

THE PRICE OF NET ZERO

AVIATION INVESTMENTS TOWARDS DESTINATION 2050

EXECUTIVE SUMMARY



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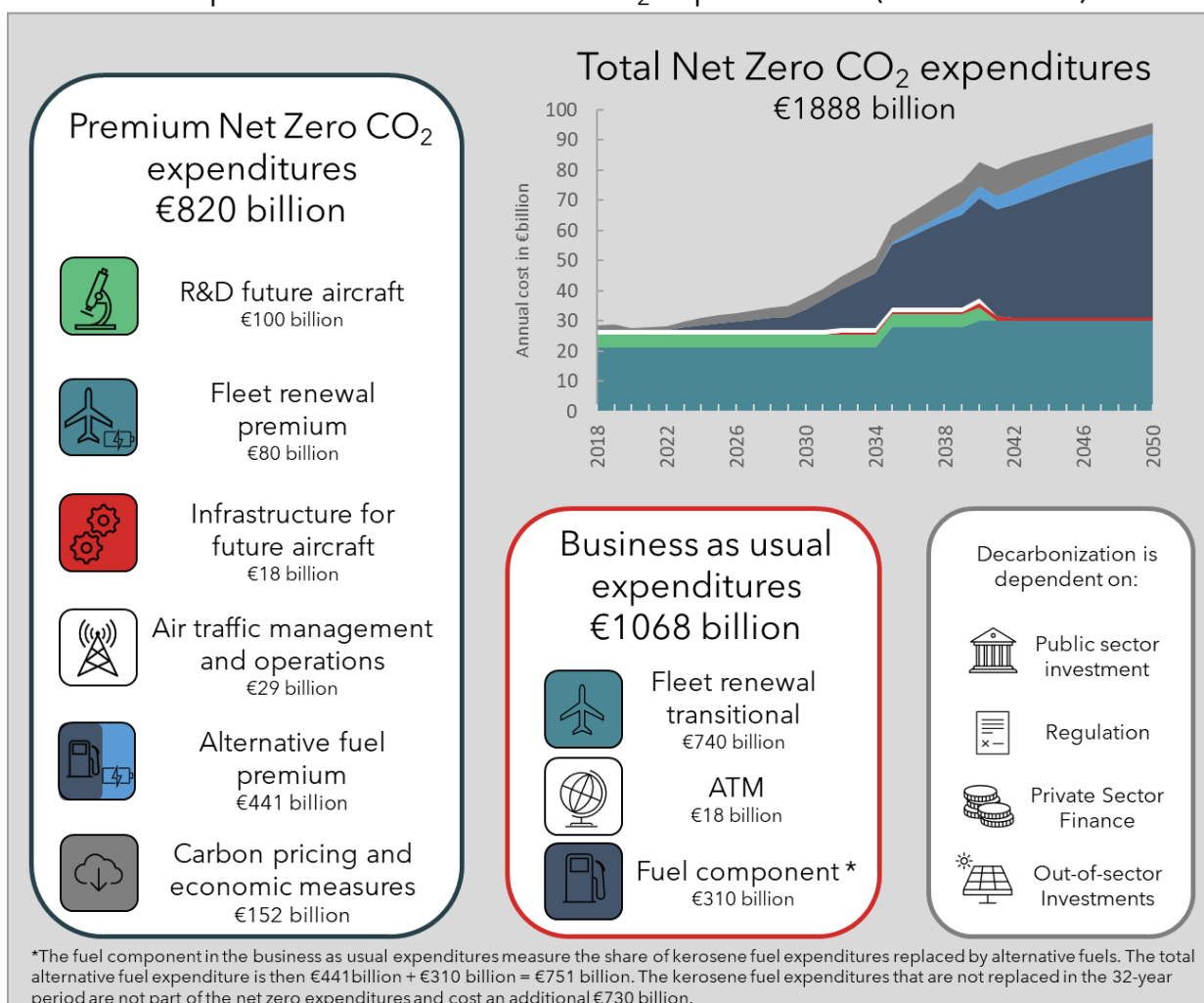
Executive Summary: The Price of Net Zero

Expenditures needed to reach net zero aircraft emissions for European aviation by 2050 require considerable additional efforts compared to business as usual. The premiums paid towards new aircraft technologies, air traffic management, sustainable aviation fuels and negative emissions amount to €820 billion over the 32-year period. A successful, on-time decarbonization therefore requires sufficient access to finance and public investments, which in turn depend on supportive legislation.

In this study, SEO Amsterdam Economics (SEO) and Royal Netherlands Aerospace Centre (NLR) calculate the expenditures necessary to achieve net zero aircraft CO₂ emissions along the Destination 2050 pathway. The investment needs and associated cost are identified for the four main mechanisms of emissions reduction: technology, air traffic management (ATM) and operations, sustainable aviation fuels (SAF) and economic measures.

Figure S.1 Destination 2050 expenditures

European Aviation Net Zero CO₂ Expenditures (2018 - 2050)



The total price premium towards achieving net zero, i.e. the sum of expenditures entirely towards sustainability is €820 billion, see Figure S.1. This sum is composed of:

- €441 billion towards drop-in sustainable aviation fuels (54%),
- €152 billion for carbon pricing and economic measures (19%),
- €100 billion future aircraft research and development (12%),
- €80 billion towards fleet renewal with advanced, ultra-efficient future aircraft (10%),
- €29 billion for realising efficiency improvements in air traffic management (ATM) and ground operations at airports (3%),
- €18 billion for realising the necessary infrastructure to support alternatively fuelled future aircraft (2%).

As this study is limited to expenditures with a direct relation to aircraft carbon emissions, expenditures related to (e.g.) maintenance, repair and overhaul, personnel costs, and other fees and charges are considered out of scope and are as such not included in the presented estimates.

Total expenditures and business as usual

The total expenditures towards Destination 2050, the sum of business as usual (BAU) expenditures and premium expenditures are €1.9 trillion over the 32-year period. The BAU expenditures, which do include the cost of kerosene replaced by SAF (€310 billion) but do not include the cost for the continued use of fossil kerosene (an additional €730 billion) are required for the hypothetical continued operation without sustainability measures. The BAU expenditures amount to €1.1 trillion. The majority (70%) of this is due to ongoing fleet renewal towards newer airplanes. Clearly, part of these fleet renewal expenditures not only bring environmental benefits, but enable operational cost savings. BAU expenditures are relatively constant over time with approximately €33.3 billion per year. This can be compared to an average annual premium expenditure of €25.6 billion. The latter notably increase over time, in particular due to increased use of SAF. Further variation in expenditures over time is mainly caused by increasing fleet renewal cost from 2040 due to more expensive future aircraft, and the fact that investments in future aircraft R&D, airspace and ATM improvements end by that same year. The combined average annual expenditures towards net zero of €59 billion can be contrasted to European airline revenues, estimated at €145 billion in 2018.¹

Comparison to out-of-sector decarbonization

Financing in-sector sustainability measures yields substantially lower costs than realizing the same emission savings through out-of-sector carbon reduction. The out-of-sector scenario has been aligned with the reference (emissions) scenario presented in Destination 2050 (labelled a 'hypothetical no-action growth scenario') in terms of traffic development and baseline emissions. The difference between the baseline emissions and the net emissions is the emission reduction that in the out-of-sector scenario is solely realised through carbon pricing (i.e., carbon compensation and/or negative emissions projects). Realizing the same emission savings out-of-sector amounts to €3012 billion. It is therefore essential to reach a successful on-time transition to sustainable measures within the aviation sector. This transition is dependent on access to finance from the private sector and public investments, both influenced by legislation.

Source of finance

There are four primary sources of capital for the aviation sector: the private sector, the public sector, ticket prices and profit margins. Since the latter are historically low due to high levels of competition and compounded by recent crises, the absorption capacity by the sector, in particular that of European airlines and hubs is expected to be low. A lack of access to finance might compound the competitive distortion, lack of level playing field and carbon leakage

¹ EU GDP share (20.7%) of global airline revenues €700 billion. See <https://www.iata.org/en/pressroom/pr/2017-12-05-01/>

found in a recent study on the consequences of Fit for 55 on aviation (Adler et al., 2022). The explorative assessment of public sector investment aid contained within this study finds a wide variety of suitable state and supranational programs but the planning horizons are shorter than that of Destination 2050. Access to finance for the CO₂ net zero transition will be vital when capital reserves are insufficient to make large upfront payments for new aircraft, infrastructure and other deployment of decarbonisation technologies such as sustainable aviation fuels. Having access to 'green' finance following the Taxonomy Regulation is therefore of key importance, particularly for the measures crucial to achieving the Destination 2050 objectives.



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Please find the full report at www.seo.nl/en/publications

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