ITALY'S ACTION PLAN

ON CO_2 EMISSIONS REDUCTION

2016 edition

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Cover: photoshop based on a real picture of Castelluccio di Norcia, Umbria - Italy

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1. INTRODUCTION

Italy is a member of European Union and of the European Civil Aviation Conference (ECAC). ECAC is an intergovernmental organisation covering the widest grouping of Member States[1] of any European organisation dealing with civil aviation. It is currently composed of 44 Member States, and was created in 1955.

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 on-going 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.

Italy, 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.

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

In that context, it is the intention that all ECAC States submit to ICAO an Action Plan. This is the Action Plan of Italy.

Italy 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 infrastructure use within Europe, in particular through the Single European Sky ATM Research (SESAR), and also beyond European borders, through the Atlantic Initiative for the Reduction of Emissions (AIRE) in cooperation with the US FAA.

[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.

v. Market-based measures, which allow the sector to continue to grow in a sustainable and efficient manner, recognizing that the measures at (i) to (iv) above cannot, even in aggregate, deliver in time the emissions reductions necessary to meet the global goals. This growth becomes possible through the purchase of carbon units that foster emission reductions in other sectors of the economy, where abatement costs are lower than within the aviation sector.

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 European Union. They are reported in Chapter 3 of this Action Plan, where Italy involvement in them is described, as well as that of stakeholders.

In Italy a number of actions are undertaken at the National level, including by stakeholders, in addition to those of a supranational nature. These National actions are reported in Chapter 4 of this Plan.

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

i. 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.

ii. 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. Some of the component measures, although implemented by some but not all of ECAC's 44 States, nonetheless yield emission reduction benefits across the whole of the region (thus for example research, ETS).

An overview of the environmental performance of the European aviation system is provided by the European Aviation Environmental Report, published in 2016 (EAER), and prepared by EASA, EUROCONTROL, and EEA.

Thereafter is the link to the Report:

http://ec.europa.eu/transport/modes/air/aviation-strategy/documents/european-aviation-environmental-report-2016-72dpi.pdf

This National Action Plan was finalised on June 2016.

The section 4.2. related to "National actions for sustainable development of Air Transport" was finalized on July 2015 and shall be considered as subject to update after that date.

2. CURRENT STATE OF AVIATION IN ITALY

ENAC - the Italian Civil Aviation Authority - was established on 25th July 1997 by Legislative Decree no. 250/97 as the National Authority committed to oversee the technical regulation, the surveillance and the control in the civil aviation field.
Air Transport issues as part of ENAC institutional mandate are numerous.
Enac is engaged in dealing with the diverse regulatory aspects of air transport system and performs monitoring functions related to the enforcement of the adopted rules regulating administrative and economical issues. ENAC is also entrusted to provide traffic rights or related authorizations to Air Transport Services according to bilateral or multilateral agreements in force.
Its core business is doubtless represented by safety and security control.
According to its institutional mandate, Enac performs, in addition to the issues referred to above:

- preliminary inquiries leading to the entrustment to joint-stock companies of concessions for the total management of airports;
- oversight on free access to the market of handling services in National airports;
- regulating procedures of airport services;
- examination and assessment of land use projects and intervention programmes, as well as investments and airport development;
- evaluation of the conditions for warranting the application of state funded fares on certain city pairs;
- certification of personnel operating in the aeronautical/air navigation field;
- enforcement of recommendations issued by the National Flight Safety Agency.

Enac HQs are in Rome and Representative Offices are located in the major Italian airports.
Enac is strongly engaged at National and International level in pushing forward decision making processes for a environmental and territory protection policy. This is carried out with a holistic approach and through attentive assessments aiming at limiting the environment impact on airport areas and reducing aircraft acoustic and atmospheric pollution.

2.1 Airlines

Airlines with an Italian AOC (2016, June) and more than 19 seats capacity are listed below:

- Air Dolomiti S.p.A.
- Air Italy S.p.A.
- Alitalia Società Aerea Italiana S.p.A.
- Alitalia CityLiner S.p.A.
- Blue Panorama S.p.A.
- Meridiana Fly S.p.A.
- Mistral Air S.r.l
- Neos S.p.A.

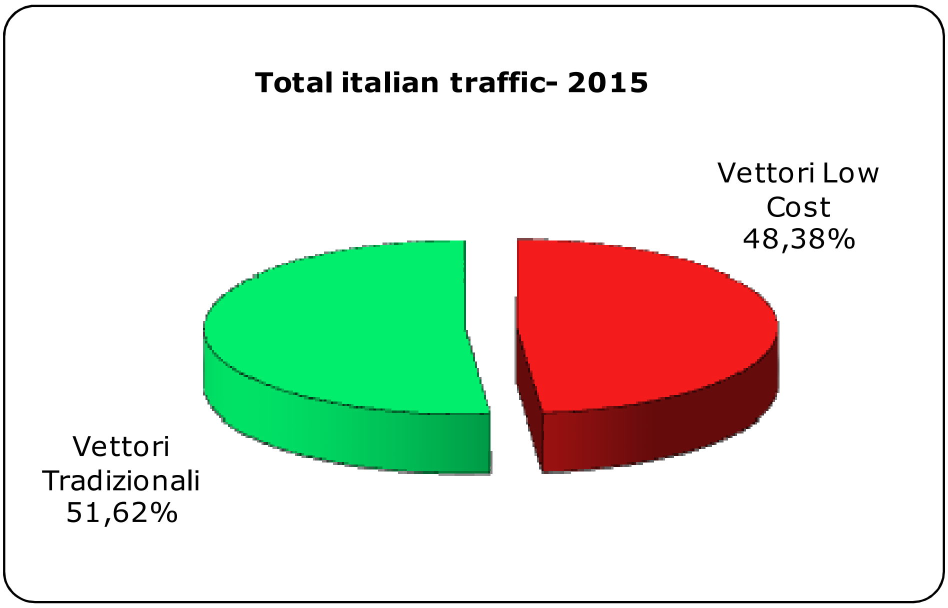
Airlines operating in Italy in 2015:

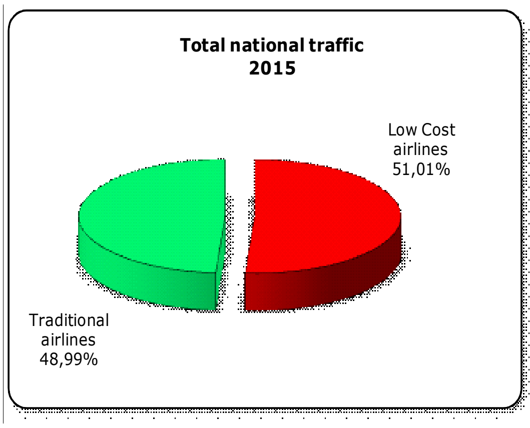
The table below shows the major 20 airlines sorted by total passengers carried in 2015.

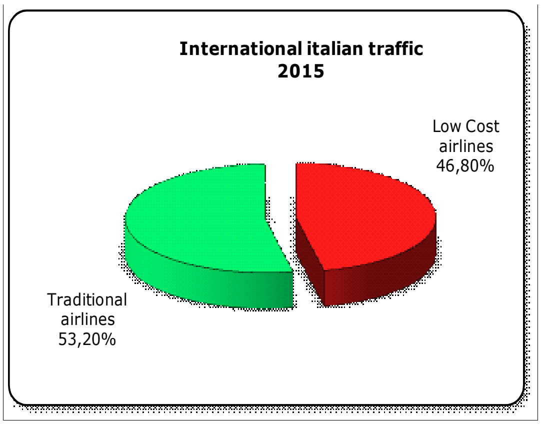
	Airline	Nationality	N. Pax
1	Ryanair	Irlanda	29.706.675
2	Alitalia - Sai	Italia	22.987.134
3	Easyjet	Gran Bretagna	14.363.022
4	Vueling Airlines	Spagna	5.304.079
5	Deutsche Lufthansa	Germania	4.336.318
6	Wizz Air	Ungheria	3.168.232
7	British Airways	Gran Bretagna	3.036.624
8	Meridiana Fly	Italia	2.803.712
9	Air France	Francia	2.790.046
10	Air Berlin	Germania	1.750.422
11	Emirates	Emirati Arabi Uniti	1.741.612
12	Turkish Airlines	Turchia	1.688.180
13	Klm Royal Dutch Airlines	Olanda	1.647.102
14	German Wings	Germania	1.529.332
15	Volotea	Spagna	1.482.243
16	Iberia	Spagna	1.193.563
17	Swiss Air International	Svizzera	1.068.405
18	Neos	Italia	1.065.501
19	Blue Panorama Airlines	Italia	1.058.342
20	Tap - Air Portugal	Portogallo	929.627

High-cost and low-cost airlines

In Italy low-cost airlines gained large market shares: they operated 48% of the total flights, exceeding in 2015 half of the national traffic reaching 51% (+13% vs 2014) and increasing also the international share up to 46%, as showed in the graphics below.







Commercial air carriers - traffic

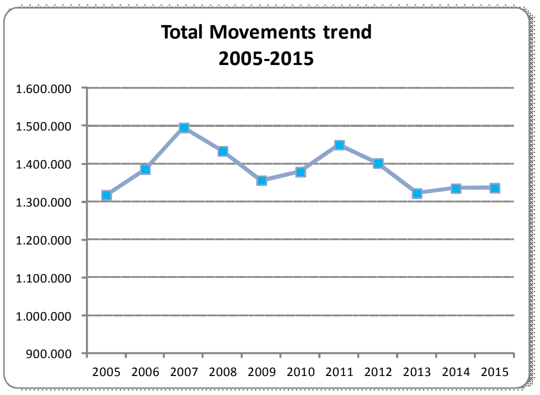
Total commercial aircraft movements in 2015 was characterized by a sustainable flat growth (+0,1% on 2014) registering more than 1.3 million movements of which 60% (803.916) are international, with origin/destination an airport located outside the national boundaries.

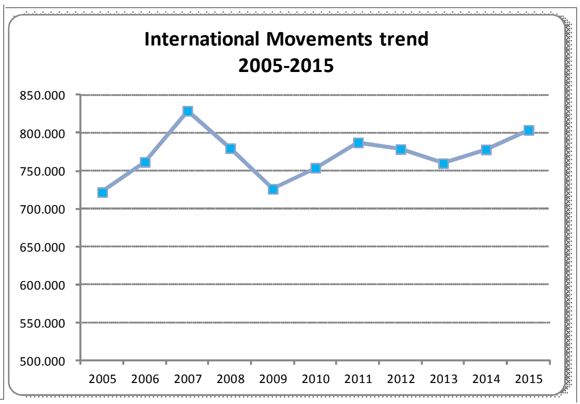
Differently from the national trend, 2015 international movement growth was around +3% vs 2014 as represented in the table below.

On a ten years long period and a total growth of 1.42% (2015 vs 2005), international movement traffic increased of more than 11%.

Aircraft movements (2005-2015)

YEAR	DOMESTIC	%	INTERNATIONAL	%	TOTAL COMMERCIAL	%
2005	595.925	-1,1	721.965	5,9	1.317.890	2,6
2006	624.321	4,8	761.902	5,5	1.386.223	5,2
2007	666.608	6,8	829.257	8,8	1.495.865	7,9
2008	654.006	-1,9	779.777	-6,0	1.433.783	-4,5
2009	630.404	-3,6	726.204	-6,9	1.356.608	-5,4
2010	624.737	-0,9	754.148	3,8	1.378.885	1,6
2011	662.807	6,1	787.535	4,4	1.450.342	5,2
2012	622.979	-6,1	778.684	-1,1	1.401.663	-3,4
2013	562.799	-9,7	759.954	-2,4	1.322.753	-5,6
2014	557.381	-1	778.303	2,4	1.335.684	1,0
2015	532.694	-4,4	803.916	3,3	1.336.610	0,1



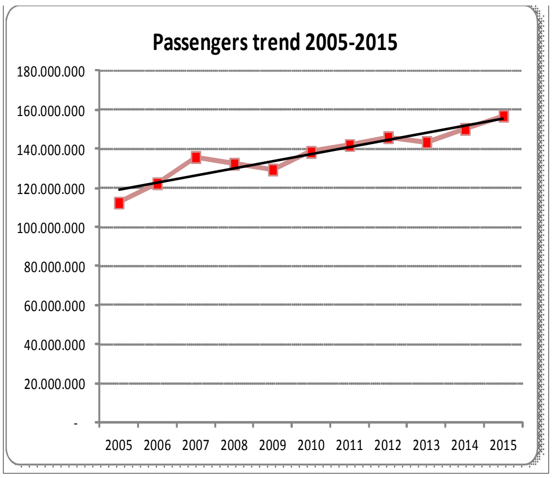


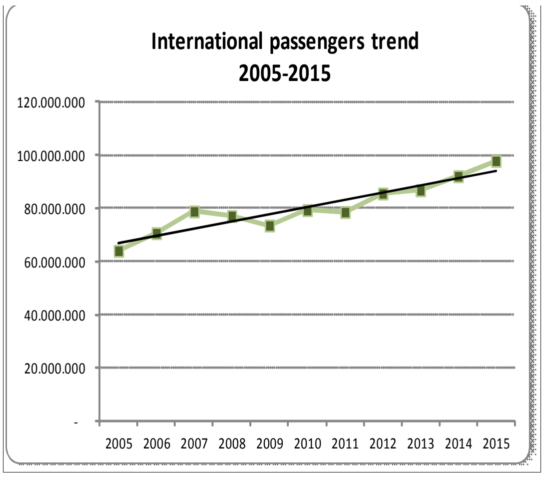
Total commercial passenger traffic registered in 2015 was 156,9 millions, of which 97,8 millions international, with origin/destination airports located outside Italy, representing the 62% of the total number. The table below shows a total passenger traffic growth of +4.5% compared to 2014, with +6.3% related only to international traffic. On the ten years long period the total increase was +39% (2015 vs 2005), of which more than 52% refers to international traffic.

Passengers (2005-2015)

YEAR	DOMESTIC	%	INTERNATIONAL	%	TOTAL COMMERCIAL	%
2005	48.440.901	-0,4	64.095.668	10,6	112.536.569	5,5
2006	51.741.346	6,8	70.657.262	10,2	122.398.608	8,8
2007	56.961.572	10,1	78.847.623	11,6	135.809.195	11,0
2008	55.347.732	-2,8	77.089.380	-2,2	132.437.112	-2,5
2009	55.940.298	1,1	73.501.762	-4,7	129.442.060	-2,3
2010	59.228.056	5,9	79.297.183	7,9	138.525.239	7,0
2011	63.365.984	7,0	78.627.665	-0,8	141.993.649	2,5
2012	60.377.775	-4,7	85.623.008	8,9	146.000.783	2,8
2013	56.704.847	-6,1	86.805.487	1,4	143.510.334	-1,7
2014	58.205.235	2,6	92.037.907	6,0	150.243.142	4,7
2015	59.094.395	1,5	97.870.858	6,3	156.965.253	4,5

The traffic sorted by passengers shows its positive restart after the long crisis that began in 2008, except for domestic data related to 2012-3.





2.2 Airports

Airports distributed all over Italian territory are illustrated in the map below.

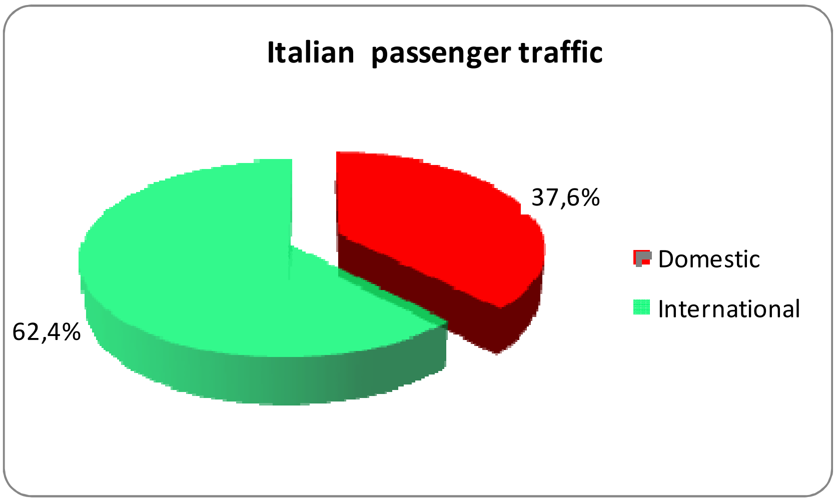
Map of Italian airports open to commercial traffic

The major Italian airport for passenger traffic is Roma Fiumicino, which registered more than 40 million passengers in 2015, 70% of which operated by International traffic. Italian airports that registered in 2015 more than 1 million passengers are shown in the table below.

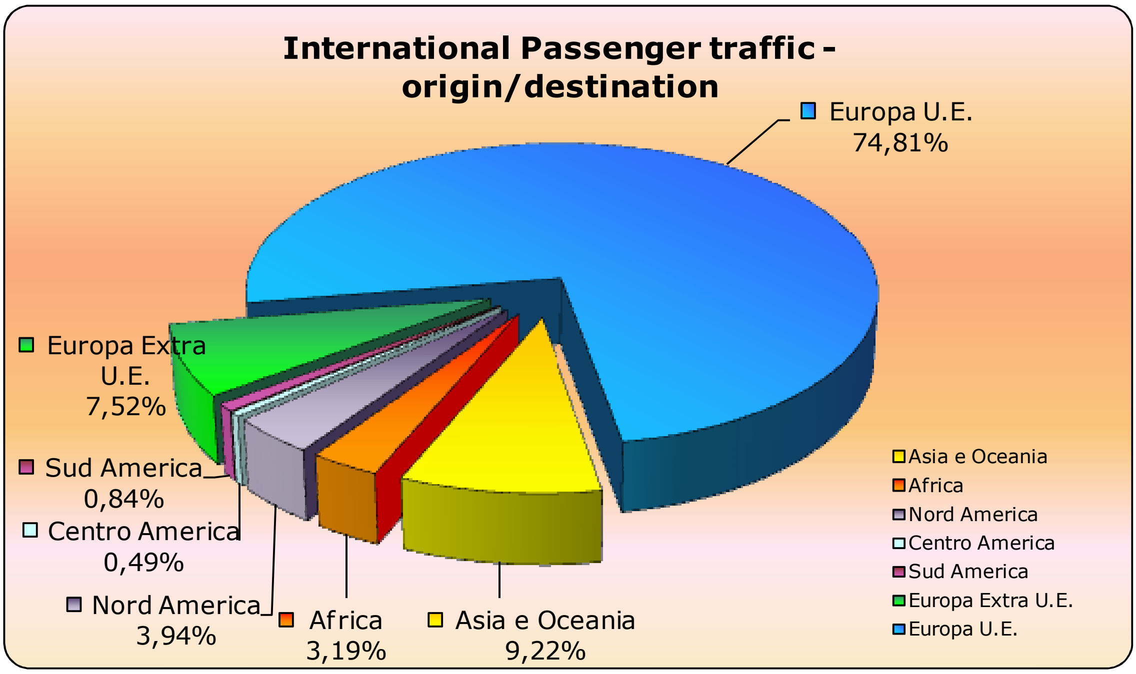
Italian Airports by volume of passenger traffic

	AIRPORT	Passengers	(%)	
			Domestic	International
1	ROMA FIUMICINO	40.233.507	*29,7*	*70,3*
2	MILANO MALPENSA	18.444.778	*13,7*	*86,3*
3	BERGAMO	10.305.158	*30,5*	*69,5*
4	MILANO LINATE	9.638.763	*52,1*	*47,9*
5	VENEZIA	8.684.205	*14,0*	*86,0*
6	CATANIA	7.028.172	*70,0*	*30,0*
7	BOLOGNA	6.857.829	*24,8*	*75,2*
8	NAPOLI	6.118.757	*39,4*	*60,6*
9	ROMA CIAMPINO	5.823.814	*14,5*	*85,5*
10	PALERMO	4.895.175	*79,6*	*20,4*
11	PISA	4.800.254	*30,3*	*69,7*
12	BARI	3.955.945	*65,8*	*34,2*
13	CAGLIARI	3.716.182	*80,1*	*19,9*
14	TORINO	3.654.812	*51,0*	*49,0*
15	VERONA	2.570.468	*30,6*	*69,4*
16	FIRENZE	2.365.334	*16,3*	*83,7*
17	TREVISO	2.358.222	*32,5*	*67,5*
18	LAMEZIA TERME	2.332.126	*81,9*	*18,1*
19	BRINDISI	2.248.697	*80,1*	*19,9*
20	OLBIA	2.212.726	*56,3*	*43,7*
21	ALGHERO	1.676.512	*67,4*	*32,6*
22	TRAPANI	1.586.028	*75,4*	*24,6*
23	GENOVA	1.353.623	*57,2*	*42,8*

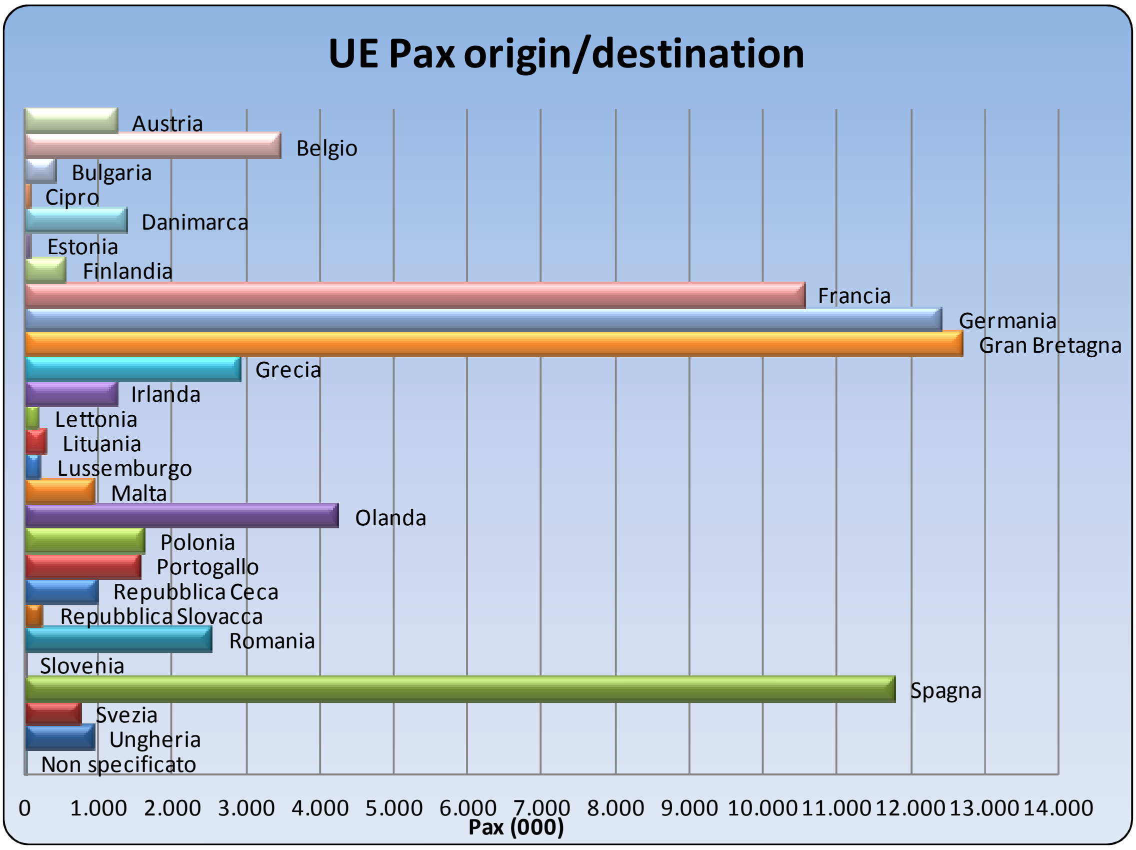
2015 Italian International traffic share reached more than 60% of the total traffic and registered the significant increase of roughly 6% compared to 2014.



Details on international passenger traffic is represented in the graphics below, where origin/destination are showed differently and indicating UE traffic represents the largest share of International traffic with more than 74%, Asia-Oceania and Europe Extra-UE cover around 8%-9%, and the rest is distributed among other areas.



Among EU States, the majority of Italian traffic is operated in UK, Germany, Spain and France.



2.2.1 Italy's current Airport capacity

The main Italian airports are coordinated.
A coordinated airport is an airport where an air carrier, or any other aircraft operator, needs a slot, allocated by a Coordinator, in order to land or take off, with the exemption of State flights, emergency landings and humanitarian flights.
The slot is assigned by the Coordinator, according to the capacity of that specific airport.
The airport capacity is the expression, in operational terms, of the whole capacity available for slot allocation at an airport during each coordination period, reflecting all technical, operational and environmental factors that affect the performance of the airport infrastructure and its different sub-systems.
The scheme below shows the coordination parameters (capacity availability) of the main Italian airports for the Summer season 2016:

Summer 2016	Runway capacity		Air Terminal Capacity					
			International:		Domestic + Schengen		International + Domestic	
Airport	Movements per hour	Number of stands	Arriving pax per hour	Departing pax per hour	Arriving pax per hour	Departing pax per hour	Arriving pax per hour	Departing pax per hour
Bergamo	26	32	1600	1800	1900	2100	2500	2500
Bologna[1]	24	32	1000	1000	2000	2000	3000	3000
Cagliari	12/16	23/25	1200	600	1850	1200	3050	1800
Catania	20	25	600	400	1400	1600	2000	2000
Forlì	15	13/17	400				1600	1400
Genova	25	20	1250	700	1250	700		
Lamezia Terme	14	19		390		600	1000	
Lampedusa	4	3					250	250
Milano Linate	18	39					4400	3800[5]
Milano Malpensa	70	132					13800[6]	7700[6]
Napoli	30	25/26	2150		2600		4750	4500
Olbia	14	27	270	270	600	1200		
Palermo	20	22/28	450	400	1450	1050	1900	1450
Pantelleria	4	4					250	250
Pisa[1]	13/14[3]	17	3450[9]		550[8]		4000	4300
Rimini	7	8	860	1000	730	500		
Roma Ciampino	10/12[2]	17					1400	1400
Roma Fiumicino[7]	70/90	123	4800	6000	9500	9000		
Torino	27	/[4]					2500	2500
Venezia	32	38		1450		5000	5500	
Verona	14	20/26	700	700	1500	1600	1500	1600

Note 1 - Scheduled Facilitated Airports

Note 2 - Limitation due to noise impact analysis in progress by ENAC (max 100 movements per day)

Note 3 - on different hours

Note 4 - Aircraft stands of Turin airports are foreseen into four flexible area, arranged for a maximum capacity of 6 wide bodies plus 19 narrow bodies

Note 5 - With maximum 600 extra - Schengen.

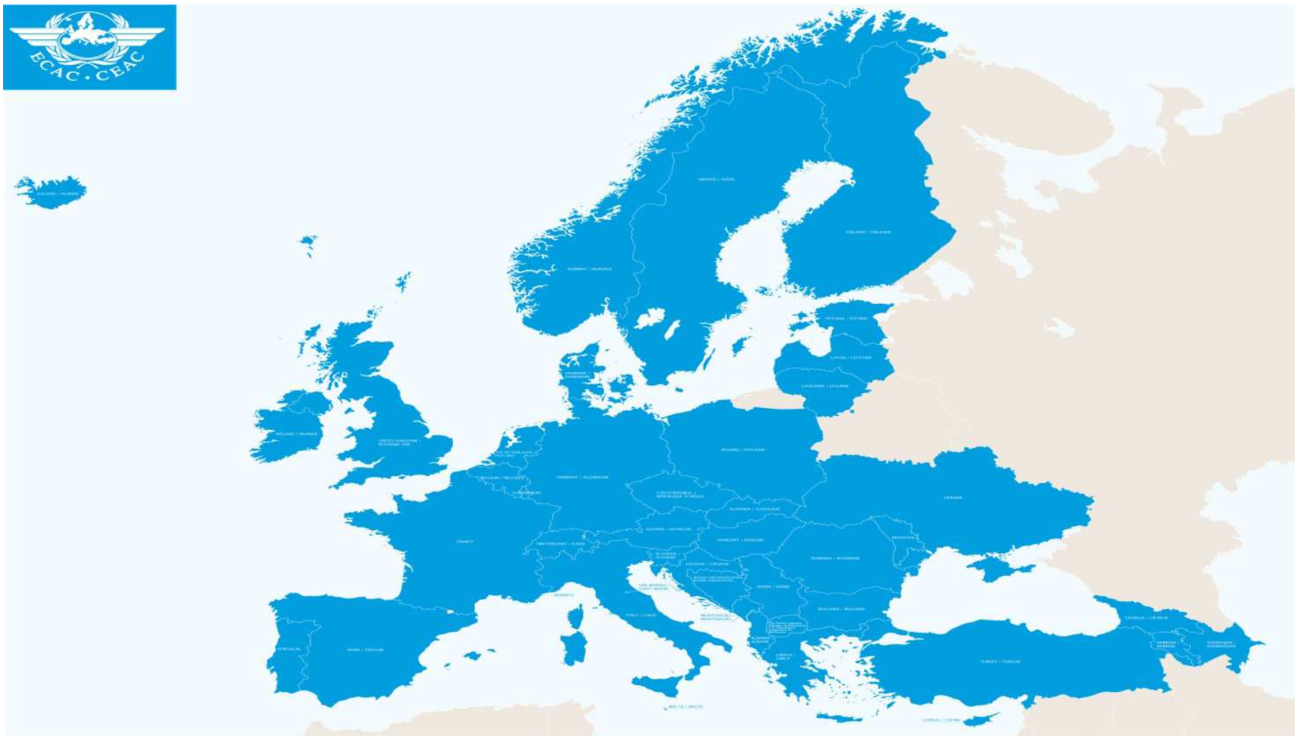
Note 6 - Total of terminal 1 and terminal 2 capacities

Note 7 - Runway movement restriction

Note 8 - Domestic only

Note 9 - International + Schengen

3. SUPRA-NATIONAL MEASURES



3.1 ECAC Baseline Scenario

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[2].

2 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.

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 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.

3.2 Actions taken at the supranational level, including those led by the EU

3.2.1 Aircraft related Technology Development

3.2.1.1 Aircraft emissions standards - Europe's contribution to the development of the aeroplane CO2 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.

3.2.1.2 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 7th 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:** demonstratin g 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/

3.2.2 Alternative Fuels

3.2.2.1 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.[3]

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.

[3] 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.

The SWAFEA final report was published in July 2011[4]. 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[5]) and economic aspects. It includes a number of 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[6]. 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

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

[5] 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

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

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[7].

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;
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	Regular testing and eventually few regular flights with HVO

7 http://ec.europa.eu/energy/technology/initiatives/doc/20110622_biofuels_flight_path_technical_paper.pdf

	vegetable oil (HVO) plants from sustainable feedstock	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 residues.	Operational by 2020.
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)*

3.2.2.2 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-JetFuel: €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.

3.2.3 Improved Air Traffic Management and Infrastructure Use

3.2.3.1 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.

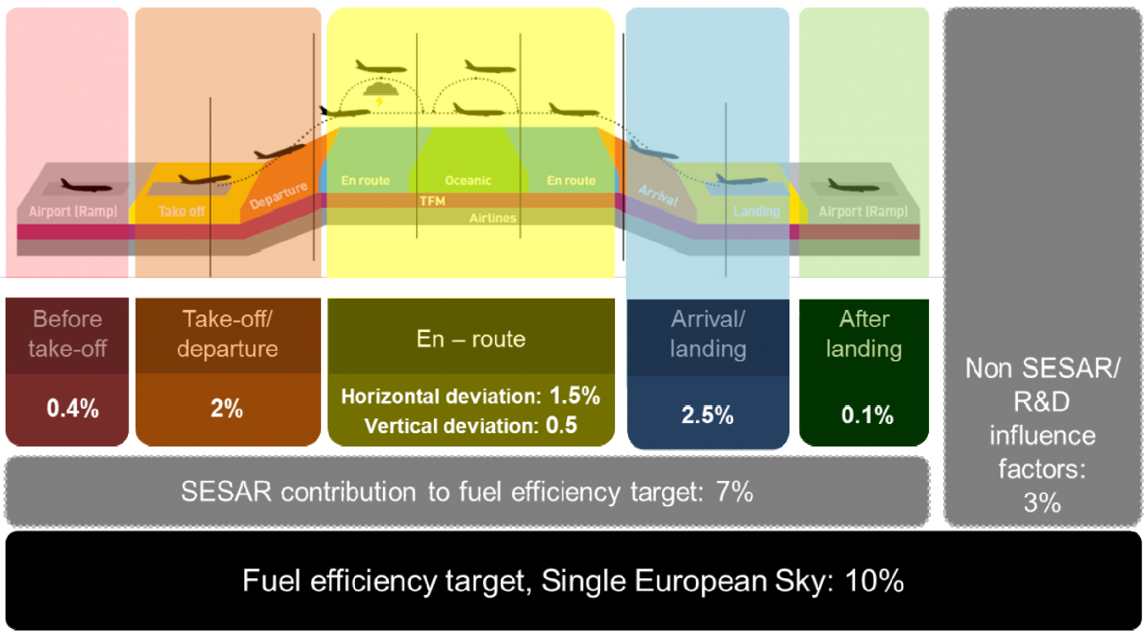
The SES aims at achieving 4 high level performance objectives (referred to 2005 context):

- 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:

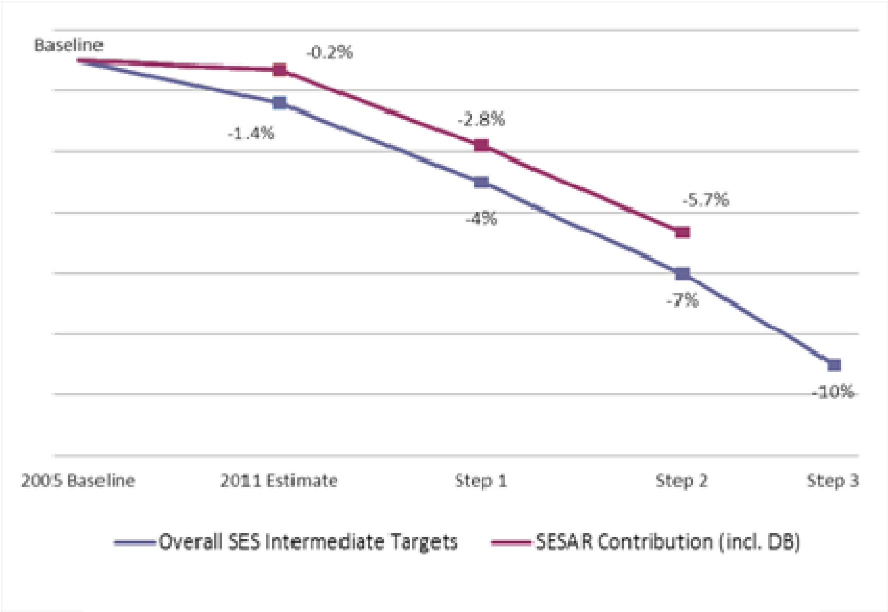


SESAR's contribution to the SES performance objectives is now targeting for 2016, as compared to 2005 performance:

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[8]) is depicted in the following graph:

[8] **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



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

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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).

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. The next Table summarises AIRE 2 projects operational aims and results.

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. 4D trajectory exercise	CO_2 & noise	220	25
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 the next Table.

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.

3.2.4 Economic/Market-Based Measures

3.2.4.1 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 CO2 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[9]. The 2006 proposal to include aviation in the EU ETS was accompanied by detailed impact assessment[10]. 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[11]. The temporary limitation applies for 2013-2016, following on from the April 2013 'stop the clock' Decision[12] 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,

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[9] 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

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

[11] 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

[12] 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

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[13] and 601/2012.[14]

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.

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[13] 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

[14] 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

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[15], 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 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[16].

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[17]. 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

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

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

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

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).

3.2.5 Eu Initiatives in Third Countries

3.2.5.1 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 CO2 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.

3.2.6 Support to voluntary actions

3.2.6.1 ACI Airport Carbon Accreditation

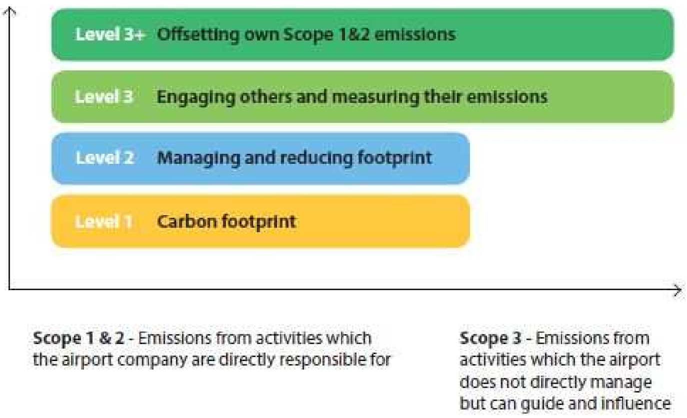
Airport Carbon Accreditation is a certification programme for carbon management at airports, based on carbon mapping and management standard specifically designed for the airport industry. It was launched in 2009 by ACI EUROPE, the trade association for European airports.

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'[18] 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)[19]	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)[20]	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

[18] '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.

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

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

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.

4. NATIONAL MEASURES IN ITALY

4.1 Historic emissions and baseline

Italy has established a baseline for International aviation, fuel consumption and traffic.

In order to quantify traffic data used in the baseline, several assumptions have been taken into consideration.

First of all, Italy has decided to adopt the IPCC methodology to differentiate international and domestic aviation operations, considering whether the departure and arrival airports for a specific flight are in the same or in different countries. Specifically, the IPCC defines an International flight as that one departing from one State and arriving in another one and a domestic flight as that one departing and arriving within the same State.

Consequently, Italian International data consider also flights operated by International carriers departing from Italy and arriving in another State, but different from the one where the airline has its place of business.

Due to the difficulties in collecting traffic data from all non Italian airlines operating in Italy, those with more than 10 million passengers registered in the last year (2014) have been considered only (Ryanair and Easyjet).

Italian International traffic in terms of total passengers registered in Italy in 2015 is represented in the table below:

	Airline	Nationality	N. Pax
1	Ryanair	Irlanda	19.490.781
2	Easyjet	Gran Bretagna	11.657.385
3	Alitalia - Sai	Italia	10.636.650
4	Vueling Airlines	Spagna	4.407.932
5	Deutsche Lufthansa	Germania	4.336.318
6	Wizz Air	Ungheria	3.168.232
7	British Airways	Gran Bretagna	3.036.615
8	Air France	Francia	2.790.046
9	Air Berlin	Germania	1.750.422
10	Emirates	Emirati Arabi Uniti	1.741.612

Furthermore, referring to Italian carriers, the baseline does not consider neither traffic data from carriers whose license was withdrawn or suspended by Italian Civil Aviation Authority in the last five years, nor flights operated by aircraft with less than 20 seats capacity.

In order to preserve the traffic, fuel consumption and CO_2 emissions trend stability, the traffic data related to one Italian airline, whose licence was suspended during the reference period, have been excluded from the baseline, even if it is now operating. However, the traffic covered by this Italian airline does not significantly affect the general scenario.

Finally, referring to another Italian airline, Enac estimated the value of RTK and fuel consumption for the first two historical years not received from the company, applying the traffic trend that the same airline had in those years.

*Year**	*Total RTKs (tonne-kilometres)*	*Total fuel (litres)*	*Total CO_2 emissions (metric tonnes)*	*International RTKs* (tonne-kilometres)*	*International fuel (litres)**	*International CO_2 emissions* (metric tonnes)*
2010	4.991.249.362	2.127.979.077	358.395.857	5.570.548.902	2.103.316.298	5.275.742
2011	5.308.410.670	2.230.578.736	473.787.326	5.942.118.246	2.228.284.996	5.589.526
2012	5.385.103.790	2.224.239.425	461.879.557	5.994.018.486	2.227.094.791	5.584.983
2013	5.152.970.906	2.161.618.362	446.265.991	5.852.074.120	2.190.858.102	5.494.087
2014	5.536.730.780	2.177.108.336	456.979.259	6.291.393.339	2.229.066.795	5.591.056
2015 preliminary - to be confirmed				6.511.592.106	2.277.343.077	5.751.658
Future years						
2016				6.739.497.830	2.326.664.910	5.876.225
2017				6.975.380.254	2.377.054.935	6.003.490
2018				7.219.518.563	2.428.536.289	6.133.511
2019				7.472.201.713	2.481.132.606	6.266.349
2020				7.733.728.773	2.534.868.035	6.402.063

The forecast represented in terms of International RTK, fuel consumption and CO_2 emissions is the result of the methodology defined by ICAO in the "*Guidance on the development of States Action Plans on CO_2 Emissions reduction activities*" applied to Italian data.

4.2 National actions for sustainable development of Air Transport

It is unthinkable to limit the growth of air transport, given that aviation is the major push to global economic development.

The overall goal of environmental strategies in the field of air transport is to balance the needs of industry growth with the fact that development must be environmentally sustainable. The emission reduction must be pursued through the adoption of appropriate technological, operational, infrastructural and economical measures.

To obtain concrete results, the measures identified by ICAO must be applied in a coordinated manner by all subjects concerned, under the supervision of National Civil Aviation Authorities. This supervision involves an objective complexity due to the multitude of stakeholders and to the difficulty of collecting consistent measurable and complete data, to refer them to a common base year and to test the goal achieved by each proposal within an appropriate timing.

In any case, looking at Italian targets of emissions reduction it must be underlined that Italy joins the group of most aeronautically developed countries, both in Europe and worldwide, for airport infrastructures, configuration of the airline's fleet and optimization of ATM.

Italy has already made several significant steps forward an environmental sustainable civil aviation, with actions individually taken by aeronautical operators and through an active participation in European programmes.

Even though, in accordance with Resolution A38-18, National Action Plans should incorporate information on activities that aim to address CO_2 emissions from International aviation, Italy considers the aviation sector as a whole.

Finally, the Italy's Action Plan provides information on measures affecting both domestic and International operations and on emissions deriving from airport and/or ground support equipment operations.

Therefore, Italy is at the forefront in this field and our country is in a prime position in fulfilling the expectations for global emissions reduction, since policies and strategies for sustainable development of air transport have been already implemented.

4.2.1 Aircraft technology and Flight operations

Aviation is a small but important contributor to climate change. Aircraft are estimated to contribute for roughly 3,5% of the total radiative forcing (a measuring unit of change in climate) produced by all human activities. This percentage, which excludes the effects of possible changes in cirrus clouds, is expected to grow.

CO_2 emissions from air transport represent roughly 2% of total global CO_2 emissions.

Fuel burning is responsible for the GHG increase and, on the other hand, the fuel price is one of the major drivers in the determination of profitability in aviation industry. The implementation of a fuel efficiency policy has been pushed forward as a consequence of the oil cost growth in the last decade. A consequence of this fuel efficiency policy is the CO_2 emissions reduction. Since 2009 some Italian airlines have been adopting several measures for fuel saving, in order to prevent a more significant downgrade, to avoid a worsening of the global economic crisis, as well as in application of the ETS system.

The basket of selected and implemented measures comprises:

- **Aircraft Related Technology Development**

- From 2009 to 2013 Italian airlines replaced most of their old aircraft (MD80; B737 old generation; B767 etc…) with new and more fuel efficient aircraft. The reduction of fuel consumption can be estimated around 20% compared to consumption of MD80 aircraft and 10% compared to consumption of B737 old generation. In absolute terms, Italian airlines saved every year CO_2 emissions equivalent to about 1000 tonnes per aircraft replaced. After the phase out of the majority of the old aircraft, and with the entrance into their fleet of new aircraft, the average age of the Italian airlines fleet is now quite low.
- Winglets have been installed on some long range aircraft with an estimated fuel saving of about 6% per modified aircraft.
- Engines replacement has been accomplished on long range aircraft with new and more efficient engines.

▪ **Improvement of Air Traffic Management**

- The Actualized Operation Flight Plan has been implemented in order to establish fuel quantity based on actualized updated information en route and on arrival.
- As much extent as possible the En Route Optimization, in coordination with pertinent Air Navigation Service Provider has been implemented.

▪ **The following more efficient operations procedures have been implemented:**

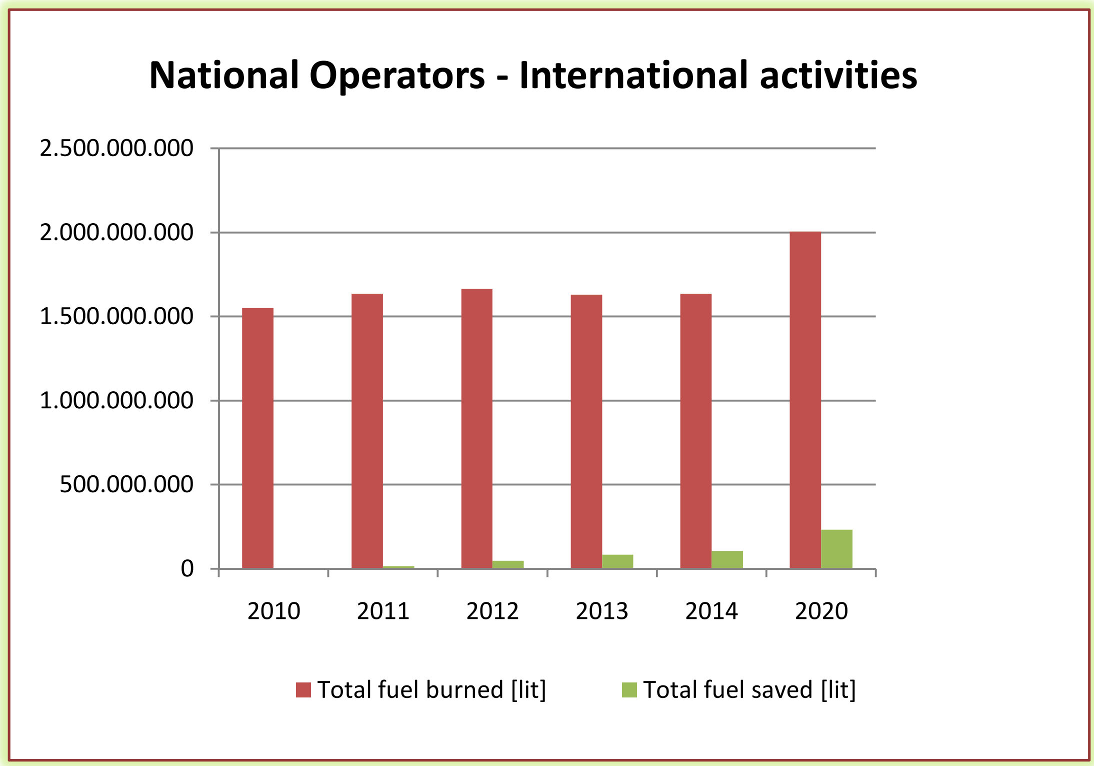
- Cost Index and Climb Profile Optimization in order to calculate economy climb, cruise and descent speeds based on aircraft performance parameters.
- Extra fuel Optimization based on Actualized Operation Flight Plan.
- Estimated Zero Fuel Weight Optimization based on load plan.
- Final Zero Fuel Weight Calculation Optimization.
- Single Engine Taxi.
- Weight Reduction by: Light weight trolleys, less catering equipment, magazine, tires Change, new life vest, paperless cockpit, ULD, coffee makers, entertainment system water load reduction, etc.
- Weigh & Balance optimization for best cruise profile.
- Reduced Flap on Landing.
- Optimization in APU operation on ground and maximization in the using of the GSE.
- MEL & CDL reduction in order to resolve malfunction causing air traffic limitation (cruise speed, flight level, etc.).

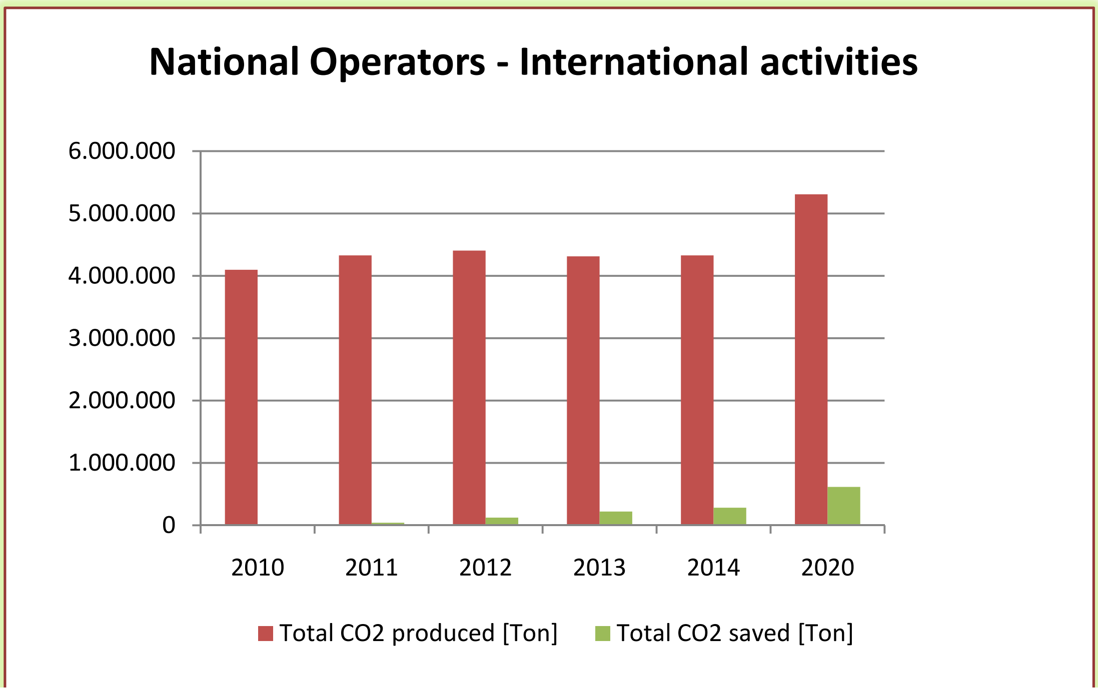
– Engines Wash in order to restore engine fuel burning efficiency.

– Close in re-fleeting and Fleet Optimization Operation in order to perform the best fleet type assigned to a given flight close to departure to better accommodate the anticipated increase or shortfall in demand.

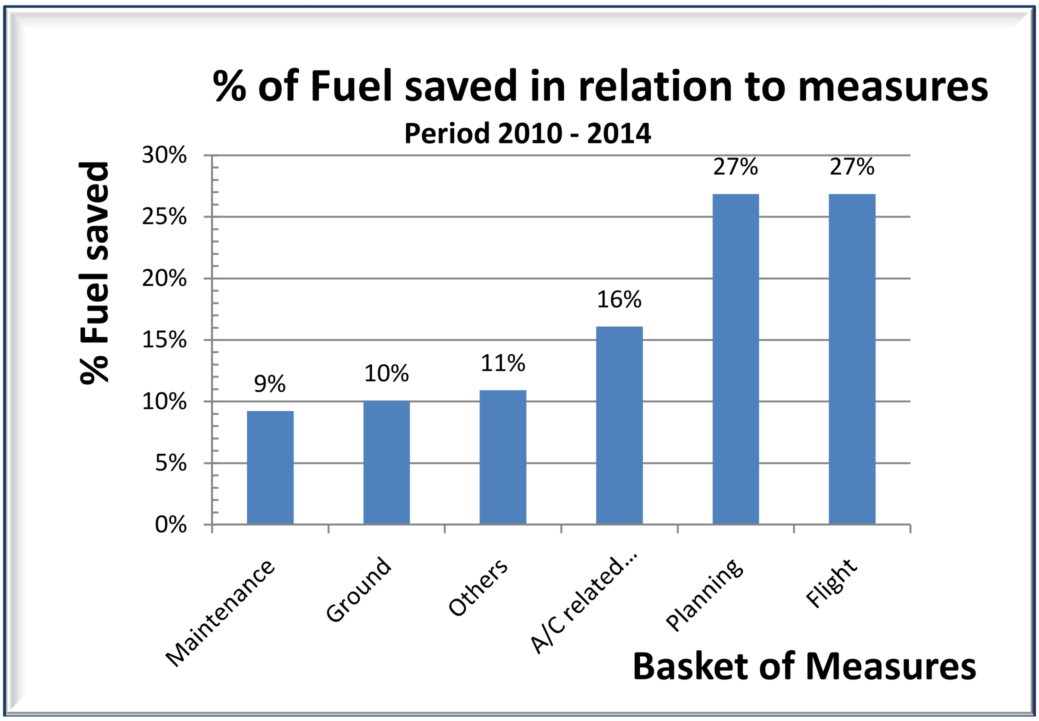
All of the above selected measures were implemented from 2009 and completed in 2014. Further improvements, in the period up to 2020, are foreseeable, i.e., the replacements of the remaining old aircraft. Looking forward to the future, up to 2050, it is not simple to predict the evolution, because several factors could affect this forecast.

The following charts show, limited to International activities and to Italian civil operators involved in International flights, the burnt fuel, the CO_2 emissions and the quantification of the effects after the implementation of the selected measures, as well as the expected results up to 2020:





In the following picture an estimation of the fuel allocation saved in relation to the implemented measures is showed.



It is important to note how the optimization of flight plan activities and flight procedures and routes plays a relevant role in CO_2 emissions reduction.

It is also important to underline the role of the aircraft related technology on the fuel saving. The obtained result is basically related to replacements of the

MD80 fleet. Now the Italian fleet is relatively young but, looking forward in the future years (2020 to 2050), Italy will have the opportunity to introduce the new aircraft with better fuel efficient system (B737 max; Airbus NEO series, B787 Dreamliner, etc…) with an estimated efficiency of roughly 20%.

4.2.2 Alternative Fuels

The use of alternative fuels as a mean to reduce the GHG effects is part of the European research and it is considered one of the most important measure. Alternative fuels can play a relevant role in achieving a significant environmental target. The use of a sustainable biofuel has been incentivized in the ETS programme and could still play a relevant role also in a MBM scheme.

Italy is involved in this challenge in order to determine whether, in the future, alternative fuels will be effectively sustainable and always grant safe operations. Issues related to alternative fuels appear rather relevant as they affect not only energetic, environmental and technological aspects, but also social, economic aspects and public acceptance.

Projects ongoing in Italy related to Alternative Fuels are:

- **ITAKA** - It is a FP7 (7th Framework Programme funded European Research and Technological Development) of the European Commission. University of Florence and an Italian Fuel Manufacturer Group are participating to the ITAKA Project. The study consists of upgrading fried used oils and is in cooperation with Neste Oil for the production of Aviation kerosene.
- **ISAFF** - It is a National Forum that gathers Alternative Fuel Stakeholders. Stakeholders are from Industry, Universities, Fuel Producers, with the goal of promoting Research & Development activities on Biofuels in Italy. Activities are ongoing under the aegis of ENAC.
- **ENI** - The Italian National Energy Company currently produces Biofuel in a fuel plant in Northern Italy (Porto Marghera). The fuel is for automotive use, but the same technology is easily adaptable for aviation purposes.
- **BIOREFLY** - It is a FP7 of the European Commission. The purpose consists of establishing in medium term a bio-kerosene plant in Southern Italy (Puglia region). The plant is expected to produce 200 t/year from lignin.

It is due to note that a wide scale usage of biofuels has been up to now strongly limited by:

- Economic burdens: Biojet premiums vs fossil jet fuel prices are unaffordable for airlines and the end of 2014 drop of crude oil price has widen that gap;
- Lack of sustainable feedstock crops, with a stable and a wide range production and without competition with food;
- Limited refining capacity: Italy is the first European country where a traditional refinery was converted in a Green Refinery (ENI's Porto Marghera refinery), but biojet production availability is expected for 2016.

Notwithstanding the above considerations, the medium term outlook for biofuels seems optimistic:

- Polls on Brent oil foresee a price increase up to 75-85 $/barrel in 2017; assuming that the convertion factor remains the current one (2015 YTD), this increase would lead to a CIF NEW price of 745-845 $/ton;
- ASTM has under approval the usage of the HRDiesel as blend for biojet fuel, which would result in an important reduction of the final costs of the biojet;
- Increase of refining capacity: Porto Marghera green refinery is expected to raise its production to 600k tons in 2016 and Gela refinery is also going to be converted into a green refinery (convertion expected to be completed within 2018);
- Growth of awareness and concrete involvement at policymakers level to support the constitution of an Italian sustainable aviation biofuel supply chain, e.g. encouraging the usage of unused fields for biojet feedstock crops and setting up a system of incentives to make it sustainable for the whole industry.

Should the above assumptions take place, we might expect to reach in medium term (5-10 years) a final price of the biojet almost equal to the traditional fuel price, with a wide scale feedstock production, right sized refining capacity and an efficient logistic and distribution system.

For several years **Alitalia,** the major Italian air carrier, has been a proactive sponsor of many projects, whose aims were to develop a National sustainable biojet fuel:

- 2009: MoU was signed with Solena with the aim to develop a project to convert Rome's area urban wastes into biofuel;
- 2011: an Action Plan was signed with Sunchem, whose target is the usage of Toboil (tobacco seeds oil) as an alternative aviation fuel;
- 2013: Alitalia is one of the first minute members of ISAFF, Italian Sustainable Aviation Fuel Forum, which has, as one of the main objectives, the development of a production, logistics and distribution system for the new biofuels;

The scenario made on Alitalia forecast consumption estimations may be quantified in:

- 30.000-70.000 tonnes in 2020
- 100.000-300.000 tonnes in 2030

4.2.3. National Research and Development

Industries like Alenia Airmacchi, Agusta Westland, SelexES, Piaggio, research centers such as CIRA and CNR and several Universities are heavily involved in several programmes related to environmental objectives for CO_2 emissions reduction, to obtain less perceptive noise per operation and to reduce NOx emissions.

The **Strategic Research Agenda Italia** (SRIA) recognizes the European objectives in the CO_2 reduction programmes. The Strategic Research and Innovation Agenda (SRIA) is the new strategic roadmap for aviation research, development and innovation developed by ACARE that accounts for both the evolution of technology as well as radical changes or 'technology shocks'.

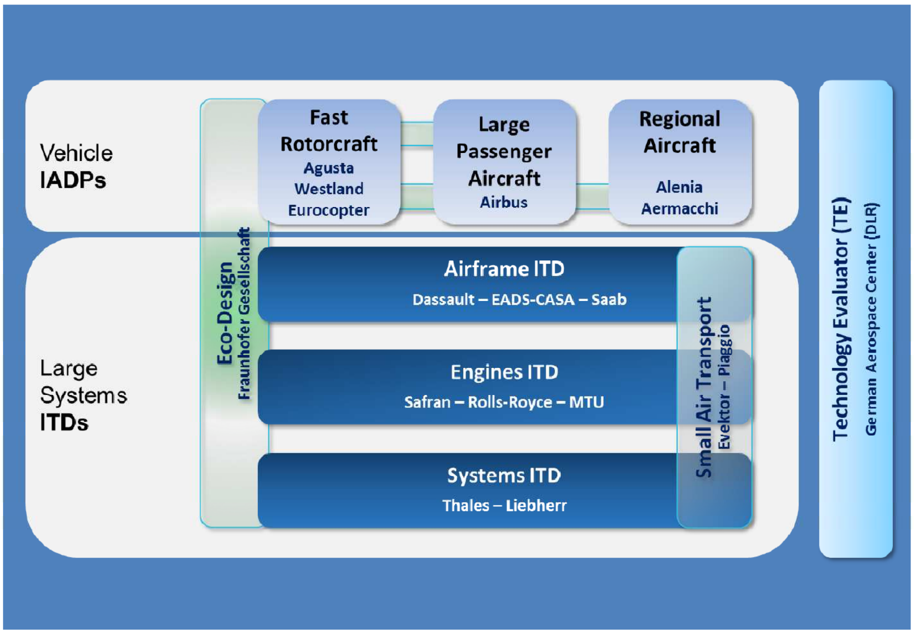
With reference to Clean Sky's environmental objectives and the formulated targets, the first assessments performed early 2012 and early 2013 strongly underlined that Clean Sky was on the right track. In particular, short/medium range commercial aircraft (which is the backbone of the air transport system) could reduce CO_2 emissions up to 30%.

Clean Sky Concept Aircraft	Noise area (take off)	CO_2	NO_X
Low Sweep Biz-Jet (Innovative Empennage)	-68%	-32%	-28%
High Sweep Biz-Jet	-36%	-22%	-26%
TP90 (Regional Turbo-prop)	-48%	-23%	Up to -43%
GTF130 (Regional Jet – Geared Turbo-fan)	-75%	-23%	Up to -46%
Short-Medium Range / CROR Engine	Up to -37%	Up to -30%	N/A
Long Range / 3-shaft Advanced Turbo-fan	Up to -28%	Up to -20%	Up to -21%
Single Engine Light	-47%	-30%	-70%
Twin Engine Light	Up to -53%	-26%	-70%

Clean Sky assessment results

Clean Sky 2, born within H2020 EU Framework for research and innovation, is the natural continuation to the achieved progress in Clean Sky.

In the Clean Sky 2 Program, Italian industries have been fully involved as per the below scheme:



The regional aircraft are a key element of Clean Sky and Clean Sky 2, providing essential building blocks towards an air transport system that respects the environment. In Clean Sky 2 the Regional Aircraft technologies, aimed at CO_2 reduction of emissions, will be pursued by the synergy between two CS2 platforms namely:

- Airframe ITD, with a relevant Alenia Aermacchi participation, will prepare the building blocks of the critical technologies then integrated and further maturated in the Regional Aircraft IADP such as low weight/high strength primary structure materials, eco-compatible and low weight materials for cabin systems;
- Regional Aircraft IADP, with the Italian leadership of Alenia Aermacchi, will bring the integration of technologies devoted to the reduction of the environmental impact, namely CO_2 reduction for the regional aircraft share, to a further level of complexity and maturity than currently pursued in Clean Sky.

The goal is to integrate and validate, at aircraft level, advanced technologies for regional aircraft useful for the CO_2 emissions reduction as well as to drastically de-risk their integration on future products.

In Clean Sky 2 Alenia Aermacchi will use the following demonstration programmes of the regional IADP to implement the technologies targeting CO_2 reduction:

- A Flying Test-bed using modified existing regional TP a/c for demonstration campaigns of air vehicle technologies such as wing structure with integrated systems, propulsion items, flight dynamics;
- Three Large Integrated Ground Demonstrators - i) full-scale fuselage and cabin including associated systems; ii) flight simulator; iii) iron bird - to fully and completely demonstrate low weight materials for fuselage structures, low weight eco-compatible materials for cabin, mission trajectory solutions and more effective flight controls solutions leading to a CO_2 reduction.

Full-scale demonstrations are essential to validate the insertion of breakthrough technologies on regional aircraft entering into service from 2025. To increase synergies and cross fertilization across the different ITDs and IADPs, some of technologies will be shared with other CS2 ITDs, namely Airframe for the low weight materials, Eco-Design for the low emission material and Systems and Engine ITD for the engine and on-board systems.

The Clean Sky 2 activities are distributed in all Regional Aircraft demonstrators and Airframe ITDs. In the following list a detail of content and technologies considered for application:

- FTB1 - Innovative Wing and Flight Controls (Regional IADP) the wide scope is the integration and flight testing of technologies suitable to regional aircraft applications for a new generation wing and advanced flight control systems. The technologies contributing to CO_2 reduction envisaged to be integrated in this demonstrator are:
  - smart materials allowing morphing of control surfaces and then drag and CO_2 emissions reduction
  - electromechanical actuators applied to primary control surfaces reducing weight and power consumption then again less fuel burnt and lower CO_2 emissions
  - movable winglet to improve aerodynamic effectiveness, reduce drag and in turn reduce fuel consumption and CO_2 emission
  - control surfaces with a dedicated control for load control in order to reduce weight and in turn fuel burnt and CO_2 emission
- Full-scale innovative fuselage and passenger cabin (Regional IADP) - the technologies, that will be integrated in the demonstrator, will be:
  - Low weight and eco-compatible material for cabin systems;
  - Low weight structural material with SHM feature to reduce weight thus fuel burnt and CO_2 emissions.
- Flight Simulator (Regional IADP) - starting from the Clean Sky GRA Flight Simulator, an advanced Flight Simulator will be set up and used to

demonstrate new avionics features allowing a more efficient trajectory for CO_2 reductions;

- Iron Bird (Regional IADP) - Virtual and Physical "Iron Birds" will also be an important part of the Regional A/C Ground Demonstration Programme. It will be used to optimize and validate the systems modification of the Flying Test Bed leading to the weight reduction and to the definition of optimal aircraft trajectory for CO_2 reduction.

The Agusta Westland's involvement into the Clean Sky programme is related to the "Fast Rotorcraft Technology Demonstrator", based on new NextGenCTR tilt-rotor concept.

The Fast Rotorcraft Technology Demonstrator has the primary objective in obtaining environmental benefits through a new efficient technology that uses the concept of high speed transportation solutions with a minimal infrastructure footprint.

This will be accomplished by means of:

- Design, manufacturing and testing of a full scale technology demonstrator;
- Analytical form through the technology evaluator efforts which are integral part of the CS2 programme.

The first flight of the technology demonstrator is planned for 2021.

The estimation of CO_2 emission reduction, based on the application of the Fast Rotorcraft Technology, is still under evaluation. The benefits strongly depend on the final choice of aircraft configuration and on the supporting technological solutions as well as on the possibility of effective insertion within the future airspace, ATM requirements and market requirements.

Alenia Aermacchi and SelexES are involved in the Air Traffic Management within the Single European Sky (SES) initiative and the SESAR programme.

Alenia Aermacchi is basically involved in:

- Taxi phase: the analysis of excess taxi time indicates that at least at the largest and most heavily utilized network hubs, there may be scope to reduce taxi times and hence improve fuel efficiency. In this phase, Alenia is committed in the development of an Airport Navigation Function (ANF) software for providing the capability of taxi routing during the airport surfaces operations as well as the on-ground traffic alerts, managed in cooperation among pilots and ATC controllers that will significantly improve the safety aspects and speed-up the taxi runway procedures reducing the fuel consumption.
- Terminal Maneuvre Area (TMA): the analysis of the Arrival Sequencing and Merging area (ASMA) indicator shows that queue management within the 40Nm radius of arrival airports could contribute to excess fuel burn per flight across the European network. Some Alenia Aermacchi

initiatives are in progress in the integration of advanced services enabled by the Ground Based Augmentation System (GBAS), and on new approaches concepts (vertical profile, curved approach & runway approach) integrated in the Flight Management System on board the aircraft that will assist the pilot in the implementation of more efficient approaches to the airport. These functions, that were developed and validated in-flight using the real improved operation procedures, demonstrated the capability to reduce the fuel consumption, as a consequence of a better flight profile but also due to the reduction of the holding procedures.

- En-route: The analysis of the En-route horizontal flight / fuel efficiency shows excess fuel burn beyond the 40Nm radius of origin / destination airports across the European network. The development of the "Airborne initial 4D for trajectory management", with an important contribution of Alenia Aermacchi, will allow a continuous synchronization of the aircraft trajectories between air traffic controllers and pilots allowing to fly the most fuel-efficient flight route, optimizing airspace usage.

Selex ES:

- is engaged in providing means for a more efficient Aircraft Navigation System aimed mainly to pursue the environmental goals promoted by Clean Sky European Project as assessed in the Strategic Research Agendas (SRA1 and SRA2) and confirmed in the Challenge 3 of the Strategic Research and Innovation Agenda (SRIA) and the "Report of the High Level Group on Aviation Research - Flight Path 2050 – Europe's Vision for Aviation".
- is involved in the Work Package 3 - Management of the Trajectory and Mission - dealing with the task of providing the pilot with an aid in the choice of the best trajectory to follow in case of an unexpected (or differently expected) events, in particular weather events, forcing the pilot to change the Reference Flight Plan assessed before the take-off.
- its task in Clean Sky programme is related to the optimization of the path for minimum pollution by means of clear, accurate and timely knowledge of the environmental situation and the provision of a Decision Support System (DSS) identifying, selecting and suggesting the most suitable actions to counteract the change, as a valid help to the pilot for the success of the flight together with the maximum reduction in induced pollution, saving the safety constraints.

Unexpected weather event is one of the major causes of disruptions leading to heavier fuel consumption. In this frame, Selex ES developed two cooperating technologies concerning the improvement of presently available airborne weather radar performances to identify weather situation (Advanced Weather Radar = A-WXR), and the algorithms to optimize flight routes in presence of unforeseen weather – but not only weather – hazardous situations (Trajectory Optimizer, shortly Q-AI = Quasi-Artificial Intelligence, where "Quasi" means that the Optimizer does not replace pilot's skill, but pilot is always the main stakeholder in the decisional loop) and to display the results to the pilot to improve his situation awareness and help him in decision making process.

To reach this gate the A-WXR and the Q-AI have been integrated in two different flight simulators: the Alenia Aermacchi Green Aircraft Simulator, emulating the ATR72 regional aircraft, and the IDS company's simulator, emulating the A320 aircraft and the ATC.

Preliminary data referred to the cruise phase indicate that a benefit in the CO_2 emission reduction of about 2% to 5% could be obtained. Such data are derived as a mean from many flight extracted by Flight Aware as well as simulating unexpected weather events on the aircraft route.

SESAR Very Large Demonstration Projects: Free solutions

The Flexible Airspace Management and Free Route is one of the six of the so-called Pilot Common Project supporting the implementation of the European Air Traffic Management Master Plan (Commission Implementing Rule EU 716/2014), which provides for the implementation (by FL 310+) of Direct Routing operations (by 1 January 2018) and operations Free Routing (by 1 January 2022).

In this context **ENAV**, Italy's Air Navigation Service Provider, has decided to follow up the activity carried out in 2013 with the SESAR WE-FREE project, by developing a new project – also thanks to the technical / operational and co-financing opportunities offered by the SESAR JU - called **FREE Solutions** (Free Route and Environmental Efficient Solutions).

FREE Solutions aims to complete, between 2015 and 2016, a cycle of demonstration flights in operating cross-FAB environment (Blue Med and FABEC specifically) to prove the feasibility and applicability of Direct Routing /Free Routing concepts and the definition of technical and operational requirements essential for the implementation of the Free Routing. It is carried out in collaboration with a significant group of ANSP and Airspace User. The project was launched under the guidance of ENAV, in September 2014. Just six months after, the first set of demonstration flights was successfully completed. Two weekends have been dedicated to the trials and more than 120 flights were operated by project partner airlines on point-to-point connection between European airports with optimized City-Pairs routes. A first analysis of the data collected during this session confirms and enhances the preliminary expectations: each day 1450Kg of fuel on average were saved, resulting in lower emission CO_2 equal to 4400Kg.

Other demonstration flights are dedicated to the identification of specific Direct Routes and to a Free Route specific Airspace Area (FRA), trans-national and multi-FAB, where users can plan their route indicating just an entry point, an exit point and a limited (or null) set of intermediate points, freeing themselves from the current network of ATS routes.

4.2.4 Air Traffic Management

ENAV is the State Company in charge of the management and control of Civil Air Traffic in Italy.

Entirely controlled by the Ministry of Economy and Finance and supervised by the Ministry of Infrastructures and Transport, ENAV was transformed into a publicly controlled joint-stock company on the first of January 2001.

ENAV's goal is to allow aircraft to fly within the assigned airspace with constantly enhanced levels of safety, optimizing the effectiveness of the service provided and the efficiency of the company.

ENAV can count on about 3,300 employees, two thirds of which are in charge of operational activities. The Company provides control and support to allow approaches, departures and landings from the control towers in 42 airports spread over the National territory, and en route services from the four Area Control Centers located in Brindisi, Milan, Padua and Rome. Thanks to these complex operational units, ENAV provides around the clock air traffic services ensuring air traffic flow and regularity, with absolute safety.

Presently ENAV manages more than 1,6 million flights per year, with peaks that can reach 6,000 flights per day.

As in all high complexity sectors, a constant and consistent technological innovation has to be placed side by side to human skill and experience.

For this reason ENAV continues to invest in modernization, new technologies and professional training. ENAV is a component of the European ATM (Air Traffic Management) system and participates with full rights in all the activities of development, operational validation, research and coordination with systems that are perfectly integrated with the International technological context.

ENAV Group consists of:

- **Techno Sky**, responsible for the operational management, the support, the maintenance and the hardware/software development of entire range of systems and equipment used to provide flight assistance services.
- **ENAV Asia Pacific** - based in Kuala Lumpur - launched with the attempt to manage all ENAV's commercial activities in that area.
- **Consortium SICTA** that creates research projects for systems relative to air traffic services.

ENAV has its legal HQs in Rome and operating facilities throughout the National territory. Professional training and continuous professional development for Air Traffic Controllers, Air Traffic Assistance Specialists, Meteorologists and Flight Inspection Pilots are carried out through ENAV's Academy in Forlì.

ENAV participates in research and development activities in coordination with International aviation organizations such as ICAO, EUROCONTROL and CANSO.

ENAV's Flight Efficiency Plan

One of the objectives of ENAV is to contribute in lowering the environmental impact related to flight operations. In this regard, in accordance with International guidelines, it proposes initiatives to decrease the amount of greenhouse gases released into the atmosphere.

In 2009, the Company developed and launched its first, a three-year action plan, which is annually monitored and reviewed. Moreover, ENAV has in place structural initiatives, mainly regular meetings with Airlines, aimed at increasing cooperation and sharing of operational suggestions with Airspace Users to cooperate and share operational suggestions. The information exchange has followed-up important feedbacks to fine-tune ENAV's FEP initiatives.

Since ENAV's FEP first disposition, through a continuous process of review and improvement of the air navigation system, the projects and measures had been set to ensure a greater accessibility of the airspace delivering increased route availability, designing airspace portions and new operational procedures to enable a more efficient use of terminal areas and approaches by using P-RNAV routes (Precision Area Navigation) and Continuous Descent Operations.

In the framework of the National Performance Plan endorsed according to the EU Regulation n.691/2010 and n.390/2013 ENAC monitors ENAV's FEP because of its environmental relevance.

The implemented measures have allowed considerable savings in terms of fuel consumption and GHG emissions thus producing their positive effects year after year. Focusing on the last couple of years implementations, it is worthwhile to mention two major projects which also took into account the objective to increase Capacity and Cost-Efficiency performance while maintaining and/or increasing Safety performance and to meet the performance requirements defined by EU Regulation 691/2010: the Italian Airspace Reorganization and the Free Route Italy.

The Italian Airspace Reorganization project has involved all Italian Area Control Centres (ACCs), reviewed the preexisting airspace structure and improved the network usability with a flight efficiency oriented solution. Besides having achieved shorter route, it has mainly enabled improvements in flight profiles, by gradually free up higher flight levels for most domestic city pairs and some cross-border connections.

The Free Route Italy - whose second step has been completed at the beginning 2015 making available direct and near-direct routes for overflights above FL315 at night and during the weekends - is aimed to deploy free route operation in Italy above FL365 by winter 2016/2017.

In cooperation with airport operators and airspace users ENAV is leading the deployment of A-CDM (Airport Collaborative Decision Making) for the main Italian airports. The project is targeted to enhance the airport operations' efficiency, by improving the departure sequence and the taxi-times (-out and -in). At the end of 2014 three Italian airports have implemented Full or Local A-CDM: Rome Fiumicino, Milan Malpensa and Venice. Air Traffic Controllers skilled in delivering efficient ground operations along with automation represent enabling factors for the reduction of apron and taxiway congestion while still guaranteeing the traffic flows and the airspace users' needs. In a number of other airports a basic system for automatic data exchange managed by ENAV is available. When estimating the performance both enabling factors are to be taken into account and the recorded performance also includes the improvements resulting from the specific training for ATCOs.

In fact, one of the four cornerstones of the Flight Efficiency Plan is to raise Air Traffic Controllers' awareness since they can give a mighty contribution for fuel savings both to in flight and on ground operations. The principles of flight efficiency and their environmental implications were planned to be part of all the trainings and updating for ATCOs ever since ENAV's first FEP in 2009. Currently they are included in both the training plans and report cards of ab-initio and advanced courses of the ATCO students of ENAV Academy as well as in the ATCOs continuous training courses. The positive achievements in the airports ground operation and in tactical behavior in every phase of flight are the main follow-up of this increasing in-depth training for operational personnel more deeply focused on efficiency.

The planning for the years 2015-2017 and the main achievements since winter 2008/2009 are reported hereafter.

En-Route Airspace Design and Network Availability

Plan 2015 - 2017	
2015	➢ Free Route in Italy - Phase 2: lowering Night and Weekend Routes MON-FRI 21000600 in Winter/ MON-FRI 2100-0500 in Summer /H24 in Weekend from FL365 to FL315 (Jan 2015 – achieved) ➢ New routes for northbound traffic between Rome ACC and Padua ACC and Realignment of routes ➢ Changes in Route time availability from NGT-WE to H24 ➢ Review of CDR classification following the implementation of military areas with high flexible use, first phase: IONIO area

2016 - 2017	
	➢ Free Route in Italy - Phase 3: Implementation of "Full Free Route " H24, from FL365 and above, and lowering of ATS Routes to FL365 ➢ Review of CDR classification: second phase SICILY area, other phases to be planned in coordination with AMI ➢ Coordination with FAB Blue Med Partners to improve both intra-FAB and trans-FAB route network: ▪ New interface ATS routes for Italy-Greece-Malta airspaces; ▪ Implementation of intra-FAB BM DCTs for selected routings (FAB BM entry to FAB BM exit and/or between intra-FAB BM city-pair); ▪ Demo trial for inter-FAB Free Route (FABEC-BM) Network optimization based on traffic demand and harmonization of the new RAD implementations.

Achievements 2008 - 2014

- ✓ Free route in Italy (FRI): first phase implemented winter 2013/2014 in upper airspace between FL365 and FL460 during night time, weekends and holidays through the implementation of 63 direct or near-direct routings and the extension of the temporal availability of some ATS routes
- ✓ Redesign of the Italian Airspace and ACC Airspace Reorganization (2014)
- ✓ Continuous improvements to the network availability on the basis of traffic demand (recurrent)
- ✓ Implementation of new more direct ATS routes, extensions, realignments (2008 to 2013)
- ✓ Reorganization of route network portion over Alghero , Bolzano, Florence and Verona areas
- ✓ User preferred flight level through raising or removal of level cappings for city-pairs:
- ✓ Increase of hourly network availability in winter seasons
- ✓ Reorganization of route network for Milan and Rome U/FIRs
- ✓ Streamlining routes ACC Rome area
- ✓ Summer season two more hours clear of RAD constraints every day
- ✓ Improvements in flight profile Italy to/from France, Spain and Tunisia.

Performance of sole implementations achieved in 2014	Δ Km	**-1.525.000**
	Δ T Fuel	**-9.240**
	Δ T CO_2	**-29.106**

Design and use of Terminal areas

Plan 2015 - 2017
➢ Reorganisation TMAs ▪ ROMA TMA, Spring 2015 (achieved) ▪ MILANO TMA, Autumn 2015 ➢ Reorganisation CTRs: LIMJ, LIPY, LIBP ➢ New implementations or improvements of P-RNAV SIDs/STARs: LIEA, LIBD, LIRN, LICJ , LIPX ➢ Implementations of RNP Approach procedure: LIBD, LICG, LIEA , LIEO , LIRN , LIME, LIMJ, LIMF, LIPX, LIRQ ➢ Implementation of CDO with IFP: LIRF, LIMC, LIML, LIPX, LIPZ, LIPE, LIEO, LIMF, LIRQ, LICJ ➢ CCO application without dedicated procedures (e.g. radar vectoring): Venezia, Verona, Olbia ➢ CCO application with IFP ➢ Implementation of APV SBAS procedure for helicopters

Achievements 2008 - 2014
✓ Reorganization of LICJ, LIPY, LIPE, LIME, and LIRF CTRs and related IFP ✓ Implementation of RNAV approach procedures for LIEA ✓ Review of LIMP and LIPZ Initial Climb Procedures and SIDs ✓ New SIDs: LIMZ ✓ Reorganization of SIDs for LIRF and LICJ ✓ New STAR and/or SID for LIMP, LIBP and LIPY ✓ New IAC for LIBC ✓ P-RNAV SIDs/STARs: LIPX, LIRF, LIMZ, LIPZ, LIEO ✓ New IFPs (STAR or SID or IAP or ICP): LIBC, LIPO, LIRZ ,LIMP, LIRA, LIRF ✓ Publication of an ad hoc AIC describing the implementation of Continuous Descent Operations in Italy ✓ Implementations of P-RNAV SIDs/STARs: LIPE, LIPX, LICJ, LIRQ (2014) ✓ Implementations of New SIDs: LICA, LIMP (2014)

Performance of sole implementations achieved in 2014	Δ Km	**-685.000**
	Δ T Fuel	**-1.880**
	Δ T CO_2	**-5.992**

Airport Operations

Plan 2015 - 2016
➢ Implementation of A-CDM - Local and Full - with SW support for automatic data exchanging among ATC, AOP, Airlines, NMOC (EU Network Manager) and related operational procedures for LIPZ (Jan 2015 – achieved), LIML, LIRN. ➢ Extension of the automation of the Apron Management Service for LIEE, LIRA, LIPX

Achievements 2008 - 2014
✓ Optimization and automation of the Apron Management Service of LIMC, LIML, LIME, LIMF, LIPE, LIPZ, LIRN and LICJ. ✓ Extension of the automation of the Apron Management Service at LIEA, LIMJ, LIRQ, LIEO, LIBD, LICC and LICA. ✓ Local implementation of A-CDM with SW support for automatic data exchanging among ATC, Airport Operators, Airlines, and related operational procedures for LIRF. ✓ Full A-CDM i.e.SW support for automatic data exchanging with NMOC (EU Network Manager)): Fiumicino and Malpensa Airports evaluated results show a significant reduction of taxi-time. (2014) ✓ Local A-CDM ,Venezia Airport (2014)

Performance of A-CDM Airports in 2014	Δ min TTout	**-73.500**
	Δ T Fuel	**-1.205**
	Δ T CO_2	**-3.796**

Operational staff awareness

Plan 2015 - 2016
➢ Ab initio and advanced ATCOs students will follow around 315 hours on flight efficiency. ➢ ATCOs continuation training will include around 4.200 hours focused on flight efficiency.

Achievements 2008 - 2014
✓ 900 people - ab initio ATCOs, advanced ATCOs and FISO students - have attended modules on flight efficiency at ENAV's Academy ✓ Managerial dedicated workshops for all ENAV's ATS Units ✓ 19.000 hours on flight efficiency provided to ATCOs during continuous training

4.2.5 Airports and Infrastructure Use

The Airport Management Companies have undertaken since quite a few years several initiatives and interventions aiming at reducing CO_2 emissions. Progress has been achieved through diverse actions at National, European and International level. It is worth to add those actions promoted through new Airport Charges Regulatory System which are scheduled to enter into force by 2020.

As regards CO_2 emissions, ENAC has asked the Airport Managing Companies a complete resumé of the related activities but, up to now, certified comprehensive data are not available yet.

Some collected information is available and represent roughly 90% of total traffic of Italy's airport system, which means 135 million passengers.

- Airports which represent 84% of National Air Traffic have already promoted significant interventions aiming at improving visual aid lighting such as the installation of LEDs or automatically controlled system for lighting – by 2020, this percentage is expected to increase at 87% of the total air traffic;
- Airports which represent 78% of National Air Traffic have promoted interventions aiming at improving energy production power plants (electricity/heating/cooling) through cogeneration, trigeneration or installation of high efficiency air treatment units (ATU) – by 2020, this percentage is expected to increase at 84% of the total air traffic;
- Airports which represent 41% of National Air Traffic have promoted interventions for energy efficiency retrofits and/or installation of building envelope components with high performance in terms of thermal transmittance – by 2020, this percentage is expected to increase at 57% of the total air traffic;
- Airports which represent 58% of National Air Traffic have promoted interventions of Green Procurement – by 2020, this percentage is expected to increase at 60% of the total air traffic;
- Airports which represent 59% of National Air Traffic have promoted interventions on Personnel Training regarding Airport Employees comprising initiatives of familiarization with environmental issues and the correct use of energy – by 2020, this percentage is expected to increase at 64% of the total air traffic;
- Airports which represent 82% of National Air Traffic have already promoted the adoption of management protocols and organizational instruments to increase technological usage and the planning of further interventions to improve energy efficiency of airports' infrastructures – by 2020, this percentage is expected to increase at 84% of the total air traffic;

- Other few airports are planning to undertake by 2020 interventions as regards the installation of photovoltaic plants ad adopt photocatalytic materials for road areas;
- The ACI Europe Airport Carbon Accreditation programme has been endorsed by a number of airports that represent 51% of air traffic and it is expected to increase to 65% of the total air traffic by 2020.

Upon the data collected to this date (which have been delivered by the most important airports which represent 70% of total National Traffic), the identified indicator as $KgCO_2$/pax/year has been quantified and it is expected that it will decrease of more than 13% by 2020. The average of 1,68 $kgCO_2$/pax/year in 2014 will decrease to 1,45 $KgCO_2$/pax/year by 2020.

This average decrease of global CO_2 emitted by the Italian airport system will be achieved through interventions directly made by the Airports Managing Companies. These actions are included in the renewals of the Airport Charges Regulatory System, as listed hereafter, and have a significant impact on the CO_2 emissions reduction.

Airport Charges Regulatory models, upon which the Airport Managing Company is committed to present an Environmental Quality and Safeguard Plan, have been issued. This is aimed at improving the reduction of environmental impact of airport activities and the Airport Managing Company is committed to respect those quality indicators of environmental safeguard included in the Plan.

The indicators of environmental safeguard are identified upon the following criteria:

- Clearly respond to the real needs of improvement of the interested airport and firstly refer to such aspects which show major environmental deficiencies; doing so, the mechanism may represent a means to uniform the level of environmental performances throughout Italy's airports net;
- Be of significant importance as regards the environmental performances of each single airport infrastructure, as to represent a concrete chance to improve ecological level of the concerned airport's area;
- Be balanced as regards the dimension of the concerned airport area and the related charges increase comparing to the achievement of the objective;
- Be mostly related to request coming from Institutions and Associations concerned by environmental issues.

Among the most relevant indicators, those reported hereafter have a significant impact on the CO_2 emissions reduction:

Energy savings

INDICATOR	MEASURING UNIT
New lighting plants with low energy consumption (LED, fluorescent aids, etc.) in substitution of the previous ones	kWh used after the intervention / KWh before the intervention
Installation of building opaque envelope elements with transmittance below the thermal values requirement s (value limit as indicated by Law)	% of W/m2K savings comparing to the Law limit
Installation of transparent building envelope components with transmittance below the thermal values requirement s (value limit as indicated by Law)	% of W/m2K savings comparing to the Law limit
Energy consumption reduction through lighting plants' managing systems (building Management System – photosensitive cells, movement sensors, etc.)	% energy savings on historical consumption
Energy consumption reduction through installation of high efficiency air conditioning plants	kWh installed/kWhpre-existent conditions

Energy production from renewable sources

INDICATOR	MEASURING UNIT
Electric energy production through installation of photovoltaic plants on parking recoveries, integrated or on surfaces and transit areas for passengers	MWh produced/MWh total consumption
Reduction of energy consumption for passive heating through heating accumulation and passive restitution, heating recovery	kWh/m2/year
Energy consumption reduction through usage of passive ventilation for local cooling	kWh/m2/year
Energy production through rooftop or front solar water heating plants	MWh produced/ MWh totally installed
Electric energy and heating production through plants fed with locally available biomasses	MWh produced energy/ MWh totally installed
Electric, heating and cooling energy production through cogeneration and trigeneration plants	MWh produced energy/ MWh totally installed
Electric and heating energy production through low enthalpy geothermal plants	MWh produced energy/ MWh totally installed

The Civil Aviation Authority is requiring the Airport Managing Companies to point out those indicators which are really significant in relation with an implementation policy of environmental safeguard, taking into account the specificity of the airport based on its energy analysis.

Should the necessary environmental data to be used as analysis basis for the choice of the interventions to be done not be available yet, each Managing Company is required to start at short term a programme of detailed analysis on consumption, emissions and natural resources needs to be used by the airport, as per single disaggregated functions.

The monitoring programme is conceived to measure and certify current consumption values and to plan future significant interventions.

In addition to the monitoring programmes put in place by the Airport Managing Companies, ENAC has recently completed an important energy auditing campaign (an EU programme). This project has taken into account 46 buildings present in 15 airports allocated in, the so called, "Regioni obiettivo Convergenza" (Regions with converging objectives) such as: Naples, Salerno, Lamezia Terme, Reggio Calabria, Crotone, Bari, Brindisi, Foggia, Taranto, Catania, Palermo, Trapani, Comiso, Lampedusa e Pantelleria.

The phases of the Energy Audit made on the buildings are the following:

Phase 1 - energy census of buildings;

Phase 2 – energy analysis of the buildings;

Phace 3 – economic and technical evaluation of the efficiency interventions.

For each infrastructure and each building an energy diagnosis has been done, first at a preliminary level (1st audit level) and then a detailed analysis (2nd audit level). Afterwards, an energy certification with a related activity of listing of the correspondent improvement plans on an economic and technical evaluation basis have been carried out.

The results consist of 46 energy certifications of buildings in the airports of Sicily, Campania, Puglia, Calabria and 15 airport reports containing 311 concluded interventions of energy efficiency.

4.3 Emission Trading System

Since January 1 2012, the emissions deriving from Air Transport are included in the EU system of exchange of GHG emissions, named ETS, as regulated by the EU Directive 2003/87/CE.

The provisions related to Civil Aviation in the ETS implemented since January 1, 2013 and attributed to air carriers administrated by Italy, have been endorsed through the Legislative Decree n. 30 dated 13 March 2013, as National application of the EU Directive 2009/29/CE which supersedes Directive 2003/87/CE in order to improve and make more extensive the EU system of exchange of GHG.

The Legislative Decree n.30/2013 entered into force on April 5, 2013.

As stated by the Decree, the National Committee for the management of the Directive 2003/87/CE and for supporting the management of those project activities related to the Kyoto Protocol (ETS Committee) undertakes the function of Competent Authority for the National implementation of the ETS system in Air Transport as well.

The participants in the Committee are the Ministry for Environment, Safeguard of Territory and Sea, the Ministry for the Economic Development, the Ministry for Infrastructures and Transport and ENAC.

The Ministry for Economy and Finance, the Ministry for the European Policies and the Conference for the relations between State and Regions participate in the Committee in a consulting role.