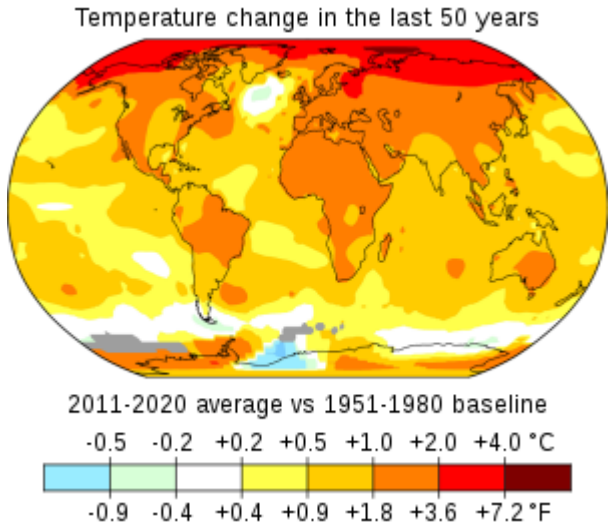
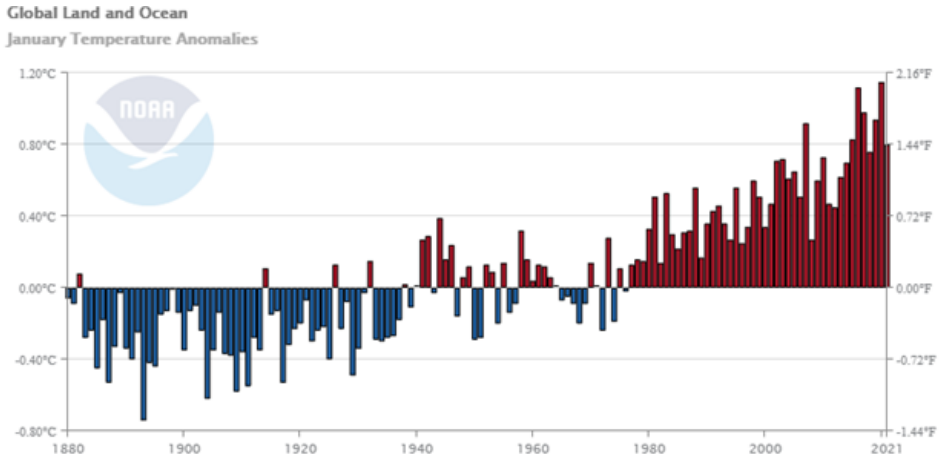
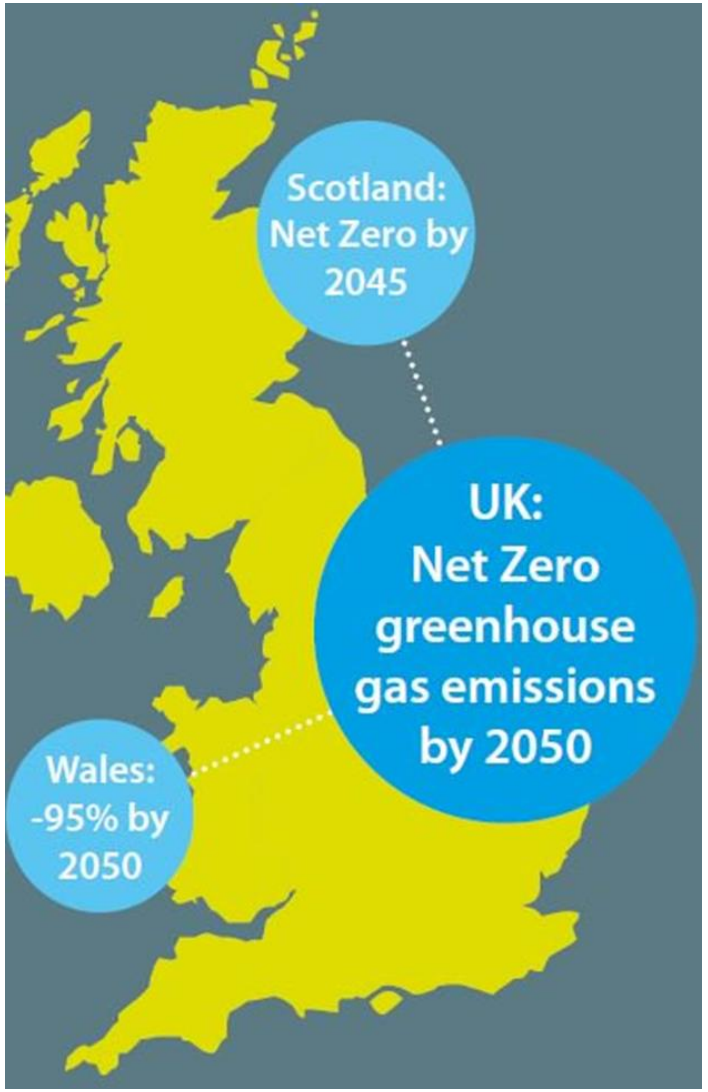
Abigail Dombey
Chair, Hydrogen Sussex
abigail@hydrogensussex.org

Climate Change is Here





Net Zero by 2050



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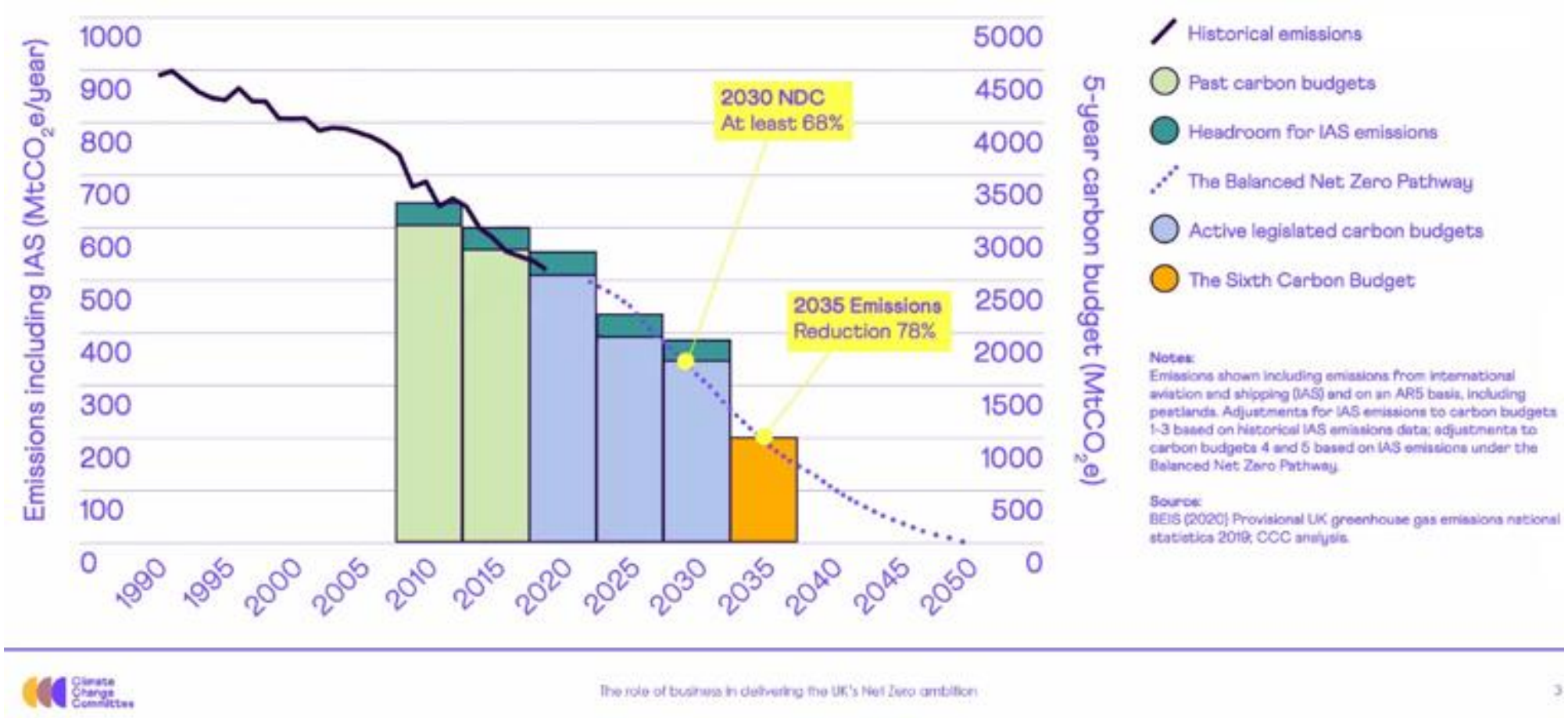
Net Zero Target



Hydrogen SUSSEX

Chris Stark
@ChiefExecCCC

Setting the UK's Sixth Carbon Budget (2033-37) in law is a huge moment. A 78% reduction in territorial emissions between 1990 and 2035.

Until 2019 the UK's 2050 target was an 80% reduction. It has effectively been brought forward by 15 years.

That's the implication of #NetZero.

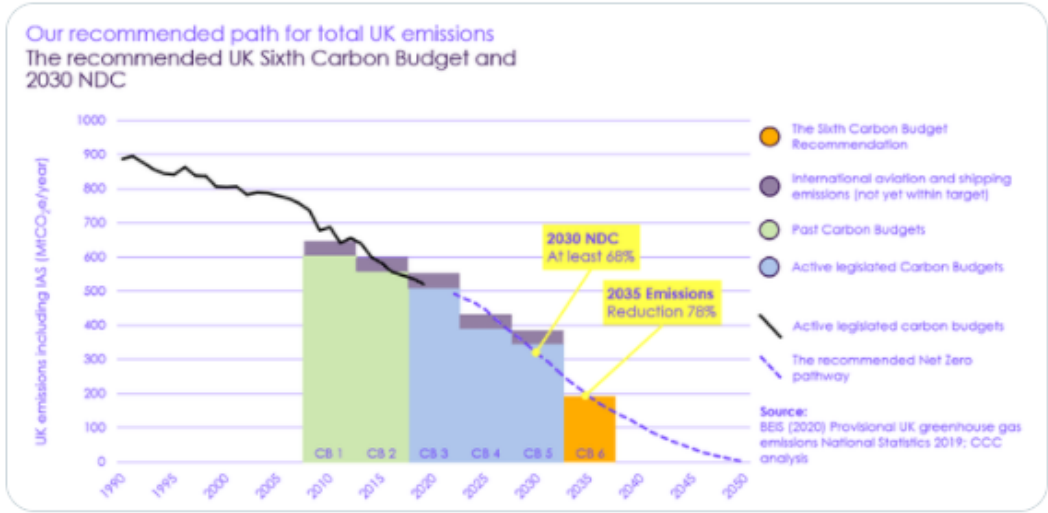


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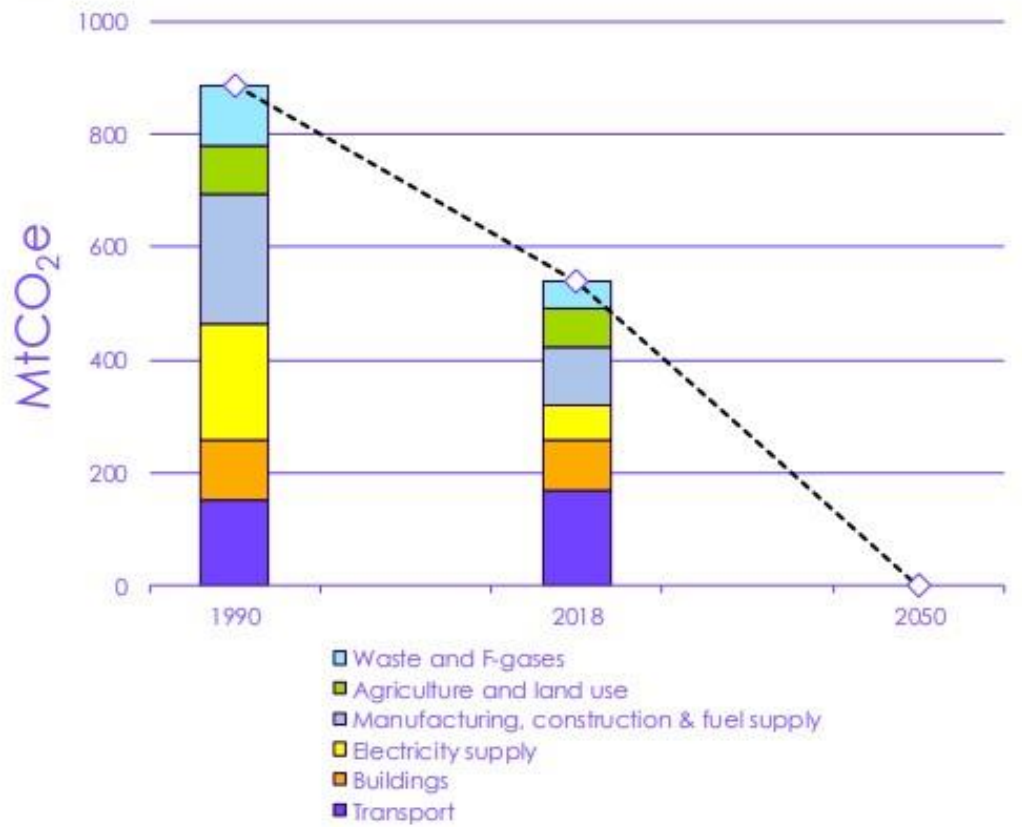
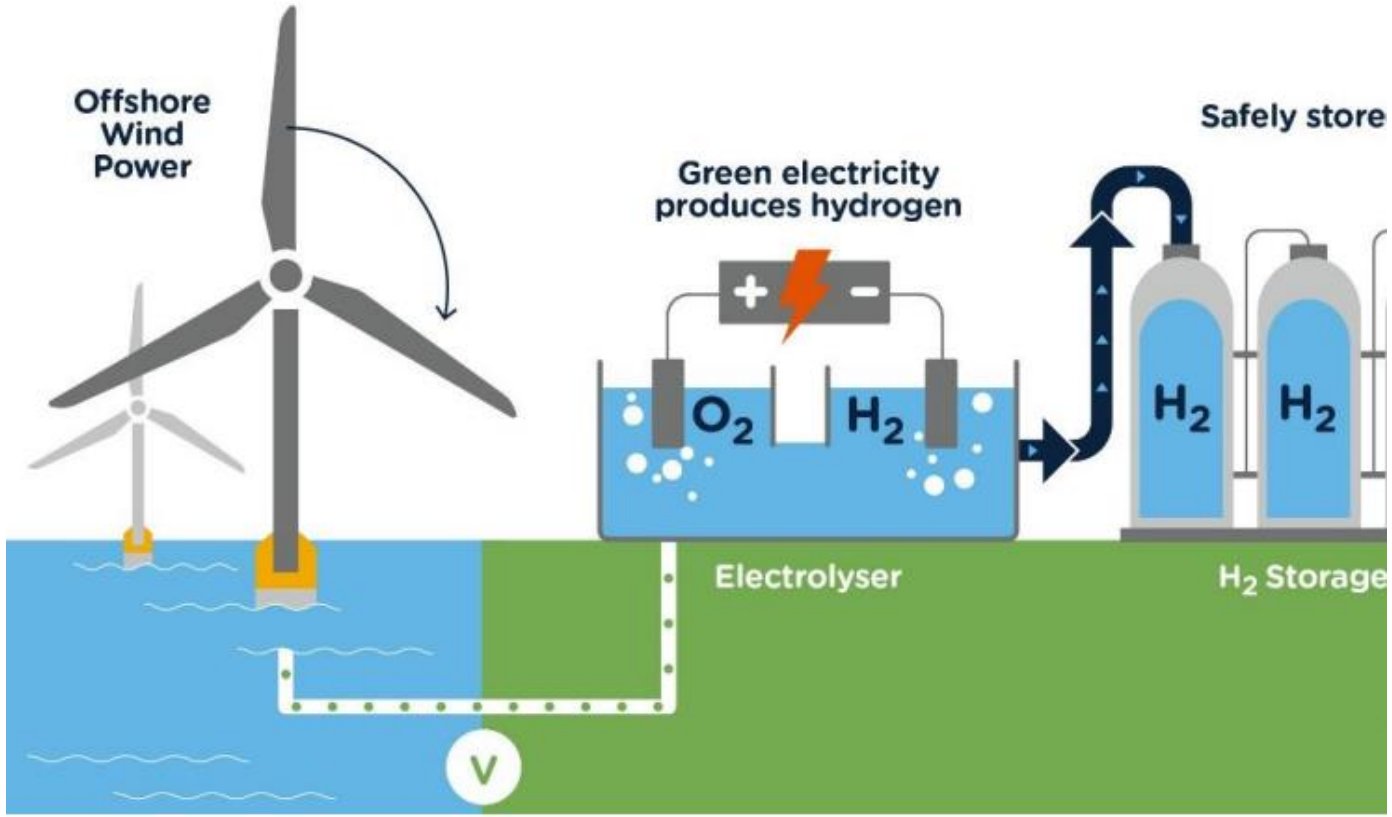
Figure 2.2 To meet Net Zero, emissions must fall in all sectors and at a faster rate than the last thirty years



Source: BEIS (2020) *Provisional UK greenhouse gas emissions national statistics 2019*; CCC analysis.
Notes: Net Zero emissions in 2050 will require any residual emissions to be offset by the UK land use sink and greenhouse gas removals.

Hydrogen – energy carrier



Green Hydrogen is produced from electrolysis using renewable electricity

Energy Densities

Hydrogen	Diesel/LPG	Battery
40 kWh/kg	13 kWh/kg	0.05 kWh/kg

Great Energy Carrier

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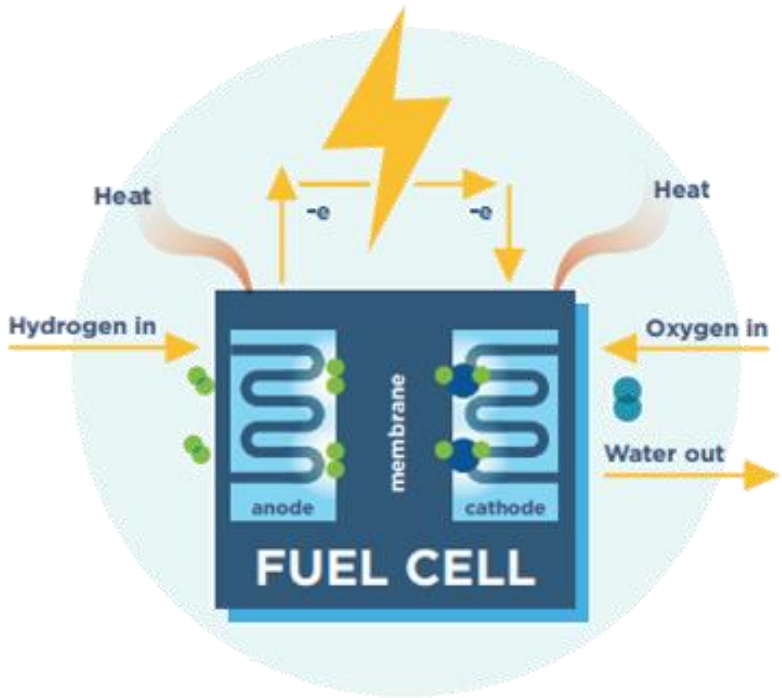
Fuel Cells

HOW FUEL CELLS WORK

A fuel cell is an electrochemical energy conversion device – it utilizes hydrogen and oxygen to generate electricity, heat, and water.

1. The hydrogen atoms enter at the anode.
2. The atoms are stripped of their electrons in the anode.
3. The positively charged protons pass through the membrane to the cathode and the negatively charged electrons are forced through a circuit, generating electricity.
4. After passing through the circuit, the electrons combine with the protons and oxygen from the air to generate the fuel cell's byproducts: water and heat.



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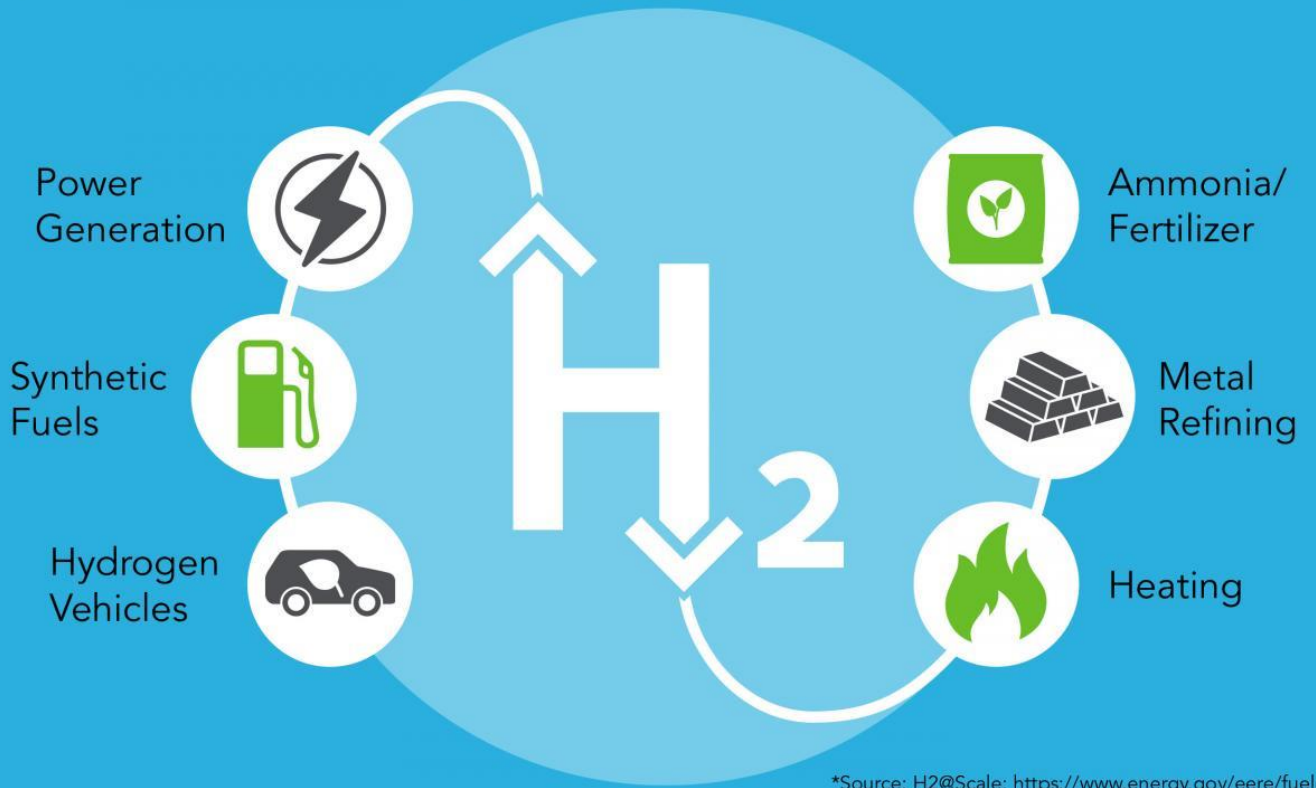
Why do we need **HYDROGEN?**

Hydrogen has the highest energy content by weight of any chemical fuel – three times higher than gasoline – and it's a critical feedstock for the chemical industry, including oil refining and fertilizer production. It also powers fuel cells with little or no emissions. Advances in hydrogen technology could spur innovation in everything from steel manufacturing and ironmaking to energy storage and transportation by light-duty and heavy-duty vehicles, trains, planes and boats.



*Source: H2@Scale: https://www.energy.gov/eere/fuelcells/h2scale

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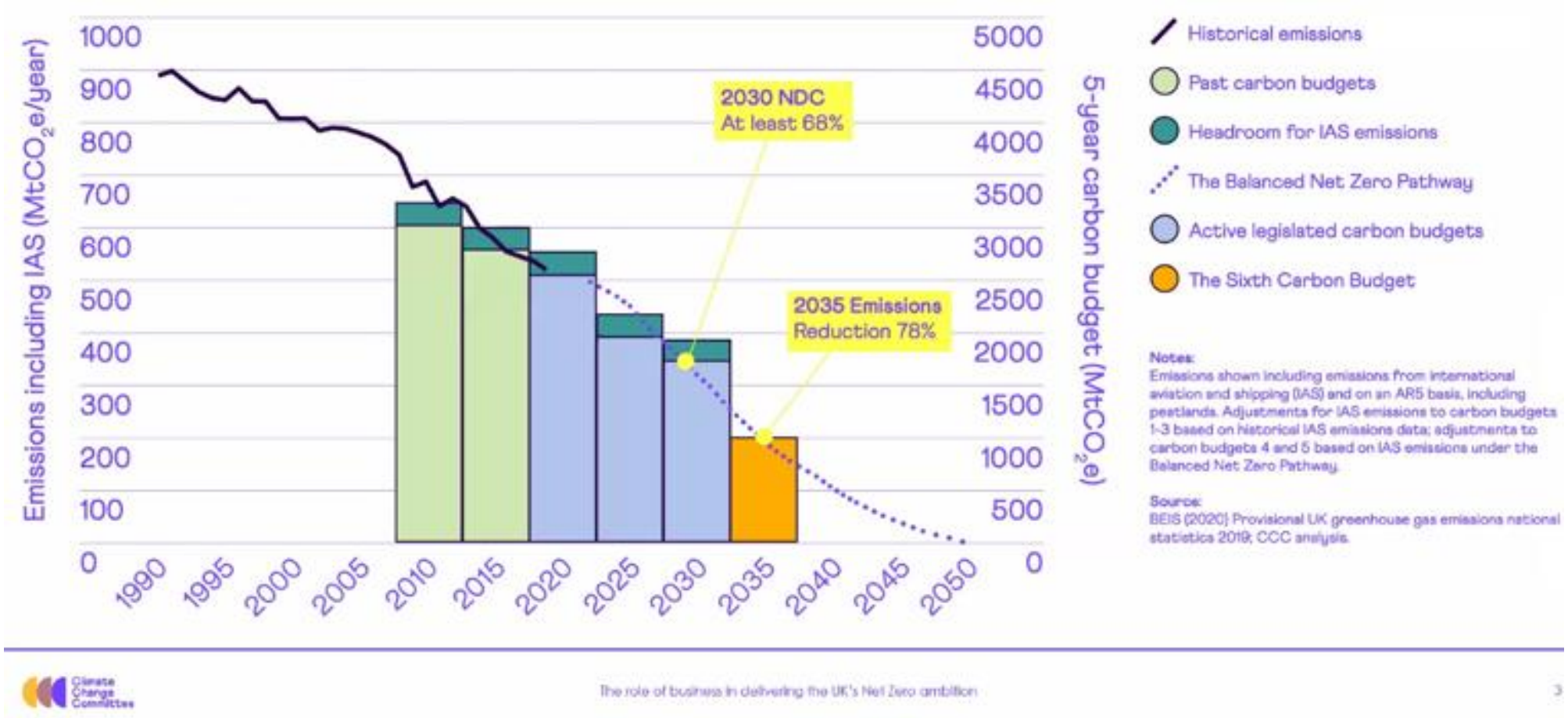
Net Zero Target



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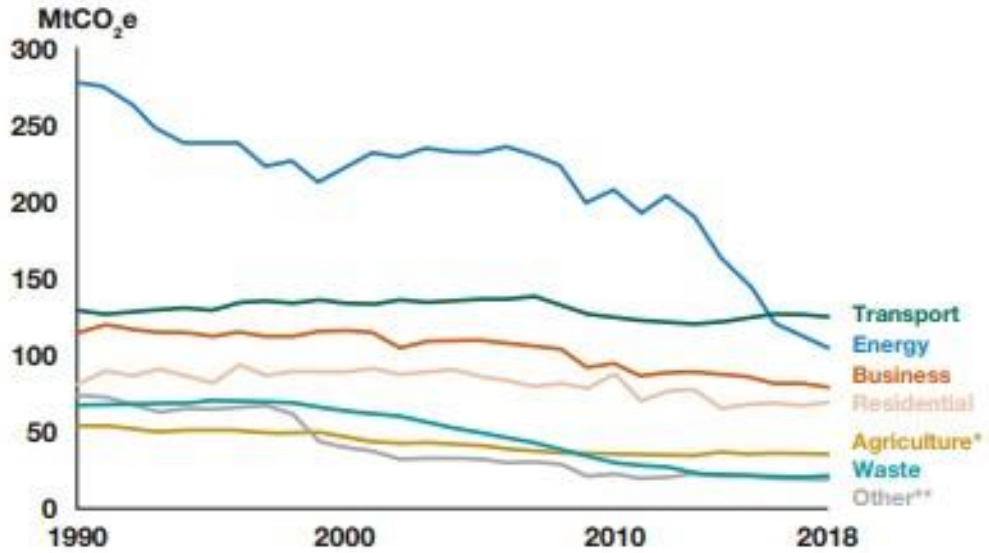
Net Zero - Transport

Figure 2: UK Domestic GHG emissions, 2018



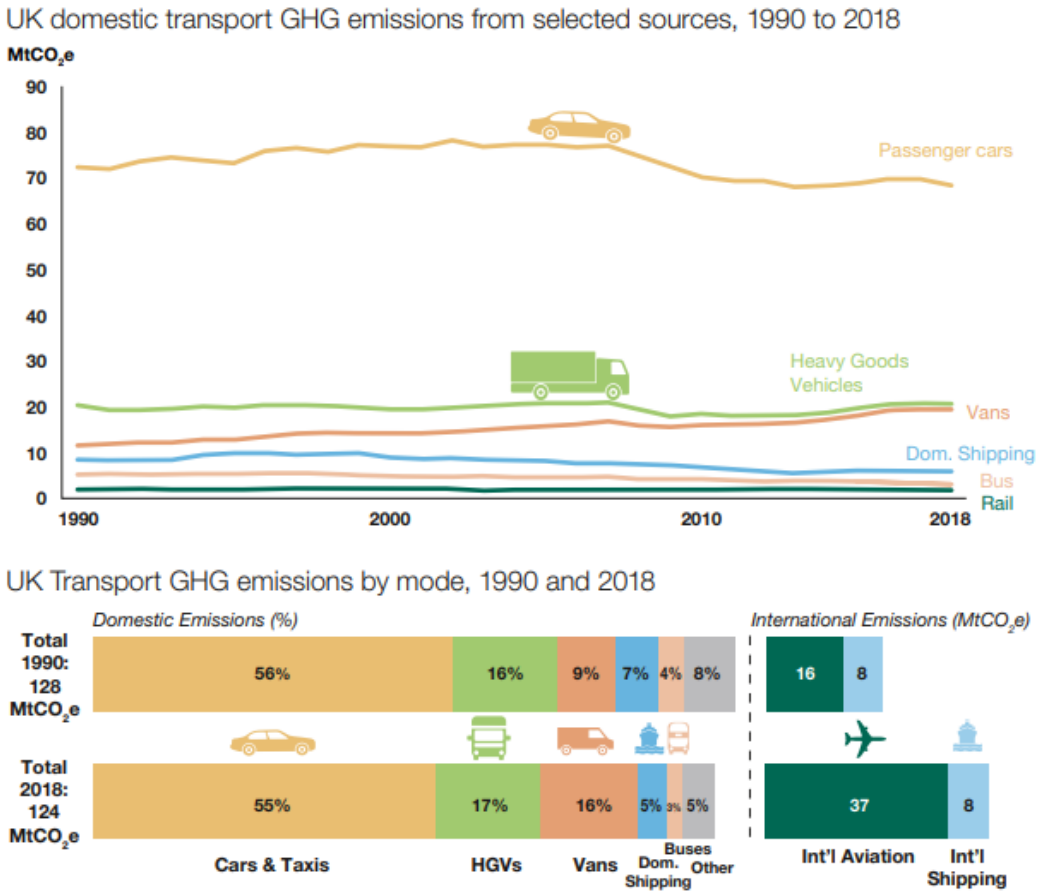
* Includes Land Use, Land Use Change and Forestry
** Includes Public and Industrial Processes emissions

Transport became the largest emitting sector of GHG emissions in 2016
This follows large decreases in energy emissions while transport emissions have remained relatively static.

451 million tonnes of CO_2 equivalent ($MtCO_2e$)
is the total net domestic greenhouse gas emissions from all UK sectors in 2018, down 2.1% from 2017.

Source: 2018 UK greenhouse gas emissions[10]

Net Zero - Transport



Source: Decarbonising Transport: Setting the Challenge

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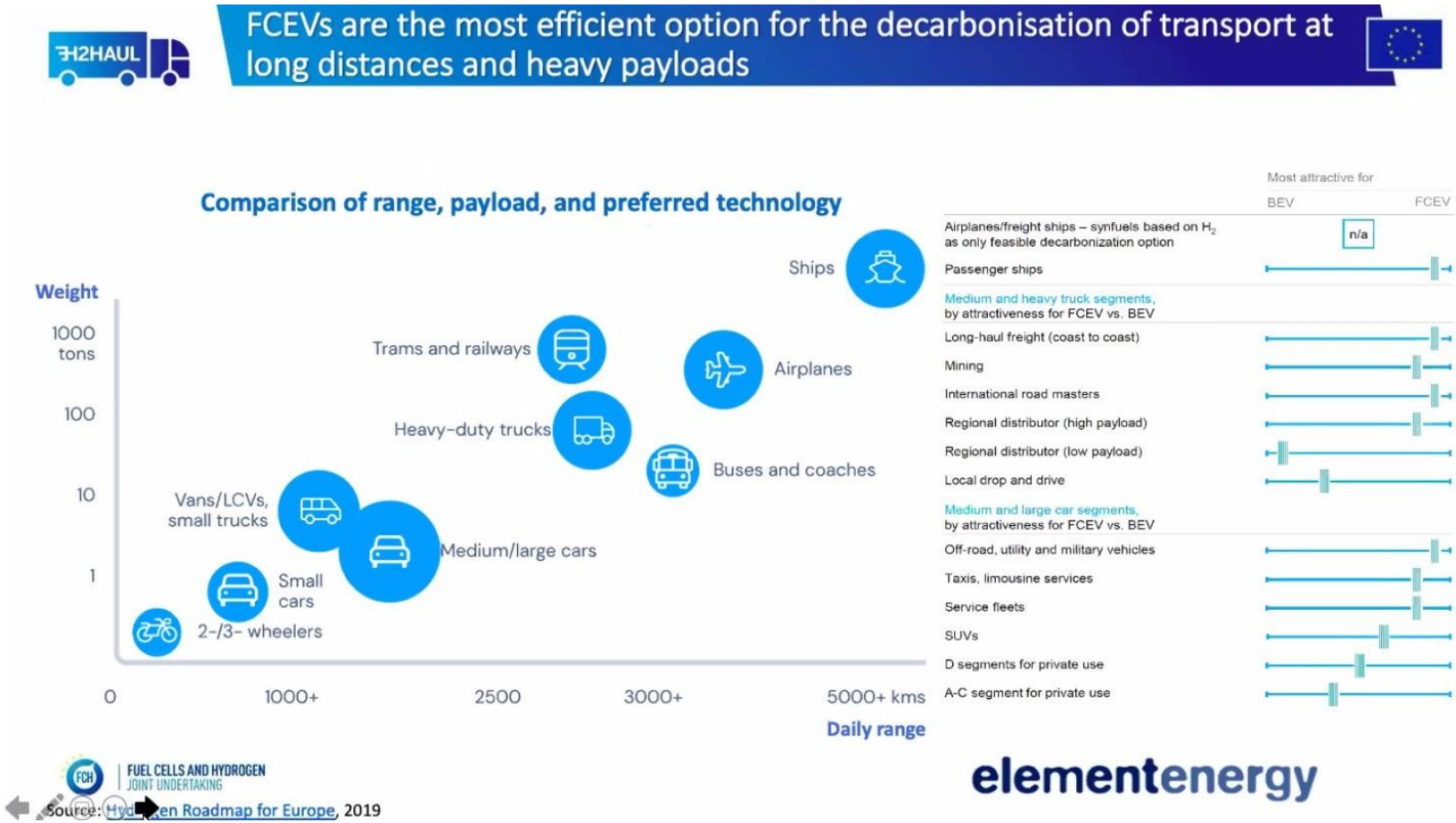
Fuel Cell Vehicles



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Other Key Uses of Hydrogen

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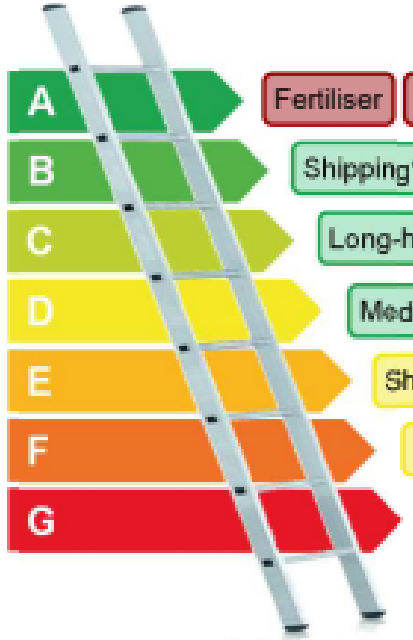
Clean Hydrogen Ladder: Competing technologies

Liebreich Associates

Unavoidable

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



A	Fertiliser	Hydrogenation	Methanol	Hydrocracking	Desulphurisation		
B	Shipping*	Non-Road Mobile Machinery	Chemical feedstock	Steel	Long-term storage		
C	Long-haul aviation*	Remote trains	Coastal and river vessels	Vintage vehicles*	Local CO2 remediation		
D	Medium-haul aviation*	Long distance trucks and coaches	High-temperature industrial heat	Generators			
E	Short-haul aviation	Local ferries	Commercial heating	Island grids	Clean power imports	UPS	
F	Light aviation	Rural trains	Regional trucks	Mid/Low-temperature industrial heat	Domestic heating		
G	Metro trains and buses	H2FC cars	Urban delivery	2 and 3-wheelers	Bulk e-fuels	Power system balancing	

Uncompetitive

** Most likely via ammonia or e-fuel rather than H2 gas or liquid Source: Liebreich Associates (concept credits: Adrian Hiel/Energy Cities & Paul Martin)*

Hydrogen SUSSEX

Hydrogen Sussex

Our vision is for Sussex

- to become a leading Hydrogen region in:
  - green hydrogen production
  - the development and uptake of low carbon hydrogen (when best available technology)
- to establish the innovation, skills and supply chain that will underpin our energy transition.
- Working with local organisations across the public and private sectors to adopt low carbon hydrogen.
- Priority to switch to low carbon hydrogen
  - where it will enable decarbonisation asap

Hydrogen Sussex

Our unique selling points are our

- natural resources,
- infrastructure,
- skilled engineering workforce,
- partnership.

Hydrogen Sussex Members include:

Shoreham Green Hydrogen Hub

- **Developer** – H2 Evolution Ltd
- **Location** – Shoreham Port: strategically placed for local and regional customers
- **Partners** – Shoreham Port Authority, historic Port Trust, logistics and distribution capabilities
- **Site** – 6,700m^2 brownfield light industrial site with good access
- **Plant** – nominal 20MW, 340kg/h high purity green hydrogen from renewable energy and electrolysis
- **Utilities** – embedded renewable generation at the Port (wind, solar, wave)
- **Customers** – fuel cell electric vehicles, buses and refuse collection targeted
- **Impact** – decarbonize at least 300 buses, reduce emissions by 115 tCO_2/day
- **Benefits** – enabler for local authority decarbonisation plans, Brighton's city centre ultra-low emissions zone, significant contribution toward net zero

Key Dates

Planning Application Submission	Autumn 2021
Project Financial Close	Summer 2022
Commence Commercial Operation	Late 2024

shoreham port

H2e H2 evolution

Hydrogen SUSSEX

A leading global engineering and environmental consultancy establishing a H_2 Transport Centre of Excellence to accelerate H_2 technology development & deployment

HYDROGEN TRANSPORT CoE

H_2 TECHNOLOGY DEVELOPMENT

H_2 PEOPLE & SKILLS DEVELOPMENT

WORLD CLASS H_2 TEST FACILITIES

DIGITAL PROCESSES & TOOLS

Automotive | Commercial Vehicle | Off-Highway & Industrial | Personal Transport | Aerospace | Defence | Marine | Rail | Energy

HYDROGEN is central to achieving Ricardo's vision to CREATE A WORLD FIT FOR THE FUTURE

Fuel Cell Future Fleet – Phase One (Metrobus Crawley)

- 20 Fastway buses and (dependent on funding bids) 34 standard Metrobus buses - mixture of single & double decks
- If funding bids successful, ⅓ to ½ of Crawley based fleet converted to zero emission in one go – largest deployment in Europe

Fuel Cell Future Fleet – Phase Two (B&H Buses, Newhaven)

- Newhaven Town Deal Fund for hydrogen refuelling station and shared bodywork facility - linkage with hydrogen skills and job opportunities
- Seeking funding for 37 HFC buses
- Would result in air quality improvements across 3 air quality management areas
- Ground breaking collaboration: big group buying power and large regional fleet of buses, lowering the costs of entry for other heavy fleet (refuse collection vehicles, gritters and locally based logistics fleet)

HYDROGEN SUSSEX – An Eco-System for Green Growth

Academic partners:

University of Brighton

University of Sussex

SMEs

Technology Development

Hydrogen Transport CoE

Academia & Future Skills

Vehicle Conversions

UK Supply Base

Pilot Fleets

Hydrogen Sussex

Green H_2 Production

Renewable Electricity Supply

H_2 Supply Infrastructure

Zero Emissions Buses, Refuse Vehicles..

CO_2 Reduction

Air Quality

shoreham port

H2 evolution

Brighton City Airport

Brighton&Hove

essential travel for our city

Greater Brighton

Adur & Worthing Councils

Brighton & Hove City Council

RICARDO

Hydrogen Sussex

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