...giving Hydrogen the green light?

16th April 2021

FUTURE OF TECHNOLOGY SERIES

SHARING IDEAS
UNLOCKING OPPORTUNITIES

ADVANCED PROPULSION CENTRE UK

The UK in a global hydrogen race

Richard Halsey

CATAPULT
Energy Systems

About Me

- Capabilities Director at Energy Systems Catapult (ESC) leading team of over 100 planners, engineers, modellers, data and social scientists
- Over 15 years working in clean tech, decarbonisation and energy innovation in the UK and internationally
- Led the ESC delivery of the Smart System and Heat Programme and Responsible for ESC management of the BEIS Electrification of Heat Demonstration Project
- Leading the Catapult Networks new Hydrogen Innovation Initiative
- Member of the BEIS Hydrogen Advisory Council (HAC)
- Responsible for a number of innovation projects looking at the development and integration of hydrogen in Net Zero energy systems

About Energy Systems Catapult

Mission: **Unleash innovation and open new markets to capture the clean growth opportunity**

200 Innovation experts

Hubs in Birmingham and Derby

We work with Innovate UK

Established, overseen and part-funded by Innovate UK. Independent from Government. Not for profit

Bridge the gap between stakeholders in the sector

Supporting innovators

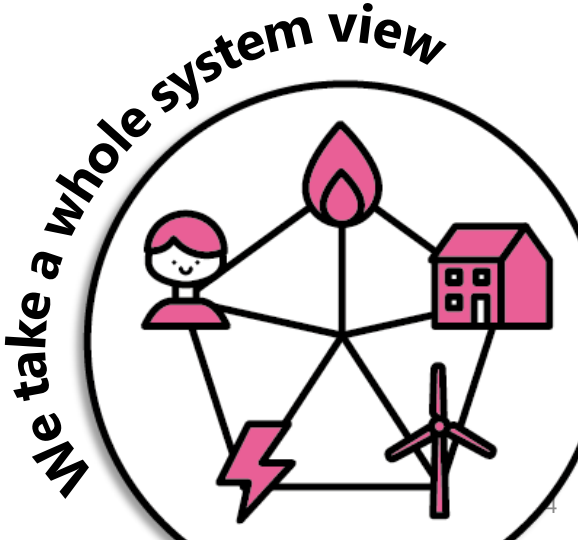
Research

Trials

Systems engineering

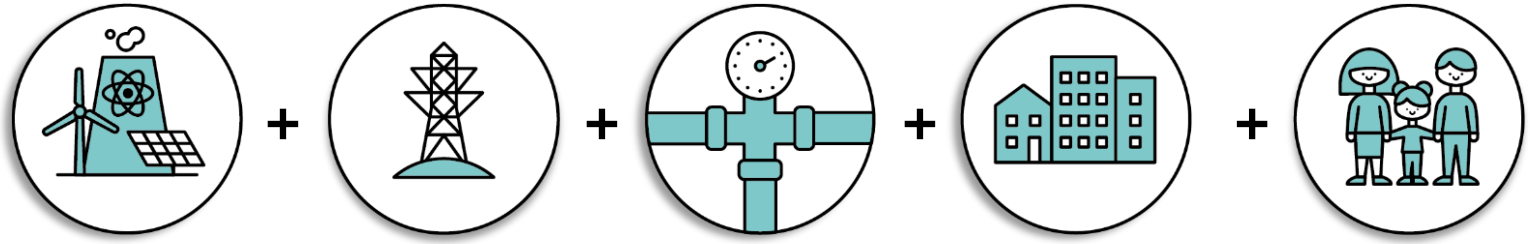
Digital

Modelling and simulation

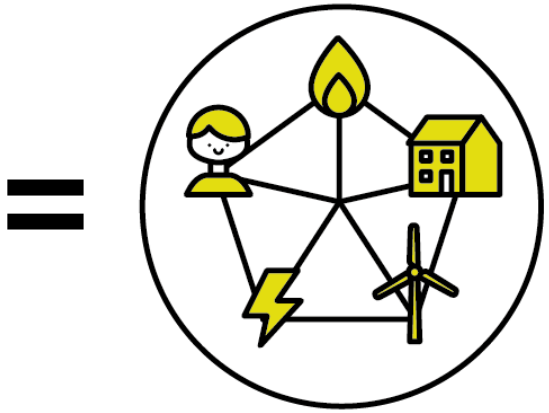


What is a whole system approach?

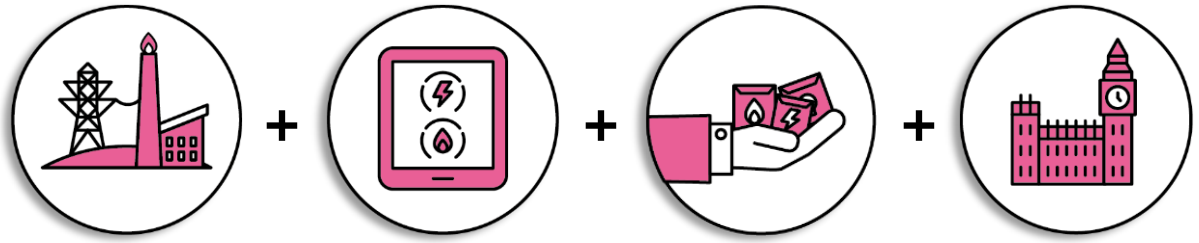
Joining up the system from sources of energy to the consumer



Breaking down silos between different parts of the energy system



Joining up physical requirements of the system, with policy, market and digital arrangements



Delivering Net Zero means a vastly increased role for Hydrogen in global energy systems. The UK is no different

H_2

From limited energy use to... **200 – 300 TWh per year**

https://es.catapult.org.uk/reports/innovating-to-net-zero/

Hydrogen is one of three zero carbon vectors needing unprecedented scale-up to displace fossil fuels for final energy

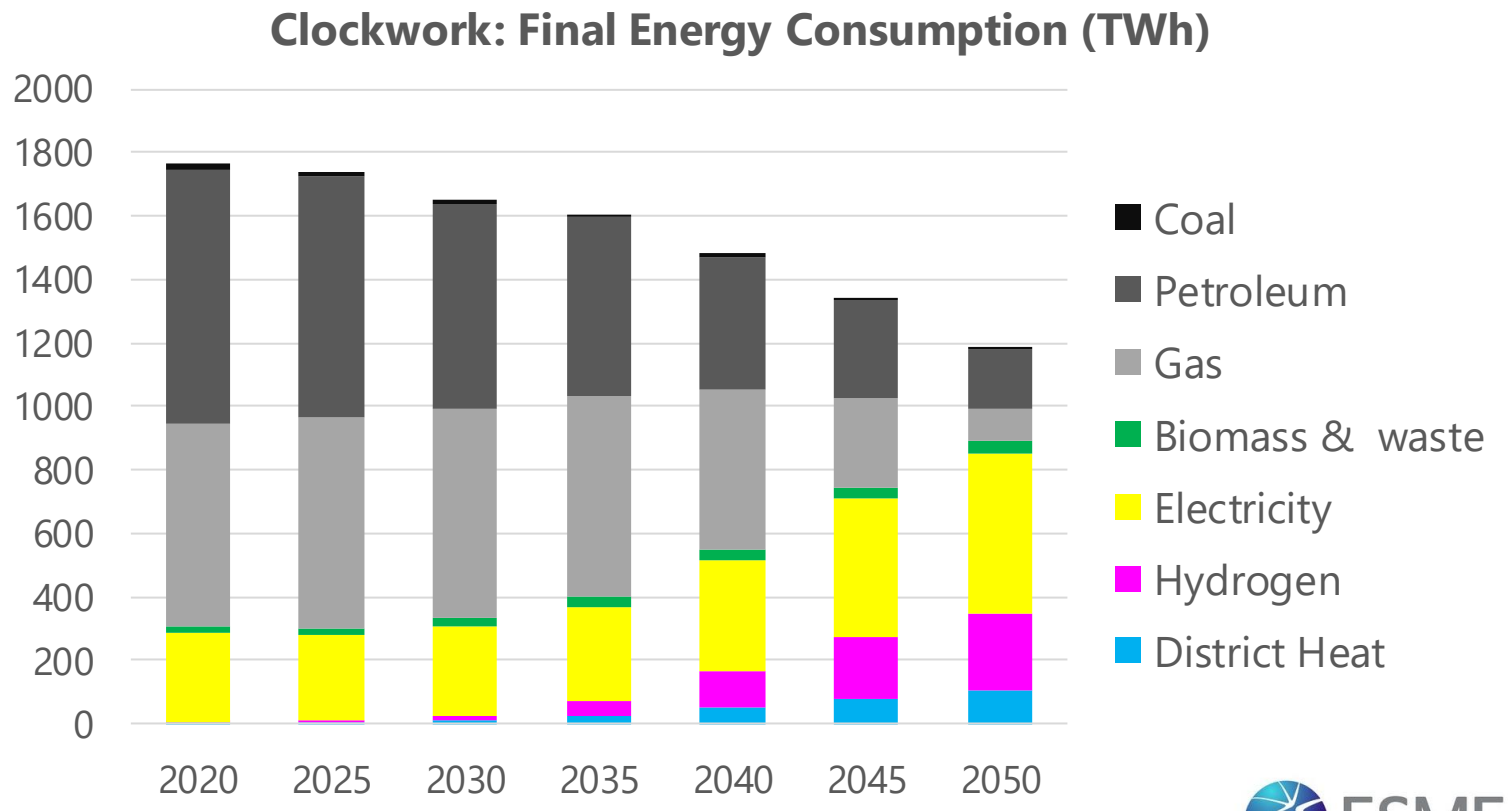
Could mean:

Unabated Fossil Fuel consumption down from **~1500TWh to <300TWh**

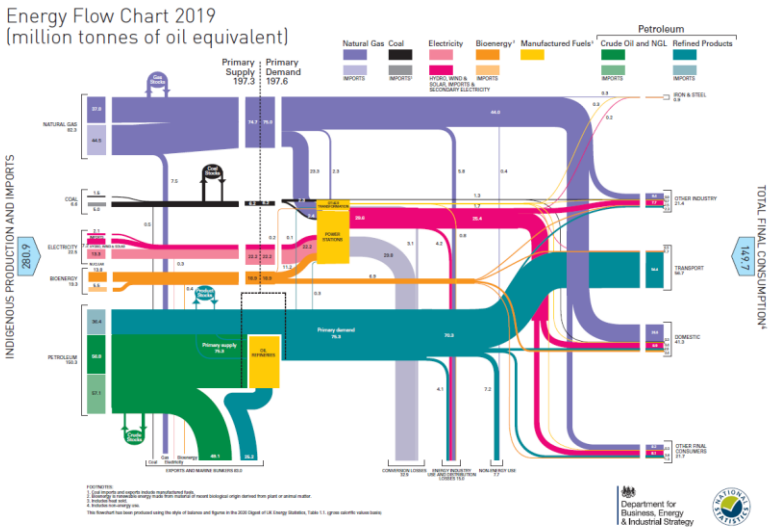
Electricity **600-800TWh**

Hydrogen **200-300TWh**

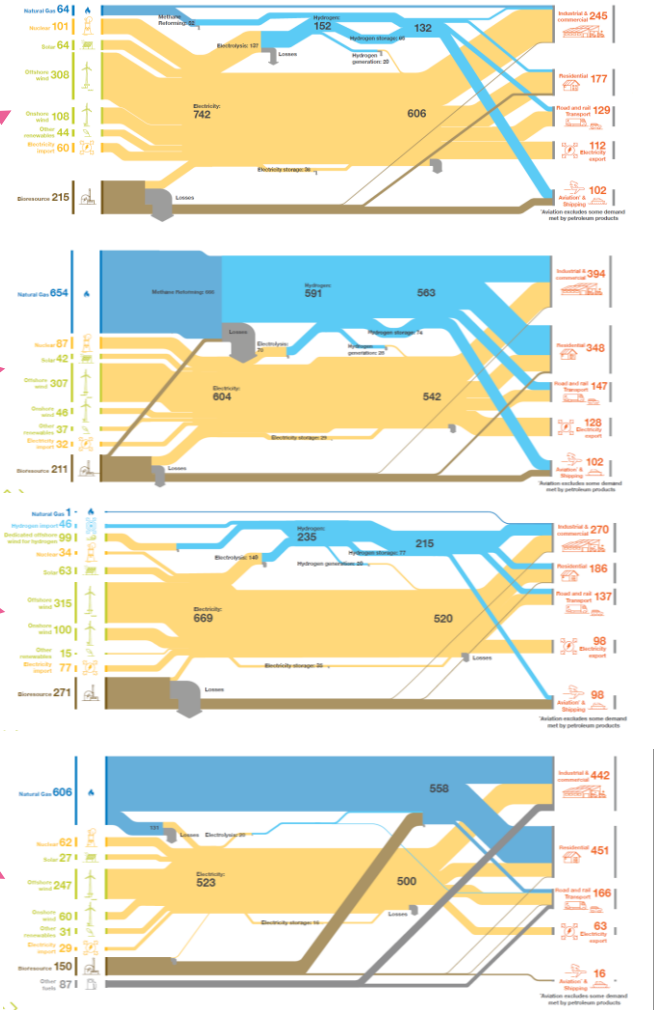
District Heat **Up to 150TWh**



There are many ways that global and the UK energy system could be configured and the role Hydrogen might play

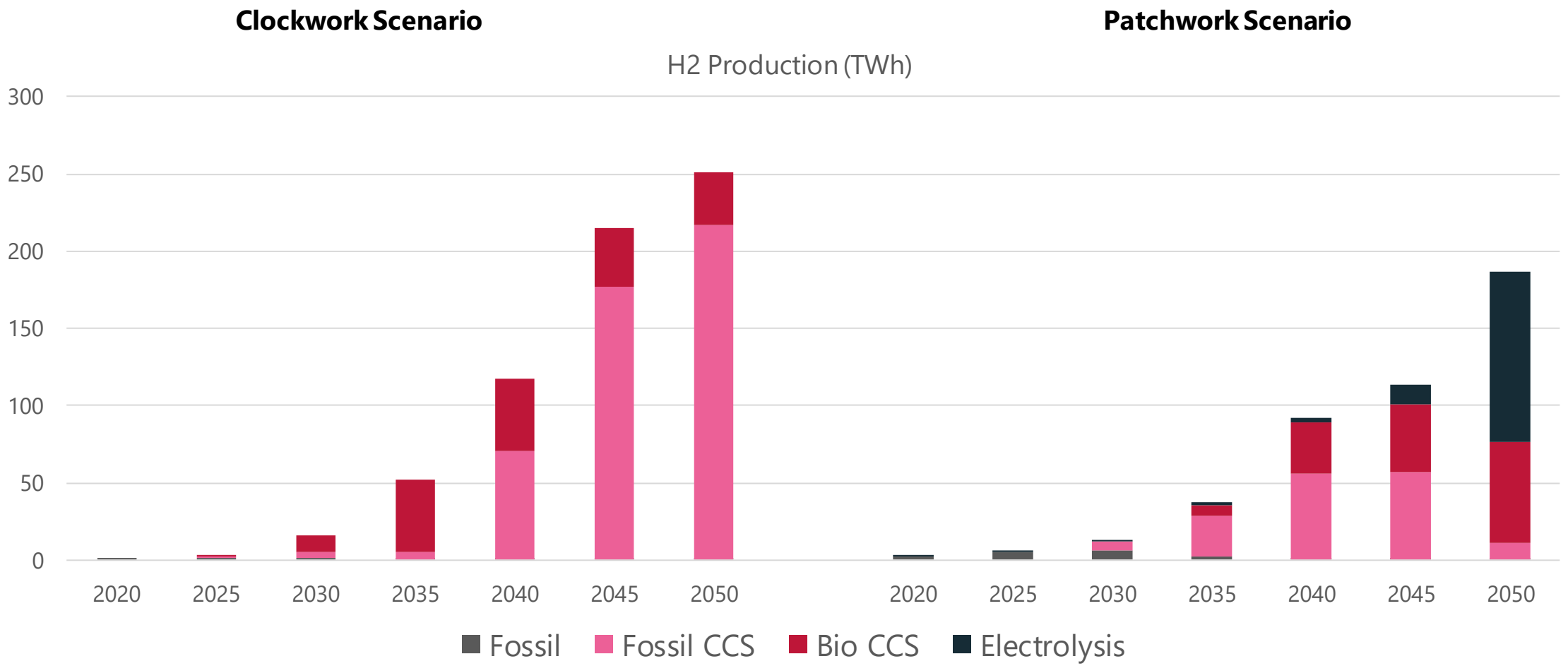


Energy Flow Chart 2019 (BEIS, 2019)



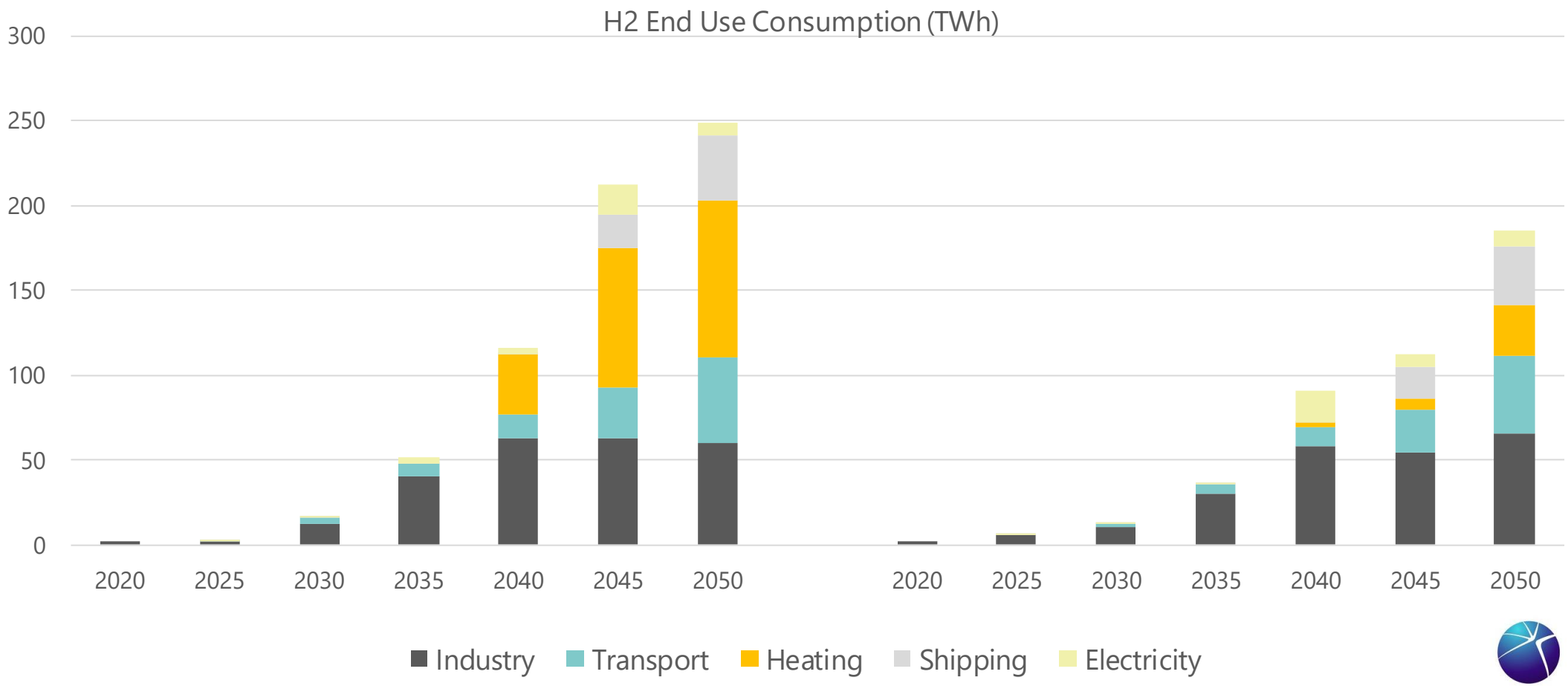
Future Energy Scenarios (National Grid ESO, 2020)

UK Hydrogen Production for Net Zero

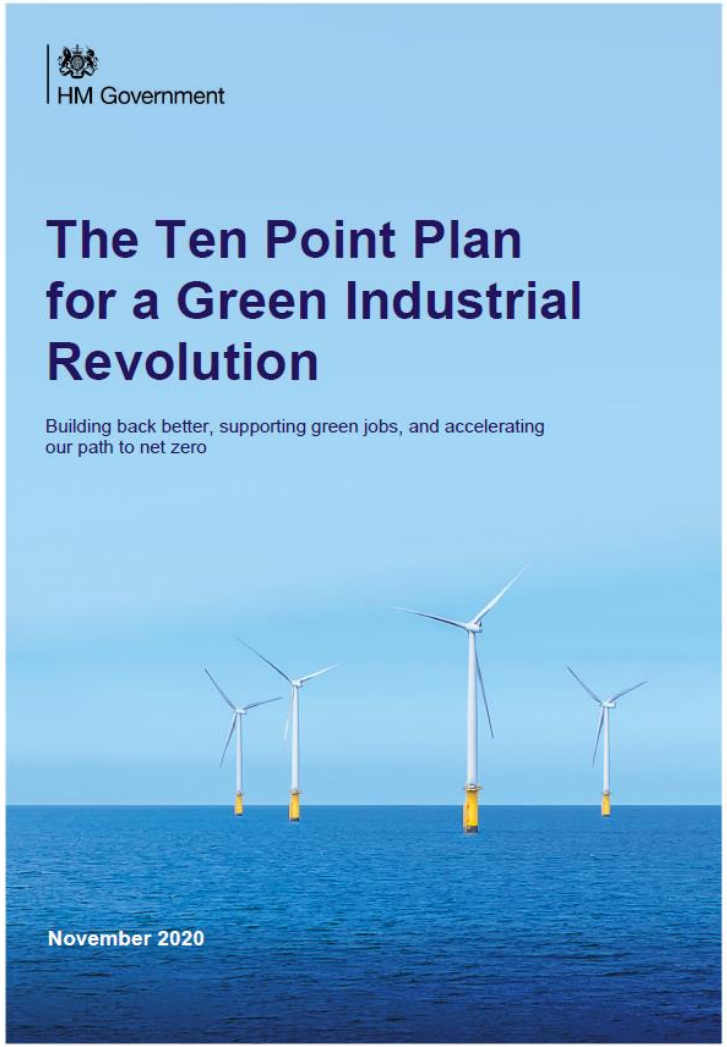


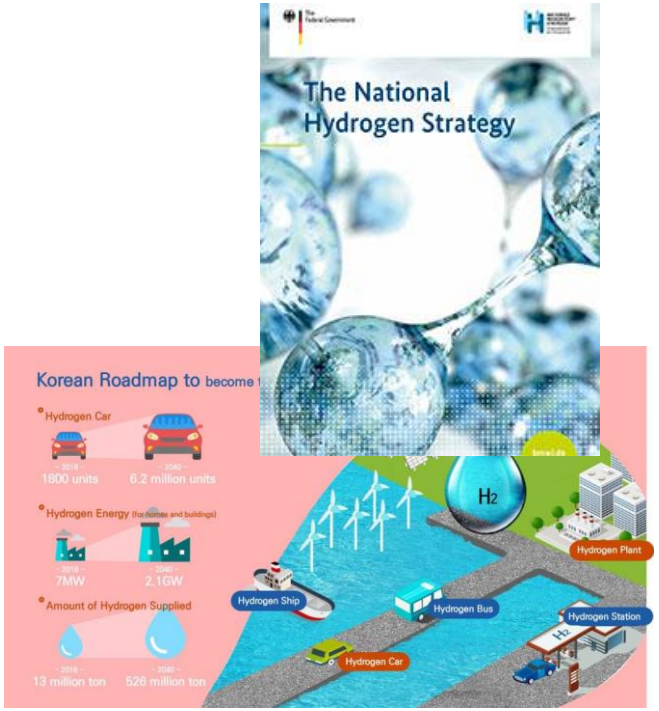
UK Hydrogen End Use Consumption for Net Zero

Clockwork Scenario **Patchwork Scenario**



The UK is getting its running shoes on





There's actually quite a lot going on in the UK

INDUSTRY

	PROJECT NAME	LOCATION
1	Scotland's Net Zero Infrastructure	Scotland
2	Net Zero Teeside Project	Teeside
3	Humber Industrial Decarbonisation Deployment Project	Humber
4	HyNet CCUS	North West & North Wales
5	South Wales Industrial Cluster	South Wales
6	Green Hydrogen for Humber	Humberside
7	HyNet North West	North West & North Wales
8	State-of-the-art fuel mix for UK cement production to test the path for net zero	North West
9	Alternative fuel switching technologies for the glass sector	Yorkshire
10	Hydrogen Alternatives to Gas for Calcium Lime Manufacturing	Buxton

GAS NETWORK

	PROJECT NAME	LOCATION
1	Hy4HEat	TBC
2	H21	Leeds (Yorkshire)
3	Hy Deploy 1 & 2	Keele & North of England
4	H100 Feed Study	Levenmouth
5	Energy Kingdom	Milford Haven
6	BIG HIT	Orkney

MOBILITY

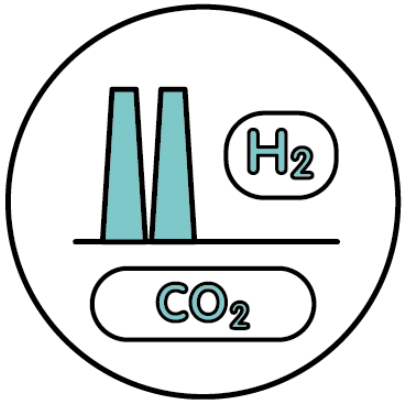
	PROJECT NAME	LOCATION
1	Towards commercial deployment of FCEV buses and hydrogen refuelling	Aberdeen Liverpool
2	Hydrogen Mobility Expansion Project II	Crawley
3	Northern Ireland Hydrogen Transport	Belfast
4	Tees Valley Hydrogen Initiative	Middlesbrough & Stockton on Tees
5	Riversimple Clean Mobility Fleet	Monmouthshire
6	HydroFlex	Birmingham
7	HySeas III	Orkney
8	HyFlyer	Orkney

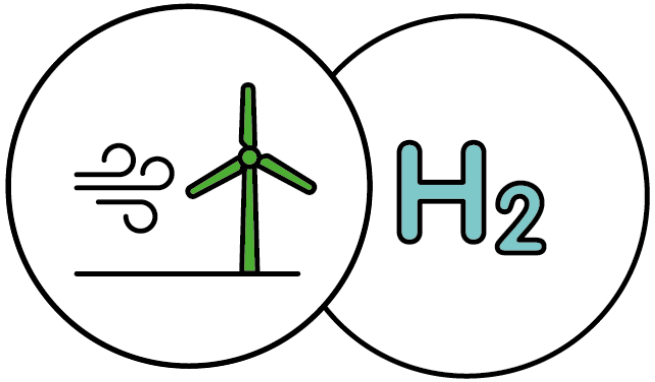
PRODUCTION

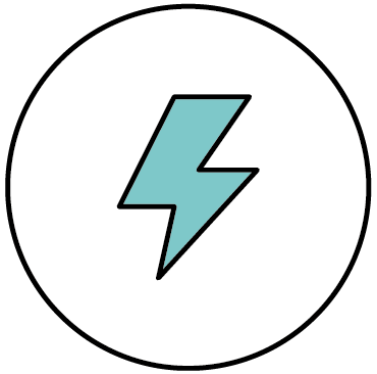
	PROJECT NAME	LOCATION
1	HyNet 1 & 2	Liverpool Bay Area
2	Dolphyn	Aberdeen
3	Gigstack	Grimsby
4	Acorn Hydrogen Project	Aberdeen
5	HyPER	Cranfield
6	Surf'N'Turf	Orkney
7	Bacton Hub	Bacton
8	Orion	Shetland Islands

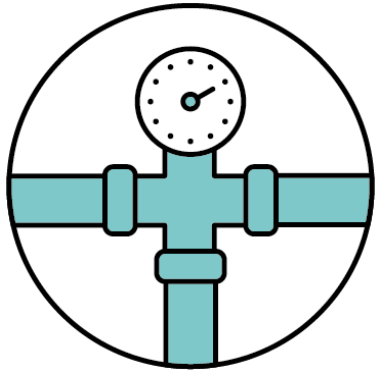
Offshore Wind and Hydrogen: Solving the Integration Challenge, ORE Catapult, OWIC, 2020

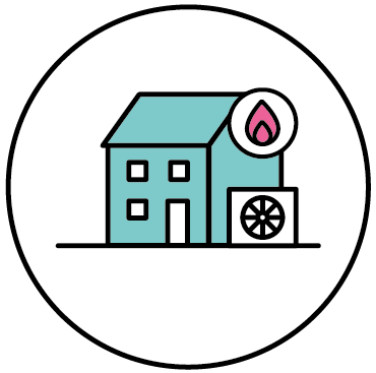
So what does this mean going forward?

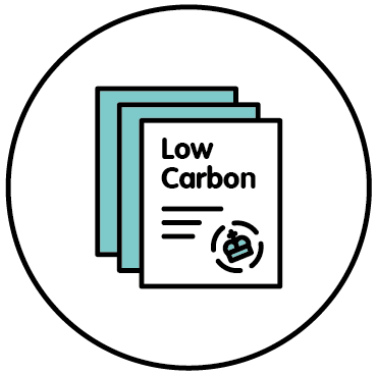












And we need a more connected innovation ecosystem

Hydrogen Innovation Initiative

Catapult Network

Advanced Propulsion Centre

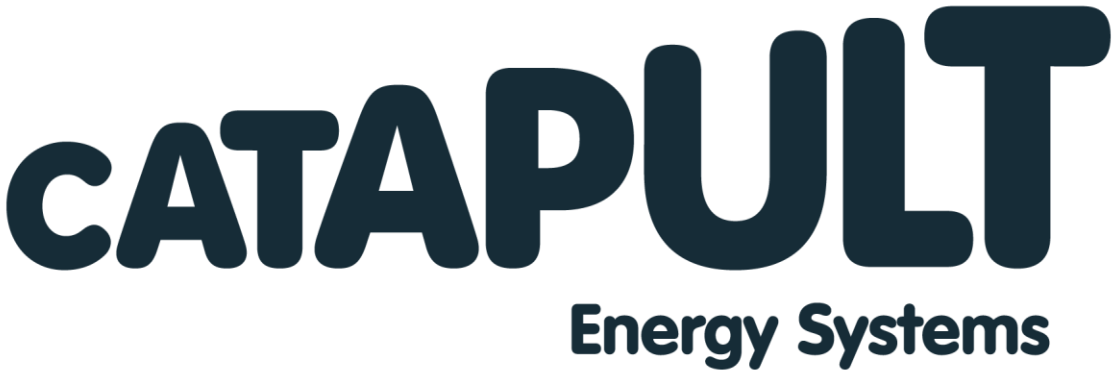
Technology Driving Transition

OGTC

Aerospace Technology Institute

NPL National Physical Laboratory

https://catapult.org.uk/wp-content/uploads/2021/04/9384_Accelerating-a-UK-Hydrogen-Economy-1.pdf



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Engineering and Physical Sciences Research Council

Energy
For a Low Carbon Future

APC

Future of Technology Series

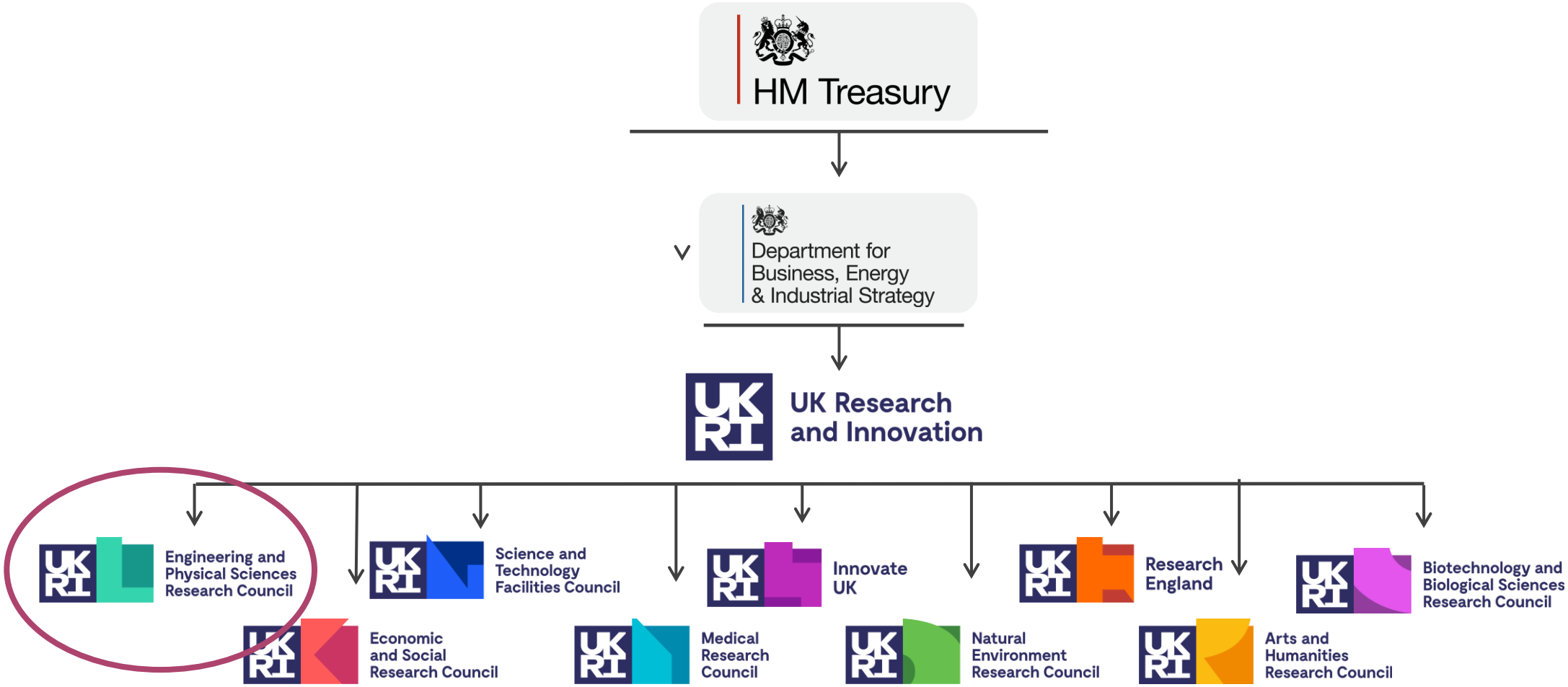
16th April 2021

About Me

Dr Laura Finney,
Senior Portfolio Manager, EPSRC
Energy Theme, EPSRC (Hydrogen and Alternative Vectors, Fuel Cells) and ISCF Industrial Decarbonisation Challenge.

Senior Technical Advisor, BEIS (Part-Time Secondee)
Hydrogen Economy Team

The UKRI Family



UK Research and Innovation

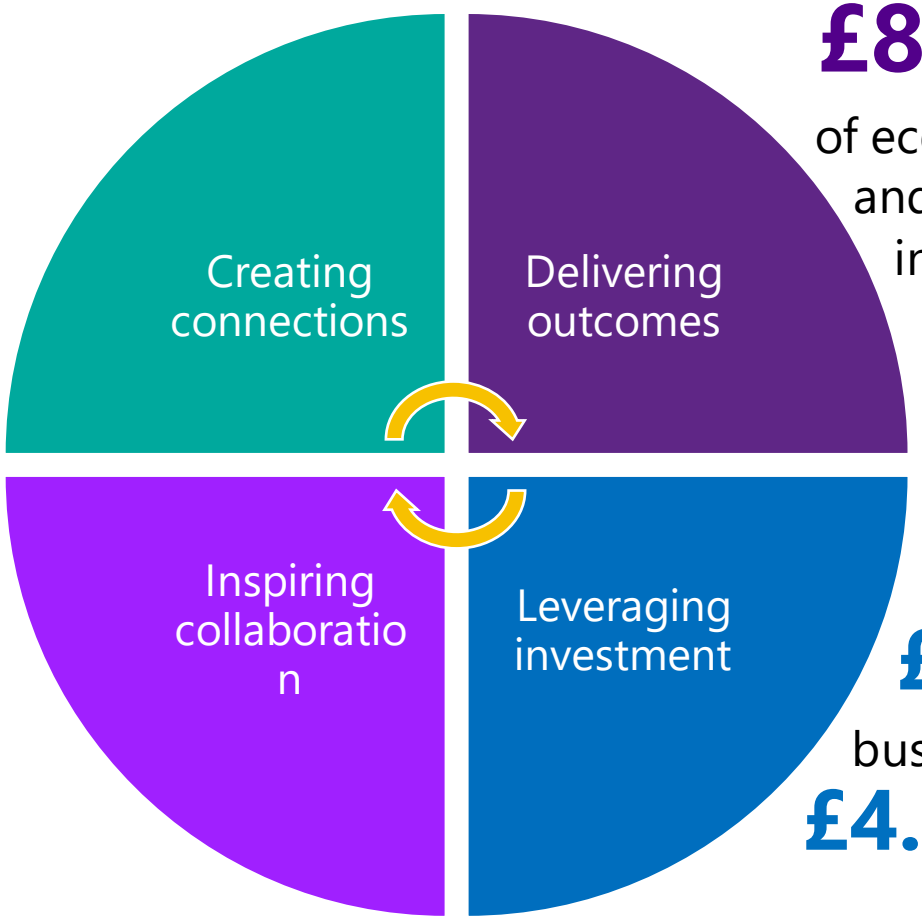
EPSRC - Who we are & What we do

£4.6 billion

EPSRC research and training portfolio, of which

£3.4 billion

is relevant to industrial sectors



£80 billion

of economic activity and cost efficiencies from an EPSRC investment of

£7.8 billion

3,800

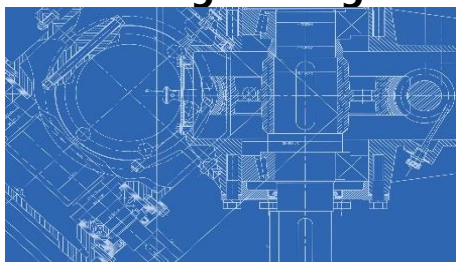
collaborating organisations

£1.2 billion leveraged from business against a current portfolio of

£4.6 billion

A Snapshot of Our Portfolio

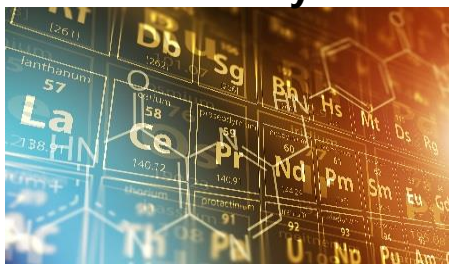
engineering



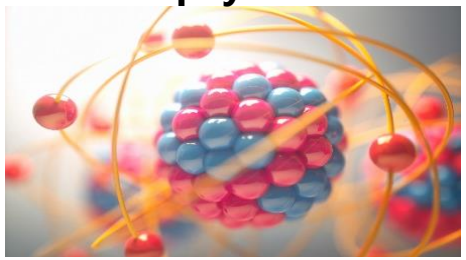
materials

mathematics

chemistry



physics



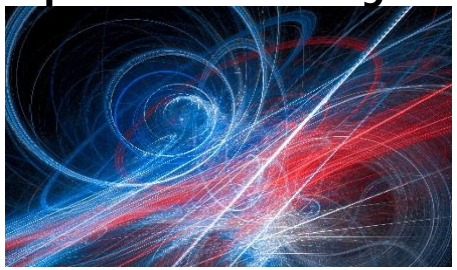
healthcare technologies

digital economy

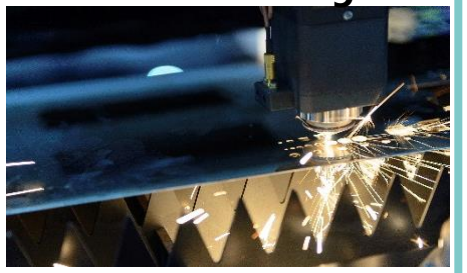
cybersecurity

ICT

quantum technologies



manufacturing



energy

EPSRC Energy Theme Mission

Energy
For a Low Carbon Future

News story

UK becomes first major economy to pass net zero emissions law

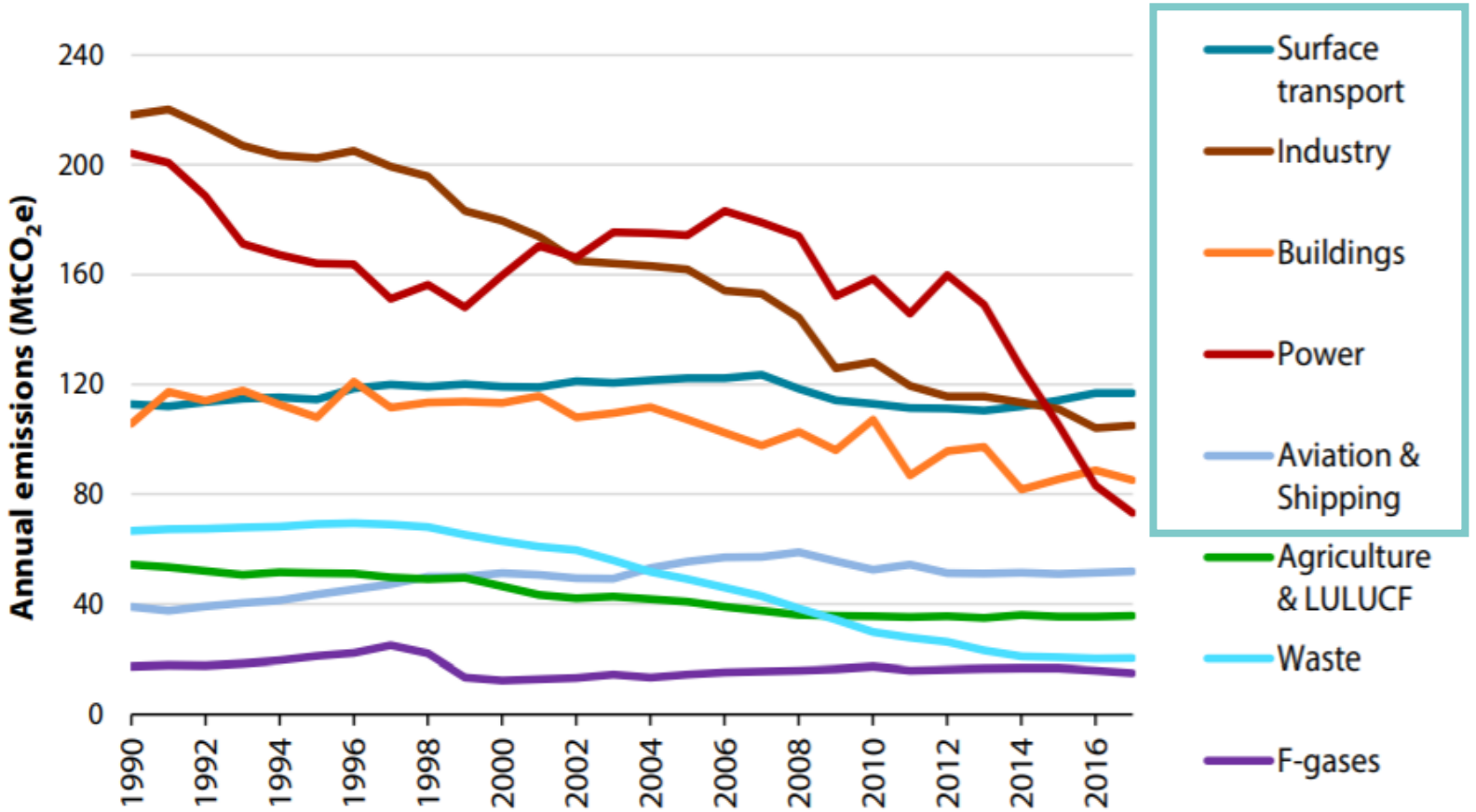
New target will require the UK to bring all greenhouse gas emissions to net zero by 2050.

Published 27 June 2019
From: Department for Business, Energy & Industrial Strategy and Chris Skidmore MP

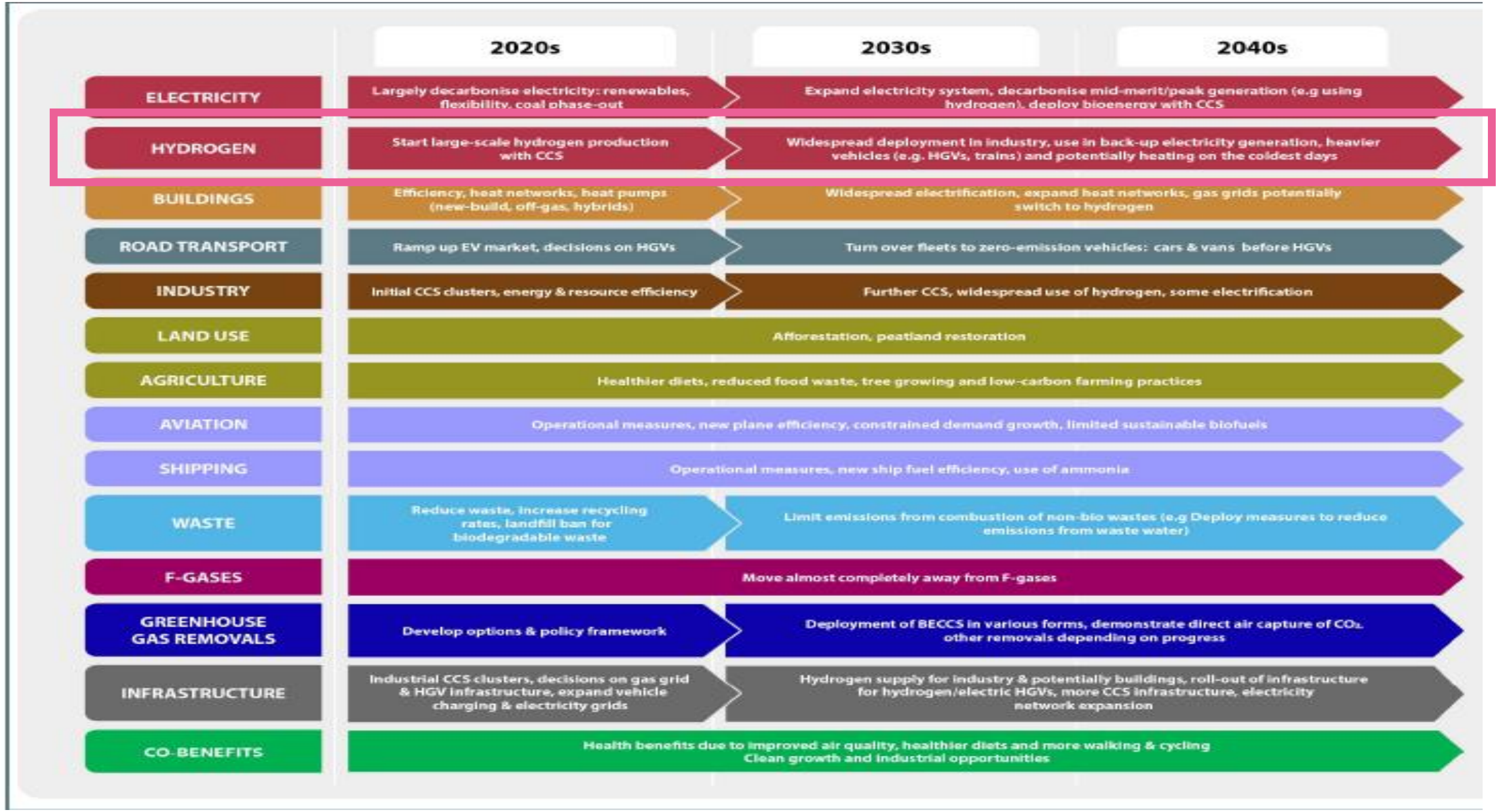
Chris Skidmore signs legislation to commit the UK to a legally binding target of net zero emissions by 2050

Why do hydrogen and fuel cells matter and what is their role in Net Zero?

Figure 1.4. Progress reducing emissions in the UK has been imbalanced



Source: BEIS (2019) *Final UK greenhouse gas emissions national statistics 1990-2017*; CCC analysis. LULUCF = land use, land use change and forestry.


2020s
2030s
2040s
ELECTRICITY
Largely decarbonise electricity: renewables, flexibility, coal phase-out
Expand electricity system, decarbonise mid-merit/peak generation (e.g using hydrogen), deploy bioenergy with CCS
HYDROGEN
Start large-scale hydrogen production with CCS
Widespread deployment in industry, use in back-up electricity generation, heavier vehicles (e.g. HGVs, trains) and potentially heating on the coldest days
BUILDINGS
Efficiency, heat networks, heat pumps (new-build, off-gas, hybrids)
Widespread electrification, expand heat networks, gas grids potentially switch to hydrogen
ROAD TRANSPORT
Ramp up EV market, decisions on HGVs
Turn over fleets to zero-emission vehicles: cars & vans before HGVs
INDUSTRY
Initial CCS clusters, energy & resource efficiency
Further CCS, widespread use of hydrogen, some electrification
LAND USE
Afforestation, peatland restoration
AGRICULTURE
Healthier diets, reduced food waste, tree growing and low-carbon farming practices
AVIATION
Operational measures, new plane efficiency, constrained demand growth, limited sustainable biofuels
SHIPPING
Operational measures, new ship fuel efficiency, use of ammonia
WASTE
Reduce waste, increase recycling rates, landfill ban for biodegradable waste
Limit emissions from combustion of non-bio wastes (e.g Deploy measures to reduce emissions from waste water)
F-GASES
Move almost completely away from F-gases
GREENHOUSE GAS REMOVALS
Develop options & policy framework
Deployment of BECCS in various forms, demonstrate direct air capture of CO_2, other removals depending on progress
INFRASTRUCTURE
Industrial CCS clusters, decisions on gas grid & HGV infrastructure, expand vehicle charging & electricity grids
Hydrogen supply for industry & potentially buildings, roll-out of infrastructure for hydrogen/electric HGVs, more CCS infrastructure, electricity network expansion
CO-BENEFITS
Health benefits due to improved air quality, healthier diets and more walking & cycling
Clean growth and industrial opportunities

Current Priorities

- Investment in high-quality, inter-disciplinary research to target the **energy 'trilemma'** of reducing carbon emissions, energy security and affordability → **Net Zero/Decarbonisation**
- **Systems Approach:** whole energy systems and integration within the energy system.
- **Understanding Future Energy Options:** Social, governmental environmental and economic implications.
- **Reducing Energy Consumption and Demand:** Development of behavioural, market and technological advances informed by a whole system understanding.
- **Enabling Technologies:** that underpin research across disciplines, such as energy storage, materials, digital technology.
- **Speculative Research:** To define future energy options and draw developments from other disciplines into energy research.
- **Accelerated Deployment of Technologies:** Working with Innovate UK, BEIS and others to tackle challenges around deployment and encourage policy and user impact from research, e.g. the Energy Catalyst
- **Building Capacity and Diversity**: Providing the skilled people to deliver new energy futures through the training and development of new researchers, policy makers and business leaders. e.g. Growth in career advancement and leadership fellows.
- **Build on our major international links:** Working with China, India, USA and other priority countries, enabling leading researchers to address global energy challenges together.

UK Net Zero 2050 target

Commitment: bring all UK greenhouse gas emissions to Net Zero by 2050 (does not include imported emissions)

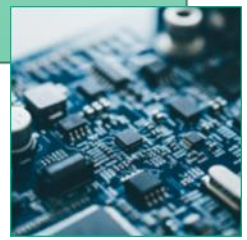
What needs to happen?

A whole-systems approach

Reduce

Reduce demand *for GHG-intensive products, processes and services*

Improve efficiency *to reduce demand through both technical solutions and behaviour change*



Remove

The ***ability to capture, store and utilise*** *GHGs from essential processes that cannot be decarbonised.*

The Committee for Climate Change estimates that we need to capture 75-175 ***$MtCO_2$ annually by 2050.***

Replace

Replace GHG emitting products, processes and services *with low and zero carbon solutions. This includes the need for extensive electrification and solutions for needs that cannot be met through electrification.*

There is a lot going on…

Announcements

- £1bn Net Zero Innovation Portfolio
- Net Zero Hydrogen Fund
- Industrial Decarbonisation Strategy
- ISCF Industrial Decarbonisation – Deployment

Later in 2021

- Hydrogen Strategy

UK Net Zero 2050 target – what is the role of research and innovation?

What is UKRI's role working closely with our partners?

Deploy

Deploying at scale those technologies and solutions that are ready

*Address the **research questions that arise during deployment*** and understand the **policy, regulatory, financial, institutional decisions and incentives/disincentives** that will be most effective.

Develop

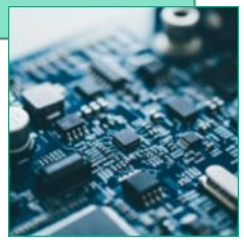
Developing those technologies and solutions that are not yet ready

Create new **scientific insights, innovative technologies, and unlock deployment**

Discover

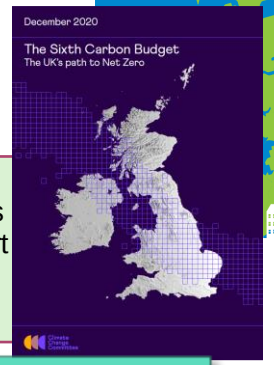
Discovering solutions to problems that we cannot yet solve.

And deliver the **disruptive science** that contributes to achieving global carbon neutrality in the long-term.



UKRI already has work underway…

deploy, develop, discover



Some examples,

- UK Energy Research Centre (**UKERC**)
- Energy Systems Catapult
- Prospering from the Energy Revolution Challenge
- UK Geoenergy Observatories (**UKGEOS**)
- SUPERGEN Energy Networks Hub (HubNet)
- Centre for Climate Change Economics and Policy (CCCEP)
- Centre for Evaluation Complexity across the Nexus (CECAN)
- Centre for Energy System Integration (CESI)
- ADdressing Valuation of Energy and Nature Together (ADVENT)
- Centre for Doctoral Training in Wind and Marine Energy Systems
- Centre for Doctoral Training in Future Power Networks and Smart Grids
- Centre for Doctoral Training in Power Networks

A whole-systems approach

Reduce

Reduce demand *for GHG-intensive products, processes and services*

- UK Centre for Research in Energy Demand Solutions (**UKCREDS**)
- Centre for Doctoral Training in Energy Demand (LoLo)
- Transforming the Foundation Industries

Remove

*The **ability to capture, store and utilise** GHGs from essential processes that cannot be decarbonised.*

- UK Carbon Capture and Storage Research Centre
- Pilot-scale Advanced CO2 Capture Technology (PACT)
- British Geological Survey
- **Industrial Decarbonisation Challenge**

Replace

Replace GHG emitting products, processes and services *with low and zero carbon solutions.*

- **SUPERGEN Hydrogen and Fuel Cell Research Hub**
- **Green Ammonia Demonstrator**
- **Centre for Doctoral Training in Sustainable Hydrogen**
- **Centre for Doctoral Training in Fuel Cells and their Fuels**
- **SUPERGEN Bioenergy Hub**
- **Transport Network + and Networks**
- Wind Supergen
- Energy Storage Supergen
- Offshore Renewable Energy Catapult
- Energy Catalyst

H2FC SUPERGEN
THE HYDROGEN AND FUEL CELL RESEARCH HUB

….but there is more to do

deploy, develop, discover

Investing in the research, innovation, skills, partnerships and infrastructure to support Net Zero:

- UKRI **Energy** Programme Priorities include research and innovation to support:
  - **Growth of a hydrogen economy - production, storage, distribution and use.**
  - Wide-scale deployment of carbon capture utilisation and storage (**CCUS**)
  - A reduction in **energy demand** through a combination of engineering (applied data science, AI), behaviour change and regulation.
  - **Clean energy technologies** focussing on areas of UK strength and opportunity (including bioenergy, nuclear, energy storage, offshore energy, advanced solar technologies)
  - In Transport areas of particular interest include maritime and aviation
- We are working in partnership to develop R&D strategies and plans for:
  - **Hydrogen** with BEIS, DfT, ESC Catapult, OfGEM
  - Decarbonising **transport** with DfT (engaged with DfT Tees Valley Transport Hub)
  - Decarbonising the **built environment** with MHCLG and BEIS
  - Net Zero **agriculture** and **land use** with Defra
  - Decarbonising **heating and cooling** with input from BEIS and MHCLG
  - **Whole-systems** approaches and integration challenges associated with Net Zero
  - A coordinated R&D plan for Net Zero across government with the Net Zero Innovation Board

Increasing the environmental sustainability of our own operations, activities and programmes

By 2020
we will embed environmental sustainability into the objectives and remit of the UKRI leadership team.

By 2021
we will establish the UKRI Carbon Fund for carbon improvement across the UKRI-owned/majority-funded estate and infrastructure.

By 2022
we will adopt Biodiversity Action Plans across the UKRI-owned estate.

By 2024
we will agree and adopt a UKRI-wide approach to reduce and abate emissions associated with business travel activities including international air travel.

By 2025
we will have embedded environmental sustainability across all our investment decisions.

By 2040
we will achieve 'net-zero' for our carbon emissions.

The Future – Comprehensive Spending Review

This is a time of high pressures on public spending

We are preparing for a series of potential outcomes across the whole of UKRI

CATAPULT Energy Systems

Building on the opportunity of the UK's Presidency of COP26

UKRI COP26 Programme

UKRI are shaping the submission for the event at COP 26, as well as looking at a surrounding programme of activities before and after the event. Activities are being planned so that they can be

- Celebrate UK Research and Innovation
- Highlight the UK's role in climate action
- Support the Government's COP26 plans
- Inspire action

Engineering and Physical Sciences Research Council

Energy For a Low Carbon Future

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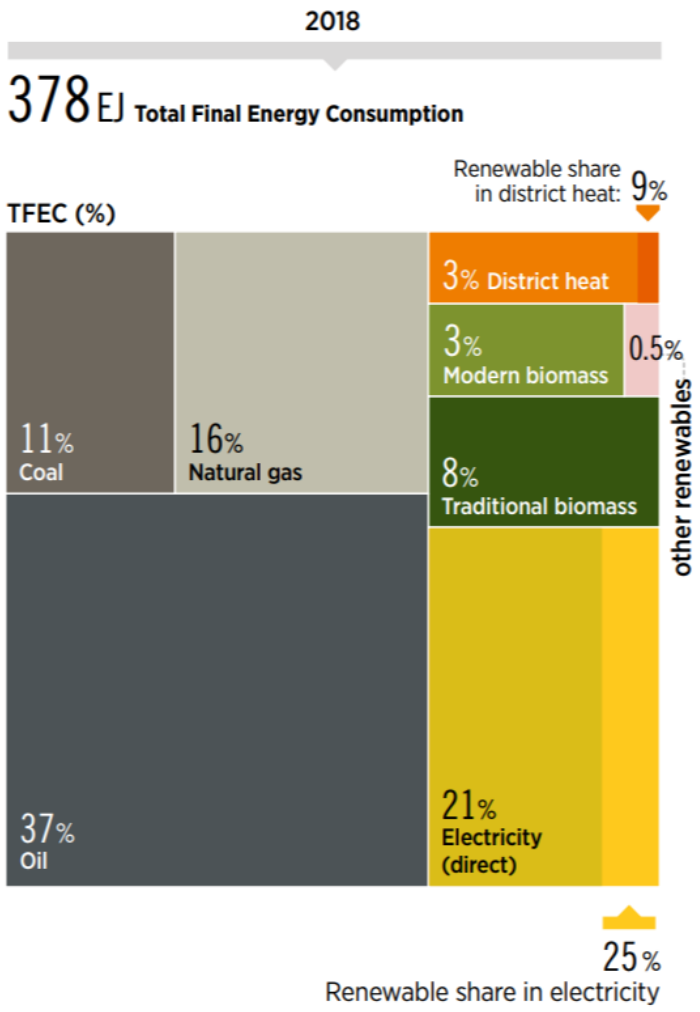
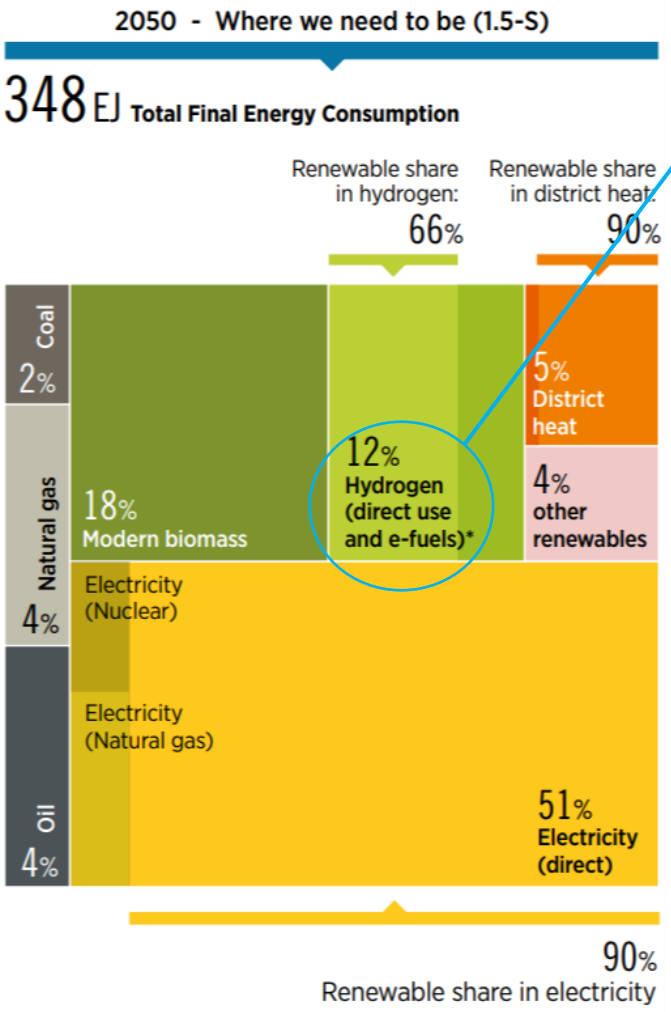
INDUSTRIAL STRATEGY

UK Research and Innovation

Hydrogen Fuel Cell Technology at the bmw group.
Today's Panelist.

Climate neutrality requires electrification and replacement of fossil fuels with hydrogen and its derivatives.





Roles of „green“ hydrogen

Hydrogen can

- ✓ transport (esp. long distances)
- ✓ import energy (from regions with high-yield production of renewable electricity)
- ✓ store (esp. long duration) renewable energy.

Hydrogen can be used

- ✓ to replace fossil fuels
- ✓ as a raw material & energy for industry (e.g. steel, fertilizer, petrochemicals)
- ✓ as the basis for e-fuels/synfuels (Power-to-X)

Passenger Cars: hydrogen Fuel cell powertrains can complement battery electric vehicles (BEV).

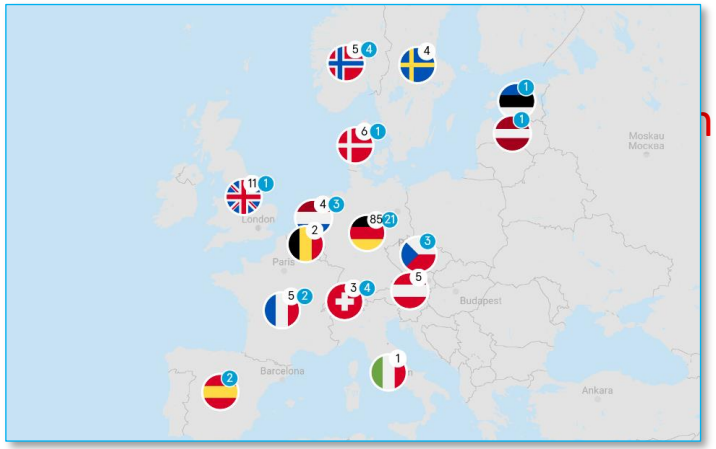
Fuel Cell powertrain (FCEV) as a complement to BEV:

- Commercial vehicles: lorries, coaches, trains, ship and airplanes.
- Zero-emission option for larger passenger vehicles where BEVs reach limits.
- Long-distance and high flexibility (e.g. business travelers, fleets).
- Customers without convenient e-charging options (e.g. inner cities).

Prerequisites for market penetration of FCEV passenger cars:

- Significant reduction in manufacturing costs for fuel cell systems.
- Filling station infrastructure and large-scale industrial supply chain with "green" H2 at competitive prices.

➢ Exploit synergies btw. passenger cars and commercial vehicles (e.g. cost reduction through economies of scale, H2 infrastructure).



HYDROGEN EXPERTISE AT BMW Group.

FUEL CELL

HYDROGEN GAS @ 70 MPa

>20 years

1997
1st Fuel Cell

1999
BMW 750hL
with Auxilliary Power Unit

2013
BMW 1st FCEV

2015
BMW 5Series GT

2022
BMW i Hydrogen Next

Cooperation with Toyota

1980 | 1990 | 2000 | 2010 | 2020

1979
BMW 520h

1984
BMW 745h

1999
BMW 750hL

2001
BMW 745h

2004
BMW H2R

2006
BMW Hydrogen 7

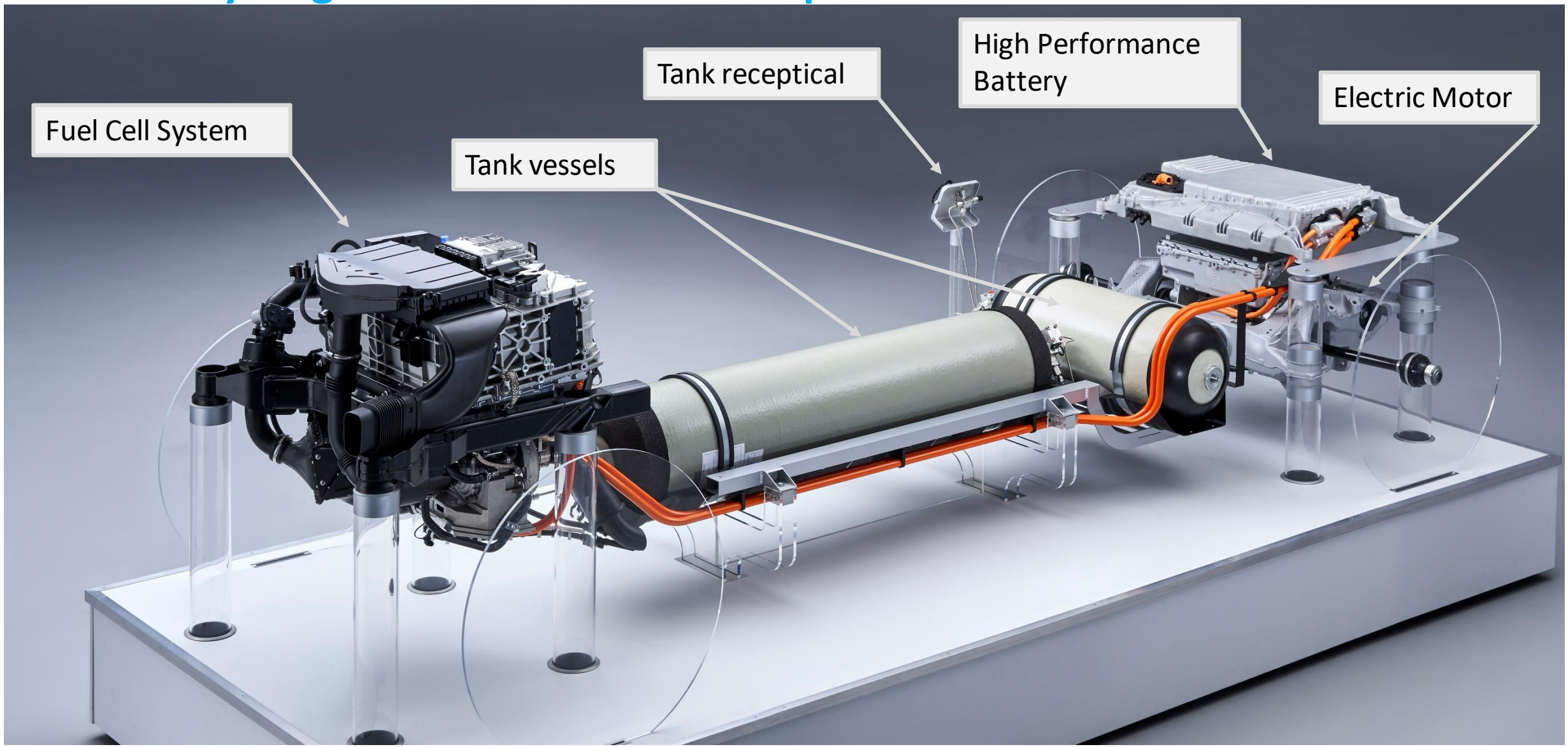
COMBUSTION ENGINE

LIQUID HYDROGEN

>40 years

BMW i Hydrogen NEXT – The Car.

BMW i Hydrogen NEXT – The Fuel Cell powertrain.



Hydrogen FUEL CELL TECHNOLOGY at the bmw group.

Dr. Juergen Guldner

BMW Group

BMW GROUP

ROLLS-ROYCE MOTOR CARS LTD

...giving Hydrogen the green light?

13th-16th April 2021

FUTURE OF TECHNOLOGY SERIES

SHARING IDEAS
UNLOCKING OPPORTUNITIES

ADVANCED PROPULSION CENTRE UK

global Hydrogen Economy

Dr Michaela Kendall, CEO – Adelan

info@adelan.co.uk

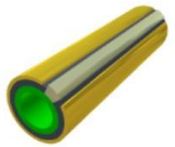
ADELAN 25 YEARS PIONEERING THE HYDROGEN ECONOMY

Market Acceleration

2012
First sale of 250W system and UAV demonstrator

2003
First handheld demonstrator

1996
Founded Adelan, manufactured microtubes

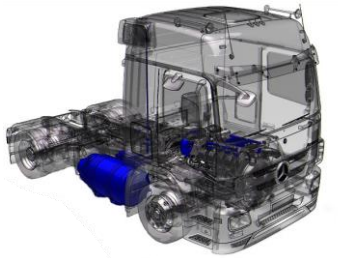


1997
Built first large demonstrator

1998-2000
First commercial vehicles project in Birmingham

2013-2015
Portable power for campervan demonstrator

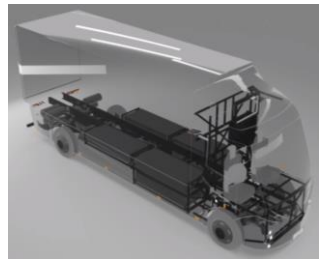
2015-2016
Portable power for truck demonstrator



2016-2017
Mobile and nano chargers

2020
mCHP

2021
Buses & HGVs



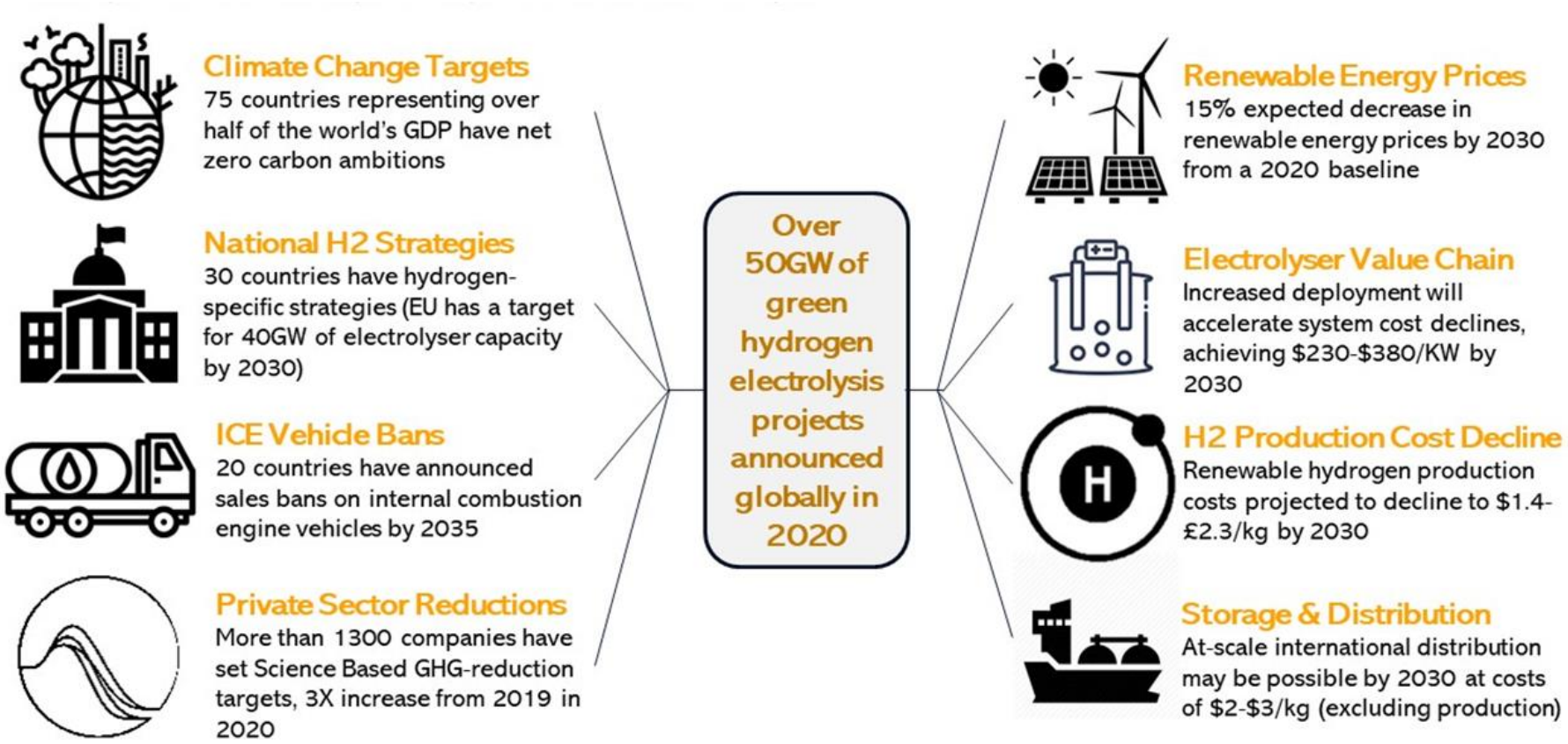
Why now:
- **Adelan invested for 25+ years to build core technology and market knowledge**
- **We have IP in this area • Built products, early sales of FC units and hydrogen**
- **Recent market growth • Climate change, air quality and energy security issues**

Est. 1996

45

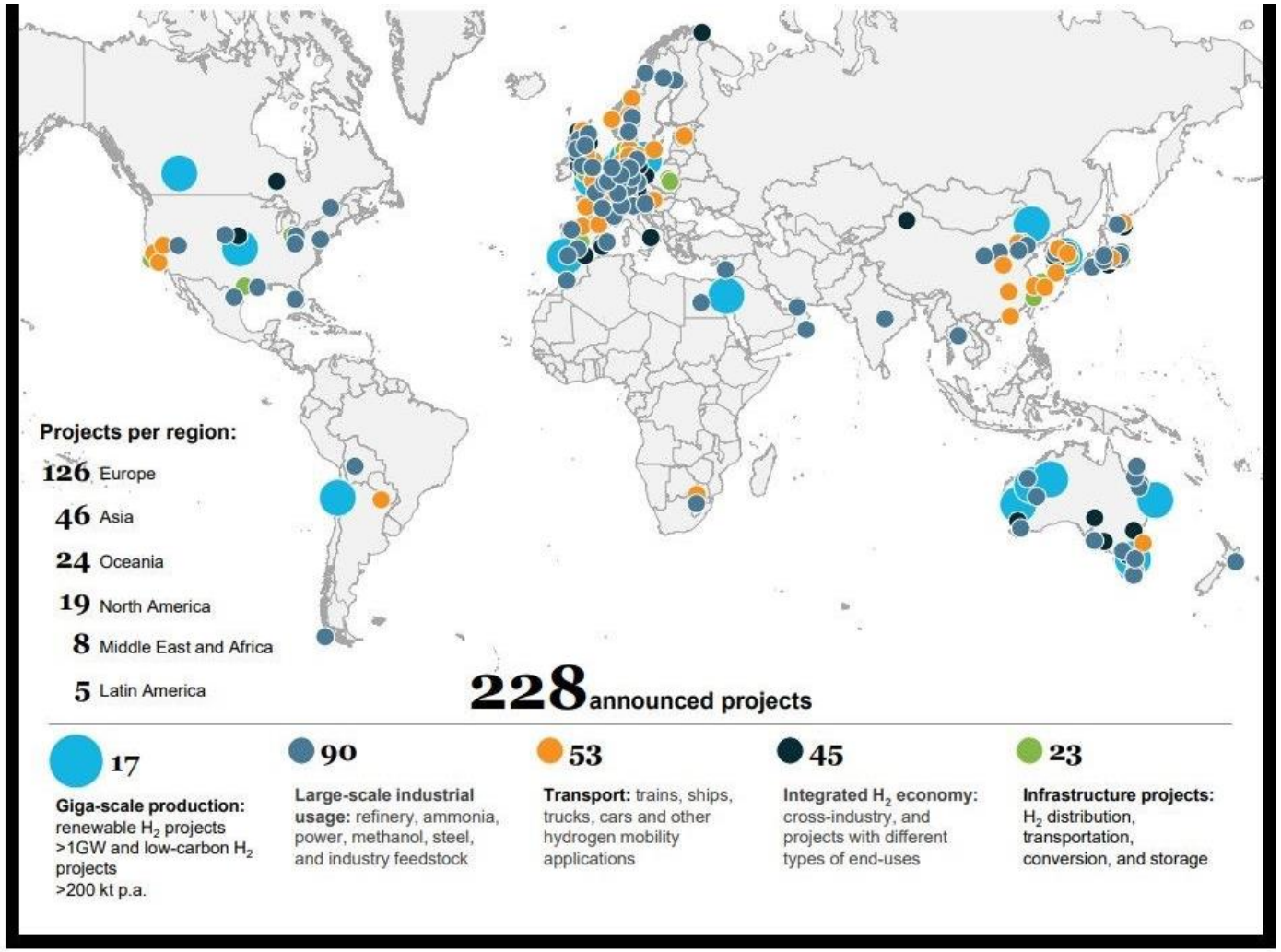
HYDROGEN GLOBAL MEGATREND

Market Acceleration

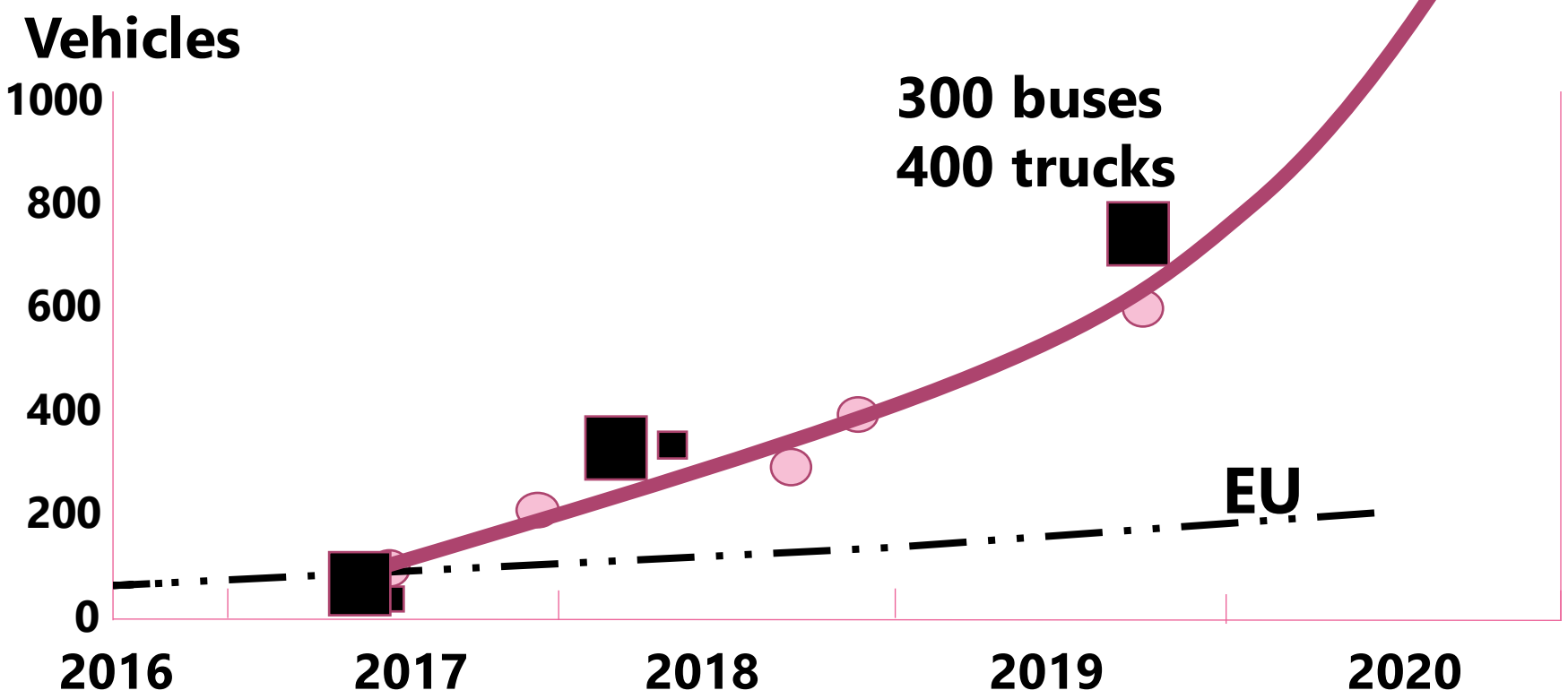


HYDROGEN TECHNOLOGY INVESTMENTS

Geography of Value Chain



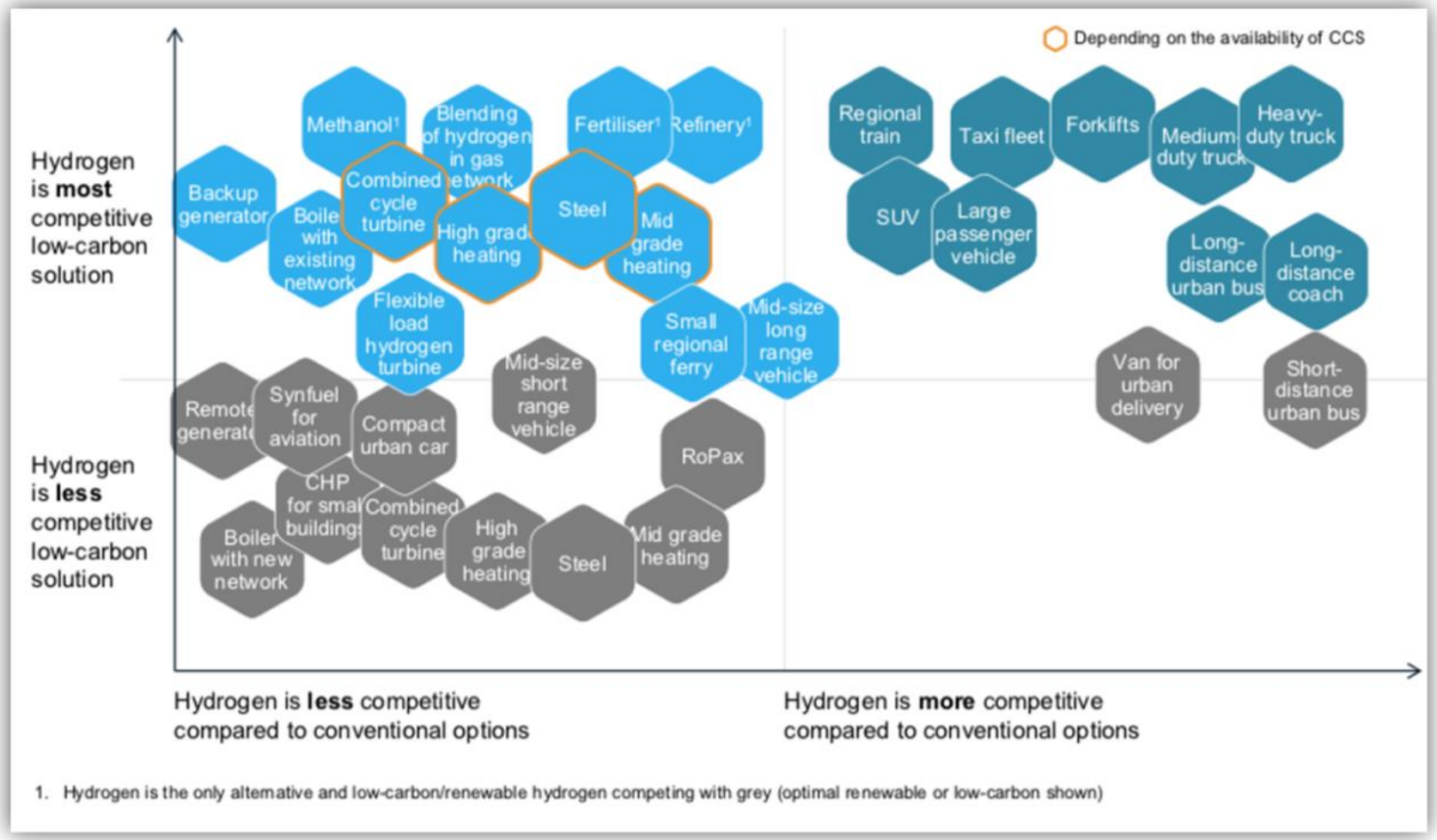
Hydrogen Vehicles in Foshan vs. EU



Hydrogen Opportunities

IN A NUTSHELL

- 9 applications expected to be **cost competitive** with conventional by 2030
- 13 applications where hydrogen is the **best choice** to decarbonize



Passenger Cars & Captive Fleets


Toyota Mirai


Honda Clarity


Hyundai Tucson


Hyundai Genesis

- Japanese vehicle production increases dramatically.
- FCEV registration is now being tracked in California.
- Norway anticipates application of FCEVs incentives similar to BEVs.

Buses

- **UC Transit in Oakland**, CA, USA - largest fleet in North America, with 12 fuel cell buses.
- Foshan and Yunfu – $17 million order for 300 fuel cell buses.
- European Union Coordination a national Call for order in progress for a 1000 FC Buses
- South Korea - planning to replace 27,000 CNG buses with FC buses by 2030.

Heavy Duty Trucks

Nikola Motor Company H2 powered **long range tractor trailer**

Logistics Vehicles

UPS - first hydrogen fuel cell electric class 6 delivery van. 17 vans in the U.S. by year end 2018.

Toyota a heavy duty drayage vehicle (class 8), **Amazon** buying $70 million of **fuel-cell forklifts.**

Light Rail Trains

In 2017, **Alstom** unveiled its **Coradia iLint**, which will **replace diesel trains** in the extensive, **un-electrified sections** of rail in Germany.

Airplanes & Drones

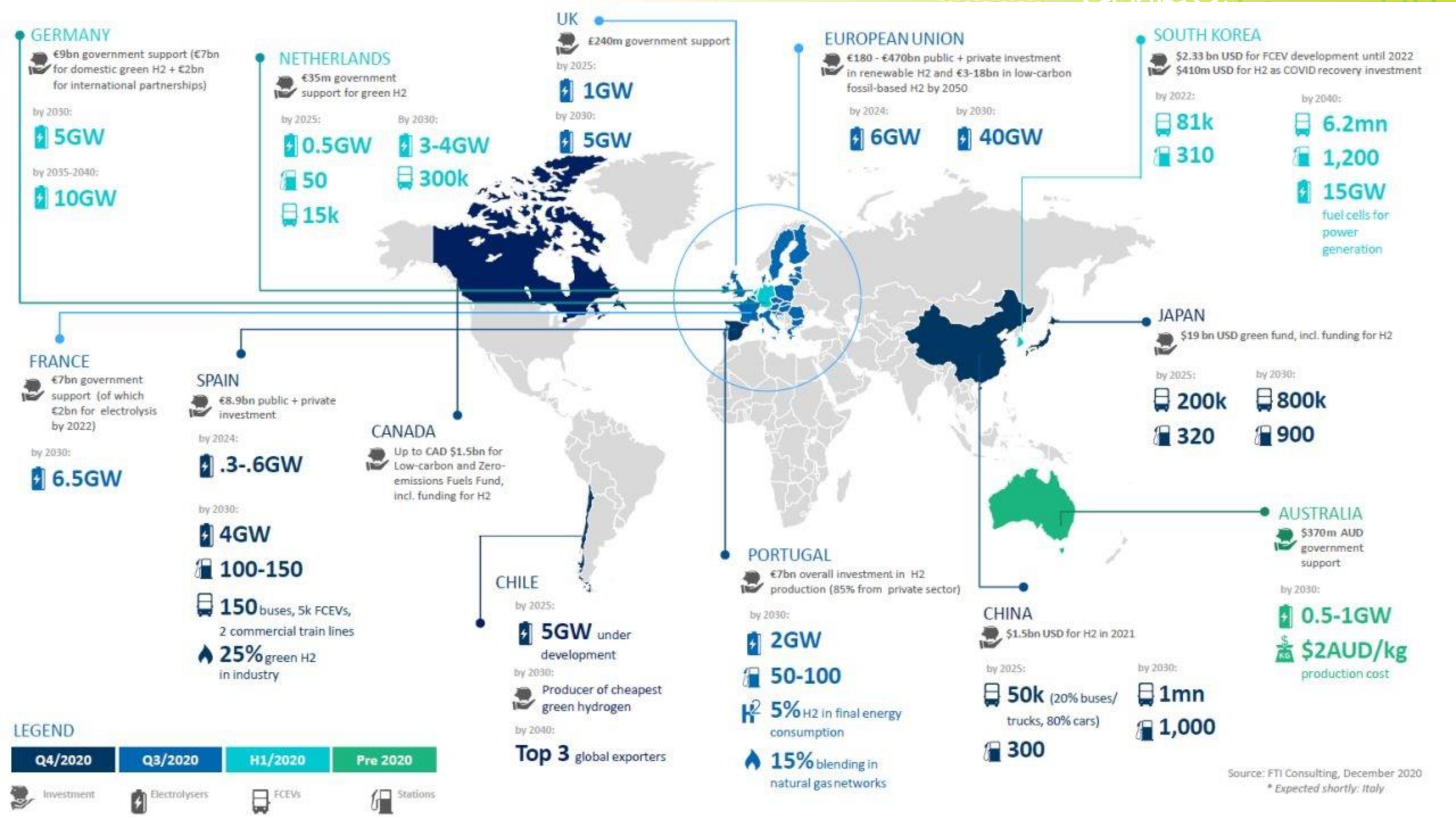
Hydrogen-powered Drone
Fuel cell technologies power drones varied applications from lightweight Hycopter to larger military based applications like the Boeing Insitu's ScanEagle drone.
HY4 Hydrogen Fuel Cell Electric Aircraft, World's first 4 seater H2 plane.
HYCARUS & FLHYSAFE EU projects to integrate auxiliary power units onboard comercial aircraft

Maritime

90% of all trade is by ship. Maritime tourism is huge global industry.

The **Red and White Ferry Company** and **Sandia National Laboratory** have teamed up on a feasibility study for designing, building and operating a high-speed hydrogen fuel cell powered passenger ferry and refueling station.

Portables

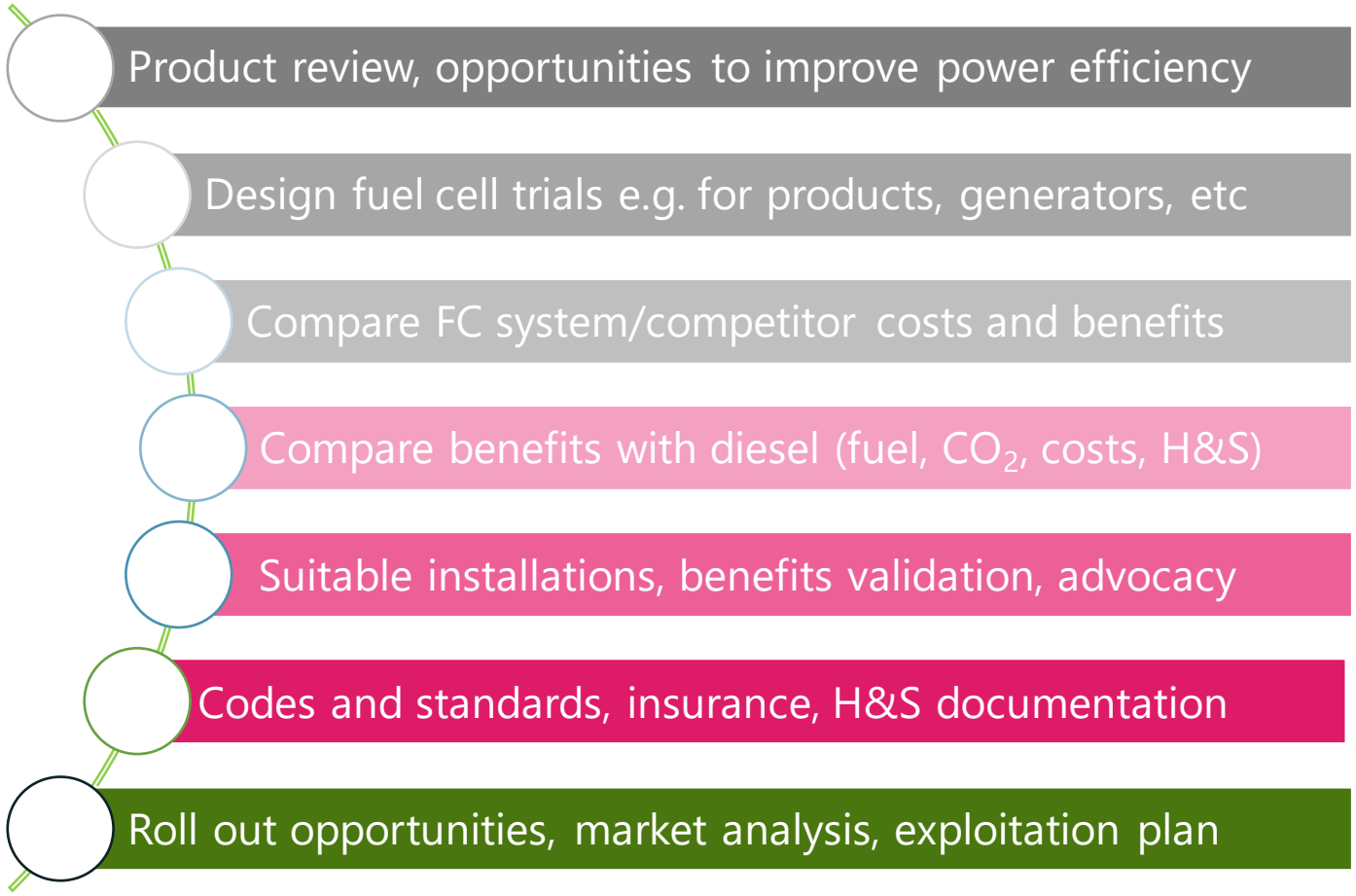


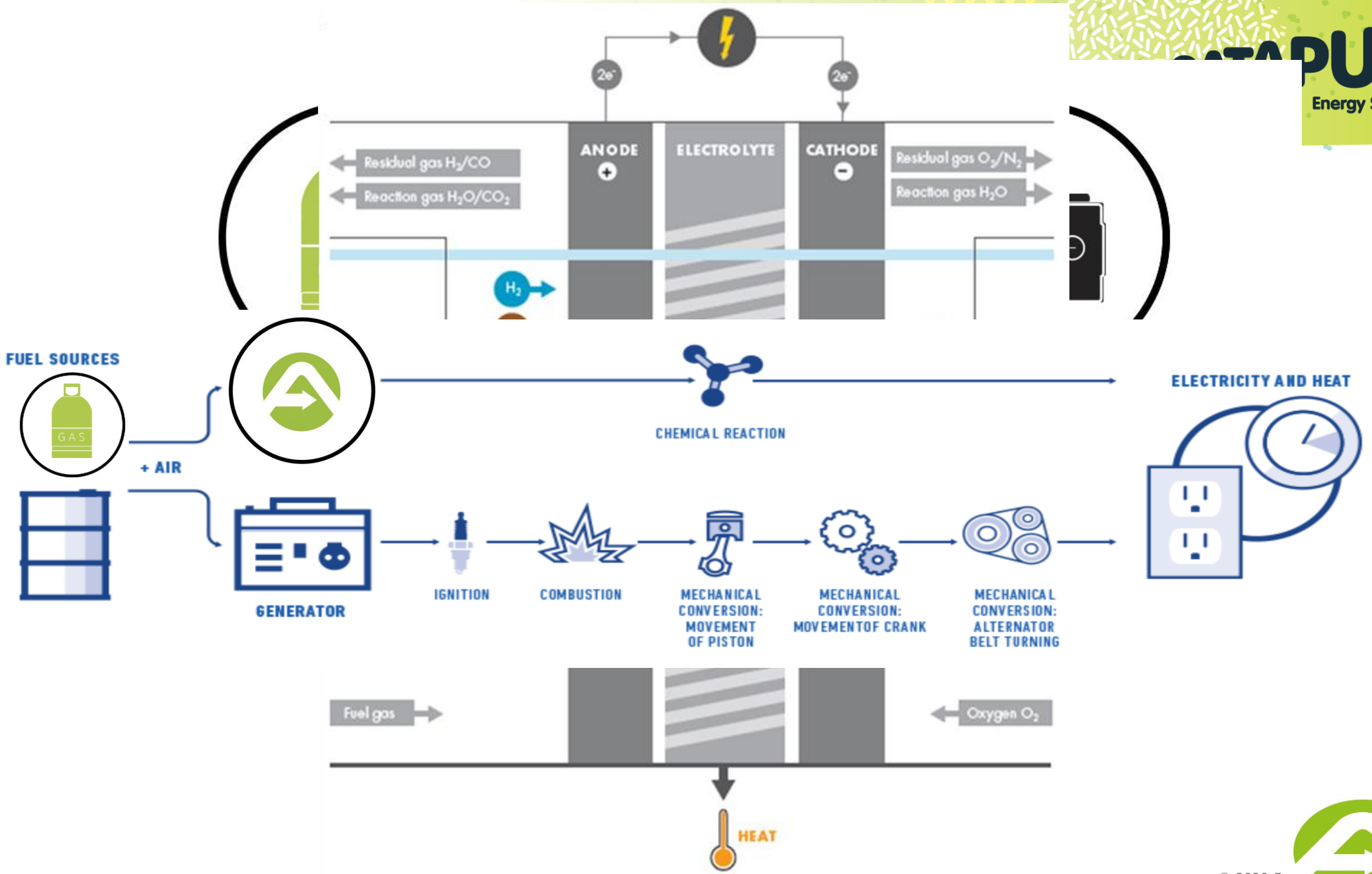
Source: FTI Consulting, December 2020

** Expected shortly: Italy*

Adelan Hydrogen Technologies

Synchronizing Supply and Demand of Hydrogen Technologies Across Markets




2e⁻
2e⁻
ANODE
ELECTROLYTE
CATHODE
Residual gas H_2/CO
Reaction gas H_2O/CO_2
Residual gas O_2/N_2
Reaction gas H_2O
H_2
FUEL SOURCES
GAS
+ AIR
GENERATOR
CHEMICAL REACTION
ELECTRICITY AND HEAT
IGNITION
COMBUSTION
MECHANICAL CONVERSION: MOVEMENT OF PISTON
MECHANICAL CONVERSION: MOVEMENTOF CRANK
MECHANICAL CONVERSION: ALTERNATOR BELT TURNING
Fuel gas
Oxygen O_2
HEAT

Today the UK H2 market is small and not low carbon. Expansion, driven in part by North Sea resources, can bring clean growth opportunities

ATAPULT Energy Systems

Current status

- **Only 10- 27TWh of H2 is produced in UK p.a.** and a fraction is low carbon. Production centred in coastal industrial clusters
- **Production is mainly from methane reformation** and industrial processes which release by-product H2. Neither method currently uses CCUS
- **A small amount is produced from electrolysis** (using an electrical current to split water into H2 and oxygen), this route is more expensive, currently primarily for use in transport
- **Demand mainly from outside the energy system.** Petrochemicals industry is the largest user, either as a feedstock (e.g. fertilizer production) or for processing other fuels (e.g. refining)

Opportunities

- **Growing interest, coordination of activities and demand** for low carbon H2 domestically and internationally
- **UK has technical strengths and expertise** across the whole H2 value chain, demonstrating global leadership on potential of H2 for heat
- **UK geography, geology, history and institutional arrangements offer specific advantages –** incl. long term sustainability and viability of Oil and Gas infrastructure, offshore wind capacity and potential, H2 storage in salt caverns and gas grid, coastal industrial clusters
- **Scale up of the H2 economy could yield significant clean growth opportunities –** exploring further in support of clean, resilient recovery from Covid-19

Hydrogen Economy

Today

Midlands Strengths

- Home to industry leaders
- Innovation leadership
- Advanced manufacturing capabilities and supply chains
- Academic centres of excellence
- End users – home of automotive, future mobility, construction, 11 million consumers and more
- International reach – proven exporting powerhouse

Midlands Opportunities

- Investment ready
- Private sector commitment
- Articulate the Midlands USP
- Help inform Government investment priorities
- Grow awareness of capabilities and investment needs / sector levers
- Scale of economic opportunity – job creation and growth
- An enabler – energy supply security
- Extend international reach

THANK YOU

ADELAN info@adelan.co.uk

- Global players in hydrogen economy: UK BEIS Hydrogen Champion, going to COP26, Mission Innovation
- Unrivalled technical knowledge, uniquely experienced team
- Longest running British fuel cell company, privately held
- Invented and own world class low carbon, fuel cell technology (SOFC), 25 years ago; advises on all FCs
- Strong commercial and operational team building the UK business, global fuel cell and hydrogen tech networks
- Adelan SOFCs enable a wide range of applications and are fuel flexible (LPG, methane, hydrogen, etc), but also deep knowledge of other FC tech and comparative advantages
- Birmingham (UK) base, global reputation, >35 years in FCH

Pioneering the Hydrogen Economy

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ADELAN
Fuel cell innovation realised