KPMG

Who pays for aviation's decarbonization?

Aviation 2030 series

Introduction

Aviation continues to find itself under increasing pressure over its environmental impact – a trend that will only continue for the foreseeable future. Despite its low contribution to global CO_2 emissions today[1], aviation endures a higher scrutiny than many other sectors with similar or larger footprints, possibly because of its perceived discretionary nature and expected growth in the coming decades.

Aviation emissions are, effectively, hard to abate; as other transport modes or sectors are expected to decarbonize more easily, the industry faces a profound challenge to meet its self-imposed target of net zero by 2050. The task is complicated by the absence of an agreed roadmap, with many of the technologies expected to decarbonize in-flight emissions still relatively far from commercial maturity and scale. In reality, decarbonization may see a complex mix of technologies to tackle aviation's many sources of emissions, each contributing according to its own timeline. Conquering this complexity will inevitably come at a significant cost. Whilst aviation yields proven economic and social benefits through its facilitation of trade, tourism and friend and family bonds, still only a small proportion of the global population flies on a regular basis, and a mere 1% of the world's population is responsible for 50% of commercial aviation's CO_2.[2] This begs a key question for a sector with notoriously poor profitability and a relatively limited pool of frequent customers: who should pay?

> "Commercial airline customers have mixed feelings around how to fund the sector's decarbonization. The social and economic benefits clearly outweigh the environmental considerations for millions of citizens daily, while our research suggests the carbon footprint of comparable journeys is low on priorities. Flight times, airport choice, price remain king."
>
> Chris Brown, KPMG in Ireland

1 The sector accounts for no more than ~2% of anthropomorphic CO_2 emissions, though this becomes around 4-5% of CO_2e (CO_2 equivalent) once non-CO_2 factors like contrails are considered.
2 https://www.lunduniversity.lu.se/article/one-percent-worlds-population-accounts-more-half-flying-emissions

Aviation emissions: a complicated picture

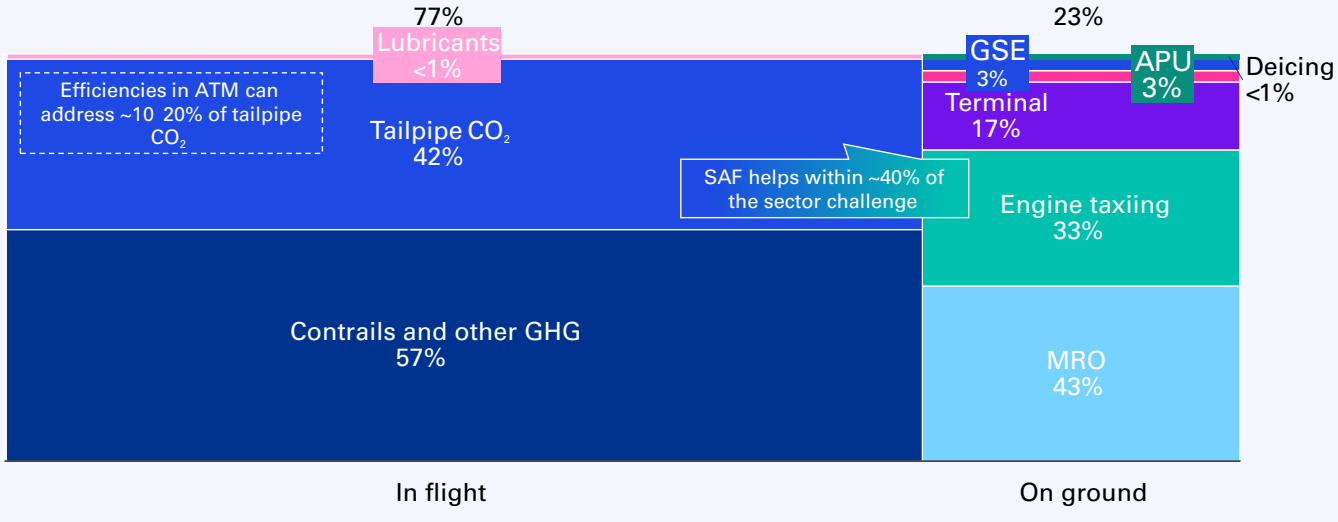
There is no one-size-fits-all technology for aviation decarbonization. In our view, the rapid industry-wide switch to electric and hydrogen technologies advocated by startup founders and the media solves for specific niches rather than the sector as a whole. Initially, electric and hydrogen planes will realistically need to operate within a 'closed loop' of airports with the necessary infrastructure in place, from storage or charging needs to the necessary fire service capabilities. (An upcoming Aviation 2030 report will look into the opportunities and challenges of hydrogen planes in more detail.)

Sustainable Aviation Fuel (SAF), in contrast, is a drop-in replacement for jet fuel. Whilst it faces production constraints, the ability to be used in current planes and infrastructure makes it an attractive option for the next 30 years, with significantly fewer capex implications at the airport. SAF will likely remain attractive even in the longer term, but no combination of fuel or powertrain technology will be sufficient to entirely decarbonize the sector, even on its most optimistic projections. All these paths – electric, hydrogen and SAF – face energy supply chain bottlenecks and system-wide coordination challenges.

New fuels and technology roll-out will instead need to be supplemented by investments in quality offsetting and carbon capture technologies as well as other incremental gains realized through evolved engine design, air space usage, taxiing practices and non-CO_2 emissions reductions (particularly adjusting flight plans to mitigate formation of persistent contrails).

The big picture

KPMG estimated CO_2e breakdown from across aviation



Note: Excludes commutes to airport for passengers and staff; excludes aerospace supply chain for new aircraft. Source: KPMG analysis
ATM = Air Traffic Management; GHG = Greenhouse Gases; GSE = Ground Service Equipment; APU = Auxiliary Power Unit; MRO = Maintenance, Repair and Overhaul

The SAF potential

Besides the relative ease of mitigating contrails, SAF offers the next greatest potential for the next 30+ years of aviation's decarbonization journey. SAF covers a range of technology and feedstock pathways, some relatively proven and already operational, others less so. Voluntary demand for SAF from airlines is increasing rapidly, with many already seeking to secure supplies over multi-year periods. This demand will escalate during the mid to late 2020s, as national and supra-national mandates come into effect, especially in Europe.

However, SAF also faces a real supply scaling challenge. For several pathways this is due to limitations on feedstocks as well as biodiversity, food and water security risks. For example, if the UK's kerosene needs were to be met by domestically sourced biofuel, this would equate to displacing around half of the country's total food production capacity.[3]

In our view, significant SAF scale-up will rely on the expansion of Power to Liquid (PtL) or e-fuels, produced using low-carbon hydrogen and captured CO_2. However, e-fuels are heavily dependent on the rapid expansion of 'clean' electricity production (renewable or nuclear), and highly energy-intensive to produce. If aviation was to rely on the production of e-fuels to decarbonize, for example, it would require current global total electricity production (both renewable and non-renewable) to increase by up to 50%. A considerable ask given only approximately 30% of global electricity is currently renewable.[4]

This all means that when left to free market forces, SAF, today and for the foreseeable future, carries a price premium over fossil fuels. The UK government, for instance, expects ticket prices may increase by up to 15% by 2040 as a result of greater SAF use.[5] As SAF mandates in Europe and several other countries begin to bite, airlines will face a choice between paying this premium or non-compliance penalties, ultimately likely to feed through to the consumer in either case. This is in addition to other climate-related costs for the sector, as Europe and several countries elsewhere begin to tax aviation's carbon footprint. Airlines are likely to challenge the fairness of such penalties, on the grounds that they are levied for non-compliance with meeting SAF supply targets, even though supply is the remit of energy companies.

3 https://royalsociety.org/news/2023/02/net-zero-aviation-fuels-report/

4 iea.org/reports/global-energy-review-2021/renewables

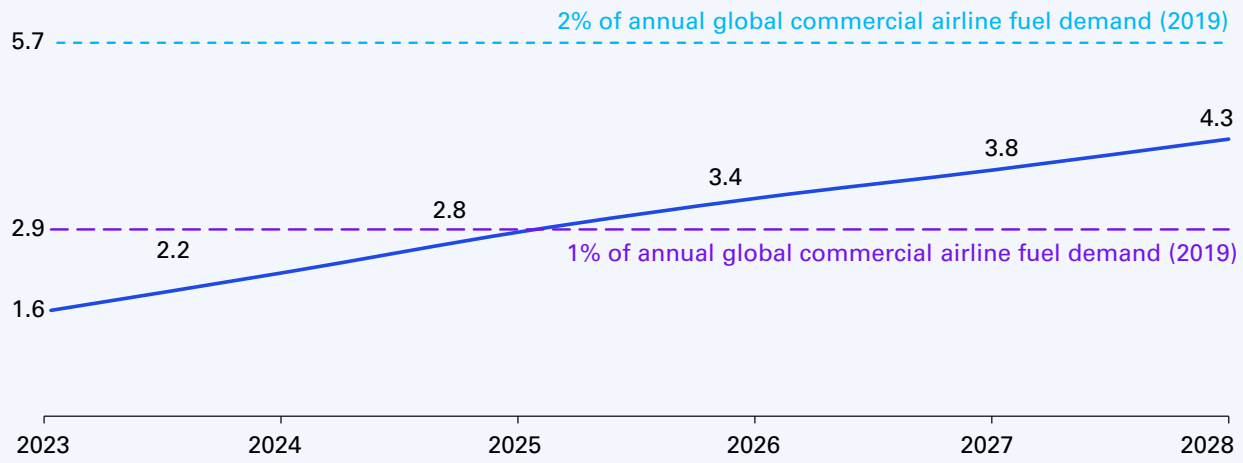
5 The second UK SAF mandate consultation sets out estimates of potential price increases under different feedstock availability scenarios. With low feedstock availability, the UK government expects price increases between 5.8% and 14.5% in 2040. UK sustainable aviation fuel mandate: consultation-stage cost benefit analysis (publishing.

The SAF complication: aligning ambition and reality

According to our analysis of Ishka's SAF database, the announced SAF production pipeline to 2028 barely provides for 2% of jet fuel needed globally by 2030 – a fact starkly at odds with industry and government ambition statements often declaring that SAF targets of around 10% of aviation fuel by the same year look feasible.

Announced SAF production

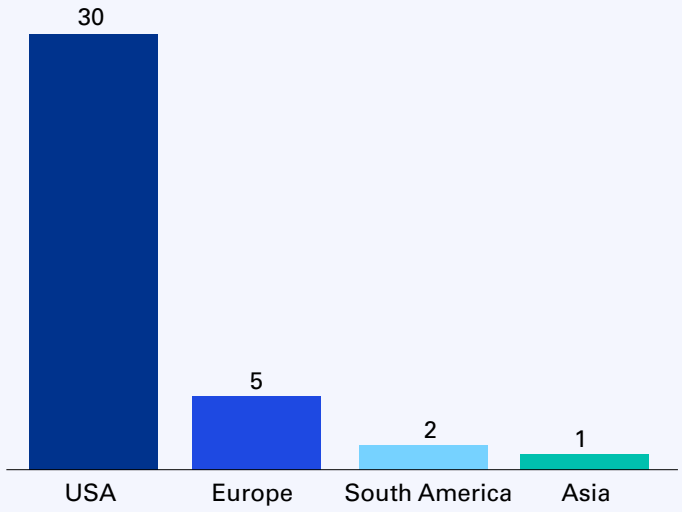
Announced SAF production pipeline to 2028 (million tonnes) today



Note: Assumes constant production for all announced contracting years. Source: Ishka, June 2023

SAF production by continent

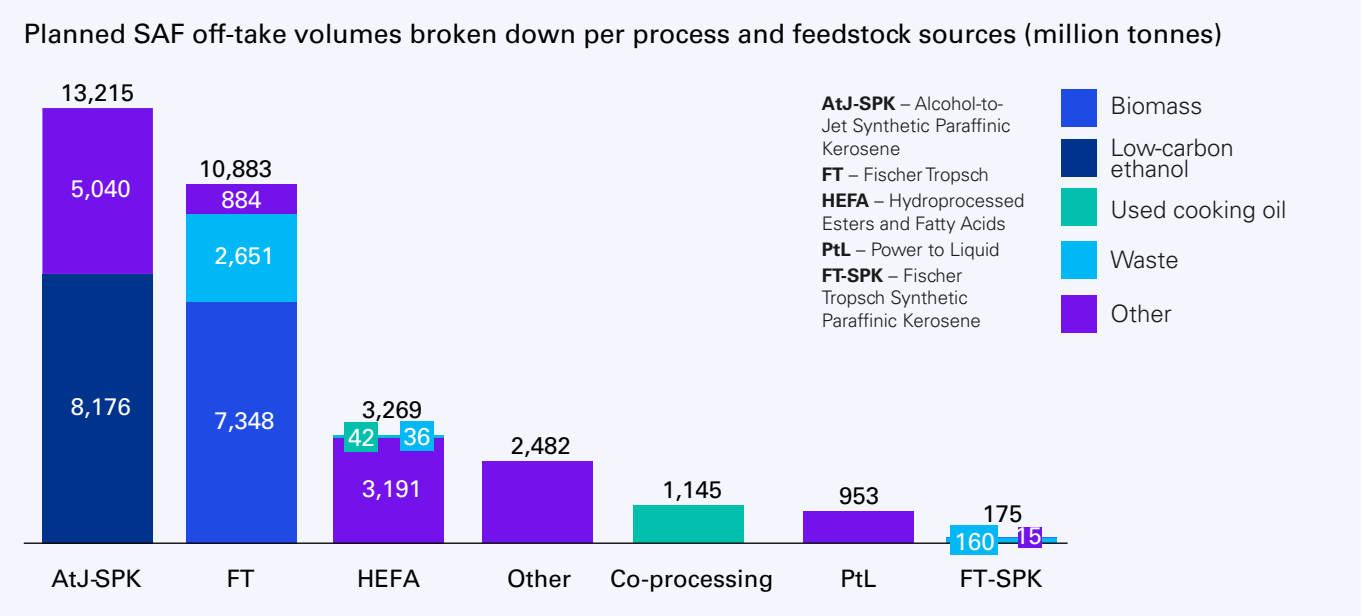
Known SAF production by continent for planned future production (million tonnes)



Source: Ishka, June 2023

In the US, incentives are in place with the Inflation Reduction Act to encourage new SAF projects, contributing to what is becoming a significant capacity lead over the EU. However, the majority of this capacity is reliant on biomass and ethanol feedstocks, raising serious questions about SAF scalability and genuine sustainability. Outside the US, most SAF projects in the pipeline also entail SAF production technologies that face serious constraints on scaling past the 2030s, in part reflecting the major role of agriculture in some policy landscapes.

SAF production by feedstock and process

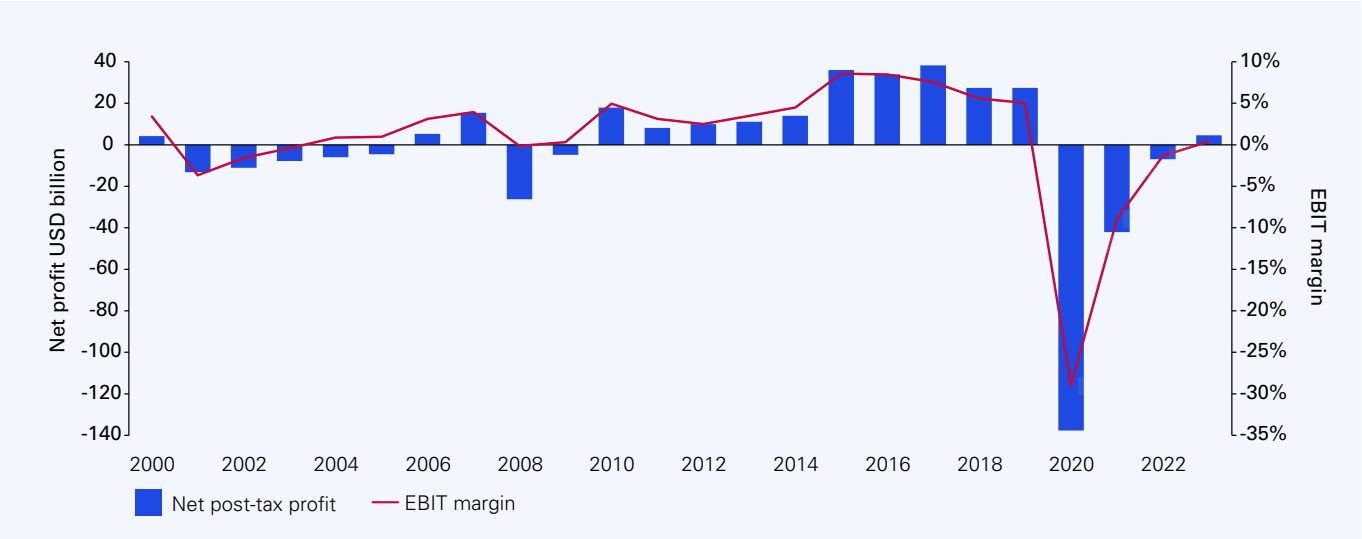


Source: Ishka, June 2023

For an airline seeking long-term decarbonization solutions, these facts present a catch-22. It is not often possible to say with such confidence that demand for a commodity will far outstrip supply in 20 years time, yet that is the scenario with SAF. So, airlines face the challenge of securing sustainable fuel in a way that supports the development of the SAF industry but does not inflate cost premiums, depress profitability, or exacerbate price-based competition.

All this has to be achieved at a moment when the sector is still recovering from the loss of years' worth of profit through pandemic restrictions and related indebtedness, while the efforts by some to curb sector growth (e.g. the Dutch plans to cap the number of flights at Schiphol) may limit its ability to invest in decarbonization further.

Airline industry net profit and EBIT margin



Source: IATA

Finally, with business / first class travel 2-3 times more carbon intensive than economy, there is likely to be particular pressure on this passenger segment as businesses consider how to reduce travel emissions. This can potentially place further downwards pressure on profits (premium classes account for about 5% of travellers but 30% of profits, according to IATA).[6]

6 https://www.reuters.com/business/aerospace-defense/corporate-business-travel-carbon-budgets-loom-airlines-2021-10-10/

The price spiral: where is the limit?

Ultimately, net zero cannot be achieved without additional cost to the aviation supply chain. Additional carbon taxes, SAF price premiums, mandatory offsets, or other measures will all result in ticket price hikes as the sector pays for its decarbonization. Whether consumers will, in fact, stomach these kinds of increases remains to be seen, and is pivotal to the sector's net zero pathway.

To answer this question, we surveyed 950 frequent flyers (both leisure and business travellers across cabins and geographies) and interviewed over a dozen influencers of corporate travel policy to gauge attitudes. Among other findings, we learned the following:

Only some 2% of passenger respondents considered carbon emissions to be a priority when booking a flight.

Across all age groups, fewer than 22% of respondents consider it 'very important' to know the carbon impact of their flights.

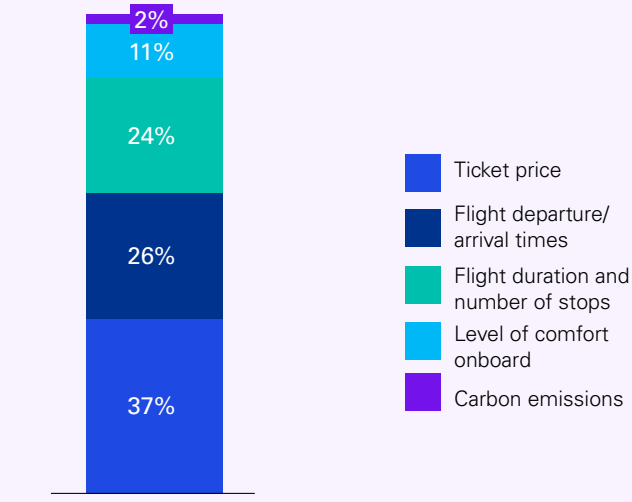
Only 3% of respondents claim to have mitigated the impact of past flying with offsets.

Only 19% of respondents believe that customers should have to pay the premium required to produce SAF. A far larger proportion (43%) believe that airlines should be responsible for this cost.

Fewer than 20% of respondents think that airlines are 'doing enough' to mitigate the environmental impact of flying.

Flight choice factors

When booking an air ticket, how would you rank the following factors in terms of priority? (count of number of times ranked first or second)



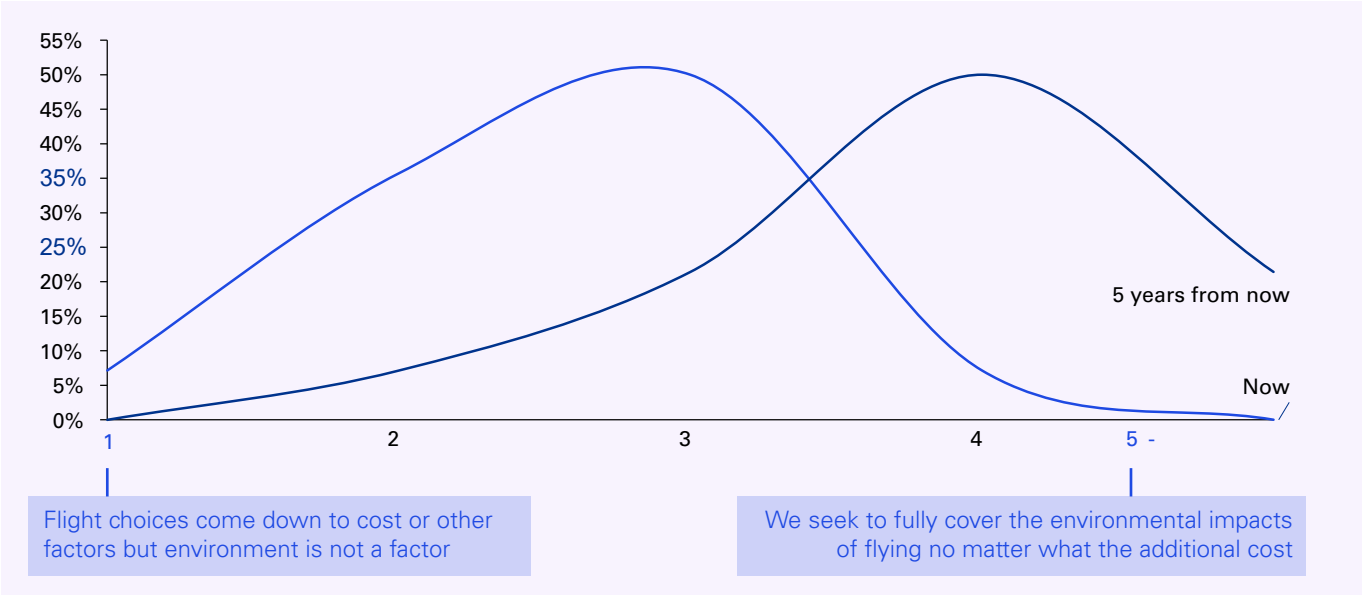
Source: KPMG survey, 2023

These results suggest that it may be difficult, at least in the short term, to persuade consumers willingly to absorb the costs of decarbonization. Any attempt to do so could risk provoking responses that ultimately depress demand, such as switching to other modes of transport (at least for short-haul and / or where dense high-speed rail networks exist). Airlines wishing to pass on the cost of rising SAF prices therefore face a serious public relations challenge.

On the other hand, airlines may take some comfort from the fact that when asked about what ticket price increase would be fair to cover the cost of aviation's decarbonization, respondents generally agreed that increases equivalent to ~USD50 for short haul and ~USD150 for long haul would not materially impact their frequency of flying.[7] In our own modelling, when we account for SAF premiums at 10-50% of fuel blend, these 'tolerable' price uplifts would often be sufficient to cover the airline's increased fuel costs, but variables in local SAF pricing and other factors like offsetting costs could swing that balance.

Meanwhile in the premium world of private jet charters, broker Victor has recently announced the results of a year-long trial with SAF producer Neste, in which they found that one in five customers were willing to voluntarily pay more to replace fossil fuel with SAF, adding over USD1,000 to their 5-figure bookings, on average. Our own survey with those involved in corporate travel policy likewise suggests a willingness to pay a premium, albeit this is still often seen as 'something for tomorrow'.

Where would you position your company's corporate travel policy in relation to the environmental impacts of flying?



Source: KPMG, 2023

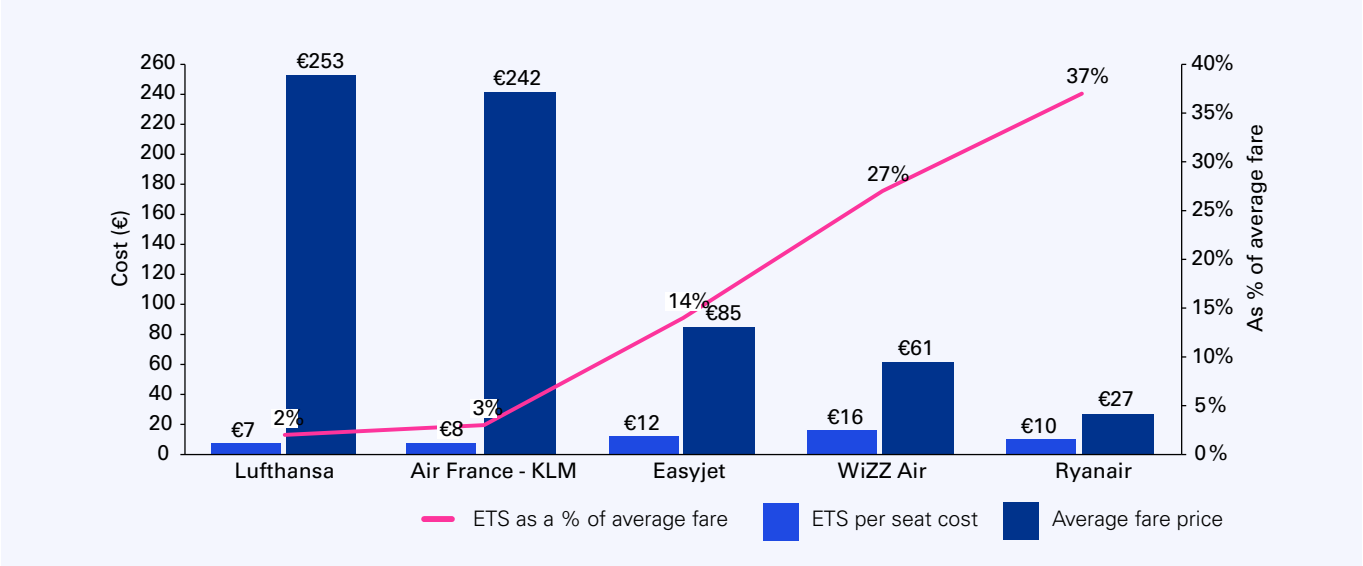
Considering side by side that respondents want airlines to pick up any SAF premium, but are somewhat flexible on ticket price, we see a warning to airlines that seek both a green reputation and to itemize the SAF premium pass-on to end customers. Passengers may be more willing to pay if this premium is seen as incurred by airlines in the first instance as a standard cost of doing business, as opposed to a self-congratulatory green tax on their tickets, although the ultimate effect will be the same.

In the European context, Emissions Trading Scheme (ETS) levies also need to be considered – they are projected to equate to EUR10-20 per ticket (in a low SAF supply scenario) as free allowances that airlines currently receive are phased out. Our survey data would suggest such a price rise is within customers' bounds of tolerance, notwithstanding significant differences across carriers that depend on their geographic areas of operation (only flights within the EU are subject to the ETS) and average fares.

7 A short-haul flight was assumed to cost USD70, while a long-haul flight was assumed to cost USD700.

ETS cost per airline

Modelled EU ETS cost per seat at €150 EU allowance

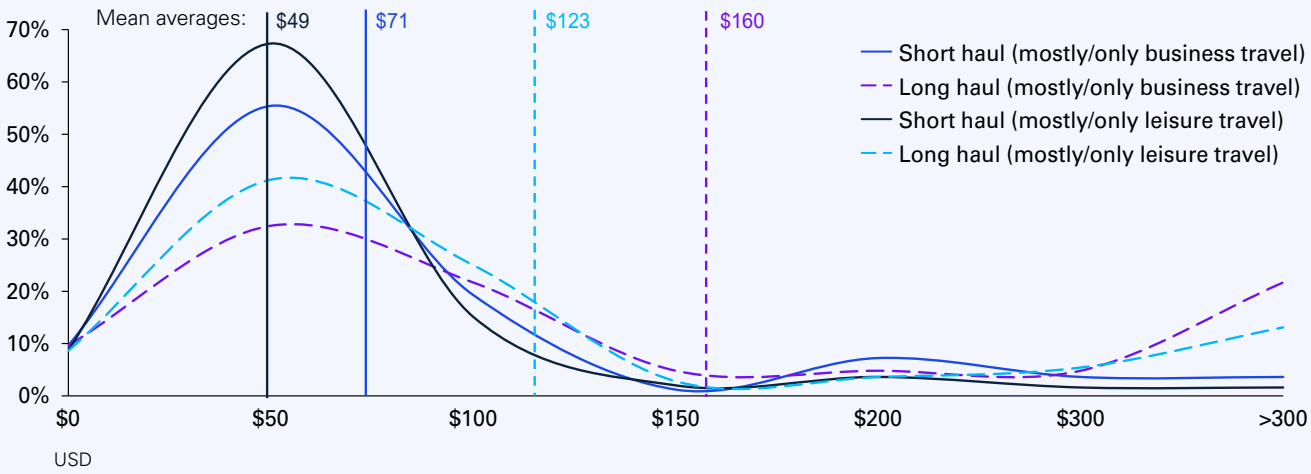


Average airline fair source: Statista Modelled in PACE using EU ETS allowance price of €150

We can expect to see highly varied willingness to pay across different passenger cohorts. Our own survey suggests that low-frequency travellers are much more relaxed about incremental decarbonization costs than high-frequency ones, while attitudes also vary across cabin classes.

Accepted price increases

What ticket price increase would you think is fair to cover aviation's decarbonisation, while not impacting your frequency of flying?



KPMG survey, 2023

For the sector, two major strategic questions emerge: how much ticket inflation will consumers tolerate before it eats at the sector's growth, and therefore its ability to continue to invest in emissions reduction technologies? And for those countries where aviation is of strategic importance (e.g. Ireland, Australia), is there a case for general taxation / investment to mitigate the wider economic and social damage?

> "More than half of the passengers we interviewed believe the government has a key role to play to support aviation decarbonization technology uptake and that technology's price reduction."
>
> Giorgio Parolini, KPMG in the UK

Tough choices loom

Aviation sector leaders and policymakers have a hard job: balance net zero goals with the need to sustain growth and investment levels, as well as – for certain jurisdictions – protect industries of national strategic importance. Sensible decarbonization strategies will involve multiple levers over different periods in the long march to 2050, including carbon pricing and heavy investment in SAF, as well as hydrogen and electric aircraft for regional aviation. With airlines unlikely to meet these costs themselves, policymakers must make choices about who pays, and how they do it. There are a huge range of instruments available, each with its own pros and cons to balance:

Governments can deploy multiple policy instruments to support the uptake of low carbon fuels, with varied benefits and impact (1/2)

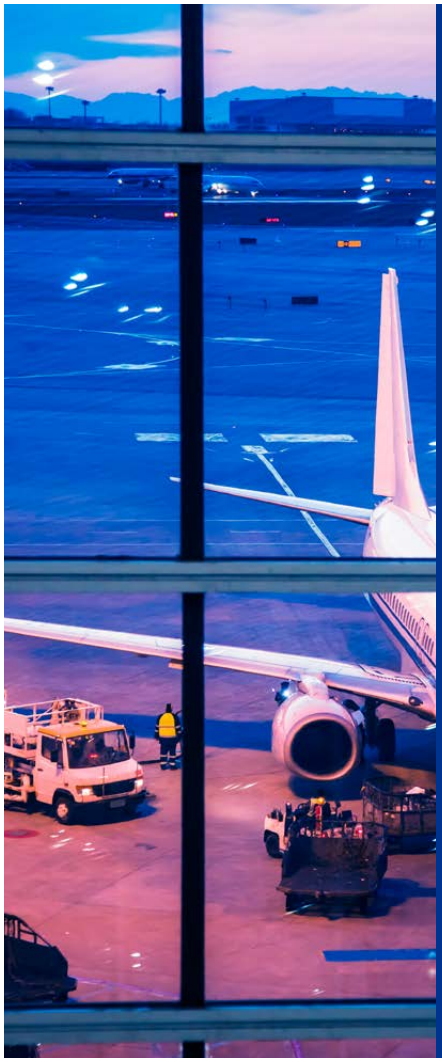
Instrument	Description	Time	Cost	Benefits	Challenges	Incidence	Examples
Ambition and Targets	Public commitment for a volume or blending ambition	Long term	$$	• Reputational • Promotes investor confidence • Complementary with other policy	• Non binding and lacks disincentives or penalties • Oversimplification and lack of deterrents	Taxpayer Industry	
Technical / Regulatory standards and market making	Policies that aim to reduce barriers to market development, such as by addressing information asymmetries	Medium term	$	• Supports the development of efficient markets, facilitating increased consumption & production	• Require a wider portfolio of policies to materially improve market development	Taxpayer Industry	
Stakeholder Engagement	Convening round tables with various actors across the supply chain	Short term		• Raises profile and visibility • Supports supply chain development	• Difficulty obtaining consensus • Non binding and lacks disincentives or penalties	NA	

Governments can deploy multiple policy instruments to support the uptake of low carbon fuels, with varied benefits and impact (2/2)

Instrument	Description	Time	Cost	Benefits	Challenges	Incidence	Examples
Discretionary Grants	One-off investment grants to support production to fuel producers and / or feedstock producers	Short term	$$	• Positive perceived welfare impacts • Promotes investor confidence • Complementary with other policy	• Securing funding (grants are competitive) • Fiscal constraints • Selecting eligible fuels carries risk (e.g. picking winners)	Taxpayer	
Loan guarantees	Safety net in event of project / producer default	Short term	$	• Promotes investor confidence • Complementary with other policies	• Credit risk appetite • Capital requirement in event of default	Taxpayer	
Subsidy and/ or tax credits	Convening round tables with various actors across the supply chain	Short term	$$$	• No upfront cash requirement • Transparent, subsidy level assured and locked in from investor perspective	• Setting the appropriate incentive level to encourage production or demand • 'Lock-in' risk and challenges of winding up subsidy programs • Monitoring and reporting	Taxpayer	
Regulatory Mandate	Blending mandates and penalty for non compliance in the form of a charge or tax	Long term	$$	• Market mechanism and minimal intervention required to maintain volume certainty • Ability to increase obligation over time • Can support revenues via certificates	• Set up and maintenance of buyout / tax price or ticket trading system • Higher costs passed on to consumers, unless offsetting changes to fuel excise or tax • Monitoring and reporting	End-users	
Floor price / Contracts for Difference	Government guarantee a minimum price for the fuel	Short to	$$	• Visible and transparent price • Provides investor certainty • Self-extinguishes as cost curve comes down or price of fossil fuel alternatives increase	• Setting and maintaining floor / strike prices • Monitoring and reporting • Competitive allocation of CfDs and risk of long-term lock-in / limited exit routes	Design-	
Public procurement	Government uses its purchasing power to stimulate growth in target markets (e.g. renewables, green h2, fuel consumption targets, etc)	All		• Generates reliable demand to grow scale for uneconomic goods • Strong community engagement given visibility, can be packaged with broader energy transition policies	• May compel government to purchase more expensive goods & services • Benefits are not replicable in all jurisdictions due to need for scale	Taxpayer	

Access to capital critical

There is a huge opportunity for the financial sector to smooth this complex transition. Success will require innovative thinking on the part of lenders, investors and insurers, which will need to overcome traditional silos (between, say, aviation and energy divisions) to be able to exploit their unique position as inter-industry brokers.



"Sectors are more interconnected and intertwined than ever before. Aviation is a prime example; its decarbonization is a mammoth task and unrealistic without new technologies in the energy sector, such as sustainable aviation fuel and carbon capture, powered with a massive scale-up of low carbon generation. Meanwhile, the energy sector doesn't yet have sufficient confidence in long-term returns on investment in new technologies like e-fuels. This dependency on another sector (and that sector's hesitations) have yet to fully surface across aviation's stakeholder network. Financial institutions can play a major role here, by collaborating across their various industry cluster coverage teams internally to develop alliances, partnerships, and blueprints. With foresight, financial institutions can accelerate the path to net zero, to the benefit of their internal and external stakeholders. Financiers that pro-actively assume such responsibility are likely to enjoy a competitive advantage."

Ulrike Ziegler, Chair, Impact on Sustainable Aviation.

Ultimately, answering the question of who pays for aviation's decarbonization is likely to be a fraught process. While passengers may tolerate SAF and / or ETS premiums on tickets that have often been implied as larger than they are, only 2% of surveyed passengers ranked carbon emissions amongst their top two priorities when choosing flights, and so are unlikely to do so voluntarily. The case for governments to do so is likely to face piercing scrutiny, and the ability of airlines to bear green premiums is in doubt. Navigating this uncertainty is arguably the strategic priority for the industry. In our view, SAF represents its best short-to-medium term potential, but only if suitable incentives are enacted to radically scale supply – measures which are largely still absent and for which aviation needs to make more friends in energy and finance fairly quickly in order to be heard. In the long term, the industry might hope and work for an attitudinal sea change from customers on the importance of decarbonization, whilst ensuring this does not translate to radically depressed volumes.

> "The chicken-and / or -egg challenge here is individual airlines being brave on baking in long-term SAF off-take premiums into ticket prices, without inviting other airlines to undercut on ticket prices. Ultimately, it is worth bearing in mind that the decarbonization premiums we envisage are often dwarfed by existing ticket price differences based on airline cost structures."
>
> Chris Brown, KPMG in Ireland

To conclude, we draw out some specific actions by player type which remain largely consistent with our previous papers:

Airlines

- According to our data, passenger awareness of and engagement with aviation's decarbonization ambitions is low (for example, only 47% of our sample was aware of battery or hydrogen technologies for flight, and only 36% aware of contrails). Educate passengers on industry net zero commitments, actions, costs and benefits and ensure any communication campaign is simple and transparent.
- Advocate for government support and strategic clarity on advanced technologies and particularly the rapid scaling of e-fuels.
- Mitigate contrails proactively before the sector loses another PR battle on the backfoot (more to follow on this in the Aviation 2030 series).
- Secure long-term, fixed-price SAF supply contracts and consider investments in production to give the energy sector the required comfort to accelerate its pivot.

Energy players

- Long-term demand for SAF is there. Push for long-term offtake agreements with airlines – derisk by courting new sources of funding, e.g. the aviation finance community, the green finance community.
- Consider long-term exposure across biofuels vs. e-fuels, keeping in mind that first-mover advantage has already passed on the former, while is still to play for on the latter.
- Sooner or later, political and public scrutiny will ask why the energy sector isn't investing more in SAF. Get on the front foot.

Lessors and investors

- SAF, especially e-fuel, provides an opportunity for the aviation finance community to diversify risk within a sector it already understands well, pre-empting future environmental scrutiny on the wider aviation value chain which could otherwise dampen the long-term growth rate of the global fleet.

Policymakers

- The currently-announced SAF production pipeline is wholly inadequate to meet industry ambitions for up to 10% of aviation fuel by 2030. This is a supply chain challenge that needs policy attention on the energy sector more so than it does on the demand side and airlines.
- As SAF can only assist with ~40% of commercial aviation emissions, wider incentives will be required that incorporate contrails and renewed attention on airspace efficiency gains.
- Care will be needed to balance decarbonization ambitions with local competitiveness, especially in jurisdictions where aviation is strategically critical. This likely translates into different national blends of policy funding, to balance who ultimately pays between the general taxpayer and the end customer.

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