Response to Transport Select Committee Call for Evidence
"Fuelling the future: motive power and connectivity"

UKPIA represents the eight main oil refining and marketing companies operating in the UK. The UKPIA member companies – bp, Essar, Esso Petroleum, Petroineos, Phillips 66, Prax Refining, Shell, and Valero – are together responsible for the sourcing and supply of petroleum products meeting over 85% of UK inland demand, accounting for a third of total primary UK energy.

Thank you for the opportunity to respond to the Call for Evidence. We understand the committee are interested in evidence on the following topics:

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

A broad range of approaches will be required in order to meet future transport needs and connectivity while achieving the lowest possible Greenhouse Gas (GHG) emissions. A joined-up approach to Government fuel policy is therefore required to meet future transport requirements, taking account of the needs and technologies suitable for each transport mode.

In 2019, the UK's transport sector consumed 659 TWh of energy, of which 96% was provided by the downstream sector with the remainder electricity[1]. To date, prioritisation of movement at the lowest cost has led to the proliferation of transport powered by fossil-derived fuels, but this could change in the future to take account of other important factors such as the environment. The urgent priority to reduce net transport GHG emissions highlights the need to reduce the use of fossil-derived fuels and embrace the range of technologies available to meet the scale of demand currently supplied by crude oil-derived energy.

There are three important facets to transport energy provision. In the UK, all motored transport is dependent on both energy transfer and energy conversion, with a third dependency for most transport operations (except where in-operation energy transfer can occur, such as rail) being the requirement for on-board energy storage. The primary energy vectors available include liquid fuels, carbon-based gaseous fuels, hydrogen, and electricity.

Virtually all energy vectors can reach low, or Net Zero carbon emissions. No single energy vector works for every transport mode and when considering current capacity there are some limitations in the lowest GHG emission options such as hydrogen, highlighting the need for all technologies. The International Energy Agency (IEA) recently reinforced this point stating that "a broad range of different technologies working across all sectors of the economy" would be required to achieve Net Zero GHG emissions[2].

Not all emissions for the transport sector occur in-use – vehicle manufacture also has significant cradle-to-grave GHG emissions[3] that must be accounted for when considering a Net Zero target. Currently all motorised transport modes have a lifecycle GHG emissions impact – even if their tailpipe GHG emissions are zero – and to meet Net Zero it is these emissions right across the lifecycle of all vehicles and their use that must be decarbonised.

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[1] BEIS, Energy White Paper: Powering our Net Zero Future 170 (2020)
[2] IEA, Energy Technology Perspectives 2020 (2020)
[3] Patterson, J. Understanding the life cycle GHG emissions for different vehicle types and powertrain technologies. 54 (2018)

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

The Government approach to legislation encompassing alternative fuels needs to be appropriate and create a "level-playing field" to allow a just transition to Net Zero. The Government is encouraged to engage with stakeholders in identifying and removing potential barriers to alternative fuels in existing legislation such as the Renewable Transport Fuels Obligation (RTFO), as amended. Particular aspects of alternative fuels are also identified below.

Road Fuels:

A current limitation in terms of low carbon fuels development has been finding sufficient scale to improve their commercial viability. A potential solution to this is the implementation of an investment framework operating in parallel with an emissions regulation (e.g. tailpipe emissions standard) that can enable suitable levels of investment for low carbon energy scale-up. In turn, the investor (likely a vehicle manufacturer or fleet operator) may then claim GHG emissions savings towards their GHG obligation through fulfilment of the 'contract' – an approach that has been explored in depth by Cerulogy[4]. The wider policy frameworks that could incentivise investment in low carbon solutions are identified in the FuelsEurope "Clean Fuels For All" report[5].

Such an approach does not require restructuring of existing GHG regulatory frameworks, but would complement them, and provide much needed upfront fiscal support for more difficult to decarbonise transport modes such as heavy goods vehicles. It could also be developed for adoption in passenger cars with some form of upfront fuel purchase providing suitable investment certainty.

Sustainable Aviation Fuel:

Achieving large scale SAF production in the UK is not without its challenges – significant government support and collaboration amongst a range of industries and sectors will be required to achieve meaningful volumes of fuel. These volumes must then be deployable and resilient, with novel plants requiring financial support through their early production phases to understand their full range of failure modes whilst providing dedicated airport supply (e.g. road tankers). Other challenges to consider will be in making sure SAFs have necessary approvals for use. The US government has provided precedent for championing SAF production – supporting the establishment of a US Clearing House and testing novel SAFs in military hardware – the UK has also announced plans for its own SAF Clearing House in the Ten Point Plan[6]. Once technical and supply readiness has been proven, SAFs may be deployed via established supply routes.

There are early, encouraging signs of SAF manufacture in the UK, with the Altalto waste-to-fuels plant – a joint venture between British Airways and Velocys – being granted planning permission to construct a plant in Immingham, North Lincolnshire.[7] The plant plans to utilise 500,000 tonnes of non-recyclable waste when production commences in the mid-2020s[8]. In 2021, Fulcrum

[4] Malins, C. Truckin' on: Using the heavy-duty CO_2 standard to drive investment in fuel decarbonisation. (2019)
[5] FuelsEurope. Clean Fuels for All: EU Refining Industry Proposes a Potential Pathway to Climate Neutrality by 2050. (2020)
[6] HM Government. The Ten Point Plan for a Green Industrial Revolution. (2020)
[7] Parr, K., Swinburn, S., Watson, D., & Swinburn, K., Planning Application Summary – DM/0664/19/FUL. (2019)
[8] Jeffery, R. Plans submitted for the first waste to jet fuel plant in the UK and Europe. Velocys. (2019)

BioEnergy and Essar announced plans for a new £600m waste-to-fuel plant in the North West of England, which could be operational in 2025, and will convert several hundred thousand tonnes of pre-processed household waste into approximately 100 million litres of low carbon SAF every year[9].

Even when considering generous Fischer-Tropsch yields, and assuming 100% SAF of such yields, a plant such as Altalto Immingham at full operation would supply only ~3% of current aviation turbine fuel demand.[10] Given aviation demand is forecast to grow to 2050 (even considering the impacts of COVID on short and long-term demand), a future UK will require more such SAF manufacturing operations to be built[11].

While SAFs offer major decarbonisation potential, aviation may need to consider other non-technology options. The International Civil Aviation Organization (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) programme is currently undergoing a pilot period with likely deployment in the mid-2020s.[12] The future UK aviation industry is likely to participate in such schemes to offset the most challenging decarbonisation aspects of its operations.

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

Colocation of ultra-rapid EV charging points for the growing Battery Electric Vehicle (BEV) vehicle parc may be the most visible infrastructure change to the consumer in coming years. These chargers are particularly important for users without home charging available (such as on-street parking) and high utilisation vehicles such as ride-hailing services with charging times likely to be around 10 minutes.

Given Internal Combustion Engines (ICEs) will be prevalent well into the 2030s and likely beyond, liquid fuel dispensers will continue to feature on most UK filling station forecourts (there are currently over 8,000 in the UK). In line with the RTFO and other incentives to decarbonise that may emerge, liquid fuels offered are likely to be increasingly renewable in content such as bio-oxygenates, biodiesel and Hydrogenated Vegetable Oil (HVO) with updated EN 228 and EN 590 fuel standards likely to be needed. In the short-term, increased blending of renewable fuels will be adopted under existing standards, or through supply of products meeting higher blend fuel standards, such as the B10 and B20+ and B30. The downstream sector has demonstrated its support for increased deployment of low carbon fuels in the UK in the immediate term by fully supporting the mandated introduction of E10 petrol and increasing the buy-out price of the RTFO, but from a consumer perspective, little has changed at the pump[13].

In the medium term, dedicated hydrogen refuelling forecourts are likely to increase in number – especially on the critical road network to accommodate fuel cell HGVs. Larger forecourts may install hydrogen provision as an additional energy vector.

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[9] Gosden, E. Stanlow refinery to make jet fuel from household rubbish. The Times (2021)
[10] Digest of UK Energy Statistics (DUKES). GOV.UK (2020)
[11] Sustainable Aviation. Decarbonisation Roadmap: A Path to Net Zero (2020)
[12] ICAO. CORSIA Fact Sheet. (2020)
[13] Significant expansion of biofuels capacity for Phillips 66. Fuel Oil News (2020).

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

The steps that the government could take will depend largely on the technology and options available for each transport mode.

Road:

For cars and vans as the most prevalent vehicle type in the UK, and most significant source of transport energy demand, a range of technologies and initiatives will be needed to decarbonise vehicles at the lowest societal cost. In the coming decade, the UK will see an unprecedented diversification of powertrain type in its vehicle parc. However, with the average age of a vehicle in the UK being 8.3 years[14], it will take time to significantly reduce GHG emissions given the current low proportion of hybrid and EV vehicles. A legacy fleet in need of decarbonising will exist well beyond the 2035 milestone.

Similar issues exist with the fleet of buses, coaches, and HGVs where it will take time to significantly reduce GHG emissions given the small base the hybrid and EV market is starting from.

In the 2020s, the RTFO will continue increasing renewable fuel content of road fuels reducing the lifecycle emissions of today's ICEs[15] [16]. In 2019, renewable fuel blending under the RTFO saved a total of 5.37 Mt CO2 e – this is equivalent to taking 2.5 million cars off the road for a full year and is expected to increase as the RTFO mandate continues to rise until 2032[17].

Rail:

The combination of fixed, shorter routes in urban areas means short range rail such as trams, subways / metros and commuter rail are well placed to be electrified with this largely already having taken place. The main evolution for light rail (beyond Net Zero carbon electricity supply) will be seamless integration into other transport systems including unified ticketing / travel pass offers.

Intercity and freight trains can also electrify with Overhead Cabling and as they are heavy duty this will have large efficiency benefits. For now, 28% of the UK passenger rail fleet remains diesel operated (on 58% of the physical rail network), so infrastructure will be the principal challenge for decarbonisation especially in rural locations[18].

Low carbon fuels could replace the 1.7 billion litres currently used per year for rail, with return-to-depot refuelling meaning rail is well suited to dedicated, high blend biofuel supply utilising existing infrastructure while overhead cabling is built[19]. Electrified intercity rail featuring hydrogen fuel cells may also be a flexible long-term solution. The HydroFLEX hydrogen fuel cell train is an example of such technology and is currently being trialled in the Midlands and can be powered up

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[14] EU JRC Report. Blagoeva, D. T., Dias, P. A., Marmier, A. & Pavel, C. C. Wind power, photovoltaic and electric vehicles technologies, time frame: 2015-2030. 196 (2016).
[15] European Parliament Regulation (EC) No 443/2009. (2009)
[16] UK Government. The Renewable Transport Fuel Obligations Order 2007. (2007).
[17] UK Government. The Motor Fuel (Road Vehicle and Mobile Machinery) Greenhouse Gas Emissions Reporting Regulations 2012. (2012).
[18] Shirres, D. Could hydrogen trains be the future of rail? Institution of Mechanical Engineers (2018).
[19] UKPIA. The Economic Contribution of the UK Downstream Oil Sector. (2019).

to 75 miles by 20 kg of compressed hydrogen via a hydrogen fuel cell system[20]. The electrified powertrain is also compatible with existing infrastructure for an easy and flexible option. Other hydrogen powered trains are in service with a range of up to 600 miles meaning such trains may prove the long-term solution to the UK's 'unelectrifiable' rail[21].

Rail freight may pose the biggest challenge, with only 16% of the UK's freight locomotives currently electric. The operational needs for unrestricted overhead access means this mode may prove challenging to fully electrify – a third rail likely to be the only practical option. Low carbon fuels may prove the most viable short- and medium-term means of decarbonising rail freight.

Marine:

Decarbonising the marine sector offers unique challenges. For the lightest craft like dingies, liquid fuels are likely to remain as their long-term energy storage stability are well suited to intermittent operation, but battery-electric propulsion is likely to prove most suitable for other light boats with marinas offering charging points for docked vessels.

International shipping currently produces 2.9% of global GHG emissions[22], and technology such as LNG, methanol, batteries, and hydrogen are most likely to be required to decarbonise this sector.

The port of the future will integrate developments in vessel automation, low carbon energy provision, and intelligent port operations to improve logistics efficiency and throughput. It will also likely host new energy vector filling stations and be supported by smaller Net Zero craft.

Aviation:

The aviation sector presents the most significant energy demand per kilometre travelled. With no viable alternative to jet engines identified, and strict fuel quality control measures for safety, aviation is the most challenging mode to decarbonise with few alternatives to kerosene-type fuel as an energy carrier.

Fortunately, such fuels can be made with lower lifecycle GHG emissions with Sustainable Aviation Fuels (SAFs) already utilised in some markets, and their use is expected to rapidly grow as the aviation sector seeks to further decarbonise[23].

The airport of the future will allow technology to further streamline the airport experience for users, with reduced queues, increasingly tailored retail experiences, and possibly the use of digital passports underpinned by blockchain technology.

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

The potential for both electrification and hydrogen shows that – with increasing levels of renewable electricity production – widespread use of zero carbon energy vectors can become a reality for UK transport in the future. However, the climate challenge demands immediate action,

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[20] DfT. UK embraces hydrogen-fuelled future as transport hub and train announced. (2020).

[21] BBC. Hydrogen trains: Are these the eco-friendly trains of the future? (2019)

[22] I. & Hino, M. Raising Ambition to Reduce International Aviation and Maritime Emissions. 24 (2015).

[23] Sustainable Aviation. Sustainable Aviation Fuels Road-Map. (2020).

and low carbon fuels offer the most readily available displacement of the currently predominant, fossil-derived, carbon-based fuels/chemical energy vector. Low carbon fuels for transport in the UK are defined by the sustainability criteria set-out in the Renewable Transport Fuel Obligations Order 2007 (as amended) [16].

Over time, low carbon fuels can be replaced by a wide range of climate neutral fuels and fuelling models to power UK transport with Net Zero emissions. Their deployment can continue as needed depending on climate neutrality, other environmental factors, and supply – for example in the case of limited feedstocks they can be diverted to aviation and marine as light duty vehicles are electrified. It is for these reasons that one of the recommendations by the IMechE in its 'Accelerating Road Transport Decarbonisation' report was for "substantial investment (similar to that provided for battery electric vehicles and charging infrastructure) in sustainable and low-carbon fuel development and associated internal combustion engine technology".[24]

E-fuels may also play a role in the decarbonisation of high energy density demand sectors such as aviation. Losses incurred via the energy input phase may be offset by the efficiencies gained in infrastructure and fuel quality. E-fuels manufactured in markets with greater renewable energy resources – such as solar in North Africa – could be readily imported using existing UK import infrastructure. [25]

As explored in depth in the UKPIA TTI Report[26], multiple options exist to produce low carbon fuels; from hydrogenated vegetable oil (HVO) to lignocellulosic residues as feedstocks, to the production of e-fuels for hard-to decarbonise sectors such as aviation.

While vehicle and supply infrastructure could make use of low carbon liquid fuel options, the economic incentive to shift away from fossil-derived fuels to towards renewable options is currently limited. A product lifecycle emissions based regulatory framework, embedding WTT GHG emissions into UK fuels policies can accelerate the deployment of renewable fuels in the UK by making low carbon options preferable to more carbon intensive equivalents. In Germany, a WTT GHG reduction target for fuels with a carbon cost for under-delivery of the target has proven to be an effective means of driving WTT GHG emissions reductions[27].

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[24] Institution of Mechanical Engineers. Accelerating Road Transport Decarbonisation. 18 (2020).
[25] Bothe, D. Indirect Electrification for a Successful Transport Transition. ATZ worldwide vol. 120 20–25 (2018).
[26] UKPIA Transition, Transformation, and Innovation Report. (2020)
[27] Giuntoli, J. Advanced Biofuel policies in select EU member states: 2018 update. 16 International Council on Clean Transportation (2018).