Written evidence submitted by the Renewable Transport Fuel Association (RTFA) (RDF0017)

Sustainable fuels as a complementary solution for road freight decarbonisation

About the RTFA

The Renewable Transport Fuel Association (RTFA) is a trade body formed to promote the rapid decarbonisation of transport through substituting high carbon intensity fossil fuels with renewable and sustainable alternatives. It has 37 corporate members, and includes all UK bioethanol and biodiesel producers, all companies dispensing biomethane for transport in the UK and prospective manufacturers of sustainable aviation fuel. Our evidence is confined to the theme of decarbonisation of road freight.

Introduction

Road transport accounts for 27% of UK greenhouse gas (GHG) emissions, and HGVs account for 17.6% of this[1]. The current focus is almost exclusively on future electrification and hydrogen solutions, and overlooks the near-term contribution that the decarbonisation of fuels can deliver. A recent report from FVV[2] indicated that “the carbon footprint of the existing fleet is decisive when it comes to adhering to the climate budget.”

It is the use of more sustainable fuels that is delivering current emissions savings, and it is important that they play the maximum role they can, as;

- They represent the only viable way to immediately decarbonise the HGV sector. Vehicles are available and infrastructure is either in place or being put in place across Europe.
- Internal combustion vehicles will be on the roads for some decades to come, during the transition to zero emission alternatives like hydrogen or electrification
- The UK needs to scale up production of renewable and sustainable fuels for the sectors where it will have an enduring role, for example long haul aviation.

The RTFA believes that the HGV proposal consulted upon earlier this year, and the Green Paper that sets out the proposed legislative approach to implementing a phase out are flawed. On 10th November, the Prime Minister confirmed plans that no new non-zero tailpipe emission heavy goods vehicles

(HGVs) would be sold beyond 2040[3]. The challenges of decarbonising road freight are well-understood and are not repeated here since we discussed them in our response to the recent HGV consultation[4].

This response shows that a more holistic, life-cycle based approach is superior to a technology-specific approach. It can deliver greater carbon emission savings and enable them to take place sooner. It also allows OEMs to innovate optimum solutions for specific applications. There is no silver bullet to solve the decarbonisation of heavy duty vehicles (or indeed any transport mode), therefore no logic in dismissing options that can deliver real benefit, and quickly.

A Life-Cycle Approach is Essential

This response is focused on decarbonisation and consequently we have looked at the probable impact on life-cycle greenhouse gas (GHG) emissions of the different vehicle and fuel combinations for road freight. Life cycle analysis is a technique for quantifying the environmental and human health impacts of a product over its lifespan and is sometimes referred to as 'cradle-to-grave analysis'.

Figure 1 shows how the various parts of a product's lifecycle fit together and it is important we consider all these steps to avoid unforeseen consequences that could arise by from too narrow a focus. The principle applies to all products.

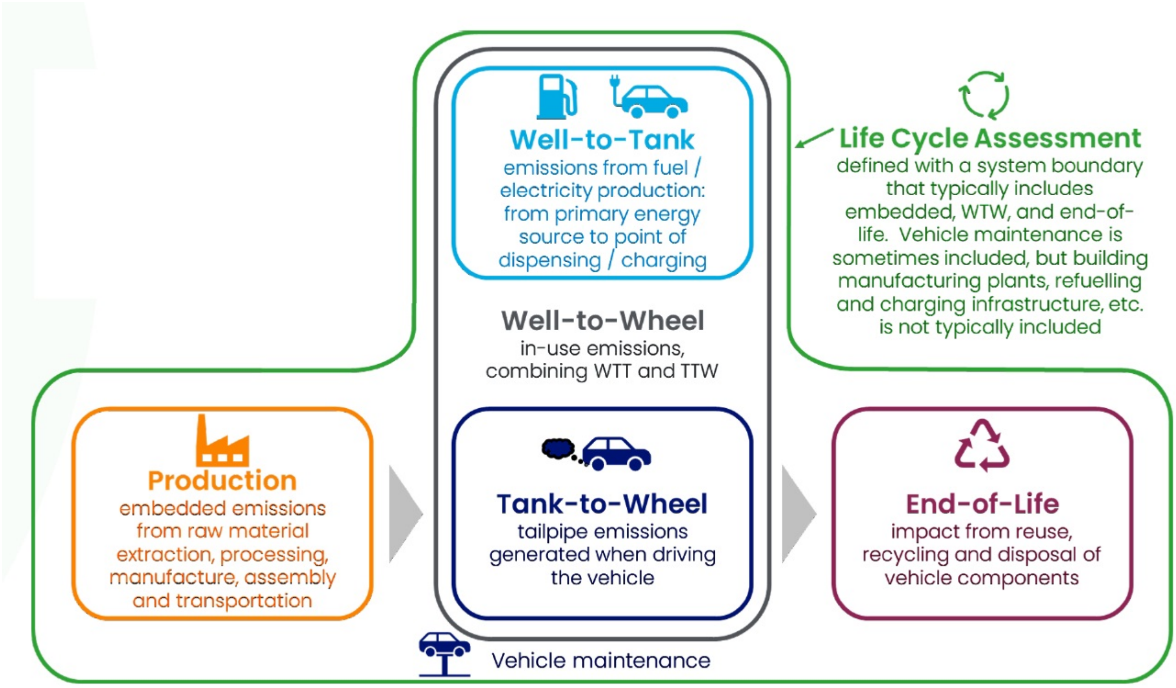

Figure 1: Well-to-Wheel and vehicle Life Cycle Assessment system boundaries[5]

Life Cycle Assessment (LCA) considers the impact of each step on the particular variable under consideration, in this case GHG emissions. GHG emissions are usually quantified in terms of "equivalent CO_2" (CO_2e). Whilst there are many emissions that impact climate change in LCA they are each converted to an equivalent amount of CO_2 and then summed to calculate the total in terms of CO_2e. LCA considers the CO_2e emissions associated with, for example, mining the raw materials (e.g. metals), processing those into usable material, manufacturing the product, the use of the product during its lifetime including any "fuel" consumed, and then the disposal/recycling of that product at the end of its life.

Currently we only consider tailpipe emissions in our legislative framework i.e. the "Tank-To-Wheels" (TTW) emissions shown in Figure 1 above. From this perspective, it is clear to see why the focus is on electric and fuel cell vehicles - they emit no CO_2 from the vehicle at point of use. They are widely referred to as "zero emission vehicles", but this is a misnomer and is misleading; they are technically zero *tailpipe* emission vehicles. There are emissions associated with the production and distribution of the fuel they use, i.e. "Well-To-Tank" (WTT), and this can comprise a significant proportion of the full life cycle emissions of these vehicles, see the light green areas in Figure 2.

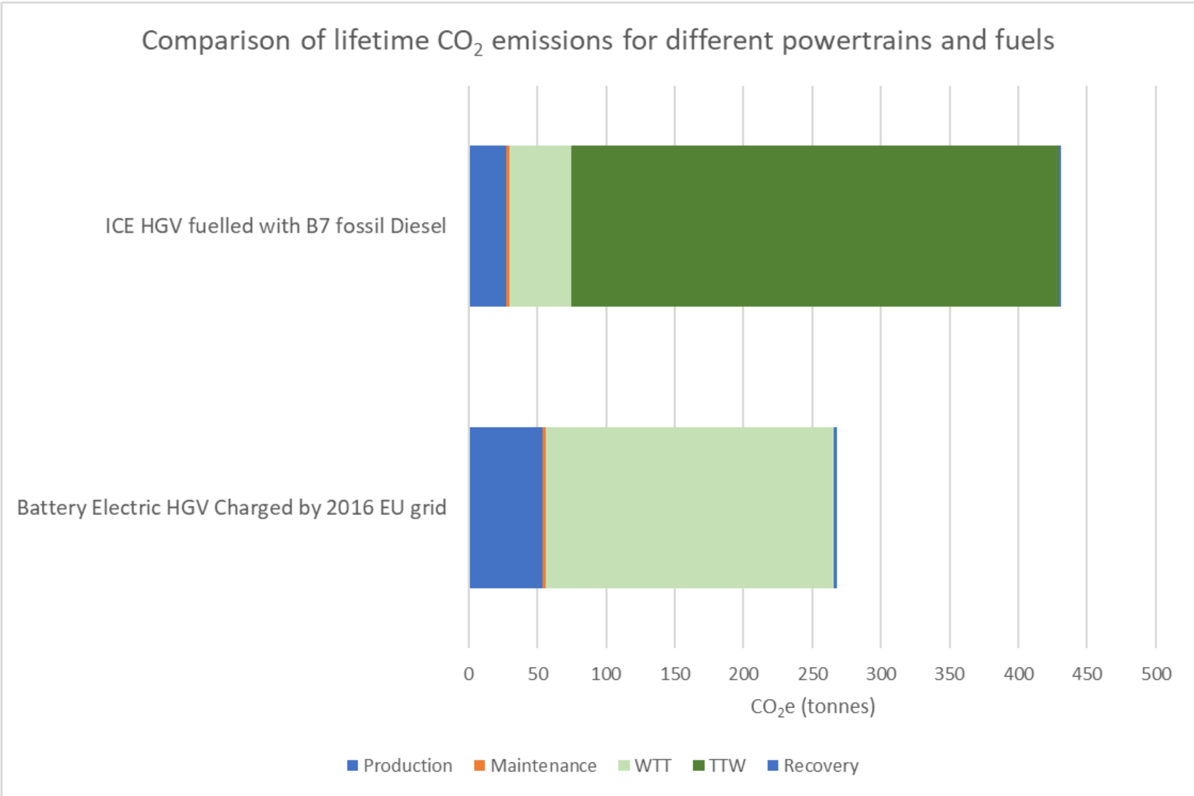

Figure 2: LCA analysis of 28t rigid body truck propulsion systems (source: Scania)

The data in Figure 2 is taken directly from a report published by Scania[6] in 2021 and shows the relative proportions of the CO_2e emissions attributed to the various stages of the life cycle for different propulsion systems for a 28-tonne rigid body truck, based on the following assumptions:

- Vehicle lifetime: 500,000km
- Average payload: 6.1 tonnes
- Battery pack: 300kWh
- Only one battery pack is required for the lifetime of the vehicle (i.e. it does not have to be replaced)
- Recycling: The carbon footprint of the recovery and recycling of the BEV vehicle is the same as that of the ICE (Internal Combustion Engine) vehicle as the recycling of the battery pack has been *excluded* due to lack of data
- Grid carbon intensity (the amount of CO_2e produced in generating the electricity): 2016 average EU mix of 424gCO_2e/kWh

Scania splits the in-use phase into the well-to-tank (WTT) and tank-to-wheel (TTW), recognising that the production of the "fuel" also generates CO_2.

Figure 2 shows that the majority of CO_2 emissions come from the in-use phase, irrespective of the type of fuel used (the green bars in the figures). The results show that, for the 2016 EU average grid intensity, the total CO_2 emissions from the BEV version of the truck are significantly lower than the ICE version running on fossil diesel. However, the proportion of CO_2 emitted during the production phase is significant (~20% of the total) and a significant proportion of this is associated with the manufacture of the battery pack. In this example, the battery pack is 300kWh, equating to a range of around 300km and the embedded carbon in the vehicle manufacture is approximately double that of the ICE version.

Figure 3 shows what happens when diesel is replaced with a 100% renewable fuel. In this case, Scania have used hydrotreated vegetable oil (HVO) as a drop-in fuel since their engines are already able to use it. This dramatically reduces emissions from the in-use phase of an ICE truck.

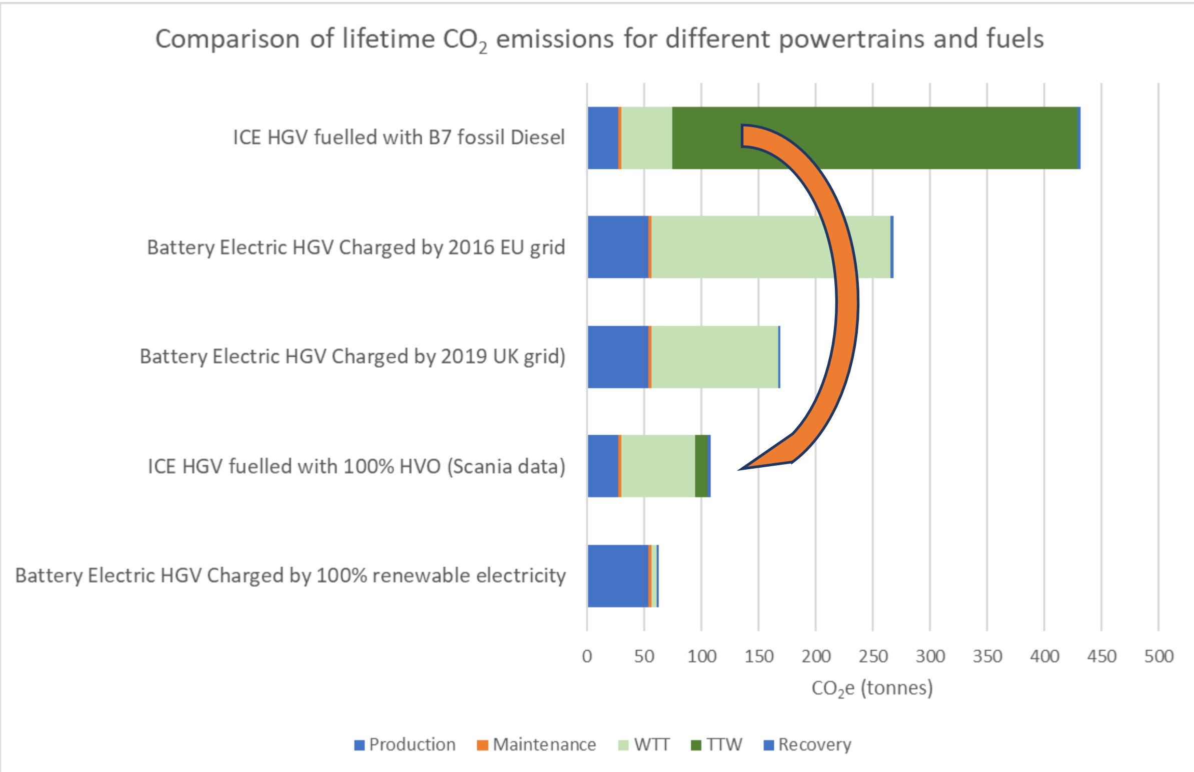

Figure 3: LCA analysis using renewable sources for "fuel" production

It also shows the impact of different charging scenarios for the battery electric vehicle. Firstly, the 2019 UK grid intensity is significantly better than the average EU mix at 225gCO_2e/kWh (source: EEA) which further reduces the life-cycle emissions of the battery-electric version. Secondly, the WTT component drops to near zero for the electric truck if renewable energy (e.g. wind) is used to generate the electricity. Whilst the HVO ICE performance is still not as good as the battery electric version charged with 100% renewable electricity, it is significantly better than a battery HGV charged from the average UK grid (2019 mix). This is a very important consideration when it is recognised that HGVs are valuable, long-life assets that remain in the fleet for a long time. On average HGVs have a life of twelve years (6 – 10 years in commercial fleets, and thereafter in the second-hand market[7]).

However, it is not only about the overall total CO_2 emissions, it is also about the timing of those emissions. Any reductions or increases we make now are more powerful than anything promised in the future. Figure 4 shows the same data as in Figure 3 but now using the driven distance as the x-axis.

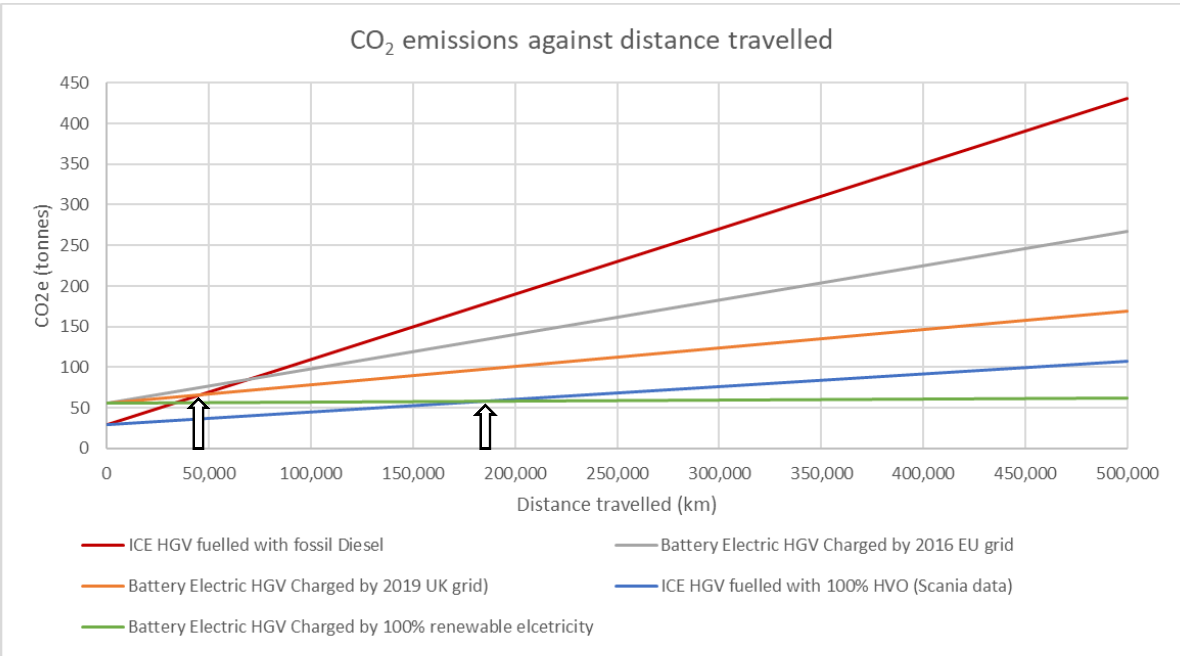

Figure 4: Cumulative CO_2 emissions of various powertrains and fuels over time

It is clear that the front-loading of the embedded carbon in the manufacture of the electric vehicle means that the CO_2 breakeven point is around 45,000km for the 2019 UK grid when compared to the fossil-fuelled vehicle (where the red and orange lines cross). When running both vehicles on renewables, that breakeven point is not reached until 175,000km (where the blue and green lines cross) and both result in a huge reduction in overall CO_2 emissions. **However, we must recognise that electrification does not address the existing fleet (which will dominate for 2-3 decades) and anything we can do to reduce the GHG emissions associated with that should be embraced**.

Other considerations

The above analysis makes the assumption that the battery pack is able to last at least 500,000km. If the battery pack has to be replaced during this period, the embedded emissions in manufacture will increase significantly.

The range of the electric version has been calculated to be ~300km based on the pack capacity of 300kW and Scania's declared energy consumption of 98.7kWh/100km including charge losses. The equivalent ICE HGV has a of ~600km based on the declared energy consumption of 25.5 litres/100km meaning that the electric version will require refuelling twice as often.

The carbon intensity of the UK electricity grid is improving all the time and so the in-use phase of the pure electric version can be expected to improve still further towards the 100% renewable data shown above.

It has often been cited that there is insufficient biomass to support application of sustainable fuels across all sectors and this has been used to dismiss the development and scale up of those fuels. Firstly, post-analysis performed by FuelsEurope[8] of a recent report published by Imperial College Consultants[9] concludes that there is sufficient biomass available to support aviation, marine and a share of road transport and so biomass availability should not be used as an excuse not to act.

Secondly, it is possible to incrementally increase the proportion of renewable fuels used as production capacity increases. Since other sectors will also have a requirement for sustainable biomass feedstocks, expansion of biofuels and their associated supply chains is a "no regrets" option. Drop-in fuels can be blended at any level, and high blends of biodiesel are widely used and could be supplied at the UK's network of filling stations serving HGVs. Figure 5 shows the impact these can have (note WTT and TTW have been combined into a single well-to-wheel (WTW) value that represents the in-use phase, based on the Scania data). This would enable us to start reducing CO_2 emissions from the existing fleet immediately whilst incentivising the scale up of the industry and providing a more managed transition.

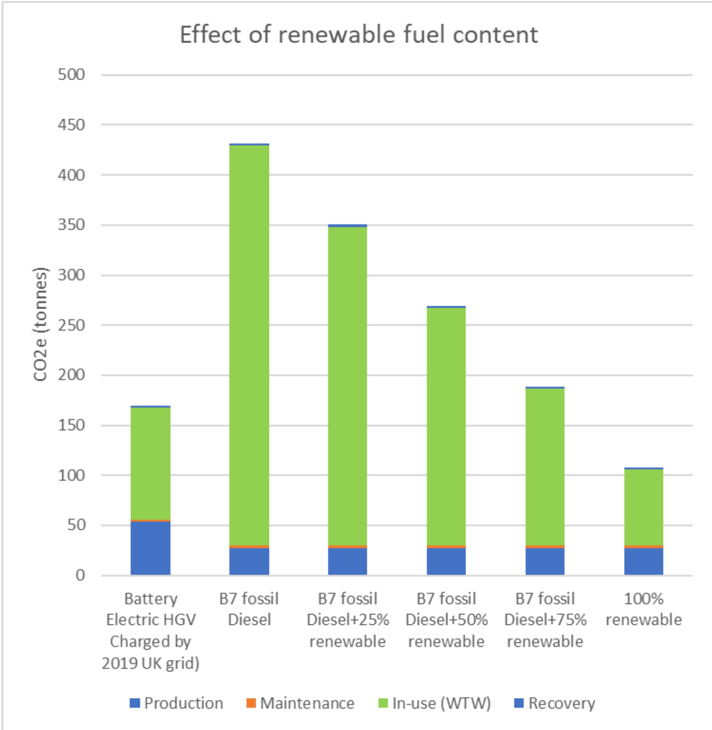

Figure 5: Effect of increasing the blend ratio of renewable fuel on CO_2 emissions

Finally, although not part of this analysis, we should be acutely conscious of the additional CO_2 emissions associated with the construction of the infrastructure required to support any of these solutions. Existing infrastructure can be used for the liquid biofuels and the infrastructure for fuelling gas HGVs is already being rolled out at scale[10]. Of the gas dispensed to transport in 2020 93% was renewable (i.e. biomethane)[11]. It would be relatively easy for these to be converted to dispense hydrogen if necessary. However, very significant infrastructure will be required for electric charging and hydrogen production.

Other sustainable fuels

Whilst these specific Scania results relate to HVO, savings through the use of other renewable hydrocarbon fuels such as biomethane and biodiesel have been analysed, based on the Scania data.

A recent study published by Zemo[12] in October 2021 showed biomethane HGVs emitted 87% less GHG than the fossil diesel HGVs. When manure is used as a feedstock for biomethane production, a credit for avoided methane emissions results in a net negative CO_2e figure. Figure 6 shows the comparison when applied to the Scania data.

The same Zemo study has shown that GHG savings of 83% can be achieved for biodiesel. These are also shown on Figure 6. For completeness, the same study showed that the WTT GHG savings associated with HVO were 93% (i.e. higher than the Scania data) and these data are included in Figure 6 to ensure source consistency.

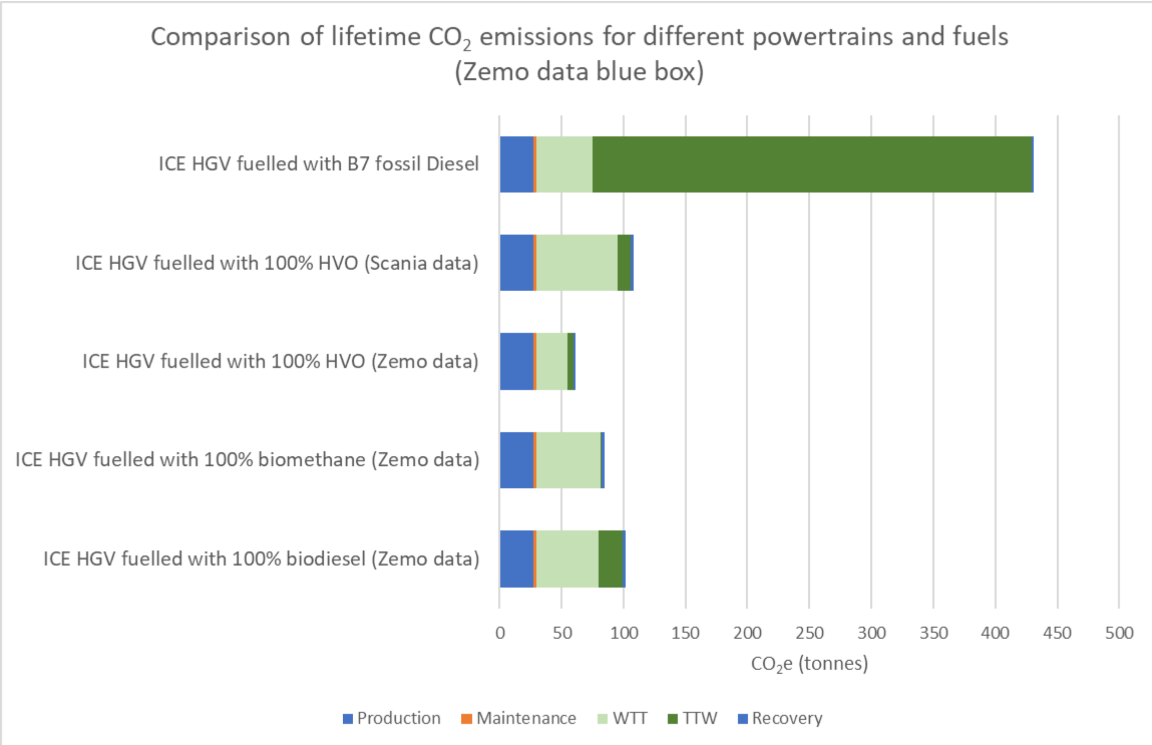

Figure 6: Comparison of sustainable hydrocarbon fuels based on data from the Zemo Partnership

It is clear all these biofuels achieve significant reductions in GHG emissions and they are all relatively easy to apply right now. However, with the current focus on banning ICE technology rather than fossil fuels, the industry is struggling with the business case to scale up and provide the volumes that are required.

Another potentially sustainable fuel is hydrogen, but the GHG savings associated with this are only really achievable if that hydrogen is green i.e. generated by the electrolysis of water using renewable electricity or biological methods rather than steam methane reformation (SMR). Blue hydrogen where the CO_2 emissions associated with SMR and similar processes are captured and stored is a step along the way but not a long term solution.

Using hydrogen in an ICE should not be overlooked as that removes the need (cost and weight) for the associated battery systems and the complex power electronics, motors and drives. Although better than a battery pack, the energy density of hydrogen is poor when compared to liquid hydrocarbon fuel. It also offers a more managed transition as existing ICE technology can be adapted to run on hydrogen, as recently announced by JCB[13].

Hybridisation

The RTFA wholeheartedly supports the adoption of zero tailpipe emission capability in urban areas, something that a pure IC-engined vehicle cannot do even if running on sustainable fuel. However, rather reaching for the pure electric or fuel cell solutions for all applications, hybridisation offers a more pragmatic and potentially lower GHG emission solution. Striving for pure battery electric long haul freight vehicles drives the requirement for bigger and bigger batteries that add more weight, cost and embedded carbon to the vehicle inventory. Instead, an appropriately sized (plug-in) battery pack that is capable of a reasonable EV-only range will give those vehicles the ability to do the majority of their mission away from city centres on energy dense sustainable fuel, thereby minimising cost, weight and embedded carbon and maximising payload optimisation. This promising avenue of development is ruled out by the UK Government's approach.

Conclusions

There is no "one size fits all" solution to reduce GHG emissions from the road freight sector. Banning our way to net-zero is not a constructive approach as it stifles innovation and suppresses investment in solutions that could be viable now. Instead, we should be stimulating our way towards the portfolio of fuels and vehicles that will help us reach our goals.

A more balanced view incorporating a substantial contribution from renewable fuels could help us navigate a more constructive and complementary path that would have more significant impact on CO_2 emissions in the near future. This can be achieved as sustainable fuels are able to address the existing fleet, something electrification and fuel cell technology is unable to do.

Additionally, the current focus on tailpipe emissions takes no account of the life cycle impact and runs the risk of either shifting the burden out of our field of vision or somewhere else in the world, or both. Whilst this might look good on paper, it is purely a manifestation of the chosen system boundary - and there is only one system boundary that matters – the planet.

Renewable fuels have a huge part to play and it is better to start doing something now even if it is not perfect. It represents a "no regrets" solution as there is nothing to lose. Conversely, doing nothing with the existing fleet will waste a huge opportunity to reduce GHG emissions in the short-to-medium term.

Recommendations

The RTFA recommends:

1) The focus should be on progressively restricting the ability of HGVs to use high carbon intensity fuels until the point where the requirement is 100% sustainable renewable fuels. At that point all vehicles, regardless of when they were sold, would either have to be zero tailpipe emission or running solely on clean fuels.

   This approach has the following advantages

   - It sends a powerful - and arguably clearer - message to OEMs to develop net-zero vehicles than the approach set out in the Green Paper
   - It addresses emissions from the legacy fleet as well as new and hybrid vehicles
   - It enables OEMs to be more innovative in their approach, for example developing hybrid solutions which would be likely to have better life-cycle emissions performance (both in terms of GHG emissions and other environmental parameters)

2) Adoption of a life-cycle approach in determining future road freight policy in order to avoid the potentially disastrous consequences of shifting the GHG emissions burden out of our legislative field of vision or somewhere else in the world, or both.

3) Significant investment in renewable and sustainable fuels in order to:
   a. Scale up the industry in order to provide the volumes required for road freight at an acceptable price-point
   b. Enable us to minimise the amount of additional infrastructure required for the electricity and hydrogen-based solutions
   c. Buy us time to install (and pay for) that infrastructure

d. Stimulate the scale-up required in production of sustainable fuels that will inevitably be required by other sectors such as aviation and marine.

November 2021

Endnotes

[1] Department for Transport statistics, Energy and environment, Table ENV0201 (TSGB0306) Data from 2019.
[2] Six theories on climate neutrality in the European transport sector: www.fvv-net.de/fileadmin/user_upload/medien/download/FVV__Future_Fuels__StudieIV_Briefing_Paper__R600_2021-10__EN.pdf
[3] https://www.gov.uk/government/news/uk-confirms-pledge-for-zero-emission-hgvs-by-2040-and-unveils-new-chargepoint-design
[4] https://rtfa.org.uk/wp-content/uploads/2021/09/21-09-03RTFA-HGVconsultationResponseFinal.pdf
[5] Graphic courtesy of Zemo Partnership
[6] Life cycle assessment of distribution vehicles: Battery electric vs diesel driven https://www.scania.com/content/dam/group/press-and-media/press-releases/documents/Scania-Life-cycle-assessment-of-distribution-vehicles.pdf
[7] Market opportunities to decarbonise heavy duty vehicles using high blend renewable fuels. Zemo Partnership. 2021. www.zemo.org.uk/assets/lowcvpreports/Market_opportunities_decarb_HDVs%20using%20HBRF_2021_.pdf
[8] https://www.fuelseurope.eu/mediaroom/sufficient-sustainable-biomass-feedstock-available-to-support-an-ambitious-low-carbon-liquid-fuels-strategy-for-eu-transport/
[9] Sustainable biomass availability in the EU to 2050 https://www.concawe.eu/wp-content/uploads/Sustainable-Biomass-Availability-in-the-EU-Part-I-and-II-final-version.pdf
[10] The map available on https://gasvehiclehub.org/ currently shows 34 stations. With those currently under construction and planned, the total is likely to be well over 100 in 5 years' time.
[11] https://www.ngvnetwork.co.uk/natural-gas/gas-as-a-transport-fuel-industry-growth
[12] https://www.zemo.org.uk/assets/reports/Zemo_Hydrogen_Vehicle_Well-to-Wheel_GHG_and_Energy_Study_2021.pdf
[13] https://www.jcb.com/en-gb/news/2021/10/jcb-hydrogen-engine-gets-100m-injection