Aviation biofuels

Avoiding past sustainability mistakes

TRANSPORT & ENVIRONMENT

Aviation biofuels

Avoiding past sustainability mistakes

June 2016

Summary

Aviation is responsible for 5% of man-made climate change; the sector currently emits around 2.3% of annual global CO_2 emissions. Without action this is expected to grow considerably. Some sections of industry and governments see biofuels as a key avenue for reducing the sector's emissions. ICAO is developing a methodology to assess fuels life cycle emissions. Lessons learned in road transport suggest that while biofuels may play a role in decarbonising the sector, focusing on quantity without properly addressing sustainability concerns – notably direct and indirect land-use change (ILUC) – will backfire. Policymakers must ensure quality first: so that aviation biofuels are better than kerosene from a climate perspective even when including ILUC, and are compliant with sound environmental and social criteria, including a certification scheme. No credible scenarios exist for large-scale production of such biofuels at acceptable prices.

1. The challenge of aviation emissions

Aviation is responsible for 5%[i] of man-made climate change. Its CO_2 emissions alone are expected to increase by up to 300% by 2050[ii] if no action is taken. By 2050, unchecked, emissions from international aviation could amount to 22% of all emissions under a pathway to limit a temperature increase to under 2°C.[iii] The ambition stated in the Paris agreement of limiting a temperature increase to 1.5°C requires urgent emission reductions from all sectors, including international aviation. In particular, meaningful emission reductions need to begin pre-2020 if the 1.5°C target is to have any chance of success.

The Kyoto Protocol tasked parties with working through the UN's International Civil Aviation Organisation (ICAO) to limit and reduce emissions from international aviation, as they are not included in domestic targets. In the almost 20 years since, ICAO has failed to adopt any meaningful measures to reduce emissions.

ICAO has set a target of carbon neutrality from 2020 and is developing a market-based measure to achieve this. However this target is inadequate. To limit a temperature increase to under 2°C, aviation should in 2050 emit 41% less than in 2005.[iv] To pursue a limit of under 1.5°C, the effort should be even greater. Industry, represented through the International Air Transport Association (IATA), has put forward an aspirational goal of a 50% absolute emissions reduction in 2050 compared to 2005; the biggest slice of that commitment it is asserted it will come from biofuels and unspecified 'other technologies' – see below.

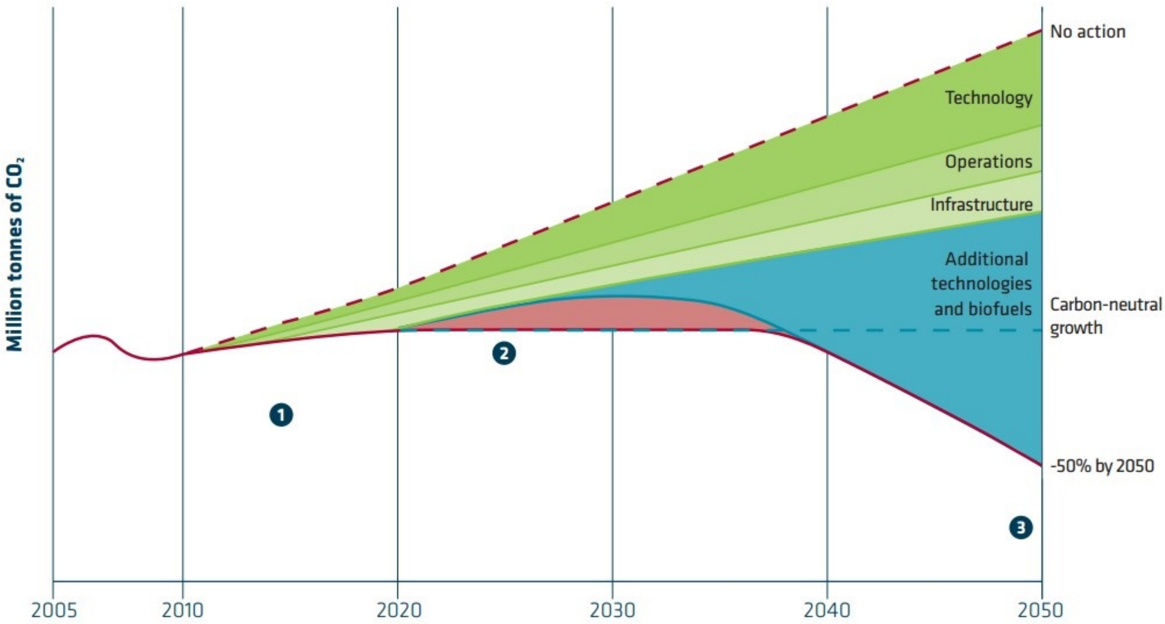

Figure 1: IATA's view on reducing aviation emissions through 2050[v]

The key question is how to achieve either emissions reduction goals. It will need to be a combination of measures, as the diagram above suggests. It is clear that industry intends to rely heavily on biofuels to achieve its target. That is also the case for ICAO, which proposes that an important part of the reductions needed to achieve its target of carbon neutral growth above 2020 levels should, by 2050, come through biofuels.[vi]

But is this a good idea? Only if it is done properly. Biofuels policy in Europe, targeted for road transport, can teach us several lessons. The most important one is that without proper rules and guidelines unsustainable biofuels that are worse than the fossil fuels they replace could be incentivised[vii].

2. A realistic assessment

Some in the aviation sector are very optimistic about the potential of biofuels and are pushing hard to ensure that biofuels will replace as much kerosene as possible in the coming years and decades. But it is important to carefully consider all the pros and cons of such policies.

Efficiency first. Aviation is by far the most climate-intensive form of transport. No matter what fuel is used, the amount of energy that is needed for a person to travel the same distance is greater by air than by any other transport mode. This can first be addressed by measures such as an effective CO_2 design standard for aircraft, an opportunity that was missed earlier this year when ICAO moved to adopt a standard which will have no impact on the efficiency of the sector and potentially a perverse impact.

Land-using biofuels can't be the solution. Figure 1 – the IATA graph – in the previous section suggests that biofuels should contribute around 700 MT of CO_2 reductions by 2050. Assuming – fairly optimistically – that each hectare of biofuels can lead to 3 tonnes of CO_2 savings (an estimate that excludes CO_2 from land use change, that implies that around 230m hectares or 15% of today's agricultural land should be planted for biofuel, all just for one sector.

Aviation should be able to compete for biomass on a level playing field with other sectors. Arguably, the aviation sector has fewer options to achieve long-term full decarbonisation than other transport modes, which is why some argue that the limited supply of truly sustainable biomass should be directed towards it. However, for the foreseeable future there are numerous other sectors, including surface transport, that will not be electrified any time soon. In addition, there are currently perverse factors that prevent fair competition. Aviation enjoys exemptions from fuel tax and VAT for example, so there is no room for incentives such as tax reductions/exemptions, leaving only fuel mandates as an option. And public money is already being spent on funnelling biomass into other sectors, such as power, heat and ground transportation, which have other decarbonisation solutions.

Relying on bad biofuels carries huge risks for industry brands that are exposed to public scrutiny. Biofuels must not contribute to deforestation, biodiversity loss or food insecurity. We must ensure that the policy is right from the very beginning to avoid repeating the same mistakes that Europe made in incentivising investment in unsustainable biofuels for road transport – resulting in wasted money, emissions increase[viii] and lost time. Many of the most sustainable biofuels suffer from a considerable price gap with cheaper fossil fuels, a situation exacerbated by the recent decline in the price of oil. So any support given to aviation biofuels needs to focus on biofuels that deliver real and substantial emission reductions and do not contribute to land use problems.

Prospects of biofuels should not delay action. Decision-makers should be wary of technologies being 'hyped' by industry as a way to undermine other, more effective, policies. A recent study has shown that industry often touts the possible development of new technologies, including biofuels, as a reason to defer concrete steps to reduce the sector's climate impact [ix]. Until there is certainty as to the supply of sustainable alternative fuels, decision-makers should continue and expand proven aviation abatement measures including effective efficiency standards and market-based measures.

3. GHG performance and indirect impacts

ICAO, within the Alternative Fuels Task Force, is developing a methodology to assess fuels life cycle emissions of biofuels[x]. This will be the basis for determining any reductions in offsetting liabilities due to CO2 reductions from these biofuels. Several lessons can be learnt in this regard from the EU's experience. With the Renewable Energy Directive (RED) in 2009, Europe's demand for land-based biofuels skyrocketed as the EU established a volume target for renewables in transport, where most of the demand would be covered by biofuels. To meet it, global biofuel production increased with a direct impact on agriculture worldwide as there were no appropriate safeguards to prevent it. New demand causes the expansion of the agricultural frontier, which in turn causes drastic changes in land use – including deforestation. When rainforests, grasslands or peatlands are cleared for agricultural use, massive amounts of carbon, hitherto stored for hundreds of years, is suddenly released into the air, worsening climate change.[xi]

If the deforested land is used to grow biofuel feedstocks (such as palm oil), the emissions are part of **direct land-use change** (DLUC). The emissions emitted during the destruction of the rainforest for instance, can be directly allocated to the biofuel produced.

Biofuels can also be produced with European crops, such as rapeseed. However, these are also linked to deforestation. If a plot of land previously used to grow food is now used to produce biofuels, new agricultural land is therefore needed elsewhere to compensate for this. This is how increasing demand for biofuels displaces agricultural production to new land. This clearing of new land for agricultural use is called **indirect land-use change** (ILUC).

If land-use change is considered, both direct and indirect, the use of certain biofuels can actually be worse for the climate than the use of conventional kerosene. What is clear is that if we are pursuing a policy for climate reasons (promoting aviation biofuels to reduce the climate impact of the sector), we must be certain that the alternative is considerably better than the baseline (burning kerosene). The graph below shows the carbon intensity of different road biofuels for illustrative purposes with different GHG thresholds, based on the recently released Globiom study[xii], contracted by the European Commission. These biofuels were a direct result of a volume target. This policy backfired spectacularly and net emissions increased.

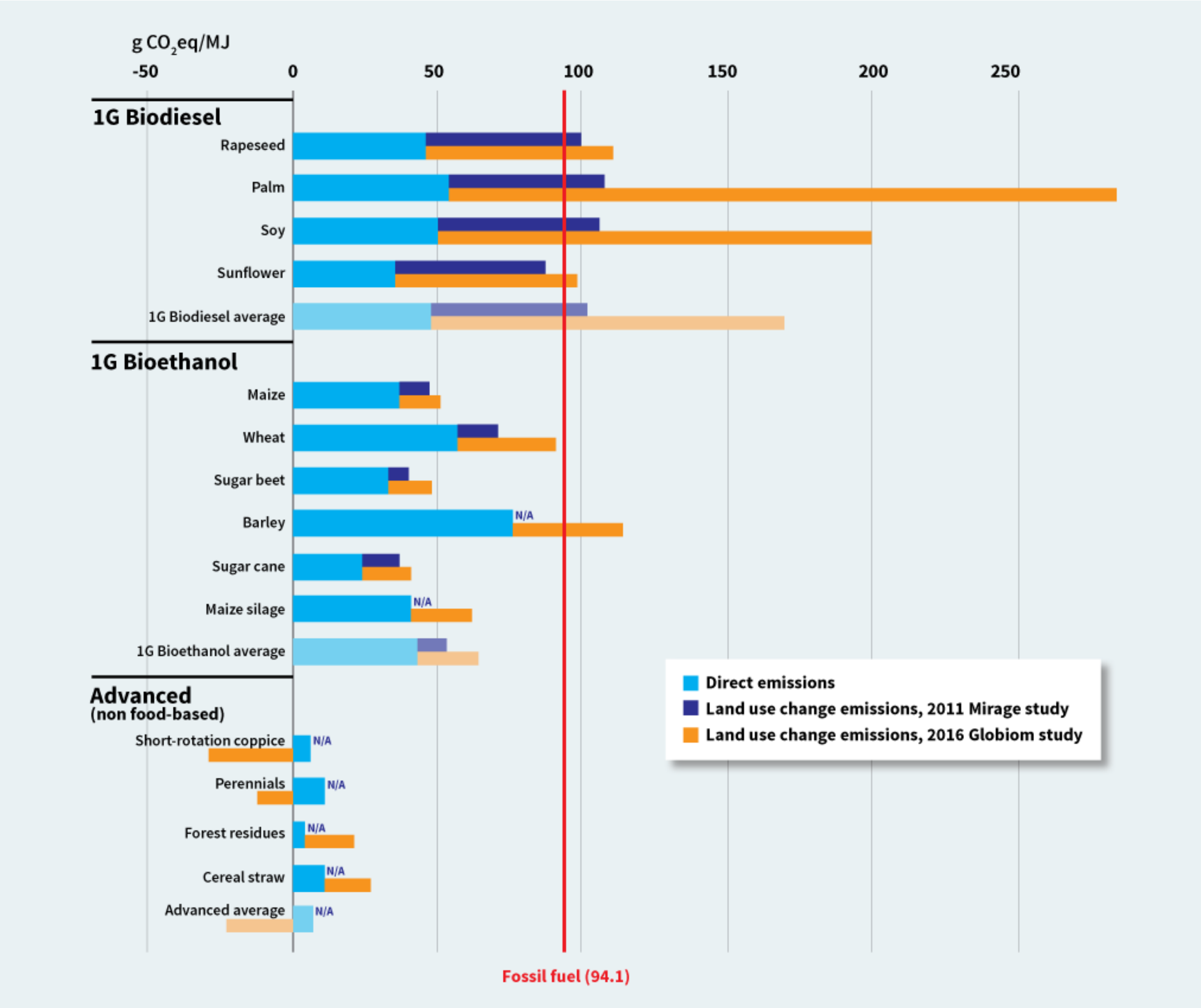

Figure 2: Carbon intensity of different road biofuels [xiii]

Those values refer to road biofuels and the impact of European policy. Even if these values are not directly applicable to aviation biofuels, it is important to understand the impact of the demand that was created by European biofuel policy, which amounted 25 [xiv] Mtoe after a cap on land-based biofuels was introduced. The aviation sector could have energy requirements by 2050 thirty times higher than this figure. The key is smart policies, accurate carbon accounting and sustainability.

4. Sustainability criteria are key

Ensuring that aviation biofuels produce fewer emissions than their fossil counterpart is the very minimum because that is the end goal of switching from kerosene. However, sustainability is about more than climate change. We need to ensure that aviation biofuels are not the cause, for instance, of biodiversity loss or the violation of human rights. Doing this would entail requirements for prior and informed consent for land use and food sovereignty.

Sound and integral sustainability criteria for aviation biofuels must be introduced, monitored, reported and verified. Certification is key to ensuring that aviation biofuels follow established criteria. ICAO should ensure that only truly sustainable biofuels are promoted. The system should seek to build public confidence that aviation biofuels are not having negative impacts, and therefore transparency should be promoted.

5. Scalability and availability

There are a number of exercises underway to establish the amount of biofuels that could be available to the aviation sector over the coming decades. Coming up with an accurate number is, in principle, impossible. Models rely on a large number of assumptions and methodological choices. Sectors compete with each other for this resource, and often the assumptions made do not ensure that the predicted supply would be sustainable and without undesired consequences.

At this stage, governments establishing volume targets would be premature and go against what we have learned from EU biofuels policy reform. If a volume target is established before ensuring it is feasible in a sustainable way, the policy will result in the exact opposite of what it is trying to achieve: reducing emissions. Instead of focusing on quantity, the priority should be defining robust rules for enabling only the production and use of quality biofuels.

The debate must never lose sight of the fact that land, especially arable land is a limited resource. In that sense land-based biofuels are not truly 'renewable' since the land used it lost for other purposes. Using land to produce fuel is inefficient. On three-quarters of the world's land, solar photovoltaic (PV) systems today can generate more than 100 times the useable energy per hectare that bioenergy is likely to produce in the future – even using optimistic assumptions for bioenergy.[xv] What's more, PV installations do not need arable land or water; they work perfectly fine in deserts. The electricity can be converted into hydrogen or hydrocarbons. It is surely not the most energy-efficient pathway thinkable – more than half of the electric energy is lost – but this so-called 'power-to-liquid' is still dozens of times more land-efficient than biofuels. Natural photosynthesis simply cannot compete with photovoltaics on efficiency.

Biofuels should ideally come from feedstocks that would be otherwise wasted. For instance, agricultural residues. But even in that case, agricultural residues play a role in soil fertility and are already used for animal feed and bedding. Such advanced biofuels might play a role, but their role will be limited as sustainable feedstocks are limited and competition exists with other sectors.

6. How to reduce aviation emissions?

6.1. Truly sustainable fuels

Aviation biofuels must be produced from feedstocks that are not primary users of land while having robust sustainability criteria in place to avoid potential negative effects on the environment or the climate. Examples include municipal organic waste, urban wood waste or unused sawdust. Some positive examples are under development, although they are currently facing some financial difficulty due to low oil prices.

Biofuels, however, are not the only alternative for the aviation sector. For instance, power-to-liquids is a process that produces liquid hydrocarbons using renewable sources of hydrogen and carbon, such as water and atmospheric carbon dioxide, while being powered by renewable electricity from solar and wind. This is the type of disruptive technology that needs a considerable amount of research and development as it faces much lower scalability and sustainability obstacles than biofuels.

6.1. Proven measures to reduce emissions

Aviation has long benefited from a favourable regulatory regime which has allowed it to escape meaningful climate action. There is no time for further delay if the sector is to avoid undermining the ambition outlined in the Paris Agreement. Measures need to be introduced speedily and in particular before 2020. We cannot wait for biofuels.

Pre-2020, effective measures would include maintaining and extending the scope of aviation in EU ETS. That scope was reduced to intra-EU flights only until 2017 in order to give ICAO time to work on a global market-based measure (GMBM). However there is no reason why the scope should remain constrained in the period to 2020, and possibly beyond. Extending the scope would be an important aspect of the pre-

2020 ambition required to keep hope of limiting a temperature increase to 1.5°C alive. Other countries should follow New Zealand's lead through putting domestic aviation into domestic emissions trading schemes. China, projected to have the largest domestic aviation market in 2025, is currently considering such a proposal.

The tax-free status of fuel for international aviation continues to inflate the sector's growth and reduce incentives for efficiency. This can be rectified through the introduction of fuel taxation, either at a global level or, to begin with, for routes between groups of states. If effective calculations for CO_2 emissions from biofuels are developed, and sustainability is ensured, these can be used to reduce the tax rate on these fuels, helping to close the price gap between sustainable biofuels and fossil fuels.

For longer-term impact, ICAO must review the recently agreed CO_2 standard for new aircraft. This must have a stringency level that would ensure emission reductions beyond business as usual. Failure to introduce such a standard will lock in unnecessary fuel consumption for decades given the lifespan of new aircraft (20-30 years).

Meanwhile the CO2 metric developed as part of the standard could and should be used for differentiating existing charges e.g. route charges or airport charges on the basis of the CO2 performance of the aircraft.

Regions that operate sales taxes or value added tax should not mandate, allow or operate exemptions for air tickets.

The GMBM being developed by ICAO must have a level of ambition commensurate with 1.5°C and must only use emission units which have a high degree of environmental integrity. The GMBM can facilitate 1.5°C by raising its overall ambition beyond carbon neutral growth from 2020, including by permitting routes between certain groups of states to have a more ambitious baseline. If truly sustainable aviation biofuels are developed they should reduce the extent to which carriers need to offset emissions commensurate with the life cycle calculation.

Further information

Carlos Calvo Ambel
Transport and Energy Analyst
Transport & Environment
carlos.calvoambel@transportenvironment.org
Tel: +32(0)2 851 02 13

Endnotes

[i] Lee et al., 2009. Aviation and global climate change in the 21st century.
[ii] ICAO, 2009. http://www.icao.int/environmental-protection/GIACC/Giacc-4/CENV_GIACC4_IP1_IP2%20IP3.pdf
[iii] European Parliament, 2015. Emission Reduction Targets for International Aviation and Shipping.
[iv] Ibid.
[v] Global Aviation Industry, 2010. The right flightpath to reduce aviation emissions
[vi] ICAO, 2013. Present and future trends in aircraft noise and emissions (Assembly 28th Session No. Working paper).
[vii] T&E, 2016. Globiom: the basis for biofuel policy post-2020.
[viii] Ibid.
[ix] Peeters et al., 2016. Are technology myths stalling aviation climate policy?
[x] IATA, 2014. IATA 2014 Report on Alternative Fuels.
[xi] Birdlife, EEB and T&E, 2014. The little book of biofuels.
[xii] Ecofys, IIASA and E4Tech, 2015. The land use change impact of biofuels consumed in the EU. Quantification of area and greenhouse gas impacts
[xiii] European Commission, 2012. Impact Assessment accompanying ILUC proposal
[xiv] Ecofys, IIASA and E4Tech, 2015. The land use change impact of biofuels consumed in the EU. Quantification of area and greenhouse gas impacts. Transport demand in 2020: 12,294 PJ. 8.4% of this would be biofuels after the cap was introduced.
[xv] Searchinger & Heimlich, 2015. Avoiding bioenergy competition for food crops and land