

Research for TRAN Committee – Investment scenario and roadmap for achieving aviation Green Deal objectives by 2050

KEY FINDINGS

- As part of the European Green Deal decarbonisation targets, emissions from EU aviation will need to decrease significantly.
- Decarbonising aviation is challenging because of long aircraft replacement cycles and the lack of viable zero-carbon alternatives to kerosene fuel in the short-term. Most of the reduction will occur after 2030; emissions are expected to decrease by 61 % from 2030 to 2050.
- Achieving reductions requires a multitude of technical measures, such as improvements in aircraft technology and operations, together with a significant uptake in the use of sustainable aviation fuels (SAF).
- New zero-carbon aircraft using hydrogen may be available for all market segments between 2030 and 2040, but this is too late to be the main means for decarbonising aviation.
- Significant investments of EUR 378 billion between 2020 and 2050 will be needed to replace aircraft and introduce new technologies. This investment may deliver improvements in efficiency leading to lower operating costs for the industry, potentially balancing out the increase in fuel costs as a result of wider uptake of SAF.
- The EU supports this transition by funding research and development activities on aircraft and air traffic management (ATM) technologies, together with the deployment of digital and physical ATM infrastructure.
- The EU should continue to use funding and regulatory action to support increased production of SAF to achieve large scale cost reductions and technology maturity.
- Expanding the scope of the Taxonomy Regulation to include activities such as the sale or lease of more efficient/low-carbon emission aircraft, aircraft manufacturing and technology development aiming at/supporting decarbonisation, and production, storage and distribution of SAF, would attract green finance to the sector.



The European Green Deal and the challenge of decarbonising aviation

This study assesses the cost to decarbonise aviation by 2050, the technologies to do so, and the European Union (EU) role in this process. Meeting the targets for a decarbonised European aviation system will require

The present document is the executive summary of the study on Investment scenario and roadmap for achieving aviation Green Deal objectives by 2050. The full study, which is available in English can be downloaded at: <https://bit.ly/3r4hvlT>

significant reductions from aircraft, through more efficient technology or low-carbon fuels, which form the focus of this work.

The European Green Deal targets carbon neutrality by 2050. Overall, the transport sector is expected to contribute a 90 % reduction in emissions relative to 1990 levels; decarbonisation scenarios from the European Commission indicate that emissions from European aviation are expected to be 89 % lower under the Green Deal. While emissions are expected to peak by 2025, the majority of the reduction will come after 2030, declining by 61 % from 2030 to 2050, and significant residual emissions will remain by then. Aviation is considered a difficult sector to decarbonise (due to substantial obstacles in electrifying aircraft) and will require measures on several fronts – technological, regulatory, financial.

Technological landscape

The study considered a wide range of developing technologies to support the decarbonisation of the aviation sector:

- Aircraft technologies;
- Operational measures;
- Sustainable aviation fuels (SAF).

Technologies were identified that could reduce energy consumption of aircraft by up to 50%¹. While efficiency improvements are expected, several issues will limit the impact of new technologies on emissions:

- i. Manufacturers will wish to avoid high business risks of launching new aircraft with multiple new technologies;
- ii. Most aircraft in the market have been released recently and will not be upgraded for several years;
- iii. Aircraft have long replacement cycles: many aircraft delivered in the coming decade, with current technologies will still be flying in 2050.

For the past two decades, the EU has been developing its Single European Sky to improve air traffic management (ATM), which may offer fuel savings of 9-11 % by enabling aircraft to fly at optimum speed and altitude.

One area offering great potential is SAF (drop-in fuels, hydrogen, electricity), which can offer emissions reductions of 20-100%. While hydrogen and electricity will require novel aircraft types and may not be available for all market segments before 2040, drop-in SAF has the potential to reduce aviation emissions today. The main constraints on drop-in fuel use are the price and availability at commercial scale.

Table 1-1: Effects of technologies and alternative fuels on emissions in 2050

	Tank-to-wake (TTW) emissions (MT)	Well-to-wake (WTW) emissions (MT)	Change in WTW emissions relative to baseline
Baseline	150.2	184.8	
With technologies	67.0	82.4	-55.4 %
With technologies and alternative fuels	31.6	18.4	-90.1 %

Source: Authors' calculations using demand data from the [2020 Reference Scenario](#), energy consumption data from the [MIX scenario](#), energy efficiency assumptions for technologies and emissions factors from [ICAO Annex 16 Volume IV](#).

¹ The greatest reduction in energy consumption identified for an individual technology is 50% for the full-electric propeller-driven aircraft.

To meet the objectives of the Green Deal, WTW emissions in 2050 need to be less than 49.1 MT (a reduction of 73 % relative to the baseline value of 184.8 MT in Table 1). Table 1 shows that aircraft technologies and operational measures alone will not deliver these objectives. Including alternative fuels, however, allows the targets to be met with a comfortable margin.

The development of new technologies, the purchase of new aircraft with those technologies, and the uptake of SAF will impose costs on the aviation industry. While the purchase of aircraft with new technologies is expected to lead to *additional* costs (compared to aircraft with current technology) of EUR 378 billion between 2020 and 2050², with the research and development (R&D) of those technologies incurring costs of EUR 50 billion³, the increased efficiency of new aircraft is expected to give fuel cost savings of EUR 395 billion (2020-2050). The overall costs of decarbonisation measures are expected to be about EUR 33 billion between 2020 and 2050⁴.

EU role – legislation

The EU has and will continue to have an important legislative role in strengthening the decarbonisation of aviation. The main areas of action have been:

- Market-based measures to support emissions reduction;
- Aviation fuel;
- Financial incentives to promote measures on infrastructure.

Perhaps the most consequential EU action to date has been including aviation in the EU Emissions Trading System (ETS), which requires all airlines operating in the EU to verify and report their emissions. However, its scope was limited by excluding flights to outside the EU and granting airlines a certain number of free allowances. The EU ETS is expected to be amended, removing free allowances and integrating it with the ICAO CORSIA scheme, which may improve its effectiveness.

Two proposals on aviation fuel are included in the 'Fit for 55'⁵ package. First, an amendment to the Energy Taxation Directive will impose a tax on fossil kerosene used as jet fuel. Second, the ReFuelEU Aviation Regulation will impose a blending mandate requiring the minimum proportion of SAF in aviation fuel to increase from 2025 to 2050. Together, these two initiatives offer substantial potential to shift demand from fossil fuel towards SAF.

The main EU tool on financial incentives is Regulation (EU) 2020/852, the Taxonomy Regulation, which defines environmentally sustainable economic activities and sets a framework to facilitate sustainable investment in economic activities associated with major GHG emissions. The Regulation already covers a number of activities that can support the decarbonisation of the aviation sector, such as the production of hydrogen and biofuels, and the construction of low-carbon airport infrastructure.

EU role – funding

Existing EU programmes have typically funded R&D for aircraft and ATM-related technologies, as well as deployment of the technologies. While these are key areas in the pathway to decarbonisation, an important share of future investments will need to cover the commercial availability of new fuels and purchase of more efficient aircraft. The EU can play a role in creating the necessary regulatory conditions for commercial products to be more widely available and providing financial support (loans or grants) to spur investment in the low-carbon fuels market. For example, the EU could promote the uptake of lower emission aircraft and the shortening of the aircraft

² For context, some estimates put the costs of achieving the European Green Deal objective of carbon neutrality across the EU economy at up to EUR 800 billion *per year* for the next 30 years, (Consultancy.eu, 2021).

³ Estimated development costs here should be considered those supported through major European research programmes. The additional costs to take a new technology through to a new aircraft type are borne by the manufacturer and are uncertain and significantly higher. These latter costs are not considered in this study.

⁴ All values in the text are undiscounted. The application of discount rates changes the magnitude of these total net costs.

⁵ The EU is working on a revision of its climate, energy and transport-related legislation under the Fit for 55 package to align current law with the 2030 and 2050 ambitions.

replacement cycle via the inclusion of the sale or lease of more efficient aircraft in the Taxonomy Regulation.

Policy recommendations

The EU can accelerate progress in aviation decarbonisation by taking action in a number of fields:

- The EU should continue to pursue a multifaceted approach and act in all areas of aviation, including deployment of new aircraft technologies, market-based measures and wider use of SAF.
- The EU can continue to play a key role in innovation through ongoing support for R&D of new technologies for aircraft, ATM and SAF. Funding from the EU ETS for aviation and the proposed tax on kerosene could be earmarked for research in these areas.
- Increasing the production of SAF and hydrogen is crucial. Without large-scale production of sustainable fuels, it will be impossible to achieve the targeted emissions reductions. In its funding and regulatory capacity, the EU can play a role in this market to ensure that all types of SAF are produced in the necessary volume.
- EU action will be needed to certify SAF (in collaboration with other economic blocks), ensure that feedstocks are prioritised for aviation (and other sectors where decarbonisation depends on drop-in fuels), and create the conditions for investment in production capacity (and potentially support that production capacity directly).
- To incentivise investment in aviation decarbonisation, the Taxonomy Regulation should be expanded to include activities such as the sale or lease of more efficient/low-carbon emission aircraft, aircraft manufacturing and technology development, and production, storage and distribution of SAF.

Further information

This executive summary is available in the following languages: English, French, German, Italian and Spanish. The study, which is available in English, and the summaries can be downloaded at: <https://bit.ly/3r4hvlT>

More information on Policy Department research for TRAN: <https://research4committees.blog/tran/>



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