Fuelling Movement: current and future options for transport fuel decarbonisation

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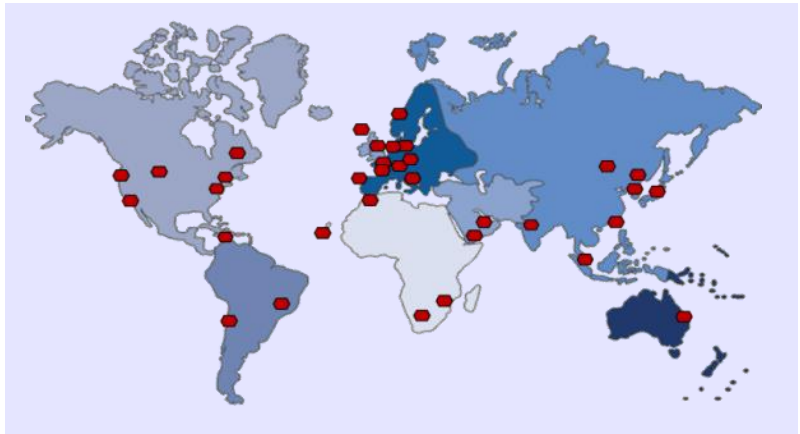
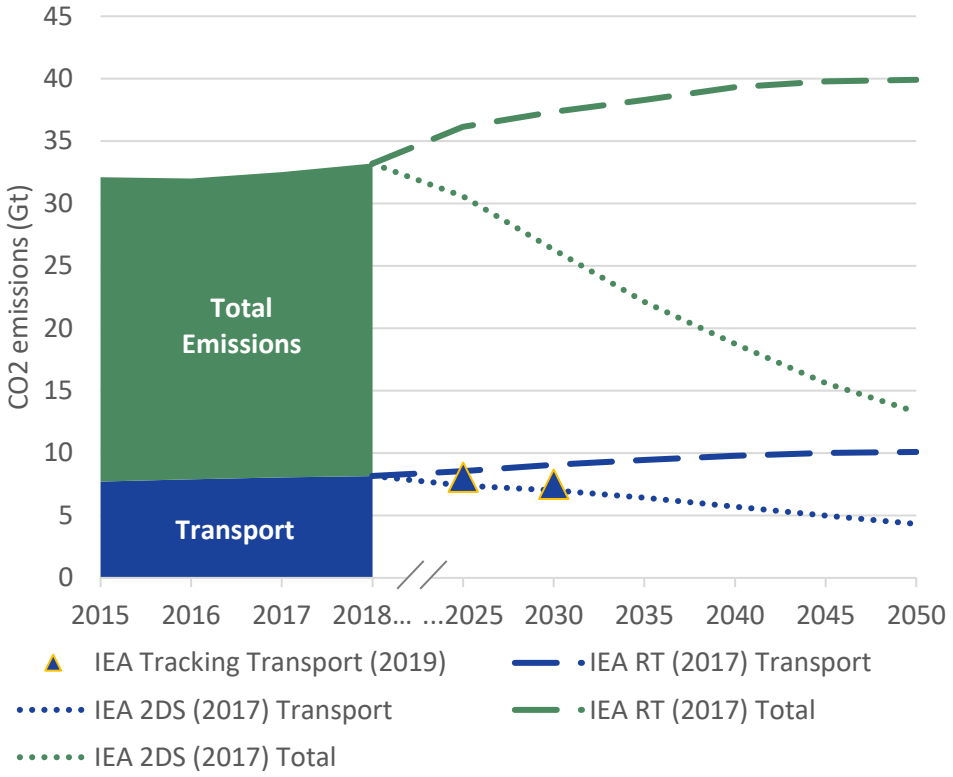
E4tech's perspective: strategy, energy and sustainability

- International consulting firm, offices in UK and Switzerland
- Focus on sustainable energy
- Established 1997, always independent
- Deep expertise in technology, business and strategy, market assessment, techno-economic modelling, policy support
- Spectrum of clients from start-ups to global corporations



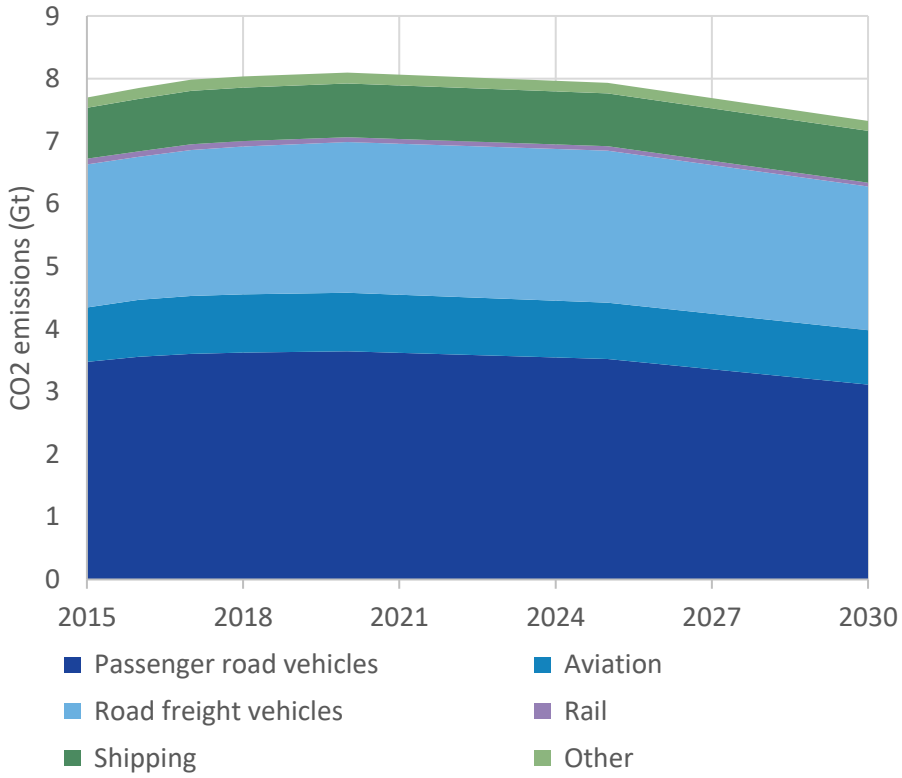
Transport contributes 25% of global emissions today. Transport's emissions need to reduce by more than half by 2050 in the IEA's 2°C scenario

Current and projected share of transport CO_2 emissions



IEA RT = ETP Reference Technology Scenario
IEA 2DS = ETP 2 Degrees Scenario

Projected emissions by transport mode 2015-2030



IEA Sustainable Development Scenario

In the UK pathways to net zero show the need for much greater reductions, with a fast decline in emissions from today

Figure 18: DfT's latest domestic GHG emissions projections based on current policies, compared to Clean Growth Strategy (CGS) targets and CCC Net Zero 'Further Ambition' and 'Speculative' scenarios[77]

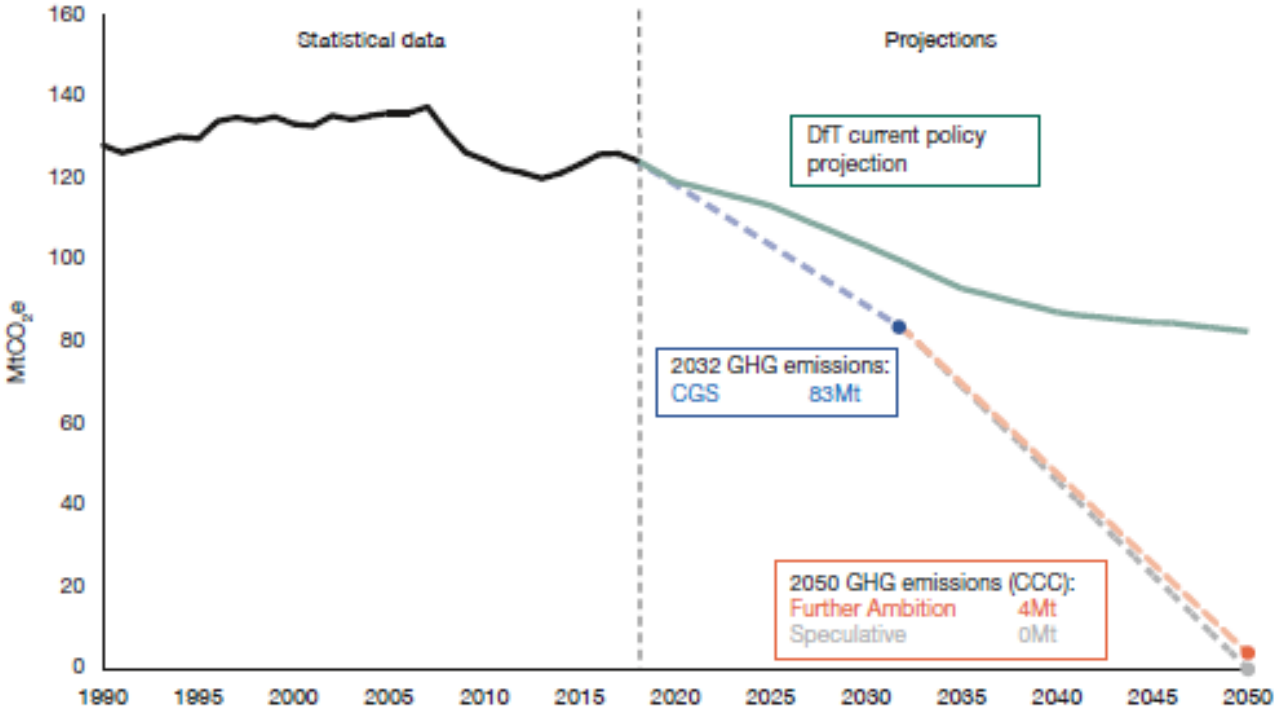
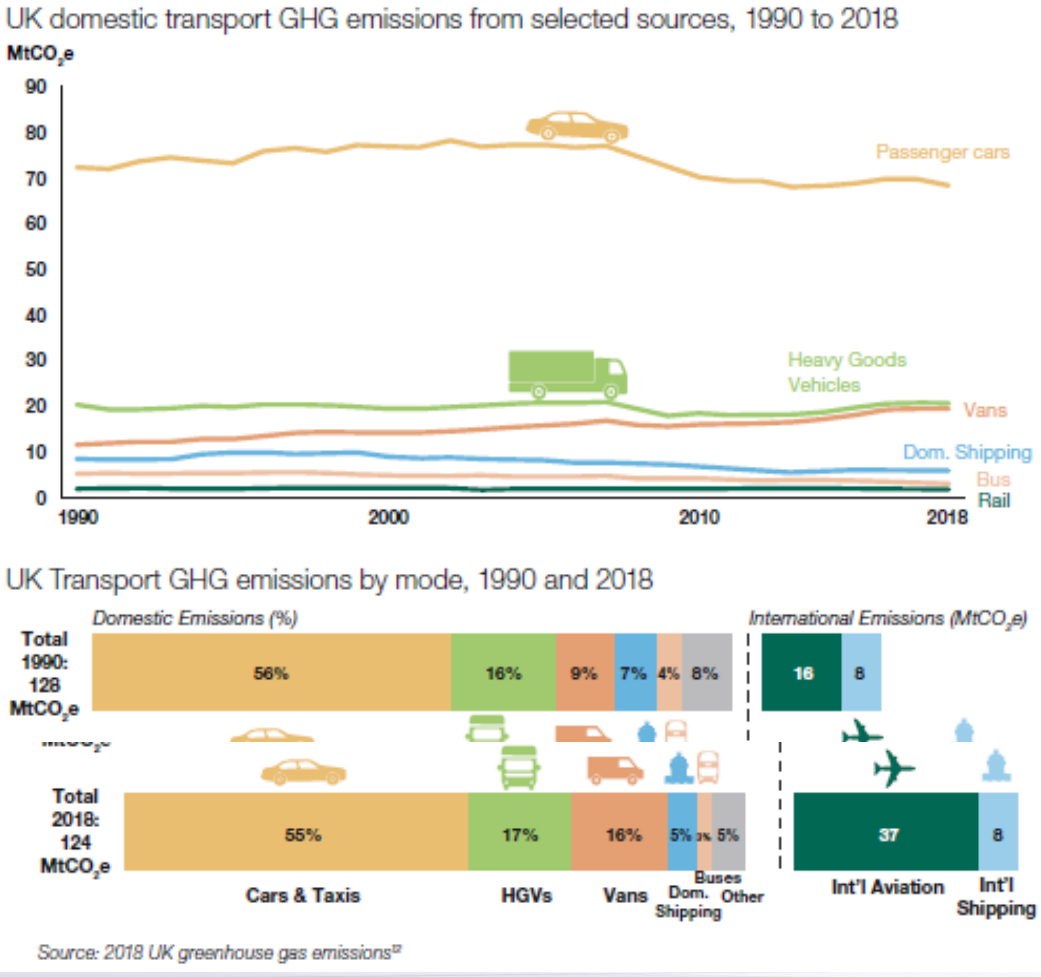


Figure 3: UK domestic and international GHG emissions, 2018



Source: 2018 UK greenhouse gas emissions[12]

Options for decarbonizing transport involve changes to fuels, vehicles, infrastructure and usage patterns

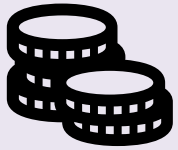
Reduce demand for travel	Reduce demand for energy	Reduce emissions from energy used

• Urban planning
• Video conferencing
• Pricing
	• Modal shift (walking, cycling, public transport)
	• Vehicle efficiency (electrification, fuel cells, lightweighting)
	• Routing
	• Ride sharing
		• Lower carbon fuels
		  • electricity
		  • hydrogen
		  • ammonia
		  • biofuels
		  • low carbon fuels
		  • e-fuels

- Policy is in place to promote all of these options, though with varying degrees of ambition and enforcement
- Low carbon fuels can make an important contribution in the near term, especially if they can be used in today's vehicles and infrastructure

Making policy to support low carbon fuels is difficult, as they have very different characteristics

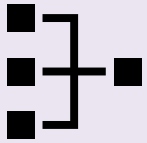
Cost



Sustainability

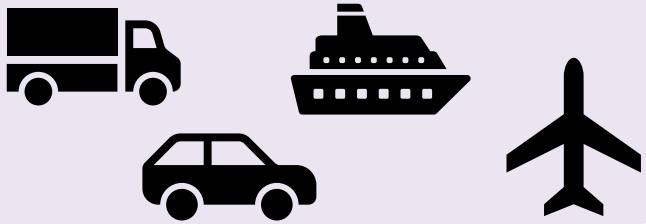
Stage of commercialisation

Supply chain



Resource potential

End uses

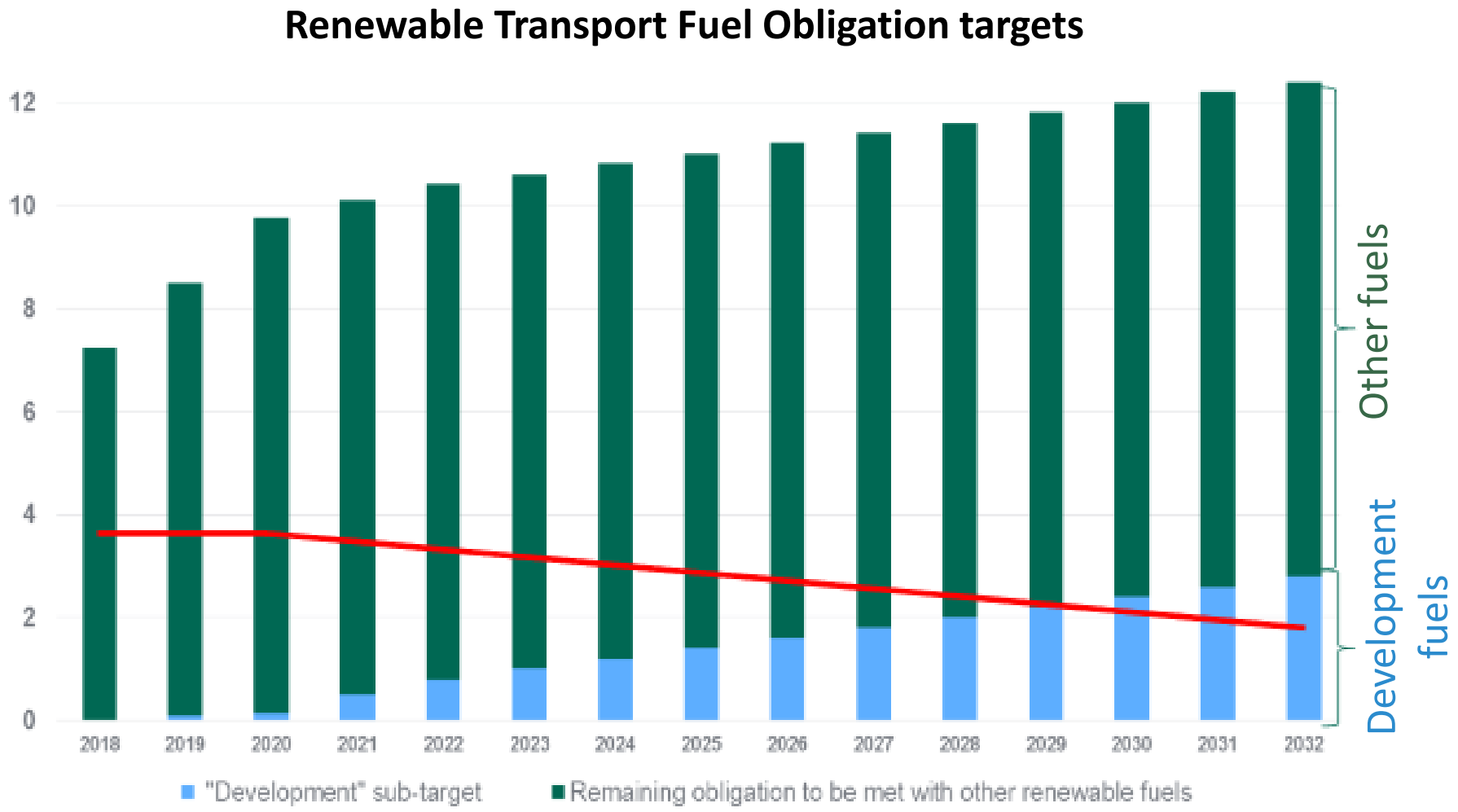


Different options for fuel decarbonisation have different challenges across different modes of transport today

Legend: Low challenges | Medium challenges | High challenges

	Electricity	Hydrogen	Gaseous fossil fuels (CNG, LNG, LPG)	Biofuels	E-fuels	Ammonia
Car	Global stock of electric vehicles passed 5 million in 2018	FCV use is expected to grow significantly. Short refuelling times and long range makes H_2 a key option for heavy-duty vehicles	Limited environmental benefits compared to other routes, with greater infrastructure modifications required	Biofuel blending is already common in many regions	Blending or drop-in replacement possible, very high costs today	Although feasible, little research has been conducted in this area
Heavy duty	Some electric options exist, but range is limited					
Rail	Electric trains account for 74% of passenger kilometers globally	H_2 trains demonstrated, and expected to be competitive with battery-electric for some routes	Possible, but current use is limited. Modest GHG benefit	Diesel accounts for 53% of energy demand in rail, and biofuel blending/ drop-in possible	Blending or drop-in replacement possible, very high costs today	Ammonia could be used for rail applications, but this is less mature than hydrogen in rail
Coastal & international shipping	Electric boats are in use, but ranges are limited	Possible, although less cost-competitive than ammonia due to high storage costs	LNG is used in shipping, although leakage can be an issue	Drop-in biofuels can be used in current ships, also interest in bio-methanol, but limited policy support	Blending or drop-in replacement possible, but limited policy support	Better energy density than H2 or methanol, potentially lower cost but tricky to store and handle
Medium+ long haul aviation	Battery electric aircraft severely limited in both size and range	Would require significant storage volumes and redesign. Longer term perhaps	Low GHG benefit does not justify necessary changes to aircraft	9 production pathways are approved for blending, but limited policy support	One route is certified for blending, but limited policy support	Modest energy density means that range would be limited

In the UK, the Renewable Transport Fuels Obligation is the main form of policy support for renewable fuels



- Rises to 12.4% vol for 2032, including double counting
- Crop cap reducing to 2.33% by 2030.
- Double counting for fuels from certain wastes and residues, dedicated energy crops and renewable fuels of non-biological origin (RFNBOs)
- Sub target for 'development fuels' of 3.2% in 2032: waste or renewable electricity-derived
  - Hydrogen
  - Aviation fuel
  - BioSNG or
  - Fuels that can be blended at above 25% renewable content in petrol or diesel

There is growing international discussion on how to incentivise decarbonisation of aviation and marine fuels

Aviation

- Growing activity: 9 accredited fuel pathways, numerous commercial flights and tests
- International policy: Carbon Offsetting and Reduction Scheme (CORSIA) from ICAO
  - Voluntary from 2020, mandatory from 2027.
  - Airlines can reduce CO_2 emissions by using alternative fuel, or buy carbon offsets
- Countries starting to introduce sustainable aviation fuel mandates or opt-ins

Shipping

- IMO 'Initial Plan' for GHG reduction by 2050 announced in 2018, but little policy as yet.
- Interaction with air quality and domestic carbon budgets
- Consultation due on whether and how the UK Renewable Transport Fuel Obligation could be used to encourage the uptake of low carbon fuels in maritime

- International sectors, with high expected growth
- Strong drivers: Few alternative options to liquid fuels
- Barriers to adoption: high cost of alternative fuels vs fossil fuels, availability and certification

Overcoming challenges to low carbon fuels deployment in the UK

Policy clarity

- Long term vision from government on how to decarbonise transport – the path to net zero
- Near term clarification of potential changes to the RTFO

Proof of commercial viability and sustainability for fuels that are not yet commercialised

- Further demonstration of technologies and related supply chains
- Evidence of biomass availability and sustainability, and development of feedstock supply chains

Access to finance for fuels that are not yet commercialised

- More engagement on the part of strategic investors

For certain fuels

- Infrastructure development (e.g. gaseous fuels)
- Standards and certification (e.g. higher ethanol blend standards, aviation and marine biofuels)

E4tech – Strategic thinking in sustainable energy

- For more information please visit our website:

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