Marubeni Europower

Hydrogen as a road fuel

challenges and opportunities from a fuel-providers' perspective

Dr Joe Paton

Company Profile

Marubeni was founded in May 1858 as a textile company and expanded to other consumer goods in the 1920s. In 1949, it was incorporated and started to diversify into machinery, metals and chemicals, followed by energy and power infrastructure.

In 1991, **Marubeni Europower Ltd**. was founded in the UK to develop renewable energy projects in Europe.

The decision to switch to renewables supported massive business growth, and Marubeni now has a net profit of approx. £2.4 billion (JPY 471 billion), 130 branches and offices globally, 50,200 employees as Marubeni Group, and collaborates with 490 companies.

Established	**May 1858**
Net profit	**Circa £2.4 billion (JPY 471 billion)**
Number of employees	**4,337 (Number of employees of the Group 50,200)**
Number of Branches and Offices (*)	**130 (Including Tokyo Head Office)**
Number of Consolidated Companies	**490**

As of 31st March 2024 (exchange rate : 200JPY/GBP)

Power Business & Infrastructure Group – UK

Marubeni Europower

1. Ossian @Firth of Forth

Development of up to 3.6GW floating offshore wind power with SSE and CIP.
Will provide power equivalent to 6mil households and offset around 7.5 million tonnes of harmful carbon emissions.

2. HyClyde - Glasgow Green Hydrogen @Glasgow

Hydrogen project to contribute to decarbonisation of Glasgow, the host city of COP26.

3. HyBont - Bridgend Green Hydrogen @Bridgend

Development of AEMS (Area Energy Management System) utilising hydrogen including green hydrogen production

4. Upper Ogmore Wind Farm @Bridgend

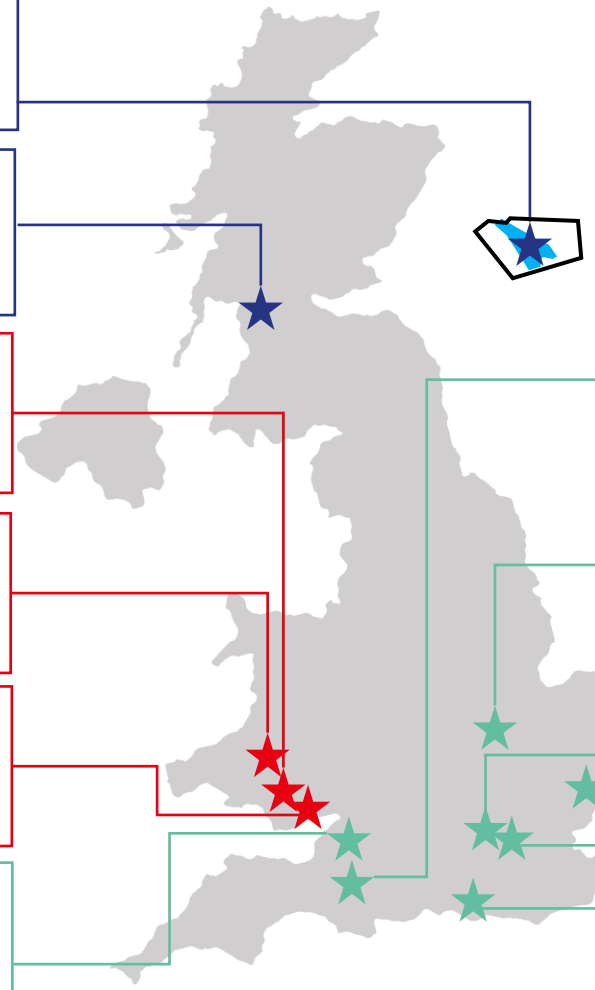
Development of 25.7MW onshore wind farm, expected to generate c.70GWh per annum from around 2028

5. HyHAUL – Green Hydrogen Infrastructure @M4

A demonstration project consists of 30+ hydrogen fuel cell heavy goods vehicles and multiple hydrogen refuelling stations along the M4, starting around 2026

6. Vertical Aerospace (*) Aerospace Group

Business partnership with Vertical Aerospace Group Ltd. placed at Bristol, a pioneer in the development of electric Vertical Take-Off and Landing, to carry out market research for the purpose of commercialization of the air mobility



Marubeni Signs MoU for Cooperation in Clean Energy Projects with the UK Government in Oct 2023

The MoU affirms the partnership between the UK government and Marubeni, indicating the UK Government's commitment to supporting Marubeni's plan, with its partners, to invest approx. £10billion in clean energy projects over the next 10 years

10. Biomethane project @Somerset

Biomethane production using Anaerobic Digestion (AD) technology in UK Agricultural wastes as feedstock

9. ZeMpower @Letchworth

Onsite decarbonisation solution platform (management of the green power utilizing Solar PV, Bi-directional EV charger and EV)

8. Carbon Clean @London

Design and development of CO2 capture system at low cost. Development of CCUS projects worldwide, including Carbon Capture as a Service (CaaS)

smartestenergy

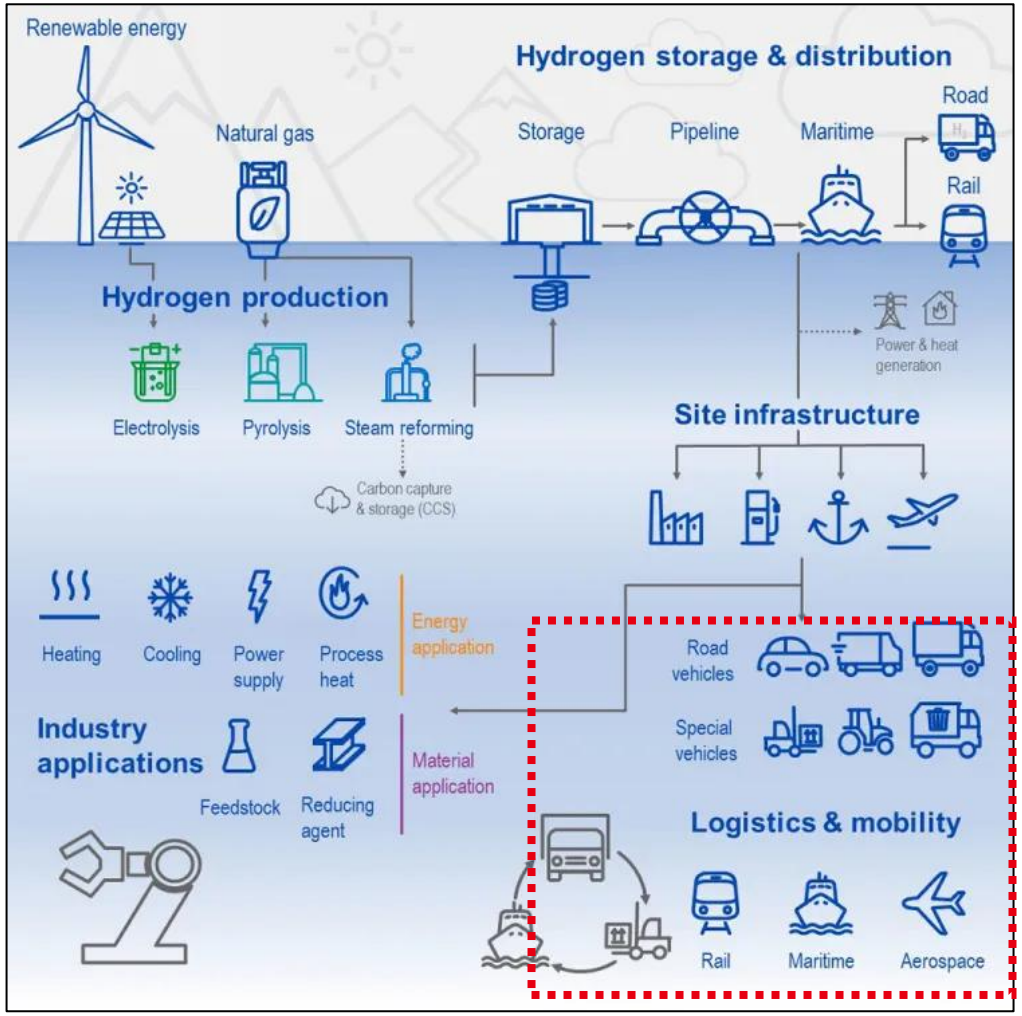
7. SmartestEnergy @London/Ipswich/Worthing

No.6 supply volume for retail power sale (Renewable Aggregation, Trading & Retail sale of green power)
Number of employees of the UK group: 400 +

Legend ★ **Scotland** ★ **England** ★ **Wales**

What is the hydrogen value chain for use as a road fuel?

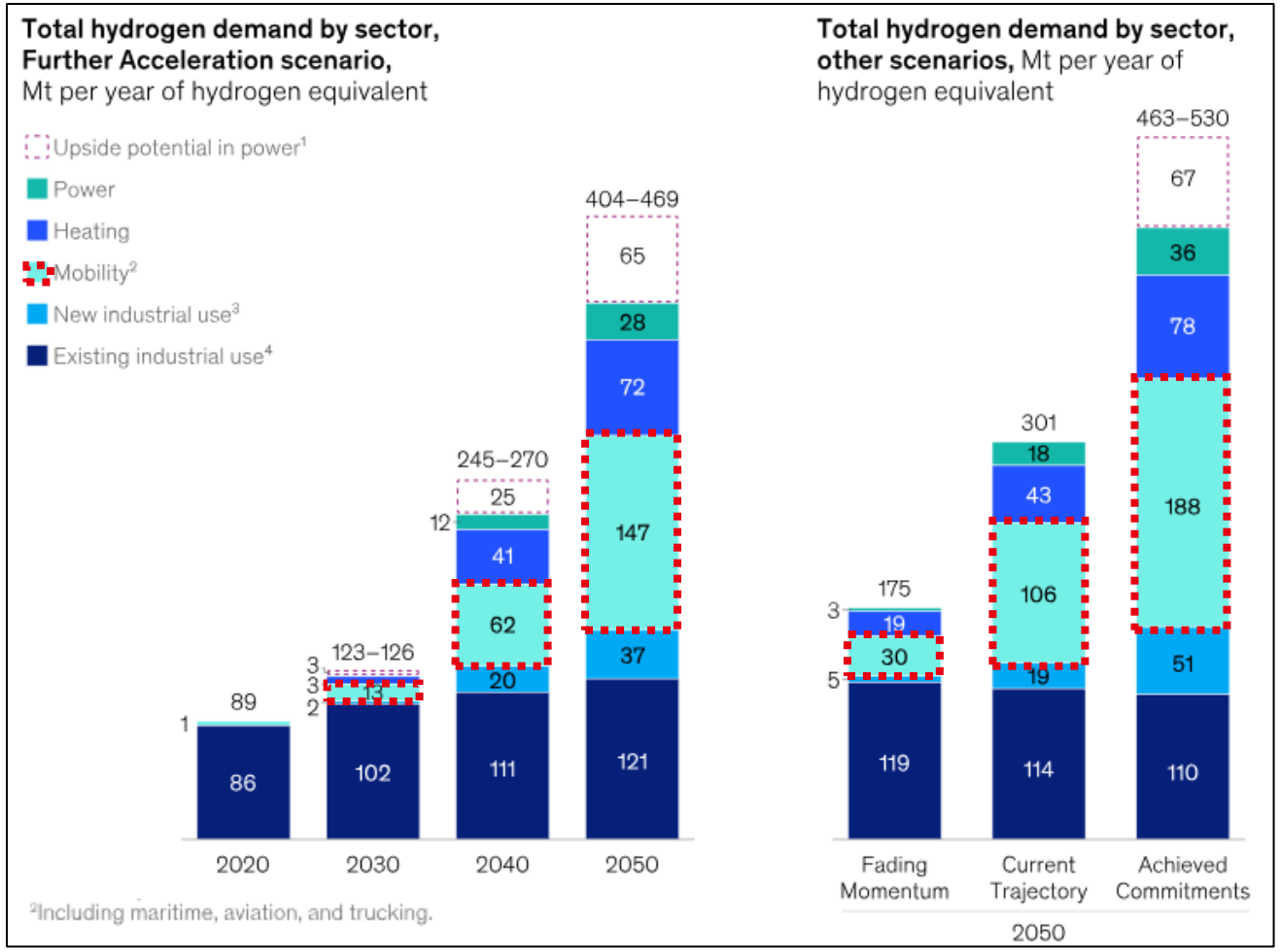
- Hydrogen has been used as a road-fuel for decades
- In the customer's eyes, the value chain of hydrogen as a road fuel represents a close approximation of the diesel value chain
- Hydrogen offers long-distances without refuelling, fast refuelling times and high payload
- Current policy broadly encourages:
  - Hydrogen production via the electrolytic ('green') pathway
  - Dispensing and usage in fuel cell vehicles
- Areas for further development:
  - Hydrogen ICE (reducing capital cost of vehicles, supporting current supply chains)
  - Enhancing demand-side support and/or mandates



Hydrogen Value Chain Services UK - For A Carbon-Free Future | TÜV SÜD

Hydrogen as a road fuel: the opportunity…

- In any scenario, mobility is a large opportunity for hydrogen demand
- Trucking is the near-term opportunity, aviation and maritime will follow
- Most major commercial vehicle OEMs have announced plans or ambitions for hydrogen Heavy Goods Vehicle (HGV) production
- Direct electrification is always the most efficient use of renewable power … but hydrogen is essential for journeys that cannot be economically completed with batteries
- For customers: hydrogen vehicles allow decarbonisation of their fleets without the need to completely change their operations



Global Energy Perspective 2023: Hydrogen outlook | McKinsey

Case study 1: UK Hydrogen Refuelling Production led model

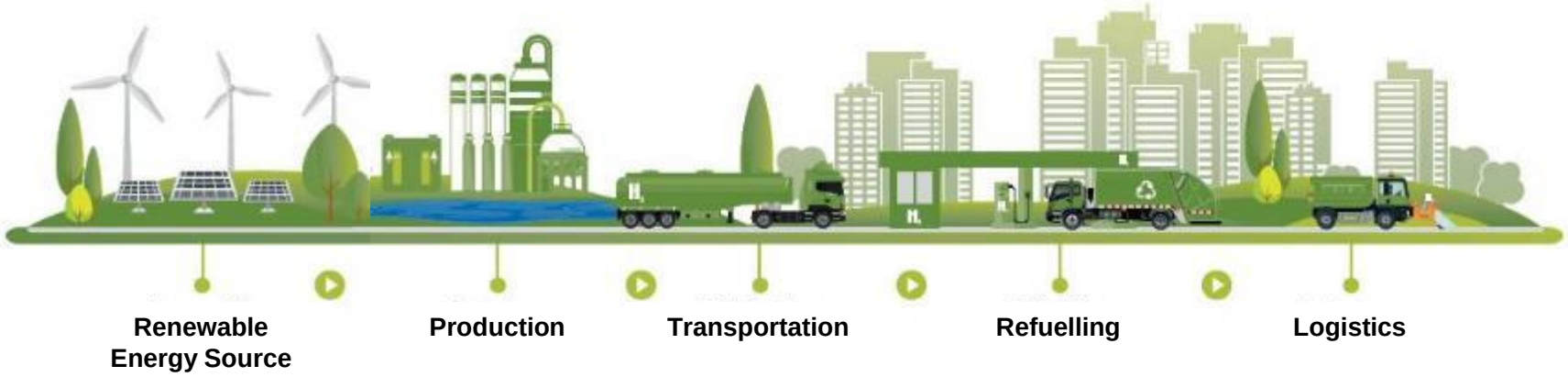
25.7MW onshore wind farm, expected to generate c.70GWh per annum from around 2027 at Bridgend

Subsidised production project in Bridgend (HyBont) funded by DESNZ under the Hydrogen Production Business Model

Participation in HyHAUL

- Developing infrastructure projects along M4 between Swindon and Swansea
- UK Grant on H2 infrastructure project
- Deploying hydrogen fuel cell heavy goods vehicles, and multiple hydrogen refuelling stations starting around 2026

Marubeni Hydrogen Value Chain @ Bridgend in Wales



Case study 2: Japan Hydrogen Refuelling: Truck OEM/consortium model

- The "Strategic Roadmap for Hydrogen and Fuel Cells“ of Japan has set a target of 1,000 hydrogen refuelling stations by 2030, in line with the spread of fuel cell vehicles

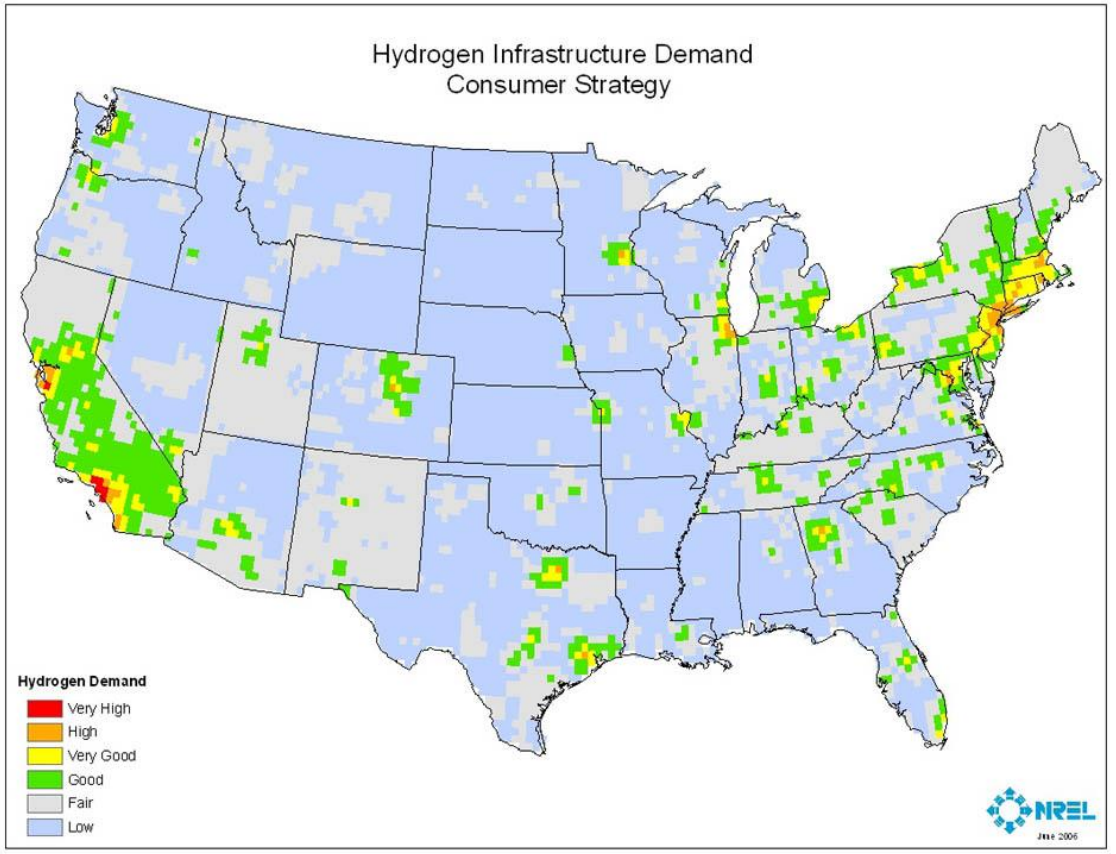
- Marubeni provides a variety of services including gasoline, diesel, kerosene and other fuel oils
  through approximately 650 service stations including affiliated dealers nationwide. Ambition to transition fuel forecourt to hydrogen, reducing the operation cost of HRS’

- Targeting partnerships with Japanese automakers to create a business model that packages hydrogen and FC trucks into a service offering

- A consortium-project “Commercial Japan Partnership Technologies” develops the vehicles in-partnership with the fuel provider network

Case study 3: USA Hydrogen Refuelling Demand led model

- Marubeni signed an MOU with a major U.S. truck station operator to collaborate on the establishment of a hydrogen ecosystem, including HRS', in the U.S.
- Focus on California; via the Advanced Clean Fleet Directive:
  - Mandates to force transition of 'drayage trucks' to ZEV between 2024 and 2035
  - Hydrogen networks already exist
  - Customers appear willing to transition in small numbers
- Mobile refuelling (depot-based) creates further opportunity
- Production-side carbon intensity not considered
- Aggregation of end-users can allow the development of public refuelling



Geospatial Data Science | NREL

A comparison of three case studies that aim to incentivise the roll-out of hydrogen vehicles

	Risk sharing	Investibility	Scalability	Speed of execution	Incentive or mandate-driven?
1  production led	Difference between the lifecycle of a vehicle and Government CfDs	HAR projects well developed and deliverable but FIDs to be confirmed	Pricing certainty for large volumes can allow scale-up	Requires careful line-up of the value chain to realise speed	Incentive
2  truck OEM led	All value chain moves together with known risk & business model	Business models still in development;	Demonstration projects only; up to hundreds of vehicles in the first-instance	Bureaucracy can hamper speed	Mixture
3  demand led	Mandates forces the end-user to transition; independent of existence of the rest of the value chain	Combined with IRA and local-subsidies, business models could work	Forced-adoption of ZEV encourages scale-up	Will force behaviours to change	Mandate

Current status for zero emission HGVs

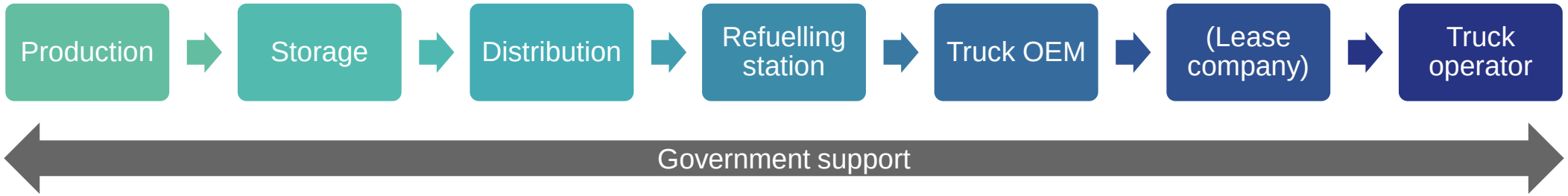
- Battery electric is seen as limiting, difficult to scale and expensive for many use cases
- Hydrogen fuel cell is seen as expensive and technologically immature

We will need a combination of both technologies to get to net zero; neither is developed enough to be commercially viable

- Vehicle availability and capital cost remains an issue; demonstration and then scale-up is key
- Cross-functional collaboration is a key to success: industry, Government and academia

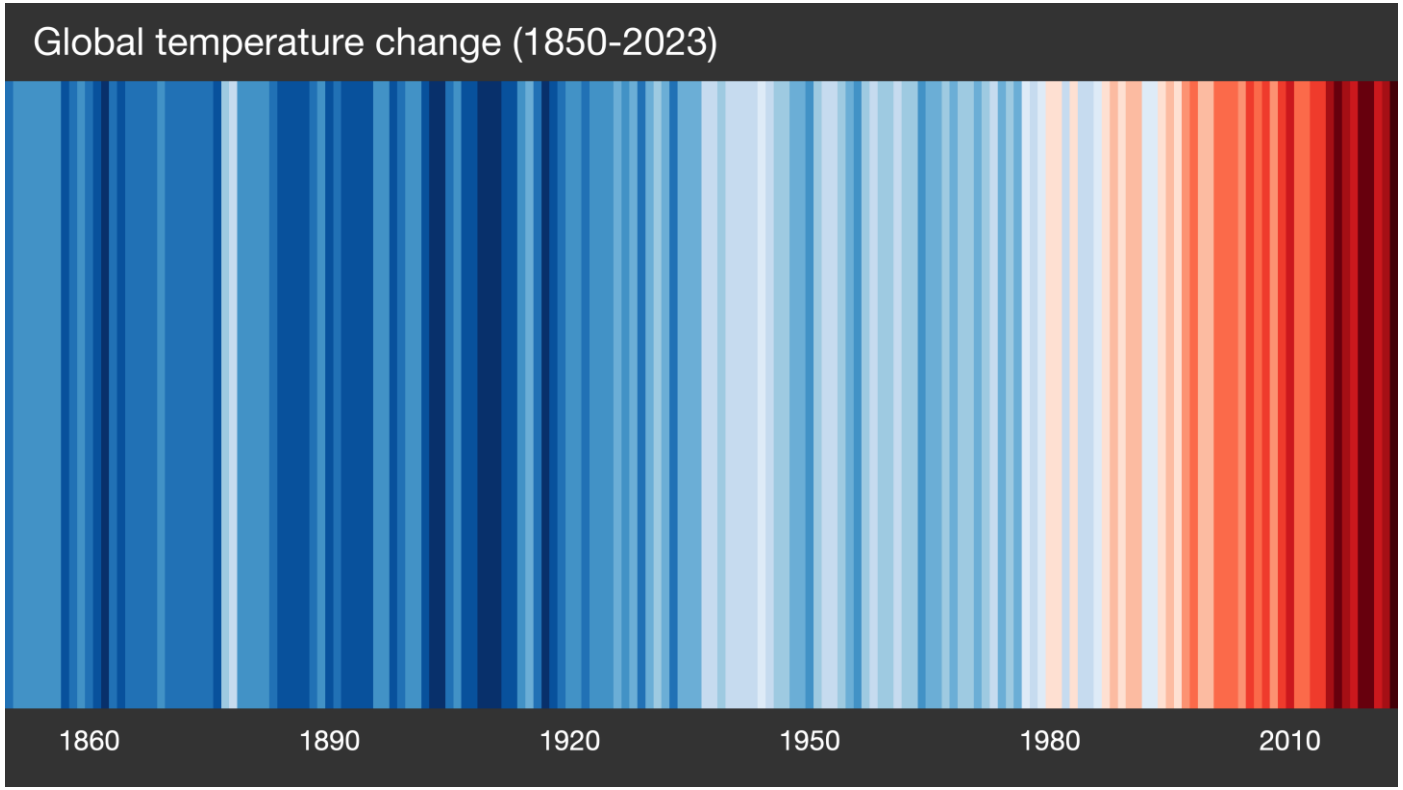
Summary

- The size and complexity of the challenge is significant; we are displacing a very convenient fuel
- The key to get projects to work is having the entire value chain lined-up; underpinned by Government support



- Commercialisation will happen when the economy of scale for vehicle production exists
- The comparator fuel for Total Cost of Ownership (TCO) will evolve from diesel to battery electric

Thank you



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