State Aviation Administration

Action plan of Ukraine for reducing aviation CO_2 emissions

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29 May 2016

DOCUMENT APPROVAL

The following representatives have successfully approved the present issue of the document and their signature reflects the confirmation of their participation of the performance improvement process and their commitment to implement the actions indentified in the Action Plan.

Official's Name	Position	Signature
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FOREWORD

Ukraine supports the position to comply a global approach for monitoring and reducing of aviation emissions that includes implementation of the ICAO Resolution A37-19 provisions (Consolidated statement of continuing ICAO policies and practices related to environmental protection – Climate change), encourages States to submit their action plans outlining their respective policies and actions to achieve 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.

According to the decision of the European Civil Aviation Conference all ECAC Member States, including Ukraine, agreed to provide its National Plan to ICAO and coordinated the format of such plan.

State aviation administration of Ukraine with the support of leading scientists and experts was created the Working Group for development of the Action Plan with the assistance of aviation industry representatives whose activity may affect on the final result: airlines, airports, fuel suppliers, air navigation service provider, etc.

The objective of Ukrainian action plan is to calculate and forecast the CO_2 aviation emission and implementation of appropriate measures to reduce and prevent pollution.

ACTION PLAN OF UKRAINE

Content

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INTRODUCTION

Ukraine is a member of the International Civil Aviation Organization (ICAO) from 09 September 1992, European Civil Aviation Conference (ECAC) from 15 December 1999 and European Organization for the Safety of Air Navigation (EUROCONTROL) from 1 January 2004. ECAC is an intergovernmental organisation covering the widest grouping of Member States[1] of any European organisation dealing with civil aviation. It is currently composed of 44 Member States, and was created in 1955.

Ukraine is also member of the World Trade Organization (WTO) from 2008 year

ECAC States share the view that environmental concerns represent a potential constraint on the future development of the international aviation sector, and together they fully support ICAO's ongoing efforts to address the full range of these concerns, including the key strategic challenge posed by climate change, for the sustainable development of international air transport.

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

Ukraine recognises the value of each State preparing and submitting to ICAO a State Action Plan on emissions reductions, as an important step towards the achievement of the global collective goals agreed at the 37th Session of the ICAO Assembly in 2010.

In that context, all ECAC States submitting to ICAO an Action Plan, regardless of whether or not the 1% de minimis threshold is met, thus going beyond the agreement of ICAO Assembly Resolution A/37-19. 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:

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

In Europe, many of the actions which are undertaken within the framework of this comprehensive approach are in practice taken at a supra-national level, most of them led by the EU. They are reported in Section 1 of this Action Plan, where Ukraine's involvement in them is described, as well as that of stakeholders.

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

In relation to actions which are taken at a supranational level, it is important to note that:

The extent of participation will vary from one State and another, reflecting the priorities and circumstances of each State (economic situation, size of its aviation market, historical and institutional context, such as EU/ non EU). The ECAC States are thus involved to different degrees and on different timelines in the delivery of these common actions. When an additional State joins a collective action, including at a later stage, this broadens the effect of the measure, thus increasing the European contribution to meeting the global goals.

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

Nonetheless, acting together, the ECAC States have undertaken to reduce the region's emissions through a comprehensive approach which uses each of the pillars of that approach.

CURRENT STATE OF AVIATION IN UKRAINE

Structure of aviation sector

President of Ukraine and Cabinet of Ministers of Ukraine shall ensure implementation of the aviation development policy of Ukraine in accordance with the Constitution and Laws of Ukraine.

Authorized body for civil aviation is the Central Executive (governmental) Body on Civil Aviation that shall be established and which status shall be defined by the President of Ukraine (hereinafter referred to as the Civil Aviation Authority). Authorized executive body for state aviation is the Ministry of Defense.

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

State Aviation Administration of Ukraine (SAAU) is a Civil Aviation Authority of Ukraine established by the Cabinet of Mibisters of Ukraine Edict from 08October 2014 №520/

State Aviation Administration of Ukraine shall implement the Ukraine's state policy and strategy for aviation development, and it shall exercise regulation of civil aviation in such areas:

- ensuring aviation safety, aviation security, ecological safety, economic and information security;
- creation of conditions for development of aviation activity, air transportation and its servicing, exercising aerial works and flights of general aviation;
- air traffic management and airspace regulation of Ukraine;
- representation of Ukraine in the international civil aviation organizations and in external relations in the field of civil aviation;
- drafting, adoption and implementation of aviation rules;
- certification of aviation entities and facilities;
- issue of licenses for economic activities pertaining to rendering services on transportation of passengers and/or cargo by air as well as authorization of air lines operation and assignment to air carriers;
- continuous supervision and monitoring of the observance of the requirements set by legislation, including aviation rules of Ukraine.

State Aviation Administration of Ukraine is a duly authorized and independent body with regard to ensuring utilization of the airspace of Ukraine by aviation entities of Ukraine and oversight the provision of air navigation services.

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

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

The **Ukrainian State Air Traffic Service Enterprise (UkSATSE)** is the main air navigation services provider of Ukraine as well as core for the Integrated Civil-Military Air Traffic Management System of Ukraine (ICMS). The Enterprise is authorized by the Governmental Regulation Body for provision of Air Navigation Services in the ATS airspace of Ukraine and in the part of the high seas of the Black Sea, where the responsibility for the provision of ATS is delegated to Ukraine (hereinafter referred to as ATS airspace of Ukraine) by International Civil Aviation Organization (ICAO). This identifies 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;
- radio-technical and electrical provision of ATS and flight operation;
- provision of activity and development of the Joint Civil-Military ATM System Units;
- alerting Services and participation in Search and Rescue operations;
- provision of airspace users with Aeronautical Information;
- modernization and development of the Air Navigation System of Ukraine;
- training and refresher training of the UkSATSE experts;
- provision of social development and security of its personnel.

The Ukrainian State Air Traffic Service Enterprise web address: http://uksatse.ua

Participation in International Organisations

1992 - Ukraine became the Full Member State of International Civil Aviation Organisation (ICAO)
1994 - Accession of UkSATSE to International Federation of Air Traffic Controllers' Associations (IFATCA)
1995 - Signature of Bilateral Agreement between Ukraine and Central Route Charges Office (EUROCONTROL)
1997 - Accession of UkSATSE to Air Traffic Control Association (ATCA)
1997 - Introduction of new Flight Information Region (FIR) boundaries over the Black Sea
1998 - UkSATSE became a founder member of Civil Air Navigation Services Organisation (CANSO)
1999 - Ukraine became the Member State of 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 Ukrainian Parliament
1999 - UkSATSE joined International Organisation Information Co-ordinating Council on Air Navigation Charges (IKSANO)
1999 - Conclusion of Agreement between UkSATSE and the EUROCONTROL Central Flow Management Unit (CFMU)
2000 - UkSATSE became the 33rd Member State of International Federation of Air Traffic Safety Electronics Associations (IFATSEA)
2003 - UkSATSE initiates creation of the Regional Air Navigation Services Development Association (RADA)
2004 - Ukraine became the 33rd Member State of EUROCONTROL. Experts of UkSATSE are fully engaged in EUROCONTROL activities
2005 - Contract between SELEX Sistemi Integrati S.p.A. (Italy) and UkSATSE for Supply and Installation of Approach Radars (Dnipropetrovs'k, Kyiv, L'viv, Odesa, Simferopol')
2006 - Ukraine hosted 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

Aviation degree in Ukraine can be obtained in three aviation universities. Kyiv National Aviation University is recognized as a leader of higher aviation education in Ukraine. Kyiv Aviation University cooperates closely with Civil Aviation authorities across the world and even has a special ICAO institute in its structure.

Kirovograd flight academy is famous for pilot training and Kharkov Aerospace academy is recognized for preparing best specialists in the fields of space research, aircraft manufacturing and aeronautical engineering. Kharkov University is closely connected to the industry.

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 directed to fulfill the obligations of Ukraine within the framework of the international treaties.

The major legislative document of Ukraine in aviation activity is Air Code of Ukraine in force since 19 May 2011 № 3393–VI which regulates among other questions the question of environmental protection. This chapter include requirements about:

- Maximum acceptable level of aviation noise, air engine emissions established by the Aviation Rules of Ukraine.
- Compensation for damage caused as result of the aviation activity.
- Limitations and prohibitions for civil aircraft if they exceed noise levels established by the Civil Aviation Authority.
- Limitations and prohibitions taking account taking account of measures aimed to reduction of noise levels at the airport and in its vicinity including:
- Technical noise reduction at the source.
- Space zoning of the airport adjacent territory and a proper zone planning.
- Operational measures to reduce aircraft noise and emissions.
- The cost of the measures aimed at reduction and prevention in noise and emissions shall be funded by airport taxes taking account ICAO recommendations.

Other Laws of Ukraine in environmental field:

- "About atmospheric air protection", from 16.10.1992, № 2708-XII
- "About ecological expertise", from 09.02.1995, № 46/95-BP
- "About sanitary and epidemiological population welfare ", from 24.02.1994, № 4005-XII
- "About environmental protection", from 26.06.1991, № 1268-XII
- “About high danger objects”, from 15.05.2003, № 762-IV
- “About main strategy in state ecological policy of Ukraine for 2020 year”from 21.12.2010 № **2818-VI**

Convention on International Civil Aviation, signed at Chicago on 7 December 1944, hereinafter referred to as the Chicago, ratified by Ukraine on 10 August1992, Ukraine has the obligation to implement and enforce such provisions of Convention, as well as standards set out in annexes.

United Nations Framework Convention on Climate Change, ratified by 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 corresponds to Annex I countries which have ratified the Protocol have committed to reduce their emission levels of greenhouse gasses to targets that are mainly set below their 1990 levels. They may do this by allocating reduced annual allowances to the major operators within their borders. Ukraine adopted list of regulations concerning prevention of climate change. Among them Law of Ukraine "About atmospheric air protection" from 16.10.1992, № 2708-XII.

Kyoto Protocol to the United Nations Framework Convention on Climate Change, adopted by Ukraine on 04 February, 2004.

Committee on Aviation Environmental Protection. ICAO's current environmental activities are largely undertaken through the Committee on Aviation Environmental Protection (CAEP), which was established by the Council in 1983, superseding the Committee on Alircraft Noise (CAN) and the Committee on Aircraft Engine Emissions (CAEE).

CAEP assists the Council in formulating new policies and adopting new Standards on aircraft noise and aircraft engine emissions.

Ukraine is a member of CAEP and took active part in working groups and steering groups.

National Airlines network

List of national airlines that include carriers executing regular and charter flights

№	Operator
1.	Limited Liability Company “Kharkiv Airlines”
2.	Limited Liability Company “Air Company Aviaexpress”
3.	Limited Liability Company “Ukrainian-Mediterranean Airlines Ltd”
4.	Limited Liability Company “Wind Rose” Aviation Company
5.	Limited Liability Company “Aircompany “Meridian”, Ltd
6.	Private joint-stock company “Bukovyna” airlines”
7.	Limited Liability Company "BUSINESS JET TRAVEL" AIRLINE" LTD
8.	Limited Liability Company “ YanAir”
9.	Limited Liability Company “Aircompany “ZetAvia”
10.	Limited Liability Company “Eleron”
11.	Limited Liability Company “Ukrainian Airlines company “AEROSTAR”
12.	Private Corporation “International Joint-Stock Aviation Company “Urga”
13.	Limited Liability Company Wizz Air Ukraine Airlines LLC
14.	Limited Liability Company “Utair-Ukraine Airlines” Limited Liability Company
15.	SE “Production Association Yuzhny Machine–Building Works named after O.M. Makarov” Aviation Transport Company “YUZMASHAVIA”
16.	Limited Liability Company “Atlasjet Ukraine”
17.	Limited Liability Company “Europa Air”
18.	Antonov Company
19.	Joint Stock Company “Aviation Company “Dniproavia”
20.	“DART” Limited Liability Company
21.	Private Stock Company “Ukraine International Airlines”
22.	Limited Liability Company “Avia-Souse”
23.	Private Joint Stock Company “Airline ”Ukraine-AirAlliance
24.	State Air Enterprise “Ukraine”
25.	Limited Liability Company “Maximus Airlines”
26.	Public Liability Company Motor Sich JSC
27.	Limited Liability Company “HASCOM”
28.	DF “Aviaton”
29.	Limited Liability Company “Shovkoviy Shlyah” Ltd
30.	Limited Liability Company “Horisont”
31.	Limited Liability Company Bravo Airways
32.	Limited Liability Company “Aircompany ”ISD Avia” Ltd
33.	Limited Liability Company “Bora”
34.	Flight Scool “Condor”
35.	Limited Liability Company “CAVOK AIR”
36.	Limited Liability Company AEROJET LTD
37.	“Aircompany Constanta” Private Joint-Stock Company
38.	Limited Liability Company “Verus”
39.	Private joint-stock company “Air Columbus”
40.	Kremenchuk Flight College of National Aviation University
41.	Kharkiv Aeroclub named after V.S. Grizodubova of DSS of Ukraine
42.	Joint Stock Company “Aviation Company “Dniproavia”
43.	State Aviation Company “Kherson-Avia”
44.	Crimea State Aviation Enterprise “Universal-Avia”
45.	Opened joint-stock company “Airline of special purpose ”Mykolayiv-Aero”

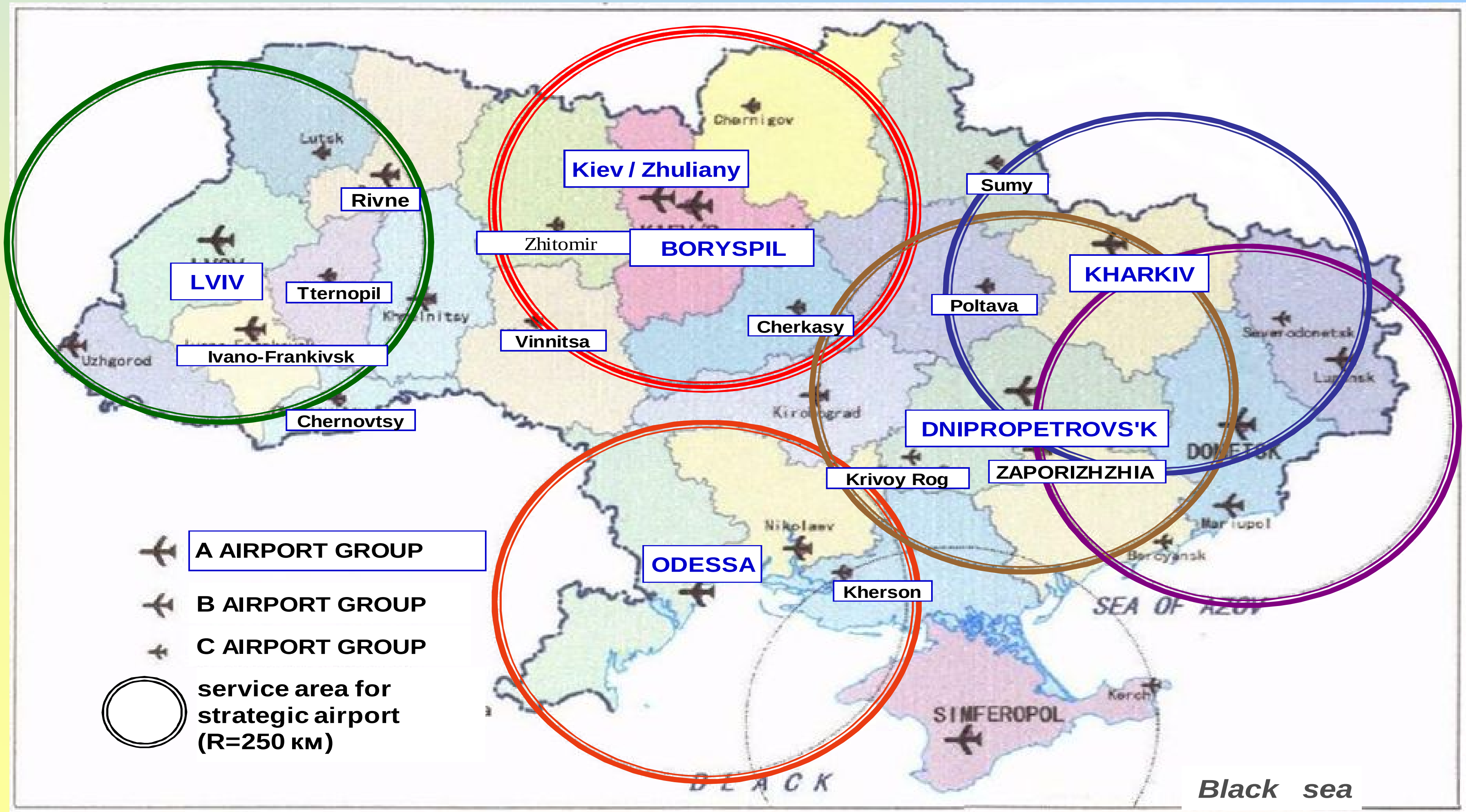
46.	Kirovograd Flight Academy of the National Aviation University
47.	Limited Liability Company Aviation-Transport Agency “Kroonk” Ltd
48.	Ukrainian State Air Traffic Service Enterprise
49.	Limited liability company “Aircompany “Rosavia”
50.	Limited Liability Company “Aircompany ”ISD Avia” Ltd
51.	Limited Liability Company “V-Avia” Airline” Ltd
52.	Limited Liability Company Aircompany “AviaExpress”
53.	Limited Partnership “Airline “Albatros”
54.	Limited Liability Company “Prostor Avia” Ltd
55.	Association with limited liability “Breeze” Ltd
56.	Private Joint Stock Company “Aviation Company “Ukrainian helicopters”
57.	Enterprise “Aviation company “AgroaviaDnipro”
58.	Limited Partnership Production Commercial Firm “Ukraviatechservis”
59.	Private Enterprise “PoltavAvia”
60.	Private Enterprise “Proskuriv-Avia”
61.	Multiprofile Aviation Company “Spets Avia Indastria”
62.	Limited Partnership “Turaerodan”
63.	Limited Liability Company Challenge Aero Ukraine LLC
64.	Limited Liability Company “ORBITA-777” Ltd
65.	“Global Air Company” Limited Liability Partnership
66.	Limited Liability Company “Z-Aero” Airlines”, ltd
67.	Limited Liability Company “Air Taurus”
68.	Private Enterprise “Yunikom Avia”
69.	Private enterprise “Avia-Styl”
70.	Limited Liability Company "Jumisair" LTD
71.	Limited Liability Company “YugAvia” LLC
72.	Limited Partnership “Fenix Air”

National Airports network of Ukraine

Institutionally 18 airports are independent bodies, 2 airports are state-owned enterprises, 14 are municipal enterprises, 4 are community property enterprises.

	AIRPORTS	
1	International airport "Borispol"	State
2	International airport "Dnipropetrovsk"	community property
3	International airport "Kiev" (Zhuliany)	municipal
4	International airport "Ivano-Frankivsk"	community property
5	International airport "Krivyi Rig"	municipal
6	International airport "Lviv"	State
7	International airport "Zaporizhzhia"	municipal
8	Airport Zhitomir	community property
9	International airport "Odessa"	municipal
10	International airport "Chernivtsi"	municipal
11	International airport "Rivne"	municipal
12	International airport "Kharkiv"	community property
14	Airport "Sumy"	municipal
15	Airport "Ternopil"	municipal
16	Airport "Vinnitsa" (Havryshivka)	municipal
17	Airport "Cherkasy"	municipal
18	Airport "Poltava"	municipal

Airport of Ukraine



Economic information related to the contribution of international aviation

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

According to statistics in 2014 operated 142,4 thousand aircrafts (against 212,7 thousand in 2013). Passengers flow through the airports in Ukraine decreased by 28 percent compared to the 2013 and amounted to 10,896.5 thousand passengers, mail and cargo - by 8.9 percent and amounted to 38 thousand. tons.

The main airport of Ukraine "Borispol" operated by 2014 6,888.3 ths. passengers (13 percent less than in 2013). Passengers flow through the airport Kyiv (Zhulyany) decreased by 40.6 percent and amounted to 1092.4 thousand. passengers, Odessa - by 19.2 percent (864 thousand. passengers), Lviv- 16.5 percent (585.2 thousand. passengers), Dnipropetrovsk -by 1.8 percent (446.8 thousand. passengers), Kharkov - by 27.7 percent (437.4 thousand. passengers)

CO2 EMISSIONS INVENTORIES, FORECASTS AND BASELINE CALCULATION

INTERNATIONAL AVIATION CO2 EMISSIONS INVENTORIES

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

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

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

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

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

CO2 EMISSIONS INVENTORIES METHODOLOGY (UNFCCC)

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

For aircraft emissions estimation equipped with jet and turboprop engines, was used method correspond to the **Tier 3a of the IPCC sectoral approach**.

The next tendencies directly affecting the level of aircraft emissions were observed.

In the period of 2001-2004 there was a dramatic increase of the number of domestic flights, and in 2008-2009 dramatic fall, caused by decline of business activity. This led to corresponding changes in the level of CO2 emissions. At the same time there have been changes in the structure of the fleet, which operates domestic flights. Since 2000, there has been a constant renewal of USSR-produced aircraft (AN-24, AN-26, Yak-40, Yak-42) on modern aircrafts (Embraer, Boeing, Airbus), which in 2000 year was made more than 95% of all domestic flights and in 2010 performed about 50% of all domestic flights.

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

Separation of aircraft emission

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

Calculation of aircraft emissions

It was used data based on departures of aircrafts from airports situated on the territory of Ukraine. Data about flight include next information according to each flight:

- date and time of flight;
- depart and destination points;
- air company;
- aircraft code by ICAO.

Assessment of aircraft emissions was making in 2 steps: preliminary data processing and aircraft emissions calculation.

Estimation of aircraft emissions has been produced in accordance with the detailed methodology EMEP/CORINAIR, which correspond to the **Tier 2b**.

Fuel consumption:

Fuel consumption cycle per LTO cycle taken according to the methodology EMEP / CORINAIR, and fuel consumption at cruise was calculated according to the flight length.

The length of the flight was defined as orthodromic distance between departure and destination points, taking into account the deflection coefficient of the actual flight path and orthodromic. Deflection coefficient was taken as 1.095.

For recalculation of jet fuel consumption from mass units into energy units, as shown in the methodology EMEP / CORINAIR, it used low-value calorific capacity equal to 44.59 MJ / kg.

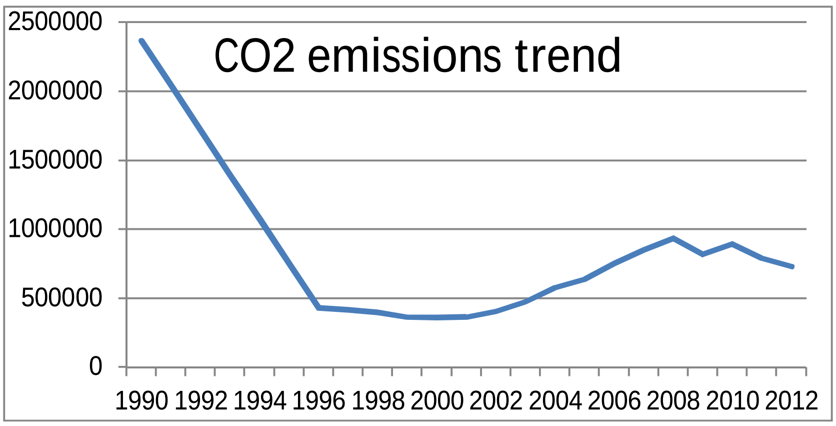
Calculation of CO_2 emissions:

Coefficient of CO_2 emissions for reactive fuel was taken as 19,5 tonne C/TJ.

INTERNATIONAL BUNKERS AND MULTILATERAL OPERATIONS

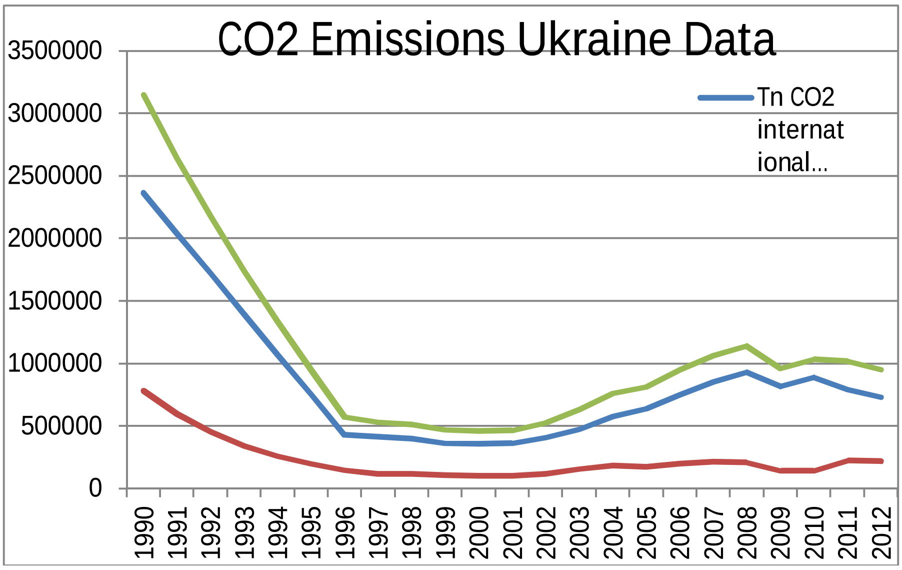
Last data from the Ukrainian National Inventory reported to UNFCCC:

Year	Greenhouse Gas Source	Aggregate Consumption Data	Implied Co2 Emission Factor	Co_2 Emissions
		(TJ)	(t/TJ)	(Gg)
1990	Jet Kerosene	33 118,66	71,50	2 367,98
1991	Jet Kerosene	28 596,93	71,50	2 044,68
1992	Jet Kerosene	24 075,20	71,50	1 721,38
1993	Jet Kerosene	19 553,47	71,50	1 398,07
1994	Jet Kerosene	15 031,74	71,50	1 074,77
1995	Jet Kerosene	10 510,02	71,50	751,47
1996	Jet Kerosene	5 988,29	71,50	428,16
1997	Jet Kerosene	5 809,65	71,50	415,39
1998	Jet Kerosene	5 548,23	71,50	396,70
1999	Jet Kerosene	5 082,83	71,50	363,42
2000	Jet Kerosene	5 036,98	71,50	360,14
2001	Jet Kerosene	5 059,46	71,50	361,75
2002	Jet Kerosene	5 696,22	71,50	407,28
2003	Jet Kerosene	6 650,57	71,50	475,52
2004	Jet Kerosene	8 062,97	71,50	576,50
2005	Jet Kerosene	8 923,37	71,50	638,02
2006	Jet Kerosene	10 529,95	71,50	752,89
2007	Jet Kerosene	11 944,43	71,50	854,03
2008	Jet Kerosene	13 057,95	71,50	933,64
2009	Jet Kerosene	11 457,15	71,50	819,19
2010	Jet Kerosene	12 478,25	71,50	892,19
2011	Jet Kerosene	11 097,27	71,50	793,44
2012	Jet Kerosene	10 242,71	71,50	732,35



TOTAL CO2 EMISSIONS

YEAR	Domestic aviation CO2 emissions, Gg	International aviation CO2 emissions, Gg	TOTAL
1990	781,30	2367,98	3149,28
1991	597,92	2044,68	2642,60
1992	454,03	1721,38	2175,41
1993	343,18	1398,07	1741,25
1994	259,31	1074,77	1334,08
1995	197,50	751,47	948,97
1996	146,14	428,16	574,30
1997	116,23	415,39	531,62
1998	115,07	396,70	511,77
1999	107,68	363,42	471,10
2000	101,04	360,14	461,18
2001	102,06	361,75	463,81
2002	119,09	407,28	526,37
2003	158,46	475,52	633,98
2004	185,45	576,50	761,95
2005	176,06	638,02	814,08
2006	197,16	752,89	950,05
2007	213,06	854,03	1067,09
2008	210,08	933,64	1143,72
2009	143,98	819,19	963,17
2010	141,55	892,19	1033,74
2011	223,46	793,44	1 016,90
2012	222,05	732,35	954,40



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%

Source: EUROCONTROL (Feb. 2015)

BASELINE CALCULATION AND EXPECTED RESULTS

The State Aviation Administration of Ukraine has decided to calculate a Baseline as a suitable element 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. Such "*business as usual*" scenario will be used as the reference to estimate the expected results once the measures identified on the Action Plan are implemented and will represent the projected fuel consumption and CO2 emissions willing to reach as results.

To calculate the baseline for the evaluation of the Action Plan measures, it has been estimated an average year growth of air traffic (RTK) of 5,3% from 2010-2020 and 4,5% from 2020 to 2025 taken from the EUROCONTROL forecasts included in the previous paragraph.

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*.

<u>Historic data sources</u>:

Historic data from 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 (passengers, freight and mail).

METHOD 3 OF ICAO GUIDANCE

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

1. Getting fuel consumption data (volume of fuel) and traffic (RTK) for the latest available years.
2. Determining the RTK future scenarios by considering EUROCONTROL Ukrainian forecasts.
3. Determining 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.

ICAO GUIDANCE METHOD 3 BASELINE CALCULATION FOR UKRAINE:

INTERNATIONAL FUEL CONSUMPTION (L) AND EMISSIONS (Kg CO2)

		INTERNATIONAL			
TRAFFIC FORECAST	**YEAR**	**l Fuel**	**RTK**	**Efficiency factor**	**Kg CO2**
	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 CO2)

	TOTAL				
TRAFFIC FORECAST	**YEAR**	**l Fuel**	**RTK**	**Efficiency factor**	**Kg CO2**
	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

The baseline scenario of ECAC States presents the following sets of data (in 2010) and forecast (in 2020 and 2035), which were provided by EUROCONTROL:

- European air traffic (includes all international and national passenger flight departures from ECAC airports, in number of flights, and RPK calculated purely from passenger numbers, which are based on EUROSTAT figures. Belly freight and dedicated cargo flights are not included),
- its associated aggregated fuel consumption (in million tonnes)
- its associated emissions (in million tonnes of CO_2), and
- average fuel efficiency (in kg/10RPK).

The sets of forecasts correspond to projected traffic volumes and emissions, in a scenario of “regulated growth”.

Scenario “Regulated Growth”, Most-likely/Baseline scenario

As in all 20-year 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. In the 20-year forecast published in 2013 by EUROCONTROL, the scenario called ‘Regulated Growth’ was constructed as the ‘most-likely’ or ‘baseline’ scenario, most closely following the current trends. It considers a moderate economic growth, with regulation reconciling the environmental, social and economic demands.

Table 1. Summary characteristics of EUROCONTROL scenarios:

	A: Global Growth	C: Regulated Growth	D: Fragmenting World	C': Happy Localism
2019 traffic growth	High ↗	Base →	Low ↘	Base →
Passenger				
Demographics (Population)	Aging UN Medium-fertility variant	Aging UN Medium-fertility variant	Aging UN Zero-migration variant	Aging UN Medium-fertility variant
Routes and Destinations	Long-haul ↗	No Change →	Long-haul ↘	Long-haul ↘
Open Skies	EU enlargement later +Far & Middle-East	EU enlargement earliest	EU enlargement latest	EU enlargement earliest
High-speed rail (new & improved connections)	54 city-pairs faster implementation	54 city-pairs	42 city-pairs later implementation	54 city-pairs faster implementation
Economic conditions				
GDP growth	Stronger ↗	Moderate →	Weaker ↘↘	Weaker ↘
EU Enlargement	Later	Earliest	Latest	Earliest
Free Trade	Global, faster	Limited, later	None	More limited, even later
Price of travel				
Operating cost	Decreasing ↘↘	Decreasing ↘	No change →	Decreasing ↘
Cost of CO_2	Lowest	Lower	Highest	Lower
Price of oil	Lower	Low	High	High
Other charges	Noise: ↗ Security: ↘	Noise: ↗ Security: →	Noise: → Security: ↗	Noise: ↗ Security: →
Structure				
Network	Middle-East hubs ↗↗ Europe ↘ Turkey ↗	Middle-East hubs ↗↗ Europe and Turkey ↗	No change →	Middle-East hubs ↗↗ Europe and Turkey ↘
Market Structure	Medium ↗↗ Large - Very Large ↗	Medium to Very Large ↗	Large ↗ Very Large ↗	Large ↗ Very Large ↗

The table above presents a summary of the social, economic and air traffic-related characteristics of the different scenarios developed by EUROCONTROL for the purposes of EUROCONTROL 20-year forecast of IFR movements[1].

ECAC baseline scenario

The ECAC baseline scenario presented in the following tables was generated by EUROCONTROL for all ECAC States including the Canary Islands. Over-flights of the ECAC area have not been included.

The baseline scenario, which is presented in the following tables, does not include business and dedicated cargo traffic. It covers only commercial passenger flight movements for the area of scope outlined in the previous paragraph, using data for airport pairs, which allows for the generation of fuel efficiency data (in kg/RPK). Historical fuel burn (2010) and emission calculations are based on the actual flight plans from the PRISME data warehouse, including the actual flight distance and the cruise altitude by airport pair. Future year fuel burn and emissions (2020, 2035) are modelled based on actual flight distances and cruise altitudes by airport pair in 2014. Taxi times are not included. The baseline is presented along a scenario of engine-technology freeze, as of 2014, so aircraft not in service at that date are modelled with

[1] The characteristics of the different scenarios can be found in Task 4: European Air Traffic in 2035, Challenges of Growth 2013, EUROCONTROL, June 2013 available at ECAC website

the fuel efficiency of comparable-role in-service aircraft (but with their own seating capacities).

The future fleet has been generated using the Aircraft Assignment Tool (AAT) developed collaboratively by EUROCONTROL, the European Aviation Safety Agency and the European Commission. The retirement process of the Aircraft Assignment Tool is performed year by year, allowing the determination of the amount of new aircraft required each year. This way, the entry into service year (EISY) can be derived for the replacement aircraft. The Growth and Replacement (G&R) Database used is largely based on the Flightglobal Fleet Forecast - Deliveries by Region 2014 to 2033. This forecast provides the number of deliveries for each type in each of the future years, which are re-scaled to match the EUROCONTROL forecast.

The data and forecasts for Europe show two distinct phases, of rapid improvement followed by continuing, but much slower improvement after 2020. The optimism behind the forecast for the first decade is partly driven by statistics: in the 4 years 2010-2014, the average annual improvement in fuel efficiency for domestic and international flights was around 2%, [Source: EUROCONTROL] so this is already achieved. Underlying reasons for this include gains through improvements in load factors (e.g. more than 3% in total between 2010 and 2014), and use of slimmer seats allowing more seats on the same aircraft. However, neither of these can be projected indefinitely into the future as a continuing benefit, since they will hit diminishing returns. In their place we have technology transitions to A320neo, B737max, C-series, B787 and A350 for example, especially over the next 5 years or so. Here this affects seat capacity, but in addition, as we exit from the long economic downturn, we see an acceleration of retirement of old, fuel-inefficient aircraft, as airline finances improve, and new models become available. After that, Europe believes that the rate of improvement would be much slower, and this is reflected in the ‘technology freeze’ scenario, which is presented here.

Table 2. Total fuel burn for passenger domestic and international flights (ECAC)

Year	Traffic (millions of departing flights)	Total Fuel burn (in million tonnes)
2010	7,12	40,34
2020	8,48	48,33
2035	11,51	73,10

Table 3. CO_2 emissions forecast

Year	CO_2 emissions (in million tonnes)
2010	127,47
2020	152,72
2035	231,00

Table 4. Traffic in RPK (domestic and international departing flights from ECAC airports, PAX only, no freight and dedicated cargo flights)

Year	Traffic (in billion RPK)
2010	1 329,6
2020	1 958,7
2035	3 128,2

Table 5. Fuel efficiency (kg/10RPK)

Year	Fuel efficiency (in kg/10 RPK)
2010	0,3034
2020	0,2468
2035	0,2337

Table 6. Average annual fuel efficiency improvement

Period	Fuel efficiency improvement
2020 - 2010	-2,05%
2035 - 2020	-0,36%
2035 - 2010	-1,04%

In order to further improve fuel efficiency and to reduce future air traffic emissions beyond the projections in the baseline scenario, ECAC States have taken further action. Supranational measures in order to achieve such additional improvement will be described in the following sections.

It should be noted, however, that a quantification of the effects of many measures is difficult. As a consequence, no aggregated quantification of potential effects of the supranational measures can be presented in this action plan.

B. ACTIONS TAKEN AT THE SUPRANATIONAL LEVEL

1. **AIRCRAFT-RELATED TECHNOLOGY DEVELOPMENT**
2. **ALTERNATIVE FUELS**
3. **IMPROVED AIR TRAFFIC MANAGEMENT AND INRASTRUCTURE USE**
4. **ECONOMIC/MARKET-BASED MEASURES**
5. **EU INITIATIVES IN THIRD COUNTRIES**
6. **SUPPORT TO VOLUNTARY ACTIONS**

1. AIRCRAFT-RELATED TECHNOLOGY DEVELOPMENT

1.1. Aircraft emissions standards (Europe's contribution to the development of the aeroplane CO_2 standard in CAEP)

European Member States fully supported the work achieved in ICAO’s Committee on Aviation Environmental Protection (CAEP), which resulted in an agreement on the new aeroplane CO_2 Standard at CAEP/10 meeting in February 2016, applicable to new aeroplane type designs from 2020 and to aeroplane type designs that are already in-production in 2023. Europe significantly contributed to this task, notably through the European Aviation Safety Agency (EASA) which co-led the CO_2 Task Group within CAEP’s Working Group 3, and which provided extensive technical and analytical support.

The assessment of the benefits provided by this measure in terms of reduction in European emissions is not provided in this action plan. Nonetheless, elements of assessment of the overall contribution of the CO_2 standard towards the global aspirational goals are available in CAEP.

1.2. Research and development

Clean Sky is an EU Joint Technology Initiative (JTI) that aims to develop and mature breakthrough “clean technologies” for air transport. By accelerating their deployment, the JTI will contribute to Europe’s strategic environmental and social priorities, and simultaneously promote competitiveness and sustainable economic growth.

Joint Technology Initiatives are specific large-scale EU research projects created by the European Commission within the 7^{th} Framework Programme (FP7) and continued within the Horizon 2020 Framework Programme. Set up as a Public Private Partnership between the European Commission and the European aeronautical industry, Clean Sky pulls together the research and technology resources of the European Union in a coherent programme, and contribute significantly to the ’greening’ of aviation.

The first Clean Sky programme (**Clean Sky 1 -** 2011-2017) has a budget of € 1,6 billion, equally shared between the European Commission and the aeronautics industry. It aims to develop environmental friendly technologies impacting all flying-segments of commercial aviation. The objectives are to reduce CO_2 aircraft emissions by 20-40%, NO_x by around 60% and noise by up to 10dB compared to year 2000 aircraft.

What has the current JTI achieved so far?

It is estimated that Clean Sky resulted in a reduction of aviation CO_2 emissions by more than 20% with respect to baseline levels (in 2000), which represents an ***aggregate reduction of 2 to 3 billion tonnes of CO_2 over the next 35 years***

This was followed up by a second programme (**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 RTD efforts under Clean Sky 2 are:

- **Large Passenger Aircraft**: demonstration of best technologies to achieve the environmental goals while 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 superior passenger experience.
- **Fast Rotorcraft:** demonstrating new rotorcraft concepts (tilt-rotor and FastCraft compound helicopter) 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 investigate innovative fuselage structures will be 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 future generation aircraft in terms of maturation, demonstration and Innovation.
- **Small Air Transport:** demonstrating the advantages of applying key technologies on small aircraft demonstrators and to revitalise an important segment of the aeronautics sector that can bring key new mobility solutions.
- **Eco-Design:** coordinating research geared towards high eco-compliance in air vehicles over their product life and heightening the stewardship in intelligent Re-use, Recycling and advanced services.

In addition, the **Technology Evaluator** will continue and 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). More details on Clean Sky can be found at the following link:
http://www.cleansky.eu/

2. ALTERNATIVE FUELS

2.1. European Advanced Biofuels Flightpath

Within the European Union, Directive 2009/28/EC on the promotion of the use of energy from renewable sources ("the Renewable Energy Directive" – RED) established mandatory targets to be achieved by 2020 for a 20% overall share of renewable energy in the EU and a 10% share for renewable energy in the transport sector. Furthermore, sustainability criteria for biofuels to be counted towards that target were established.[2]

In February 2009, the European Commission's Directorate General for Energy and Transport initiated the SWAFEA (Sustainable Ways for Alternative Fuels and Energy for Aviation) study to investigate the feasibility and the impact of the use of alternative fuels in aviation.

The SWAFEA final report was published in July 2011[2]. It provides a comprehensive analysis on the prospects for alternative fuels in aviation, including an integrated analysis of technical feasibility, environmental sustainability (based on the sustainability criteria of the EU Directive on renewable energy[3]) and economic aspects. It includes a number of

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[2] Directive 2009/28/EC of the European Parliament and of the Council of 23/04/2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, Article 17 Sustainability criteria for biofuels and bioliquids, at pp. EU Official Journal L140/36-L140/38.

[2] http://www.icao.int/environmental-protection/GFAAF/Documents/SW_WP9_D.9.1%20Final%20report_released%20July2011.pdf

[3] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

recommendations on the steps that should be taken to promote the take-up of sustainable biofuels for aviation in Europe.

In March 2011, the European Commission published a White Paper on transport[4]. In the context of an overall goal of achieving a reduction of at least 60% in greenhouse gas emissions from transport by 2050 with respect to 1990, **the White Paper established a goal of low-carbon sustainable fuels in aviation reaching 40% by 2050**.

ACARE Roadmap targets regarding share alternative sustainable fuels:

Aviation to use:

- **at minimum 2%** sustainable alternative fuels **in 2020**;

- **at minimum 25%** sustainable alternative fuels **in 2035**;

- **at minimum 40%** sustainable alternative fuels **in 2050**

Source: ACARE Strategic Research and Innovation Agenda, Volume 2

As a first step towards delivering this goal, in June 2011 the European Commission, in close coordination with Airbus, leading European airlines (Lufthansa, Air France/KLM, & British Airways) and key European biofuel producers (Choren Industries, Neste Oil, Biomass Technology Group and UOP), launched the **European Advanced Biofuels Flight-path**. This industry-wide initiative aims to speed up the commercialisation of aviation biofuels in Europe, with **the objective of achieving the commercialisation of sustainably produced paraffinic biofuels in the aviation sector by reaching a 2 million tonnes consumption by 2020**.

This initiative is a shared and voluntary commitment by its members to support and promote the production, storage and distribution of sustainably produced drop-in biofuels for use in aviation. It also targets establishing appropriate financial mechanisms to support the construction of industrial "first of a kind" advanced biofuel production plants. The Biofuels Flight path is explained in a technical paper, which sets out in more detail the challenges and required actions[5].

More specifically, the initiative focuses on the following:

1. Facilitate the development of standards for drop-in biofuels and their certification for use in commercial aircraft;
2. Work together with the full supply chain to further develop worldwide accepted sustainability certification frameworks
3. Agree on biofuel take-off arrangements over a defined period of time and at a reasonable cost;
4. Promote appropriate public and private actions to ensure the market uptake of paraffinic biofuels by the aviation sector;

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[4] Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, COM (2011) 144 final

[5] http://ec.europa.eu/energy/technology/initiatives/doc/20110622_biofuels_flight_path_technical_paper.pdf

5. Establish financing structures to facilitate the realisation of 2nd Generation biofuel projects;
6. Accelerate targeted research and innovation for advanced biofuel technologies, and especially algae.
7. Take concrete actions to inform the European citizen of the benefits of replacing kerosene by certified sustainable biofuels.

The following "Flight Path" provides an overview about the objectives, tasks, and milestones of the initiative.

Time horizons (Base year - 2011)	**Action**	**Aim/Result**
Short-term (next 0-3 years)	Announcement of action at International Paris Air Show	To mobilise all stakeholders including Member States.
	High-level workshop with financial institutions to address funding mechanisms.	To agree on a "Biofuel in Aviation Fund".
	> 1 000 tonnes of Fisher-Tropsch biofuel become available.	Verification of Fisher-Tropsch product quality. Significant volumes of synthetic biofuel become available for flight testing.
	Production of aviation class biofuels in the hydro-treated vegetable oil (HVO) plants from sustainable feedstock	Regular testing and eventually few regular flights with HVO biofuels from sustainable feedstock.
	Secure public and private financial and legislative mechanisms for industrial second generation biofuel plants.	To provide the financial means for investing in first of a kind plants and to permit use of aviation biofuel at economically acceptable conditions.
	Biofuel purchase agreement signed between aviation sector and biofuel producers.	To ensure a market for aviation biofuel production and facilitate investment in industrial 2G plants.
	Start construction of the first series of 2G plants.	Plants are operational by 2015-16.
	Identification of refineries & blenders which will take part in the first phase of the action.	Mobilise fuel suppliers and logistics along the supply chain.
Mid-term (4-7 years)	2000 tonnes of algal oils are becoming available.	First quantities of algal oils are used to produce aviation fuels.
	Supply of 1,0 M tonnes of hydrotreated sustainable oils and 0,2 tonnes of synthetic aviation biofuels in the aviation market.	1,2 M tonnes of biofuels are blended with kerosene.
	Start construction of the second series of 2G plants including algal biofuels and pyrolytic oils from	Operational by 2020.

	residues.	
Long-term (up to 2020)	Supply of an additional 0,8 M tons of aviation biofuels based on synthetic biofuels, pyrolytic oils and algal biofuels.	2,0 M tonnes of biofuels are blended with kerosene.
	Further supply of biofuels for aviation, biofuels are used in most EU airports.	Commercialisation of aviation biofuels is achieved.

When the Flight-path 2020 initiative began in 2010, only one production pathway was approved for aviation use; no renewable kerosene had actually been produced except at very small scale, and only a handful of test and demonstration flights had been conducted using it. Since then, worldwide technical and operational progress of the industry has been remarkable. Four different pathways for the production of renewable kerosene are now approved and several more are expected to be certified. A significant number of flights using renewable kerosene have been conducted, most of them revenue flights carrying passengers. Production has been demonstrated at demonstration and even industrial scale for some of the pathways. Use of renewable kerosene within an airport hydrant system was demonstrated in Oslo in 2015.

Performed flights using bio-kerosene

IATA: 2000 flights worldwide using bio-kerosene blends performed by 22 airlines between June 2011 and December 2015

Lufthansa: 1189 flights Frankfurt-Hamburg using 800 tonnes of bio-kerosene (during 6 months – June/December 2011)

KLM: a series of 200 flights Amsterdam-Paris from September 2011 to December 2014, 26 flights New York-Amsterdam in 2013, and 20 flights Amsterdam-Aruba in 2014 using bio-kerosene

Production (EU)

***Neste** (Finland): by batches*

- Frankfurt-Hamburg (6 months) 1189 flights operated by Lufthansa: 800 tonnes of bio-kerosene

- Itaka: €10m EU funding (2012-2015): > 1 000 tonnes

***Biorefly**: €13,7m EU funding: 2000 tonnes per year – second generation (2015) – BioChemtex (Italy)*

***BSFJ Swedish Biofuels**: €27,8m EU funding (2014-2019)*

2.2. Research and Development projects on alternative fuels in aviation

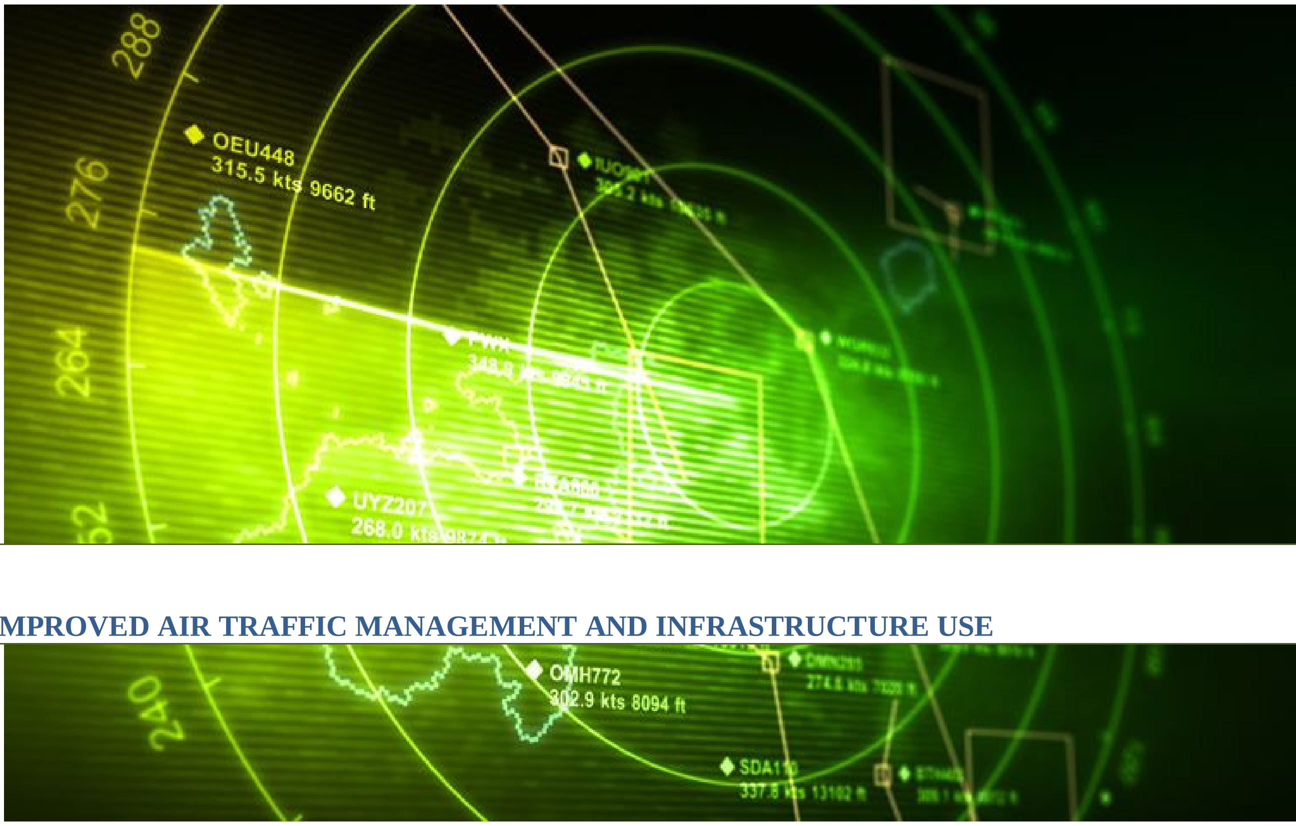
In the time frame 2011-2016, 3 projects have been funded by the FP7 Research and Innovation program of the EU.

ITAKA: €10m EU funding (2012-2015) with the aim of assessing the potential of a specific crop (camelina) for providing jet fuel. The project aims entail the testing of the whole chain from field to fly, assessing the potential beyond the data gathered in lab experiments, gathering experiences on related certification, distribution and on economical aspects. As feedstock, ITAKA targets European camelina oil and used cooking oil, **in order to meet a minimum of 60% GHG emissions savings compared to the fossil fuel jetA1**.

SOLAR-JET: this project has demonstrated the possibility of producing jet-fuel from CO_2 and water. This was done by coupling a two-step solar thermochemical cycle based on non-stoichiometric ceria redox reactions with the Fischer-Tropsch process. This successful demonstration is further complemented by assessments of the chemical suitability of the solar kerosene, identification of technological gaps, and determination of the technological and economical potentials.

Core-Jet Fuel: €1,2m EU funding (2013-2017) this action evaluates the research and innovation "landscape" in order to develop and implement a strategy for sharing information, for coordinating initiatives, projects and results and to identify needs in research, standardisation, innovation/deployment, and policy measures at European level. Bottlenecks of research and innovation will be identified and, where appropriate, recommendations for the European Commission will be elaborated with respect to re-orientation and re-definition of priorities in the funding strategy. The consortium covers the entire alternative fuel production chain in four domains: Feedstock and sustainability; conversion technologies and radical concepts; technical compatibility, certification and deployment; policies, incentives and regulation. CORE-JetFuel ensures cooperation with other European, international and national initiatives and with the key stakeholders in the field. The expected benefits are enhanced knowledge of decision makers, support for maintaining coherent research policies and the promotion of a better understanding of future investments in aviation fuel research and innovation.

In 2015, the European Commission launched projects under the Horizon 2020 research programme with capacities of the order of several 1000 tonnes per year.



3. IMPROVED AIR TRAFFIC MANAGEMENT AND INFRASTRUCTURE USE

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

SESAR Project

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 larger volume of flights in a safer, more cost-efficient and environmental friendly manner.

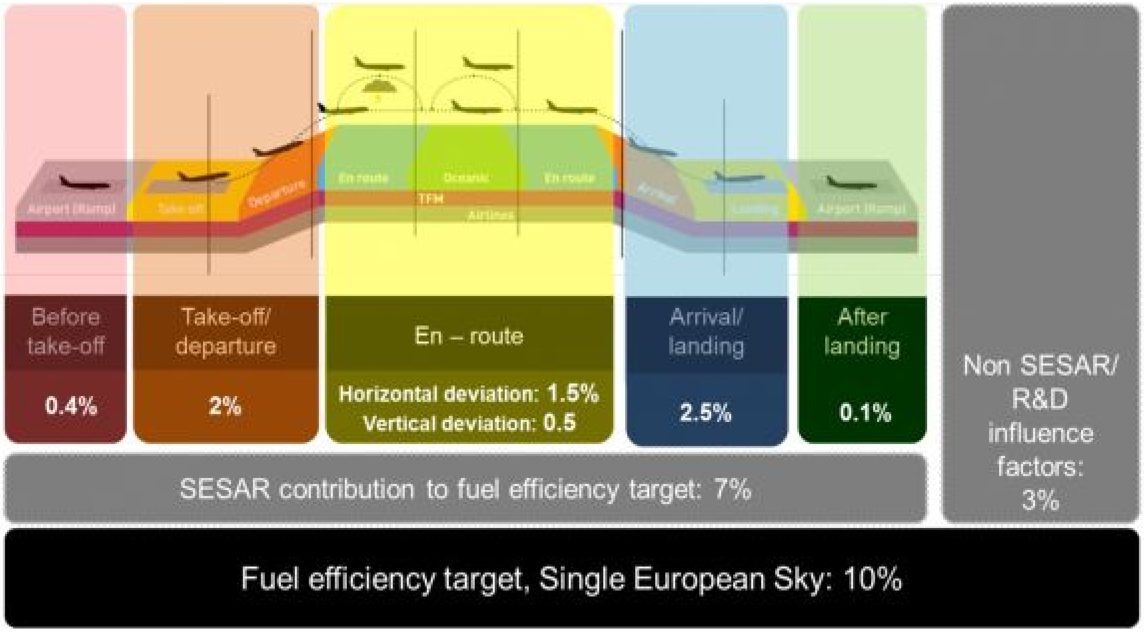
The SES aims at achieving 4 high level performance objectives (referred to 2005 context):

- Triple capacity of ATM systems
- Reduce ATM costs by 50%
- Increase safety by a factor of 10
- **Reduce the environmental impact by 10% per flight**

SESAR, the technological pillar of the Single European Sky, contributes to the Single Sky's performance targets by defining, developing, validating and deploying innovative technological and operational solutions for managing air traffic in a more efficient manner.

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

The estimated potential fuel emission savings per flight segment is depicted below:

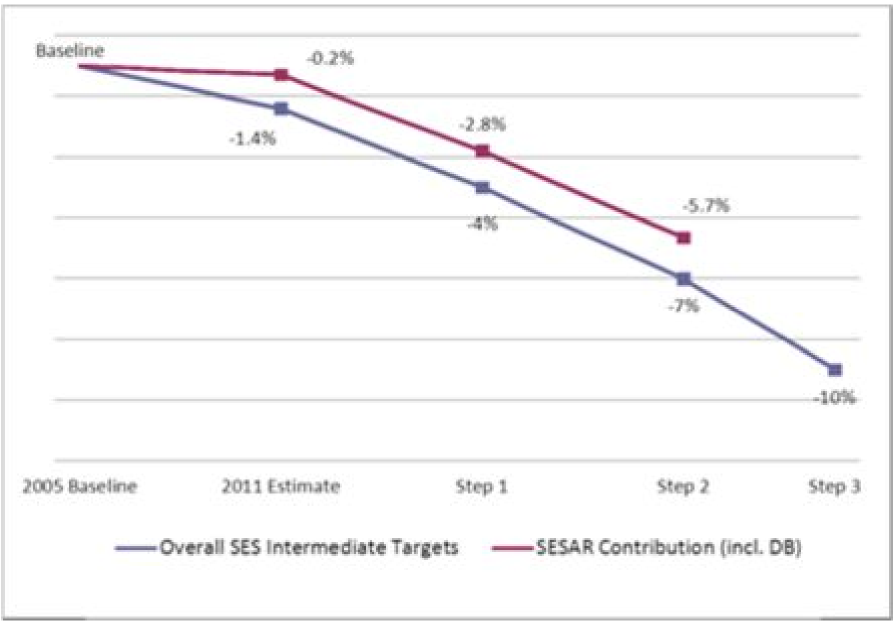


SESAR's contribution to the SES performance objectives is now targeting for 2016, as compared to 2005 performance:

1) 27% increase in airspace capacity and 14% increase in airport capacity;
2) Associated improvement in safety, i.e. in an absolute term, 40% of reduction in accident risk per flight hour.
3) **2,8 % reduction per flight in gate to gate greenhouse gas emissions;**
4) 6 % reduction in cost per flight.

The projection of SESAR target fuel efficiency beyond 2016 (Step 1[6]) is depicted in the following graph:

[6] Step 1, "Time-based Operations" is the building block for the implementation of the SESAR Concept and is focused on flight efficiency, predictability and the environment. The goal is a synchronised and predictable European ATM system, where partners are aware of the business and operational situations and collaborate to optimise the network. In this first Step, time prioritisation for arrivals at airports is initiated together with wider use of datalink and the deployment of initial trajectory-based operations through the use of airborne trajectories by the ground systems and a controlled time of arrival to sequence traffic and manage queues.
Step 2, "Trajectory-based Operations" is focused on flight efficiency, predictability, environment and capacity, which becomes an important target. The goal is a trajectory-based ATM system where partners optimise "business and mission trajectories" through common 4D trajectory information and users define priorities in the network. "Trajectory-based Operations" initiates 4D-based business/mission trajectory management using System Wide Information Management (SWIM) and air/ground trajectory exchange to enable tactical planning and conflict-free route segments.
Step 3, "Performance-based Operations" will achieve the high performance required to satisfy the SESAR target concept. The goal is the implementation of a European high-performance, integrated, network-centric, collaborative and seamless air/ground ATM system. "Performance-based Operations" is realised through the achievement of SWIM and collaboratively planned network operations with User Driven Prioritisation Processes (UDPP).



It is expected that there will be an ongoing performance contribution from non-R&D initiatives through the Step 1 and Step 2 developments, e.g. from improvements related to FABs and Network Management: the intermediate allocation to Step 1 development has been set at -4%, with the ultimate capability enhancement (Step 3) being -10%. 30% of Step 1 target will be provided through non-R&D improvements (-1,2% out of -4%) and therefore -2,8% will come from SESAR improvements. Step 2 target is still under discussion in the range of 4,5% to 6%.

The SESAR concept of operations is defined in the European ATM Master Plan and translated into SESAR solutions that are developed, validated and demonstrated by the SESAR Joint Undertaking and then pushed towards deployment through the SESAR deployment framework established by the Commission.

SESAR Research Projects (environmental focus)

Within the SESAR R&D activities, environmental aspects have mainly been addressed under two types of projects: Environmental research projects which are considered as a transversal activity and therefore primarily contribute to the validation of the SESAR solutions and SESAR demonstration projects, which are pre-implementation activities. Environment aspects, in particular fuel efficiency, are also a core objective of approximately 80% of SESAR's primary projects.

Environmental Research Projects:

Four Environmental research projects are now completed:

- Project 16.03.01 dealing with Development of the Environment validation framework (Models and Tools);
- Project 16.03.02 dealing with the Development of environmental metrics;
- Project 16.03.03 dealing with the Development of a framework to establish interdependencies and trade-off with other performance areas;
- Project 16.03.07 dealing with Future regulatory scenarios and risks.

In the context of Project 16.03.01 the IMPACT tool was developed providing SESAR primary projects with the means to conduct fuel efficiency, aircraft emissions and noise assessments at the same time, from a web based platform, using the same aircraft performance assumptions. IMPACT successfully passed the CAEP MDG V&V process

(Modelling and Database Group Verification and Validation process). Project 16.06.03 has also ensured the continuous development/maintenance of other tools covering aircraft GHG assessment (AEM), and local air quality issues (Open-ALAQS). It should be noted that these tools have been developed for covering the research and the future deployment phase of SESAR.

In the context of Project 16.03.02 a set of metrics for assessing GHG emissions, noise and airport local air quality has been documented. The metrics identified by Project 16.03.02 and not subject of specific IPRs will be gradually implemented into IMPACT.

Project 16.03.03 has produced a comprehensive analysis on the issues related to environmental interdependencies and trade-offs.

Project 16.03.07 has conducted a review of current environmental regulatory measures as applicable to ATM and SESAR deployment, and another report presenting an analysis of environmental regulatory and physical risk scenarios in the form of user guidance. It identifies both those Operation Focus Areas (OFA) and Key Performance Areas which are most affected by these risks and those OFAs which can contribute to mitigating them. It also provides a gap analysis identifying knowledge gaps or uncertainties which require further monitoring, research or analysis.

The only Environmental Research project that is still on-going in the current SESAR project is the SESAR Environment support and coordination project which ensures the coordination and facilitation of all the Environmental research projects activities while supporting the SESAR/AIRE/DEMO projects in the application of the material produced by the research projects. In particular, this project delivered an Environment Impact Assessment methodology providing guidance on how to conduct an assessment, which metrics to use and do and don'ts for each type of validation exercise with specific emphasis on flight trials.

New environmental research projects will be defined in the scope of SESAR 2020 work programme to meet the SESAR environmental targets in accordance to the ATM Master Plan.

Other Research Projects which contribute to SESAR's environmental target:

A large number of SESAR research concepts and projects from exploratory research to preindustrial phase can bring environmental benefits. Full 4D trajectory taking due account of meteorological conditions, integrated departure, surface and arrival manager, airport optimised green taxiing trajectories, combined xLS RNAV operations in particular should bring significant reduction in fuel consumption. Also to be further investigated the potential for remote control towers to contribute positively to the aviation environmental footprint.

Remotely Piloted Aircraft (RPAS) systems integration in control airspace will be an important area of SESAR 2020 work programme and although the safety aspects are considered to be the most challenging ones and will therefore mobilise most of research effort, the environmental aspects of these new operations operating from and to non-airport locations would also deserve specific attention in terms of emissions, noise and potentially visual annoyance.

SESAR demonstration projects:

In addition to its core activities, the SESAR JU co-finances projects where ATM stakeholders work collaboratively to perform integrated flight trials and demonstrations validating solutions for the reduction of CO_2 emissions for surface, terminal and oceanic operations to substantially accelerate the pace of change. Since 2009, the SJU has co-financed a total 33 "green" projects in collaboration with global partners, under the Atlantic Interoperability Initiative to Reduce Emissions (AIRE), demonstrating solutions on commercial flights.

A total of 15767 flight trials were conducted under the AIRE initiative involving more than 100 stakeholders, demonstrating savings ranging from 20 to 1000kg fuel per flight (or 63 to 3150 kg of CO_2), and improvements to day-to-day operations. Other 9 demonstration projects took place from 2012 to 2014 focusing also on environment and during 2015 and 2016 the SESAR JU is co-financing 15 additional large-scale demonstrations projects more ambitious in geographic scale and technology. More information can be found at http://www.sesarju.eu

AIRE – Achieving environmental benefits in real operations

AIRE was designed specifically to improve energy efficiency and lower engine emissions and aircraft noise in cooperation with the US FAA, using existing technologies by the European Commission in 2007. SESAR JU has been managing the programme from an European perspective since 2008. 3 AIRE demonstration campaigns took place between 2009 and 2014.

A key feature leading to the success of AIRE is that it focused strongly on operational and procedural techniques rather than new technologies. AIRE trials have almost entirely used technology which is already in place, but until the relevant AIRE project came along, air traffic controllers and other users hadn't necessarily thought deeply about how to make the best use operationally of that technology. In New York and St Maria oceanic airspace lateral [separation] optimisation is given for any flight that requests it because of the AIRE initiative and the specific good cooperation between NAV Portugal and FAA.

Specific trials have been carried for the following improvement areas/solutions as part of the AIRE initiative:

a. Use of GDL/DMAN systems (pre departure sequencing system / Departure Manager) in Amsterdam, Paris and Zurich;
b. Issue of Target-Off Block time (TOBT), calculation of variable taxi out time and issue of Target-Start-up Arrival Time (TSAT) in Vienna;
c. Continuous Descent Operations (CDOs or CDAs) in Amsterdam, Brussels, Cologne, Madrid, New York, Paris, Prague, Pointe a Pitre, Toulouse, and Zurich;
d. CDOs in Stockholm, Gothenburg, Riga, La Palma; Budapest and Palma de Majorca airports using RNP-AR procedures;
e. lateral and vertical flight profile changes in the NAT taking benefit of the implementation of Automatic Dependent Surveillance-Broadcast (ADS-B) surveillance in the North Atlantic;
f. Calculation of Estimated Times of Arrival (ETA) allowing time based operations in Amsterdam;
g. Precision Area Navigation - Global Navigation Satellite System (PRNAV GNSS) Approaches in Sweden;
h. Free route in Lisbon and Casablanca, over Germany, Belgium, Luxembourg, Netherlands in the EURO-SAM corridor, France, and Italy;
i. Global information sharing and exchange of actual position and updated meteorological data between the ATM system and Airline AOCs for the vertical and lateral optimisation of oceanic flights using a new interface;

The **AIRE 1** campaign (2008-2009) has demonstrated, with 1152 trials performed, that significant savings can already be achieved using existing technology. **CO_2 savings per flight ranged from 90kg to 1250kg and the accumulated savings during trials were equivalent to 400 tonnes of CO_2.** This first set of trials represented not only substantial improvements for the greening of air transport, but high motivation and commitment of the teams involved creating momentum to continue to make progress on reducing aviation emissions.

Domain	Location	Trials performed	CO_2 benefit/flight
Surface	Paris, France	353	190-1200 kg
Terminal	Paris, France	82	100-1250 kg
	Stockholm, Sweden	11	450-950 kg
	Madrid, Spain	620	250-800 kg
Oceanic	Santa Maria, Portugal	48	90-650 kg
	Reykjavik, Iceland	48	250-1050 kg
	Total	1152	

The **AIRE 2** campaign (2010-2011) showed a doubling in demand for projects and a high transition rate from R&D to day-to-day operations. 18 projects involving 40 airlines, airports, ANSPs and industry partners were conducted in which surface, terminal, oceanic and gate-to-gate operations were tackled. 9416 flight trials took place. Table 2 summarises AIRE 2 projects operational aims and results.

Table 6: Summary of AIRE 2 projects

Project name	Location	Operation	Objective	CO_2 and Noise benefits per flight (kg)	Nb of flights
CDM at Vienna Airport	Austria	CDM notably pre-departure sequence	CO_2 & Ground Operational efficiency	54	208
Greener airport operations under adverse conditions	France	CDM notably pre-departure sequence	CO_2 & Ground Operational efficiency	79	1800
B3	Belgium	CDO in a complex radar vectoring environment	Noise & CO_2	160-315; -2dB (between 10 to 25 Nm from touchdown)	3094
DoWo - Down Wind Optimisation	France	Green STAR & Green IA in busy TMA	CO_2	158-315	219
REACT-CR	Czech republic	CDO	CO_2	205-302	204

Flight Trials for less CO_2 emission during transition from en-route to final approach	Germany	Arrival vertical profile optimisation in high density traffic	CO_2	110-650	362
RETA-CDA2	Spain	CDO from ToD	CO_2	250-800	210
DORIS	Spain	Oceanic: Flight optimisation with ATC coordination & Data link (ACARS, FANS CPDLC)	CO_2	3134	110
ONATAP	Portugal	Free and Direct Routes	CO_2	526	999
ENGAGE	UK	Optimisation of cruise altitude and/or Mach number	CO_2	1310	23
RlongSM (Reduced longitudinal Separation Minima)	UK	Optimisation of cruise altitude profiles	CO_2	441	533
Gate to gate Green Shuttle	France	Optimisation of cruise altitude profile & CDO from ToD	CO_2	788	221
Transatlantic green flight PPTP	France	Optimisation of oceanic trajectory (vertical and lateral) & approach	CO_2	2090+1050	93
Greener Wave	Switzerland	Optimisation of holding time through 4D slot allocation	CO_2	504	1700
VINGA	Sweden	CDO from ToD with RNP STAR and RNP AR.	CO_2 & noise	70-285; negligible change to noise contours	189
AIRE Green Connections	Sweden	Optimised arrivals and approaches based on RNP AR & Data link.	CO_2 & noise	220	25

		4D trajectory exercise			
Trajectory based night time	The Netherlands	CDO with pre-planning	CO_2 + noise	TBC	124
A380 Transatlantic Green Flights	France	Optimisation of taxiing and cruise altitude profile	CO_2	1200+1900	19
				Total	9416

CDOs were demonstrated in busy and complex TMAs although some operational measures to maintain safety, efficiency and capacity at an acceptable level had to developed.

The AIRE 3 campaign comprised 9 projects (2012-2014) and 5199 trials summarised in table 3

Project name	Location	Operation	Number of Trials	Benefits per flight
AMBER	Riga International Airport	turboprop aircraft to fly tailored Required Navigation Performance – Authorisation Required (RNP-AR) approaches together with Continuous Descent Operations (CDO),	124	230 kg reduction in CO_2 emissions per approach; A reduction in noise impact of 0.6 decibels (dBA)
CANARIAS	La Palma and Lanzarote airports	CCDs and CDOs	8	Area Navigation-Standard Terminal Arrival Route (RNAV STAR) and RNP-AR approaches 34-38 NM and 292-313 kg of fuel for La Palma and 14 NM and 100 kg of fuel for Lanzarote saved.
OPTA-IN	Palma de Mallorca Airport	CDOs	101	Potential reduction of 7-12% in fuel burn and related CO_2 emissions
REACT plus	Budapest Airport	CDOs and CCOs	4113	102 kg of fuel conserved during each CDO
ENGAGE Phase II	North Atlantic – between Canada & Europe	Optimisation of cruise altitude and/or Mach number	210	200-400 litres of fuel savings; An average of 1-2% of fuel conserved
SATISFIED	EUR-SAM Oceanic corridor	Free routing	165	1578 kg in CO_2 emissions
SMART	Lisbon flight information region (FIR), New York Oceanic and Santa Maria FIR	Oceanic: Flight optimisation	250	3134 kg CO_2 per flight

WE-FREE	Paris CDG, Venice, Verona, Milano Linate, Pisa, Bologna, Torino, Genoa airports	free routing	128	693 Kg of CO_2 for CDG-Roma Fiumicino ; 504 kg of CO_2 for CDG Milano Linate
MAGGO*	Santa Maria FIR and TMA	Several enablers	100*	*

*The MAGGO project couldn't be concluded

SESAR solutions and Common Projects for deployment

SESAR Solutions are operational and technological improvements that aim to contribute to the modernisation of the European and global ATM system. These solutions are systematically validated in real operational environments, which allow demonstrating clear business benefits for the ATM sector when they are deployed including the **reduction by up to 500 kg of fuel burned per flight by 2035 which corresponds to up to 1,6 tonnes of CO_2 emissions per flight, split across operating environments**.

By end of 2015 twenty-five SESAR Solutions were validated targeting the full range of ATM operational environments including airports. These solutions are made public on the SESAR JU website in a datapack form including all necessary technical documents to allow implementation. One such solution is the integration of pre-departure management within departure management (DMAN) at Paris Charles de Gaulle, resulting in a 10% reduction of taxi time, 4 000-tonne fuel savings annually and a 10% increase of Calculated Take Off Time (CTOT) adherence and the Implementation. Another solution is Time Based Separation at London Heathrow, allowing up to five more aircraft per hour to land in strong wind conditions and thus reduces holding times by up to 10 minutes, and fuel consumption by 10% per flight. By the end of SESAR1 fifty-seven solutions will be produced.

The deployment of the SESAR solutions which are expected to bring the most benefits, sufficiently mature and which require a synchronised deployment is mandated by the Commission through legally binding instruments called Common Projects.

The first Common Projects identify six ATM functionalities, namely Extended Arrival Management and Performance Based Navigation in the High Density Terminal Manoeuvring Areas; Airport Integration and Throughput; Flexible Airspace Management and Free Route; Network Collaborative Management; Initial System Wide Information Management; and Initial Trajectory Information Sharing. The deployment of those six ATM functionalities should be made mandatory.

- The Extended Arrival Management and Performance Based Navigation in the High Density Terminal Manoeuvring Areas functionality is expected to improve the precision of approach trajectory as well as facilitate traffic sequencing at an earlier stage, **thus allowing reducing fuel consumption and environmental impact in descent/arrival phases.**
- The Airport Integration and Throughput functionality is expected to improve runway safety and throughput, **ensuring benefits in terms of fuel consumption** and delay reduction as well as airport capacity.
- The Flexible Airspace Management and Free Route functionality is expected to enable a more efficient use of airspace, thus providing significant **benefits linked to fuel consumption** and delay reduction.

- The Network Collaborative Management functionality is expected to improve the quality and the timeliness of the network information shared by all ATM stakeholders, thus ensuring significant benefits in terms of Air Navigation Services productivity gains and delay cost savings.
- The Initial System Wide Information Management functionality, consisting of a set of services that are delivered and consumed through an internet protocol-based network by System Wide Information Management (SWIM) enabled systems, is expected to bring significant benefits in terms of ANS productivity.
- The Initial Trajectory Information Sharing functionality with enhanced flight data processing performances is expected to improve predictability of aircraft trajectory for the benefit of airspace users, the network manager and ANS providers, implying less tactical interventions and improved de-confliction situation. This is expected to have a positive impact on ANS productivity, **fuel saving** and delay variability.

SESAR 2020 programme

SESAR next programme (SESAR 2020) includes in addition to exploratory and industrial research, very large scale demonstrations which should include more environmental flight demonstrations and goes one step further demonstrating the environmental benefits of the new SESAR solutions.

4. ECONOMIC/MARKET-BASED MEASURES

4.1.The EU Emissions Trading System

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. It operates in 31 countries: the 28 EU Member States, Iceland, Liechtenstein and Norway. The EU ETS is the first and so far the biggest international system capping greenhouse gas emissions; it currently covers half of the EU's CO_2 emissions, encompassing those from around 12 000 power stations and industrial plants in 31 countries, and, under its current scope, around 640 commercial and non-commercial aircraft operators that have flown between airports in the European Economic Area (EEA).

The EU ETS began operation in 2005; 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.

By the 30th April each year, companies, including aircraft operators, have to surrender allowances to cover their emissions from the previous calendar year. If a company reduces its emissions, it can keep the spare allowances to cover its future needs or sell them to another company that is short of allowances. The flexibility that trading brings ensures that emissions are cut where it costs least to do so. The number of allowances reduces over time so that total emissions fall.

As regards aviation, legislation to include aviation in the EU ETS was adopted in 2008 by the European Parliament and the Council[7]. The 2006 proposal to include aviation in the EU ETS was accompanied by detailed impact assessment[8]. After careful analysis of the different options, it was concluded that this was the most cost-efficient and environmentally effective option for addressing aviation emissions.

In October 2013, the Assembly of the International Civil Aviation Organization (ICAO) decided to develop a global market-based mechanism (MBM) for international aviation emissions. The global MBM design is to be decided at the next ICAO Assembly in 2016, including the mechanisms for the implementation of the scheme from 2020. In order to sustain momentum towards the establishment of the global MBM, the European Parliament and Council have decided to temporarily limit the scope of the aviation activities covered by the EU ETS, to intra-European flights[9]. The temporary limitation applies for 2013-2016, following on from the April 2013 'stop the clock' Decision[10] adopted to promote progress on global action at the 2013 ICAO Assembly.

The legislation requires the European Commission to report to the European Parliament and Council regularly on the progress of ICAO discussions as well as of its efforts to promote the international acceptance of market-based mechanisms among third countries. Following the 2016 ICAO Assembly, the Commission shall report to the European Parliament and to the Council on actions to implement an international agreement on a global market-based measure from 2020, that will reduce greenhouse gas emissions from aviation in a non-discriminatory manner. In its report, the Commission shall consider, and, if appropriate, include proposals on the appropriate scope for coverage of aviation within the EU ETS from 2017 onwards.

Between 2013 and 2016, the EU ETS only covers emissions from flights between airports which are both in the EEA. Some flight routes within the EEA are also exempted, notably flights involving outermost regions.

The complete, consistent, transparent and accurate monitoring, reporting and verification of greenhouse gas emissions remain fundamental for the effective operation of the EU ETS. Aviation operators, verifiers and competent authorities have already gained experience with monitoring and reporting during the first aviation trading period; detailed rules are prescribed by Regulations (EU) N°600/2012[11] and 601/2012.[12]

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

[8] http://ec.europa.eu/clima/policies/transport/aviation/documentation_en.htm

[9] Regulation (EU) No 421/2014 of the European Parliament and of the Council of 16 April 2014 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in view of the implementation by 2020 of an international agreement applying a single global market-based measure to international aviation emissions http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32014R0421

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

[11] Commission Regulation (EU) No 600/2012 of 21 June 2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32012R0600&from=EN

The EU legislation establishes exemptions and simplifications to avoid excessive administrative burden for the smallest aircraft operators. Since the EU ETS for aviation took effect in 2012 a *de minimis* exemption for commercial operators – with either fewer than 243 flights per period for three consecutive four-month periods or flights with total annual emissions lower than 10 000 tonnes CO_2 per year –applies, which means that many aircraft operators from developing countries are exempted from the EU ETS. Indeed, over 90 States have no commercial aircraft operators included in the scope of the EU ETS. From 2013 also flights by non-commercial aircraft operators with total annual emissions lower than 1 000 tonnes CO_2 per year are excluded from the EU ETS up to 2020. A further administrative simplification applies to small aircraft operators emitting less than 25 000 tonnes of CO_2 per year, who can choose to use the small emitter`s tool rather than independent verification of their emissions. In addition, small emitter aircraft operators can use the simplified reporting procedures under the existing legislation.

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 consider options available in order to provide for optimal interaction between the EU scheme and that country's measures. In such a case, flights arriving from the third country could be excluded from the scope of the EU ETS. The EU therefore encourages other countries to adopt measures of their own and is ready to engage in bilateral discussions with any country that has done so. The legislation also makes it clear that if there is agreement on global measures, the EU shall consider whether amendments to the EU legislation regarding aviation under the EU ETS are necessary.

Impact on fuel consumption and/or CO_2 emissions

The environmental outcome of an emissions trading system is determined by the emissions cap. Aircraft operators are able to use allowances from outside the aviation sector to cover their emissions. The absolute level of CO_2 emissions from the aviation sector itself can exceed the number of allowances allocated to it, as the increase is offset by CO_2 emissions reductions in other sectors of the economy covered by the EU ETS.

Over 2013-16, with the inclusion of only intra-European flights in the EU ETS, the total amount of annual allowances to be issued will be around 39 million. Verified CO_2 emissions from aviation activities carried out between aerodromes located in the EEA amounted to 56,9 million tonnes of CO_2 in 2015. This means that the EU ETS will contribute to achieve more than 17 million tonnes of emission reductions annually, or around 68 million over 2013-2016, partly within the sector (airlines reduce their emissions to avoid paying for additional units) or in other sectors (airlines purchase units from other ETS sectors, which would have to reduce their emissions consistently). While some reductions are likely to be within the aviation sector, encouraged by the EU ETS's economic incentive for limiting emissions or use of aviation biofuels[13], the majority of reductions are expected to occur in other sectors.

Putting a price on greenhouse gas emissions is important to harness market forces and achieve cost-effective emission reductions. In parallel to providing a carbon price which incentivises emission reductions, the EU ETS also supports the reduction of greenhouse gas emissions

[12] Regulation (EU) No 601/2012 of the European Parliament and of the Council of 21 June 2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council, http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32012R0601

[13] The actual amount of CO_2 emissions savings from biofuels reported under the EU ETS from 2012 to 2014 was 2 tonnes

through €2,1 billion funding for the deployment of innovative renewables and carbon capture and storage. This funding has been raised from the sale of 300 million emission allowances from the New Entrants' Reserve of the third phase of the EU ETS. This includes over €900 million for supporting bioenergy projects, including advanced biofuels[14].

In addition, through Member States' use of EU ETS auction revenue in 2013, over €3 billion has been reported by them as being used to address climate change[15]. The purposes for which revenues from allowances should be used encompass mitigation of greenhouse gas emissions and adaptation to the inevitable impacts of climate change in the EU and third countries, to reduce emissions through low-emission transport, to fund research and development, including in particular in the fields of aeronautics and air transport, to fund contributions to the Global Energy Efficiency and Renewable Energy Fund, and measures to avoid deforestation.

In terms of contribution towards the ICAO global goals, the States implementing the EU ETS will together deliver, in “net” terms, a reduction of at least 5% below 2005 levels of aviation CO_2 emissions for the scope that is covered. Other emissions reduction measures taken, either at supra-national level in Europe or by any of the 31 individual 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.

Estimated emissions reductions resulting from the EU-ETS

Year	*Reduction in CO_2 emissions*
2013-2016	*65 million tonnes*

The table presents projected benefits of the EU-ETS based on the current scope (intra-European flights).

[14] For further information, see http://ec.europa.eu/clima/policies/lowcarbon/ner300/index_en.htm

[15] For further information, see http://ec.europa.eu/clima/news/articles/news_2014102801_en.htm

5. EU INITIATIVES IN THIRD COUNTRIES

5.1. Multilateral projects

At the end of 2013 the European Commission launched a project of a total budget of €6,5 million under the name "*Capacity building for CO_2 mitigation from international aviation*". The 42-month project, implemented by the ICAO, boosts less developed countries' ability to track, manage and reduce their aviation emissions. In line with the call from the 2013 ICAO Assembly, beneficiary countries will submit meaningful State action plans for reducing aviation emissions, and also receive assistance for establishing emissions inventories and piloting new ways of reducing fuel consumption. Through the wide range of activities in these countries, the project contributes to international, regional and national efforts to address growing emissions from international aviation. The beneficiary countries are the following:

Africa: Burkina Faso, Kenya and Economic Community of Central African States (ECCAS) Member States: Angola, Burundi, Cameroon, Central African Republic, Chad, Republic of Congo, Democratic Republic of Congo, Equatorial Guinea, Gabon, Sao Tome and Principe.

Caribbean: Dominican Republic and Trinidad and Tobago.

6. SUPPORT TO VOLUNTARY ACTIONS

6.1. ACI Airport Carbon Accreditation

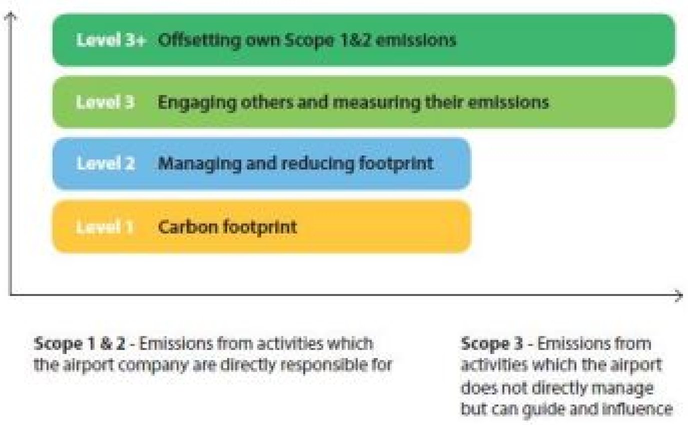
Airport Carbon Accreditation is a certification programme for carbon management at airports, based on carbon mapping and management standard specifically designed for the airport industry. It was launched in 2009 by ACI EUROPE, the trade association for European airports.

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

This industry-driven initiative was officially endorsed by EUROCONTROL and the European Civil Aviation Conference (ECAC). It is also officially supported by the United Nations Environmental Programme (UNEP). The programme is overseen by an independent Advisory Board.

In 2014 the programme reached global status with the extension of the programme to the ACI North American and Latin American & Caribbean regions, participation has increased to 125 airports, in over 40 countries across the world – an increase of 23% from the previous year, growing from 17 airports in Year 1 (2009-2010). These airports welcome 1,7 billion passengers a year, or 27,5% of the global air passenger traffic.

Airport Carbon Accreditation is a four-step programme, from carbon mapping to carbon neutrality. The four steps of certification are: Level 1 “Mapping”, Level 2 “Reduction”, Level 3 “Optimisation”, and Level 3+ “Carbon Neutrality”.



Levels of certification (ACA Annual Report 2014-2015)

One of its essential requirements is the verification by external and independent auditors of the data provided by airports. Aggregated data are included in the *Airport Carbon Accreditation* Annual Report thus ensuring transparent and accurate carbon reporting. At level 2 of the programme and above (Reduction, Optimisation and Carbon Neutrality), airport operators are required to demonstrate CO_2 reduction associated with the activities they control.
In Europe, participation in the programme has increased from 17 airports to 92 in 2015, an increase of 75 airports or 441% since May 2010. 92 airports mapped their carbon footprints, 71 of them actively reduced their CO_2 emissions, 36 reduced their CO_2 emissions and engaged others to do so, and 20 became carbon neutral. European airports participating in the programme now represent 63,9% of European air passenger traffic.

Anticipated benefits:

The Administrator of the programme has been collecting CO_2 data from participating airports over the past five years. This has allowed the absolute CO_2 reduction from the participation in the programme to be quantified.

Emissions reduction highlights

	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
Total aggregate scope 1 & 2 reduction (tCO_2)	51 657	54 565	48 676	140 009	129 937	168 779
Total aggregate scope 3 reduction (tCO_2)	359 733	675 124	365 528	30 155	223 905	550 884

Emissions performance summary

Variable	2013 -2014		2014-2015	
	Emissions	**Number of airports**	**Emissions**	**Number of airports**
Aggregate carbon footprint for 'year 0'[16] for emissions under airports' direct control (all airports)	2 044 683 tonnes CO_2	85	2 089 358 tonnes CO_2	92
Carbon footprint per passenger	2,01 kg CO_2		1,89 kg CO_2	
Aggregate reduction in emissions from sources under airports' direct control (Level 2 and above)[17]	87 449 tonnes CO_2	56	139 022 tonnes CO_2	71
Carbon footprint reduction per passenger	0,11 kg CO_2		0,15 kg CO_2	
Total carbon footprint for 'year 0' for emissions sources which an airport may guide or influence (level 3 and above)[19]	12 777 994 tonnes CO_2	31	14 037 537 tonnes CO_2	36
Aggregate reductions from emissions sources which an airport may guide or influence	223 905 tonnes CO_2		550 884 tonnes CO_2	
Total emissions offset (Level 3+)	181 496 tonnes CO_2	16	294 385 tonnes CO_2	20

Its main immediate environmental co-benefit is the improvement of local air quality.

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

The scope of *Airport Carbon Accreditation*, i.e. emissions that an airport operator can control, guide and influence, implies that aircraft emissions in the LTO cycle are also covered. Thus, airlines can benefit from the gains made by more efficient airport operations to see a decrease in their emissions during the LTO cycle. This is coherent with the objectives pursued with the inclusion of aviation in the EU ETS as of 1 January 2012 (Directive 2008/101/EC) and can support the efforts of airlines to reduce these emissions.

[16] 'Year 0' refers to the 12 month period for which an individual airport's carbon footprint refers to, which according to the Airport Carbon Accreditation requirements must have been within 12 months of the application date.

[17] This figure includes increases in emissions at airports that have used a relative emissions benchmark in order to demonstrate a reduction.

[19] These emissions sources are those detailed in the guidance document, plus any other sources that an airport may wish to include.

SECTION 2- NATIONAL ACTIONS IN UKRAINE

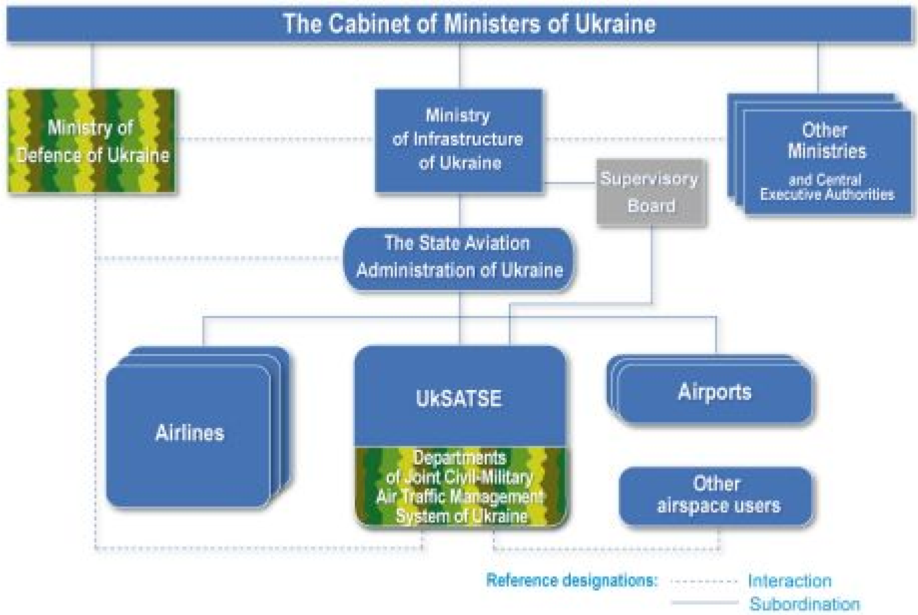
1. IMPROVED AIR TRAFFIC MANAGEMENT AND INFRASTRUCTURE USE

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)**.

One of main activities is the 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 CO2 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:	**2020+.**

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 CO2 emission.

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.

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 CO2 emissions reductions in international flights.

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 kilometre performed;

The estimated expected benefits in terms of fuel savings and emissions reductions of the basket of measures included in this plan are the following:

AIRCRAFT RELATED TECHNOLOGY DEVELOPMENT:

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

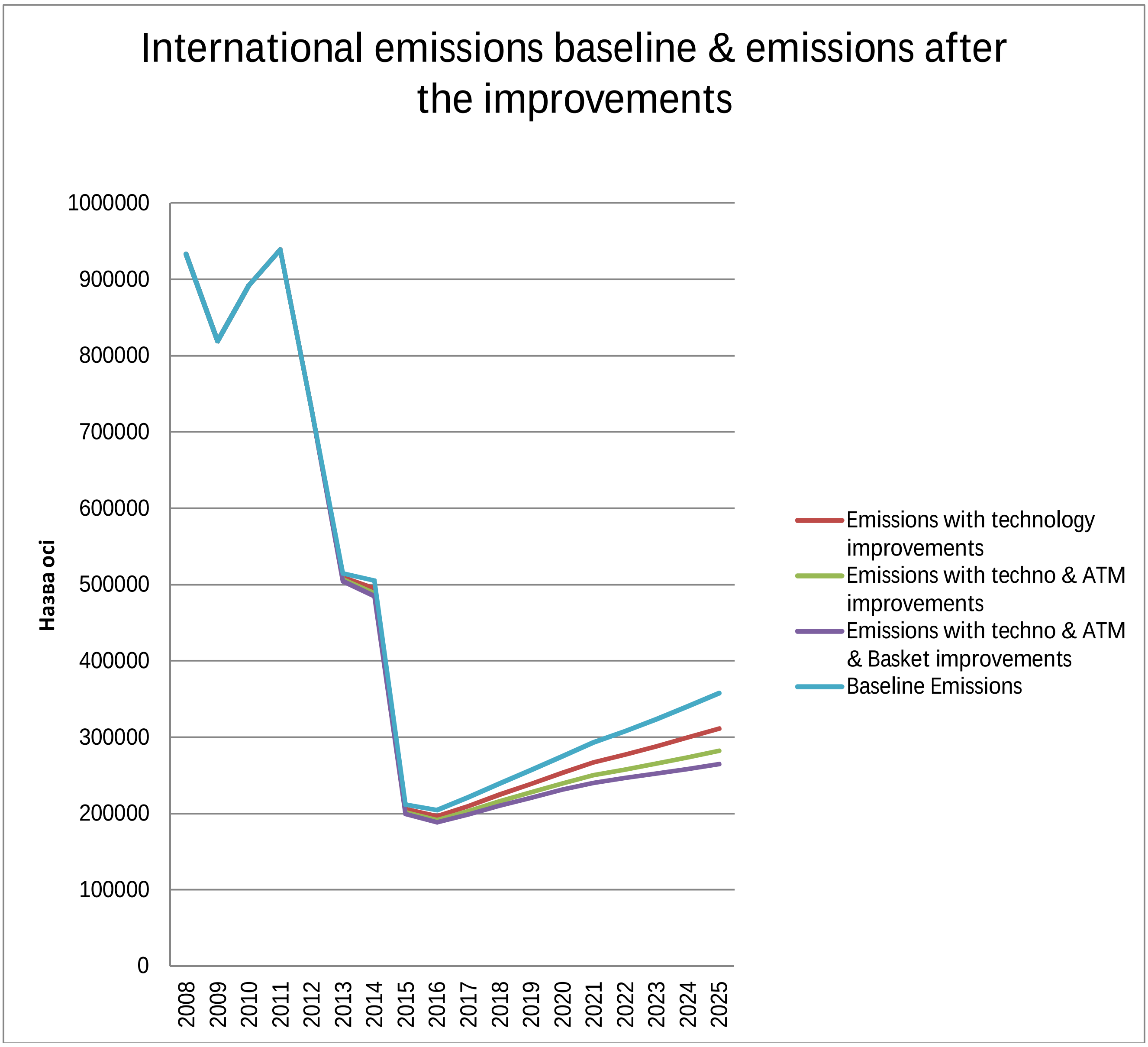
6 % accumulated efficiency improvement in 2020

EXPECTED RESULTS:

The estimated results in terms of fuel and CO2 emissions savings are summarized in the following table:

Year	Tot RTK	Int RTK	Tot Fuel (L) after measures	Int Fuel (L) after measures	Tot CO2 (Kg) after measures	Int CO2 (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

CONCLUSION:



It is estimated that through the combination of measures included in this Action Plan, the accumulated emissions savings in 2020 could be around 231344.707 tons CO2.