Fuelling the Future: motive power and connectivity

Response to the Transport Select Committee

January 2022

Summary - electrify everything you can!

Decarbonising transport can only be achieved through an end to the use of all fossil fuels which must be completed by 2050 if climate goals are to be met. The availability of land, and supply of waste, to produce biofuels are limited and in huge global demand and can therefore only make a limited contribution. Accordingly, renewable electricity will do the heavy lifting to decarbonise transport.

If the UK selects the most efficient options for using renewable energy in transport (including batteries for all road vehicles), this will require 369 TWh of renewable energy by 2050 - slightly more than the total amount of UK electricity supplied today. Generating this power requires 92 GW of offshore wind capacity: equivalent to over 13,000 offshore turbines. Choosing less efficient pathways, including unnecessary use of hydrogen and synthetic fuels in vehicles, could result in over 50% higher renewable electricity demand. Transport cannot therefore be decarbonised one mode at a time, but instead requires a holistic approach that prioritises the most efficient pathways for energy use that are also the cheapest in the long-term.

Vehicles will be overwhelmingly electrified with batteries - and for cars this is advancing well. Early market purchase grants can now be replaced with attractive (but not zero) tax rates along with regulations (the Zero Emissions Vehicles Mandate) to guarantee supply. A systematic approach to charging can address the current postcode lottery including requiring and resourcing local authorities to develop and implement local charging plans alongside charge point operators. Regulations should require an increasing share of car parking places to install chargers.

The market for vans and trucks are much less developed and purchase grants and other forms of early market support remain necessary until regulations are in place and the market is more mature.

Successful electric car policies have been framed around initial support followed by regulations to deliver a phase out of conventional vehicles. The same approach can be adopted in the aviation and maritime sectors. Setting a 2040 end date for the use of liquid fuels in domestic aviation, with intermediate targets for an increasing share of zero-emission miles flown on UK routes, will stimulate the market for zero emission aircraft using both batteries and hydrogen. This can enable the UK to develop world leading capabilities in these important emerging technologies. A similar 2040 end date for use of fossil fuels in domestic shipping should also be implemented.

For long haul aviation, and intercontinental shipping, e-kerosene and ammonia respectively (made from green hydrogen and CO2 or nitrogen captured from the air) will compete with advanced biofuels to produce sustainable aviation and shipping fuels. To drive the market there should be a commitment to end the use of fossil kerosene and heavy fuel oil in the UK by 2050 and a mandate on the supply of these fuels to progressively grow the supply to reach 100% by 2050. Support for new production can be delivered through a contract for difference approach, guaranteeing a growing market share of e-kerosene, advanced biofuels and ammonia.

The pathways to decarbonise transport through use of renewable fuels are now clear, what is now needed is a comprehensive suite of policies to make this happen.

1. This submission

This submission summarises Transport and Environment (T&E's) views of the questions posed in the call for evidence of the Transport Select Committee: Fuelling the Future: motive power and connectivity. T&E is Europe's foremost sustainable transport think tank and environmental group. It is a federation of almost 60 national organisations across the UK and Europe campaigning for greener transport. Our work has informed and influenced key European Union and national policies and we regularly brief UK Government Ministers, officials and other key stakeholders on the steps needed to decarbonise transport.

2. The effect of Government fuel policy on future road, rail, air and maritime connectivity

Transport is both the biggest source of CO2 emissions and the dominant cause of air pollution hotspots throughout the UK. The primary purpose of transport fuel policies should therefore be to reduce the environmental impact of transport - whilst maintaining mobility and ideally improving energy security. The consensus view is that transport decarbonisation will be overwhelmingly achieved through electrification using renewable electricity.

Batteries will be used for almost all vehicles

Battery storage of renewable electricity will be the cheapest and most efficient solution to decarbonise cars, vans, powered-two-wheelers, urban and regional delivery trucks and probably long haul trucks. It is

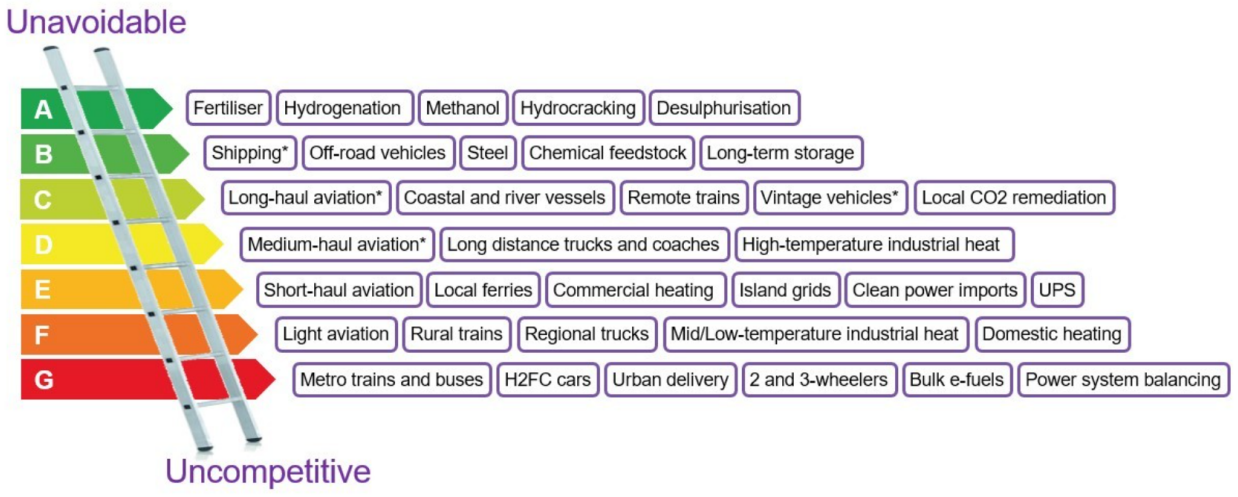
highly likely within a decade batteries will also power light aircraft flying short distances (less than 750 miles) and are already used on short shipping routes (such as in Oslo).

Battery prices have fallen by 89% in the last decade and energy storage densities have improved. A study by Bloomberg New Energy Finance for T&E shows that battery electric cars and vans should reach purchase price parity with petrol cars in all market segments by 2027. They are already substantially cheaper to run.

Battery electric long-haul articulated trucks and coaches are also expected to dominate new vehicle sales within 10-15 years and largely replace diesel trucks by 2050. T&E analysis shows they are cheaper than other options and can be charged from gigachargers or catenary systems (overhead wires). However, there may also be a niche role for hydrogen and biomethane.

Hydrogen: a key feedstock for aviation and shipping fuels

The role for hydrogen in road vehicles is likely to be niche. By 2030 just 0.28% of cars produced in the EU are forecast to have hydrogen fuel cells compared to 50% battery electric models. The production of green hydrogen is also three-times less efficient than using electricity directly, increasing operating costs. Only green hydrogen, produced by electrolysis using renewable electricity, should be used in transport. Blue-hydrogen, made by steam reforming of natural gas with carbon capture, does not capture all fugitive emissions and will not achieve the zero emission objective for transport. The hydrogen ladder effectively illustrates the key uses of hydrogen in transport and where it is not needed.



The Clean Hydrogen Ladder, Version 4.0 Source: Liebreich Associates (concept credit: Adrien Hiel/Energy Cities)

The recent Hydrogen Strategy states: *"By 2030, we envisage hydrogen to be in use across a range of transport modes, including HGVs, buses and rail, along with early stage uses in commercial shipping*

and aviation." The hydrogen ladder - that T&E broadly supports - illustrates that it makes far more sense for most HGVs and buses to use batteries.

Transitional fuels including fossil gas: the time is past for partial fixes

There should be no role for so-called "transitional fuels" in transport including using natural gas in trucks and shipping. Gas trucks have no climate or air pollution benefits and are not part of the climate solution. LNG shipping runs the risk of locking out superior zero emission technologies like ammonia. LNG shipping in ports reduces the space and capital available for investments in ammonia that can deliver zero emission shipping and not an incremental reduction in emissions. With so little time to complete the switch to zero-emission technologies, the focus of policy and investment should now be on developing the solutions that will deliver zero emission transport.

Synthetic fuels: the only solution for long haul aviation and international shipping

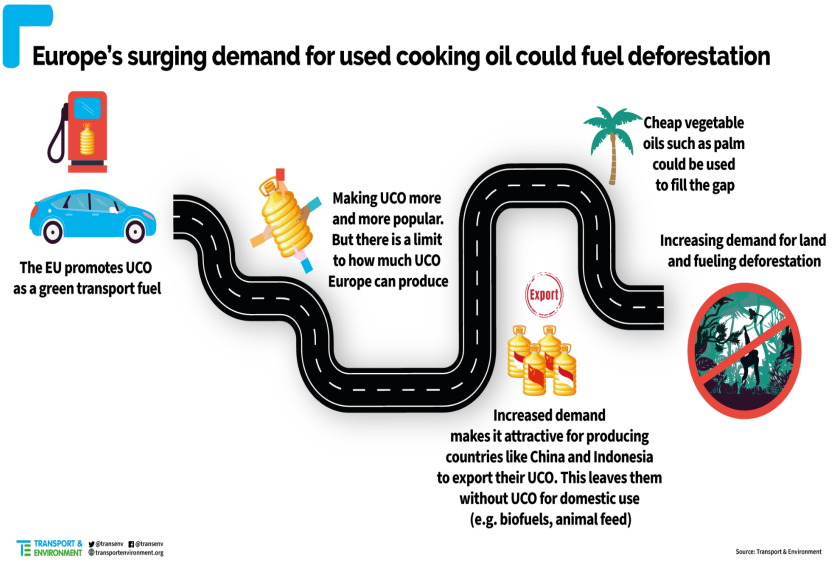
Except for the shortest commercial flights, carrying a small number of passengers, batteries will not have the required energy density for use in aircraft. On longer regional flights (one industry survey estimated flights up to 1000km by 2030) green hydrogen could be used with a fuel cell or burned in the engine. For long haul flights, and intercontinental shipping, green hydrogen will be used to make synthetic kerosene (e-kerosene) for aircraft and ammonia for ships by combining it with a carbon or nitrogen source (ideally captured from the air) to produce a near zero emission liquid fuel.

Production of hydrogen, ammonia and e-kerosene from renewable electricity is three to four times less efficient than storing and using the electricity directly, but a liquid fuel is necessary to achieve the required energy density. However, to avoid creating unsustainable demand for renewable electricity it is necessary to limit the use of synthetic fuels and hydrogen only to transport modes in which there is no alternative.

Biofuels: limited land availability means they can only provide a niche role in long haul aviation

Competing demands on land and for wastes are likely to severely limit the contribution of biofuels in transport. First generation biofuels made from crops are a highly inefficient use of land and both directly and indirectly drive deforestation. They should therefore be phased out as the share of conventional cars declines, with the land made available converted to rewilding and carbon capture uses. The Government has committed to planting 30,000 hectares of woodland per year by the end of this parliament and land used inefficiently for biofuels could be released for this purpose. Current biofuels policy, inherited from the EU, is continuing to drive deforestation and is entirely counterproductive.

The use of used cooking oil (UCO) should be limited to collections made in the UK and Europe to avoid indirect land use change arising from its import. 85% of UCO used in the UK is imported: much from China and south-east Asia, similar proportions of biomethane are also imported. In the medium term, the global need to decarbonise will make it untenable for the UK to disproportionately import valuable and scarce biofuel feedstocks from countries that also need to decarbonise.



Waste-based fuels should eventually only be used in aviation, however there are limitations on the amount of waste available. The DEFRA Waste Management Plan for England shows clearly the intention to apply the waste hierarchy so that incineration and production of fuels from waste will be deprioritised compared to prevention, reuse and recycling which will restrict waste supplies. T&E analysis for European jet fuel demand concluded that waste-based SAF would only account for 11.4% of total demand in 2050 - meaning that to fully decarbonise aviation fuels, large amounts of synthetic fuels will be required. The UK needs to focus on solutions to decarbonising transport that it can realistically scale. Battery electric vehicles, and hydrogen and synthetic fuels for aviation and shipping provide scalable solutions. All others do not.

The right policy suite

The creation of markets for renewable fuels in transport take many years to scale up. Policy is essential as until the technology achieves a significant scale it will struggle to compete on a cost basis and will often lack the required delivery infrastructure. There are three key stages of a transition to renewable fuels in transport:

1. Support - government incentives for technology developers are needed in the form of research, development, demonstration and early adoption funding (for example research support or contracts for difference, or electric vehicle grants)
2. Regulate to phase out - stipulating an increasing share of the renewable fuel or technology must be supplied - such as the proposed zero emission vehicle mandate or sustainable aviation fuels mandate
3. Ban (End) date - a stated year after which conventional technology cannot be sold (like 2030 for cars), or used (usually 2050)

This approach is outlined in detail in a recent T&E aviation policy paper. as *Support, Regulate, Ban* and is being successfully applied to shift to electric cars and vans and is proposed for trucks. It has, to date, only been partially adopted in aviation and shipping.

Ultimately shifting to renewable fuels in transport should reduce costs and therefore aid connectivity. A policy that shifts all flights and ferries between the Scottish Islands, Northern Ireland and mainland UK to zero emission by 2050, should result in lower operating costs - and therefore lower ticket prices. LoganAir analysis suggests that using a hydrogen fuel cell plane for its longest domestic route (Glasgow - Barra) would result in a 16% reduction in cost-per-available-seat-kilometre. The electricity and hydrogen needed could be made locally, potentially resulting in more local employment and balance of payment benefits.

3. Whether and how the Government is 'technology neutral' in its regulation and assessment of alternative fuels, and policies on alternative fuels influence investment, research, development and production

Technology neutrality

Energy markets are highly regulated and policy has never been technology neutral. For example: the decisions to phase out coal in the 1980's; support for renewable technologies; or more recently new build nuclear plants have all been political decisions made for strategic reasons. Whilst governments may claim they do not "pick winners", all do with regard to energy policy - including in transport. Furthermore, intervention is essential as an entirely technology neutral policy will require investment by industry, and the public sector, in multiple powertrains and fuel distribution systems leading to an enormous waste of capital. Technology neutrality will also delay alternatives achieving the economies of scale needed to compete with petroleum, the incumbent solution, as market growth and investment will be reduced. For example, it makes no sense to invest equally in charging for battery electric cars and hydrogen powered cars when sales of the former are likely to be in the future fifty times higher.

Industries opposing the shift to electric cars often claim the focus on zero emission vehicles is also misguided, as additional emissions incurred in production of the electricity and vehicles will offset the lower emissions in use. These claims are frequently exaggerated and suggestions vehicle emissions regulations should be based upon well to wheel or lifecycle emissions rather than those from the vehicle tailpipe misguided. Electricity grids are decarbonising rapidly and embedded battery production emissions will also decline as more cells are made in the UK and Europe.

Renewable generation

The primary constraint on decarbonising transport is likely to be generating sufficient new renewable electricity to decarbonise electricity grids and produce the substantial amount of green hydrogen needed to produce sustainable aviation and maritime fuels (as well as the considerable non-transport applications). T&E estimates by 2050 even the most efficient transport fuel pathways will require 369TWh of generation for transport use alone, slightly more than the total amount of electricity currently being supplied. This would require 92 GW of offshore wind capacity to be deployed over the next 30 years: equivalent to over 13,000 offshore turbines.

Policy gaps

We recently commissioned Cerulogy to undertake research for T&E on the topic of building an effective UK alternative transport energy policy. This concluded that "*Over the last ten years, transport fuel policy in the UK, and in Europe more broadly, has had some successes but has also in some respects failed to deliver.*" Specifically we, and the report authors, are concerned that the RTFO has failed to create a basis for sustained investment in advanced biofuel or synthetic fuel production for use in aviation and shipping. To achieve this the report identifies two areas of policy opportunity:

1. Continuation of the development fuel obligation on fuel suppliers, and
2. Introduction of a system of 'contracts for difference' (CfDs) awarded to specific fuel producers developing advanced renewable fuels like e-kerosene and green ammonia.

Proposals for a SAF Mandate should only allow fuels that are judged to have a 70% lifecycle greenhouse gas saving. Furthermore, it should specifically include an e-kerosene mandate, meaning that fuel suppliers are obliged to supply minimum and increasing levels of e-kerosene. This should start from 2025. There are still no proposals for fossil fuels supplied for shipping to attract an obligation to supply renewable fuels as part of the RTFO; nor any proposed mandate for sustainable shipping fuels.

4. The infrastructure required to develop, produce, store and dispense alternative fuels

Charging for electric cars

T&E recently undertook a detailed examination with Cenex on the state of UK electric car charging. We have also developed tools to illustrate the adequacy of charging in every UK local authority. Our overall conclusion is that much of the criticism of the lack of public charging infrastructure in the UK is ill informed. There is one charge point for every 9 battery electric cars on the road today, sufficient for the number of chargeable cars on the road. Just 1% of EV drivers want to go back to a combustion engine car. Tackling the poor perception of the UK charging network requires: tackling the postcode lottery in the availability of charging; addressing the poor reliability of some networks; and making it

easier to access charging points. Steady growth in charging is needed up to 2025 with a rapid increase after this. It is therefore essential to create the conditions to ensure the network can grow with the number of expected BEVs on the road.

The postcode lottery in charging must be addressed by the new Local Electric Vehicle Charging Fund, which in particular must focus on supporting local authorities to appoint EV Charging Officers to develop local charging plans in partnership with charge point operators. T&E analysis shows that London already has the charge points it needs for 2025 (although these are disproportionately located in central London, whilst outlying suburbs have a considerable deficit). Northern Ireland only has 31% of the chargers it needs by 2025.

In our previous Transport Select Committee evidence we detailed how policy to support the shift to electric vehicles should evolve. More recently we have become particularly concerned that: the planned charging strategy is late; the government recently backtracked on plans to require charging to be rolled out in non-residential car parks; and that planned reforms to car and van taxes are also stalled. We are also disappointed at the continuing refusal of the Department for Transport to allow renewable electricity for charging to count towards targets in the Renewable Transport Fuels Obligation. Detailed proposals to achieve this are detailed in a report for T&E by Cerulogy.

Infrastructure for aviation fuels and zero emission aircraft

For aviation, SAF is a 'drop-in' fuel, meaning that the existing pipeline infrastructure can, and will, be used. Zero-emission planes will eventually require upgrades to electricity infrastructure at the airports from which they operate. These would either take the form of a hydrogen pipeline and onsite storage system, or an upgraded electricity distribution system, Initially it is feasible to tanker hydrogen to airports, and accommodate slower charging speeds for electric planes.

Some of the best initial locations for zero emission aircraft will be on routes between the Scottish Islands and mainland Scotland. These are relatively short routes (that currently already use small planes) that cross water. As the market scales and battery prices fall the high cost of the aircraft will fall. The operating costs of electric planes could be very low, with the electricity created onsite or near the airports using renewable wind with zero marginal cost. Lowering the operating costs of flights could therefore improve connectivity between these locations.

As mentioned in the previous section, a key gap in UK capabilities is that there are no commercial e-kerosene production facilities, despite the UK having extensive refining and chemicals plants. The Government has announced a target of having 5 GW of low carbon production capacity by 2030, and policies that require e-kerosene to be used in planes would provide a demand for the green hydrogen produced. The Government is currently considering a SAF mandate, and T&E has previously suggested that jet fuel suppliers should be specifically mandated to supply a minimum percentage of e-kerosene in its fuel mix. The Government has committed £180m towards developing and building UK SAF plants, and

at least some of this money should be reserved for e-kerosene plants, but it should also explore the potential for using a contracts for difference approach.

5. Steps that the Government could take to maximise the utility of the UK's existing transport stock, while meeting its climate change commitments

Vehicles

The aim of current policy should be to end the use of all fossil fuels and eliminating all direct emissions of CO2 in transport by 2050. Without achieving this goal it is unlikely that the UK's overall Net-Zero climate goal can be met. The shift to zero emission transport does not need to have significant implications for the utility of the UK's existing transport stock so long as there is an adequate lead time between the end date for sales of new fossil-fuelled vehicles and 2050. The lifetime of the average lifetime of a car and truck are 14 years and 11.4 years respectively. But the average masks some vehicles being used for considerably longer than the average.

To ensure only vehicles with zero emissions are used beyond 2050 the government should consider applying a limit on the Type Approval of new cars so these cannot be operated after 2050. This limitation will only affect a minority of vehicles and will help to ensure very low levels of sales of conventional vehicles in the years immediately preceding the phase out date, as it is likely to depress residual values. Heritage vehicles could continue to be driven using synthetic fuels.

Aviation

A similar approach should be adopted to end the sale of fossil kerosene in planes from 2040 for domestic flights and 2050 for all aircraft refuelling and taking off from the UK. Announcing phase out dates for fossil kerosene in advance gives the aviation industry policy certainty and would ensure the maximum utility of the UKs transport stock is retained.

The Government should also make use of tax to encourage sustainable fuels and tax polluting aviation emissions. Previous research from the Energy Systems Catapult showed that air transport pays the lowest effective carbon price of all the UK sectors. Applying a kerosene tax would provide an incentive for airlines and fuel producers to invest in SAF and zero-emission planes (jet fuel is currently untaxed in the UK). The UK ETS also fails to provide the disincentives it should: in 2021 the aviation industry received 4 million free allowances. This does not encourage airlines to investigate lower carbon alternatives. Announcements of future minimum tax levels on fuels would encourage a shift to zero emission alternatives.

6. The contribution that alternative fuels could make to sustainability, transport decarbonisation and connectivity

Decarbonising transport can only be achieved through an end to the use of all fossil fuels in the sector by 2050. Availability of land and supply of waste to produce biofuels or other synthetic fuels are limited, so renewable electricity will be at the core of the transition. If the UK selects the most efficient options for using renewable power in transport (including using batteries and electric road systems for all vehicles), by 2050 it will require 369 TWh - slightly more than the total amount of electricity currently being supplied. This would require 92 GW of offshore wind capacity to be deployed over the next 30 years: equivalent to over 13,000 offshore turbines.

The scale of transport electricity demand post 2030 means that renewable electricity will remain a 'scarce' commodity and must be used as efficiently as possible. Transport cannot therefore be decarbonised one mode at a time, but instead requires a holistic approach that prioritises efficient pathways which use renewable energy directly and via batteries. Accordingly, there is a clear hierarchy for the use of renewable electricity in transport: direct use & battery storage > hydrogen > synthetic fuels. This is also the ranking in terms of costs. So wherever possible in trains renewable electricity should be used directly; vehicles should use batteries, as should light aircraft on short trips and short shipping routes. Less efficient energy pathways, and the limited supply of biofuels, necessitate that these should be directed to the hardest to decarbonise sector - long haul aviation and intercontinental shipping.

The electrification of cars is proceeding well and the early market support can now be replaced with regulations, like the ZEV Mandate, with attractive tax rates instead of purchase grants and a systematic approach to charging to address the current postcode lottery. Specifically a comprehensive charging network requires local authorities to develop and implement local charging plans alongside charge point operators. Regulations should be used to require an increasing share of car parking places to also install charges. The market for vans and trucks are much less developed and purchase grants remain necessary until regulations are in place.

The lessons learned from the success of vehicle policies should now also be applied to decarbonise the aviation and shipping sectors. Setting a 2040 end date for the use of liquid fuels in domestic aviation and intermediate targets, beginning in 2028, for an increasing share of zero-emission miles flown on domestic routes will stimulate the market for zero emission aircraft. This would enable the UK to develop world leading capabilities in this critical future industry. Similarly, a commitment to end the use of fossil kerosene by 2050 and a mandate on the supply of sustainable aviation and maritime fuels that steadily increases to reach 100% of supplied fuels will progressively grow the market. Support for new production can be provided through a contract for difference approach, guaranteeing a growing market share of e-kerosene, advanced biofuels and ammonia. The pathways to decarbonise transport through use of renewable fuels are now clear. What is still evolving is the comprehensive suite of policies to make this happen.

Further information

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