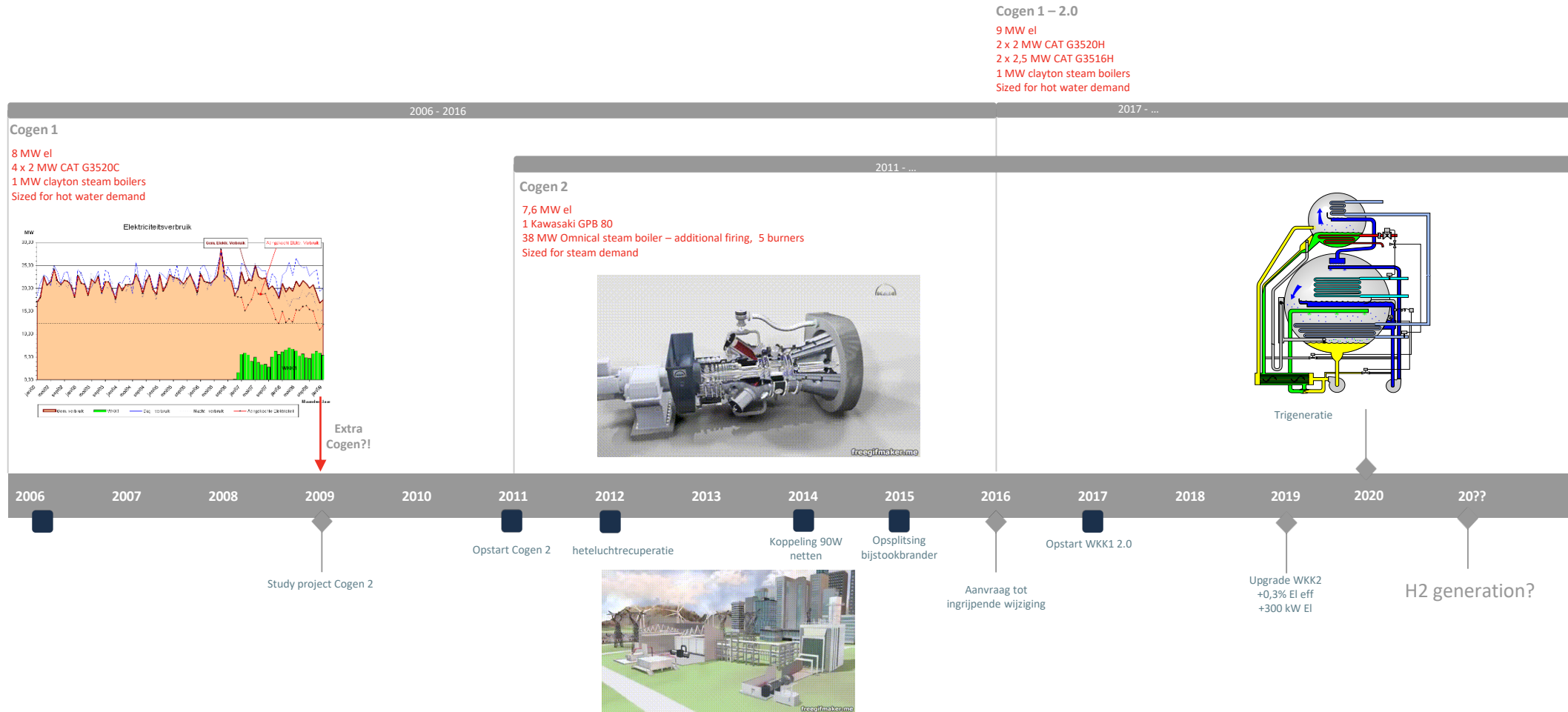
- Electriciteit: 125.000 MWh
  - Eigen productie: 100.000 MWh
  - 36.000 gezinnen
  
- Aardgas: 375.000 MWh
  - 20.000 gezinnen
  
- Water: 600.000 m<sup>3</sup>
  - 142.000 m<sup>3</sup> gerecupereerd (WZI)
  - 5.000 gezinnen
  
- Omzetting naar secundaire energievormen
  - Koeling, verwarming, stoom, perslucht,...

# Types of secondary energy

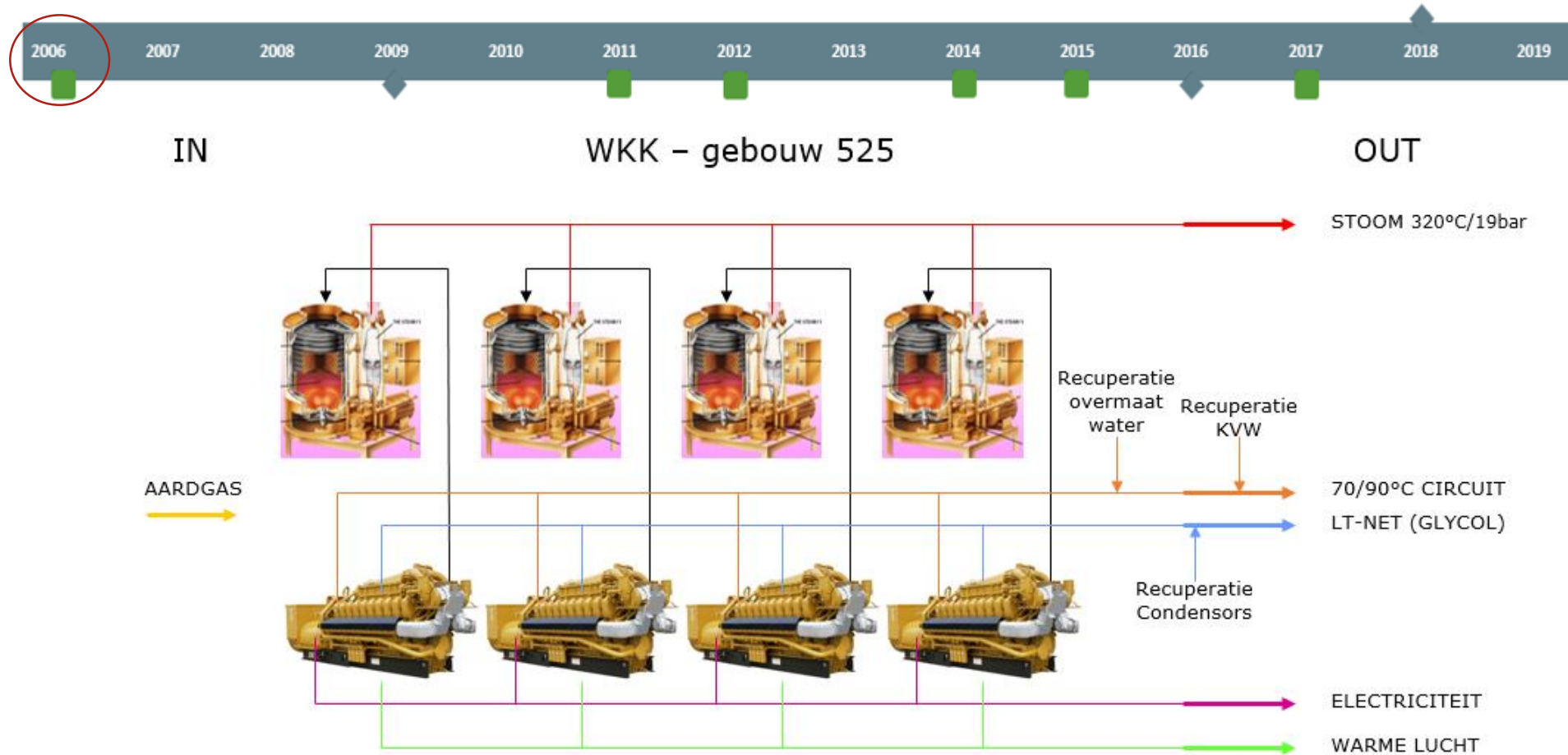




# Cogeneration @ Agfa



# WKK1 - Origineel



# WKK2



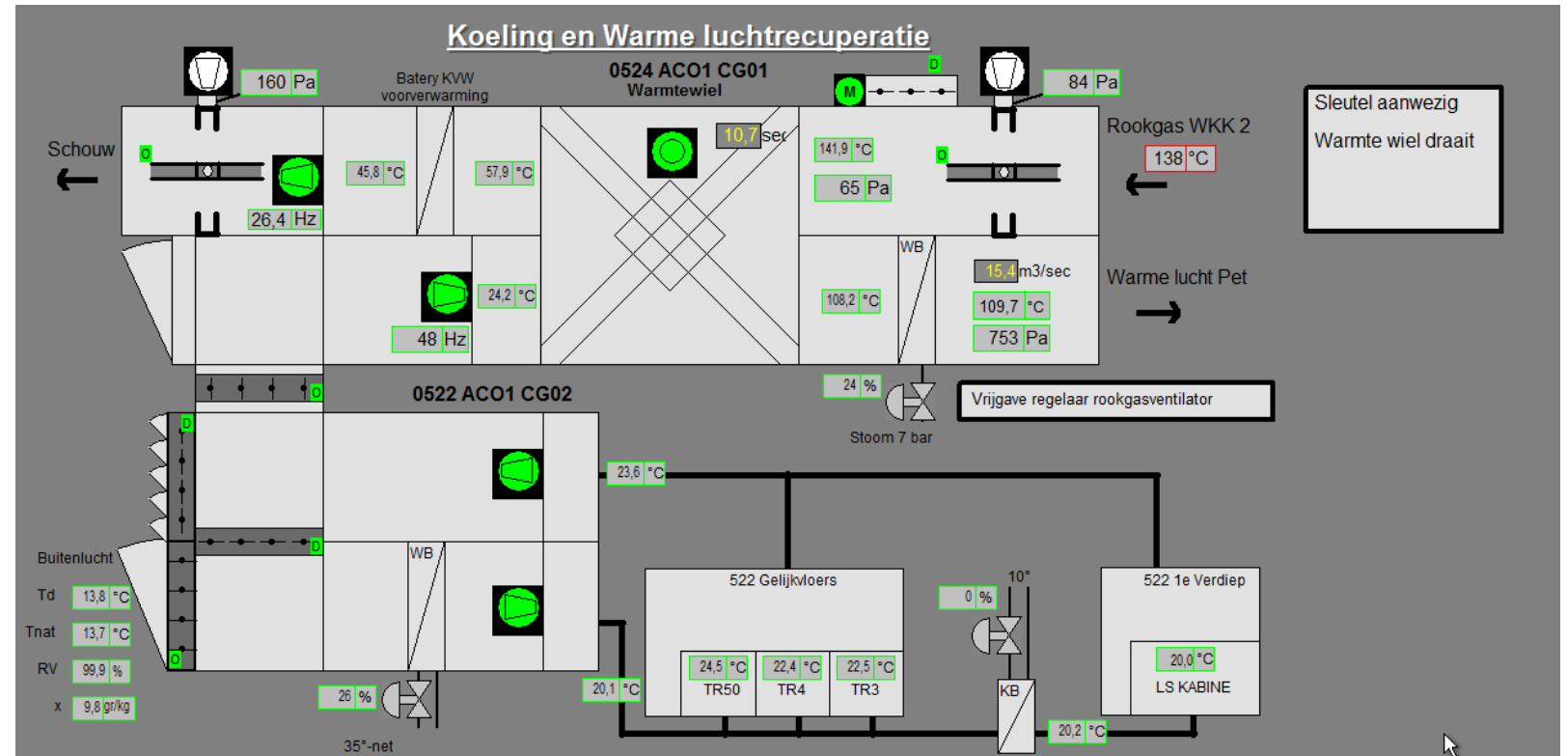
- 7,6 MW Kawasaki
- 40 ton Omnical afgasketel met bijstook
  - 5 branders

	Type machine	vermogen	$\eta$ mech	$\eta$ elek	$\eta$ tot	RPE
WKK2 2011	gasturbine 7,8 MW	7,8 MW	NVT	34%	88%	18%
WKK2 2011	gasturbine 7,8 MW + warme luchtrecup	7,8 MW	NVT	34%	93%	24%



# WKK2 - luchtrecuperatie

- Warmtewiel 4m
- 2 MW recup
- RPE 24%





# WKK1 – Ingrijpende Wijziging



- Van 40% rendement naar 42%
- Wel meer 90/70 en LT en minder stoom

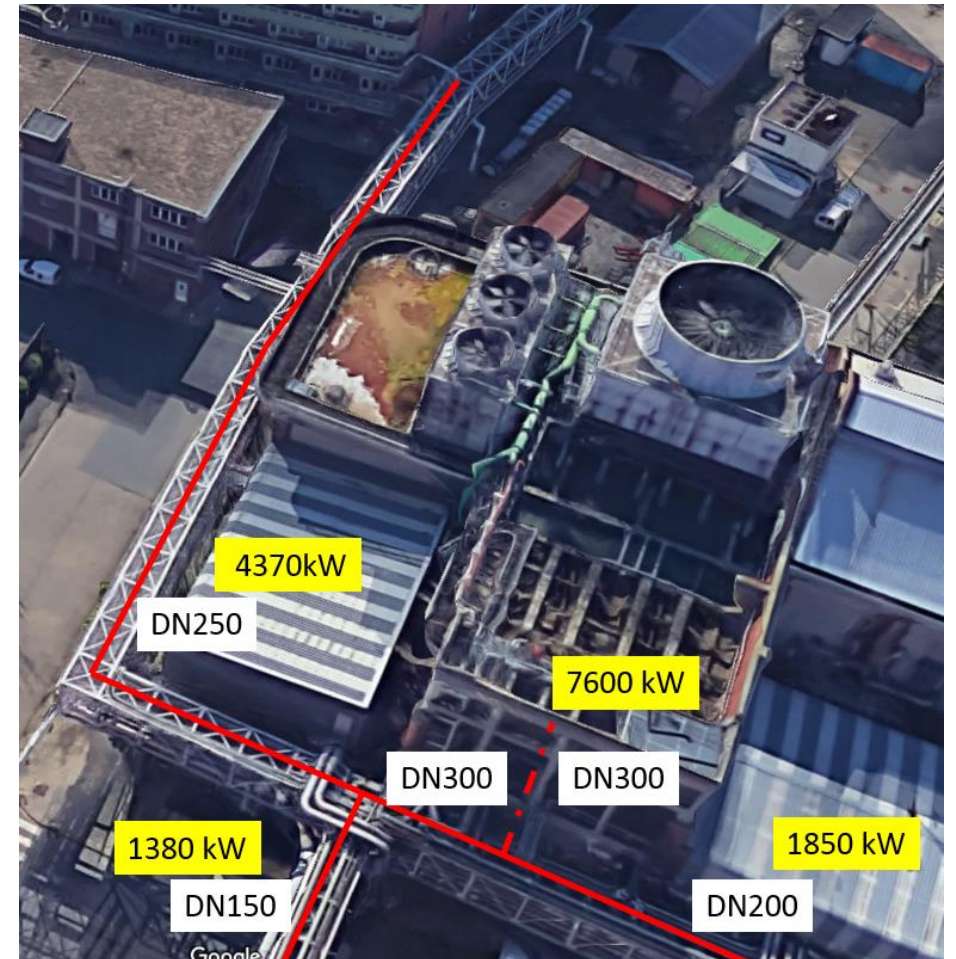
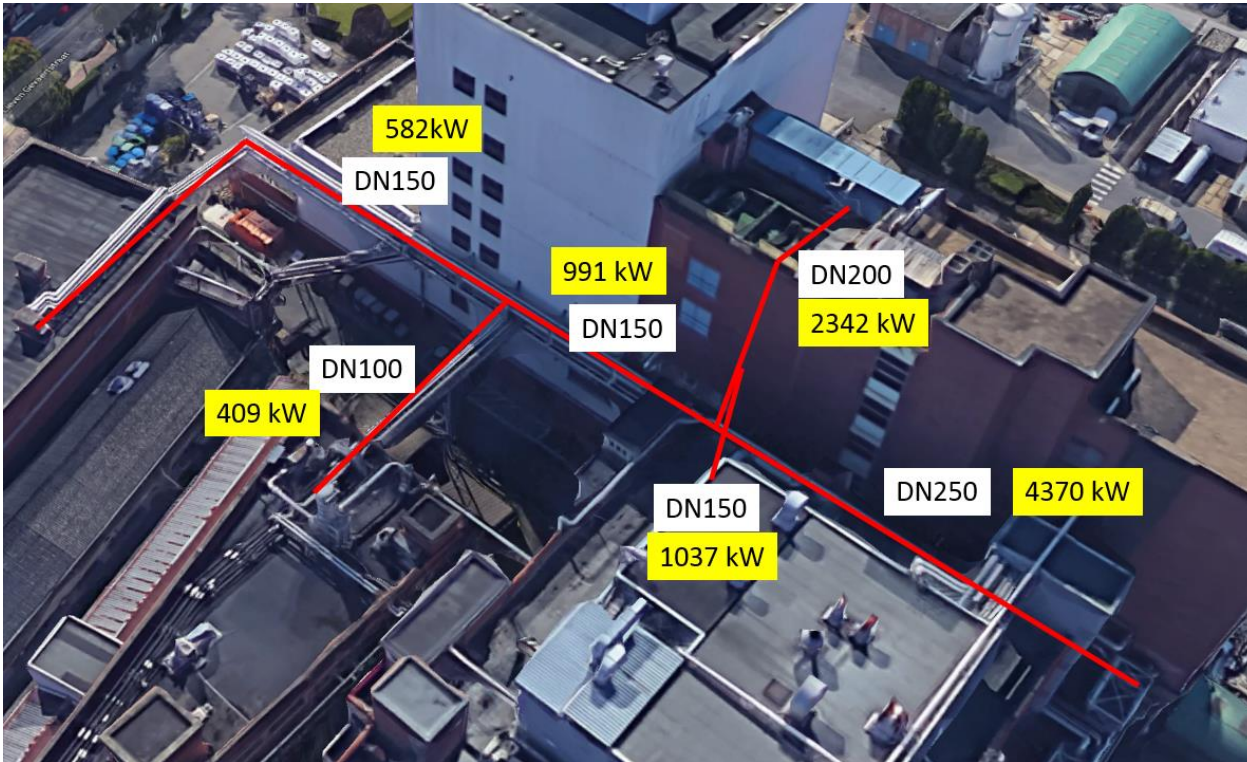
	Type machine	vermogen	η mech	η elek	η tot	RPE
WKK1 2017	4 gasmotoren	8 - 9 MW	NVT	42%	95%	29%
WKK1 2017	4 gasmotoren + LT net 18/33	8 - 9 MW	NVT	42%	100%	32%





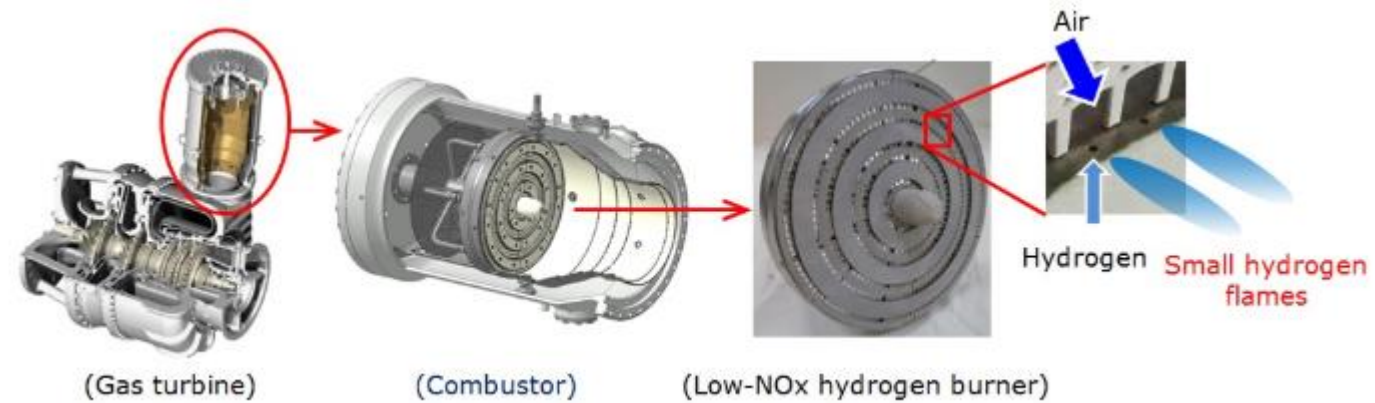
# Trigeneratie - Warmtepomp

- Gecombineerde productie van warmte en koude
  - Recuperatie restwarmte -> HVAC cluster 0188



# H2 – Generation & Utilisation

- Power to gas to power
  - Netbalancing via H2
  - CO2 reductie WKK
- Issues
  - Vlamsnelheid x7
  - Hogere vlamtemperatuur -> Nox
- Beperkt % bijmenging in bestaande turbine
  - Max 10% bij lag cal. Gas
  - Max 15% bij hoog cal. Gas



Source: <https://global.kawasaki.com/>

# Vragen?

- Rondleiding WKK
  - Gelieve geen fotos te maken!

