

WIC MEETING SEPTEMBER 8, 2022

Welcome to the WIC meeting!



AGENDA

10.00-10.05: Introduction VDL & WaterstofNet

New members presentation

10.05 -10.35

Key notes

10.35-10.50: Status and developments on LOHC, Prof. Dr. Patrice Perrault, University of Antwerp
10.50-11.05: Bosch hydrogen technology developments, Mrs Antje Seitz, Senior expert in SOFC & Bosch

WIC news

11.05 - 11.30

News from WIC members

11.30-11.45

VDL activities & tour/demo FC truck

11:45-12.30

NEW MEMBERS PRESENTATION TODAY



Performance by design.
Caring by choice.™



RWE



Who We Are

Company Overview

Jasper Smets

EMEA Business Development Manager Specialties

September 8, 2022

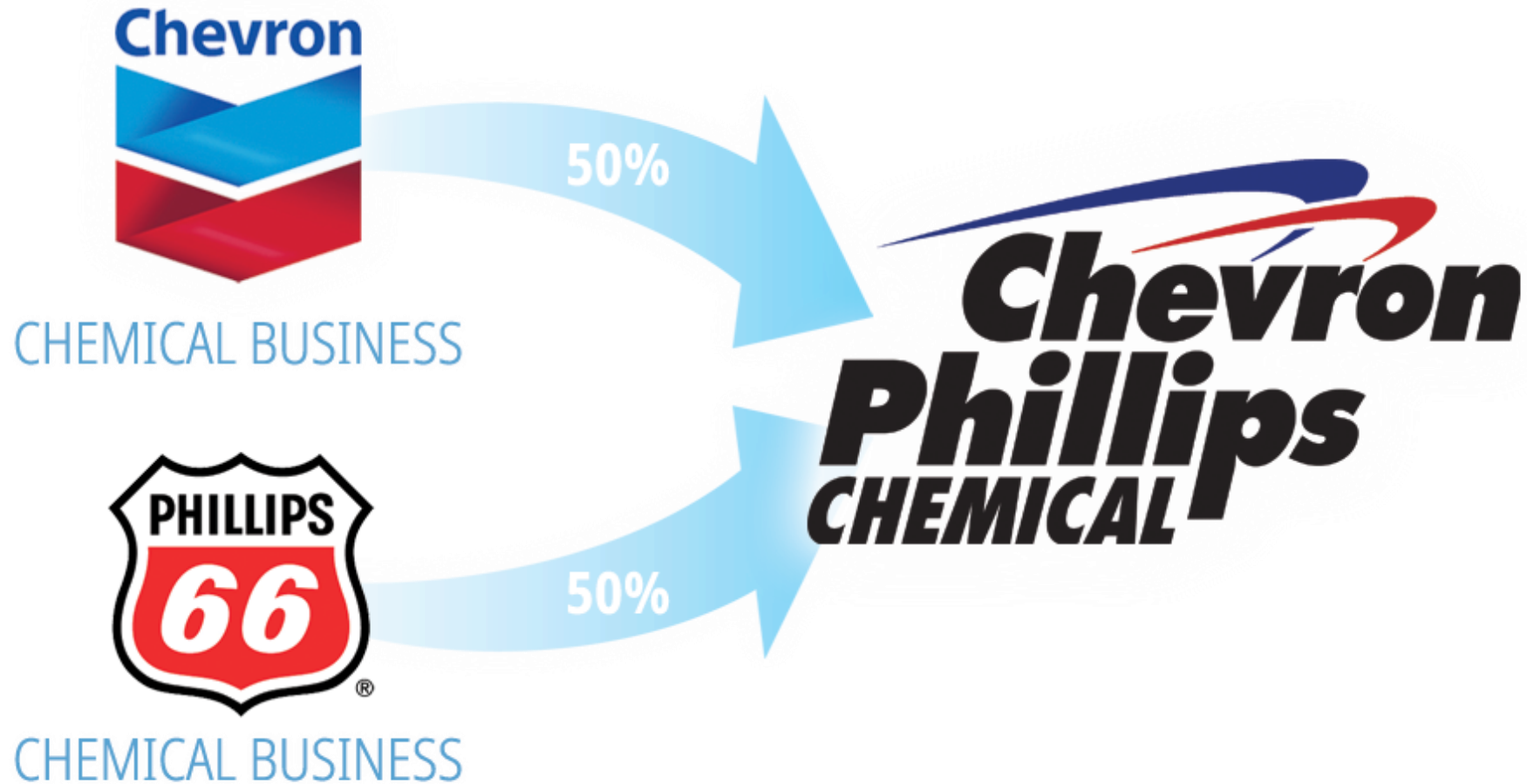


Performance by design.
Caring by choice.™

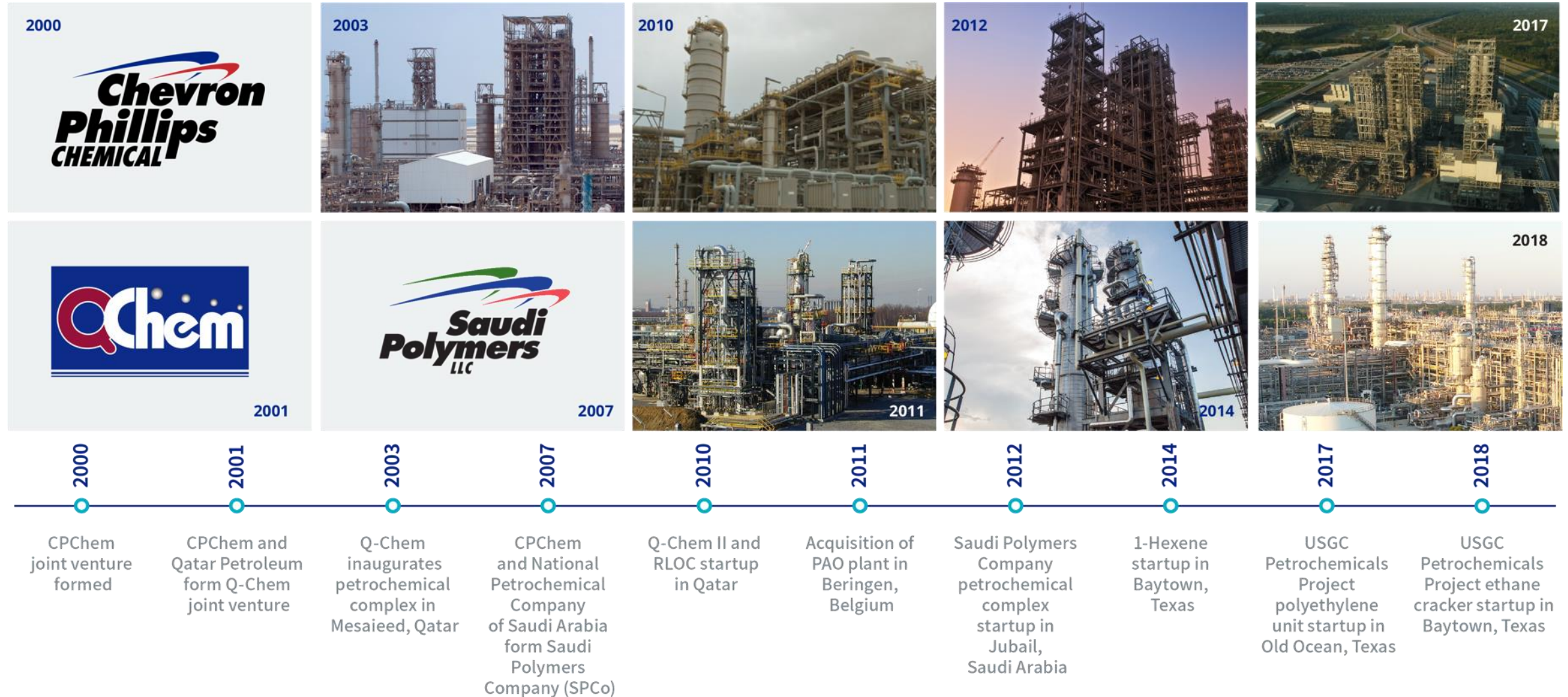


Our Heritage

Celebrating 20 years since company founding in 2000



History of our Growth



Designed to Perform



Premier chemical company, known as employer, supplier, neighbor and investment of choice

Global manufacturer of petrochemicals essential to 70,000+ consumer and industrial goods

Tripled asset base since inception to nearly \$18 billion and \$14+ billion in annual revenues

Trusted supplier to customers in nearly 140 countries

Offer enriching careers to 5,000 highly educated, diverse employees across four continents



Trusted Global Presence

31 manufacturing and research centers



Products that Perform. People who Care.

Global supplier of products making modern life possible

World's largest supplier of high-density polyethylene

MarTECH[®] loop slurry technology among most widely-licensed for polyethylene production

80+ commercial reactor complexes worldwide licensed to use MarTECH[®]



Aromatics



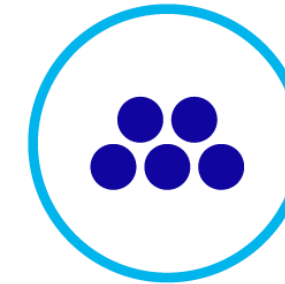
Drilling Specialties



NAO



Olefins



Performance Pipe



PAO



Polyethylene



Specialty Chemicals

ACCELERATING CHANGE

for a sustainable future



Actively protect our planet

Improve quality of life



CLIMATE CHANGE

Reduce GHG emissions and emissions intensity

Invest in renewable energy

Improve climate risk resilience



PRODUCT SUSTAINABILITY & CIRCULARITY

Lead in circular products development

Reduce product carbon footprint

Join efforts to eliminate plastic waste in environment



SOCIAL RESPONSIBILITY

Do our part to protect human rights

Prioritize health, safety and wellbeing

Increase economic prosperity through our products and actions

PROACTIVE ENGAGEMENT

Educate • Empower • Advocate • Report

Europe

A long-standing local presence.



Polyalphaolefins



Europe Region Headquarters

Airport Plaza - Stockholm Building
Leonardo Da Vincilaan 19
1831
Diegem
+32-2-689-12-11



Beringen, Belgium

Industriezone Ravenshout 7303
Industrieweg 152
B-3583
Beringen
+32 (0) 11-37-45 11



Specialty Chemicals



Tessenderlo, Belgium

Industrieterrein Schoonhees 2166
Fabrieksstraat 5
B-3980
Tessenderlo
+32 (0) 13-61-04-11

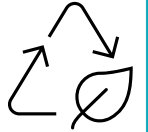
Hydrogen Odorization - Facilitating the energy transition

Improved leak detection



- Independent safety layer
- Maintenance & Inspection free
- Universal 'smell'
- Better public safety awareness

More sustainable solution



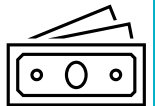
- Non-toxic
- Zero tailpipe emissions
- Life cycle design

End-use compatibility



- Fuel cell electrocatalysts
- Catalytic aftertreatment devices
- Hydrogen storage
- Cost effective removal

Extra benefits



- Improved sensor leakage detection
- Inhibition of hydrogen embrittlement
- Very low-cost safety solution

Odorization of hydrogen facilitates the transition towards a low carbon society

Connect with Us

www.cpchem.com

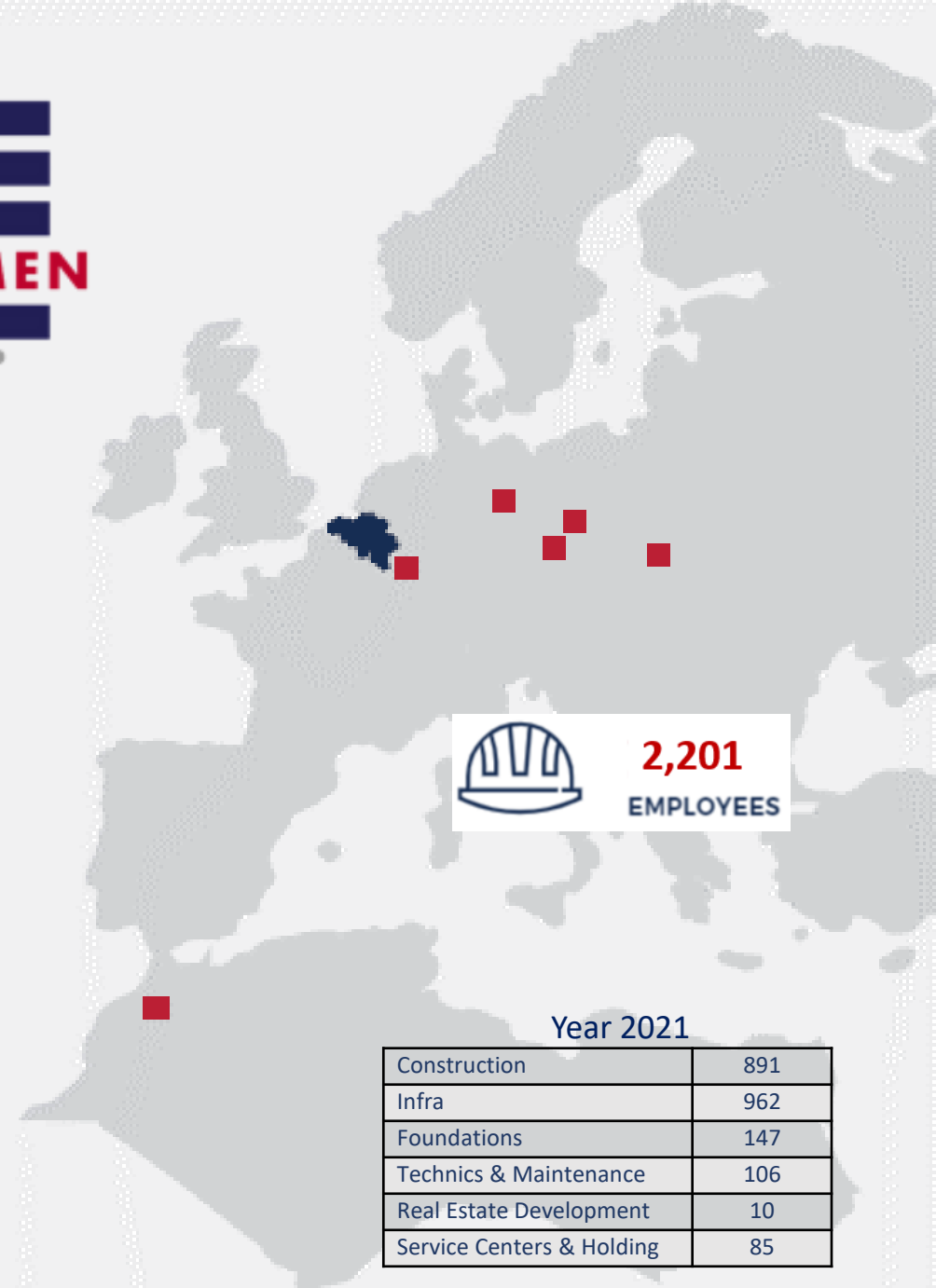
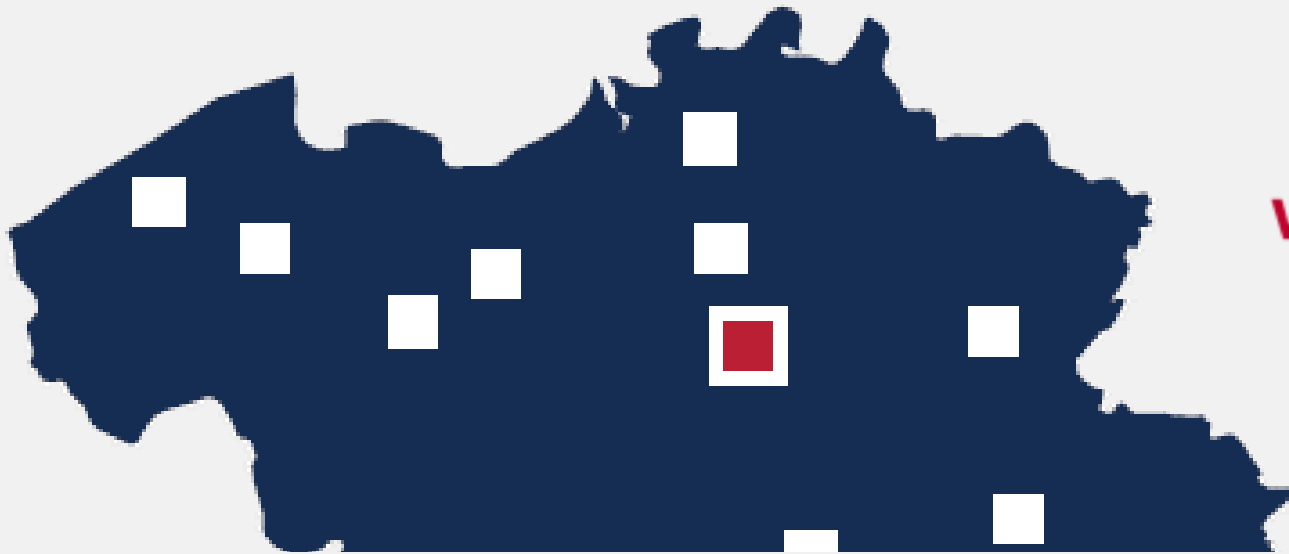




Sustainable strategy Willemen Group

WIC meeting - 8 September 2022
Franky Van den Berghe - sustainability manager





2,201
EMPLOYEES

Year 2021

Construction	891
Infra	962
Foundations	147
Technics & Maintenance	106
Real Estate Development	10
Service Centers & Holding	85

1

GENERAL CONTRACTORS

BUSINESS LINE CONSTRUCTION

- Willemen Construct
- Willemen Construction (*Luxembourg*)
- Willemen Construct DE (*Germany*)
- Cosimco
- Cosimco Maroc (*Morocco*)
- Franki
- Franki Construct
- Tools

BUSINESS LINE INFRA

- Willemen Infra
- Mobilmat
- Vandamme-Madoc
- Kumpen

2

SPECIALIST SERVICES

BUSINESS LINE FOUNDATIONS

- De Waal Solid Foundations
- De Waal Polska (*Poland*)
- Willemen Carpati (*Romania*)
- Studiebureel Sondex

BUSINESS LINE TECHNICS & MAINTENANCE

- Sanitechniek
- Albitum
- W-Care

3

REAL ESTATE DEVELOPMENT

- Willemen Real Estate
- Willemen Promotion (*Luxembourg*)
- Willemen Grondbank

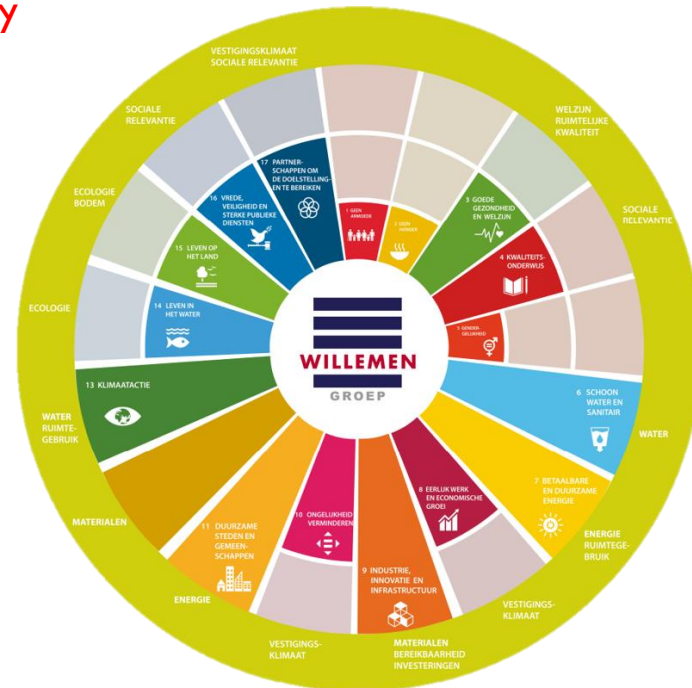
HOLDING

- Willemen Groep
- Willemen Finance
- Willemen Project Finance

WILLEMEN GROUP – MISSION

'Building a better world'

- Increase the **positive impact** and value **creation**;
- We endorse the agenda of the United Nations **Sustainable Development Goals**;
- We prepare for the **European Green Deal** and the shift to a more **circular economy**;
- Evolution of a group strategy with a sustainability policy to an **integrated sustainable strategy**



STRATEGY WILLEMEN GROEP

I. FUTURE-ORIENTED BUILDING



COMMITMENT TOPICS

1. Affordable and future-oriented living, working and living environments and infrastructure
2. Synergy from the diversity within Willemen Group
3. Innovative business models and partnerships



STRATEGY WILLEMEN GROEP

II. EFFICIENT AND CLIMATE CONSCIOUS



COMMITMENT TOPICS

4. CO2-neutral construction
5. Protecting the environment and ecosystems
6. Circular materials, construction industrialization and innovative construction methods
7. Lean in project management, execution and construction logistics



STRATEGY WILLEMEN GROEP

III. SOCIAL RESPONSIBILITY



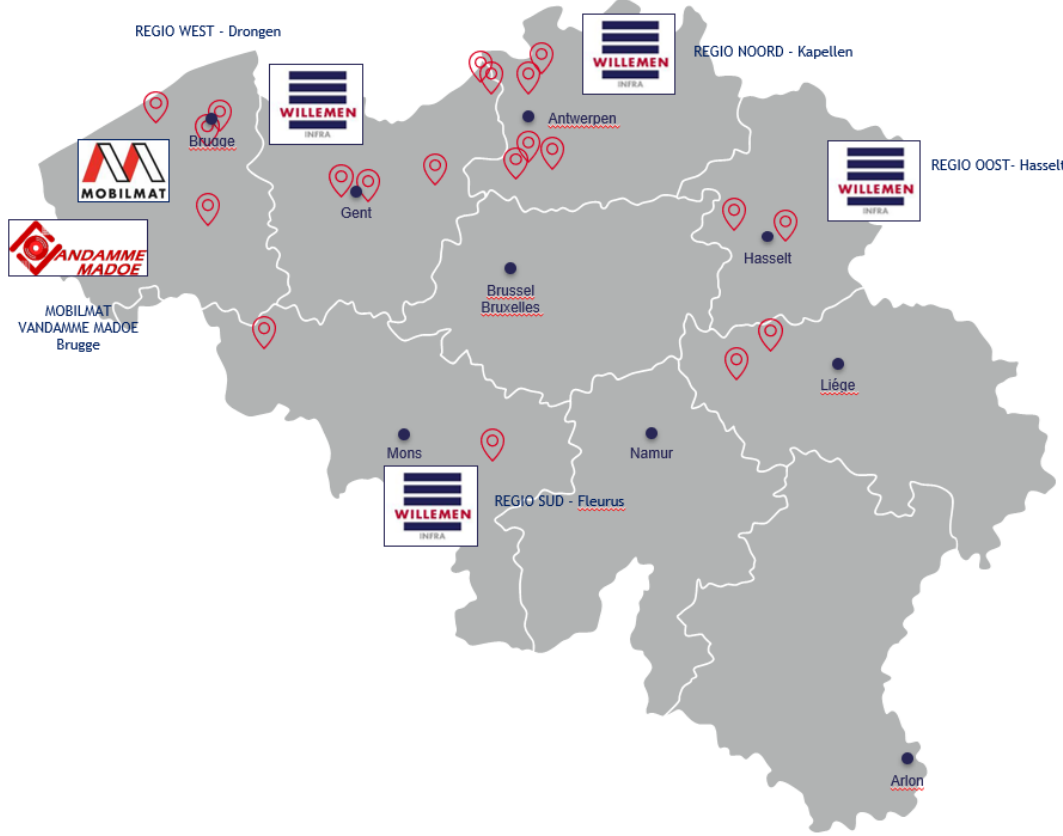
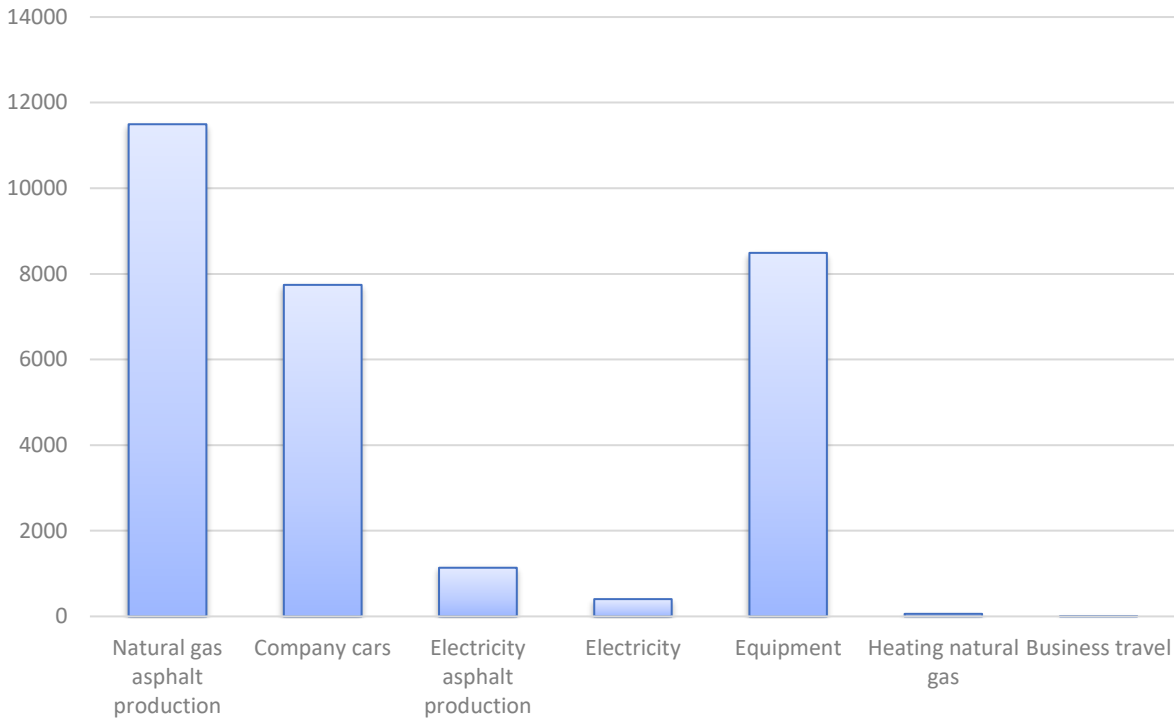
COMMITMENT TOPICS

- 8. Offering growth opportunities
- 9. Social and involved
- 10. Exemplary role for sustainability



CO2-Footprint Willemen Infra

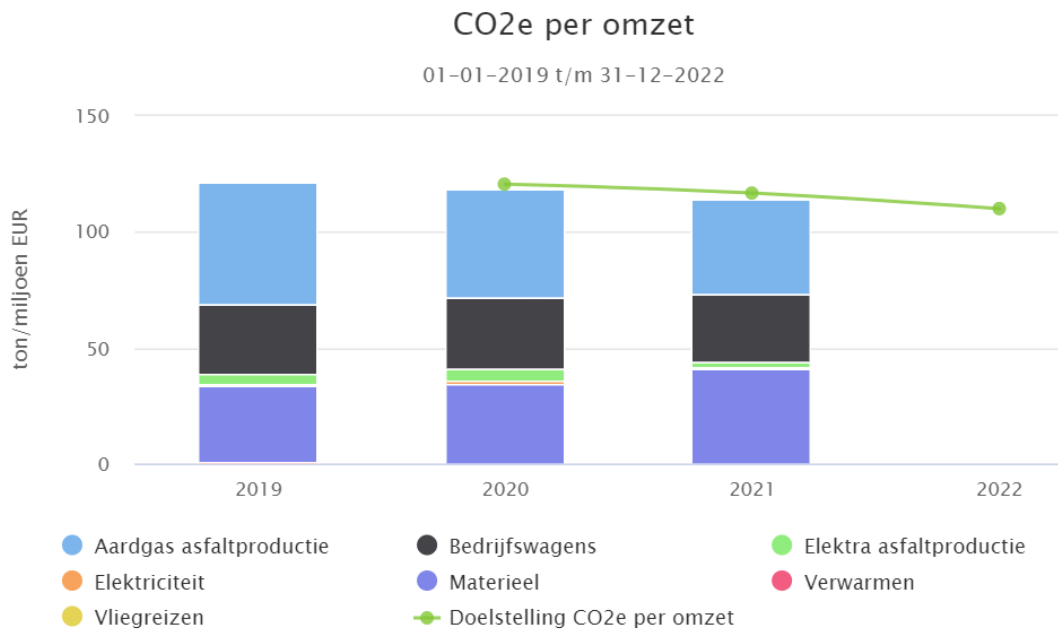
31500 ton CO₂ (2021)



DEVELOP AND IMPLEMENT ENERGY AND CO₂ REDUCTION MEASURES

CO₂-objective for 2020-2022

For the period 2020 to 2022, we intend to reduce our CO₂ emissions by 10% compared to the emissions in 2019 (in relation to turnover).



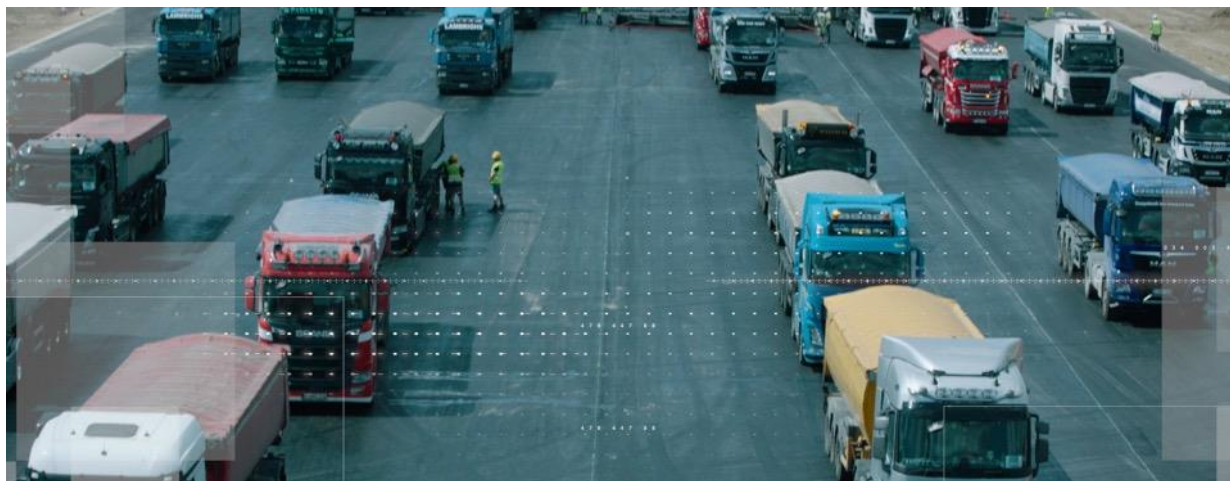
How did we get a 10% reduction?

- 4% in the switch to Belgian green electricity by the end of 2022 for the asphalt plants
- 2% in optimization asphalt plants: low temp asphalt, insulation, applying BAT studies, etc.
- 1% by switching to Belgian green electricity by the end of 2022 for all other activities
- 1.5% due to optimization of logistics/mobility
- 1.5% when renewing equipment, replacing power groups with fixed connections

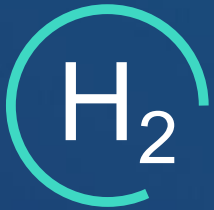


THE PATH TO ZERO EMISSIONS: WIDE USE OF GREEN HYDROGEN

- replacing fossil natural gas used in the asphalt plant by green hydrogen and electricity.
- energy carrier for mobility and transport, generators and heavy machinery



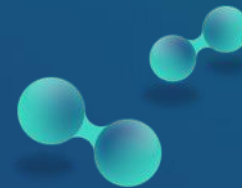
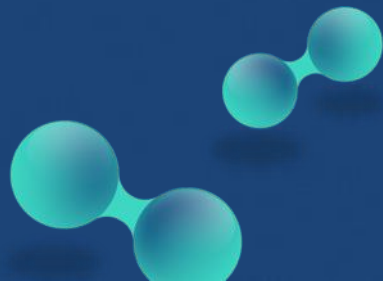
RWE

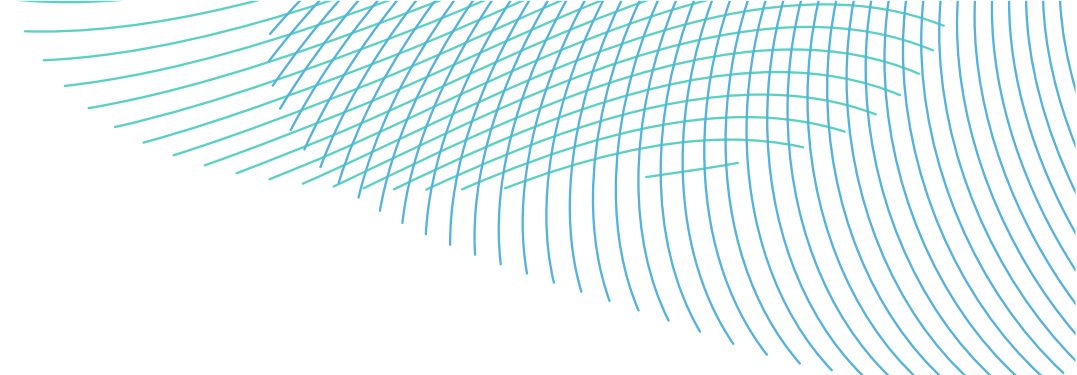


Introduction to RWE Hydrogen

WIC Meeting

08-09-2022





RWE as part of the solution – Transition to a net zero world

RWE to achieve net zero by 2040 #RWEGoesClimateNeutral

1

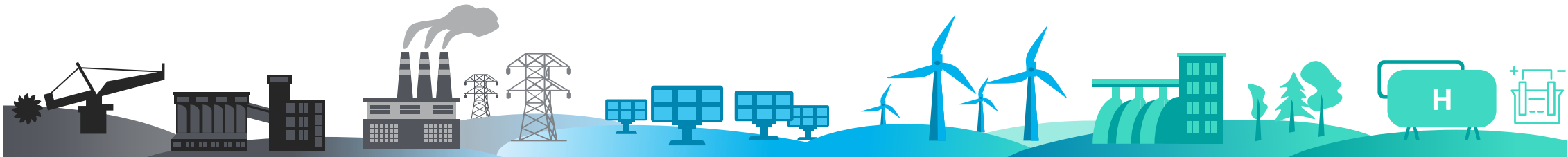
RWE fully supports global climate goals for a sustainable life

2

Target to achieve net zero for its direct and indirect GHG emissions by 2040

3

Focus on renewables expansion and innovative technologies to support the energy transition



Growing Green: Leading the way to a green energy world

- **RWE is perfectly positioned:** vast experience in green technologies, strong market presence in industrial growth markets, operating a leading commercial platform
- **We significantly accelerate our green growth programme:** €50bn gross / €30bn net cash investments until 2030, leading to 35 GW gross / 25 GW net capacity additions
- Our investment plans are driven by **excellent teams** – our **development pipeline** stands at **more than 55GW across all relevant technologies**
- **Our portfolio in 2030 is powerful and green:** 50 GW net installed capacity across wind, solar, batteries, flexible generation and hydrogen offering tailor-made energy supply solutions
- **Attractive investment returns** result in **earnings growth** in our core business **of on average 9% annually** and **Group EBITDA ambition of €5bn in 2030**
- Investment programme fully funded by **strong operating cash flow and utilisation of our financial headroom** – in line with our **commitment to a strong investment grade rating**
- **Sustainability is at the heart of our strategy:** Our ambition is to reduce carbon emissions in line with a 1.5°C compliant pathway and to become net zero by 2040

Ideally positioned for the hydrogen economy

Strong expertise along the value chain



Hydrogen market growth

- Strongest global growth momentum in Europe
- Industrial demand centres located in RWE's European core markets

European electrolyser capacity

40 GW
EU Hydrogen Strategy 2030

Rapid growth of green H₂ production

Growth target backed by strong project pipeline

RWE with market leading growth target in electrolyser capacity

+2GW
RWE by 2030

Requirements for electrolyser investments

- Regulatory and political framework
- Support and funding schemes
- Reliable offtake agreements

RWE's hydrogen development pipeline

10 GW
pro rata

Mostly early-stage development projects

Selected hydrogen development projects:

 Get H ₂ IPCEI	 Eemshydrogen
 Aqua Primus 2 IPCEI	 North ₂
 Aqua Ventus/Ductus IPCEI	 FUREC
 HyTech Hafen Rostock IPCEI	 SW Industrial Cluster

Hydrogen as essential building block for realizing a successful energy transition

Green H₂ as **pivotal element for successful decarbonization** / energy transition, in particular in **hard-to-electrify sectors**



Requirement to kick-start H₂ economy now

- Every sector has to **contribute to 2030 climate targets**
- Industry needs **clarity for investment decisions**

Technological leadership in H₂ technologies



Scaling-up hydrogen technologies by large-scale applications in H₂ generation and replacing grey with green hydrogen

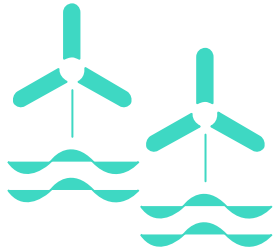


EU goal:
carbon neutrality
by 2050

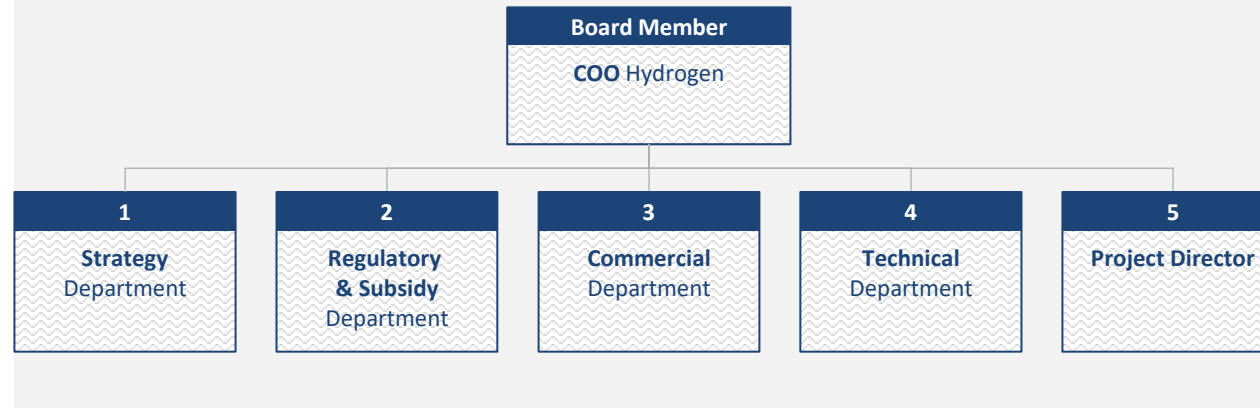


RWE has made Hydrogen an executive agenda topic with start-up organization character

RWE Renewables



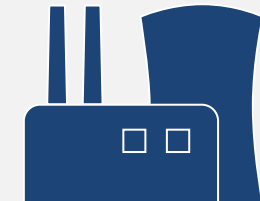
RWE Generation



RWE Supply & Trading



- **Dedicated Board member** for H₂ at RWE Generation defining and implementing RWE's H₂ strategy
- **Start-up organization** with four functional pillars plus dedicated project directors for advanced projects
- **Close cooperation with** RWE Renewables & RWE Supply & Trading on Hydrogen topics



RWE's hydrogen strategy has five clear guidelines

Guidelines of RWE's hydrogen strategy

- 1 By entering into **green hydrogen production**, RWE will extend the value chain of **renewables**
- 2 RWE will not focus on producing **blue and turquoise H₂**. Yet further developments of these technologies and market opportunities will be closely observed, including use at RWE plants
- 3 RWE will establish **partnerships** along the value chain for carbon-neutral H₂ and focus on **industrial customers**
- 4 RWE will pursue opportunities to produce green hydrogen in **GER, UK and NL** as well as in **international focus markets for renewables**
- 5 **Proactively developing projects** and building a strong H₂ expertise will put RWE in a good position for benefitting from expected H₂ support schemes

Currently: Refinement and adaptation by means of market-specific strategies.

Value chain coverage, commitment as well as reputation & reach make RWE a strong partner

1

Value chain coverage



- I **Green power generation** with individual offtake contracts guaranteeing tailor-made customer solutions
- II **Access to well-suited sites for electrolysers** (i.e. close to infrastructure and/or off-takers) providing location advantage
- III **Managing flexibility and security of supply** through experienced trading department and storage facilities

2

Commitment to green H₂



- IV **Development pipeline strength** of green hydrogen & decarbonization projects
- V **Financial investment power** for green hydrogen & decarbonization projects
- VI **Attractive ESG rating** demonstrating strong commitment to sustainability

3

Reputation & reach



- VII **Trusted partner** with proven track record for reliably delivering large-scale projects and operating significant asset fleet
- VIII **Optimised usage of project funding potential** through superior expertise in regulatory and subsidy mgmt.
- IX **Strengthening position of project partners** through established partnerships/network and political clout

RWE develops innovative lighthouse projects involving the energy source of the future along the entire value chain

- Initially, development and operation of electrolysers in core markets (GER, NL, UK)
- RWE is working with strong partners from industry and the scientific community to drive forward more than 30 hydrogen projects in these three countries
- State support for all these projects needed
- Once green hydrogen growth picks up substantially, scale up can be pursued globally

South Wales Industrial Cluster
Milford Haven

FUREC
Limburg Prov.

NorthH₂
Northern Netherlands

Eemshydrogen
Eemshaven

H₂ Brunsbüttel
Brunsbüttel

GET H₂
Lingen

AquaVentus
Helgoland

HyTech Harbour Rostock
Rostock

HySupply
Berlin



H₂

Learn more on our [hydrogen website](#)



 **SODECO**
valves

Specialist in Industrial valves
Wide range of Brands



Products





Products

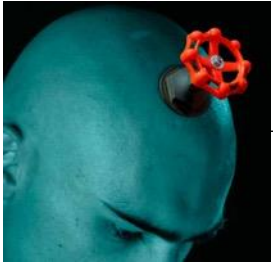




Key strengths



Expertise



Technical support



Automation center



International contracts



Stock (dedicated)





Quality control



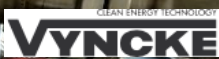
Certification Iso 9001



Ecovadis
sustainability



References

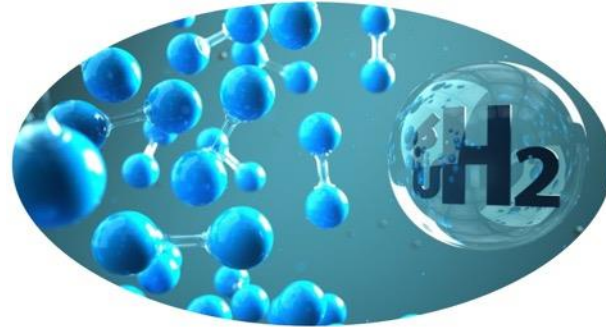
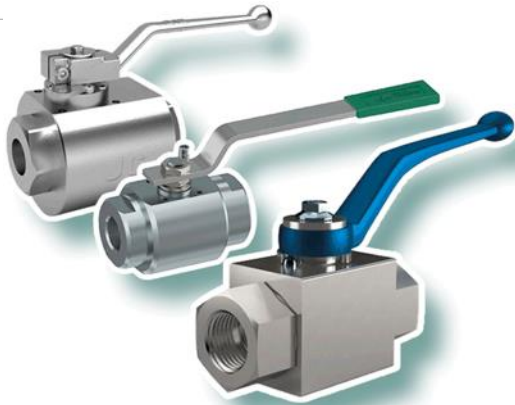




Hydrogen



Adjusted ball valves:
JC / MHA / Alfa / SBV



Flame arrestors:
Elmac



HPBV's:
Value Valve



Safety valves
Niezgodka





Questions?



sodeco@sodeco.be

+32 2 583 55 00



Sibelga

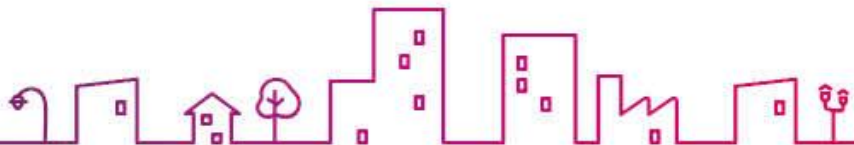
Estimate of the H₂ Potential in Brussels Sibelga (Gas & Electricity DSO – Brussels)

WIC meeting 08/09/2022



01

Sibelga – on the front line of the energy in Brussels



Our mission

Ensure a reliable and high-quality energy access to all in Brussels



Network operator



Market enabler



Authorities's partner



Clients



Markets



Networks

Our Vision

Sibelga as a key partner for an accessible, affordable and inclusive energy transition

Public Service Obligations activities

Related to DSO activities

- Design, construction and maintenance of the public lighting network on municipal roads.
- Safety of indoor gas systems
- Management of protected consumers, who are people experiencing difficulties paying their commercial suppliers

Related to the energy transition for public stakeholders

- Getting better green energy prices via setting up a purchasing centre
- Roll out of electric charging points next to public roads
- Roll out of Combined Heat Power
- Roll out of PV panels installation on public buildings

02

Challenges of the energy transition

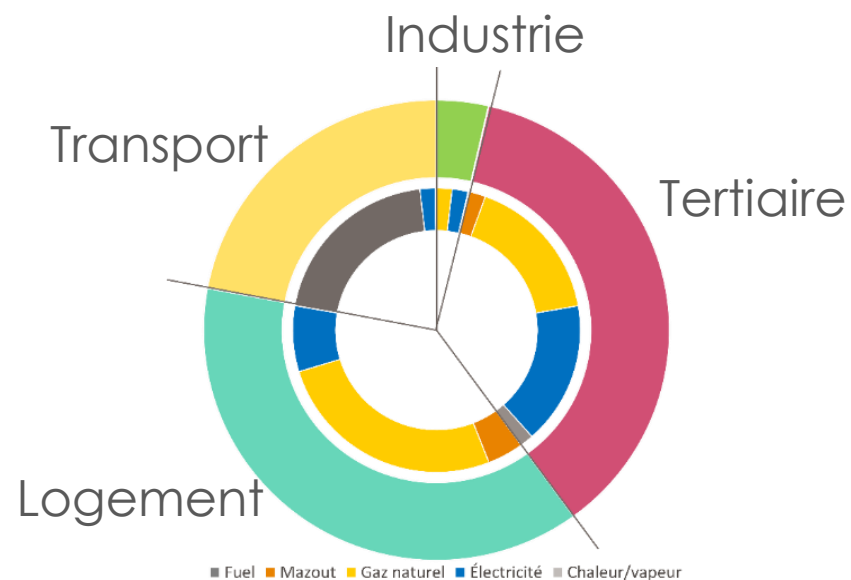
- 1) How do we provide enough green heat in Brussel in 2050?
- 2) How do we make green mobility solutions available in Brussels ?



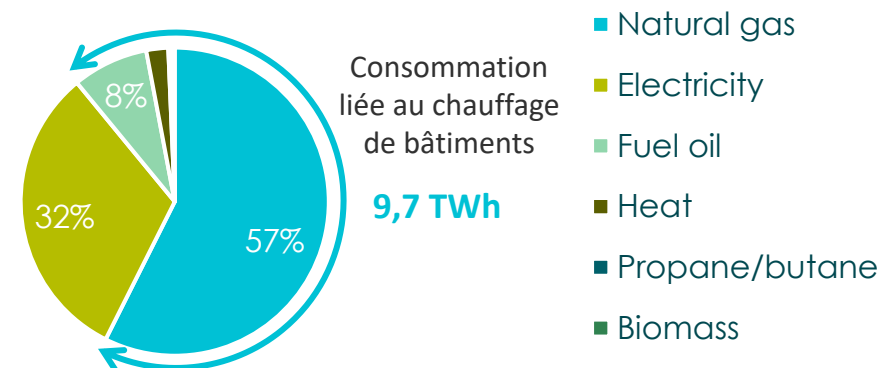
No fossil fuels in 2050 requires a strong decrease in energy demand as well as heavy reliance on green gases

THE ENERGY TRANSITION WILL BE MOST SEVERE FOR BUILDINGS AND TRANSPORTS DUE TO THEIR LARGE SHARE OF GHG IN THE BRUSSELS MIX

Consommation finale énergétique en RBC par secteur
Total: 19.45 TWh



Consommation finale énergétique des bâtiments
Total: 14,4 TWh



Source: Bruxelles Environnement / Leefmilieu Brussel, 2018 figures

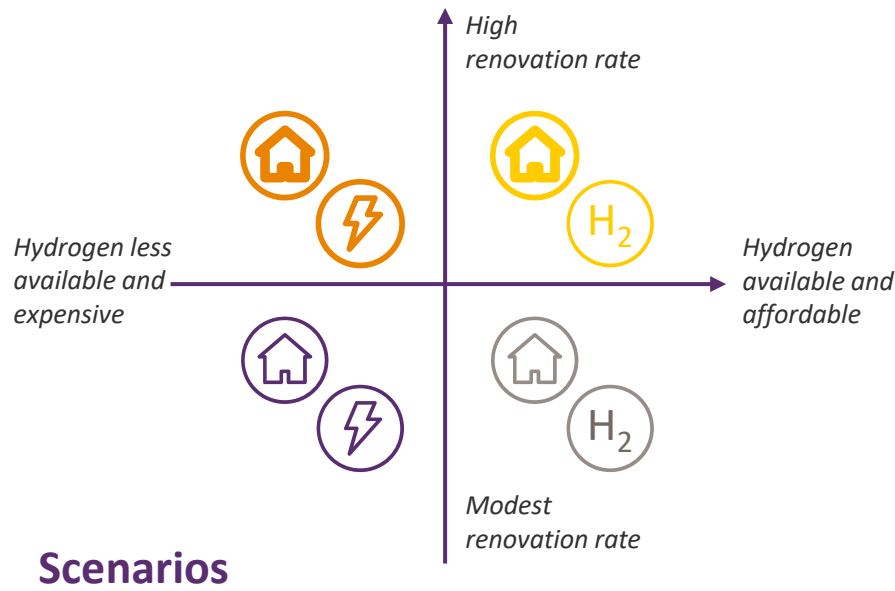
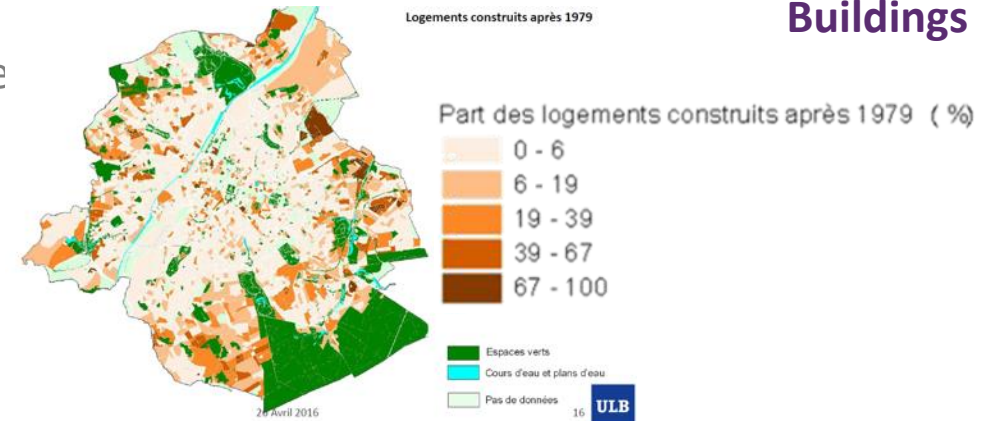
Study of hydrogen potential for Brussels

SIBELGA 2022 (WITH SWECO & DELOITTE)

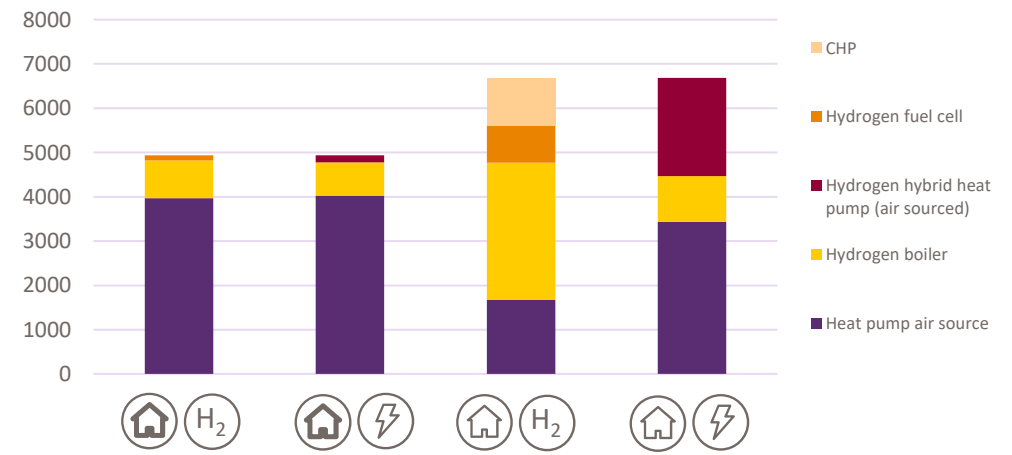
Objectives

1. Quantify the technical and economical potential for H2 in Brussels in 2050
2. Impact of hydrogen flows on the present gas network
3. Analyse of the present and future hydrogen market (European, Belgian, Brussels)

Buildings



Demande en chaleur par solution technologique (GWh)

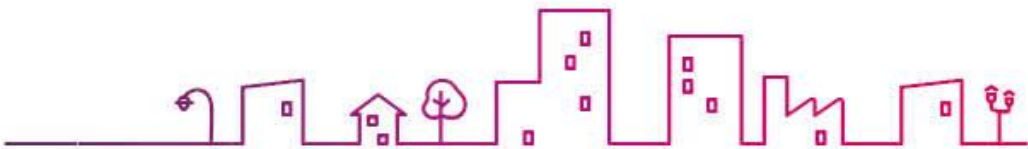


Main conclusions of the study

- The best option to guarantee an accessible and affordable energy transition is to use both gas and electricity networks
 - Heat pumps + Electricity = best option for very good insulated buildings
 - H2/Molecules = preferred option for less insulated/difficult to isolate buildings if a massive H2 market is available
- No show-stoppers have been identified concerning reusability of the Brussels gas network - however a lot of technical/field investigations remains to be done (residential connections, filters, meters, welds, etc) as well as identify the impact of pure hydrogen flows on current intervention methods
- H2 for heavy mobility = interesting operational & economical solution
- Availability of H2 at a fair price requires the development of a global market for H2 comparable as the present one for natural gas

Currently in the pipe

- Developing partnerships to facilitate the deployment of H2 infrastructure in Brussels (HRS, pipelines-backbone)
 - Commercial approach
 - H2 lab : grid, working process & beyond
 - Projects studies : HRS, Brussels H2 Backbone
- Partnership with Fluxys & The Brussels Transport Public Operator





Sibelga

Merci pour
votre attention
Bedankt voor
uw aandacht





TÜV AUSTRIA GROUP An Introduction



WATERSTOFNET WIC – 8 September, VDL Eindhoven | Bolsman | September 2022

05/09/2022

Who

are we?

A

leading

international

independent

service provider

for integrated management of

safety

quality

environment

resources

training

Performing

our services

in a

socially

environmentally

ethically

responsible

way

What

do we stand for?

Video 150 Years TA



What is our history?

Foundation



Internationalization begins

Rebuilding

our organisation

1872

1945

1994

2017

2018

2019

2020



STANDARDS & COMPLIANCE



innotec GmbH



Cybersecurity Lab Malaysia



MILLNER



BOREAS



Plant Safety

Explosion Protection

Fire Protection

Energy Efficiency

Pressure Equipment

QA / QC

Electrical Engineering

Cranes, Lifts, Doors

Machinery Safety

PPE

Calibration

Telecommunications / EMC

Product Safety (Consumer Products)

Process Engineering and Functional Safety

Acoustic Emission Testing / Advanced NDT

Damage Analysis

Special Inspection and Fitness for Service
Concepts

i.e. Risk Based Inspection,
Lifetime Assessment
Fit-for-Service / Remaining useful Life

3rd Party Inspection, Expediting

Materials Testing

Welding Technology

Environment Protection

Health and Safety

TÜV AUSTRIA BELGIUM

BELGIUM ANTWERP (Kontich), BRUSSEL (Krainem), LEUVEN (Rotselaar)

✓ OK COMPOST

- Bioplastics Certification Industrial

✓ inspections & certifications

- Notified Body – PED

- EN 1090

- Welder and Welding Procedure Qualification

✓ Non-Destructive-Testing (acc. ISO and ASME)

- TOFD, Phased Array, Corrosion mapping

- VT, PT, MT, ET, UT, RT, HT, PMI

- Tube Testing, PEC, tank inspection

✓ METALogic

- Acoustic Emission Testing
- Risk Based Inspections
- Corrosion analysis and examination
- Materials analysis and examination
- Corrosion engineering
- Coating examination and testing
- Research



The TÜV logo is displayed in large black letters. A red checkmark is superimposed over the 'V', and a red diagonal line is drawn through the top right corner of the 'V'.



The flag of Austria is shown, consisting of three horizontal stripes of red, white, and red.



About NEXT HORIZON



Open Innovation & Collaboration



Service Design Thinking



The Pioneers



Co-Working Space

About NEXT HORIZON

Our NEXT HORIZON Pioneers explore new technologies and methods in three areas. Based on that they develop pioneering service innovations.



The (digital) Acceleration Incubator
of the TÜV AUSTRIA Group.

Hydrogen – Current Business and Near-future Development



Current H2 Business

- ✓ Green and Low carbon H2 certification
- ✓ Retrofitting/repurposing gas networks and pipelines
- ✓ Certification H2 filling stations
- ✓ HIC and other hydrogen induced degradations
- ✓ Electroliser plant services
 - Functional Safety Assessment
 - Pressure equipment
 - Fire and explosion safety
 - Electrical safety
- ✓ Pipeline integrity
- ✓ Lab testing - Materials
- ✓ Etc.

(near) Future H2 Developments

- ✓ H2 Squad (DigiTÜV; Est. 2021)
- ✓ Expand H2 Lab
- ✓ Specialist materials assessments for H2
- ✓ H2 ‘Green Fingers’ – traceability of Hydrogen pollution on ppb level
- ✓ Composite Materials – Ph.D. Uni Bologna
- ✓ Fuel cell evaluation and performance
- ✓ Etc.



Hydrogen – Projects currently under contract

- ✓ Design Appraisal *Project H2CC expansion*
- ✓ *Project* (electroliser) Design Appraisal
- ✓ Final Acceptance Test *Project* (electroliser)
- ✓ Re-purposing of 9km gas pipeline – pilot evaluation for *Customer* (gas network operator)
- ✓ Acceptance Test 3rd Prototype Electrolyser
- ✓ ASME consultancy for *Customer* by our ASME Supervisor
- ✓ First operational Test Project (electroliser)
- ✓ Final Acceptance Test -*Project H2CC expansion*
- ✓ H2 Mobility *City and Province* – Appraisal 2 Hydrogen Filling-stations (H2 Mobility)
- ✓ *Customer Energie* - H2 Field Test
- ✓ Assembly acceptance H2 dryer for *Customer*
- ✓ *Project Storage Customer* - H2 dryer

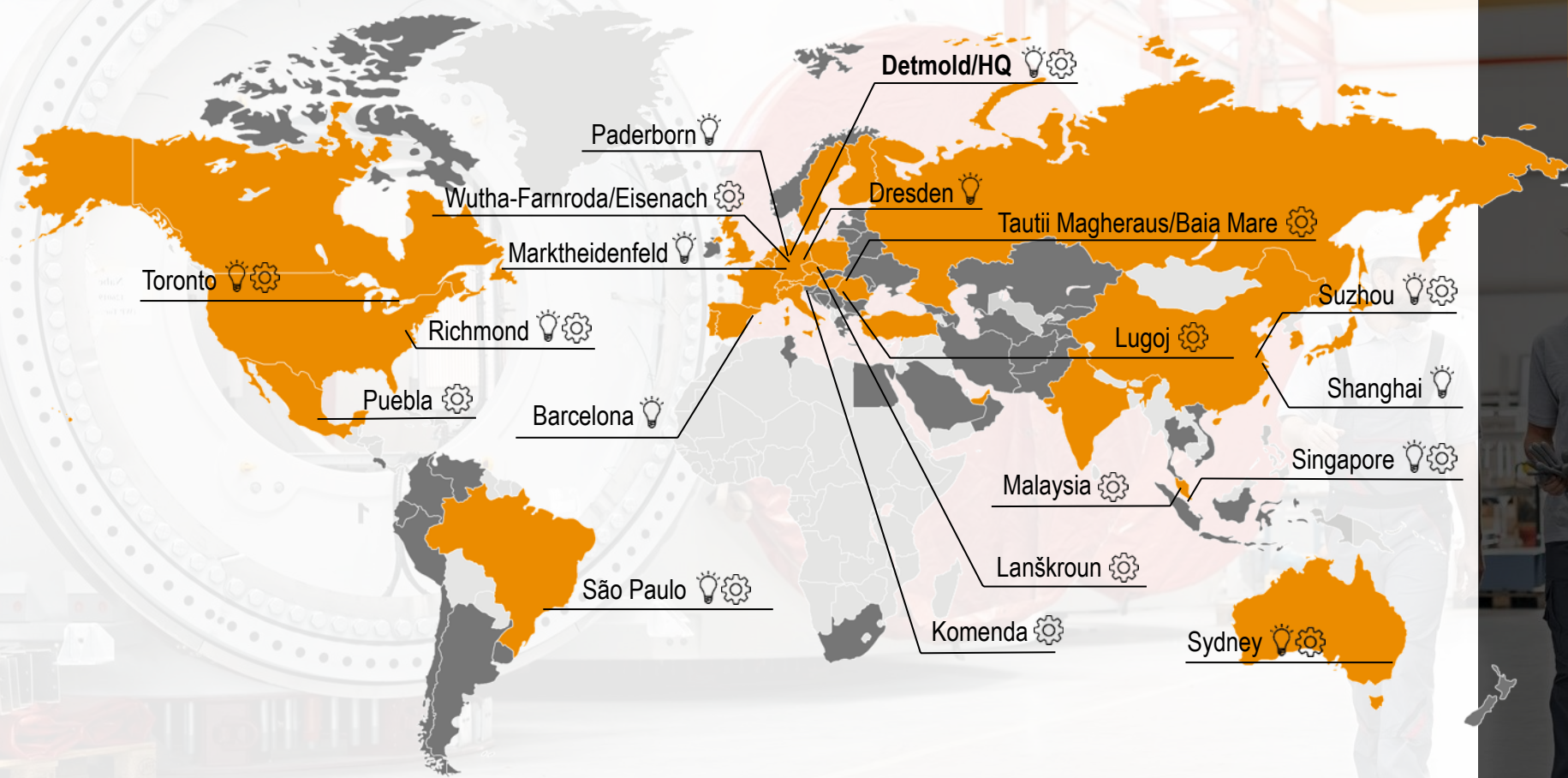
New Energy


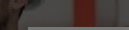



Exciting Hydrogen and our Contribution



XXXX
XXX
Detmold, 2022

Our locations worldwide




-  Group companies
-  Agencies and representative offices
-  Distributors and direct sales
-  Development
-  Production

Machine and Factory Automation



 Consumer Goods & Packaging

 Automotive & Suppliers

 Elevators & Escalators

 Intralogistics

Energy



 Wind

 Photovoltaics


 Traditional Power


 Transmission & Distribution

Process



 Water treatment

 Oil & Gas

 Chemical & Pharmaceuticals

 Hydrogen

Transport



 Railway

 Marine

 Mobility Concepts

 Infrastructure

Building infrastructure



 Office buildings

 Industrial buildings

 Commercial buildings

 Official buildings

Device manufacturers



 Robotics

 Control devices

 Telecommunications-devices

 Power electronics



The Playground of New Energy

Weidmüller is an expert in the transmission of **power, signals and data** in industrial environments.

Photovoltaics

Combiner Boxes
& String Monitoring



Electrolysis

Data Acquisition
& Energy Management



Wind

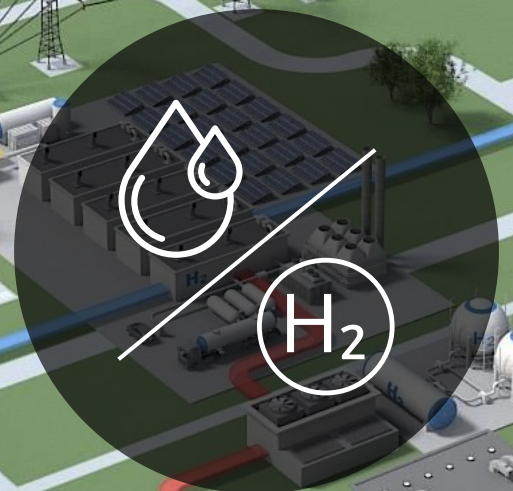
Condition Monitoring
& Data Analysis



Enabler From Data to Value



- Data Analysis
- Data Communication
- Data Pre-Processing
- Data Acquisition



Industry Competence

- Certification Expertise
- Hazardous Area Approvals
- Engineering Competence



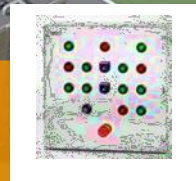
Metering Interfaces
& Data Communication
Smart Grids



Compressor Monitoring
& Smart Control
H2-Storage / Supply



Control Panels
& Marshalling Connectivity
Process



Where Weidmüller play role

Transmission of **Power, Signal and Data**

OEM Product
Manufacturer



Fast Delivery
The ideal solution
for very demanding
delivery schedules

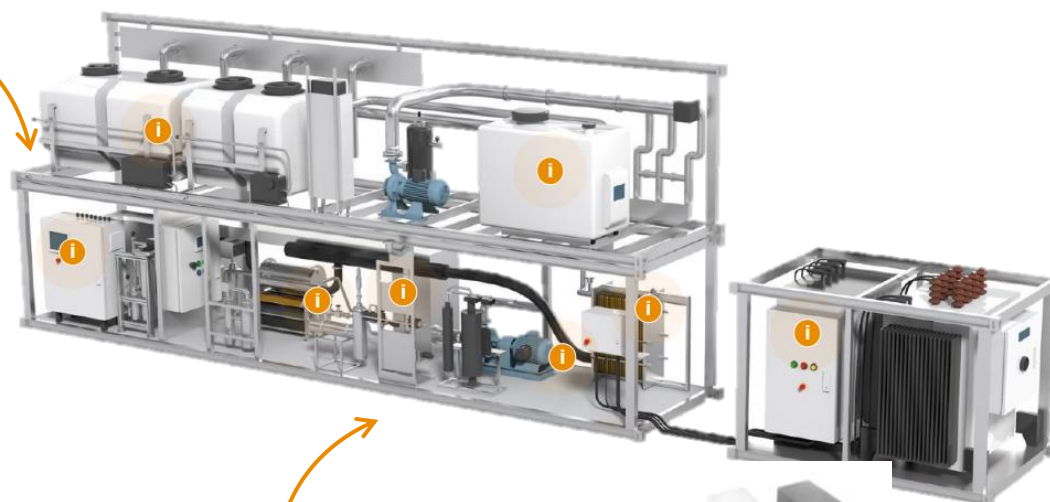
- 5* Day Delivery Europe-wide
- Selected product range
- 10* Day Delivery Europe-wide
- Wide range of products

* Valid for orders from Germany

Modified and assembled
enclosures



Solution Provider



Custom Cable
Assemblies



Product
Manufacturer

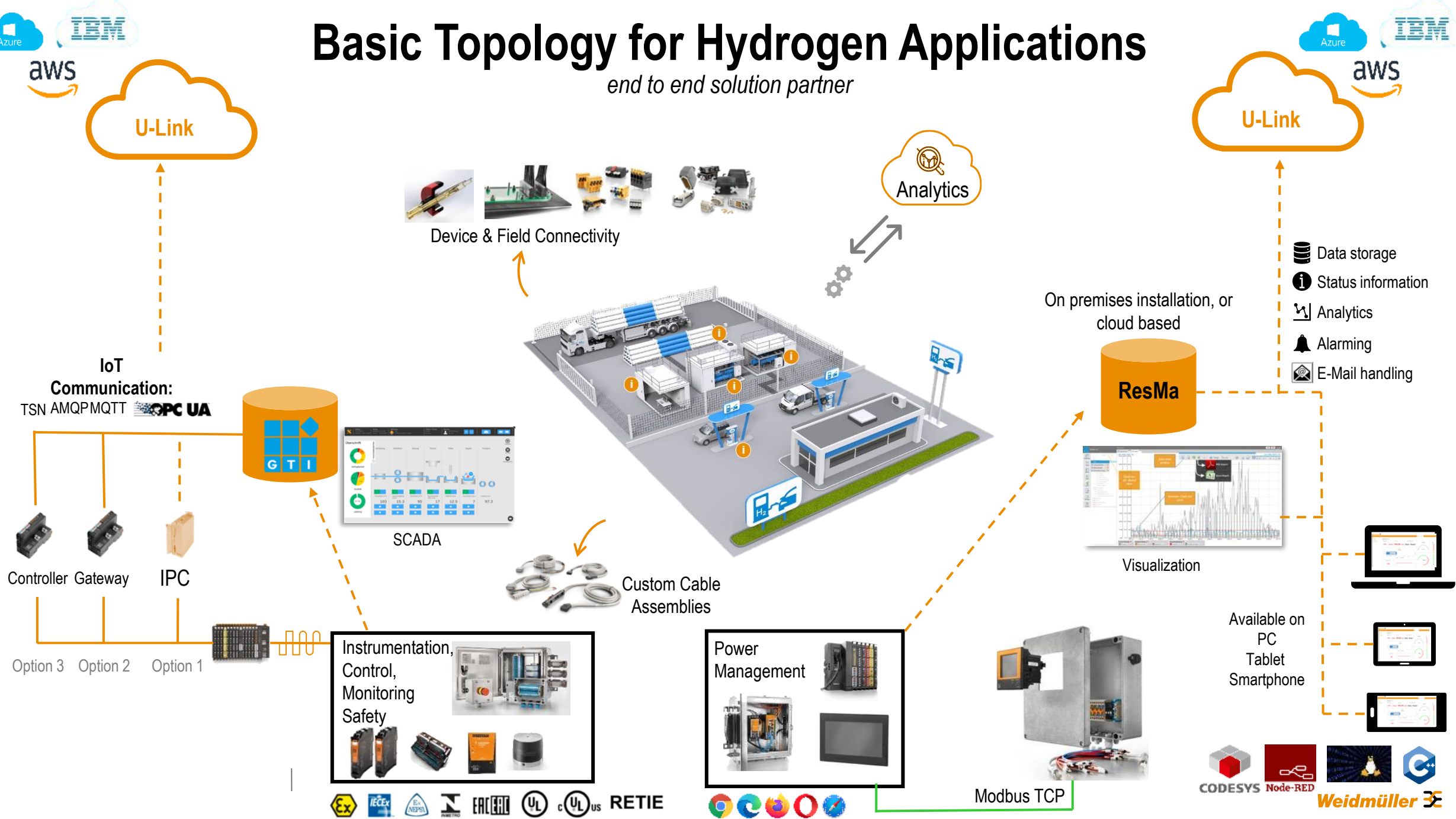


Application
Specific
Solutions
Provider



Basic Topology for Hydrogen Applications

end to end solution partner



What topic can we discuss?

1 Modified and assembled enclosures
Including Fast Delivery Service

2 Connectivity
Terminal Blocks, PCBs, OEM designs

3 Automation & Software
Overview of full range

4 Electronics
PS, ASC, Fieldbus distributors

5 Industrial Ethernet
Ethernet Portfolio with software solutions

6 Single Pair Ethernet
The network infrastructure for the Industrial IoT

A Power feed-in
Transformers, Rectifiers Applications

B De-centralized automation solutions
Pump, Motor control and Housing systems

C Heat Management & Battery Control
UPS Back up system control

D Compressor, Storage and Tank Monitoring
Engineering and assembly of Zone1&2 control, power cabinets

E Control Cabinet , Communication
Hardware & Software solutions

F Industrial Analytics
Industrial Analytics & AML

Industrialization

Automation

Digitalization



Presentation for Waterstofnet

Bart Paijmans

MPET, Noordzee and Europa terminal



PSA AMBITION

Scope 1 & 2 emissions

Milestone 1

2030

Reduce **absolute** carbon emissions by **50%**

Milestone 2

2040

Reduce absolute carbon emissions by **75%**

Milestone 3

2050

Be **carbon neutral**

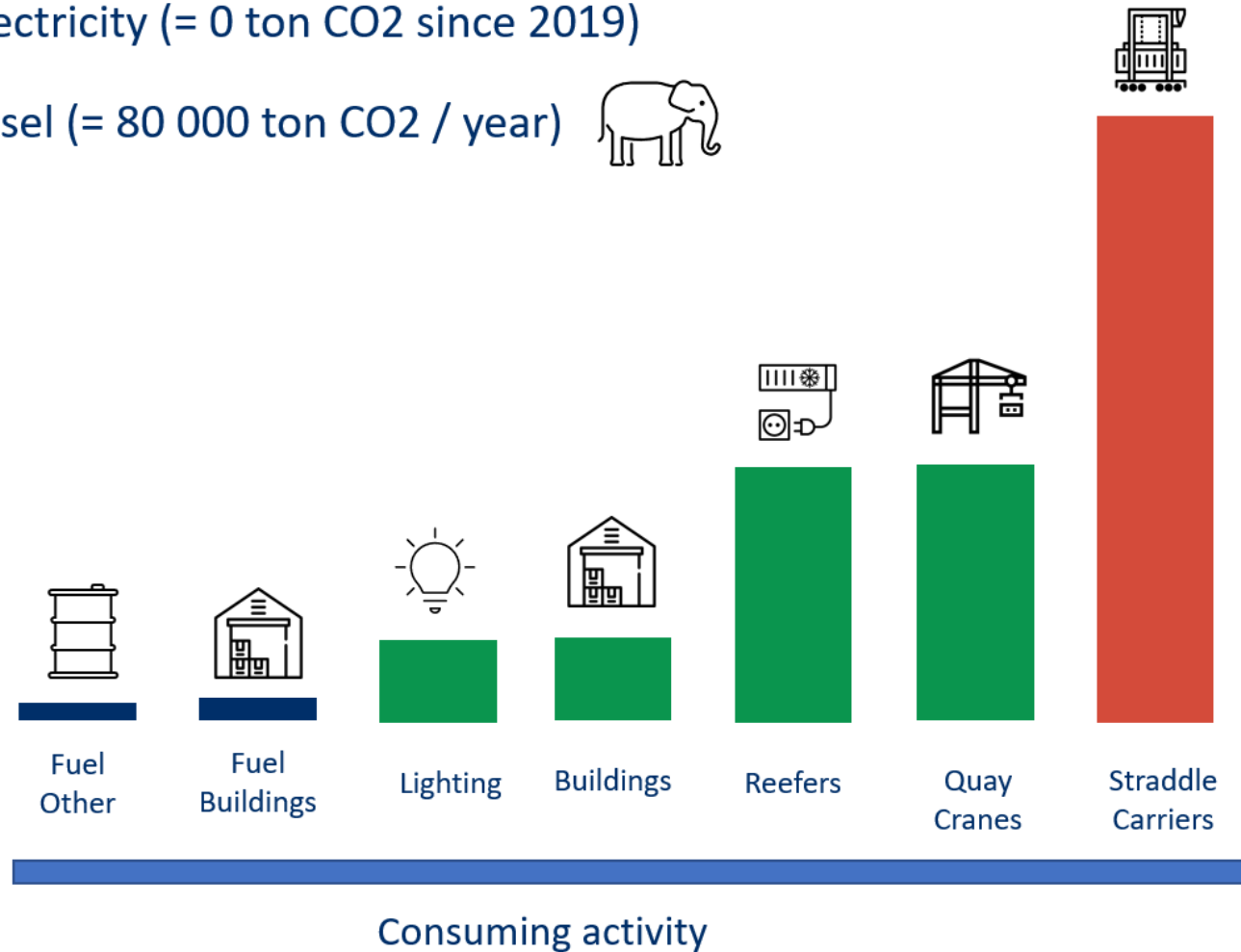
against a 2019 baseline year



Our big tickets ?

100 GWh of Green Electricity (= 0 ton CO2 since 2019)

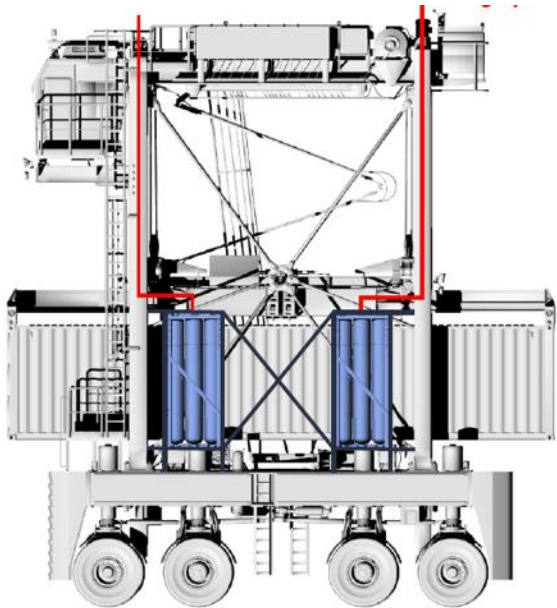
30 Million litre of Diesel (= 80 000 ton CO2 / year)



Expressed in primary energy, Tjp

Green Straddle Carrier

Green Straddle Carrier



Hybrid

Electric SC - ESC

Hydrogen

Alternative Fuels

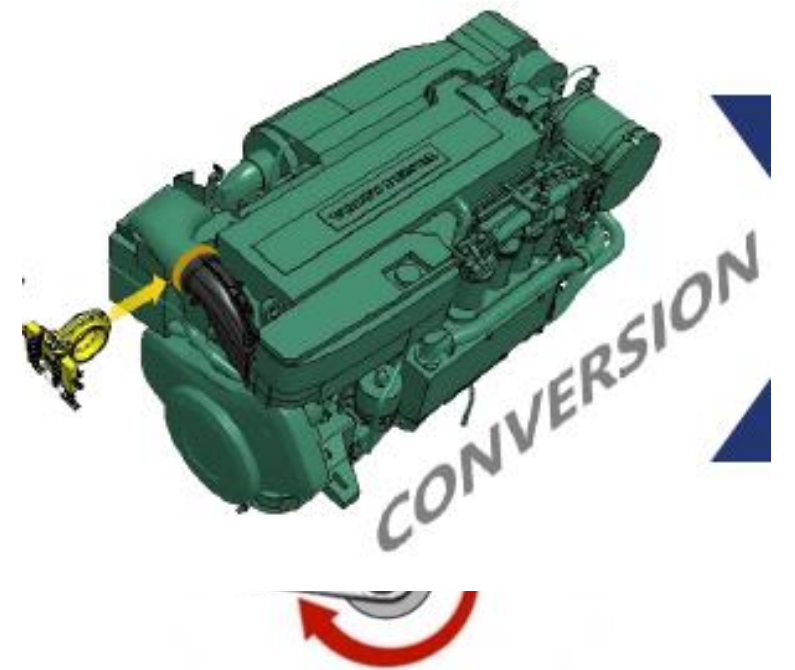


PIONEERS

CMB
.TECH

DUAL FUEL TECHNOLOGY AS A TRANSITION

CMB.TECH



DUAL FUEL TECHNOLOGY AS A TRANSITION

- Injection of hydrogen into the diesel engine : **30% to 90%**
- Can be **retrofitted** on existing Straddle Carriers
- Can be used in combination with **Hybrid Straddle Carriers**
- Robust and **reliable**
- Allows to **gradually** build up the H2 infrastructure and blend in more green H2



Refueling concept



- Demonstration directly from the tube trailer, on-demand
- Full roll out: connection to pipelines
1 ton H₂/day -> 4 ton H₂/day



AGENDA

10.00-10.05: Introduction VDL & WaterstofNet

New members presentation

10.05 -10.35

Key notes

10.35-10.50: Status and developments on LOHC, Prof. Dr. Patrice Perrault, University of Antwerp

10.50-11.05: Bosch hydrogen technology developments, Mrs Antje Seitz, Senior expert in SOFC & Bosch

WIC news

11.05 - 11.30

News from WIC members

11.30-11.45

VDL activities & tour/demo FC truck

11:45-12.30



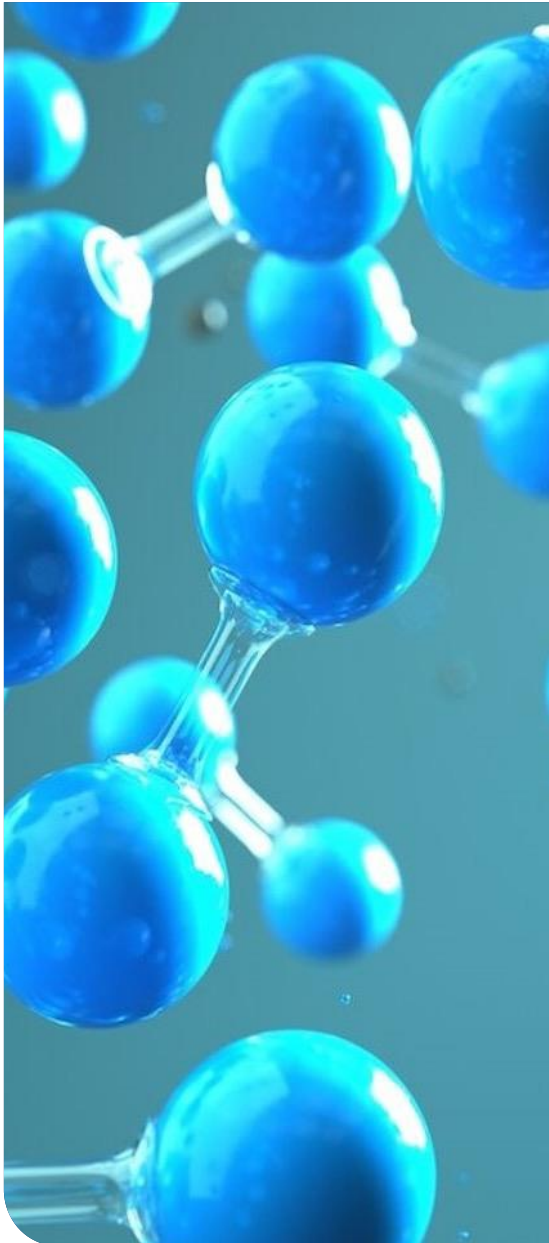
University of Antwerp
Sustainable Energy,
Air & Water Technology

Challenges in the hydrogen economy: light element – heavy stuff

Patrice Perreault

May 25, 2022





Who & what

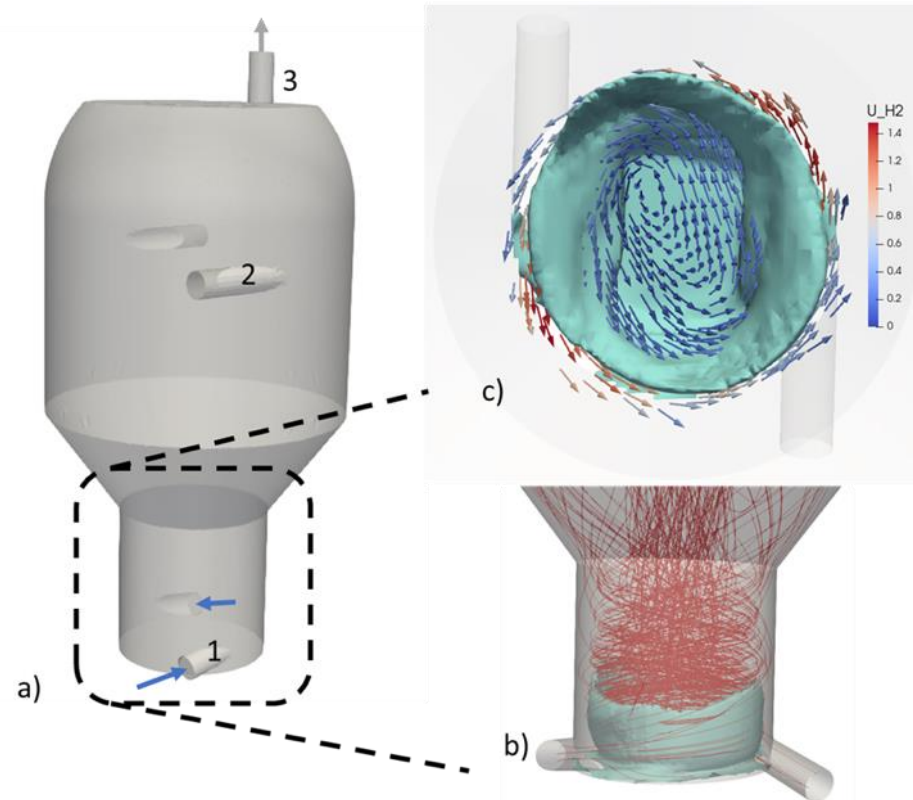


Polytechnique Montréal, 2016

UGent, 2016-2017

UADY (Mexico), 2017-2019

UA: 2019...



Sustainable Energy,
Air & Water Technology
University of Antwerp

BlueApp

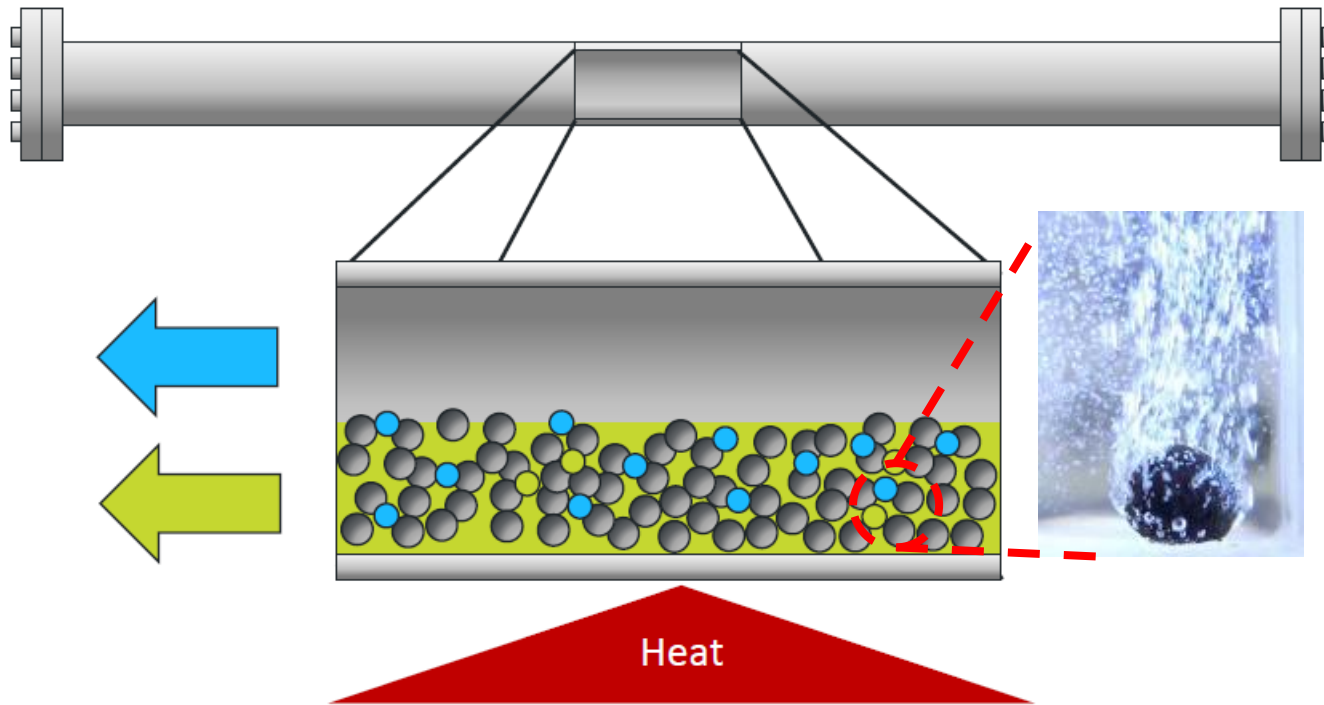
Powered by UAntwerp



Technology development



Why focusing on reactor design?



Power density ($\text{kW}_{\text{th}}/\text{m}^3$ reactor) has to be increased

Liquid Organic Hydrogen Carriers (LOHC)

Hydrogen stored as an oil

54 kg H₂/m³

62 kg H₂/t (6,2%)

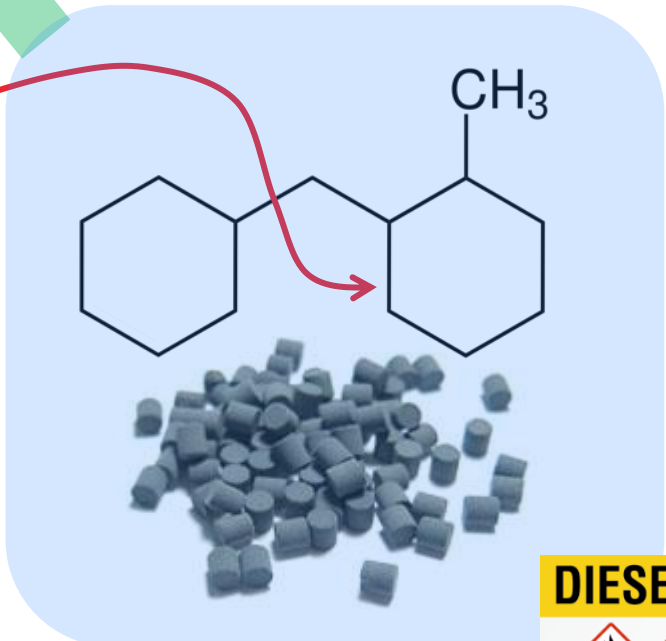
11 kWh/kg

10 kWh/kg

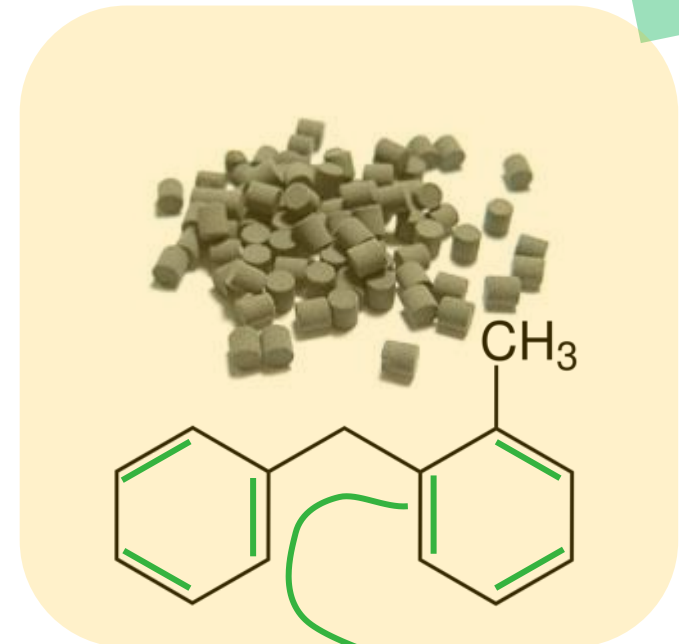
Hydrogenation

25-50 bar, 250 °C

6 H₂



(di)benzyl toluene



Dehydrogenation

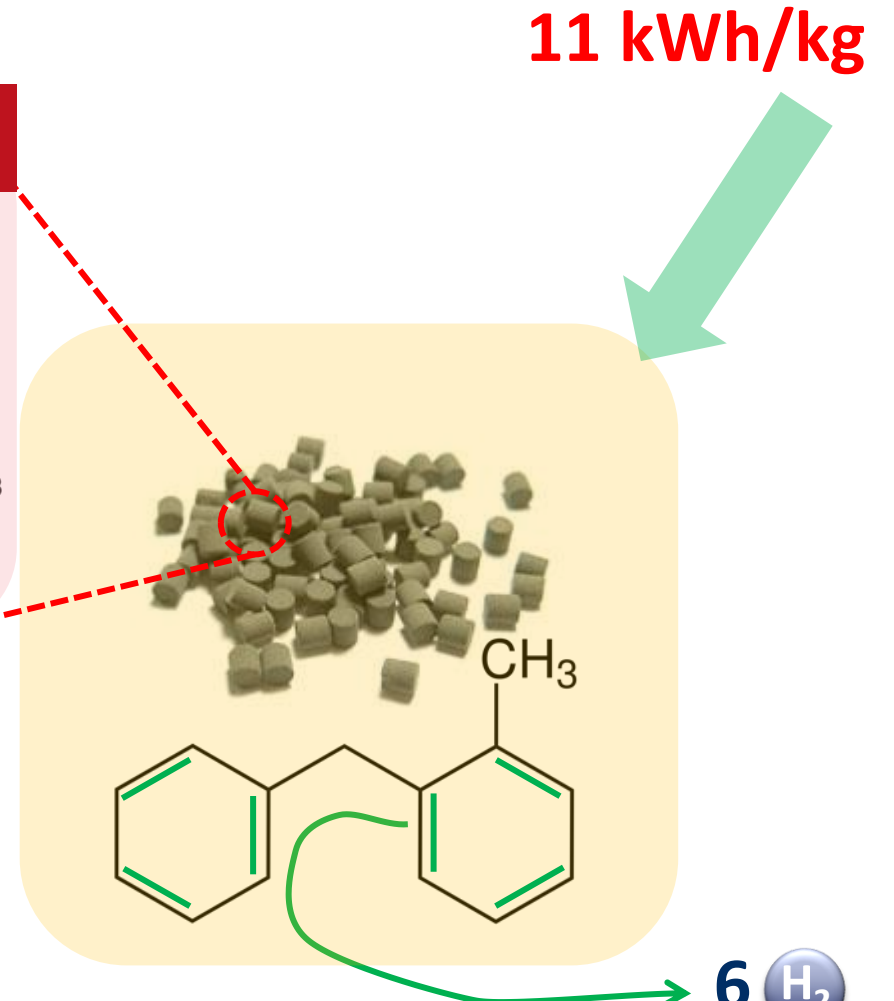
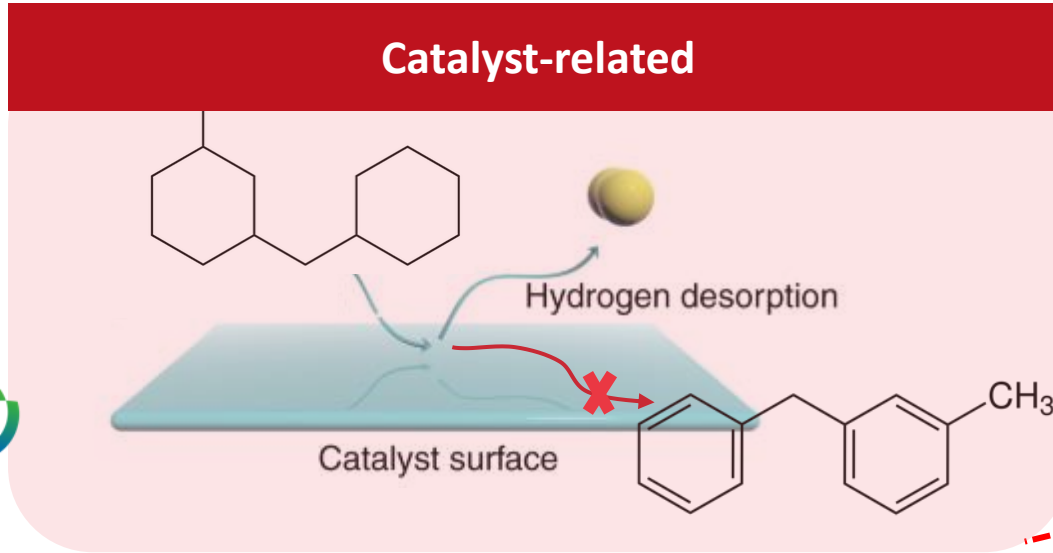
1-3 bar, 300 °C

DIESEL FUEL



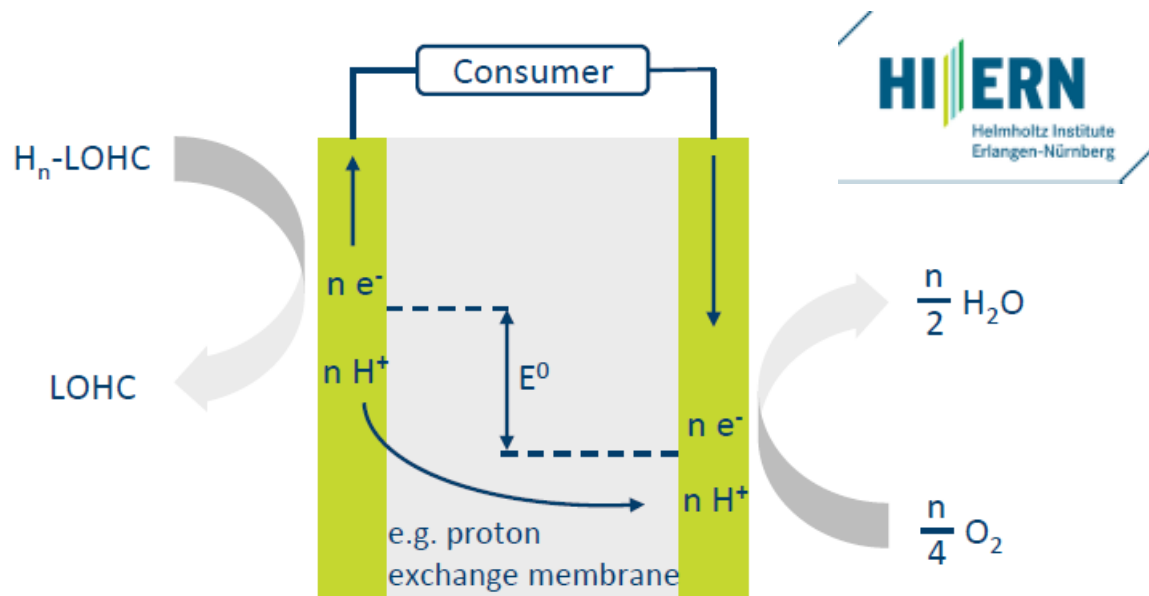
EASTMAN

Current Challenges for LOHCs

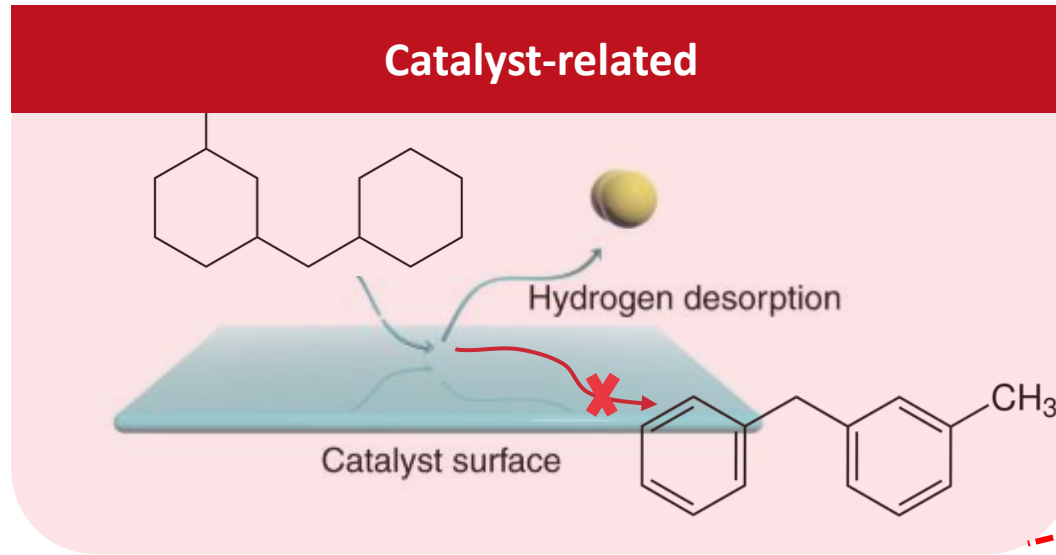


Dehydrogenation

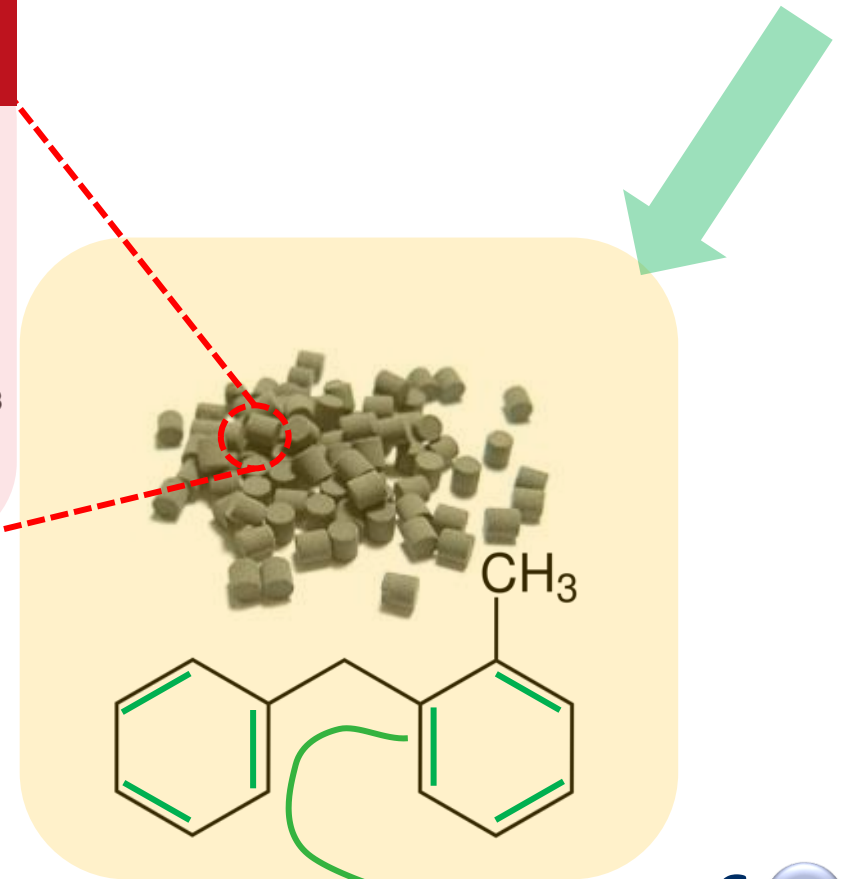
1-3 bar, **300 °C**



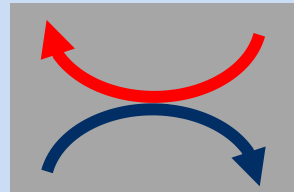
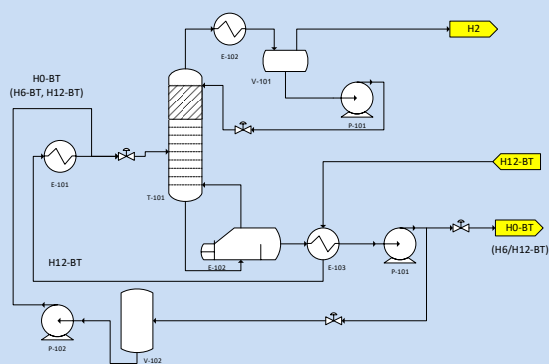
Current Challenges for LOHCs



11 kWh/kg



Lowering Energy Requirements



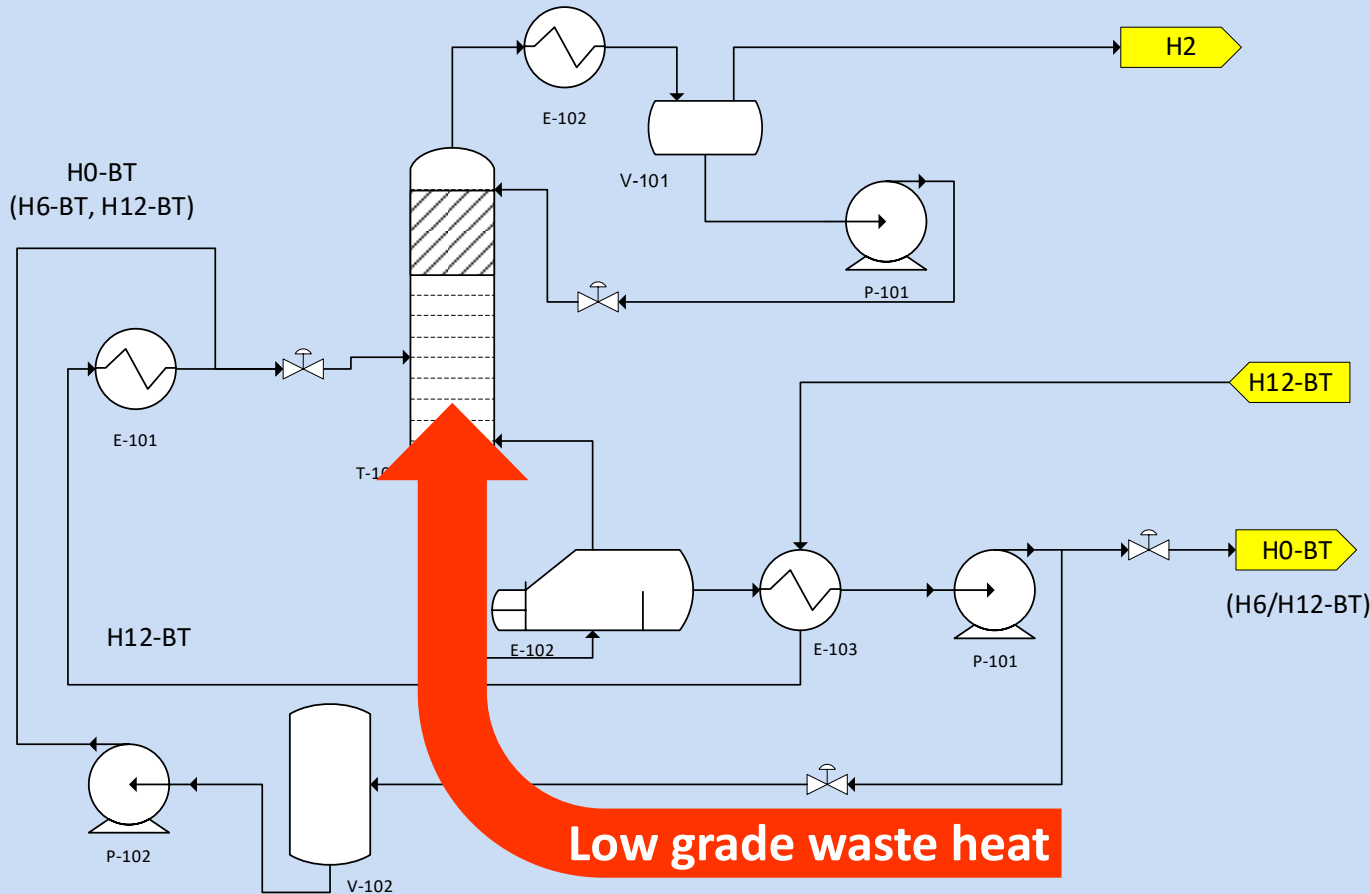
Dehydrogenation

1-3 bar, 300 °C

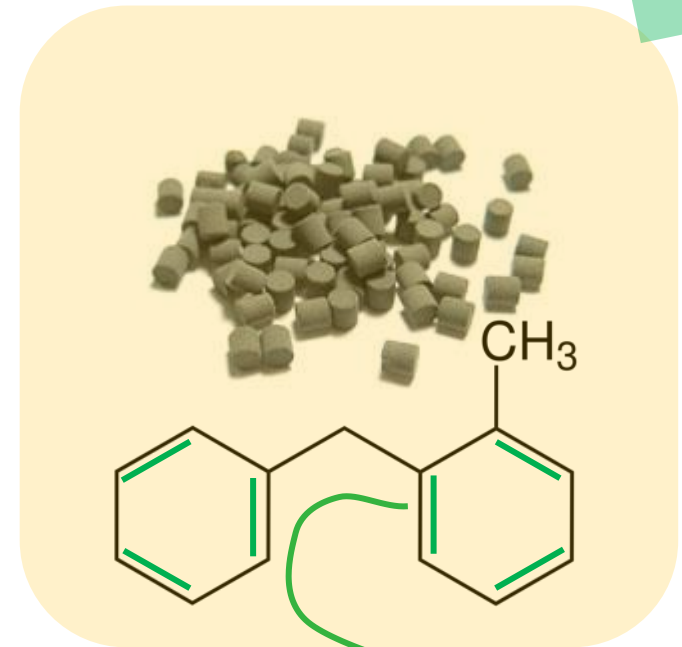


Current Challenges for LOHCs

Lowering Energy Requirements



11 kWh/kg

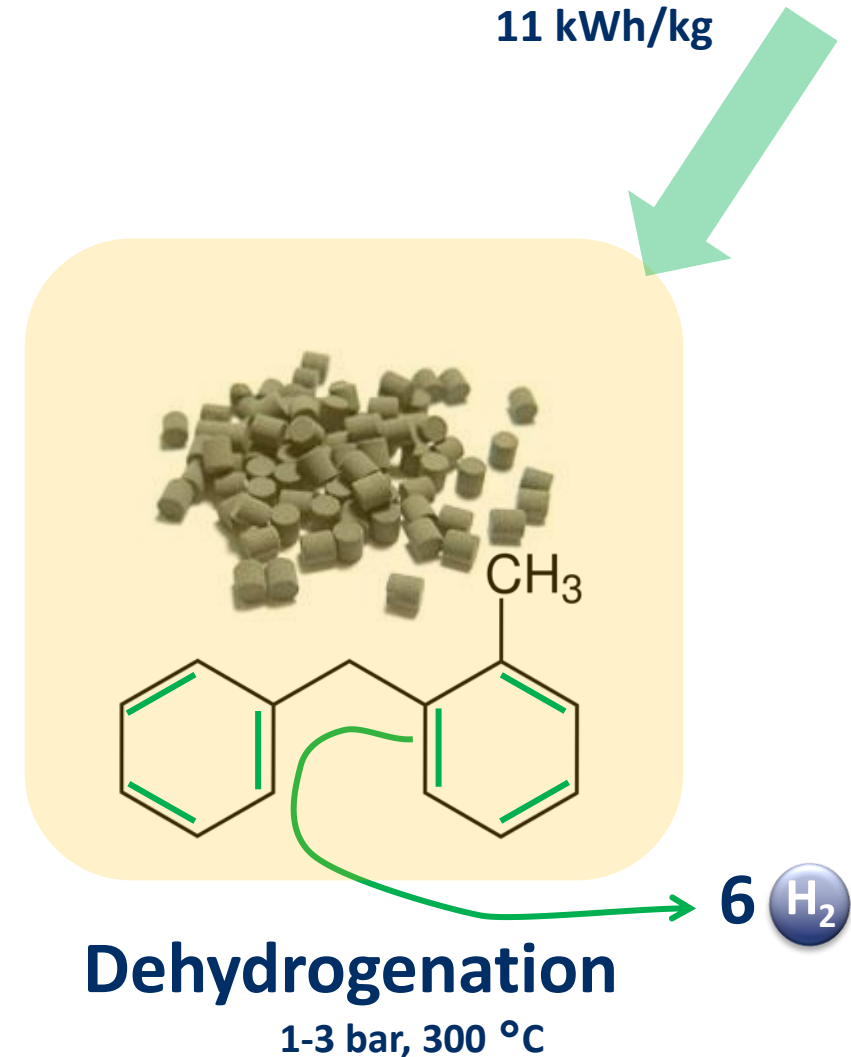
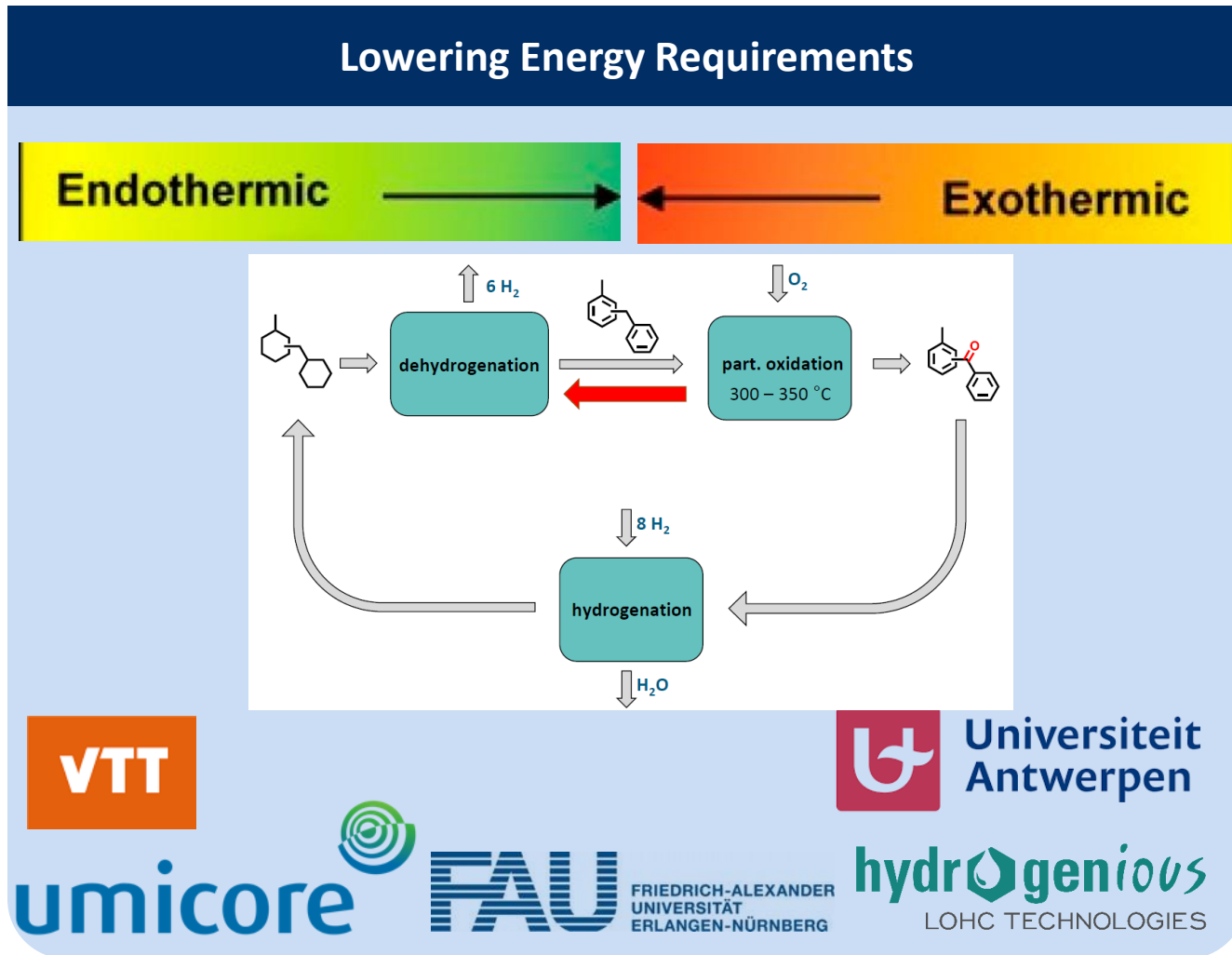


6 H₂

Dehydrogenation

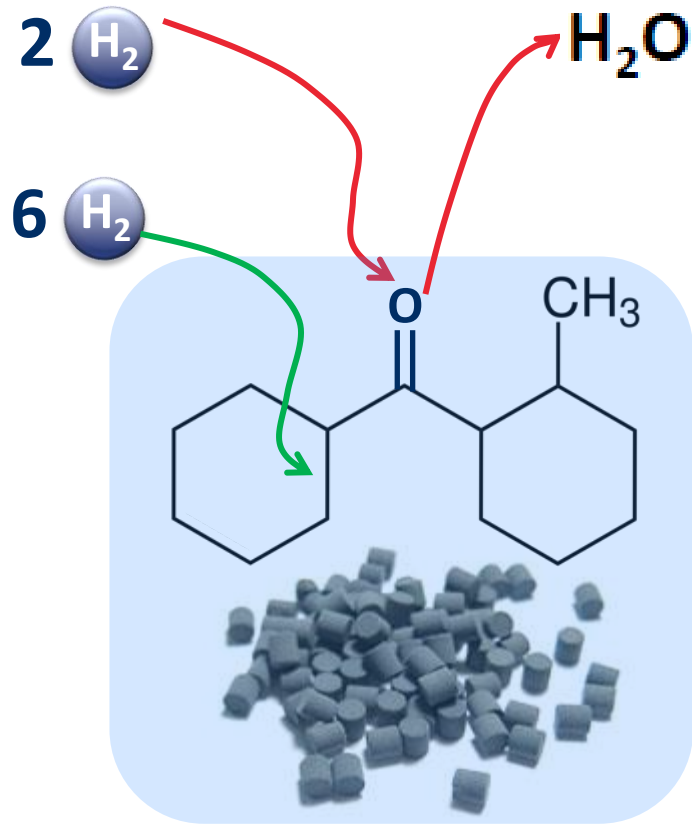
1-3 bar, 300 °C

Current Challenges for LOHCs



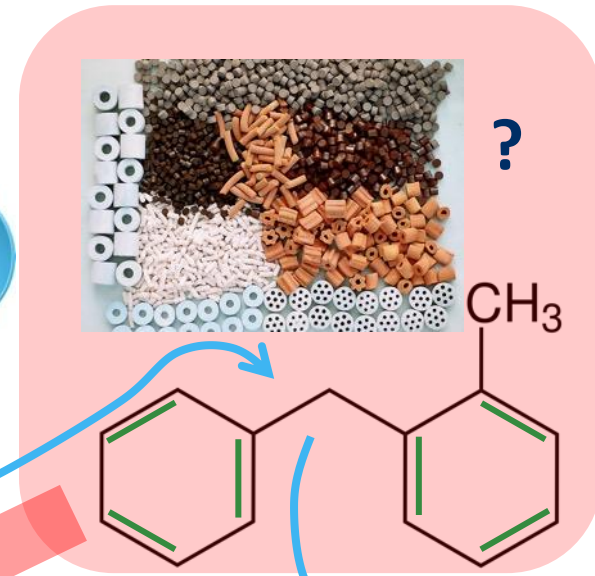
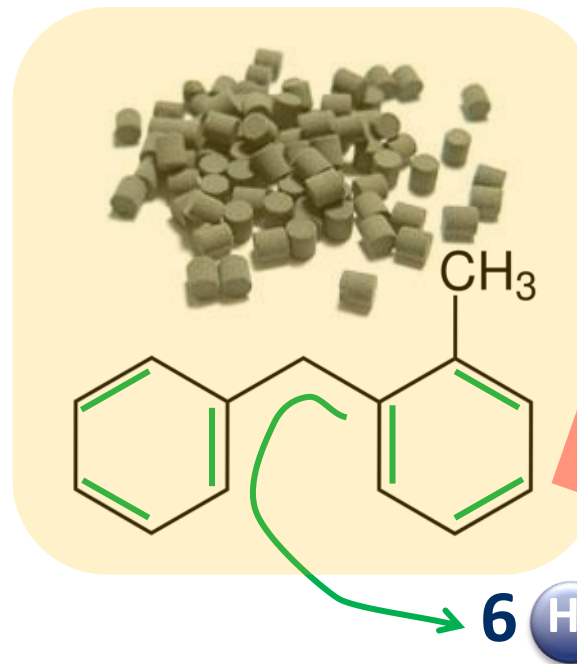
Current Challenges for LOHCs

Lowering Energy Requirements



Hydrogenation

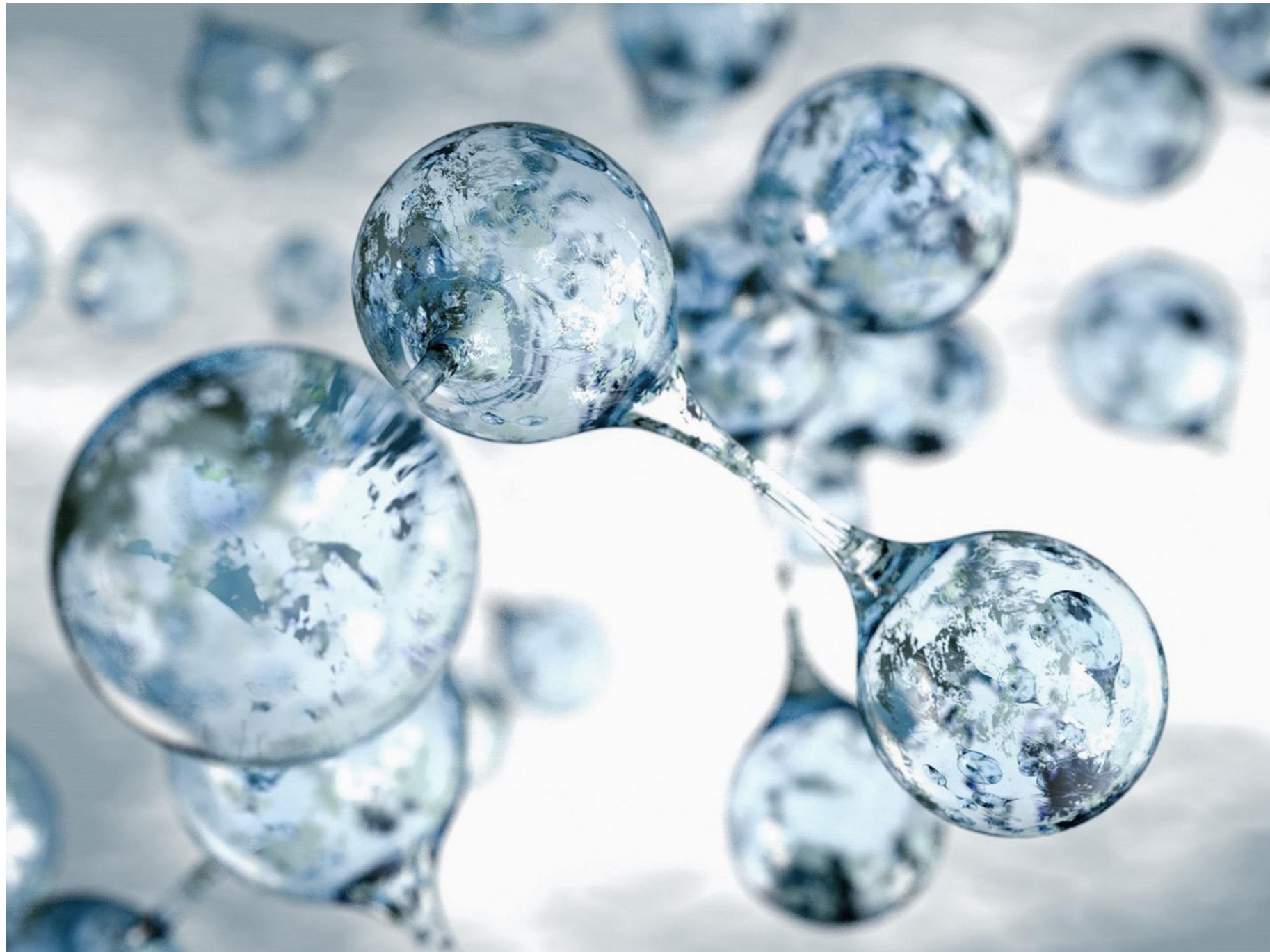
Dehydrogenation



Partial Oxidation

Thank you

- Questions?

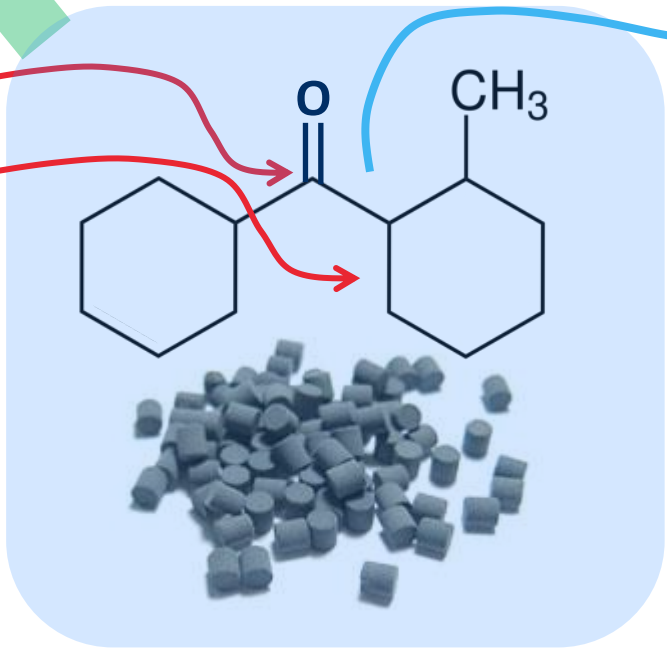


10 kWh/kg

Hydrogenation

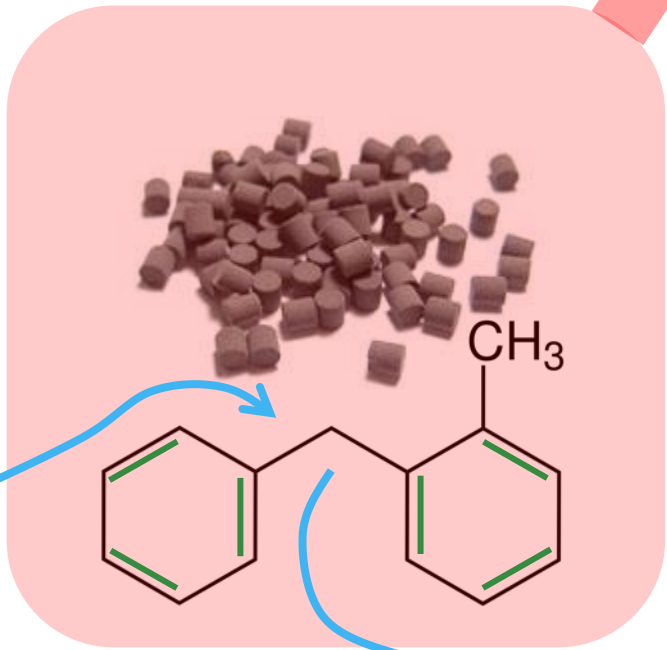
25-50 bar, 250 °C

8 H₂



H₂O

O₂
Oxygen



+ H₂O

Partial oxidation

1-3 bar, 350 °C

WN/WIC News

COMMUNICATION : WIC NEWSLETTER

- **Content:**

- Newsflash

- Regional

- International

- **MEMBER NEWS !!!**

- New events

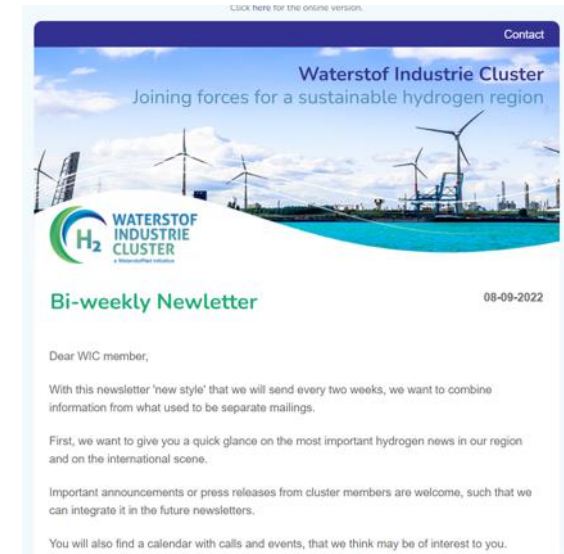
- New calls

- **Timeline**

- Each 14 days

- Excluded : half July until half August

Brand new



- **WIC :** **news letter + yearly catch-up meeting**
 - Large public : structural contacts with press
 - Government : structural contacts with cabinets
 - Knowledge institutes : structural visits
 - Federations : structural meetings
 - NGO's : yearly meeting
-

- **Content:**

- Companies

- About us

- Expertise

- Employees

- Presentation

- Members

- Function in company

- Contact info

- Working groups

- Downloads & call information

WaterstofNet

Individuals

WIC MEMBER PORTAL

- **Functions:**

- Find companies
- Contact other members
- Find the right information about the working groups
- One place to find all the presentation, downloads & call information

Main activity

- R&D
- Study & conception
- Funding
- Manufacturing & production

Manufacturing production area of expertise

Only fill in when 'Manufacturing & production' selected above

- Electrical
- Electrolyser
- Purification & compressor units
- Other auxiliary equipment

[Reset filter](#)



- Council took their position on the Renewable Energy Directive (RED II) in June
- The Industry, Research and Energy (ITRE) Committee of the European Parliament finalized their position on July 13
 - ✓ Plenary vote during Strasbourg session (**12-15 September**)
 - ✓ Trilogues expected to start soon after

	EC	Council	Parliament
Overall target	40% (July 2021), <u>45%</u> (REPowerEU)	40%	45% (position ITRE – plenary vote in September)
GHG emission reduction target in TRANSPORT	13% with a 2.6% target for renewable fuels of non-biological origin (RFNBOs) in the transport sector by 2030	13% with a 2.6% target for renewable fuels of non-biological origin (RFNBOs) in the transport sector by 2030	16% by 2030 with a 5.7% target for renewable fuels of non-biological origin (RFNBOs) in the transport sector by 2030 + new sub-target of at least 1.2% RFNBOs by 2030 in the maritime sector
Green Hydrogen in INDUSTRY	50% in 2030 (July 2021), <u>75%</u> (REPowerEU)	35% in 2030 en 50% in 2035	50% in 2030 en 70% in 2035 (position ITRE – plenary vote in september)

EU

- CET Partnership Joint Call 2022 → opens on September 14, 2022, and closes on November 23, 2022 ([More info](#));
 - Info day on September 13 (Click [here](#) to register)
 - There are 11 modules with focus on power planning tools, heat and cold, storage technologies, energy systems for safe renewable generation and solutions for existing buildings and new buildings.

NL

- SDE++ → opens on June 28, 2022, and closes on October 6, 2022 ([More info](#))

STATUS IPCEI 'HY2TECH'

- 18/7 – Approval of first 41 Important Projects of Common EU Interest from the Technology wave
- 15 Member States (Austria, Belgium, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Netherlands, Poland, Portugal, Slovakia and Spain) have agreed to spend **5.4 billion euros**
- 35 companies are receiving the subsidy
- 3 cluster members are amongst them

Commission approves up to €5.4 billion support by 15 Member States for an Important Project of Common European Interest (IPCEI) in the **Hydrogen Technology value chain** "IPCEI Hy2Tech"



*SME



Evaluation & statements Related to EU or national legislation

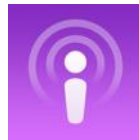
- Policy recommendations
 - ✓ Position paper certification process H₂, compatibility with NL & DE systems, to be discussed in Policy WG
 - ✓ Position paper additionality, reaction to public consultation European Commission
- Visits cabinets BE-FL
 - ✓ Brouns, Demir, Dermine, Diependaele, Jambon, Peeters, Van der Straeten
 - ✓ Joint meeting planned for this autumn
- Future way of working policy team
 - ✓ Frequency (every 2 months)
 - ✓ Membership (Dutch members welcome)



Disclosing the world of H₂ to the broader public

Two new podcast episodes upcoming:

- Hydrogen combustion engines
- The role of ports in the hydrogen economy





Third edition starting soon

- The third edition of the Hydrogen Academy will start soon: (Monday 3, 10, 17, 24 October and 7, 14 November 2022)
- Specialised speakers will discuss everything from existing and future applications, the policy and regulatory framework and much more.
- Hosted by cluster member Agfa in Antwerp
- **Registration still open**



WORKING GROUP MOBILITY



Monitoring and facilitating H2 refuelling stations in Benelux.
Increase utilisation.

- Working on a road map for H2Mobility in Belgium-Netherlands-Luxemburg (plan for scaling up # HRSs and prognoses of FCEVs and FCET(ruck)s)
 - Working on proposal for HRS certification project in Interreg Call
 - Utilisation of HRS, by scaling up FCEV fleets with companies located near new and existing HRSs"
-



Knowledge exchange H2 combustion

- Joint vision on the use of combustion engines in the energy transition
- Next meeting October (tbc)
 - Discussing vision
 - Following actions
- Podcast on H2 combustion also available soon



Development of H₂ pilots & infrastructure for shipping;
(in collaboration with De Blauwe Cluster)

- H2Barge: status
 - H2 container
 - In close cooperation with Rhine project
 - Swappable
 - Market Neutral
 - Standardised
 - Joint Venture: discussions ongoing
 - Cooperation with Green Deal Shipping
-

WG PORT EQUIPMENT



- 20 partners will participate
 - Terminal operators
 - Equipment manufacturers
 - Tank installation manufacturers
 - Retrofitting companies
 - ...
- Kick-off Sept 23
 - Introduction round
 - Initialisation of projects

WG CONSTRUCTION EQUIPMENT



- New idea : start working group construction equipment
- Consultation round will start
- **Call to all interested parties** : feel free to contact WaterstofNet (Tom Verlinden)

- **Permitting**

- Knowledge exchange
- Simple procedures



- **Education & training of technical workforce on H2**

- Inventory
- Examples abroad
- Coordination



UPCOMING EVENTS

- Sept 19-20 **Visit to Saksen for FL companies**, organization FIT
 - Oct 3: **Start Hydrogen Academy** 6 sessions, 18.00-22.00 @ Agfa, Mortsel
 - Oct 17-20 **Visit to Gießen (Hessen) for BE companies**, AKH organisation (DE-BE-LUX), (with Cluster Tweed) [link](#)
 - Dec 1: **WIC meeting** North Sea Port Terneuzen
 - **Meet & Greet** → to be planned Nov-Dec (hybrid)
 - **Yearly visit WIC** → to be planned Jan 2023
-

NEWS FROM CLUSTER MEMBERS



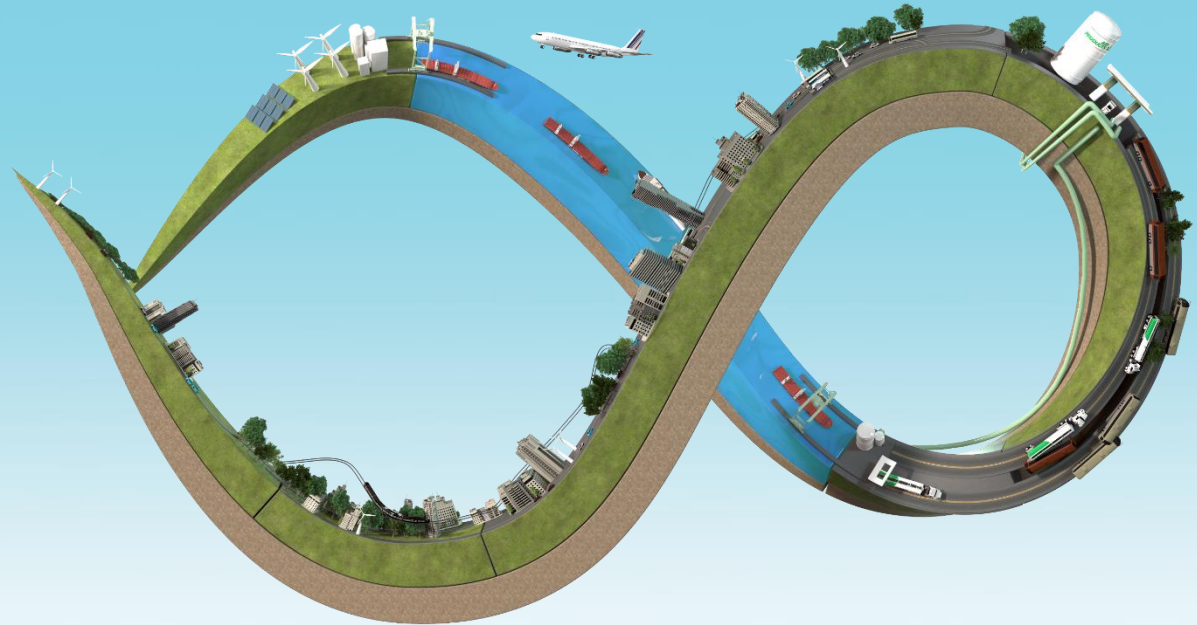
Air Products
BESIX

H₂fM[®]

Hydrogen for Mobility

WIC Meeting
@ VDL Eindhoven
8th September 2022

Generating a Cleaner Future



AIR
PRODUCTS 

Air Products globally today

An industrial gas company



\$10.3

billion in FY21 sales

20,000+

employees

50+

countries

~\$65B

market cap

80

years in business

170,000+

customers

3,000 km

of industrial gas
pipeline

750+


production
facilities

30+

industries
served

The world's largest hydrogen producer with



 1,100+ kilometers of pipeline
>32 billion Nm³/year


H₂ The world's longest H₂ pipeline system and world class liquid hydrogen supplier

25+ years safe fueling

 **250+** hydrogen fueling projects worldwide

 **30+** H₂ Electrolyser projects

 **20+** countries
Unique product offering for H₂ fueling

1,500,000 fueling per year
 13 million total fueling

~50 patents for hydrogen fueling


We are H₂ experts along the entire value chain

- We provide **end to end** solution
- We **produce** H₂
- We **distribute** H₂ in trailers in liquid and gaseous form
- We build H₂ **pipelines**
- We build and operate **hydrogen refuelling stations**
- We **lead by example and convert** our own vehicle fleet to H₂

Production: Electrolyser (wind, solar), SMR (biogas/off-gas), ATR (carbon capture)

Distribution: Pipeline, liquid tanker & gaseous trailer



Hydrogen Leadership

Air Products has more than **60 years of hydrogen experience** and is at the forefront of hydrogen energy technology development.

Following our expertise in large scale project developments...

...since 2020 we have announced investment in **~\$15 Bn on green and blue H₂ global production projects**

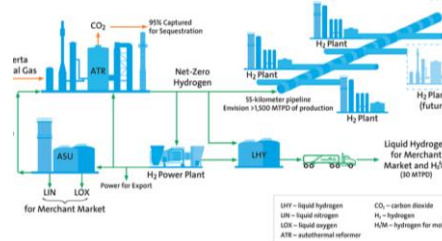
08/ **2020**
Saudi Arabia



Production facility in **NEOM** powered by **renewable energy** for production and export of **650 TPD green hydrogen to global market**



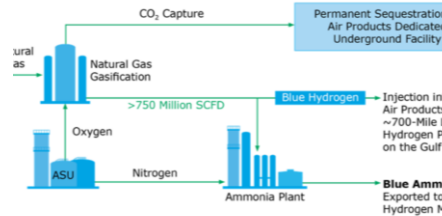
06/ **2021**
Canada



World-Scale Net-Zero Hydrogen Energy Complex producing **1500 TPD of blue hydrogen production**

\$1.3 bn

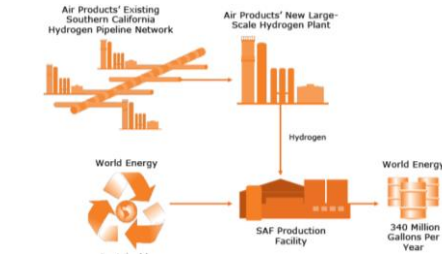
10/ **2021**
Louisiana (US)



Blue Hydrogen Clean Energy Complex with capacity of **1900 TPD of blue hydrogen production**

\$4.5 bn

04/ **2022**
California (US)



Conversion of Sustainable Aviation Fuel (SAF) production facility with production capacity of **340 Million gallons per year**

\$2 bn

05/ **2022**
Oman



Joint Development Agreement Toward **World-Scale Green Hydrogen-Based Ammonia** Production Facility

\$2 bn

In Europe, we want to position as the 1st strategic partner to decarbonize industry and mobility

We will bring large volumes of green ammonia from NEOM to Europe by 2026

In Feb 2022 we signed an MoU with **Hamburg Port Authority**

to accelerate the production, supply chain and consumption of hydrogen in the North of Germany and Hamburg



In Jul 2022 we signed a JDA for a green ammonia import terminal in **Port of Rotterdam**

the import terminal is expected to provide green hydrogen to the Netherlands and Europe by 2026



In Aug 2022 we announced with **Associated British Ports (ABP)** the intention to partner in bringing the first large scale, green hydrogen production facility to the UK.



Rotterdam, Botlek (The Netherlands)

First Rotterdam **green** hydrogen filling station for trucks



KEY FEATURES

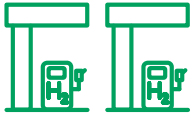
HRS type
Gaseous

Fuelling
2 dispensers
350 bar

Capacity
4,000 kg/day

Onstream +/- mid 2023

End Users



Trucks



Your Contacts For Hydrogen for Mobility Projects @ Air Products Belgium & The Netherlands



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blokdir@airproducts.com





Excel in creating sustainable solutions for a better world



CO₂-PRESTATIELADDER

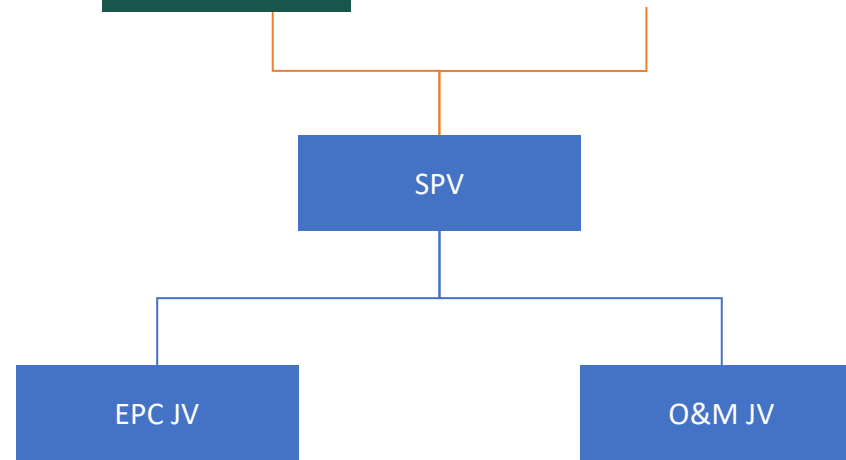
BESIX news on the Green Hydrogen market

Green H2 news @ BESIX

- Hyoffwind 25 MW (Zeebrugges)- Project awarded
- Development of production plant in Belgium & The Netherlands
(capacities in project structure, financing,...)
- Project development support in Australia and Middle East
- Offtake opportunities in-house
- Support for researches workgroup

Hyoffwind – 25 MW - Zeebrugges

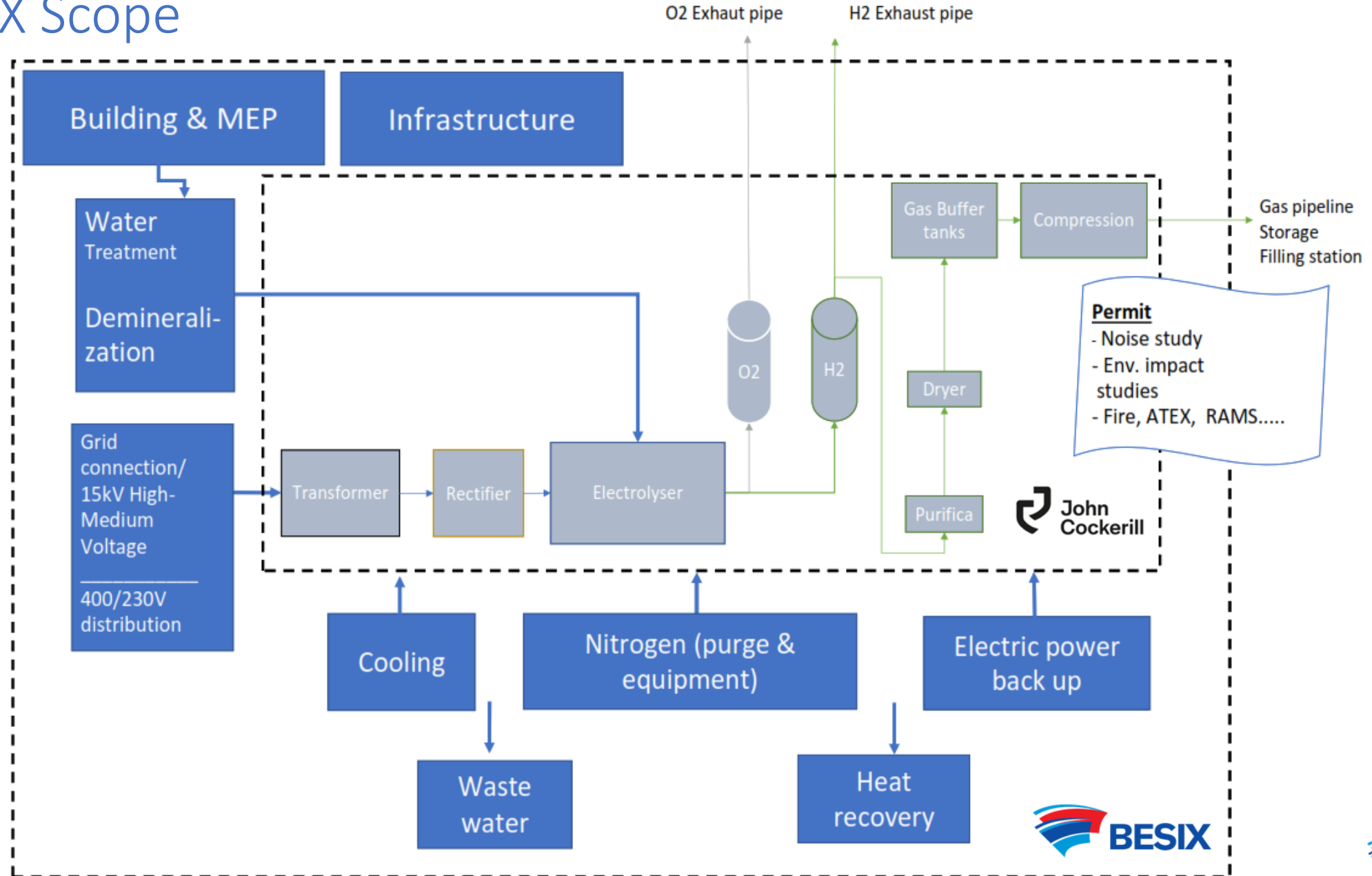
Project structure



TBC



BESIX Scope



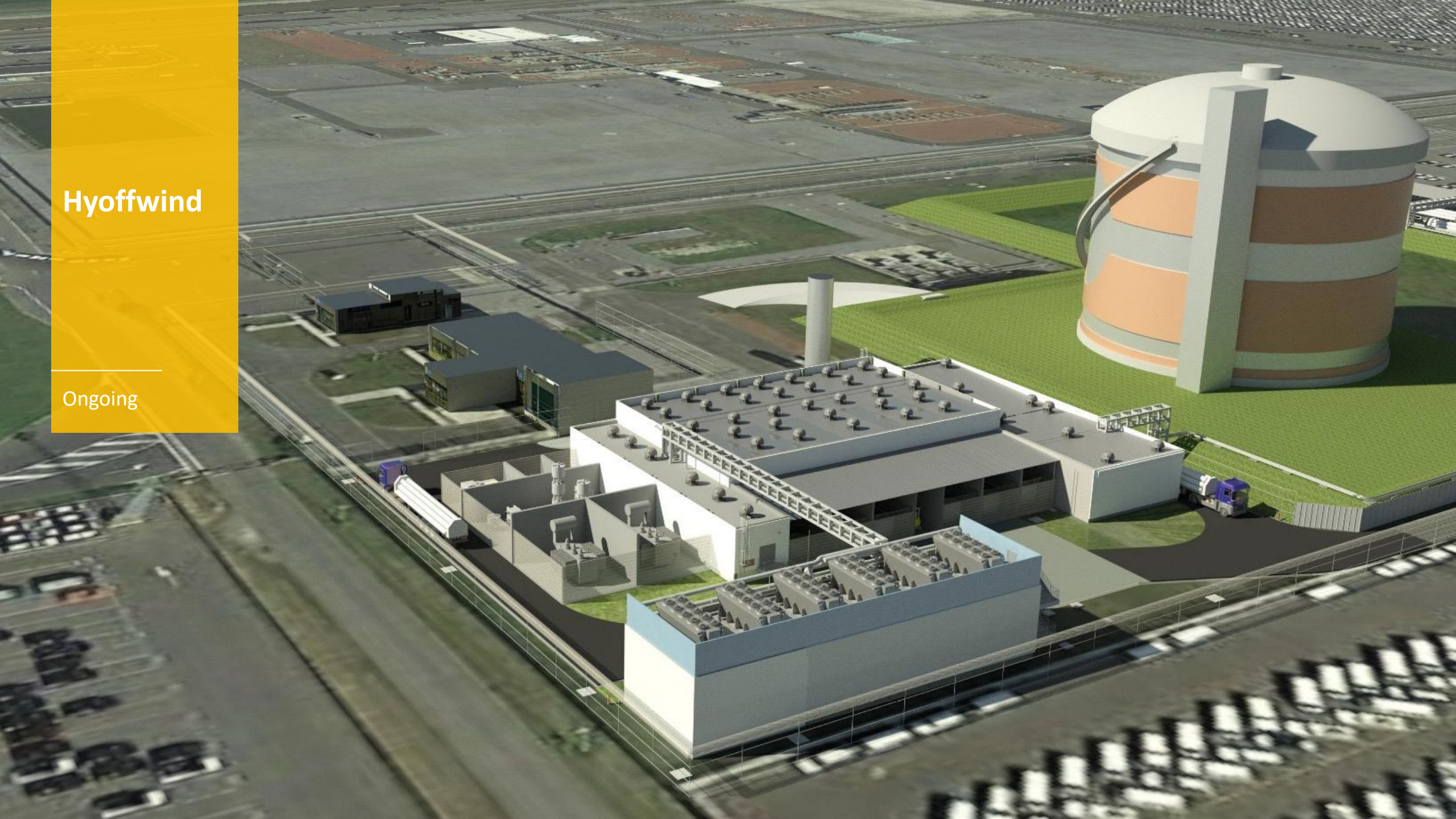
Hyoffwind

Ongoing



Hyoffwind

Ongoing



Hyoffwind

Ongoing

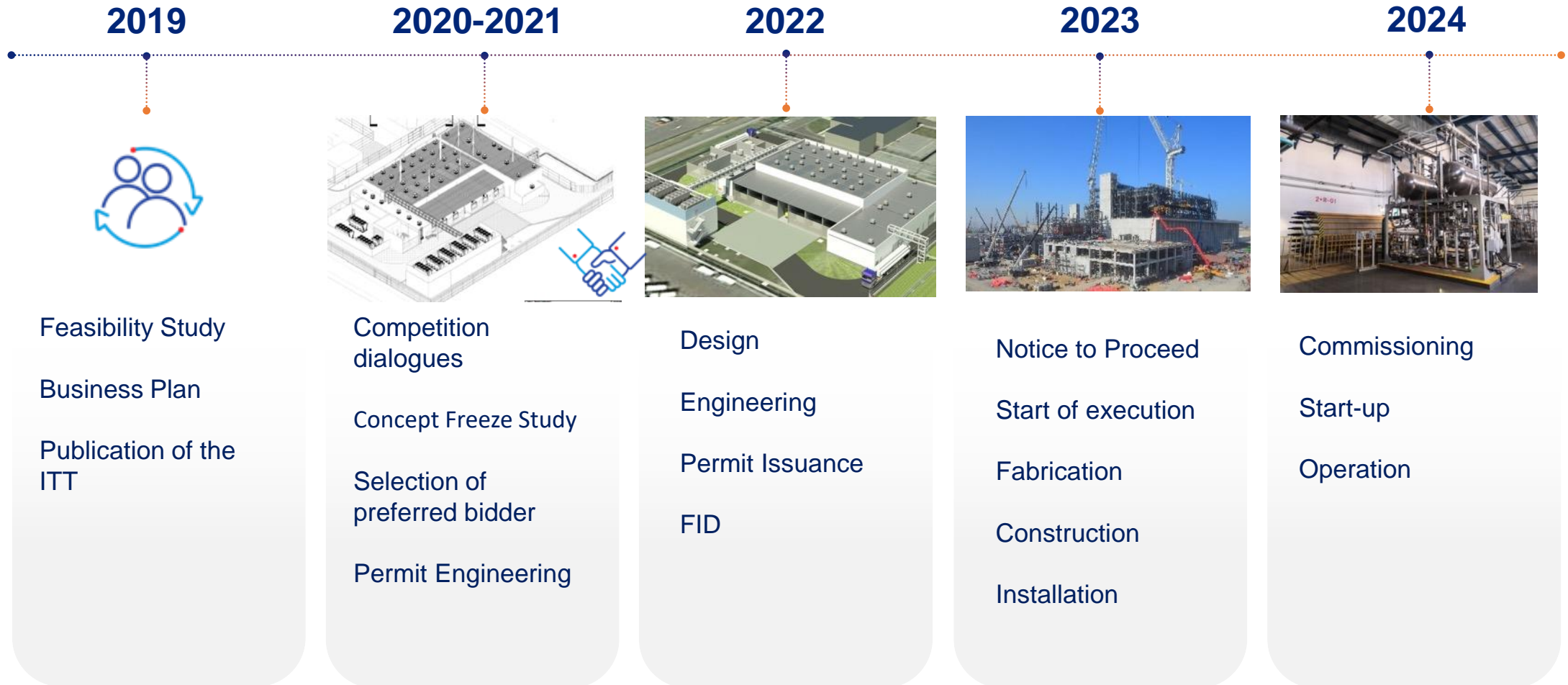


Hyoffwind

Ongoing



Project Timeline





BESIX



BESIX Environment

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AGENDA

10.00-10.05: Introduction VDL & WaterstofNet

New members presentation

10.05 -10.35

Key notes

10.35-10.50: Status and developments on LOHC, Prof. Dr. Patrice Perrault, University of Antwerp
10.50-11.05: Bosch hydrogen technology developments, Mrs Antje Seitz, Senior expert in SOFC & Bosch

WIC news

11.05 - 11.30

News from WIC members

11.30-11.45

VDL activities & tour/demo FC truck

11:45-12.30

+ LUNCH

RENEWABLE ENERGY

UPDATE 2022



Ruud Bouwman



Picture: 3energy.nl

Facts & figures



107 COMPANIES



SPREAD ACROSS
20 COUNTRIES



TURNOVER
€ **6,0** BILLION

PROFIT
€ **180** MILLION



>15,000 EMPLOYEES



84% EXPORT
to **105 COUNTRIES**



COMPANY ACTIVITIES
DIVIDED AMONG **4 DIVISIONS**



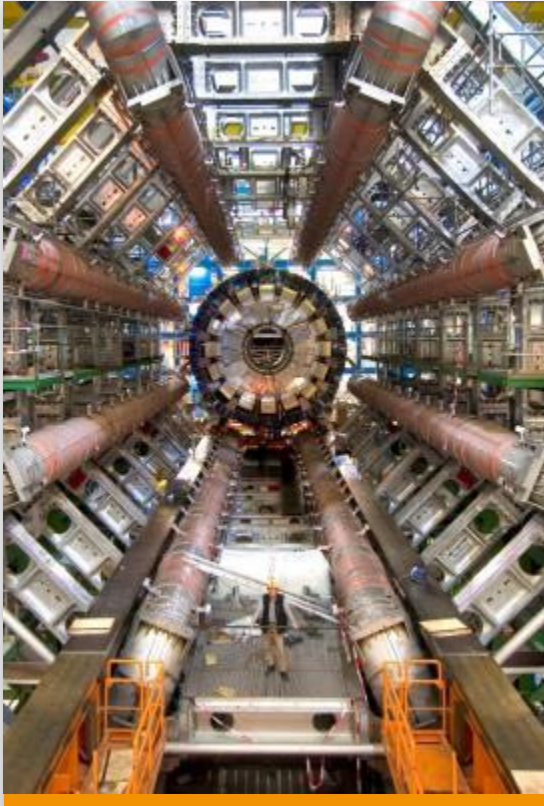
STRONG BALANCE SHEET POSITION
SOLVENCY **58%**



>1,400,000 M²
PRODUCTION SURFACE AREA



Highlights



Subcontracting



Car Manufacturing



Bus & Coach

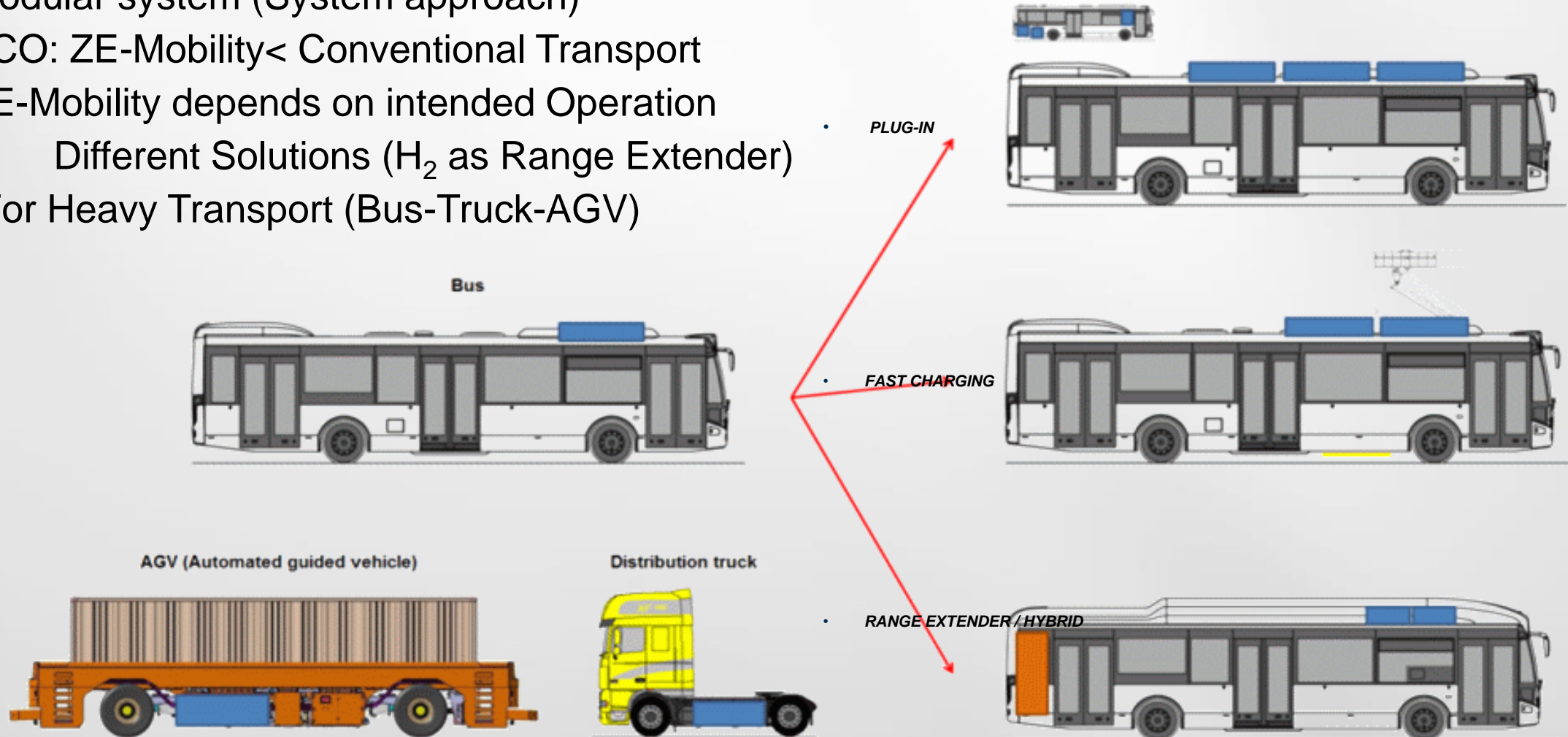


End Products

General VDL Strategy on ZE mobility!

Strategy ZE

1. Modular system (System approach)
2. TCO: ZE-Mobility < Conventional Transport
3. ZE-Mobility depends on intended Operation
Different Solutions (H₂ as Range Extender)
4. For Heavy Transport (Bus-Truck-AGV)



VDL Zero Emission BEV products (2013 - now)

Battery Electric for Public Transport, Distribution, Storage.....



City ZE-bus



Distribution ZE-truck



ZE-AGV



**Energy Storage Systems
(kW)**

H₂obby 1998 - 2013

Zero Emission-Hydrogen

Conclusions:

Electrical (Public) Transport
within 5-15 years is feasible
Also for bigger vehicles >24m

-Not one-solution-

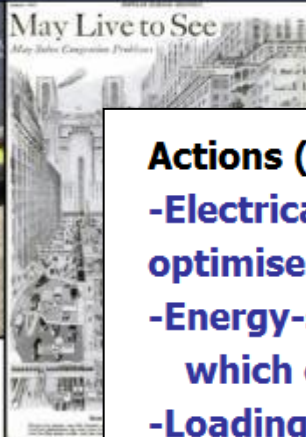
1-Combination of Battery technology
(Power+Recuperation)
and H₂ technology
(Range+Flexibility)

Actions (Modularity):

- Electrical vehicle, optimise on weight-volume-price
- Energy-storage as module, which can follow its development
- Loading principle flexible and depends on operation

Integration
is needed

Experiences with H₂ vehicles in Public Transport



29 Februari 2012
Ruud Bouwman



1998-2000: ICE-H₂ DAF and Liquid hydrogen



2010-2014: FC Ballard Phileas Cologne



1999: H₂ Trailer



2013: FC Hydrogenics Range Extender



2010-2014: FC Ballard Phileas Amsterdam



VDL Hydrogen Mobility Fuel Cell 2016-now

FCE projects bus 2016-now:

- 3E Motion (2016-now)
 - 1 Giantleap [ElringKlinger 70kW]
 - 4 Citea [Ballard 85kW]



Range Extender Generation 2



FCE projects truck 2016-2022:

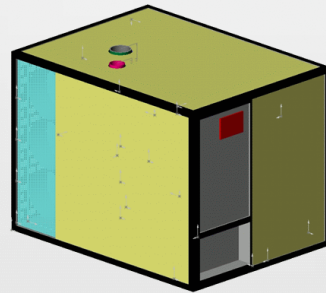
- Interreg2.0 and H2Share
 - 1 Truck-Trailer [Ballard 85kW]
 - 1 Rigid [Ballard 85kW]



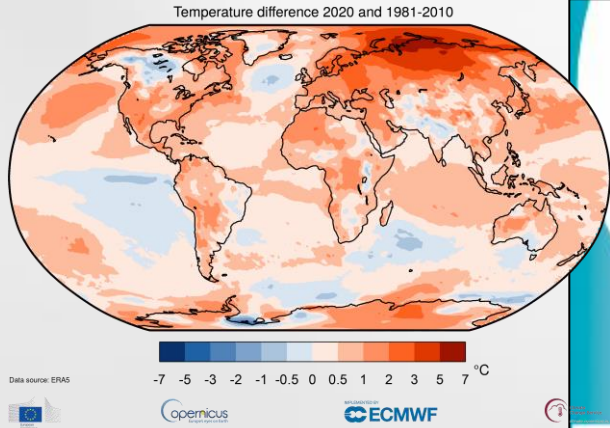
VDL for Consumers of Renewable Energy

VDL projects and prospects based on StasHH (LEGO):

- Regional Bus (NGC)
- Coach (HyFleet)
- Truck (H2Haul)
- Mobility (GTD H₂)
- GenSet (Maritime-Rail-AGV):
 - Charging station (SynFuel or H₂)
 - 50- 100kW (Mobile)
 - 200- 500kW (10ft)
 - 550-1.000kW (20ft)



Q&A OR OPINIONS



Conclusie (1)

- /// **H2 is de toekomst**
- /// **Energieomzetter**
 - /// ICE
 - /// FC vanaf >2010
 - /// RFC vanaf 2015
- /// **Energieopslag**
 - /// CGH2 700-1000bar
 - /// LH2
 - /// Vanaf 2012 nano-fibers

BERKHOF JONCKHEERE

Hydrogen Systems N.V.

BJG-HD project

Afgerond 03/10/00
Video TVL

BERKHOF JONCKHEERE

Hydrogen Systems N.V.

SYCOR&X

een objectieve kijk op WATERSTOF

GEVOELIG KLIMAAT? HARDE GETALLEN!

Lezingmiddag
Donderdag 7 maart: 13:00 – 18:15
Planetaarium, Amsterdam

Keynote: Nic Lewis
over Klimaatgevoeligheid

Tevens: Rob de Vos, Benny Peiser,
Theo Wolters, Richard Tol,
Guus Berkhout

Programma en Tickets: (€10 – €35)
Ontgroeningsdag.nl



„Ich glaube, daß eines Tages Wasserstoff und Sauerstoff, aus denen sich Wasser zusammensetzt, allein oder zusammen verwendet eine unerschöpfliche Quelle von Wärme und Licht bilden werden.“

Jules Verne, Die geheimnisvolle Insel, 1874

