STATE AVIATION
ADMINISTRATION OF UKRAINE

State Aviation Administration of Ukraine

Action plan of Ukraine for reducing aviation CO_2 emissions

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FOREWORD

Ukraine strongly supports a global approach to monitoring and reducing aviation emissions, in accordance with the provisions of ICAO Resolutions A37, A38, A39, A40, and A41. These resolutions provide a comprehensive framework for ICAO's policies and practices aimed at addressing climate change and promoting environmental sustainability in the aviation sector. Ukraine fully aligns with the goals set forth in ICAO Resolution A40-18 (Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection – Climate Change), which establishes guidelines for mitigating aviation-related emissions.

Resolution A37-19 (2010) on climate change introduced the State Action Plan, encouraging States to develop their own policies and strategies for addressing aviation-related emissions. This initiative was reaffirmed by subsequent resolutions: A38-18 (2013), A39-2 (2016), and A40-18 (2019), which all emphasized the importance of global cooperation in achieving sustainable aviation development. Most recently, Resolution A41-21 (2022) reiterated the commitment to environmental protection and climate change mitigation, further consolidating ICAO's policies in this area.

Ukraine encourages States to submit action plans outlining specific policies and measures to achieve key targets, including a global annual fuel efficiency improvement of 2% until 2020, with an aspirational goal of 2% improvement per year from 2021 to 2050. Furthermore, Ukraine supports efforts to ensure that net carbon emissions from aviation remain at 2020 levels. In this regard, Ukraine reiterates its commitment to ICAO’s environmental framework and underscores the importance of international cooperation to ensure the sustainable development of aviation worldwide.

Ukraine encourages States to submit their action plans outlining respective policies and actions to achieve a global annual average fuel efficiency improvement of 2 per cent until 2020, an aspirational global fuel efficiency improvement rate of 2 per cent per annum from 2021 to 2050, and to keep net carbon emissions from 2020 at the same level.

According to the decision of the European Civil Aviation Conference, all ECAC Member States, including Ukraine, agreed to submit their National Plans to ICAO and coordinated the format for the common section of this plan.

The State Aviation Administration of Ukraine, with the support of leading scientists and experts, created a Working Group for the development of the Action Plan, with the assistance of aviation industry representatives whose activities may affect the final result: airlines, airports, fuel suppliers, air navigation service providers, etc.

The objective of the Ukrainian Action Plan is to calculate and forecast CO_2 aviation emissions and implement appropriate measures to reduce and prevent pollution.

STATE AVIATION ADMINISTRATION OF UKRAINE

ACTION PLAN OF UKRAINE

Content

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INTRODUCTION

Ukraine has been a member of the International Civil Aviation Organization (ICAO) since 9 September 1992, the European Civil Aviation Conference (ECAC) since 15 December 1999, and the European Organization for the Safety of Air Navigation (EUROCONTROL) since 1 January 2004.

ICAO (International Civil Aviation Organisation) is a specialised agency of the United Nations, established in 1944. Its work involves developing global standards and regulations for civil aviation safety, security, efficiency, and environmental protection. ICAO's mission is to promote the development of international civil aviation in a safe and orderly manner, while encouraging the global sharing of airspace among its 193 Member States. Ukraine recognises the importance of each State preparing and submitting an updated State Action Plan on emissions reductions to ICAO as an essential step toward achieving the global collective goals established at the 37th Session of the ICAO Assembly in 2010.

EUROCONTROL (European Organisation for the Safety of Air Navigation) is an intergovernmental organization founded in 1960, which operates in the field of air traffic management across Europe. It currently includes 42 Member States. EUROCONTROL coordinates and plans air traffic management for Europe, ensuring safe, efficient, and sustainable air navigation. It works closely with national authorities, air navigation service providers, airports, and both civil and military airspace users.

Ukraine has been a member of **the World Trade Organization (WTO) since May 16, 2008.**

ECAC is an intergovernmental organisation that encompasses the widest grouping of Member States of any European organisation dealing with civil aviation. It currently consists of 44 Member States and was established in 1955. The ECAC States fully support ICAO's ongoing efforts to address a wide range of environmental concerns, including the key strategic challenge posed by climate change, in order to ensure the sustainable development of international air transport. Ukraine, like all 44 ECAC States, is fully committed to and actively engaged in the fight against climate change. It is working towards a resource-efficient, competitive, and sustainable multimodal transport system.

In this context, all ECAC States submitting Action Plans to ICAO, regardless of whether or not the 1% de minimis threshold is met, are going beyond the agreement of ICAO Assembly Resolution A37-19, as reaffirmed by A38-18, A39-2, A40-18, and A41-21. This is the Action Plan of Ukraine.

Ukraine shares the view of all ECAC States that a comprehensive approach to reducing aviation emissions is necessary, and that this should include:

- Emission reductions at source, including European support for CAEP work.
- Research and development of emission reduction technologies, including public-private partnerships.
- The development and deployment of low-carbon sustainable alternative fuels, including research and operational initiatives undertaken jointly with stakeholders.
- The optimisation and improvement of Air Traffic Management and CNS infrastructure within Europe.
- The application of global approaches to reduce the negative impact of international aviation on the environment.

In Europe, many of the actions undertaken within the framework of this comprehensive approach are, in practice, carried out at a supranational level, with most of them led by the European Union (EU). These actions are reported in Section 1 of this Action Plan, where Ukraine's involvement, as well as that of other stakeholders, is described.

In Ukraine, a number of actions are undertaken at the national level, including by stakeholders, in addition to those of a supranational nature. These national actions are reported in Section 2 of this Plan.

In relation to actions taken at a supranational level, 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).

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, even at a later stage, this broadens the effect of the measure, thereby increasing the European contribution to meeting global goals.

Nonetheless, by acting together, the ECAC States have committed to reducing the region's emissions through a comprehensive approach that incorporates each of its pillars.

CURRENT STATE OF AVIATION IN UKRAINE

Structure of the aviation sector

The President of Ukraine and the Cabinet of Ministers of Ukraine shall ensure the implementation of Ukraine's aviation development policy in accordance with the Constitution and laws of Ukraine.

The State Aviation Administration of Ukraine (SAAU) is a central executive body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Vice Prime Minister for Reconstruction of Ukraine — Minister for Development of Communities and Territories (hereinafter referred to as the Minister). The SAAU implements state policy in the field of civil aviation and the use of Ukraine's airspace and serves as the authorised body for civil aviation.

The Civil Aviation Authority and the Ministry of Defense, within their powers, are entrusted with the regulation of Ukraine's airspace.

The State Aviation Administration of Ukraine (SAAU) is the Civil Aviation Authority of Ukraine, established by the resolution of the Cabinet of Ministers of Ukraine № 520 on October 8, 2014.

The State Aviation Administration of Ukraine shall implement Ukraine's state policy and strategy for aviation development and shall regulate the civil aviation in the following areas:

- ensuring aviation safety, aviation security, ecological safety, economic security, and information security;
- creating conditions for the development of aviation activities, air transportation, and its servicing, as well as for conducting aerial work and flights of general aviation;
- air traffic management and airspace regulation in Ukraine;
- representing Ukraine in international civil aviation organisations and in external relations concerning civil aviation;
- drafting, adopting, and implementing of aviation rules;
- certifying aviation entities and facilities;
- issuing licenses for economic activities related to providing services for the transportation of passengers and/or cargo by air, as well as authorising airline operations and assigning them to air carriers;
- continuous supervision and monitoring of compliance with the requirements set by legislation, including aviation regulations of Ukraine.

The State Aviation Administration of Ukraine is a duly authorised and independent body responsible for ensuring the utilisation of Ukraine's airspace by Ukrainian aviation entities and overseeing the provision of air navigation services.

For the purpose of aviation safety, the State Aviation Administration of Ukraine shall cooperate with law enforcement agencies and other executive bodies.

State Aviation Administration of Ukraine website: http://www.avia.gov.ua/

The **Ukrainian State Air Traffic Services Enterprise (UkSATSE)** is the main air navigation services provider in Ukraine and serves as the core of the Integrated Civil-Military Air Traffic Management System of Ukraine (ICMS). UkSATSE is providing Air Navigation Services in Ukrainian airspace and in the portion of the airspace over high seas of the Black Sea, where responsibility for providing ATS has been delegated to Ukraine by the International Civil Aviation Organization (ICAO). This establishes the mission and main tasks of UkSATSE.

Main tasks:

- Air traffic management: air traffic services, airspace management and air traffic flow management in the airspace of Ukraine;
- Arrangement and provision of CNS and power supply system support for air traffic services and flight operations;
- Provision of activity and development of the Joint Civil-Military ATM System Units;
- Arrangement of Alerting Services and participation in Search and Rescue operations;
- Provision of airspace users with aeronautical information.

The Ukrainian State Air Traffic Services Enterprise website: http://uksatse.ua

Participation in International Organisations

1992 – Ukraine became a Full Member State of the International Civil Aviation Organisation (ICAO).

1994 – Accession of UkSATSE to the International Federation of Air Traffic Controllers' Associations **(**IFATCA).

1995 – Signature of a Bilateral Agreement between Ukraine and the Central Route Charges Office (EUROCONTROL).

1997 – Accession of UkSATSE to the Air Traffic Control Association (ATCA).

1997 – Introduction of new Flight Information Region (FIR) boundaries over the Black Sea.

1998 – UkSATSE became a founding member of the Civil Air Navigation Services Organisation (CANSO).

1999 – Ukraine became a Member State of the European Civil Aviation Conference (ECAC).

1999 – Ratification of the Agreement between the EBRD and the Government of Ukraine concerning the Ukrainian ANS Modernisation Project by the Ukrainian Parliament.

1999 – UkSATSE joined the International Organisation Information Co-ordinating Council on Air Navigation Charges (IKSANO).

1999 – Conclusion of an Agreement between UkSATSE and the EUROCONTROL Central Flow Management Unit (CFMU).

2000 – UkSATSE became the 33rd Member State of the International Federation of Air Traffic Safety Electronics Associations (IFATSEA).

2003 – UkSATSE initiated the creation of the Regional Air Navigation Services Development Association (RADA).

2004 – Ukraine became the 33rd Member State of EUROCONTROL. Experts from UkSATSE are fully engaged in EUROCONTROL activities.

2005 – Contract between SELEX Sistemi Integrati S.p.A. (Italy) and UkSATSE for the supply and installation of approach radars (Dnipropetrovsk, Kyiv, Lviv, Odesa, Simferopol).

2006 – Ukraine hosted the NATO Air Traffic Management Committee (NATMC) Plenary Session.

Name	Date of Founding	Date of Entrance
International aviation organisations, where Ukraine is a member		
ICAO	1944	1992
ECAC	1954	1999
EUROCONTROL	1963	2004
International aviation organisations, where UkSATSE is a member		
IFATCA	1961	1994
ATCA	1956	1997
CANSO	1998	1998
IKSANO	1999	1999
IFATSEA	1972	2000

Education

In Ukraine, aviation specialists are trained at several leading universities. The most notable ones include:

1. **Kyiv Aviation Institute (KAI)** – Formerly known as the National Aviation University (NAU), it is one of the leading institutions for aviation education in the country. It specialises in various aviation-related fields, including air traffic control, aviation engineering, and aerospace technologies. KAI also cooperates closely with civil aviation authorities worldwide and features a dedicated ICAO institute within its structure.
2. **State Flight Academy of Ukraine (Kirovograd Flight School)** – This academy is well-known for its pilot training programs and also offers courses in air navigation, flight operations, and aviation management.
3. **National Aerospace University "Kharkiv Aviation Institute" (KhAI)** – KhAI specializes in preparing professionals in aerospace research, aircraft manufacturing, aeronautical engineering, and related fields. It is also closely connected to the aerospace industry.

These universities are the primary institutions in Ukraine for obtaining an aviation degree. Kyiv Aviation Institute is recognized as the leader in higher aviation education in the country, with strong international collaboration. The State Flight Academy of Ukraine is renowned for pilot training, while Kharkiv Aviation Institute is noted for producing highly qualified specialists in aerospace and aviation engineering.

National Aviation Policy

Ukraine, with a large power-consuming economy and correspondingly high emissions of greenhouse gases, is committed to the prevention of global climate change.

The primary task of the Government of Ukraine is to create and implement a national policy aimed at fulfilling the obligations of Ukraine within the framework of international treaties.

The major legislative document of Ukraine regarding aviation activities is the Air Code of Ukraine, which has been in force since May 19, 2011 (No. 3393-VI). This code regulates, among other issues, environmental protection. The relevant chapter includes requirements regarding:

- the maximum acceptable level of aviation noise and air engine emissions, as established by the Aviation Rules of Ukraine;
- compensation for damage caused as a result of aviation activities;
- limitations and prohibitions for civil aircraft if they exceed the noise levels established by the Civil Aviation Authority;
- Limitations and prohibitions based on measures aimed at reducing noise levels at the airport and in its vicinity, including:
- technical noise reduction at the source;
- spatial zoning of the airport's adjacent territory and proper land-use planning;
- operational measures to reduce aircraft noise and emissions;
- the cost of measures aimed at reducing and preventing noise and emissions shall be funded by airport taxes, in accordance with ICAO recommendations.

Other Laws of Ukraine in environmental field:

- [June 26, 1991] "On Environmental Protection" June 26, 1991, No. 1268-XII.
- [October 16, 1992] "On Atmospheric Air Protection", October 16, 1992, No. 2708-XII.
- [February 09, 1995] "On Ecological Expertise, February 09, 1995 No. 46/95-VR.
- [February 24, 1994] "On Sanitary and Epidemiological Welfare of the Population" February 24, 1994, No. 4005-XII.
- [October 29, 1996] "Ukraine’s Law dated October 29, 1996, No. 435/96-VR "On the Ratification of the United Nations Framework Convention on Climate Change."
- [May 15, 2003] "On High-Dangerous Objects" May 15, 2003, No. 762-IV.
- [February 4, 2004] Ukraine’s Law dated February 4, 2004, No. 1430-IV "On the Ratification of the Kyoto Protocol to the United Nations Framework Convention on Climate Change."
- [August 18, 2005] Resolution of the Cabinet of Ministers of Ukraine dated August 18, 2005, No. 346 "On Approving the National Action Plan for the Implementation of the Kyoto Protocol to the United Nations Framework Convention on Climate Change."
- [September 12, 2005] Decree of the President of Ukraine dated September 12, 2005, No. N 1239 "On the Coordinator of Actions for the Implementation of Ukraine’s Commitments under the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the Framework Convention on Climate Change."
- [April 10, 2006] Resolution of the Cabinet of Ministers of Ukraine dated April 10, 2006, No. 468 "On the Procedure for Coordinating Actions for the Implementation of Ukraine’s Commitments under the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the Convention."
- [April 21, 2006] Resolution of the Cabinet of Ministers of Ukraine dated April 21, 2006, No. 554 "On Approving the Procedure for the Operation of the National System for Assessing Anthropogenic Emissions and Absorption of Greenhouse Gases Not Regulated by the Montreal Protocol on Substances that Deplete the Ozone Layer."
- [April 17, 2008] Resolution of the Cabinet of Ministers of Ukraine dated April 17, 2008, No. 392 "On Ensuring the Fulfillment of Ukraine’s International Obligations under the United Nations Framework Convention on Climate Change and the Kyoto Protocol."
- [May 28, 2008] Resolution of the Cabinet of Ministers of Ukraine dated May 28, 2008, No. 504 "On the Formation and Maintenance of the National Electronic Register of Anthropogenic Emissions and Absorption of Greenhouse Gases."
- [December21, 2010] "On the Main Strategy of State Ecological Policy of Ukraine for 2020" December21, 2010, No. 2818-VI.

- [March 23, 2011] Resolution of the Cabinet of Ministers of Ukraine dated March 23, 2011, No. 348 "On Approving the Procedure for the Use of Funds Provided in the State Budget for Measures Aimed at Reducing Greenhouse Gas Emissions (Increasing Absorption)."
- [October 17, 2011] Resolution of the Cabinet of Ministers of Ukraine dated October 17, 2011, No. 1056 "Certain Issues of Using Funds in the Area of Energy Efficiency and Energy Saving."
- [January 13, 2012] Order of the Ministry of Energy and Environmental Protection of Ukraine dated January 13, 2012, No. 8 "On Approving the Regulation for Establishing the Presence or Absence of Ozone-Depleting Substances in Goods Intended for Import or Export."
- [October 1, 2014] National Action Plan for Renewable Energy until 2020, approved by the Cabinet of Ministers of Ukraine on October 1, 2014, No. 902.
- [February 4, 2015] Order of the Ministry of Ecology and Natural Resources dated February 4, 2015, No. 7 "On the Creation of a Working Group on the Formation of National Climate Policy."
- [November 25, 2015] National Action Plan for Energy Efficiency until 2020, approved by the Cabinet of Ministers of Ukraine on November 25, 2015, No. 1228.
- [March 18, 2016] Order of the Ministry of Ecology and Natural Resources of Ukraine dated March 18, 2016, No. 104 "On the Establishment of the Ministry's Commission for the Distribution of the Quotas for Ozone-Depleting Substances Among Economic Entities."
- [December 7, 2016] Concept for the Implementation of State Policy on Climate Change for the Period until 2030, approved by the Cabinet of Ministers of Ukraine on December 7, 2016, No. 932.
- [May 23, 2017] Ukraine's Law dated December 18, 2017, No. 2059-VIII "On Environmental Impact Assessment."
- [August 18, 2017] Energy Strategy of Ukraine until 2035, approved by the Cabinet of Ministers of Ukraine on August 18, 2017, No. 605.
- [November 8, 2017] National Plan for Reducing Emissions from Large Combustion Plants, approved by the Cabinet of Ministers of Ukraine on November 8, 2017, No. 796.
- [November 8, 2017] National Waste Management Strategy in Ukraine until 2030, approved by the Cabinet of Ministers of Ukraine on November 8, 2017, No. 820.
- [December 6, 2017] Action Plan for Implementing the Concept of State Policy in Climate Change until 2030, approved by the Cabinet of Ministers of Ukraine on December 6, 2017, No. 878.
- [December 6, 2017] Low Carbon Development Strategy of Ukraine until 2050, approved by the Protocol Decision of the Cabinet of Ministers of Ukraine on July 18, 2018, No. 28.
- [May 30, 2018] National Transport Strategy of Ukraine until 2030, approved by the Cabinet of Ministers of Ukraine on May 30, 2018, No. 430.
- [July 18, 2018] Low Carbon Development Strategy of Ukraine until 2050, approved by the Protocol Decision of the Cabinet of Ministers of Ukraine on July 18, 2018, No. 28.
- [February 20, 2019] National Waste Management Plan until 2030, approved by the Cabinet of Ministers of Ukraine on February 20, 2019, No. 117.
- [February 28, 2019] Ukraine's Law dated February 28, 2019, No. 2697-VIII "Main Principles of State Environmental Policy of Ukraine until 2030."
- [August 14, 2019] Irrigation and Drainage Strategy in Ukraine until 2030, approved by the Cabinet of Ministers of Ukraine on August 14, 2019, No. 688.
- [December 12, 2019] Ukraine's Law dated December 12, 2019, No. 376-IX "On Regulation of Business Activities Related to Ozone-Depleting Substances and Fluorinated Greenhouse Gases."
- [December 12, 2019] Ukraine's Law dated December 12, 2019, No. 377-IX "On Principles of Monitoring, Reporting, and Verification of Greenhouse Gas Emissions."
- [January 24, 2020] Resolution of the Cabinet of Ministers of Ukraine dated January 24, 2020, No. 33 "On the Formation of an Interagency Working Group on Coordinating the Mitigation of Climate Change Consequences under the European Commission's 'European Green Deal' Initiative."
- [September 23, 2020] Resolution of the Cabinet of Ministers of Ukraine dated September 23, 2020, No. 877 "On Approving the Procedure for Decision-Making on Cross-Border Environmental Impact Assessment."

- [September 23, 2020] Resolution of the Cabinet of Ministers of Ukraine dated September 23, 2020, No. 879 "On the Formation of the Interagency Commission on Climate Change and Ozone Layer Protection."
- [September 23, 2020] Resolution of the Cabinet of Ministers of Ukraine dated September 23, 2020, No. 992 "On Certain Issues of Regulating Activities in the Field of Ozone Layer Protection."
- [September 23, 2020] Resolution of the Cabinet of Ministers of Ukraine dated September 23, 2020, No. 1086 "On Certain Issues of Issuing Certification Documents (Certificates) for Activities Defined in Part One of Article 10 of the Law of Ukraine 'On Regulation of Business Activities with Ozone-Depleting Substances and Fluorinated Greenhouse Gases'."
- [October 21, 2020] Action Plan for Implementing the Irrigation and Drainage Strategy in Ukraine until 2030, approved by the Cabinet of Ministers of Ukraine on October 21, 2020, No. 1567.
- [March 3, 2021] National Economic Strategy until 2030, approved by the Cabinet of Ministers of Ukraine on March 3, 2021, No. 179.
- [March 23, 2021] Decision of the National Security and Defense Council of Ukraine "On Challenges and Threats to National Security in the Environmental Sector and Urgent Measures for Their Neutralization" dated March 23, 2021. Implemented by Decree of the President of Ukraine dated March 23, 2021, No. 111/2021.
- [March 24, 2021] Resolution of the Cabinet of Ministers of Ukraine dated March 24, 2021, No. "On the Formation of a Working Group to Agree on the Application of the Carbon Border Adjustment Mechanism to Ukraine for Consultations with the European Commission."
- [April 7, 2021] Action Plan for Implementing the National Transport Strategy of Ukraine until 2030, approved by the Cabinet of Ministers of Ukraine on April 7, 2021, No. 321.
- [July 30, 2021] Updated Nationally Determined Contribution of Ukraine to the Paris Agreement (NDC2), approved with technical and legal adjustments by the Cabinet of Ministers of Ukraine on July 30, 2021, No. 868-p.

Joint Implementation Projects

- [22.02.2008] Cabinet of Ministers of Ukraine Resolution No. 221 of February 22, 2008 "On Approving the Procedure for Considering, Approving, and Implementing Targeted Environmental (Green) Investment Projects During the Period of Commitment by the Parties to the Kyoto Protocol to the United Nations Framework Convention on Climate Change."
- [28.05.2008] Cabinet of Ministers of Ukraine Resolution No. 504 of May 28, 2008 "On the Formation and Maintenance of the National Electronic Register of Anthropogenic Emissions and Greenhouse Gas Absorption."
- [2008] First signing of the "Covenant of Mayors" in Ukraine (Kamianets-Podilskyi city).

International Trade in Greenhouse Gas Emission Quotas

- [28.05.2008] Cabinet of Ministers of Ukraine Resolution No. 504 of May 28, 2008 "On the Formation and Maintenance of the National Electronic Register of Anthropogenic Emissions and Greenhouse Gas Absorption."
- [30.07.2008] Cabinet of Ministers of Ukraine Order No. 1028 of July 30, 2008 "On the Introduction into Circulation of Units (Parts) of the Established Quantity."
- [01.10.2008] Cabinet of Ministers of Ukraine Order No. 1294-p of October 1, 2008 "On Operations with Units (Parts) of the Established Quantity."
- [29.01.2009] Cabinet of Ministers of Ukraine Order No. 90 of January 29, 2009, on the Conclusion of a Contract between the National Agency for Environmental Investments of Ukraine and the Organization for the Development of New Energy and Industrial Technologies (Japan).
- [18.03.2009] Cabinet of Ministers of Ukraine Order No. 277 of March 18, 2009, on the Conclusion of Agreements for the Sale of Units of Established Quantity.
- [18.06.2009] Memorandum of Understanding between the National Agency for Environmental Investments of Ukraine and the Ministry of Environment, Land, and Sea of the Italian Republic on Cooperation in the Field of Climate Change, Development of Joint Implementation Projects, and

Participation in International Emission Trading under the Kyoto Protocol to the United Nations Framework Convention on Climate Change.

- [18.11.2009] Cabinet of Ministers of Ukraine Order No. 1388 of November 18, 2009, on the Conclusion of a Contract for the Purchase and Sale of Units (Parts) of Established Quantity between the National Environmental Investment Agency and the Ministry of Environment, Agriculture, and Fisheries of Spain.
- [27.06.2014] Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community, and their Member States, on the other hand.
- [16.09.2015] Expected Nationally Determined Contribution, approved by Cabinet of Ministers of Ukraine Order No. 980 of September 16, 2015, and submitted to the UNFCCC Secretariat on September 19, 2016.
- [12.12.2015] Paris Agreement.
- [14.07.2016] Law of Ukraine No. 1469-VIII of July 14, 2016 "On the Ratification of the Paris Agreement."
- [07.03.2018] Memorandum of Cooperation between the Ministry of Ecology and Natural Resources of Ukraine and the Institute of Space Research of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine of March 7, 2018.
- [23.09.2020] Cabinet of Ministers of Ukraine Resolution No. 880 of September 23, 2020 "On Approving the List of Activities Whose Greenhouse Gas Emissions Are Subject to Monitoring, Reporting, and Verification."
- [23.09.2020] Cabinet of Ministers of Ukraine Resolution No. 959 of September 23, 2020 "On Approving the Procedure for Verification of the Operator's Greenhouse Gas Emissions Report."
- [23.09.2020] Cabinet of Ministers of Ukraine Resolution No. 960 of September 23, 2020 "On Approving the Procedure for Monitoring and Reporting Greenhouse Gas Emissions."

The Convention on International Civil Aviation, signed at Chicago on 7 December 1944, hereinafter referred to as the "Chicago Convention," was ratified by Ukraine on 10 August 1992. Ukraine is obligated to implement and enforce the provisions of the Convention, as well as the standards set out in its annexes.

The United Nations Framework Convention on Climate Change (UNFCCC) was ratified by the Verkhovna Rada of Ukraine on 29 October 1996. The objective of the treaty is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Ukraine is listed among Annex I countries, which have ratified the Protocol and committed to reducing their greenhouse gas emissions to levels mainly below their 1990 levels. They may do this by allocating reduced annual allowances to major operators within their borders. Ukraine has adopted a list of regulations concerning the prevention of climate change, including the Law of Ukraine "On Atmospheric Air Protection" (16 October 1992, No. 2708-XII).

The Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted by Ukraine on 4 February 2004.

The Committee on Aviation Environmental Protection (CAEP) is a key body within ICAO, responsible for addressing aviation environmental issues. CAEP was established by the Council in 1983, replacing the previous Committee on Aircraft Noise (CAN) and the Committee on Aircraft Engine Emissions (CAEE).

CAEP assists the Council in formulating new policies and adopting new standards related to aircraft noise and engine emissions.

Ukraine is a member of CAEP and actively participates in working groups and steering committees.

STATE AVIATION ADMINISTRATION OF UKRAINE

National Airlines Network

Number of aircraft included in valid approvals, as of February 2025 and operated, (Part-CAT and Part-SPO) in accordance with the requirements of the Aviation Regulations of Ukraine "Technical requirements and administrative procedures for flight operations in civil aviation", approved by the order of the State Aviation Service of Ukraine dated July 5, 2018 No. 682, registered with the Ministry of Justice of Ukraine on September 27, 2018 under No. 1109/32561:

№	AIR OPERATORS
1	LLC "Aviation company "Windrose"
2	LLC "Aviation company "Zetavia"
3	PJSC "INTERNATIONAL JOINT-STOCK AVIATION COMPANY "URGA"
4	LLC "SKYLINE EXPRESS"
5	ANTONOV AIRLINES
6	PJSC "AIRLINE "UKRAINE-AEROALLIANCE"
7	State Aviation Enterprise "UKRAINE"
8	LLC "MAXIMUS AIRLINES"
9	PJSC "MOTOR SICH"
10	LLC "KAVOK AIR"
11	PJSC "Constanta Airlines"
12	LTD "YANEIR".
13	LLC "VULCAN AIR"
14	LLC "SKYUP AIRLINE"
15	LLC "SUPERNOVA AIRLINES"
16	LLC "Airline "Prominterservice"
17	LLC "RS AVIA"
18	PJSC "Aviation Company Ukrainian helicopters"
19	LLC "GLOBAL AIR COMPANY"
20	LLC "AIR TAURUS"
21	LLC "KSENA"
22	LLC "NZOPERATIONS" "
23	PJSC "COLUMBUS Airline"
24	LLC "AIR COMPANY "UKRAGROAVIA"
25	LLC "HORIZONT"
26	LLC "Meridian Avia Agro"

STATE AVIATION ADMINISTRATION OF UKRAINE

National Airports network of Ukraine

№	AIRPORTS
1	Boryspil International Airport
2	Dnipro International Airport
3	Kyiv International Airport (Zhuliany)
4	Ivano-Frankivsk International Airport
5	Kryvyi Rih International Airport
6	Lviv Danylo Halytskyi International Airport
7	Zaporizhzhia International Airport
8	Zhytomyr International Airport
9	Odesa International Airport
10	Chernivtsi Leonid Kadeniuk International Airport
11	Rivne International Airport
12	Kharkiv International Airport
13	Sumy Airport
14	Ternopil Airport
15	Vinnytsia Airport
16	Cherkasy Airport
17	Poltava Airport
18	Kherson Airport
19	Uzhhorod International Airport
20	Mykolaiv International Airport

Economic information related to the contribution of international aviation

In recent years there has been a significant decline in the overall performance of the aviation industry in Ukraine.

Since the beginning of the full-scale military aggression of the Russian Federation against Ukraine, its sovereignty, territorial integrity, and citizens, the air space of Ukraine has been closed for civil aircraft since February 24th, 2022, and air traffic has been suspended.

Russia conducted active missile attacks against all key Ukrainian airfields. As a result, 19 out of 35 airfields were damaged, including 12 civilian ones and 7 combined ones (not taking into account military airfields). Some airfields were subjected to repeated attacks. Similarly to the situation with roads, detailed information regarding the state of damage/repair capabilities of airfields in most airports can be established only after thorough technical surveys, which, in turn, are possible only after the end of active armed hostilities in the area where the airports are located (this pertains to those located in the central, southern, eastern, northern parts of Ukraine). However, according to preliminary estimates, the total amount of damage made to the aviation industry (airports, airfields, aviation equipment) is about 57.3 billion UAH.

A comparable amount is also made up of indirect losses, which the industry has suffered from military operations because, since the beginning of the full-scale invasion, the activities of the entire civil aviation industry were practically suspended; income from passenger traffic was completely ceased. According to preliminary estimates, the total indirect losses, that the industry has suffered since the beginning of the full-scale invasion, are equaled to 154.7 billion UAH, 13.6 billion UAH of which are losses of airports, 125.2 billion UAH – losses of airlines, 7.4 billion UAH – losses of the Ukrainian State Air Traffic Services Enterprise (UkSATSE), 8.4 billion UAH – losses of other business entities performing commercial activities at airports.

In connection with the introduction of the legal regime of martial law on the territory of Ukraine, and in accordance with Part Two of Article 9 of the Law of Ukraine 'On the Legal Regime of Martial Law,' Subparagraph 1 of Clause 1 of the Law of Ukraine 'On the Legal Regime of Martial Law,' the Law of Ukraine 'On Protection of the Interests of Subjects of Reporting and Other Documents during a State of War or Martial Law,' Article 11 of the Air Code of Ukraine, and the Regulations on State Aviation Administration of Ukraine, approved by the Resolution of the Cabinet of Ministers of Ukraine dated October 8, 2014, No. 520, the statistical information specified above remains unchanged.

With the objective of reducing the negative impact of aviation on the environment, specifically CO2 greenhouse gas emissions, Ukraine joined the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) in 2016, in accordance with the 39th Assembly Resolutions of the International Civil Aviation Organization (ICAO).

Paragraph 5 of Resolution 39-3 of the Assembly requested the introduction of a global market-based scheme for the establishment of the International Aviation Carbon Offsetting and Reduction Scheme (CORSIA), to review the annual total CO2 emissions from international civil aviation.

Currently, a preparatory stage for the implementation of CORSIA programs is underway, with the introduction of monitoring, reporting, and verification (MRV) systems for Ukrainian operators (airlines). To support this, the State Aviation Administration of Ukraine developed and approved the Aviation Rules of Ukraine "Technical Requirements and Administrative Procedures for Monitoring Emissions of Civil Aircraft Services," dated 02.08.2019, No. 1001.

The goal of ensuring the environmental safety of civil aviation is essentially to minimize the harmful effects of its activities while maintaining a balance between the natural environment and the sustainable opportunities for aviation activities.

In line with this proposal, and to ensure compliance with Article 10 and Section X of the State Code of Ukraine, the State Aviation Administration of Ukraine will take measures to implement and maintain balanced accounting for flight safety and environmental protection requirements.

The use of aerodromes is required to ensure flight safety and environmental protection, as well as to implement elements of environmental management systems (EMS) in accordance with the international standard DSTU ISO 14001:2015.

CO_2 EMISSIONS INVENTORIES, FORECASTS AND BASELINE CALCULATION

INTERNATIONAL AVIATION CO_2 EMISSIONS INVENTORIES

Ukraine ratified the United Nations Framework Convention on Climate Change on October 29, 1996, as an Annex I country. One of the commitments of the parties to the Convention is to compile national inventories of their emission sources.

For domestic flights, emissions are considered part of the national inventory of the country in which the flights occur. For international flights, inventories are also calculated and reported to the UNFCCC under the terminology "emissions from international aviation bunker fuels."

As per the ICAO Assembly Resolutions, the CO2 emissions generated by international flights are calculated and reported to ICAO.

Ukraine also adopted the Kyoto Protocol to the United Nations Framework Convention on Climate Change in 2004.

As a result, the calculation of the Baseline for Ukraine has been based on the available information from the National Inventories reported to the UNFCCC, and provided by the Ministry of Ecology and Natural Resources of Ukraine. The methodology used for the calculation of these inventories follows the IPCC 2006 Guidelines for National Greenhouse Gas Inventories.

Since Ukraine has established this systematic method to estimate, report, and verify GHG emissions, these procedures will be used to ensure that the estimation, reporting, and verification of CO2 emissions in its action plan are undertaken in accordance with the ICAO Guidance on States' Action Plans, Appendix E recommendations.

CO_2 EMISSIONS INVENTORIES METHODOLOGY (UNFCCC)

Emissions estimation was conducted separately for aircraft with jet and turboprop engines, which use jet fuel, and for those equipped with piston engines, which use aviation gasoline.

For estimating emissions from aircraft equipped with jet and turboprop engines, a corresponding method was used.

In recent years, there has been a significant reduction in the basic performance of the aviation industry. The main factors that led to the decline in demand for air travel and caused the subsequent breakdown of the current economic situation are as follows: the military-political situation in the country, the annexation of Crimea, safety recommendations from international organizations and the EU regarding the avoidance of that area of Ukraine by using alternative airspace routes. Several national airports have not been operational for the entire year, and many airlines have significantly reduced their route networks.

Separation of Aircraft Emissions

Emissions from domestic aviation include all emissions from aircraft flights where both the departure and arrival airports are located within the territory of Ukraine. Emissions from international aviation include emissions from flights where the departure airport is located in Ukraine, and the destination airport is located outside Ukraine.

Calculation of Aircraft Emissions

Data based on aircraft departures from airports situated within the territory of Ukraine were used. The data on flights includes the following information for each flight:

- date and time of the flight
- departure and destination points
- airline;
- aircraft code according to ICAO.

The assessment of aircraft emissions was conducted in two steps: preliminary data processing and aircraft emissions calculation.

Estimation of aircraft emissions was carried out in accordance with the detailed methodology of EMEP/CORINAIR, which corresponds to Tier 2b.

Fuel Consumption:

Fuel consumption per LTO (Landing and Take-Off) cycle was taken according to the EMEP/CORINAIR methodology, and fuel consumption during cruise was calculated based on the flight length.

The length of the flight was defined as the orthodromic distance between the departure and destination points, with consideration given to the deflection coefficient of the actual flight path compared to the orthodromic distance. The deflection coefficient was set at 1.095.

To recalculate jet fuel consumption from mass units to energy units, as outlined in the EMEP/CORINAIR methodology, a lower heating value of 44.59 MJ/kg was used.

TRAFFIC FORECASTS

Annual IFR Movements and 2011-2021 average annual growth.

	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**AAGR 2021/ 2014**
H	-	-	-	-	135	133	147	163	178	194	211	-5,5%
B	453	466	494	312	132	128	138	149	160	171	183	-7,4%
L	-	-	-	-	130	122	128	136	144	151	158	-9,2%

Annual growth rates and 2011-2021 average annual growth.

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	AAGR 2021/ 2014
H	-	-	-	-	-57%	- 1,6%	11,0 %	10%	9,4 %	9,2 %	8,3 %	-5,5%
B	5,5%	2,9 %	6,0 %	-37%	-58%	- 3,5%	8,0 %	8,2 %	7,3 %	7,2 %	6,5 %	-7,4%
L	-	-	-	-	- 5,8%	- 5,8%	5%	6,2 %	5,4 %	5,3 %	4.7 %	-9,2%

BASELINE CALCULATION AND EXPECTED RESULTS

Consistency with CORSIA: icao.int

To align with the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), it is advisable to adopt a consistent methodology throughout the State Action Plan. This includes using data reported under CORSIA for both baseline calculations and the evaluation of implemented measures.

CORSIA's approach involves comparing total CO_2 emissions for a year against a baseline level of CO_2 emissions. Originally, the CORSIA baseline was set as an average of 2019 and 2020 emissions from international aviation. However, due to the COVID-19 pandemic's impact on air travel, adjustments have been made. For the years 2021-2023, the baseline is the CO_2 emissions from international aviation for the year 2019. For the years 2024-2035, the baseline is 85% of CO_2 emissions from international aviation for the year 2019.

By adopting the CORSIA methodology, Ukraine can ensure consistency in its emissions reporting and align with international standards, facilitating more accurate assessments of the effectiveness of implemented measures.

For further guidance on developing State Action Plans and aligning with CORSIA, ICAO provides comprehensive resources and tools.

In 2022, the International Civil Aviation Organization (ICAO) made significant adjustments to the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) baseline emissions:

Pilot Phase (2021–2023) The baseline was set as the average of total CO_2 emissions from international aviation in 2019 and 2020.

Post-Pilot Phase (2024–2035) The baseline was revised to 85% of the 2019 CO_2 emissions.

As of 2023, ICAO reported that CO_2 emissions from international aviation had risen to approximately 530 million tonnes, a 23.5% increase from 2022 levels.

This upward trend indicates that emissions are approaching pre-pandemic levels, which may influence future offsetting requirements under CORSIA.

The State Aviation Administration of Ukraine has decided to calculate a baseline as a key component of its action plan to estimate the levels of fuel consumption, CO2 emissions, and air traffic (expressed in RTK) that can be expected in the time horizons of 2020 and 2025. This 'business as usual' scenario will serve as the reference for estimating the expected results once the measures outlined in the Action Plan are implemented, representing the projected fuel consumption and CO2 emissions to be achieved.

To calculate the baseline for evaluating the Action Plan measures, an average annual growth of air traffic (RTK) of 5.3% from 2010 to 2020 and 4.5% from 2020 to 2025 has been estimated, based on the EUROCONTROL forecasts mentioned in the previous paragraph.

Please note that the Ukraine baseline calculation is for informational purposes and will be used to compare with the estimated benefits of measures implemented at the national level. Ukraine is also considered in the ECAC baseline and its scenarios, as presented below.

Methodological approach

The baseline calculation is based on the extrapolation of past trend data in order to determine future levels of fuel consumption and traffic, and through the calculation of a *Fuel Efficiency Metric*, following the recommendations of the *ICAO Guidance Material for the Development of States Action Plans*.

Historic data sources:

Historic data on fuel consumption have been taken from the official National Emissions Inventory, as described above.

Historic traffic data expressed in RTK have been taken from the ICAO database provided through the APER Website.

Fuel efficiency metric:

Following the ICAO Guidance, the fuel efficiency metric expresses the rate of efficiency improvement over time, and its calculation is based on the following metric:

Fuel efficiency = Volume of fuel/RTK (1)

This metric is an indicator of the efficiency of fuel usage (in liters) per tonne of revenue load carried, including (passengers, freight and mail).

METHOD 3 OF ICAO GUIDANCE

Following ICAO Guidance Method 3, the baseline for Ukraine has been calculated as follows:

1. Obtain fuel consumption data (volume of fuel) and traffic (RTK) for the latest available years.
2. Determine the RTK future scenarios by considering EUROCONTROL Ukrainian forecasts.
3. Determine the projected volume of fuel for the 2010-2025 scenarios, assuming the same growth rate as for the RTK as follows:

Volume of fuel year n+1 = Volume of fuel year n x (1 + RTK growth)

Such methodology is equivalent to apply the following formula:

$$\textbf{Volume of fuel}_{\text{year } n+1} = \textbf{efficiency factor}_{\text{year } n} * \textbf{RTK}_{\text{year } n+1}$$

To estimate CO_2 emissions expressed in Kg from fuel consumption expressed in L, a **0'8 Kg/L** density has been considered.

Then the expected results will be estimated though subtracting the fuel gains due to additional measures to the projected fuel consumption.

On the following tables, the baseline calculation results for both international and total fuel and CO_2 emissions are presented.

STATE AVIATION ADMINISTRATION OF UKRAINE

ICAO GUIDANCE METHOD 3 BASELINE CALCULATION FOR UKRAINE:

ICAO.INT

In 2022, the International Civil Aviation Organization (ICAO) adopted a Long-Term Global Aspirational Goal (LTAG) aiming for net-zero carbon emissions in international aviation by 2050.

This goal encourages States to align their action plans with the 2050 target, allowing for the inclusion of measures up to that year.

The LTAG emphasizes that each State's contribution should consider its unique circumstances and capabilities, ensuring that efforts are both effective and equitable.

By extending the baseline calculation to 2050, States can develop more comprehensive and forward-looking strategies to achieve the net-zero target, incorporating a wide range of measures and technologies.

This approach aligns with the global commitment to sustainable aviation and supports the broader objectives of the United Nations Framework Convention on Climate Change (UNFCCC).

INTERNATIONAL FUEL CONSUMPTION (L) AND EMISSIONS (Kg CO_2)

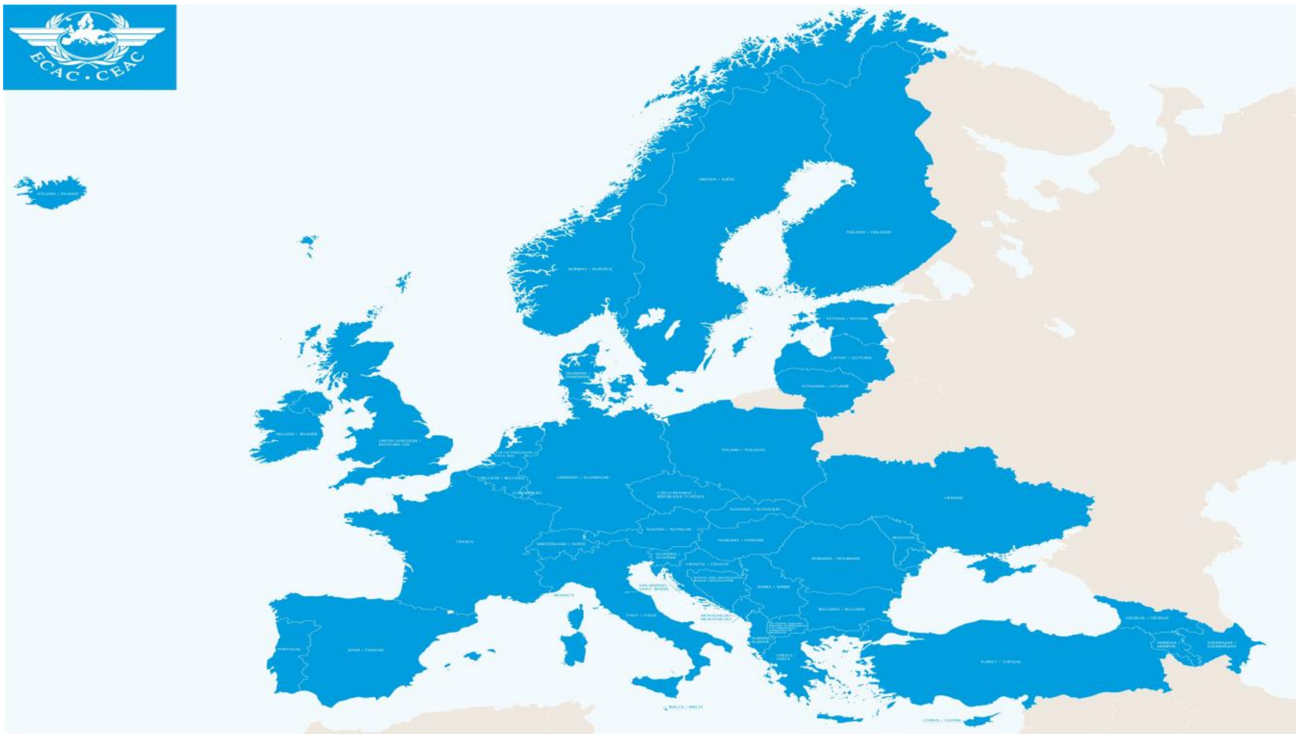
TRAFFIC FORECAST		INTERNATIONAL			
	YEAR	**l Fuel**	**RTK**	**Efficiency factor**	**Kg CO_2**
	1990	937589480,98			2367983857,79
	1991	809579320,41			2044680322,48
	1992	681569159,83			1721376787,17
	1993	553558999,26			1398073251,86
	1994	425548838,69			1074769716,55
	1995	297538678,12			751466181,24
	1996	169528517,54			428162645,93
	1997	164471246,66			415389960,17
	1998	157070458,28			396698466,96
	1999	143894984,92			363422380,92
	2000	142596898,65	169711000,00	0,84023	360143923,36
	2001	143233302,30	179197000,00	0,79931	361751229,74
	2002	161260007,82	176824000,00	0,91198	407279628,43
	2003	188277627,95	266708000,00	0,70593	475515556,44
	2004	228262656,79	538749000,00	0,42369	576502080,68
	2005	252620569,70	772859000,00	0,32687	638020629,86

	2006	298103052,02	894011000,00	0,33344	752891568,71
	2007	338146812,07	1078059000,00	0,61920	854026424,99
	2008	369670574,77	1203276000,00	0,58585	933643104,50
	2009	324352159,57	1268003000,00	0,60690	819186534,93
5,30%	2010	353259388,59	659 728 283,00	0,53546	892191911,81
	2011	314163830,28	941 321 646,00	0,33375	793452169,75
	2012	289971227,70	1 002 460 838,00	**0,28926**	732351332,68
	2013	204044379,25	705 402 743,00		515334484,23
	2014	200167509,75	692 000 000,00		505543062,64
-58,00%	2015	84070354,10	290 640 000,00		212328086,31
-3,50%	2016	81127891,70	280 467 600,00		204896603,29
8,00%	2017	87618123,04	302 905 008,00		221288331,55
8,20%	2018	94802809,13	327 743 218,66		239433974,74
7,30%	2019	101723414,20	351 668 473,62		256912654,89
7,20%	2020	109047500,02	376 988 603,72		275410366,05
6,50%	2021	116135587,52	401 492 862,96		293312039,84
5,10%	2022	122058502,48	421 968 998,97		308270953,87
	2023	128283486,11	443 489 417,92		323992772,52
	2024	134825943,90	466 107 378,23		340516403,92
	2025	141702067,04	489 878 854,52		357882740,52

TOTAL FUEL CONSUMPTION (L) AND EMISSIONS (Kg CO_2)

TRAFFIC FORECAST	**TOTAL**				
	YEAR	**l Fuel**	**RTK**	**Efficiency factor**	**Kg CO_2**
	1990	1.253.570.808,76			3.166.018.435
	1991	1.051.050.179,16			2.654.532.332
	1992	864.639.226,18			2.183.732.830
	1993	691.682.537,23			1.746.913.416
	1994	529.707.437,40			1.337.829.104
	1995	376.684.391,49			951.354.099
	1996	227.934.945,64			575.672.499
	1997	210.781.075,04			532.348.683
	1998	202.749.280,48			512.063.583
	1999	186.582.480,61			471.232.713
	2000	182.631.282,99	184.586.000,00	0,98941	461.253.568
	2001	183.681.857,73	195.209.000,00	0,94095	463.906.900
	2002	208.457.269,78	190.424.000,00	1,09470	526.479.681
	2003	251.053.205,65	288.817.000,00	0,86925	634.059.976

	2004	301.762.175,29	588.180.000,00	0,51304	762.130.550
	2005	322.528.267,45	827.229.360,00	0,38989	814.577.392
	2006	376.429.744,44	935.686.000,00	0,40230	950.710.963
	2007	422.689.385,69	581 105 187,00	0,72739	1.067.544.313
	2008	452.939.714,20	655 000 000,00	0,69151	1.143.944.542
	2009	381.370.433,69	596 000 000,00	0,63988	963.189.167
5,30%	2010	409 338 031,36	***703 000 000,00***	0,58227	1 033 824 132
	2011	401 418 072,97	***992 000 000,00***	0,40466	1 013 821 485
	2012	376 636 412,20	***1 062 000 000,00***	**0,35465**	951 232 923
	2013	272 015 186,59	***767 000 000,00***		687 001 555
	2014	254 637 423,69	***718 000 000,00***		643 112 277
-58,00%	2015	106 947 717,95	***301 560 000,00***		270 107 156
-3,50%	2016	103 204 547,82	***291 005 400,00***		260 653 406
8,00%	2017	111 460 911,65	***314 285 832,00***		281 505 678
8,20%	2018	120 600 706,40	***340 057 270,22***		304 589 144
7,30%	2019	129 404 557,97	***364 881 450,95***		326 824 152
7,20%	2020	138 721 686,15	***391 152 915,42***		350 355 491
6,50%	2021	147 738 595,74	***416 577 854,92***		373 128 597
5,10%	2022	155 273 264,13	***437 823 325,52***		392 158 156
	2023	163 192 200,60	***460 152 315,12***		412 158 222
	2024	171 515 002,83	***483 620 083,19***		433 178 291
	2025	180 262 267,97	***508 284 707,44***		455 270 384



ECAC BASELINE SCENARIO AND ESTIMATED BENEFITS OF 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, 2023) 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 'Base' scenario, corresponding to the most-likely scenario, while corresponding fuel consumption and CO_2 emissions assume the technology level of the year 2023 (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 'Base'

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 Aviation Long-Term Outlook to 2050[1] has been published in 2024 and inspects traffic development in terms of Instrument Flight Rule (IFR) movements to 2050.

In the latter, the scenario called ‘Base’ is constructed as the ‘most likely’ scenario for traffic, most closely following the current trends. It considers a moderate economic growth with regulation reflecting environmental, social and economic concerns to address aviation sustainability. This scenario follows both the current trends, and what are seen as the most likely trends into the future.

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

- **Global economy** factors represent the key economic developments driving the demand for air transport.
- Factors characterizing 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.
- **Market structure** considers a detailed analysis of the fleet forecast and innovative projects, hence the future size of aircraft used to satisfy the passenger demand (modelled via the Aircraft Assignment Tool).

Table 1 below presents a summary of the social, economic and air traffic related characteristics of three different scenarios developed by EUROCONTROL. The year 2023 served as the baseline year of the 30-year forecast results[2] (published in 2024 by EUROCONTROL). Historical data for the year 2010 and 2019 are also shown later for reference.

Table 1. Summary characteristics of EUROCONTROL scenarios

	High	***Base***	*Low*
7-year flight forecast 2024-2030	High ↗	Base →	Low ↘
Passenger			
Demographics (Population)	Aging UN Medium-fertility variant	Aging UN Medium-fertility variant	Aging UN Zero-migration variant
Routes and Destinations	Long-haul ↗	No Change →	Long-haul ↘
High-Speed&Night trains (new & improved connections)	32 HST/29 NT city-pairs faster implementation	31 HST/29 NT city-pairs	26 HST city-pairs later implementation.
Economic conditions			
GDP growth	Stronger ↗	Moderate →	Weaker ↘↘
EU Enlargement	+7 States, Later	+7 States, Earliest	+7 States, Latest
Free Trade	Global, faster	Limited, later	None
Price of travel			
Operating cost	Decreasing ↘↘	Decreasing ↘	No change →
Price of CO_2 in Emission Trading Scheme	Moderate, increasing ↗	Moderate, increasing ↗	Moderate, Increasing ↗
Price of oil/barrel	Moderate	Moderate	High
Price of SAF	Relatively High ↗	Relatively High ↗	Highest ↗↗
Structure Network	Hubs: Mid-East ↗↗ Europe ↘ Türkiye ↗ Point-to-point: N-Atlantic. ↘	Hubs: Mid-East ↗↗ Europe & Türkiye ↗ Point-to-point: N-Atlantic ↗, European Secondary Airports. ↗	No change →
Market Structure	Industry fleet forecast, Clean Aviation and STATFOR assumptions	Industry fleet forecast, Clean Aviation and STATFOR assumptions	Industry fleet forecast, Clean Aviation and STATFOR assumptions
Fuel mix	In line with ReFuelEU Aviation (2%SAF in 2025 to 70% in 2050)	In line with ReFuelEU Aviation (2% SAF in 2025 to 70% in 2050)	5 years behind ReFuelEU Aviation (0.5%SAF in 2025 to 42% in 2050)

Update of the EUROCONTROL Aviation Long-Term Outlook to 2050

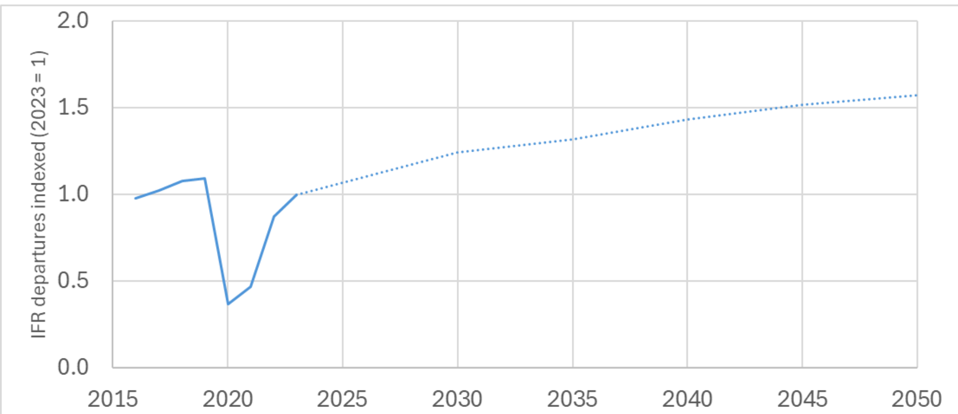
In November 2023, EUROCONTROL started to work on an update of its EUROCONTROL Aviation Long-Term Outlook to 2050 (EAO). It is an update of the previously published EAO[3] (April 2022), covering the long-term flights and CO_2 emissions forecast to 2050, which was based on 2019 historical flight data. The 2024 edition of the EAO forecast is now based on the latest available actual flight data (2023) and uses the EUROCONTROL seven-year forecast (2024-2030). It includes a complete review of the fleet forecast assumptions as well as a review of other inputs: high-speed rail network development, impact of Sustainable Aviation Fuels (SAF) mandate, jet fuel and CO_2 allowances on ticket prices, as well as future airport capacity constraints.

EUROCONTROL also provides an update of its modelling framework and traffic environmental assessment with the IMPACT model including:

- an updated technological freeze baseline operations forecast using only growth and replacement in-production aircraft in the baseline year (traffic and fleet baseline scenario) from 2023 to 2050;
- an updated baseline passenger data (Eurostat). Additional data sources may be required to cover the ECAC region;
- Latest versions of the Aircraft Noise and Performance (ANP) database, BADA, ICAO Aircraft Engine Emissions Database (AEEDB), - versions of March 2024;
- Updated assumptions on future technologies, operational efficiency, SAF (e.g. based on the CAEP/13 Environmental Trends complemented with information on emerging technologies).

Figure 1 below shows the ECAC scenario of the passenger flight forecasted international departures for both historical (solid line) and future (dashed line) years.

Figure 1. Updated EUROCONTROL 'Base' scenario of the passenger flight forecast for ECAC international departures from 2024 to 2050.



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[4] from ECAC airports, as forecasted in the aforementioned traffic 'Base' scenario. The number of passengers per flight is derived from Eurostat data.

EUROCONTROL also generates a forecast for 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[5]). 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[6] data warehouse used by EUROCONTROL, including the actual flight distance and the cruise altitude by airport pair. These calculations were made with a subset of total passenger traffic (with available and usable information in the flight plans) covering 98% in 2010, and 99% in 2019 and 2030. 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 2023 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 use the technology level of 2023. The usable forecast passenger traffic for calculation represents 99.7% of the total available passenger traffic.

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 available passenger estimation datasets (Scheduled, Low-cost, Non-Scheduled flights, available passenger information, etc.) these results are determined for 96% of the historical passenger traffic in 2010, 97% in 2019, 99% in 2023, and around 99% of the passenger flight forecasts.

From the RPK values, the passenger flights RTK can be calculated as the number of tonnes carried by kilometres, assuming that one 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. Therefore, the fuel efficiency can only be calculated for city pairs for which the fuel burn and the RPK values exists[7].

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.

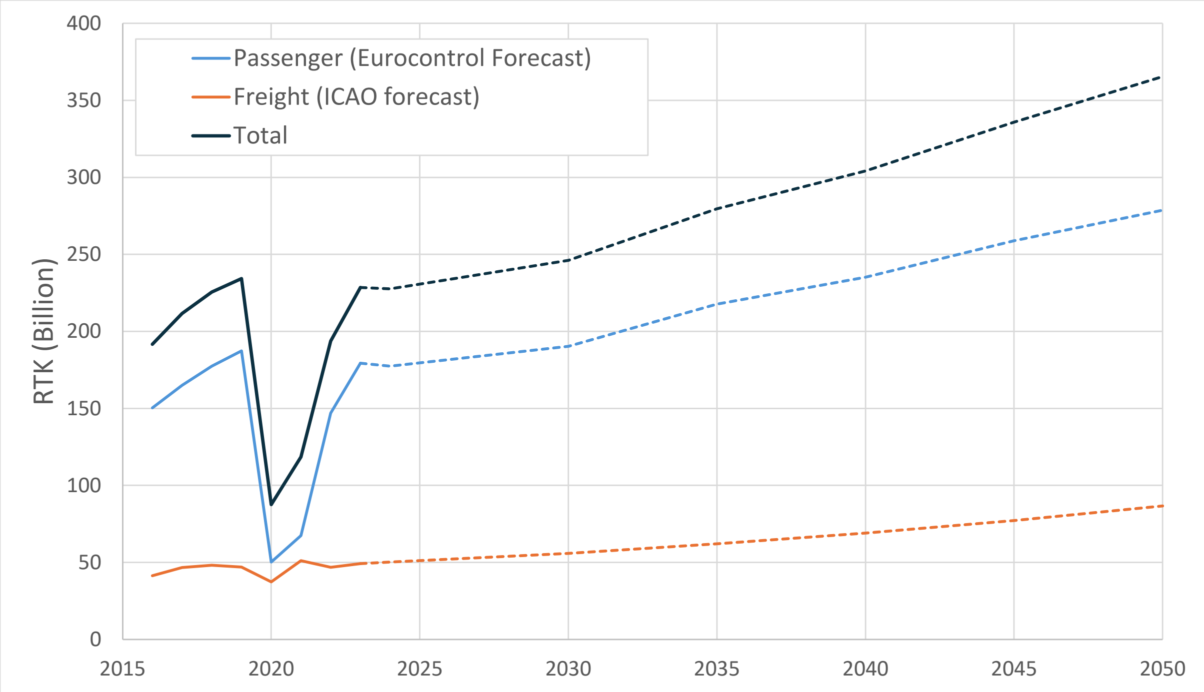
Table 2. Baseline forecast for international traffic departing from ECAC airports

Year	Passenger Traffic (IFR movement) (million)	Revenue Passenger Kilometres[8] RPK (billion)	All-Cargo Traffic (IFR movements) (million)	Freight Tonne Kilometres transported[9] FTKT (billion)	Total Revenue Tonne Kilometres[10] RTK (billion)
2010	4.71	1,140	0.198	41.6	155.6
2019	5.88	1,874	0.223	46.9	234.3
2023	5.38	1,793	0.234	49.2	228.5
2030	6.69	2,176	0.262	55.9	273.5
2040	7.69	2,588	0.306	69.0	327.8
2050	8.46	2,928	0.367	86.7	379.5

Table 3. Fuel burn and CO_2 emissions forecast for the baseline scenario

Year	Fuel Consumption (10^9kg)	CO_2 emissions (10^9kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	38.08	120.34	0.0327	0.327
2019	53.30	168.42	0.0280	0.280
2023	48.41	152.96	0.0268	0.268
2030	54.46	172.10	0.0250	0.250
2040	62.19	196.52	0.0240	0.240
2050	69.79	220.54	0.0238	0.238
For reasons of data availability, results shown in this table do not include cargo/freight traffic.				

Figure 2. Forecasted traffic until 2050 (assumed both for the baseline and implemented measures scenarios)



Although data are not shown in **Table 2**, the number of flights between 2019 and 2023 in **Figure 2** is reflecting the impact of the COVID-19 starting in 2020. If the passenger segment has been drastically affected by the outbreak, the freight segment seemed more immune.

As detailed by the **Table 3**, from 2010 to 2019, the CO_2 emissions increased from 120 to 168 million tonnes, corresponding to an annual growth rate of 3.8%. In 2023, due to the impact of the COVID-19 crisis on the traffic, the CO_2 emissions were lower than the 2019 level, with 153 million tonnes. For the forecast years, the estimated CO_2 emissions of the ECAC Baseline scenario would increase from 172 million tonnes in 2030 to 220 million tonnes in 2050 (corresponding to annual growth rate of 1.25%).

The fuel efficiency improvement is expected to be less important in the forecast years (annual growth rate of 0.4% between 2023 and 2050) than between 2010 and 2023 (1.5% per year), mainly due to the entry into service of the new generation aircraft families (e.g. MAXs, NEOs).

2. ECAC Scenario with Implemented Measures: Estimated Benefits

To improve fuel efficiency and to reduce future air traffic emissions beyond the projections in the baseline scenario, ECAC States have taken further action. Assumptions for a top-down assessment of the 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 chapters.

For reasons of simplicity, the scenario with implemented measures is based on the same traffic volumes as the baseline case, i.e. updated EUROCONTROL's 'Base' scenario described earlier. Unlike in the baseline scenario, the effects of aircraft-related technology development and improvements in ATM/operations as well as SAF 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 the fuel efficiency improvements of the expected future aircraft types with conventional engines (e.g. Boeing

777X, reengineered Airbus A321Neo, etc..) and powered by hybrid electric and hydrogen engines. The simulated future fleet of aircraft has been generated using the Aircraft Assignment Tool[11] (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.

This technical improvement is modelled by a constant annual improvement of fuel efficiency of 1.16% per annum is assumed for each aircraft type, with entry into service from 2024 onwards. This rate of improvement corresponds to the 'Advanced' fuel technology scenario used by CAEP to generate the fuel trends for the Assembly. This modelling methodology is applied to the years 2030 to 2050. In addition, the entry into service of hybrid electric and hydrogen aircraft types in the traffic induce a percentage of baseline fuel consumption reduction ramping up from 0% in 2035 to 5% in 2050.

The effects of improved **ATM efficiency** are captured in the Implemented Measures Scenario based on the European ATM Master Plan, managed by SESAR 3. This document defines a common vision and roadmap for ATM stakeholders to modernise and harmonise European ATM systems, including an aspirational goal to reduce average CO_2 emission per flight by 5-10% (0.8-1.6 tonnes) by 2035 through enhanced cooperation. Improvements in ATM system efficiency beyond 2023 were assumed to bring reductions in full-flight CO_2 emissions gradually ramping up to 5% in 2035 and 10% in 2050. These reductions are applied on top of those coming from aircraft/engine technology improvements.

The yet un-estimated benefits of Exploratory Research projects[12] are expected to increase the overall future fuel savings.

While the effects of **introduction of SAF** were modelled in previous updates on the basis of the European ACARE goals[13], the expected SAF supply objectives for 2020 were not met. In the current update, the SAF benefits are modelled as a European regional common measure applied to the EU27+EFTA international traffic. It assumes that the minimum shares of SAF laid down in ReFuelEU Aviation Regulation would be met in the base scenario. According to the Regulation, the percentage of SAF used in air transport gradually ramps from 2% in 2025, up to 20% in 2035 and 70% in 2050. A decarbonation factor value of 70% of CO_2 emissions is expected for synthetic aviation fuels and 65% for aviation biofuels. As the SAF-related calculations can only be applied for countries that are expected to implement regional regulations (e.g. ReFuelEU Aviation), **the tank-to-wake Net CO_2 emissions are reported in the Appendix A of this document for EU27+EFTA international traffic only**.

However, numerous initiatives related to SAF (e.g. ReFuelEU Aviation) are largely described in **Section B Chapter 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 explicitly in the top-down assessment of the implemented measures scenario presented here. CORSIA aims for carbon-neutral growth (CNG) of aviation, and this target is therefore shown in **Figure 4**[14].

The EU ETS quantifications are described in more details in Section B Chapter 4.

Tables 4-6, **Figure 3** and **Figure 4** summarize the results for the scenario with implemented measures. It should be noted that **Table 4** and **Table 6** show 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).

Figure 3. Fuel consumption forecast for the baseline and implemented measures scenarios (international passenger flights departing from ECAC airports).

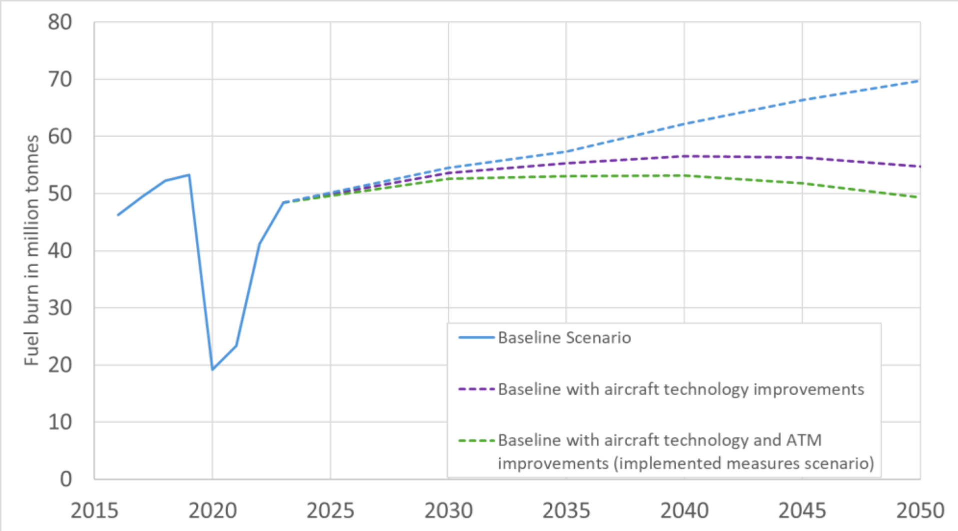
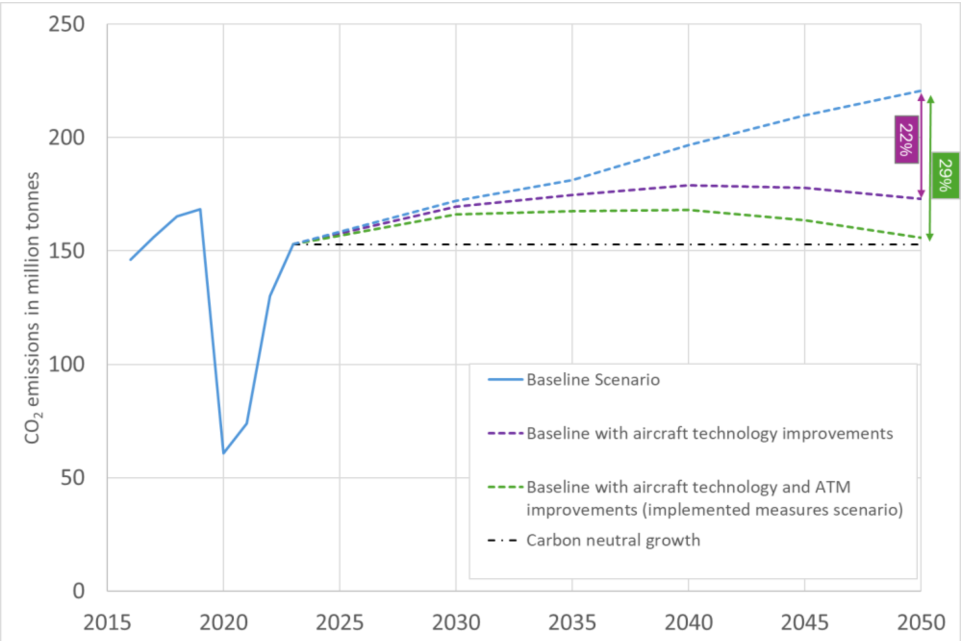


Figure 4. CO_2 emissions forecast for the baseline and implemented measures scenarios



As shown in **Figure 3** and **Figure 4**, the impact of improved aircraft technology indicates an overall 22% 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 (conventional, hybrid electric and Hydrogen) and ATM-related measures, are projected to lead to a 29% reduction in 2050 compared to the baseline.

Table 4. Fuel burn and CO_2 emissions forecast for the Implemented Measures Scenario (new aircraft technology and ATM improvements only)

Year	Fuel Consumption (10^9kg)	CO_2 emissions (10^9kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	38.08	120.34	0.0327	0.327
2019	53.30	168.42	0.0280	0.280
2023	48.41	152.96	0.0268	0.268
2030	52.57	166.11	0.0241	0.241
2040	53.20	168.11	0.0205	0.205
2050	49.29	155.75	0.0168	0.168
For reasons of data availability, results shown in this table do not include cargo/freight traffic.				

As detailed in **Table 5**, under the currently assumed aircraft and ATM improvement scenarios, the fuel efficiency is projected to lead to a 37% reduction from 2023 to 2050. The annual rate of fuel efficiency improvement is expected to be at 1.5% between 2023 and 2030 and reach 2% between 2040 and 2050. However, aircraft technology and ATM improvements alone will not be sufficient to meet the post-2020 carbon neutral growth objective of ICAO, nor will the use of alternative fuels, even if Europe's ambitious targets for alternative fuels (SAF) are met. This confirms that additional action, particularly market-based measures, are required to fill the gap.

Table 5. Average annual fuel efficiency improvement for the Implemented Measures Scenario (new aircraft technology and ATM improvements only)

Period	Average annual fuel efficiency improvement (%)
2010-2023	-1.50%
2023-2030	-1.51%
2030-2040	-1.60%
2040-2050	-1.98%

The **Table 6** below summarises the cumulated effects of each implemented measure. It identifies the weight of the technical improvement on the reduction of CO_2 emissions (from 2% in 2030 to 22% in 2050 compared to the Baseline scenario). The overall impact of the implemented measures (aircraft technology improvements and ATM) shows a reduction of CO_2 emissions by 29% in 2050 compared to the Baseline scenario.

Table 6. Summary of CO_2 emissions forecast for the scenarios described in this chapter

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	120.34			
2019	168.42			
2023	152.96			
2030	172.10	169.50	166.11	-3%
2040	196.52	178.84	168.11	-14%
2050	220.54	173.06	155.75	-29%
For reasons of data availability, results shown in this table do not include cargo/freight traffic.				

The section **Appendix A** of this document provides the detailed results for each scenario, Baseline, and by implemented measure, as well as the CO_2 equivalent and EU27+EFTA Net CO_2 emissions.

SECTION 1- SUPRA-NATIONAL ACTIONS, INCLUDING THOSE LED BY THE EU

B. ACTIONS TAKEN COLLECTIVELY IN EUROPE

1. TECHNOLOGY AND STANDARDS

1.1 Aircraft emissions standards

European Member States fully support ICAO's Committee on Aviation Environmental Protection (CAEP) work 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 Aviation Safety Agency (EASA). It is fully committed to its implementation in Europe and the need to review the standard on a regular 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 are available in CAEP.

1.2 Research and development

1.2.1 Clean Sky

Clean Sky[15] 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 on the 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 with 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 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**[16] 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

With the Horizon 2020 programme coming 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)**[17] will follow in the footsteps of CleanSky2. 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.

General objectives of EPCA:

(a) To contribute to reduce 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.

(b) 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 remains a secure, reliable, cost-effective, and efficient means of passenger and freight transportation.

Specific objectives:

(a) To integrate and demonstrate disruptive aircraft technological innovations able to decrease net emissions of greenhouse gasses 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.

(b) 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.

(c) 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 related programmes.

ASSESSMENT

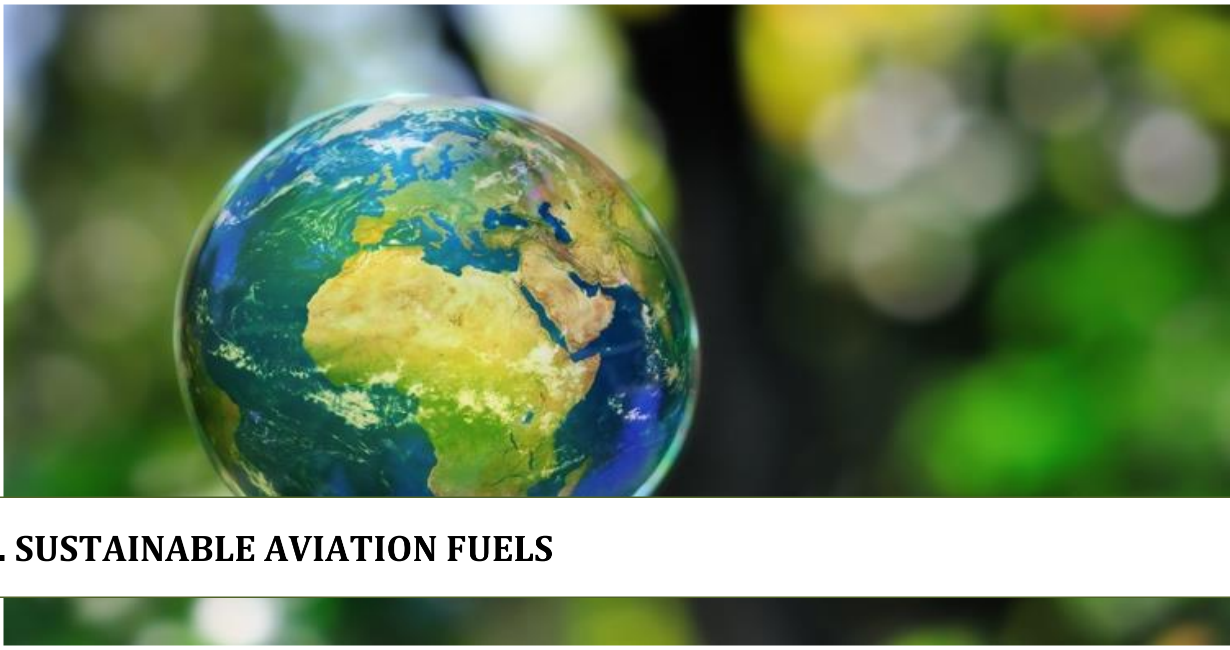
The quantitative assessment of the technology improvement scenario from 2020 to 2050 has been calculated by EUROCONTROL and EASA and it is included in Section A above (ECAC Baseline Scenario and Estimated Benefits of Implemented Measures) and in Appendix A.

Table 7 Fuel consumption and CO_2 emissions of international passenger traffic departing from ECAC airports, with aircraft technology improvements after 2019 included:

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	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 Average annual fuel efficiency improvement for the Implemented Measures Scenario (new aircraft technology only):

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



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 focuses on its 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[18]. 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 Plan.

2.1 ReFuelEU Aviation Initiative

The ReFuelEU Aviation Regulation sets out EU-level harmonised obligations on aviation fuel suppliers, aircraft operators and Union airports for scaling up SAF used for flights departing from all EU airports above a certain annual traffic thresholds (passenger traffic above 800,000 or freight traffic above 100,000 tons). Starting in 2025, aviation fuel suppliers are required to supply a minimum of 2% blend of SAF with conventional fossil-based fuels to Union airports and this gradually increases to at least 70% by 2050. Synthetic aviation fuels are subject to an ambitious sub-mandate, starting with 1.2% in 2030, 2% in 2032 and reaching 35% in 2050 [1]. Aircraft operators departing from EU airports must also refuel with the aviation fuel necessary to operate the flight. This avoids the excessive emissions related to extra weight and minimises the risks of carbon leakage caused by so-called ‘economic tankering’ practices. Between 2025 and 2034, aviation fuel suppliers can supply the minimum shares of SAF as an average over all the aviation fuel they have supplied across Union airports for that reporting period. This flexibility mechanism allows the industry to develop the production and supply capacity accordingly and the fuel suppliers to meet their obligations in the most cost-effective way without reducing the overall ambition. The Commission’s Report will identify and assess the developments on SAF production and supply on the Union aviation fuel market, as well as assess possible improvements or additional measures to the existing flexibility mechanism, such as setting a potential accounting and trading mechanism for SAF (a so-called 'book and claim' system). [27]

In order to support the achievement of the ReFuelEU Aviation supply mandate, the EU has put in place various regulatory, financial and other supporting measures, including:

- A zero emissions rating of RED-compliant SAF used under the EU Emissions Trading System (ETS);
- A maximum of 20 million extra ETS (with an estimated value of €1.6 billion) allowances will be allocated to aircraft operators during 2024 to 2030 for the uplifting of SAF to also cover part of, or all of the price difference with fossil kerosene, depending on the type of SAF and the uplift location;
- A fuel tax structure under the proposed revision of Energy Taxation Directive that would incentivise SAF over fossil kerosene through preferential tax rates;
- A flight emissions label laying down harmonized rules for the estimation of airline emissions taking into account SAF uptake;
- The inclusion in the EU Taxonomy of SAF production and uptake to improve access to green finance;
- R&D and deployment financing support under Horizon Europe, Innovation Fund, InvestEU programmes to de-risk SAF production at all technology maturity stages;
- The accelerated qualification of new SAF technologies and approval of new production plants through creation of EU SAF Clearing House and inclusion of SAF in the Net Zero Industry Act proposal;
- Cross-sectoral cooperation in the Renewable and Low-Carbon Fuels Value Chain Industrial Alliance (RLCF Alliance). The RLCF Alliance, as the industrial pillar of ReFuelEU Aviation to support SAF supply, and emergence of SAF projects and match-making with potential fuel offtakers, is open to all stakeholders.
- EU-funded international cooperation SAF projects with partner States in Africa, Asia, Latin America and the Caribbean. This includes a €4 million ACT-SAF project to conduct feasibility studies and capacity building activities.
- Designation of SAF as a 2024 Global Gateway Flagship initiative, supporting the development, production and use of SAF by de-risking SAF investments outside Europe via different types of funding.
- International cooperation at ICAO level, including the EU's role in the negotiations to reach an agreement at CAAF/3 in November 2023.

2.2 Addressing barriers of SAF penetration into the market

SAF 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'

The first study, 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.

The remaining significant 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[19] 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[20], 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.

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[21], was required to further impulse its implementation. As a result, the European Commission launched in 2016 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 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[22].

The project was concluded with a Stakeholders conference in Brussels on 27 November 2019, and the publication of a report summarizing 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 the Horizon 2020, which is the biggest Research and Innovation program of the EU.

BIO4A[23]: The "*Advanced Sustainable Biofuels for Aviation»* project plan 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.

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[24]: *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 expected duration is from April 2018 to March 2022.

FlexJET[25]: *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 13 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[26]: 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 crosscutting 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 11 partners from 6 European countries and its expected duration is from 1 April 2020 to 31 March 2024.

BL2F[27]: The *Black Liquor to Fuel* (BL2F) project will use "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" (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 12 partners from 8 countries around Europe and its expected duration is from 1 April 2020 till 31 March 2023.

FLITE[28]: 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[29]: 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 Sustainable Aviation Fuels 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.

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 (RTD) 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 operation 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) and 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 contribution 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 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 below, with the ambition for environment, expressed in CO_2 reduction, highlighted by the green dotted rectangle of **Figure 5** below:

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 5: Performance Ambitions for 2035 for Controlled airspace (Source: European ATM Master Plan 2020 Edition).

While all SESAR solutions bring added value to ATM performance, some have a higher potential to contribute 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[30] is planned to be completed by 2027. However, the benefits highlighted in **Figure 6** below have been measured where the functionalities have already been implemented.

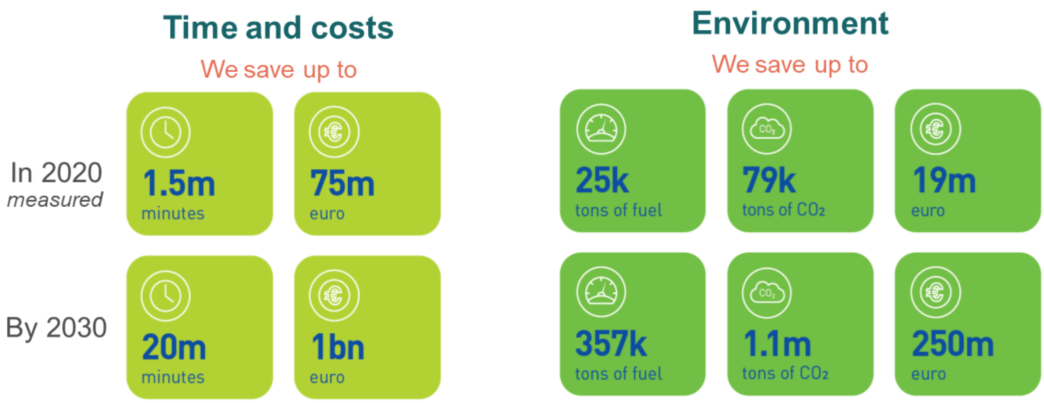


Figure 6: First results of the first common project implemented.

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[31] 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 Committee on Aviation Environmental Protection Modelling and Database Group (CAEP) assessments, the conduct of studies in support of the European Aviation Environment Report (EAER) editions 2016 and 2019, and has been adopted by a large range of aviation stakeholders.
- The initial development/maintenance Open-ALAQS that provides a mean to perform emissions inventory at airports, emissions concentration calculation and dispersion.
- The development of an IMPACT assessment process[32].

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.

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[33] 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 call Performance Assessment and Gap Analysis Report (PAGAR). The Updated version of PAGAR 2019 provides the following environmental achievements:

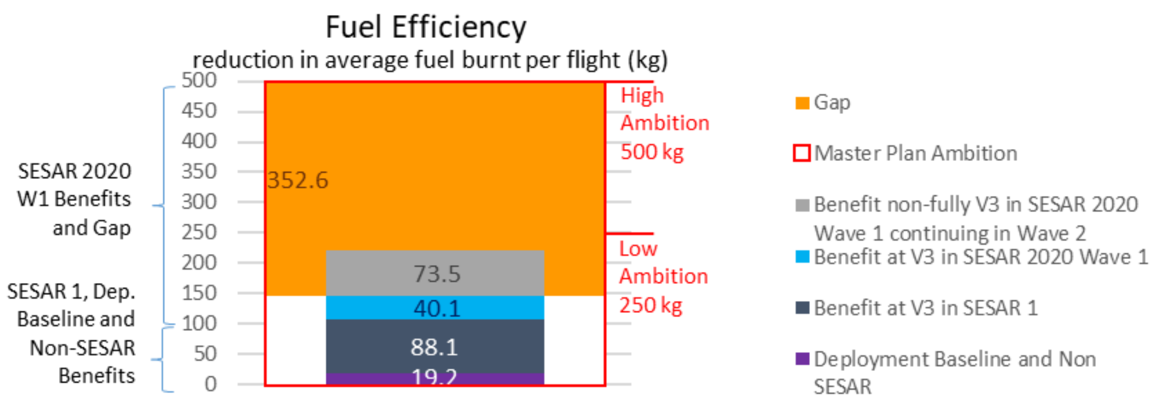


Figure 7: SESAR fuel efficiency achievement versus gap (Source: Updated version of PAGAR 2019)

The Fuel Efficiency benefits at V3 maturity level in SESAR 2020 Wave 1 represents 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 5,280kg 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.

In SESAR, a value of 5,280 Kg of fuel per flight for the ECAC (including oceanic region) is used as a baseline [34]. Based on the information provided by the PAGAR 2019 document[35], 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[36].

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[37] 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 1 000kg of fuel per flight (or 63 to 3150 kg 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[38], 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, which the aim to 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.

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’ initiative.

The SRIA[39] 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

The quantitative assessment of the operational and ATM improvement scenario from 2020 to 2050 has been included in the modelled scenarios by EUROCONTROL on the basis of efficiency analyses from the SESAR project indicated in Figure 7 above and it is included in Section A above (ECAC Baseline Scenario and Estimated Benefits of Implemented Measures).

Table 9. CO_2 emissions forecast for the ATM improvements scenarios.

Year	CO_2 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.

4. MARKET-BASED MEASURES

4.1 The Carbon Offsetting and Reduction Scheme for International Aviation

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 (CORSIA).

The 39th General Assembly of ICAO (2016) reaffirmed the 2013 objective of stabilising CO_2 emissions from international aviation at 2020 levels. In addition, the 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.

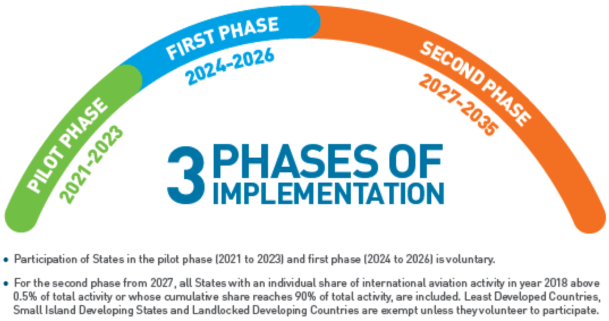
4.1.2 CORSIA implementation

CORSIA scope and timeline

CORSIA operates on a route-based approach and applies to international flights, i.e. flights between two ICAO States. A route is covered by CORSIA offsetting requirements if both the State of departure and the State of destination are participating in the Scheme and is applicable to all aeroplane operators on the route (i.e. regardless of the administering State).

All aeroplane operators with international flights producing annual CO_2 emissions greater than 10, CO_2 emissions covered by CORSIA's offsetting requirements above 000 tonnes from aeroplanes with a maximum take-off mass greater than 5700 kg, are required to monitor, verify and report their CO_2 emissions on an annual basis from 2019. The CO_2 emissions reported for year 2019 represent the baseline for carbon neutral growth for CORSIA's pilot phase (2021-2023), while for the first and second phases in 2024-2035, the baseline is 85% of the CO_2 emissions reported for year 2019. The aviation sector is required to offset any international these baseline levels.

CORSIA includes three implementation phases. During the pilot and first phases, offsetting requirements will only be applicable to flights between States which have volunteered to participate in CORSIA offsetting. There has been a gradual increase of States volunteering to join CORSIA offsetting, rising from 88 States in 2021 to 129 in 2025 [8]. The second phase applies to all ICAO Contracting States, with certain exemptions.



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[40] that confirmed that the EU ETS will be the main European instrument to achieve the EU's binding 2030 target of an at least 40%[41], and will be revised to be aligned with the latest Conclusions in December 2020[42], prescribing at least 55% domestic reduction (without using international credits) of greenhouse gases compared to 1990.

The EU ETS began 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 the factories, power plants, other installations and aircraft operators in the system. Within this cap, companies can sell to or buy emission allowances from one another. The limit on allowances available provides certainty that the environmental objective is achieved and gives allowances a market value.

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[43].

Following the 2013 ICAO agreement on developing CORSIA, the EU decided[44] to limit the scope of the EU ETS to flights between airports located in the European Economic Area (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[45].

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[46]. 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"[47].

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 be excluded from the scope of the EU ETS. This is the case between the EU and Switzerland[48] 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 200 MT of CO_2 emission reductions between 2013 and 2020[49]. 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 Emissions Trading System (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[50].

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, the states implementing the EU ETS have delivered, in "net" terms, the already achieved reduction of around 200 MT 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 the EU ETS, will also contribute towards the ICAO global goals. Such measures are likely to moderate the anticipated growth in aviation emissions.

5. ADDITIONAL MEASURES

5.1 5.1.1 Aircraft Operations

Performance Based Navigation (PBN)

The use of Performance Based Navigation (PBN) enables an optimum aircraft flight path trajectory to mitigate environmental impacts, particularly in the vicinity of airports, without having to overfly ground-based navigation aids. Implementation of the PBN Regulation [15] has shown a positive trend since the last report. As of July 2024, 75% of instrument runways are now fully compliant with the requirements and the implementation of PBN has respectively started for 81% Standard Instrument Departures (SIDs) and 82% Standard Terminal Approach Routes (STAR) at these runways. Completion is due by 2030.

The implementation of the PBN Regulation is expected to result in a number of environmental benefits, although neither their evaluation nor their quantification is mandated. As such, it has proven challenging to identify relevant data for this report. Stakeholders responsible for putting in place the required PBN routes and procedures are encouraged to optimise airspace design and the potential environmental benefits, in particular for flight efficiency and route placement flexibility.

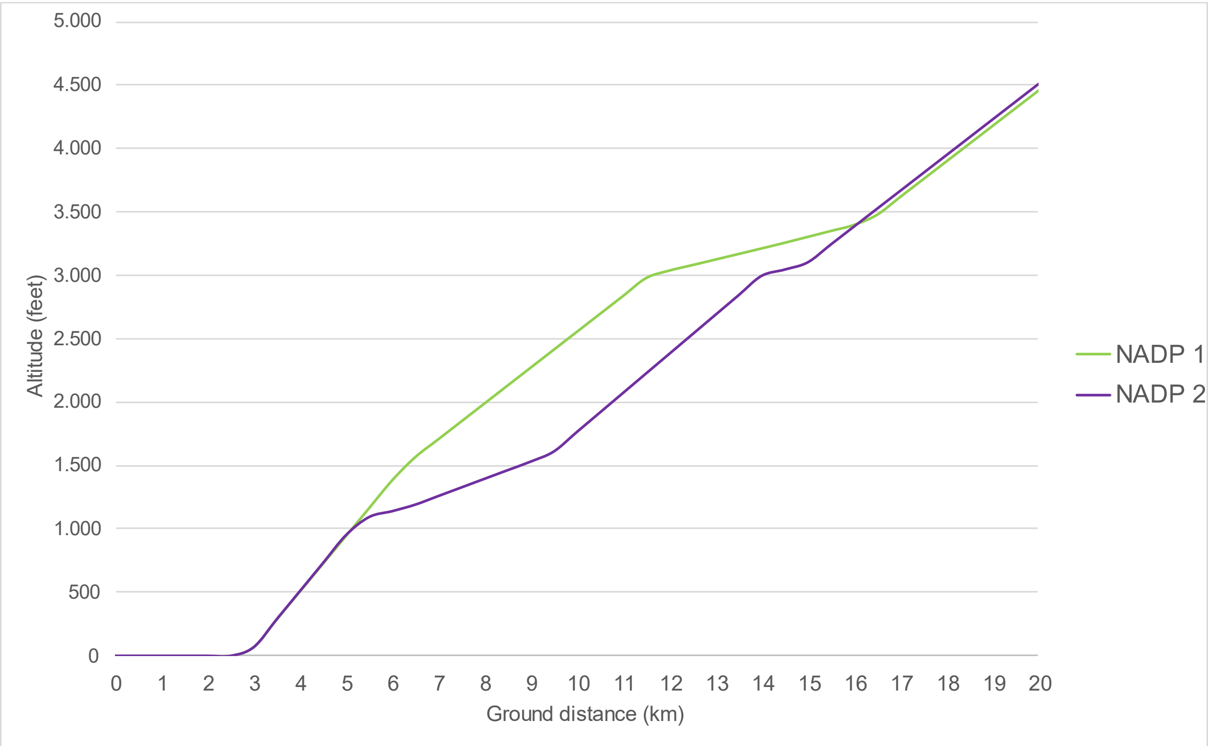
Green Operational Procedures

Building on the previous ALBATROSS research project [16], the goal of the SESAR project HERON launched in 2023 is to reduce the environmental impact from aviation through the deployment of already-mature solutions that range from more efficient aircraft operations to optimised management of air traffic during flights [17]. This includes the Green Apron Management demonstration, which uses sensors and artificial intelligence for more predictable and efficient aircraft handling during airport stopovers.

Noise Abatement Departure Procedures (NADPs)

NADPs aim to reduce the noise impact of departing aircraft by selecting the appropriate moment to clean the aircraft (i.e. retract flaps), which has an impact on the flown vertical profile. NADP1 results in noise reductions close to the airport, while NADP2 reduces noise further away and has lower fuel consumption (Figure 5.1). Depending on the operational context (aircraft type, take-off weight, weather, etc) and on the location of the noise sensitive areas, the best balance between noise and emission reductions needs to be determined.

Figure 5.1 Example of the difference between NADP 1 and 2 for a wide body aircraft with thrust reduction at 1,000ft.



A study performed by EUROCONTROL highlighted that in many cases a fixed NADP procedure for all aircraft types and runways is advised or mandated by the airport authorities, but that this is not always the optimal solution to balance noise and emission reductions. Noise sensitive areas vary from airport to airport, and from departure runway to runway. As such, airports should identify key noise sensitive areas in each Standard Instrument Departure procedure. By taking the local operational context into consideration and allowing the flight crew to determine the best NADP, additional noise or emission reductions could be achieved.

The study concluded that in some cases where NADP1 procedures are applied, using NADP2 procedures could reduce fuel burn by 50kg to 200kg while only marginally increasing noise by 1dB close to the airport.

Sustainable Taxiing

Trials linked to sustainable taxiing are ongoing at various airports (e.g. Amsterdam Schiphol, Eindhoven, Paris Charles-de-Gaulle and Brussels) through various SESAR research projects as well as national projects. To incentivise implementation and to synchronize developments, a EUROCONTROL / ACI-EUROPE Sustainable Taxiing Taskforce developed a Concept of Operations in 2024 [18].

The Concept of Operations (CONOPS) addresses the potential fuel burn reductions of several sustainable taxiing solutions, which could be up to 400kg CO_2 from a single aisle aircraft taxi-out phase. In addition, there are noise and air quality benefits as the aircraft engine start-up and shut-down procedures occur away from the gate area.

These benefits are mainly the result of operational improvements, such as single engine taxing, combining engine start-up while taxiing, or combining pushback and taxi clearances by air traffic control, thereby reducing total taxi and engine running times that still take into consideration engine thermal stabilization and some additional complexity in ground operations. Research is also looking into limiting Auxiliary Power Units (APU) use to outside certain temperature above a certain threshold. On-going trials are expected to further clarify how to integrate the different taxi operational solutions and quantify their benefits by end of 2025.

5.1.2 Airport Infrastructure

Various EU research projects, including TULIPS [19], OLGA [20] and STARGATE [21], are currently demonstrating innovative environmental solutions at airports, which can be replicated on a European scale.

Ground Support Equipment

Sustainable ground operations at airports have received growing attention in the last few years as a way to address concerns regarding health and working conditions of airport operational staff, as well as the impact on communities in the vicinity of airports. States are already in the process of adopting more stringent regulations to address these concerns resulting in airports looking to fully electrify their ground operations [22].

To advance carbon neutrality of ground operations, Skytanking and Brussels Airport have been developing electric hydrant fuel dispensers, which deliver aviation fuel from the underground hydrant system into the aircraft. After a successful test period in 2023 during which two diesel fuel dispensers were retrofitted to run on electricity, Skytanking commissioned two custom made fully electric hydrant fuel dispenser, which were delivered in 2024 leading to a significant reduction in noise and exhaust gases, which is important for both the local environment and for the ground handling staff. As part of the same research project, DHL Express has replaced a third of its ground handling fleet (tractors, container lifts, belly loaders and pushbacks) with fully electric equivalents.

In 2024, Frankfurt Airport commissioned an expansion to its vertical photovoltaic solar energy system beside Runway 18 West in order to supply renewable energy to power electrified ground support equipment [23]. This facility has provided such encouraging results that its gradually expanded from 8.4kW to 17.4MW, and is now considered the world's largest facility of its kind at an airport. The airport is also using charging infrastructure bidirectionally, which means it's possible to turn electric vehicles into mobile power storage units [24].

Zero Emission Aircraft

The European Commission has established the Alliance for Zero Emission Aircraft (AZEA) to prepare the aviation ecosystem for the entry into service of hydrogen and electric aircraft (see Technology-Design chapter). This will require major investment in energy infrastructure is required to prepare for the introduction of zero-emission aircraft with electric and hydrogen propulsion. The large-scale introduction of zero-emission aircraft will be a crucial pillar in reaching net zero carbon emissions by 2050.

GOLIAT is an EU project that brings together all relevant aviation stakeholders to demonstrate small-scale liquid hydrogen aircraft ground operations at three European airports [25]. Launched in 2024, the group will support the aviation industry's adoption of liquid hydrogen (LH2) transportation and energy storage solutions by:

- Developing and demonstrating LH2 refuelling technologies scaled-up for future large aircraft;
- Demonstrating small-scale LH2 aircraft ground operations at airports;
- Developing the standardisation and certification framework for future LH2 operations; and
- Assessing the sizing and economics of the hydrogen value chains for airports.

New airport pavement bearing strength calculation to optimise maintenance works

In order to ensure safe aircraft operations, airports need to continuously monitor the lifetime and life cycle of critical pavement infrastructure (runways, taxiways and aprons) based on the impact caused by different types of aircrafts with different weights, tyre geometry and tyre pressure. In 2024 EASA published guidance to European airports and competent authorities that changed the Aircraft Classification Rating - Pavement Classification Rating (ACR-PCR) methodology used to calculate pavement bearing strength [26]. These changes are expected to optimise the use of pavement, reduce maintenance needs and costs and also reduce greenhouse gas emissions through a well-managed and better targeted pavement life cycle management by airports.

Sustainable Aviation Fuels

The European policy framework for the deployment of SAF is ReFuelEU Aviation Regulation, which sets out a supply mandate for aviation fuel suppliers and an obligation on Union airports to facilitate this supply of aviation fuels containing the minimum shares of SAF to aircraft operators. European airports are also taking voluntary actions to support the uptake of SAF through various means (Table 5.1). A detailed overview of these types of SAF incentive initiatives by European airports has been compiled by ACI EUROPE [27].

Table 5.1 Overview of airport initiatives to support the uptake of SAF

Supply Chain Investment
• Support airlines on logistic issue to facilitate the delivery of SAF. • Engage in joint negotiations with SAF suppliers, carriers and other airports to develop SAF projects. • Invest in SAF production facilities.
Raise Awareness
• Inform passengers and corporations on opportunities to purchase SAF for their flights and/or support SAF projects to compensate for their CO_2 emissions.
Financial Incentives
• Provide airlines with SAF incentive programmes (e.g. cost sharing of SAF price premium, differentiated landing and take-off fees based on SAF use, free SAF storage).
Policy Engagement
• Engage with government and local stakeholders to support SAF development and financial incentives for airlines, but not through any kind of minimum shares of SAF other than those of ReFuelEU Aviation.

The EU ALIGHT research project, led by Copenhagen airport, is looking into how to address the barriers to the supply and handling of SAF at major airports by improving the logistics chain in the most efficient and cost-effective manner [28].

Greening Aviation Infrastructure

As the aviation sector evolves to address environmental challenges, this transition is being supported through Member State actions and EU support, notably the Trans-European Transport Network [29], the Alternative Fuels Infrastructure Regulation [30] and their 'financial arm' in the form of the Connecting Europe Facility [31].

Trans-European Transport Network (TEN-T)

The revision of the TEN-T Guidelines [32] introduces requirements on Member States that include the improvement of airport connections to the trans-European railway network, air traffic management infrastructure to enhance the performance and sustainability of the Single European Sky, alternative fuels infrastructure and pre-conditioned air supply to stationary aircraft.

Alternative Fuels Infrastructure Regulation (AFIR)

The AFIR introduces mandatory targets for Member States on the provision of electricity to stationary aircraft at TEN-T network airports and requires Member States to define national strategies on deployment of ground infrastructure for electric and hydrogen aircraft.

Connecting Europe Facility (CEF)

Under CEF Transport Alternative Fuel Infrastructure Facility, 20 projects representing 63 airports from across the EU were selected since 2021, with a total EU Grant support exceeding €160 million [33, 34]. The support has been directed to electricity and pre-conditioned air supply to stationary aircraft, electric charging of ground support equipment, electricity grid connections and green electricity generation.

5.2 Net Zero CO_2 Emissions

The ACI EUROPE Sustainability Strategy was launched in 2019 [35], which included the Net Zero Resolution that has been updated in 2024 [36]. 303 European airports have since committed to net zero[51] carbon emissions from airport operations within their control by 2050 and provided a roadmap detailing how this will be achieved [37].

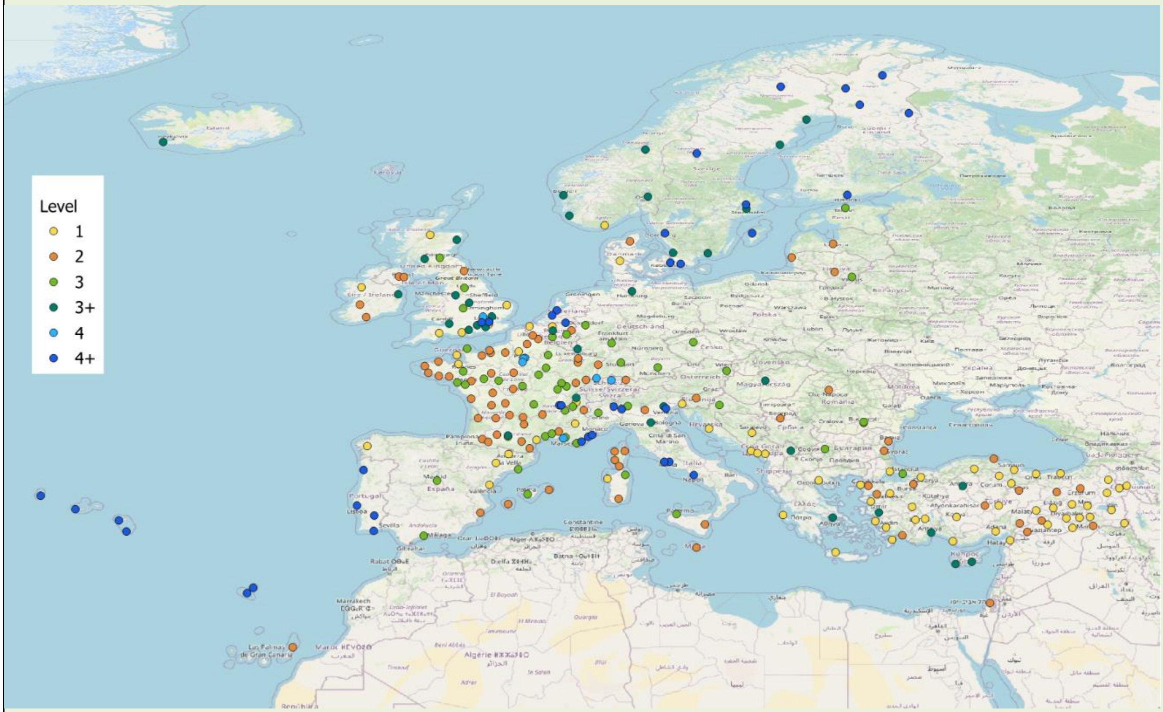
This net zero commitment covers Scope 1 direct airport emissions and Scope 2 indirect emissions (e.g. consumption of purchased electricity, heat or steam). 132 airports have announced a net zero target by 2030 or earlier, and 13 airports have already achieved net zero. In 2022, guidance on reducing Scope 3 emissions from others operating at the airport which are the largest share of emissions (e.g. aircraft, surface access, staff travel) was published [38] and this was followed in 2023 with guidance on developing Net Zero carbon roadmaps [39].

STAKEHOLDER ACTIONS

Airport Carbon Accreditation Programme

The Airport Carbon Accreditation (ACA) programme [40] was launched in 2009 by the Airports Council International Europe and, as of June 2024, now includes 564 airports on a global basis. The ACA is a voluntary industry led initiative, overseen by an independent Administrator and Advisory Board, that provides a common framework for carbon management with the primary objective to encourage and enable airports to reduce their CO_2 emissions. All data submitted by airports is externally and independently verified. As of the latest 2022-2023 reporting period, there were **290 European airports** participating in the programme corresponding to 77.8% of European passenger traffic (Figure 5.2).

Figure 5.2 – European airports participating in the ACA programme



The ACA programme was initially structured around four levels of certification (Level 1: Mapping, Level 2: Reduction, Level 3: Optimisation; Level 3+: Neutrality) with increasing scope and obligations for carbon emissions management (Scope 1: direct airport emissions, Scope 2: indirect emissions under airport control from consumption of purchased electricity, heat or steam and Scope 3: emissions by others operating at the airport such as aircraft, surface access, staff travel).

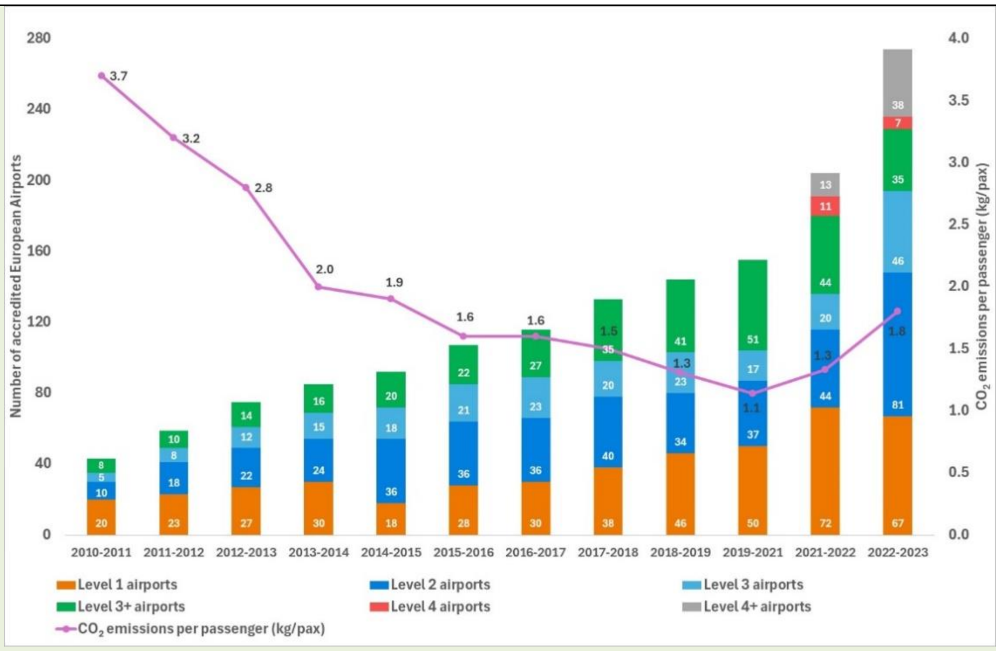
In 2020, Levels 4 (Transformation[52]) and 4+ (Transition[53]) have been added as interim steps towards the long-term goal of achieving net zero CO_2 emissions and to align it with the objectives of the Paris Agreement. Guidelines were also published to inform airports about offsetting options, requirements and recommendations, as well as dedicated guidance on the procurement of offsets.

In 2023, a new Level 5 was added to the ACA programme. When applying for Level 5 airports are required to reach and maintain ≥ 90% absolute CO_2 emissions reductions in Scopes 1 and 2 in alignment with the ISO Net Zero Guidelines, as well as commit to achieving net zero CO_2 emissions in Scope 3 by 2050 or sooner. Any residual emissions need to be removed from the atmosphere through investment in credible carbon removal projects. To support airports in this endeavour, an update to the Airport Carbon Accreditation Offset Guidance Document [41] was published on carbon removal options and most effective removal strategies. Level 5 accredited airports need to outline detailed steps to achieve their emissions reduction targets, as part of their Carbon Management Plan.

Level 5 also requires airports to submit a verified carbon footprint for Scopes 1 and 2, and all relevant categories of Scope 3 as per the requirements of the GHG Protocol Guidance [42], notably covering all significant upstream and downstream activities from third parties, including airlines. Finally, airports must establish a Stakeholder Partnership Plan underpinning their commitment to net zero CO_2 emissions in Scope 3, by engaging with the entire airport ecosystem and actively driving third parties towards delivering emissions reductions with regular milestone to gauge progress.

Ten airports were certified against Level 5 at launch, including 9 European airports (Amsterdam Schiphol, Eindhoven, Rotterdam-The Hague, Beja, Madeira, Ponta Delgada, Göteborg Landvetter, Malmö and Toulon-Hyères). Ivalo, Kittilä, Kuusamo and Rovaniemi airports were also subsequently accredited to Level 5 in 2024.

Figure 5.3 – Increasing number of accredited European airports and decreasing CO_2 emissions per passenger



The carbon emission per passenger travelling through European airports at all levels of Airport Carbon Accreditation has increased to **1.8 kg CO_2/passenger** (Figure 5.4). A total reduction in Scope 1 and 2 emissions compared to a three year rolling average[54] of **452,893 tonnes of CO_2** for all accredited airports in Europe was also reported (Figure 5.3). This represents about 20% reduction compared to the three-year rolling average.

Figure 5.4 – Scope 1 and 2 emissions reductions in airport CO_2 emission

Further developments in the ACA programme are envisaged in 2025 that will focus on the efforts of airport supply chains to reduce their CO_2 emissions.

STAKEHOLDER ACTIONS

Airport Council International Europe (ACI EUROPE)

ACI EUROPE represents over 500 airports in 55 countries, which accounts for over 90% of commercial air traffic in Europe. It works to promote professional excellence and best practice amongst its members, including in the area of environmental sustainability.

Digital Green Lane

The Digital Green Lane [43] was launched in 2023 and is a fully digital system for the delivery and collection of goods between freight forwarders and ground handlers, facilitated using cloud-based applications. This process offers numerous benefits, including shorter waiting times for the trucks that deliver and collect goods, a reduction in CO_2 emissions, increased transparency and less paper. The Digital Green Lane was further expanded by cargo community organisation Air Cargo Belgium and some 95% of all cargo in the Brussels Airport cargo zone is now processed via this system. A pilot programme incorporating this same system has also been launched at Athens airport.

Airport Regions Council (ARC)

ARC is an association of local and regional authorities hosting or adjacent to both major European hub airports and smaller airports. The organisation's expertise is at the intersection of airport operations and local/regional policies, and it supports maximising benefits and minimising environmental impact, ultimately striving to improve the well-being of residents in airport regions.

Digital Twin

Within the EU Horizon 2020 research project 'Stargate' [44], IES and Brussels Airport have developed a Digital Twin of the airport's 40 most energy-intensive buildings before modelling scenarios such as installing solar panels, electric vehicle chargers and replacing gas boilers with heat pumps to find the most effective routes to net zero carbon emissions by 2030. This marks a significant step up from the current use of digital twin technology, where it has most commonly been used to optimise commercial operations. Through rigorous modelling stages, it was verified that energy saving measures had the potential for up to 63% CO_2 savings against the 2019 baseline year. This approach will also be replicated at Athens, Budapest and Toulouse airports and promoted across ARC Members.

Non-Governmental Organisations (NGOs)

Environmental NGOs are actively involved in policy-making discussions to address the environmental impacts of aviation. They communicate civil society concerns and positions associated with noise, air pollution, climate change and social justice. They also contribute to raising awareness on aviation's environmental impact through transparency of data.

Tracking progress of business travel emissions savings

Travel Smart is a global campaign aiming at reducing corporate air travel emissions by 50% or more from 2019 levels by 2025, led by a coalition of NGOs in Europe, North America and Asia. The campaign ranks over 327 companies based on the sustainability of their business travel practices and holds them accountable through an Emissions Tracker [45]. This tool uses Carbon Disclosure Project [46] corporate emissions database and allows users to track the progress of a company's business air travel emissions reduction target.

The tracker shows through coloured bars whether companies have returned to levels of emissions above their targets or whether they have maintained reductions of -50% or more, thereby highlighting leaders and incentivising competition between companies. Through this Travel Smart campaign, various company best practices have highlighted that reducing flying is compatible with continued development of profitable business [47].

5.3 Areas of International Collaboration

The aviation sector has a long-standing history of making use of International Cooperation through technical cooperation programmes to grow the capabilities of States in the areas of safety, security and ATM, and EU entities are trusted and experienced partners in those initiatives.

During the last decade, the number of technical cooperation programmes dedicated to environmental protection has grown in line with the increasing ambitions of States to mitigate the environmental impact of aviation. European entities have been key contributors to this having collaborated with 112 Partner States and committed an estimated €20 million in civil aviation environmental protection projects since 2022. At global level, ICAO has developed technical capacity building programmes, such as ACT-CORSIA and ACT-SAF, which offer a common umbrella to the capacity building efforts in environment [48]. The contribution of the European Commission to these programmes amounts to €56.5 million[55], including €9.6 million in projects directly implemented by ICAO. The European States and the European industry are also contributing to these ICAO programmes.

These European projects, implemented by EASA, European States, European Industry or directly by ICAO with European funds, have supported capacity building in numerous regions covering various technical topics that are summarised in this section. Building on this, there is a commitment to continue engaging through International Cooperation initiatives to pursue sustainable aviation on a global basis.

5.3.1 CORSIA Implementation

The initiatives of EU entities, either through the ICAO ACT-CORSIA programme or through dedicated technical cooperation projects, have contributed to the increasing numbers of States volunteering to take part in CORSIA during the Pilot Phase (2021-2023) and First Phase (2024-2026) by facilitating the implementation of the Monitoring, Reporting and Verification (MRV) process and in some cases the development of their National accreditation process.

As described in detail within Chapter 4 on Market-Based Measures, CORSIA has now entered the First Phase (2024-2026) where, after the recovery of air traffic following the COVID-19 pandemic, the scheme is likely to lead to offsetting obligations for aeroplane operators flying between two volunteering States. CORSIA offers two ways to perform the offsetting, either by purchasing and cancelling CORSIA Emission Units (CEU) or by using CORSIA Eligible Fuels (CEF). In both cases, specific criteria and rules apply to CEU or to CEF production in order to deem them as eligible offsets. While CEU and CEF can be purchased worldwide, States are looking to benefit from the environmental and economic benefits of CORSIA by providing CEU and CEF on a domestic basis.

Increasing commitments of States under the Paris Agreement through their National Determined Contributions (NDC) may result in greater competition for the use of CEU within international markets. As such, technical cooperation is also playing an important role to facilitate the understanding of the complementarity of CORSIA with other carbon markets, enabling positive synergies to maximise their intended goals and avoiding potential double-counting of emissions and emission cancellations. The cooperation between European entities and Partner States in the period 2025-2027 is expected to focus on the sound implementation of the offsetting mechanisms under CORSIA and facilitating an increase in the availability of carbon projects providing CEU.

5.3.2 SAF Development

The development of Sustainable Aviation Fuels (SAF) is the most cost-effective measure and has the biggest potential to significantly reduce the carbon footprint of air transport in the short- and long-term. The carbon reduction of SAF is on a life cycle basis.

The 3rd ICAO Conference on Alternative Aviation Fuels (CAAF#3) in 2023, called as part of the efforts to achieve the LTAG, resulted in its Member States adopting the “Global Framework for Sustainable Aviation Fuels (SAF), Lower Carbon Aviation Fuels (LCAF) and other Aviation Cleaner Energies” which includes an objective to reduce the emission of air transport of 5% by 2030 thanks to SAF and other cleaner energies [49]. As part of this Framework, it was acknowledged that support to States and industry to develop end finance SAF initiatives is essential to ensure that “No Country is Left Behind” in the decarbonisation efforts. As such, the ICAO ACT-SAF Programme was established to support States in developing their full potential in SAF, through specific training activities, development of feasibility studies, and other implementation support initiatives.

A rapid and geographically balanced scaling up of SAF production requires both significant investments and well-informed decision-making. In this regard, EU entities are advocating and supporting the development of SAF within 42 Partner States in Africa, Asia and Latin America through different International Cooperation initiatives.

The first stage of this support is to raise awareness, to exchange best practices and to develop technical capabilities on SAF. The second stage involves supporting the development of local capabilities to enable local SAF production.

As part of the first stage, EU funded projects have been facilitating SAF workshops and webinars around the world and has also funded, via projects implemented by ICAO, 7 SAF Feasibility Studies - for Kenya, Trinidad and Tobago, Dominican Republic, Burkina Faso, Zimbabwe, Côte d'Ivoire and Rwanda [50, 51, 52, 53, 54, 55, 56]. Beyond Feasibility Studies, the technical cooperation initiatives from EU entities have facilitated bringing all relevant stakeholders together in order to develop a common understanding on SAF, the potential of SAF within their State and what their role could be in the development of local SAF production. This has covered the entire value chain of SAF including the different pathways for production, technoeconomic analyses, readiness studies and policy dialogues. Depending on the State profile, the support and collaboration has been tailored towards its specific potential for SAF production (e.g. analysing the activation of specific feedstocks, taking advantage of existing refining capabilities, potential use of electricity from renewable sources) and assessing at high level the technoeconomic viability of possible production pathways.

Similarly to the support provided on State Action Plans for CO_2 emissions, the most valuable contribution has been to facilitate a common understanding on SAF among the potential SAF actors in a State, and more crucially among different Governmental Departments (e.g. Ministries of Energy, Transport, Environment, Finance, Civil Aviation Authorities) and non-aviation stakeholders (e.g. gas and oil industry, feedstock producers).

In the framework of the EU Global Gateway strategy, EU entities have now reached the start of the second stage with the funding by the European Commission of SAF projects in 15 Partner States: Cameroun, Cote d'Ivoire, Egypt, Equatorial Guinea, Ethiopia, Kenya, India, Madagascar, Mauritania, Morocco, Mozambique, Nigeria, Rwanda, Senegal, South Africa. These projects will be implemented by ICAO and by EASA and aim to support them in achieving local SAF production projects.

The funds are being committed under the EU Global Gateway strategy and contribute to ICAO's ACT-SAF programme and other technical cooperation projects that follow a similar approach. The support initiatives are discussed and agreed with the Partner States in order to map out the main areas of potential collaboration:

- **Developing and managing the SAF programme at State level**, including the definition of the SAF Roadmap, organising the stakeholder engagement and launching communication campaigns to explain the need of SAF for decarbonisation of air transport.
- **Designing and deploying the most adequate SAF framework**, as a set of State initiatives providing favourable conditions for SAF production projects to become viable (e.g. SAF policies, financial initiatives, capacity building), starting with having a good understanding of the State's potential in the form of a feasibility study.
- **Defining viable Direct Supply Lines (SAF production and supply projects)**, assessing the technoeconomic viability of different scenarios, identifying challenges and defining actions at State level (e.g. SAF policies or regulations, incentive schemes, research on sustainability of feedstocks) or at project

level (e.g. adjusting technologies, establishing partnerships, securing feedstocks) for those production projects to become viable.

- **Facilitating access to finance**, enabling the bankability of the SAF production project by derisking investment and accessing dedicated funds (e.g. Development Banks, EU Global Gateway).

The initiatives are following and contributing to the development of ICAO's ACT-SAF programme framework, templates and tools. This collaborative work is providing a common and harmonised toolkit that helps both the Partner States and relevant stakeholders match needs and supporting resources in a more agile manner, and allows for more efficient cooperation, even with multiple and concurrent partners.

This coordination is deemed essential to maximise the output of the resources dedicated to the upscale of SAF production worldwide.

5.3.3 Environmental Management Systems for Airports

As defined by ICAO, an Environmental Management System (EMS) provides a methodology and framework to systemically identify and cost-effectively manage significant environmental aspects in the operation of aviation organisations. It has been proven effective across a wide range of organisations, including airports, air carriers, manufacturers and government agencies. EMS is one of the tools available for managing environmental matters at an airport, along with sustainability plans, certifications and other processes.

Through the support from EU funded projects to the ASEAN Member States, Thailand, Laos PDR, Philippines, Indonesia and Vietnam have all developed technical capacity for the implementation of EMS in selected airports of their network. The support provided through a series of training sessions, and the exchange of experiences between airport officials, has facilitated the local implementation of the EMS and the progressive transformation of airport infrastructure to reduce its environmental impact.

As an example, Iloilo Airport in the Philippines was supported in developing and implementing their EMS, including associated manuals, processes and action plans, which led to certification against ISO14001 in 2023 [57]. This attested to a well-established system and the commitment from airport senior officials to mitigate the impact of the infrastructure and its operation on the environment and surroundings. The environmental team from Iloilo Airport, together with the Civil Aviation Authority of Philippines (CAAP) and the support of EU Projects, has subsequently developed an EMS implementation package to support CAAP in progressively rolling out the EMS across the airport network from 2024 onwards.

The implementation of EMS is location specific and faced different scenarios and environmental challenges at each airport. For example, Luang Prabang Airport in Laos PDR is an airport surrounded by UNESCO sites where the need to respect the local cultural heritage was essential during the implementation of their EMS.

All the expertise accumulated in the various EMS implementations is being shared among the ASEAN Member States in thematic workshops facilitated by EU funded projects, and in a dedicated workstream at ASEAN level led by the ASEAN Air Transport Working Group (ATWG).

5.4 Global Gateway

The European Commission is promoting the green transition externally, aiming to combat climate change and to minimise threats to the environment in line with the Paris Agreement together with Partner States. This includes notably the so-called Global Gateway strategy.

Global Gateway will foster convergence with European or international technical, social, environmental and competition standards, reciprocity in market access and a level playing field in the area of transport infrastructure planning and development. It will serve to enhance the recharging and refuelling infrastructure for zero-emission vehicles and foster the supply of renewable and low-carbon fuels. It will serve to strengthen aviation and maritime links with key partners, while also setting new standards to enhance environmental and social sustainability, create fair competition and reduce emissions in those sectors.

Air transport is acknowledged as a hard to decarbonise sector, while at the same time global air traffic is projected to continue growing, contributing to economic and social growth. This increase in air traffic will increase total aviation emissions if no action is taken. To face this challenge, acknowledging SAF as a cost-effective measure with the potential to significantly reduce the carbon footprint of air transport in the short- and long-term, increased availability and use of SAF outside of Europe has become a strategic objective for the EU. SAF also has a high potential to contribute to the economic development of States, notably in Africa, and to reduce their dependence on imported energy sources.

In December 2023, the European Council endorsed the list of Global Gateway flagship initiatives for 2024, including the global development and use of SAF [58], in line with the strategy's pledge to enhance sustainable transport connections. This will support achieving the objectives of both the Long-Term Aspirational Goal of net zero CO_2 emissions from international aviation by 2050 and the ReFuelEU Aviation Regulation mandate that 70% of fuel supplied by 2050 must be SAF.

The recognition of SAF as a strategic priority provides the opportunity to access dedicated funds that can help reduce the investment gap for sound SAF production projects in Partner States.

5.5 Aviation Environmental Project Coordination Group (AEPCG)

Mindful of the need to maximise the impact of the technical and financial resources made available to Partner States, the European Commission (EC) and the European Union Aviation Safety Agency (EASA) established the Aviation Environmental Projects Coordination Group (AEPCG) in 2020 as a forum to raise awareness and facilitate the coordination of international cooperation support being delivered by EU Entities.

The AEPCG meets twice a year with an increasing number of participants[56] and initiatives being discussed. While the initial intent of the group was to raise awareness and facilitate coordination, the discussions among the group identified synergies in the implementation of CORSIA and the development of SAF. For example, following the provision of technical support to Cambodia that was coordinated between DGAC

France and an EU funded project (EU-SEA CCCA CORSIA Project), the Partner State decided to join CORSIA during its voluntary phase. Looking forward, similar synergies are being developed in the concurrent support of the EU and the Government of the Netherlands to the SAF development in Kenya through the ACT-SAF Programme.

This close coordination and collaborative spirit among support partners will be a key factor in successfully meeting future environmental goals.

APPENDIX A

DETAILED RESULTS FOR ECAC SCENARIOS FROM SECTION A

1. BASELINE SCENARIO

a) Baseline forecast for international traffic departing from ECAC airports

Year	Passenger Traffic (IFR movement) (million)	Revenue Passenger Kilometres[57] RPK (billion)	All-Cargo Traffic (IFR movements) (million)	Freight Tonne Kilometres transported[58] FTKT (billion)	Total Revenue Tonne Kilometres[59] RTK (billion)
2010	4.71	1,140	0.198	41.6	155.6
2019	5.88	1,874	0.223	46.9	234.3
2023	5.38	1,793	0.234	49.2	228.5
2030	6.69	2,176	0.262	55.9	273.5
2040	7.69	2,588	0.306	69.0	327.8
2050	8.46	2,928	0.367	86.7	379.5
Note that the traffic scenario shown in the table is assumed for both the baseline and implemented measures scenarios.					

b) Fuel burn and CO_2 emissions forecast for the baseline scenario

Year	Fuel Consumption (10^9 kg)	CO_2 emissions (10^9 kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	38.08	120.34	0.0327	0.327
2019	53.30	168.42	0.0280	0.280
2023	48.41	152.96	0.0268	0.268
2030	54.46	172.10	0.0250	0.250
2040	62.19	196.52	0.0240	0.240
2050	69.79	220.54	0.0238	0.238
For reasons of data availability, results shown in this table do not include cargo/freight traffic.				

2. IMPLEMENTED MEASURES SCENARIO

2A) EFFECTS OF AIRCRAFT TECHNOLOGY IMPROVEMENTS AFTER 2019

a) *Fuel consumption, CO_2, and CO_2 equivalent emissions of international passenger traffic departing from ECAC airports, with aircraft technology improvements after 2023 included. The well-to-wake emissions are determined by assuming 3.88 Kg of CO_2 equivalent emissions for 1 Kg of Jet-A fuel burn:*

Year	Fuel Consumption (10^9 kg)	CO_2 emissions (10^9 kg)	Well to Wake CO_2 equivalent emissions (10^9 kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	38.08	120.34	147.77	0.0334	0.334
2019	53.30	168.42	206.80	0.0284	0.284
2023	48.41	152.96	187.82	0.0270	0.270
2030	53.64	169.50	208.12	0.0246	0.246
2040	56.60	178.84	219.59	0.0218	0.218
2050	54.77	173.06	212.50	0.0187	0.187
For reasons of data availability, results shown in this table do not include cargo/freight traffic.					

a) *Average annual fuel efficiency improvement for the Implemented Measures Scenario (new aircraft technology only)*

Period	Average annual fuel efficiency improvement (%)
2010-2023	-1.50%
2023-2030	-1.22%
2030-2040	-1.19%
2040-2050	-1.55%

b)

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

a) a) *Fuel consumption, CO_2 and CO_2 equivalent emissions of international passenger traffic departing from ECAC airports, with aircraft technology and ATM improvements after 2023. The well-to-wake CO_2 equivalent emissions are determined by assuming 3.88 Kg of CO_2 equivalent emissions for 1 Kg of Jet-A fuel burn:*

Year	Fuel Consumption (10^9 kg)	CO_2 emissions (10^9 kg)	Well-to-Wake CO_2 equivalent emissions (10^9 kg)	Fuel efficiency (kg/RPK)	Fuel efficiency (kg/RTK)
2010	38.08	120.34	148.02	0.0327	0.327
2019	53.30	168.42	207.16	0.0280	0.280
2023	48.41	152.96	188.14	0.0268	0.268
2030	52.57	166.11	204.31	0.0241	0.241
2040	53.20	168.11	206.78	0.0205	0.205
2050	49.29	155.75	191.58	0.0168	0.168
For reasons of data availability, results shown in this table do not include cargo/freight traffic.					

b) Average annual fuel efficiency improvement for the Implemented Measures Scenario (new aircraft technology and ATM improvements)

Period	Average annual fuel efficiency improvement (%)
2010-2023	-1.50%
2023-2030	-1.51%
2030-2040	-1.60%
2040-2050	-1.98%

b) cEquivalent CO_2e emissions forecasts for the scenarios described in this common section, assuming 3.88 Kg of CO_2 equivalent emissions for 1 Kg of Jet-A fuel burn:

Year	Well-to-wake CO_2e emissions (10^9 kg)			% improvement by Implemented Measures (full scope)
	Baseline Scenario	Implemented Measures Scenario		
		Aircraft techn. improvements only	Aircraft techn. and ATM improvements	
2010	147.77			
2019	206.80			
2023	187.82			
2030	211.32	208.12	203.95	-3%
2040	241.30	219.59	206.41	-14%
2050	270.79	212.49	191.24	-29%
For reasons of data availability, results shown in this table do not include cargo/freight traffic.				

2C) EFFECTS OF AIRCRAFT TECHNOLOGY, ATM IMPROVEMENTS AND SAF AFTER 2023 ON EU27+EFTA INTERNATIONAL DEPARTURES

The Net CO_2 emissions and expected benefits of SAF use are calculated where regional measures are taken (e.g. ReFuelEU Aviation) in the European scenario with measures.

c) Fuel consumption, CO_2, Net CO_2 emissions of international passenger traffic departing from EU27+EFTA airports, with aircraft technology and ATM improvements after 2023 The tank-to-wake Net CO_2 emissions are based on the use of Sustainable Aviation Fuels (ReFuelEU Aviation, 70% decarbonation factor for the synthetic aviation fuels, and 65% for aviation biofuels).

Year	Fuel Consumption (10^9 kg)	CO_2 emissions (10^9 kg)	Tank-to-Wake Net CO_2 emissions (10^9 kg)
2010	27.84	87.97	87.97
2019	38.19	120.69	120.69
2023	34.08	107.71	107.71
2030	36.97	116.84	112.21
2040	35.63	112.60	87.15
2050	32.80	103.63	54.67
For reasons of data availability, results shown in this table do not include cargo/freight traffic.			

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

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 – the 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

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

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

SECTION 2- NATIONAL ACTIONS IN UKRAINE

The information included in this section provides a description of the implementation of national of measures which are to be considered as Ukraine's contribution to the quantified supranational measures.

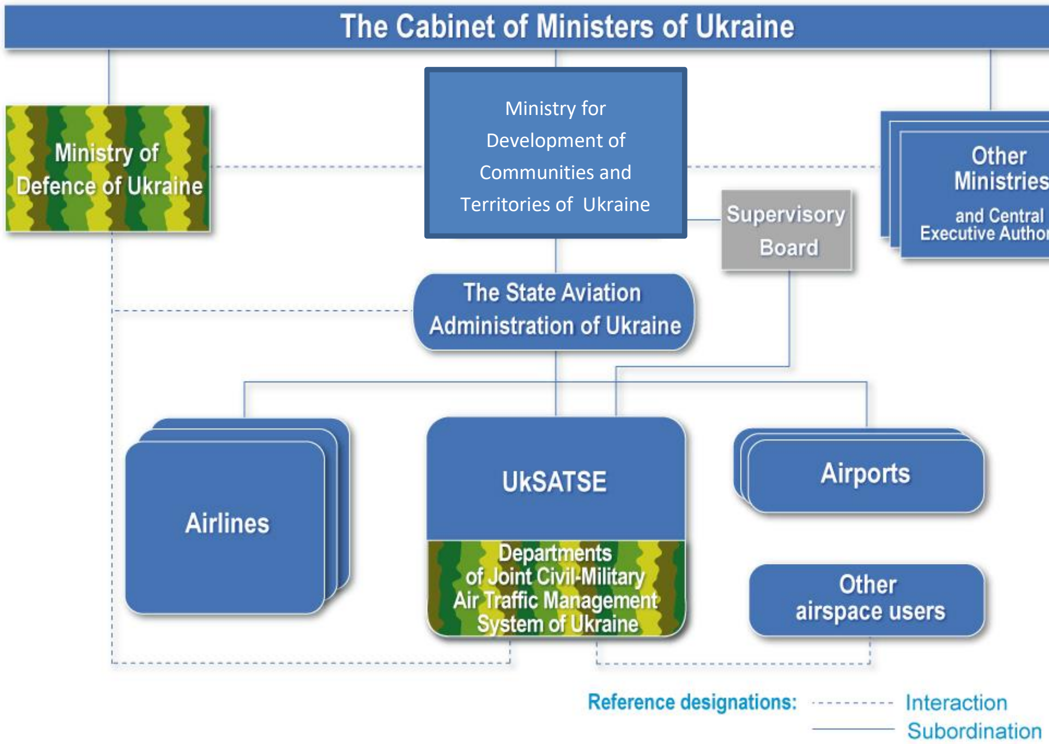
1. IMPROVED AIR TRAFFIC MANAGEMENT AND INFRASTRUCTURE USE

Ukraine contributes to the implementation of the European Air Traffic Management (ATM) Master Plan which is the main planning tool for in the airspace of the 44 European Civil Aviation Conference (ECAC) States. It defines the development and deployment priorities needed to deliver the Single European Sky ATM Research (SESAR) the performance ambition for the ECAC area, which is quantified in the ECAC baseline scenarios and expected results.

The main National Stakeholders involved in ATM in Ukraine are the following:

- The Regulator, the State Aviation Administration (SAA);
- Air Navigation Service Provider, UkSATSE;

Their activities are detailed in the following subchapters and their relationships are shown in the diagramme below.



The **Ukrainian State Air Traffic Services Enterprise (UkSATSE)** is undertaken a set of measures for the optimization of the national **Air Navigation System and the Integrated Civil-Military Air Traffic Management System of Ukraine (ICMS)**.

Its main activities include the following:

Implementation of Performance-Based Navigation (PBN):

a) **Introduction of Performance-Based Navigation (PBN)**

PBN is one of the main initiatives of the ICAO Global Air Navigation Plan and is one of the activities in modernization of Ukrainian airspace. Implementation of PBN will contribute to the optimization of the Ukrainian airspace, with a positive effect on fuel efficiency and related CO_2 emissions both in the Terminal areas and en-route airspace.

In order to implement PBN in a harmonized way, Ukraine developed the document named 'Implementation of PBN: Strategy and Roadmap 2013-2025'. This document was approved at the SAA level in 2013 and presented to the community at one of EUR PBN TF regular meetings.

This document distinguishes the following timeline:

short term:	**now – end of 2015;**
medium term:	**2016 – end of 2019;**
long term:	**2023+.**

At the 36th Session of the ICAO Assembly, it has been agreed by Resolution A36/23: ―All the contracting States should have a PBN implementation plan in place by 2009 to ensure a globally harmonized and coordinated transition to PBN by 2016.‖

This resolution was superseded in 2010 by the 37th ICAO Assembly Resolution A37/11 with the following specific requirements:

-Implementation of RNAV and RNP operations (where required) for en route and terminal areas according to established timelines and intermediate milestones;

- Implementation of approach procedures with vertical guidance (APV) (Baro- VNAV and/or augmented GNSS), including LNAV only minima for all instrument runway ends, either as the primary approach or as a back-up for precision approaches by 2016 with intermediate milestones as follows: 30 per cent by 2010, 70 per cent by 2014; and

- Implementation of straight-in LNAV only procedures, as an exception to 2) above, for instrument runways at aerodromes where there is no local altimeter setting available and where there are no aircraft suitably equipped for APV operations with a maximum certificated take-off mass of 5 700 kg or more.

In complement to the global ICAO intention the following pan-European tasks were assessed and legally approved in Local Single Sky Implementation (LSSIP) Ukraine (formally known as LCIP) document:

- NAV03: Implementation of Precision Area Navigation RNAV (P-RNAV);

- NAV10: Implement Approach Procedures with Vertical Guidance (APV).

By introducing the PBN environment supported by GNSS technology, SAA wants to facilitate more efficient use of airspace and more flexibility for procedure design, which cooperatively result in improved safety, capacity, predictability, operational efficiency, fuel economy, and environmental effects.

Objectives

The strategic objectives established by SAAU in accordance with ICAO framework for Ukrainian air navigation system up to 2025 are:

- to improve flight safety by recognition of multi-constellation GNSS navigation with a backup ground-based infrastructure;
- to develop a interoperable harmonised CNS/ATM system supported by modern ATM techniques, flow performance metrics and perspective CNS capabilities;
- to improve airports accessibility with GNSS/APV approaches;
- to improve operational efficiency by implementation of CDO, Free Routes and ETA concepts;
- to protect environment by reducing fuel emission, noise pollution over sensitive areas.

More efficient air traffic management on terminal control area (tma):

b) **TMA implementation of PBN**

Based on the global planning by the ICAO Assembly Resolution A37/11 and the regional planning by EUROCONTROL, legally approved in Local Single Sky Implementation (LSSIP) Ukraine (formally known as LCIP), taking into account the high level of PBN equipage of international traffic to/from Ukraine and the relative low PBN equipage of domestic traffic, the following principles were applied for the implementation roadmap for TMA's in Ukraine:

- *At short term perspective RNAV 1 is introduced to facilitate IFR traffic in all TMA's with considerable international traffic with a temporary exemption for GA and domestic air traffic to follow conventional routes.*

- *At medium term perspective RNAV 1 will become mandatory for all IFR traffic in all TMA's serving international flights. Timing will be dependent on operational need and aircraft equipage. Consideration be given to A-RNP introduction in Kyiv TMA. At domestic aerodromes RNAV 1 will be introduced only if there is an operational need.*

- *At long term perspective A-RNP is introduced for all IFR traffic in all TMA's serving international flights. Consideration will be given to A-RNP mandatory in Kyiv TMA. This also implies that mandatory carriage of GNSS is needed. A-RNP mandatory in other TMA's only if there has been shown an operational need and adequate aircraft PBN equipage for minimum 90 % of all traffic.*

Currently RNAV 1 ICAO PBN specification is implemented in following TMAs:	
Kyiv TMA	**AIRAC AMDT 04/12 EFF 31 MAY 2012**
Kharkiv TMA	**AIRAC AMDT 03/12 EFF 03 MAY 2012**
Dnipropetrovs'k TMA	**AIRAC AMDT 05/12 EFF 23 AUG 2012**
L'viv TMA	**AIRAC AMDT 07/12 EFF 13 DEC 2012**
Odesa TMA	**AIRAC AMDT 01/14 EFF 06 FEB 2014**

Detailed planning information is contained in 'Implementation of PBN: Strategy and Roadmap 2013-2025', which is publicly available at the SAA' official web site

c) Continuous Descent Operations

Implementation of Area Navigation, is expected to facilitate the development of Continuous Descent Operations (CDO) procedures in a second phase.

CDO in Kyiv (Boryspil') Airport was implemented in the end of 2013.

Implementation of CDO in Kyiv (Zhuliany), Odesa, Dnipropetrovs'k, L'viv and

Kharkiv (Osnova) Airports is expected to be done around 2015 – 2016.

Continuous Descent Operations (CDO) describes the optimum way to reduce noise and emissions produced during the approach. The procedure makes full advantage of the onboard Flight Management System by planning an uninterrupted idle decelerating descent to intercept final approach landing. This not only minimizes noise disturbance, it also reduces fuel consumption and emissions during the approach phase.

The procedure requires air traffic control to apply specific, or minimum, speeds to inbound aircraft and to pass adequate ―range from touchdown‖ information to a pilot to ensure he can manage his aircraft's vertical profile. Such speed control maximizes runway capacity.

The nature and extent of the benefit from CDO will vary depending on the local situation but would typically include significant reductions in noise, fuel and emissions in the areas prior to the point at which the Instrument Landing System (ILS) is acquired for the approach. This is usually between 10 and 25 nautical miles (18-37 kilometers) from the airport.

Taking into account the facts that the aircraft guidance system needs some time to capture the ILS localizer and glide slope and the aircraft has to be stabilized for landing in a timely manner, it is preferable to intercept the final straight in segment not later than at a height of approximately 2000 ft AAL. The final straight in segment of the CDO includes the avoidance of the application of noise and drag produced by flaps and undercarriage until the latest possible moment.

All of these improvements depend on the provision of accurate real-time data on aircraft position and intent, and improvements in flight data processing systems and CNS systems, particularly data communications. They also depend on new technology in navigation systems performance.

d) **Collaborative Environmental Management**

Ukraine is studying the implementation of Collaborative Environmental Management (CEM) on Kyev Boryspil airport by dec 2013.

CEM is a commonly agreed strategic management process for establishing an airport environmental partnership, between the key operational stakeholders at an airport. This partnership will prioritise and meet environmental challenges caused by the direct environmental impacts of aircraft operations.

In more mature CEM levels, the stakeholders at an airport will work collaboratively to enhance an airport‘s environmental performance, by introducing a range of practical improvements. Key CEM aims include:

■ a more unified and coordinated interface between airport operational stakeholders;

■ reduction of the risk of environmentally related conflict between the stakeholders;

■ to facilitate links between CEM airports to foster sharing of good practice

More efficient air traffic management on en-route operations:

e) **RVSM airspace**

Reduced Vertical Separation Minimum (RVSM) is applicable in volume of Ukraine airspace between FL 290 and FL 410 inclusive, except for State aircraft.

f) **Flexible Use of Airspace (civil/military)**

Ukrainian authorities through enhanced civil/military coordination, established a national framework for the flexible use of Airspace (civil/military), ensuring that any airspace segregation is temporary and based on real use for a specified time period according to user requirements.

According to ICAO and EUROCONTROL recommendations, the implementation of the FUA concept has benefits in both civil and military aviation with:

Increased flight economy offered through a reduction in distance, time and fuel;

The establishment of an enhanced Air Traffic Services (ATS) route network and associated sectorisation providing:

- An increase in Air Traffic Control (ATC) capacity;
- A reduction in delays to General Air Traffic;
- More efficient ways to separate Operational and General Air Traffic;
- Enhanced real-time civil/military co-ordination;
- A reduction in airspace segregation needs;

The definition and use of temporary airspace reservation that are more closely in line with military operational requirements and that better respond to specific military requirements.

The implementation of Advanced Airspace Management (LSSIP AOM19) is planned by the end of 2016.

The improved planning process refers to the use of specific procedures allowing Aircraft Operators (AOs) to optimise their flight planning in order to achieve a more efficient utilization of available airspace through more dynamic responses to specific short notice or real-time airspace status changes, requirements and route optimisation at the pre-tactical and/or tactical levels.

Consequently, the implementation of Advanced Airspace Management (LSSIP AOM19) will lead to the next expected environment benefits: aircraft emissions will be reduced through the use of more optimum routes/trajectories.

g) **En-route Area Navigation (RNAV)**

In 1998, B-RNAV became mandatory as the primary means of navigation in all ECAC en-route airspace from FL95 and above while VOR/DME should remain available for reversionary navigation and for use on domestic ATS routes in the lower airspace, as appropriate.

The development of PBN for en-route operations in Ukraine airspace should be in line with European planning as developed by the ICAO European Program coordinating Group.

In accordance with ‘Implementation of PBN: Strategy and Roadmap 2013-2025’ approved by SAA in 2013, Ukraine plans to implement (B) RNAV -5 and (P) RNAV 1 in the following steps:

Presently	**RNAV- 5 above FL 275;**
2013 - 2016	**RNAV- 5 (upper and lower airspace);**
2016+	**RNAV 1.**

h) **Free Route Airspace Concept**

Since 05 March 2015 Ukraine has implemented Free Route Airspace (FRAU) Step 1 during the Night Time within 4 current UTAs: (UTA L'viv, UTA Kyiv, UTA Dnipropetrovs'k-North, UTA Odesa-North) from FL275 to FL660.

The implementation of FRAU allows airspace users to reduce flight distances and flight time due

to more available direct flights within FRAU, and as a result to reduce fuel burn and CO_2 emissions.

The development of FRAU Step 2 is discussed, that will include flight operations within defined airspace during H24. That will result in an improved capacity, flexibility and flight efficiency which will generate cost savings for aircraft operators while maintaining safety standards. This Step is quite actual for Ukraine because mainly flight operations are during Day Time.

Calculations in other European Airspaces show that the concept can drive to an average saving of between 1-1,5 % (fuel and flying time).

This section includes information on the basket of possible measures to be taken in Ukraine, according to the capacity of national key agents to implement then.

Flexible use of airspace:

i) **Implementation of scenario 1b of the Airspace of Free Routes of Ukraine (FRAU)**:

According to the plan for the implementation of changes in the ATS system related to the implementation of the airspace of free routes of Ukraine (Stage 1, scenario 1b), the implementation of scenario 1b FRAU is divided into the following phases:

phase 1 - implementation of FRA H24 procedures within the FRA Lviv district. Implemented - December 6, 2018;

phase 2 - implementation of regional FRA H24 procedures within the FRA KIDRO area, which will cover the airspace elements of UTA Kyiv, UTA Dnipro-North and the ATS sector of UTA Dnipro-South DVS. Introduced - May 23, 2019;

phase 3 - implementation of FRA H24 procedures within the FRA Odesa area (within the UTA Odesa-North).

Implementation of FRA-H24 in FRA Odesa (UTA Odesa-North) (Phase 1, Scenario 1b, Phase 3) allowed to optimize the structure of UTA Odesa-North and FIR Odesa airspace, to provide more flexible use of available airspace, to simplify R & D procedures for ATS, air traffic management, airspace management and civil-military coordination in ATS. For operators, this simplifies flight planning and provides an additional opportunity to reduce fuel consumption, reduce flight time and emissions.

j) **Introduction of advanced flexible use of airspace (A-FUA)**

The development of airspace management is taking place in accordance with EU legislation and is being improved in accordance with the concept of improved flexible use of airspace A-FUA, which will improve the coordination of the needs of civilian and military airspace users and address the following:

- implementation of advanced ASM rules and procedures (Airspace management, airspace management);
- ensuring flight safety during flights of civil and state aircraft (AIR), carrying out other activities on the use of airspace;
- ensuring the need to use the airspace of different categories of users;
- improving the attractiveness of Ukrainian airspace for operators;
- increase in transit air traffic flows;

- increasing the efficiency of flights of aircraft operators and the use of airspace;

- reduction of emissions of harmful substances by reducing the length of flight routes of aircraft;

- improving control over the use of Ukrainian airspace.

Next steps

In order to achieve operational and economic goals, to harmonize the airspace of Ukraine with the European network and simplify the use of airspace by operators, it is planned to implement the following projects:

- further implementation of the regional FRA within the airspace of Ukraine and in cooperation with related providers of AIEs should allow airlines to use more direct and efficient trajectories;

- to improve flight efficiency in the aerodrome area at the busiest aerodromes and in the terminal control areas, new ATS techniques will be introduced using A-CDM (Airport Collaborative Decision Making), AMAN (Arrival management, arrival management system), DMAN (Departure management, system departure management). For incoming air traffic, improved interaction will be introduced between the authorities providing the district air traffic control service and the air traffic control service approach;

- The introduction of A-FUA will improve the coordination of the needs of civilian and military airspace users

- implementation of CCO procedures (Continuous climb operations) will satisfy the requirements of airlines for optimal altitude schemes both in the route segment and in the terminal airspace;

- Improved and joint planning of the airport according to the A-CDM concept for operators will reduce the number of delays on the ground and thus save fuel due to reduced taxiing time.

2. AIRCRAFT RELATED TECHNOLOGY DEVELOPMENT

Research & Development

Ukraine-based Antonov Design Bureau, a scientific and technical complex named after Oleg Konstantinovich (O.K.) Antonov, designs transport, regional, and special purpose aircraft. The bureau is engaged in designing and building new prototype aircraft and modifications of earlier designs, providing their operational support and follow-up engineering work on the aircraft service life extension. Specifically, Antonov offers basic and conversion training of flight and maintenance crews, sends high-skilled specialists to render assistance in mastering the aircraft and training local personnel, provides international air transportation of cargoes including oversized ones on a charter basis, participates in the international co-operation in the field of aircraft and equipment design and manufacture, and develops land transit vehicles. Among its designs are the An-124 and the An-225, the world's largest plane, which can carry things no other aircraft can. The An-124 was originally designed for military use, while the An-225 was designed to carry the Soviet space shuttle. These giants have been marketed in the West since the late 1980s. Besides enjoying a corner on the outsized air freight market, Antonov aircraft have made possible previously inconceivable logistical undertakings, and their ability to quickly transport huge pieces of equipment across the world has saved mining, construction, and manufacturing industries from costly downtime.

Fields of commercial activity of Antonov include:

- Aircraft construction and manufacture
- Airfreight services (Antonov Airlines)
- Aircraft maintenance and upgrading
- Aerospace related engineering support
- Operation of the Gostomel airport (Antonov Airport)
- Trolley bus construction and manufacture (a spin-off, using existing technical expertise).
- Air Start project. Satellite launch from the modified version of Ruslan.

The State Aviation Administration of Ukraine has undertaken a consultation process with national stakeholders, to identify the potential basket of measures currently ongoing or planned to be implemented, that could have potential CO_2 emissions reductions in international flights.

The air traffic forecast is based on actual data on the performance of flights in the shortest possible time, taking into account the reduction in air traffic 2014 - 2016 due to restrictions on the use of airspace over the Black Sea and bans on the use of airspace within the established airspace of the Dnieper and Simferopol districts of Polish information (FIR), caused by a temporary employee of the Russian Federation of the Autonomous Republic of Crimea and the situation in Ukraine.

As a result, air traffic in 2014 decreased by 35% compared to 2013, and in 2015 and 2016 continued to decrease by 33% and 8.7%, respectively.

Since 2017, there has been a steady trend of increasing air traffic: + 19% - until 2017, + 18% - until 2018, + 11.5% - until 2019. In 2020 and 2021, due to the spread of COVID-19 coronavirus in Ukraine and other countries, a number of measures have been taken to combat the pandemic (in particular, scheduled air travel has been restricted). As a result, in 2020 there was a drop in air traffic by 59%

At the beginning of 2022, in connection with the invasion of Ukraine by the Russian Federation and the introduction of martial law on the territory of Ukraine, in accordance with Part Two of Article 9 of the Law of Ukraine "On the Legal Regime of Martial Law", Paragraph One of Clause 1 of the Law of Ukraine "On Protection of the Interests of Reporting Entities and Other Documents for the Period of Military or War", Article 11 of the Air Code of Ukraine, the Regulation on the State Aviation Administration of Ukraine, approved by Resolution of the Cabinet of Ministers of Ukraine dated October 8, 2014 No. 520, the airspace over the territory of Ukraine was closed.

3. ANALYSIS AND PROPOSALS OF MEASURES IN THE FIELD OF CARBON DIOXIDE REDUCTION, AIRPORTS SECTION

National Mitigation measures selected	Estimated benefits per year
Application of the Automated Building Management System, introduction of new lighting systems	The use of LED technology saves 50% of electricity compared to the use of fluorescent lamps, also reduces the amount of hazardous waste - used fluorescent lamps
Installation and use of service systems at airports (as an example, stationary aerodrome ground power units AXA 2300 Power Coil (type 3GVC-200/260-N) and stationary aerodrome air conditioning units SIAT aircraft (type PCA B.03) integrated into telescopic ladders type APRON DRIVE	Reduction of electricity consumption by 17%
Use of service systems such as mobile converters static APOJET S 400Hz 90kVA on air bridges 2, 2A and in the hangar. **The purpose of the event:** **- reduction of CO_2 emissions;**	

- exclusion of costs for the purchase of fuel	
Implementation of the Continuous Climb Operations (CCO) method	
Runway use (during landings): the use of minimum radar intervals at the final stage of approaching the runway provides optimal runway use time and minimizes the probability of the next ACFT entering the second round. **Objective: To reduce the time spent on the runway.**	**Saving aviation kerosene in one operation is close** **1000 kg**
Purchase of 5 units of electric tractors with replaceable batteries	**Reduction of CO_2 emissions (2-4%) into the atmosphere by minimizing the use of groundwater with internal combustion engines for ground maintenance**
Decommissioned vehicles with diesel engines of Euro1 standard: platform buses "Neoplan -9012" - 6 units, "Neoplan -9022" - 1 unit, "Neoplan -9122" - 2 units; **Decommissioned vehicles that ran on A-76, A-80 gasoline (A-76, A-80 gasoline are not used at the enterprise).**	**When the fleet was renewed, emissions were reduced from 7 to 15%**
Renewal of the trailer fleet; purchased: **- GPU - 2 units;** **- Tricks - 2 units with environmental emission standards of Euro 5;** **- marking machines - 1 unit with environmental emission standards Tier4 * (instead of Euro 1);** **- bitumen-smelting boiler - 1 unit with environmental emission standards Tier4 * (instead of Euro 1).** **Objective: to reduce greenhouse gas emissions in exhaust gas mixtures from car engines.**	**Emissions reduced to** **10%**
Technical re-equipment of the fuel boiler house: **Purpose: to reduce the use of natural gas, as well as heat loss in the production and transfer of thermal energy by replacing steam boilers E-1 / 9G with a steam capacity of 0.9 t. Steam / h for two gas boilers with a capacity of 98 kW each.**	**Natural gas use decreased by 15-20%**

Use of thermal energy produced at installations from non-traditional or renewable energy sources **Objective: to reduce the use of natural gas in thermal energy production** **Purchase of thermal energy produced by KYIV GREEN ENERGY LLC at its own installation from a renewable energy source.**	**Purchase of 19,000 Gcal / year ensures the exclusion of consumption of 2.5 million m3 of natural gas**

ESTIMATED BENEFITS AND CONCLUSION

The State Aviation Administration of Ukraine through the measures included in this Action Plan is willing to contribute achieving ICAO's climate change goals for international aviation, as stated in Assembly Resolution A37-19: A global **annual average fuel efficiency improvement of 2 per cent until 2020** and an aspirational **global fuel efficiency improvement rate of 2 per cent per annum from 2021 to 2050**, calculated on the basis of volume of fuel used per revenue tonne kilometer performed;

The estimated expected benefits in terms of fuel savings and emissions reductions of the basket of measures included in this plan are already estimated among the common ECAC estimated benefits of implemented measures.

Nevertheless, and following ICAO guidance, the following estimation quantifies the contribution of Ukraine to the common ECAC estimated benefits:

AIRCRAFT RELATED TECHNOLOGY DEVELOPMENT:

2 % annual efficiency improvement (accumulated 16%) till 2020 (including RTK efficiency optimization, through adaptation of aircraft fleets to specific airline's needs)

IMPROVED AIR TRAFFIC MANAGEMENT AND INFRASTRUCTURE USE

5 % accumulated efficiency improvement in 2020

BASKET OF POSSIBLE OPERATIONAL OR ADDITIONAL MEASURES TO BE TAKEN IN UKRAINE, ACCORDING TO THE CAPACITY OF NATIONAL KEY AGENTS

6 % accumulated efficiency improvement in 2020

EXPECTED RESULTS:

The estimated results in terms of fuel and CO_2 emissions savings are summarized in the following table:

Year	Tot RTK	Int RTK	Tot Fuel (L) after measures	Int Fuel (L) after measures	Tot CO_2 (Kg) after measures	Int CO_2 (Kg) after measures
2012	1062000000,00	1002460838,00	376636412,20	289971227,70	951232922,66	732351332,68
2013	767000000,00	705402743,00	266574882,86	203279212,83	673261524,15	505027794,55
2014	718000000,00	692000000,00	244451926,75	198666253,43	617387786,19	485321340,13
2015	301560000,00	290640000,00	100530854,87	83124562,61	253900727,07	199588401,13
2016	291005400,00	280467600,00	94948184,00	79910973,33	239801133,50	188504875,02
2017	314285832,00	302905008,00	100314820,48	85975283,23	253355110,61	199159498,39
2018	340057270,22	327743218,66	106128621,63	92669745,92	268038446,80	210701897,77
2019	364881450,95	351668473,62	111287919,86	99053174,57	281068770,39	220944883,21
2020	391152915,42	376988603,72	116526216,36	105776075,02	294298612,05	231344707,48
2021	416577854,92	401492862,96	121145648,51	112216011,44	305965449,88	240515872,67
2022	437823325,52	421968998,97	124218611,30	117481308,64	313726524,70	246616763,10
2023	460152315,12	443489417,92	127289916,47	122991792,31	321483413,03	252714362,56
2024	483620083,19	466107378,23	130351402,15	128758776,43	329215501,27	258792466,98
2025	508284707,44	489878854,52	133394078,30	134794091,27	336900084,16	264833227,98