

Will Bio-Jet Fly? Towards a Carbon Neutral Aviation Sector

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Global governance of aviation emissions

A recent study conducted for the European Parliament estimated that in order to achieve the 2°C scenario as agreed at COP15 in 2009, carbon dioxide emissions would need to be reduced by 41% by 2050.¹ Historically, however, emissions from aviation and many other inherently transnational enablers of the global economy such as international shipping have been neglected at all jurisdictional levels. Due to the apparent difficulty of allocating emissions to individual countries², both the 1997 Kyoto Protocol as well as the more recent 2015 Paris Climate Agreement exclude aviation from their ambit, leaving its governance to the jurisdiction of the ICAO, a UN specialized agency and industry's main governing body at the international level.³

Mounting pressure has, in recent years, pushed both public and private stakeholders to take on more serious commitments. Various targets aimed at reducing emissions have been set at the global and European levels and a number of initiatives created in order to achieve them. The EU's Advisory Council for Aviation Research and Innovation, for instance, sets a 75% reduction target by 2050 (relative to 2000 levels). On the global stage, the International Air Transport Association (IATA) of the world's airlines for its part pledges to achieve "carbon neutral growth" from 2020 onwards and to halve emissions by 2050 (relative to 2005 levels)⁴, while the ICAO's general assembly has committed to annually improve fuel efficiency by 2% as well as to limit carbon dioxide emissions at 2020 levels. The ICAO has, in addition adopted a carbon dioxide certification standard that is mandatory for all aircraft manufacturers worldwide. No binding emission reduction targets have been adopted so far, however.⁵

Aviation has transformed society over the past five decades, effectively shrinking the planet and bringing socio-economic benefits to an increasing number of people. Its unremitting growth does, however, come at a price. Direct emissions from civil aviation account for approximately 2% of global GHG emissions and for 3% of EU emissions. They amount to only a third of those in the road transport sector, but display a high per-passenger intensity and are increasing rapidly along with the relentless rise in demand for air transport. Global projected annual growth rates of 5% up to 2030 could lead to a more than six-fold increase in emissions by 2050 when compared to 1990 levels, which makes aviation the fastest growing source of greenhouse gases in the world. Industry stakeholders are becoming aware of their need to adopt measures to reduce the sector's carbon footprint, if one is to end up anywhere near the ambitious 1.5°C objective set out at COP21.

Achieving the abovementioned goals is dependent on the implementation of what is often referred to as a "basket" composed of various measures regulated to different degrees. This basket includes plans to cut emissions by relying on better air traffic management, improved ground operations as well as technical advances such as enhanced engine and aircraft efficiency. Such measures will surely play a non-negligible role in curbing emissions, but they are not projected to suffice in bringing about the necessary reductions. For this reason, long-term emissions drops are mainly expected to be brought about by the creation of market-based instruments such as the ICAO's global carbon offsetting scheme or the EU's

Emissions Trading System (ETS) as well as by the expansion of the use of sustainable advanced alternative fuels for aviation, otherwise known as aviation biofuels or simply bio-jet (see fig. 1). Establishment of these measures has been slow, however. Both market-based mechanisms and biofuels have been controversial topics in the past years and the bio-jet sector, in particular, lacks a dedicated policy framework.

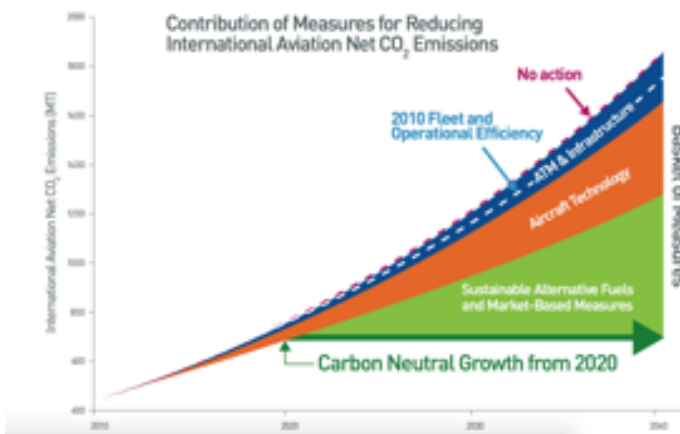


Figure 1. Role of biofuel in emissions reduction for aviation.⁶

Market-based measures

In 2012, the EU attempted to pioneer the creation of a market-oriented framework for aviation emissions by making its emissions trading scheme (a cap and trade system) officially applicable to all flights to and from the European Economic Area, thus forcing both EU and non-EU carriers to cap their emissions or otherwise bear the burden of purchasing emission allowances when flying within EEA territory. Although the European Court of Justice confirmed the legality of the scheme⁷, strong backlash from the international community led European legislators to suspend the allegedly unilateral application of the ETS in 2013. The EU vowed to nevertheless re-instate the scheme, should the ICAO fail to establish a global system by the end of 2016.

On 7th October 2016 the ICAO's 191 member states reached a first and long awaited agreement on the implementation of a global market-based measure: the

Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The scheme aims to compensate any increase in emissions post-2020 by mandating operators to surrender units generated by emission-reducing projects in other sectors.⁸ The political agreement is noteworthy in succeeding to create a starting point for the global governance of aviation emissions. It is expected to result in an operational and sector specific system that is projected to cover 80% of global emissions. Further, it contains a review clause, allowing it to be adapted as the technologies and needs evolve. Yet, reaching the agreement required the watering down of the scheme's initial design – carbon neutral growth already after 2020 and to align ambitions with the Paris Climate agreement that will enter into force later this year. In fact, it allows for emissions to grow unhindered until 2020, with only a pilot phase of the offsetting system expected to be launched in 2021 and, crucially, only voluntary participation up until 2026. Additionally, due to jurisdictional limitations inherent to the nature of ICAO as an UN body, domestic flights are excluded from the agreement's ambit, leaving massive existing and emerging markets like those of the US, EU, India or China unaffected.

The details of how CORSIA will function in practice have yet to be hashed out by specialised working groups, created for that purpose by ICAO. These are attributed the duty to safeguard the spirit of the agreement, by ensuring that its mechanism delivers on the promised emission reductions. In particular, its specifics must be carefully set out and the often painful lessons learnt from the operation of other offsetting measures such as the EU's ETS or the UNFCCC's Clean Development Mechanism should be duly taken into consideration to ensure effectiveness and fairness in its implementation.⁹ Further, the application of additional market-based measures at the local or regional levels should be considered as complementary policy measures to address neglected areas, such as domestically generated emissions. For the ETS in particular, it is now time for EU institutions to

take stock of ICAO's action and to seriously consider the extent to which the block's stance regarding the international application of its cap and trade scheme should or should not be reviewed.

Sustainable alternative fuels

Benefits

Market-based measures, be they at global or regional level, will address aviation's environmental impact to some extent. It appears nonetheless important to also seriously consider methods that directly affect aircraft emissions. As illustrated in figure 1 above, alongside the technological and air traffic management improvements, the most promising measures relate to the development of sustainable alternative fuels. Aviation biofuels are biomass-based fuels that have the exact same technical specifications as current Jet-A1 fuels. Biofuels can thus act as "drop-in" replacements for fossil fuels. They do not require any change in supply infrastructure and can be safely blended with conventionally produced Jet-A1 be it during transportation or use. Aviation, unlike e.g. road transport, relies exclusively on liquid fuels as a safe and certified alternative. Besides the unlikely reduction in air traffic, it seems to offer the main solution for sufficiently narrowing down the gap between the environmental ambitions and actual emissions by 2050. This is acknowledged by the European Commission, which lists advanced biofuels as a particularly important element for aviation in the medium term in its 2016 low-emission mobility communication.¹⁰

Initiatives aimed at developing sustainable alternative fuels for aviation have mushroomed in the past decade.¹¹ Major R&D efforts from over 100 multi-stakeholder initiatives have managed to secure technical certification of four production pathways by the ASTM.¹² Considering the stringent technical specifications and safety requirements to which the aviation sector is subject, this is a genuine milestone in the acceptance of new fuel for commercial flights.¹³ Over 2000 flights with different de-

grees of biofuel blends have taken place as of 2015, and the work to diversify certified pathways, scale-up production and ensure the economic viability of the aviation biofuels sector is ongoing. In the EU, for instance, the Advanced Biofuels Flightpath Initiative launched by the European Commission and multiple industry stakeholders sets out a roadmap with clear milestones and the objective of achieving an annual production of 2 million tonnes of sustainable aviation biofuel by 2020.¹⁴

Direct reduction in emissions through the use of sustainably produced alternative fuels would appear to bring a further benefit as opposed to other methods such as carbon taxes or offsets: in the medium to long term they would help avoid excessive increases in operational costs (and therefore e.g. ticket prices) while maintaining the socio-economic benefits brought about by the development of international aviation. The construction of new supply-chains increases the use of biofuels, which would in turn reduce dependency on oil imports, improve supply security and limit reliance on volatile oil prices. Once sufficiently scaled-up, the use of bio-jet would also contribute to national and regional emissions reduction targets, provided respect for sustainability standards is guaranteed. The high initial cost of using bio-kerosene as opposed to conventional kerosene remains nevertheless the main barrier for the market to take off. Policies and laws that push for further technological advances, promote the construction of the necessary supply chains and allow adequate accounting of bio-jet as a renewable energy source are indispensable long-term transitional measures toward carbon neutrality.

Policy context

Only very small quantities of sustainable alternative aviation fuels are currently available commercially. Insufficient dedicated feedstock supply, high R&D and certification costs, differing sustainability standards and access to fuel supply infrastructure are some of the elements constraining their growth and market up-

take.¹⁵ Although multi-stakeholder initiatives to expand the production and use of bio-jet are being founded, they remain too small and have so far been unable to achieve the necessary scale-up. Crucially, a specific legal and policy framework and targeted financial support aimed at levelling the playing field between sustainable bio-jet and fossil-based kerosene is lacking. Policies that do exist are for the most part directed towards the road transport sector and do not provide the necessary incentives for potential bio-jet producers. Several broad areas for development can be identified, both in the EU and globally, based on the issues identified above.

Levelling the playing field in terms of support

The EU's Renewable Energy (2009/28/EC) and Fuel Quality (98/70/EC) Directives contain provisions that enable Member States to offer financial support to sustainable biofuel production and use.¹⁶ Yet, due to inequalities in technological readiness, production costs and demand between biofuels for road transport and biofuels for aviation, support measures have been focused on road biofuels, as a simpler way for Member States to achieve their 10% renewables in transport target.¹⁷ In 2013, authorities in the Netherlands pioneered a mechanism, whereby aviation biofuels were made eligible under Dutch renewable energy targets. Under this voluntary opt-in scheme, aviation biofuels may generate "green" certificates that can then be sold to parties (e.g. ground vehicle fuel producers) officially obligated by the system. The multiplication of such measures can be beneficial as it would allow bio-jet producers and users to be compensated for contributing to emission reductions in the transport sector and receive financial support from Member States within the already existing regulatory framework established by the Directive 2009/28/EC that, until now, has mostly benefited road transport. Financial support in the form of direct subsidies to producers or users, off-set agreements or public procurement (e.g. for military aviation) seem promising for increasing production quantities, a fundamental element in the upscale of bio-jet if it is to match the abun-

dant availability and prices of fossil-based jet fuel and convince airlines to switch from one to the other.

Feedstock and supply security

At the production level, feedstock availability is essential. Aircraft operators must be guaranteed sufficient and secure supply quantities if they are to invest in developing the necessary supply chains that would bring bio-jet to airport fuelling stations. Here again, there is a need to level the playing field between the already well-established industry producing biofuels for road transport and the emerging aviation biofuels one. Tough performance and safety requirements mean that a bio-fuel that is already suitable for ground vehicles is only an intermediate product for the refineries in the bio-jet transformation process. But because the raw materials for both aviation and ground vehicle biofuels can be identical, road and air uses often compete at that level of the value chain. Indeed, potential producers might prefer to dedicate any available feedstock to the cheaper, simpler and economically viable manufacture of biofuels for ground vehicles over the complex, expensive and currently non-profitable production of bio-jet. In contrast to road vehicles, aircraft are, however, unlikely to benefit from alternative energy carriers such as electrical batteries or natural gas by 2030 or 2050. Biofuels constitute an essential element in reducing emissions in the aviation sector. It is therefore crucial to ensure sufficient flow of raw materials to prospective producers that possess bio-jet manufacturing technology and capability. Targeted legislative incentives, giving priority to aviation over road transport at the raw material harvesting level could ensure a steady supply of advanced feedstock dedicated to bio-jet production. The revision of the EU's Waste Directive (2008/98/EC) in the context of the Commission's recent Circular Economy Package offers opportunities in this sense. Bio-waste has emerged as a promising feedstock for the production of bio-jet. It is estimated that its abundance and local availability could have the potential of providing up to 30% of jet fuel in the EU per year if appropriately exploit-

ed. The proposed amendments to the Waste Directive already contain obligations for Member States to separately collect, recycle and treat bio-waste in an environmentally safe manner. Adding provisions that encourage EU countries to direct organic waste streams towards bio-jet production could help construct the infrastructure and supply chains necessary to ensure a stable, solid supply of bio-jet to airlines while also providing additional environmental benefits such as reduced landfilling and thus, even higher GHG savings.

Sustainability

Reducing emissions from aviation is the main objective underpinning the development of alternative fuels. Ensuring the sustainability of the produced bio-jet is therefore essential. Currently, there exist no harmonized sustainability standards for bio-jet at the international level. In the EU and the US, biofuel sustainability is ensured by Directive 2009/28/EC on renewable energy sources and by the Renewable Fuel Standard respectively. Both instruments set out strict criteria relating to minimum GHG emission savings as well as specific protection of certain types of highly biodiverse land. Although pursuing a similar goal, the two sets of sustainability standards are not identical. Differences exist, for instance, in terms of advancing the stringency of minimum GHG savings throughout the years, or regarding the approach to indirect land-use change – a heated topic in the EU.¹⁸ R&D investments in advanced biofuels have moved these quite high up on the sustainability scale in terms of low or no ILUC effects and high degree of GHG savings. Despite this, the impassioned debates about the calculation methods of ILUC-effects and the changes in legislation have brought a lot of uncertainty in the field. For the aviation sector, which is inherently global in nature, the development of clear criteria at the international level would seem like a logical step forward. Common environmental standards would match the sector's largely harmonized technical and safety requirements as well as facilitate an ample supply of certified sustainable alternative fuels at all major

hubs. To date, the voluntary sustainability certification scheme operated by the Roundtable on Sustainable Biomaterials has emerged as the most likely starting point, should an effort at global harmonization of sustainability standards be undertaken.

Conclusion

Aviation industry stakeholders need to seriously consider adopting effective measures to mitigate the sector's increasing impact on climate change. The many voluntary commitments and initiatives as well as the ICAO's recent offsetting agreement represent steps forward. Nonetheless, additional measures and, in particular, the development of ways to achieve direct reductions in the aviation sector appear necessary. Sustainable alternative fuels for aviation have emerged as a strong candidate in this sense, but they lack a dedicated policy framework and targeted incentives to enable expansion and market uptake. It is essential to ensure harmonized sustainability standards and to level the playing field between aviation and ground vehicles, so as to put aviation on the path to carbon neutrality in the long term.

Footnotes

- ¹ European Parliament, Environment, Public Health and Food Safety Committee 2015, "Emission Reduction Targets for International Aviation and Shipping", IP/A/ENVI/2015-11 (available at [http://www.europarl.europa.eu/RegData/etudes/STUD/2015/569964/IPOL_STU\(2015\)569964_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/STUD/2015/569964/IPOL_STU(2015)569964_EN.pdf)).
- ² Oberthür, S. 2003, "Interactions of the Climate Change Regime with ICAO, IMO, and the EU Burden-Sharing Agreement", Project deliverable D3 (available at <http://ecologic.eu/sites/files/download/projekte/850-899/890/in-depth/unfcc.pdf>).
- ³ Reyes, O. 2016, "Climate Con: why a new global deal on aviation emissions is really bad news", New Internationalist Magazine (available at <https://newint.org/features/web-exclusive/2016/09/27/climate-con-a-new-global-deal-on-aviation-emissions/>).
- ⁴ IATA, 2013, "Reducing Emissions from Aviation Through Carbon-Neutral Growth from 2020", Position paper developed for 38th ICAO Assembly (available at <http://www.iata.org/policy/environment/Documents/atag-paper-on-cng2020-july2013.pdf>).
- ⁵ See Deane, P. et al. 2015, "Biofuels for Aviation", Insight-E Rapid Response Energy Brief, n°5.
- ⁶ See: http://cfapp.icao.int/tools/38thAssyikit/story_content/external_files/Flyer_US-Letter_ENV_MBMs_2013-08-30.pdf (accessed 7 October 2016).
- ⁷ ECJ, case C-366/10, Air Transport Association of America and Others v Secretary of State for Energy and Climate Change, 21.12.2011.
- ⁸ Projects in the forestry sector have emerged as likely candidates in this sense, but remain controversial and are often criticised for imposing harsh climate change mitigation actions on least developed countries and for being highly burdensome from an administrative point of view.
- ⁹ See Hermwille, L. 2016, "Offsetting for International Aviation. The State of Play of Market-Based Measures under ICAO". Jiko Policy Brief, n°01/2016.
- ¹⁰ European Commission 2016, Communication on a European Strategy for Low-Emission Mobility, SWD(2016)244 final.
- ¹¹ For instance, BioPort Holland in the Netherlands, FlyGreenFund in Sweden or CAAFI in the US at national level, ITAKA, CORE Jet-Fuel or SWAFEA at EU level and SAFUG et the global level.
- ¹² The ASTM (or American Society for Testing and Materials) certification is a lengthy process which can take up to 6 years and covers certification of the full value chain running from raw materials (biomass) to the final drop-in product. So far, four production pathways have been certified: HEFA-jet, Fischer-Tropsch, DHC and Alcohol-to-Jet. The maximum allowed blend is currently up to 50% bio-jet.
- ¹³ See Mawhood R. et al. 2016, "Production pathways for renewable jet fuel: a review of commercialisation status and future prospects", Biofuels, Bioproducts & Biorefining, Vol. 10, Issue 4, Society of Chemical Industry.
- ¹⁴ European Commission 2013, "2 million tons per year: A performing biofuels supply chain for EU aviation", Technical Paper (available at https://ec.europa.eu/energy/sites/ener/files/20130911_a_performing_biofuels_supply_chain.pdf).
- ¹⁵ Gegg et al. 2014, "The market development of aviation biofuel: Drivers and constraints", Journal of Air Transport Management, n°39, 34-40.
- ¹⁶ Article 3(3), Dir. 2009/28/EC.
- ¹⁷ Article 3(4), Dir. 2009/28/EC.
- ¹⁸ Jansson, Max S. & Kalimo, Harri 2014, "On a Common Road Towards Sustainable Biofuels? EU and U.S. Approaches to Regulating Biofuels", Pittsburgh Journal of Environmental and Public Health Law, Vol. 8, Issue 2: 104-159.

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