

Welcome to the WIC meeting!



AGENDA

10.00-10.05: Welcome (Callens)

10.05-10.40: New WIC members presentations

10.40-11.00: 'Geological (white) hydrogen, the ultimate, disruptive solution?',
Peter Driessen, independent geo-scientist

11.00-11.15: News of cluster members

11.15-11.35: WIC news

11.35-11.50: Education and training needs in our region (incl. Group poll)

11.50-12.10: 'Experiences with the Callens 20MW hydrogen steam boiler in a chemical
plant' (Bart Goossens, Vynova)

12.10-13.10: Tour Callens factory

NEW CLUSTER MEMBERS SINCE MARCH '23



‘Geological (white) hydrogen, the ultimate, disruptive solution?’

Peter Driessen, independent geo-scientist

NEWS FROM CLUSTER MEMBERS



Air Liquide
Sweco
Von Karman institute



Air Liquide's Ammonia Cracking Technology

May 8th 2023

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NAME AND FUNCTION OF THE BUSINESS OWNER: Dieter Ulber & Michael Lutz, Project Managers

DISTRIBUTION LIST: Neste Technology Day - Air Liquide Participants

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An Innovative Group

Innovation is at the heart of the Group's customer-centric transformation strategy



347
new patents
filed in 2020

4,300
employees⁽¹⁾
contribute to
innovation

€303m
innovation
expenses⁽¹⁾

(1) 2020 Figures OECD Definition.

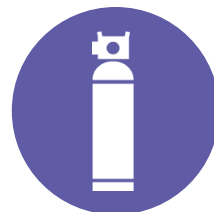
R&D: 8 scientific and technological expertises



**PROCESS
ENGINEERING**



COMBUSTION



MATERIALS SCIENCE



**DESIGN AND
MANUFACTURING**



**COMPUTATIONAL
&
DATA SCIENCE**



ANALYTICAL SCIENCE



FINE CHEMISTRY



LIFE SCIENCE

Ammonia Cracking Pilot Plant in industrial scale

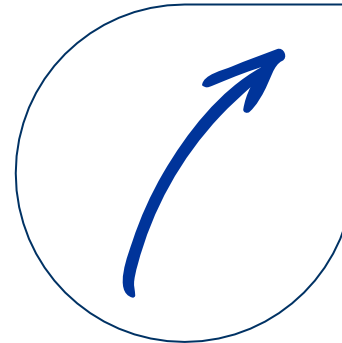


Demonstration of

- **Ammonia Cracking**
- **Ammonia Firing**

in industrial, full scale next-generation reactor tubes

Startup: Q2 2024



Scale-up!

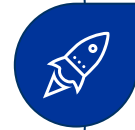
The pilot plant and **operational experience** thereof enables Air Liquide to **scale-up** to a **commercial size**

Timeline



Q1 2023

Final Investment Decision on the Ammonia Cracking pilot plant



Q2 2024

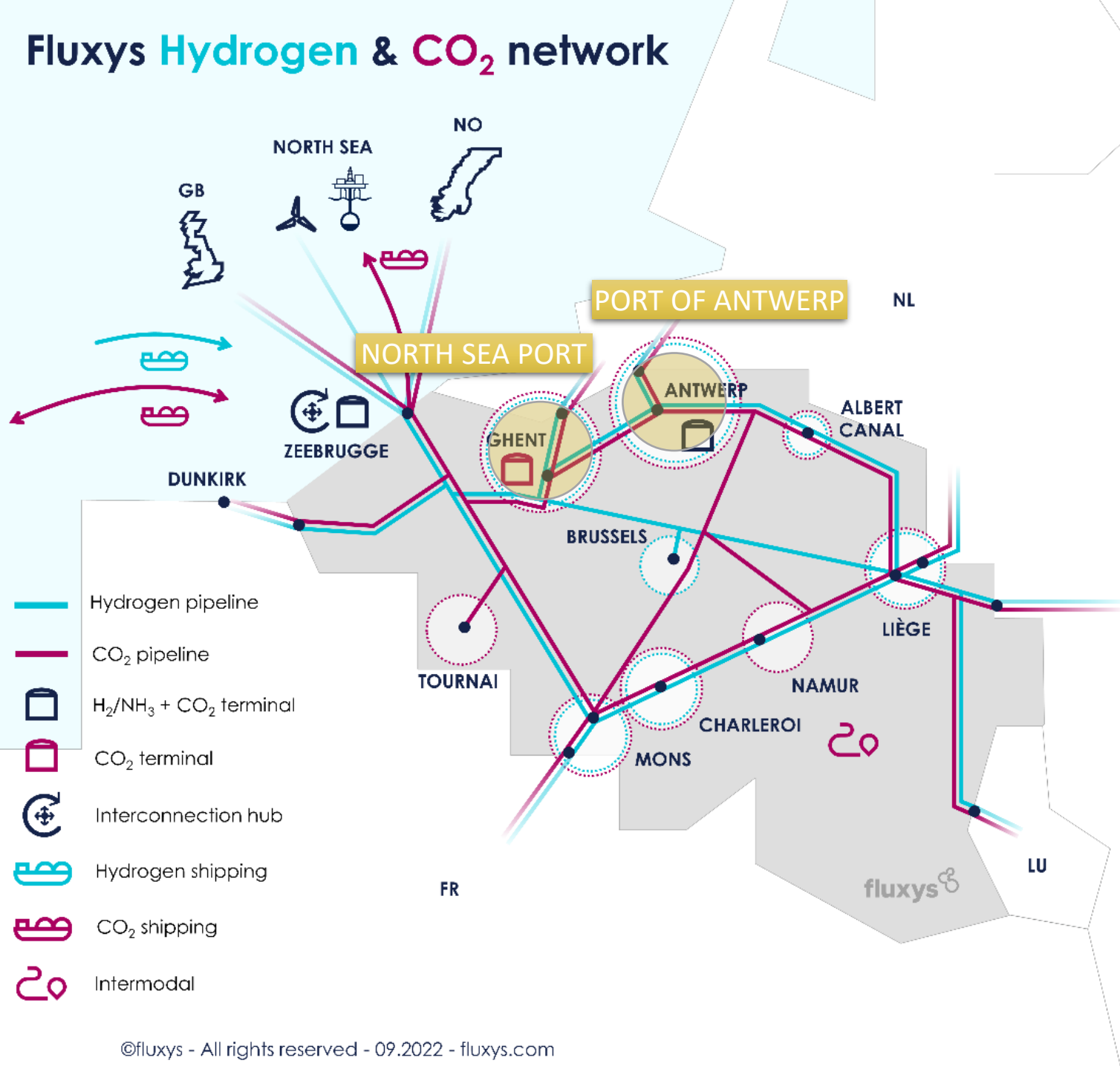
Start-up of the Ammonia Cracking Industrial scale pilot plant



End 2024

Ready to offer commercial scale Ammonia Cracking plants

Fluxys Hydrogen & CO₂ network



Sweco studies 70 km of hydrogen pipelines in Flemish ports for Fluxys Belgium

- Construction and conversion of a *Hydrogen Highway* in Belgium, open access
- Decarbonisation of hard to electrify industry
- Interconnection with neighbour countries
- Importance of European hubs in energy transition
- Main challenges design
 - Complex underground area, big diameters
 - Synergy with other infrastructure works
 - Many stakeholders
 - Market capacity material and execution

A front-facing view of the Airbus ZEROE hydrogen-powered aircraft in flight. The aircraft is white with blue accents and features the 'AIRBUS ZEROE' logo on the upper fuselage. It has a unique design with two large, circular engine nacelles mounted on the upper fuselage and two smaller, rectangular ones on the lower fuselage. The aircraft is flying above a layer of white clouds against a clear blue sky.

Hydrogen Powered Aviation

Agoria FLAG – WaterstofNet Working Group on Aviation
WIC Meeting 08/06/2023

1. Decarbonization of Aviation

.AGORIA

FLAG
FLEMISH AEROSPACE GROUP

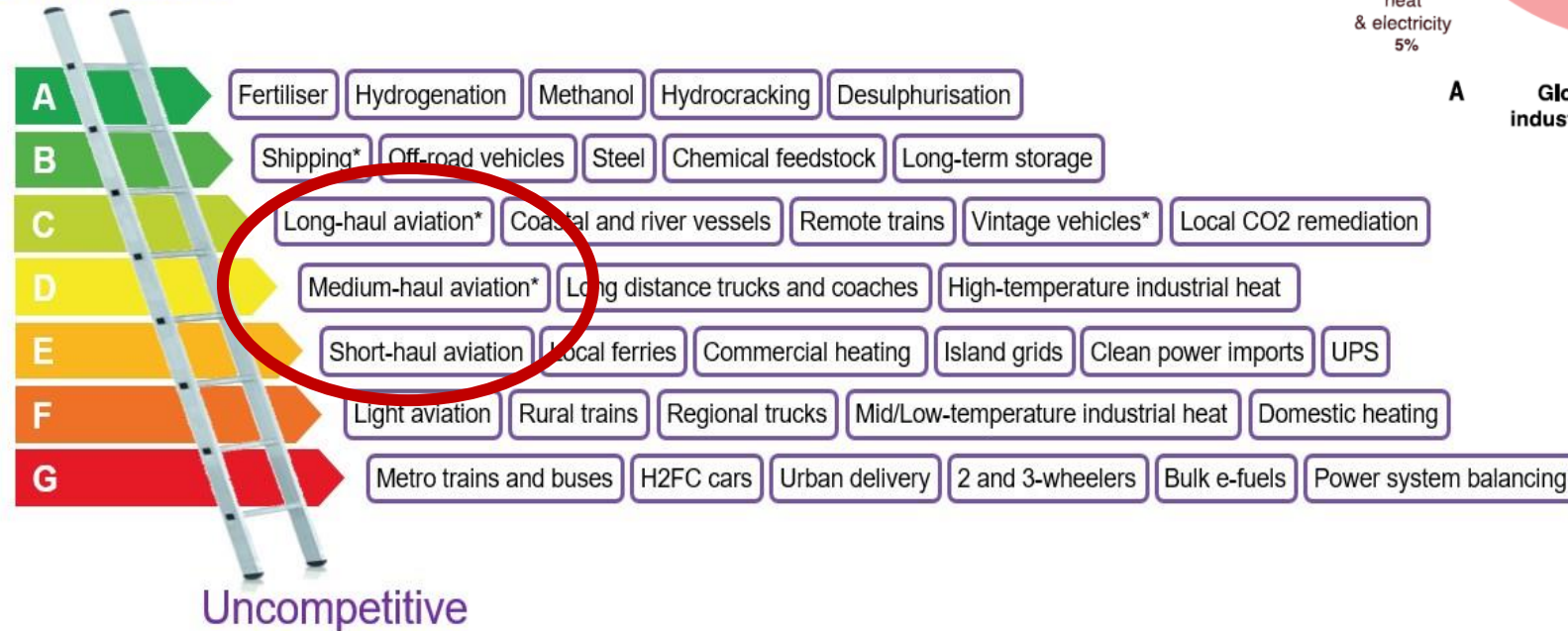


**von KARMAN INSTITUTE
FOR FLUID DYNAMICS**

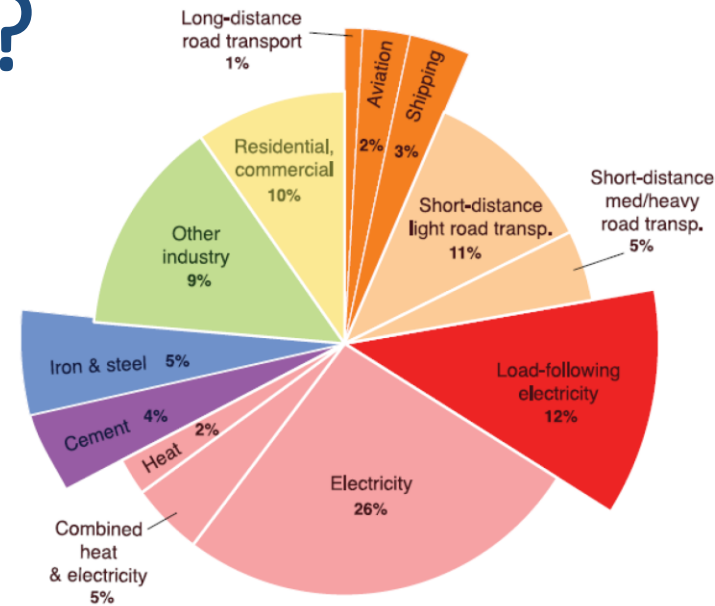
Decarbonising Aviation: why?

- 2% contribution to global CO₂ emission
- Generally considered as a hard-to-abate application

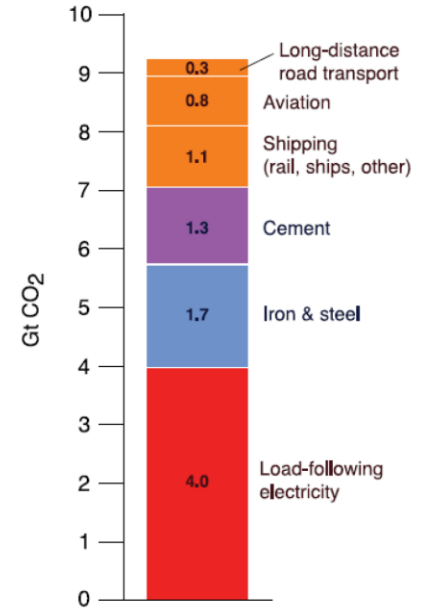
Unavoidable



* Via ammonia or e-fuel rather than H₂ gas or liquid



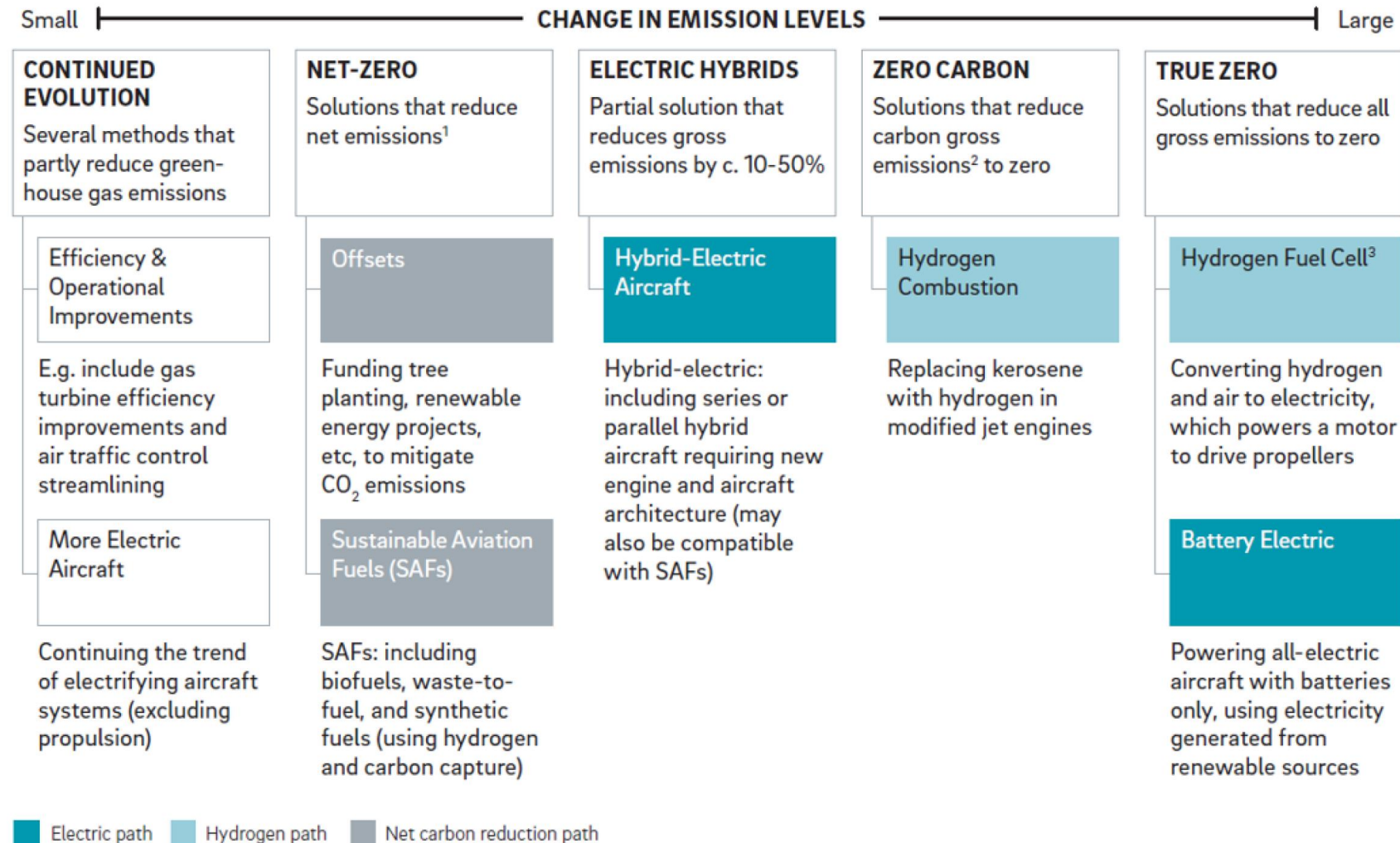
A Global fossil fuel & industry emissions, 2014 (33.9 Gt CO₂)



B Difficult-to-eliminate emissions, 2014 (9.2 Gt CO₂)

Source: Liebreich Associates (concept credit: Adrian Hiel/Energy Cities)

Decarbonising Aviation: how?

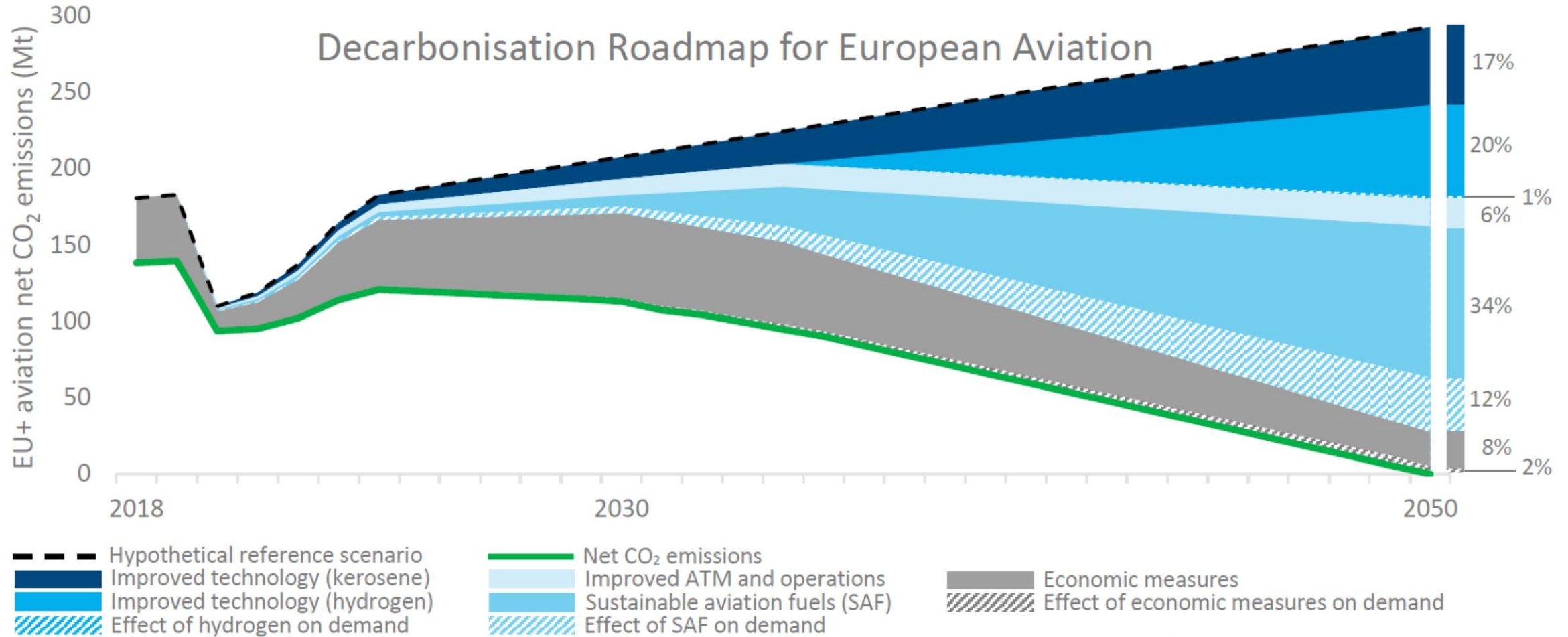


¹ Net emissions = Gross emissions produced by an entity minus any carbon sinks attributed to that entity; ² Gross emissions = The actual emissions produced by an entity;

³ True zero only if hydrogen is produced from zero carbon sources and if the aircraft is operated appropriately.

Source: Roland Berger

Decarbonising Aviation: the role of Hydrogen



2. Challenges?

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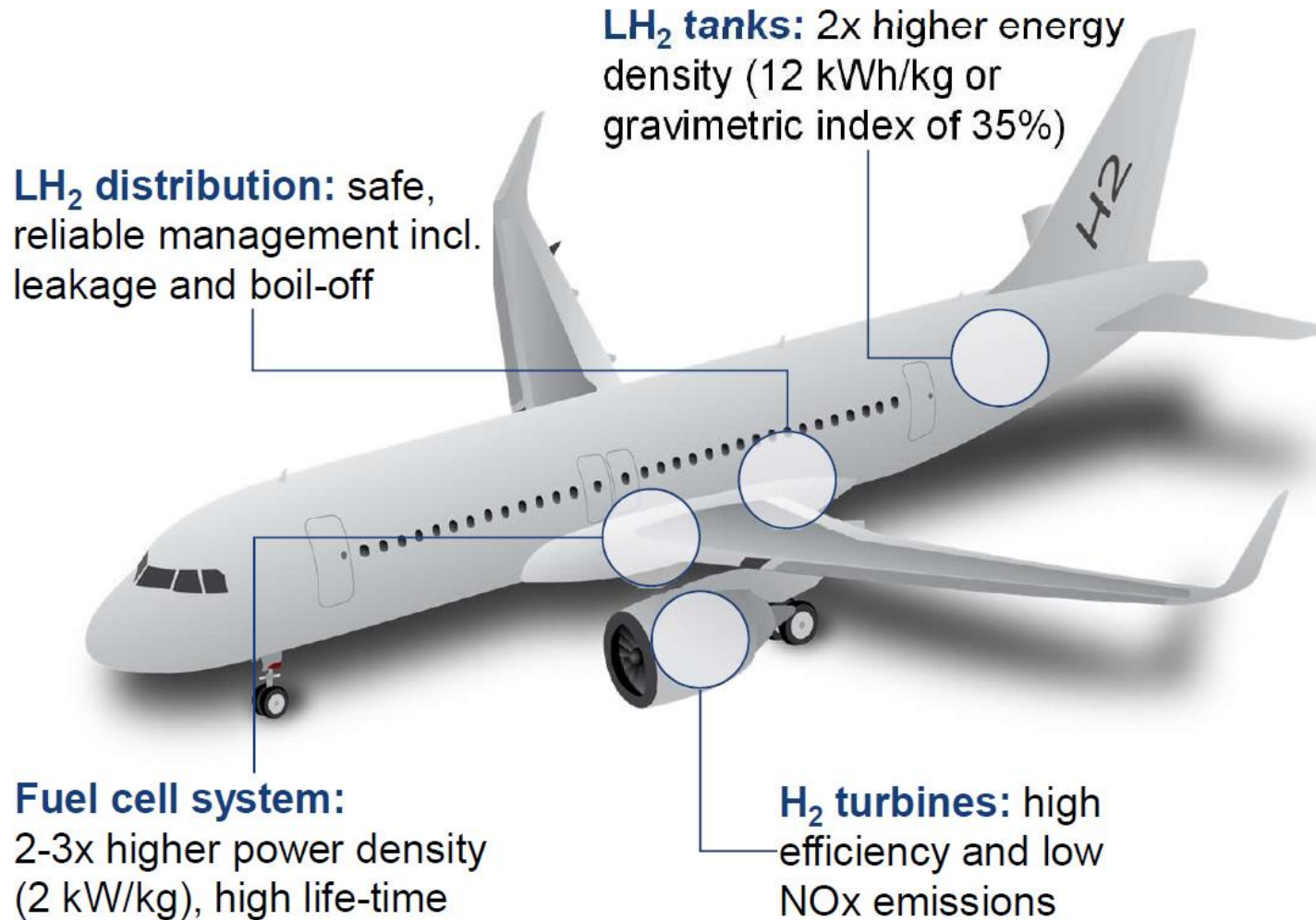


**von KARMAN INSTITUTE
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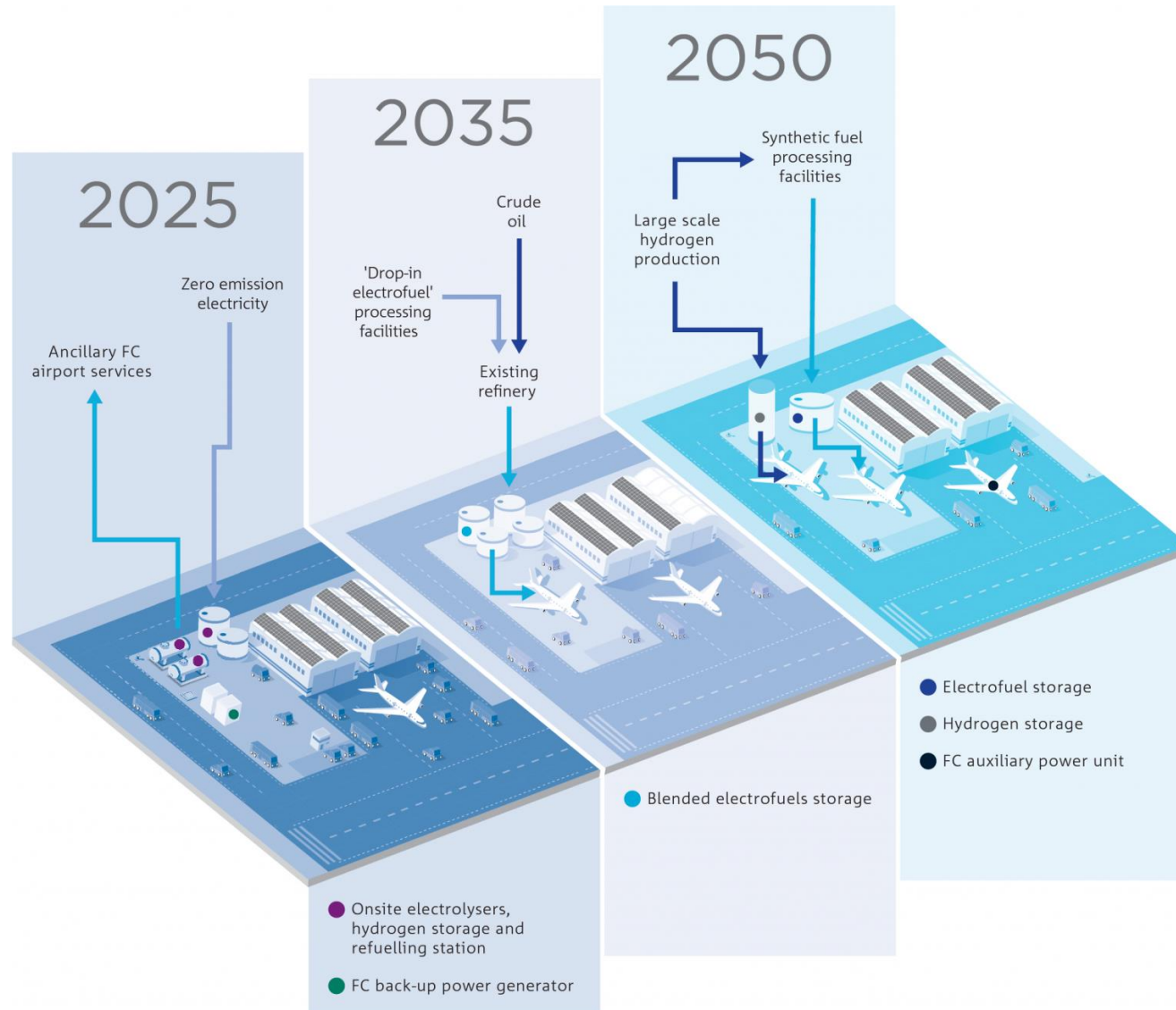
Required Aircraft Modifications

TIMEFRAME 2035

EXEMPLARY PICTURE



Supply Chain: Development and upscaling



- Short term: on-site H2 production; compressed H2; swappable fuel tanks
- Mid term: scaling up SAF supply
- Long term: H2 supply by pipeline; on-site liquefaction; efficient refueling systems (via hydrant?)

Refueling Infrastructure for Aviation: 3 major challenges

Can be accommodated in prevailing infrastructure

Updates of infrastructure / operations required

Full overhaul of infrastructure / operations required

Until 2040 (hydrogen 15% of fleet)

From 2040 to 2050 (hydrogen 40% of fleet)



1 H₂ production and distribution for aviation

5% of global hydrogen demand
Can be served with LH₂ trucks from central production sites or on-site

10% of global hydrogen demand
At-scale distribution requires pipelines to airport



2 Required LH₂ airport infrastructure

Centralized liquefaction (unless on-site production)
Truck-based refueling
No major infrastructure updates

Onsite liquefaction
At-scale refueling systems
Larger gate sizes and on-ground traffic changes



3 Refueling times

Within usual turnaround times for shorter range flights
New safety regulations required for parallel operations

Extends beyond usual turnaround times for longer range flights¹

No insurmountable roadblocks in early ramp-up years

Significant but manageable challenges in scale-up years

1. Considering similar flow rates like kerosene and double the amount of refuelling points

3. Joint Working Group: H2 in Aviation

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FOR FLUID DYNAMICS**



Joint Working Group: H2 in Aviation

- Joint initiative Agoria FLAG + WaterstofNet, exploiting complementarities in knowledge and ecosystems



- Aviation market knowledge
- Aviation technology knowledge
- Flight segment knowledge

- Hydrogen market knowledge
- Hydrogen technology knowledge
- Supply chain knowledge

Joint Working Group: H2 in Aviation → Topics

- Flight Segment
 - LH2 fuel tank
 - Combustion engine
 - Fuel Cells
 - Propellant Management systems (pipes, valves, heat exchanger, pumps...)
- Supply Chain -> how to bring H2 to the aircraft?
 - Production
 - Liquefaction
 - refueling
- Ground Segment -> hard to abate ground support vehicles
 - Tow trucks
 - Crash tenders
 - ...



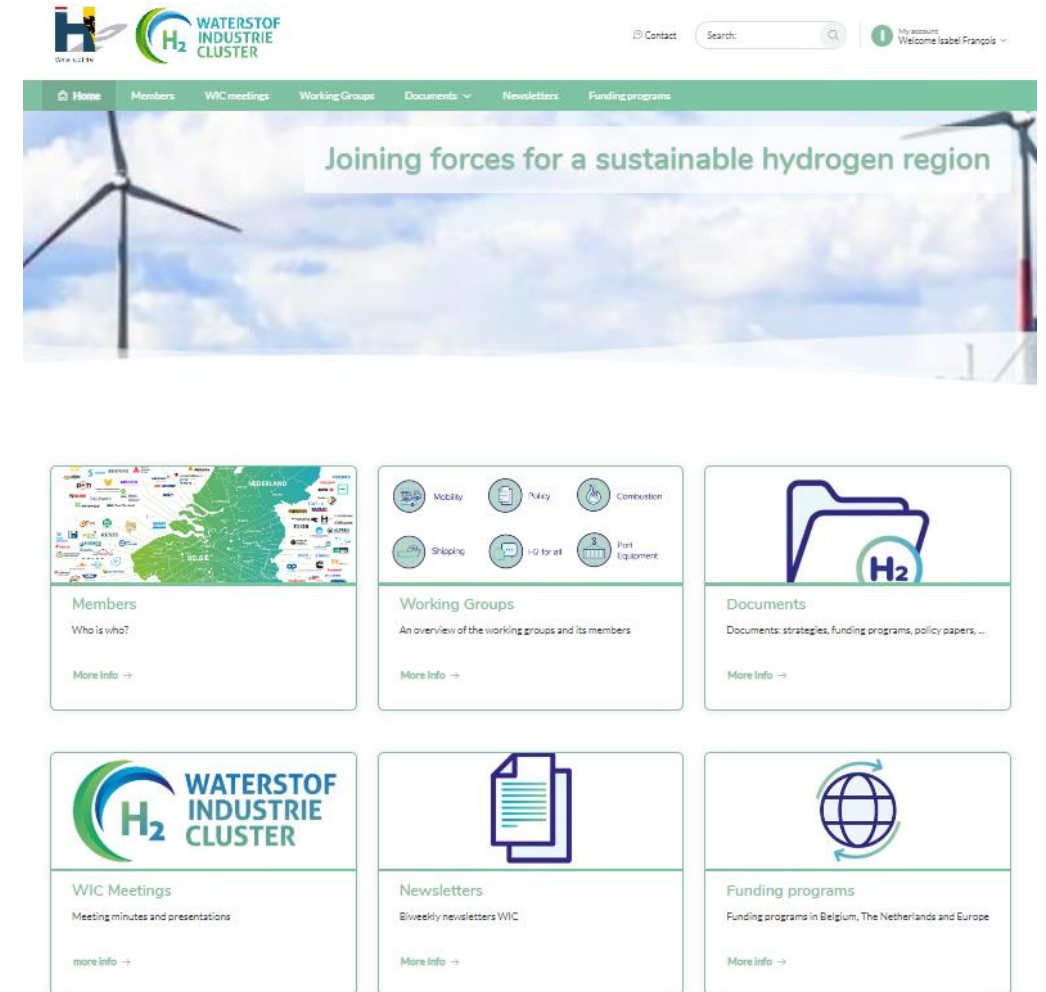
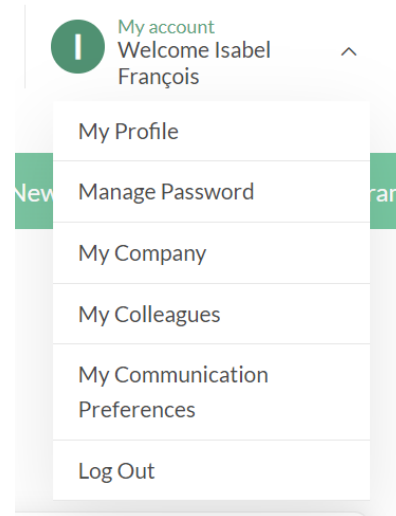
WN/WIC News

WIC PORTAL

All members have received a mail to register:

- Create your login
- Every member can modify its company data, categories and add colleagues.
- A company presentation can be added

Feedback is welcome!



Possibility to add company presentation

Accelera

Technology, Production H2, Manufacturing & production

✉ Contact →

Address

Nijverheidsstraat 48c
BE 2260 Oevel

📍 Open location →

Website



🌐 <https://www.cummins.com/?locset=gb>

Documents

↓ [2023Q2_Accelera by Cummins_Electrolyzer Business.pdf](#)



Manage Company Information

	Address	Emailaddress	Fixed	Mobile	Edit
WaterstofNet	Open Manufacturing Campus, Slachthuisstraat 112 bus 1, 2300 TURNHOUT	info@waterstofnet.eu	+3214 40 12 19		 

About

B → I → U → S →

≡ → ≡ → ↶ → ↷ →

Mission

WaterstofNet is a knowledge and collaboration platform. We aim to contribute to a carbon-neutral society by supporting and realising hydrogen projects in Flanders and the Netherlands. Together with the industrial sector and the government, we enable concrete achievements in the field, laying the basis for further collaboration. By doing so, we assist in the further development of Flanders and the Netherlands as leaders in hydrogen.

Vision

Sustainable hydrogen will play a key role in the decarbonisation of our community. It can contribute to zero-emission transport and function as a sustainable raw material for industry, as a means of energy storage and a carbon-free source for heat.


Flanders and the Netherlands host a unique value chain of companies and research institutes that are active in the field of hydrogen. As a knowledge and collaboration platform, WaterstofNet acts as a catalyst for this ecosystem in the further realisation of a hydrogen economy.

Bank account

IBAN

Invoicing email address

Logo



logoWN web.JPG (40 kB)

×

Bestand kiezen

Geen bestand gekozen

File upload

1_Membership Waterstof Industrie Cluster_sept2022.pdf

(1,061 kB)

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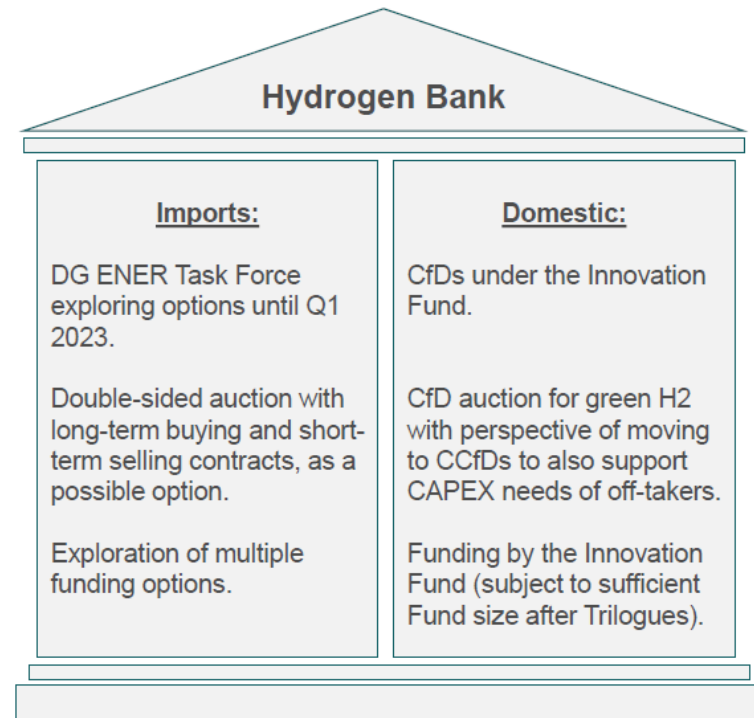
Bestand kiezen

Geen bestand gekozen

← Company description

← Option to add Company presentation

- Hydrogen bank
 - **Domestic pillar** → 3 BLN from the innovation fund, approx. 800 million for this year, managed by DG CLIMA
 - **International pillar** → DG ENER



- CfDs for Hydrogen production under the Innovation Fund at this point the most likely implementation option for the domestic leg of the H2 Bank.
- Creating a domestic market and price discovery has other requirements than securing diversified imports of H2 (derivatives) from abroad.



- A [stakeholder consultation on the draft Terms and Conditions](#) of the H2 Bank was open until May 11
- Workshop hosted by the Commission on May 16
- For domestic production, the H2 Bank proposes a single auction providing a fixed ten-year premium of **€4/kg** of hydrogen, covering CAPEX, OPEX and transport costs
- Funded under the Innovation Fund (€800 million)
- The final Terms and Conditions are expected to be published by the end of summer and the pilot auction is to be launched in December.



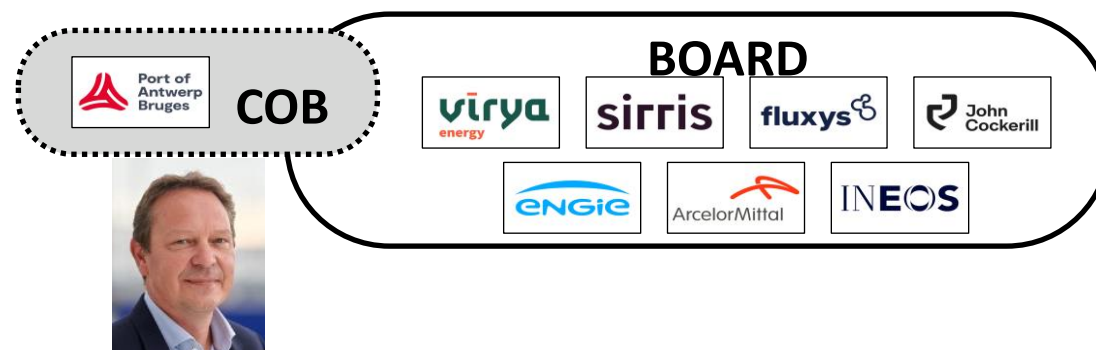
- European Hydrogen Bank will be linked with Germany's H2Global support scheme
 - H2Global will be open to all EU Member States interested in running their own hydrogen tenders
 - The Bank and the German initiative will also jointly develop a European auction targeting international hydrogen imports.
- Announced on 31 May by European Commissioner for Energy Kadri Simson and German Federal Minister for Economic Affairs Robert Habeck

- Political agreement reached on 27/03/23
- A Hydrogen Refuelling Station should be deployed
 - Every 200 km on the TEN-T core network by 2030
 - In every “urban node”
- The HRS should have a daily capacity of 1 ton H₂, provide 700 bar and 350 bar dispensing and be public
- Each Member State should have a HRS deployment plan by 2027

	HRS in Urban Nodes Ten-T	HRS on TEN-T core Network every 200 km	Total
Belgium	11	4	15
Netherlands	24	3	27
Luxembourg	1	1	2

Belgian Hydrogen Council

- ✓ Board elected and president chosen (Dec 2022)



- ✓ 2nd round of task meetings finished (May 2023)
- ✓ Newsletter with updates will be distributed in Next week

NLHydrogen launched

- Independent sector organisation, replacing H2 Platform
- Official kick-off on May 25
- Director Alice Krekt (former DeltaLinqs)
- Policy Officer: Joyce Coninx (former employee of BE FPS economy..)
- 20 members (at the start)
- 5 board members (engaged for 3-4 years)
- Topics:
 - Use of H₂,
 - Sustainable production & import,
 - System & infrastructure
 - Safety
- <https://nlhydrogen.nl/>

Lancering Branchevereniging NLHydrogen



Background:

- May 2021: Start of collaboration to get the Flemish Ports on the www.h2v.eu map as a hydrogen valley
- October 2022: “Flemish Hydrogen Ports Valley” officially online on <https://h2v.eu/hydrogen-valleys/flemish-hydrogen-ports-valley>
- 17 January 2023: Clean Hydrogen Partnership call for large and small scale hydrogen valleys opened
- 18 april 2023: Submission deadline
- Evaluation outcome to be published in July 2023

Main project developer and contact person:

Davine Janssen

davine.janssen@waterstofnet.eu

CHP large-scale H2 valley call requirements:

- Produce at least **4,000 tonnes of clean hydrogen per year** using new hydrogen production capacity.
- At least **two hydrogen applications** from at least **two different sectors** should be part of the project, with a clear focus on **energy, industry and transport** sectors.
- Total available subsidy: 20 €MLN

Main project developer and contact person:

Davine Janssen

davine.janssen@waterstofnet.eu

The FLHyPorts' proposal:

- Objective: **Activating a long-lasting hydrogen economy within and beyond the Flemish sea ports through the development of a highly visible large-scale Hydrogen Valley**
- Timeline: 2024-2029
- Contains hydrogen production, transport and end-use as well as monitoring, international replication and public outreach/skills
- Partners from four member states



WORKING GROUPS WIC

Mobility



Policy



Combustion



Shipping

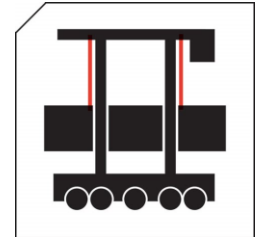


(coll. With De Blauwe Cluster)

H₂ for all



Port equipment



Permitting





- Next workgroup shipping : 20/06 in Nieuwpoort
 - Status of Condor project
 - Status of Metag and Hydrotug
 - H2Stroom project
 - Sailing with Candela (hydrofoiling vessel)
- Green deal inland navigation (Vlaamse Waterweg) !



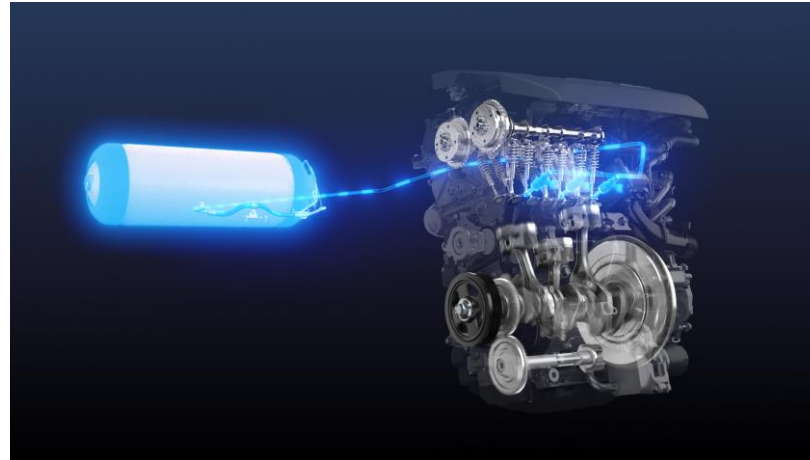
WG PORT EQUIPMENT



- First Straddle Carrier on hydrogen : 30/03/23
 - PSA
 - ATS
 - CMB Tech
- ATS : One of the submitted projects in Flhyports
 - Different types of equipment
 - Different technologies
 - Link with tanktainer project (Naval Inland Navigation)



- Position paper ready for feedback
- Roll out (communication)
 - Meeting on 16/06
 - WG finalised



1. H2 Roadmaps for BeNeLux

- Define H2 mobility roadmap for Belgium based on WIC targets (in Draft)
- Next steps => conclude and discuss with stakeholders (Be-> NL -> Lux)

2. Monitoring, exchanging “data and experiences” of HRS and FCEV

- Station openings NL
- Station openings Belgium upcoming
- BMW IX5 Hydrogen in BE and NL
- (BE nr#2 market for BMW company cars => 2026 important year)

3. Short, uniform and transparent approach of opening an HRS

- Process to opening of HRS on hold

4. Increase utilisation HRS

- Mobilise WIC members and other networks for end-users
- Mobilise operators for captive fleets (authorities, public transportation, lease companies, taxi companies, ...)
- “Concrete” case for HRS Wilrijk and HRS Breda
- ALD information package for fleetmanagers incl. Masterclas for increase nr# of cars at BE stations
- Vollenhoven request for the same at NL stations.

5. Communication and lobby

- Sector point of view H2 mobility projects (roadmap/policy paper H2Mobility, also for AFIR national plan)
- Joined lobby with authorities (visits with Flemish government for permitting and “doelregelgeving”)



Evaluation & statements
Related to EU or national legislation

- BE Interregional meeting on certification (04/05)
 - ✓ Position paper certification Q4 2022
 - ✓ Mandate from federal and Flemish governments to take action
 - ✓ Interregional meeting on certification with representatives from administrations and regulators at every level
 - ✓ Next: write detailed proposal on centralisation of the Belgian certification system
- Next steps
 - ✓ Certification proposal
 - ✓ Memorandum to prepare 2024 elections
 - ✓ Close follow up on EU Hydrogen bank
- WIC policy Meetings
 - ✓ Call for more NL members
 - ✓ Act in Benelux context

EU

- Innovation Fund third call for small scale projects, **deadline 19 September 2023** ([more info](#))
- CEF Energy Call for Energy Infrastructure Projects, **deadline 5 September 2023** ([more info](#)) & recording of the info day can be found [here](#)!
- LIFE CET call for clean energy transition, **deadline 16 November 2023** ([more info](#))
- CEF Transport Alternative Fuels Infrastructure Facility call for proposal, **2 deadlines on 13 April 2023, 17:00 (CEST) and on 19 September 2023, 17:00 (CEST)** ([more info](#))

NL

- Market consultation for new subsidy for the hydrogen manufacturing industry: production lines and factory environments → **please use this [link](#) before June 20th** to participate in the consultation

UPCOMING EVENTS

- New **WIC meetings** 2023
 - WIC meeting 3: Thursday 21 sept @ Atlas Copco**
 - WIC meeting 4: Thursday 7 dec @ Cummins**
 - **WIC/BHC conference** October 16, 2023 in Brussels
 - **WIC visit NRW** (pre-visit WaterstofNet and FIT in June, WIC visit postponed to autumn)
 - **Meet & Greet:** next edition in November
 - **Webinars:** if topics are proposed we organise!
 - **Thematic workshops** to be planned in autumn, input for topics is welcome
-

**The search for skilled
people...**

- Huge training needs for engineers, technicians, public bodies !!
- Different steps
 - **Phase 1** : interviews (what is existing + future ambitions)
 - Universities
 - High schools
 - Secondary schools
 - Adult education
 - Public bodies
 - **Phase 2** : analyses of shortages
 - **Phase 3** : common plan for new training/education
 - **Phase 4** : broad communication



- +/- 30 training courses inventorised
- Interviews done with
 - Secondary schools
 - 'Hogescholen'
 - Universities
 - Professional training institutes
 - Fire department



- H₂ training is given on all levels
- Mostly scattered in different courses
- Almost no dedicated courses for H₂
- Few hands on training
- Lack of students !!
- No dedicated course at bachelor level
 - Do we need this?
- No dedicated course at master level
 - Do we need this?



- Dedicated course at postgraduate level
- Dedicated course at technician level
 - Only for automotive !!
- Hardly anything at technician level besides automotive
 - Nothing in secondary schools
 - Very little in 'hogescholen'
- Willingness to start trainings is great IF students will come



POLL

- [Slido.com](https://www.slido.com) with #2767895
- Password for WIFI: 3256720846



EDUCATION & TRAINING TECHNICAL WORKFORCE ON H₂

- What level is most urgently needed?
 - Master
 - Bachelor
 - Technician
- How specific are your training needs ?
 - Specific hydrogen education
 - General technical education
 - Training on the job
 - Safety training
- Is certification an absolute requirement?
 - Yes
 - No
- How many (H₂)-skilled people do you expect to engage the coming 5 years?
 - 0-5
 - 5-20
 - >20
- For which type of employees do you have your biggest training need?
 - Newcomers
 - existing workforce (re-skilling)
 - existing workforce (up-skilling)
- What is the most important topic for your training needs?
 - Cloud overview
- Would you like to engage in more detailed search for the industrial H₂ education needs (name + company)?
 - Cloud overview





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A leading European PVC and chlor-alkali company



Strong regional presence

Production network of 6 manufacturing sites, strategically located in key European markets.



Committed employees

1,265 employees in manufacturing, supply chain, sales & marketing and support services.



Broad product range

Product portfolio that includes PVC, KOH and other potassium derivatives, NaOH and sodium hypochlorite.



Solid financial performance

Founded in 2015, we have grown to generate sales of 830 million euros. Our profitability enables us to pursue ambitious growth opportunities.



Main product groups



PVC



Caustic Soda



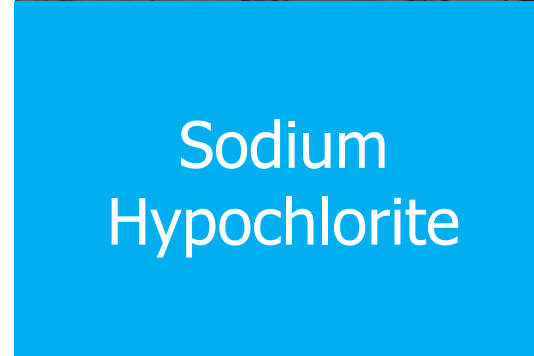
Potassium
Derivatives



Vinyl
Intermediates



Hydrochloric
Acid



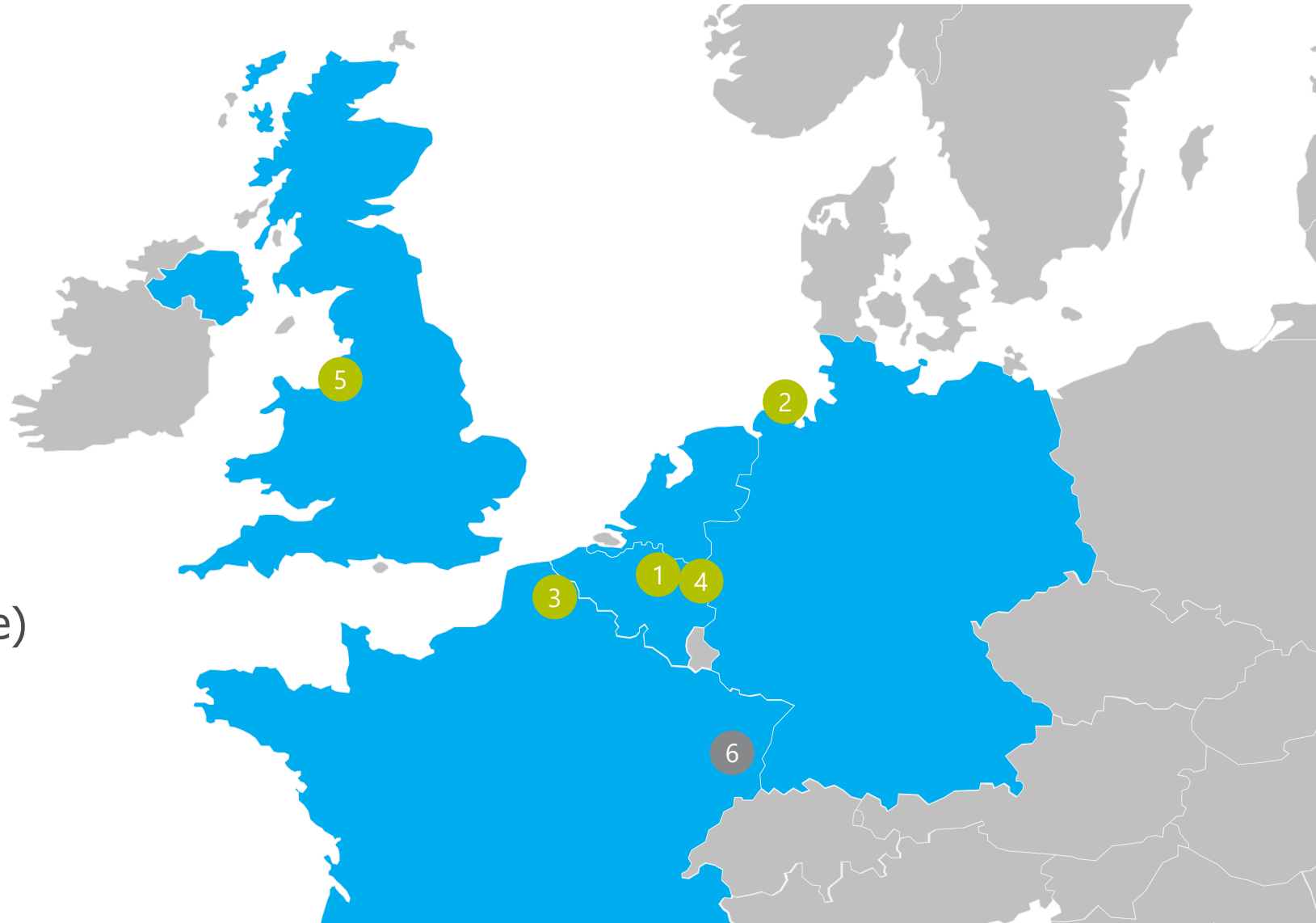
Sodium
Hypochlorite



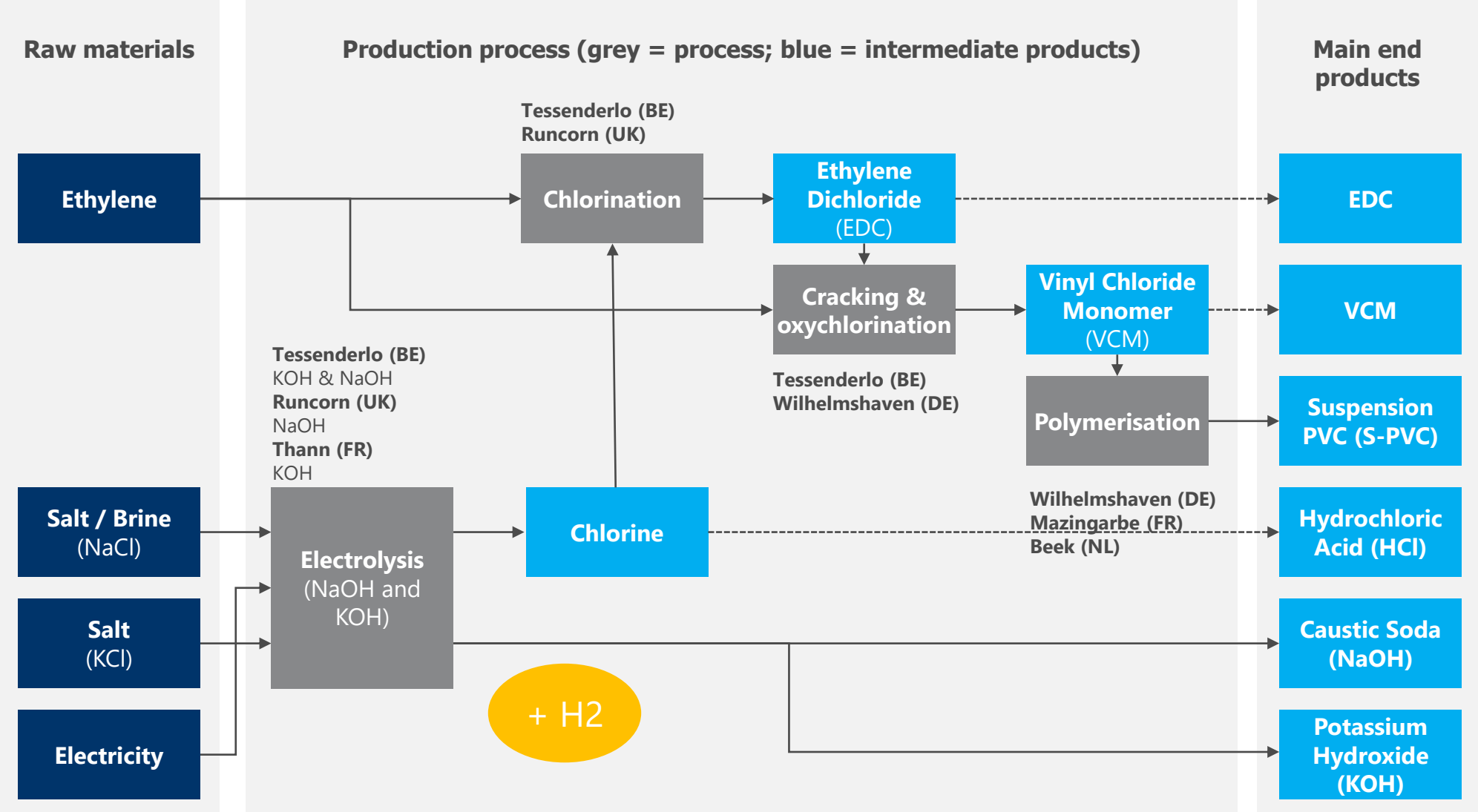
Production network in five countries



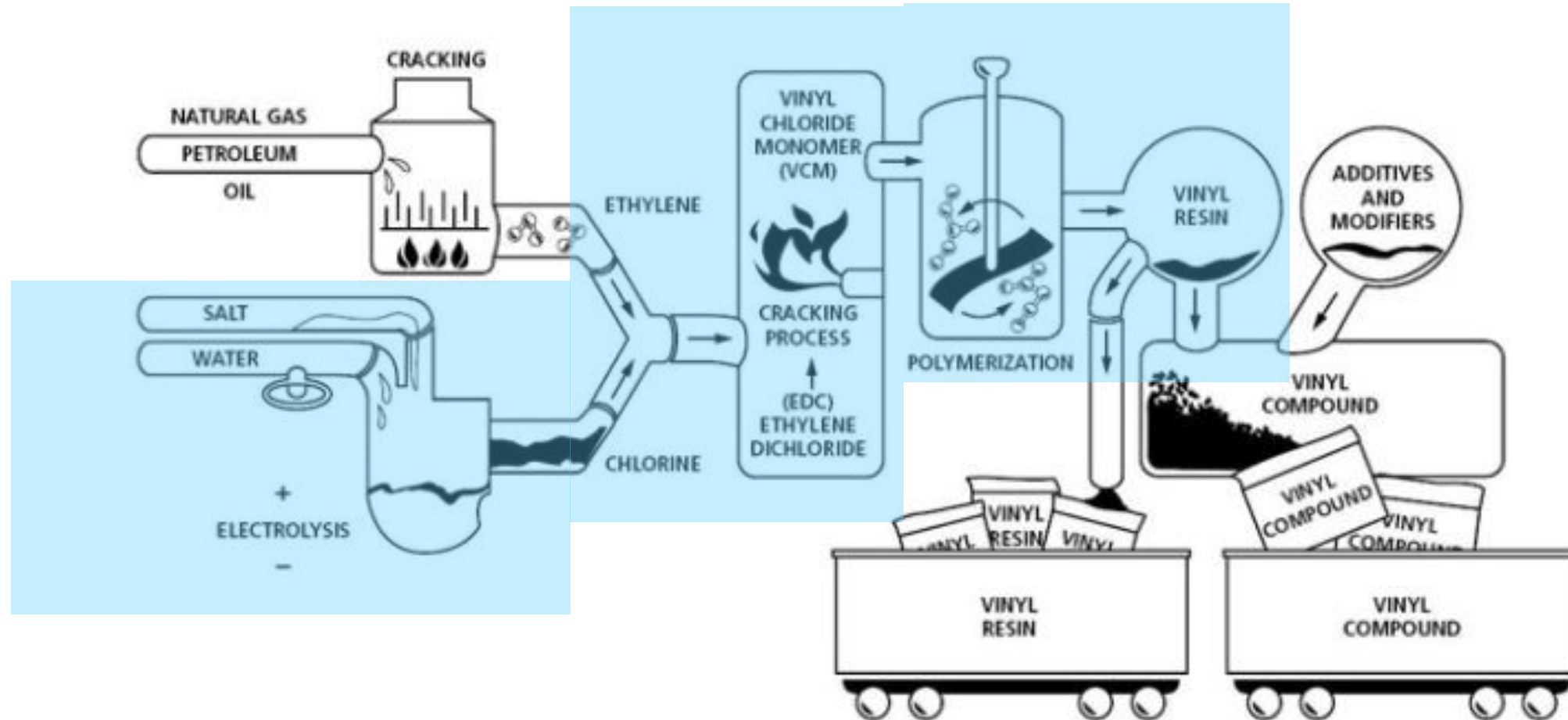
- ① Tessenderlo - Belgium
- ② Wilhelmshaven - Germany
- ③ Mazingarbe - France
- ④ Beek - Netherlands
- ⑤ Runcorn - UK
- ⑥ Thann - France (affiliated site)



Interconnected value chain



PVC & Vynova Value Chain

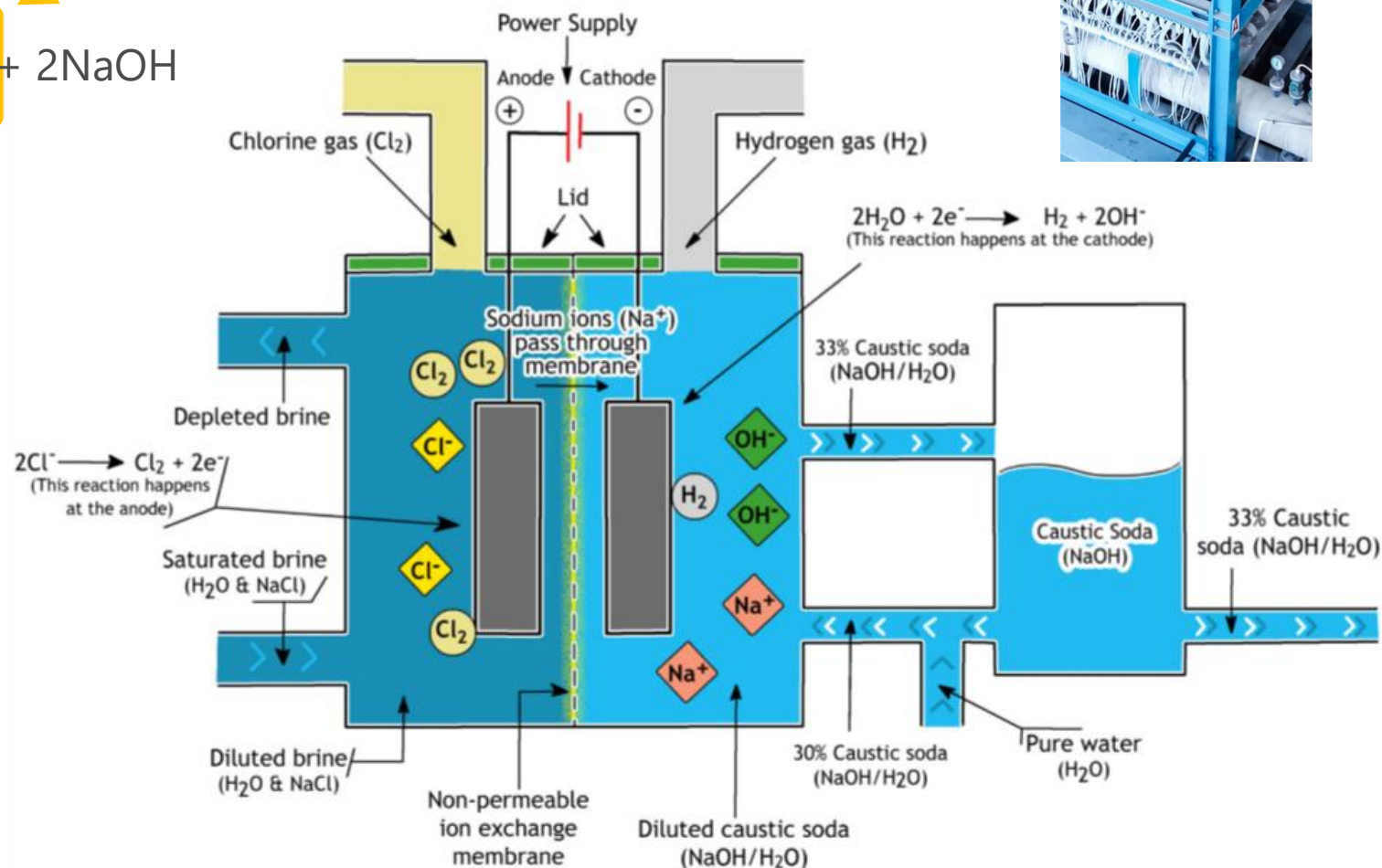
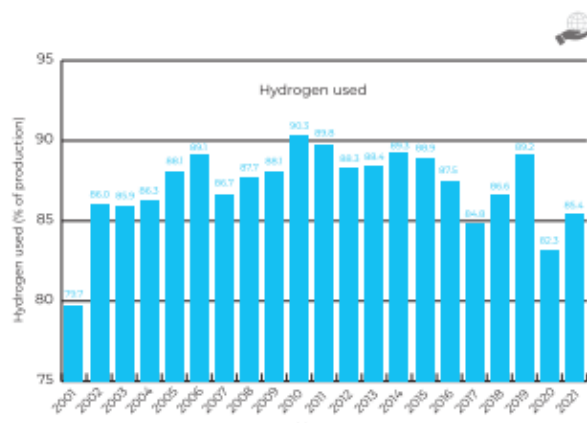


Membrane electrolysis



Eurochlor data :

- 9,5 mio ton chlorine/y in **Europe**
- 265,000 ton H₂ produced
- 2% of total produced H₂ in Europe
- Use 85-90%



Our sites: Tessenderlo - Belgium



- State-of-the-art membrane electrolysis plants for the production of chlorine (Cl_2), caustic soda (NaOH) and potassium hydroxide (KOH)
- Central location with excellent access to logistic facilities and export markets (close to Antwerp and Ruhr chemical clusters)
- Ca. 585 employees
- ISO 9001, ISO 14001 and ISO 50001 certified & ISO 17025 accredited

Products made on-site

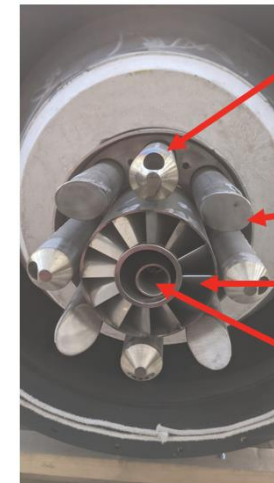


Vinyl Chloride Monomer (VCM), Ethylene Dichloride (EDC), Caustic Soda (NaOH), Potassium Hydroxide (KOH), Potassium Carbonate (K_2CO_3), Sodium Hypochlorite (NaOCl)

- Max H2 production on site : 11,250 ton/y
- Used as raw material and for steam production
- Reorganisation of site -> new H2 consumers required
- H2 excess – H2 vented to atmosphere -> action !!
- -> **new steam boiler with use of H2.**
- **Challenges :**
 - **maximum steam production on available plotspace -> 30 t/h**
 - **fuel : solo NG, solo H2 and as much of flexibility**
 - **fuel change over without stopping the burner**
 - **Nox < 80 mg/Nm³ @3 vol% O2 dry**
 - **Soundlevel < 80 dBA**
 - **operator/maintenance ergonomics**



Steam boiler - bifuel

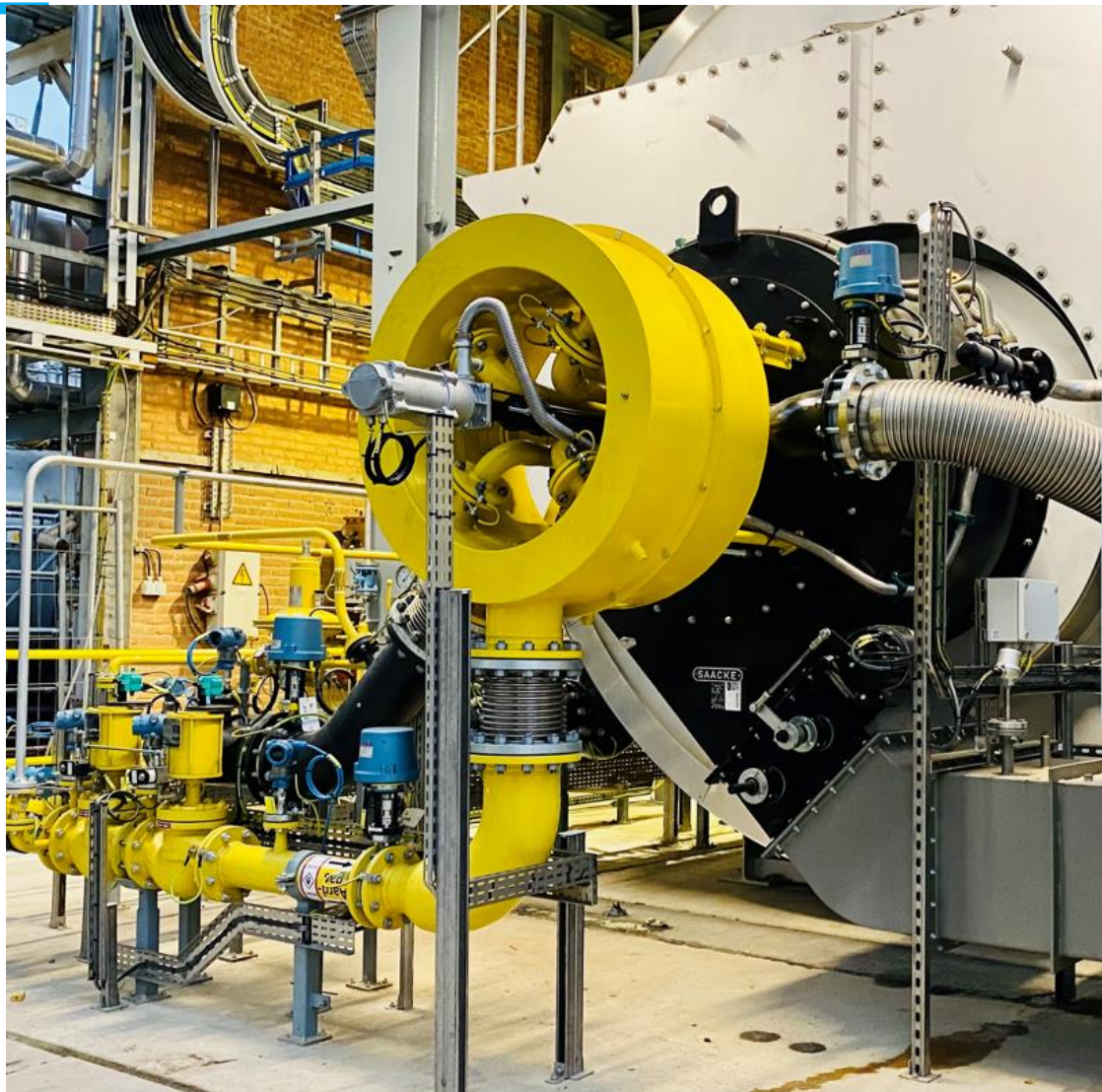


Aardgas (CH_4) - 4 lanzen

Waterstof (H_2) - 4 lanzen

Verbrandingslucht

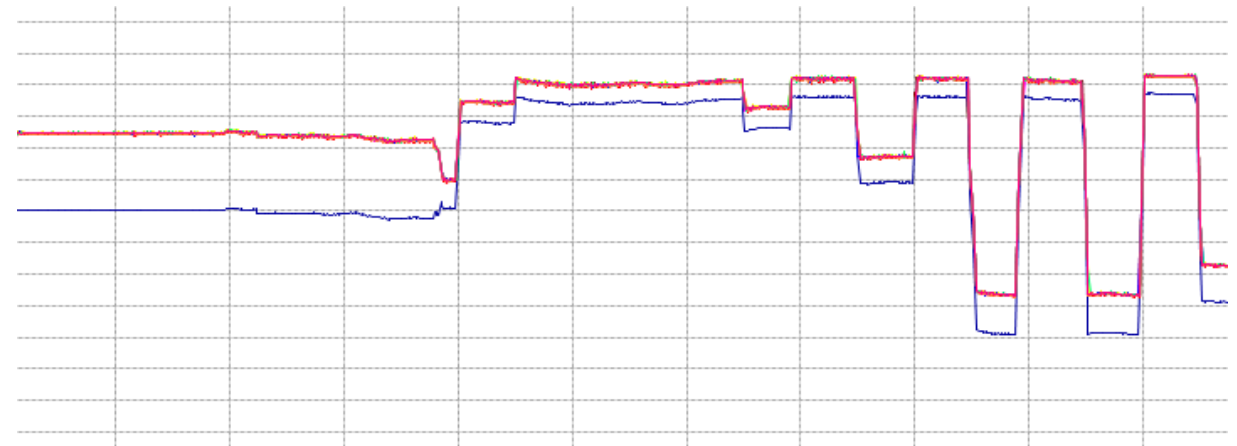
Piloot brander



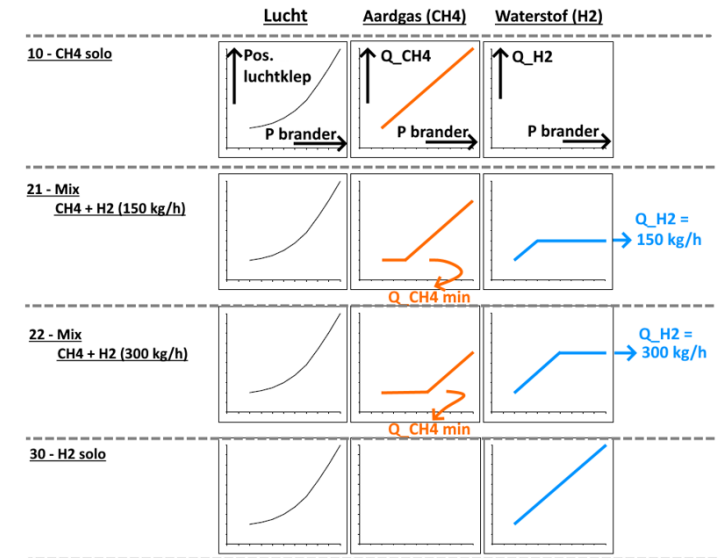
Tessenderlo specifics



- Low pressure H2 network (350 mbarg)
- Production : 2 electrolysis plants (NaOH and KOH)
- Consumers : 3 users, new Callens is 4th
- No gasbuffer – direct link between production and consumers
- No buffer ? Piping “creates” 75 m³ buffer and gasses are compressible ?
-> because of low pressure only **seconds** reaction time.
- Electrolysis requires a lot of electrical power.
-> opportunity in electricity purchasing leads to load shedding
- **Unbalance** between production and consumption requires bi-fuel burner



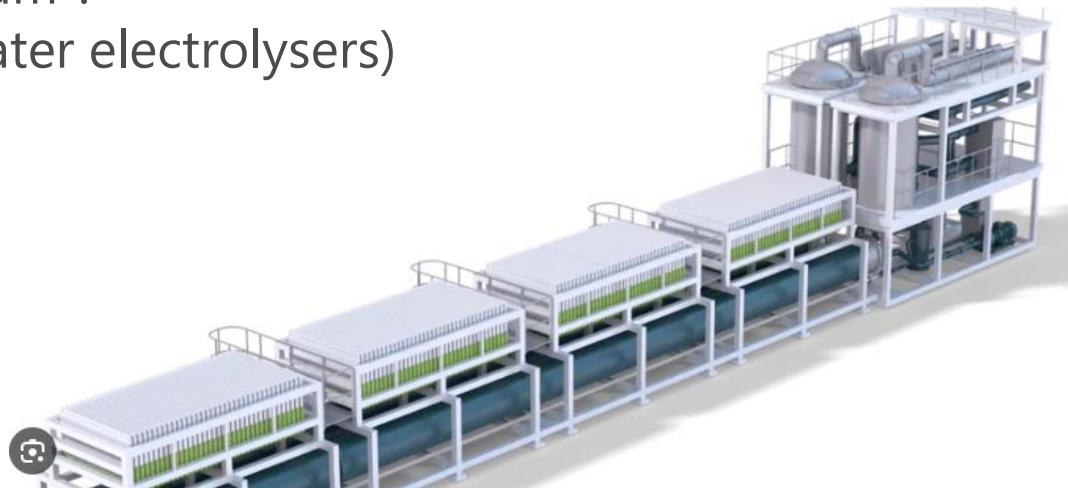
- **Bifuel**
- H2 and Natural gas
- Burner management
- Can run on H2 only, NG only, and fixed points on H2 flow inbetween
- Condensation issues in burner which is offline -> solved
- **Controls**
- Managing **Steam** pressure and **H2** pressure
- Changes in production / consumption
- 2 H2 producers and different H2 consumers -> balance



Decarbonisation ?



- Energy saving projects
- Using maximum of the produced H₂
(but other consumers as steam production because of energy saving projects, less steam required)
- **Next steps ?**
- Electrification where possible (heat pumps, electrical steam boiler,...)
- Replacement of NG by H₂ import
 - future of H₂ grid in Belgium ?
 - H₂ production on site (water electrolyzers)



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