MINISTRY OF
TECHNOLOGY AND INDUSTRY

International Civil Aviation Organization (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

State Action Plan

Hungary

September 2022

Impressum

Ministry of Technology and Industry
Climate Policy Department
44-50. Fő Street
1011 Budapest
Hungary

September 2022

Source of the cover picture: EUROCONTROL 2022 (https://www.eurocontrol.int/aviation-sustainability)

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I. INTRODUCTION

Hungary is a Contracting State of the International Civil Aviation Organisation (ICAO), a Member State of the European Union (EU), and of the European Civil Aviation Conference (ECAC). ECAC is an intergovernmental organisation covering the widest grouping of Member States[1] of any European organisation dealing with civil aviation. It is currently composed of 44 Member States – including all EU Member States - and was created in 1955.

ECAC States share the view that the environmental impacts of the aviation sector must be mitigated, if aviation is to continue to be successful as an important facilitator of economic growth and prosperity, being an urgent need to achieve the ICAO goal of Carbon Neutral Growth from 2020 onwards (CNG2020), and to strive for further emissions reductions. Together, they fully support ICAO's on-going efforts to address the full range of those impacts, including the key strategic challenge posed by climate change, for the sustainable development of international air transport.

All ECAC States, in application of their commitment in the 2016 Bratislava Declaration, support CORSIA implementation and have notified ICAO of their decision to voluntarily participate in CORSIA from the start of its pilot phase and have effectively engaged in its implementation.

Hungary, like all of ECAC's 44 States, is fully committed to and involved in the fight against climate change and works towards a resource-efficient, competitive, and sustainable multimodal transport system.

Hungary recognises the value of each State preparing and submitting to ICAO an updated State Action Plan for CO_2 emissions reductions as an important step towards the achievement of the global collective goals agreed since the 38th Session of the ICAO Assembly in 2013.

In that context, it is the intention that all ECAC States submit to ICAO an Action plan[2]. This is the action plan of Hungary.

Hungary strongly supports the ICAO basket of measures as the key means to achieve ICAO's CNG2020 target and shares the view of all ECAC States that a comprehensive approach to reducing aviation CO_2 emissions is necessary, and that this should include:

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[1] Albania, Armenia, Austria, Azerbaijan, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, and the United Kingdom

[2] ICAO Assembly Resolution A40-18 also encourages States to submit an annual reporting of international aviation CO_2 emissions, which is a task different in nature and purpose to that of action plans, strategic in their nature. Also this requirement is subject to different deadlines for submission and updates as annual updates are expected. For that reason, the reporting to ICAO of international aviation CO_2 emissions referred to in paragraphs 10 & 14 of ICAO Resolution A40-18 is not necessarily part of this Action Plan, and may be provided separately, as part of routine provision of data to ICAO, or in future updates of this action plan.

- Emission reductions at source, including European support to CAEP work in this matter (standard setting process).
- Research and development on emission reductions technologies, including public-private partnerships.
- Development and deployment of sustainable alternative fuels, including research and operational initiatives undertaken jointly with stakeholders.
- Improvement and optimisation of Air Traffic Management and infrastructure use within Europe, in particular through the Single European Sky ATM Research (SESAR), and also beyond European borders through participation in international cooperation initiatives; and
- Market Based Measures, which allow the sector to continue to grow in a sustainable and efficient manner, recognizing that the measures at (i) to (iv) above cannot, even in aggregate, deliver in time the emissions reductions necessary to meet the ICAO 2020 CNG global goal.

In Europe, many of the actions which are undertaken within the framework of this comprehensive approach are in practice taken collectively, most of them led by the European Union. They are reported in *Chapter 3* of this Action Plan, where the involvement of Hungary is described, as well as that of other stakeholders.

In Hungary, a number of actions are undertaken at the national level, including those by private stakeholders. These national actions are reported in *Chapter 4*.

In relation to European actions, it is important to note that:

- The extent of participation will vary from one State to another, reflecting the priorities and circumstances of each State (economic situation, size of its aviation market, historical and institutional context, such as EU/non-EU). The ECAC States are thus involved to different degrees and on different timelines in the delivery of these common actions. When an additional State joins a collective action, including at a later stage, this broadens the effect of the measure, thus increasing the European contribution to meeting the global goals.
- Acting together, the ECAC States have undertaken measures to reduce the region's emissions through a comprehensive approach. There are measures, which were only implemented by some of ECAC's 44 States, nonetheless yield emission reduction benefits across the whole of the region (for example research, SAF promotion or ETS).

II. CURRENT STATE OF AVIATION IN HUNGARY

Civil aircraft fleet

As of September 2022, there is a total of 1,286 aircraft in the Hungarian aircraft register, and there are eight Hungarian AOC and OL holders with 224 aircraft. Furthermore, it is important to note that 162 aircraft belong to one AOC holder. Those aircraft operated under AOC-s are performing commercial activity.

Domestic airports

Figure 1 below visualises active airfields, aerodromes, and heliports in Hungary. The map highlights facilities used both for civil and military aviation. As displayed in *Table 1*, there are three main airports engaging in international commercial air traffic activities in Hungary.

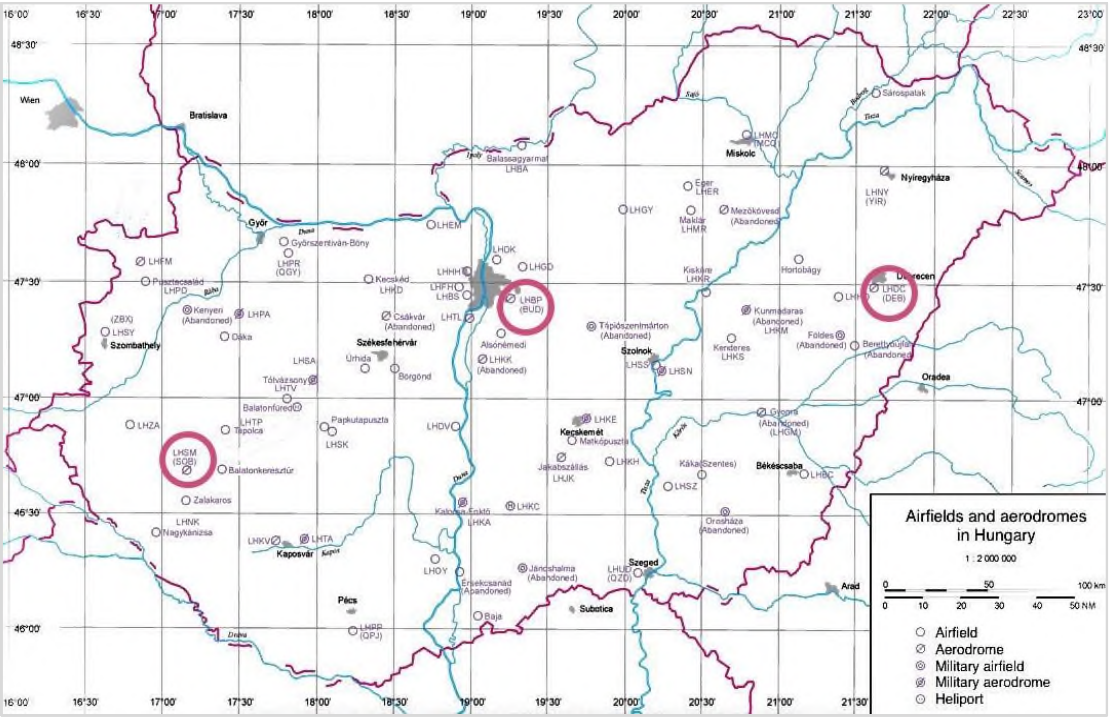


Figure 1. Airfields and aerodromes in Hungary

	Owner	Operator
Budapest Liszt Ferenc International Airport (BUD)	State of Hungary Concession right holder: Budapest Airport Ltd.	Budapest Airport Ltd.
Debrecen International Airport (DEB)	State of Hungary Ownership right representative: Ministry of Foreign Affairs and Trade	Debrecen International Airport Llc.
Hévíz-Balaton International Airport (SOB)	State of Hungary Ownership right representative: National Tourism Agency & Municipality of Hévíz	Hévíz Balaton Airport Llc.

Table 1. Ownership structure of domestic airports

Traffic figures - Budapest Liszt Ferenc International Airport

As most of the international commercial air traffic in Hungary is directed to Budapest Liszt Ferenc International Airport (Budapest Airport), the following paragraphs describing air traffic and the current state of the aviation industry in Hungary are centred around Budapest Airport. Descriptions are supported by publicly accessible data, Budapest Airport's Sustainability Report 2021, and information directly provided by Budapest Airport and HungaroControl (the Hungarian ANSP) to the Ministry of Technology and Industry. Relevant references are provided accordingly.

Budapest Airport Ltd. is an essential actor in the Hungarian business ecosystem. It directly employs 1,200 workers and through its partners it indirectly provides jobs for around 50,000 people (Budapest Airport, 2022). In addition, it is one of the largest regional hubs for trade, and it contributes greatly to the connectivity of both Hungary and the Central Eastern European region.

Figures 2-5 demonstrate recent year's volume of passenger and freight traffic at Budapest Airport, and the overflight movements in the Hungarian airspace.

As shown in *Figure 2*, prior to the COVID-19 pandemic, Budapest Airport has had a growing air traffic trajectory peaking in 2019 with 61,410 arriving and 61,404 departing flights with a total of 122,814 (Budapest Airport, 2022). Passenger rates show a similar upward trajectory between 2012-2019. Nevertheless, while the increase in flight numbers from 2012 to 2019 is 40%, the total number of passengers nearly doubled from 8,5 million in 2012 to 16,2 in 2019 with a 91% increase. Consequently, it can be noted that in the case of some air carriers and flights, more and more aircraft were set to fly at full capacity due to increasing passenger numbers, and hence reduced per passenger emissions rates.

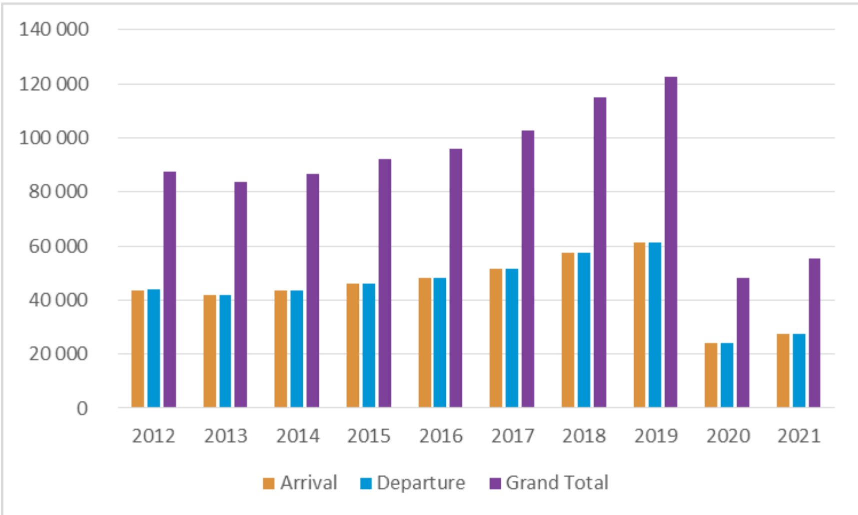


Figure 2. Number of flights at Budapest Airport, 2012-2021

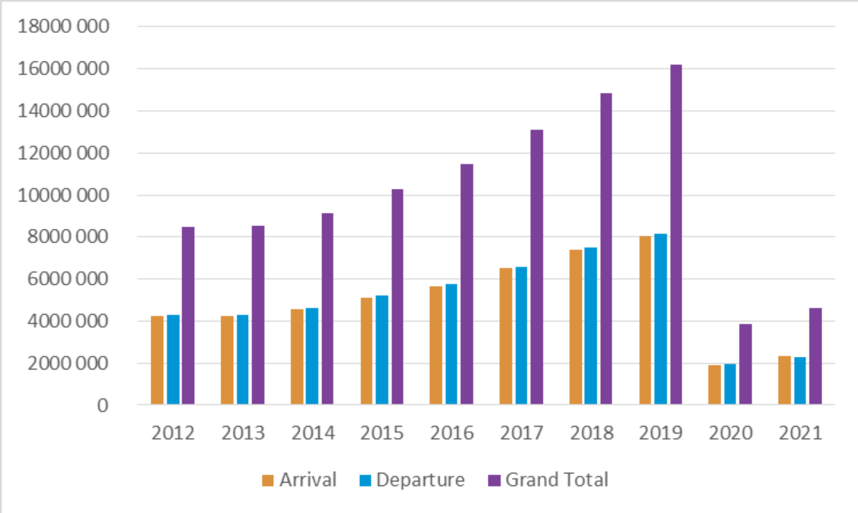


Figure 3. Number of passengers at Budapest Airport, 2012-2021

Furthermore, Budapest is also a regional hub for the transport of goods. Local logistical and infrastructural expansions contributed to the growing figures of freight volumes between 2012-2021 shown in *Figure 4*. Due to the restrictions amid the COVID-19 pandemic, while individuals' freedom of movement was limited, as seen in *Figure 4* below, freight traffic was less affected. With 125,844 tonnes, so far 2021 was the peak year for trade at Budapest Airport.

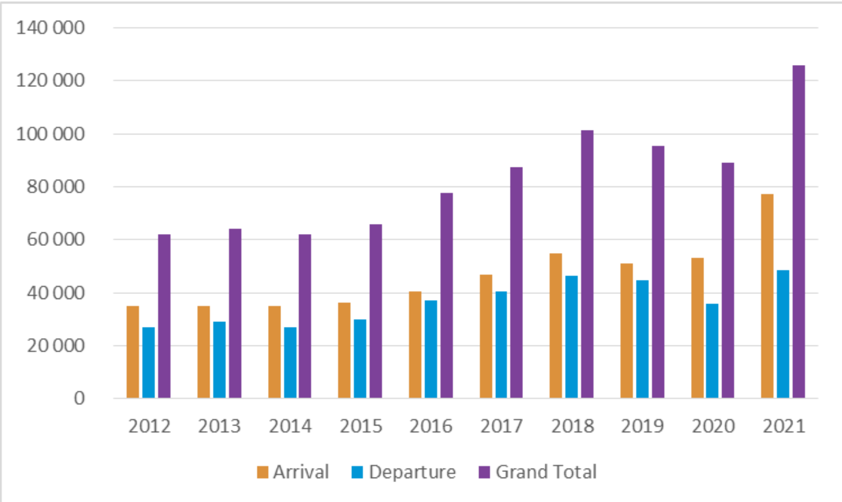


Figure 4. Freight volume at Budapest Airport, 2012-2021

Figure 5 below highlights two major events influencing air traffic and related emissions statistics in recent years: the COVID-19 pandemic (from March 2020) with a sudden drop, and the military invasion of Ukraine by the Russian Federation (in February 2022) with a sudden and continuous increase in overflight movements in the Hungarian airspace. The ongoing recovery of air traffic after the pandemic has begun as borders reopened, nevertheless, as seen in *Figures 2-3* it is yet to reach pre-pandemic levels. At the same time, the closure of airspaces around Ukraine has resulted in increased air traffic with a monthly peak of 95,874 movements in the Hungarian airspace in August 2022 (HungaroControl, 2022).

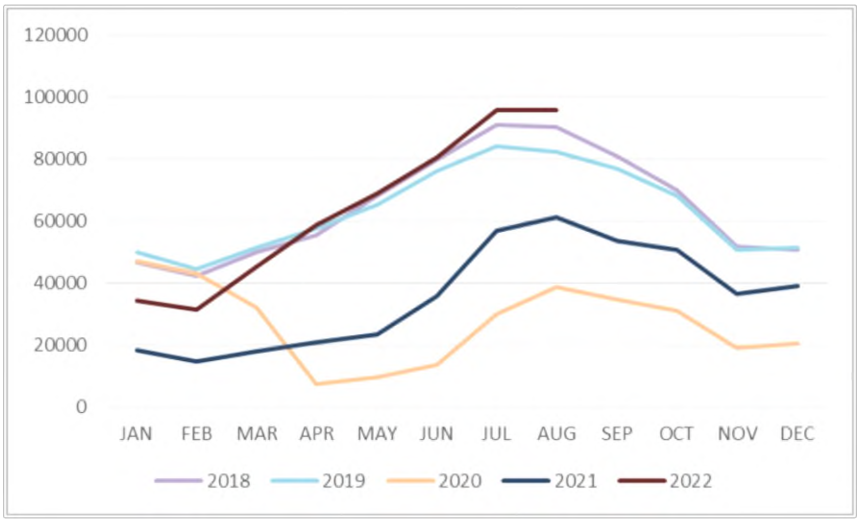


Figure 5. Overflight movements in the Hungarian airspace, 2018-2022

The following air operators account for a large share of the international commercial air traffic at Budapest Airport. In addition, Wizz Air is one of the key actors in the Hungarian aviation industry with the largest share of passenger traffic in recent years (Budapest Airport, 2022). *Table 2* below lists the top 10 airlines with largest passenger traffic at Budapest Airport (Budapest Airport, 2022).

Airlines
Wizz Air
Ryanair
Lufthansa
EasyJet
KLM Royal Dutch Airlines
Eurowings
Norwegian
LOT Polish Airlines
Air France
British Airways

Table 2. Top 10 airlines with largest passenger traffic at Budapest Airport

Current use of fuels in the Hungarian aviation sector

Currently in Hungary as well as globally, the share of fossil fuel (JetA1 kerosine) used in aviation is over 99% of total. Consequently, both European and local measures are currently considered for introduction in order to contribute to the reduction of this share. On a European level, the most significant intervention is the ReFuelEU Aviation regulative initiative (ReFuelEU Aviation) expected to be finalised in 2022, and as described later in *Chapters 3-4*, complementary measures and incentives are continuously planned and implemented for the deployment of alternative fuels, electric, and hydrogen-based technologies and supporting infrastructure. State level, additional related measures are outlined in national policy frameworks such as the National Energy Strategy, National Hydrogen Strategy, the National Energy and Climate Plan and other related guidelines. Future interventions shall all be in line with such existing frameworks.

This State Action Plan is in line with the above-mentioned strategies and later on lists additional local measures taken by the Ministry of Technology and Industry, and four major stakeholders in the Hungarian aviation sector, namely Wizz Air Hungary, Budapest Airport, HungaroControl, and MOL Hungary.

Both common European efforts and local measures (*Chapter 3* and *Chapter 4* respectively) discuss incentives for the decarbonization of aviation supporting the following main areas; research and development, novel aircraft technologies, enhanced air traffic management, alternative fuels, and market-based measures.

III. ECAC/EU COMMON SECTION

Executive summary

The European section of this Action Plan presents a summary of the actions taken collectively throughout the 44 States of the European Civil Aviation Conference (ECAC) to reduce CO_2 emissions from the aviation system and provides an assessment of their benefit against an ECAC baseline. It also provides a description of future measures aimed to provide additional CO_2 savings.

Aviation is a fundamental sector for the European economy, and a very important means of connectivity, business development and leisure for European citizens and visitors. For over a century, Europe has promoted the development of new technology, and innovations to better meet societies' needs and concerns, including addressing the sectoral emissions affecting our climate. Since 2019, the COVID-19 pandemic has generated a world-wide human tragedy, a global economic crisis, and an unprecedented disruption of air traffic, significantly changing European aviation's growth and patterns and heavily impacting the aviation industry. The European air transport recovery policy is aiming at accelerating the achievement of European ambitions regarding aviation and climate change.

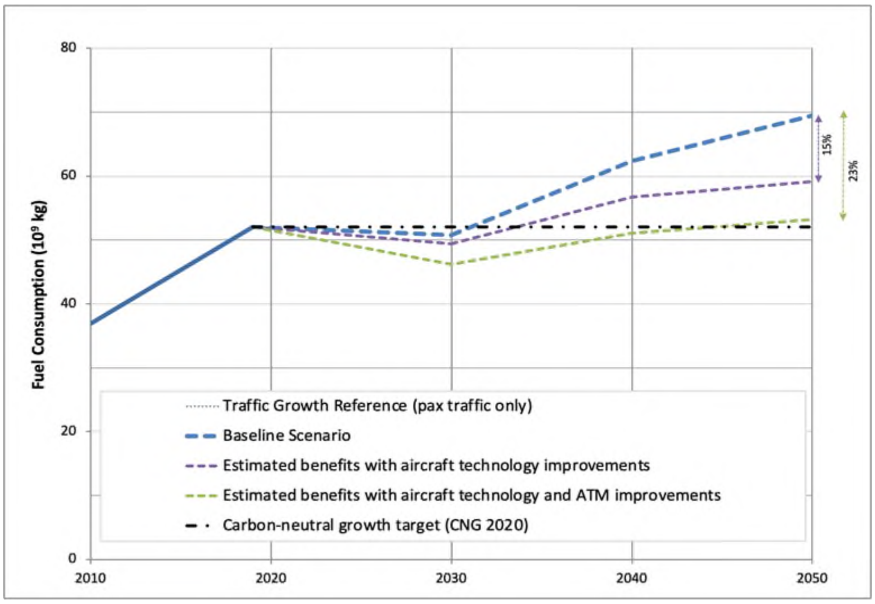


Figure 6. Fuel consumption forecast for the baseline and implemented measures scenarios

Aircraft related technology

European members have actively contributed to support progress in the ICAO Committee on Aviation Environmental Protection (CAEP). This contribution of resources, analytical capability and co-leadership has facilitated leaps in global certification standards that have helped drive the markets demand for technology improvements. Europe is now fully committed to the implementation of the 2017 ICAO CO_2 standard for newly built aircraft and to the need to review it on a regular basis in light of developments in aeroplane fuel efficiency.

Environmental improvements across the ECAC States are knowledge-led and at the forefront of this is the Clean Sky EU Joint Undertaking that aims to develop and mature breakthrough "clean technologies". The second joint undertaking (Clean Sky 2 – 2014-2024) has the objective to reduce aircraft emissions and noise by 20 to 30% with respect to the latest technologies entering service in 2014. Under the Horizon Europe programme for research and innovation, the European Commission has proposed the set-up of a European Partnership for Clean Aviation (EPCA) which will follow in the footsteps of Clean Sky 2, recognizing and exploiting the interaction between environmental, social and competitiveness aspects of civil aviation, while maintaining sustainable economic growth. For such technology high end public-private partnerships to be successful, and thus, benefit from this and from future CO_2 action plans, securing the appropriate funding is essential.

The main efforts under Clean Sky 2 include demonstrating technologies: for both large and regional passenger aircraft, improved performance and versatility of new rotorcraft concepts, innovative airframe structures and materials, radical engine architectures, systems and controls and consideration of how we manage aircraft at the end of their life in use. This represents a rich stream of ideas and concepts that, with continued support, will mature and contribute to achieving the goals on limiting global climate change. The new European Partnership for Clean Aviation (EPCA) has objectives in line with the European Green Deal goals to reach climate neutrality in 2050 and will focus on the development of disruptive technologies and maximum impact.

Sustainable Aviation Fuels (SAF)

ECAC States are embracing the introduction of sustainable aviation fuels (SAF) in line with the 2050 ICAO Vision and are taking collective actions to address many current barriers for SAF widespread availability and use at European airports.

Collective European SAF measures included in this Action Plan focus on their CO_2 reductions benefits. Nevertheless, SAF has the additional benefit of reducing air pollutant emissions of non-volatile Particulate Matter (nvPM), which can provide important other non-CO_2 benefits on the climate, which are not specifically assessed within the scope of this Plan.

At European Union (EU) level, the ReFuelEU Aviation aims to boost the supply and demand for SAF at EU airports, while maintaining a level playing field in the air transport market. This initiative resulted in a legislative proposal in 2021.

The common European section of this Action Plan also provides an overview of the current sustainability and life cycle emissions requirements applicable to SAF in European Union Member States, as well as estimates of life cycle values for a number of technological pathways and feedstock.

Collective work has also been developed through the European Union Aviation Safety Agency on addressing barriers of SAF penetration into the market.

The European Research and Innovation programme is moreover giving impulse to innovative technologies to overcome such barriers as it is highlighted by the numerous recent European research projects put in place and planned to start in the short-term.

Improved Air Traffic Management

The European Union's Single European Sky (SES) policy aims to transform Air Traffic Management (ATM) in Europe towards digital service provision, increased capacity reduced ATM costs with high level of safety and 10% less environmental impact. SES policy has several elements, one of which is developing and deploying innovative technical and operational ATM solutions.

SESAR 1 (from 2008 to 2016), SESAR 2020 (started in 2016) and SESAR 3 (starting in 2022) are the EU programmes for the development of SESAR solutions. The SESAR solutions already developed and validated are capable of providing: 21% more airspace capacity; 14% more airport capacity; a 40% reduction in accident risk; 2.8% less greenhouse emissions, and a 6% reduction in flight costs. Future ATM systems will be based on 'Trajectory-based Operations' and 'Performance-based Operations'.

Much of the research to develop these solutions is underway and published results of the many earlier demonstration actions confirm the challenge but give us confidence that the goals will be achieved in the ECAC region with widespread potential to be replicated in other regions.

Market Based Measures (MBMs)

ECAC States, in application of their commitment in the 2016 Bratislava Declaration, have notified ICAO of their decision to voluntarily participate in Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) from its pilot phase, have effectively engaged in its implementation, and encourage other States to do likewise and join CORSIA.

ECAC States have always been strong supporters of a market-based measure scheme for international aviation to incentivise and reward good investment and operational choices, and so welcomed the agreement on CORSIA.

The 30 European Economic Area (EEA)[3] States in Europe have implemented the EU Emissions Trading System (ETS), including the aviation sector with around 500 aircraft operators participating in the cap-and-trade approach to limit CO_2 emissions. Subject to preserving the environmental integrity and effectiveness it is expected that the EU ETS legislation will continue to be adapted to implement CORSIA.

As a consequence of the linking agreement with Switzerland, from 2020 the EU ETS was extended to all departing flights from the EEA to Switzerland, and Switzerland applies its ETS to all departing flights to EEA airports, ensuring a level playing field on both directions of routes.

In accordance with the EU-UK Trade and Cooperation Agreement reached in December 2020, the EU ETS shall continue to apply to departing flights from the EEA to the UK, while a UK ETS will apply effective carbon pricing on flights departing from the UK to the EEA.

[3] The EEA includes EU countries and also Iceland, Liechtenstein and Norway.

In the period 2013 to 2020, EU ETS has saved an estimated 200 million tonnes of intra-European aviation CO_2 emissions.

ECAC Scenarios for Traffic and CO_2 Emissions

The scenarios presented in this common section of State Action Plans of ECAC States take into account the impacts of the COVID-19 crisis on air transport, to the extent possible, and with some unavoidable degree of uncertainty. The best-available data used for the purposes of this Action Plan has been taken from EUROCONTROL's regular publication of comprehensive assessments of the latest traffic situation in Europe.

Despite the current extraordinary global decay on passengers' traffic due to the COVID-19 pandemic, hitting the European economy, tourism and the sector itself, aviation is expected to continue to grow in the long-term, develop and diversify in many ways across the ECAC States. Air cargo traffic has not been impacted as the rest of the traffic and thus, whilst the focus of available data relates to passenger traffic, similar pre-COVID forecasted outcomes might be anticipated for cargo traffic both as belly hold freight or in dedicated freighters.

The analysis by EUROCONTROL and EASA have identified the most likely scenario of influences on future traffic and modelled these assumptions out to future years. On the basis of this traffic forecast, fuel consumption and CO_2 emissions of aviation have been estimated for both a theoretical baseline scenario (without any additional mitigation action) and a scenario with estimated benefits from mitigation measures implemented since 2019 or provided benefits beyond 2019 that are presented in this Action Plan.

Under the baseline assumptions of traffic growth and fleet rollover with 2019 technology, CO_2 emissions would significantly grow in the long-term for flights departing from ECAC airports without mitigation measures. Modelling the impact of improved aircraft technology for the scenario with implemented measures indicates an overall 15% reduction of fuel consumption and CO_2 emissions in 2050 compared to the baseline. Whilst the data to model the benefits of ATM improvements may be less robust, they are nevertheless valuable contributions to further reduce emissions. Overall CO_2 emissions, including the effects of new aircraft types and ATM-related measures, are projected to improve to lead to a 23% reduction in 2050 compared to the baseline.

In the common section of this Action Plan the potential of sustainable aviation fuels and the effects of market-based measures have not been simulated in detail. Notably, CORSIA being a global measure, and not a European measure, the assessments of its benefits were not considered required for the purposes of the State Action Plans. But they should both help reach the ICAO carbon-neutral growth 2020 goal. As further developments in policy and technology are made, further analysis will improve the modelling of future emissions.

A. ECAC BASELINE SCENARIO AND ESTIMATED BENEFITSOF IMPLEMENTED MEASURES

1. ECAC Baseline Scenario

The baseline scenario is intended to serve as a reference scenario for CO_2 emissions of European aviation in the absence of any of the mitigation actions described later in this document. The following sets of data (2010, 2019) and forecasts (for 2030, 2040 and 2050) were provided by EUROCONTROL for this purpose:

- European air traffic (includes all commercial and international flights departing from ECAC airports, in number of flights, revenue passenger kilometres (RPK) and revenue tonne-kilometres (RTK);
- its associated aggregated fuel consumption; and
- its associated CO_2 emissions.

The sets of forecasts correspond to projected traffic volumes in a scenario of "Regulation and Growth", while corresponding fuel consumption and CO_2 emissions assume the technology level of the year 2019 (i.e. without considering reductions of emissions by further aircraft related technology improvements, improved ATM and operations, sustainable aviation fuels or market based measures).

Traffic Scenario "Regulation and Growth"

As in all forecasts produced by EUROCONTROL, various scenarios are built with a specific storyline and a mix of characteristics. The aim is to improve the understanding of factors that will influence future traffic growth and the risks that lie ahead. The latest EUROCONTROL long-term forecast[4] was published in June 2018 and inspects traffic development in terms of Instrument Flight Rule (IFR) movements to 2040.

In the latter, the scenario called 'Regulation and Growth' is constructed as the 'most likely' or 'baseline' scenario for traffic, most closely following the current trends[5]. It considers a moderate economic growth, with some regulation particularly regarding the social and economic demands.

Amongst the models applied by EUROCONTROL for the forecast, the passenger traffic sub-model is the most developed and is structured around five main group of factors that are taken into account:

- Global economy factors represent the key economic developments driving the demand for air transport.
- Factors characterising the passengers and their travel preferences change patterns in travel demand and travel destinations.
- Price of tickets set by the airlines to cover their operating costs influences passengers' travel decisions and their choice of transport.
- More hub-and-spoke or point-to-point networks may alter the number of connections and flights needed to travel from origin to destination.

[4] Challenges of Growth - Annex 1 - Flight Forecast to 2040, EUROCONTROL, September 2018.
[5] Prior to COVID-19 outbreak.

- Market structure describes size of aircraft used to satisfy the passenger demand (modelled via the Aircraft Assignment Tool).

COVID-19 impact and extension to 2050

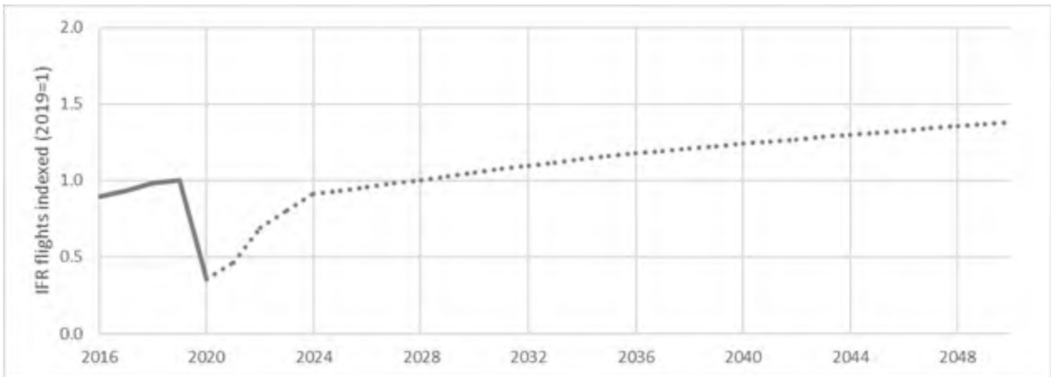
Since the start of 2020, COVID-19 has gone from a localised outbreak in China to the most severe global pandemic in a century. No part of European aviation is untouched by the human tragedy or the business crisis. This unprecedented crisis hindered air traffic growth in 2020: flight movements declined by 55% compared to 2019 at ECAC level, and it still continues to disrupt the traffic growth and patterns in Europe. In Autumn 2020, EUROCONTROL published a medium-term forecast[6] to 2024, taking into account the impact of the COVID-19 outbreak. The paper concluded that ECAC flights will only reach 92% of their 2019 levels in 2024.

In order to take into account the COVID-19 impact and to extend the horizon to 2050, the following adaptations have been brought to the original long-term forecast. Considering the most-likely scenarios of the long-term forecast and the medium-term forecasted version of the long-term flight forecast has been derived:

- Replace the long-term forecast horizon by the most recent medium-term forecast to account for COVID impact.
- Update the rest of the horizon (2025-2040) assuming that the original growth rates of the long-term forecast would remain similar to those calculated pre-COVID-19; and
- Extrapolate the final years (2040-2050) considering the same average annual growth rates as the one forecasted for the 2035-2040 period, but with a 0.9 decay[7].

The method used relies on the calculation of adjustment factors at STATFOR[8] region-pair level and has been applied to the original long-term forecast. Adjusting the baseline enables to further elaborate the baseline scenario as forecasted future fuel consumption and to 2030, 2040 and 2050, in the absence of action.

Figure 7 below shows the ECAC scenario of the passenger flight forecasted international departures for both historical (solid line) and future (dashed line) years.



[6] Five-Year Forecast 2020-2024, IFR Movements, EUROCONTROL, November 2020.

[7] As the number of flights has not been directly forecasted via the system but numerically extrapolated, it does not include any fleet renewal, neither network change (airport pairs) between 2040 and 2050. This factor is aimed at adjusting the extrapolation to capture the gradual maturity of the market.

[8] STATFOR (Statistics and Forecast Service) provides statistics and forecasts on air traffic in Europe and to monitor and analyse the evolution of the Air Transport Industry.

Figure 7. Updated EUROCONTROL "Regulation and Growth" scenario of the passenger flight forecast for ECAC international departures including the COVID-19 impact between 2020-2024

Further assumptions and results for the baseline scenario

The ECAC baseline scenario was generated by EUROCONTROL for all ECAC States. It covers all commercial international passenger flights departing[9] from ECAC airports, as forecasted in the aforementioned traffic scenario. The number of passengers per flight is derived from Eurostat data.

EUROCONTROL also generates a number of all-cargo flights in its baseline scenario. However, no information about the freight tonnes carried is available. Hence, historical and forecasted cargo traffic have been extracted from another source (ICAO[10]). This data, which is presented below, includes both belly cargo transported on passenger flights and freight transported on dedicated all-cargo flights.

Historical fuel burn and emission calculations are based on the actual flight plans from the PRISME[11] data warehouse used by EUROCONTROL, including the actual flight distance and the cruise altitude by airport pair. These calculations were made for about 99% of the passenger flights (the remaining flights had information missing in the flight plans). Determination of the fuel burn and CO_2 emissions for historical years is built up as the aggregation of fuel burn and emissions for each aircraft of the associated traffic sample characteristics. Fuel burn and CO_2 emission results consider each aircraft's fuel burn in its ground and airborne phases of flight and are obtained by use of the EUROCONTROL IMPACT environmental model, with the aircraft technology level of each year.

Forecast years (until 2050) fuel burn and modelling calculations use the 2019 flight plan characteristics as much as possible, to replicate actual flown distances and cruise levels, by airport pairs and aircraft types. When not possible, this modelling approach uses past years traffics too, and, if needed, the ICAO CAEP forecast modelling. The forecast fuel burn and CO_2 emissions of the baseline scenario for forecast years uses the technology level of 2019.

For each reported year, the revenue per passenger kilometre (RPK) calculations use the number of passengers carried for each airport pair multiplied by the great circle distance between the associated airports and expressed in kilometres. Because of the coverage of the passenger estimation data sets (Scheduled, Low-cost, Non-Scheduled flights, available passenger information, etc.) these results are determined for about 99% of the historical passenger traffic, and 97% of the passenger flight forecasts. From the RPK values, the passenger flights RTK were calculated as the number of tonnes carried by kilometres, assuming that 1 passenger corresponds to 0.1 tonne.

The fuel efficiency represents the amount of fuel burn divided by the RPK for each available airport pair with passenger data, for the passenger traffic only. Here, the RPK and fuel

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[9] International departures only. Domestic flights are excluded. A domestic is any flight between two airports in the State, regardless of the operator or which airspaces they enter en-route. Airports located overseas are attached to the State having the sovereignty of the territory. For example, France domestic include flights to Guadeloupe, Martinique, etc.

[10] ICAO Long-Term Traffic Forecasts, Passenger and Cargo, July 2016. Cargo forecasts have not been updated as new ICAO forecast including COVID-19 effects will be made available after the end of June 2021, so those cannot be considered in this action plan common section.

[11] PRISME is the name of the EUROCONTROL data warehouse hosting the flight plans, fleet and airframe data.

efficiency results correspond to the aggregation of these values for the whole concerned traffic years.

The following tables and figures show the results for this baseline scenario, which is intended to serve as a reference case by approximating fuel consumption and CO_2 emissions of European aviation in the absence of mitigation actions.

Year	Passenger traffic (IFR movements) (million)	Revenue passenger kilometres[12] RPK (billion)	All-cargo traffic (IFR movements) (million)	Freight tonne kilometres transported[13] FTKT (billion)	Total revenue tonne kilometres[14] RTK (billion)
2010	4.56	1,114	0.198	45.4	156.8
2019	5.95	1,856	0.203	49.0	234.6
2030	5.98	1,993	0.348	63.8	263.1
2040	7.22	2,446	0.450	79.4	324.0
2050	8.07	2,745	0.572	101.6	376.1

Table 3. Baseline forecast for international traffic departing from ECAC airports

[12] Calculated based on Great Circle Distance (GCD) between airports, for 97% of the passenger traffic for forecast years.
[13] Includes passenger and freight transport (on all-cargo and passenger flights).
[14] A value of 100 kg has been used as the average mass of a passenger incl. baggage (ref: ICAO).

Year	Fuel consumption (10^9 kg)	CO_2 emissions (10^9 kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	36.95	116.78	0.0332	0.332
2019	52.01	164.35	0.0280	0.280
2030	50.72	160.29	0.0252	0.252
2040	62.38	197.13	0.0252	0.252
2050	69.42	219.35	0.0250	0.250
For reasons of data availability, results shown in this table do not include cargo/freight traffic.				

Table 4. Fuel burn and CO_2 emissions forecast for the baseline scenario

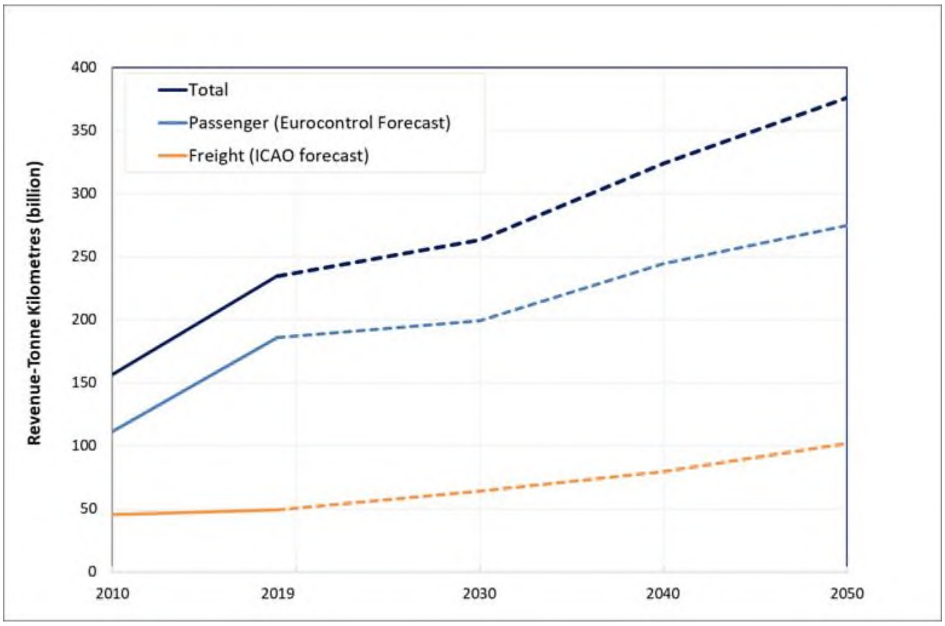

Figure 8. Forecasted traffic until 2050 (assumed both for the baseline and implemented measures scenarios)

The impact of the COVID-19 in 2020 is not fully reflected in *Figure 8*, as this representation is oversimplified through a straight line between 2019 and 2030. The same remark applies for *Figure 9* and *Figure 10*.

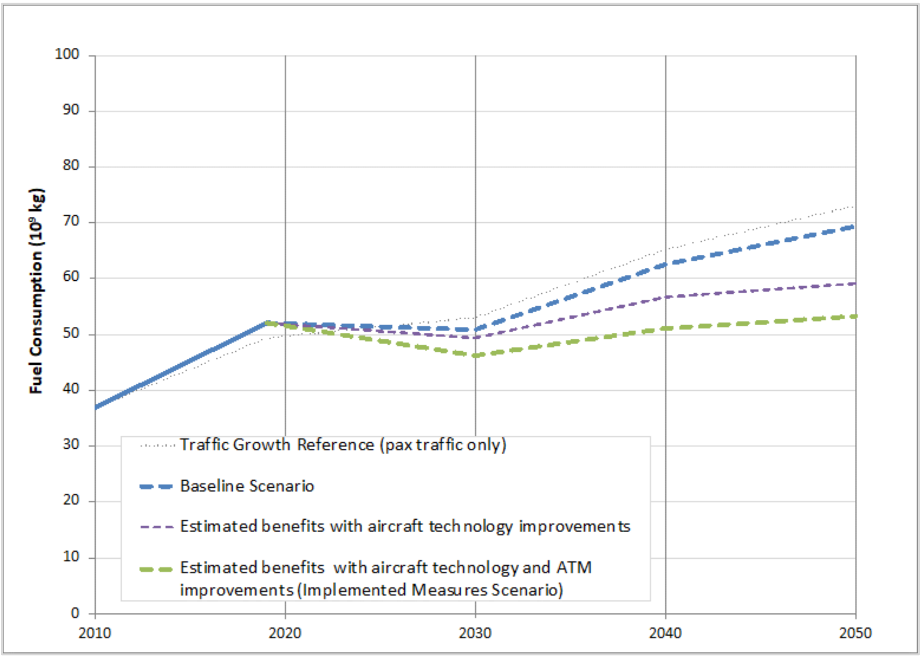

Figure 9. Fuel consumption forecast for the baseline and implemented measures scenarios (international passenger flights departing from ECAC airports)

2. ECAC Scenario with Implemented Measures: Estimated Benefits

In order to improve fuel efficiency and reduce future air traffic emissions beyond the projections in the baseline scenario, ECAC States have taken further actions. Assumptions for a top-down assessment of effects of mitigation actions are presented here, based on modelling results by EUROCONTROL and EASA. Measures to reduce aviation's fuel consumption and emissions will be described in the following subchapters.

For reasons of simplicity, the scenario with implemented measures is based on the same traffic volumes as the baseline case, e.g., updated EUROCONTROL's 'Regulation and Growth' scenario described earlier. Unlike in the baseline scenario, the effects of aircraft related technology development and improvements in ATM/operations are considered here for a projection of fuel consumption and CO_2 emissions up to the year 2050.

Effects of improved aircraft technology are captured by simulating fleet roll-over and considering fuel efficiency improvements of new aircraft types of the latest generation (e.g., Airbus A320Neo, Boeing 737Max, Airbus A350XWB etc.). The simulated future fleet of aircraft has been generated using the Aircraft Assignment Tool[15] (AAT) developed collaboratively by EUROCONTROL, EASA, and the European Commission. The retirement process of AAT is performed year by year, allowing the determination of the number of new aircraft required each year. In addition to the fleet rollover, a constant annual improvement of fuel efficiency of 1.16% per annum is assumed for each aircraft type with entry into service from 2020 onwards. This rate of improvement corresponds to the 'Advanced' fuel technology scenario used by CAEP to generate the fuel trends for the Assembly. This technology improvement modelling is applied to the years 2030 and 2040. For the year 2050, as the forecast

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15 https://www.easa.europa.eu/domains/environment/impact-assessment-tools

traffic reuses exactly the fleet of the year 2040, the technological improvement is determined with the extrapolation of the fuel burn ratio between the baseline scenario and the technological improvement scenario results of the years 2030 to 2040.

The effects of improved ATM efficiency are captured in the Implemented Measures Scenario on the basis of efficiency analyses from the SESAR project. In SESAR, a value of 5,280 kg of fuel per flight for ECAC (including oceanic region) is used as a baseline[16]. Based on the information provided by the PAGAR 2019 document[17], and compared to a 2012 baseline, the benefits at the end of Wave 1 could be about 3% CO_2/fuel savings achieved by 2025 equivalent to 147.4 kg of fuel/flight. So far, the target for Wave 2 remains at about 7% more CO_2/fuel savings (352.6 kg of fuel) to reach the initial Ambition target of about 10% CO_2/fuel savings (500 kg fuel) per flight by 2035. The 2030 efficiency improvement is calculated by assuming a linear evolution between 2025 and 2035. As beyond 2035, there is no SESAR Ambition yet, it is assumed that the ATM efficiency improvements are reported extensively for years 2040 and 2050.

The yet un-estimated benefits of Exploratory Research projects[18] are expected to increase the overall future fuel savings.

While the effects of introduction of Sustainable Aviation Fuels (SAF) were modelled in previous updates on the basis of the European ACARE goals[19], the expected SAF supply objectives for 2020 were not met, and in the current update the SAF benefits have not been modelled as a European common measure in the implemented measures scenario. However, numerous initiatives related to SAF (e.g., ReFuelEU Aviation) are largely described in *Section B Part 2* and it is expected that future updates will include an assessment of its benefits as a collective measure.

Effects on aviation's CO_2 emissions of market-based measures including the EU Emissions Trading System (ETS) with the linked Swiss ETS, the UK ETS and the ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) have not been modelled in the top-down assessment of the implemented measures scenario presented here as, at the time of the submission of this Action Plan, a legislative proposal for the revision of the EU ETS Directive concerning aviation is under development to complete the implementation of CORSIA by the EU and to strengthen the ambition level of the EU ETS. CORSIA is not considered a European measure but a global one. It aims for carbon-neutral growth (CNG) of aviation as compared to the average of 2019 and 2020 levels of emissions in participating States, and an indication of a corresponding (hypothetical) target applied to Europe is shown in *Figure 10*, while recalling that this is just a reference level, given that CORSIA was designed to contribute to the CNG 2020 globally and not in individual States or regions.

Tables 5-7 and *Figure 10* summarise the results for the scenario with implemented measures. It should be noted that *Table 5* shows direct combustion emissions of CO_2 (assuming 3.16 kg CO_2 per kg fuel). More detailed tabulated results are found in *Appendix A*, including results expressed in equivalent CO_2 emissions on a well-to-wake basis (for comparison purposes of SAF benefits).

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[16] See SESAR ATM Master Plan – Edition 2020 (www.atmmasterplan.eu) - eATM.
[17] See SESAR Performance Assessment Gap Analysis Report (PAGAR) updated version of 2019 v00.01.04, 31-03-2021.
[18] See SESAR Exploratory Research projects - https://www.sesarju.eu/exploratoryresearch
[19] https://www.acare4europe.org/sria/flightpath-2050-goals/protecting-environment-and-energy-supply-0

Year	Fuel consumption (10^9 kg)	CO2 emissions (10^9 kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	36.95	116.78	0.0332	0.332
2019	52.01	164.35	0.0280	0.280
2030	46.16	145.86	0.0229	0.229
2040	51.06	161.35	0.0206	0.206
2050	53.18	168.05	0.0192	0.192
2050 vs 2019			-32%	
For reasons of data availability, results shown in this table do not include cargo/freight traffic.				

Table 5. Fuel burn and CO_2 emissions forecast for the implemented measures scenario (new aircraft technology and ATM improvements only)

Period	Average annual fuel efficiency improvement (%)
2010-2019	-1.86%
2019-2030	-1.82%
2030-2040	-1.03%
2040-2050	-0.74%

Table 6. Average annual fuel efficiency improvement for the Implemented Measures Scenario (new aircraft technology and ATM improvements only)

Year	CO_2 emissions (10^9 kg)			% Improvement by implemented measures (full scope)
	Baseline scenario	Implemented measures scenario		
		Aircraft technology improvements only	Aircraft technology and ATM improvements	
2010	116,78			NA
2019	164,35			NA
2030	160,3	156,0	145,9	-9%
2040	197,1	179,3	161,4	-18%
2050	219,4	186,7	168,0	-23%
For reasons of data availability, results shown in this table do not include cargo/freight traffic. Note that fuel consumption is assumed to be unaffected by the use of sustainable aviation fuels.				

Table 7. CO_2 emissions forecast for the scenarios described in this chapter

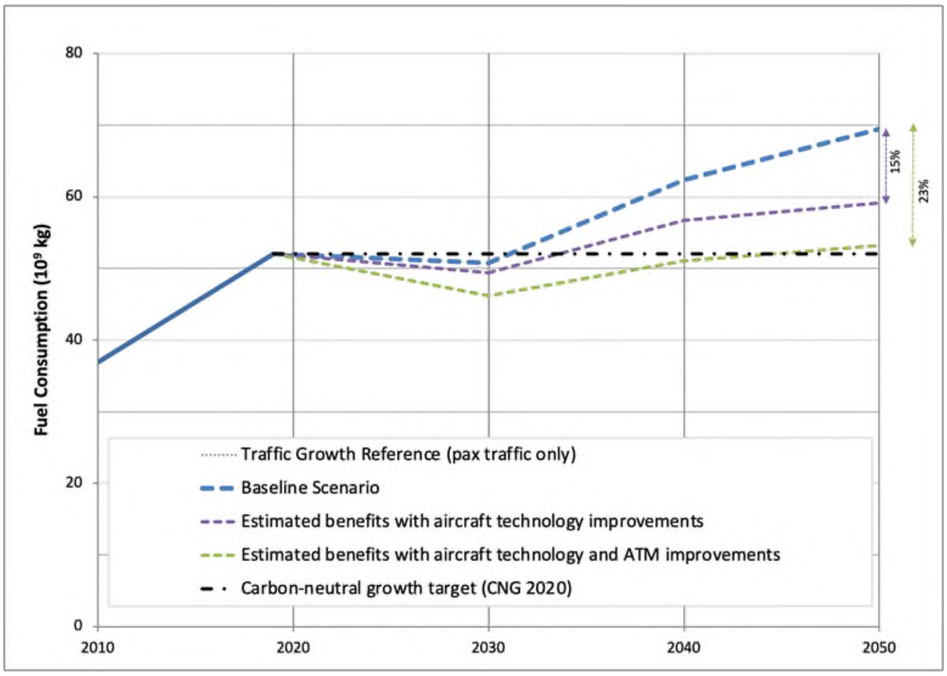


Figure 10. Fuel consumption forecast for the baseline and implemented measures scenarios

As shown in *Figure 10*, the impact of improved aircraft technology indicates an overall 15% reduction of fuel consumption and CO_2 emissions in 2050 compared to the baseline scenario. Overall CO_2 emissions, including the effects of new aircraft types and ATM-related measures, are projected to lead to a 23% reduction in 2050 compared to the baseline.

From *Table 5*, under the currently assumed aircraft technology and ATM improvement scenarios, the fuel efficiency is projected to lead to a 32% reduction from 2019 to 2050. Indeed, the annual rate of fuel efficiency improvement is expected to progressively slow down from a rate of 1.82% between 2019 and 2030 to a rate of 0.74% between 2040 and 2050. Aircraft technology and ATM improvements alone will not be sufficient to meet the post-2020 carbon neutral growth objective of ICAO. This confirms that additional action, particularly market-based measures and SAF, are required to fill the gap. There are among the ECAC Member States additional ambitious climate strategies where carbon neutrality by 2050 is set as the overall objective. The aviation sector will have to contribute to this objective.

B. ACTIONS TAKEN COLLECTIVELY IN EUROPE

1. TECHNOLOGY AND STANDARDS

1.1. Aircraft emissions standards

1.2. Research and development: Clean Sky and the European Partnership for Clean Aviation

2. SUSTAINABLE AVIATION FUELS (SAF)

2.1. ReFuelEU Aviation

2.2. Addressing barriers of SAF penetration into the market

2.3. Standards and requirements for SAF use

2.4. Research and development projects

3. OPERATIONAL IMPROVEMENTS

3.1. The EU's Single European Sky Initiative and SESAR

4. MARKET-BASED MEASURES

4.1. The EU Emissions Trading System and its linkages with other systems (Swiss ETS and UK ETS)

4.2. The Carbon Offsetting and Reduction Scheme for International Aviation

5. ADDITIONAL MEASURES

5.1. ACI Airport Carbon Accreditation

5.2. European industry roadmap to a net zero European aviation: Destination 2050

5.3. Environmental Label Programme

5.4. Multilateral capacity building projects

5.5. Green Airports research and innovation projects

6. SUPPLEMENTAL BENEFITS FOR DOMESTIC SECTORS

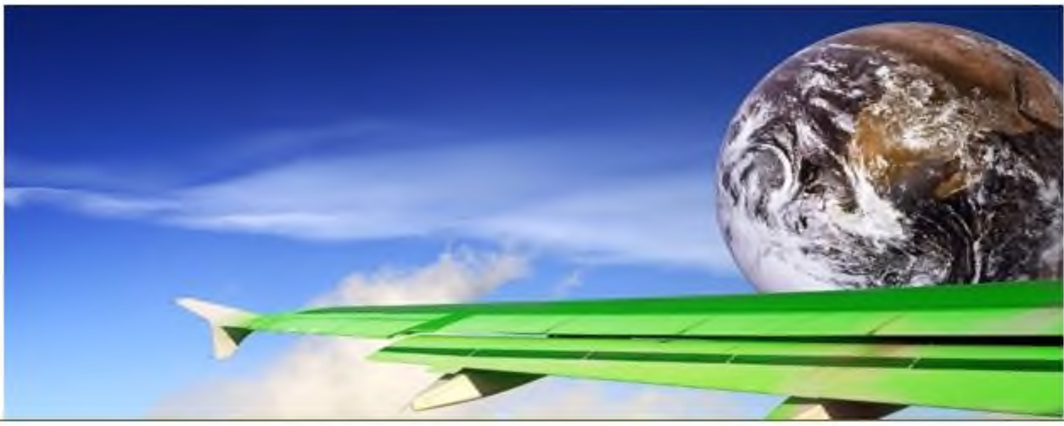
6.1. ACI Airport Carbon Accreditation

6.2. ReFuelEU Aviation

6.3. SAF Research and development projects

6.4. The EU's Single European Sky Initiative and SESAR

6.5. Green Airports research and innovation projects



1. TECHNOLOGY AND STANDARDS

1.1 Aircraft emissions standards

European Member States fully support the work of ICAO's Committee on Aviation Environmental Protection (CAEP) on the development and update of aircraft emissions standards, in particular to the ICAO Aircraft CO_2 Standard adopted by ICAO in 2017. Europe significantly contributed to its development, notably through the European Union Aviation Safety Agency. EASA is fully committed to its implementation in Europe and the need to review the standard on a regulatory basis in light of developments in aeroplane fuel efficiency. EASA has supported the process to integrate this standard into European legislation (2018/1139) with an applicability date of 1 January 2020 for new aeroplane types.

ASSESSMENT

This is a European contribution to a global measure (CO_2 standard). Its contribution to the global aspirational goals is available in CAEP.

1.2 Research and development

1.2.1 Clean Sky

Clean Sky[20] is an EU Joint Undertaking that aims to develop and mature breakthrough "clean technologies" for air transport globally. Joint Undertakings are Public-Private Partnership set up by the European Union for EU research programmes. By accelerating their deployment, the Joint Undertaking will contribute to Europe's strategic environmental and social priorities, and simultaneously promote competitiveness and sustainable economic growth. The first Clean Sky Joint Undertaking (Clean Sky 1 - 2011-2017) had a budget of €1.6 billion, equally shared between the European Commission and the aeronautics industry. It aimed to develop environmental-friendly technologies impacting all flying-segments of commercial aviation. The objectives were to reduce aircraft CO_2 emissions by 20-40%, NO_x by around 60% and noise by up to 10dB compared to year 2000 aircraft.

This was followed up by a second Joint Undertaking (Clean Sky 2 – 2014-2024) with the objective to reduce aircraft emissions and noise by 20 to 30% with respect to the latest

[20] http://www.cleansky.eu/

technologies entering into service in 2014. The current budget for the programme is approximately €4 billion.

The two Interim Evaluations of Clean Sky in 2011 and 2013 acknowledged that the programme is successfully stimulating developments towards environmental targets. These preliminary assessments confirm the capability of achieving the overall targets at completion of the programme.

Main remaining areas for Research and Technological Development (RTD) efforts under Clean Sky 2 were:

- Large Passenger Aircraft: demonstration of best technologies to achieve the environmental goals whilst fulfilling future market needs and improving the competitiveness of future products.
- Regional Aircraft: demonstrating and validating key technologies that will enable a 90-seat class turboprop aircraft to deliver breakthrough economic and environmental performance and a superior passenger experience.
- Fast Rotorcraft: demonstrating new rotorcraft concepts (tilt-rotor and compound helicopters) technologies to deliver superior vehicle versatility and performance.
- Airframe: demonstrating the benefits of advanced and innovative airframe structures (like a more efficient wing with natural laminar flow, optimised control surfaces, control systems and embedded systems, highly integrated in metallic and advanced composites structures). In addition, novel engine integration strategies and innovative fuselage structures will be investigated and tested.
- Engines: validating advanced and more radical engine architectures.
- Systems: demonstrating the advantages of applying new technologies in major areas such as power management, cockpit, wing, landing gear, to address the needs of a future generation of aircraft in terms of maturation, demonstration and innovation.
- Small Air Transport: demonstrating the advantages of applying key technologies on small aircraft demonstrators to revitalise an important segment of the aeronautics sector that can bring new key mobility solutions.
- Eco-Design: coordinating research geared towards high eco-compliance in air vehicles over their product life and heightening the stewardship with intelligent Re-use, Recycling and advanced services.

In addition, the Clean Sky Technology Evaluator[21] will continue to be upgraded to assess technological progress routinely and evaluate the performance potential of Clean Sky 2 technologies at both vehicle and aggregate levels (airports and air traffic systems).

1.2.1 Disruptive aircraft technological innovations: European Partnership for Clean Aviation

As the Horizon 2020 programme came to a close in 2020, the Commission has adopted a proposal to set up a new Joint Undertaking under the Horizon Europe programme (2021-2027). The European Partnership for Clean Aviation (EPCA)[22] will follow in the footsteps of CleanSky 2. The EU contribution proposed is again €1.7 billion. The stakeholder community has already formulated a Strategic Research and Innovation Agenda (SRIA), which is intended to serve as a basis of the partnership once established. Subject to the final provisions of the partnership and the EU budget allocation, industry stakeholders have proposed a commitment of €3 billion from the private side.

[21] https://www.cleansky.eu/technology-evaluator-te

[22] https://clean-aviation.eu/

General objectives of EPCA

- To contribute to reducing the ecological footprint of aviation by accelerating the development of climate neutral aviation technologies for earliest possible deployment, therefore significantly contributing to the achievement of the general goals of the European Green Deal, in particular in relation to the reduction of Union-wide net greenhouse gas emissions reduction target of at least 55% by 2030 compared to 1990 levels and a pathway towards reaching climate neutrality by 2050.
- To ensure that aeronautics-related research and innovation activities contribute to the global sustainable competitiveness of the Union aviation industry, and to ensure that climate-neutral aviation technologies meet the relevant aviation safety requirements, and remain a secure, reliable, cost-effective, and efficient means of passenger and freight transportation.

Specific objectives

- To integrate and demonstrate disruptive aircraft technological innovations able to decrease net emissions of greenhouse gases by no less than 30% by 2030 compared to 2020 state-of-the-art technology while paving the ground towards climate-neutral aviation by 2050.
- To ensure that the technological and the potential industrial readiness of innovations can support the launch of disruptive new products and services by 2035, with the aim of replacing 75% of the operating fleet by 2050 and developing an innovative, reliable, safe and cost-effective European aviation system that is able to meet the objective of climate neutrality by 2050.
- To expand and foster integration of the climate-neutral aviation research and innovations value chains, including academia, research organisations, industry, and SMEs, also by benefitting from exploiting synergies with other national and European programmes.

ASSESSMENT

The quantitative assessment of the technology improvement scenario from 2020 to 2050 has been calculated by EUROCONTROL and EASA and it is included in *Section A* above (ECAC baseline scenario and estimated benefits of implemented measures) and in *Appendix A*.

Year	Fuel consumption (10^9 kg)	CO2 emissions (10^9 kg)	Well-to-wake CO_2e emissions (10^9 kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	36.95	116.78	143.38	0.0332	0.332
2019	52.01	164.35	201.80	0.0280	0.280
2030	49.37	156.00	191.54	0.0232	0.232
2040	56.74	179.28	220.13	0.0217	0.217
2050	59.09	186.72	229.26	0.0202	0.202
For reasons of data availability, results shown in this table do not include cargo/freight traffic.					

Table 8. Fuel consumption and CO_2 emissions of international passenger traffic departing from ECAC airports, with aircraft technology improvements after 2019

Period	Average annual fuel efficiency improvement (%)
2010-2019	-1.86%
2019-2030	-1.22%
2030-2040	-0.65%
2040-2050	-0.74%

Table 9. Average annual fuel efficiency improvement for the implemented measures scenario (new aircraft technology only)

2. SUSTAINABLE AVIATION FUELS

Sustainable aviation fuels (SAF) including advanced biofuels and synthetic fuels have the potential to significantly reduce aircraft emissions, and ECAC States are embracing their large-scale introduction in line with the 2050 ICAO Vision.

The European collective SAF measures included in this Action Plan focus on their CO_2 reductions benefits. Nevertheless, SAF has the additional benefit of reducing air pollutant emissions of non-volatile Particulate Matter (nvPM) with up to 90% and sulphur (SO_X) with 100%, compared to fossil jet fuel[23]. As a result, the large-scale use of SAF can have important other non-CO_2 benefits on the climate which are not specifically assessed within the scope of this Action Plan.

2.1 ReFuelEU Aviation

On 15 January 2020, the European Parliament adopted a resolution on the European Green Deal in which it welcomed the upcoming strategy for sustainable and smart mobility and agreed with the European Commission that all modes of transport will have to contribute to the decarbonisation of the transport sector in line with the objective of reaching a climate-neutral economy. The European Parliament also called for "*a clear regulatory roadmap for the decarbonisation of aviation, based on technological solutions, infrastructure, requirements for sustainable alternative fuels and efficient operations, in combination with incentives for a modal shift*".

The Commission's work programme for 2020 listed under the policy objective on Sustainable and smart mobility, a new legislative initiative titled "*ReFuelEU Aviation – Sustainable Aviation Fuels*".

This initiative aims to boost the supply and demand for SAF in the EU including not only advanced biofuels, but also synthetic fuels. This in turn will reduce aviation's environmental footprint and enable it to help achieve the EU's climate targets.

The EU aviation internal market is a key enabler of connectivity and growth but is also accountable for significant environmental impact. In line with the EU's climate goals to reduce

[23] ICAO 2016 Environmental Report, Chapter 4, Page 162, Figure 4.

emissions by 55% by 2030 and to achieve carbon neutrality by 2050, the aviation sector needs to decarbonise.

While several policy measures are in place, significant potential for emissions savings could come from the use of SAF, i.e. liquid drop-in fuels replacing fossil kerosene. However, currently only around 0.05% of total aviation fuels used in the EU are sustainable.

The ReFuelEU Aviation aims to maintain a competitive air transport sector while increasing the share of SAF used by airlines.

ASSESSMENT

A meaningful deployment of SAF in the aviation market will lead to a net decrease of the air transport sector's CO_2 emissions. SAF can achieve as high as 85% or more emissions savings compared to conventional jet fuel, and therefore, if deployed at a large scale, have important potential to help aviation contribute to EU reaching its climate targets.

The assessment of the benefits provided by this collective European measure in terms of reduction in aviation emissions is expected to be included in a future update of the common section of this Action Plan.

2.2 Addressing barriers of SAF penetration into the market

SAFs are considered to be a critical element in the basket of measures to mitigate aviation's contribution to climate change in the short-term using the existing global fleet.

However, the use of SAF has remained negligible up to now despite previous policy initiatives such as the European Advanced Biofuels Flightpath, as there are still significant barriers for its large-scale deployment.

The European Aviation Environmental Report (EAER) published in January 2019, identified a lack of information at European level on the supply and use of SAF within Europe. EASA completed two studies in 2019 to address the lack of SAF monitoring in the EU.

2.2.1 Sustainable Aviation Fuel 'Facilitation Initiative'

A supporting study completed by EASA in 2019 addressing the barriers of SAF penetration into the market, examines how to incentivise the approval and use of SAF as drop-in fuels in Europe by introducing a SAF Facilitation Initiative.

Significant remaining industrial and economic barriers limit the penetration of SAF into the aviation sector. To reduce the costs and risk that economic operators face in bringing SAF to the aviation market, this study examined how to incentivise the approval and use of SAF as drop-in fuels in Europe by introducing a SAF Facilitation Initiative.

The report begins by analysing the status of SAFs in Europe today, including both more established technologies and ones at a lower Technology Readiness Level (TRL). It reviews one of the major solutions to the obstacle of navigating the SAF approval process, namely the US Clearing House run by the University of Dayton Research Institute and funded by the Federal Aviation Administration (FAA). The issue of sustainability is also examined, via an analysis of the role of Sustainability Certification Schemes (SCS) and how they interact with regulatory sustainability requirements, particularly those in the EU's Renewable Energy Directive (RED II) and ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Through interviews with a wide range of stakeholders the best form of European facilitation initiative has been identified. This study recommends that such an initiative be divided into two separate bodies, the first acting as an EU Clearing House and the second acting as a Stakeholder Forum.

The report is available at EASA's website: 'Sustainable Aviation Fuel 'Facilitation Initiative'.

2.2.2. Sustainable Aviation Fuel 'Monitoring System'

In response to a lack of information at the EU level on the supply and use of SAF within Europe identified by the European Aviation Environmental Report, EASA launched a second study to identify a cost effective, robust data stream to monitor the use and supply of SAF, as well as the associated emissions reductions. This included identifying and recommending performance indicators related to the use of SAF in Europe, as well as the associated aviation CO_2 emissions reductions achieved.

The study followed five steps:

1. Identification of possible performance indicators by reviewing the current 'state of the art' SAF indicators and consultation with key stakeholders.
2. Identification of regulatory reporting requirements, and other possible sources of datasets and information streams in the European context, with the potential to cover the data needs of the proposed performance indicators.
3. Examination of sustainability requirements applicable to SAF, and potential savings in greenhouse gas (GHG) emissions compared to fossil-based fuels.
4. Review of SAF use today and future expectations for SAF use within Europe.
5. Definition of a future monitoring and reporting process on SAF use in Europe and related recommendations to implement it.

The results will be used as a basis for subsequent work to include SAF performance indicators in future EAERs, which will provide insight into the market penetration of SAF over time in order to assess the success of policy measures to incentivize uptake.

The report is available at EASA's website: 'Sustainable Aviation Fuel 'Monitoring System'.

ASSESSMENT

While these studies are expected to contribute to addressing barriers of SAF penetration into the market, its inclusion is for information purposes and the assessment of its benefits in terms of reduction in aviation emissions is not provided in the present Action Plan.

2.3 Standards and requirements for SAF

2.3.1. European Union standards applicable to SAF supply

Within the European Union there are currently applicable standards for renewable energy supply in the transportation sector, which are included in the revised Renewable Energy Directive (RED II) that entered into force in December 2018 (Directive 2018/2001/EU).

It aims at promoting the use of energy from renewable sources, establishing mandatory targets to be achieved by 2030 for a 30% overall share of renewable energy in the EU and a minimum of 14% share for renewable energy in the transport sector including for aviation, but without mandatory SAF supply targets.

Sustainability and life cycle emissions methodologies

Sustainability criteria and life cycle emissions methodologies have been established for all transport renewable fuels supplied within the EU to be counted towards the targets, which are fully applicable to SAF supply.

These can be found in RED´s[24] Article 17, *Sustainability criteria for biofuels and bioliquids*. Those requirements remain applicable on the revised RED II (Directive (EU) 2018/2001)38, Article 29 *Sustainability and greenhouse gas emissions saving criteria for biofuels, bioliquids and biomass fuels* paragraphs 2 to 7, although the RED II introduces some new specific criteria for forestry feedstocks.

Transport renewable fuels (thus, including SAF) produced in installations starting operation from 1 January 2021 must achieve 65% GHG emissions savings with respect to a fossil fuel comparator for transportation fuels of 94 g CO_2eq/MJ. In the case of transport renewable fuels of non-biological origin[25], the threshold is raised to 70% GHG emissions savings.

To help economic operators to declare the GHG emission savings of their products, default and typical values for a number of specific pathways are listed in the RED II Annex V (for liquid biofuels). The European Commission can revise and update the default values of GHG emissions when technological developments make it necessary.

Economic operators have the option to either use default GHG intensity values provided in RED II (Parts A & B of Annex V) so as to estimate GHG emissions savings for some or all of the steps of a specific biofuel production process, or to calculate "actual values" for their pathway in accordance with the RED methodology laid down in Part C of Annex V;

In the case of non-bio-based fuels, a specific methodology is currently under development to be issued in 2021.

2.3.2. ICAO standards applicable to SAF supply

Europe is actively contributing to the development of the ICAO CORSIA Standards and Recommended Practices (SARPs) though the ICAO Committee on Aviation and Environmental Protection (CAEP), establishing global Sustainability Requirements applicable to SAF as well as to the CORSIA Methodology for Calculating Actual Life Cycle Emissions Values, and to the calculation of CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels. CORSIA standards are applicable to any SAF use to be claimed under CORSIA in order to reduce offsetting obligations by aeroplane operators.

ASSESSMENT

The inclusion of European requirements for SAF respond to ICAO Guidance (Doc 9988) request (Para. 4.2.14) to provide estimates of the actual life cycle emissions of the SAF which are being used or planned to deploy and the methodology used for the life cycle analysis. It is therefore provided for information purposes only, and no further assessment of its benefits in terms of reduction in aviation emissions is provided in this Action Plan common section.

[24] Directive 2009/28/EC

[25] In the case of renewable fuels of non-biological origin, two types are considered: a) Renewable liquid and gaseous transport fuels of non-biological origin (including categories commonly referred as Power to Liquid -PtL-, Electro-fuels and Synthetic fuels). b) Waste gases, which are under the category of REcycled FUel from NOn-BIOlogical origin (also known as REFUNIOBIO).

2.4 Research and Development projects on SAF

2.4.1 European Advanced Biofuels Flightpath

An updated and renewed approach to the 2011 Biofuels FlightPath Initiative[26] was required to further impulse its implementation. As a result, in 2016 the European Commission launched the new Biofuels FlightPath to take into account recent evolutions and to tackle the current barriers identified for the deployment of SAF.

The Biofuels FlightPath was managed by its Core Team, which consists of representatives from Airbus, Air France, KLM, IAG, IATA, BiojetMap, SkyNRG, and Lufthansa from the aviation industry's side, and Mossi Ghisolfi, Neste, Honeywell-UOP, Total, and Swedish Biofuels on the biofuel producers' side.

A dedicated executive team, formed by SENASA, ONERA, Transport & Mobility Leuven, and Wageningen UR, coordinated for three years the stakeholder's strategy in the field of aviation by supporting the activities of the Core Team and providing sound recommendations to the European Commission.

A number of communications and studies were delivered and are available[27].

The project was concluded with a Stakeholders conference in Brussels on 27 November 2019, and the publication of a report summarising its outcomes.

2.4.2 Projects funded under the European Union's Horizon 2020 research and innovation programme

Since 2016, seven new projects have been funded by Horizon 2020, which is the biggest Research and Innovation program of the EU.

BIO4A[28]: The "*Advanced Sustainable Biofuels for Aviation"* project plans to demonstrate the first large industrial-scale production and use of SAF in Europe obtained from residual lipids such as used cooking oil.

The project will also investigate the supply of sustainable feedstocks produced from drought-resistant crops such as Camelina, grown on marginal land in EU Mediterranean areas. By adopting a combination of biochar and other soil amendments, it will be possible to increase the fertility of the soil and its resilience to climate change, while at the same time storing fixed carbon into the soil.

BIO4A will also test the use of SAF across the entire logistic chain at industrial scale and under market conditions, and it will finally assess the environmental and socio-economic sustainability performance of the whole value chain.

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[26] In June 2011 the European Commission, in close coordination with Airbus, leading European airlines (Lufthansa, Air France/KLM, & British Airways) and key European biofuel producers (Choren Industries, Neste Oil, Biomass Technology Group and UOP), launched the European Advanced Biofuels Flight-path. This industry-wide initiative aimed to speed up the commercialisation of aviation biofuels in Europe, with an initial objective of achieving the commercialisation of 2 million tonnes of SAF by 2020, target that was not reached due to the commercial challenges of SAF large-scale supply. https://ec.europa.eu/energy/sites/ener/files/20130911_a_performing_biofuels_supply_chain.pdf

[27] https://www.biofuelsflightpath.eu/ressources

[28] www.bio4a.eu

Started in May 2018, BIO4A will last until 2022, and it is carried out by a consortium of seven partners from five European countries.

KEROGREEN[29]: *Production of sustainable aircraft grade kerosene from water and air powered by renewable electricity, through the splitting of CO_2, syngas formation and Fischer-Tropsch synthesis.* KEROGREEN is a Research and Innovation Action (RIA) carried out by six partners from four European countries aiming at the development and testing of an innovative conversion route for the production of SAF from water and air powered by renewable electricity.

The new approach and process of KEROGREEN reduces overall CO_2 emission by creating a closed carbon fuel cycle and at the same time creates long-term large-scale energy storage capacity which will strengthen the EU energy security and allow creation of a sustainable transportation sector.

The KEROGREEN project duration is from April 2018 to March 2022.

FlexJET[30]: *Sustainable Jet Fuel from Flexible Waste Biomass* (flexJET) is a four-year project targeting diversifying the feedstock for SAF beyond vegetable oils and fats to biocrude oil produced from a wide range of organic waste. This is also one of the first technologies to use green hydrogen from the processed waste feedstock for the downstream refining process thereby maximising greenhouse gas savings.

The project aims at building a demonstration plant for a 12 t/day use of food & market waste and 4000 l/day of Used Cooking Oil (UCO), produce hydrogen for refining through separation from syngas based on Pressure Swing Absorption technology, and finally deliver 1200 tons of SAF (ASTM D7566 Annex 2) for commercial flights to British Airways.

The consortium with thirteen partner organisations has brought together some of the leading researchers, industrial technology providers and renewable energy experts from across Europe. The project has a total duration of 48 months from April 2018 to March 2022.

BioSFerA[31]: The *Biofuels production from Syngas Fermentation for Aviation and maritime use,* BioSFerA project aims to validate a combined thermochemical - biochemical pathway to develop cost-effective interdisciplinary technology to produce sustainable aviation and maritime fuels. At the end of the project, next generation aviation and maritime biofuels, completely derived from second generation biomass, will be produced and validated by industrial partners at pilot scale. The project will undertake a full value chain evaluation that will result in a final analysis to define a pathway for the market introduction of the project concept. Some cross-cutting evaluations carried out on all tested and validated processes will complete the results of the project from an economic, environmental and social point of view.

The project is carried out by a consortium of eleven partners from six European countries and its expected duration is from 1 April 2020 to 31 March 2024.

BL2F[32]: The *Black Liquor to Fuel* (BL2F) project uses "Black Liquor" to create a clean, high-quality biofuel. Black liquor is a side-stream of the chemical pulping industry that can be transformed into fuel, reducing waste and providing an alternative to fossil fuels. Launched in April 2020, BL2F will develop a first-of-its-kind Integrated "Hydrothermal Liquefaction"

[29] www.kerogreen.eu
[30] www.flexjetproject.eu
[31] https://biosfera-project.eu
[32] https://www.bl2f.eu

(HTL) process at pulp mills, decreasing carbon emissions during the creation of the fuel intermediate. This will then be further upgraded at oil refineries to bring it closer to the final products and provide a feedstock for marine and aviation fuels.

BL2F aims to contribute to a reduction of 83% CO_2 emitted compared to fossil fuels. A large deployment of the processes developed by BL2F, using a variety of biomass, could yield more than 50 billion litres of advanced biofuels by 2050.

The project brings together twelve partners from eight countries around Europe and its expected duration is from 1 April 2020 till 31 March 2023.

FLITE[33]: The *Fuel via Low Carbon Integrated Technology from Ethanol* (FLITE) consortium proposes to expand the supply of low carbon jet fuel in Europe by designing, building, and demonstrating an innovative ethanol-based Alcohol-to-Jet (ATJ) technology in an ATJ Advanced Production Unit (ATJ-APU). The ATJ-APU will produce jet blend stocks from non-food/non-feed ethanol with over 70% GHG reductions relative to conventional jet. The Project will demonstrate over 1000 hours of operations and production of over 30,000 metric tonnes of Sustainable Aviation Fuel.

The diversity of ethanol sources offers the potential to produce cost competitive SAF, accelerating uptake by commercial airlines and paving the way for implementation.

The project is carried out by a consortium of five partners from six European countries and its expected duration is from 1 December 2020 till 30 November 2024.

TAKE-OFF[34]: is an industrially driven project aiming to be a game-changer in the cost-effective production of SAF from CO_2 and hydrogen. The unique TAKE-OFF technology is based on conversion of CO_2 and H_2 to SAF via ethylene as intermediate. Its industrial partners will team up with research groups to deliver a highly innovative process, which produces SAF at lower costs, higher energy efficiency, and higher carbon efficiency to the crude jet fuel product than the current benchmark Fischer-Tropsch process. TAKE-OFF's key industrial players should allow the demonstration of the full technology chain, utilising industrial captured CO_2 and electrolytically produced hydrogen. The demonstration activities will provide valuable data for comprehensive technical and economic and environmental analyses with an outlook on Chemical Factories of the Future.

The project is carried out by a consortium of nine partners from five European countries and its expected duration is from 1 January 2021 till 24 December 2024.

ASSESSMENT

This information on SAF European Research and Development projects are included in this common section of the Action Plan to complement the information on SAF measures and to inform on collective European efforts. No further quantitative assessment of the benefits of this collective European measure in terms of reduction in aviation emissions is provided in the common section of this Action Plan.

[33] https://cordis.europa.eu/project/id/857839
[34] https://cordis.europa.eu/project/id/101006799

3. OPERATIONAL IMPROVEMENTS

3.1 The EU's Single European Sky Initiative and SESAR

3.1.1 SESAR Project

SES and SESAR

The European Union's Single European Sky (SES) policy aims to reform Air Traffic Management (ATM) in Europe in order to enhance its performance in terms of its capacity to manage variable volumes of flights in a safer, more cost-efficient, and environmentally friendly manner.

The SESAR (*Single European Sky ATM Research*) programme addresses the technological dimension of the single European sky, aiming in particular to deploy a modern, interoperable and high-performing ATM infrastructure in Europe.

SESAR contributes to the Single Sky's performance targets by defining, validating, and deploying innovative technological and operational solutions for managing air traffic in a more efficient manner. SESAR coordinates and concentrates all EU research and development activities in ATM.

SESAR is fully aligned with the Union’s objectives of a sustainable and digitalised mobility and is projected towards their progressive achievement over the next decade. To implement the SESAR project, the Commission has set up, with the industry, an innovation cycle comprising three interrelated phases: definition, development, and deployment. These phases are driven by partnerships (SESAR Joint Undertaking and SESAR Deployment Manager) involving all categories of ATM/aviation stakeholders.

Guided by the European ATM Master Plan, the SESAR Joint Undertaking (SJU) is responsible for defining, developing, validating, and delivering technical and operational solutions to modernise Europe’s ATM system and deliver benefits to Europe and its citizens. The SESAR JU research programme is developed over successive phases, SESAR 1 (from 2008 to 2016), SESAR 2020 (started in 2016), and SESAR 3 (starting in 2022). It is delivering SESAR solutions in four key areas, namely airport operations, network operations, air traffic services, and technology enablers.

The SESAR contributions to the SES high-level goals set by the Commission are continuously reviewed by the SESAR JU and are kept up to date in the ATM Master Plan.

SESAR and the European Green Deal objectives

The European Green Deal launched by the European Commission in December 2019 aims to create the world's first climate-neutral bloc by 2050. This ambitious target calls for deep-rooted change across the aviation sector and places a significantly stronger focus on the environmental impact of flying. Multiple technology pathways are required, one of which is the digital transformation of air traffic management, where SESAR innovation comes into play. Over the past ten years the SESAR JU has worked to improve the environmental footprint of air traffic management, from CO_2 and non-CO_2 emissions to noise and local air quality. The programme is examining every phase of flight and use of the airspace and seeing what technologies can be used to eliminate fuel inefficiencies. It is also investing in synchronised data exchange and operations on the ground and in the air to ensure maximum impact. The ambition is to reduce by 2035 average CO_2 emissions per flight by 0.8-1.6 tonnes, taking into account the entire flight from gate to gate, including the airport.

Results

To date, the SESAR JU has delivered over 90 solutions for implementation, many of which offer direct and indirect benefits for the environment, with more solutions in the pipeline in SESAR 2020. Outlined in the SESAR Solutions Catalogue, these include solutions such as wake turbulence separation (for arrivals and departure), optimised use of runway configuration for multiple runway airports, or even optimised integration of arrival and departure traffic flows for single and multiple runway airports. Looking ahead, it is anticipated that the next generation of SESAR solutions will contribute to a reduction of some 450 kg CO_2 per flight.

Considering the urgency of the situation, the SESAR JU is working to accelerate the digital transformation in order to support a swift transition to greener aviation. Large-scale demonstrators are key to bridging the industrialisation gap, bringing these innovations to scale and encouraging rapid implementation by industry. Such large-scale efforts have started now with the recently launched ALBATROSS project. They will also be the focus of the future SESAR 3 Joint Undertaking, which is expected to give further and fresh impetus to this important endeavour.

The Performance Ambitions for 2035 compared to a 2012 baseline for Controlled airspace for each key performance area are presented in the *Figure 12* below, with the ambition for environment, expressed in CO_2 reduction, highlighted by the green dotted rectangle below in *Figure 12*.

Key performance area	SES high-level goals 2005	Key performance indicator	Performance ambition vs. baseline: Baseline value (2012)	Ambition value (2035)	Absolute improvement	Relative improvement
Capacity	Enable 3-fold increase in ATM capacity	Departure delay[4], min/dep	9.5 min	6.5-8.5 min	1-3 min	10-30%
		IFR movements at most congested airports[5], million	4 million	4.2-4.4 million	0.2-0.4 million	5-10%
		Network throughput IFR flights[5], million	9.7 million	~15.7 million	~6.0 million	~60%
		Network throughput IFR flight hours[5], million	15.2 million	~26.7 million	~11.5 million	~75%
Cost efficiency	Reduced ATM services unit costs by 50% or more	Gate-to-gate direct ANS cost per flight[1] -EUR(2012)	EUR 960	EUR 580-670	EUR 290-380	30-40%
Operational efficiency		Gate-to-gate fuel burn per flight[2], kg/flight	5280 kg	4780-5030 kg	250-500 kg	5-10%
		Additional gate-to-gate flight time per flight, min/flight	8.2 min	3.7-4.1 min	4.1-4.5 min	50-55%
		Within the: Gate-to-gate flight time per flight[3], min/flight	(111 min)	(116 min)		
Environment	Enable 10% reduction in the effects flights have on the environment	Gate-to-gate CO_2 emissions, tonnes/flight	16.6 tonnes	15-15.8 tonnes	0.8-1.6 tonnes	5-10%
Safety	Improve safety by factor 10	Accidents with direct ATM contribution[6], #/year Includes in-flight accidents as well as accidents during surface movement (during taxi and on the runway)	0.7 (long-term average)	no ATM related accidents	0.7	100%
Security		ATM related security incidents resulting in traffic disruptions	unknown	no significant disruption due to cyber-security vulnerabilities	unknown	-

1 Unit rate savings will be larger because the average number of Service Units per flight continues to increase.
2 "Additional" means the average flight time extension caused by ATM inefficiencies.
3 Average flight time increases because the number of long-distance flights is forecast to grow faster than the number of short-distance flights.
4 All primary and secondary (reactionary) delay, including ATM and non-ATM causes.
5 Includes all non-segregated unmanned traffic flying IFR, but not the drone traffic flying in airspace below 500 feet or the new entrants flying above FL 600
6 In accordance with the PRR definition: where at least one ATM event or item was judged to be DIRECTLY in the causal chain of events leading to the accident. Without that ATM event, it is considered that the accident would not have happened.

Figure 11. Performance Ambitions for 2035 for Controlled airspace (European ATM Master Plan 2020 Edition)

While all SESAR solutions bring added value to ATM performance, some have a higher potential to contribute to the performance of the entire European ATM network and require a coordinated and synchronised deployment. To facilitate the deployment of these SESAR solutions, the Commission establishes common projects that mandate the synchronised implementation of selected essential ATM functionalities based on SESAR solutions developed and validated by the SESAR JU.

The first common project was launched in 2014, and its implementation is currently being coordinated by the SESAR Deployment Manager throughout the entire European ATM network. It includes six ATM functionalities aiming in particular to:

- Optimise the distancing of aircraft during landing and take-off, reducing delays and fuel burn while ensuring the safest flying conditions.
- Allow aircraft to fly their preferred and usually most fuel-efficient trajectory (free route).
- Implement an initial, yet fundamental step towards digitalising communications between aircraft and controllers and between ground stakeholders allowing better planning, predictability, thus less delays and fuel optimisation and passenger experience.

The first common project[35] is planned to be completed by 2027. However, the benefits highlighted in *Figure 13* below have been measured where the functionalities have already been implemented.

[35] https://ec.europa.eu/transport/modes/air/sesar/deployment_en

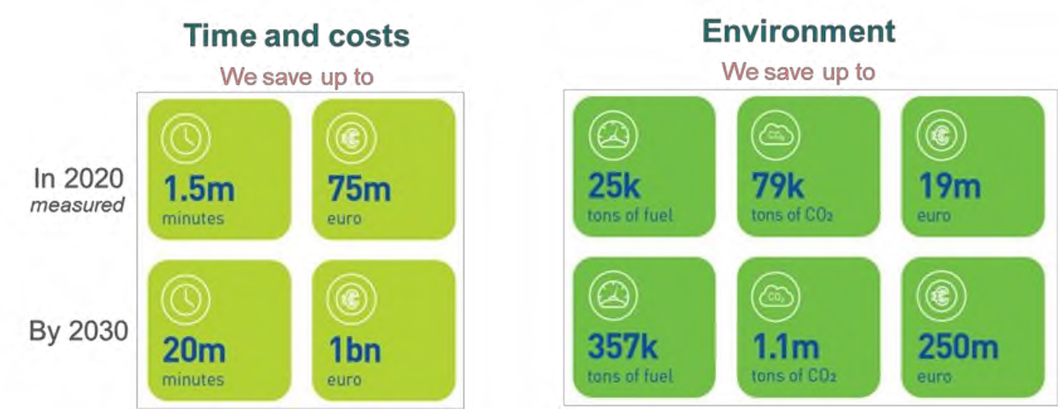

Figure 12. First results of the first common project implemented

3.1.2 SESAR Exploratory Research (V0 to V1)

SESAR Exploratory Research projects explore new concepts beyond those identified in the European ATM Master Plan or emerging technologies and methods. The knowledge acquired can be transferred into the SESAR industrial and demonstration activities. SESAR Exploratory Research projects are not subject to performance targets but should address the performances to which they have the potential to contribute.

3.1.3 SESAR Industrial Research & Validation Projects (environmental focus)

The main outcomes of the industrial research and validation projects dedicated to the environmental impacts of aviation in SESAR 1 were:

- The initial development by EUROCONTROL of the IMPACT[36] web-based platform which allows noise impact assessments and estimates of fuel burn and resulting emissions to be made from common inputs, thus enabling trade-offs to be conducted. IMPACT has since been continuously maintained and developed by EUROCONTROL, used for ICAO CAEP assessments, the conduct of studies in support of the European Aviation Environment Report (EAER) editions, and has been adopted by a large range of aviation stakeholders.
- The initial development/maintenance Open-ALAQS that provides a means to perform emissions inventory at airports, emissions concentration calculation and dispersion.
- The development of an IMPACT assessment process[37].

It should be noted that these tools and methodology were developed to cover the research and the future deployment phase of SESAR, as well as to support European states and agencies in conducting environmental impact assessments for operational or regulatory purposes. They are still in use in SESAR.

SESAR Industrial Research and Validation assesses and validates technical and operational concepts in simulated and real operational environments according to a set of key performance areas. These concepts mature through the SESAR programme from V1 to V3 to become SESAR Solutions ready for deployment.

36 https://www.eurocontrol.int/platform/integrated-aircraft-noise-and-emissions-modelling-platform
37 https://www.sesarju.eu/sites/default/files/documents/transversal/SESAR%202020%20-%20Environment%20Impact%20Assessment%20Guidance.pdf

SESAR has a wide range of solutions to improve the efficiency of air traffic management, some of which are specifically designed to improve environmental performance, by reducing noise impact around airports and/or fuel consumption and emissions in all phases of flight.

A catalogue of SESAR Solutions is available[38] and those addressing environment impacts are identified by the following pictogram:

3.1.4 SESAR2020 Industrial Research and Validation - Environmental Performance Assessment

The systematic assessment of environmental impacts of aviation are at the heart of SESAR Industrial Research and Validation activities since SESAR 1, with a very challenging target on fuel/CO_2 efficiency of 500kg of fuel savings on average per flight.

SESAR Pj19.04 Content Integration members are monitoring the progress of SESAR Solutions towards this target in a document called Performance Assessment and Gap Analysis Report (PAGAR). The Updated version of PAGAR 2019 provides the following environmental achievements:

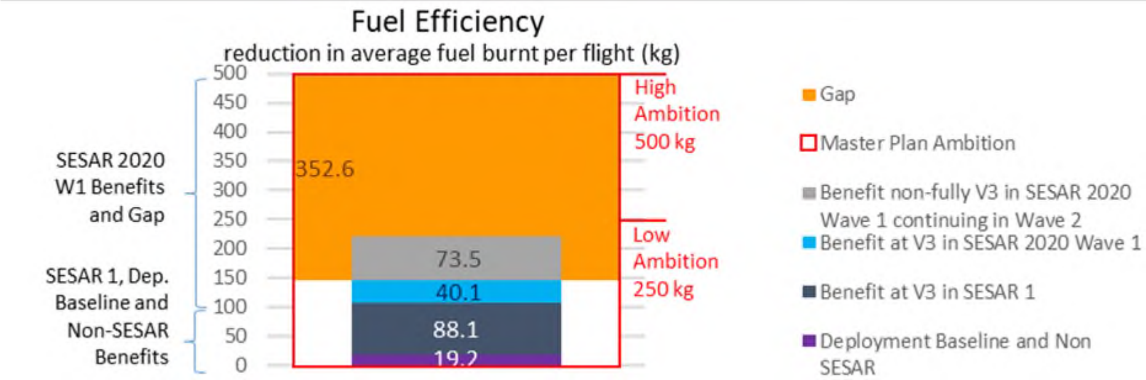

Figure 13. SESAR fuel efficiency achievement versus gap (Updated version of PAGAR 2019)

The Fuel Efficiency benefits at V3 maturity level in SESAR 2020 Wave 1 represent an average of 40.1 kg of fuel savings per flight. There would therefore be a gap of 352.6 kg in fuel savings per flight to be filled by Wave 2, compared to the high fuel savings Ambition target (and a gap of 102.6 kg with respect to the low Ambition target, as the Master Plan defines a range of 5-10% as the goal). Potentially 73.5 kg might be fulfilled from Wave 1 Solutions non-fully V3 continuing in Wave 2.

A fuel saving of 40.1 kg per ECAC flight equates to about 0.76% of the 5,280 kg of fuel burnt on average by an ECAC flight in 2012 (SESAR baseline). Although this might seem marginal, in 2035, ECAC-wide, it would equate to 1.9 million tonnes of CO_2 saved, equivalent to the CO_2 emitted by 165,000 Paris-Berlin flights; or a city of 258,000 European citizens; or the CO_2 captured by 95 million trees per year.

[38] https://www.sesarju.eu/news/sesar-solution-catalogue-third-edition-now-out

In SESAR, a value of 5,280 Kg of fuel per flight for the ECAC (including oceanic region) is used as a baseline[39]. Based on the information provided by the PAGAR 2019 document[40], the benefits at the end of Wave 1 could be about 3% CO_2/fuel savings achieved by 2025 equivalent to 147.4kg of fuel/flight. So far, the target for Wave 2 remains at about 7% more CO_2/fuel savings (352.6kg of fuel) to reach the initial Ambition target of about 10% CO_2/fuel savings (500kg fuel) per flight by 2035. Beyond 2035, there is no SESAR Ambition yet. To this could be added the as yet non-estimated benefits of Exploratory Research projects[41].

3.1.5 SESAR AIRE demonstration projects

In addition to its core activities, the SESAR JU co-financed projects where ATM stakeholders worked collaboratively to perform integrated flight trials and demonstrations of solutions. These aimed to reduce CO_2 emissions for surface, terminal, and oceanic operations and substantially accelerate the pace of change. Between 2009 and 2012, the SESAR JU co-financed a total of 33 "green" projects in collaboration with global partners, under the Atlantic Interoperability Initiative to Reduce Emissions (AIRE).

AIRE[42] is the first large-scale environmental initiative bringing together aviation players from both sides of the Atlantic. So far, three AIRE cycles have been successfully completed.

A total of 15,767 flight trials were conducted, involving more than 100 stakeholders, demonstrating savings ranging from 20 to 1000kg of fuel per flight (or 63 to 3150kg of CO_2), and improvements in day-to-day operations. Another nine demonstration projects took place from 2012 to 2014, also focusing on the environment, and during 2015/2016 the SESAR JU co-financed fifteen additional large-scale demonstration projects, which were more ambitious in geographic scale and technology.

3.1.6 SESAR 2020 Very Large-Scale Demonstrations (VLDs)

VLDs evaluate SESAR Solutions on a much larger scale and in real operations to prove their applicability and encourage the early take-up of V3 mature solutions.

SESAR JU has recently awarded ALBATROSS[43], a consortium of major European aviation stakeholder groups to demonstrate how the technical and operational R&D achievements of the past years can transform the current fuel intensive aviation to an environment-friendly industry sector.

The ALBATROSS consortium will carry a series of demonstration flights, with the aim of implementing a "perfect flight" (in other words the most fuel-efficient flight) will be explored and extensively demonstrated in real conditions, through a series of live trials in various European operating environments. The demonstrations will span through a period of several months and will utilise over 1,000 demonstration flights.

[39] See SESAR ATM Master Plan – Edition 2020 (www.atmmasterplan.eu) - eATM
[40] See SESAR Performance Assessment Gap Analysis Report (PAGAR) updated version of 2019 v00.01.04, 31-03-2021
[41] See SESAR Exploratory Research projects - https://www.sesarju.eu/exploratoryresearch
[42] https://ec.europa.eu/transport/modes/air/environment/aire_en#:~:text=The%20joint%20initiative%20AIRE%20(Atlantic,NEXTGEN%20in%20the%20United%20States
[43] https://www.sesarju.eu/projects/ALBATROSS

3.1.7 Preparing SESAR

Complementing the European ATM Master Plan 2020 and the High-Level Partnership Proposal, the Strategic Research and Innovation Agenda (SRIA) details the research and innovation roadmaps to achieve the Digital European Sky, matching the ambitions of the 'European Green Deal' and the 'Europe fit for the digital age' initiatives.

The SRIA[44] identifies inter-alia the need to continue working on "optimum green trajectories", on non-CO_2 impacts of aviation, and the need to accelerate decarbonisation of aviation through operational and business incentivisation.

ASSESSMENT

Quantitative assessment of the operational and ATM improvement scenario from 2020-2050 has been included in the modelled scenarios by EUROCONTROL on the basis of efficiency analyses from the SESAR project indicated in *Figure 13* and it is included in Section A above (ECAC Baseline Scenario and Estimated Benefits of Implemented Measures).

Year	CO2 emissions (10^9 kg)	
	Baseline scenario	Implemented measures scenario
		ATM improvements
2030	160.29	149.9
2040	197.13	177.4
2050	210.35	197.4
For reasons of data availability, results shown in this table do not include cargo/freight traffic. Note that fuel consumption is assumed to be unaffected by the use of sustainable aviation fuels.		

Table 10. CO_2 emissions forecast for the ATM improvements scenarios.

44 https://www.sesarju.eu/node/3697

4. MARKET-BASED MEASURES

4.1 The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

ECAC Member States have always been strong supporters of a market-based measure scheme for international aviation to incentivise and reward good investment and operational choices, and so welcomed the agreement on the Carbon Offsetting and Reduction Scheme for International Aviation.

The 39th General Assembly of ICAO (2016) reaffirmed the 2013 objective of stabilising CO_2 emissions from international aviation at 2020 levels. In addition, States adopted the introduction of a global market-based measure, namely the '*Carbon Offsetting and Reduction Scheme for International Aviation*' (CORSIA), to offset and reduce international aviation's CO_2 emissions above average 2019/2020 levels through standard international CO_2 emissions reductions units which would be put into the global market. This major achievement was most welcome by European States which have actively promoted the mitigation of international emissions from aviation at a global level.

4.1.1 Development and update of ICAO CORSIA standards

European Member States have fully supported ICAO's work on the development of Annex 16, Volume IV to the Convention on International Civil Aviation containing the Standards and Recommended Practices (SARPs) for the implementation of CORSIA, which was adopted by the ICAO Council in June 2018.

As a part of the ICAO's Committee on Aviation Environmental Protection (CAEP) work programme for the CAEP/12 cycle, CAEP's Working Group 4 (WG4) is tasked to maintain the Annex 16, Volume IV and related guidance material, and to propose revisions to improve those documents as needed.

Europe is contributing with significant resources to the work of CAEP-WG4 and EASA in particular by providing a WG4 co-Rapporteur, and by co-leading the WG4 task on maintaining the Annex 16, Volume IV and related guidance material.

4.1.2 CORSIA implementation

In application of their commitment in the 2016 "Bratislava Declaration", the 44 ECAC Member States have notified ICAO of their decision to voluntarily participate in CORSIA from the start of the pilot phase in 2021 and have effectively engaged in its implementation. This shows the full commitment of the EU, its Member States, and the other Member States of ECAC to counter the expected in-sector growth of total CO_2 emissions from air transport and to achieve overall carbon neutral growth.

On June 2020, the European Council adopted COUNCIL DECISION (EU) 2020/954 on the position to be taken on behalf of the European Union within ICAO as regards the notification of voluntary participation in CORSIA from 1 January 2021 and the option selected for calculating aeroplane operators' offsetting requirements during the 2021-2023 period.

ASSESSMENT

CORSIA is a global measure, whose assessment is undertaken globally by ICAO. Thus, the assessment of the benefits provided by CORSIA in terms of reduction in European emissions is not provided in this Action Plan.

4.2 The EU Emissions Trading System and its linkages with other systems (Swiss ETS and UK ETS)

The EU Emissions Trading System (EU ETS) is the cornerstone of the European Union's policy to tackle climate change, and a key tool for reducing greenhouse gas emissions cost-effectively, including from the aviation sector.

The 30 EEA States in Europe have already implemented the EU Emissions Trading System (ETS), including the aviation sector with around 500 aircraft operators participating in the cap-and-trade approach to limit CO_2 emissions. It was the first and is the biggest international system capping greenhouse gas emissions. In the period 2013 to 2020, EU ETS has saved an estimated 200 million tonnes of intra-European aviation CO_2 emissions.

It operates in 30 countries: the 27 EU Member States, Iceland, Liechtenstein, and Norway. The EU ETS currently covers half of the EU's CO_2 emissions, encompassing those from around 11,000 power stations and industrial plants in 30 countries, and, under its current scope, around 500 commercial and non-commercial aircraft operators that fly between airports in the European Economic Area (EEA). The EU ETS Directive was revised in line with the European Council Conclusions of October 2014[45] confirming that the EU ETS will be the main European instrument to achieve the EU's binding 2030 target of an at least 40%[46], and will be revised to be aligned with the latest Conclusions in December 2020[47], prescribing at least 55% domestic reduction (without using international credits) of greenhouse gases compared to 1990.

The EU ETS began its operation in 2005, for aviation in 2012; a series of important changes to the way it works took effect in 2013, strengthening the system. The EU ETS works on the "cap and trade" principle. This means there is a "cap", or limit, on the total amount of certain greenhouse gases that can be emitted by factories, power plants, other installations, and aircraft operators in the system. Within this cap, companies can sell to or buy emissions allowances from one another. The limit on allowances available provides certainty that the environmental objective is achieved and gives allowances a market value.

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[45] http://www.consilium.europa.eu/en/meetings/european-council/2014/10/23-24/

[46] Directive (EU) 2018/410 of the European Parliament and of the Council of 14 March 2018 amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments, and Decision (EU) 2015/1814, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018L0410

[47] 1011-12-20-euco-conclusions-en.pdf (europa.eu)

For aviation, the cap is calculated based on the average emissions from the years 2004-2006, while the free allocation to aircraft operators is based on activity data from 2010. The cap for aviation activities for the 2013-2020 phase of the ETS was set to 95% of these historical aviation emissions. Starting from 2021, free allocation to aircraft operators is reduced by the linear reduction factor (currently of 2.2%) now applicable to all ETS sectors. Aircraft operators are entitled to free allocation based on a benchmark, but this does not cover the totality of emissions. The remaining allowances need to be purchased from auctions or from the secondary market. The system allows aircraft operators to use aviation allowances or general (stationary installations) allowances to cover their emissions. Currently, 82% of aviation allowances are distributed through free allocation, 3% are part of a special reserve for new entrants and fast growers, and 15% are auctioned.

The legislation to include aviation in the EU ETS was adopted in 2008 by the European Parliament and the Council[48].

Following the 2013 ICAO agreement on developing CORSIA, the EU decided[49] to limit the scope of the EU ETS to flights between airports located in the EEA for the period 2013-2016, and to carry out a new revision in the light of the outcome of the 2016 ICAO Assembly. The European Commission assessed the outcome of the 39th ICAO Assembly and, in that light, a new Regulation was adopted in 2017[50].

The legislation maintains the scope of the EU ETS for aviation limited to intra-EEA flights and sets out the basis for the implementation of CORSIA. It provides for European legislation on the monitoring, reporting, and verification rules through a delegated act under the EU ETS Directive of July 2019[51]. It foresees that a further assessment should take place and a report be presented to the European Parliament and to the Council considering how to implement CORSIA in Union law through a revision of the EU ETS Directive. The European Green Deal and 2030 Climate Target Plan clearly set out the Commission's intention to propose to reduce the EU ETS allowances allocated for free to airlines. This work is currently ongoing and is part of the "Fit for 55 package"[52].

The EU legislation foresees that, where a third country takes measures to reduce the climate change impact of flights departing from its airports, the EU will facilitate interaction between the EU scheme and that country's measures and flights arriving from the third country could

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[48] Directive 2008/101/EC of the European Parliament and of the Council of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0101

[49] Decision No. 377/2013/EU derogating temporarily from Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, http://eur-lex.europa.eu/LexUriServLexUriServ.do?uri=CELEX:32013D0377:EN:NOT

[50] Regulation (EU) 2017/2392 of the European Parliament and of the Council of 13 December 2017 amending Directive 2003/87/EC to continue current limitations of scope for aviation activities and to prepare to implement a global market-based measure from 2021, http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2017.350.01.0007.01.ENG&toc=OJ:L:2017:350:TOC

[51] Commission Delegated Regulation (EU) 2019/1603 of 18 July 2019 supplementing Directive 2003/87/EC of the European Parliament and of the Council as regards measures adopted by the International Civil Aviation Organisation for the monitoring, reporting and verification of aviation emissions for the purpose of implementing a global market-based measure https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2019.250.01.0010.01.ENG

[52] 2021_commission_work_programme_new_policy_objectives_factsheet_en.pdf (europa.eu)

be excluded from the scope of the EU ETS. This is the case between the EU and Switzerland[53] following the agreement to link their respective emissions trading systems, which entered into force on 1 January 2020.

As a consequence of the linking agreement with Switzerland, from 2020 the EU ETS was extended to all departing flights from the EEA to Switzerland, and Switzerland applies its ETS to all departing flights to EEA airports, ensuring a level playing field on both directions of routes. In accordance with the EU-UK Trade and Cooperation Agreement reached in December 2020, the EU ETS shall continue to apply to departing flights from the EEA to the UK, while a UK ETS will apply effective carbon pricing on flights departing from the UK to the EEA.

Impact on fuel consumption and/or CO_2 emissions

The EU ETS has delivered around 200MT of CO_2 emission reductions between 2013 and 2020[54]. While the in-sector aviation emissions for intra-EEA flights kept growing, from 53,5 million tonnes CO_2 in 2013 to 69 million in 2019, the flexibility of the EU ETS, whereby aircraft operators may use any allowances to cover their emissions, meant that the CO_2 impacts from these flights did not lead to overall greater greenhouse gas emissions. Verified emissions from aviation covered by the EU ETS in 2019 compared to 2018 continued to grow, albeit more modestly, with an increase of 1% compared to the previous year, or around 0.7 million tonnes CO_2 equivalent[55].

To complement the EU ETS price signal, EU ETS auctioning revenues should be used to support transition towards climate neutrality. Under the EU ETS (all sectors covered), Member States report that from 2012 until 2020, over €45 billions of ETS auction revenue has been used to tackle climate change, and additional support is available under the existing ETS Innovation Fund that is expected to deploy upwards of €12 billion in the period 2021-2030. The EU ETS' current price incentive per tonne for zero emission jet fuel, is by itself insufficient to bridge the price gap with conventional kerosene. However, by investing auctioning revenues through the Innovation Fund, the EU ETS can also support deployment of breakthrough technologies and drive the price gap down.

In terms of its contribution towards the ICAO carbon neutral growth goal from 2020, States implementing the EU ETS have delivered, in "net" terms, the already achieved reduction of around 200MT of aviation CO_2 emissions will continue to increase in the future under the new legislation. Other emission reduction measures taken, either collectively throughout Europe or by any of the States implementing EU ETS, will also contribute to ICAO's global goals. Such measures are likely to moderate the anticipated growth in aviation emissions.

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[53] Commission Delegated Decision (EU) 2020/1071 of 18 May 2020 amending Directive 2003/87/EC of the European Parliament and of the Council, as regards the exclusion of incoming flights from Switzerland from the EU emissions trading system, OJ L 234, 21.7.2020, p. 16.

[54] See the 2019 European aviation environmental report: "Between 2013 and 2020, an estimated net saving of 193.4 Mt CO_2 (twice Belgium's annual emissions) will be achieved by aviation via the EU ETS through funding of emissions reduction in other sectors.", https://www.eurocontrol.int/publication/european-aviation-environmental-report-2019

[55] https://ec.europa.eu/clima/news/carbon-market-report-emissions-eu-ets-stationary-installations-fall-over-9_en

ASSESSMENT

A quantitative assessment of the EU Emissions Trading System benefits based on the current scope (intra-European flights) is shown in *Table 11*.

Estimated emissions reductions resulting from the EU-ETS[56]

Year	Reduction in CO_2 emissions
2013-2020	~200 MT57
Those benefits illustrate past achievements.	

Table 11. Summary of estimated EU-ETS emission reductions

[56] Include aggregated benefits of EU ETS and Swiss ETS for 2020.
[57] See the 2019 European aviation environmental report: "Between 2013 and 2020, an estimated net saving of 193.4 Mt CO_2 (twice Belgium's annual emissions) will be achieved by aviation via the EU ETS through funding of emissions reduction in other sectors.", https://www.eurocontrol.int/publication/european-aviation-environmental-report-2019

5. ADDITIONAL MEASURES

5.1 ACI Airport Carbon Accreditation

Airport Carbon Accreditation (ACA) is a certification programme for carbon management at airports, based on international carbon mapping and management standards, specifically designed for the airport industry. It was launched in 2009 by Airport Council International (ACI) EUROPE, the trade association for European airports. Since then, it has expanded globally and is today available to members of all ACI Regions.

This industry-driven initiative was officially endorsed by EUROCONTROL and ECAC. The programme is overseen by an independent Advisory Board comprised of many distinguished, independent experts from the fields of aviation and environment, including the European Commission, ECAC, ICAO, and the UNFCCC.

airport carbon accreditation

The underlying aim of the programme is to encourage and enable airports to implement best practice carbon and energy management processes and to gain public recognition of their achievements. It requires airports to measure their CO_2 emissions in accordance with the World Resources Institute and World Business Council for Sustainable Development GHG Protocol and to get their emissions inventory assured by an independent third party.

In addition to the already existing four accreditation levels, in 2020 two new accreditation levels were introduced: Level 4 and Level 4+. The introduction of those two new levels aims on one hand to align the programme with the objectives of the Paris Agreement, and on the other hand, to give, especially to airports that have already reached a high level of carbon management maturity, the possibility to continue their improvements[58].

The six steps of the programme are shown in *Figure 15* and are as follows: Level 1 “Mapping”, Level 2 “Reduction”, Level 3 “Optimisation”, Level 3+ “Neutrality”, Level 4 “Transformation” and Level 4+ “Transition”.

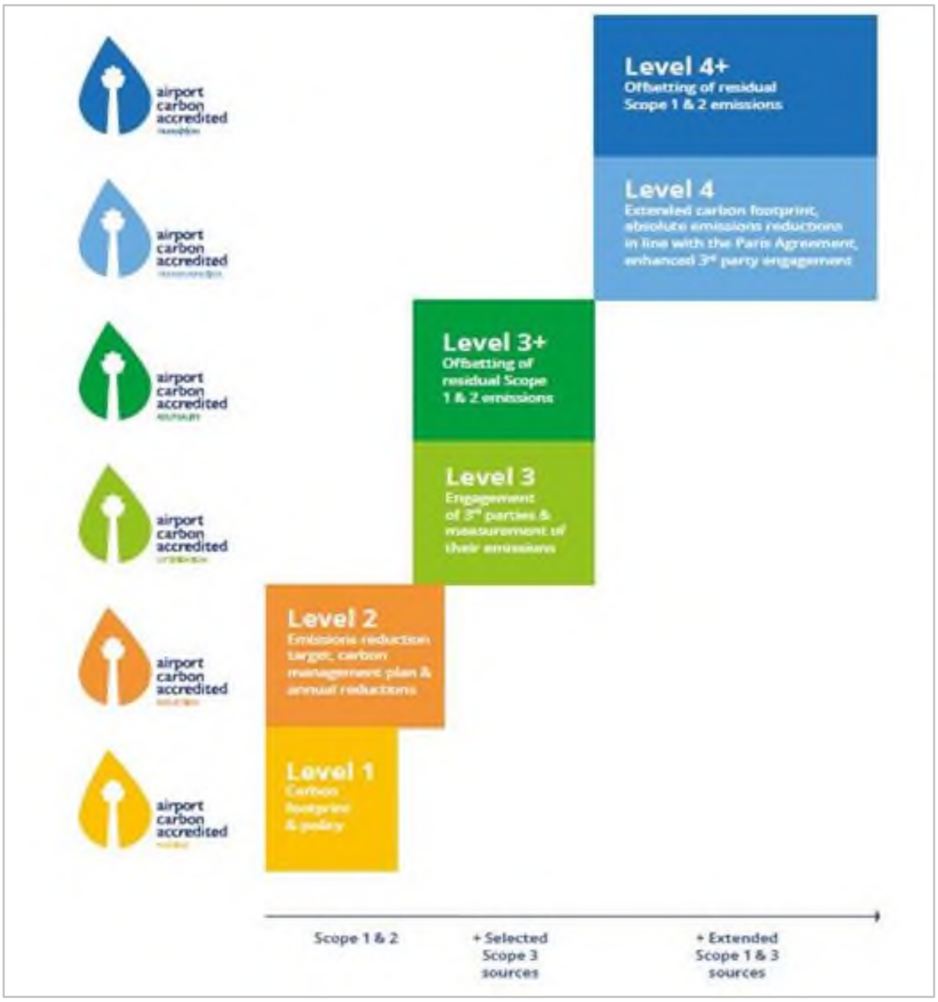

Figure 14. Six steps of Airport Carbon Accreditation

As of 31 March 2021, there are in total 336 airports in the programme worldwide. They represent 74 countries and 45.9% of global air passenger traffic. 112 reached a Level 1, 96 a Level 2, 63 a Level 3, and 60 a Level 3+ accreditation. Furthermore, five airports have already achieved accreditation at the newly introduced levels: 1 a Level 4 and 4 airports a Level 4+ accreditation.

One of its essential requirements is the verification by external and independent auditors of the data provided by airports. The Administrator of the programme has been collecting CO_2 data from participating airports since the programme launch. This has allowed the absolute CO_2 reduction from the participation in the programme to be quantified.

Aggregated data are included in the *Airport Carbon Accreditation* Annual Reports thus ensuring transparent and accurate carbon reporting. At Level 2 of the programme and above,

[58] Interim Report 2019 – 2020, *Airport Carbon Accreditation* 2020

airport operators are required to demonstrate CO_2 reductions associated with the activities they control.

The Annual Report, which is published in the fall of each year, typically covers the previous reporting year (e.g., mid-May to mid-May) and presents the programme's evolution and achievements. However, because of the extraordinary conditions faced in 2020 due to COVID-19 pandemic, special provisions are applied to all accredited airports. *Tables 13-15* below show carbon performance metrics until the 2018/2019 regular reporting cycle.

For historical reasons, European airports remain at the forefront of airport actions to voluntarily mitigate and reduce their impact on climate change. The strong growth momentum is still being maintained as there are 167 airports in the programme. These airports account for 69.7% of European passenger air traffic.

	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019
Total aggregate scope 1 & 2 reduction ($ktCO_2$)	51.7	54.6	48.7	140	130	169	156	155	169	158
Total aggregate scope 3 reduction ($ktCO_2$)	360	675	366	30.2	224	551	142	899	1160	1763

Table 12. Emissions reduction highlights for the European region

	2015-2016	2016-2017	2017-2018	2018-2019
Aggregate emissions offset, Level 3+ (tCO_2)	222339	252218	321170	375146

Table 13. Emissions offset for the European region

The table above presents the aggregate emissions offset by airports accredited at Level 3+ of the programme in Europe. The programme requires airports at Levels 3+ and 4+ to offset their residual Scope 1 & 2 emissions as well as Scope 3 emissions from staff business travel.

Indicator	Unit	Time period (2018-2019)	Absolute change compared to the 3-year rolling average	Change (%)
Aggregate scope 1 & 2 emissions from airports at Levels 1-3+	tCO_2	6,520,255	-322,297	-4.9%
Scope 1 & 2 emissions per passenger from airports at Levels 1-3+	kgs of CO_2	1.81	-0.09	-4.3%
Scope 1 & 2 emissions per traffic unit from airports at Levels 1-3+	kgs of CO_2	1.55	-0.08	-4.3%
Offsetting of aggregate scope 1 & 2 & staff business travel emissions from airports at Level 3+	tCO_{2e}	710,673	38.673	5.8%
Scope 3 emissions from airports at Levels 3 and 3+	tCO_2	60,253,685	6,895,954	12.9%

Table 14. Airport Carbon Accreditation key performance indicators, 2018-2019

The programme's main immediate environmental co-benefit is the improvement of local air quality.

Costs for the design, development and implementation of *Airport Carbon Accreditation* have been borne by ACI EUROPE. *Airport Carbon Accreditation* is a non-for-profit initiative, with participation fees set at a level aimed at allowing for the recovery of the aforementioned costs.

The scope of *Airport Carbon Accreditation*, i.e. emissions that an airport operator can control, guide and influence, implies that as of Level 3, aircraft emissions are also covered. Thus, airlines can benefit from the gains made by more efficient airport operations to see a decrease in their emissions. This is consistent with the ambition of the European Green Deal, the inclusion of aviation in the EU ETS and the implementation of CORSIA, and therefore can support the efforts of airlines to reduce these emissions.

ASSESSMENT

The inclusion of this collective European measure is descriptive for information purposes, and no quantitative assessment of its benefits in terms of reduction in aviation emissions is provided in the common section of this action plan.

5.2 European industry roadmap to a net zero European aviation: *Destination 2050*

Destination 2050[59] is an initiative and roadmap developed by aviation industry stakeholders (A4E, ACI Europe, ASD, CANSO, and ERA) showing an ambitious decarbonisation pathway for European aviation.

These European industry organisations commit to work together with all stakeholders and policymakers to achieve the following climate objectives:

- Reaching net zero CO_2 emissions by 2050 from all flights within and departing from the European Economic Area, Switzerland, and the UK. This means that by 2050, emissions from these flights will be reduced as much as possible, with any residual emissions being removed from the atmosphere through negative emissions, achieved through natural carbon sinks (e.g., forests) or dedicated technologies (carbon capture and storage). For intra-EU flights, net zero in 2050 might be achieved with close to no market-based measures.
- Reducing net CO_2 emissions from all flights within and departing from the EEA, Switzerland and the UK by 45% by 2030 compared to the baseline[60]. In 2030, net CO_2 emissions from intra-EU flights would be reduced by 55% compared to 1990 levels.
- Assessing the feasibility of making 2019 the peak year for absolute CO_2 emissions from flights within and departing from the EEA, Switzerland and UK.

With the Destination 2050 roadmap and through these commitments, the European aviation sector contributes to the Paris Agreement, recognising the urgency of pursuing the goal of limiting global warming to 1.5°C.

By doing so, the European aviation sector is also effectively contributing to the collective European Green Deal and EU's climate neutrality objectives.

This roadmap is complementary to the WayPoint 2050 Air Transport Action Group (ATAG) global pathway for the decarbonization of aviation.

ASSESSMENT

The inclusion of this collective European measure is descriptive for information purposes, and no quantitative assessment of its benefits in terms of reduction in aviation emissions is provided in the common section of this Action Plan.

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[59] www.destination2050.eu

[60] A hypothetical 'no-action' scenario whereby CO_2 emissions are estimated based on the assumption that aircraft deployed until 2050 have the same fuel efficiency as in 2018.

5.3 Environmental Label Programme

In response to the growing expectations of citizens to understand the environmental footprint of their flights, the European Union Member States, Switzerland, Norway, Lichtenstein, the United Kingdom and the European Commission have mandated EASA to explore voluntary environmental labelling options for aviation organisations. The proposals will be aligned with the European Green Deal, established in December 2019, and that strives to make Europe the first climate-neutral continent. The overall objective of the EASA Environmental Labelling Programme is to increase awareness and transparency, and ultimately to support passengers and other actors in making informed sustainable choices by providing harmonised, reliable and easily understandable information on their choices' environmental impacts, co-ordinated within EASA Member States. It should allow rewarding those air transport operators making efforts to reduce their environmental footprint. The label initiative covers a wide range of components of the aviation sector, including aircraft, airlines, and flights.

In the proof-of-concept phase, EASA developed potential technical criteria and label prototypes for aircraft technology and design as well as airline operations, to inform European citizens on the environmental performance of aviation systems. Such information would be provided on a voluntary basis by aviation operators that have chosen to use the label. Different scenarios were developed and tested to consider how citizens could interact with labelling information, e.g. on board the aircraft and/or during the booking process as well as on a dedicated website, and smartphone application. Various key environmental indicators were reviewed, including the absolute CO_2 emissions and average CO_2 emissions per passenger-kilometre of airlines.

The pilot phase covering the period 2021-2023 will further expand the scope of indicators and take into account life-cycle considerations, e.g. to cover aspects from the extraction of raw materials to recycling and waste disposal. The pilot phase also foresees an impact assessment of the label.

While the potential CO_2 emissions reductions generated by such a label were not quantified at this stage, it is proposed to keep the ICAO updated on future developments concerning the European environmental labelling initiative, including on potential CO_2 emissions savings.

ASSESSMENT

The inclusion of this collective European measure is descriptive for information purposes, and no quantitative assessment of its benefits in terms of reduction in aviation emissions is provided in the common section of this Action Plan.

5.4 Multilateral capacity building projects

The European Union is highly committed to ensuring sustainable air transport in Europe and worldwide. In this endeavour, the EU is launching a number of initiatives in different areas to assist partner States in meeting the common environmental commitments.

5.4.1 EASA capacity-building partnerships

EASA has been selected as an implementing Agency for several of these initiatives, including the EU-Southeast Asia Cooperation on Mitigating Climate Change impact from Civil Aviation (EU-SEA CCCA) launched in 2019, and a Capacity-Building Project for CO_2 Emissions Mitigation in the African and Caribbean Region, launched in 2020.

The overall objective of these projects[61] is to enhance the partnership between the EU and partner States in the areas of civil aviation environmental protection and climate change, and to achieve long-lasting results that go beyond the duration of the projects. The specific objectives of the two projects are to develop or support existing policy dialogues with partner States on mitigating GHG emissions from civil aviation, to contribute to the CORSIA readiness process of partner States, as well as to implement CORSIA in line with the agreed international schedule, including considerations of joining the voluntary offsetting phase starting in 2021 or at the earliest time possible. On top of the CORSIA-related support, these projects are assisting partner States in the development and update of their State Action Plans to reduce CO_2 emissions from civil aviation, as well as providing support in the development of emission data management tools supporting the implementation of State Action Plans and CORSIA.

By January 2021, the EU-SEA CCCA had improved the technical readiness of all 10 partner States in the region, as well as their aeroplane operators' capabilities to comply with CORSIA requirements. Five States had implemented emissions data management solutions to generate CORSIA Emission Reports, and eight States had successfully submitted their 2019 CORSIA CO_2 Emissions Reports to ICAO. Four CORSIA verification bodies had been accredited in the region with dedicated support to their respective National Accreditation Bodies to finalise the accreditation process.

In addition, EASA is implementing, on behalf of the Commission, technical cooperation projects in the field of aviation in Asia, Latin-America and the Caribbean, which include an environmental component aiming at cooperation and improvement of environmental standards.

These projects have been successful in supporting regional capacity-building technical cooperation to partner States with regards to environmental standards. With regards to CORSIA, support is provided for the development or enhancement of State Action Plans, as well as for the implementation of the CORSIA MRV system. Projects have also been successful in engaging with key national and regional stakeholders (regulatory authorities, aeroplane operators, national accreditation bodies, verification bodies), thereby assessing the level of readiness for State Action Plan and CORSIA implementation on wider scale in the respective regions, and to identify further needs for additional support in this area.

5.4.2 ICAO - European Union Assistance Project

The assistance project *Capacity-Building on CO_2 mitigation from International Aviation* was launched in 2013 with funding provided by the European Union, while implementation was carried out by ICAO Environment.

Fourteen States from Africa and the Caribbean were selected to participate in this 5-year programme, successfully implemented by ICAO from 2014 to 2019, achieving all expected results and exceeding initial targets.

The first objective of the ICAO-EU project was to create national capacities for the development of Action Plans. ICAO organised specific training-seminars, directed the establishment of National Action Plan Teams in the selected States, and assisted each Civil Aviation Authority directly in the preparation of their Action Plans.

By June 2016, the fourteen selected States had developed Action Plans fully compliant with ICAO's guidelines, including robust historical data and a reliable baseline scenario. A total of 218 measures to reduce fuel consumption and CO_2 emissions were proposed in the Action

[61] https://www.easa.europa.eu/domains/international-cooperation/easa-by-country/map#group-easa-extra

Plans, including those related to aircraft technology, operational measures, and sustainable aviation fuels.

Four pilot mitigation measures and five feasibility studies were executed with project funding in beneficiary States. In addition to those, beneficiary States implemented 90 mitigation measures within the project timeframe, which had been included in their Action Plans[62].

With the support provided by the ICAO-EU project, ICAO has succeeded in assisting beneficiary States transform the organisational culture towards environmental protection in aviation, through the establishment of Environmental Units with dedicated staff in the Civil Aviation Authorities along with the voluntary decision of seven selected States of the project to join the ICAO Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) from its outset.

Phase two of this project is currently being implemented by ICAO and EASA. It covers ten African States: Benin, Botswana, Cabo Verde, Comoros, Côte d'Ivoire, Madagascar, Mali, Rwanda, Senegal and Zimbabwe. The project will run between 2020 and 2023.

ASSESSMENT

The inclusion of this collective European measure is descriptive for information purposes, and no quantitative assessment of its benefits in terms of reduction in aviation emissions is provided in the common section of this Action Plan.

5.5. Green Airports research and innovation projects

Under the EU research and innovation actions in support of the European Green Deal and funded by the Horizon 2020 Framework Programme, the European Commission has launched in 2020 the call for tenders: *Green airports and ports as multimodal hubs for sustainable and smart mobility*.

A clear commitment of the European Green Deal is that "transport should become drastically less polluting", highlighting in particular the urgent need to reduce greenhouse gas emissions (GHG) in aviation and waterborne transport.

In this context, airports play a major role, both as inter-connection points in the transport networks, but also as major multimodal nodes, logistics hubs, and commercial sites, linking with other transport modes, hinterland connections, and integrated with cities.

As such, green airports as multimodal hubs in the post COVID-19 era for sustainable and smart mobility have a great potential to immediately contribute to start driving the transition towards GHG-neutral aviation, shipping and wider multimodal mobility, already by 2025.

The scope of this research program is therefore addressing innovative concepts and solutions for airports and ports, in order to urgently reduce transport GHG emissions and increase their contribution to mitigating climate change.

Expected outcomes

The projects will perform large-scale demonstrations of green airports, demonstrating low-emission energy use (electrification or sustainable aviation fuels) for aircraft, airports, other/connected and automated vehicles accessing or operating at airports (e.g. road vehicles,

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62 https://www.icao.int/environmental-protection/Documents/ICAO-EU_Project_FinalReport.pdf

rolling stock, drones), as well as for public transport and carpooling, with re-charging/re-fuelling stations and use of related incentives.

They will also put focus on the development of SAF for its use at airports.

The deadline to receive project proposals was closed in January 2021, and at the time of this Action Plan update, proposals are under revision. Future Action Plan updates will provide further information on the benefits of the implementation of this measure.

ASSESSMENT

The inclusion of this collective European measure is descriptive for information purposes, and no quantitative assessment of its benefits in terms of reduction in aviation emissions is provided in the common section of this Action Plan.

6. SUPPLEMENTAL BENEFITS FOR DOMESTIC SECTORS

Although the benefits of all the European collective measures included in this Action Plan are focused on international aviation, they are also applicable to domestic aviation (except CORSIA) and thus, will bring supplemental benefits in terms of CO_2 emissions reductions in the domestic European air traffic.

In addition, a number of those measures taken collectively in Europe and contained in this Action Plan offer as well additional supplemental benefits for domestic sectors beyond CO_2 savings. Those are summarised below.

6.1 ACI Airport Carbon Accreditation

Airport Carbon Accreditation is referred among the measures contained in this Action Plan aiming to encourage and enable airports to implement best practice carbon and energy management processes.

While its main objective is supporting airport actions to voluntarily mitigate and reduce their impact on climate change, the programme's main immediate environmental co-benefit is the improvement of local air quality linked to the non-CO_2 additional emissions benefits from the reduction of fuel burn that an airport operator can control, guide, and influence.

6.2 ReFuelEU Aviation

Through the large-scale use of SAF, emissions of other pollutants impacting local air quality and other non-CO_2 effects on the climate can also be reduced, implying important potential supplemental benefits beyond CO_2 emissions reductions.

In addition to the reduction of CO_2 emissions, SAF has the additional benefit of reducing air pollutant emissions around airports when emitted during take-off and landing as emissions of non-volatile Particulate Matter (nvPM) with up to 90% and sulphur (SO_X) with 100%, compared to fossil jet fuel[63].

Preserving the quality of natural resources can be considered an additional benefit of any policy measure aiming to increase the sustainability of aviation by boosting the SAF market while

[63] ICAO 2016 Environmental Report, Chapter 4, Page 162, Figure 4.

paying particular attention to the overall environmental integrity of the SAF incentivised, as it is the case of the ReFuelEU Aviation.

Finally, the production of SAF notably from biogenic waste could contribute and be an incentive for more effective waste management in the EU.

6.3 SAF Research and development projects

One European research project funded by the Horizon 2020 Research and Innovation program of the EU is currently assessing, among other objectives, the additional supplemental benefits for domestic sectors of the use of sustainable aviation fuels, beyond its climate benefits.

AVIATOR PROJECT[64]: The project "*Assessing aviation emissions Impact on local Air quality at airports: Towards Regulation*" aims to better understand air quality impacts of aviation issues, developing new tools and regulation, and linking with the health community, providing unbiased data to society.

The project will measure, quantify, and characterise airborne pollutant emissions from aircraft engines under parking (with functioning APU), taxiing, approach, take-off and climb-out conditions, with specific reference to total UFPs, NOx, SOx and VOC under different climatic conditions.

It includes among its objectives measuring emissions from aircraft engines using commercially available sustainable aviation fuels to investigate its impact on total Particulate Matter formation and evolution in the plume as well as the wider airport environment.

Will perform measurements of air quality in and around three international airports: Madrid-Barajas, Zurich, and Copenhagen, to validate model developments under different operational and climatic conditions, and develop a proof-of-concept low-cost, and low-intervention sensor network to provide routine data on temporal and spatial variability of key pollutants including UFP, total PM, NO_x and SO_x.

With seventeen partners from seven countries involved, the project started in June 2019 and it is expected to finalise in 2022.

6.4 The EU's Single European Sky Initiative and SESAR

The European Union's Single European Sky (SES) initiative and its SESAR (*Single European Sky ATM Research Programme*) programme are aiming to deploy a modern, interoperable and high-performing ATM infrastructure in Europe, as has been described above in detail in this action plan, among its key operational measures to reduce CO_2 emissions.

Nevertheless, the environmental outcomes of SESAR implementation go far beyond reducing fuel burn, and the key deliverables from the SESAR Programme have also a significant potential to mitigate non-CO_2 emissions and noise impacts.

It should be noted that although no targets have yet been set for non-CO_2 emissions (at local or global level) and noise impacts, the ATM Master Plan requires that each SESAR solution with an impact on these environmental aspects assesses them to the extent possible and within available resources.

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64 https://aviatorproject.eu

In this context, for example the EUROCONTROL *Integrated aircraft noise and emissions modelling platform* IMPACT, which delivers noise contour shape files, surface, and population counts based on the European Environment Agency population database, estimates of fuel burn and emissions for a wide range of pollutants, and geo-referenced inventories of emissions within the landing and take-off portion, is one of the recommended models for conducting environmental impact assessments in SESAR.

6.5. Green Airports research and innovation projects

The European Commission's Green Airports research and innovation projects referred to in this Action Plan among the "Other measures" commonly implemented in Europe has key objectives to achieve important supplemental benefits beyond CO_2 emissions reductions, among them:

Circular Economy

- Developing the built environment (construction/demolition) using more ecologically friendly materials and processes and incorporating these improvements in the procurement processes to sustainably decrease the ecological footprint.
- Promoting the conversion of waste to sustainable fuels.
- Addressing the sustainable evolution of airports, also in the context of circular economy (e.g. activities linked to aircraft decommissioning and collection/sorting of recyclable waste), considering institutional and governance aspects, ownership, regulation, performance indicators, and balance of force between regulators, airlines, and airport operators.
- Addressing the feasibility of a market-based instrument to prevent/reduce Food Loss and Waste (FLW) and to valorise a business case of transformation of FLW into new bio-based products. This includes FLW measurement and monitoring methodologies and the subsequent mapping of FLW total volume at stake in the considered airport.

Biodiversity

- Enhancing biodiversity, green land planning and use, as well as circular economy (e.g. repair, reuse and recycling of buildings and waste, in the context of zero-waste concepts).

Non-CO_2 impacts

- Addressing air quality (indoor, outdoor, including decontamination from microbiological pathogens), and noise trade-off.
- Assessing non-technological framework conditions, such as market mechanisms and potential regulatory actions in the short - and medium-term, which can provide financial/operational incentives and legal certainty for implementing low emissions solutions.
- Developing and promoting new multi-actor governance arrangements that address the interactions between all airport-related stakeholders, including authorities, aircraft owners and operators, local communities, civil society organisations, and city, regional or national planning departments.

IV. NATIONAL ACTIONS IN HUNGARY

Policy framework

As an EU Member State, Hungary is determined to deliver commitments made at European level by supporting both regional and local initiatives. The policy frameworks mentioned above, - the European Green Deal, the Fit for 55 package, the Smart and Green Mobility Strategy, and the soon-to-be-introduced ReFuelEU Aviation provide guidance for Member States' related agendas. As presented above, in relation to sustainable aviation, policies can be grouped around four main policy tracks: aircraft technology development, enhanced air traffic management, sustainable aviation fuels, and market-based mitigation measures.

Institutional arrangements

In addition to European efforts, complementary national mitigation measures of carbon emissions reduction can be identified in relation to these main policy fields and are described in this chapter. Firstly, national initiatives coordinated by the Ministry of Technology and Industry are presented. The Ministry is the main government body in the aviation ecosystem, and it embodies the most important policy experts for aviation and sustainability. The Energy Policy Department, the Climate Policy Department, the Transport Policy Department, the Civil Aviation Authority and the National Climate Protection Authority all work together in related matters under the auspices of the Ministry of Technology and Industry.

In order to present a comprehensive overview of the shared efforts of stakeholders from the Hungarian aviation sector, actors were invited to contribute to the State Action Plan by describing their related guidelines and activities. In this chapter, following the first section on public initiatives, statements from industry actors are showcased.

MITIGATION MEASURES OF THE MINISTRY OF TECHNOLOGY AND INDUSTRY

Coordination

The Hungarian Government aims to leverage its role as a central actor in the innovation ecosystem. Climate goals are multidisciplinary and complex, hence public coordination, guidance, and incentives are essential. Hungarian ministries work closely to align targets and efforts to bridge policy gaps, invaluable in the case of sustainable aviation where climate, energy, and transport policy expertise is all needed. In the case of innovative technologies that can put aviation on a climate-friendly, sustainable track, many of these technologies will likely emerge from other sectors. Recognizing such opportunities will surely provide long-term solutions for forward-thinking states and private actors.

Research and development

Sustainability is a fundamental pillar of Hungary's aviation-related research and development agenda. In addition to European programmes, Hungary also encourages local research initiatives and development projects concerning technologies, alternative fuels, hydrogen, electrification, and circular industry practices.

Through a government initiative in early 2022, the Hungarian Aviation Cluster was established to boost stakeholder engagement, cooperation, and knowledge transfer in the aviation sector. The Cluster entails six working groups for significant subfields, including research and development and higher education, essential for the advancement of local R&D projects on topics related to innovation and sustainability.

In 2022, EASA and the Hungarian Ministry of Technology and Industry (formerly the Ministry for Innovation and Technology) also signed a Memorandum of Understanding (MoU) supporting R&D initiatives in high-priority areas such as digitalization, urban air mobility, artificial intelligence, SAF and green energy, and airspace integration. The first projects under the auspices of the MoU will kick off later in 2022.

Furthermore, Hungary applied to the Assistance, Capacity-building and Training for Sustainable Aviation Fuels (ACT-SAF) programme launched by ICAO as a requesting state to gain insight into related best practices and take part in collaborations with partner organisations. ACT-SAF will provide support for both private and public entities. Consequently, government organisations as well as local stakeholders will learn how to identify local opportunities in SAF-related activities through the programme.

MITIGATION MEASURES OF STAKEHOLDERS OF THE HUNGARIAN AVIATION SECTOR

A. Mitigation measures - Budapest Airport

> *"Budapest Airport is on a promising path towards achieving net zero emissions. We worked hard on a detailed net carbon roadmap, which will ensure that we reach zero emissions latest by 2035, at least 15 years earlier than the 2050 target date set by the Paris Agreement on climate change, setting an example for other airports in Europe and beyond."* - Chris Dinsdale CEO, Budapest Airport

Aviation contributes close to 3% of all greenhouse gas (GHG) emissions globally, and airports are responsible for 2% of this portion (Budapest Airport, 2022). Budapest Airport recognizes and articulates that in order to decarbonize aviation much action is urgently needed, and airports have an important role to play here. The airport embraces opportunities of the required transition and adheres to ambitious measures recommended by international authorities and stakeholders such as the Intergovernmental Panel on Climate Change (IPCC), ACI Airport Carbon Accreditation (ACA), and Science Based Targets initiative (SBTi). Beyond its own footprint, Budapest Airport also supports its partners in setting and adapting to more sustainable business practices. One example is the facilitation of deployment of climate friendly airside and landside ground service equipment (GSE).

The carbon footprint of Budapest Airport - Direct emissions

According to its Sustainability report (2021), total emission of Budapest Airport was 220 kt CO_{2e} in 2021. As shown in *Figure 16* below, net zero carbon emissions target covers the airport's direct emissions from owned or controlled sources (Scope 1) and indirect emissions from the generation of purchased electricity (Scope 2). These originate from the maintenance and operation of buildings and infrastructure, and the operation of airport owned vehicles.

In accordance with EU directive 2003/87/EC and applicable Hungarian legal provisions, Budapest Airport takes part in the EU Emissions Trading Scheme (EU-ETS) since its introduction in 2005. It is part of the scheme as heat and hot water are supplied for airport facilities by a central heat generation system, which is powered primarily by natural gas, or alternatively by fuel oil.

For the sake of achieving the ambitious target, BUD maintains a strict and transparent carbon management procedure and seeks to address the challenge by increasing the energy efficiency of its infrastructure and operations, reducing the use of fossil fuel energy sources, increasing on-site renewable energy capacities, procuring electricity from renewable energy sources, further boosting e-mobility (fleet and infrastructure), and reshaping its waste and wastewater management towards circular practices.

Indirect emissions

Besides the Scope 1&2 emissions, as showcased in *Figure 15* a large share of total GHG emissions come from the operation of the airport to which the airport operator does not have much direct influence. According to Budapest Airport's Sustainability report (2022), these indirect emissions (Scope 3) account for over 92% of the airport's total carbon footprint.

Conclusively, Scope 3 emissions have a significant impact in the overall carbon footprint, and active cooperation with partners operating at the airport is essential to reduce it. To facilitate this, Budapest Airport is developing a Stakeholder Engagement Plan and established its Green Airport Program in which several programs and initiatives have been and will be carried out to mitigate the carbon emissions of the partners and the airport as a whole (Budapest Airport, 2022).

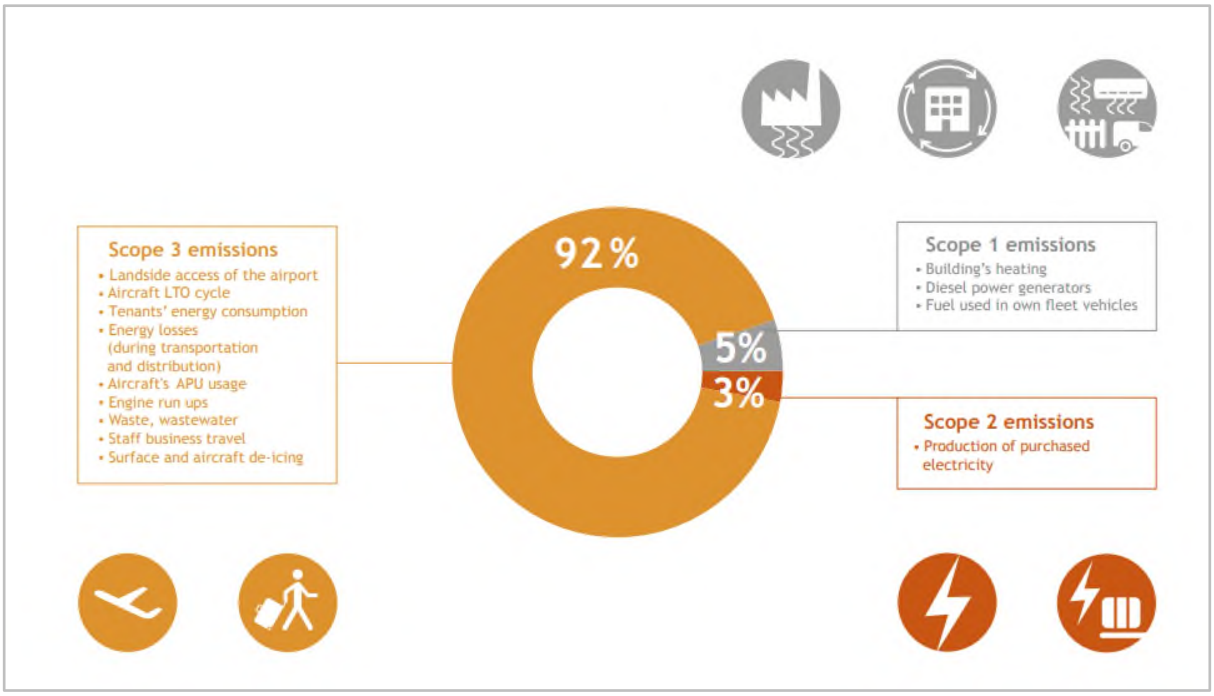

Figure 15. Budapest Airport's emissions in Scope 1, 2 and 3 (for year 2021)

BUD has halved its direct carbon emissions in the last 10 years

Budapest Airport aims to achieve net zero carbon emissions by no later than 2035 and to become the first net zero carbon airport in the region.

In order to enhance the journey towards net zero, Budapest Airport joined together with 190 other airports ACI's NetZero by 2050 initiative that aims to reduce carbon emissions from direct airport operations to zero by 2050. Additionally, Budapest Airport also joined the Toulouse Declaration during the preparation of the present report to further strengthen its commitments towards net zero emissions. By getting on board with these international organisations, BUD reinforces its commitment towards net zero by learning best practices through knowledge-sharing and taking bolder steps.

Over the past 10 years Budapest Airport almost halved its direct carbon dioxide emissions, and reduced carbon dioxide emissions per passenger to one-third between 2011 and 2019. It is important to note that this reduction was achieved while traffic has significantly increased as shown in *Figure 1-2* in *Chapter 2*.

In addition, to neutralise remaining emissions not covered by the above-mentioned efforts, Budapest Airport purchases carbon credits as per the EU-ETS regulation and voluntary carbon offsets in the ACI Airport Carbon Accreditation scheme. For its overall sustainability scheme, in 2021 Budapest Airport received ACI's level 3+ carbon neutrality level accreditation for the fourth time. This makes BUD one of the 59 carbon neutral airports globally that meet these stringent requirements.

STARGATE Project – Innovation for sustainability

In line with its local climate measures, Budapest Airport joined an international consortium with Brussels Airport, Athens Airport, and Toulouse Airport, along with 18 other non-airport members in 2021 for a large-scale research and development project. The consortium applied for the Horizon 2020 program and has received a fund of EUR 25 million from the European Commission, as part of a sustainability project called STARGATE (SusTainable AiRports, the Green heArT of Europe). STARGATE's mission is to develop, test, and implement innovative solutions that offer short - and medium-term green solutions for airports' day-to-day operations (Budapest Airport, 2022). As part of the project Budapest Airport is set to develop and put in place a cloud-technology based, paperless air cargo handling system, along other sustainability-related projects, concerning mainly the terminal, energy efficiency, sustainable aviation fuel, and traffic developments.

B. Mitigation measures - HungaroControl

HungaroControl is the air navigation service provider (ANSP) responsible for air navigation services in the Hungarian airspace. Its dedicated measures targeting emissions reduction are listed in the following sections.

Free Route in Hungary

Free route airspace (FRA) is a specified airspace within which airspace users may freely plan a route between defined entry and exit points. Subject to airspace availability, airspace users must have the possibility to choose a route via intermediate, published or unpublished waypoints without reference to the ATS route network. Within that airspace, flights remain subject to air traffic control.

COMMISSION IMPLEMENTING REGULATION (EU) 2021/116 (CP1 IR) requires FRA to be implemented across the entire Single European Sky Airspace at least above FL305 by December 2025.

Hungary was the first country in Europe to introduce the FRA in its entire airspace (withdrawing the current route structure at the same time), and the first one to introduce it in one step without any limitation (time and/or vertical) in 2015. In the same year, the FRA operation was extended across the Hungarian-Romanian state border. Currently, the full cross-border FRA operation from the Black sea up to the Baltic Sea is available (SEEFRA + BALTIC FRA).

Projects related to FRA included the cross-border operations aiming at providing airspace users with as many route planning options (on top of the current routes) as possible without compromising flight safety. With opening the FRA environment, airspace users have gained extra overflight alternatives which have most likely been chosen in different circumstances.

Continuous Descent Operations (CDO)

HungaroControl has always been deeply committed to environmental protection, therefore, great emphasis was placed on improving the proportion of continuous descent operations (CDO), which is a scientifically proven way to reduce fuel consumption and harmful emissions. We are proud to say that in the last 10 years, the CDO proportion has increased from ~40% to 70% due to our successfully completed projects targeting fuel efficiency, in spite of the fact that traffic has also soared in this period.

Our first successful attempt at making flight paths shorter and more predictable was the introduction of T-bar approaches, which brought about a paradigm shift in handling and sequencing arrival traffic. Air traffic controllers now plan more ahead and resolve sequencing conflicts through speed restrictions instead of route lengthening. As a consequence, the always changing routes to the threshold, which is the greatest stumbling block in achieving CDO-s, have been widely eliminated.

In the second phase of streamlining arrival traffic handling, HungaroControl had the airspace structure redesigned in order to avoid level flight segments due to non-controlled airspace blocks standing in the way of optimal descent paths. Having finished these projects, it is safe to say that the remaining room for further improvement is the responsibility of airlines and pilots.

PBN4HU Project - Satellite navigation at seven civil and three military airports

With 85% funding intensity and as an individual applicant, HungaroControl was able to secure a grant from INEA (Innovations and Networks Executive Agency) to carry out its project titled "*Implementation of PBN procedures in Hungary (PBN4HU)*". Within the framework of this project, performance based navigation (PBN) procedures were designed for seven civil (Békéscsaba, Debrecen, Győr-Pér, Nyíregyháza, Pécs-Pogány, Sármellék, Szeged) and three military airports (Kecskemét, Pápa, Szolnok) in Hungary. As an additional part of the project, a national GNSS - (GPS, Galileo and GLONASS) signal monitoring network was installed.

As a result of the PBN4HU project, the density of airports provided with PBN accessibility had reached a level similar to that of France. With special regard to comparable GNSS signal detection and processing systems deployed in neighbouring or closely located countries (e.g. BLUE MED FAB), further synergies might also be exploited in the long-term.

SESAR PJ38-W3-ADSCENSIO (Tesla tool)

Better predicting the trajectories of flights can significantly contribute to emissions reduction. Instrumental in this is the sharing of data real-time between the aircraft and air traffic control ground systems. The SESAR research project ADSCENSIO, is demonstrating a solution (ADS-C/Extended project profile) to downlink aircrafts' intentions via datalink. The research is feeding into deployment efforts to see whether by 2027 Europe's air traffic control ground systems are capable of making use of aircraft trajectory data, and whether all aircraft flying above FL285 have the capability to downlink EPP through ADS-C from December 2027 onwards.

The purpose of joining the project is to adapt the previously developed Tesla tool (a short - and medium-term conflict alert tool) to HungaroControl's needs and to test its usefulness in ACC and APP environments.

This project aims at completing the operational demonstrations of the usage of ADS-C and evaluating the appropriateness of proposed infrastructure to convey and share ADS-C data, and as such the project shall:

- Continue the data collection of ADS-C reports and related data sent by airlines' aircraft equipped with the capacity to downlink flight trajectory information.
- Analyse characteristics, performance and behaviour of ADS-C Data Contents from operational and technical perspectives.
- Perform operational evaluations to demonstrate and characterise the benefit of integrating ADS-C data in ATC systems.
- Demonstrate the feasibility of an efficient distributed ADS-C service ("ADS-C Common Service") on the ground.

The goal of HungaroControl is to investigate the possibility of future integration of Tesla tool into its ATM system.

SESAR PJ.10-W2-73 Flight Centric ATC (sectorless ATC)

This new approach encompasses the investigation of Flight Centric ATC (FCA), previously also known as the sectorless ATC concept. The idea is to dissolve sector boundaries and to have one controller (at the time) in charge of a single flight to guide it through a large portion of airspace. As a basic principle of Flight Centric ATC, a controller is no longer in charge of managing the entire traffic within a given sector. Instead, he/she is now responsible for a certain number of aircraft throughout their flight segment within a given airspace whereas other controllers are responsible for a certain number of different aircraft within the same airspace. ATC still has the responsibility for separation provision and the controller has to ensure a conflict-free flight.

The responsibility of control nowadays is linked to a jurisdiction over a specific volume of airspace. In this project the jurisdiction will be shared among several controllers. This SESAR Solution also addresses transition/switch strategies from current operations to Flight Centric ATC and vice versa as well as the traffic allocation strategies of aircraft to controllers.

Within Flight Centric ATC there are at least two different strategies regarding traffic allocation: dynamic allocation (e.g. based on the current/expected workload) and static allocation (e.g. according to traffic flows).

Conflict detection and resolution (CD&R) strategies are tool supported, particularly in cases when the conflicting traffic is under jurisdiction of two or more different controllers, and may also consider situations e.g. if both aircraft are already within the Flight Centric Area or if one is still outside. Tasks regarding building up and maintaining the mental picture (situation awareness) of the traffic situation (perceiving important cues in the environment to extract information, integrating different pieces of information, predicting future states to detect conflicts, etc.) may be supported differently by the system, due to the nature of the change described earlier. A key cornerstone of FCA is to efficiently present the relevant information to the ATCOs in a relatively large airspace, without causing information/sensory overload. Thus, well-designed and reliable CD&R tools and filtering methodologies would show all relevant traffic, and those aircraft which could also be of interest in terms of future conflicts.

Communication might be supported by Wide Area Communication (WAC) technology. For this, current ground communication infrastructure needs to be modified in order to allow flexible allocation of frequencies to the assigned controller and aircraft. It is assumed that in this case no modification of avionics is required.

Flight Centric ATC is envisaged to be applied in different operational environments, i.e. in Free Route Airspace and also in fixed route airspace.

GreAT - Greener Air Traffic Operations

Joint project run by EU and China based on Grand Agreement (number: 875154)

The Project is addressing environmental challenges, especially global warming, which is more than ever a must for the community to act upon.

The international project “Greener Air Traffic Operations” (GreAT) has been launched in line with this perspective in a very special cooperation of Chinese and European partners, including airline operator, air navigation service provider, authority, consultants, research institutes, system developers, and universities.

In MWP3, the first objective is to develop a Heterogeneous En-Route Airspace Management (HERAM) concept by identifying the boundary to divide China’s en-route network into the Eastern (fixed route) and Western (flexible route) region, putting focus on the planning of Flexible En-Route Airspace in the West of China (FERA-WoC). The second approach is to optimise long haul flight trajectory based on integrated air-ground information (e.g., traffic situation, dynamic upper wind field), which aims at achieving a wind-optimal path and flight profile to decrease total fuel consumption and emissions during long haul flight in both structured and flexible en-route airspace.

Air-ground cooperative operation of long-haul flight based on FF-ICE is to increase the availability of user-preferred 4DT profiles and flexibility of air traffic operation. The 4DT management process based on FF-ICE can promote greener long-haul flights, which supports the cross-border sharing and cooperation of 4DT. Support of the traffic flow management in density airspace, the approach of trajectory management models and algorithms related to demand and capacity balance, traffic synchronisation and conflict management are also addressed.

C. Mitigation measures - MOL Hungary

MOL Hungary is one of Central Eastern Europe's most significant international, integrated oil and gas companies. It is a key player in Hungary's energy and fuel strategies. MOL Hungary recognizes that in order to contribute to the decarbonization of the aviation sector, the use of alternative fuels is the most feasible way in the short - and medium-term.

Responding to the European Commission's proposal on the EU-wide SAF blending mandate (ReFuelEU Aviation Initiative as part of the "Fit for 55" package), more and more new, official SAF production projects are announced, however, their current, overall capacity does not cover the European Union's need from 2035 onwards (when SAF blending mandate increases from 5% to 20% in 2035). MOL Hungary believes that the missing amount of SAF can be provided by further new production capacities, capacity switches from renewable diesel production or importing SAFs from other countries.

As for the different production pathways, HEFA (Hydro processed Esters & Fatty Acids) is the most widespread technology, used also by the current, commercial scale production capacities in the EU. Other SAF production units, using different technologies (e.g. Alcohol-to-Jet or Fischer-Tropsch), are still not operated on commercial scale, including the synthetic aviation fuel production (Power-to-Liquids or PtL), which currently also exists only in pilot phase.

Being one of the possible measures of CO_2 reduction in aviation, different SAF related initiatives have been started in Hungary. Despite the fact that the current SAF production capacities are concentrated in Northern & Western Europe, refinery assets are being upgraded to make imported SAF blending possible even before 2025. Similarly to many oil companies in the EU, Danube Refinery is also being prepared to produce SAF through co-processing of waste fats and used cooking oil with fossil-based feeds in the existing refinery infrastructure in the short term by 2025. As for a longer time horizon, projects have been started to evaluate the establishment of future standalone SAF production units to fulfil the increasing blending mandates, including the mandatory share of synthetic fuels.

D. Mitigation measures - Wizz Air

Introduction

Wizz Air is one of the key stakeholders in the Hungarian aviation sector with its headquarters in Budapest. The airline has flights to and from many cities across Europe, as well as some destinations in North Africa, the Middle East, and South Asia. It currently serves 44 countries.

Overall target

Wizz Air is committed to the 2030 goal of reducing CO_2 emission intensity to 43 grams per passenger kilometre, whilst the company is working on an even more ambitious 2050 target.

Hungarian fleet renewal program

Wizz Air currently owns a fleet of 165 Airbus A320 and A321 aircraft and has two bases in Hungary in Budapest and Debrecen. It has a fleet renewal program, as part of which the previous Airbus A320ceo and A321ceo aircraft will be gradually re-delivered and changed to A320neo and A321neo aircraft, which are the most efficient single aisle aircraft with the lowest fuel consumption per seat-kilometre in their categories. The A321neo delivers exceptional fuel economies by reducing fuel consumption by 10% compared to the A321ceo, which further translates to 20% fuel savings compared to the A320ceo aircraft. On top of fleet renewal, Wizz Air is working on fuel saving initiatives and improving related data science. The key actions to deliver on our CO_2/RPK glidepath are fleet renewal, fuel efficiency measures and Sustainable Aviation Fuel, out of which fleet renewal is contributing 22.5% reduction by F30 (financial year 2030 in Wizz Air's reporting period). Wizz Air currently operates one of the youngest fleets in the world with an average age of 4.66 years as of 21 September.

Mobile Electronic Flight Bag

A key project for Wizz Air's flight operations in financial year 2022, was the introduction of the Mobile Electronic Flight Bag (Mobile EFB), which is a considerable step-change for in-flight optimization and will help the pilots to make more accurate fuel planning decisions, based on instantly updated data. This digital solution is not just replacing printed manuals, but it also helps improve fuel and operational efficiencies in numerous ways.

CO_2 per revenue passenger kilometre (CO_2/RPK) reduction

This is the key environmental metric for Wizz Air as Scope 1 CO_2 emissions from operations are the most significant contributor to its carbon footprint. One tonne of fuel burn emits 3.15 tonnes of CO_2 (as per international conversion standards). Wizz Air declared a target reduction to 43g CO_2/RPK emissions by fiscal 2030 versus its fiscal 2020 baseline of 57.2g CO_2/RPK.

Initiative	Start date	% efficiency
Differentiated cost index	Jun-18	0.4%
Performance/idle factors	Jun-20	0.1%
ZFW optimisation	Jun-20	0.1%
Reduced take-off configuration	Oct-20	0.3%
CONF 3 landing	Sep-19	0.2%
Mobile EFB	Dec-21	0.05%
Fuel efficiency platform	Apr-22	0.8%

Table 15. Wizz Air's fuel efficiency initiatives that reduce their impact on the environment

Qualifying a SAF supply chain

Wizz Air is compliant with regulatory requirements with regards to sustainable aviation fuels (SAF) at European Union and country level. The supply, quality, and price level of SAFs are deemed not sufficient to meet SAF blending mandates as part of Fit For 55 2025 onwards. As such, Wizz Air is working with stakeholders to qualify a SAF supply chain in line with the ULCC principles whilst meeting ISCC+, RSB and EU Renewable Energy Directive II criteria on feedstock.

Actions to achieve this include industry engagements, public support of the book-and-claim system in the EU and establishing offtake agreements that can achieve a strategic advantage for Wizz Air, while ensuring the necessary SAF volumes, which will enable Wizz Air to deliver on its emission reduction goals. A key objective is the selection of technology partners to support Wizz Air's ambitious long-term climate targets by ensuring a superior production cost profile, reliable and competitive sustainable feedstock source, and advanced engineering capabilities.

Wizz Air confirms its commitment to comply with new blending mandates and has launched a SAF tender recently to secure sufficient volumes to meet the obligations set out by the Fit for 55 package. Therefore, Wizz Air supports the EP's idea of a SAF flexibility mechanism (book and claim system) to ensure 'access' to SAF for every airline regardless of the region they mainly operate in.

Wizz Air has conducted a SAF to market deployment assessment considering the dimensions of production technology readiness, feedstock availability and life cycle GHG emissions reduction potential of the different SAF pathways with particular focus on identifying the most feasible supply options for its key regions.

On 28 June 2022, Wizz Air operated its first green demonstration flight between Bucharest and Lyon at the European Commission's *"Connecting Europe Days 2022"* sustainable mobility conference, taking up 4.5 tonnes of a SAF fuel blend, consisting of 30% pure SAF and 70% Jet A1 fuel.

Total aircraft CO_2 emissions

Scope 1 CO_2 emissions (Carbon Dioxide) by Wizz Air Group operations was 2,620,321 tonnes (based on our jet fuel consumption of 831,847.9 tonnes multiplied by the standard 3.15 multiplier to convert jet fuel kerosene into CO_2 emissions). This includes the entire fleet across Wizz Air's vast network.

Offsets purchased by customers

Wizz Air supports two verified carbon-reducing projects: The International Small Group and Tree Planting Program (TIST) in Uganda, an award-winning and longstanding reforestation project; and The Pichacay Landfill Gas to Renewable Energy Project in Ecuador, which recovers and repurposes landfill methane to produce clean electricity.

Both projects are certified by the Verified Carbon Standard to measurably reduce emissions. Since the start of the program, only a very small percentage of bookings have elected to offset carbon.

	F22	F21
Scope 1 CO2 emissions with EU/UK ETS offsets (excluding free credits)	**1,746,695**	863,909
Scope 1 CO2 emissions with CORSIA offsets (excluding baseline credits)	**-**	-
Scope 1 CO2 emissions with voluntary offsets	**1,064**	105
Scope 1 CO2 emissions without offset (free credits, baseline offsets)	**788,777**	474,358

Table 16. Scope 1 offsetting activities of Wizz Air

Qualify future technology building blocks and industry partnerships to enable a Net Zero by 2050 commitment

Wizz Air is committed to driving sustainable change within the Hungarian and regional aviation industry; thus, is cooperating with suppliers, partners and various industry stakeholders in projects concerning technological and operational innovations.

ALBATROSS: Launched in February 2021, ALBATROSS project seeks to implement the most energy efficient flights in Europe. As part of the initiative, a series of live demonstration flights have been conducted, demonstrating the feasibility of increased energy-efficient flights, utilising both technical and operational innovations, known as SESAR Solutions. ALBATROSS is following a holistic approach by covering all flight phases, and, as such, involving all key stakeholders like airlines, ANSPs, network managers or airports. Wizz Air UK has been participating in the project's working group meetings and alignments and will continue to be involved in the next phase as well.

Airbus – ZEROe Hydrogen Project: Wizz Air has signed a Memorandum of Understanding with Airbus earlier in 2022 on its ZEROe Hydrogen Project, which will help analyse the evolution of the hydrogen ecosystem globally and the impact of hydrogen aircraft on Wizz Air's fleet, operations, and infrastructure taking into account specific aircraft characteristics. The agreement will also include common advocacy and communication to advance awareness for the mutual benefit of Wizz Air and Airbus. Wizz Air provides key commercial and operational input for Airbus and adds ultra-low-cost carrier related insights to the ZEROe Hydrogen Project team. At the same time, Airbus will continuously share information on the expected aircraft performance and ground operations characteristics. The project will provide Wizz Air a better understanding of how a zero-emission aircraft could be put into service and how it will impact the airline's infrastructure and processes, as well as its efficient performance.

EASA Environmental Labelling Programme for Aviation: Wizz Air has entered a voluntary cooperation with EASA on the operational testing of their environmental labelling platform. The project aims to collect accurate data from stakeholders (airlines, airports, etc.) and publicly communicate transparent environmental performance information to consumers in an easily digestible format.

Important Projects of Common European Interest (IPCEI): Wizz Air joined the FlyHy Project consortium led by VPP Solar Ltd. and Messer Hungarogáz Ltd. to promote the use of hydrogen and to accelerate the decarbonization of the aviation sector. The consortium connects the expertise from the aviation sector, as well as the renewable energy, hydrogen, and airport industries. In 2019 VPP Solar Ltd. launched a new business arm for the creation of the full value chain of hydrogen and began the planning and implementation of its first carbon-free hydrogen production plant project in Hungary in 2021. Messer Group GmbH is a global producer and supplier of industrial gases, engaging also in the development of applied technologies. The FlyHy IPCEI Hydrogen Project Proposal, submitted in November 2021, plans the deployment of carbon free, green hydrogen gas production plants and distribution stations near Hungarian (or also other EU) airports. Initially, these would supply ground vehicles and SAF production and later, the deployment of liquid hydrogen infrastructure and production, utilised as air fuel. IPCEI project grants would be provided from national funds, but also need the approval of the European Commission.

V. CONCLUSION

As presented in this State Action Plan, Hungary is taking measures at different scopes – both EU level and national - to comply with regulations and climate targets. The Hungarian government dedicates utmost importance to climate protection and has set strong strategic goals in line with the European target of reaching climate neutrality by 2050 and, in line with the Paris Agreement to limit global warming. Hungary has set the national greenhouse gas (GHG) emission reduction target of at least 40% by 2030 compared to 1990 and committed to becoming climate-neutral by 2050. To achieve this ambitious goal, all sectors and stakeholders shall contribute to their dedicated areas of operations, including those in the aviation industry. Hungary enshrined national emission reduction goals in Law No. XLIV of 2020 on Climate Protection.

The aim of this State Action Plan was to present mitigation measures currently in planning phase or already taking place in Hungary. In the near future, Hungary's mission will be to further explore and expand its capacities especially concerning alternative aviation fuels. Hungary is eager to join international initiatives to establish long-term regional partnerships and learn from best practices. As crises affecting energy supply unfold, it is the common interest of both the European community and Hungary to expand its domestic energy supply capacities. SAFs provide invaluable opportunities for States heavily relying on imported energy in the past.

In order to fulfil commitments presented in this State Action Plan, on the one hand, States need effective regulations. The ongoing negotiations on the Fit for 55 package, - which includes the EU ETS aviation, CORSIA, and ReFuelEU Aviation dossiers - will be crucial in laying the foundations for a sustainable aviation industry in Europe. On the other hand, the role of private actors in successfully implementing such regulations is also immense. Consequently, the government will continue to further coordinate initiatives at state level and facilitate both small – and large-scale public-private partnerships.

Conclusively, Hungary, as an ICAO Contracting State, and an ECAC and EU Member State expresses its commitment to take further steps and develop additional measures to mitigate the emissions of the aviation sector. This State Action Plan is a declaration of national intent and guarantee of public commitment towards stakeholders in the industry. While sustaining the highest level of safety and competitiveness in the EU aviation sector, Hungary will continue to support research, development, and innovation to incentivize the green transformation of the aviation industry.

APPENDIX A
DETAILED RESULTS FOR ECAC SCENARIOS FROM SECTION A

1. Baseline Scenario

Year	Passenger traffic (IFR movements) (million)	Revenue passenger kilometres[65] RPK (billion)	All-cargo traffic (IFR movements) (million)	Freight tonne kilometres transported[66] FTKT (billion)	Total revenue tonne kilometres[67] RTK (billion)
2010	4.56	1,114	0.198	45.4	156.8
2019	5.95	1,856	0.203	49.0	234.6
2030	5.98	1,993	0.348	63.8	263.1
2040	7.22	2,446	0.450	79.4	324.0
2050	8.07	2,745	0.572	101.6	376.1
Note that traffic scenario shown in the table is assumed for the baseline and implemented measures scenarios.					

Table 17. Baseline forecast for international traffic departing from ECAC airports

Year	Fuel consumption (10^9 kg)	CO_2 emissions (10^9 kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	36.95	116.78	0.0332	0.332
2019	52.01	164.35	0.0280	0.280
2030	50.72	160.29	0.0252	0.252
2040	62.38	197.13	0.0252	0.252
2050	69.42	219.35	0.0250	0.250
For reasons of data availability, results shown in this table do not include cargo/freight traffic.				

Table 18. Fuel burn and CO_2 emissions forecast for the baseline scenario

[65] Calculated on the basis of Great Circle Distance (GCD) between airports, for 97% of the passenger traffic for forecast years.
[66] Includes passenger and freight transport (on all-cargo and passenger flights).
[67] A value of 100 kg has been used as the average mass of a passenger incl. baggage (ref: ICAO).

2. IMPLEMENTED MEASURES SCENARIO

2A) EFFECTS OF AIRCRAFT TECHNOLOGY IMPROVEMENTS AFTER 2019

Year	Fuel consumption (10^9 kg)	CO_2 emissions (10^9 kg)	Well-to-wake CO_2 emissions (10^9 kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	36.95	116.78	143.38	0.0332	0.332
2019	52.01	164.35	201.80	0.0280	0.280
2030	49.37	156.00	191.54	0.0232	0.232
2040	56.74	179.28	220.13	0.0217	0.217
2050	59.09	186.72	229.26	0.0202	0.202
For reasons of data availability, results shown in this table do not include cargo/freight traffic.					

Table 19. Fuel consumption and CO_2 emissions of international passenger traffic departing from ECAC airports, with aircraft technology improvements after 2019

Period	Average annual fuel efficiency improvement (%)
2010-2019	-1.86%
2019-2030	-1.22%
2030-2040	-0.65%
2040-2050	-0.74%

Table 20. Average annual fuel efficiency improvement for the implemented measures scenario (new aircraft technology only)

2B) EFFECTS OF AIRCRAFT TECHNOLOGY AND ATM IMPROVEMENTS AFTER 2019

Year	Fuel consumption (10^9 kg)	CO_2 emissions (10^9 kg)	Well-to-wake CO_2e emissions (10^9 kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	36.95	116.78	143.38	0.0332	0.332
2019	52.01	164.35	201.80	0.0280	0.280
2030	46.16	145.86	179.09	0.0217	0.217
2040	51.06	161.35	198.12	0.0196	0.196
2050	53.18	168.05	206.33	0.0182	0.182
For reasons of data availability, results shown in this table do not include cargo/freight traffic.					

Table 21. Fuel consumption and CO_2 emissions of international passenger traffic departing from ECAC airports, with aircraft technology and ATM improvements after 2019

Period	Average annual fuel efficiency improvement (%)
2010-2019	-1.86%
2019-2030	-1.82%
2030-2040	-1.03%
2040-2050	-0.74%

Table 22. Average annual fuel efficiency improvement for the implemented measures scenario (new aircraft technology and ATM improvements)

Year	Well-to-wake CO_2 emissions (10^9 kg)			% Improvement by implemented measures (full scope)
	Baseline scenario	Implemented measures scenario		
		Aircraft technology improvements only	Aircraft technology and ATM improvements	
2010	143.38			NA
2019	201.80			NA
2030	196.8	191.5	179.1	-9%
2040	242.0	220.1	198.1	-18%
2050	269.3	229.3	206.3	-23%
For reasons of data availability, results shown in this table do not include cargo/freight traffic. Note that fuel consumption is assumed to be unaffected by the use of sustainable aviation fuels.				

Table 23. Equivalent (well-to-wake) CO_2e emissions forecasts for the scenarios described in this common section

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APPENDIX B
NOTE ON THE METHODS TO ACCOUNT FOR THE CO_2 EMISSIONS ATTRIBUTED TO INTERNATIONAL FLIGHTS

1. Background

The present note addresses recommendations on the methodologies to account the CO_2 emissions, for the guidance on the development of the common European approach for ECAC States to follow, in view of the submission to ICAO of their updated State Action Plans for CO_2 Emissions Reduction (APER).

The ECAC APER guidance shall be established on the basis of the ICAO 9988 Guidance on the Development of States' Action Plans on CO_2 Emissions Reduction Activities document (3rd edition). One of its objectives is to define a common approach for accounting CO_2 emissions of international flights: two different methods are proposed for CO_2 accounting, namely ICAO and IPCC. Because of their intrinsic definitions, it is expected that these two different approaches induce both accounting differences, and practical issues, and furthermore, two ways to target the CO_2 Emissions Reduction Activities, and to define the action plans, de facto.

As the objective of the definition of the common section of the ECAC APER guidance consists into determining a common approach for all the foreseen activities, including CO_2 accounting and monitoring, the ECAC APER Task Group required to assess the details of each method and to propose recommendations in this present note.

2. Accounting methods

The ICAO Doc 9988 document 3rd edition defines the two CO_2 accounting methods (§3.2):

- ICAO: each State reports the CO_2 emissions from the international flights operated by aircraft registered in the State (State of Registry).
- IPCC: each State reports the CO_2 emissions from the international flights departing from all aerodromes located in the State or its territories (State of Origin).

The international flights concern aircraft movements from a country to another country. Each method determines the country assignment of the movement.

2.1 Comparisons: flown distance and number of operations

The comparison of the number of operations and flown distance of 2019, aggregated at ECAC or State levels provide a good indication of the possible differences for CO_2 accounting.

At the ECAC area level, the relative difference between the ICAO and IPCC methods, is -0.66% for operations number and + 0.26% on flown distance (Source EUROCONTROL/CRCO). This is explained by the fact that movements of the operators registered outside the ECAC area member states are not counted in.

The table hereafter lists the countries for which the relative differences of counting the number of operations or flown distance is more than 50% or less than -50% (Source EUROCONTROL/CRCO).

The previous table highlights the possible relative differences for a country-by-country approach:

- High differences for low-cost origin countries (Ireland, Austria, Hungary) as all the movements exceed the departures capacity: nb operations ICAO >> nb operations IPCC
  - Example: Ireland (Ryanair), Austria (EasyJet), Hungary (Wizz Air)
- High differences for business jet country locations: nb operations ICAO > nb operations IPCC
  - Example: Monaco, Malta, Liechtenstein
- Difference for countries with lot of low-cost departures: nb operations ICAO < nb operations IPCC
  - Example: Greece, Italy

3. Impact on the action plan definitions

The choice of the method entails two significantly different approaches. The ICAO approach would bring the focus on the capability of a State to manage the emissions evolution of only its own “flag carriers”. A State having a significant aviation activity operated by non-flag carriers would therefore not be able to reflect in the plan its possible policy on the evolution of its overall aviation activity. Also, if the State flag carriers have an important aviation activity between third countries, this would become a “responsibility” of the State in terms of emissions reduction plans.

The IPCC method, on the contrary, brings the focus on the management of the emissions reductions for the State related aviation activity, integrating the State’s policy in terms of evolution and importance of the aviation business for it and national plans to reduce emissions (e.g., promotion of operations with more fuel-efficient aircraft).

Allowing States to use the ICAO or the IPCC method has the risk of under estimation for some as well as double counting for others if consolidating the States action plans.

It is also worth noting that the IPCC method actually allows consolidating and correlating the data with the CORSIA reporting. Indeed, under CORSIA emissions are reported by States aggregated at country pair level with no info on the operator. If all States were reporting action plans based on the IPCC approach aggregating at country pair level, this info can be consolidated and correlated with the CORSIA reported one. The ICAO method for the action plans would not allow this.

3.1 Impact on the baseline definition (ECAC)

The selection of the ICAO/IPCC method also affects the definition and estimation of the CO_2 emissions of the international flights at the ECAC level.

The Base year dataset and the forecasts dataset that EUROCONTROL shall define and assess (at the ECAC level), are based on the IPCC. The ICAO method cannot be used for such assessments.

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LIST OF ABBREVIATIONS

AAT	Aircraft Assignment Tool
ACARE	Advisory Council for Research and Innovation in Europe
ACA	Airport Carbon Accreditation
ACI	Airports Council International
AIRE	The Atlantic Interoperability Initiative to Reduce Emissions
AOC	Air Operator Certificate
APER TG	Action Plans for Emissions Reduction Task Group of the ECAC/EU Aviation and Environment Working Group (EAEG)
ATM	Air Traffic Management
CAEP	Committee on Aviation Environmental Protection
CNG	Carbon neutral growth
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
EAER	European Aviation Environmental Report
EASA	European Aviation Safety Agency
EC	European Commission
ECAC	European Civil Aviation Conference
EEA	European Economic Area
EFTA	European Free Trade Association
EU	European Union
EU ETS	EU Emissions Trading System
GHG	Greenhouse Gas

ICAO	International Civil Aviation Organisation
IFR	Instrumental Flight Rules
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Right
JU	Joint Undertaking
MBM	Market-based Measure
MT	Million tonnes
OL	Operating Licence
PRISME	Pan European Repository of Information Supporting the Management of EATM
RED	Renewable Energy Directive
RPK	Revenue Passenger Kilometre
RTK	Revenue Tonne Kilometre
RTD	Research and Technological Development
R&D	Research and Development
SAF	Sustainable Aviation Fuels
SES	Single European Sky
SESAR	Single European Sky ATM Research
SESAR JU	Single European Sky ATM Research Joint Undertaking
SESAR R&D	SESAR Research and Development
SMEs	Small and Medium Enterprises

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