Pathway to net zero aviation: Developing the UK sustainable aviation fuel mandate consultation response

June 2023

This paper is Transport & Environment's (T&E) response to questions posed by the consultation *Pathway to net zero aviation: Developing the UK sustainable aviation fuel mandate*.

T&E is Europe's leading clean transport think tank and campaigning group. It was created as a member organisation over 30 years ago and now has staff in 6 countries, with 63 member organisations across 24 countries. It has had a UK office since 2019. T&E coordinates the International Coalition for Sustainable Aviation, which has observer status at the International Civil Aviation Organisation (ICAO); and is also an active member of the Jet Zero Council's SAF Delivery and commercialisation groups.

Sustainable aviation fuel (SAF) is crucial to help decarbonise UK aviation, and a mandate is an excellent policy instrument for helping ensure that SAF uptake is boosted from the tiny levels currently seen. However, there are serious concerns with some types of SAF, and some tensions and contradictions in the mandate proposals. Solving these concerns and tensions is crucial to ensuring that the UK has a thriving domestic SAF industry.

Feedstocks

Thus far, the Government has not laid out overarching policy intentions around feedstocks. The Government has not confirmed what it believes the most effective and efficient use of biogenic feedstocks, municipal solid waste, electricity and hydrogen actually is, and that makes providing informed comments as to if they should be funnelled towards aviation and the SAF mandate difficult. However, the forthcoming biomass strategy should confirm what happens to the nation's waste food, forestry residues, agricultural residues and sewage, whilst other commentators have provided grounded opinions on best use of some other feedstocks. This issue was recently flagged by the DfT's Science Advisory Council:

"A sectoral prioritisation is needed to develop a hierarchy of different uses of recyclable carbon, considering the full range of manufacturing end uses and including as a feedstock for fuels in the transport sector."

This prioritisation is urgently needed as, by not having strict feedstock safeguards in place, the Government could end up decreasing emissions in one sector (aviation) whilst increasing emissions in another sector - potentially meaning that overall societal emissions are higher than they would otherwise have been. This problem is acknowledged in the consultation's associated cost-benefit analysis (CBA), but there is only a footnote (to be found on page 49) in the main consultation document indicating that steps to prevent this will be put in place. However, the Government's response to the first SAF mandate, did explicitly commit to ensuring that feedstocks are used for the best environmental use they can. This is above-and-beyond any high-level lifecycle analysis that demonstrates that individual SAFs can achieve the (as yet undetermined) required minimum lifecycle saving. It said

"The waste hierarchy will ensure that the mandate only supports true wastes i.e. those which cannot be prevented, reused or recycled, and those wastes for which the use of biofuel represents the 'best environmental outcome arising from that waste'."

This is therefore at odds with the consultation's modelling assumption (section 2.36 of the CBA) that aviation can access 3% of all the feedstocks available to the UK.

The best environmental outcome for a lot of waste feedstocks over the next decade is not using it to make SAF: that is overall total emissions will be lower if some feedstocks are used in other sectors. HEFA is a good example of this, and **the HEFA cap should therefore be set at 0%** until such time as its use in other sectors substantially falls (full explanation for this is given in the answer to question 9). The logic of the first mandate consultation response suggests that the Government should funnel 100% of a waste stream to where its best environmental use is: if the best environmental use of a feedstock is SAF, then 100% of it should go towards SAF. If it is not the best environmental use, then none of it should go towards SAF. As well as the environmental risk, there is also a huge reputational risk in using dubious feedstocks - both to airlines and the Government. **If SAF is to be viable in the long-term, it cannot be on the grounds of a dubious environmental record and poor reputation**. There is a significant risk of both happening if sufficient safeguards are not put in place now, and nothing in this consultation suggests that those have been fully applied.

Plastics are made from oil, and contain carbon that was originally trapped in fossil fuels. Therefore, converting them to SAF and burning them in a plane releases fossil-derived carbon into the air. The waste hierarchy clearly states that all recyclable plastic should be recycled, and currently, that means mechanical recycling. However, another method is via chemical recycling, where waste plastic is converted into chemical building blocks and then reused. The chemical recycling industry is nascent: there are two planned plants in the UK (on Teeside and in Perth, although the future of one company is unknown as it has just been bought). Since the waste hierarchy clearly states that recycling is above recovery, then the best environmental use of waste plastic is to simply store it until the chemical recycling industry is large enough to use it.

The UK is internationally committed to ending plastic pollution before 2040, as part of the High Ambition coalition to end plastic pollution before 2040 and will be legally bound to the forthcoming UNEP plastic pollution treaty which is due by the end of 2024. Domestically, the Environment Plan already has a target of no plastic waste by 2042. Initial steps have already been taken: the Government recently introduced a plastic packaging tax of £200 per tonne on new plastic packaging that does not contain at least 30% new recycled plastic. This is mirrored in the EU with the Circular Economy Action Plan. The British Plastics Federation has produced a roadmap that envisages 65% of all plastic being recycled by 2030.

Pragmatically, lots of plastic waste is currently burnt in energy-for-waste plants to produce electricity. One argument is that feedstocks for SAF should be prioritised over EfW plants, since electricity can be generated from renewable electricity sources. However, the Government has proposed bringing EfW plants into the UK ETS. This would have two effects: Firstly, EfW plant operators would be incentivised to install carbon capture systems onto their plants. Secondly, to ensure a level-playing field SAF derived from MSW should also be included in the UK ETS when burnt in a plane.

What becomes increasingly clear is that the feedstock supply of waste plastic over the next 15 years will become increasingly limited. Combine that with the best environmental use commitment and the current counterfactual alternative use of it (EfW plants), and it becomes clear that the plastic element of municipal solid waste cannot be relied on in large volumes. Indeed, it should not be used for SAF under the Government's own rules.

This leads to an inherent contradiction: some waste feedstocks will not be suitable for SAF in the short-term (used cooking oil and animal fats). Additionally, one type will never be suitable for SAF (fossil-derived plastics). Yet the proposals intend that waste-derived SAF makes up the majority of SAF supplied over the next few decades, despite the fact that many waste-derived SAFs should not be supplied under the Government's own rules. **Government focus should therefore shift towards feedstocks that are sustainable in the long-term: some biogenic feedstocks, some recycled carbon fuels and hydrogen-derived fuels**

Research

There are a number of policy developments (eg the forthcoming biomass strategy) and future Government commitments (eg the UNEP global plastics treaty) elsewhere that mean that the amount of total feedstock available to aviation will be less than it was in the past. However, all published research so far is based on historic levels of feedstock availability. The Department for Transport (DfT) commissioned research for this consultation, but then did not publish that research (nor, therefore, the assumptions going into that research). This makes giving informed comments impossible for some of the questions posed, but also begs the question if the commissioned research was based on historical data or was forward looking.

Power -to-liquid (PtL)

The consultation clearly states that the main constraining factor for PtL production is direct-air-captured (DAC) carbon availability. This is because the AIA modelling of PtL technologies using anything other than DAC was considered out-of-scope, as per instructions given to the AIA by DfT (as disclosed during an online Jet Zero Council SAF mandate sub-group meeting attended by Matt Finch) . It is unknown why this was, as DAC is not needed for PtL: other carbon sources can, and will, be used (although it should be noted that in the long-term, it will be needed as other carbon sources become decarbonised). Bizarrely, chapter 3 the consultation itself confirms that PtL fuels can use other carbon feedstocks. This incorrect constraining factor means that the PtL sub-mandate proposals are incredibly, and unnecessarily, low. At best, this is a genuine mistake that has slipped through. At worst, this is a deliberate attempt to ensure airlines do not have to pay for as much of the more-expensive PtL fuels as would otherwise have been, although it should be noted that DAC carbon is the most expensive form of carbon currently (more on carbon costs below).

Fossil-free hydrogen is derived from renewable electricity and water, and therefore will be available in the UK in increasingly large amounts over the next few decades. Other feedstocks have a natural maximum limit available (indeed, previous T&E research concluded that even if all European waste were diverted to aviation, waste-based SAF could only meet 11% of total European jet fuel demand in 2050) and therefore Government focus should be on promoting the only type of SAF that can significantly shift the sector's net carbon emissions. It currently is not. The SAF mandate will be the first explicit UK demand-side hydrogen policy (with no others on the horizon) and therefore the onus will be on hydrogen-derived SAF producers to link up with companies that will benefit from the supply-side regulations. A low sub-mandate level ensures that the UK has less of a chance of gaining an international competitive advantage in PtL production. **T&E therefore recommends the 2030 PtL sub-target is set at an ambitious 5.5%**.

To ensure that the mandate is as environmentally robust as possible, then strict sustainability rules should be put in place as to where any hydrogen or hydrogen-derived SAF comes from. The UK plans to have a completely decarbonised power system by 2035, but this is not true of other nations. According to Our World in Data, in 2021 there were only 19 countries where over 90% of their electricity came from low-carbon sources. With a 90% zero-carbon grid, even if the last 10% of the grid is coal-fired power generation, then the carbon footprint of the resultant fuel would still meet a 70% GHG LCA saving. This correlates with the EUs rules on RFNBOs, and with Government literature that states that SAFs can achieve a 70% LCA saving. **Therefore no SAF should be allowed to be imported from a country that has a power grid that is less than 90% decarbonised**.

The consultation asks if fossil-derived ("blue") hydrogen should be allowed into SAF. This would be a mistake. Aside from the fact that primary legislation would be needed to allow this to happen, there would always be some emissions from the production process meaning that the fuel is not as sustainable as could be. A recent study from Princeton University and Colorado State University found that the current method for estimating methane emissions from offshore oil/gas production is

a "likely substantial underestimation". Since methane has a 28 times greater global warming potential than CO2 (over 100 years), it would be downright odd for the Government to allow fossil-derived hydrogen into the Government's flagship climate change aviation policy.

Furthermore, the EU, in its RefuelEU package, has defined synthetic low-carbon aviation fuels as "fuels of non-biological origin, the energy content of which is derived from *non-fossil* low-carbon hydrogen", thus ensuring that PtL uplifted in the EU cannot be produced from blue hydrogen, which is produced from natural gas and coal. Any future UK fossil-derived hydrogen SAF plants would not be allowed to sell their products to the EU. Since businesses require policy certainty and regulatory alignment, restricting UK SAF to fossil-free hydrogen only from the start of the scheme makes sense.

In short, **fossil-derived (blue) hydrogen should not be allowed to count towards a fuel supplier's PtL obligations.**

Buy Out price

Whilst there is rationale in basing the buy-out-price on RTFO development fuel prices an alternative, and in T&E's view, better, option would be to follow the precedent laid down in the recently consulted on ZEV mandate. That proposed three criteria to set a buy out price (adapted to incorporate SAF):

- it must be greater than the additional cost to produce SAF compared to fossil jet fuel, in order to discourage fuel suppliers from simply making payments rather than supplying SAF.
- it must reflect the price of the excess carbon emissions that would result from selling fossil jet fuel rather than SAF, in accordance with cross-government carbon valuation guidance.
- it must be at least as high as the equivalent fines for non-compliance in other markets where there is significant SAF uptake.

Using these criteria completely changes the buy-out prices proposed in the consultation. **T&E recommends that the buyout price for not supplying PtL should be £4.86 per litre, and for other SAFs should be £3.40 per litre (2020 prices)**. Details on how these figures were derived is given in the answer to questions 12 and 13 below.

Furthermore, the UK should follow the EU's lead and require suppliers that miss their targets to pay the buy-out price, **AND be obliged to make up the shortfall in subsequent years**.

Conclusion

SAF is crucial to help decarbonise aviation, but the proposals contained in the SAF mandate need to be adapted and upgraded to ensure that the strictest sustainability criteria are adhered to, that final minimum percentages are based on future feedstock levels - especially for the PtL sub-mandate, and that the buy-out price reflects the environmental damage caused by any excess fossil-fuel emissions released. The Government has already set a 2030 SAF target of 10%, but the supply into jet fuel of

many waste feedstocks should be restricted or banned, under the Government's own rules. Focus should therefore be on biogenic and electrically-derived feedstocks. Currently, the consultation suggests that that is not the case.

With an adequate buy-out price, the SAF mandate will ensure that SAF is uplifted in the UK. However, by itself, it does not ensure that SAF will be produced in the UK. Whilst outside the scope of this response, more steps should be taken by the Government to ensure that plants get built. T&E has previously recommended that the UK Infrastructure Bank extend the UK loan guarantees scheme to any first-of-a-kind UK SAF plants currently under development. Furthermore, the Government should use its buying power, as a major purchaser of jet fuel (472m litres of jet fuel were bought for RAF purposes in the tax year 19/20) and tender for UK-produced SAF. This would ensure revenue certainty for whichever plant or plants win the tender. Finally, consideration should be given to putting in place an industry-funded revenue certainty scheme. This should not use either APD or ETS revenues.

T&E's Main Recommendations

- The HEFA cap should be set at 0% until at least 2032.
- The focus of the SAF mandate, and SAF policy more generally, should shift to biogenic feedstocks, some recycled carbon fuels and power-to-liquids.
- The Government should recognise that waste has a value: consideration should be given to banning the export of UK waste.
- The PtL target needs to be raised substantially: T&E recommends the 2030 minimum level should be 5.5%, and allow any carbon feedstock.
- A 'sub-sub' PtL mandate, where only direct air-captured carbon should be used to make the PtL should be applied.
- The buyout price for not supplying PtL should be £4.86 per litre, and for other SAFs should be £3.40 per litre (2020 prices).
- Should suppliers not supply enough mandated SAF (or equivalent certificates) in any given year, they should be obliged to pay the buy-out and make up the shortfall in subsequent years.
- The minimum carbon intensity reduction should be set at the same level as the EU SAF mandate scheme: 65% for biofuels, and 70% for the rest from the beginning.

Below are responses to the specific questions posed:

Targets and price support for SAF

Q1: Which 2025 target option strikes the right balance between ambition and deliverability? Do you have any evidence to support your position?

Higher levels of ambition on reducing emissions should always be strived for. It should be recognised that the ambition levels the Government puts in place will influence the deliverability: policy certainty

drives industry decisions. There are many examples of this: coal was driven off the UK power system partly by the carbon price floor; landfill taxes have reduced the amount of waste going to landfill; etc. This means that, in the long-term, the SAF mandate will be the main driver of the economics of the UK SAF industry. In the short-term, it should be recognised that the start of 2025 is only 18 months away, and that SAF may not be available. Focus therefore should be on putting in place a 2025 target level that only allows SAFs to be burnt that are made from sustainable feedstocks where SAF is the best environmental use of that feedstock: those made from biogenic feedstocks and hydrogen derived from green electricity.

Regardless of its end use, the Government should recognise that 'waste" has uses. This has been recognised in Scotland: it has banned the landfilling of biogenic waste from 2025. The UK should not only follow this example, but also consider **banning the export of (any form of) waste**.

Q2: Would you find it acceptable if the trajectory from 2025 to 2030 was set at an ambitious level and this led to high levels of buy-out and increasing costs to consumers?

Yes. It would be acceptable. By definition, in the years 2025-2030 the buy-out will be applied to far less than 10% of the total jet fuel bought. Airlines already have major fluctuations in their fuel costs, as can be seen from the graphs below (source: IATA):

Taking a look at the price action over the past twelve months:

Source: S&P Global

Jet fuel price developments - longer term perspective

Source: S&P Global, Refinitiv Eikon

As can be seen, the pandemic and the war in Ukraine changed the fuel price quite dramatically, but even before that the fuel price had risen over 100% in less than three years. There is nothing to suggest that these fluctuations will stop over the coming decade, and the potential addition of a buy-out price on far less than 10% of fuel supplied over a five year period will be far less than the fluctuations seen over the last seven years.

Q3: Do you have any comments on the post 2040 proposal to legislate for targets continuing at the 2040 level, with the plan to update these when better data is available?

This makes sense, although the declared intention of the Government should be to achieve 100% SAF by 2050, in line with the UK's overall legally-binding net zero target. It would be odd of the

Government to willingly allow one sector to not fully contribute to the effort-sharing all other sectors of the economy are undertaking.

Q4: What increasing trajectory to 2040 do you think strikes the right balance between ambition and deliverability? Do you have any evidence to support your position?
SAF production costs should reduce as demand is scaled up (as expressed in the impact assessment on ReFuelEU Aviation). Reducing production costs should ensure that suppliers are able to deliver to whatever trajectory is in place. Therefore the Government should aim for the highest ambition possible.

The issue, as explained in the executive summary, is feedstock availability: the question of which feedstocks should be diverted to SAF, when there will definitely be other uses for them, which may be better environmentally, has not been fully addressed.

Q5: Do you have an alternative trajectory option you would prefer to see, and do you have evidence to support this?
As previously mentioned, the Government should strive for the highest ambition possible, whilst only allowing feedstocks to be used that come with the highest sustainability standards.

Q6: Would you find it acceptable if the trajectory from 2030 onwards was set at an ambitious level and this led to high levels of buy-out and increasing costs to consumers?
Yes, for two reasons. It is perfectly possible to adjust the buy-out price. This happened a number of times in the RTFO, and, pragmatically, can be expected to happen in the SAF mandate. Additionally, buying-out could be used for two reasons: the first as an 'emergency' measure when SAF supplies fall short (due to, for example, an unexpected outage at a production plant), but the second is as a strategic choice: a fuel supplier decides, in advance, to pay the buy-out price rather than source suitable SAF or invest in suitable SAF plants. In the first instance, a higher buy-out price should ensure that fuel suppliers put in place a more resilient supply chain, and in the second instance the higher the buy-out, the more it acts as a deterrent.

Q7: Do you agree with where we have set our HEFA cap upper and lower bounds (upper bound is highest HEFA uptake modelled under the mandate, lower bound is no HEFA in the mandate)? Do you have any evidence to support this?
See below.

Q8: Do you agree that we should try to limit the diversion of feedstocks from difficult-to decarbonise road transport modes, as much as possible?
See below.

Q9: At what level do you think a HEFA cap should be set to balance mandate deliverability with road transport decarbonisation?
Questions 7, 8 and 9 will be answered below:

There are a number of factors that should be considered when setting the HEFA cap level: best environmental use of the feedstocks, industrial strategy, fraud potential and displacement risk.

Regardless of where the upper and lower bounds are, the best environmental use of both UCO and animal fats in the short-to-medium term is turning it into biodiesel for road transport: ie what mostly happens now. This is because less energy is needed to turn HEFA feedstocks into biodiesel than into biokerosene, and a unit of diesel emits slightly more carbon than burning a unit of kerosene. To achieve "best environmental use" of the feedstock, the upper bound level should also be zero: ie there is no realistic HEFA level which does not result in a worse environmental outcome due to the displacement effect.

Balanced against this is the fact that, in the long-term, road diesel volumes burnt in the UK will start substantially falling, and at some point, consideration should be given on how to transition UCO and animal fat use from road transport to aviation. This is not expected to happen until at least the late 2030s though - and probably later. Some vehicles are already warranted to run on high blends of biodiesel (and some farm vehicles are already warranted to run on 100% biodiesel), so feedstocks should be directed to road transport as long as diesel is still burnt in road vehicles.

Regardless, the majority of biodiesel sold in the UK came from feedstocks imported from other countries. This trend is likely to continue should UCO be allowed into SAF: of the 26 million litres of SAF supplied last year via the RTFO, 25.8m used UCO as the feedstock, and of that 21m litres (82%) were imported. This is problematic for two reasons: firstly, energy was used to import that UCO, when that UCO could have simply been used to decarbonise the road and aviation systems of the countries that it originated in; and secondly this reliance on imported feedstocks has the potential to cause future energy security issues.

One viewpoint could be to suggest that, since diesel use should fall as electric vehicle uptake progresses and SAF is expected to be needed for far longer, HEFA feedstocks should be diverted from road and into aviation as soon as possible and the UK try to become a centre-of-excellence for HEFA production. However, this does not bear up to scrutiny. HVO production is a mature technology / pathway that has already reduced costs via learnings due to its use in road transport. Moreover, there is no specific reason why the UK would have a competitive advantage over any other nation with regards to HEFA production. This is the direct opposite of other feedstock and technology routes, where the global market is comparatively nascent, and the UK could become a centre-of-excellence. This suggests that, for industrial strategy reasons, the UK should focus on other SAF technologies from the beginning.

Fraud is a huge concern with UCO use. We already know, via a Farm Europe investigation, that some of the supposed UCO used in the UK is, in fact, virgin palm oil. This is backed up by the European Biodiesel Board admitting that there were likely fraudulent declarations in its imports of Chinese

biodiesel. Put simply, UCO fraud happens, and any use of UCO in the SAF mandate is likely to make the fraud worse.

Furthermore, even if all the UCO supplied under the SAF mandate is genuine, there is a displacement risk that the counterfactual use of the UCO will be met with virgin palm oil. The SAF mandate will act as an extra demand pull for more UCO, but there are limited amounts of UCO available globally. The same is true for animal fats.

(UK kerosene produced as a by-product of biodiesel production can still be utilised in home heating: there are an estimated 1.1 million UK homes that run on an oil fired heating system)

Therefore, in the period to 2032, and potentially longer (to align with current RTFO commitments), the HEFA cap should be set at 0%.

Q10: At what level do you think a PtL mandate should be set to strike the right balance between ambition and deliverability? Do you have any evidence to support your choice, in particular considering low carbon electricity and hydrogen production, as well as carbon capture requirements?

Fossil-free hydrogen is derived from renewable electricity and water, and therefore will be available in the UK in increasingly large amounts over the next few decades.

What is clear is that any future aviation fuel market will be significantly hydrogen-derived, and therefore the Government should focus future efforts into increasing this market. Without seeing the unpublished and underlying modelling and assumptions it is impossible to comment on how the Government arrived at its recommended figures. What is clear is that there is a huge discrepancy between the percentage range the consultation document considers feasible for 2030 (0.05-1%) compared to announced Government plans and ambitions for hydrogen production. To generate 1% of 2030's expected jet fuel demand would require 0.68 GW, or nearly 14% of all anticipated green hydrogen production. This would need 5.9 TWh of electricity (for context, total wind generation in 2021 was 49 TWh). Clearly these are substantial figures, but they are also eminently achievable.

However, it should be noted that the justification given in the consultation (and implicitly referred to in the associated SAF mandate consultation-stage cost-benefit analysis) as to why the proposed PtL levels are so small does not stand up to scrutiny. The consultation states:

"Unlike with the HEFA cap, PtL availability in the AIA modelling is not constrained by feedstocks, but by direct air capture (DAC) availability".

This is simply not true. Any source of carbon could be used, as the consultation document itself makes clear in chapter three.

Carbon costs are highly dependent on how concentrated the source of CO2 is. Bioethanol processes produce gas streams that are almost 100% CO2, which therefore results in low costs. The below table, taken from analysis undertaken for T&E by Ricardo, shows the cost (in €) of different carbon sources.

CO_2 Source		Cost (€/t_{CO2})	Year Costs Obtained
Power and Heat	Coal	19-63	2015 & 2017
	Natural Gas*	34-101	2015 & 2017
	Biomass	54-101	2015
Chemical Industry	Steam methane reforming (SMR) (Ammonia production)*	12-54	2015 & 2017
Heavy Industry	Iron and steel production	19-41	2015 & 2017
	Cement, clinker and lime production	22-69	2015 & 2017
Biogenic	Biogas upgrading	5-9	2015
	Bioethanol fermentation	5-12	2015 & 2017

**Capture costs shown were obtained prior to the natural gas spike in late 2021 which could have increased CO_2 costs from these sources substantially.*

In comparison, the same research suggests that DAC costs will be €445 in 2025. Even though this price will reduce over time with learning and economies of scale, it does not get below €100 before 2050. Clearly, there is a huge gulf in carbon costs between DAC and biogas upgrading.

In time, to ensure that PtL is truly sustainable, then only biogenic and DAC CO2 should be used. However, it is acknowledged that in the short-term it may make sense to use fossil-derived sources.

With this in mind, the DfT should rethink its PtL sub-mandate approach. T&E recently released a paper on hydrogen use in UK aviation, and **recommended that the UK Government should set the 2030 sub-mandate level at 5.5%**. However, the Government's modelling does prove what levels of PtL with DAC carbon should be available in 2030. Therefore, **consideration should be given to implementing a 'sub-sub mandate' for DAC supplied PtL, following the consultation's high ambition levels**.

Q11: In which year do you think it would be most appropriate for a PtL mandate to start and how quickly do you think ambition should ramp up?

Due to a) the nascent nature of the PtL market, b) the fact that the UK's grid will be decarbonising during the 2020s, and c) to align with the EU SAF mandate, **the PtL sub-mandate should start in 2030**. However, it should be recognised that waste-based SAF will only ever be a relatively small percentage of the total market (previous T&E research concluded that waste-based SAF would only

meet 11% of total European jet fuel demand in 2050), so ambition should ramp up very quickly afterwards.

It should be stressed that the narrative that PtL plants are years away is simply wrong: UK focus has simply been on waste-based plants. To use one example, Norsk e-fuel is at a similar stage in the planning process as the planned UK SAF plants for an e-kerosene plant in Northern Norway. It expects to produce 40 million litres of e-kerosene from 2026. It will utilise carbon from biogenic and DAC sources, although the exact split is still to be determined (and will depend on the exact layout of the plant).[1]

Post-2030, ambition should ramp up quickly. Even if feedstocks for other SAF types are diverted to SAF (which may not be the best environmental outcome for them), there will ultimately still be limited amounts. Of all the SAF pathways currently available, only PtL has the potential to be unlimited (although it will always be constrained by absolute volumes of renewable electricity available), and the SAF mandate should recognise this fact.

Q12: Do you agree or disagree with the proposed use of the medium buy-out price of £2 per litre or £2,567 per tonne for the main mandate, and do you have any evidence to support your response?
Disagree. See below.

Q13: Do you agree or disagree with the proposed use of the medium buy-out price of £2.75 per litre or £3,525 per tonne for the PtL mandate, and do you have any evidence to support your response?
Disagree to both questions 12 and 13.

As mentioned in the executive summary, three criteria should be followed to produce a buy-out price. This follows the precedent currently being consulted on in the ZEV mandate consultation. This proposed three criteria to set a buy out price. Applied to aviation they are:

- it must be greater than the additional cost to produce SAF compared to fossil jet fuel, in order to discourage fuel suppliers from simply making payments rather than supplying SAF
- it must reflect the price of the excess carbon emissions that would result from selling fossil jet fuel rather than SAF, in accordance with cross-government carbon valuation guidance.
- it must be at least as high as the equivalent fines for non-compliance in other markets where there is significant SAF uptake.

Using these criteria completely changes the buy-out prices proposed in the consultation. **T&E recommends that the buyout price for not supplying PtL should be £4.86 per litre, and for other SAFs should be £3.40 per litre, in 2020 prices.**

[1] All details from an email conversation between Luisa Wagner, Communications & Corporate Development at Norsk e-fuel, and Matt Finch.

These figures were derived by estimating the cost of the pollution caused by each litre of fossil fuel sold outside the mandate, by multiplying:

- a carbon intensity of kerosene of 2.56 $kgCO_2$ per litre
- Carbon value of $£_{2020}474$
- Estimates of the carbon intensity of the SAF not supplied: 0 $kgCO_2$ per litre for PtL and 0.77 $kgCO_2$ per litre for others
- A non-CO_2 multiplier of 4, consistent with the GWP_{20} metric consistent with the timeframe of the mandate.

The carbon values used are from the Green Book / DESNEZ supplementary guidance on the valuation of carbon. The highest of the three carbon price scenarios described in this guidance was used. An average price over the duration of the mandate of $£_{2020}474$ was used, although another option for price-setting could be to simply increase the buyout price each year in line with increasing carbon values.

The carbon intensity of PtL and other SAF were assumed to be 0 $kgCO_2$ per litre for PtL and 0.77 $kgCO_2$ per litre for others, based on the assumption that a carbon saving of at least 70% when compared to conventional kerosene would be necessary to meet the sustainability criteria of the mandate.

The non-CO_2 effects of aviation are frequently neglected in Government policy, despite their significance. Due to SAFs lower levels of aromatic hydrocarbons and soot, it causes fewer of the warming effects than fossil fuel causes (but does not completely eliminate them). If SAF is not used, these elevated warming effects also need to be compensated for.

There are a range of multipliers that can be applied to the CO_2 emissions of a flight to estimate the relative impact on non-CO_2, which differ due to the time period considered; some of aviation's impacts on the climate are shorter-lived than others, although their impact on warming can be much higher than CO_2 in the short term. For this estimation, we have used a non-CO_2 GWP_{20}, which estimates the effects over a 20 year time period. This time period is most relevant as the effects should be measured over a similar time scale to the mandate. During the twenty years relevant to the mandate, non-CO_2 effects quadruple the climate impact of aviation. It is acknowledged that a GWP^*_{100} metric could be used instead to remove the issue of time scale, taking the integrated effects over a hundred year time period. In this case, adding non-CO2 effects triples aviation's climate impact.

The main comparable SAF market where there will be penalties is the EU. Fines there will be determined by the individual EU countries. They will have to be at least twice as high as the multiplication of the difference between the yearly average price of conventional aviation fuel and SAF per tonne and of the quantity of aviation fuels not complying with the minimum shares of SAF and e-kerosene. As such, a direct comparable penalty price is not available.

Additionally, the UK should follow the EU's lead and **require suppliers that miss their targets to pay the buy-out price, AND be obliged to make up the shortfall in subsequent years**. This would ensure that no supplier opts to simply not invest in SAF and pay the buy-out price instead.

Q14: Do you agree or disagree with the proposal that a buy-out mechanism should be a permanent feature of the mandate?
Agree.

Q15: Do you agree or disagree with the information we could include in our reviews? Is there anything you feel we haven't considered but should?
Agree.

Q16: Do you agree or disagree with our proposed flexible approach to review timelines?
Agree.

Eligible fuels and sustainability criteria

Q17: Do you agree or disagree that low carbon avgas, low carbon ammonia and low carbon hydrogen aviation fuel, should be eligible for incentives without being subject to obligation providing they meet the sustainability criteria?
Agree, although it should be pointed out that it is perverse that the SAF mandate is incentivising these other fuel types, but not electricity. Globally, the electric plane market is expected to be worth £23.5 billion by 2030, and many routes - including many existing domestic routes - will be suitable for electric aircraft (NB should the mandate be changed to reflect this, then attention needs to be paid to whether electricity used by eVTOLs should be part of the scheme).

Q18: Do you agree or disagree that the definition of aviation fuels should include relevant technical specifications?
Agree.

Q19: Do you agree or disagree with the proposed definition of HEFA? If not, please provide an alternative definition.
Agree.

Q20: Do you agree or disagree with the proposed definition of fuels that will be eligible for PtL certificates to be redeemed against the PtL obligation?
Agree. To stress, PtL fuels should be allowed to initially use all carbon feedstocks, not just DAC. In time, this should be restricted to biogenic andDAC carbon only (see answer to question 10).

Q21: Do you agree or disagree that the SAF mandate should adopt the criteria concerning additionality for RFNBOs that aligns with the RTFO?
Agree, but in addition there should be additional sustainability criteria, again because of displacement effects. Post-2030, green hydrogen and hydrogen-derived SAF should only be considered sustainable if they are either made in the UK, or imported from countries where the local electricity grid is substantially

decarbonised, otherwise UK hydrogen demand would actually increase emissions by displacing renewable electricity use in other countries - a form of reverse carbon leakage.

This means that some of the countries that have the potential for good solar resources should currently be excluded. According to Our World in Data, in 2021 there were 19 countries where over 90% of their electricity came from low-carbon sources.[2] With a 90% zero-carbon grid, even if the last 10% of the grid is coal-fired power generation, then the carbon footprint of the resultant fuel would still meet a 70% GHG LCA saving (this correlates with the EU's rules on RFNBOs).

Therefore, T&E recommends that for PtL to be eligible under the SAF mandate, it should come from the UK or any other country where the local grid is at least 90% decarbonised

Q22: Do you agree or disagree that additionality rules should be introduced for nuclear power that follow the same principles as those currently applied to RFNBOs in the RTFO?
Agree.

Q23: Do you agree or disagree that, where hydrogen is used as a feedstock, eligibility should be limited to biohydrogen derived from wastes or residues and electrolytic hydrogen derived from renewable and nuclear power (when legal powers allow)?
Agree.

Q24: Do you agree or disagree that the contribution of energy content from hydroprocessing should be calculated?
Agree.

Q25: What level should the maximum carbon intensity threshold be set to maintain high sustainability credentials while ensuring enough flexibility to allow a wide range of SAF to be developed? Please provide evidence to support your answer.
See answer to question 26.

Q26: Do you agree or disagree that the minimum carbon intensity reduction should be increased over time? If so, how should it evolve?
The carbon intensity threshold should be set at the same level from the start of the scheme. It is pointless setting up a framework to decarbonise aviation, and then allowing fuel with lower environmental standards to be burnt.

[2] Nearly all of these countries get a lot of their electricity from either hydropower and / or nuclear power (eg Norway and France respectively). Many of these countries also have a less extensive grid than the UKs. For example, 90.48% of Sierra Leone's grid is derived from low carbon sources, but only 26% of its population have access to electricity. Major oil exporting nations - that have expertise in handling and exporting kerosene - tend to have relatively dirty grids. For example, 98.8% of Saudi Arabia's grid is derived from fossil fuels. Energy Monitor has written about this in more depth.

As mentioned in the consultation document, a key ask from industry was to align with an existing scheme. There are two specific schemes of note to British producers that involve jet fuel: The UK ETS and RefuelEU. Under the RTFO, just 26 million litres of SAF was supplied last year, and the SAF mandate will replace the RTFO from 2025: by design, jet fuel will never be supplied under both the RTFO and the SAF mandate at the same time, therefore it is not the right scheme to align with.

Furthermore, the RTFO involves feedstocks that either won't be allowed into SAF (corn, wheat, sugar cane) or might not be allowed (used cooking oil, tallow). BEIS (now DESNZ) previously stated that the UK ETS SAF carbon intensity will be aligned with the SAF mandate, therefore it makes sense to align the UK SAF mandate with the other major SAF scheme that international fuel suppliers will have to adhere to: the EU SAF Mandate. **This version requires a 65% saving for biofuels (RED article 29 para 10), and a 70% saving for the rest from the beginning.**

Q27: Do you agree or disagree that the GHG methodologies used in the RTFO should be adopted in the SAF mandate?
Agree.

Q28: Do you agree or disagree that only disaggregated default values will be provided for downstream emissions while the rest of the SAF lifecycle will require the use of actual GHG values?
Agree.

Q29: Please provide evidence to inform which default values should be provided by DfT for downstream emissions.
No answer.

Q30: Do you agree or disagree that upstream and operational emissions should be included for nuclear power generation at the point of delivery? If yes, please provide evidence of what figure could be used for the default value.
Agree.

Involved parties

Q31: Do you agree or disagree that the Secretary of State should be the Administrator, with responsibility delegated to a DfT administration unit?
Agree.

Q32: Are there any additional powers or duties beyond those outlined above that the Administrator should be granted?
No answer.

Q33: Do you agree with the assessment time for avtur being set at the duty point? Please provide evidence to support alternative approaches.

No answer.

Q34: Do you agree that the duty point is the most suitable assessment time for renewable avgas?
Agree.

Q35: Do you agree that the point of retail sale is the most suitable assessment time for hydrogen? Please provide evidence to support alternative approaches.
No answer.

Q36: Do you agree with the end point of the chain of custody being the 'point of no return' of the relevant fuel?
No answer.

Q37: Do you agree with the use of a 370 tonne (approximately 450,000 litre volume) threshold under which conventional avtur is not obligated within the mandate? If not, please provide an alternative and any evidence to support this.
Agree.

Calculating the obligations and certificate reward UK sustainable aviation fuels mandate consultation

Q38: Do you agree or disagree that the obligation period should run for a one-year period and on a calendar year basis?
Agree.
Q39: Do you agree or disagree with dates for which actions must be completed following the end of the obligation period?
No answer.

Q40: Do you agree or disagree that the calculation of each supplier's obligation to supply SAF should be determined on the basis of energy?
Agree.

Q41: Do you agree or disagree with the calculation of certificates set out above?
No answer.

Q42: Do you consider there to be any potential issues with fraud adopting a continuous approach compared to a banded approach?
No answer.

Q43: Do you agree or disagree with the calculation of the carbon intensity factor?
No answer.

Q44: Is 26.7 gCO2/MJ an appropriate assumption for the average carbon intensity of SAF? Please provide any available evidence if suggesting an alternative value.
No answer.

Q45: In your view, should GHG reductions from CCS be rewarded under the SAF mandate? If so, should the reward extend to net negative emissions (i.e. less than 0 gCO2e/MJ on a lifecycle basis), or should these be supported by an alternative GGR policy or a combination of policies?
No answer.

(NB two question 45s were placed in the original consultation document. The following therefore correspond to the Annex A question numbers and questions).

Q46: Do you agree or disagree with the steps taken by the Administrator and the supplier to discharge the obligation at the end of a period?
Agree.

Q47: Do you agree or disagree with the approach to calculating the HEFA cap?
Agree.

Q48: Do you agree or disagree with the approach to paying the buy-out amount when a supplier does not wholly discharge its obligation?
Agree.

Submitting claims and reporting and fulfilling obligation

Q49: Do you agree or disagree with the approach to creating and closing accounts?
No answer.

Q50: Do you agree or disagree with the approach to submitting claims?
No answer.

Q51: Do you agree or disagree with the approach to reporting, demonstrating compliance with and verifying the carbon and sustainability information?
Broadly agree, but disagree with the verification point.

Currently, the RTFO currently allows fraudulent feedstocks into the country, due to RTFO requirement that only “limited” levels of assurance for sustainability data is needed for verification. “Limited” is defined as *"…nothing has come to our attention to cause us to believe there are errors in the data."*. Essentially, this means that as long as fuel suppliers ask the right question and get a satisfactory answer back they have fulfilled the verification criteria. This is the reason why fraudulent feedstocks are getting into road fuel supply chains.

T&E therefore recommends that a "reasonable" level of assurance should be required for the SAF mandate.

Q52: Do you agree or disagree that the Administrator should validate fuel amount information?
Agree.

Q53: Do you agree to (sic) disagree to the powers granted to the Administrator to validate fuel amounts where information is not checkable against HMRC data?
Agree.

Q54: Do you agree or disagree with the approach to transfer of certificates?
No answer.

Q55: Do you agree or disagree that excess certificates can be used to fulfil the obligation in the following period? If so, do you agree or disagree with the proportion of the obligation that the excess certificates can fulfil?
No answer.

Q56: Do you agree or disagree that excess PtL certificates can be used to fulfil the main obligation?
No answer.

Interactions with other domestic and international policy

Q57: Do you agree or disagree with the proposed approach to align mandate multiple incentives rules as much as possible with the RTFO?
No answer.

Q58: Does the risk of tankering as a result of the SAF mandate justify the introduction of a minimum uplift requirement? Please provide supporting evidence if available.
Tankering is real and happens now. A 2019 Eurocontrol think paper estimated that full tankering already occurs on 15% of flights within Europe, and partial tankering on a further 15%. A 2019 BBC Panorama investigation revealed that British Airways caused an extra 18,000 tonnes of carbon emissions through the practice in 2018. These two pieces of evidence alone suggest that the "risk" of tankering is more than just a risk: it happens, and the Government has to implement policies that stop the practice. Why should airlines that already engage in this practice change their habits and reduce their profits when they are not required to?

Following the EU's proposals makes perfect sense. The UK should include a provision in the final SAF mandate that requires airlines to uplift from the UK at least 90% of the jet fuel they require to reach their end destination.

Enforcement

Q59: Do you agree or disagree with the approach to revoking certificates?

No answer.

Q60: Do you agree or disagree with the reasons for receiving penalties and the approach to issuing penalties?

No answer.

Q61: Which penalty values do you consider to be high enough to be a deterrent but proportionate to the infringement?

Low penalty values will not act as a deterrent: fixed penalties should be much higher than proposed.

Further information

Name: Matt Finch
Title: UK Policy Manager
Transport & Environment
matt.finch@transportenvironment.org
Mobile: +44(0)7881 812 398