【欧州】【航空】

Aviation – Gas emissions: EASA publishes European Aviation Environmental Report 2022 with recommendations on reducing CO_2 emissions in the EU's aviation sector

Andrea Antolini　Former Researcher JTTRI

【概要：Summary】

Based on the European Green Deal's goal to achieve net-zero GHG emissions in the EU and a 90% reduction of GHG emissions in the transport sector by 2050, also the aviation sector needs to increase its efforts and fulfil its share in efforts to reduce GHG emissions.

As the European Aviation Environmental Report (EAER) 2022 shows, the aviation sector's impact on climate change, noise and air quality is still significant. While the EAER 2022 report offers an analysis of climate change, noise and air quality impacts caused by the aviation sector, it also gives recommendations on reducing emissions, among others.

The acceleration of the recovery of commercial flights in 2022 can be expected to lead to an upward trend of air traffic and a resurgence of GHG emissions in aviation. Accordingly, this article will focus on the aviation sector's GHG emissions development in the years 2020-2022, covering the period of the COVID-19 pandemic 2020 and 2021. Based on Eurostat and EUROCONTROL statistics, it will also give a first overview on the trend of GHG emissions in the EU's aviation sector in the first quarter of 2022.

The EAER 2022 report confirms that the projected growth in demand in aviation will basically compensate all GHG emission reduction efforts in the aviation sector. Therefore, the aviation sector will need more decisive emission reduction measures to achieving its fair share of the 2050 90% emission reduction goal for the transport sector in the EU.

According to the EAER 2022 report, the only option to significantly reduce GHG emissions in the aviation sector and to reach net zero CO_2 emissions by 2050 will be by focusing on a combination of all key GHG emission reduction measures. These measures should include the use of flight trajectories with less environmental impact, in line with air traffic management (ATM) and aircraft operation improvements by integrating effective environmental measures into the European ATM system and the Single European Sky. Furthermore, the aviation sector needs to focus on the uptake of sustainable aviation fuels (SAFs), to promote research and identify solutions to address climate impacts and to develop and implement necessary green airport infrastructure and operations. This combination of measures could reach an alignment of the European aviation sector with the European Green Deal's climate goals under the precondition that the policy and financing framework is secured at EU level and at Member States' national level.

【記事：Article】

1. The legal background of reducing GHG emissions from aviation

Based on the European Green Deal (COM/2019/640 final), the EU intends to achieve net-zero GHG emissions in the EU and a reduction of 90% of the transport sector's GHG emissions by 2050. The 2021 European Climate Law (Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law') incorporated the European Green Deal's goal into legislation. EU institutions and Member States must take the necessary measures at EU and national level to meet the European Green Deal's target to reach climate neutrality by 2050 and to reach the 2030 climate target of at least 55% reduction of net emissions of GHG emissions based on 1990 levels (EASA 2022a).

Since 2012, aviation is also covered by the EU-ETS for carbon emissions within the European Economic Area (EEA), based on Regulation No.421/2014 and Regulation (EU) 2017/2392, until 2023 (European Commission 2021a). The introduction of the International Civil Aviation Organization (ICAO)'s Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) in the EU leads to the parallel existence of the two systems, CORSIA and EU-ETS for aviation. From 2021, airlines will need to start offsetting the growth in emissions from the routes between states, which have volunteered to participate in CORSIA's pilot phase. However, intra-EU flights under the EU-ETS are subject to a more ambitious climate protection target than flights under CORSIA and are part of European emission reduction targets (DEHSt 2020). However, since the CORSIA scheme is not expected to significantly reduce the CO_2 emissions from aviation, a continuation of the EU-ETS for flights within the EEA is envisaged.

Furthermore, the 2050 carbon neutrality target and the mid-term target of reducing GHG emissions, set at 55%, to be met by 2030, has also put the aviation sector under additional pressure to find solutions for its CO_2 emission problem. Contrary to the road transport sector and the possibility to switch to electric vehicles, the aviation sector lacks alternatives to currently used propulsion systems or the wide utilisation of sustainable aviation fuels for significantly reducing CO_2 emissions. The development of a low to zero emission propulsion systems for aircraft is still the most challenging of all sectors.

Therefore, the need to reduce GHG emissions and other emissions from aircraft and the currently limited options for replacing combustion engines has led to considerations to introduce sustainable aviation fuels (SAFs). The take-up of SAFs is seen as an important element in the short- to mid-term efforts to reduce GHG emissions in aviation. Accordingly, the European Commission's "Fit for 55" package of 14 July 2021 includes the ReFuelEU Aviation proposal (COM (2021) 561 final) will oblige fuel suppliers to blend an increasing level of SAFs into jet fuel at EU airports. ReFuelEU Aviation proposal includes the target of reaching a share of SAFs of 2% in 2025, 5% in 2030 and 63% in 2050 (COM (2021) 561 final). However, the ReFuelEU Aviation proposal (COM (2021) 561 final) targets might not be sufficient and there are calls for further raising the percentage of SAFs. Other elements include market-based measures, the streamlining of air traffic management as well as the development of alternative propulsion technologies and aircraft may contribute in the long-term.

2. The aviation sector's GHG emissions 2020-2022

In 2017, direct emissions from aviation in the EU accounted for 3.8% of total CO_2 emissions and for 13.9% of the CO_2 emissions from the transport sector, making aviation the second biggest source

of transport GHG emissions after road transport (European Commission n.d.). In 2018, more than 99% of jet fuel used in the EU in 2018 was fossil kerosene (SWD(2021) 633 final). In 2019, aviation emissions covered by the EU-ETS amounted to 68.2 Mt Coe, representing an increase of 1.0% compared to 2018 (EEA 2020a). In 2019, the last pre-pandemic year, the aviation sector's CO_2 emissions covered by the EU-ETS amounted to 68.2 Mt CO_2e, representing an increase of 1.0% compared to 2018 (European Commission 2021a). The eight largest aircraft operators were responsible for 49% of the aviation sector's total CO_2 emissions within the European Economic Area (EEA).

The number of flights at EU27+EFTA airports increased by 15% between 2005 and 2019 to 9.3 million, while passenger kilometres almost doubling (+90%)(EASA 2022a). The CO_2 emissions of all flights departing from EU27+EFTA airports reached 147 million tonnes in 2019, which was 34% more than in 2005. Long-haul flights (above 4,000 km) represented approximately 6% of departures during 2019 and half of all CO_2 and NOX emissions. (EASA 2022a)

As a direct effect of the COVID-19 pandemic, the global, intra-EU and domestic aviation decreased significantly regarding air traffic and the number of air passengers as well as air cargo.

The pandemic's impact became visible in commercial air transport in March 2020, with a -44% decrease in the total number of commercial flights in the EU, compared with the same month in 2019 (Eurostat 2021a). The most substantial reduction in the number of commercial flights was recorded in April 2020 with a reduction of -91% compared with the same month in 2019 (Eurostat 2021a). In May 2020 a -90% reduction followed and -84% in June 2020, compared to the same months in 2019 (Eurostat 2021a). The suspension of flights due to the COVID-19 pandemic and the several lockdown periods with strict restrictions of the free movement of people in 2020 resulted in a verified reduction of GHG emissions from aviation by -63.5% between 2019 and 2020, from 68MtCO_2e to 25MtCO_2e (ETC/CME 2021).

The number of flights in the EU showed also in a reduction of -68% in January 2021 compared with same month in 2019 (Eurostat 2021b). In February 2021, compared to the same month in 2019, the number of flights decreased by -73%, in March by -71% and in April 2021 by -70%.

Altogether, there was no sign of recovery, due to the renewed and periodical introduction of travel restrictions in 2020 and 2021 (Eurostat 2021b). The first improvement became visible in June 2021, when the number of commercial flights decreased to a lesser extent than compared to the same months in 2019. In June 2021, the number of commercial flights decreased by -54% compared to pre-pandemic figures in 2019. Although it was still a more than 50% drop compared to the same month in 2019, it was a first sign of improvement compared to the number of flights in the previous months in 2021 and the number of commercial flights in the EU increased by 48% compared with August 2020 (Eurostat 2021a, Eurostat 2021b). As statistics of Eurostat and EUROCONTROL show, the EU's aviation sector experienced a partial recovery in the second half of 2021 compared to the first COVID-19 pandemic year 2020, based on the partial lifting of travel restrictions.

However, while the recent signs of recovery are welcomed by the aviation sector, this increase will unavoidably lead to a resurgence of GHG emissions in aviation.

Regarding the reporting of CO_2 emissions for 2021 under the EU-ETS, the reporting has been above 95% for most sectors and countries. All airline operators were required to report their verified CO_2 emissions for the year of 2021 by 31 March 2022. The verified data was published on the website of the EUTL on 1 April 2022 (European Commission 2022).

In 2021, the total GHG emissions covered by the EU-ETS increased again by 7.3% compared to 2020 levels. This 7.3% increase results from an 8.3%

increase in emissions from the power sector, an increase of 5.2% from main industrial sectors, and an increase of 8.7% of CO_2 emissions from the aviation sector (European Commission 2022).

The 8.7% increase of CO_2 emissions from the aviation sector followed a decrease of -61% for aviation in 2021 compared to 2019 (European Commission 2022). This 8.7% increase is still -61% lower than the 68.2 million tonnes of CO_2 emitted in the last pre-pandemic year 2019 (European Commission 2022).

The sudden drop of GHG emissions in aviation in 2020 is attributed to the COVID-19 pandemic's impact and the restrictions of free movement of people, which led to the nearly complete suspension of flights and led to a steep decline in GHG emissions from aviation.

It is also important to note that as of 2021, the EU-ETS for aviation no longer covers flights arriving from the UK, due to the UK's withdrawal from the EU and the ending of the Brexit transition period on 31 December 2020. Considering this scope change, and that the UK's aviation sector's CO_2 emissions are no longer covered by the EU-ETS for aviation in 2021, while it still was included in 2020, the CO_2 emissions from aviation covered without the UK in 2021 still decreased by -50% as compared with 2019 (European Commission 2022).

According to the Eurostat (2022b), in March 2022, in parallel to the further easing of pandemic-related restrictions, the aviation sector showed signs of recovery. The number of commercial flights increased by 156% in the EU, compared to March 2021, although this figure is still -27% below the pre-pandemic levels of March 2019 (Eurostat 2022b). Regarding the absolute number of commercial flights, which stood at 389,181 in March 2022, and compared with 151,986 in March 2021, and 296,362 in March 2020 and 530,400 in March 2019, it confirms a partial recovery of the aviation sector in the current phase of the pandemic (Eurostat 2022b). According to Eurostat (2022c), in August 2022, the number of commercial flights in the EU increased by 25% compared with August 2021. While this is still below the pre-pandemic levels, the gap is slowly closing (-14% compared with August 2019).

If the pandemic does not worsen and if no further escalation of the Russian war in Ukraine will change again the general preconditions for the EU's aviation sector, it can be expected that the recovery of commercial flights in 2022 will continue and GHG emissions of aviation will reach again pre-pandemic levels. Moreover, the resurgence of GHG emissions cannot be expected to be short-term since a replacement of fossil fuel-based kerosene with sustainable aviation fuels will only show effect beyond 2030.

Consequently, it will need decisive policies and measures like the consequent introduction of sustainable aviation fuels (SAF) under the ReFuelEU Aviation regulation, among others, to reach a longer-lasting reduction of GHG emissions levels in the aviation sector in the post-pandemic era (EEA n.d.).

3. EASA's European Aviation Environmental Report (EAER) 2022

The European Aviation Safety Agency (EASA) published its third edition of the European Aviation Environmental Report (EAER) on 21 September 2022, after the last report that was published in 2019. The core aim of the European Aviation Environmental Report 2022 is to provide information on the environmental performance of the aviation sector at the European level every three years. In the third report, the historic and future scenarios of air traffic are analysed together with its associated noise and emissions levels (EASA 2022a). The EASA report's analysis scope and assumptions include Eurostat and EUROCONTROL's historical air traffic data and covers all flights from or to airports in the EU-27 and European Free Trade Association (EFTA). The EAER reviews the aviation sector's

environmental performance and progress made since the 2019 edition and offers recommendations on reducing the aviation sector's impact on climate change, noise, and air quality (European Commission 2022). According to EASA's findings, air pollutant emissions from aviation have increased within the EU and effective action requires better characterisation of aviation's contribution compared to other sources of emissions (EASA 2022b). The CO_2 emissions have been increasing and accelerating prior to the COVID-19 pandemic, with almost half of the aviation sector's global CO_2 emissions between 1940 and 2019 having occurred since 2000 (EASA 2022b). Even if the sector has taken steps to address its impact on the environment and climate, projected growth in demand calls further decisive action. The 2022 EAER explores five key impact mitigation areas, including technology and design; sustainable aviation fuels; air traffic management operations; and airports and market-based measures (European Commission 2022).

The report shows again that the projected growth in demand will need more decisive emission reduction measures to take its share in the EU's climate and environmental goals. Furthermore, the report offers recommendations on reducing climate change, noise, and air quality impacts from aviation, among others (EASA 2022a).

While the number of flights at EU27+EFTA airports dropped dramatically from 9.3 million in 2019, to respectively 4.12 and 5.07 in 2020 and 2021 due to the COVID-19 pandemic, the longer-term trends show that the annual flights in the EU27+EFTA region will reach 12.2 million by 2050 (EASA 2022a, European Commission 2022). In this scenario, aircraft CO_2 emissions could rise to 188 million tons unless environmental protection measures are further prioritised in the sector (European Commission 2022). In this context, the report includes recommendations such as incentivising airspace users to fly trajectories with less environmental impact, in line with the Single European Sky, and focusing on in-sector measures such as the uptake of sustainable aviation fuels (European Commission 2022, EASA 2022a). The report highlights the need to independently monitor progress to ensure transparency, accountability, credibility and ultimately establish trust that the measures in place will meet the agreed targets. According to European Commissioner for Transport Adina Vălean, the report also shows there is the need to go ahead with those SAFs, which are in particular showing potential (European Commission 2022).

In February 2021, five European associations representing airlines, manufacturers, airports, and air service navigation providers including A4E, ACI-E, ASD, CANSO, and ERA, published the report "Destination 2050. A ROUTE TO NET ZERO EUROPEAN AVIATION" (A2E et.al. 2021). It outlines a roadmap for the aviation sector, in collaboration with regulators, to decarbonise significantly by 2030 and reach net zero CO_2 emissions by 2050. Among others, the sector would have to reduce net CO_2 emissions from all flights within and departing from the EU by 45% in 2030 and to reaching net zero CO_2 emissions by 2050 from all flights within and departing from the EU (EASA 2022a, A2E et.al. 2021).

The EUROCONTROL Aviation Outlook (EAO) report includes estimates of net CO_2 emissions, and it provides a real insight into how aviation can move towards the target of net-zero by 2050. The net zero CO_2 emissions is expected to be achieved by cutting 279 million tonnes of CO_2 emissions with: 17% more efficient conventional aircraft, 2% electric and hydrogen aircraft, 8% better ATM and airline operations, 41% by the utilization of SAFs and 32% by other measures (EUROCONTROL 2022).

The EAER 2022 highlights the technical measures to reduce CO_2 emissions. These include new aircraft designs certified during the last 10 years, e.g., Airbus A320neo, A350 and Boeing. The penetration of these aircraft types into the global fleet, and the accelerated retirement of

older aircraft due to the COVID-19 pandemic, has led to improvements in the overall environmental performance of the European fleet. Regarding the production engine types and the new non-volatile Particulate Matter (nvPM) standards, aircraft manufacturers are evaluating how to mitigate nvPM emissions in new engine designs. Moreover, Pipistrel Velis Electro became the first fully electric general aviation aircraft to be certified by EASA in 2020 and is now being used by pilots to learn to fly (EASA 2022a).

4. The role of SAFs to reduce CO_2 emissions from air traffic

While engine technology developments will be an important factor in future, to decrease the GHG emissions significantly in the near future, the aviation sector needs to rely on SAFs and reduce its current exclusive reliance on fossil-based jet fuel. As part of the 'Fit for 55' package of July 2021, the Commission proposed the 'ReFuelEU Aviation' initiative for boosting the uptake of SAFs and for scaling up SAF used for flights departing from all EU airports above a certain traffic threshold. A SAF is a sustainable, non-conventional, alternative to fossil-based jet fuel. Several definitions and terminology may apply and according to the ReFuelEU Aviation regulatory proposal, SAFs are defined as drop-in aviation fuels that are either biofuels produced from feedstocks listed in Annex IX of the Renewable Energy Directive (RED II) or synthetic aviation fuels, which comply with the sustainability and GHG emissions reductions criteria in Article 29 of the RED II (EASA 2022a). To be used in commercial aircraft, drop-in SAFs must go through an exhaustive approval process to fulfil strict certification criteria and prove that their physical and chemical characteristics are almost identical to fossil-based jet fuel and can therefore be safely blended. This enables SAF to be used within the existing global fleet and does not require any adaptation to the aircraft or fuel supply infrastructure (EASA 2022a). As of January 2022, seven SAF production processes have been approved. In addition, two pathways for the co-processing of renewable feedstocks in petroleum refineries are approved with a blending limit of 5% (EASA 2022a). However, current SAF supply remains low at less than of total EU aviation fuel use (EASA 2022b).

According to the EAER 2022, four production pathways of SAFs are expected to play a major role in the near future. SAF pathways such as Hydro processed Esters and Fatty Acids (HEFA), Alcohols to Jet, Biomass Gasification + Fischer-Tropsch, and Power-to-Liquid (PtL) are expected to play a major role in decarbonisation in the short/medium term. and will remain the main contributor for long-haul flights in the long term (EASA 2022b). Hydro processed Esters and Fatty Acids (HEFA) Potential feedstocks include waste and residue fats (e.g., vegetable oil, used cooking oil, animal fats) and purposely grown plants (e.g., jatropha, camelina). Both Gas+FT and AtJ are considered advanced biofuels if produced from feedstock listed in Annex IX Part A of the RED II and have significant emissions reduction and supply potential. However, they are not yet available on a commercial scale in the EU (EASA 2022a). Power-to-Liquid (PtL) Water and electricity are used to produce hydrogen, which is subsequently synthesised with CO_2 into syngas. The CO_2 needed for the PtL process can be sourced from industrial waste gases, biomass or captured directly from the atmosphere. The resulting syngas is then further processed into fuel by the Fischer-Tropsch (FT) reactor or alternatively by methanol synthesis.

SAF prices can vary depending on the production pathway, associated production costs and fluctuations in the energy market. While SAF are currently more expensive than fossil-based jet fuel, cost savings are expected notably through future production economies of scale (EASA 2022b).

Currently, certified SAF are subject to a maximum blending ratio of 50% with fossil-based jet fuel, but industry and fuel standard committees are looking into the future use of 100% SAF by 2030 (EASA 2022b). The aviation industry is already performing the needed research and test flights to evaluate the effects of 100% SAF on emissions and the performance of aircraft, with promising early results (EASA 2022b).

According to the ReFuelEU Aviation regulatory proposal, fuel suppliers would be required to follow a blending scheme with 2% of SAF by 2025, 5% by 2030 and at least 63% by 2050 (EASA 2022a). The ReFuelEU legislative proposal for the SAF blending mandate focuses on advanced biofuels and synthetic e-Fuels and also foresees a monitoring and reporting system of SAF supply and usage to provide an overview of the European SAF market (EASA 2022a). The European Commission has proposed a SAF blending mandate for fuel supplied to EU airports, with minimum SAF shares, which will gradually increase to 63% in 2050, and a sub-mandate for Power-to-Liquid SAF. To achieve this mandate, approximately 2.3 million tonnes of SAF would be required by 2030, 14.8 million tonnes of SAF in 2040, and 28.6 million tonnes by 2050 (EASA 2022b). However, current SAF supply remains low at less than 0.05% of total EU aviation fuel use (EASA 2022b). Instead,

As the emissions from the combustion of drop-in SAF are comparable to fossil-based jet fuels, except for marginal efficiency gains, the majority of the reductions in GHG emissions originate from the production process (EASA 2022b). Studies on the use of SAF blended into fossil-based jet fuel have shown that PM emissions behind the aircraft at cruising altitudes are reduced by 50-97% compared to fossil-based jet fuel (EASA 2022a). The highest reductions can be observed at low engine power, typically applied when the aircraft is taxiing, and therefore, SAFs can also improve local air quality at airports (EASA 2022a).

5. European Aviation Environmental Report (EAER) 2022 recommendations

According to the EAER 2022, in 2050, it is predicted that in-sector measures could reduce CO_2 emissions by 69% to 59 million tonnes compared to a business-as-usual “technology freeze” scenario (EASA 2022a) The following recommendations from EASA and EEA build on the information and analysis within the EAER 2022. The aim is to ensure that the aviation sector contributes to the objectives of the European Green Deal, the European Climate Law, the Sustainable and Smart Mobility Strategy and the Zero Pollution Action Plan.

EASA recommendations to achieve CO_2 emission reductions in future build on the information and analysis within the European Aviation Environmental Report (EAER) 2022. To establish long-term noise and emissions reduction pathways and aspirational goals for the European aviation sector in terms of in-sector aspects including technology, operations, fuels, and out-of-sector aspects including market-based and mitigation measures, the 2050 targets climate neutrality and 90% emission reduction level for transport-related GHG emissions and the 2030 reduction target of 55% need to be reached. Also, a 30% reduction in the share of chronically disturbed by transport noise needs to be achieved by 2030, compared to 2017, among others (EASA 2022a)

Furthermore, EASA recommends enhancing the implementation of the Single European Sky (SES) by the Network Manager, Air Navigation Service Providers (ANSPs), airports and other service providers, with a view to enable and incentivise airspace users to fly “green” flight trajectories (EASA 2022a).Moreover, cross-border solutions should be promoted, and network restrictions minimised. Also, further economic incentives should be explored that encourage greater efficiency and improve environmental performance from airspace users. For scaling up the supply and use of SAF the feasibility of

putting in place a long-term support structure needs to be explored and the successful introduction of new SAF production pathways in Europe with high potential for emission reductions needs to be ensured, among others. EASA recommends advancing approvals of higher SAF blends up to 100%, based on a diverse mix of feedstocks (EASA 2022a). EASA also points out that different types of SAF may support different aviation market segments in the medium term. It is also recommended to consider the use of the EU-ETS Innovation Fund to support higher-risk SAF production investments, and other mechanisms that incentivise the uptake of SAF. (EASA 2022a)

EASA also recommends to promoting research and to identify solutions to address environment and climate impacts as well as build climate change resilience for the aviation sector, as it is a key vulnerable economic sector that is only in the early stage of adaptation to climate change (EASA 2022a).

Further recommendations include the performance of further research on the overall climate impact of aviation, including non-CO_2 emissions and contrail-cirrus cloud formation, identify and apply "win-win" solutions that reduce both CO_2 and non-CO_2 emissions and assess trade-offs from mitigation measures to ensure an overall reduction in climate and air quality impacts from aviation. EASA recommends also to accelerating the development and deployment of technological and ATM solutions and to fostering green airport operations and infrastructures (EASA 2022a). EASA also recommends to encouraging the use of the EU Taxonomy system to incentivise sustainable investment within the aviation sector among others (EASA 2022a).

6. Conclusion

The EU's aviation sector is strategically important and provides connectivity benefits to the wider economy, but it also has negative effects on air quality and it emits ever increasing levels of GHG, which cause climate change. Therefore, the European Green Deal requires an ambitious and comprehensive approach to also decarbonize the aviation sector, as air traffic and GHG emission levels return to pre-COVID-19 pandemic levels.

According to the EAER 2022, while SAFs are currently more expensive than fossil-based jet fuel, SAFs are expected to play a major role in decarbonising the aviation sector as they can be used within the existing global fleet and fuel supply infrastructure. Currently certified SAFs are subject to a maximum blending ratio of 50% with fossil-based jet fuel, but industry and fuel standard committees are aiming doing research for introducing a level of 100% of SAF by 2030.

As the EAER report 2022 shows, it will not only need an upscaling of the supply and use of SAFs. It will also need a combination of a bundle of other measures including the improvement of ATM and Single European Sky, investments and market-based measures, research on solutions to address environment and climate impacts and to build climate change resilience, as well as technological innovation through international cooperation to achieve the decarbonisation of the aviation sector.

References

A2E et.al., A4E, ACI-E, ASD, CANSO and ERA (2021): Destination 2050. A ROUTE TO NET ZERO EUROPEAN AVIATION. In: https://www.destination2050.eu/, 11 February 2021, accessed on 2 October 2022

Clean Sky 2 JU and FCH 2 JU (2020): Hydrogen-powered aviation. A fact-based study of hydrogen technology, economics, and climate impact by 2050. In: https://www.fch.europa.eu/sites/default/files/FCH%20Docs/20200507_Hydrogen%20Powered%20Aviation%20report_FINAL%20web%20%28ID%208706035%29.pdf, May 2020, accessed 10 March 2022

COM (2021) 561 final: COM (2021) 561 final: Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on ensuring a level playing field for sustainable air transport. COM (2021) 561 final. In: https://ec.europa.eu/info/sites/default/files/refueleu_aviation_-_sustainable_aviation_fuels.pdf, accessed on 20 July 2021

EASA (2022a): European Aviation Environmental Report 2022. In: https://www.easa.europa.eu/eco/sites/default/files/2022-09/EnvironmentalReport_EASA_summary_12.pdf, 21 September 2022, accessed on 30 September 2022

EASA (2022b): European Aviation Environmental Report 2022. Executive Summary and Recommendations. In: https://www.easa.europa.eu/eco/sites/default/files/2022-09/EnvironmentalReport_EASA_summary_12.pdf, 21 September 2022, accessed on 30 September 2022

EEA (European Environment Agency) (2020): The EU Emissions Trading System in 2020: trends and projections. In: https://www.eea.europa.eu/themes/climate/the-eu-emissions-trading-system/the-eu-emissions-trading-system

ETC/CME (2021): Nissen, C.; Cludius, J.; Graichen, V.; Graichen, J.; Gores, S.: Trends and projections in the EU ETS in 2021. The EU Emissions Trading System in numbers. In: https://www.eionet.europa.eu/etcs/etc-cme/products/etc-cme-report-9-2021-trends-and-projections-in-the-eu-ets-in-2021-the-eu-emissions-trading-system-in-numbers, ETC/CME Eionet Report | 9/2021, December 2021, accessed on 17 January 2022

EUROCONTROL (2021): Europe's aviation sector launches ambitious plan to reach net zero CO_2 emissions by 2050. In: https://www.destination2050.eu/press_release_launch/, 11 February 2021, accessed on 2 October 2022

EUROCONTROL (2022): EUROCONTROL Aviation Outlook 2050. Main Report. In: https://www.eurocontrol.int/publication/eurocontrol-aviation-outlook-2050, 13 April 2022, accessed on 2 October 2022

European Commission Directorate-General for Mobility and Transport (2022): European Aviation Environmental Report 2022: Ramping up sustainability is crucial for sector's long-term viability. In: https://transport.ec.europa.eu/news/european-aviation-environmental-report-2022-ramping-sustainability-crucial-sectors-long-term-2022-09-21_en, 21 September 2022, accessed on 2 October 2022

European Environment Agency (EEA) (n.d.): Climate and Energy in the EU. Intro. In: https://climate-energy.eea.europa.eu/topics/climate-change-mitigation/european-trading-system-emissions/intro, no year, accessed on 16 September 2022

European Environment Agency (EEA 2022a): The EU Emissions Trading System in 2021: trends and projections. In: https://www.eea.europa.eu/publications/the-eu-emissions-trading-system-2, 12 Jan 2022, accessed on 16 September 2022

European Environment Agency (EEA) (2022b): EU Emissions Trading System (ETS) data viewer. In: https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1

European Commission (n.d.): Reducing emissions from aviation. In: https://ec.europa.eu/clima/eu-action/transport-emissions/reducing-emissions-aviation_en#aviation-emissions, no year, accessed on 19 September 2022

Eurostat (2021a): Commercial air transport in June 2021: preparing for take-off? In: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210712-1, 12/07/2021, accessed on 17 September 2022

Eurostat (2021b): Commercial air transport in August 2021: in recovery. In: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210914-1, 14/09/2021, accessed on 17 September 2022

Eurostat (2022a): Commercial flights in December 2021: closest yet to 2019 figures. In: https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/ddn-20220112-1, 12/01/2022, accessed on 19 September 2022

Eurostat (2022b): Commercial flights see some improvement in March 2022. In: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220414-1, 14/04/202, accessed 19 September 2022

Eurostat (2022b): August: commercial flights closer to 2019 figures. In: https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/ddn-20220909-1, 09/09/2022, accessed on 30 September 2022

SWD(2021) 633 final: COMMISSION STAFF WORKING DOCUMENT. IMPACT ASSESSMENT

Accompanying the Proposal for a Regulation of the European Parliament and of the Council on ensuring a level playing field for sustainable air transport 14.7.2021 SWD(2021) 633 final In: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021SC0633&from=EN, accessed on 19 September 2022