Discussion - Green Hydrogen

MERITO
VLAANDEREN IN EUROPA

Welcome!

18.30	Open doors
19.00	Introduction by Ivan Van de Cloot
19.10	Samuele Furfari, (chemical engineer, PhD, VUB) on the hydrogen challenge
19.30	Floris Mackor (VP large industries Air Liquide) on hydrogen opportunities
19.50	Panel Discussion
20.15	Q&A
20.30	Reception
22.00	End

MERITO
VLAANDEREN IN EUROPA

Green Hydrogen

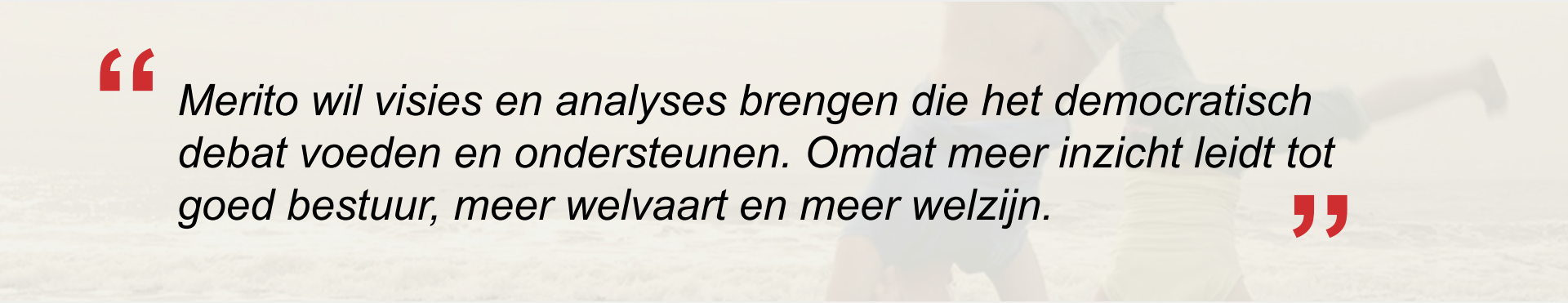
28th of January 2025, 19h - 22h
Stichting Merito - Domain Solhof

Green Hydrogen

Ivan Van de Cloot
CEO Stichting Merito

Stichting Merito

- Voor welvaart en welzijn
- Feiten en de realiteit doen ertoe
- Rentmeesterschap



“Merito wil visies en analyses brengen die het democratisch debat voeden en ondersteunen. Omdat meer inzicht leidt tot goed bestuur, meer welvaart en meer welzijn.”

MERITO
VLAANDEREN IN EUROPA

Memorandum
Hoe haalbaar is het klimaatbeleid
Event op 6 maart 2024

Het event op 6 maart '24 toonde Merito dat er wel degelijk redelijke meningsverschillen over klimaatbeleid bestaan. KUL-professor Gerard Govers bracht een visie die inging tegen het alarmisme en een pleidooi om haalbaarheid in het verhaal te brengen.

De Nederlandse deskundige Maarten van Andel bestreed de illusie dat we op 26 jaar tijd zomaar volledig kunnen omschakelen naar zonne-energie of ons viervoudige energieverbruik per wereldburger kunnen handhaven zonder fossiele brandstoffen. Van Andels had aanbevelingen inzake het remmen van ons energieverbruik, met goede technologie maar met name door ons eigen gedrag.

Eerder:

- Laten we ook onzekerheid erkennen waar die bestaat
- Wees eerlijk: klimaatbeleid kost veel.
- Er zijn heel zinvolle ingrepen mogelijk die ons energieverbruik doen halveren, met goede technologie en gedragsveranderingen.

Eerder (2):

- De markt en betaalbaarheid moeten criteria blijven voor efficiënt en innovatie. Duurzaamheid veronderstelt betaalbaarheid en beschikbaarheid.

- Wat we nodig hebben: oplossingen die verschillende doelstellingen verzoenen.

- NO REGRET maatregelen: die sowieso ook wijs zijn voor bv. leefmilieu, levenskwaliteit.

Green Hydrogen

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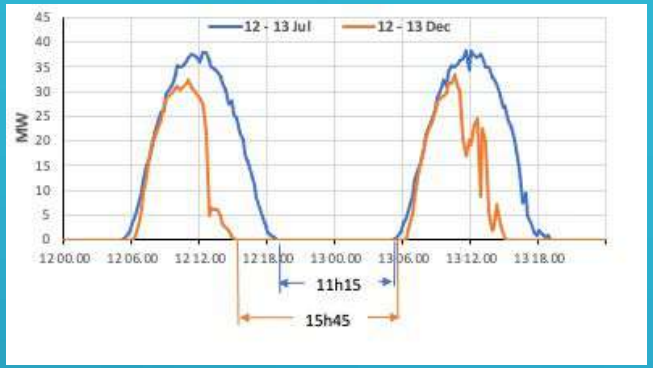
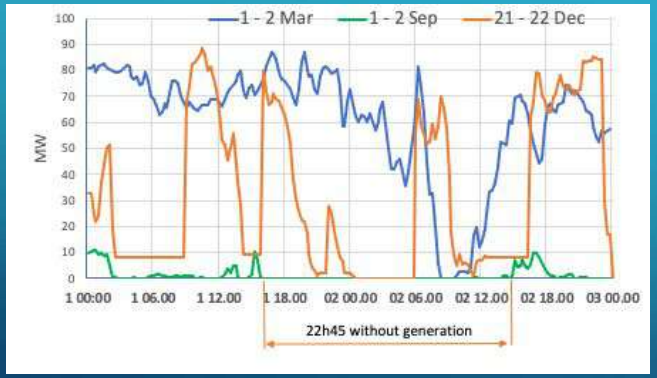
Samuele Furfari
Chemical engineer, PhD, VUB

SAMUEL FURFARI

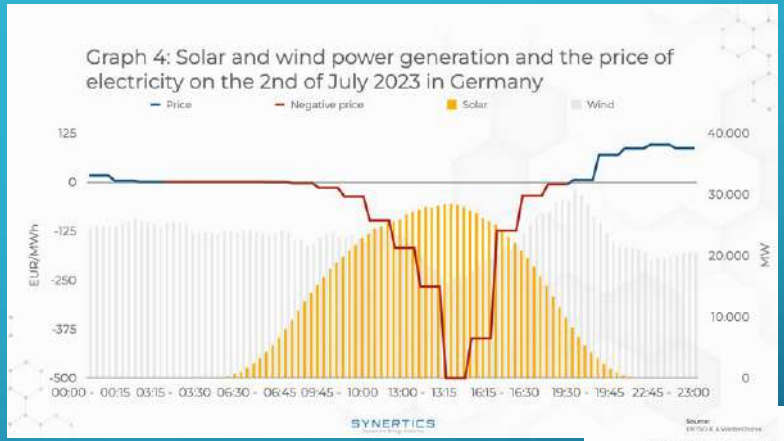
ULB ESCP EUROPE

Why hydrogen is pushed by Germany



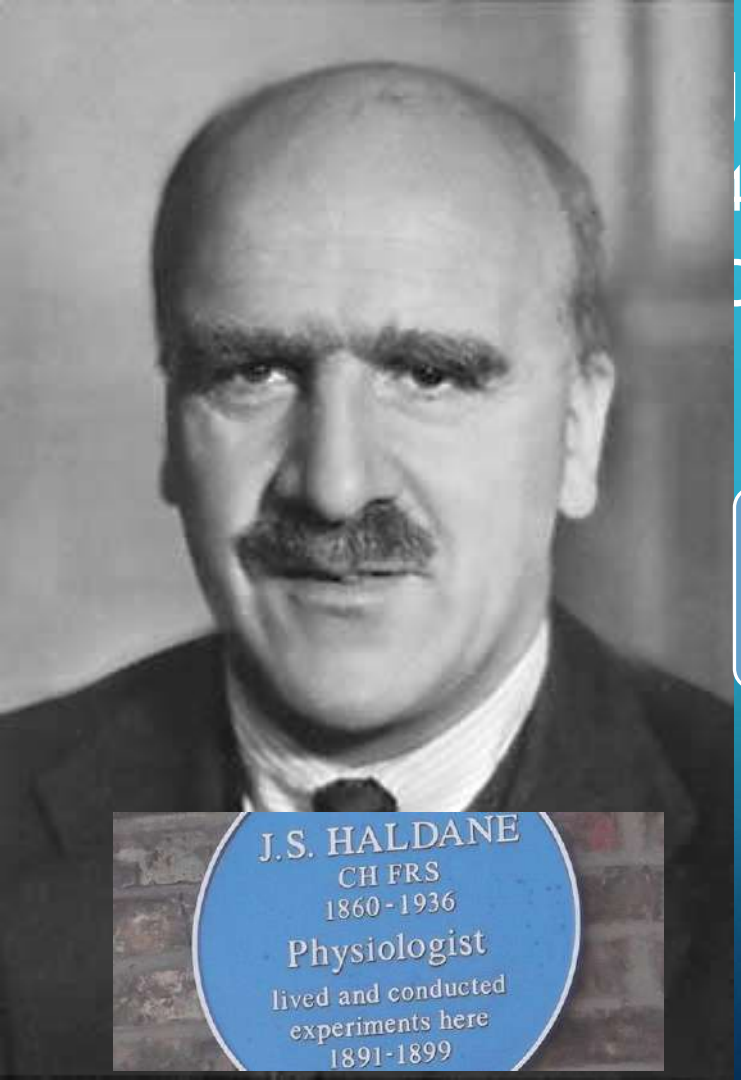


Average on 5 years	Wind	Solar
Load factor in the EU	**23 %**	**11 %**



S. Furfari, and A. Clerici, “Green hydrogen: the crucial performance of electrolysers fed by variable and intermittent renewable electricity,” Eur. Phys. J. Plus (2021) 136:509, Mai 2021

https://synertics.io/blog/126/why-is-germany-seeing-more-frequent-negative-electricity-prices



ohn Haldane

4 fév. 1923,

Cambridge Univ.

100 YEARS ANNIVERSARY

End of coal → Wind turbines → H_2

J.B.S. Haldane, in full **John Burdon Sanderson Haldane**, (born Nov. 5, 1892, Oxford, Oxfordshire, Eng.—died Dec. 1, 1964, Bhubaneswar, India), British geneticist, biometrician, physiologist, and popularizer of science who opened new paths of research in population genetics and evolution

The Nazis thought about H_2 too


Nationalsozialistische Bibliothek / Heft 38

Herausgeber: Gottfried Feder, M. d. R.

Technik und Wirtschaft im Dritten Reich

Ein Arbeitsbeschaffungsprogramm

Von

Dr.-Ing. Franz Lawaczeck

3. Auflage

Verlag Frz. Eher Nachf., G. m. b. H., München 2, NO.

- 1933
  Wind turbines but in "500 or 1000 years" … after the end of coal.
  But H_2 from hydroelectricity

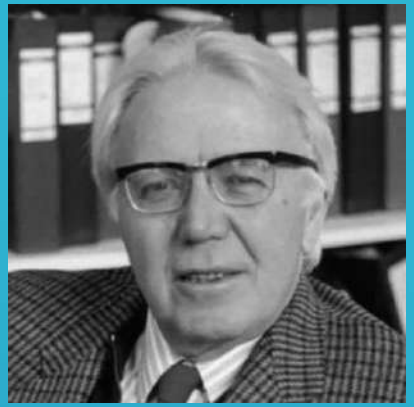
On page 60:

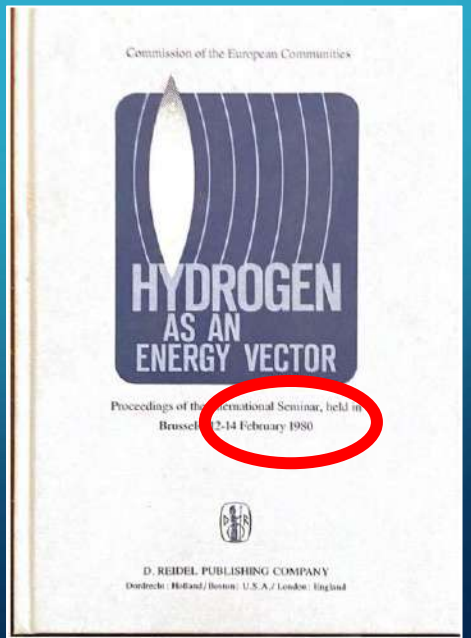
Our mission is to build the new hydro and wind power plants independent of the electrical grid, so they produce valuable storable energy in the form of hydrogen gas. Hydrogen can easily be stored and transported in pipelines. Hydrogen will be produced by pressure electrolysis, so the gas will be compressed without extra energy consumption.

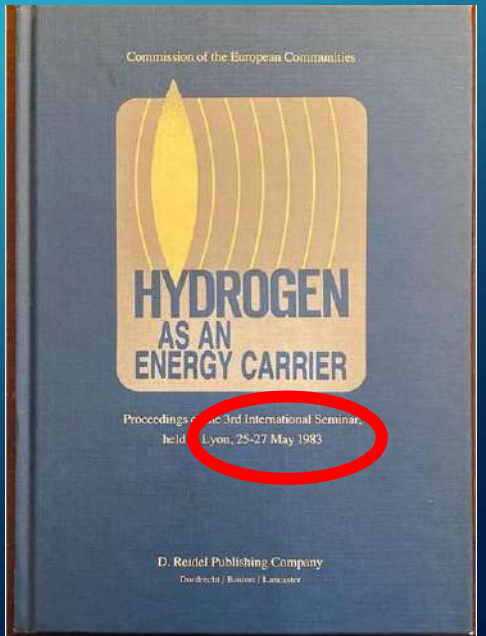
https://archive.org/details/B-001-001-049/page/n1/mode/2up

https://www.americanthinker.com/articles/2017/07/the_nazi_origins_of_renewable_energy_and_global_warming.html


EUROPA UNITA PER IL PROGRESSO E PER LA PAC
"Finalmente le frontie
in Europa vengar
abbassate e si abb
una Comunità so
e una libera circolazio
sia per le perso
sia per le co
e soprattutto per il lavoro
BELGIO
FRANCIA
ITALIA
GERMANIA
OLANDA
Roma, 25 marzo 1957
FIRMA DEI TRATTAT




Commission of the European Communities
HYDROGEN
AS AN
ENERGY VECTOR
Proceedings of the International Seminar, held in
Brussels, 12-14 February 1980
D. REIDEL PUBLISHING COMPANY
Dordrecht / Holland / Boston / U.S.A. / London / England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Dordrecht / Boston / Lancaster

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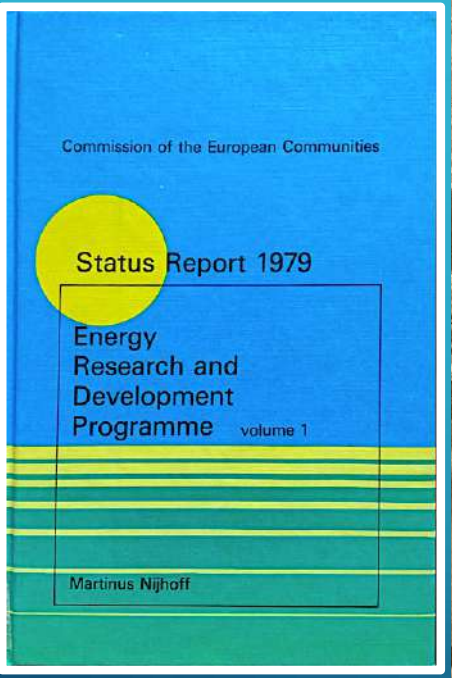
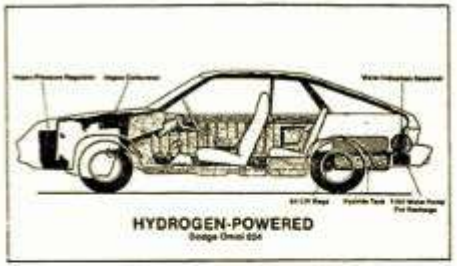
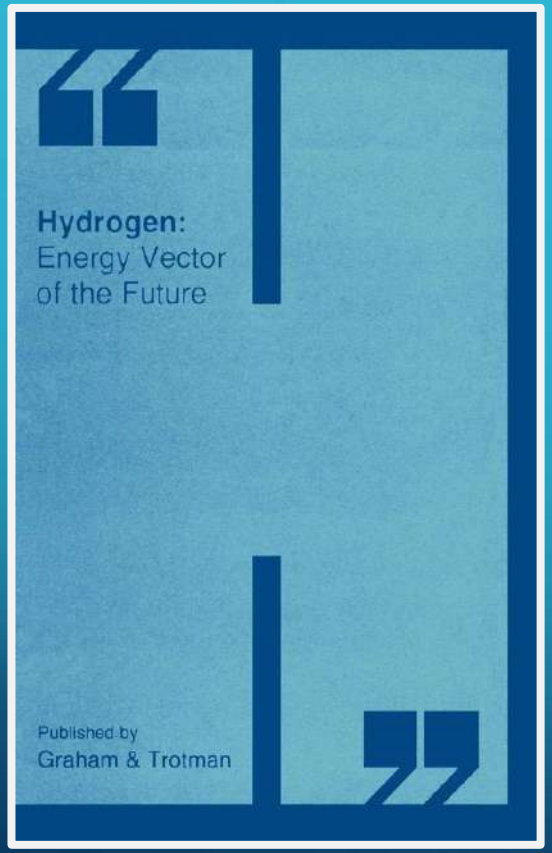
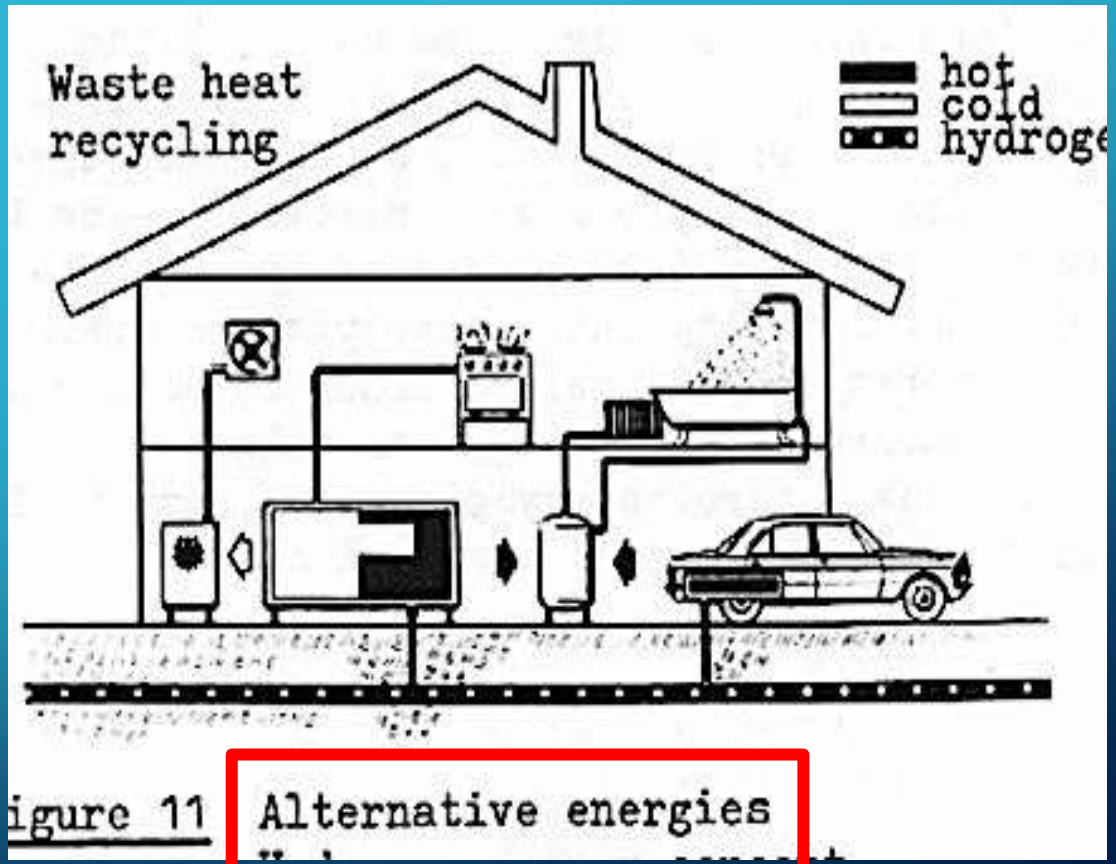


OPENING SESSION: (from left to right) Dr. G. BEGHI, Dr. H. BARNERT, Mr. M. LEGRAND, Dr. G. SCHUSTER, Dr. A. STRUB, Dr. G. IMARISIO



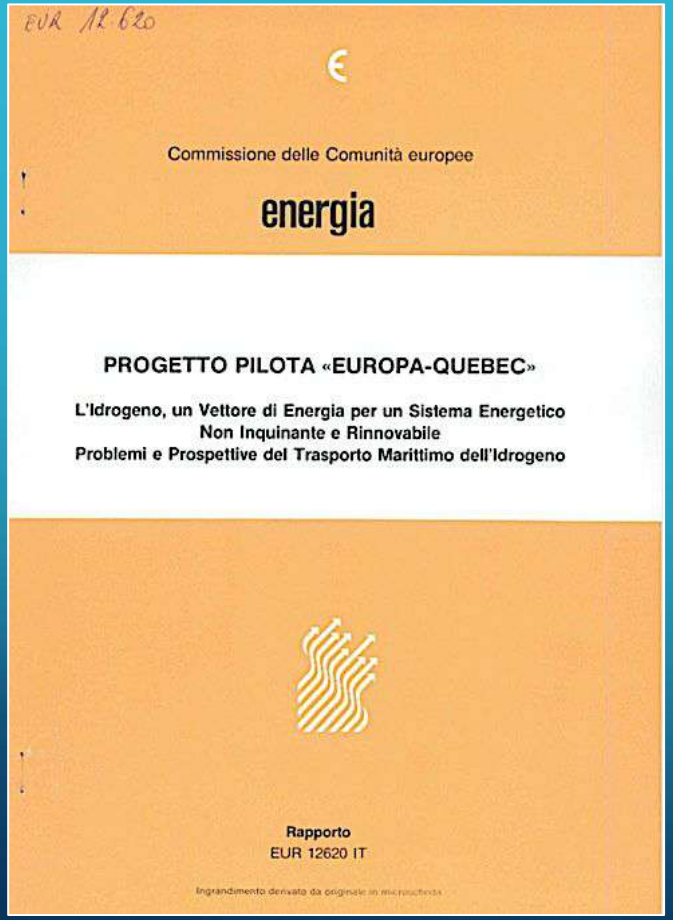
ig. 2. — Modèle de voiture Dodge alimentée à l'hydrogène (de l'Hydrogen Progress, Spring 1979, p. 17).





igure 11 Alternative energies

Collaboration EU- Quebec


EUR 12620

Commissione delle Comunità europee

energia

PROGETTO PILOTA «EUROPA-QUEBEC»

L'Idrogeno, un Vettore di Energia per un Sistema Energetico Non Inquinante e Rinnovabile
Problemi e Prospettive del Trasporto Marittimo dell'Idrogeno

Rapporto
EUR 12620 IT

Ingrandimento derivato da originale in microscheda

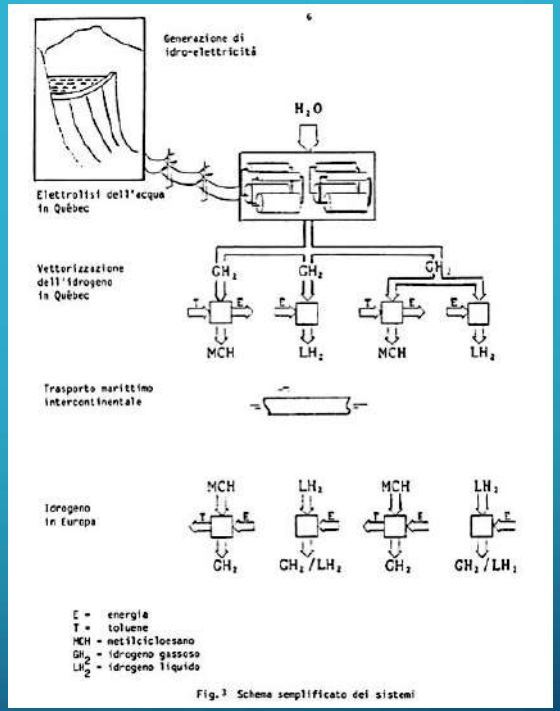
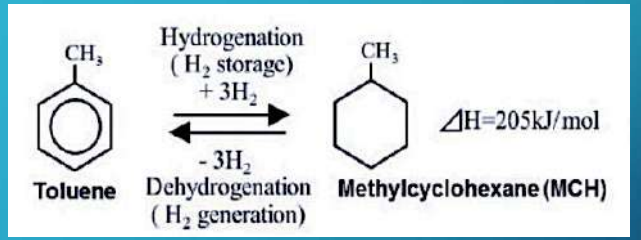


Fig. 3 Schema semplificato dei sistemi



The molar mass of toluene is 92. You therefore need to transport 92 kg to be able to transport 6 kg of H_2

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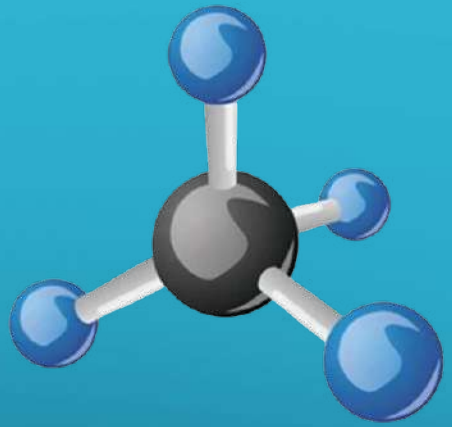
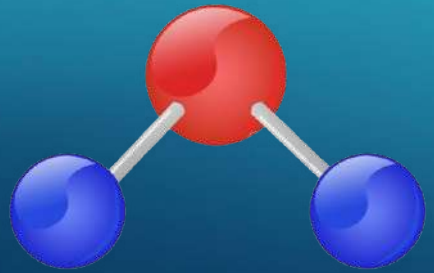
Why are the 130 million tonnes of H_2 produced almost exclusively from methane conversion?



$$CH_4 + 2\ H_20 \rightarrow 4\ H_2 + CO_2 \qquad \Delta H = -\ 164.7\ kJ$$

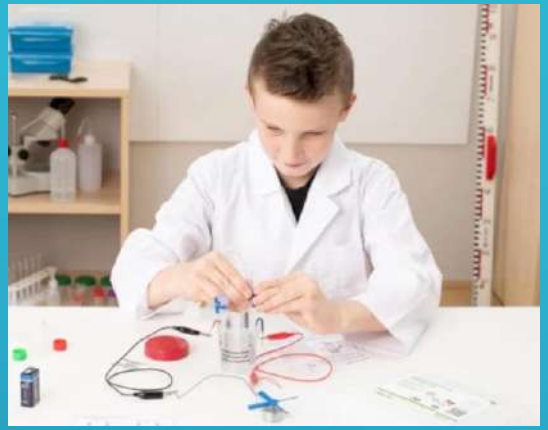
$$H_20\ (l) \rightarrow H_2 + \tfrac{1}{2}\ O_2 \qquad \Delta H = -285.8\ kJ$$

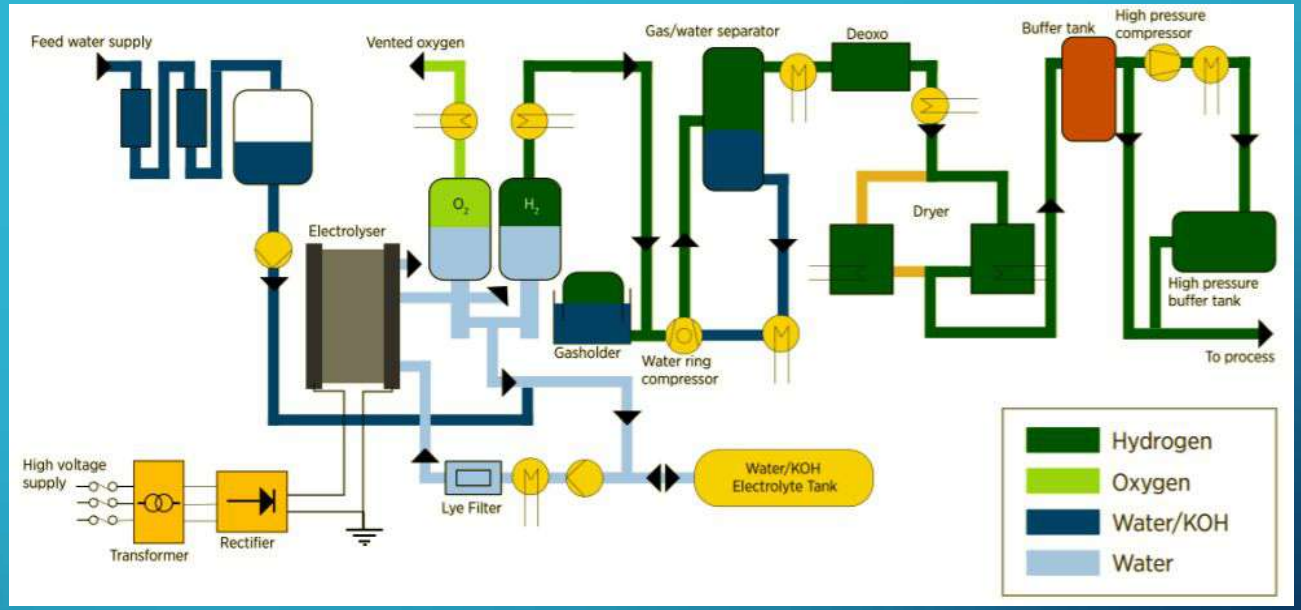
$$\frac{4\ x\ 285.8}{164.7} = 6.9$$

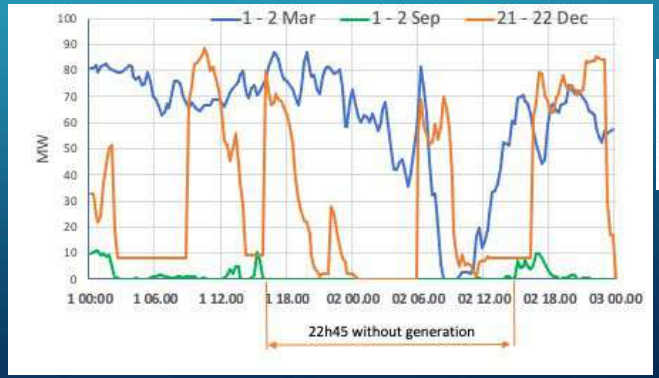


Key role of Russia thanks to its very cheap gas price

- Leader in H_2
- Leader in ammonia
- Leader in fertilizer







Delegated Regulation on Additionality

As already specified in the RED II, electricity counts as renewable if the renewable power plant and the electrolyser[3] are co-located in the same installation or there is a direct connection between them, and electricity from the grid is not used for electrolysis. Moreover, the renewable electricity generator must not have come into operation more than 36 months before the electrolyser.

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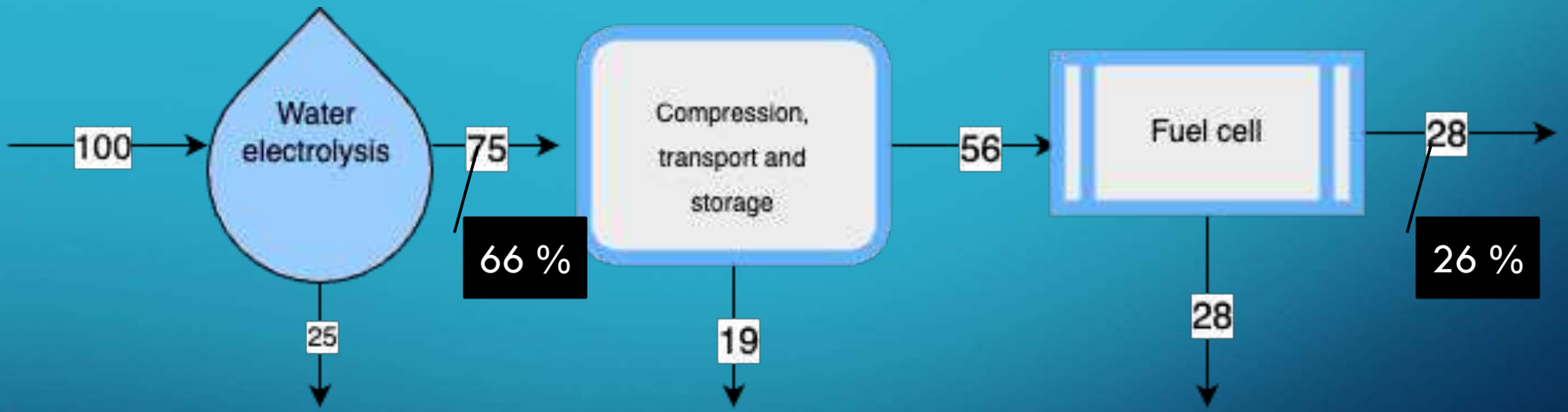
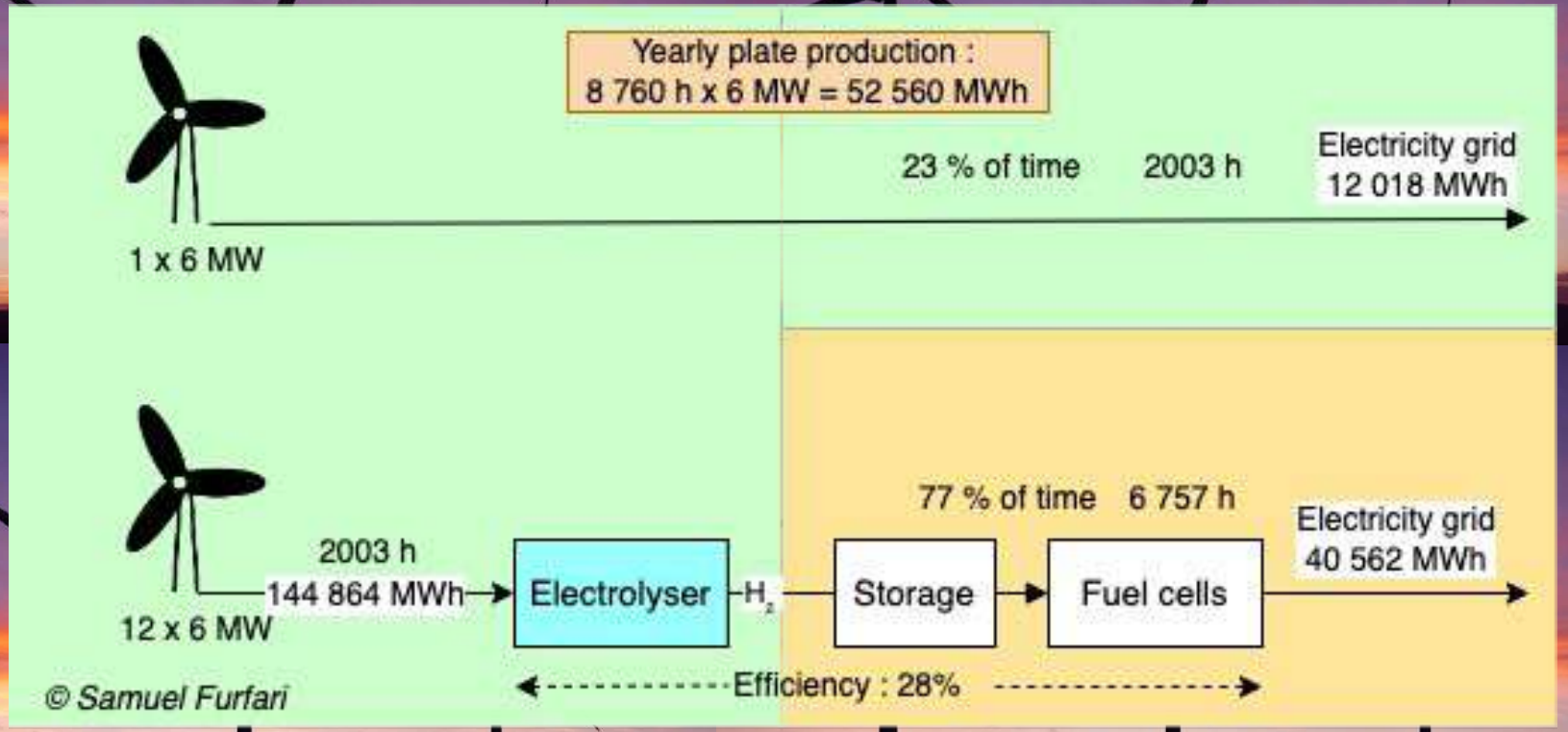
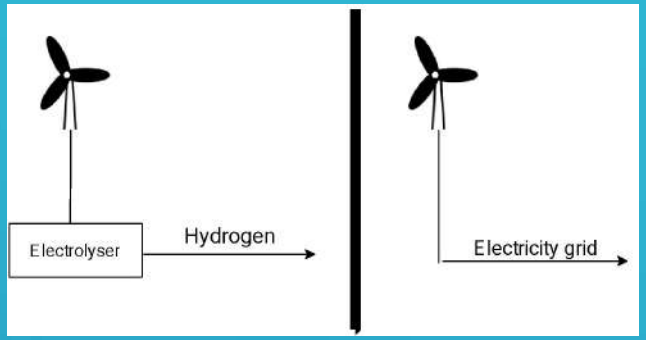
Very inefficient storage !

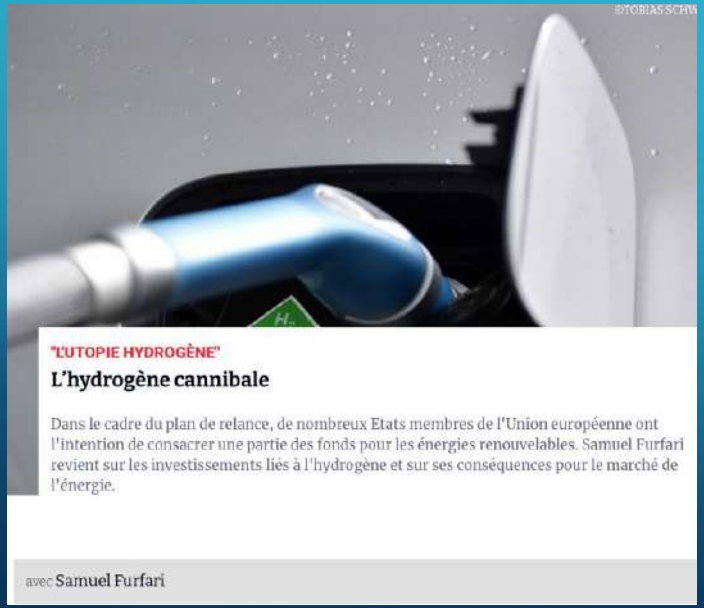


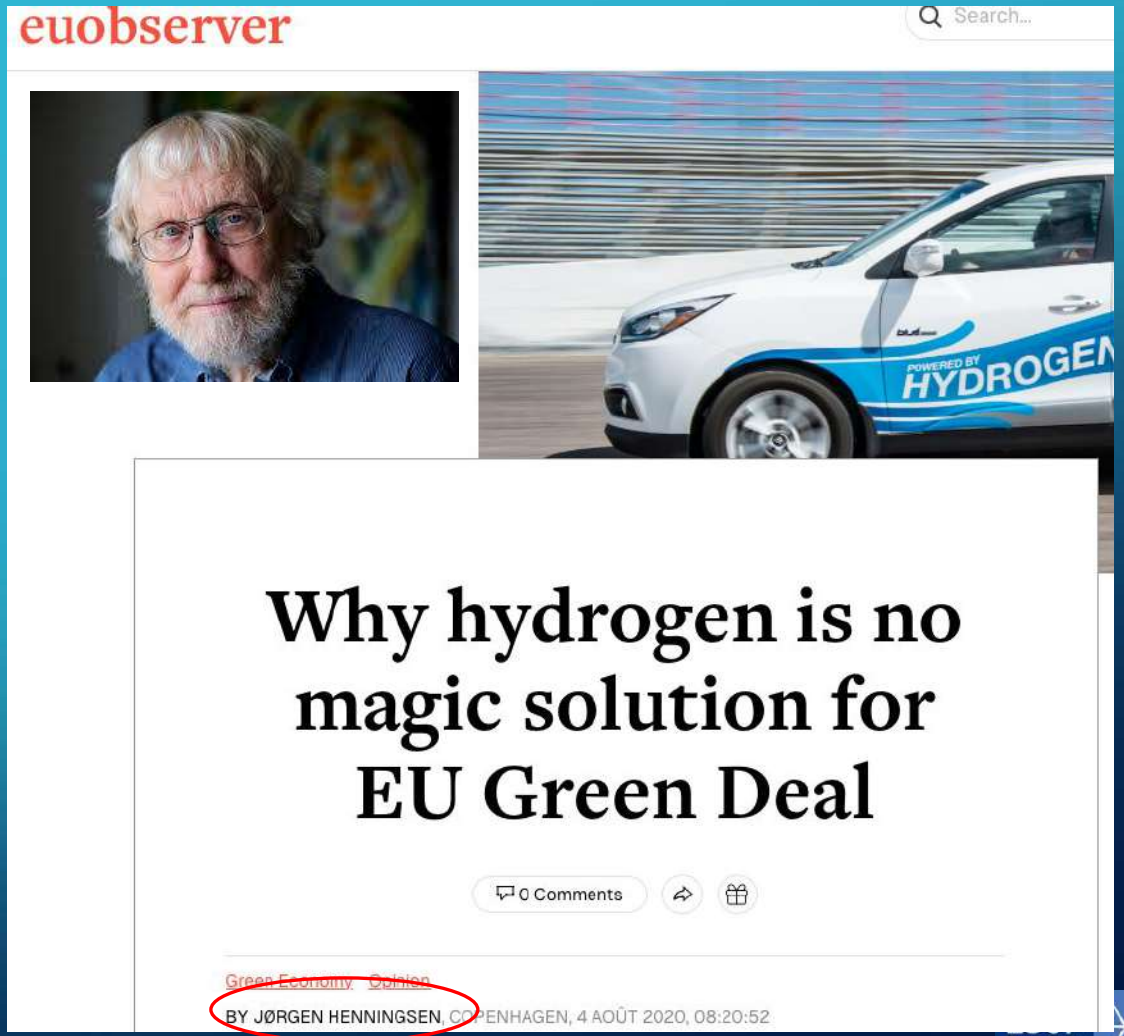
Hydrogen, the inefficient green gas



Cannibalisation

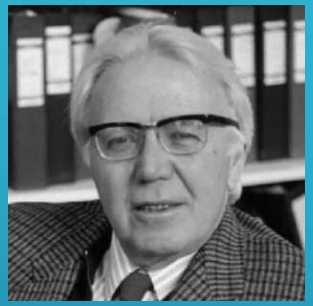


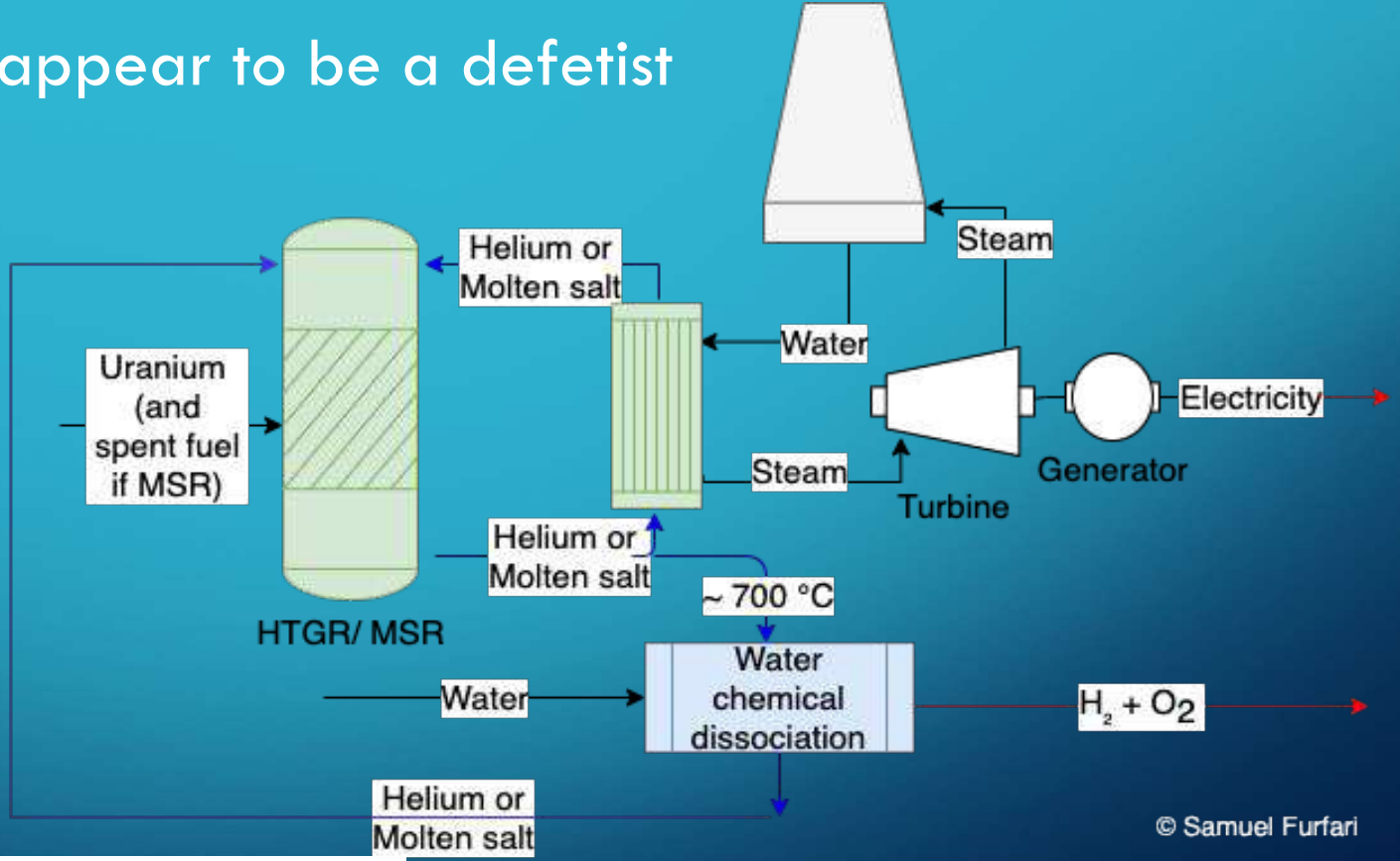


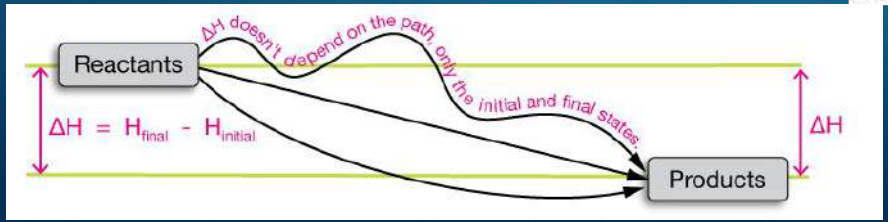


Link to Atlantico article June 2021

I do not want to appear to be a defetist







H_2O (l) → H_2 + ½ O_2 $\Delta H = -285.8$ kJ

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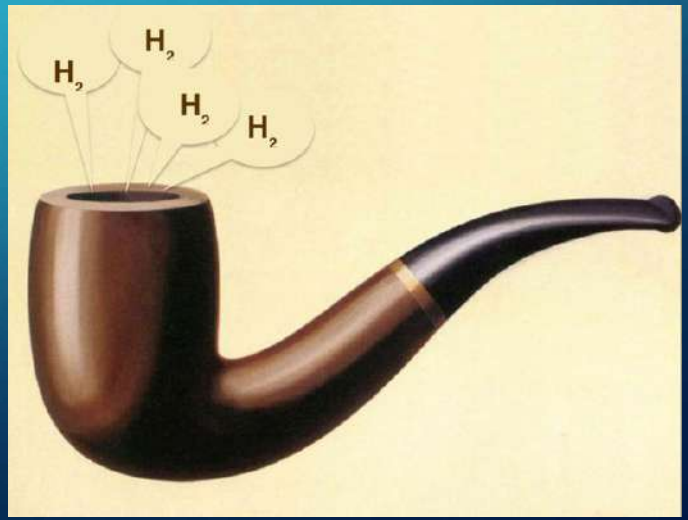
Belgian hydrogen surrealism

King Filip in Namibia to promote cooperation on green energy

King Filip landed in the Namibian capital Windhoek on Monday at the start of an official visit. He is accompanied by Belgian energy minister Tinne Van der Straeten (Flemish green) and several Belgian companies. The aim is to give an extra boost to cooperation on green hydrogen.

Namibia

- Import 60% of its electricity
  - South Africa, Zambia, Zimbabwe, the Democratic Republic of Congo, and Mozambique.
- Only 56% of population has access to the grid
- Lack of water



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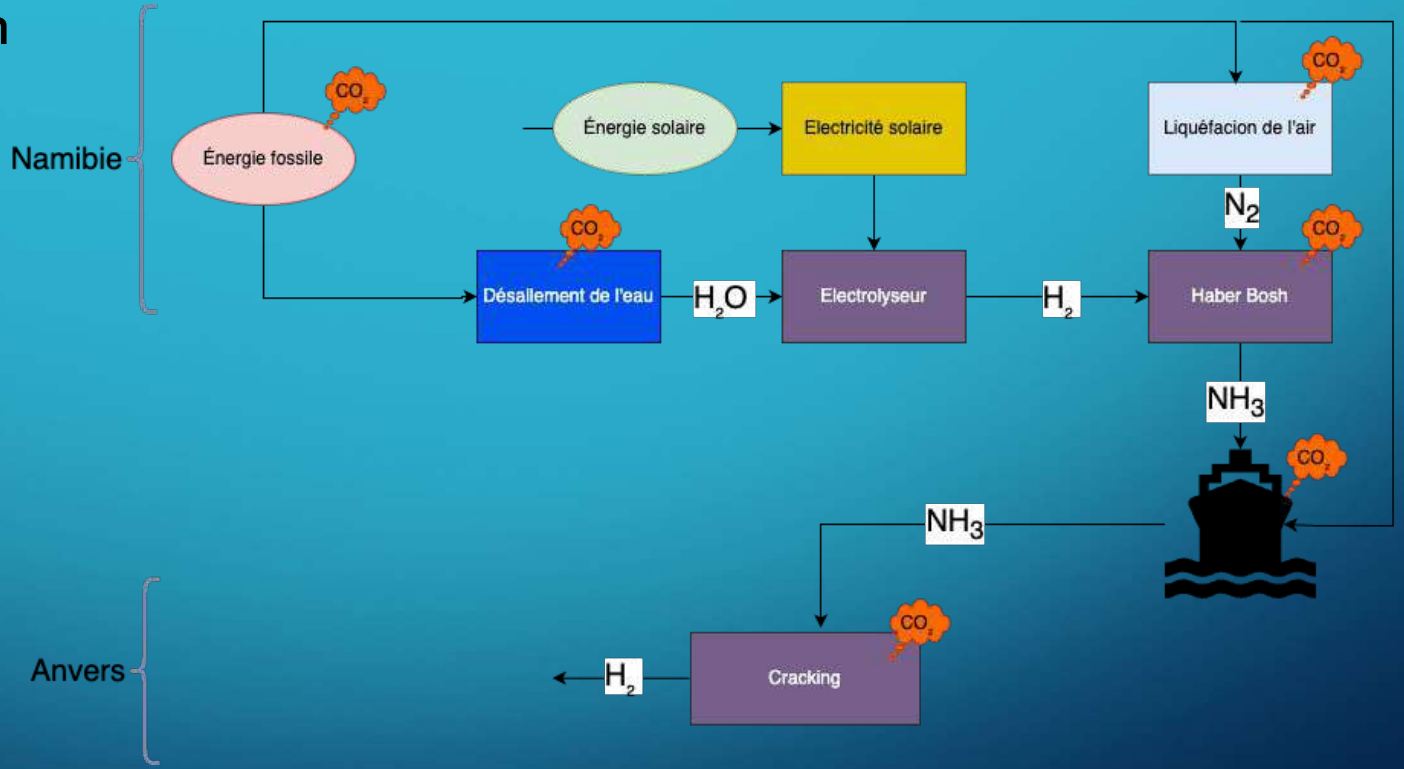
ENHANCE, public funding for a hydrogen project full of aberration



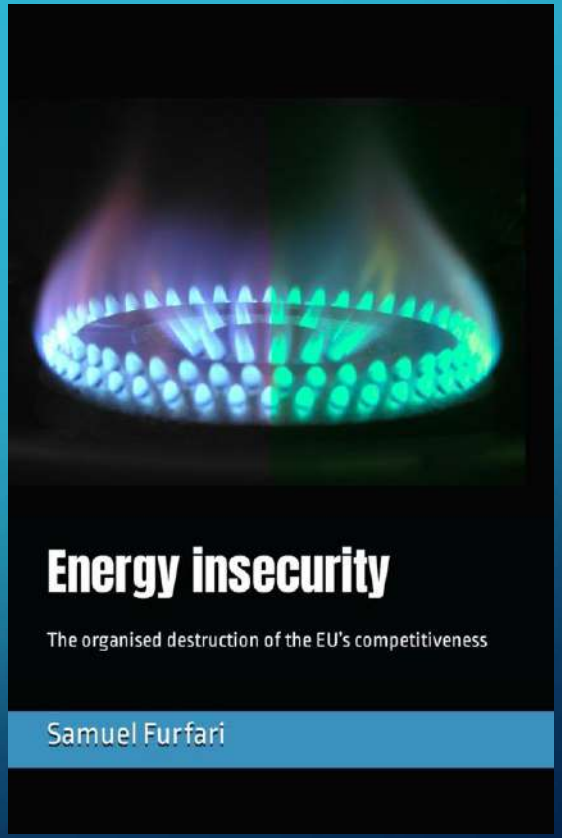
Haber Bosh process accounts for around 1 to 2% of total global energy consumption

© Caterina Furfari, 20 octobre 2024, Rumst

Belfort, 2/1/2025
7 buses x 700k€


Burning hydrogen is like
burn a Louis Vuitton handbag to
produce heat
SAMUEL FURFARI

Thank you for the attention | sfurfari@escp.eu



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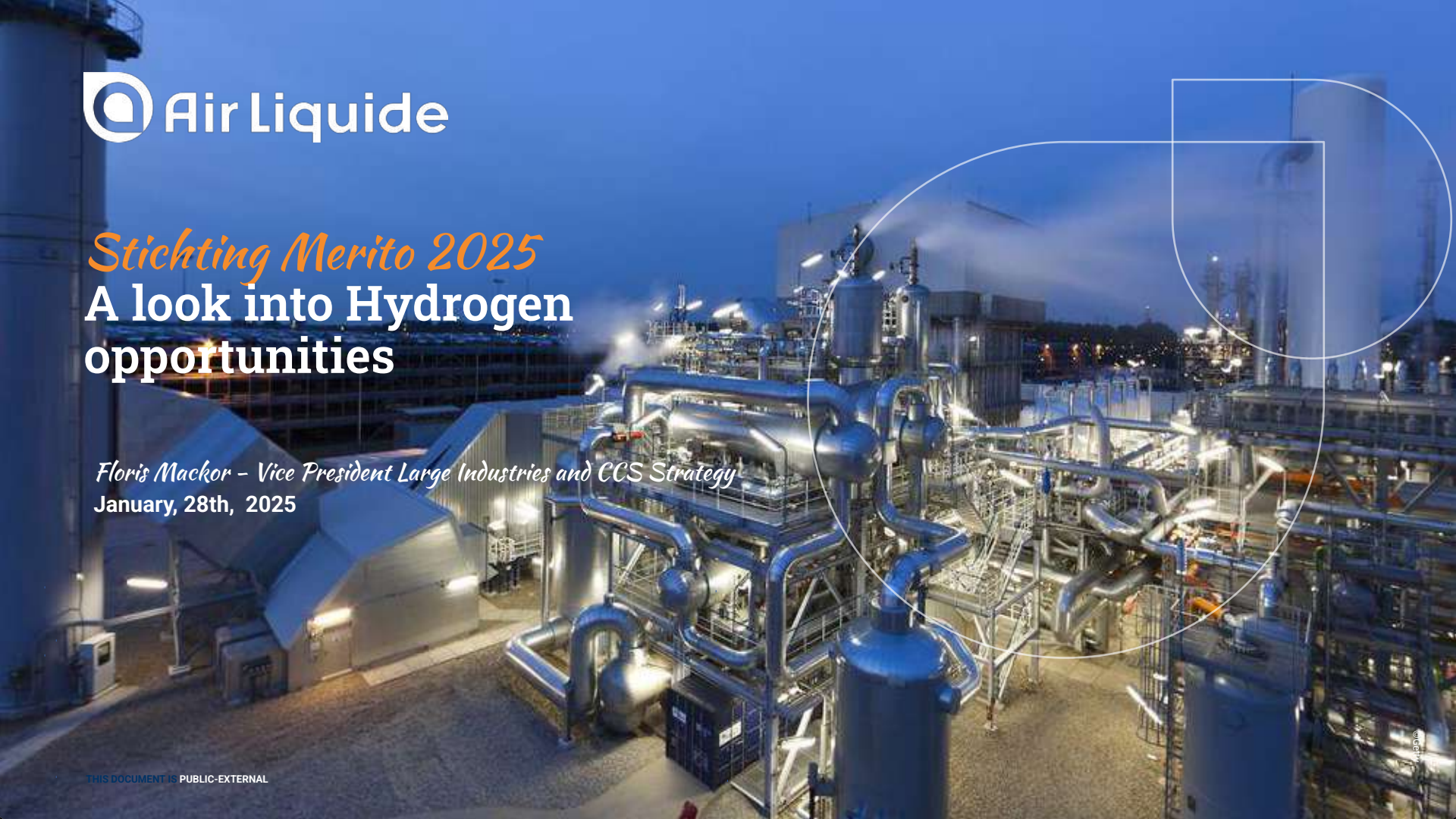
Green Hydrogen

Floris Mackor
VP Large Industry Air Liquide

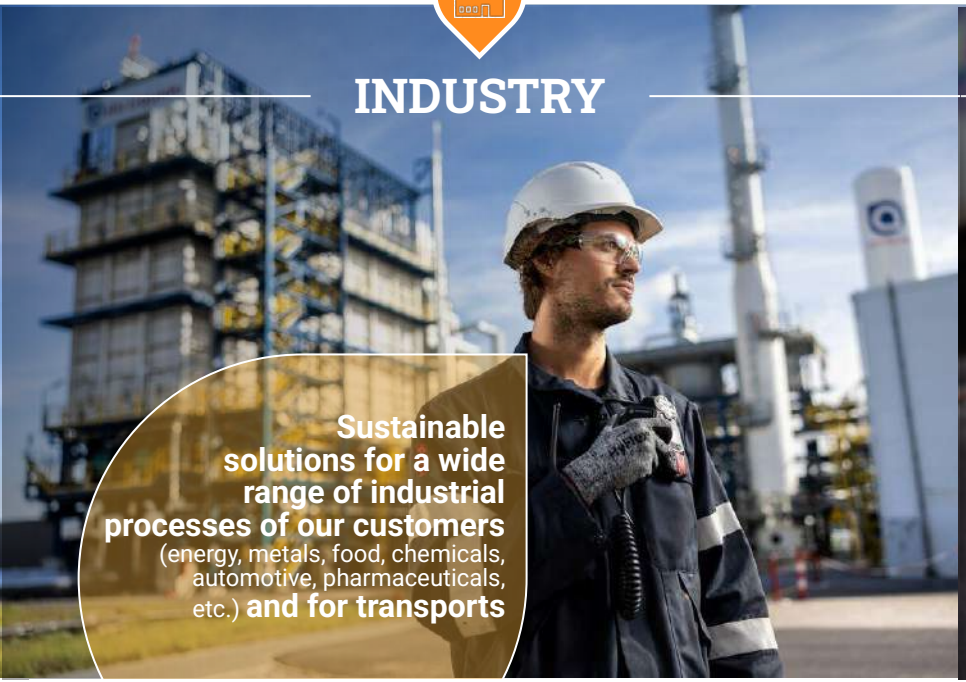


Stichting Merito 2025
A look into Hydrogen opportunities

Floris Mackor – Vice President Large Industries and CCS Strategy

January, 28th, 2025

A world leader in gases, technologies, and services for…



INDUSTRY

Sustainable solutions for a wide range of industrial processes of our customers (energy, metals, food, chemicals, automotive, pharmaceuticals, etc.) **and for transports**

HEALTH

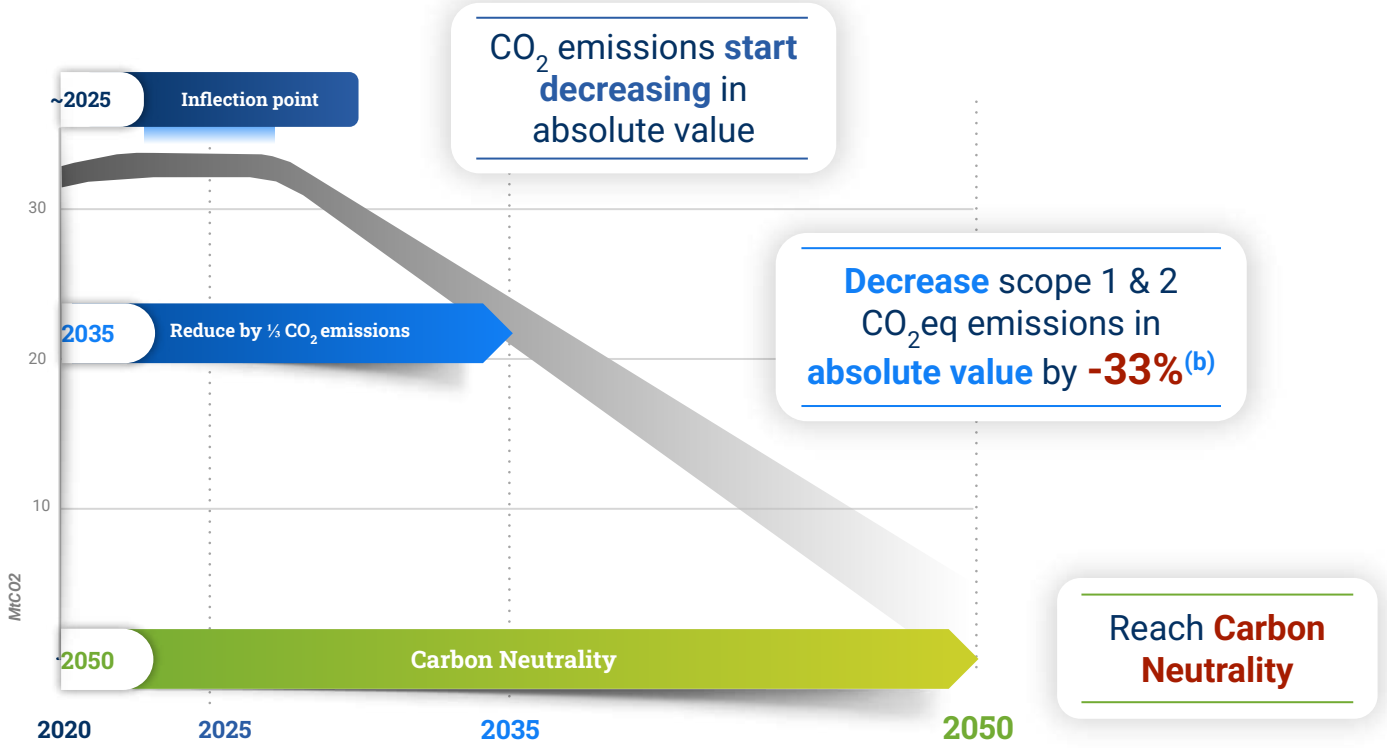
Patients at home
Hospitals
Specialty ingredients

©Adrien Daste

A clear CO_2 Abatement Trajectory

Air Liquide Commitments

Air Liquide



(a) at 2015 exchange rate and excluding IFRS16 for greenhouse gas emissions scopes 1 and 2
(b) from 2020 Market based emissions of 32.5 million tonnes CO_2eq (Scope 1+2)

Decarbonising our *H2 production* value chain

HyCO (ATR/SMR/SMR-X)

Air Liquide is committed to €8bn investments in low-carbon H_2 value chain by 2035

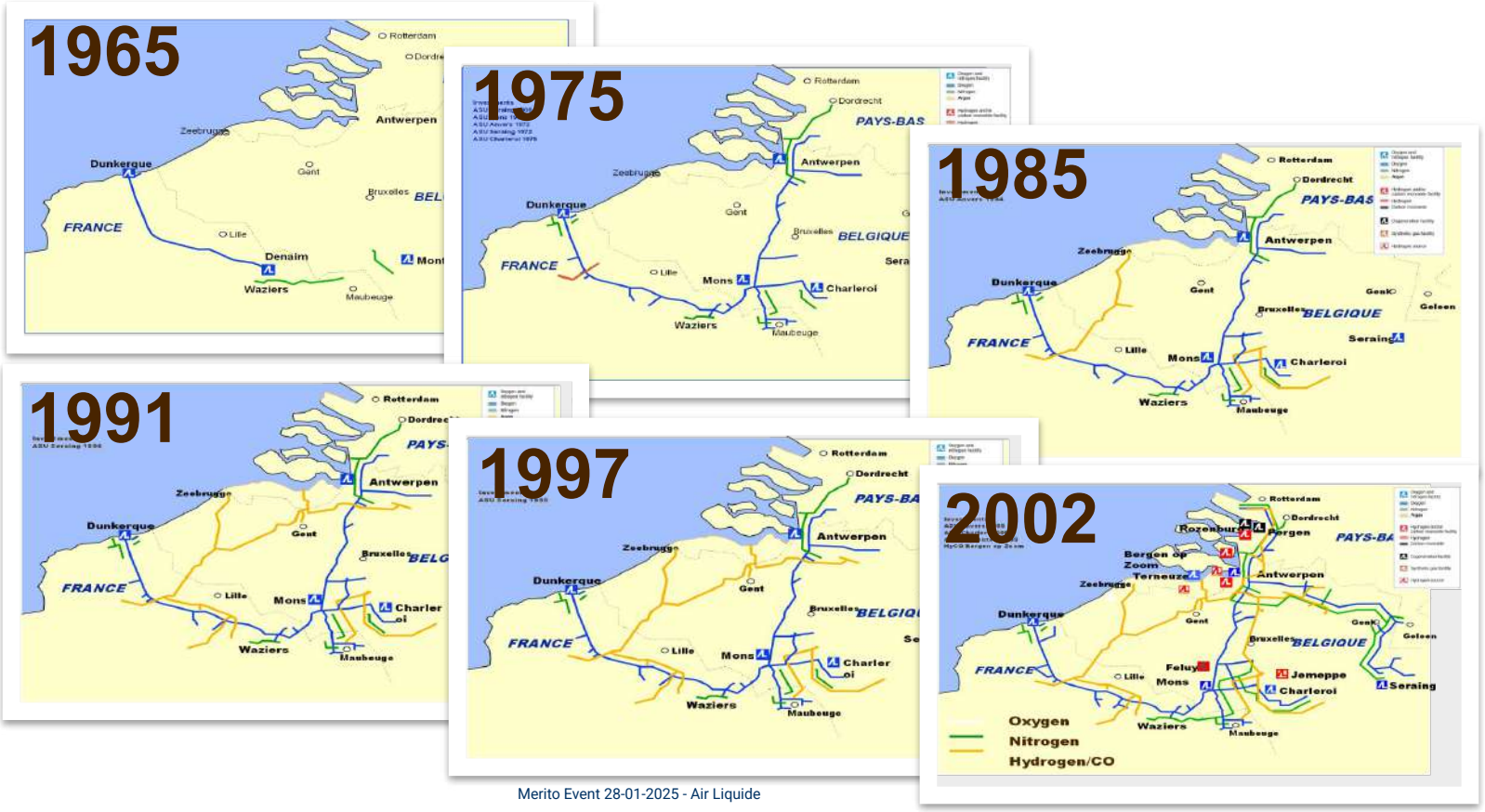
Electrolysis (H_2O)

Air Liquide is committed to 3 GW electrolysis capacity by 2030

Cracking (NH_3)

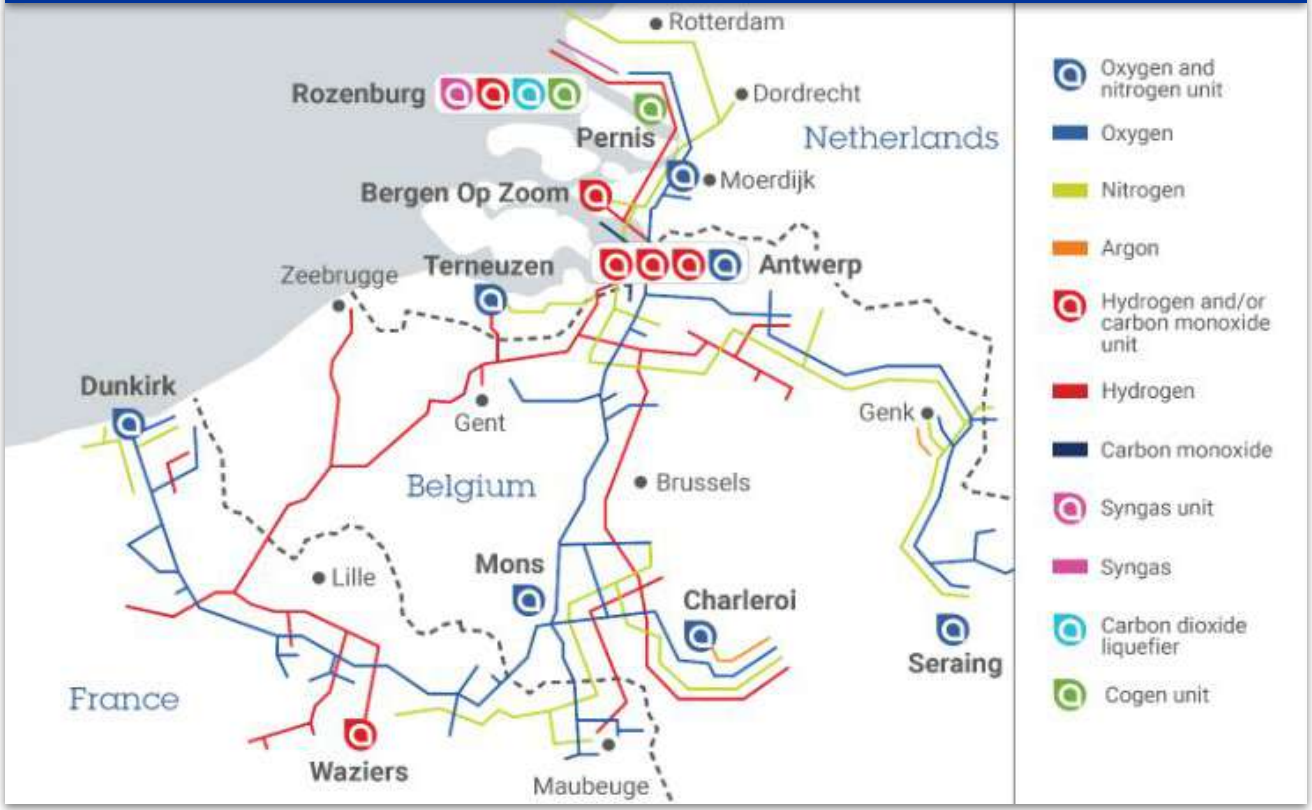
First Ammonia Cracking plant at Industrial Scale in 2024

Pipelines development since the 60's

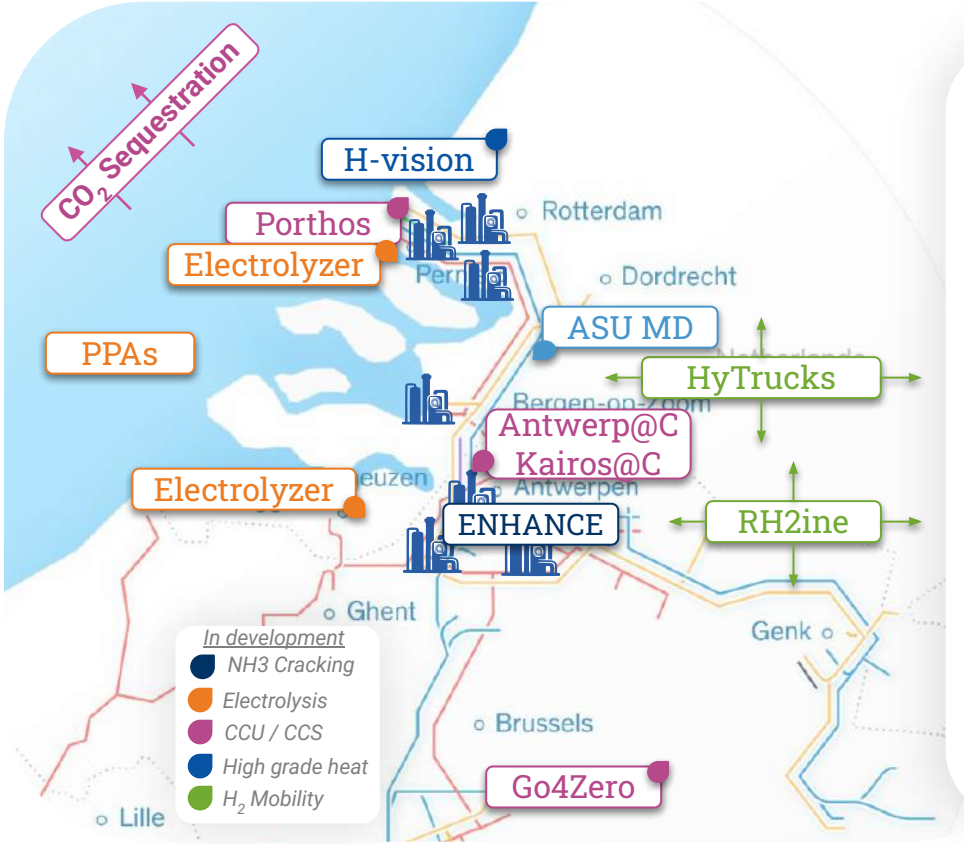


Air Liquide large industries *pipelines* today

België & Nederland : ca. 2 325 km



The Benelux ecosystem, an example of Air Liquide's strategy to focus on key basins to pursue its sustainable development



A favourable ecosystem

- Strong **renewable energy** potential
- Major **industrial & transportation hub**
- Strong **national & EU support** for emission reduction

Large Air Liquide footprint

- **7 H_2 production units** and **6 ASUs**
- **>900km** H_2 Pipeline
- **~60** customer sites supplied by Large Industries

Air Liquide involved in flagship projects

Porthos
CO_2 TRANSPORT & STORAGE

RH$_2$INE
Rhine Hydrogen Integration Network of Excellence

HyTrucks

kairos@c

ELYgator
An Air Liquide Solution

Scaling up electrolysis capacity

2018

HYBALANCE 1.25 MW PEM

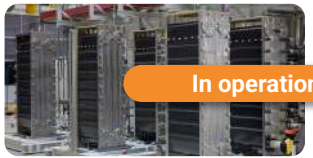
2021

BECANCOUR 20 MW Largest PEM project

In operation

2023

Giga-Factory start-up in 2023



In operation

TRAILBLAZER 20 MW PEM

In operation

2025

ELYgator 200 MW

ELYgator
An Air Liquide Solution

Under conception

2026-27

Air Liquide unknown electrolyzer

Under conception

2027

Air Liquide Normand'Hy 200 MW Largest ELY project

Under execution

Demonstration at industrial scale to de-risk Ammonia Cracking

Demonstration of the *complete* process at industrial scale and "real life" conditions

Startup: Q1 2025 - Technology validation completed by Q2 2025

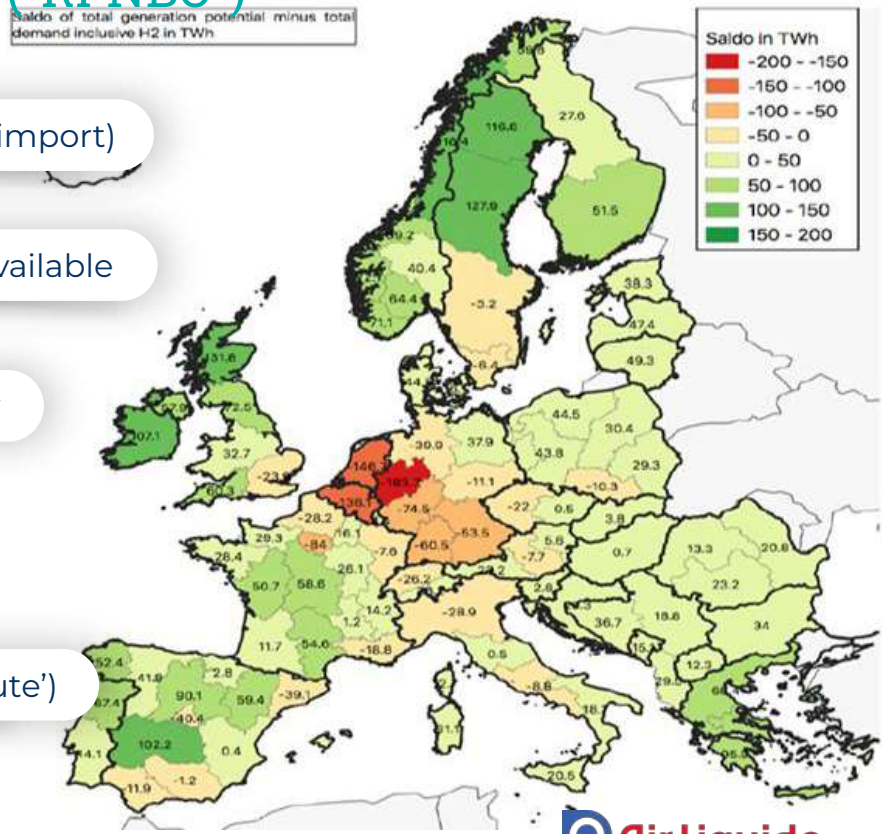
Enhance project : Ammonia Cracking + H2 liquefier

First industrial plant for Ammonia Cracking an H2 liquefier

Renewable Energy Directive (REDIII)

H2 consumption objectives ("RFNBO")

- **Water electrolysis** (domestic) & **Ammonia Cracking** (import)
- **NOT ENOUGH RENEWABLE ENERGY** sources available
- Integrate **Low Carbon Hydrogen** for industry
- Introduce **Adequate Support Mechanism**
- kickstart **RFNBO*-market for Transport** ('Refinery Route')



*Renewable fuel of non-biologic origin


Air Liquide
Thank You

Green Hydrogen

Discussion

Floris Mackor
VP Large Industry Air Liquide

Ivan Van de Cloot
CEO Stichting Merito

Samuele Furfari
Chemical engineer, PhD, VUB

Discussion

- Reaction on the 2 talks

Discussion

- How much H2 will be needed in Belgium?
  - Balance of plant: demand-supply
- What quality? Is the same purity needed for every application?
  - Pure H2 “in the mix”?

Discussion

- Many H2 projects have been cancelled or postponed in 2024: why?

- Next crucial milestones?

Discussion

- By how much can the efficiency of the processes still be improved? Learning curves?

Discussion

- The CEO of Arcelor Mittal Gent said recently that it’s important not to make the transition to net zero too rapid. What’s your view on the length of the transition? Are the current ambitions on the speed realistic?

Discussion

- What do you think about CBAM (Carbon Border Adjustment Mechanism) ?

Discussion

- What is your view on nuclear energy in our country ?

Discussion

- Can the price of steel be much higher in the EU than in the US for long?

Discussion

- Energy efficiency: less fossils needed

Noteer in de agenda:

MERITO
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Volgend event over de rol van de media: 24 april !

Donderdag 30-1: Interview in Trends over Merito project “Subsidie van de maand”

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