HyDEX

ENERGY RESEARCH ACCELERATOR

Accelerating real-world energy innovation

UK-EU Hydrogen Summit
Mon 1 July 2024

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Aston University BIRMINGHAM UK

University of Birmingham

Cranfield University

Keele University

University of Leicester

Loughborough University

University of Nottingham

Warwick

BGS British Geological Survey

UK-EU Hydrogen Summit

Developing closer UK, EU & International Relations to
Deliver the Net Zero Hydrogen Economy

PROGRAMME

Venue: Conference Hall, Press Club Brussels Europe, Rue Froissart 95, 1040 Brussels
Timings: Mon 1 July: 14:00-17:30 and Tues 2 July: 09:30-12:00

Day 1: Monday 1 July	
Time	**Activity**
13.45 - 14.00	Registration and refreshments
Introduction - Hydrogen beyond borders: a key renewable in delivering the energy transition	
14.00 – 14.05	Welcome and Opening Prof Martin Freer Director of Energy Research Accelerator / Birmingham Energy Institute
Keynote speech:	
14.05 - 14.45	Michael Liebreich - Managing Partner, EcoPragma Capital & CEO, Liebreich Associates
Exploring how the UK & EU are driving the Hydrogen acceleration to deliver Net Zero	
14.45 – 15.15	Dominik Richter - Senior Office, Trade & International Relations, Hydrogen Europe
	Mark Watts - former senior Labour MEP, CEO UKTiE
EU Research and Innovation: Driving the Hydrogen acceleration to deliver net zero	
15.15 – 15.30	Rosalinde van der Vlies- Director, Clean Planet, DG RTD, European Commission
Fostering UK, EU & International research & international collaboration	
15.30 – 16.30	Anaïs Laporte - Government Relations Manager, Battolyser Systems
	Nicole Glanemann - Energy Attaché, Perm Rep of Germany to EU The 2023 Update of the German National Hydrogen Strategy
	Goran Strbac - Imperial College Role and value of hydrogen in supporting cost effective transition to a zero carbon energy future
16.30 – 16.45	Refreshment break and Networking
Hydrogen Valleys - their critical role in the energy transition journey	
16.45 – 17.30	Geerte de Jong - HEAVENN Netherlands Hydrogen Valley
	Margherita Matzer - WIVA P&G, Austria
Conclusions from day 1 & preview of the workshop on day 2	
17.30	Martin Freer - Developing closer UK, EU & International Relations to Deliver the Net Zero Hydrogen Economy

UK-EU Hydrogen Summit

Developing closer UK, EU & International Relations to
Deliver the Net Zero Hydrogen Economy

PROGRAMME

Day 2: Tuesday 2 July
Timings: 09:30-12:00
Workshop - How Can We Develop Closer UK, EU & international Relations to Deliver the Net Zero Hydrogen Economy? This deliberative workshop will address the above question in the following four themes, in the context of the presentations made on the 1st day, with a view to producing a report with recommendations which will be shared with the new UK Government and the new European Commission.
All speakers and attendees are invited. 1. Financing and Funding: streamlining funding and creating a business case for a hydrogen economy 2. Policy Frameworks: aligning regulatory processes 3. Collaboration: Hydrogen Valleys, UK & EU, international 4. Workforce Development, Just Transition and Fostering Public Acceptance

UK-EU Cooperation on Hydrogen

HyDEX European Hydrogen Summit

1st July 2024

Michael Liebreich

Founder and CEO

Liebreich Associates

Opportunities for UK-EU cooperation

Liebreich Associates

Sectors

- Green steel
- Green fuels for aviation & shipping
- Hydrogen backbone
- Long-duration storage
- Blue hydrogen (done right)
- CO2 transport & sequestration

Themes

- Energy system modelling
- R&D
- Standards, leakage and safety
- Network control
- Resilience planning
- Finance

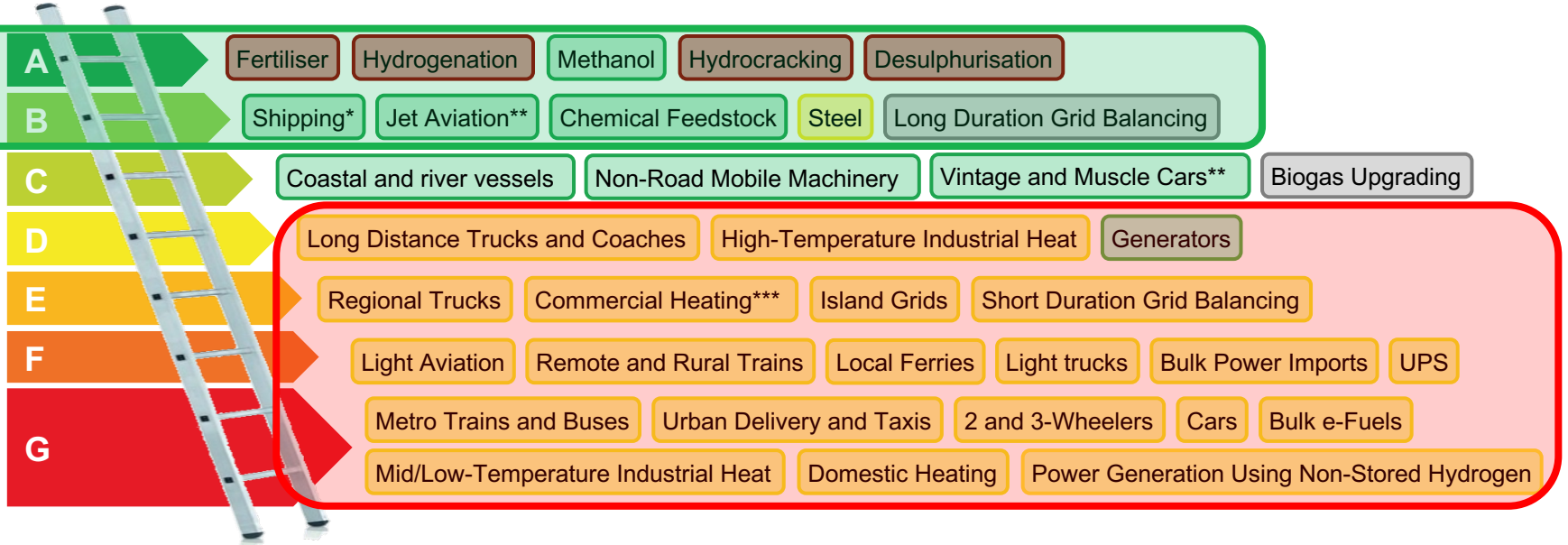
Source: Liebreich Associates

Hydrogen Ladder 5.0

Liebreich Associates

Key: No real alternative | Electricity/batteries | Biomass/biogas | Other

Unavoidable



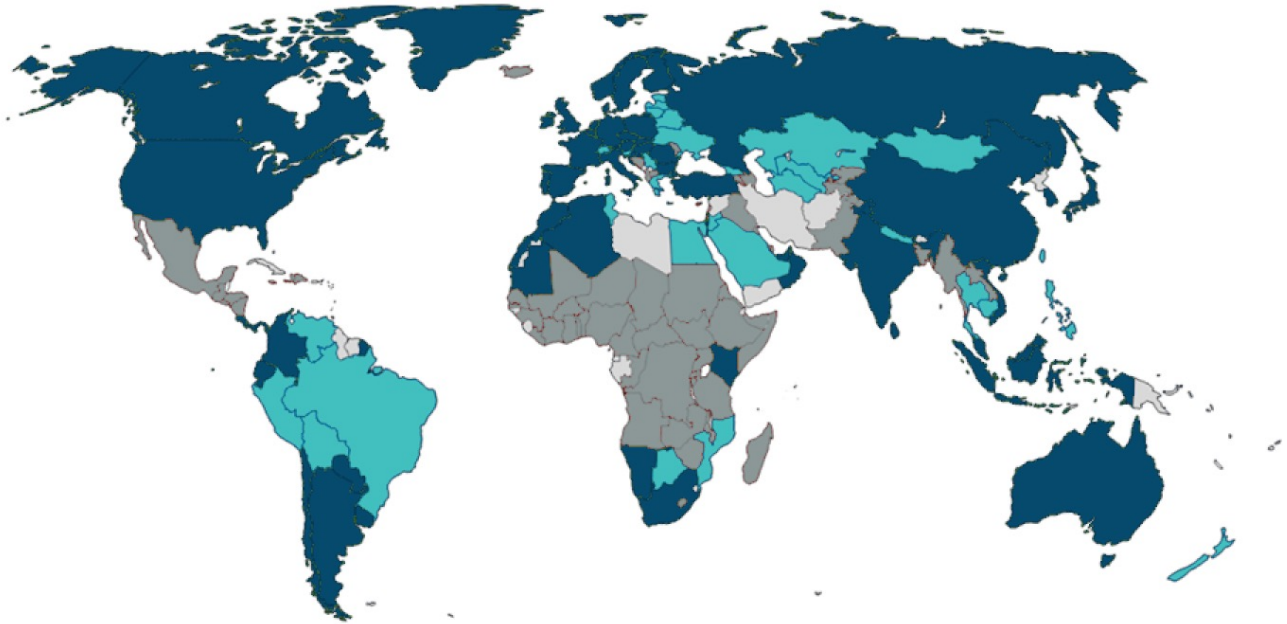
Uncompetitive

*As ammonia or methanol **As e-fuel or PBTL ***As hybrid system

Source: Michael Liebreich/Liebreich Associates, Clean Hydrogen Ladder, Version 5.0, 2023. Concept credit: Adrian Hiel, Energy Cities. CC-BY 4.0

Hydrogen futurism – 2024

Liebreich Associates



Source: BloombergNEF

Clean Hydrogen Society

Liebreich Associates

> Shifting to and developing a hydrogen society is critical for achieving decarbonization

Japanese Prime Minister Fumio Kishida
19 April 2022, visiting liquid hydrogen terminal, Hyogo

Image: Nippon.com

Hydrogen economy

Liebreich Associates

> Instead of the gas currently used for industry, heating and fuels, we will ensure hydrogen – the gas of the future – can be used, and we will create a huge boom

Olaf Scholz, German Chancellor
September 2022

Image: DW

Hydrogen futurism – 2021

Liebreich Associates

> I want the UK to become the Qatar of hydrogen

Boris Johnson
UK Prime Minister, 2021

Image: SCANPIX

EU Clean Transition Dialogue

Liebreich Associates

> Hydrogen is the natural starting point. Hydrogen has a central role to play in the transition to climate-neutrality

Ursula von der Leyen
President of the European Commission

Image: Clean Transition Dialogue

Clean Hydrogen Swiss Army Knife

Liebreich Associates

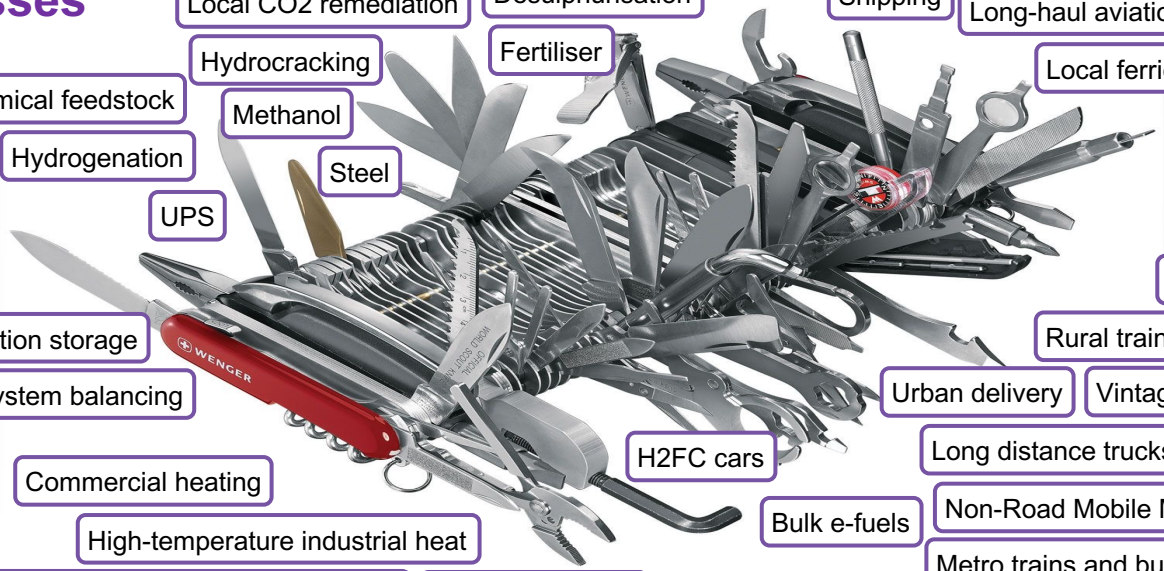
> Clean hydrogen is the "Swiss army knife" of zero-carbon technologies

Jennifer Granholm, US Energy Secretary

Image: Wikimedia Commons

Clean Hydrogen Swiss Army Knife

Liebreich Associates



Chemicals & processes

Local CO2 remediation
Desulphurisation
Hydrocracking
Fertiliser
Chemical feedstock
Methanol
Hydrogenation
Steel

Aviation & shipping

Short-haul aviation
Light aviation
Shipping
Long-haul aviation
Local ferries
Coastal and river vessels
Medium-haul aviation

Power system

Clean power imports
UPS
Island grids
Generators
Long-duration storage
Power system balancing

Land transport

Regional trucks
2 and 3-wheelers
Rural trains
Remote trains
Urban delivery
Vintage vehicles
H2FC cars
Long distance trucks and coaches
Bulk e-fuels
Non-Road Mobile Machinery
Metro trains and buses

Heat

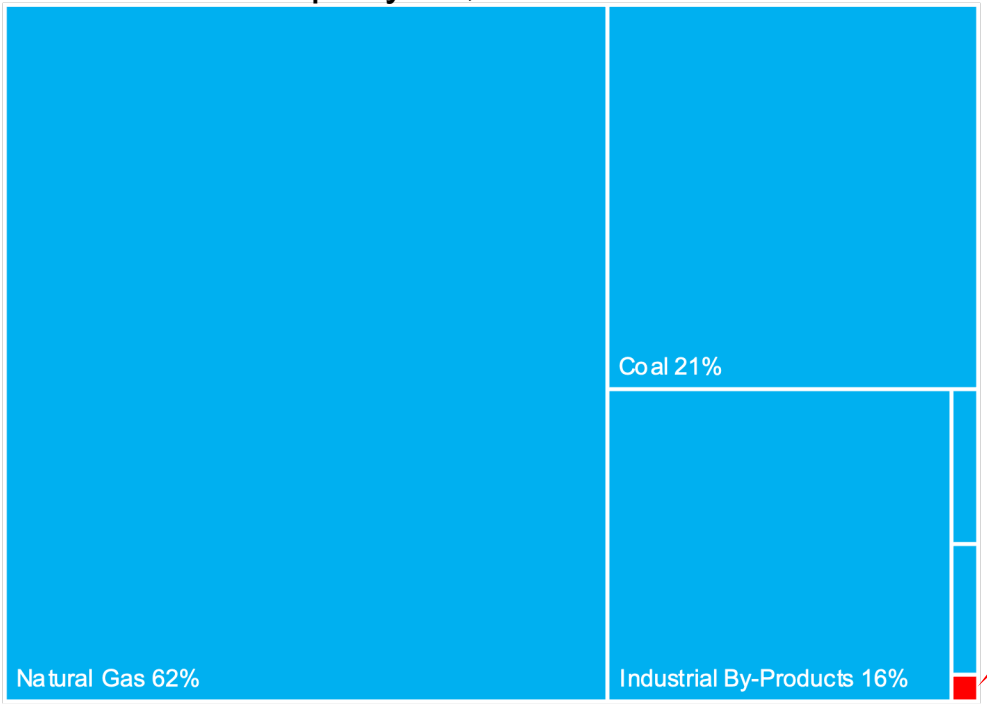
Commercial heating
High-temperature industrial heat
Mid/Low-temperature industrial heat
Domestic heating

Source: Michael Liebreich/Liebreich Associates, Clean Hydrogen Ladder, Version 4.1, 2021. Concept credit: Adrian Hiel, Energy Cities. Image: Wenger (concept credit: Paul Martin). CC-BY 3.0

150 years into hydrogen economy…

Liebreich Associates

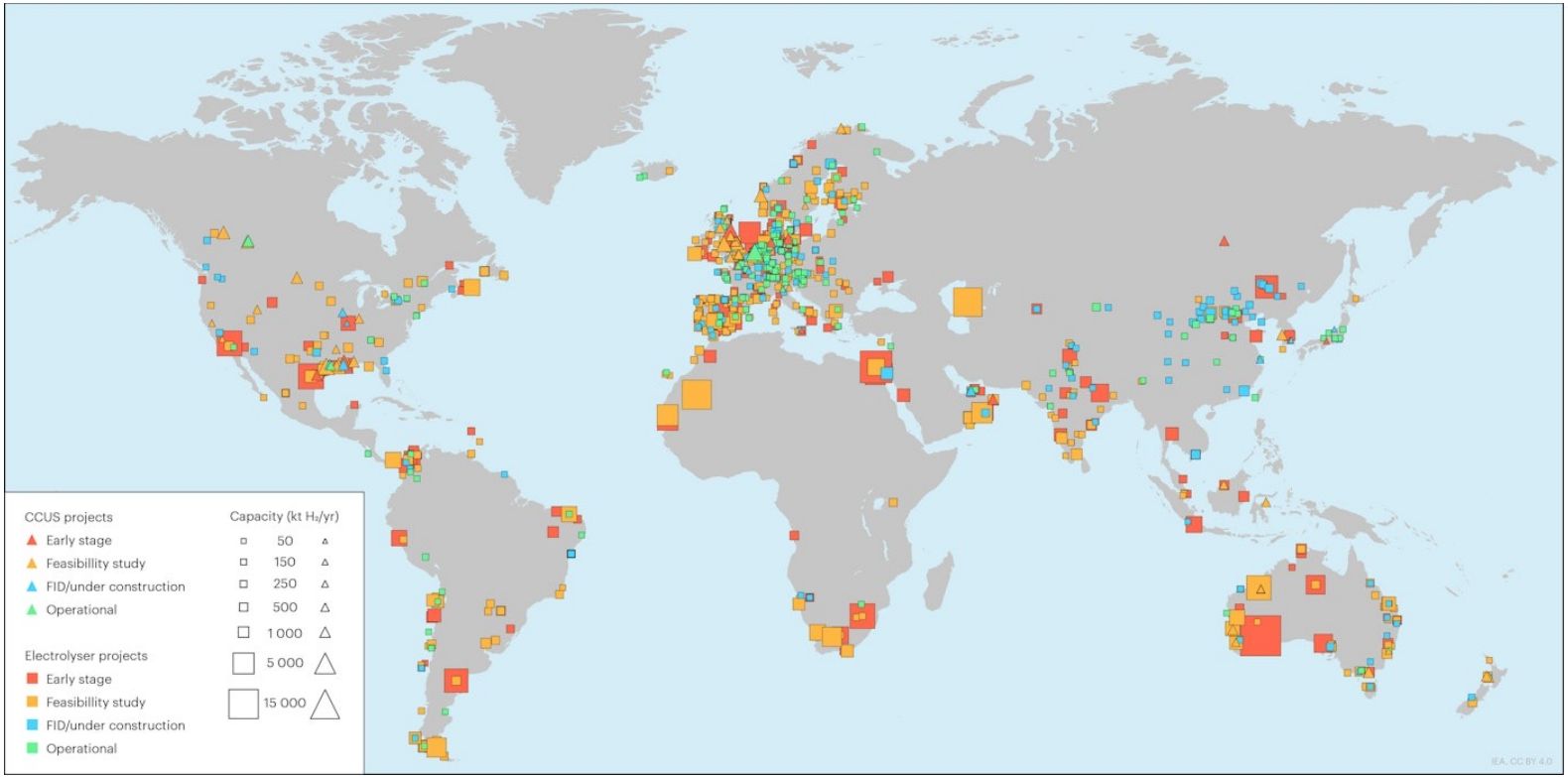
100 million tons per year, $150 billion market



Source: IEA Global Hydrogen Review 2023

Global announced hydrogen projects

Liebreich Associates

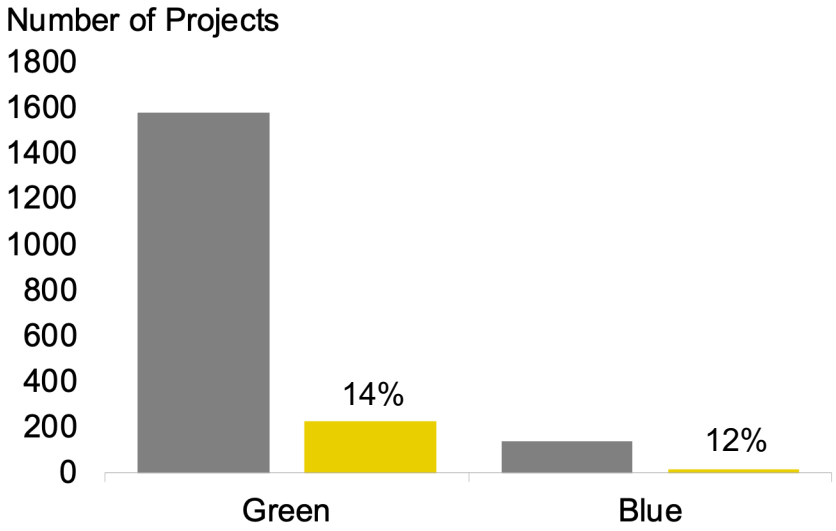


Source: IEA Hydrogen Review 2023

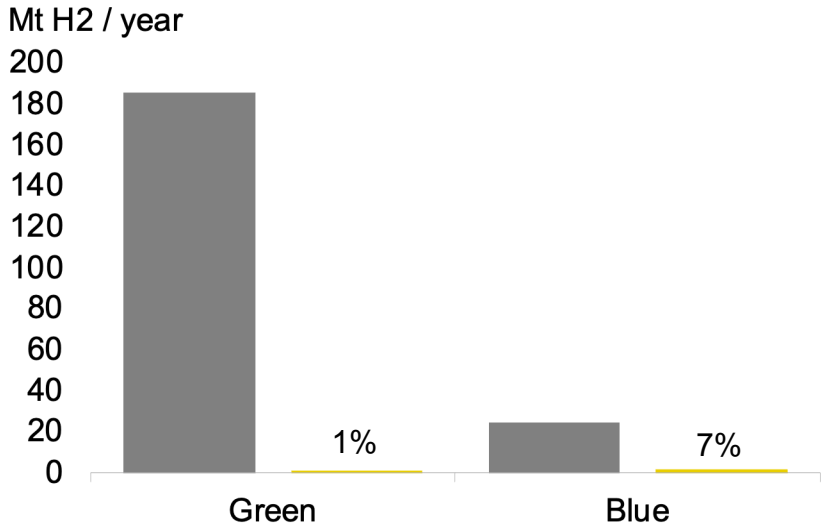
Clean hydrogen project status

Liebreich Associates

By number of projects



By production volume



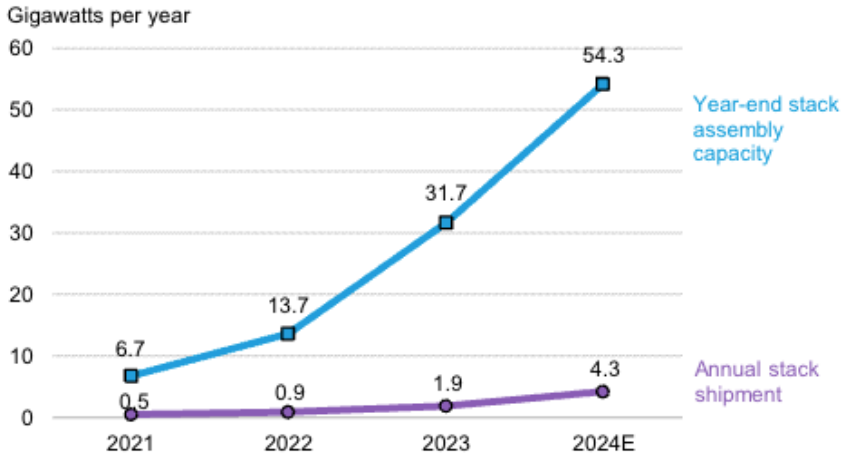
Total FID, Construction, Operational Stages

Source: BNEF, Liebreich Associates

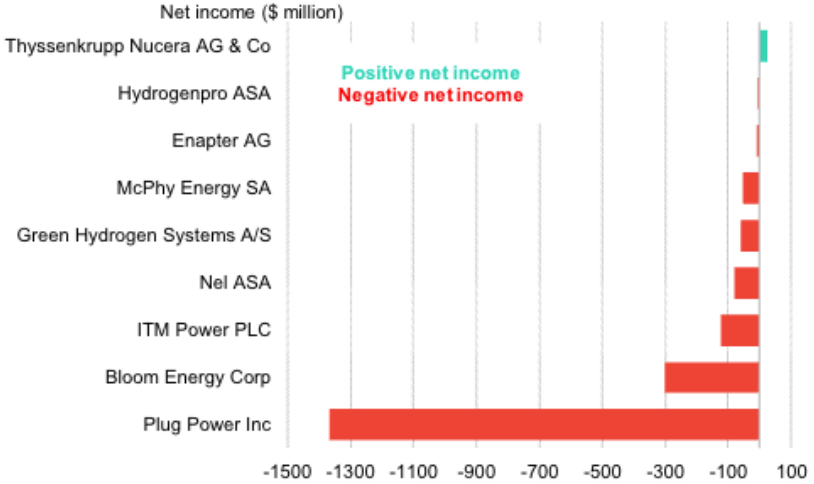
Electrolyser industry

Liebreich Associates

Manufacturing vs Demand



Manufacturer Net Income

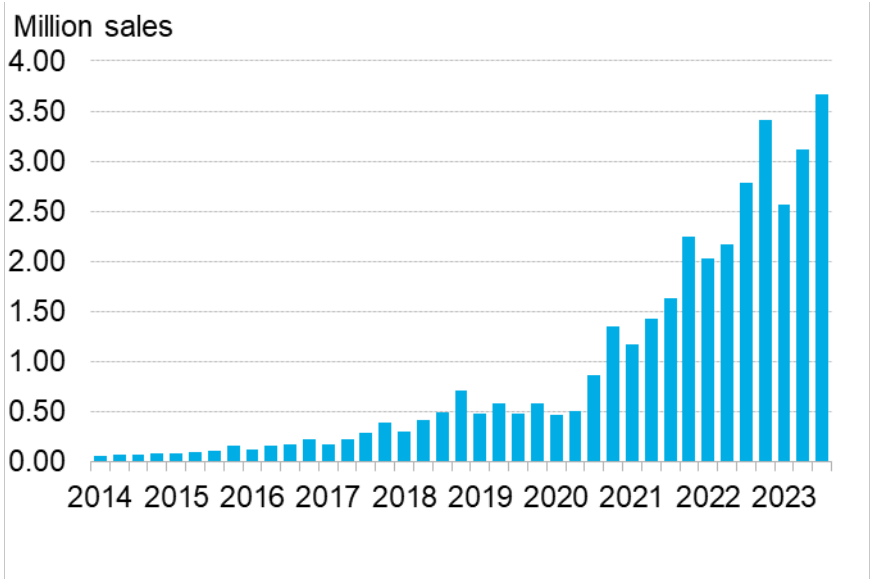


Source: BNEF

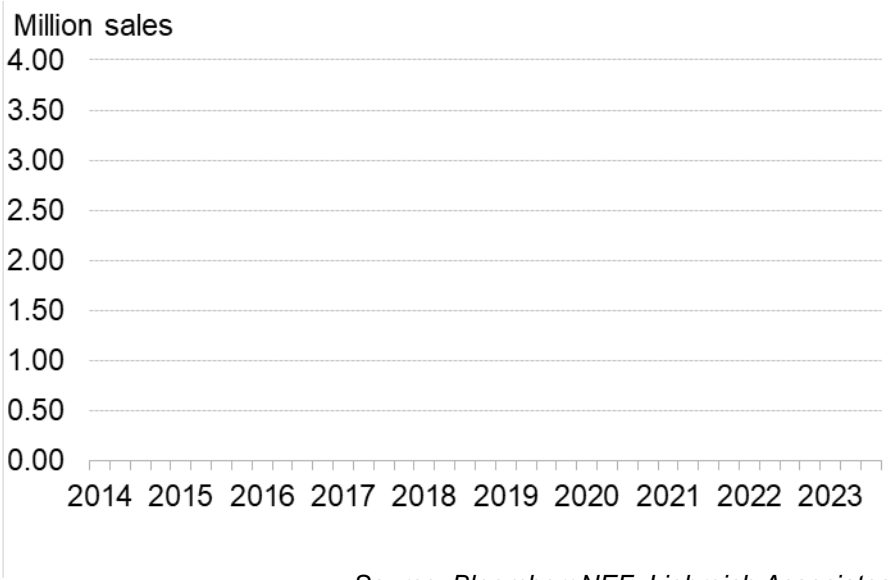
Electric vs hydrogen car sales, global quarterly

Liebreich Associates

Battery electric vehicles (inc. PHEVs)



Hydrogen fuel cell vehicles



Source: BloombergNEF; Liebreich Associates

How it started… how it's going – H2 buses

Liebreich Associates

December 2019

A French town has become the first to launch a fleet of public transit buses powered by hydrogen fuel.

Hydrogen transit buses have entered service in Pau, a town in France located on the northern end of the Pyrenees Mountains. The fleet of buses powered by this clean fuel is the first in the world.

The total fleet consists of eight hydrogen buses.

November 2023

French city that pioneered hydrogen buses will opt for battery-electric in future due to ongoing problems and high costs

Source: Hydrogen Fuel News, Hydrogen Insight

How it started… how it's going – H2 trains

Liebreich Associates

August 2022

Germany inaugurates world's first hydrogen-powered train fleet

A fleet of 14 trains powered entirely by hydrogen is launched in Germany's Lower Saxony state.

A fleet of 14 trains were provided by French industrial giant Alstom [Alstom handout/EPA]

24 Aug 2022

August 2023

No more hydrogen trains | Rail company that launched world's first H2 line last year opts for all-electric future

State-owned LNVG to buy 102 battery trains and 27 catenary-connected models in order to phase out diesel, says Lower Saxony government

Source: Al Jazeera, Hydrogen Insight

Hydrogen distribution

Liebreich Associates

One diesel / petrol tanker truck

18 hydrogen tube trailer trucks

Source: Liebreich Associates. Images: Wikimedia Commons

Hydrogen planes, demand example: London Heathrow International

Liebreich Associates

2.7GW of power 24/7 (heating Thames by 18C)

2,300 liquid hydrogen tankers per day (2 per minute)

Images: ChatGPT

Hydrogen aviation example
Frankfurt airport – 2007

Liebreich Associates

> Um alle Flugzeuge, die auf dem Frankfurter Flughafen tanken, mit Wasserstoff aus der Elektrolyse von Wasser zu versorgen, wäre die Energie von 25 Großkraftwerken nötig. Gleichzeitig würde sich so der Wasserverbrauch von Frankfurt verdoppeln.
>
> Odilo Mühling, MTU

Source: Heise Online "Auf Wiedersehen Wasserstoff"

Hydrogen and heavy goods vehicles

Liebreich Associates

> We decided to invest in a European network of hydrogen filling stations for HGVs, but I'm not sure we got it right. I think electricity is going to carry the day because of progress on batteries and light vehicles.

Patrick Pouyanné
CEO Total Energies

Image: Wikimedia Commons

Hello Hydrogen

Liebreich Associates

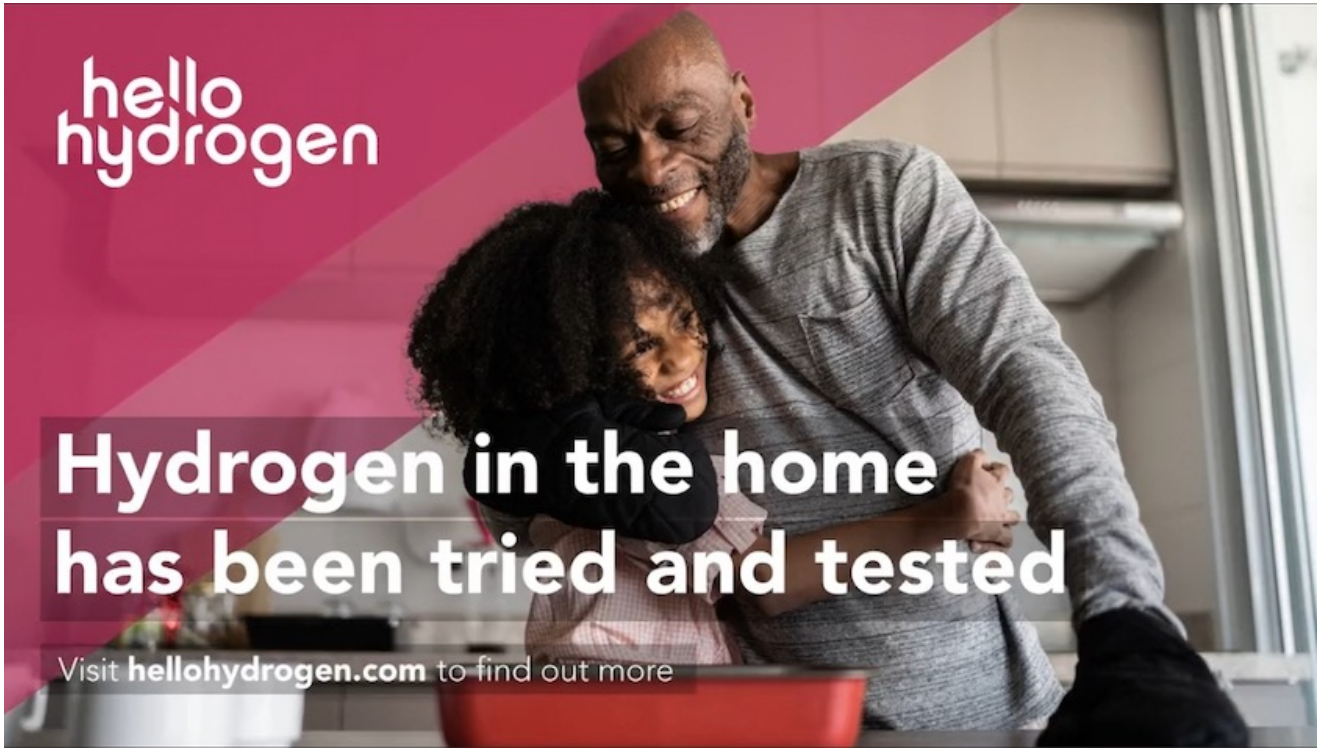


Image: HelloHydrogen

Domestic heating – HelloHydrogen!

Liebreich Associates

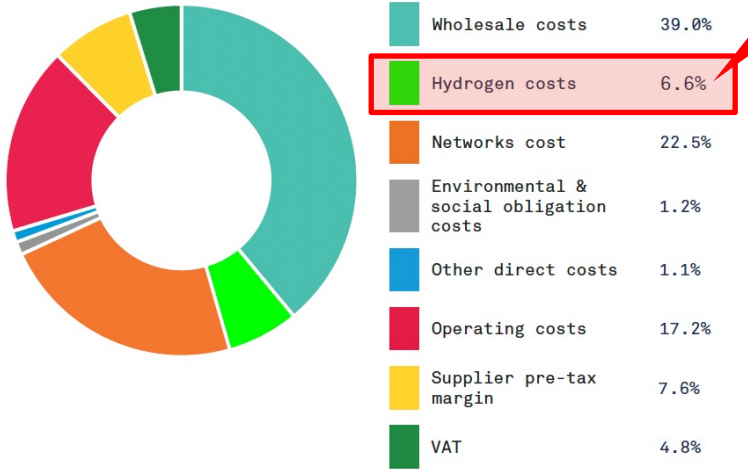
Image: Worcester Bosch

Source: Hy4Heat Safety Assessment, Liebreich Associates

Impact of hydrogen heating on utility bills
H21 North of England study, 2018

Liebreich Associates

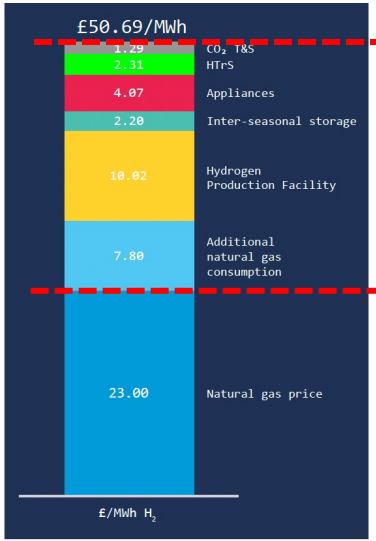
2035 new gas bill (inc. H21 NOE)



6.6% increase in bills

(assuming the cost of 3.8 million hydrogen homes in the North of England can be borne by all UK gas users)

P448: 2035 hydrogen unit price



Hydrogen price - £50.69/MWh

120% increase in unit cost

Fossil gas price - £23/MWh

Source: H21 North of England Report/2018

Hydrogen challenges

Liebreich Associates

- Expensive

- Expensive (except by pipeline)

- Small-scale: expensive
- Large-scale: unproven

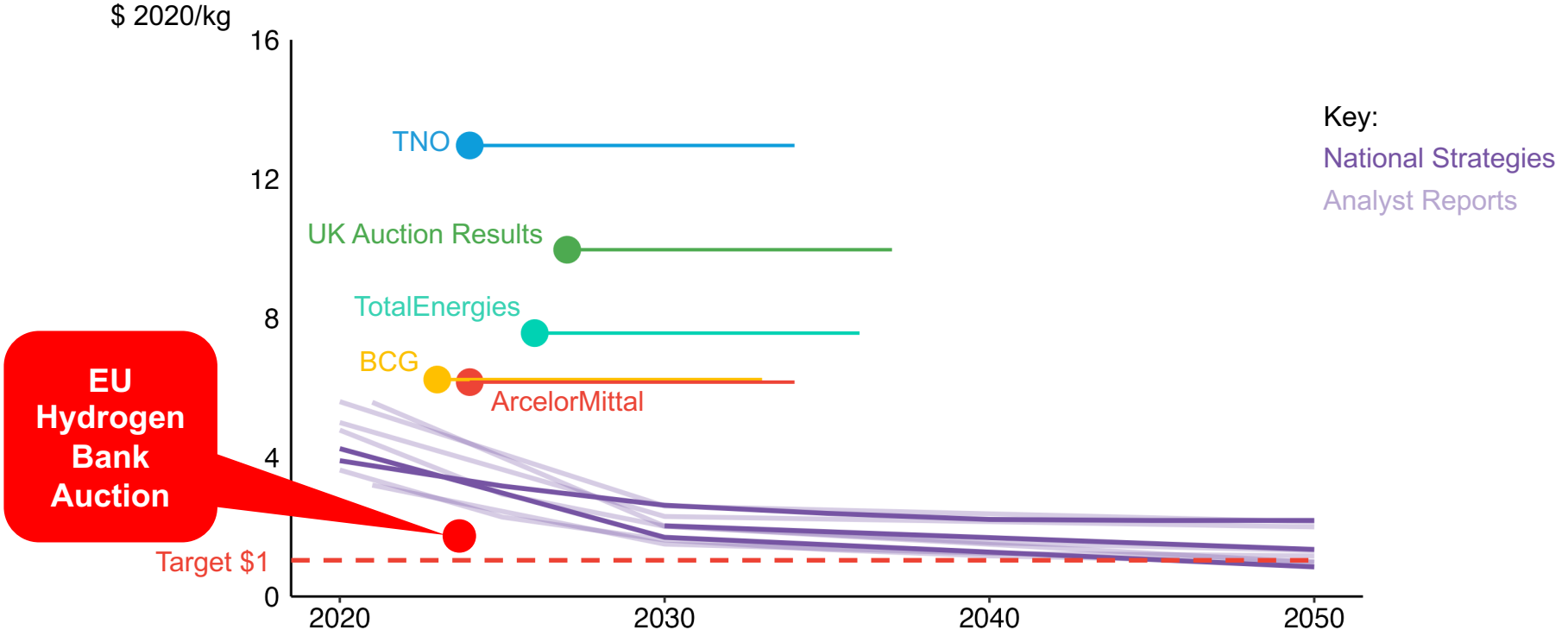
- Expensive

- Existing uses: price-sensitive
- New uses: expensive

Source: Liebreich Associates

Green hydrogen cost: hydrogen strategies vs out-turn

Liebreich Associates



Source: Various, Liebreich Associates

EU Hydrogen auctions – cleared at €0.48

Liebreich Associates

> The EU subsidies we won last week were never meant to cover cost gap with grey H2: the buyer has to pay a premium

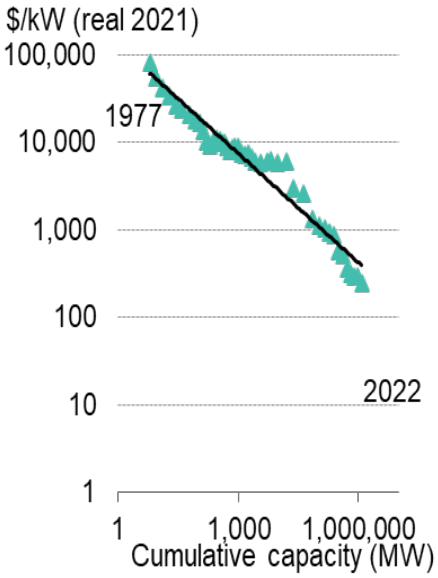
Rogaciano Rebelo
CEO, Madoqua Renewables

Image: Lisbon Energy Summit/YouTube

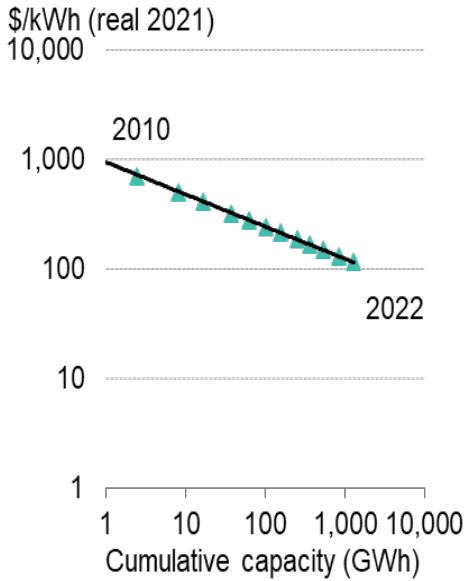
Experience curves

Liebreich Associates

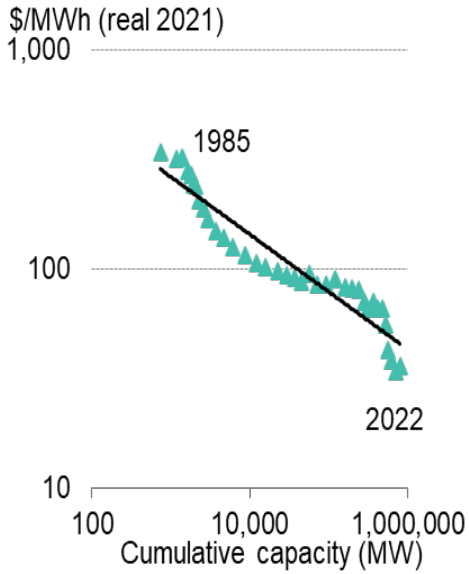
Solar Modules (28%)



Batteries (18%)



Wind (15%)

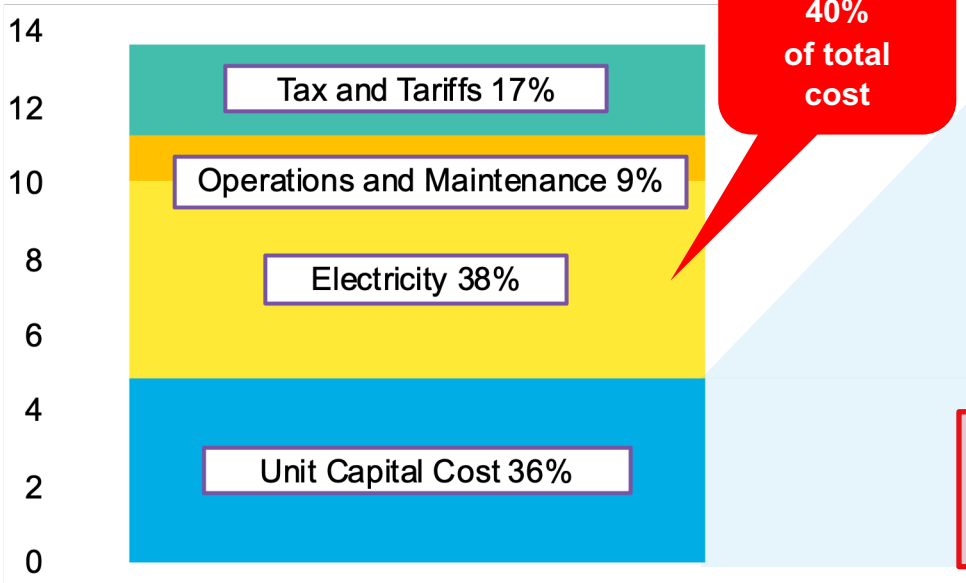


Source: Schmidt et al., BNEF, Liebreich Associates

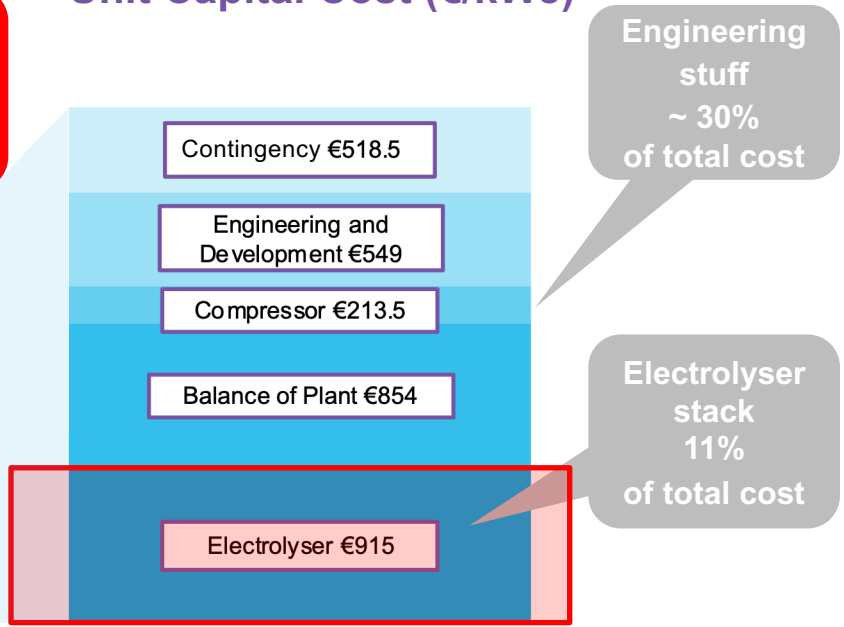
Green Hydrogen – TNO Holland Cost Study

Liebreich Associates

Levelised Cost (€/kg)



Unit Capital Cost (€/kWe)

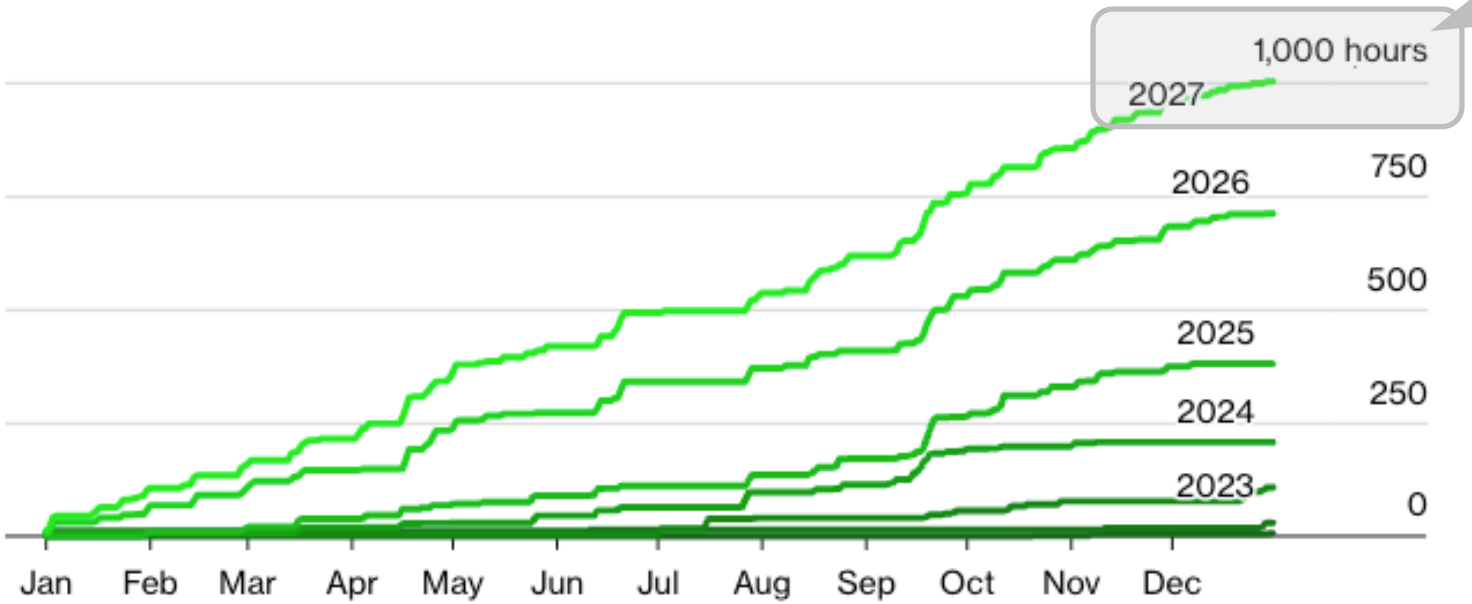


Note: Assumes 100 MWe alkaline/PEM electrolyser; 9.5% WACC; 4,800 FLH based on grid carbon intensity lower than SMR; €75/MWh electricity based on offshore wind

Source: TNO 2024, based on survey responses of current projects

Impact of surplus renewables – UK

Liebreich Associates



Free electricity 11% of the time!

89% of the time you have pay for electricity like anyone else

Source: Modo

Hydrogen challenges

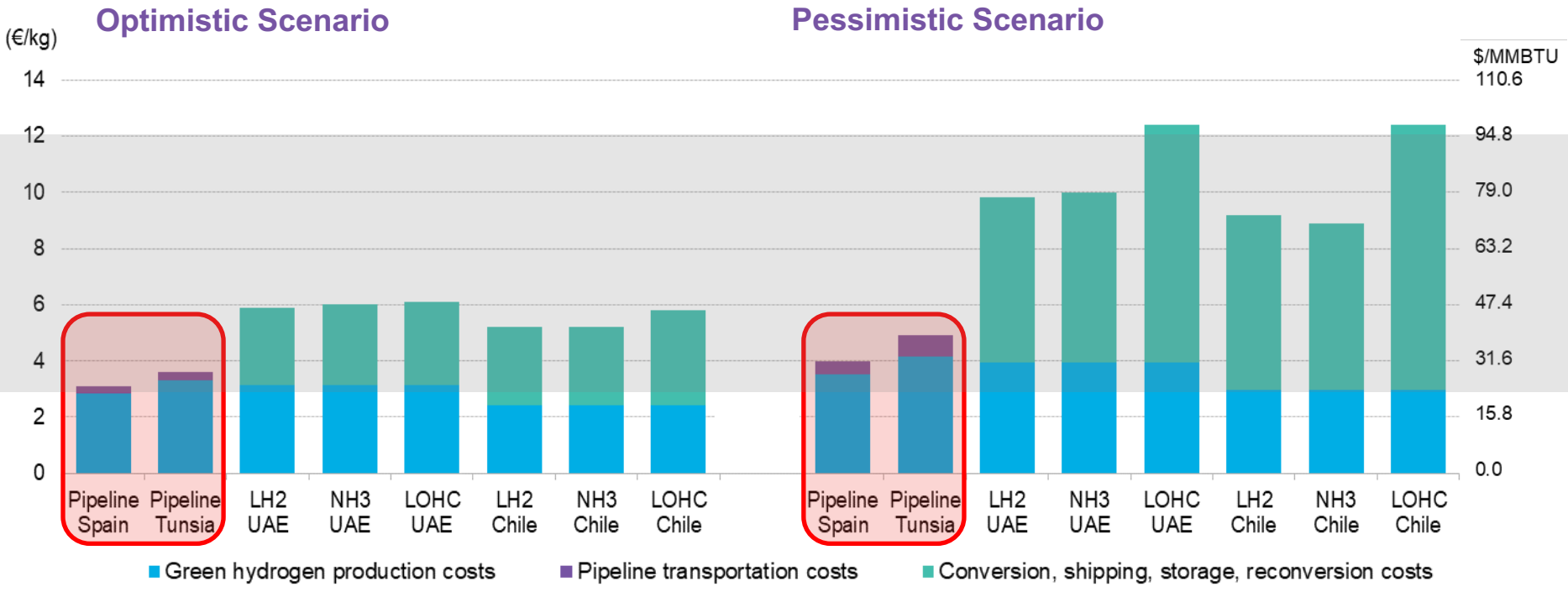
Liebreich Associates

Production	Transportation	Storage	Distribution	Use
• Expensive	• Expensive (except by pipeline)	• Small-scale: expensive • Large-scale: unproven	• Expensive	• Existing uses: price-sensitive • New uses: expensive

Source: Liebreich Associates

Cost of imported hydrogen, Austria/ Germany (2040)

Liebreich Associates



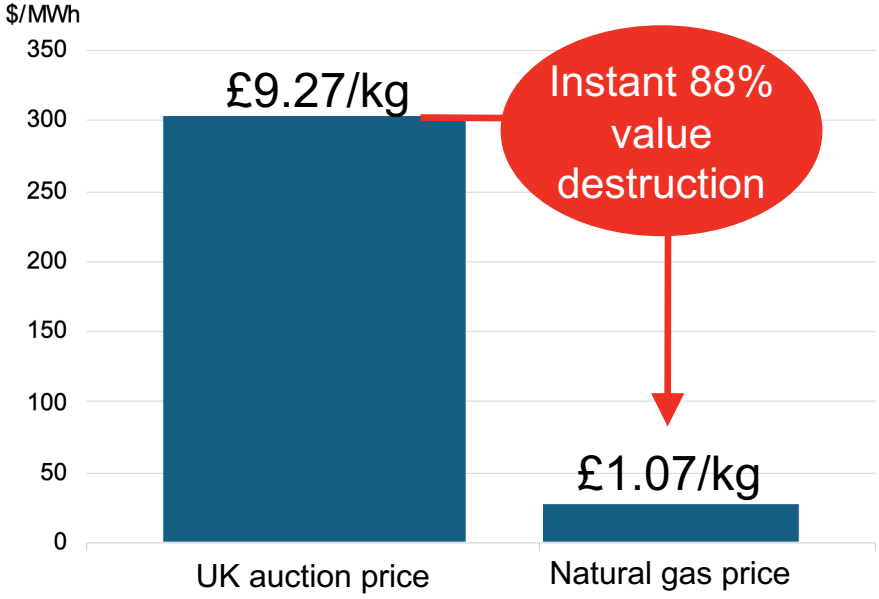
Note: Dutch TTF Natural gas prices as of Sept 2023.

Source: AIT, Bloomberg, Liebreich Associates

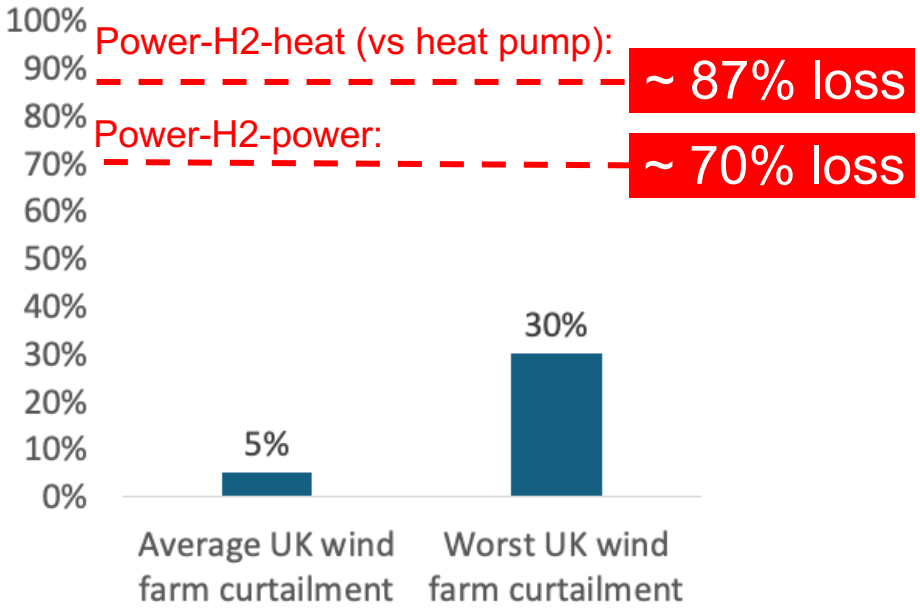
Blending – the stupidest thing from Stupidville

Liebreich Associates

Hydrogen vs heat content



Hydrogen vs grid constraints



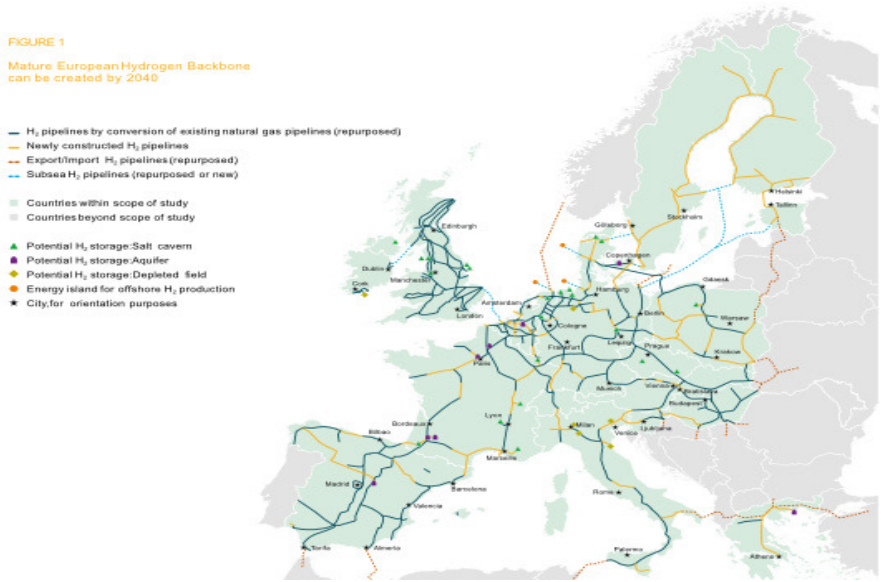
Note: Conversion based on HHV; Prices in 2024 USD

Source: DESNZ; BNEF; Bloomberg

European hydrogen pipeline plans

Liebreich Associates

2024 – European Hydrogen Backbone



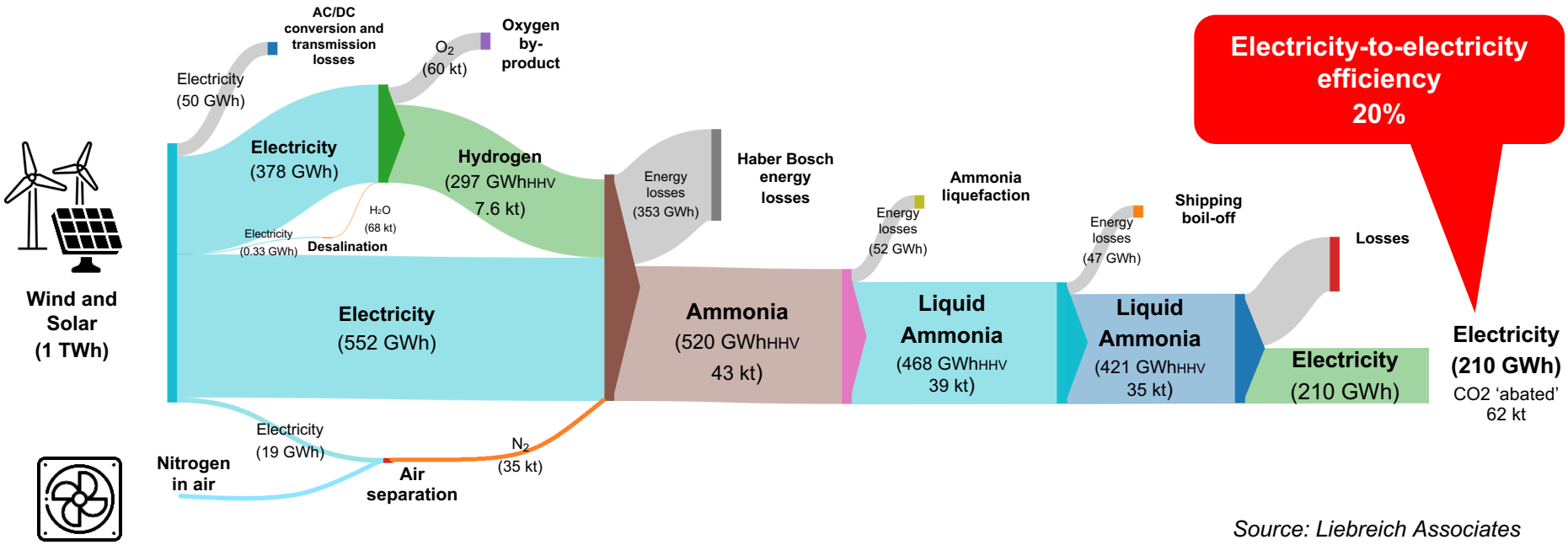
1987

Source: European Hydrogen Backbone, Spiegel

Imported green ammonia electricity generation efficiency (Energy balance)

Liebreich Associates

Manufacturing | Generation, Electrolysis, Air Separation | Haber Bosh | Liquefaction | Shipping | Ammonia firing

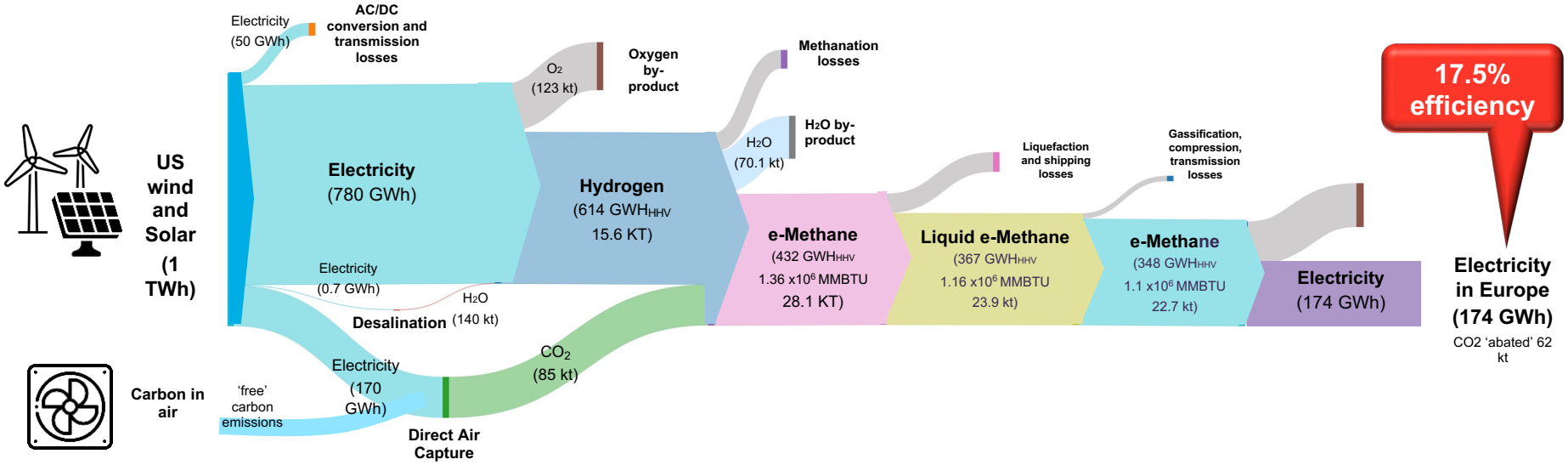


Source: Liebreich Associates

e-Methane w export to Europe
(using Direct Air Capture)

Liebreich Associates

Manufacturing | Generation and carbon capture | Electrolysis | Methanation | Liquefaction and Shipping | Re-gasification, transportation | Electricity

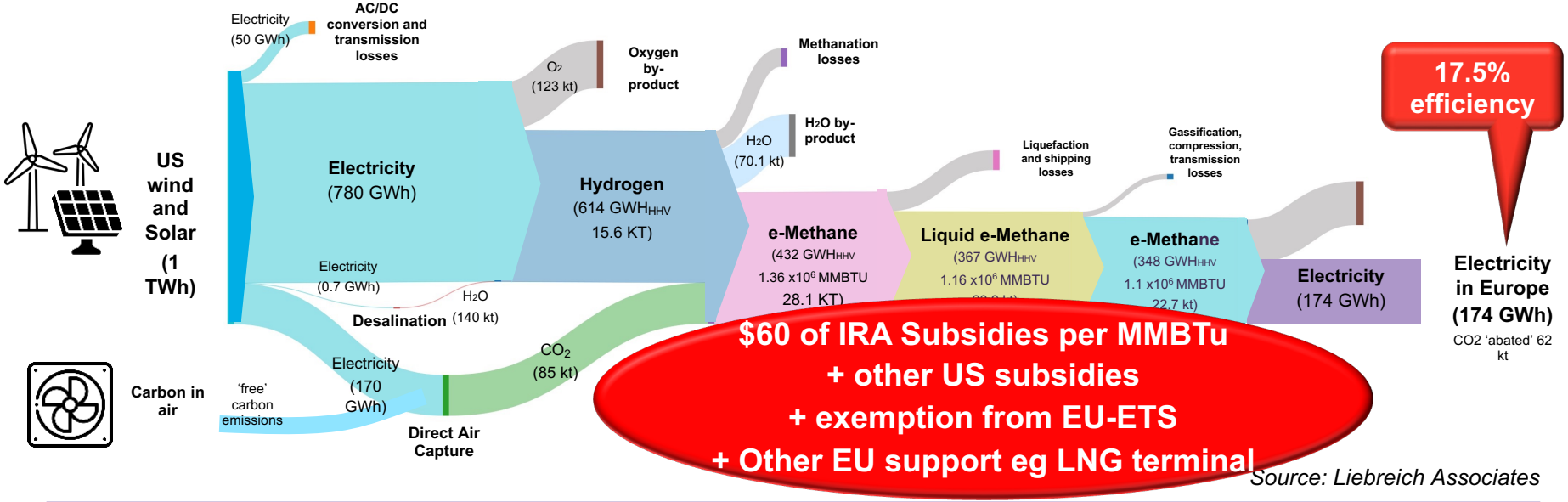


Source: Liebreich Associates

IRA subsidies on e-methane w export to Europe
(using Direct Air Capture)

Liebreich Associates

Manufacturing	Generation and carbon capture	Electrolysis	Methanation	Liquefaction and Shipping	Re-gasification, transportation	Electricity
Advanced manufacturing credit	IRA $ RE 2.6c/kWh	IRA $ CCUS $60/tonne	Infrastructure Act – Grids	IRA $ H2 $3/kg	National, regional, EU energy and climate development funds	EU-ETS exemption €93/tonne



Source: Liebreich Associates

Layering subsidies

Liebreich Associates

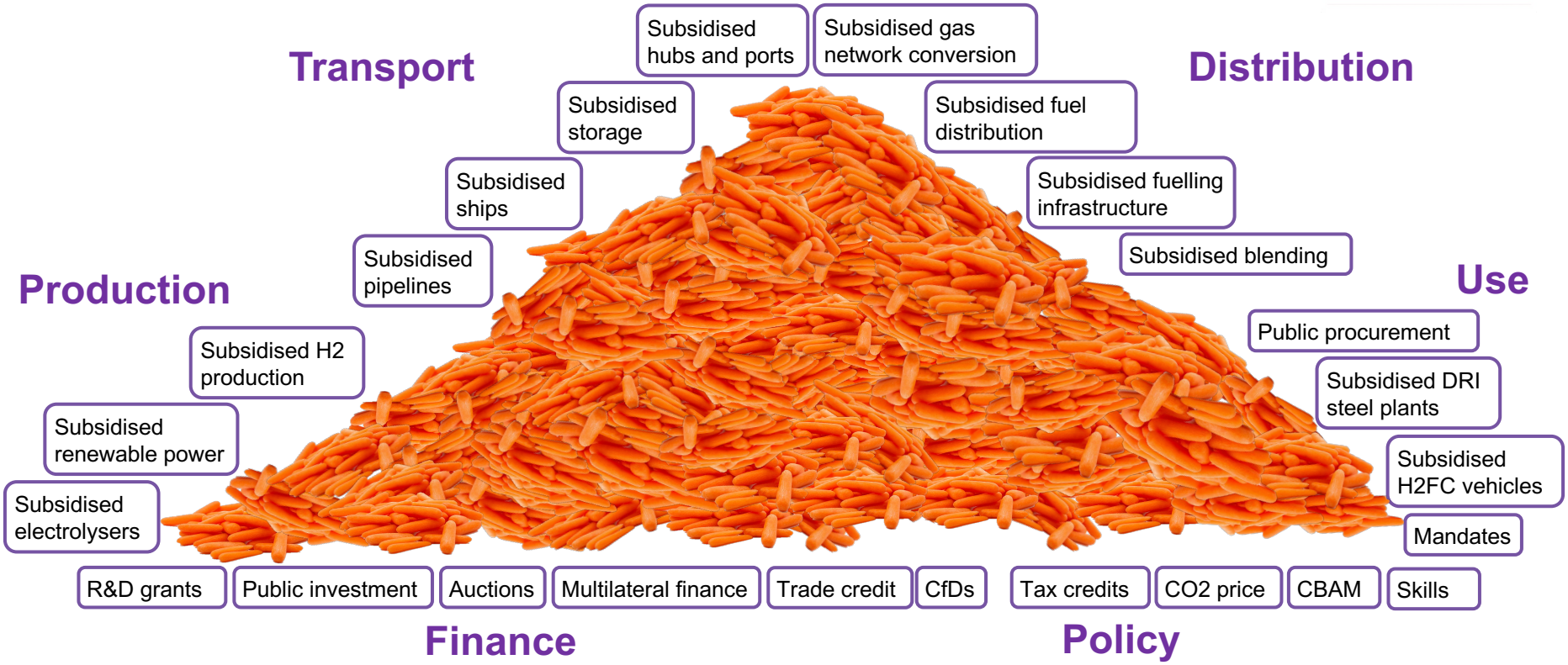
> There's a lot of money to be made in layering all the different subsidies.
>
> So, you get a subsidy for capturing CO2, you get a subsidy for producing the renewables, you get a subsidy for producing the hydrogen.
>
> And guess what, you can export that molecule!

Marco Alverá
CEO, TES

Image: Liebreich Associates

Hydrogen Carrot Economy: layering subsidies

Liebreich Associates



Source: Liebreich Associates

“This is not just a fantasy”

Liebreich Associates

> [The European Commission] discovered the 2x 40 GW electrolyzer initiative that Hydrogen Europe had drafted. They went through all the figures, and we explained, yes, this is not just a fantasy. After three months, [they] presented the strategy, and you will find the 2x 40 GW enshrined in that strategy.

Jorgo Chatzimarkakis
CEO Hydrogen Europe

Image: Cleaning Up

NEOM Green Hydrogen/Ammonia Project

Liebreich Associates

Cost: SAR 31.5 Billion ($USD 8.4 Billion)

Renewable generation: 4 GW

Announced commissioning year: 2026

H2 production: 0.22 Million tonnes/year

Ammonia production: 1.24 Million tonnes/year

0.2% of current global hydrogen demand
0.7% of current global ammonia demand

Image: NEOM

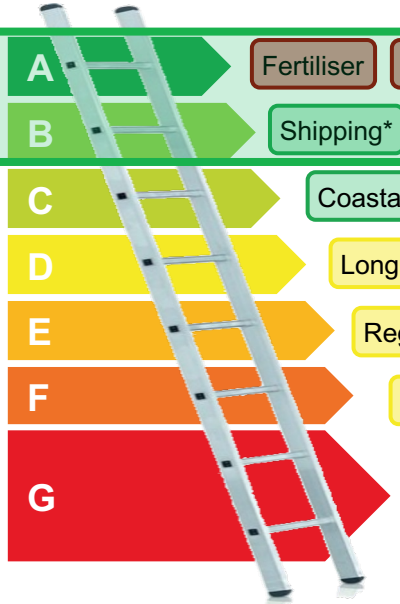
Source: NEOM, GlobalData, Liebreich Associates

Hydrogen Ladder 5.0

Liebreich Associates

Key: No real alternative | Electricity/batteries | Biomass/biogas | Other

Unavoidable



4.5x all existing wind & solar (2023)

A	Fertiliser	Hydrogenation	Methanol	Hydrocracking	Desulphurisation		
B	Shipping*	Jet Aviation**	Chemical Feedstock	Steel	Long Duration Grid Balancing		
C	Coastal and river vessels	Non-Road Mobile Machinery	Vintage and Muscle Cars**	Biogas Upgrading			
D	Long Distance Trucks and Coaches	High-Temperature Industrial Heat	Generators				
E	Regional Trucks	Commercial Heating***	Island Grids	Short Duration Grid Balancing			
F	Light Aviation	Remote and Rural Trains	Local Ferries	Light trucks	Bulk Power Imports	UPS	
G	Metro Trains and Buses	Urban Delivery and Taxis	2 and 3-Wheelers	Cars	Bulk e-Fuels		
	Mid/Low-Temperature Industrial Heat	Domestic Heating	Power Generation Using Non-Stored Hydrogen				

Uncompetitive

*As ammonia or methanol **As e-fuel or PBTL ***As hybrid system

Source: Michael Liebreich/Liebreich Associates, Clean Hydrogen Ladder, Version 5.0, 2023. Concept credit: Adrian Hiel, Energy Cities. CC-BY 4.0

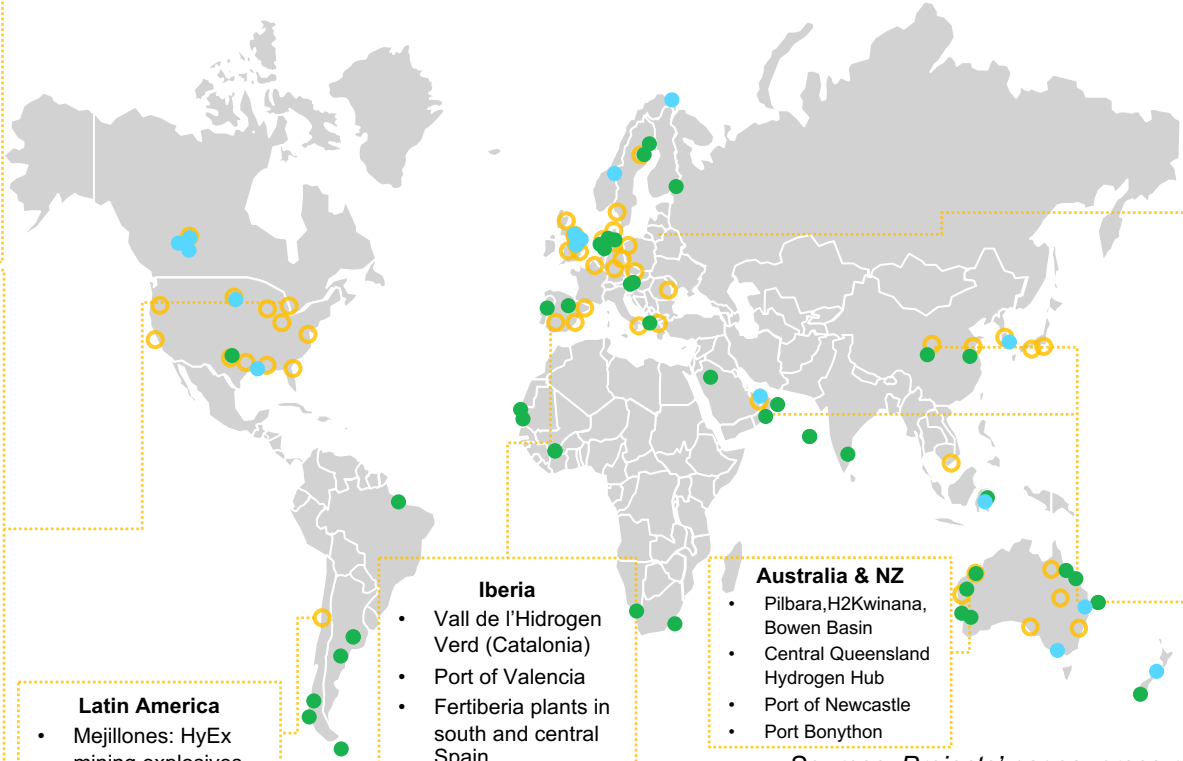
Low carbon hydrogen hubs

Hydrogen industrial hub
Green hydrogen giga-project
Blue hydrogen giga-project

Liebreich Associates

Europe - other
- Baltic Sea H2
- Steelmaking: Lulea, Duigsburg, Dunkirk, SALCOS,GravitHy
- Refineries in Lingen, Heide, Saras, Schwechat
- Copenhagen
- Western Macedonia

North America:
- Appalachian Hydrogen Hub
- California Hydrogen Hub
- Gulf Coast Hydrogen Hub
- Heartland Hydrogen Hub
- Mid-Atlantic Hydrogen Hub
- Midwest Hydrogen Hub
- Pacific Northwest Hydrogen Hub
- Great Plains Hydrogen Hub
- Horizons Clean Hydrogen Hub (Port of Corpus Christi)
- Hydrogen City
- Port of Long Beach
- Suncor Edmonton Refinery
- Mississippi Clean Hydrogen Hub
- HIF USA
- Grön Fuels



Latin America
- Mejillones: HyEx mining explosives

Iberia
- Vall de l'Hidrogen Verd (Catalonia)
- Port of Valencia
- Fertiberia plants in south and central Spain

Australia & NZ
- Pilbara,H2Kwinana, Bowen Basin
- Central Queensland Hydrogen Hub
- Port of Newcastle
- Port Bonython

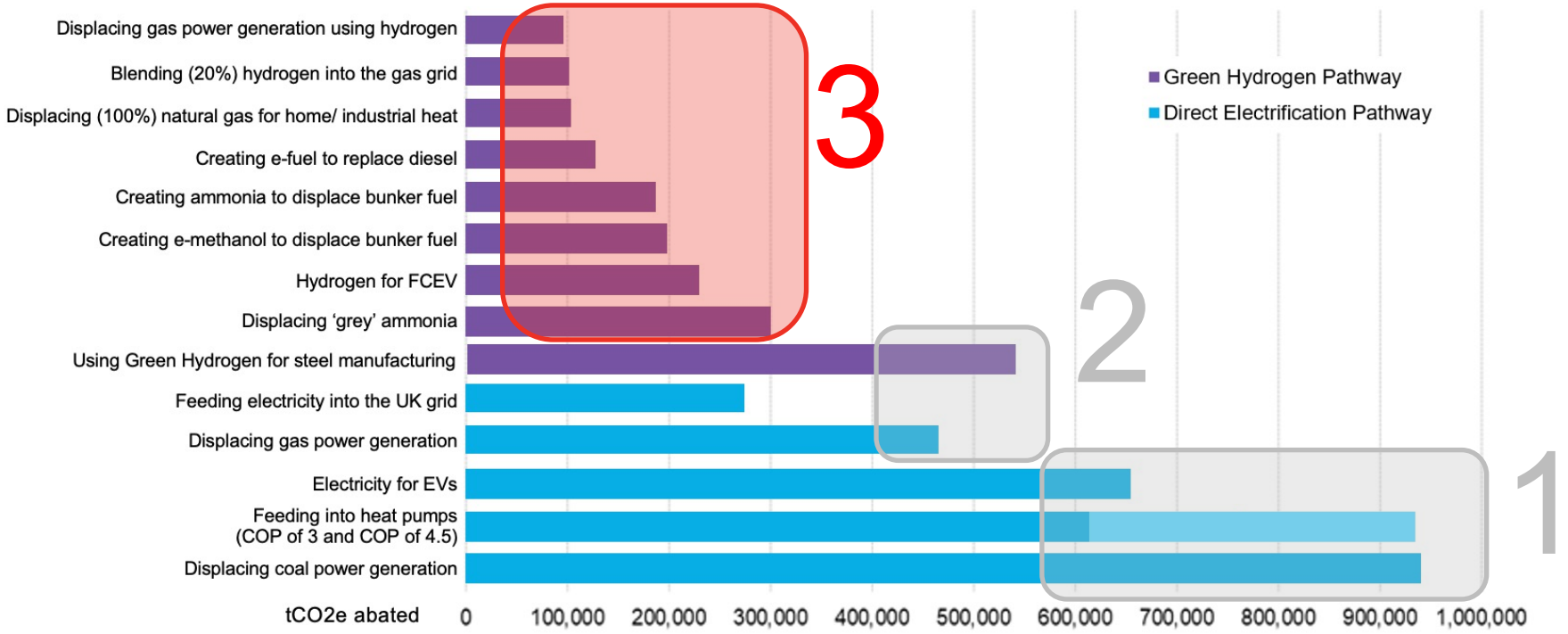
North Sea:
- NorthH2
- Port of Antwerp
- Port of Rotterdam
- North Holland
- ZeroCarbon Humber
- HyNet NorthWest
- Teesside
- Aberdeen
- Cromarty Firth
- AquaVentus
- Freeport East
- Grangemouth
- Fawley
- Green Hydrogen Hub Denmark

Gulf & Asia:
- Hebei province Duqm refinery
- Port of Onahama-Kobe Area
- Ulsan
- Datong
- H2Biscus Malaysia

Sources: Projects' pages, press releases, Liebreich Associates

Emission reduction using 1TWh of renewable energy

Liebreich Associates



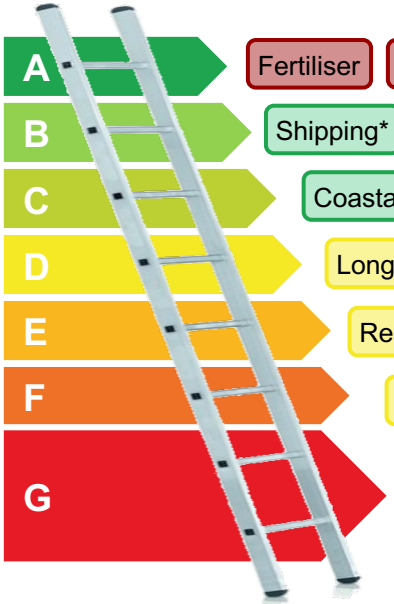
Source: CCC UK, IEA, Liebreich Associates, various

Hydrogen Ladder 5.0

Liebreich Associates

Key: No real alternative | Electricity/batteries | Biomass/biogas | Other

Unavoidable



A: Fertiliser | Hydrogenation | Methanol | Hydrocracking | Desulphurisation

B: Shipping* | Jet Aviation** | Chemical Feedstock | Steel | Long Duration Grid Balancing

C: Coastal and river vessels | Non-Road Mobile Machinery | Vintage and Muscle Cars** | Biogas Upgrading

D: Long Distance Trucks and Coaches | High-Temperature Industrial Heat | Generators

E: Regional Trucks | Commercial Heating*** | Island Grids | Short Duration Grid Balancing

F: Light Aviation | Remote and Rural Trains | Local Ferries | Light trucks | Bulk Power Imports | UPS

G: Metro Trains and Buses | Urban Delivery and Taxis | 2 and 3-Wheelers | Cars | Bulk e-Fuels | Mid/Low-Temperature Industrial Heat | Domestic Heating | Power Generation Using Non-Stored Hydrogen

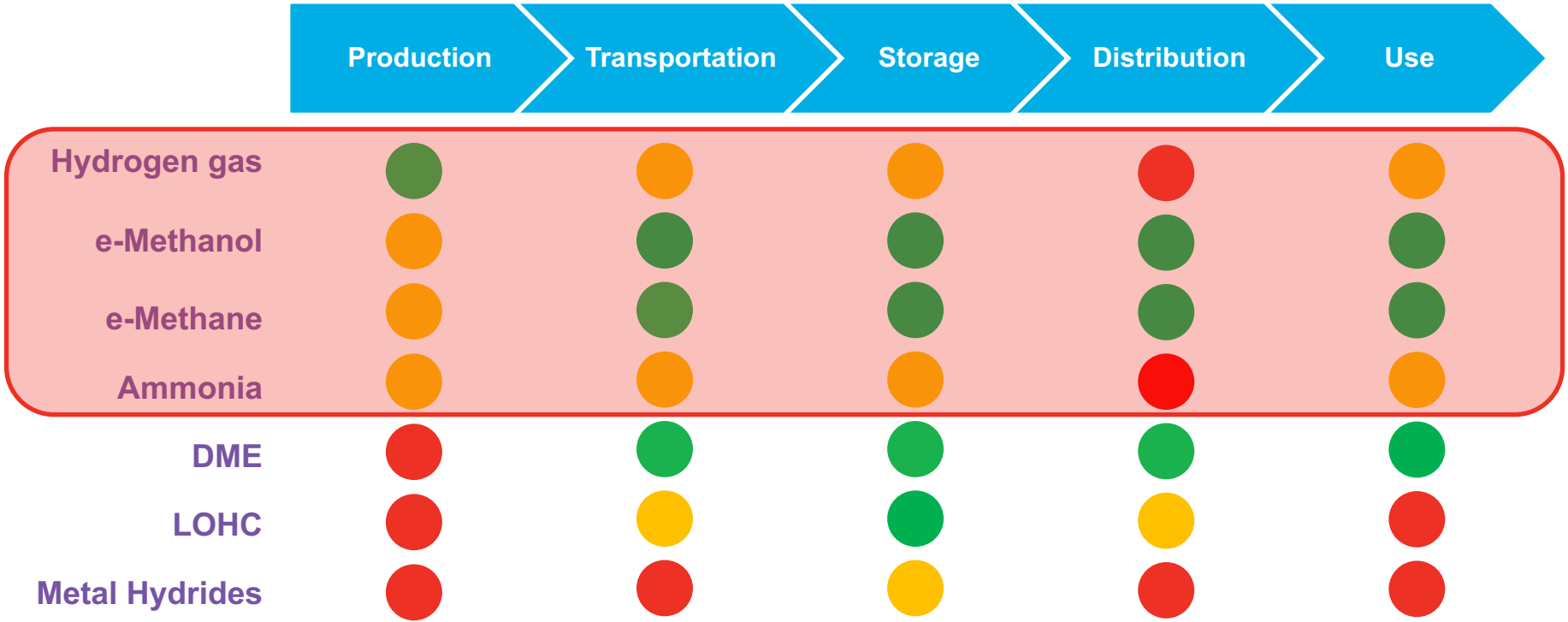
Uncompetitive

*As ammonia or methanol **As e-fuel or PBTL ***As hybrid system

Source: Michael Liebreich/Liebreich Associates, Clean Hydrogen Ladder, Version 5.0, 2023. Concept credit: Adrian Hiel, Energy Cities. CC-BY 4.0

Hydrogen storage options (long-duration)

Liebreich Associates



Sources: Liebreich Associates

Opportunities for UK-EU cooperation

Liebreich Associates

Cheap!

Sectors

- Green steel
- Green fuels for aviation & shipping
- Hydrogen backbone
- Long-duration storage
- Blue hydrogen (done right)
- CO2 transport & sequestration

Themes

- Energy system modelling
- R&D
- Standards, leakage and safety
- Network control
- Resilience planning
- Finance

Source: Liebreich Associates

Liebreich Associates

Thanks!

michael@liebreichassociates.com
www.ecopragma.capital
mliebreich.substack.com
www.liebreich.com
www.cleaningup.live

@mliebreich
@cleaninguppod

Welcome and Opening

Prof Martin Freer

Director, Energy Research Accelerator

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

HyDEX

ERA ENERGY RESEARCH ACCELERATOR

UK-EU Hydrogen Summit

ADELAN

arcola energy

UNIVERSITY OF BIRMINGHAM

cenex

EDF

ERA ENERGY RESEARCH ACCELERATOR

A HORIBA COMPANY MIRA

Intelligent Energy

ITM POWER Energy Storage | Clean Fuel

MDS Transmodal™

Midlands Connect Transport | Investment | Growth

MIDLANDS ENERGY HUB

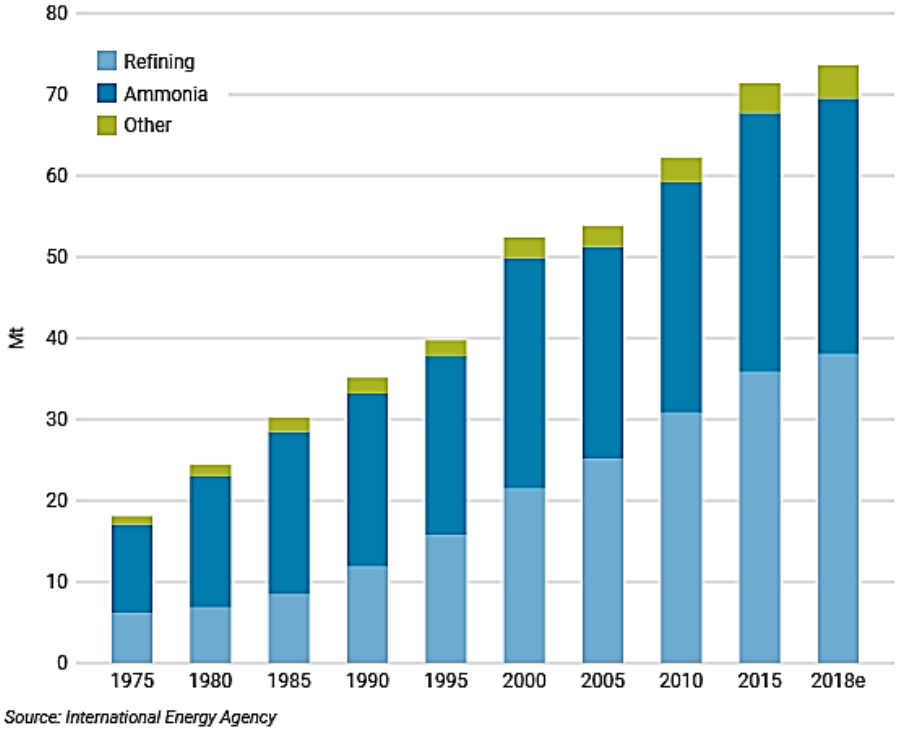
MIDLANDS ENGINE

University of Nottingham UK | CHINA | MALAYSIA

tep Pioneering Clean Energy Growth TYSELEY ENERGY PARK

TOYOTA

Global Demand



Source: International Energy Agency

About three quarters of the world's hydrogen is produced as a by-product from natural gas via steam-methane reforming (SMR); then gasification of coal

Coal contributes to 62% of China's total hydrogen production only 3% renewables, compared with a global average for coal of 18% and 6% in Japan.

Investments required to meet green hydrogen export demand in 2050 are around $2.1 trillion.

Global Hydrogen Review 2023

national
gy Agency

Figure ES.1 Map of announced low-emission hydrogen production projects

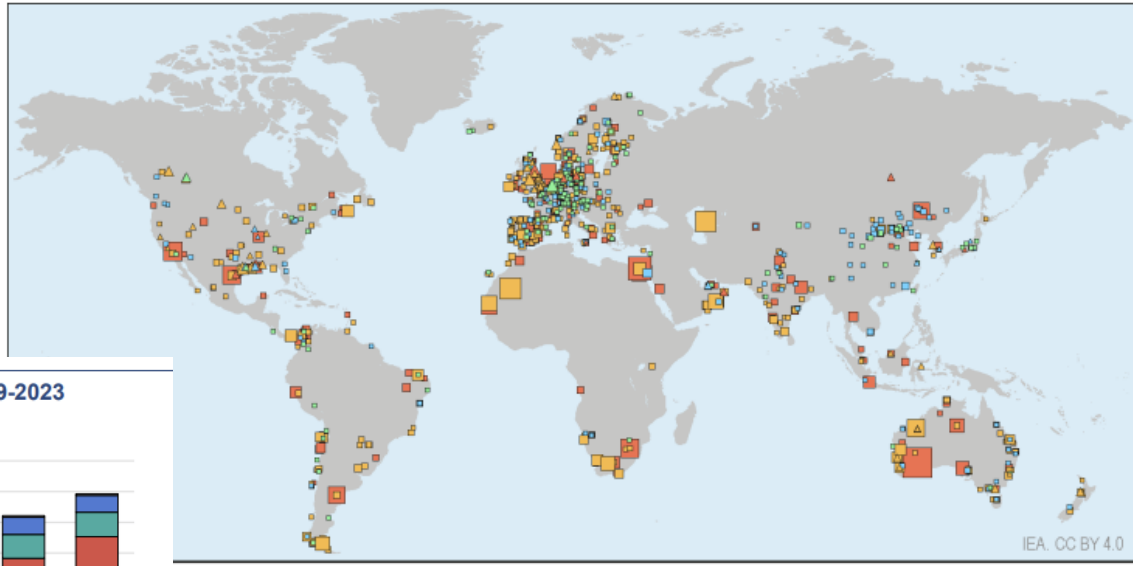
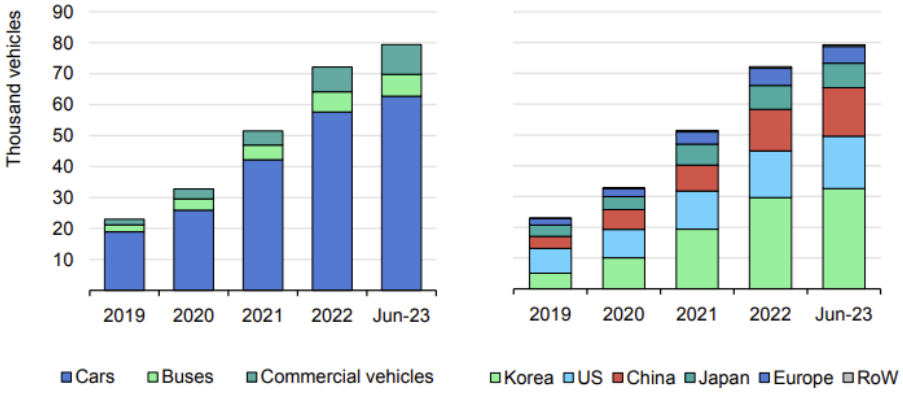


Figure 2.7 Fuel cell electric vehicle stock by segment and region, 2019-2023



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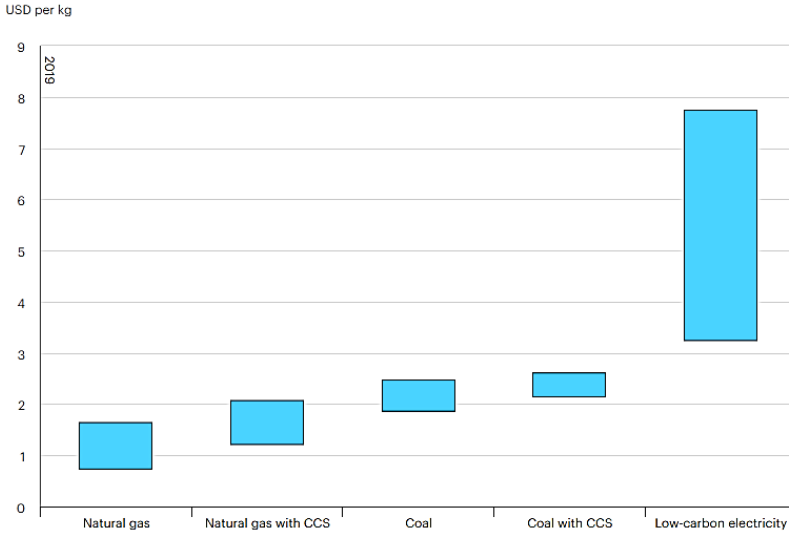
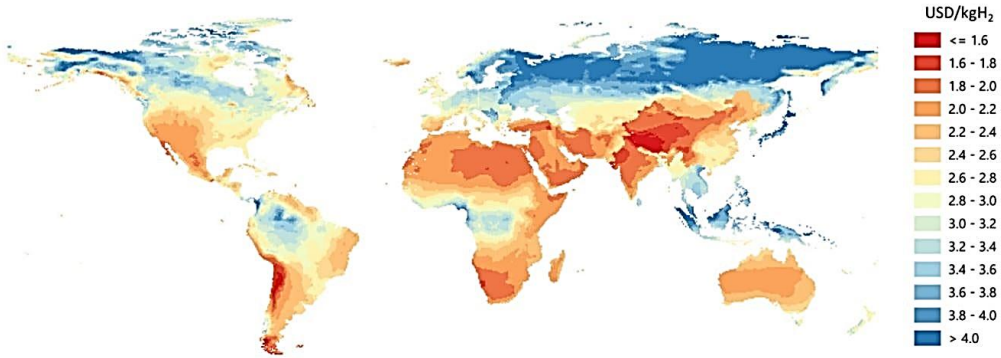
Cost

ING: €1.50/kg for grey hydrogen, €2.50/kg for blue hydrogen and €5-6/kg for green hydrogen.



Global average levelised cost of hydrogen production by energy source and technology, 2019 [IEA]

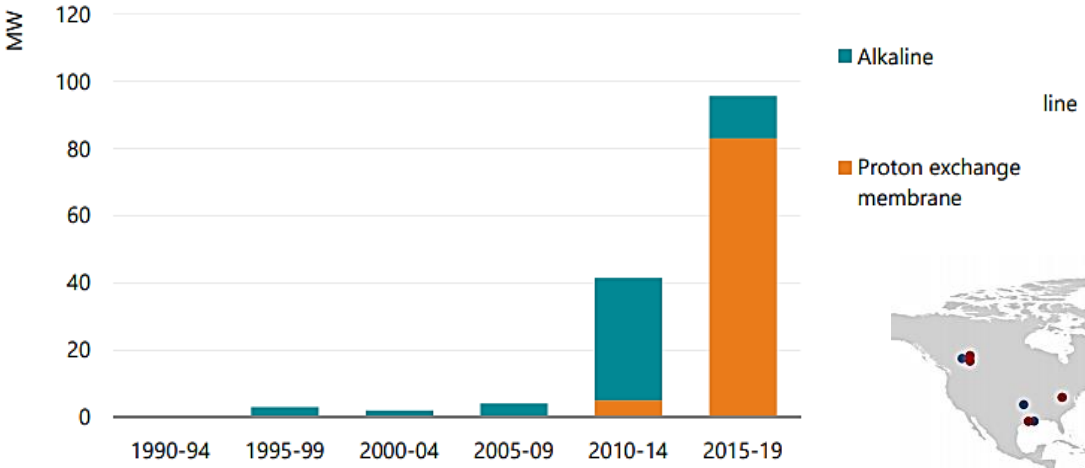
Hydrogen costs from hybrid solar PV and onshore wind systems in the long term



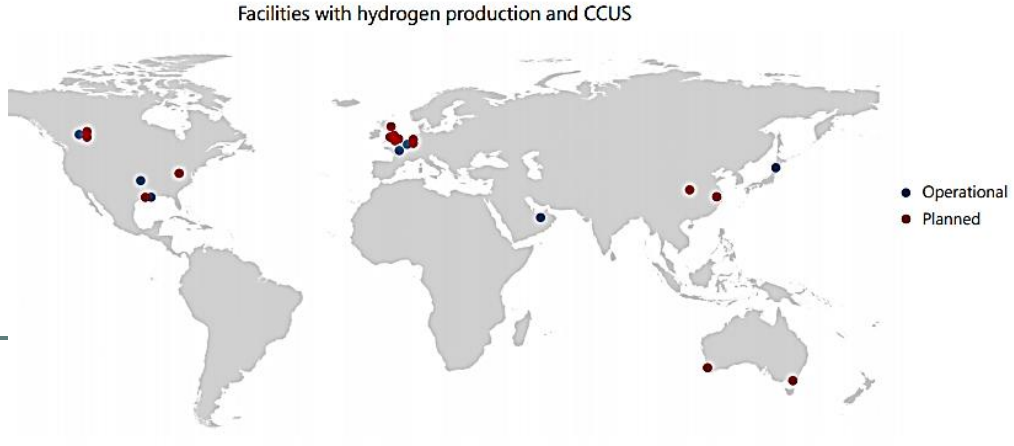
https://www.iea.org/reports/the-future-of-hydrogen

Growth in lower carbon hydrogen

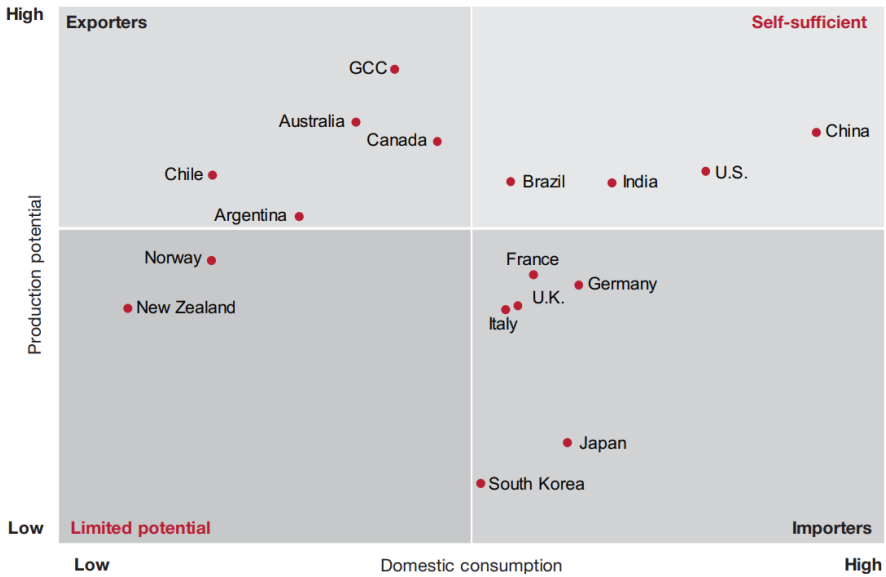
Electrolysers – new investments



[IEA]



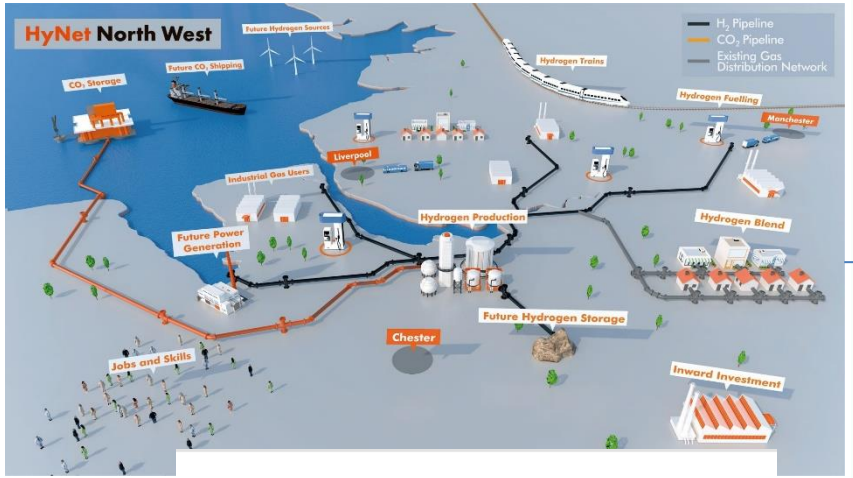
Growth in lower carbon hydrogen



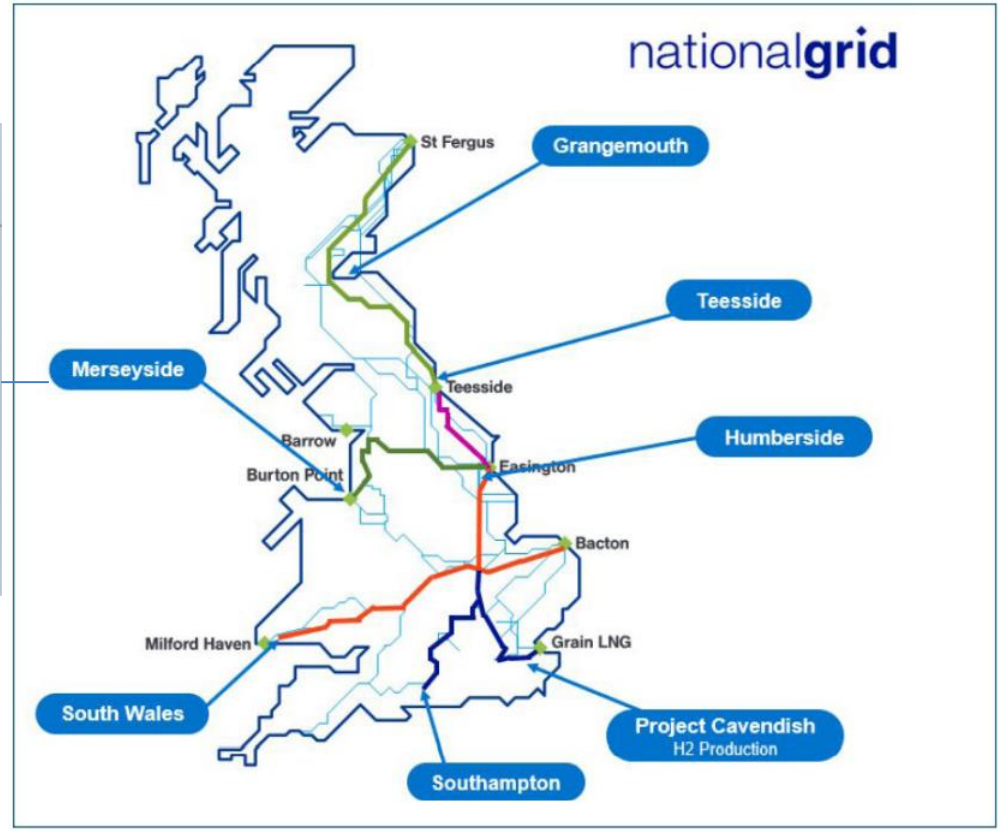
https://www.strategyand.pwc.com/m1/en/reports/2020/the-dawn-of-green-hydrogen/the-dawn-of-green-hydrogen.pdf

Air Products, in conjunction with ACWA Power and NEOM, developing a USD5 billion world-scale green hydrogen-based ammonia production facility powered by renewable energy. The project is scheduled to be onstream in 2025.

Hydrogen Networks



Redcar Hydrogen Community | with Northern Gas Networks



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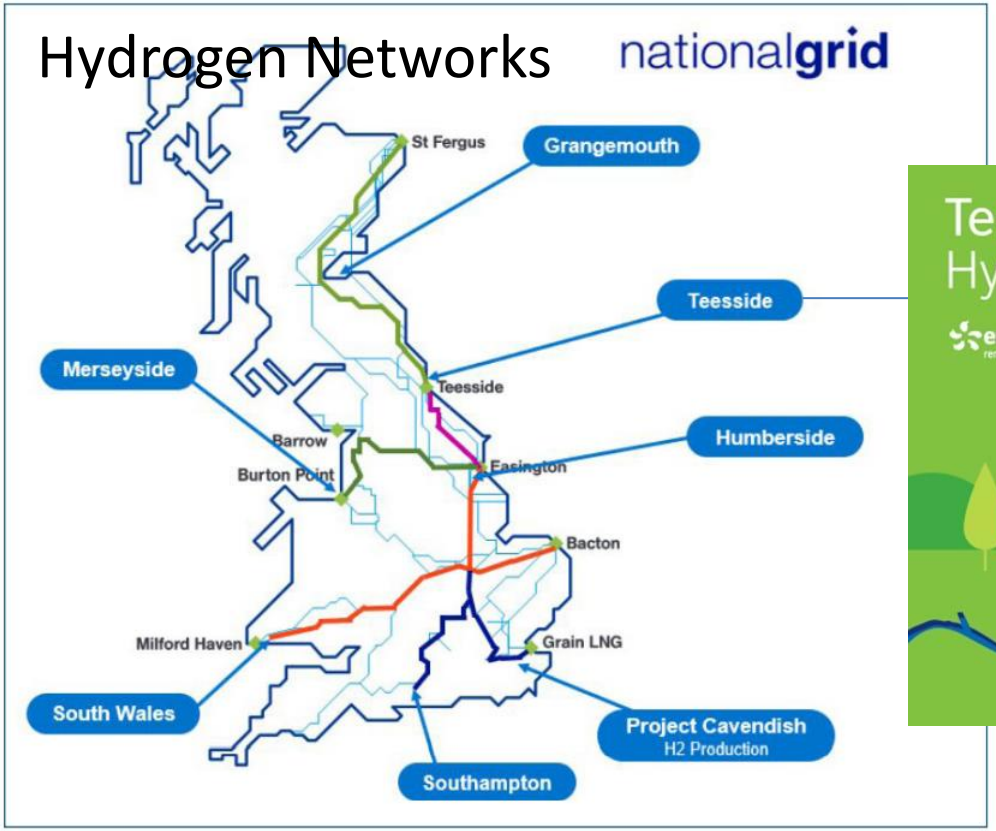
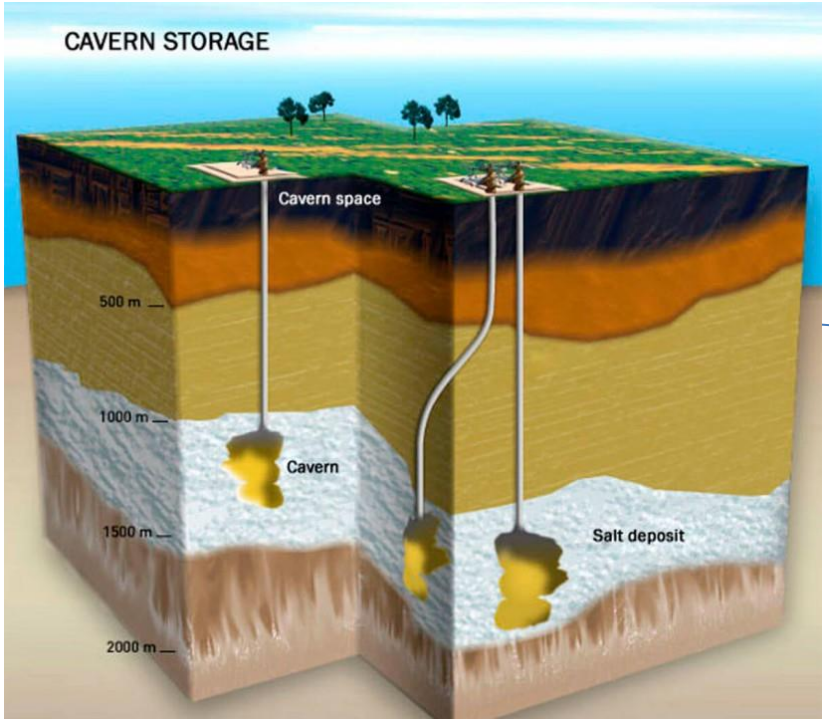
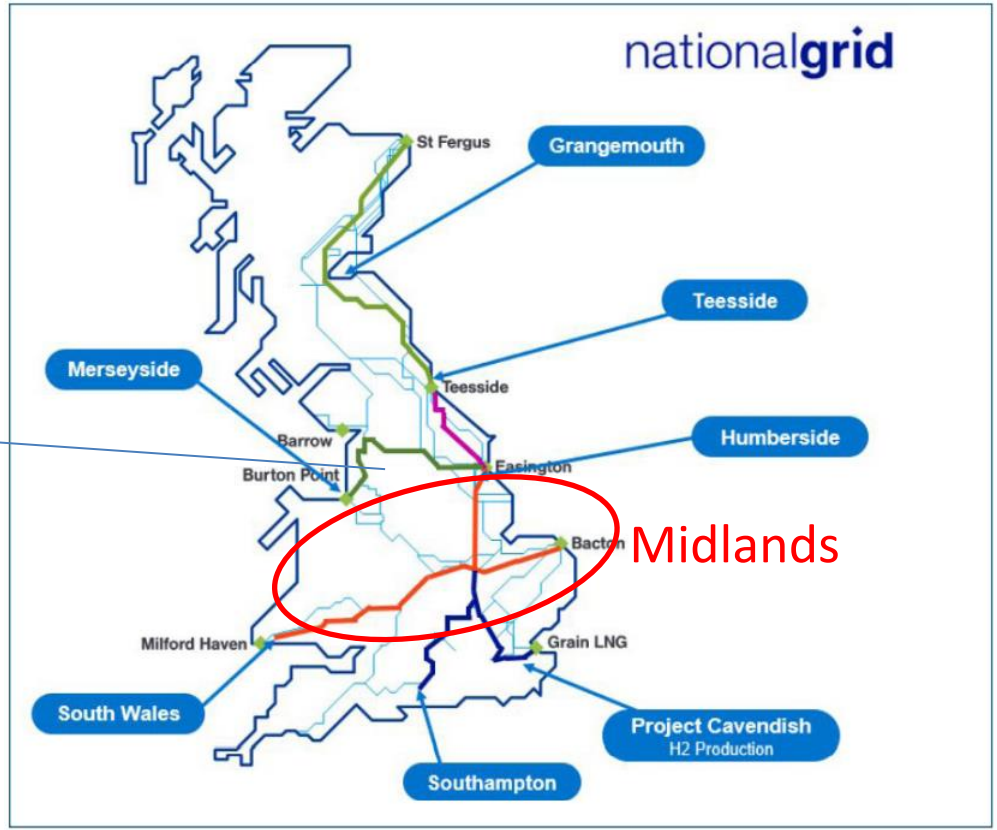
Hydrogen Networks



ENERGY RESEARCH ACCELERATOR

Hydrogen Networks/Storage





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University of Nottingham UK | CHINA | MALAYSIA
WARWICK THE UNIVERSITY OF WARWICK
British Geological Survey NATURAL ENVIRONMENT RESEARCH COUNCIL

MIDLANDS ENGINE GREEN GROWTH

HYDROGEN TECHNOLOGIES STRATEGY

DECEMBER 2021

ACCELERATING GROWTH THROUGH THE MIDLANDS ENGINE HYDROGEN TECHNOLOGIES VALLEY

The Midlands Engine Hydrogen Technologies Valley is an ecosystem that links hydrogen production with end users - based on industrialising hydrogen technologies at scale, enabled via academic and supply chain development support. This map showcases a snapshot of our partners and their projects across our region - local clusters that combine to create a regional capability. Partners are moving rapidly to act on opportunities and therefore this map can only show some of the pioneering and high-potential work that is continually being activated in our region.

KEY:

- Current Project
- Potential Project
- H2 Facilities & Research
- Airport
- Freeport
- Proposed H2 Pipeline

Our region is rightly recognised for our advanced engineering expertise and track record of manufacturing excellence. We have the capabilities and strategic intent to develop and industrialise a broad range of hydrogen technologies for power generation, heat and transport applications, as well as extending hydrogen operations across our entire region.

Our Midlands Engine Hydrogen Technologies Valley vision maps the roll out of facilities, demonstration assets and infrastructure along with a supporting innovation ecosystem.

Our partners have identified a host of opportunities to invest in projects that transition our region to a hydrogen-enabled green growth economy. These projects leverage our industrial clusters and transport corridors, as well as the green growth opportunities linked to ongoing investments in clean energy assets.

This willingness to invest is illustrated by a snapshot of example projects in the timeline shown below. The pace of development is rapid with a wide range of opportunities being pursued across power generation, heat and transport.

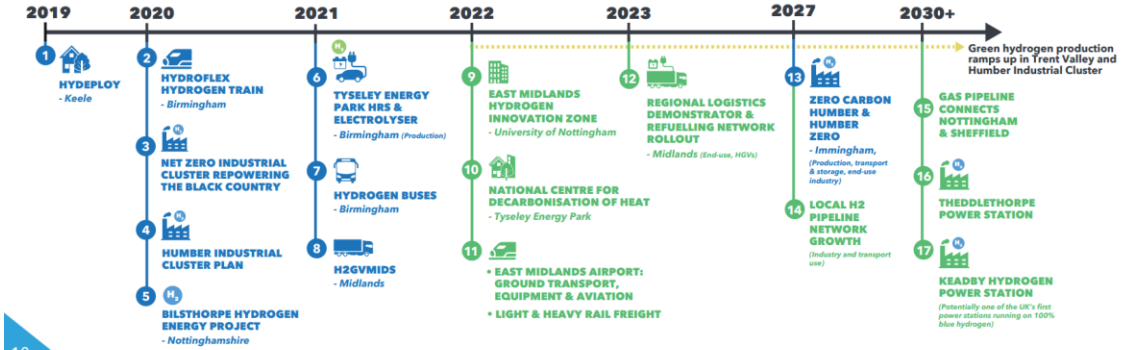
Intelligent Energy

JCB

TOYOTA

ITM POWER
Energy Storage | Clean Fuel

PURSUING OPPORTUNITIES IN POWER, HEAT & TRANSPORT



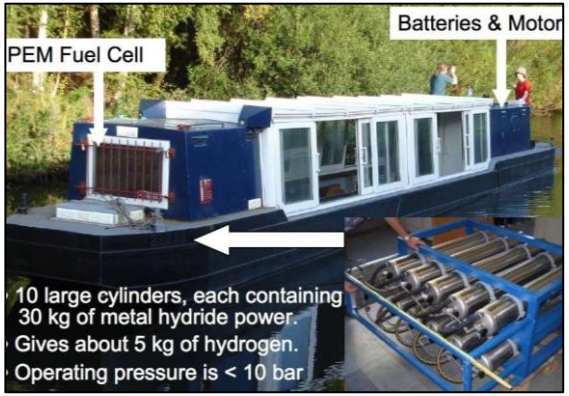
HYDROGEN FACILITIES & RESEARCH

18 ALREWAS GAS COMPRESSOR
19 BRITISH GEOLOGICAL SURVEY
20 WARWICK MANUFACTURING GROUP
21 MANUFACTURING TECHNOLOGY CENTRE
22 LOUGHBOROUGH UNIVERSITY
23 CENTRE FOR FUEL CELL & HYDROGEN RESEARCH - UNIVERSITY OF BIRMINGHAM
24 KEELE UNIVERSITY
25 ASTON UNIVERSITY
26 UNIVERSITY OF LEICESTER
27 UNIVERSITY OF NOTTINGHAM


HYDROFLEX
HYDRO
FLEX

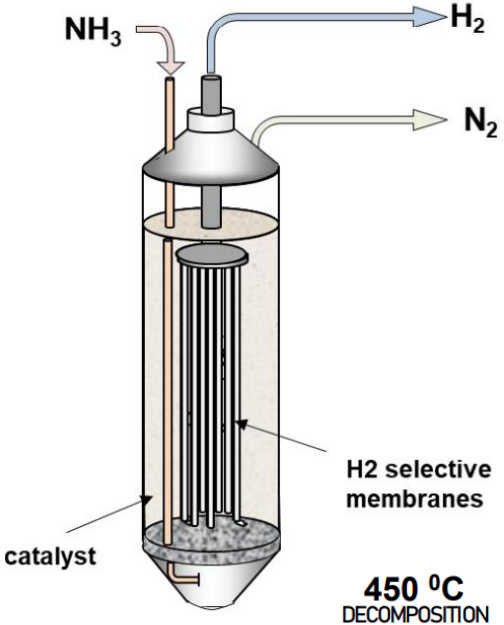

Cranfield
Aerospace
Solutions


HyDeploy


PEM Fuel Cell
Batteries & Motor
10 large cylinders, each containing
30 kg of metal hydride power.
Gives about 5 kg of hydrogen.
Operating pressure is < 10 bar

Ammonia Cracking

$NH_3 \leftrightarrow N_2 + H_2$



450 °C DECOMPOSITION PROCESS

200 kg HYDROGEN PRODUCED PER DAY

>82.3% HYDROGEN RECOVERED EFFICIENCY

c.99.999% HYDROGEN PURITY (VEHICLE-GRADE)

>90% SYSTEM AVAILABILITY

Delivered by MIDLANDS INNOVATION

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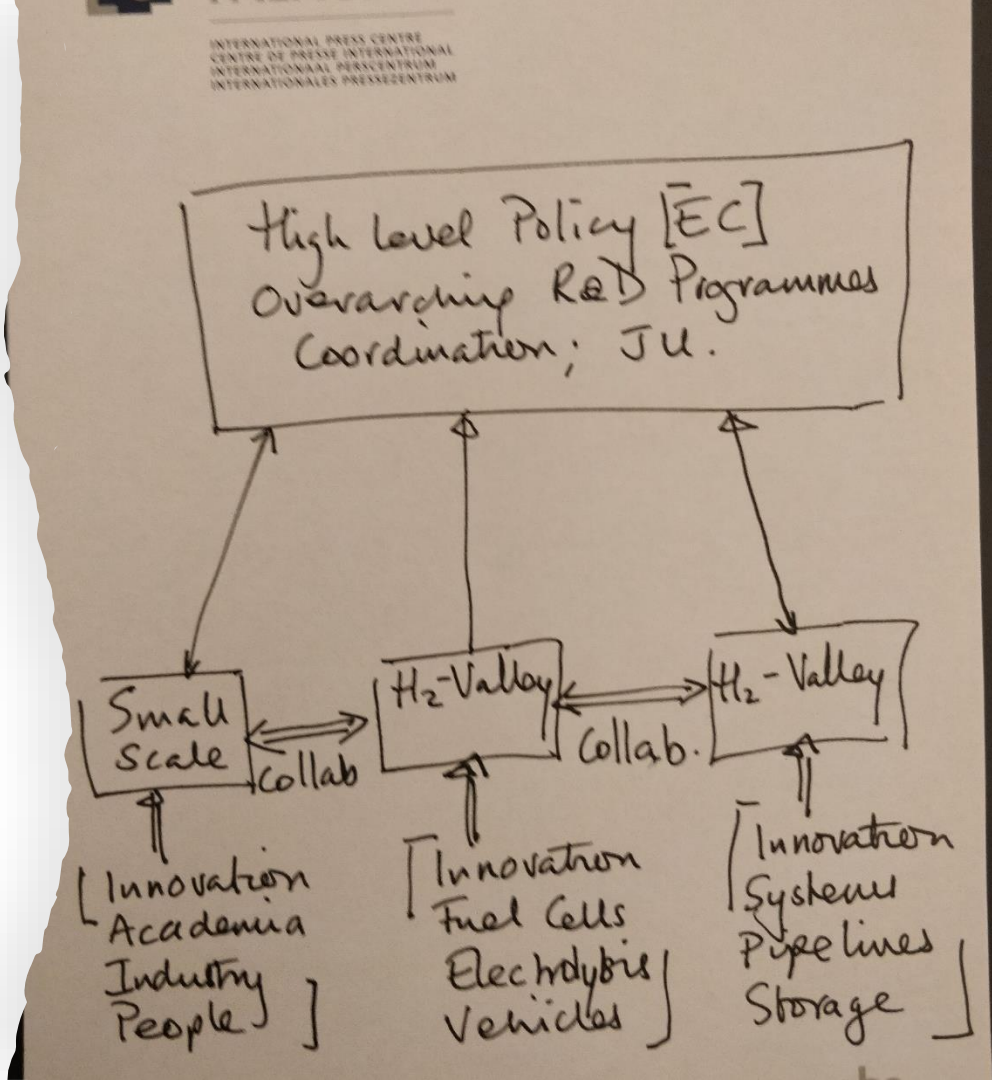
Summary: How to create success?



Session :

Exploring how the UK & EU are driving the Hydrogen acceleration to deliver Net Zero

Dominik Richter

Senior Office, Trade & International Relations

Hydrogen Europe

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

The role of hydrogen valleys

- Dominik Richter, Senior Officer, Trade and International Relations

- 2nd July 2024

ENERGY RESEARCH ACCELERATOR

Hydrogen Europe

WARWICK THE UNIVERSITY OF WARWICK

BGS British Geological Survey

Hydrogen Europe – our mission and vision

Our Vision: Hydrogen Europe is **propelling global carbon neutrality** by accelerating the European hydrogen industry.

Our Mission:

- Hydrogen Europe effectively supports and facilitates its members in their transition towards a (circular) **carbon-neutral economy** while creating and maintaining sustainable jobs.
- We **drive markets** to hydrogen-based solutions **guiding decision-makers** for hydrogen technology and applications.
- We **partner with the European Commission** and the research community in a public-private partnership, **the Clean Hydrogen Partnership**.

Hydrogen Europe in numbers

ENERGY RESEARCH ACCELERATOR

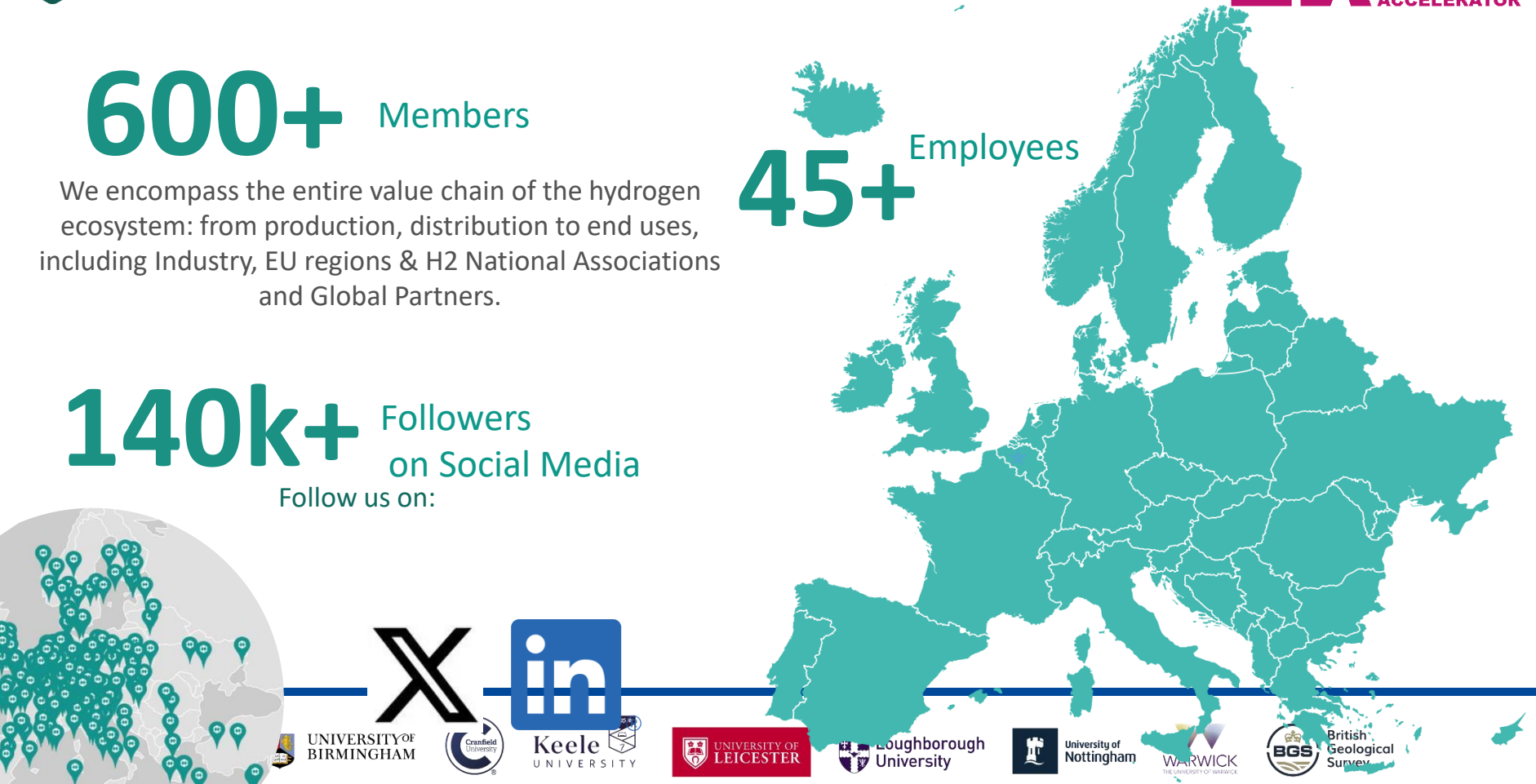
600+ Members

We encompass the entire value chain of the hydrogen ecosystem: from production, distribution to end uses, including Industry, EU regions & H2 National Associations and Global Partners.

45+ Employees

140k+ Followers on Social Media

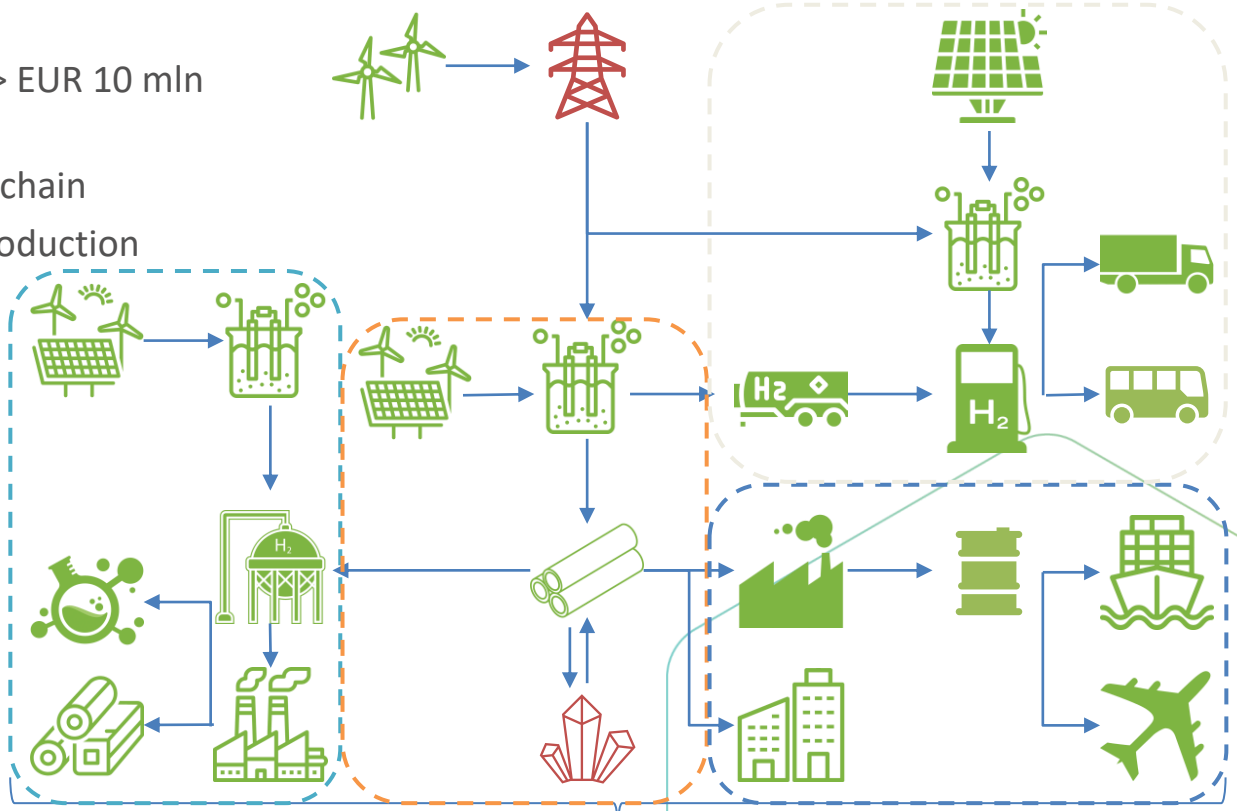
Follow us on:



UNIVERSITY OF BIRMINGHAM · Cranfield University · Keele UNIVERSITY · UNIVERSITY OF LEICESTER · Loughborough University · University of Nottingham · WARWICK THE UNIVERSITY OF WARWICK · BGS British Geological Survey

Hydrogen Valleys

- Large-scale joint investment (> EUR 10 mln and up to multi-bn EUR)
- Cover the full hydrogen value-chain
- Centralised clean hydrogen production
- Shared infrastructure
  - Pipelines, HRS
- Multiple end-uses
  - Transport
  - Energy
  - Industry
- Clear regional scope



Why Hydrogen Valleys?

Meeting the ambitious targets set by the REPowerEU and the Hydrogen Accelerator will require the EU to significantly upscale its hydrogen economy.

Hydrogen Valleys bring together clean hydrogen production, storage, distribution and end-use into fully functioning and sustainable local or regional value chains.

De-risk investment by pulling in public funding & bringing in together the whole value chain.

Promote knowledge sharing and partner matchmaking to build on the existing experience and accelerate successful development of new projects.

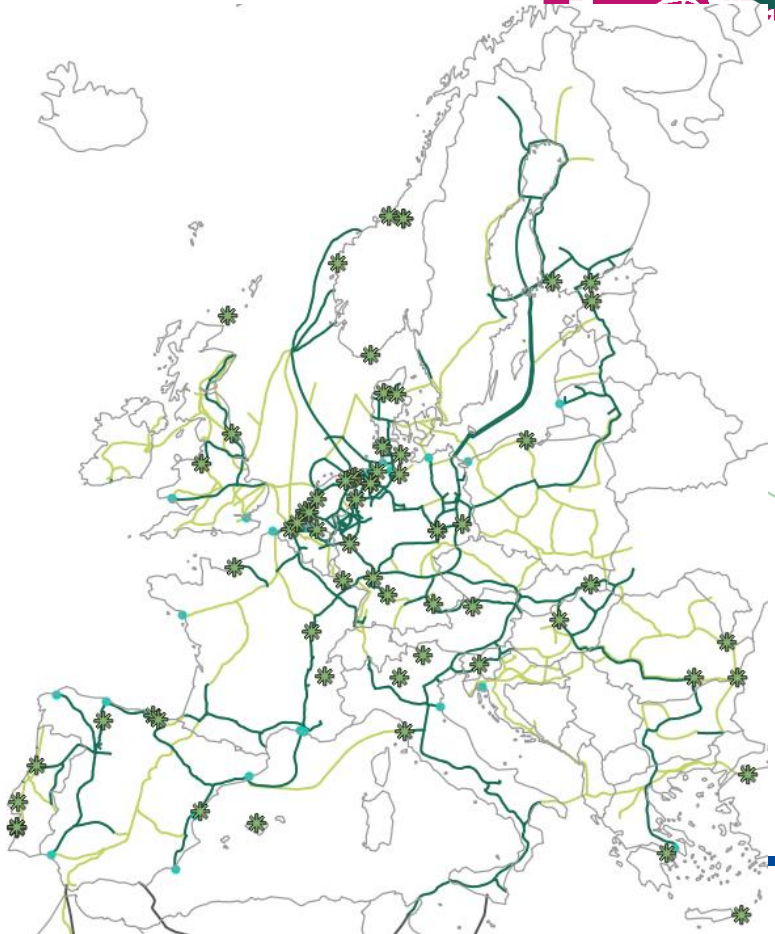
Create ecosystems where research and innovation can be tested in real time and find immediate use leading to further advances in the hydrogen sector.

Ideal for roll-out of H2 education and training, as well as awareness raising activities via demonstration of H2 use.

Hydrogen Valleys & European Hydrogen Backbone

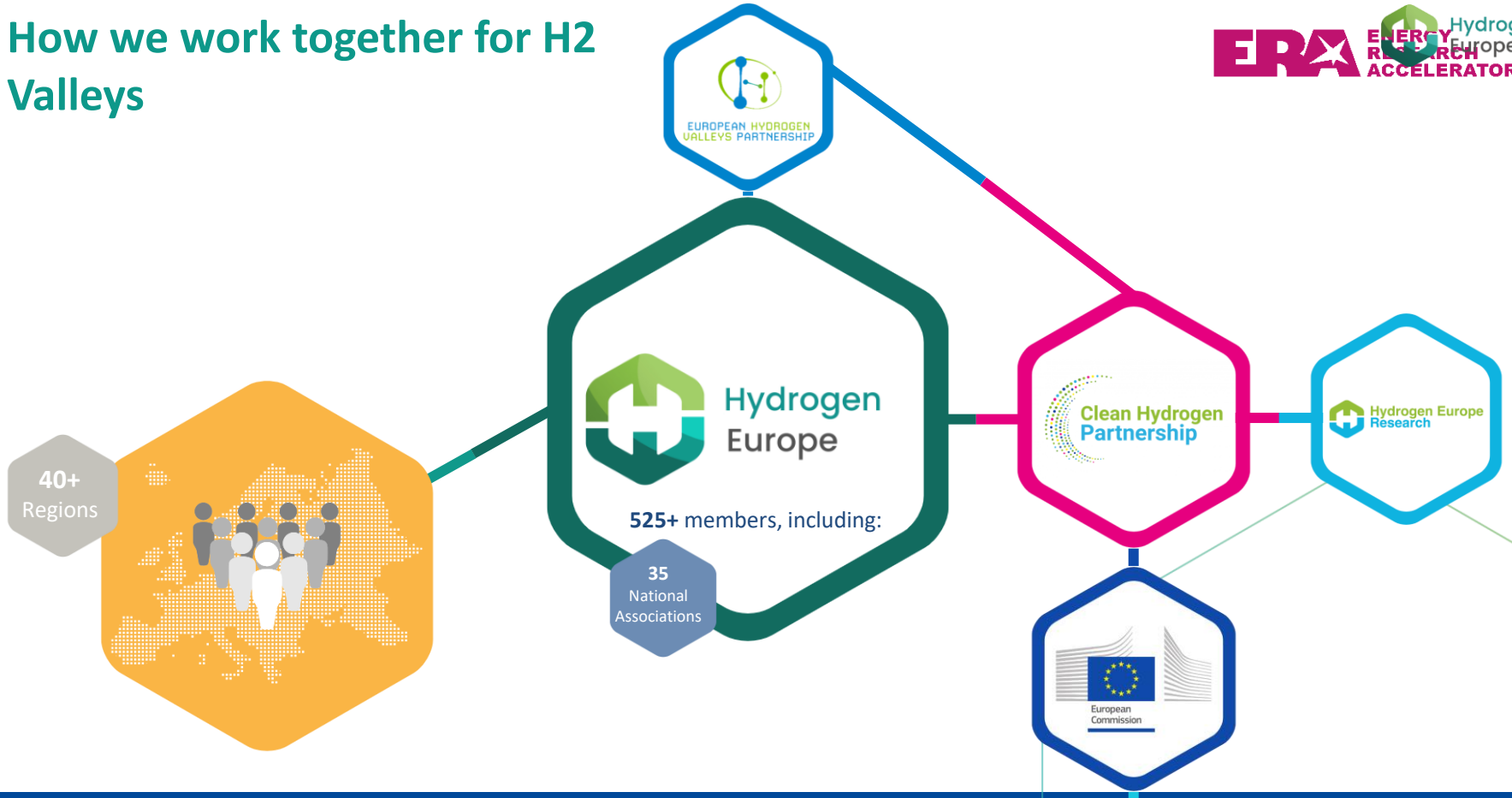
- Hydrogen valleys projects are being developed all across Europe:
  - Mission Innovation H2V target for 2025: 100 globally
  - SOA:
    - 90 valleys globally
    - 60+ in Europe

- Bottom-up local ecosystems ensuring decarbonisation of industry, energy & mobility
- To ensure European decarbonisation by 2050, linking these separate ecosystems, through trans-European networks is key!



Hydrogen Valleys in Europe and European Hydrogen Backbone, Courtesy of Mission Innovation & Guidehouse

How we work together for H2 Valleys



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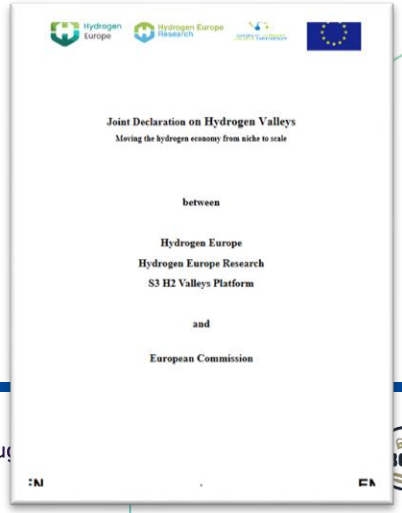
UNIVERSITY OF BIRMINGHAM
Cranfield University
Keele UNIVERSITY
UNIVERSITY OF LEICESTER
Loughborough University
Energy
R&I
MOVE
British Geological Survey

Joint declaration on hydrogen valleys

- Signed on 1st March 2023 by HE, HER, S3 H2V Partnership & European Commission.
- Reinforce the research and innovation agenda to accelerate deployment of H2 valleys;
- Continued investments in R&I via the Clean Hydrogen Partnership
- Maximise funding impact to strengthen synergies
- Promote knowledge sharing and matchmaking to successfully deploy projects;
- Stimulate development of education & skills;
- Lead the deployment of valleys to grow an European and global hydrogen economy.



Joint Declaration on Hydrogen Valleys

Moving the hydrogen economy from niche to scale

between

Hydrogen Europe

Hydrogen Europe Research

S3 H2 Valleys Platform

and

European Commission

H2V projects demonstrating sector integration

GREEN HYSLAND

Mallorca

Integration of green hydrogen for:

- Injection in gas grid
- CHP in buildings
- Hydrogen Refueling Stations

Blueprint project for decarbonization of island economies

EBRO H2 HYDROGEN C

Pays Vasco, Catalunya, Aragon, Navarra

Integration of green hydrogen for:

- Transport in gas grid
- Storage in salt caverns
- HRS & E-Fuels

Leading the deployment of renewable hydrogen in Southern Europe

ZAHYR

Stara Zagora, BG

Integration of green hydrogen for:

- Hydrogen in power plant
- HRS

Enabling the energy transition of coal intensive regions through hydrogen

Achievements & Challenges Ahead

Achievements

- Deployment of hydrogen ecosystems across Europe
- High interest from regional stakeholders in hydrogen technologies
- Decarbonisation of local economies through hydrogen

Challenges

- Synergies between public & private funding lacking e.g. bureaucracy of state aid rules, lack of funds, etc.
- Difficult to achieve connectivity within valleys and between valleys – difficult to access funding for infrastructure;
- Coordination problems – ecosystems with 30+ entities;
- Active role of regulatory authorities in

Thank You

Hydrogen Europe

Avenue Marnix 23
1000, Brussels / Belgium

secretatariat@hydrogeneurope.eu
hydrogeneurope.eu

Session :

Exploring how the UK & EU are driving the Hydrogen acceleration to deliver Net Zero

Mark Watts

Former senior Labour MEP, CEO UKTiE

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Mark Watts

Former Labour MEP

Chief Exec, UKTiE

'How the UK is Driving the Hydrogen Acceleration to Deliver Net Zero'

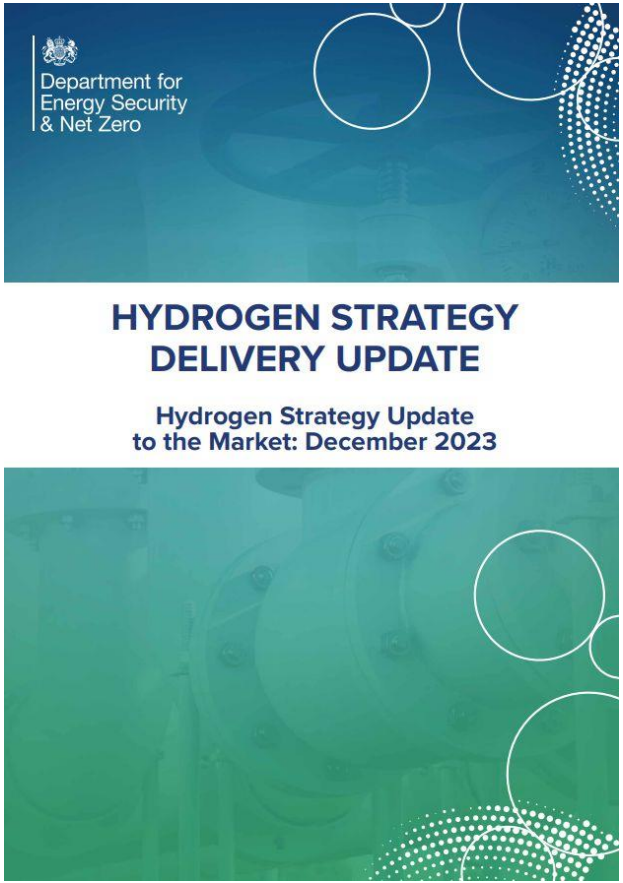
markfwatts

LP BRUSSELS

Overview

- DESNZ
- Conservative Party
- Labour Party
- Hydrogen UK
- Conclusion

DESNZ


Department for
Energy Security
& Net Zero
HYDROGEN STRATEGY
DELIVERY UPDATE
Hydrogen Strategy Update
to the Market: December 2023

'As part of its new Energy Security Strategy, the government announced in April 2022 an ambition for up to 10GW of hydrogen production capacity by 2030 — double the previous target unveiled under its national hydrogen strategy in August 2021. At least half of the capacity will come from green hydrogen.'

Department for Energy Security & Net Zero

1. In August 2021 UK Hydrogen Strategy published**.**

2. The UK's December 2023 Hydrogen Strategy Delivery Update set out progress so far.

3. Government support for the first electrolytic production projects receive an offer of funding through the UK's Hydrogen Production Business Model.

4. These 11 projects will produce 125 MW of environmentally friendly 'green' hydrogen.

Department for Energy Security & Net Zero

‘Government support for 11 major new hydrogen projects across the UK, representing the largest number of commercial scale green hydrogen production projects announced at once anywhere in Europe.’

Department for Energy Security & Net Zero

5. Made rapid progress developing one of the most comprehensive hydrogen policy frameworks in the world.

6. Launched a second hydrogen allocation round with the aim to allocate up to 875 MW of production capacity.

7. Hydrogen Production Delivery Roadmap and Hydrogen T&S Networks Pathway published. This includes UK's ambition to run annual allocation rounds out to 2030.

8. UK will see the first up to 1 GW electrolytic and up to 1 GW CCUS-enabled hydrogen projects start construction and operation on the way to the UK's 2030 ambition.

9. UK also working with international partners to build regional and global hydrogen markets.

Department for Energy Security & Net Zero

Conservative Party

1. We will maintain the leadership on climate change.

2. Delivering an affordable transition to domestic, sustainable energy.

3. Push forward with our £4.5 billion Advanced Manufacturing Plan, including clean energy.

4. Speed up the average time to sign off major infrastructure projects from four years to one.

5. Invest £1.1 billion into the Green Industries Growth Accelerator.

6. In Scotland, support workforce transition to new industries such as…hydrogen…by providing £15 million to support the Energy Transition Zone's skills programmes.

Labour Party

1. **Make Britain a clean energy superpower.**

2. Create a new publicly-owned company, **Great British Energy**. £8.3 billion, over the next parliament, to fund the delivery of clean power.

3. National Wealth Fund: A new Energy Independence Act will establish the framework for Labour's energy and climate policies. We will invest in carbon capture and storage, Hydrogen…

4. Labour's National Wealth Fund will directly invest in ports, hydrogen. £500 million to support the manufacturing of green hydrogen.

Labour

Hydrogen UK

‘The new government must prioritise hydrogen development to ensure we harness its full potential and lead the way in global clean energy innovation.’

William Mezzullo, VP of Hydrogen UK

Hydrogen UK

First 100 Days

- Ensure that first-of-a-kind hydrogen projects under Hydrogen Allocation Round 1 can progress to final investment decision immediately.
- Immediately fund projects within Track-1 of the Cluster Sequencing Process and announce successful Track-1x and Track-2 Projects.
- Expedite the first allocation rounds of the Hydrogen Storage Business Model and Hydrogen Transport Business Model.
- Introduce a Minister for Hydrogen or Office for Hydrogen.
- Adopt a single standard (i.e. the Low Carbon Hydrogen Standard) for use across the departments responsible for supply and demand.
- Re-iterate the commitment to future hydrogen allocation rounds and release the consultation on the design of the hydrogen funding mechanism.

Production

‘Support a technology-agnostic production approach that achieves the UK’s 2030 minimum 10 GW target of low carbon production and lowers subsidy cost for future production projects. By developing all production methods in tandem, the UK has an opportunity to deliver faster, deeper decarbonisation and capture the economic value associated with hydrogen.’

Hydrogen UK

Demand

‘Achieve active deployment of hydrogen technology across various end uses by 2030, by realising the necessary policy frameworks as soon as possible. Supporting a high level of aggregate demand for hydrogen will enable the development of the full value chain.’

Hydrogen UK

Networks & Storage

‘Unlock necessary capital investment, and create regulatory frameworks for crucial hydrogen storage and network infrastructure, enabling the transportation of hydrogen, and providing long-duration, large-scale storage to balance energy supply and demand.’

Conclusion

Collaboration?

Mark Watts

Fomer Labour MEP

Chief Exec, UKTiE

Thank you!

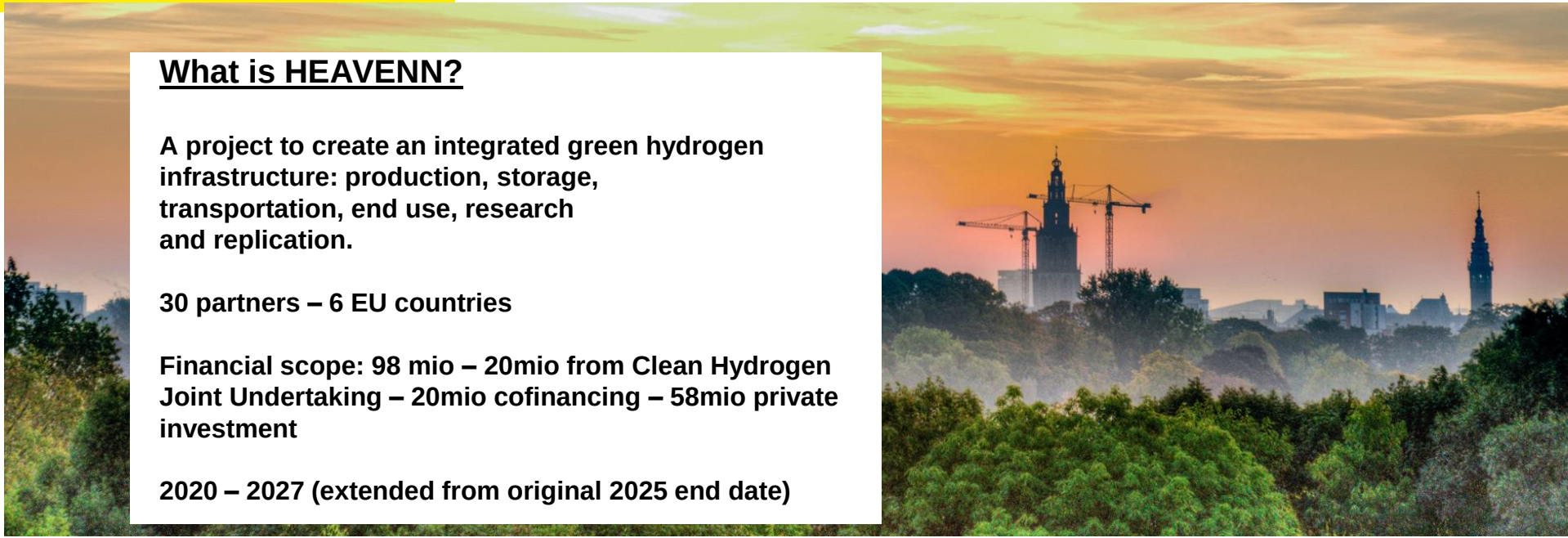
markfwatts

Session:
Hydrogen Valleys - their critical role in the energy transition journey

Geerte de Jong

HEAVENN Netherlands Hydrogen Valley

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands



What is HEAVENN?

A project to create an integrated green hydrogen infrastructure: production, storage, transportation, end use, research and replication.

30 partners – 6 EU countries

Financial scope: 98 mio – 20mio from Clean Hydrogen Joint Undertaking – 20mio cofinancing – 58mio private investment

2020 – 2027 (extended from original 2025 end date)

HEAVENN

Future successes!

HEAVENN has experienced delays – partially situation based: covid crisis, developments in current h2 market slower then expected.

Many FIDs are delayed.

Lesson: in a long project changes might be unavoidable, but good to build flexibility in your project and have steady partners in consortium.

Our solution: constant talks with Clean Hydrogen Partnership, back-to-back amendments.

HEAVENN

Some tips from HEAVENN for other H2 projects and valleys:

- **Finding the perfect balance between ambitious project / long term time frame in a quickly developing market. EU funding offers little flexibility to deviate from plans.**
- **EU funding comes with its own challenges! Many requirements (reporting, administration, audits) and many set goals that are hard to change.**
- **Co-financing and State Aid Rules – manage expectations with partners.**
- **Many smaller partners are not familia**r with EU rules and EU funding.
- **Cross-border collaboration and ability to learn will become more important.**

HEAVENN

Building a green h2 economy from valleys

- **Connecting the valleys – a valley puts down the main infrastructure and from there, connects to other valleys;**
- **If there is a steady offtaker, most else will follow;**
- **Sign provisional contracts where possible – prices might change;**
- **Currently import/export are the main issue for many countries – new countries will enter the global energy market – uncertain factor;**
- **Red3 regulations will force company policies to change by 2030;**
- **For now: final call for proposals in 2025.**

HEAVENN

Thank you for your attention!

Geerte de Jong
heavenn@newenergycoalition.org
https://heavenn.org

HEAVENN

Clean Hydrogen Partnership

Co-funded by the European Union

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 875090. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe and Hydrogen Europe Research.

Future successes!

HEAVENN

Successes!

HEAVENN

Partners who tried, but did not succeed as planned

HEAVENN

Partners who tried, but did not succeed as planned

Project might end up different then expected.

Build flexibility in your project plan by describing the process, not the outcome.

Work with flexible partners (SMEs) and backup partners to take over tasks.

Make an ambitious plan but don’t overpromise.

HEAVENN

Session:
Hydrogen Valleys - their critical role in the energy transition journey

Margherita Matzer
WIVA P&G, Austria

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

From the Energy Model Region to an European Hydrogen Valley

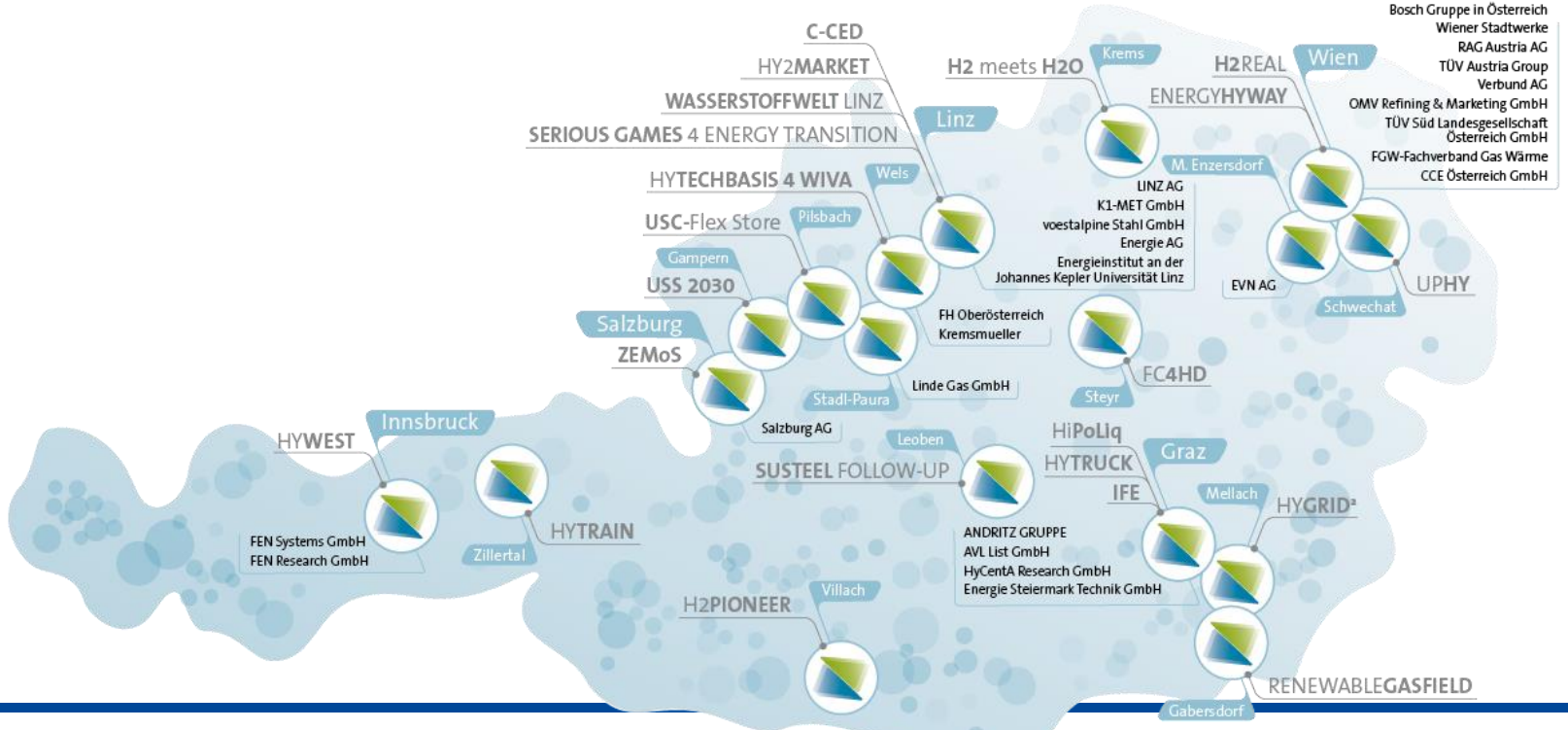
UK-EU Hydrogen Summit, 1 July 2024

Margherita Matzer
WIVA P&G

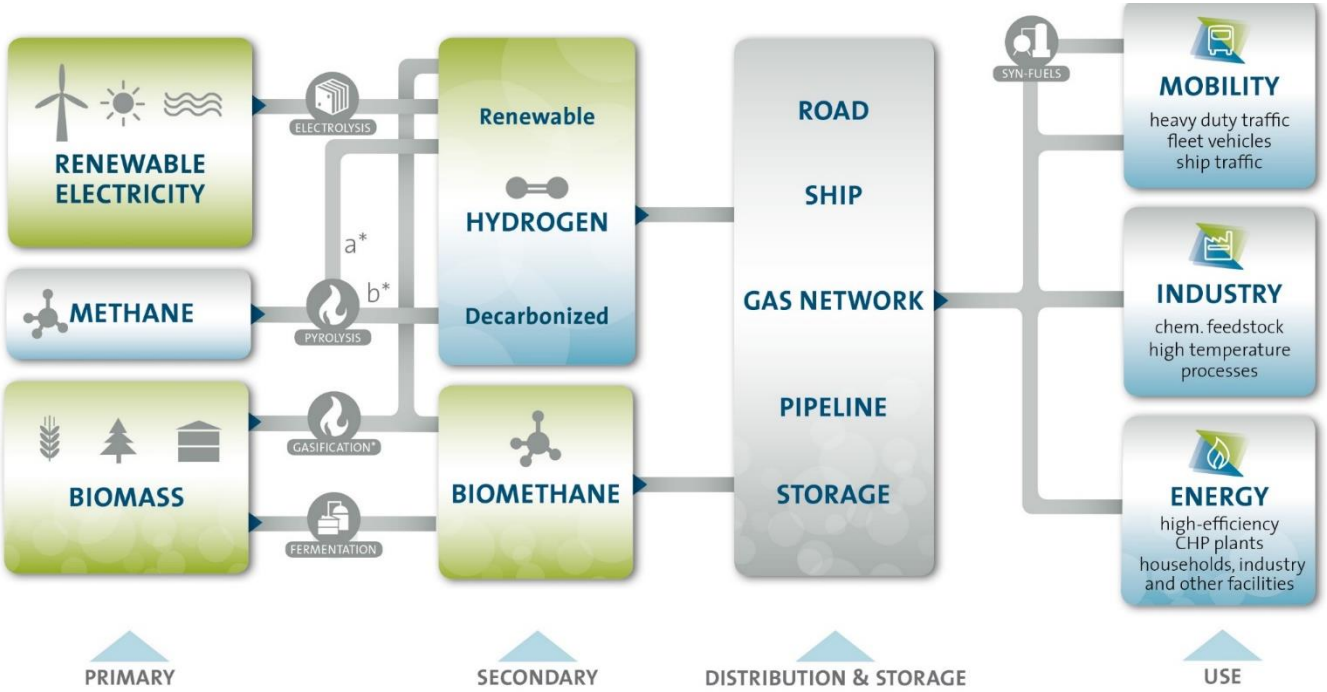
ENERGY RESEARCH ACCELERATOR

- WIVA P&G is a research association founded 2018
- Coordination and implementation of the energy model region (2018-2026)
  - Austria-wide, transregional, thematically focused on hydrogen and renewable methane
- Projects:
  - Sectorally integrated, multidisciplinary
  - Implementing an innovation structure
  - Demonstration and testing of integrated system solutions in practice
- Goal:
  - Support transition to a sustainable energy system
- Experience of more than 30 completed and ongoing projects

WIVA P&G Project Map



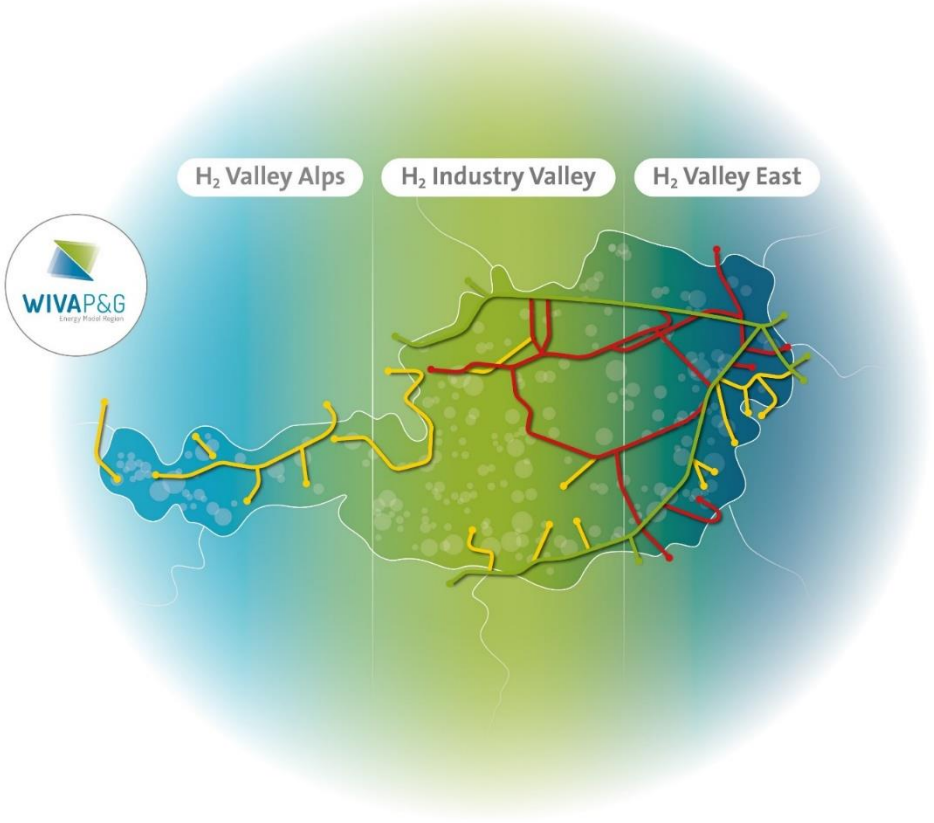
Renewable Gases in the Economic System



a* pyrolysis of biomethane: renewable hydrogen
b* pyrolysis of natural gas: decarbonised/CO_2-neutral hydrogen
* thermo-chemical conversion of solid biomass to biogenic gases

Hydrogen Value Chain

Hydrogen Valleys in Austria



How to Start a Hydrogen Valley? (Case Austria)

- Spread the Hydrogen Valley idea around the whole area
- Proposal team
- Get the regional/national government on board
- Collect and evaluate possible projects
- Identify missing link between the projects
- Form the valley picture
- Work your ass off

ERA ENERGY RESEARCH ACCELERATOR

Consortium:
32 Austrian Partners
10 International Partners
5 Associated Partners

Region:
Upper Austria
Styria
Carinthia

Production:
104 MW new Electrolysis
10.125 tons H2 per year
central, half central und decentral

start: January 2025

Planing 2025 – 2027

Deployment 2027 – 2028

Operation 2028 – 2030

17 projects:
Production
(Underground-)storage
Pipeline- und trailer distribution
Industry: steel, chemistry, cement
Mobility
Energy supply

Aston University BIRMINGHAM UK · University of Birmingham · Cranfield · Keele University · University of Leicester · Loughborough University · Nottingham · Warwick · British Geological Survey

Realizing a climate-neutral future with Hydrogen Valleys!

Margherita Matzer, matzer@wiva.at
WIVA P&G
Magazingasse 7
4020 Linz

Conclusions from day 1 & preview of the workshop on day 2

Developing closer UK, EU & International Relations to Deliver the Net Zero Hydrogen Economy

Prof Martin Freer

ERA Director

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Connect with us:

@EnergyRA
Linkedin: energyresearchaccelerator

@HydexMidlands
Linkedin: HyDEX

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HyDEX

ERA ENERGY RESEARCH ACCELERATOR

Accelerating real-world energy innovation

Thank you for your time

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Aston University Birmingham UK | University of Birmingham | Cranfield University | Keele University | University of Leicester | Loughborough University | University of Nottingham | Warwick | BGS British Geological Survey