HyDEX

ENERGY RESEARCH ACCELERATOR

Accelerating real-world energy innovation

UK-EU Hydrogen Summit
Tues 30 April, 2024

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

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

Welcome and Opening

Prof Martin Freer

ERA Director

#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

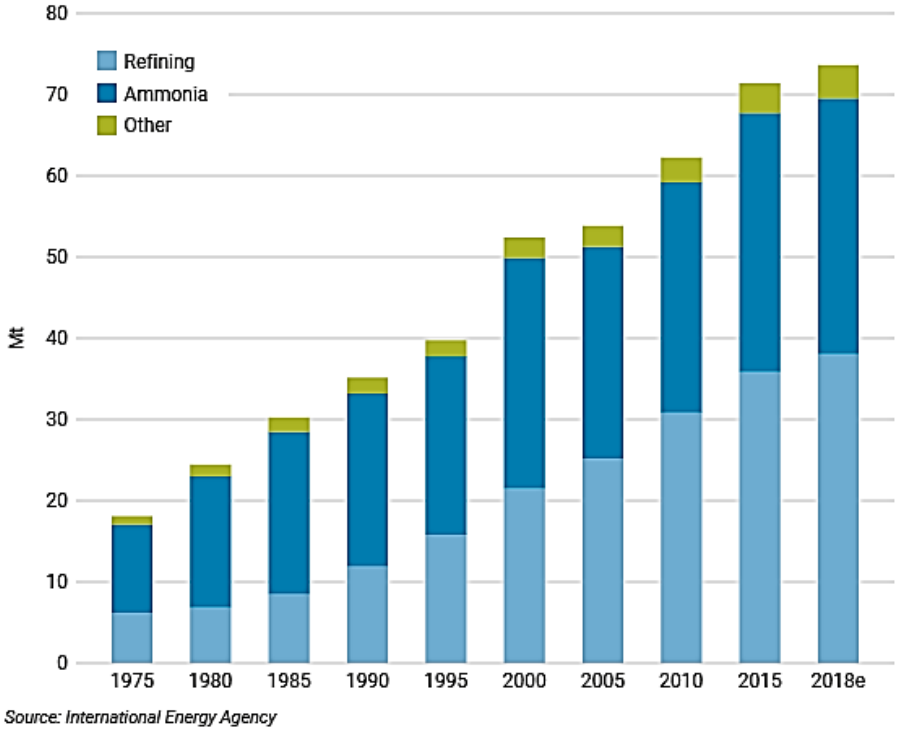
MIDLANDS ENGINE

University of Nottingham UK | CHINA | MALAYSIA

tep Powering 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

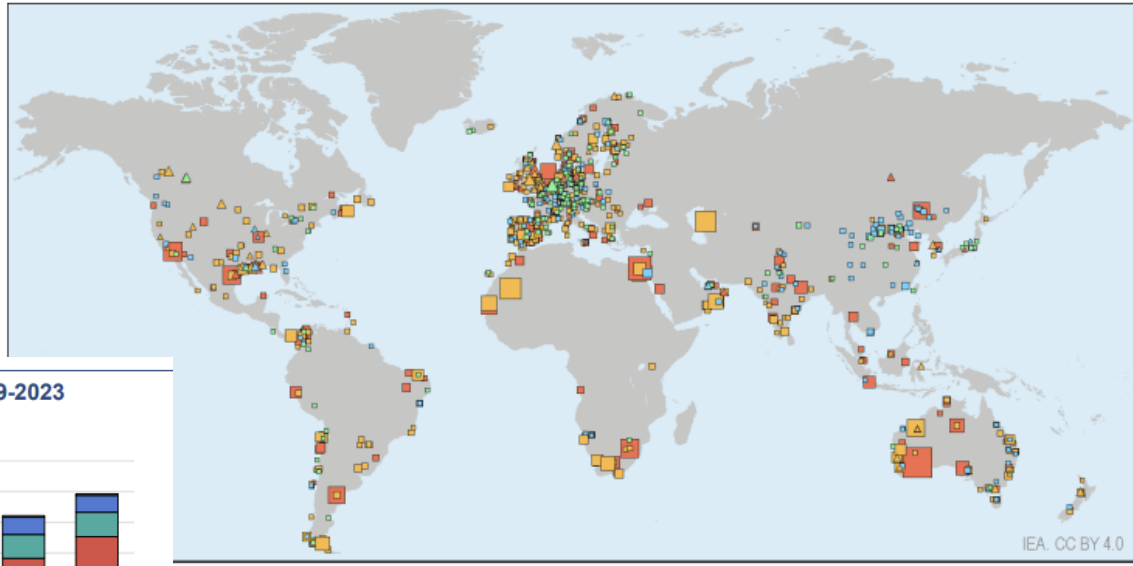
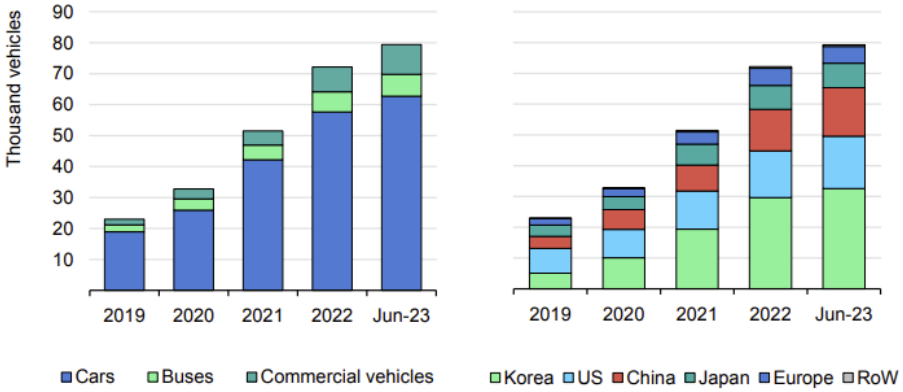


Figure 2.7 Fuel cell electric vehicle stock by segment and region, 2019-2023



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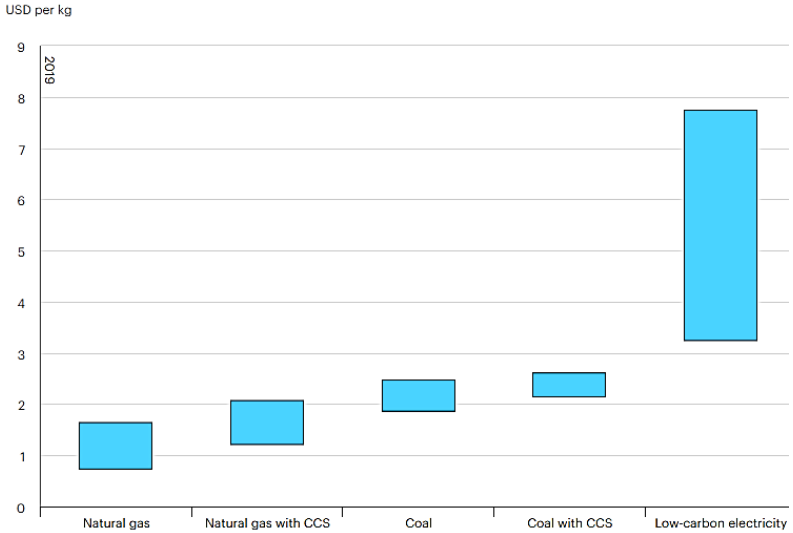
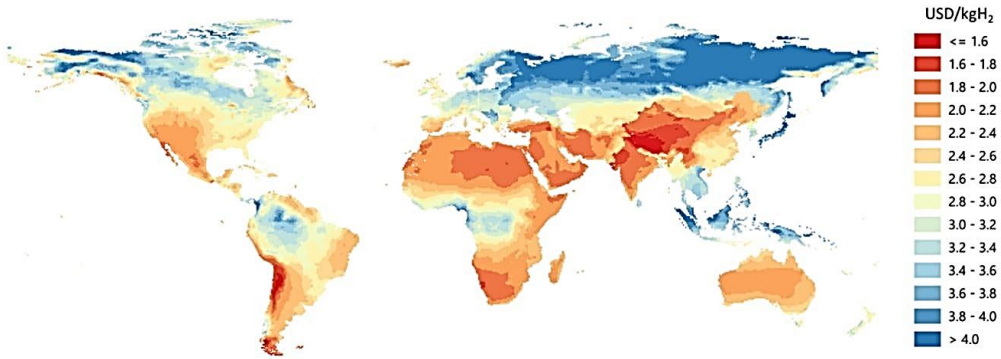
Cost

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]

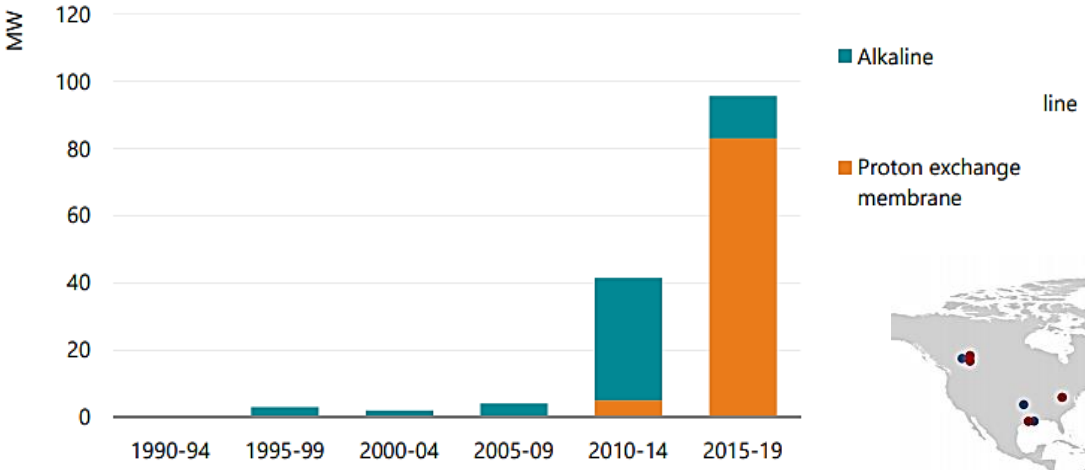
Hydrogen costs from hybrid solar PV and onshore wind systems in the long term



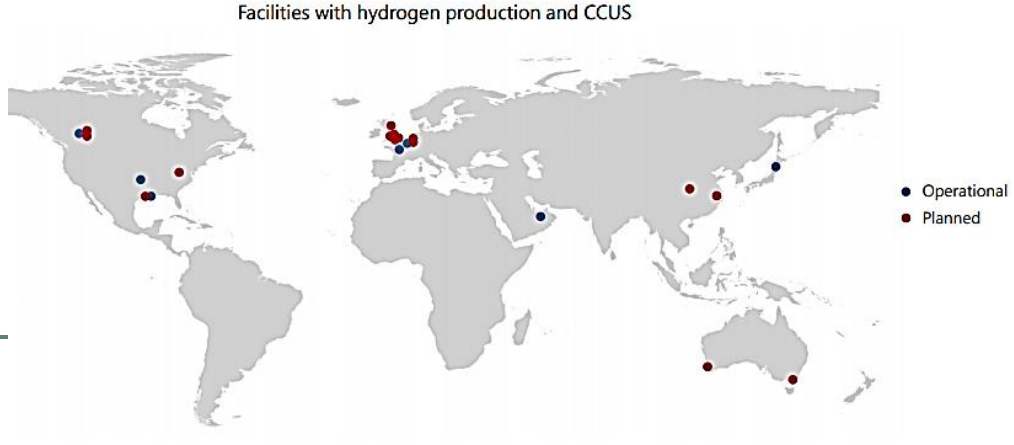
https://www.iea.org/reports/the-future-of-hydrogen

Growth in lower carbon hydrogen

Electrolysers – new investments



[IEA]



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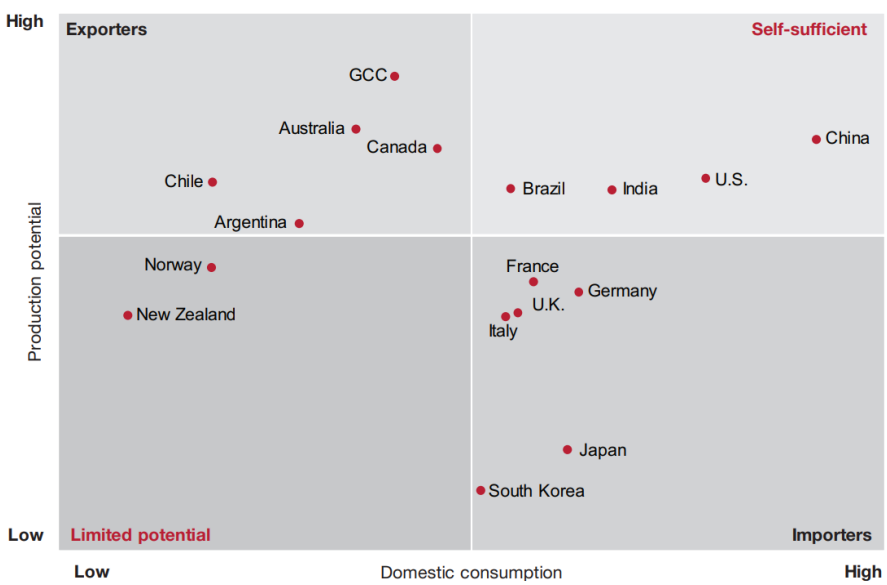
Loughborough University
University of Nottingham UK | CHINA | MALAYSIA
WARWICK THE UNIVERSITY OF WARWICK
British Geological Survey NATURAL ENVIRONMENT RESEARCH COUNCIL

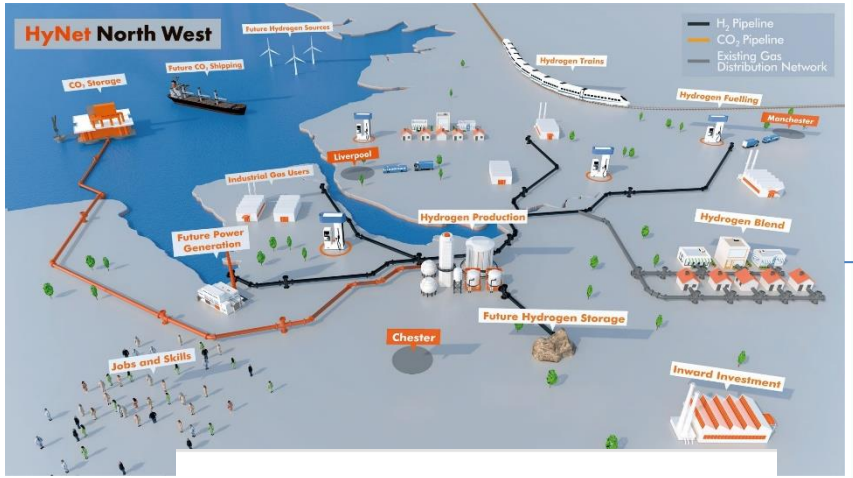
Growth in lower carbon hydrogen



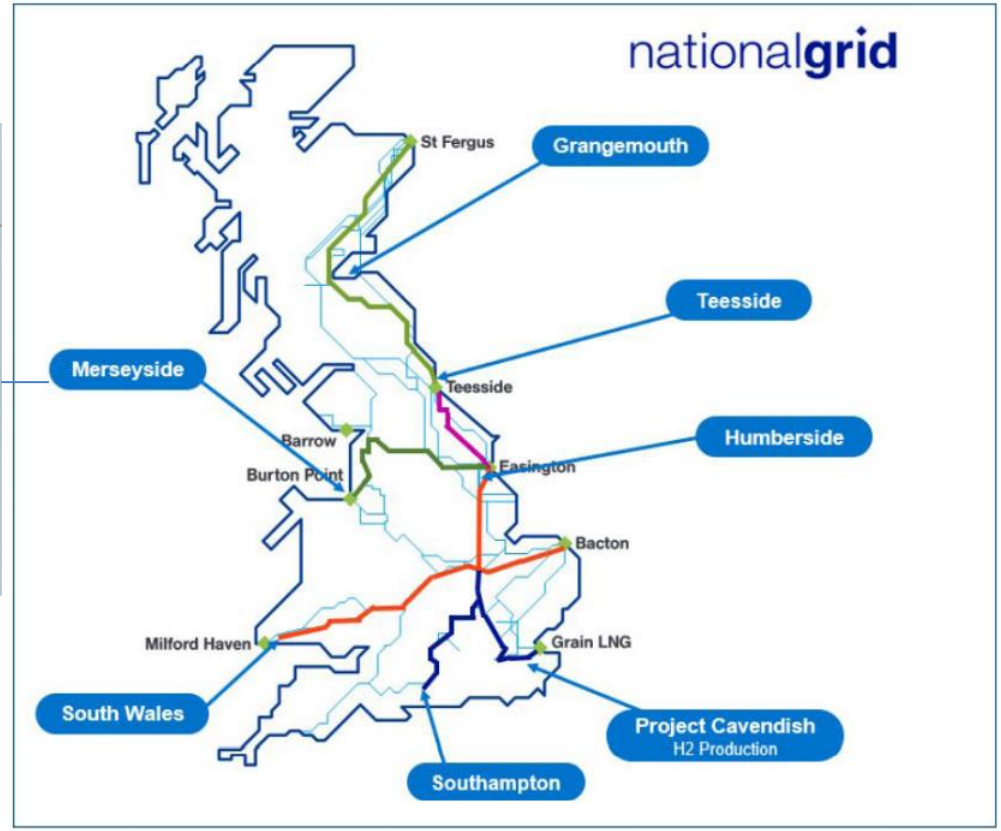
https://www.strategyand.pwc.com/m1/en/reports/2020/the-dawn-of-green-hydrogen/the-dawn-of-green-hydrogen.pdf

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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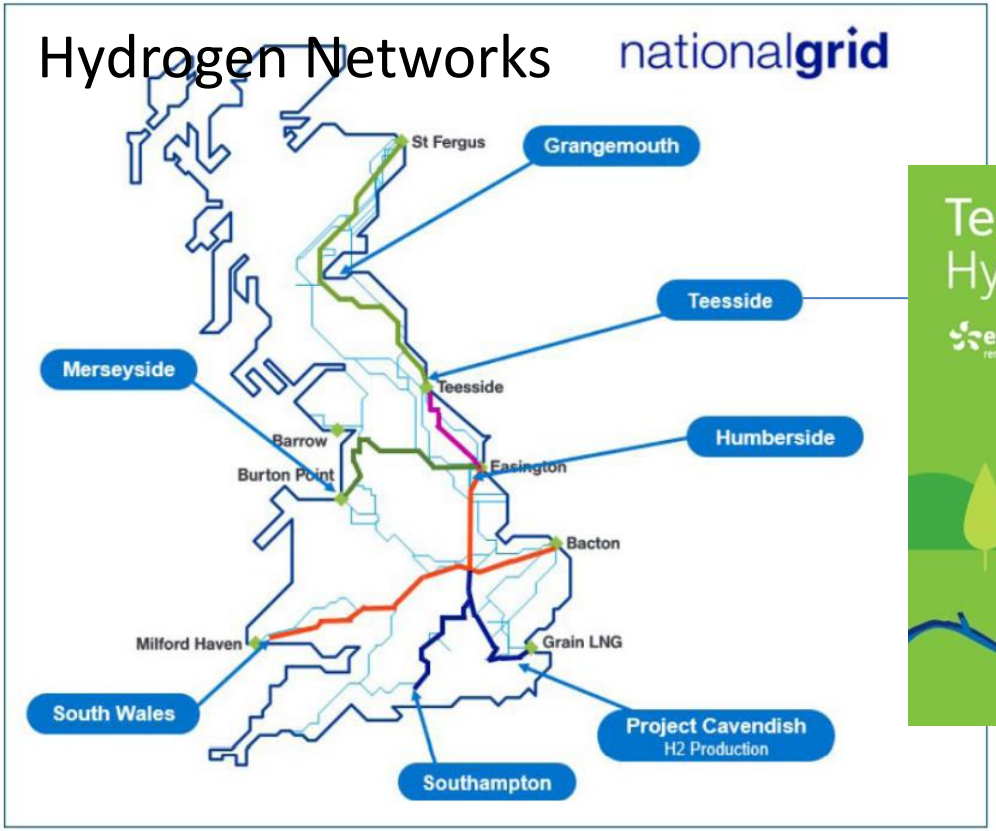
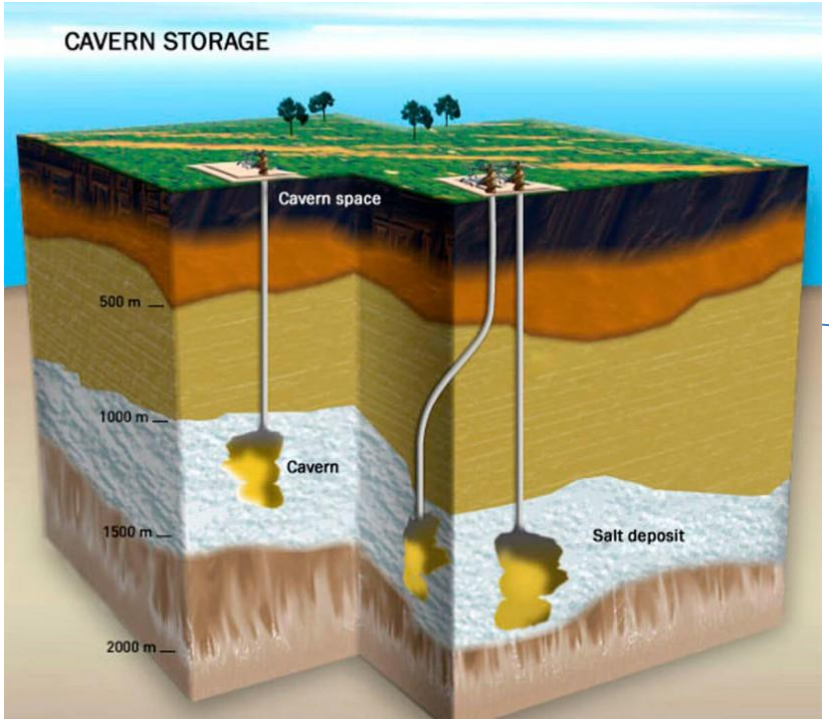
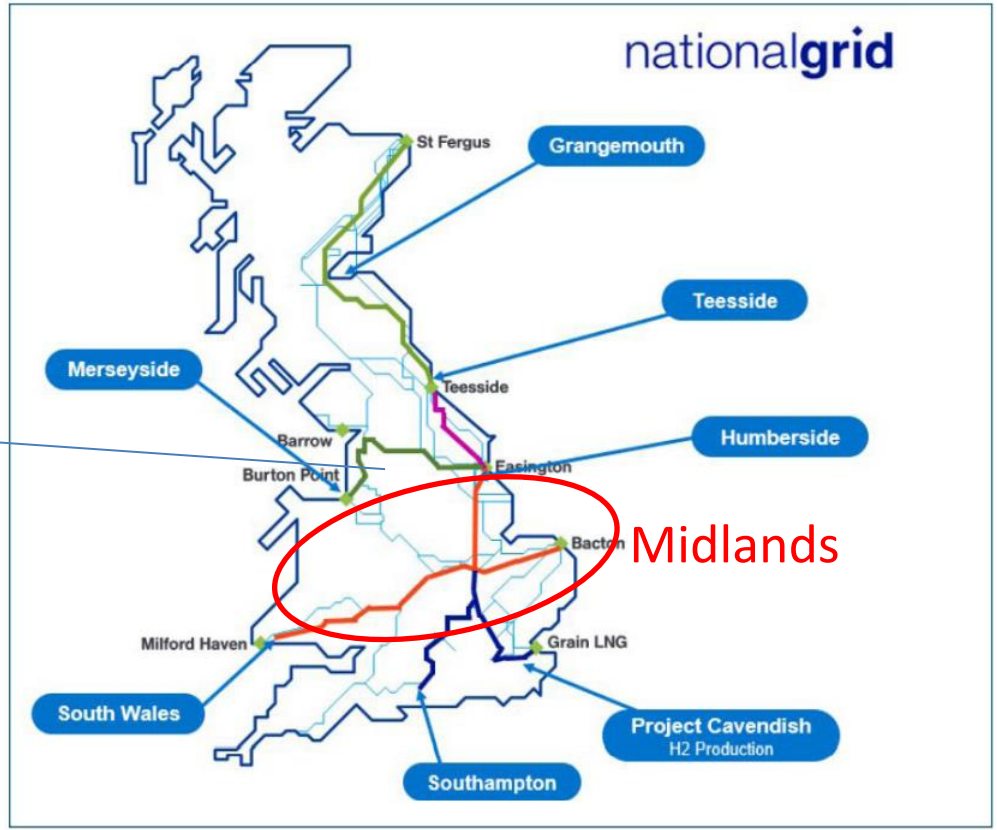
Hydrogen Networks



ENERGY RESEARCH ACCELERATOR

Hydrogen Networks/Storage





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Funded by UKRI Innovate UK

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.

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.

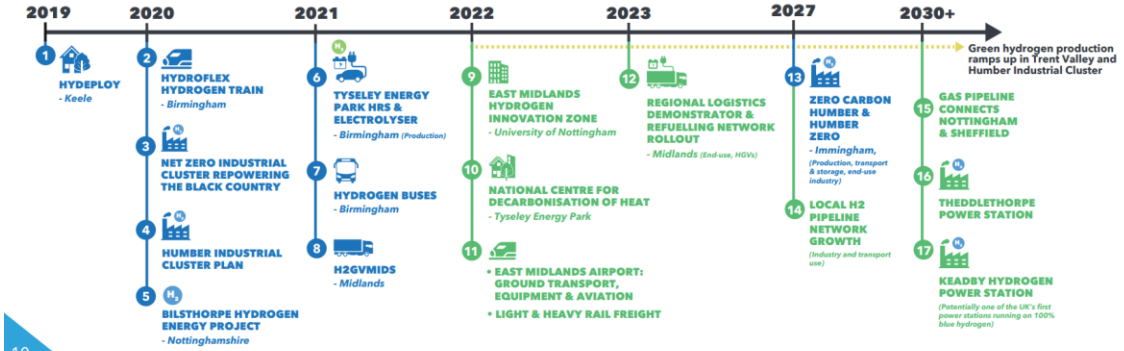
Intelligent Energy

JCB

TOYOTA

ITM POWER
Energy Storage | Clean Fuel

PURSUING OPPORTUNITIES IN POWER, HEAT & TRANSPORT



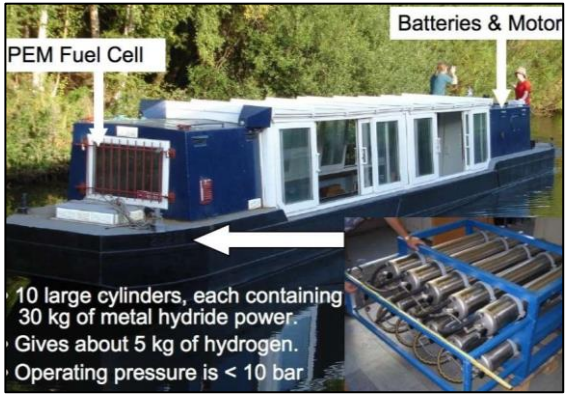
HYDROGEN FACILITIES & RESEARCH

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

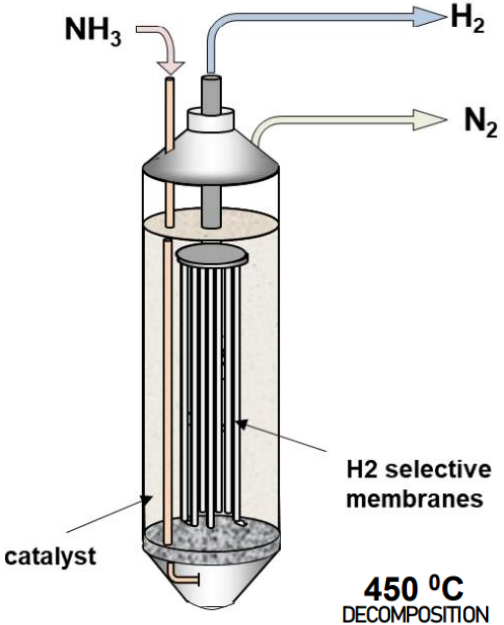

Cranfield
Aerospace
Solutions


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 ^{0}C DECOMPOSITION PROCESS

200 kg HYDROGEN PRODUCED PER DAY

>82.3% HYDROGEN RECOVERED EFFICIENCY

c.99.999% HYDROGEN PURITY (VEHICLE-GRADE)

>90% SYSTEM AVAILABILITY

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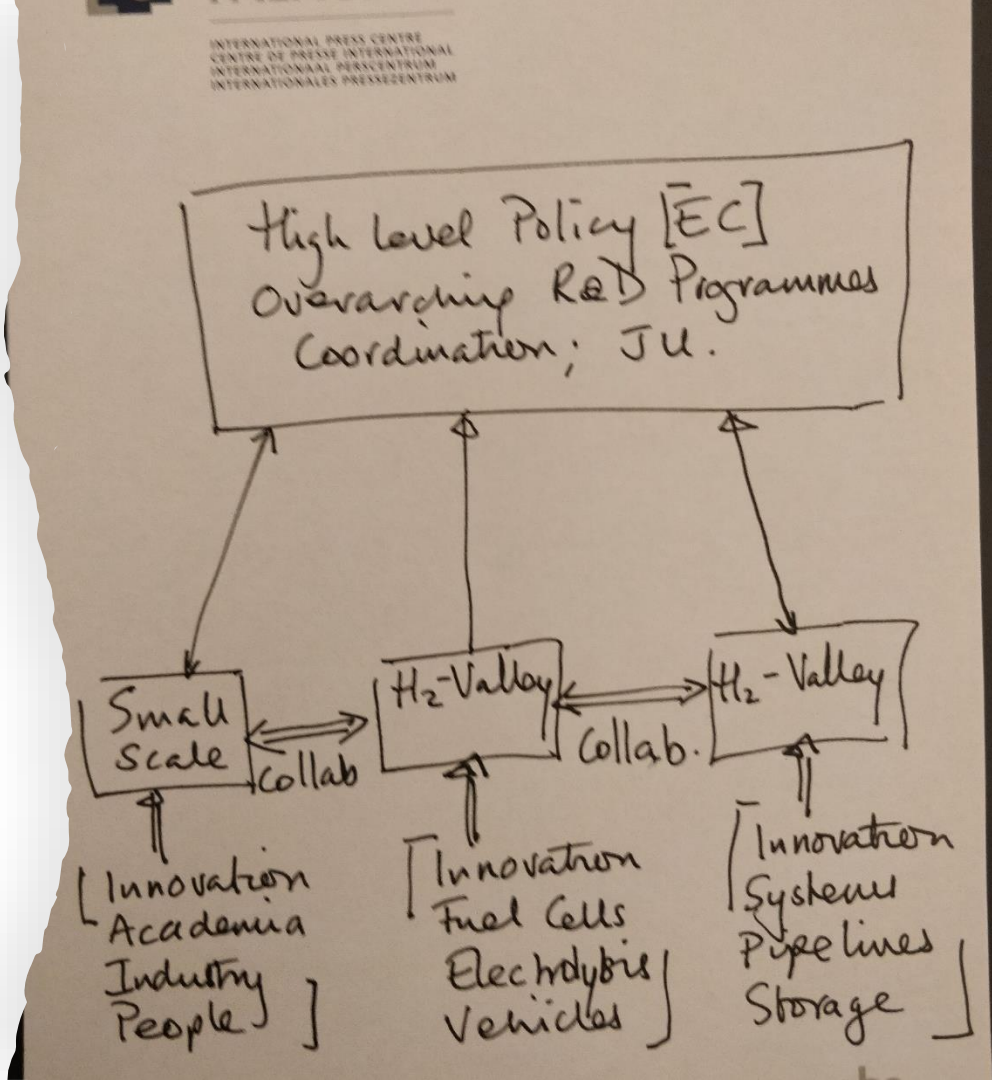
Summary: How to create success?



Introduction: Hydrogen

Alan Haigh
Active Senior
European Commission

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Alan Haigh
Active Senior
European Commission

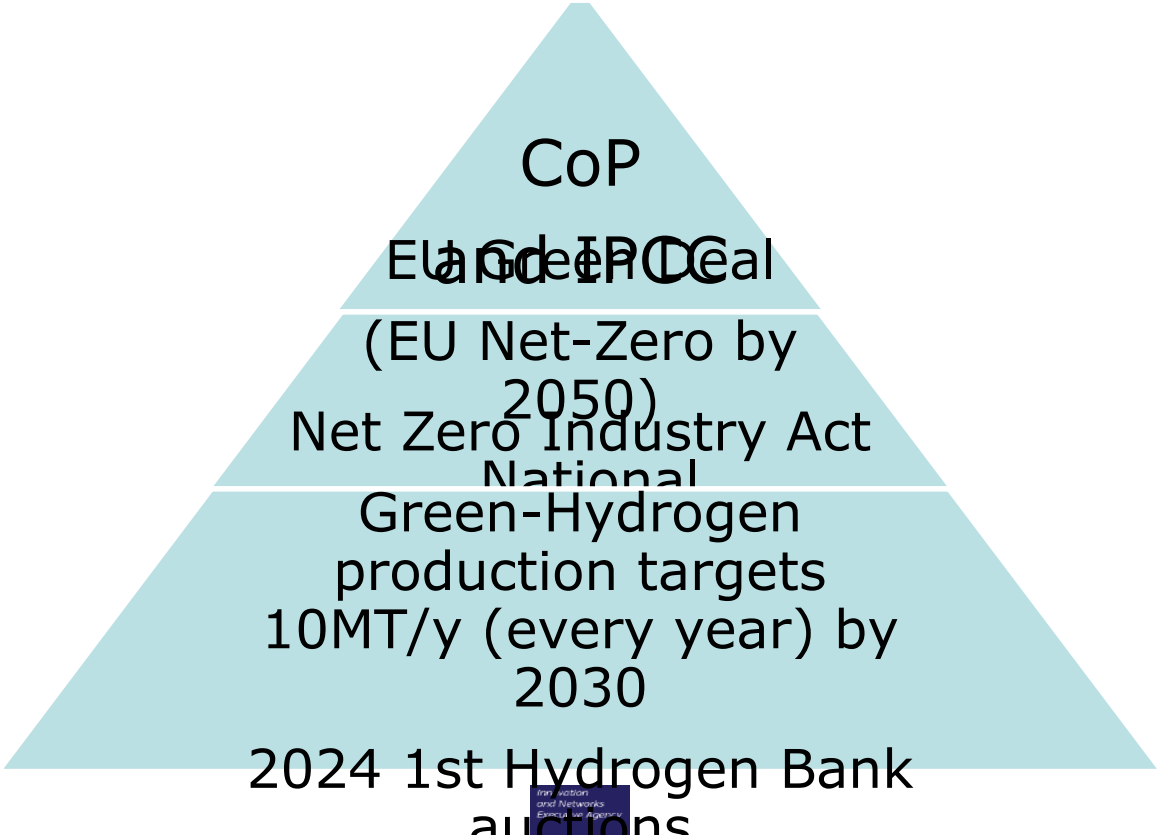
Retired Policy Advisor to the Deputy Director-General (Research and Innovation)

Former:

Head of Department,
European Commission Executive Agency (INEA)
H2020 Energy and Transport

UK Atomic Energy Authority
(1986-1999)

Chartered Engineer (C.Eng)


CoP
and IPCC
EU Green Deal
(EU Net-Zero by 2050)
Net Zero Industry Act
National
Green-Hydrogen production targets
10MT/y (every year) by 2030
2024 1st Hydrogen Bank auctions

European Commission

HORIZON EUROPE

SPECIFIC PROGRAMME IMPLEMENTING HORIZON EUROPE

Pillar I
EXCELLENT SCIENCE

- European Research Council (ERC)
- Marie Skłodowska-Curie MSCA
- Research Infrastructures

Pillar II
GLOBAL CHALLENGES & EUROPEAN INDUSTRIAL COMPETITIVENESS

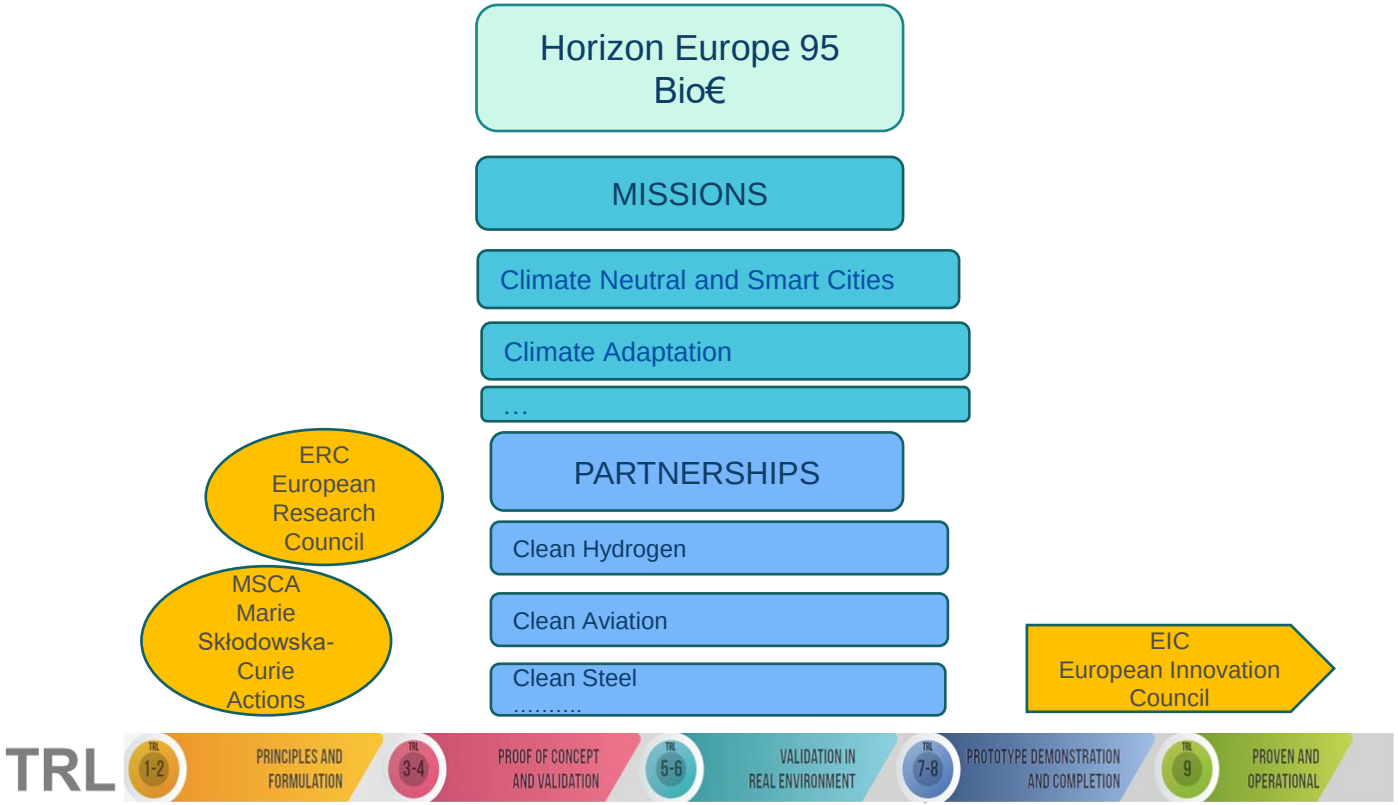
Clusters

- Health
- Culture, Creativity & Inclusive Society
- Civil Security for Society
- Digital, Industry & Space
- Climate, Energy & Mobility
- Food, Bioeconomy, Natural Resources, Agriculture & Environment

Pillar III
INNOVATIVE EUROPE

- European Innovation Council (EIC)
- European Innovation Ecosystems

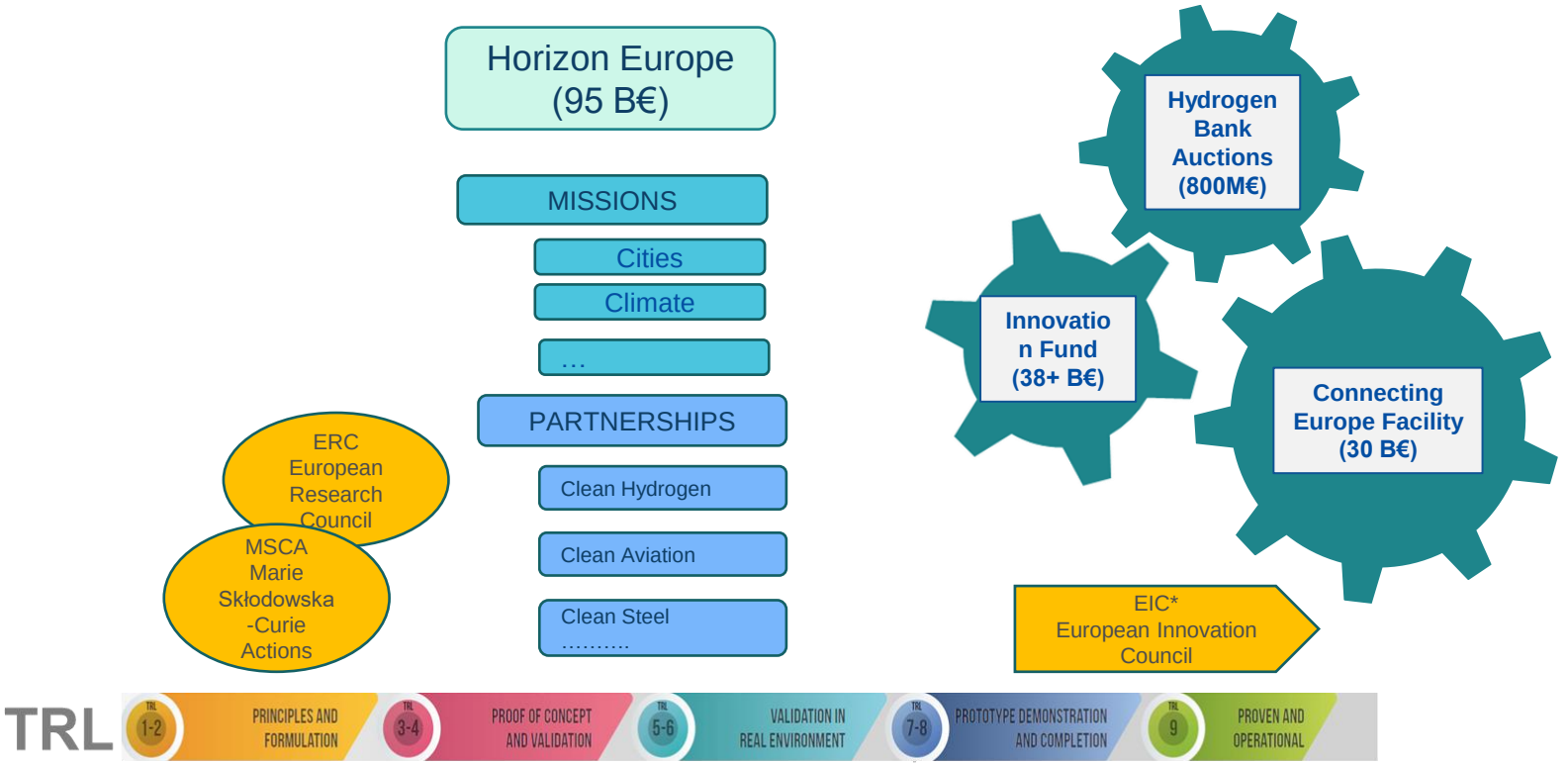
Schematic Funding Instruments and Programmes



A Haigh DG RTD

European Commission

Schematic* - Funding Instruments and Programmes



A Haigh DG RTD

*** Schematic representation, Not to scale, EIC act along the TRL chain, not only high TRL**

European Commission

Clean Hydrogen Partnership

- Publishes calls and project management (2 Bio€ total)
- Excellent interactive project map
- Establish the Fuel Cells & Hydrogen Observatory (FCHO)
- Supporting Mission Innovation Hydrogen Valley Platform (extra 200M€ from RePowerEU)

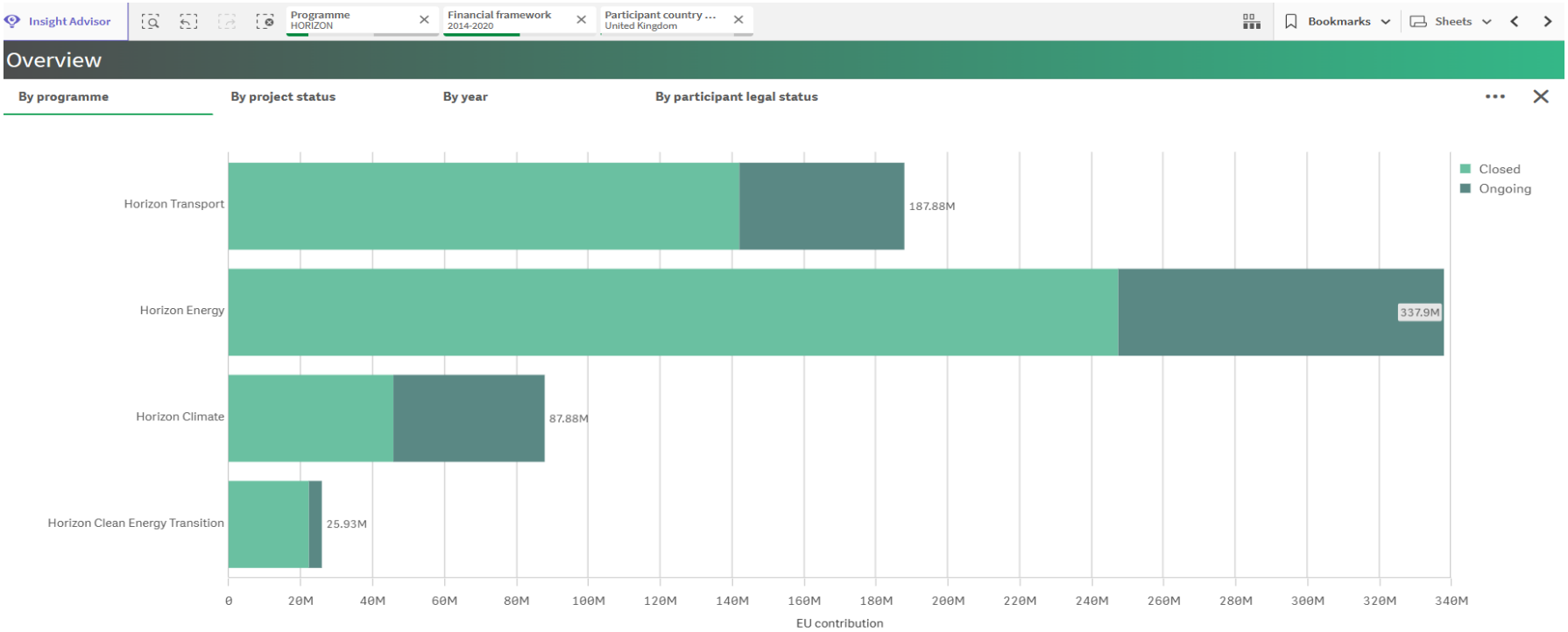
HORIZON 2020 PROGRAMME, 2014 – 2020 TOTAL PROGRAMME 80B€

EU CONTRIBUTION TO UK FOR ENERGY TRANSPORT AND CLIMATE 639M€

EU HORIZON 2020 FUNDING TO UK

European Commission

ENERGY, TRANSPORT, CLIMATE (PART)



A Haigh from H2020 Dataset 26/04/24

Innovation and Networks Executive Agency

European Commission

Example H2020 Projects

- **REMBOURAN**
  - Smart Cities and Communities call - Efficient Energy, Transport and Digital platforms
  - Nottingham, Valldolid (ES), Tepebasi (TK) 6.4M€ EU contribution
- **ENABLEH2 – Liquid Cryogenic aviation fuel to reduce CO2 and NOx emissions**
  - Pilot project involving Cranfield Uni, Heathrow airport, London South Bank Uni, Chalmers and GNK Sweden 1.86M€
- **DEMO-WIND linking offshore-wind fields and sharing grid connections**
  - UK, Belgium, Netherlands, Denmark … 2.8 M€ EU contribution
- **DEMO-TIDE Pentland Firth, Scotland,**
  - 6MW tidal array project 3M€ EU contribution
- **GREEN-hy SCALE - Coupling 6MW electrolysis cells to create 100MW units**
  - Imperial College London, EQUINOR Norway, Siemens Gamesa (BE) 30M EU contribution (to 2026)

742 Funded projects in Energy, Transport and Climate with 1522 Participations

Session 2:
Hydrogen Policy & Project Developments in the UK - Unlocking Hydrogen Economy Potential - the UK Experience

– Martin Freer

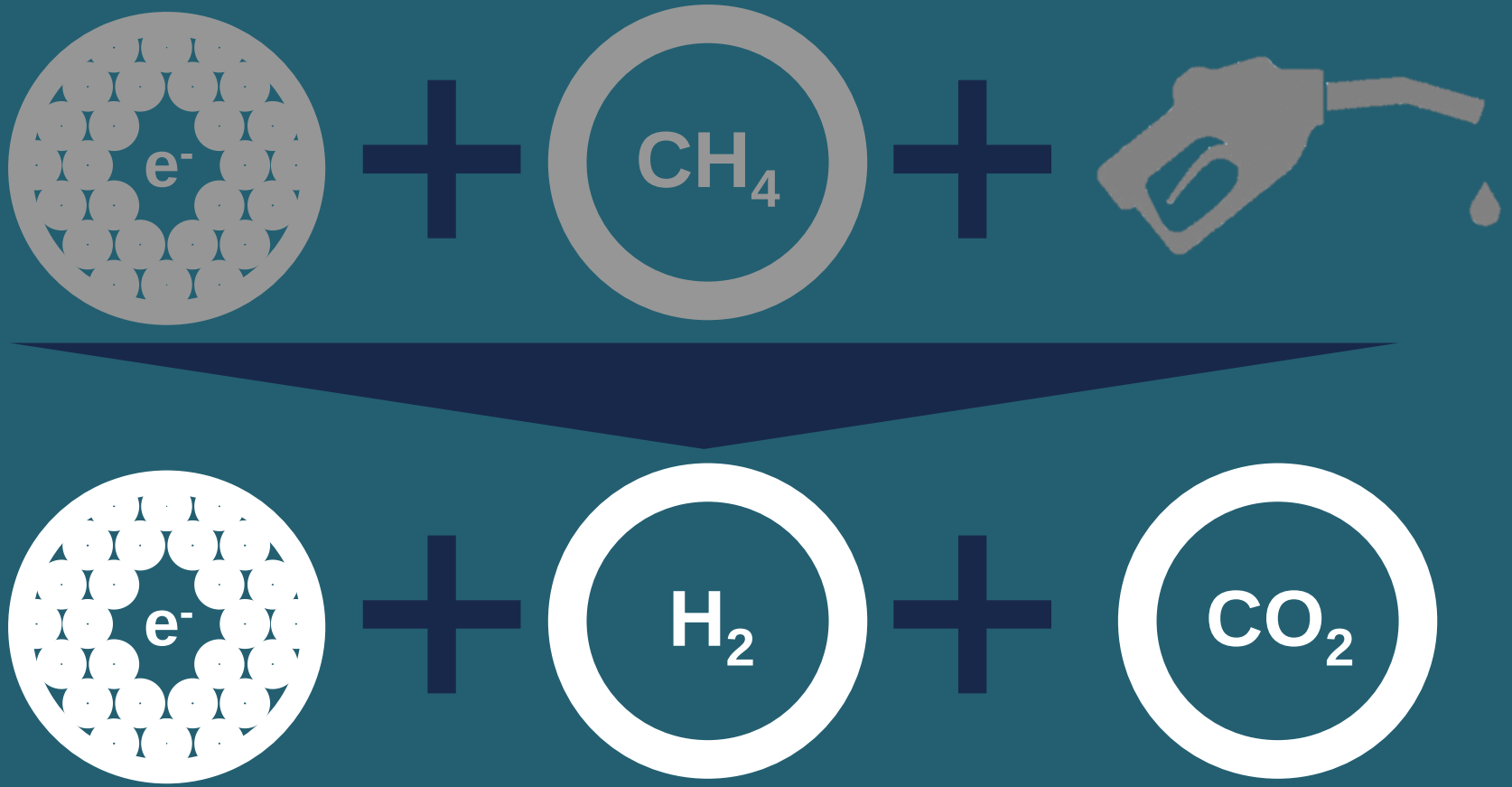
#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Delivering decarbonisation

Dr Chris Manson-Whitton, CEO
April 2024

Energy Infrastructure: Today

Energy Infrastructure: Net Zero



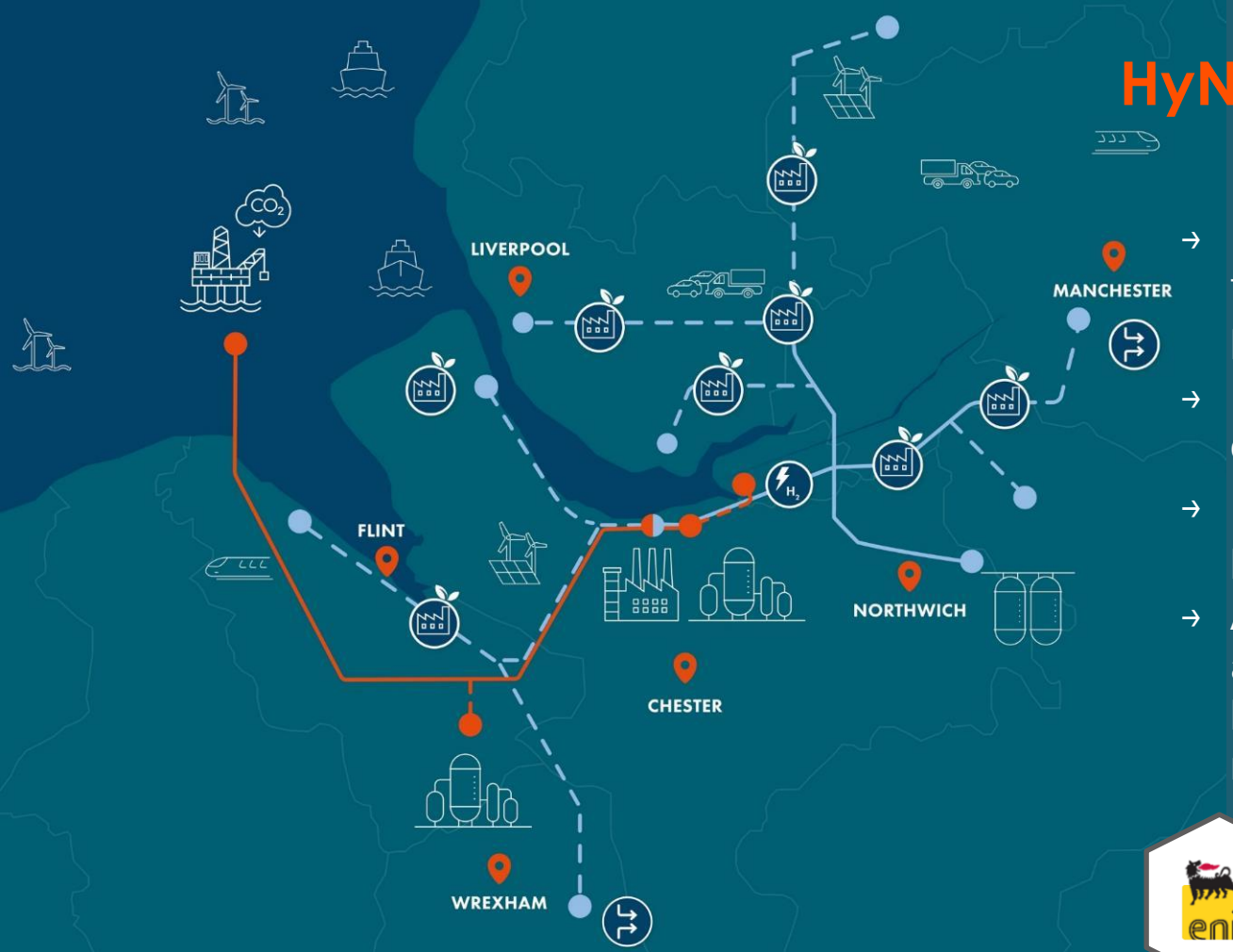
HyNet North West

- One of UK's two leading industrial decarbonisation clusters
- HyNet will:
  - produce, store and distribute low carbon hydrogen
  - capture and lock up carbon dioxide emissions from industry.
- New and reuse of pre-existing infrastructure

Demand led

Unlocking new low-carbon growth opportunities for the automotive, chemical, shipping, glass, food, material, and energy sectors

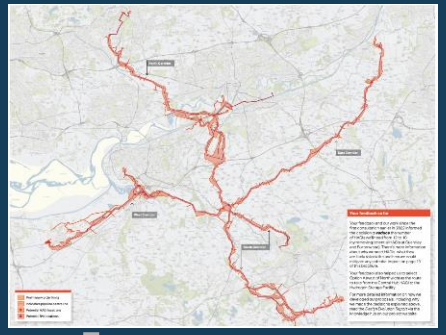
HyNet Infrastructure



- Underground pipelines to transport CO_2 emissions to permanent safe storage
- Facilities to capture CO_2 emissions
- Low-carbon hydrogen production
- A hydrogen pipeline network and salt caverns in which hydrogen can be stored ready for use

HyNet North West

HyNet: A Full Chain Hydrogen Ecosystem



H_2 Production

- EET Hydrogen delivering CCUS enabled H_2. First 350MW FID this year, 1GW FEED being completed
- Grenian & other electrolytic H2 projects across region

H_2 Network

- 120km of dedicated hydrogen pipeline
- Designed to distribute over 30TWh of hydrogen
- Finalising FEED & Consent underway

H_2 Storage

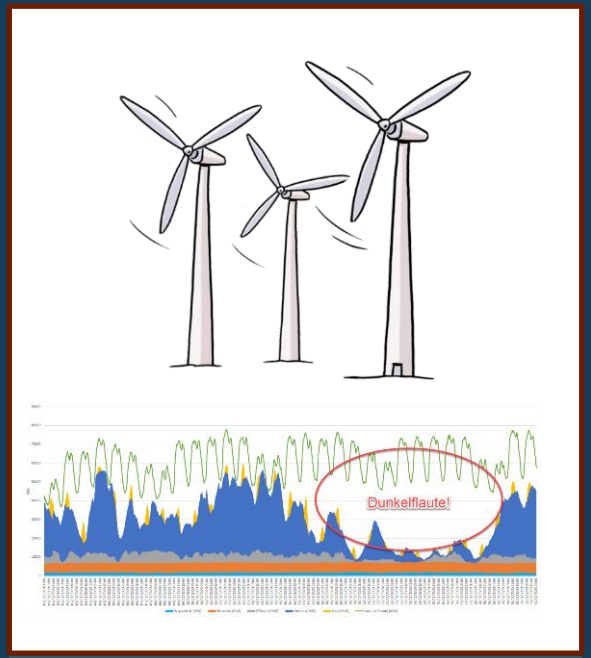
- Capable of storing 1300GWh of energy
- Most advanced H_2 store in the UK: Finalised FEED and consent

H_2 Offtakers

- Over 30 industrial and dispatchable power off-takers
- World leading demonstrations of fuel switching (Glass, FMCG, Aluminium recycling,& others)


PILKINGTON
encirc

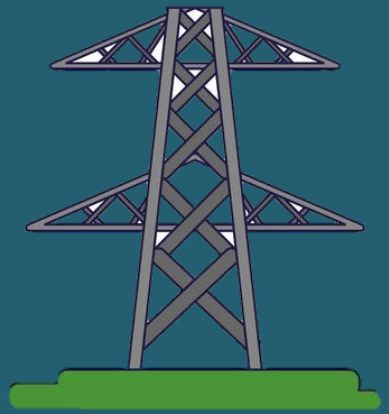
Resilient Low Carbon Electricity Supply

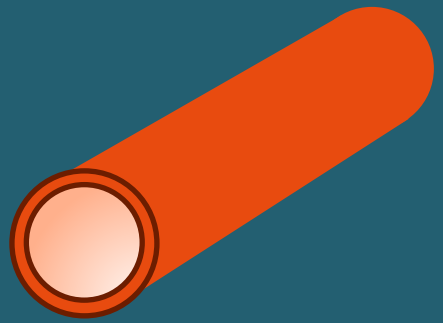


Vital renewables

Need to manage intermittency

Infrastructure is Key to cost effective Net Zero





- Individual projects → A market
- Connections to storage
  - Storage = hydrogen superpower
- Offtaker Confidence:
  - ↑ producers = ↓ risk
- Production Value for Money:
  - ↑ offtakers = ↓ risk = ↓ CoC
  - ↑ producers = ↑ competition
- Industrial users & dispatchable power needs are embedded in our networks – conversion alongside new build

What do we need to deliver?

FID September 2024 on HyNet's CO_2 system and first CCUS-H_2 facility

What do we need to deliver?

H2 storage Allocation 2025

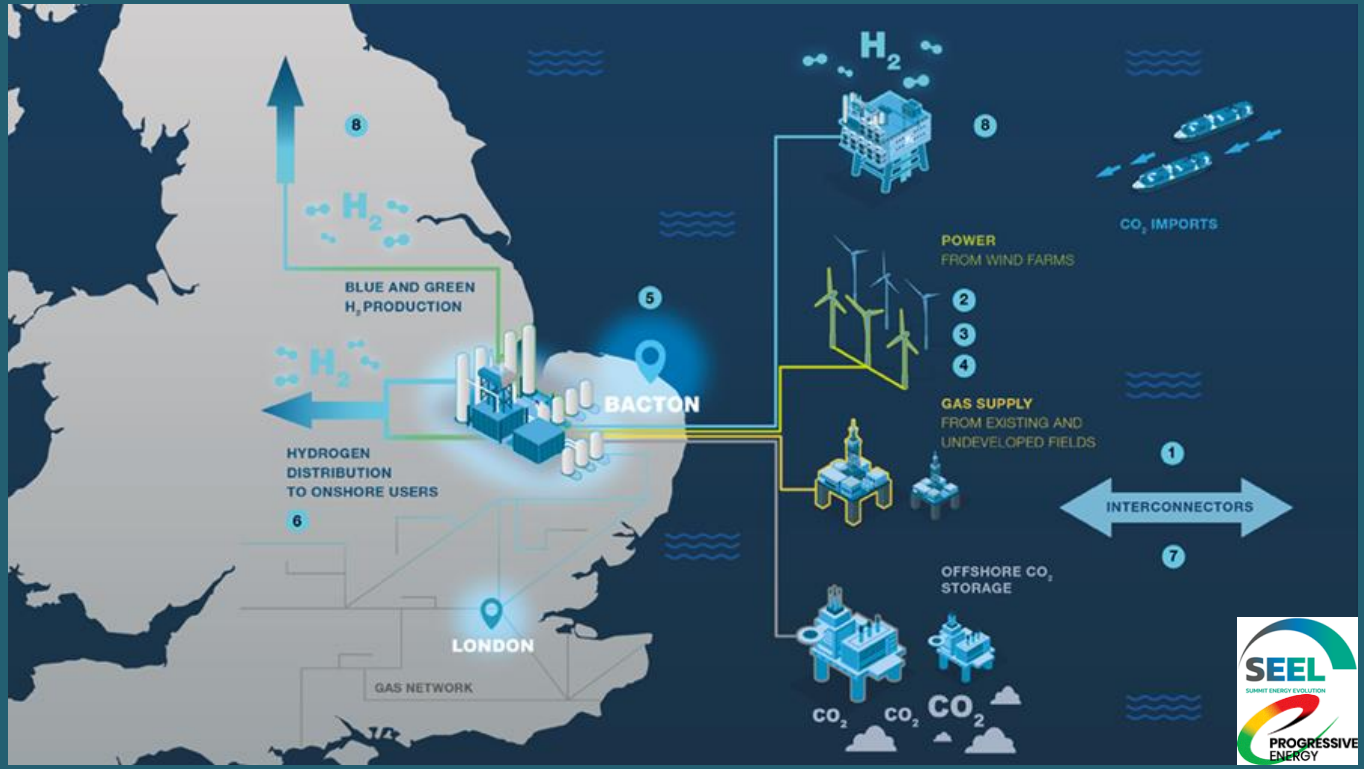
H2 transport Allocation 2025

Track 1 Expansion: Regional GW scale hydrogen Production

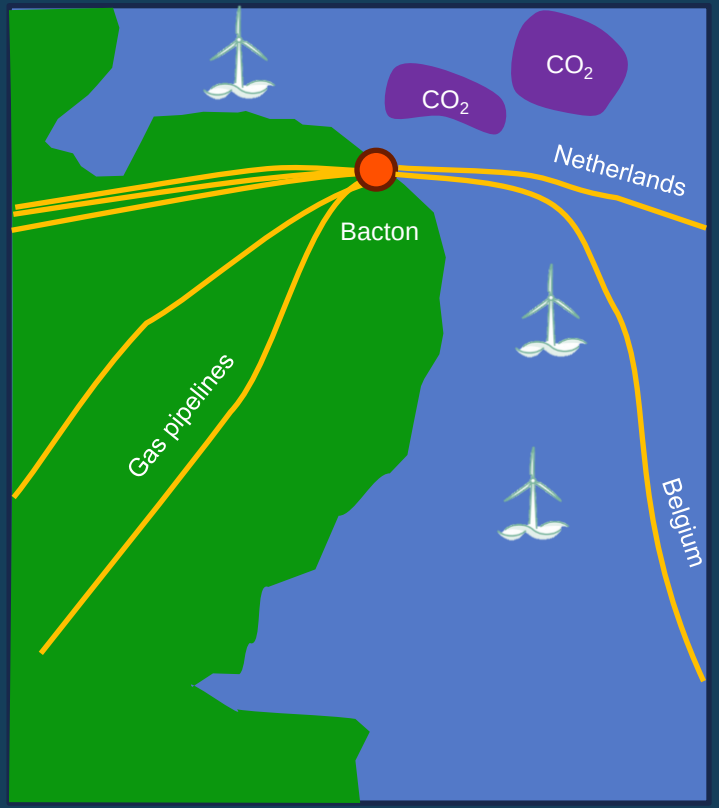
FID September 2024 on HyNet's CO_2 system and first CCUS-H_2 facility

- **Safeguard regional industry**
- **Drive inward investment**
- **Unlock wider energy system transformation**

Beyond Track 1: The Bacton example



Bacton and Europe



- Key node in the UK and European Gas system
- Existing infrastructure likely need to handle hydrogen blends
- Potential for both CCUS-enabled and electrolytic hydrogen production to be connected to Europe

Session 2:
Hydrogen Policy & Project Developments in the UK
- Unlocking Hydrogen Economy Potential
- the UK Experience

Lord Callanan
Parliamentary Under Secretary of State
(Minister for Energy Efficiency and Green Finance)

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East Midlands Hydrogen

Introduction to East Midlands Hydrogen

Will Morlidge

D2N2 & East Midlands Hydrogen

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

What is East Midlands Hydrogen?

East Midlands Hydrogen

A partnership who will:

1. **Support** bids for investment in low carbon **hydrogen production and storage**
2. **Drive** the development of **hydrogen distribution infrastructure**
3. **Encourage fuel switching to hydrogen** by industrial and commercial organisations
4. **Ensure** that hydrogen is accounted for in **Local Area Energy Planning**
5. **Grow** our hydrogen **education and skills** offering
6. **Accelerate** hydrogen freight decarbonisation
7. **Promote** and support **hydrogen technology companies** and regional innovation

BIRMINGHAM UK · UNIVERSITY OF BIRMINGHAM · UNIVERSITY · LEICESTER · University · Nottingham · WARWICK · Survey

Who?

East Midlands Hydrogen

Founding members

New members

Intelligent Energy

TAYLOR WOODROW

Beckett THERMAL SOLUTIONS

AqGas

AllWater Technologies

LUXFER GAS CYLINDERS

EEMU

Swagelok

Swagelok Manchester

P

east midlands chamber

Derbyshire | Leicestershire | Nottinghamshire

Winbro

mtc Manufacturing Technology Centre

TRANSULA

ft pipeline systems

EAST MIDLANDS IOT

UK HYDROGEN OR THE FUTURE

roadgas FUELLING GREENER FUTURES

Loughborough University

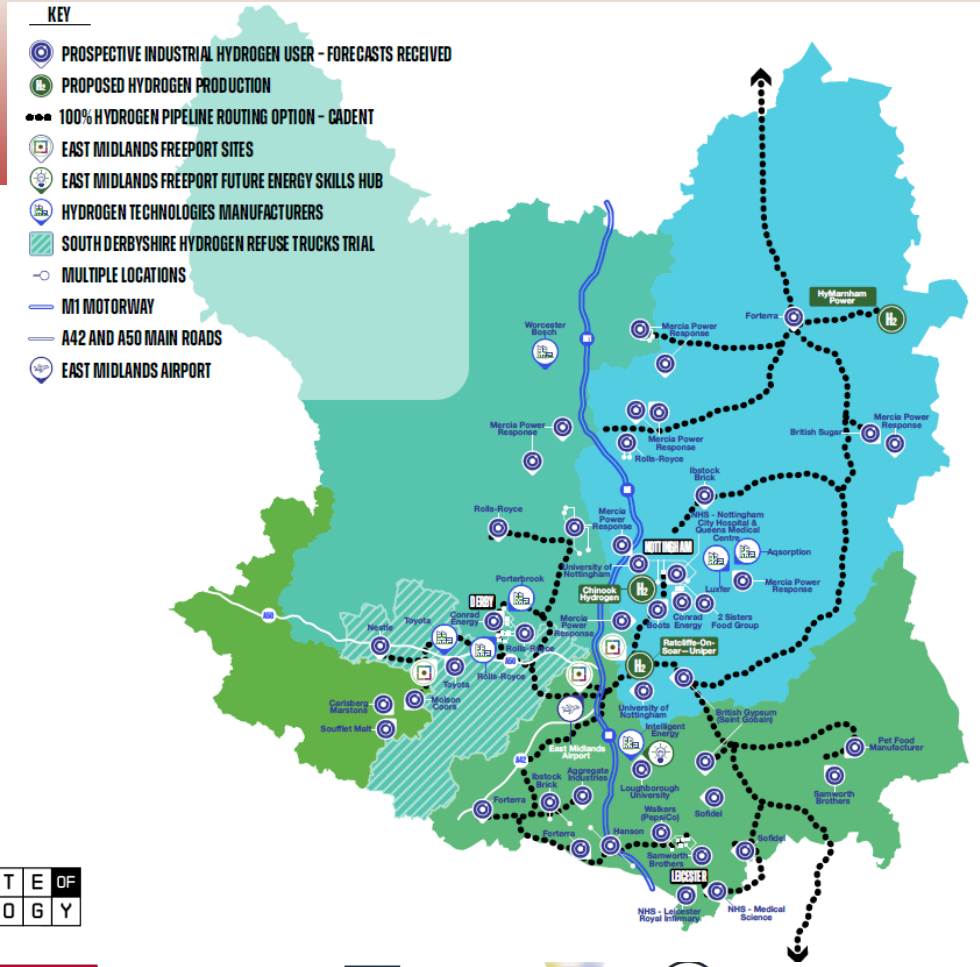
University of Nottingham

WARWICK THE UNIVERSITY OF WARWICK

BGS British Geological Survey

Why here and now?

- Growing demand, actual & potential, for hydrogen in the region
- Clusters of industry that cannot fully electrify, eg bricks, automotive, building materials, food & drink
- Huge potential hydrogen production forecasts, leading up to multi-gigawatt scale by 2050
- Unique strategic partners:



East Midlands Freeport

EAST MIDLANDS DEVELOPMENT COMPANY

EAST MIDLANDS INSTITUTE OF TECHNOLOGY

Aston University BIRMINGHAM UK

UNIVERSITY OF BIRMINGHAM

Cranfield University

Keele UNIVERSITY

UNIVERSITY OF LEICESTER

Loughborough University

University of Nottingham

WARWICK THE UNIVERSITY OF WARWICK

BGS British Geological Survey

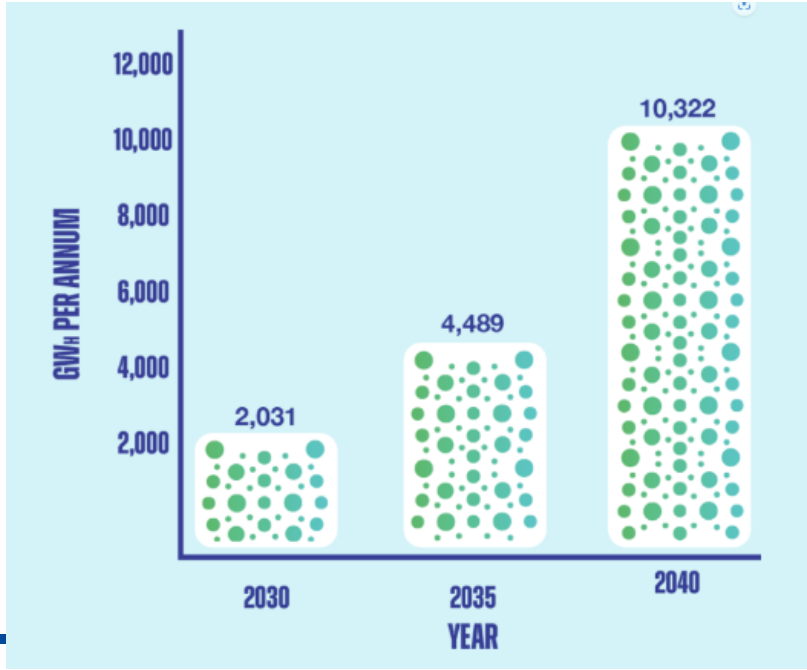
Industrial demand

East Midlands Hydrogen

Hydrogen forecasts received by Cadent from:

20 COMPANIES

70 SITES



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

Production capacity

East Midlands Hydrogen

Hydrogen forecasts received to date total:

650MW PRODUCTION CAPACITY

GW-SCALE PRODUCTION CAPACITY POSSIBLE BY 2050, MAKING USE OF EX-COAL-FIRED POWER STATION SITES AND 'MEGAWATT VALLEY' ELECTRICITY INFRASTRUCTURE

Economic Impact

East Midlands Hydrogen

Development of a full hydrogen supply chain the East Midlands leads to:

£10 BILLION
GROSS VALUE ADDED

110,000
JOBS CREATED OR PROTECTED

Analysis from PWC

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

Environmental benefits

Fuel switching alone would abate:

1.9 MILLION TONNES OF CO2 PER YEAR...

... WHICH IS EQUIVALENT TO NATURAL GAS CONSUMED BY 860,000 HOMES EVERY YEAR

ENERGY RESEARCH ACCELERATOR

East Midlands Hydrogen

Thank You

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

Session 2:
Hydrogen Policy & Project Developments in the UK
- Unlocking Hydrogen Economy Potential
- the UK Experience

Gary Wilson
Motive Fuels

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

UK-EU Hydrogen Summit

Sue Ferns, Senior Deputy General Secretary

About Prospect

- 158,000 members
- Diverse, expert, evidence-led – majority private sector
- Not politically affiliated
- Energy sector

A WORKFORCE FOR ENERGY

- Accounts Analyst
- Admin Assistant
- Advisor
- Associate Change Manager
- CAD Technician
- Complaint Resolution Agent
- Computer Security Incident Response Team Engineer
- Connections Enquiries & Applications Team
- Construction Coordinator
- Data Engineer
- Design Engineer
- Designer
- Digital Analyst
- Feed-in Tariffs Analyst
- Finance & Contract Lead
- Finance and Compliance Manager
- Lab Technician
- Operational Manager
- Product Design Manager
- Programmer Analyst
- Project Manager
- Reliability Operations Specialist
- Risk Analyst
- Sales
- Second Line Agent
- Senior Commercial Manager
- Senior CS Learning Specialist
- Senior Pricing Analyst
- Senior Security Engineer
- Senior User Researcher
- Site Support Administrator
- Smart Energy Engineer
- Software Engineer
- Software Engineering
- Squad Coach
- Trading Head
- UX Lead
- Zero Carbon Living Advisor
- Zero Carbon Living Reporting Analyst

prospect energy

Prospect's approach

- Whole system, integrated industrial and skills strategies
- Balanced, low carbon mix
- Clear, long-term focus on delivery
- Government hydrogen roadmap
- Political risk

The skills challenge

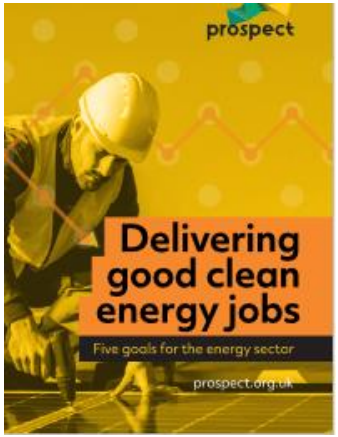
- National shortage of STEM skills
- Market competition
- Increased demand
- Transparency
- Lack of diversity

What is ‘just transition’?

- Ensuring workers and communities dependent on high-emissions industries are not left behind
- Key elements of a just transition:
  - A planned, funded route to net zero
  - Good jobs in the green economy
  - Training and relocation support
  - Support for impacted communities
  - Workers most affected have central role in decision-making
- Broader concept: distributing the costs/benefits of net zero fairly

Just transition reality testing

- What does it mean?
- Where has it happened?
- What opportunities does hydrogen create?
- Is it achievable?



Prospect priorities

- Good clean energy jobs
- Clear, timed project delivery plans
- Reform procurement regulations to give greater emphasis to social value
- Vocational / on the job routes to development
- Increased training and development throughput

Session 2:
Hydrogen Policy & Project Developments in the UK
- Unlocking Hydrogen Economy Potential
- the UK Experience

Lisa Trickett

Sera

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Session 2: Panel Discussion

Hydrogen Policy & Project Developments in the UK
- Unlocking Hydrogen Economy Potential
- the UK Experience

Chris Manson-Whitton, Lord Callanan, Will Morlidge, Gary Wilson, Sue Ferns, Lisa Trickett and Mary Meek

Host: Martin Freer

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Session 3:
Hydrogen Policy & Project Developments in the EU and Internationally

- Faye McAnulla

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Session 3:
Hydrogen Policy & Project Developments in the EU and Internationally

Brett Ryan

Head of Policy and Analysis

HUK

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

April 2024

Hydrogen UK

European Hydrogen Policy Summit

Policy & Project Developments

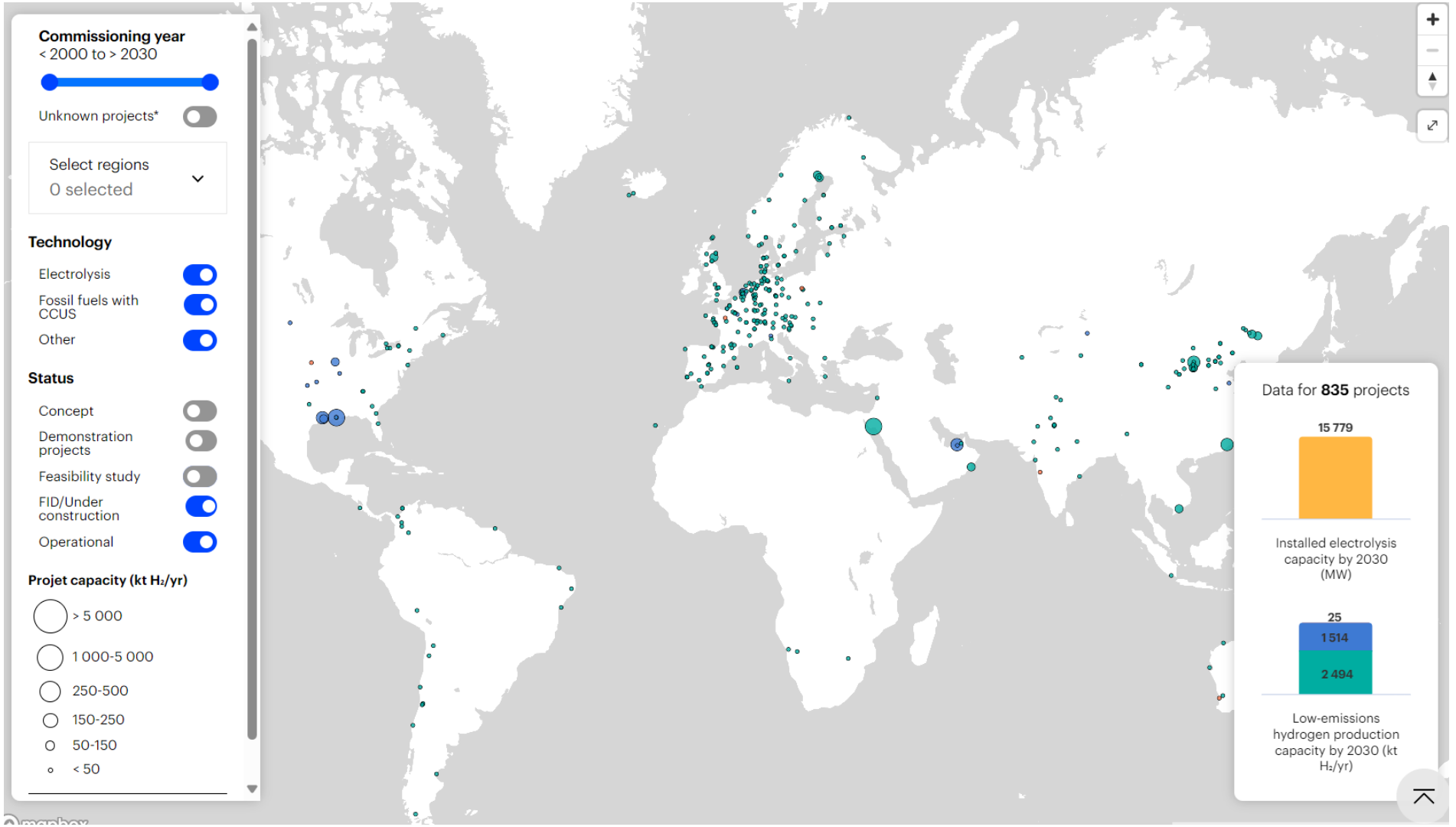
Hydrogen UK

HUK, formerly the Hydrogen Taskforce, is the UK's leading trade association in the hydrogen sector. Our membership includes the industry's largest range of organisations that operate and innovate in and across this sector.

We run Working Groups that cover the full breadth of the hydrogen value chain – from production, to transport and storage, all end use cases, and Jobs & Skills.

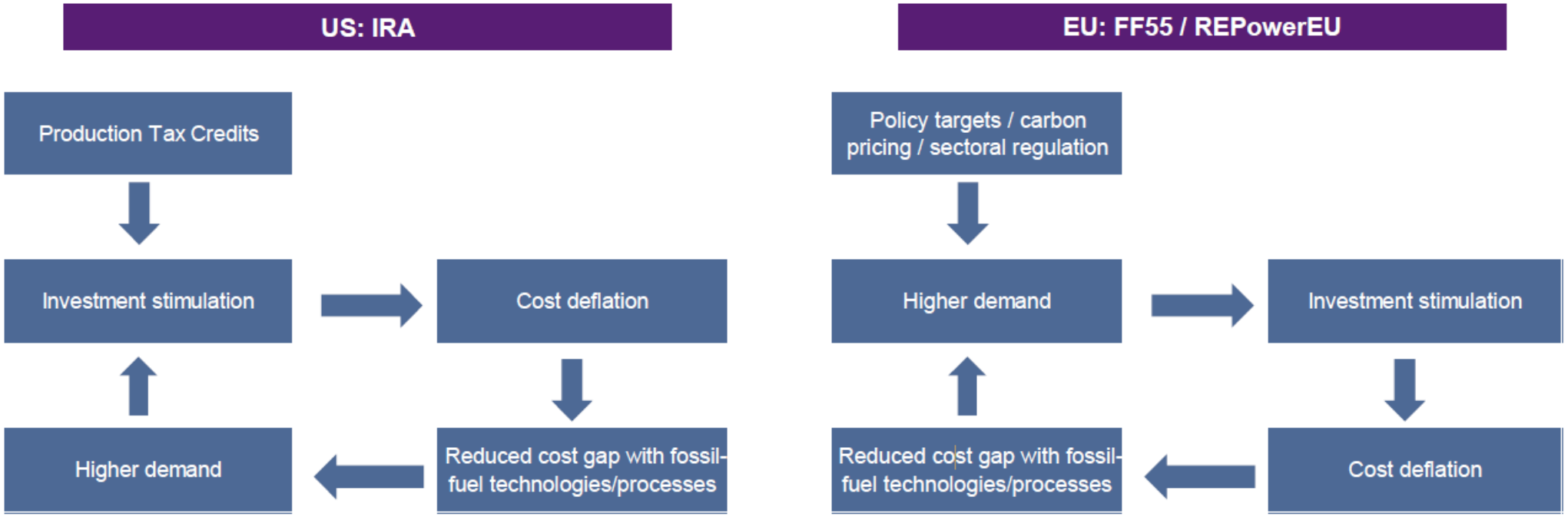
Lots of ‘projects’ but not so many investments

Less than 5% of global hydrogen projects are funded



Carrots versus Sticks

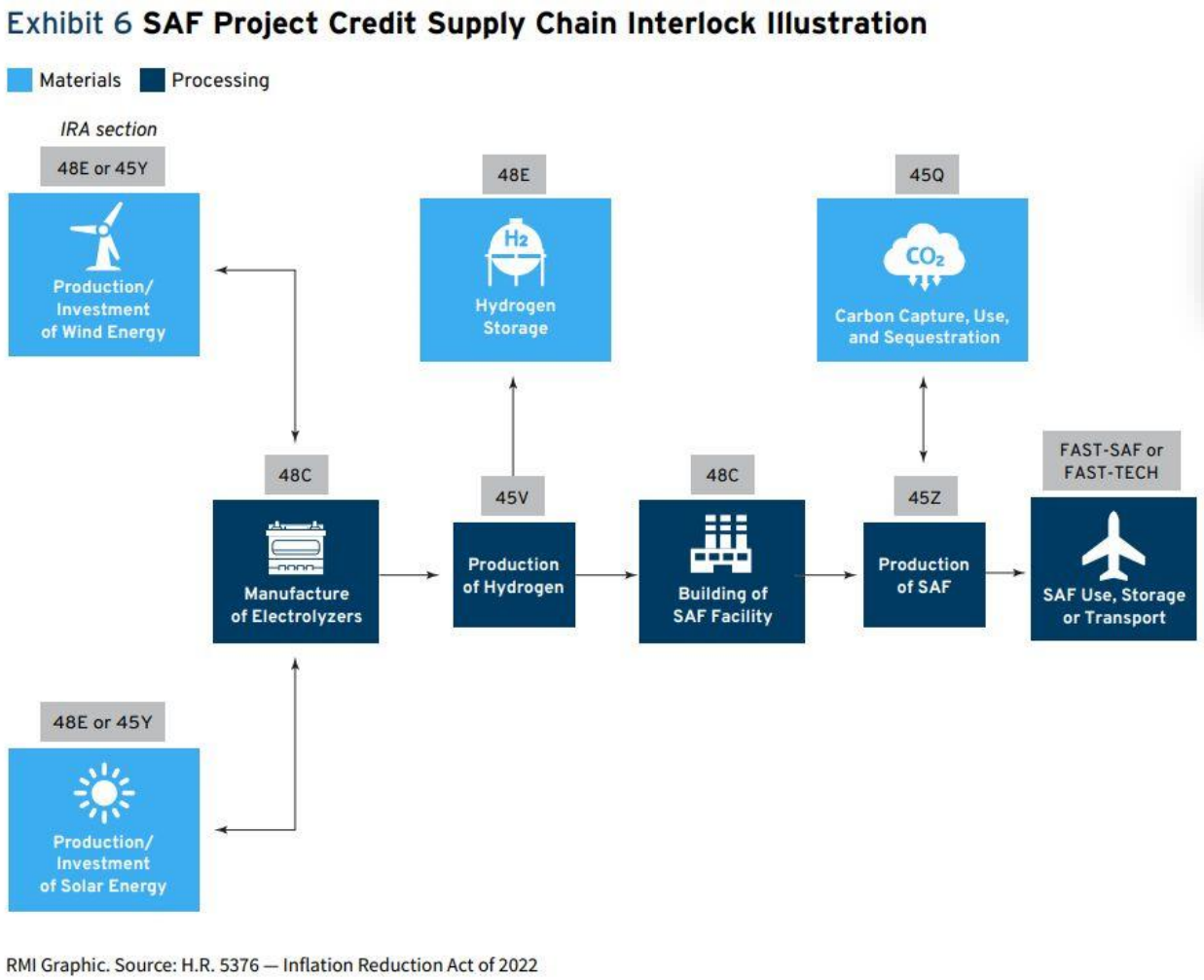
The balance between stimulating supply and demand



Source: Nataxis

The USA offers tax credits across the value chain

With both materials and processing receiving support



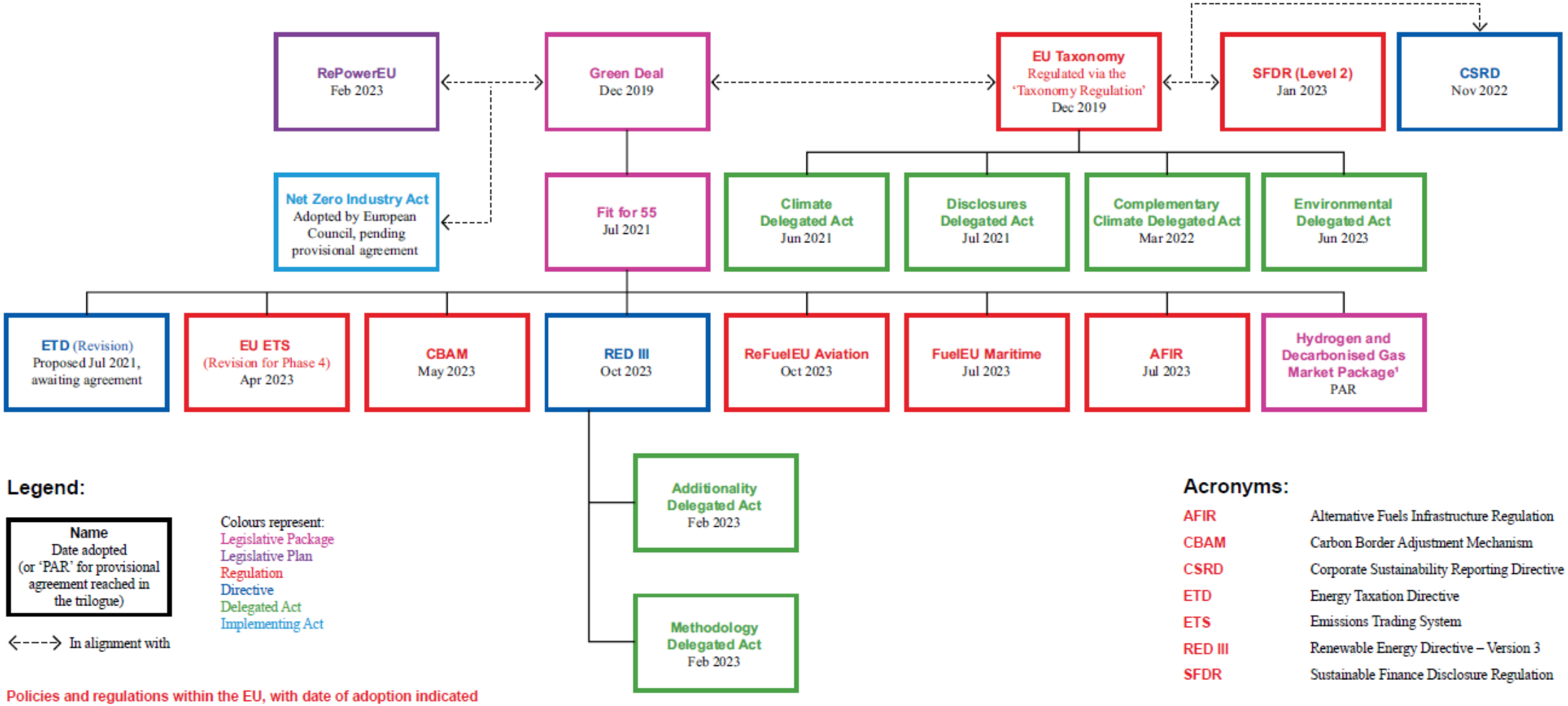
US Treasury moves to restrict hydrogen tax breaks offered by IRA

Too strict or not enough? | Draft guidance for US clean hydrogen production tax credit draws tens of thousands of comments

While industry voices criticise cost impact, others argue that guardrails will be necessary to prevent extra emissions from power supply

The EU has a robust carbon legislation framework

And hydrogen is explicitly included in all major instruments



The UK is waiting for the first FIDs…

But it has the right pieces of the puzzle to scale up quickly

Hydrogen UK

Electrolytic

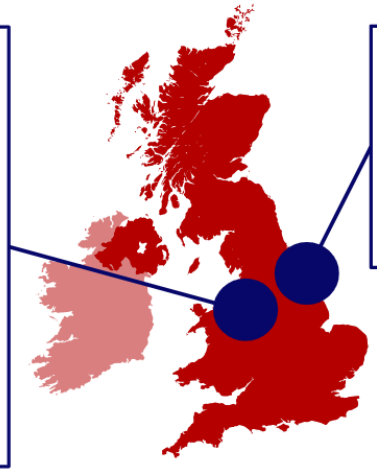
HAR1
- 125 MW
- 11 projects
- Contracts 2024

HAR2
- Up to 875 MW
- Contracts Q1 2025

HAR3+
- Annual allocation
- Up to 1 GW (tbc)
- Contracts from 2026

CCUS-Enabled

HyNet
- Hanson Padeswood Cement Works Carbon Capture and Storage Project
- Buxton Lime Net Zero
- Viridor Runcorn Industrial CCS
- Protos Energy Recovery Facility
- HyNet Hydrogen Production Plant (HPP1)



East Coast Cluster
- Net Zero Teesside Power
- bpH2Teesside
- Teesside Hydrogen CO_2 Capture

Plus:
- Track-1 Expansion
- Track-2

Improving ‘bankability’ and access to finance

Matching risk-return profiles to lenders’ criteria

Project characteristics

- Project costs – magnitude and certainty; never done at this scale; competing with other ‘green’ tech; inflation
- Revenue potential – magnitude and certainty; multiple revenue streams available for hydrogen production projects
- Benefits – wider positive impacts delivered by the project (jobs, GVA, reduced pollution, etc.)
- Risks – identification, mitigation and appropriate allocation of risks

A study by Boston Consulting Group revealed that banks want the projects they finance to:

- ✓ *Have long-term offtake agreements with good quality counterparties (offtake risk)*
- ✓ *Use mature technologies (technology risk)*
- ✓ *Operate under clear regulations and industry standards (policy risk)*
- ✓ *Be able to sell into established markets (merchant risk).*

Instruments to make hydrogen more economically viable

- Stimulate demand by mandating quotas (RED III)
- Carbon pricing schemes (compliance/voluntary; ETS, CBAM)
- Carbon markets
- Carbon contracts for difference (H2Global)
- Subsidies/Tax incentives (IRA)
- General support by government (e.g. climate action or capital investments plan; NSIPs)

Lots of challenges remain…

But every reason to be optimistic!

- Improved terms in the HPBM (RTIs, cross-chain risks, etc.)
- More clarity over Cluster Sequence
- Strategic decisions needed for large T&S infrastructure
- Demand side measures – getting the right balance of carrots and sticks
- Heat???
- Defining the role of imports and exports
- Access to robust supply chains
- Building the skilled workforce, now and future!

Collaboration is key

HUK working with Government, industry and investors to deliver on ambition

Hydrogen UK

Thank you.

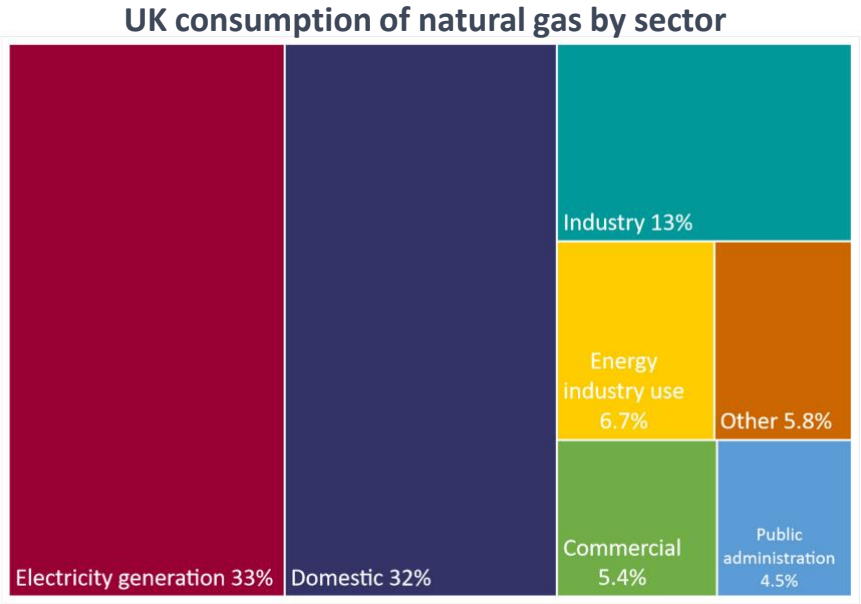
Gas Transition

Chris Galpin, Policy Advisor

April 2024

Natural Gas: UK context

- 38% of total energy demand
- Over 700 TWh used in 2023
- ~50% imported, ~50% domestic production



Source: UK Government, DUKES 2023

Transition will be driven by changing costs

Climate and cost are increasingly aligned:

> Market for high-carbon products set to shrink (both domestically and internationally)

> UK likely to be more competitive in low-carbon market

UK

- Carbon prices expected to **double** by 2030
- UK CBAM from 2027

EU

- Carbon prices expected to **double** by 2040
- EU CBAM phased in from Oct 2024

Cost will be main driver for fossil gas users to look towards low carbon alternatives

Can we produce enough?

E3G

- UK has excellent conditions for renewable H_2 production. But more investment needed to realise this potential.
- UK HAR1 – 250 MW at 24.1 p/kWh
- EU allocation and UK HAR2 should see lower prices.
- However – hydrogen still likely to remain a **high-value**, **supply-limited** fuel for the foreseeable future

What does this mean for end users?

E3G

- Renewable generated electricity will likely be cheaper industrial fuel source for many users
- However, some processes cannot be electrified efficiently
- H2 will be a critical, high-value fuel for key sectors e.g.
  - Direct Reduced Iron (for steelmaking)
  - Some aspects of ceramics, glass-making
  - Long-distance or weight-critical transport applications
  - Hydrogen to Power / long-duration energy storage

Guaranteeing supply and reducing costs will be critical to competitiveness and commercial viability of these sectors

What needs to happen next?

E3G

Key priorities for governments:

1. Boost support for green H2 and maximise production
2. Set out clearer long-term plan for gas transition, and identify key demand clusters
3. Identify priority critical sectors for end use, and act to ensure long-term security of supply

About E3G

E3G is an independent climate change think tank with a global outlook. We work on the frontier of the climate landscape, tackling the barriers and advancing the solutions to a safe climate. Our goal is to translate climate politics, economics and policies into action.

E3G builds broad-based coalitions to deliver a safe climate, working closely with like-minded partners in government, politics, civil society, science, the media, public interest foundations and elsewhere to leverage change.

More information is available at **www.e3g.org**

E3G

@E3G

Hydrogen Policy & Project Developments in the UK, EU & Internationally

30th April 2024

Agenda

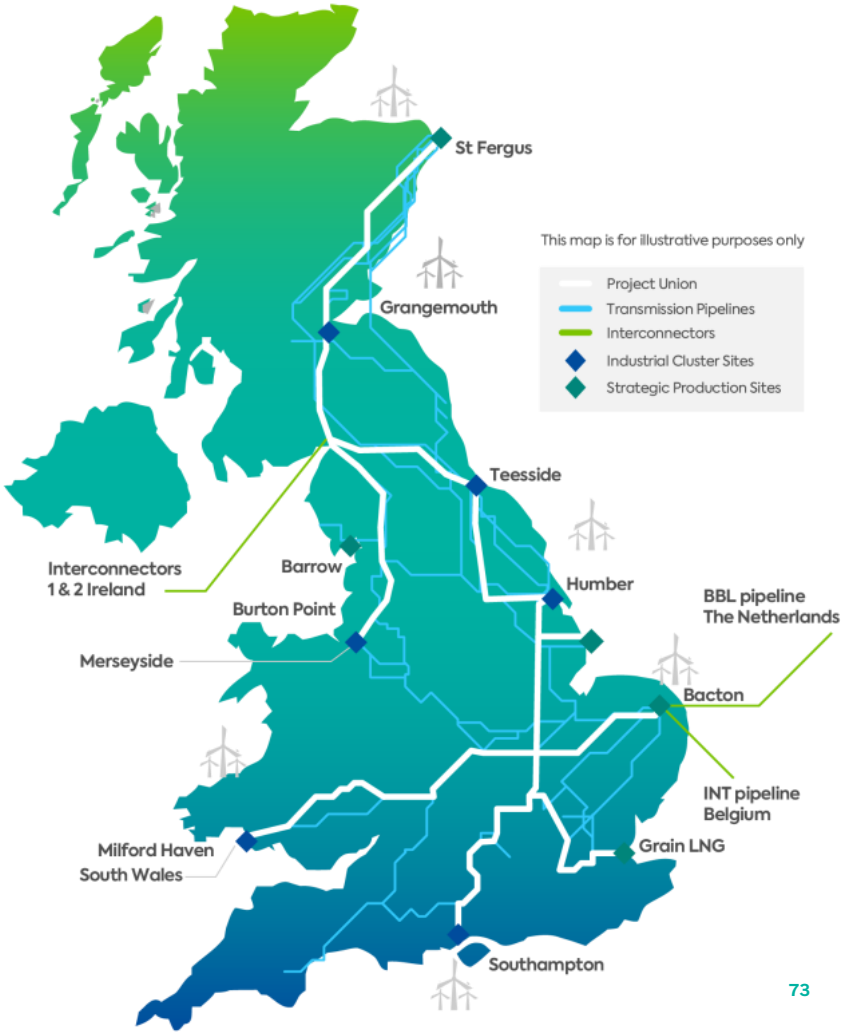
Item
Project Union – Our vision of a GB Hydrogen Network
EHB – European Hydrogen Backbone
Policies to progress hydrogen transmission

national gas transmission

ProjectUnion

Project Union will connect, enable net zero and empower a UK hydrogen economy, by creating a hydrogen ‘backbone’ for the UK by the 2030s.

- ~2,500km hydrogen transmission network
- Connect cross GB supply, demand and strategic storage sites
- Use existing infrastructure
- Enable early and affordable market growth of a low carbon hydrogen economy

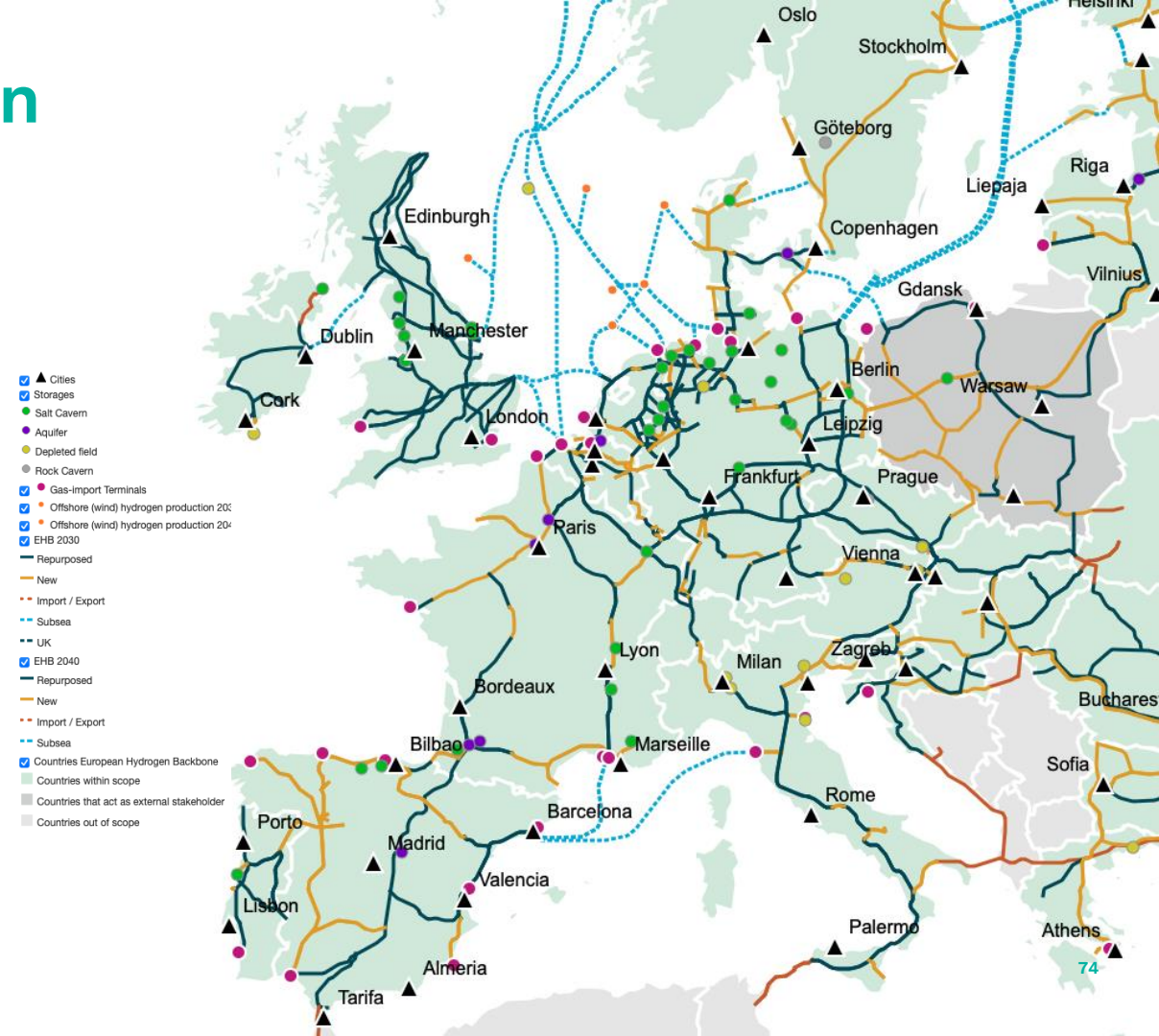


European Hydrogen Backbone

33 Infrastructure operators

Valuable comparators

Connected together
in the future to provide resilience to our European Energy Supply

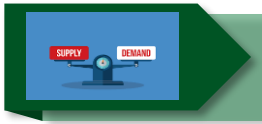


What are our main policy asks?

Timely strategic planning

Agree funding approach

Dedicated planning and permitting for hydrogen infrastructure



Develop the hydrogen market

Need to address supply chain and skills


national
gas
Thank you

Session 3: Panel Discussion

Hydrogen Policy & Project Developments in the EU & Internationally

Brett Ryan, Troy Aharonian, Chris Galpin and Malcolm Arthur
Host: Faye McAnulla

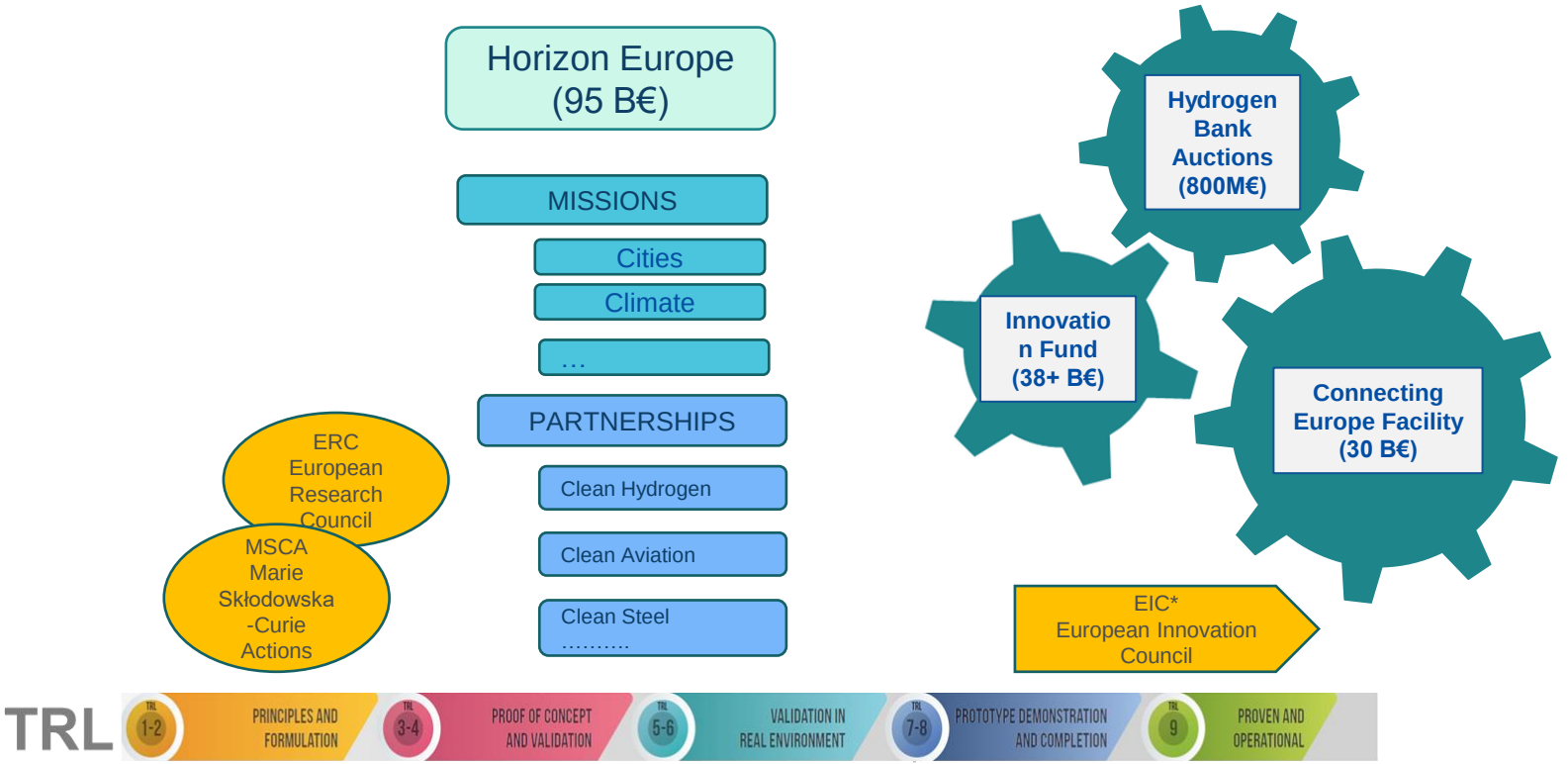
#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Session 4:
The Role of UK, European, International Collaboration in Achieving Zero Carbon Hydrogen Economy

- Alan Haigh

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Schematic* - Funding Instruments and Programmes



A Haigh DG RTD

*** Schematic representation, Not to scale, EIC act along the TRL chain, not only high TRL**

European Commission

Innovation Fund

Carbon emission reduction programme
(not primarily R&I)

October 2023 – the 4th large scale call was 4Bio€ - just closed

See the project portfolio web site

High proportion hydrogen; CCS, Clean Steel

Project must be in the EU but UK legal entities can be consortium members
(e.g. AGGREGA CO2)
UK company, O.C.O Technology, using its CO2 capture technology in Bilbao (3M€ EU funding)

Large Scale project (announced Jan 2024)
H2GS - H2GreenSteel
A Swedish steel company has been awarded 250M€ from IF. It is part of a massive project raising debt (4.2 billion€) and equity (2.1 billion€) to date.

European Hydrogen Bank – Pilot Auctions

Revision of the EU ETS Directive introduced an EU Hydrogen Bank

Initially 800M€ from the Innovation Fund Budget, later 3 Bn€?

Member State funding can be added and establish a common auction mechanism

Paying a fixed premium per kg of hydrogen produced (maximum of 10 years of operation) to cover and lower the cost gap between renewable hydrogen and fossil fuel hydrogen

Deadline was February 2024 (oversubscribed)

Connecting Europe Facility (30 Bio€)

CEF Programme - Supporting European transport, energy and digital networks (e.g. TEN-T corridors) including:

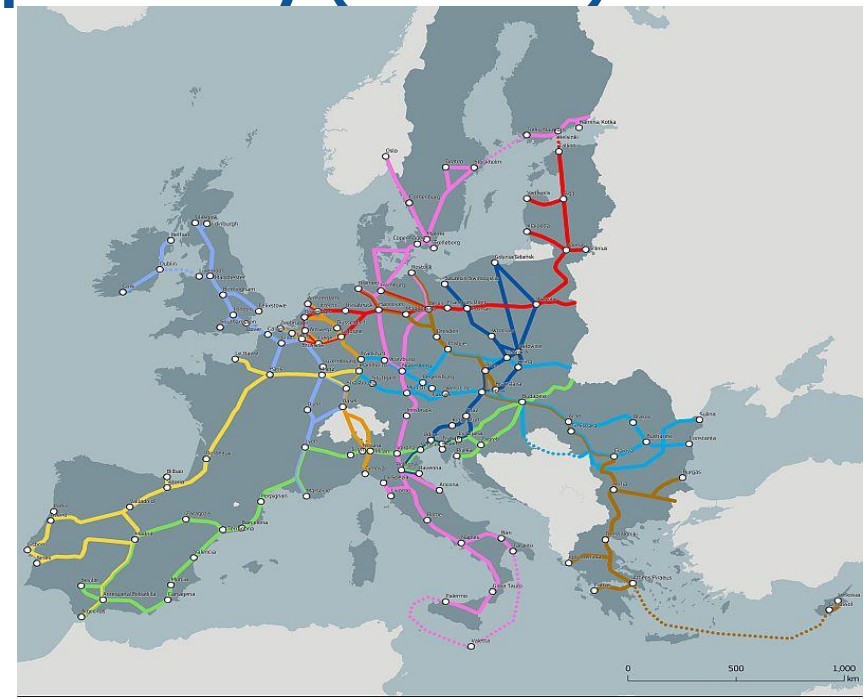
Hydrogen infrastructure e.g. pipelines, transport, fuelling stations

CEF AFIF (Alternative Fuels Infrastructure Facility)

launched in 2021.

Published in 2024:

1 Bio€ – 3 call deadlines for 24 September 2024, 11 June 2025 and 17 December 2025



Hydrogen Valleys – Mission Innovation

- Not all Hydrogen Valleys are Horizon Europe – Clean Hydrogen Partnership
- The Mission Innovation keeps a compendium of ongoing Hydrogen Valley Projects Wordwide
- 90 Valleys; 156B€, Project Map
- Mission Innovation has 7 sub-sections on Clean Hydrogen, Carbon Harvesting, net zero industry etc.
- Some Hydrogen Valleys are primarily private funding, but most are keen to share best practice (e.g. Saudi Arabia NEOM)

THE GO-TO
ENERGY SUPPLY CHAIN
TRADE ASSOCIATION,
GLOBALLY

#JoinUs

2023 WINNER

The ambition and the reality of the energy transition

Stuart Broadley FEI
CEO at EIC
Energy Industries Council (EIC)

THE VOICE OF THE ENERGY SUPPLY CHAIN, **GLOBALLY**

EXPORT | DIVERSIFY | GROW

Top 5 globally

950 members

From 2017
Global

1943
UK-only

From 1981
Energy-Agnostic

Energy supply chain focus

UK → Global → 5 hubs

→ 6th Europe hub in 2024

DataStream

Capital expenditure tracking of over 14,500 projects in development - collated, timely market intelligence, valuable for keeping you ahead of your competition

AssetMap

Operational asset mapping over 50,000 existing facilities and key contacts mapped – Worldwide coverage includes the UK, Europe & Caspian, Americas, Africa, Australasia, the ASEAN and GCC states.

SupplyMap

Interactive map of over 7,000 energy supply chain companies. Covering the UK, Brazil, Texas (USA), Malaysia and United Arab Emirates – ideal for identifying suppliers, partners and competitors

Pavillion

LIVE events

130 events p.a.

Energy Exports Conference

THE GO-TO
ENERGY SUPPLY CHAIN
TRADE ASSOCIATION,
GLOBALLY

#JoinUs

2023 WINNER

The ambition and the reality of the energy transition

The global and UK context

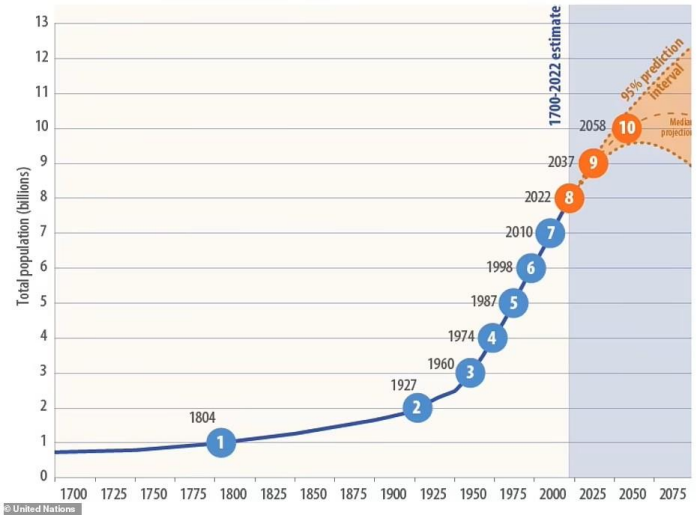
Stuart Broadley FEI
CEO at EIC
Energy Industries Council (EIC)

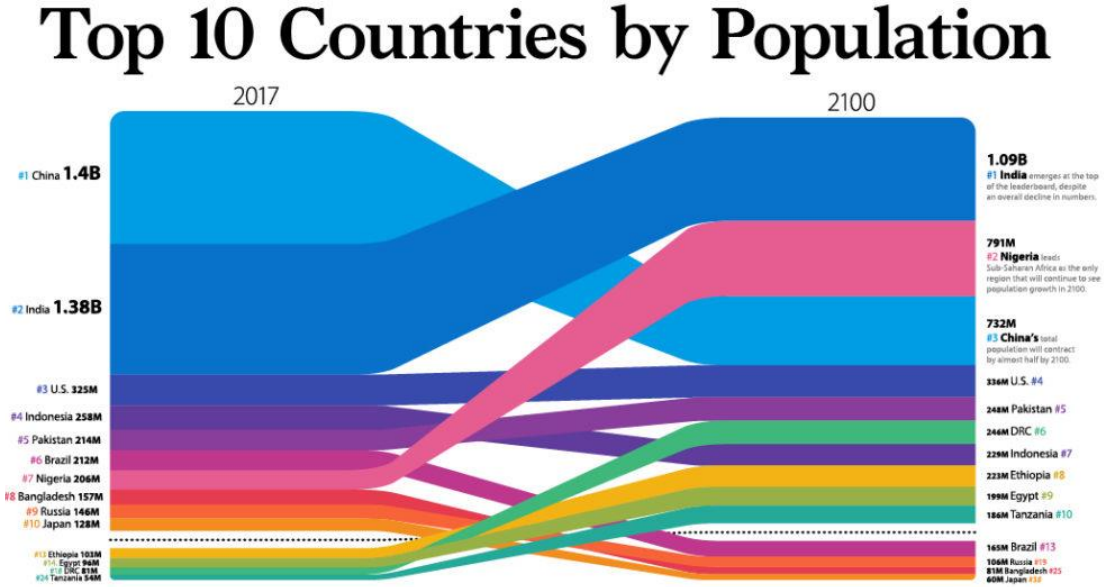
GLOBAL POPULATION GROWTH SLOWS BUT STILL +200,000 NET PER DAY

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

Figure 1

Global population size: estimates for 1700-2022 and projections for 2022-2100





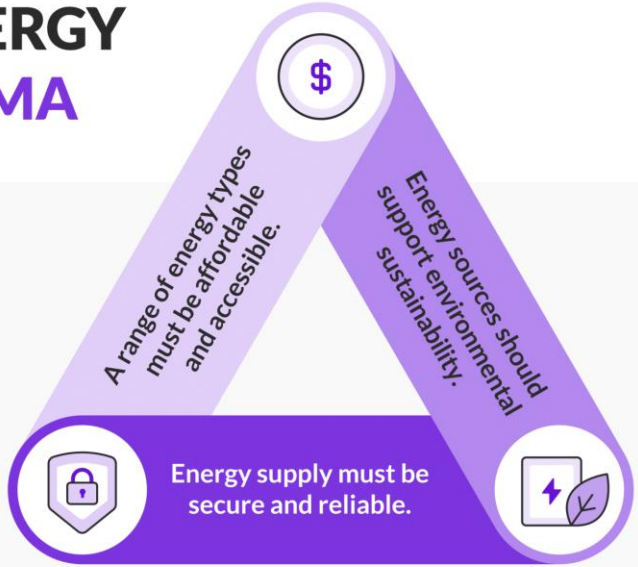
China 50% down, the rise of Africa

Source: United Nations

2023 forecast global population net growth rates : +200,000 per day

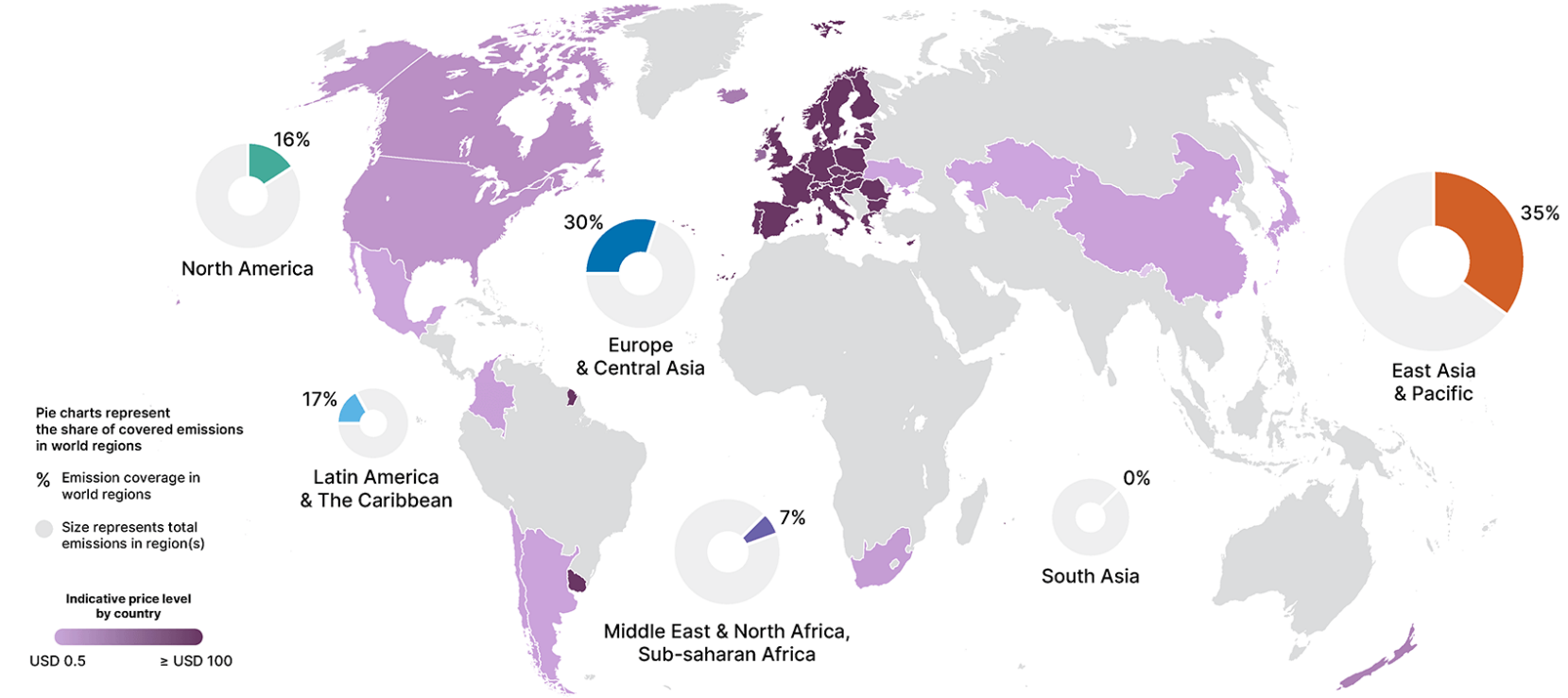
ENERGY TRILEMMA PRIORITISES ‘ENERGY SECURITY’

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY



ONLY 23% OF WORLD WITH ETS (EMISSION TRADING SCHEME) PLANS

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY



Source: World Bank

80 MILLION KM NEW GRID NEEDED

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

"The world must add or replace **80 million km of electrical grid by 2040** to meet climate targets."

That's as much as the world has built in the last 100 years…

19-Oct - IEA

FIRST 100% SAF TRANSATLANTIC FLIGHT APPROVED

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

The UK Civil Aviation Authority issues Virgin Atlantic with a permit to fly a world-first transatlantic 100% Sustainable Aviation Fuel (SAF) flight.

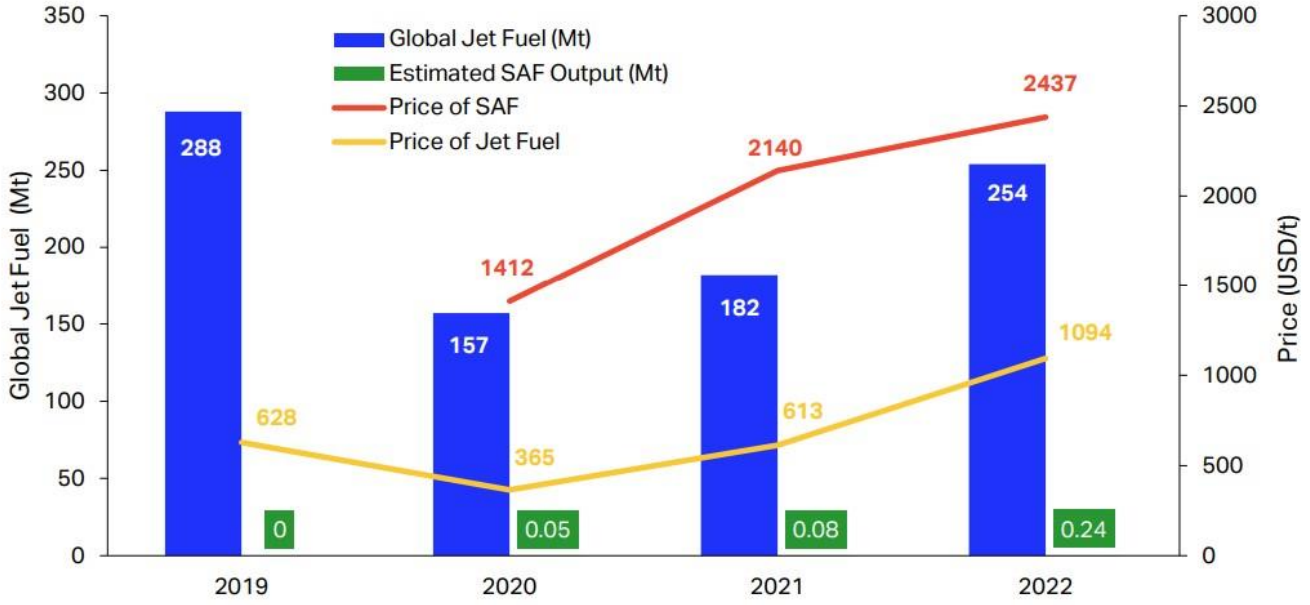
Virgin Atlantic flies across the Atlantic from London Heathrow to New York JFK on 28 November 2023 to test and showcase the feasibility of flying on **100% SAF.**

6-Nov - CAA

SAF DEMAND 'HUGELY' OUTSTRIPS SUPPLY

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

Sustainable aviation fuel output increases, but volumes still low



Source: S&P Global Commodity Insights (Platts), IATA Sustainability & Economics

Note: Price estimates are published by Platts and are based on cost-plus methodology. These estimations are subject to fluctuations, and substantial price discrepancies exist among different geographical areas. The SAF market remains comparatively limited, resulting in a deficiency of universally acknowledged valuation figures.

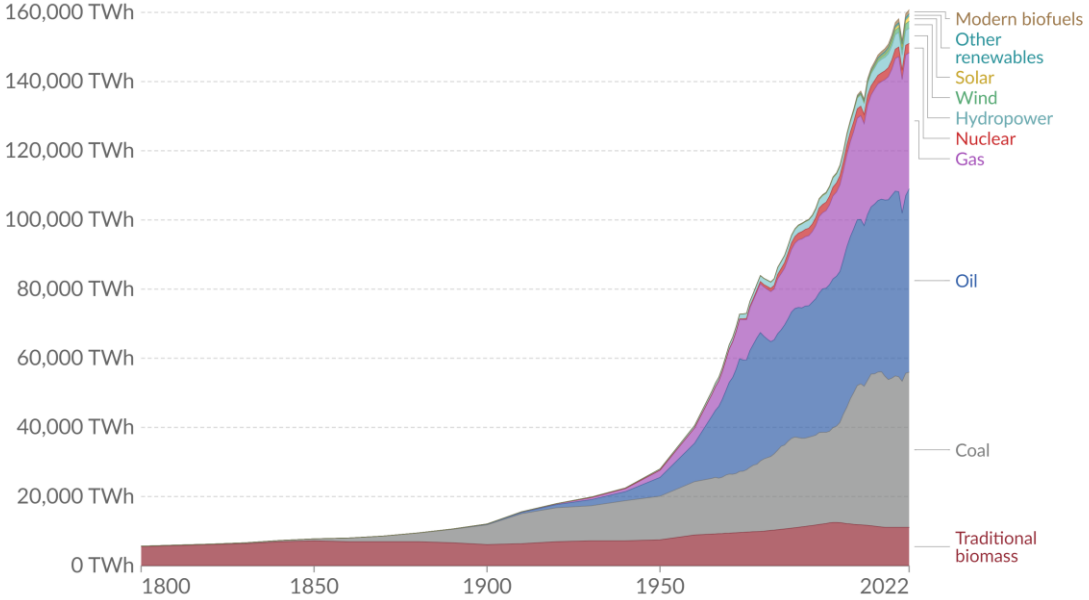
GLOBAL PRIMARY ENERGY USAGE - HYDROCARB0NS STILL DOMINATE

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

Global direct primary energy consumption

Direct primary energy consumption does not take account of inefficiencies in fossil fuel production.

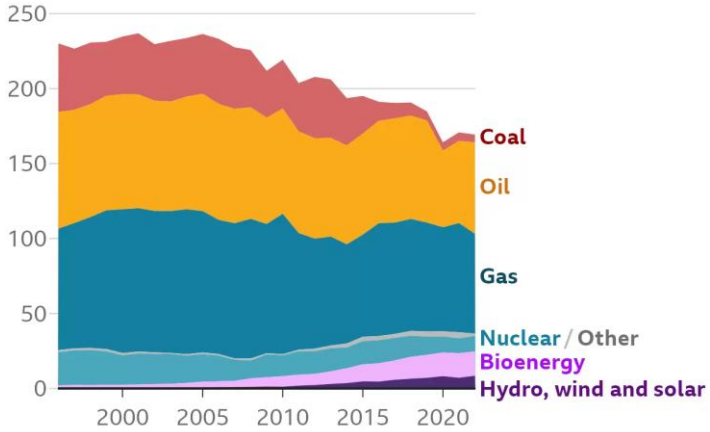
Our World in Data



Data source: Energy Institute Statistical Review of World Energy (2023); Vaclav Smil (2017)
OurWorldInData.org/energy | CC BY

How energy use has changed within the UK

Consumption for energy use (million tonnes of oil equivalent)



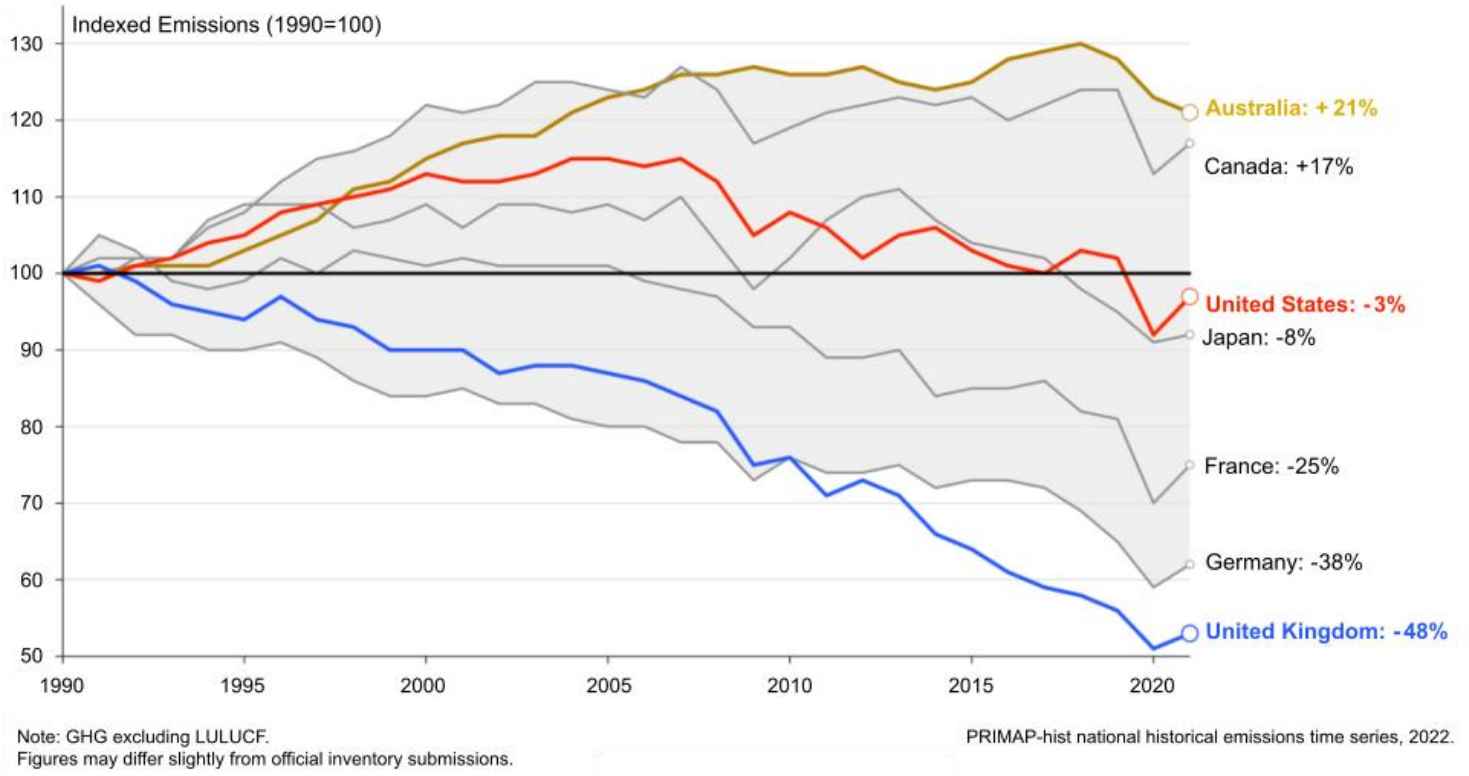
Note: Primary fuel input basis.

Source: Department for Energy Security and Net Zero

BBC

INDEXED EMISSIONS 'UK' IS DOING WELL

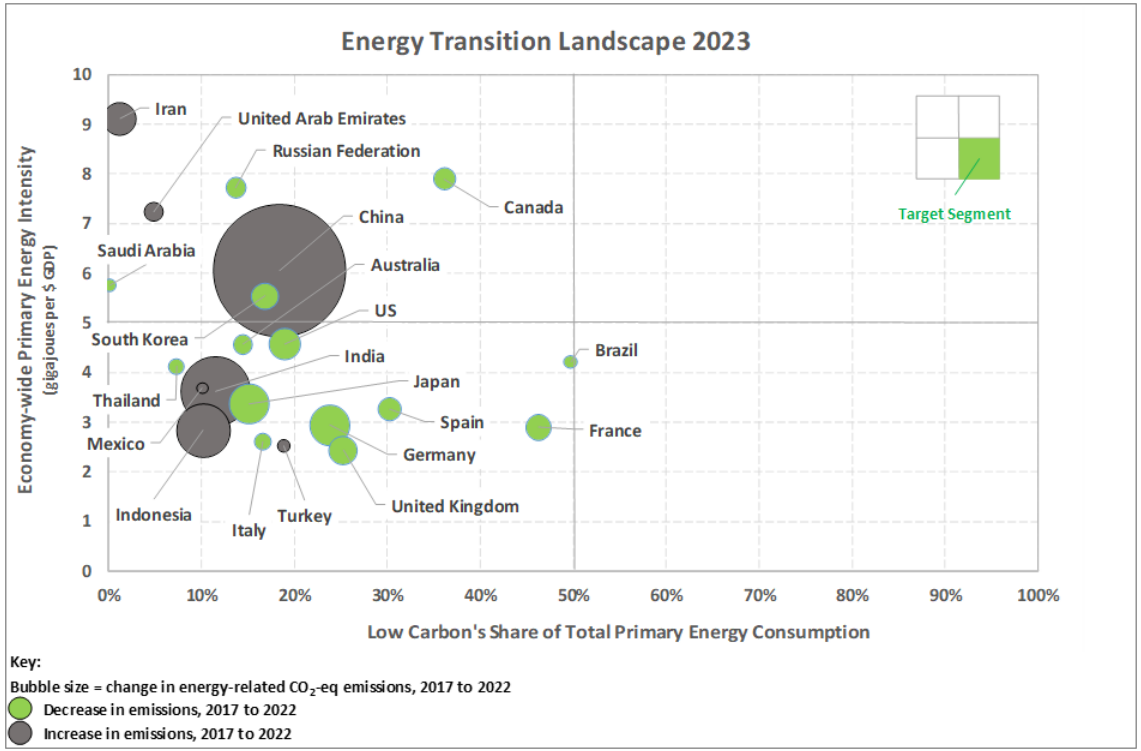
THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY



Source: UK GOV - Department for Energy Security & Net Zero

COUNTRY TRANSITION TRACKER
'UK' IS DOING WELL

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

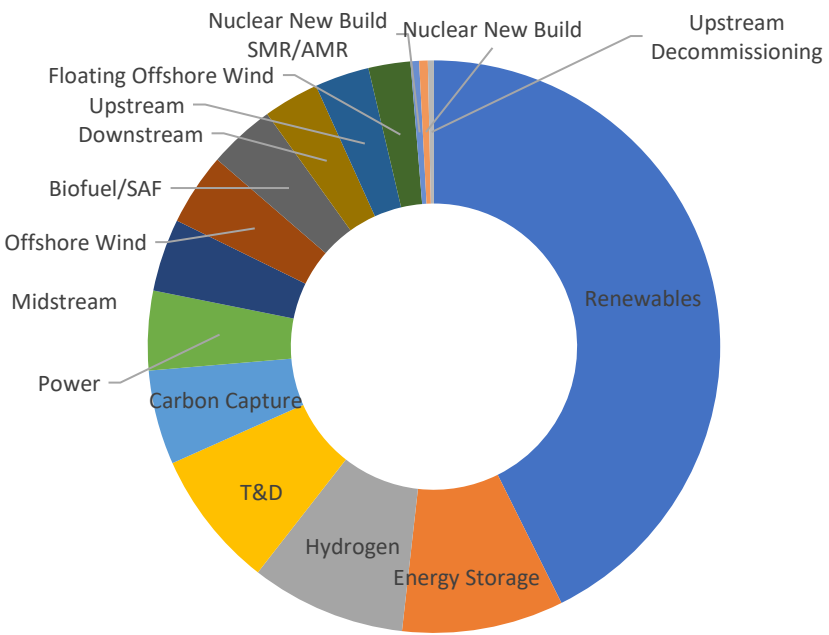


Source: Energy Institute 2023 Statistical Review

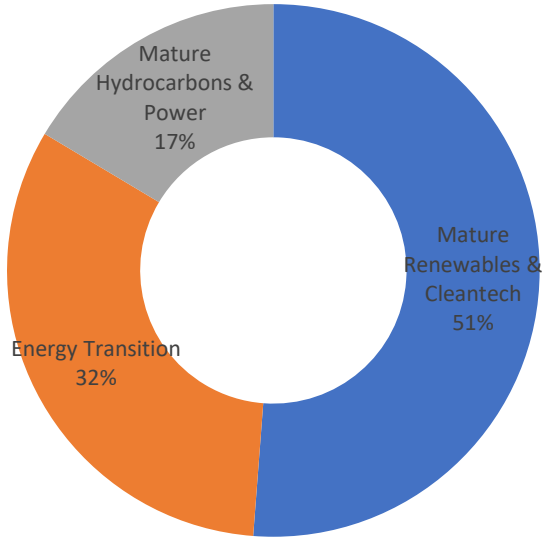
WHAT HAPPENED IN 2023

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

Projects announced all sectors since January 2023



Quantity of projects announced in 2023 (exc. T&D)

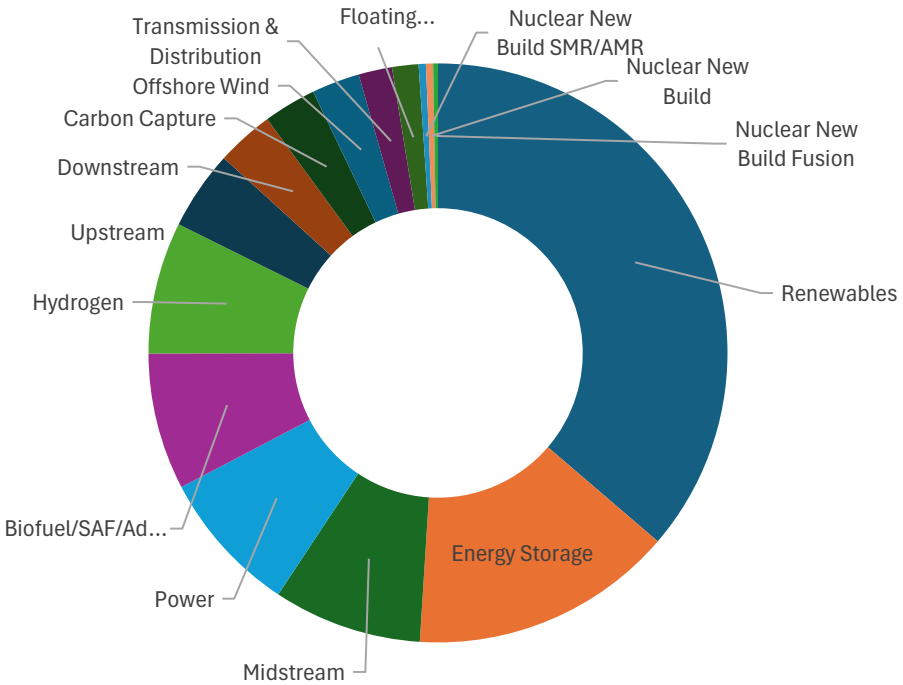


Source: EICDataStream

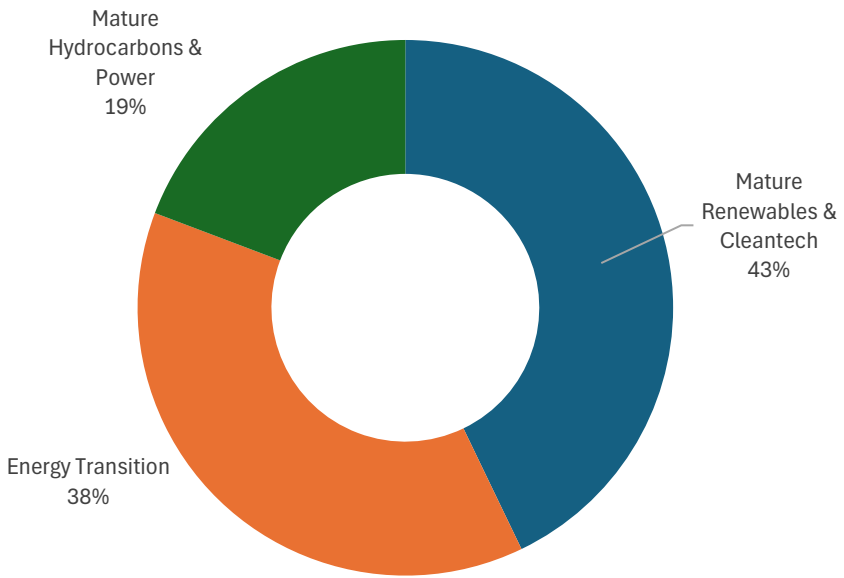
WHAT'S HAPPENED IN 2024

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

Projects announced in 2024 up to the end of March



Projects announced in 2024 up to the end of March

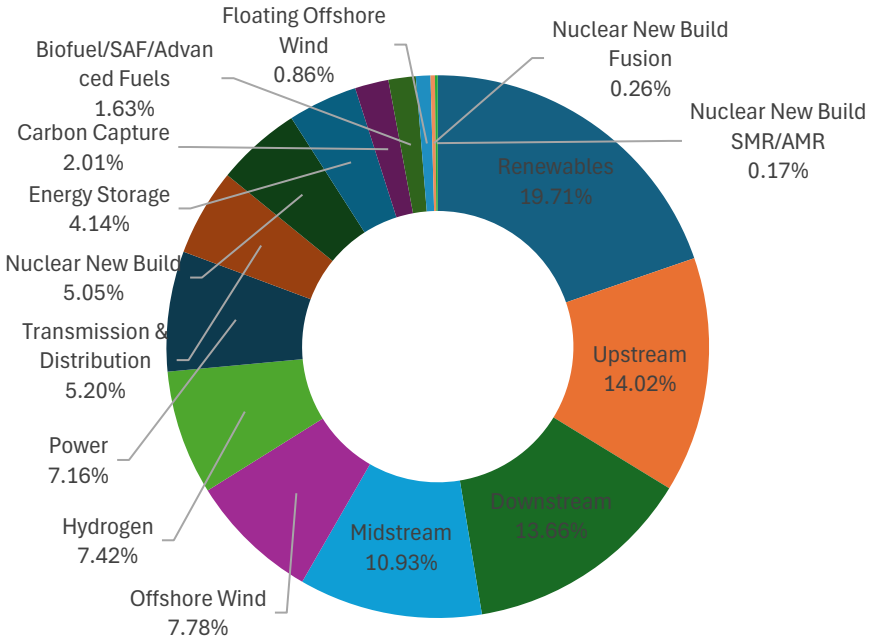


Source: EICDataStream

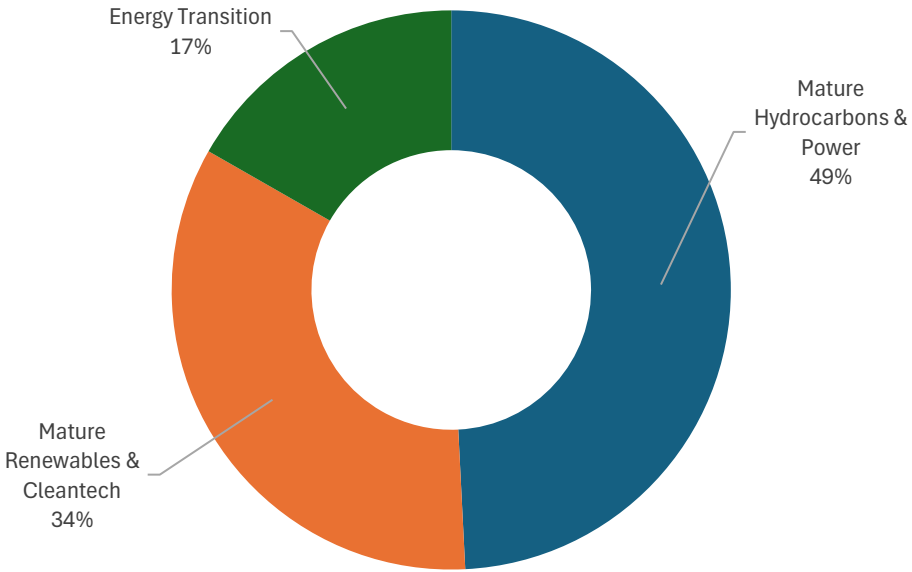
SUMMARY REMARKS – NEAR/MEDIUM TERM

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

Value of projects based on commissioning date up to 2030



Value of projects based on commissioning date up to 2030

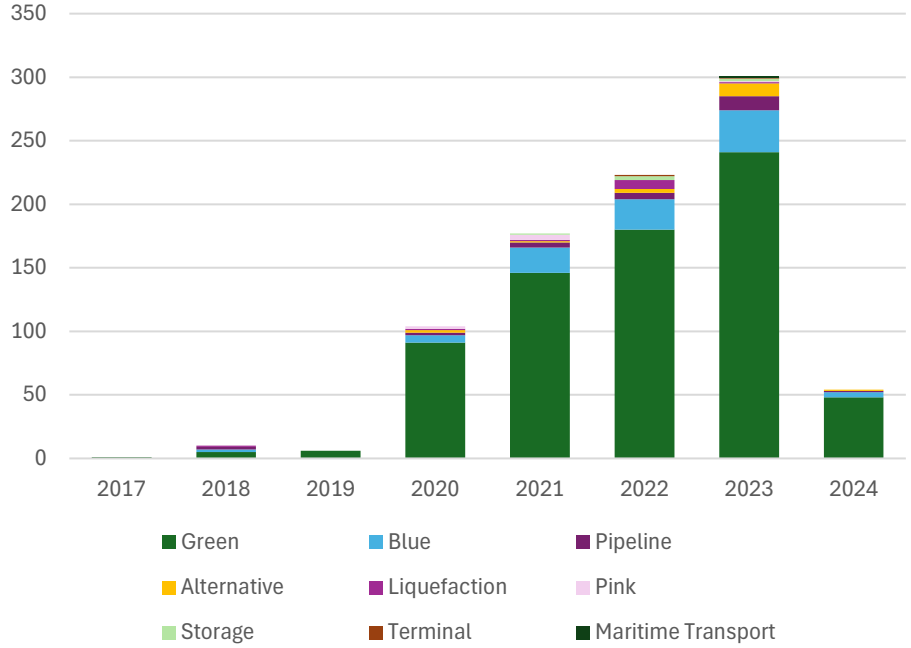


Source: EICDataStream

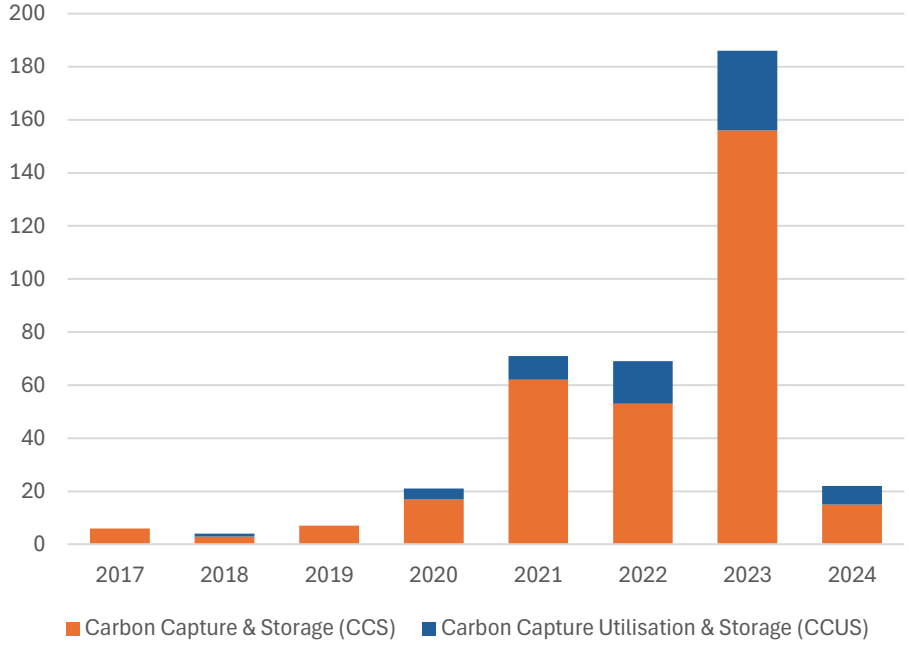
ENERGY TRANSITION HYDROGEN & CARBON CAPTURE

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

Number of announced hydrogen projects 2017 to March 2024



Number of announced carbon capture projects 2017 to March 2024

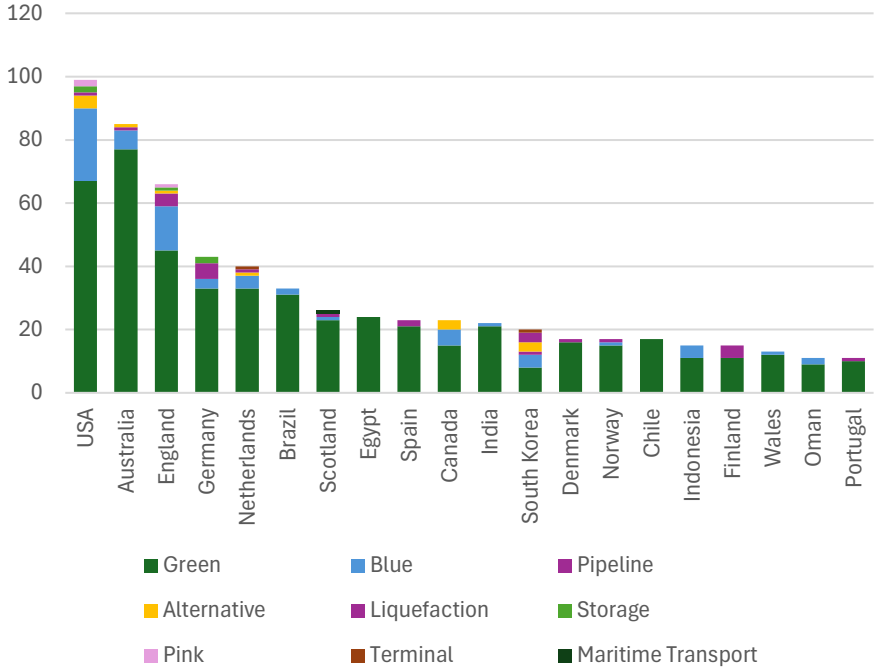


Source: EICDataStream

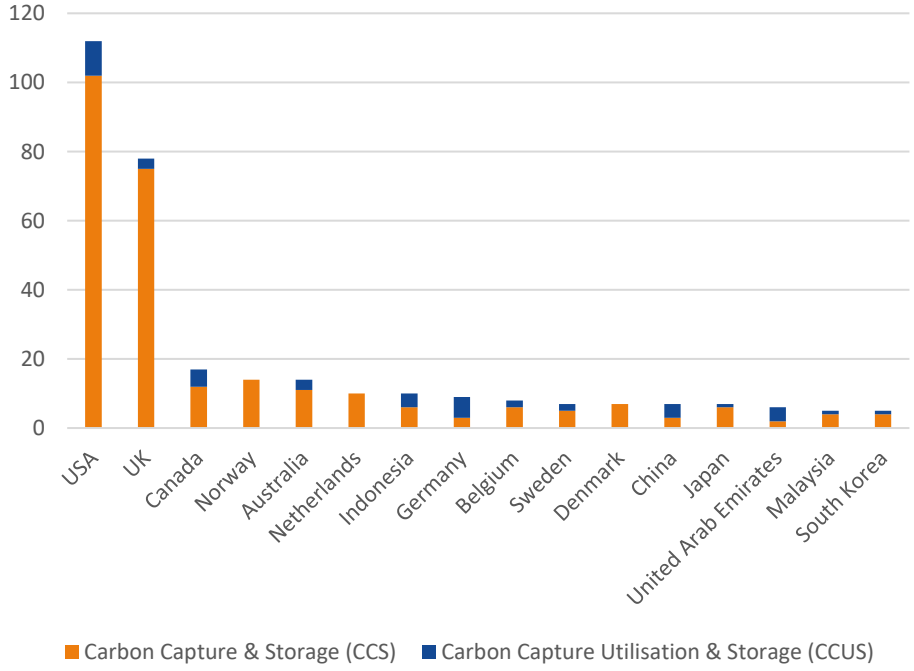
ENERGY TRANSITION HYDROGEN & CARBON CAPTURE

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

Number of hydrogen projects currently under development (Top 20 countries)



Top 15 countries by number of projects under development

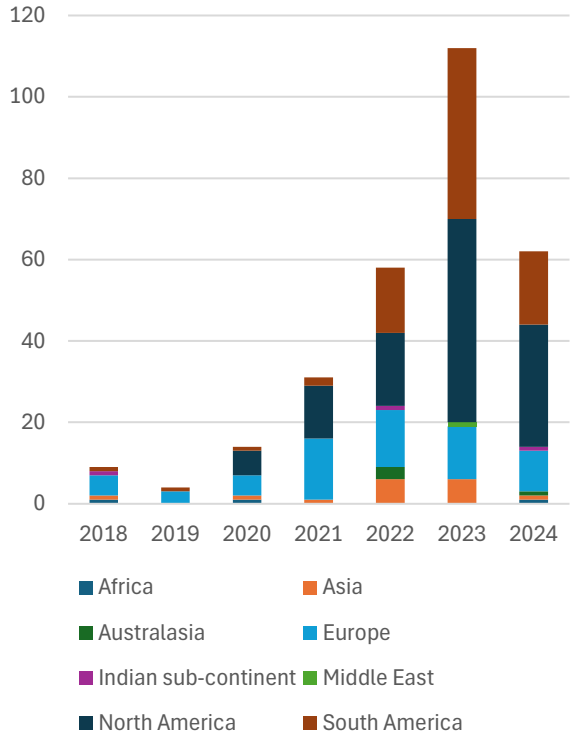


Source: EICDataStream

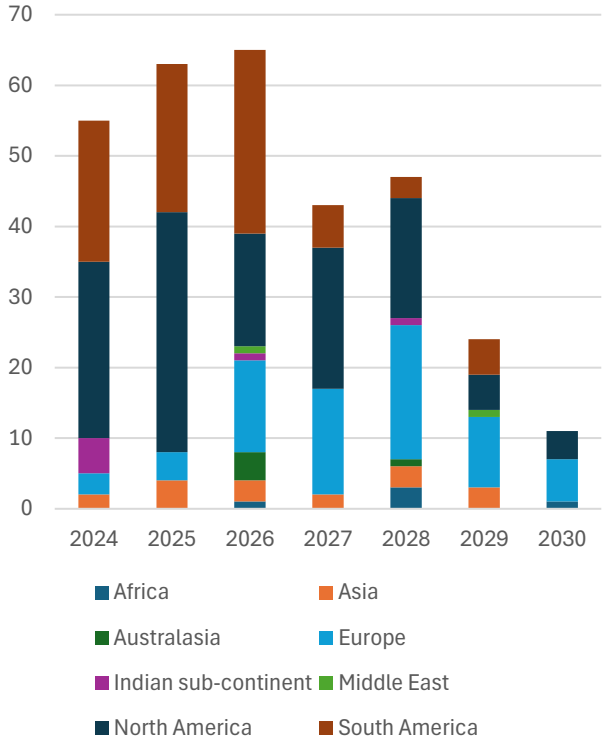
BIOFUELS

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

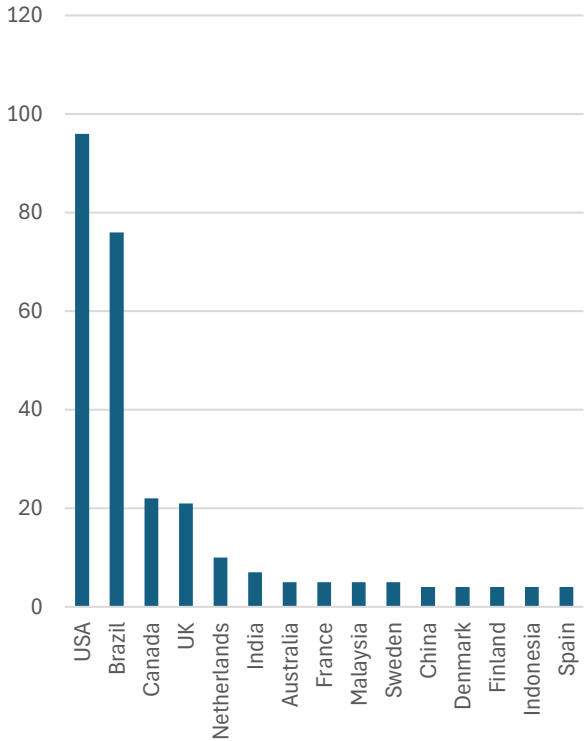
No. of Projects Announced from 2018 – April 2024 by Region



Pipeline of Projects by Startup Year and Region



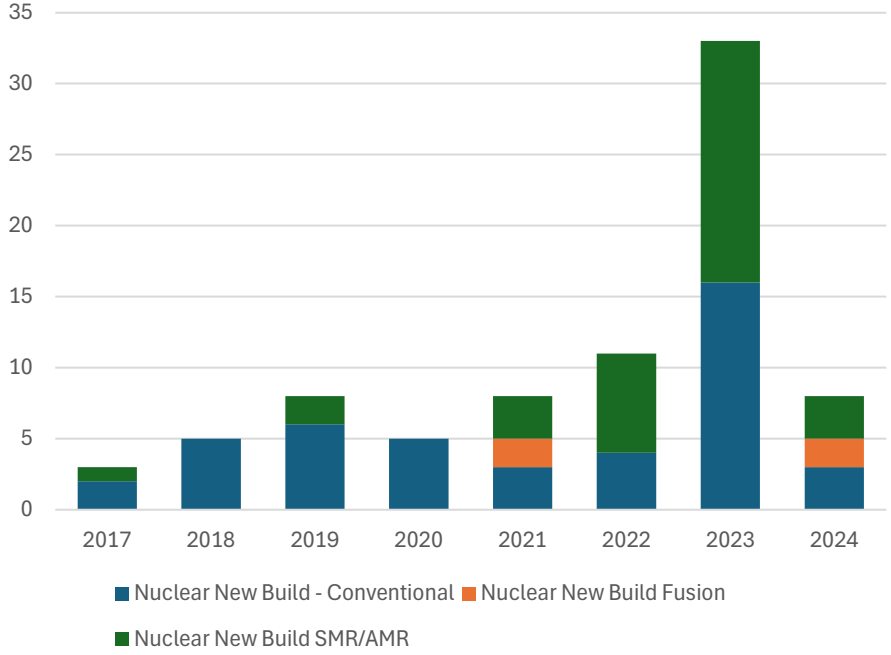
Number of Projects Under Development - Top 15 Countries



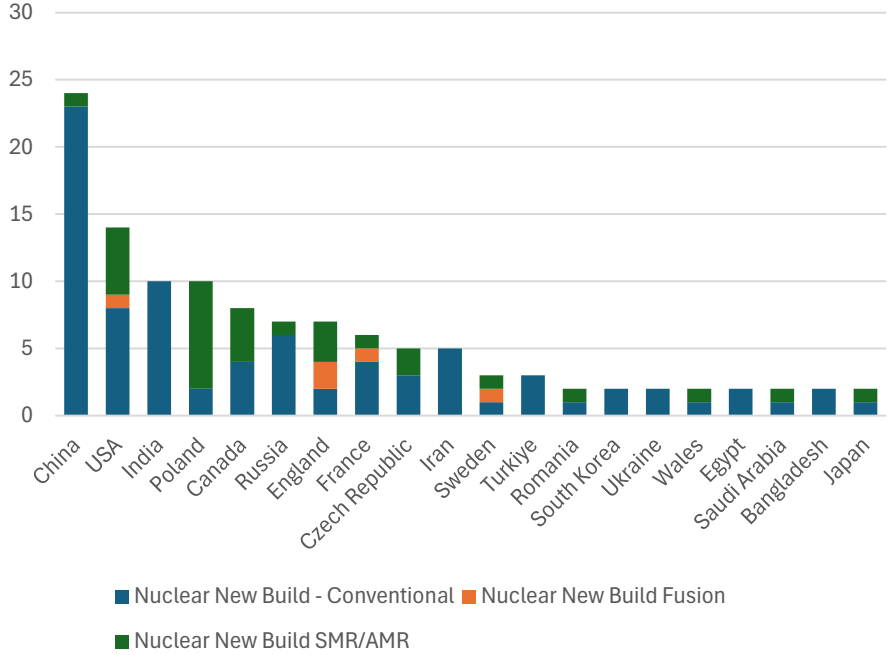
NUCLEAR POWER

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

Number of nuclear new build projects announced



Number of nuclear projects currently under development (Top 20 countries)



Source: EICDataStream

FID DATA Q1 2024

THE GO-TO ENERGY SUPPLY CHAIN TRADE ASSOCIATION, GLOBALLY

- **Are Energy Transition projects reaching the Energy Supply Chain yet?**
- Table below outlines the projects that are currently under development

Sector	Number of projects	Estimated CAPEX of projects under development ($million)	Number of projects to reach FID	CAPEX of projects under development that have reached FID($million)	% of projects to reach FID	% of overall value to reach FID
Nuclear New Build	102	960,159	39	377,100	38.24	39.27
Upstream	1077	1,317,837	227	445,051	21.08	33.77
Midstream	691	1,134,460	138	222,010	19.97	19.57
Downstream	650	1,340,777	127	258,874	19.54	19.31
Biofuel/SAF/Advanced Fuels	312	145,080	98	21,523	31.41	14.84
Carbon Capture	355	190,949	26	11,202	7.32	5.87
Offshore Wind	613	1,933,944	54	98,559	8.81	5.10
Hydrogen	792	893,224	61	33,686	7.70	3.77
Nuclear New Build SMR/AMR	33	75,140	2	600	6.06	0.80
Floating Offshore Wind	238	616,528	4	592	1.68	0.10

Source: EICDataStream

Thank you!

Stuart Broadley FEI
CEO at EIC
Energy Industries Council (EIC)

THE GO-TO
ENERGY SUPPLY CHAIN
TRADE ASSOCIATION,
GLOBALLY

#JoinUs

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

Pau Ruiz Guix, Trade and International Relations at Hydrogen Europe

April 30th, 2024

Hydrogen Europe

Our vision

To propel **global carbon neutrality** by accelerating the **European hydrogen industry**.

In a nutshell

500+
members

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

45+
employees

16
working groups

120k+
followers

In a nutshell

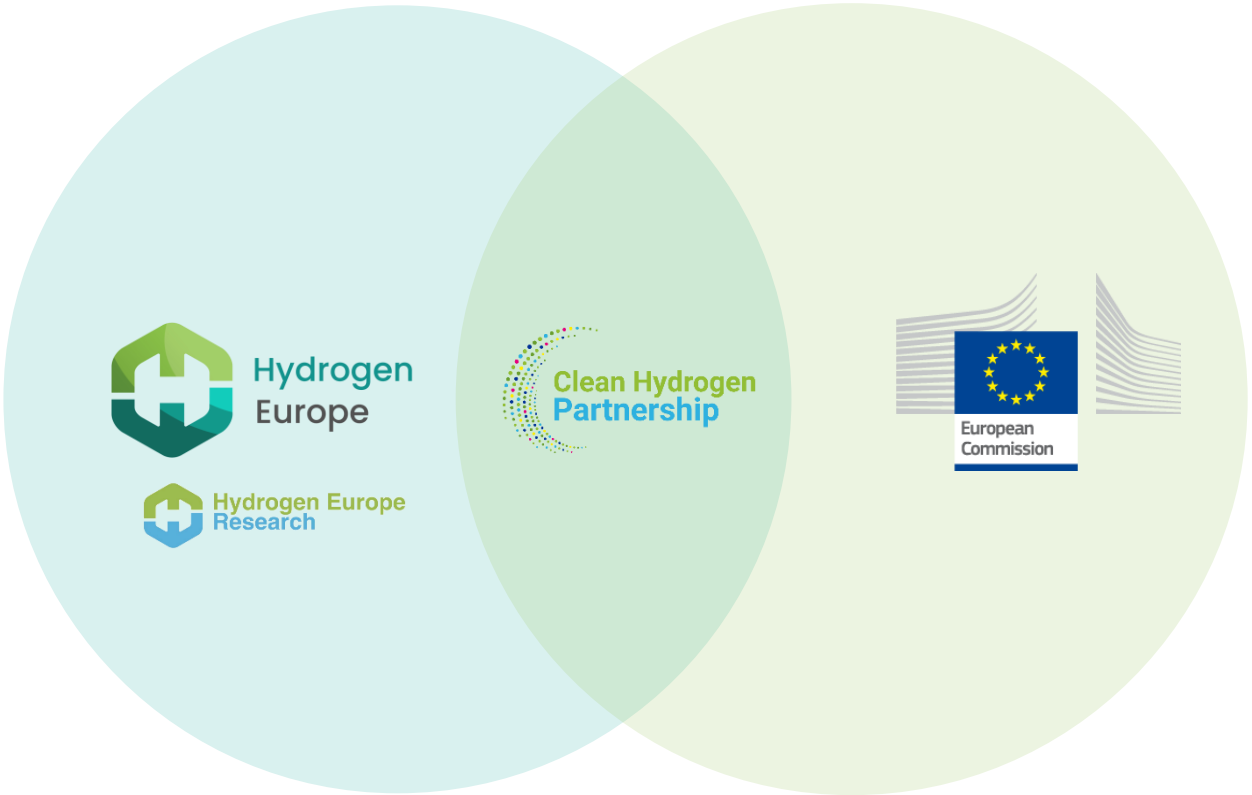
32+

members in the UK

Mostly industry corporate but also industry associations, regional and global partners.

The Clean Hydrogen Partnership

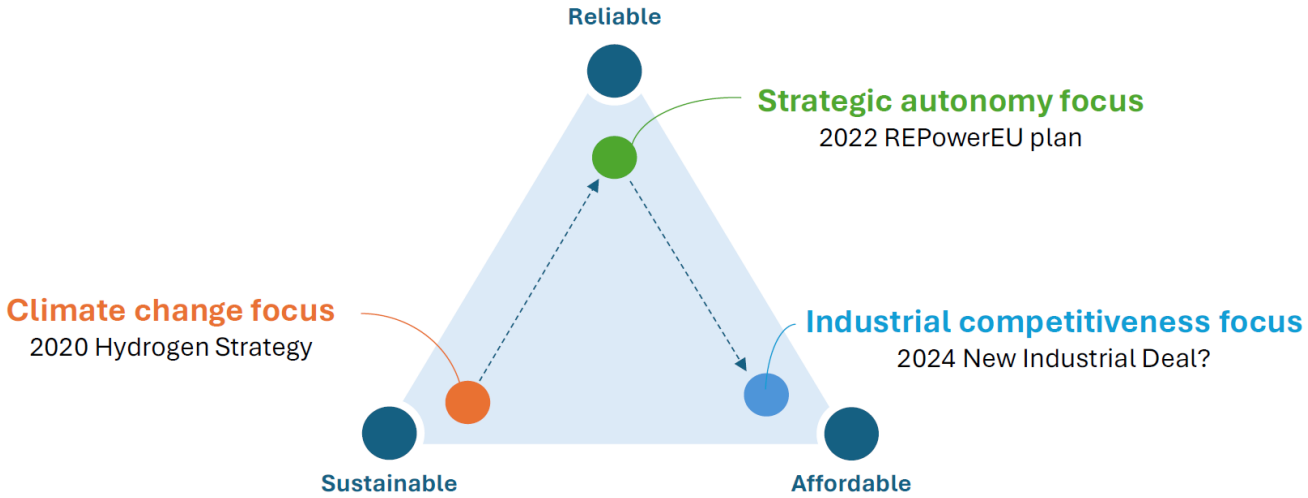
Private



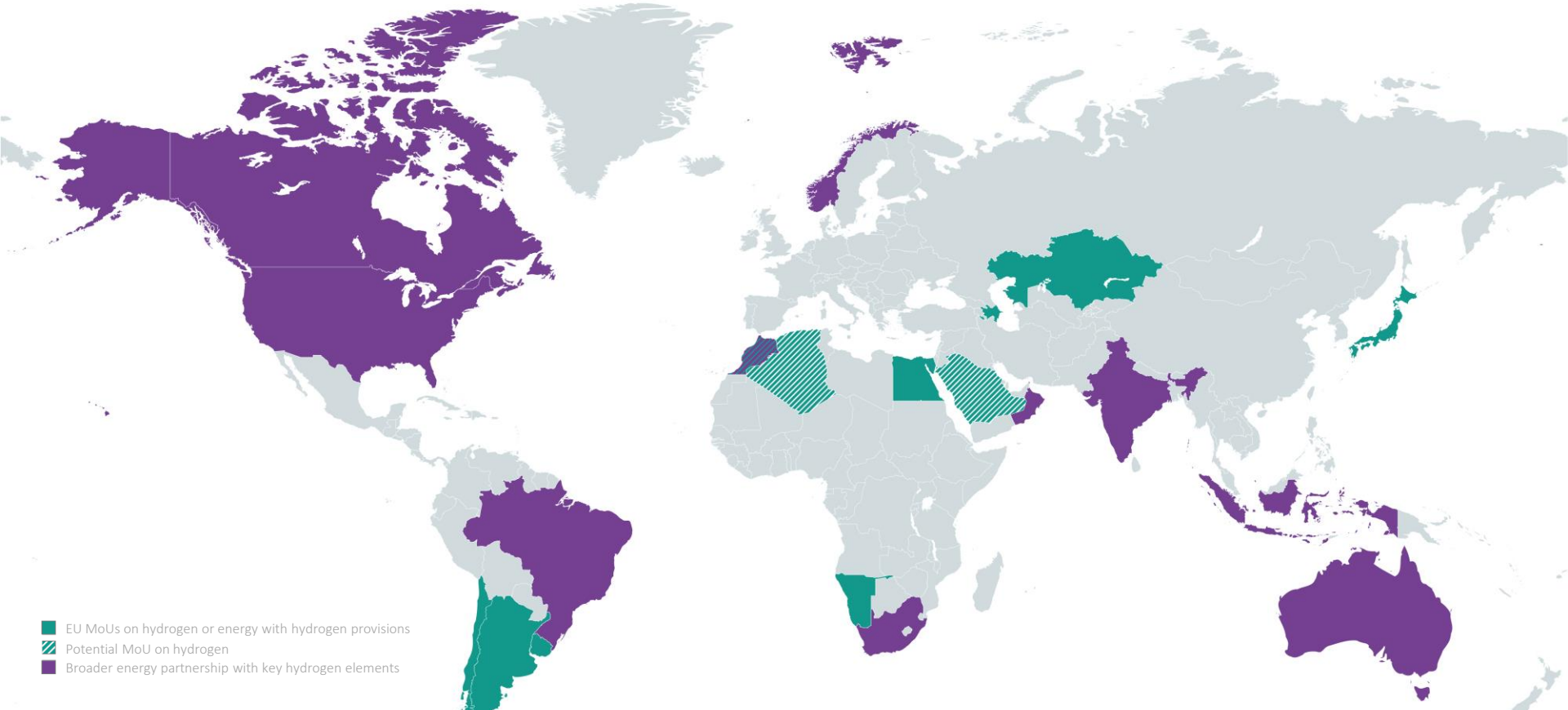
Public

To facilitate the transition to a greener EU society through the development of hydrogen technologies with a **budget of EUR 1Bn.**

The global hydrogen market develops amidst shifting geopolitical tensions in which Europe's hydrogen strategy must balance multiple objectives



The European Union will need diversified hydrogen imports to meet its security, climate and competitiveness goals



The European Union has led the establishment of a hydrogen market…

RePowerEU targets: 10 Mt domestic production and 10 Mt imports of clean hydrogen by 2030

H2 Production & Transport

Gas Package (Q4 2023)
Gases definitions and infrastructure

Net-Zero Industry Act (2024)
Response to the US Inflation Reduction Act.

Critical Raw Materials Act
(Q4 2024)
EU legislative framework on CRMs

Standards and Certification
Need for acceptance and harmonization of methodologies and rules.

H2 end-use

RED3 (agreed)
42.5 % renewables target RFNBOs

Binding targets by 2030

Transport: RES-T: 14.5% GHG reduction or 29% RES
✓ 5.5% adv. biofuels & RFNBOS (of which **1% RFNBO**)

Industry: **42% of H2 to be RFNBO**
- Can be reduced by MS by 20% if:
  - ✓ On track for RES 2030 target
  - ✓ Fossil fuel-based H2 consumption is > 23% in 2030

RFNBO H2 Definition

H2 derived from RES sources, meets additionality criteria & GHG emission reduction threshold of 70% **compared to fossil fuels comparator (94 g CO2eq/MJ)**
(agreed)

Low-Carbon H2 Definition

H2 derived from non-RES sources & meets GHG emission reduction threshold of 70% **compared to fossil fuels comparator or other criteria**
(Q4 2023)

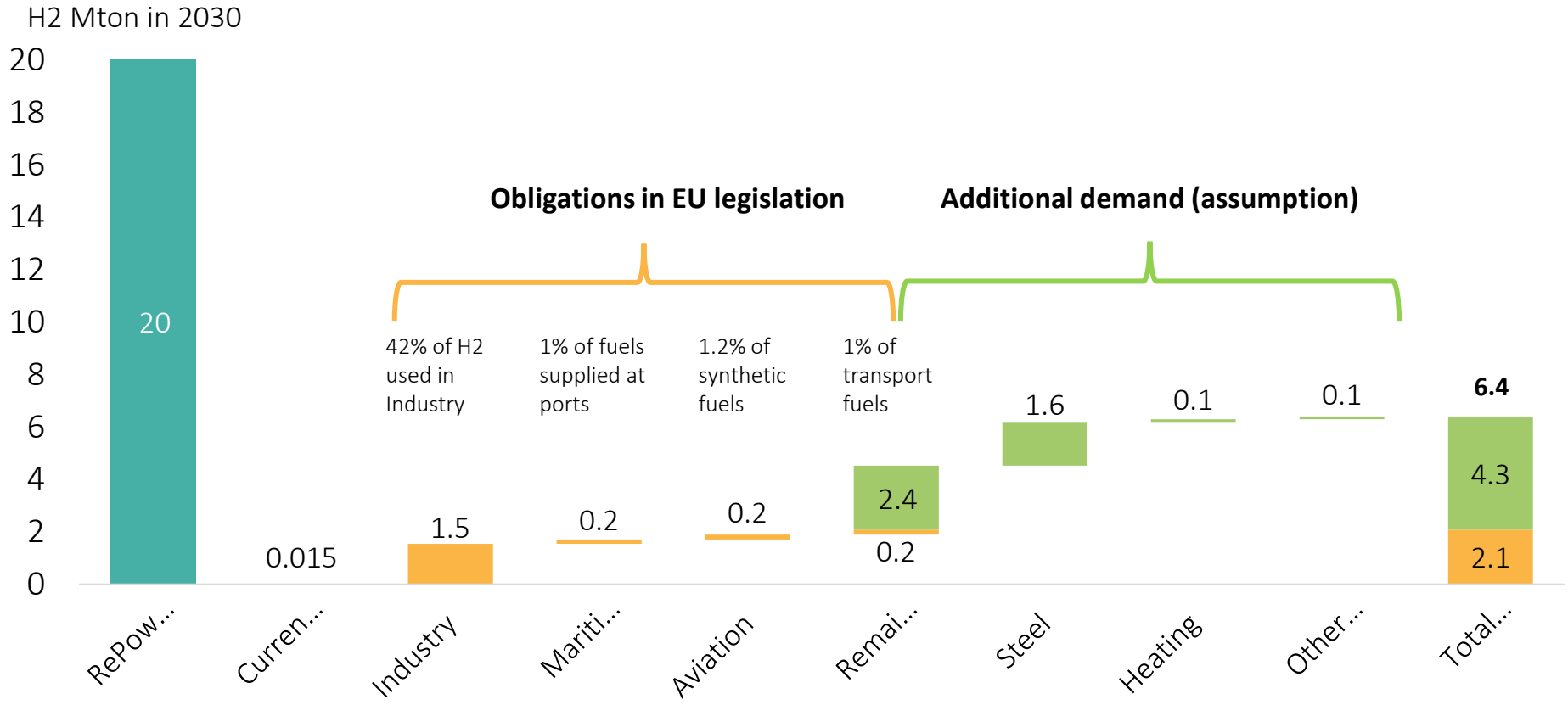
ReFuel EU Aviation (agreed)
Quotas for SAF & specific quota for RFNBO

Fuels EU Maritime (agreed)
GHG saving targets & specific quota for RFNBO

AFIR (agreed)
Targets for the deployment of hydrogen refueling stations

ETS & CBAM (adopted)
Scheme for GHG emission allowance trading within the EU.

…but political ambition is currently under test



…but political ambition is currently under test

Priorities for cooperation with the United Kingdom

1. Alignment and **workability of regulatory frameworks for hydrogen**, including definitions and carbon border adjustment mechanisms, to facilitate trade in molecules and low carbon products.

2. Greater cooperation on infrastructure development, particularly in the **North Sea** and in the context of the upcoming Offshore Network Developing Plan.

4. International cooperation on **global standardization** and mutual recognition of certificates.

5. Cooperation on **critical raw materials** essentially for hydrogen deployment, particularly under the newly developed Minerals Security Partnership, and on the **manufacturing** of hydrogen technologies, particularly in the context of NZIA and the geopolitical competition for clean technology.

6. Continued cooperation on R&D under **Horizon Europe** and the Clean Hydrogen Partnership.

European Hydrogen Week

18 - 22 November 2024

Brussels, Belgium

euhydrogenweek.eu

BOOK A BOOTH SPACE

Hydrogen Europe

Clean Hydrogen Partnership

- High-level policy conference
- 8000 sqm exhibition
- 8000 visitors
- B2B Forum
- Networking evenings

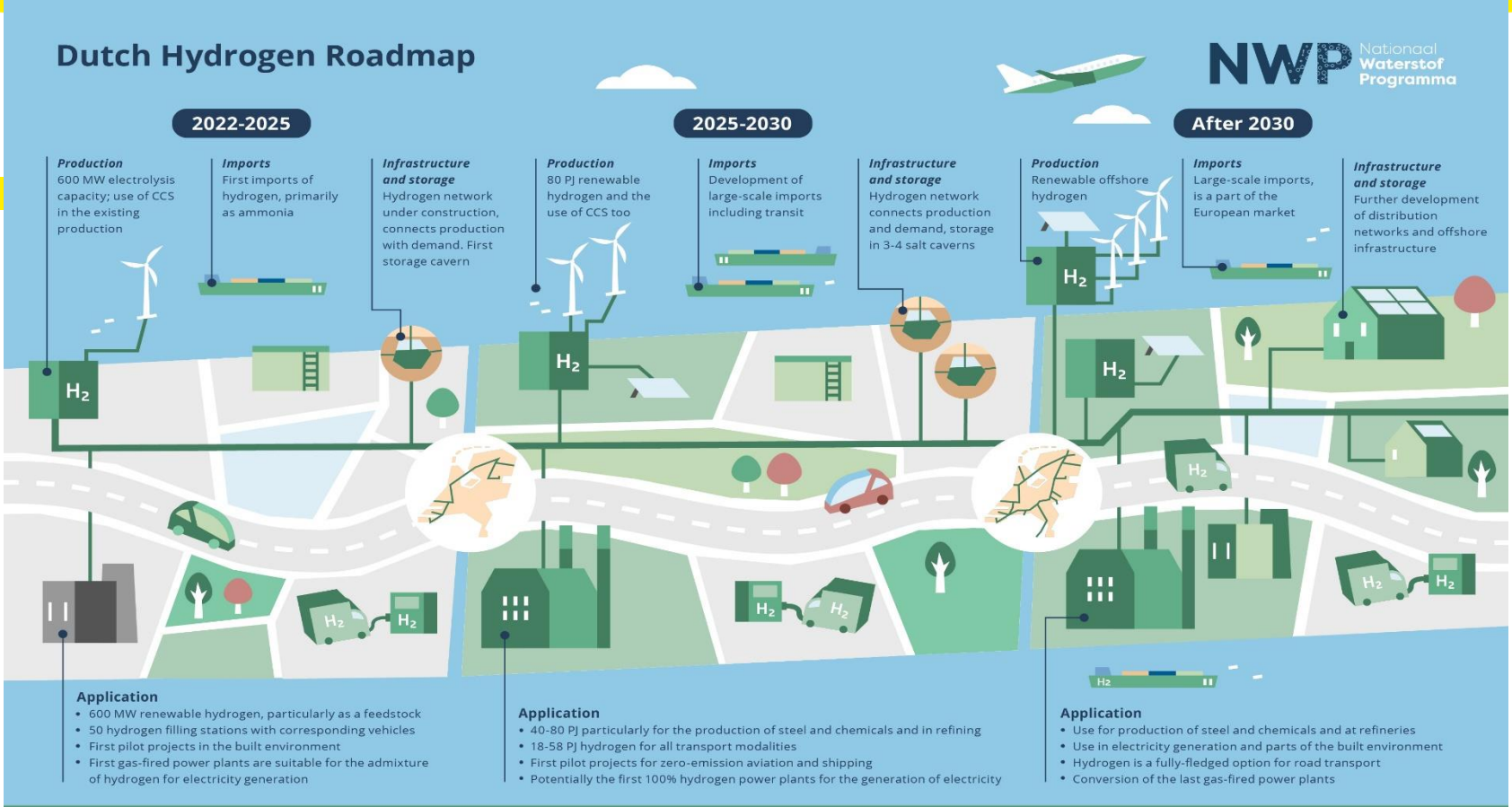
HEAVENN: Hydrogen Valley Northern Netherlands and international context

Geerte de Jong
30 April 2024

HEAVENN

Contents

- Strategic level: Hydrogen strategy for the Netherlands
- On a practical level: International H2 Platform PWI and GroenvermogenNL
- In practice: H2 Valley HEAVENN: ambitious H2 project with 30 European partners working together to decarbonize Northern Netherlands


Dutch Hydrogen Roadmap
NWP Nationaal Waterstof Programma
2022-2025
2025-2030
After 2030
Production
600 MW electrolysis capacity; use of CCS in the existing production
Imports
First imports of hydrogen, primarily as ammonia
Infrastructure and storage
Hydrogen network under construction, connects production with demand. First storage cavern
Production
80 PJ renewable hydrogen and the use of CCS too
Imports
Development of large-scale imports including transit
Infrastructure and storage
Hydrogen network connects production and demand, storage in 3-4 salt caverns
Production
Renewable offshore hydrogen
Imports
Large-scale imports, is a part of the European market
Infrastructure and storage
Further development of distribution networks and offshore infrastructure
H2
Application
600 MW renewable hydrogen, particularly as a feedstock
50 hydrogen filling stations with corresponding vehicles
First pilot projects in the built environment
First gas-fired power plants are suitable for the admixture of hydrogen for electricity generation
Application
40-80 PJ particularly for the production of steel and chemicals and in refining
18-58 PJ hydrogen for all transport modalities
First pilot projects for zero-emission aviation and shipping
Potentially the first 100% hydrogen power plants for the generation of electricity
Application
Use for production of steel and chemicals and at refineries
Use in electricity generation and parts of the built environment
Hydrogen is a fully-fledged option for road transport
Conversion of the last gas-fired power plants
Preconditions: essential if the objectives are to be achieved
Policy framework
Safety
Innovation
Social acceptance
Manufacturing industry
Human capital agenda

Platform Waterstof Internationaal - PWI

- Government programme, part of the national H2 programme
- All companies and organizations in the Netherlands that are active in international / European context come together to discuss.
- More practical, less strategy
- Exchange knowledge and information
- Conferences, events, delegations and outgoing missions.

Accelerating and realizing the green hydrogen and green chemistry economy

A public fund of >800 m. euro to accelerate the green H2 economy – mostly aimed at Dutch initiatives but also exploring international role:

- Support import trajectories – mostly in downstream (price gap matching)
- Support SME connections internationally
- Funding schemes for cross-border initiatives
- Support for IPCEI projects

https://groenvermogennl.org/en/

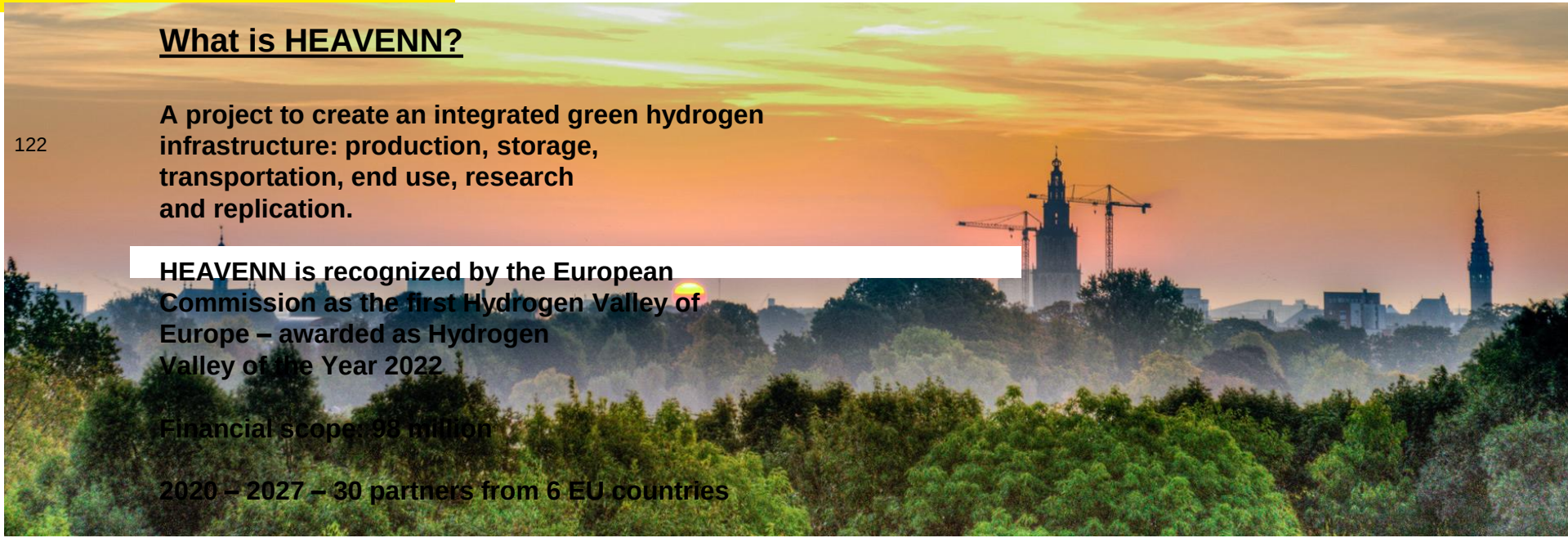
What is HEAVENN?

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

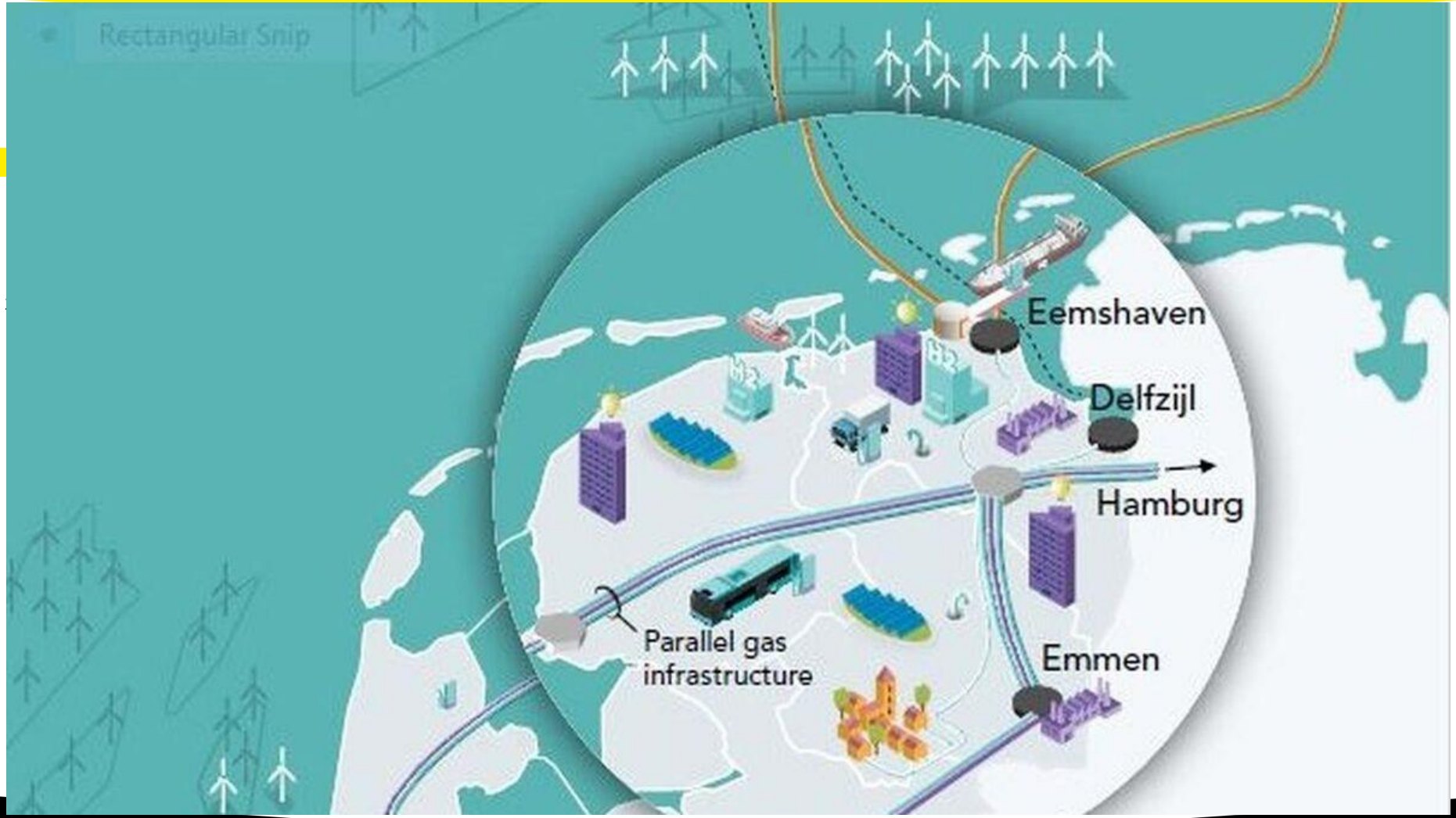
HEAVENN is recognized by the European Commission as the first Hydrogen Valley of Europe – awarded as Hydrogen Valley of the Year 2022

Financial scope: 98 million

2020 – 2027 – 30 partners from 6 EU countries



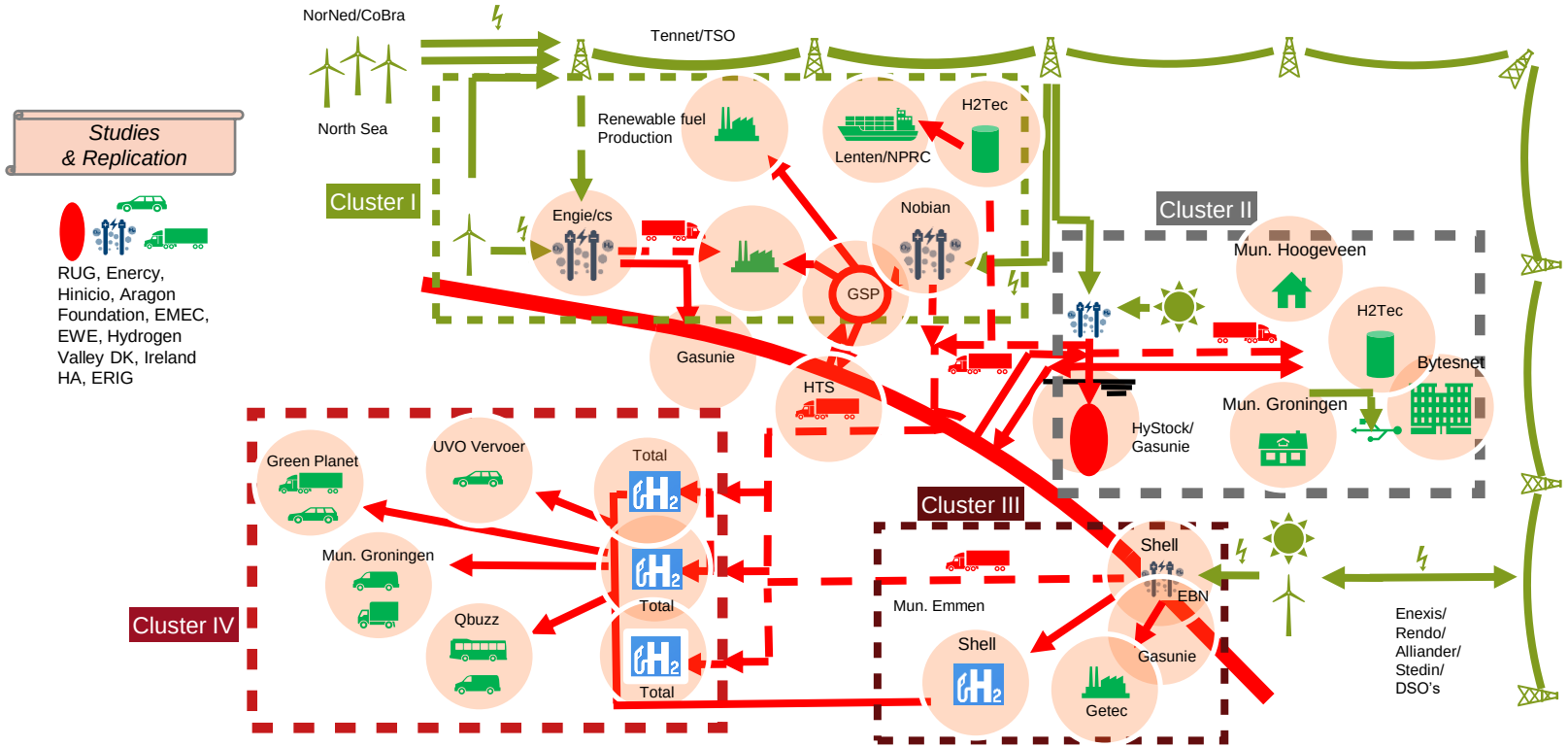
HEAVENN


Eemshaven
Delfzijl
Hamburg
Parallel gas infrastructure
Emmen

Partners in HEAVENN

Supported by

HEAVENN


Studies
& Replication
RUG, Enercy,
Hinicio, Aragon
Foundation, EMEC,
EWE, Hydrogen
Valley DK, Ireland
HA, ERIG
NorNed/CoBra
North Sea
Tennet/TSO
Renewable fuel
Production
Lenten/NPRC
H2Tec
Cluster I
Engie/cs
Nobian
GSP
Gasunie
HTS
Cluster II
Mun. Hoogeveen
H2Tec
Bytesnet
Mun. Groningen
HyStock/
Gasunie
Cluster III
Shell
EBN
Mun. Emmen
Shell
Gasunie
Getec
Enexis/
Rendo/
Alliander/
Stedin/
DSO's
Cluster IV
Green Planet
UVO Vervoer
Total
Mun. Groningen
Total
Qbuzz
Total

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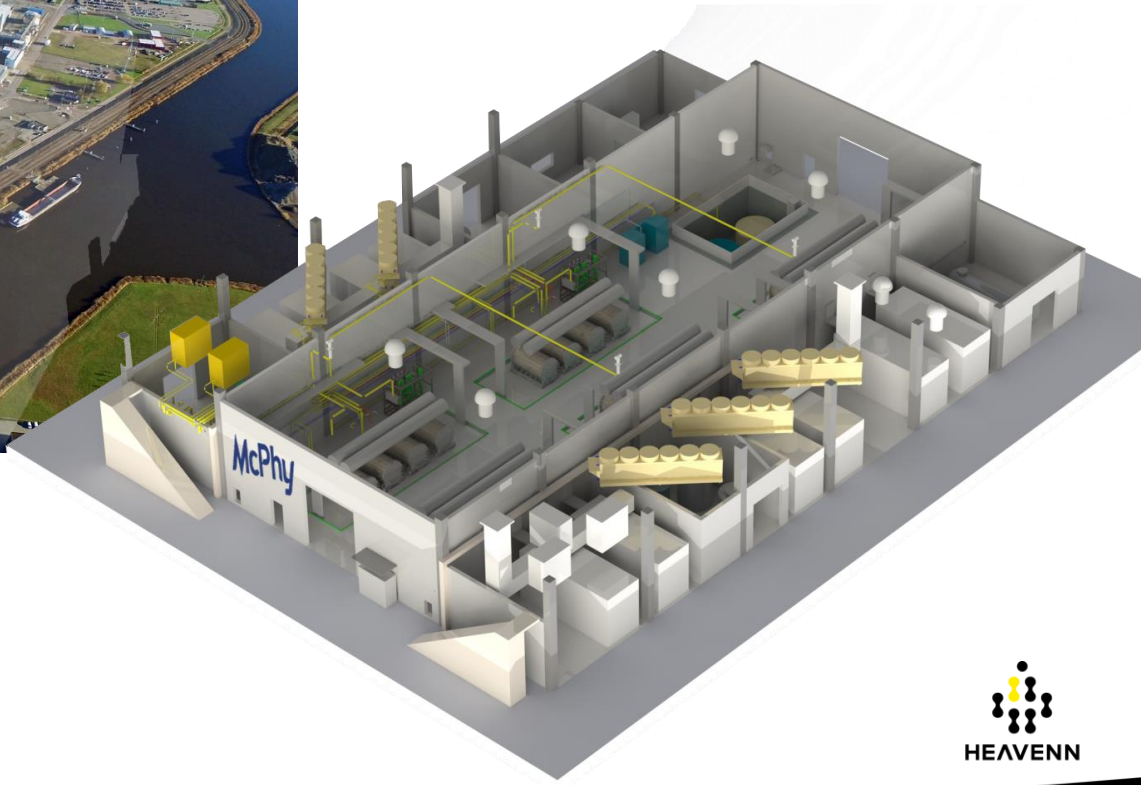

HEAVENN


ANTONIE


Waterstof
de groene
motor
Rijden op
waterstof?
40 541


bureau net


UPS


WELKOM IN HET WATERSTOF TINY HOUSE
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Alfa-college
ten kate
installatietechniek
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H2 GAS
VANHOOL
Qbuzz
qbuzz.nl/gd
streek
NL 71-BRJ-8
Shell Hydrogen

HEAVENN in RTL Transportwereld


Qbuzz
FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING
streek
groene waterstof


hydrogen
Qbuzz

HEAVENN in an international / EU context

- Connecting the valleys – the main idea of the H2 valleys and one main motivator for HEAVENN is to build more valleys, inspire and energize new initiatives, then connect valleys
  - In current market, purchasing and building applications is difficult
  - Lack of materials, personnel, expertise, prices are high
  - Great need of affordable green H2
  - On SME-level, powerful connections are made:
    - A Spanish research facility, An Icelandic truck building OEM
    - British fuel cell in Dutch data center.
    - Non-Dutch companies received regional cofinancing for their projects
    - And building new consortiums and valleys together

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.

Session 4:
The Role of UK, European, International Collaboration in Achieving Zero Carbon Hydrogen Economy

Markus Knauf
Head of the Economic and Global Affairs Department
German Embassy in London

#UKEUhydrogen / @EnergyRA / @HyDEXMidlands

Session 4: Panel Discussion
The Role of UK, European, International Collaboration in Achieving Zero Carbon Hydrogen Economy

Stuart Broadley, Pau Ruiz Guix, Geerte de Jong and Markus Knauf
Host: Alan Haigh

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HyDEX

ENERGY RESEARCH ACCELERATOR

Accelerating real-world energy innovation

Thank you for your time
We hope to see you in Brussels

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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