Aviation Impact Accelerator (AIA)

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2030 Sustainable Aviation Goals: Five Years to Chart a New Future for Aviation

Introduction

The aviation sector stands at a pivotal crossroads. It holds the potential to drive systemic, transformative change — or risk falling irreversibly behind in the race to achieve net-zero emissions. Building on insights from the **Aviation Impact Accelerator's model**, our latest report, *2030 Sustainable Aviation Goals*, identifies the most critical leverage points within the aviation ecosystem. These leverage points can trigger decisive interventions leading to powerful, sector-wide shifts. The four Sustainable Aviation Goals outlined in this report are specifically designed to focus efforts on these key areas, significantly raising ambition and laying a robust foundation for achieving net-zero aviation by 2050.

It is also vital to challenge a dangerous misconception embedded in many existing net-zero aviation pathways: the idea that transition will be smooth, with multiple technologies coexisting beyond 2050. History shows that technological transitions are rarely smooth; competing technologies typically vie for dominance until one prevails and displaces the others. This misperception of a smooth transition is harmful, as it creates the illusion that delaying action will result in only a minor increase in emissions by 2050. The findings of this report, supported by the Aviation Impact Accelerator (AIA) model, clearly demonstrate that this assumption is flawed. Transformative change will close — with profound implications for the sector and the climate alike. The next five years are not just an opportunity; they are a necessity.

The five-year plan involves immediately implementing four Sustainable Aviation Goals which provide a plan for delivering net zero aviation by 2050. These goals originated during the inaugural meeting of the Transatlantic Sustainable Aviation Partnership, held at MIT in April 2023 with representatives from the UK, US, and EU governments. The report was launched at New York Climate Week 2024 in partnership with King Charles III's Sustainable Markets Initiative.

The figure below shows the current trajectory of the aviation sector, alongside the projected scenarios for achieving net zero aviation by 2050 through implementing the 2030 goals outlined in the AIA's report. The shaded regions show the uncertainty of the various scenarios. The first thing to take away is that the current trajectory is highly uncertain, where in the worst case aviation is doing more climate damage than if we did nothing. The second thing to take away is that there is a wide range of possible pathways to net zero by 2050, two being shown here, but that these all require strong action over the next five years.

2030 Goal 1: Operation Blue Skies

In 2025, governments and industry should create several Airspace-Scale Living Labs to enable, by 2030, the start of deployment of a global contrail avoidance system. These labs must have the capability to test, learn, and pivot approaches while operating within a realistic airspace environment.

Aviation's climate impact extends beyond CO_2 emissions to include nitrogen oxides, stratospheric water vapour, particulate matter, and particularly, the formation of persistent contrails. Among these, contrails have the most significant warming effect, generally comparable

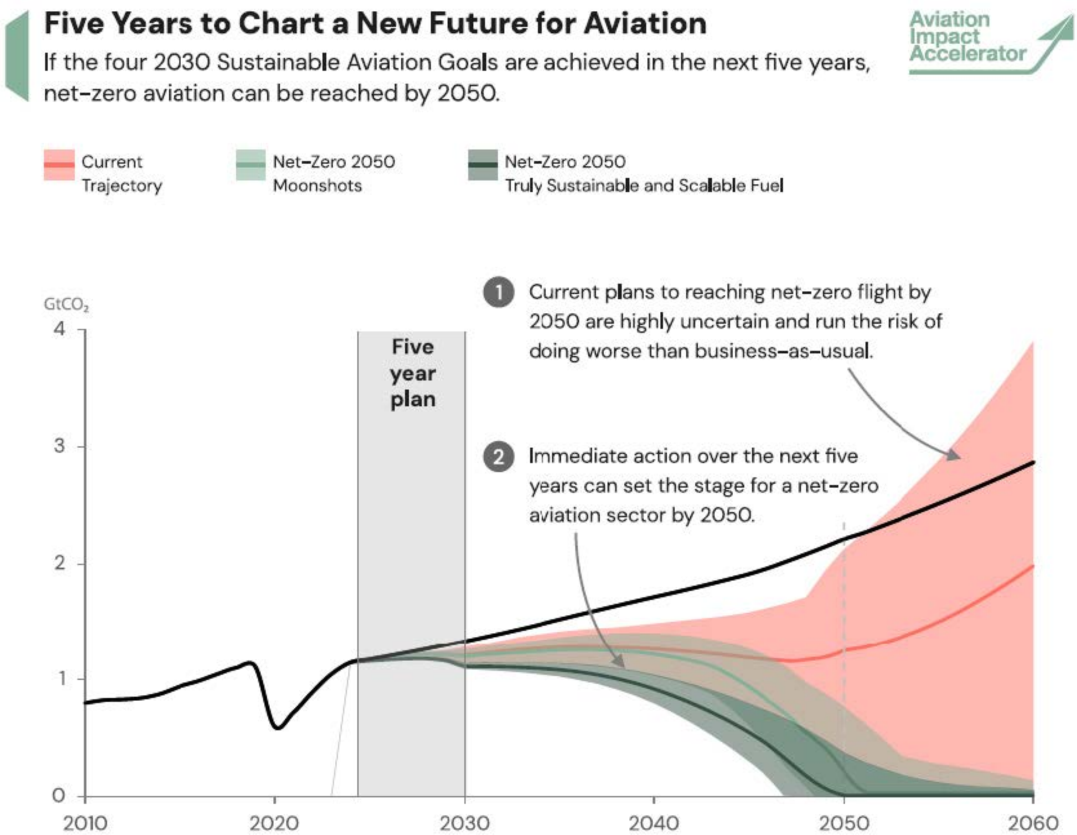
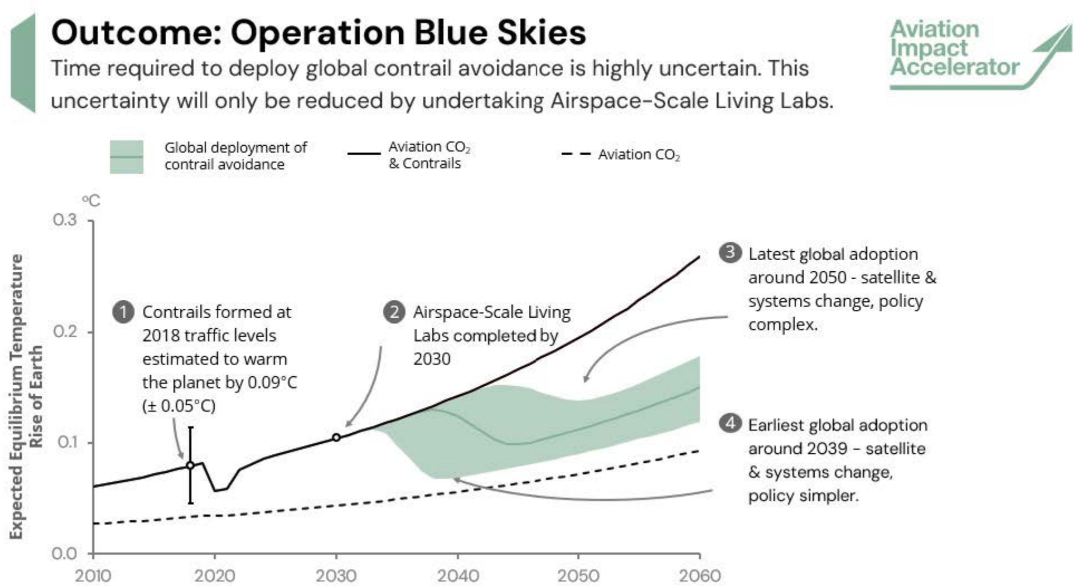


FIGURE 1



Assumptions: Equilibrium climate sensitivity of 0.80°C/(W/m²) (c.f. 0.86°C/Wm², IPPC AR6). 2018 contrail ERF 57.4 mW/m² ±70% (Lee *et. al.* 2021), scaled with demand; AIA model for km demand growth (~3.8% p.a.) & efficiency gain (accounts for next generation aircraft). Permission to deviate aircraft for targeting avoidance of all persistent contrails scales from 0% to 85% (barriers, Teoh et al. (2020)) and 95% (no barriers) after scale-up; success rate: 60% (barriers), 90% (no barriers)

FIGURE 2

in magnitude to CO_2 emissions, though with far greater uncertainty. The climate impact of persistent contrails is due to their warming impact as they spread into cirrus-like clouds trap in heat.

The climate impact of global aviation in 2050 is shown in Figure 2. This shows that the projected climate impact of global aviation CO_2 in 2050 is approximately 0.07°C, while the warming from the formation of contrail cirrus clouds could add between 0.035°C and 0.2°C. When the impact from contrails is acknowledged, total climate impacts from aviation are significantly higher than the impacts from CO_2 alone, as Figure 2 illustrates.

Persistent contrails can be avoided by adjusting an aircraft's altitude in regions where contrails form, known as Ice Supersaturated Regions (ISSRs). These regions are pancake-shaped—wide but shallow—making altitude changes effective in preventing contrail formation. However, predicting the location of ISSRs is uncertain, and altitude changes can increase fuel consumption by a few percent.

The main challenge in implementing an effective contrail avoidance system lies in the numerous uncertainties, from the underlying science to the variety of potential implementation methods. The ideal way to address these uncertainties is through a learn-by-doing approach in a realistic, field-based environment. To facilitate this, several Airspace-Scale Living Labs must be established by the end of 2025. These Labs must be designed for iteration—capable of testing, learning, and pivoting as experience is gained. If successful, the outcome of a global contrail avoidance system, launched in 2030 is shown as the green region in Figure 2.

In developing these Labs, it is crucial to draw on experiences from fields where public confidence is paramount, such as medical trials and epidemiology. Each Lab should be designed to represent the real nature of the challenge in a particular region of the world i.e., to capture the full range of weather and flight traffic conditions that are likely to be encountered. The Labs should also be conducted at a scale that accurately replicates real-world complexities while ensuring statistical quality and following a transparent review process.

The objective of the Labs is to develop the experience and strategic planning necessary to start the deployment of a global contrail avoidance system by 2030.

Goal 2: Systems Efficiency

In 2025, leading governments should set out a clear commitment to the market about their intention to drive systems-wide efficiency improvements. In tandem, governments and industry should work together to develop strategies so that, by 2030, a new wave of policies can be implemented to unlock these systemic efficiency gains.

Reducing fuel burn in aviation can be achieved through conventional measures such as new aircraft and engine technologies and improved operational efficiency. These conventional measures, shown in red in Figure 3, can lead to up to a 22% reduction in fuel burn by 2050.

However, several bold efficiency measures exist which are currently hard to access because they involve systems-wide change. These measures are shown in green in Figure 3. If implemented, these measures could reduce fuel burn by up to 50% by 2050. Figure 3 shows both the fuel burn reductions which could be achieved by both conventional and bold measures, broken down into the various actions.

The three types of bold measures include:

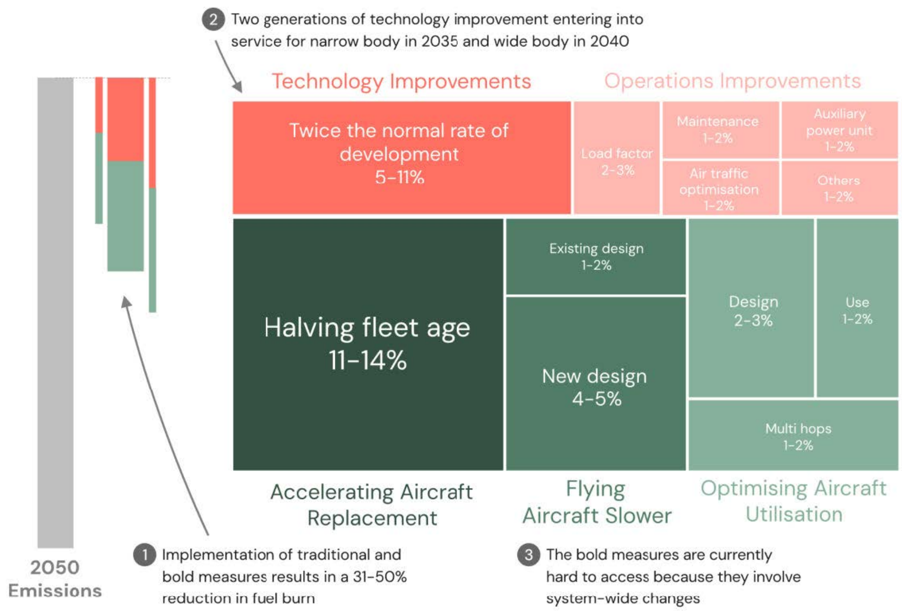
1. **Accelerated Replacement**: Increasing aircraft production to halve the fleet age.
2. **Fly Slower**: Reducing flight speed by around 15%, increasing transatlantic flight times by about 50 minutes.
3. **Match Range**: Ensuring more aircraft operate close to their design range by introducing new aircraft types and optimising purchasing and operating practices.

These bold measures are often overlooked and said to be too difficult because they are not under the control of individual organisations and require sector-wide reforms. However, all net zero pathways for aviation are hard and it is important that governments understand what policies are required to drive these systemic changes and what market signals are required.

Examples from other sectors show what's possible: the US Corporate Average Fuel Economy (CAFE) standards cut automotive fuel burn by 25% since 1975, with similar initiatives in the EU, Japan, and China. Aviation could

How can Fuel Burn be Halved by 2050?

Bold strategies like accelerating aircraft replacement, flying aircraft slower, and optimising aircraft utilisation can significantly reduce fuel burn.

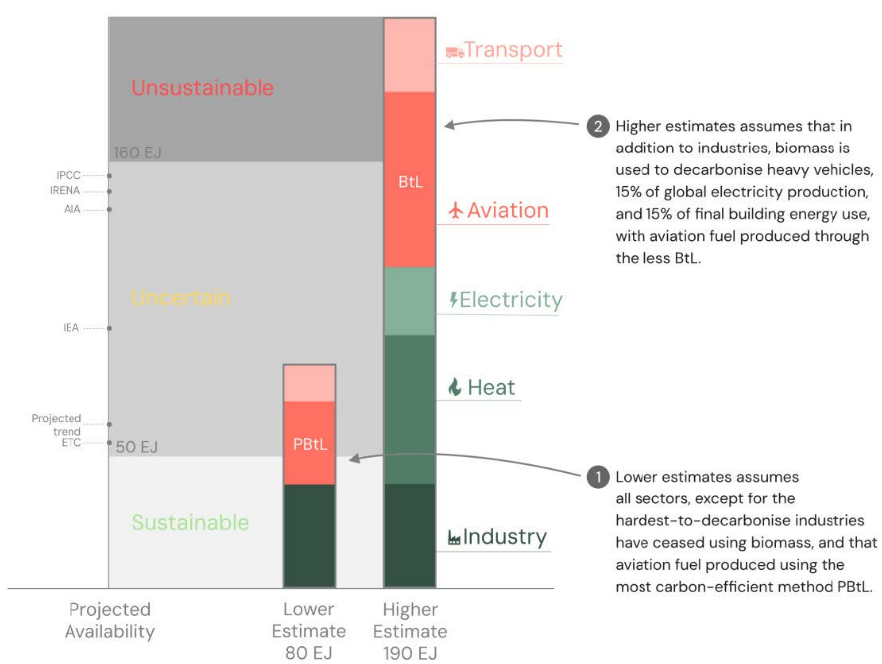


Assumptions: Other operations include decreasing aircraft weight (e.g. lighter seats) and use of automated operations and fuel management systems at airports (source: ICAO (2022)). Analysis on fleet age is based on global fleet data (Oliver Wyman 2020). Analysis on flight speed is based on work conducted at MIT (Yutko (2014), Lovegren (2011)). Analysis on range is based on data reported by ICCT (2020).

FIGURE 3

How much Biomass do all Sectors Require?

The total global biomass required to decarbonise all sectors, including aviation, by 2050 is estimated to be between 80 EJ and 190 EJ.



Assumptions: Biomass projections sourced from: ETC (2021). IEA (2023). IRENA (2022). IPCC (2011). The biomass allocation to transport (shipping, heavy & off-road vehicles) is the co-products of SAF production. Biomass projections exceeding ~160 EJ require significant land use changes, which are assumed to be unsustainable without other major shifts e.g. food production. AIA model used for 2050 biomass requirements for SAF & co-products. Lower estimate based on ETC (2021), higher estimate based on IRENA (2022) (non-transport effects).

FIGURE 4

Aviation Impact Accelerator (AIA)

follow suit by introducing Green Mandates for annual fuel reductions, offering loan guarantees for efficient aircraft purchases, reforming taxation to accelerate fleet turnover, and incentivising aircraft scrappage.

Goal 3: Truly Sustainable and Scalable Fuel

In 2025, governments should reform Sustainable Aviation Fuel (SAF) policy development to adopt a cross-sector approach, enabling rapid scalability within global biomass limitations. By 2030, governments and industry should implement a demonstration and deployment strategy that enables SAF production to move beyond purely biomass-based methods, incorporating more carbon-efficient synthetic production techniques.

Globally, progress is being made in deploying Sustainable Aviation Fuels (SAFs). One key resource for the production of such fuels is biomass – which provides the carbon critical for the development of the fuel. However multiple sectors draw on and are planning to draw on this resource, and producing it has implications for land use which is already highly pressured. There are real limitations to the scale of biomass that can be safely deployed across the economy and constraints on the sources.

Figure 4 shows two cross sector scenarios for future global biomass demand. In a lower-demand scenario, only the hardest-to-decarbonise industries continue using biomass, and aviation fuel is produced using the most efficient method. In a higher-demand scenario, biomass is also used to decarbonise heavy vehicles, parts of electricity generation, and building energy use, with aviation fuel made less efficiently. Even this higher estimate assumes an ambitious shift away from biomass in other sectors. The key takeaway is that by 2050, global biomass demand will vary significantly depending on how aggressively other sectors transition to alternative solutions and how aviation competes for limited biomass resources.

Current SAF policies focus narrowly on reducing aviation's life cycle emissions, overlooking the broader impact of biomass demand on other sectors. Without reform, SAF production could drive up emissions elsewhere, undermining both its environmental benefits and long-term scalability. To avoid this, aviation must adopt a cross-sector perspective that prioritizes minimizing total emissions across the economy. This shift offers aviation a chance to lead globally by promoting coordinated, sustainable biomass use. Governments must urgently reform SAF policies to enable cross-sector planning, giving industry the certainty to invest. By 2030, they should advance SAF production beyond biomass-based methods, incorporating more carbon-efficient synthetic techniques, and ensure aviation develops its own low-carbon electricity and green hydrogen supplies without diverting resources from other sectors.

Goal 4: Moonshots

In 2025, launch several high-reward experimental demonstration programmes to enable the focus on, and scale-up of, the most viable transformative technologies by 2030. These programmes must generate the necessary experience to assess the technology's scalability and develop the expertise required for deployment.

The primary pathway to decarbonising aviation currently focuses on producing Sustainable Aviation Fuels (SAF). However, the substantial resource requirements and complexity of fuel production present significant challenges and risks in realising this approach.

Relying solely on SAF could be avoided through the adoption of transformative technologies. In the automotive sector, for example, the shift to battery electric vehicles reduced both the planned and potential dependence on biofuels. Similar transformative technologies for aviation could include cryogenic hydrogen or methane fuels, hydrogen-electric propulsion, or synthetic biology to dramatically lower the energy demands of fuel production. Each of these technologies offers the potential to reduce aviation's resource requirements and simplify fuel production compared to SAFs. By investing now in frontier technologies, governments have a once-in-a-generation opportunity to lead in transforming aviation, much like electric vehicles have reshaped the automotive industry.

However, for such an effort to achieve significant climate benefits by 2050, demonstration programmes must be launched immediately. These programmes should be

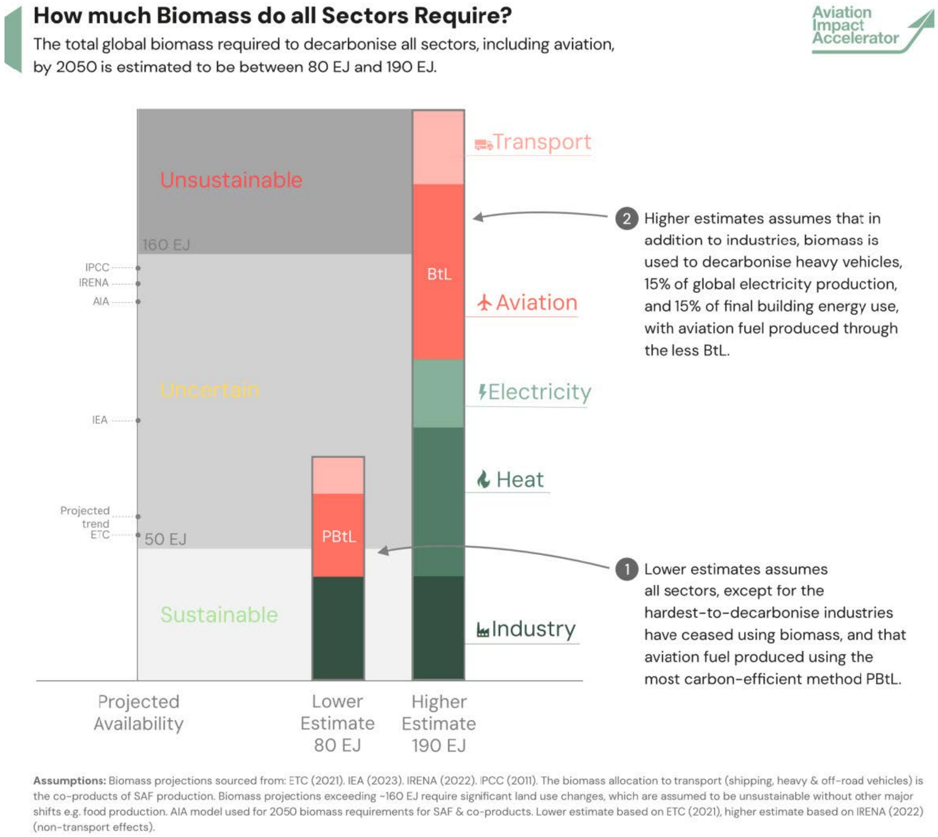


FIGURE 5

designed to give real insight into the viability of new technologies by 2030, allowing the focus on and scale-up of the most viable transformative technologies shortly after. They must generate the experience needed to assess the scalability of these technologies and develop the expertise required for their deployment.

The relative cost of the Moonshot demonstration programs is relatively small, however the cost of implementing them, if successful is not, because they require a significant change to the aviation sector. The cost of the transition to liquid hydrogen fuel on the average ticket cost is shown in Figure 5. The key take-away is that the ticket cost of hydrogen in 2050 is comparable to introducing biofuel but is more affordable than fuels like Power-and-Biomass-to-Liquid.

Conclusion

If the ambitious five-year plan outlined in this article and detailed further in the *2030 Sustainable Aviation Goals* report, is implemented, the aviation sector could be set on a credible path to net zero by 2050. Each of the four Goals targets a critical leverage point for system-wide change. Failure to implement and achieve them by 2030 would close the window for meaningful transformation, leaving the world to confront the escalating climate consequences of an aviation industry projected to at least double in size by 2050. The urgency of this moment cannot be overstated.