

# SESAR AND THE ENVIRONMENT



founding members



Air Traffic Management goes **green**.  
SESAR seeks to reduce the environmental  
impact per flight by 10%.

## Statement from the Executive Director



SESAR's mission is to build the future air traffic management system, able to cope with an expected doubling of flights in Europe by 2020. This new system does not only have to cater for safety, efficiency and capacity of air transport, but it also needs to allow for a sustainable growth.

The future of air traffic management needs to be green. It is the societal responsibility of the aviation industry to make sure that we can diminish the environmental impact of air transport which currently accounts for about three per cent of total EU greenhouse gas emissions.

One of the priorities of SESAR is to enable the reduction of the environmental impact per flight by ten per cent. We have already demonstrated that by using existing technologies more efficiently and by introducing greener procedures, emission reductions of up to two per cent can be achieved.

**Patrick Ky**

**Executive Director of the SESAR Joint Undertaking**

## Single European Sky

The Single European Sky (SES) is an ambitious initiative launched by the European Commission in 2004 to reform the architecture of European air traffic management. It proposes a legislative approach to meet future capacity and safety needs at a European rather than a local level. The ash cloud crisis in April 2010 showed the crucial importance of a better integration of the EU airspace through this package. As a consequence of the crisis, during an extraordinary transport Council meeting, the highest priority was given to the acceleration and anticipation of the full implementation of the SES including the adoption of a SESAR deployment strategy before end of 2010.

### Single European Sky ATM Research (SESAR)

SESAR is the operational and technological dimension of the Single European Sky initiative. It will help create a 'paradigm shift', supported by state-of-the-art and innovative technology capable of ensuring the safety, fluidity and sustainability of air transport worldwide over the next 30 years.

### A partnership programme

SESAR aims to evolve the air traffic management system, eliminating the fragmented approach of European ATM, bringing both public and private stakeholders together, pooling resources, capturing synergies and achieving common goals. For the first time, all relevant aviation players are involved in the definition, development and deployment of a pan-European modernisation project.



# ATM and the environment

Air traffic management affects when, how far, how high, how fast and how efficiently aircraft fly. These parameters in turn influence how much fuel a given aircraft burns, the release of greenhouse and other gases from the engines and, of course, how much noise an aircraft makes.

The quickest way to cut aircraft emissions is better flight management, an Oxford University study has found.<sup>1</sup> ATM enhancements through the optimisation of horizontal and vertical flight profiles have the potential to trim down the in-flight CO<sub>2</sub> emissions cumulated over the 2008 to 2020 period with around 50 Million tons.<sup>2</sup>

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## **Minimising the fuel consumed on each flight will generally lower all aircraft emissions**

The "rule of thumb" to obtain order of magnitude estimates:

- Average fuel burn per minute of flight = 49 kg\*
- Average fuel burn per nautical mile (NM) of flight = 11 kg
- Burning 1 ton of Jet Fuel produces 3.15 tons of CO<sub>2</sub>

\* This number is derived by dividing the total JET A1 consumption (55 billion USG) by the total of minutes flown (3.4 billion) by all airlines (scheduled and non-scheduled) as per IATA statistics for 2005. For the conversion from USG to kg fuel a factor 3.0265 (3.7831 x 0.8) was used.

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1. "Future of Mobility Roadmap, Chapter 3, Air", University of Oxford, Smith School of Enterprise and the Environment, 2010.  
2. ATM Master Plan, 2008.

# SESAR and the environment

Currently, flight paths predominantly follow set air corridors that make the route longer than necessary. On arrival at the destination the aircraft may have to circle in a holding pattern or descend in stages while awaiting a landing slot. All of these factors increase fuel consumption, pollution and greenhouse gas emissions. SESAR technology will enable more direct flight paths and smooth descent and climbing, which will eliminate some of the inefficiencies.

SESAR will enable, airspace users, air navigation service providers and airport operators to reduce the environmental impact of their operations for each flight phase. Thus environmental aspects are addressed in all of SESAR's 16 work packages.

## Airport

On average, aircraft are responsible for only about half of the emissions produced at and around airports<sup>3</sup>. As well as aircraft emissions (aircraft engines and auxiliary power units), airport-related emission sources include aircraft handling emissions (mainly ground support equipment, airside traffic, aircraft de-icing and refuelling), infrastructure or stationary sources (surface de-icing, power or heat generation plants, construction activities, etc.), and vehicle traffic on access roads.

## Departure

Aircraft take off with a full tank, meaning that they have to burn more fuel to climb. In the early years of aviation, aircraft could climb away from airports in a simple continuous climb to make the most efficient use of fuel. However, with increasing air traffic there is a need to compromise with aircraft being assigned to certain routes and flight levels to keep them separated from

each other. These compromises mean that aircraft often climb in a series of steps separated by periods of level flight, neither energy efficient nor environmentally friendly. Significant trade-offs between airport capacity, noise and emissions occur at this stage and need to be accounted for.

## Cruise

Aircraft cruise differently, depending on factors such as weight, range, cost efficiency, weather conditions and the airspace they are flying in. Flight management systems onboard aircraft can determine the most efficient cruise altitude and speed to optimise fuel burn. ATM can assist in this process by enabling capacity in the en-route phase of flight to offer aircraft the cruise levels and speeds they request. Further efficiency gains also include route changes to take advantage of favourable wind conditions for example.

3. According to ICAO Circular 303/AN 176.

## ✦ Descent

Opportunities for reductions in fuel burn and emissions in the descent phase through ATM action include delaying the aircraft's descent from cruise, where fuel burn rates are more optimal and using sophisticated arrival management tools to better sequence aircraft ensuring minimal holdings. The aim is to enable aircraft to descend smoothly without using too much thrust, which burns fuel.

### The environment in the SESAR work programme

A large number of SESAR projects, covering the different flight stages, are actively contributing to achieve environmental sustainability – it is estimated that more than 80% of projects will directly support achieving environmental benefits. Work package 16 – R&D Transversal Areas - covers the improvements needed to adapt the Transversal Areas (safety, security, environment, contingency or service continuity and human performance management system practices) to SESAR as well as towards an integrated management system. For environment its specific objectives are to improve the understanding of and response to the different environmentally sustainable impacts (environmental, social, and economic); emerging environmentally sustainable related imperatives and risks; support the definition of the SESAR Environment Management System (EMS) and all environmental impacts including emissions, noise and local air quality; and the establishment of an environmental validation framework.



### SESAR projects with environmental focus (non-exhaustive list):

- Project 04.07.02 Separation Task in En Route Trajectory based environment
- Project 04.07.03 Use of Performance Based Navigation (PBN) for En Route Separation Purposes
- Project 5.6.1 QM1 – Ground and Airborne Capabilities to Implement Sequence
- Project 05.06.02 QM2 – Improving Vertical Profile
- Project 05.07.02 Development of 4D Trajectory-Based Operations for Separation Management Using RNAV/PRNAV
- Project 05.07.04 Full Implementation of PRNAV in TMA
- Project 06.06.02 Integration of Airport – Airline/ Ground Handlers – ATC Processes (incl. Turnaround) in ATM
- Project 06.05.01 Airport Operations Plan Definition
- Project 06.08.03 Separation Minima Reductions Across Flight Phases
- Project 08.01.08 Information Modelling Environment Domain
- Project 9.1 – Airborne Initial 4D Trajectory Management
- Project 09.10 Approach with Vertical Guidance APV
- Project 9.39 – Continuous Climbing Cruise
- Project 10.09.04 CDA and CCD in High Density Traffic
- Project 12.01.07 Airport Systems Specification
- Project 15.02.07 Airport Surface Datalink





## SESAR and the environment: three questions to Alain Siebert, Chief Economics and Environment of the SESAR Joint Undertaking

*Alain, how will the environment benefit from the SESAR programme?*

The efficiency gains made possible by the implementation of SESAR will enable the reduction of the environmental impact of every movement in European airspace and at European airports. The enhancements in air traffic management through the optimisation of flight trajectories have the potential to trim down the cumulative in-flight CO<sub>2</sub> emissions up to 2020 by around 50 million tonnes. In addition, close cooperation with major initiatives such as NextGen and CleanSky will further enhance the environmental benefits for society.

*When will we see the first results?*

SESAR is focused on showing tangible results every year. In many airports in Europe, initiatives such as 'green' approaches are already being introduced – especially in densely populated areas where the reduction of noise and the improvement of local air quality are highly appreciated.

*What are the challenges of the programme from an environmental point of view?*

Air transport is a global industry and therefore international cooperation is key if we want to meet the global challenge of climate change. We are working hand-in-hand with NextGen, ICAO and other countries to align activities on interoperability. AIRE is a good example where we work collaboratively on an international basis in order to substantially accelerate the pace of change in reducing the environmental impact of air transport.



### **SESAR's environmental policy**

SESAR aims to enable the reduction of the environmental impact per flight by 10% without compromising on safety and with clear capacity and cost efficiency targets in mind. Embedded in the European Union's Single European Sky initiative, SESAR contributes to sustainable air transport within, into, out of and over Europe. The programme unites all aviation players in order to secure an effective roll-out of 'green' technological and operational improvements.

### **SESAR's environmental goals**

The aim of the SESAR Joint Undertaking is to become the most environmentally-conscious ATM development programme in the world. To this end, the SESAR programme will implement an advanced validation methodology that will ensure end-to-end consideration of environmental aspects in all R&D activities.

At the same time, SESAR is in close cooperation with other European and international initiatives relating to the integration of new, environmentally-friendly solutions for the aviation sector. One such project is the European Union's Clean Sky Joint Technology Initiative, which will develop breakthrough technologies to significantly increase the environmental performance of aircraft operating in the future ATM system.

### SESAR's green long-term objectives are to:

- **Achieve emission reductions** through the optimisation of air traffic management services. The SESAR target for 2020 is to enable 10% fuel savings per flight from ATM improvements alone, leading to a 10% reduction of CO<sub>2</sub> emissions per flight;
- **Improve the management of noise and its impact** through better flight paths and optimised climbs and descents;
- **Improve the role of ATM in enforcing local environmental rules** by ensuring that flight operations fully comply with localised aircraft type restrictions, night movement bans, noise routes, noise quotas, etc.;
- **Improve the role of ATM in developing new environmental rules** by assessing the environmental impact of ATM constraints and, following this assessment, adopting the best solutions from a European sustainability perspective.

### More precise planning...

Predictability is key in air traffic management and its environmental performance. With better information exchange and collaborative decision making, air traffic management will be dramatically improved.

SESAR will introduce the so-called '4D trajectory' when developing new and more efficient air- and ground systems as well as procedures. This integrates the fourth dimension – time – so that the aircraft will be able to follow an agreed flight trajectory with as little change requests as possible from origin to destination. Flights will follow fully optimised flight paths for all phases of

the flight including operations around airports that are the main bottlenecks in the present system. As a result, pilots will be able to choose the optimum flight path, using continuous climb and descent approaches, the most economic altitude and speed, and shorter taxiing on the ground. The 4D trajectory will permit airlines to fly a route in the most efficient way, minimising the environmental impact of both emissions and noise for every flight.

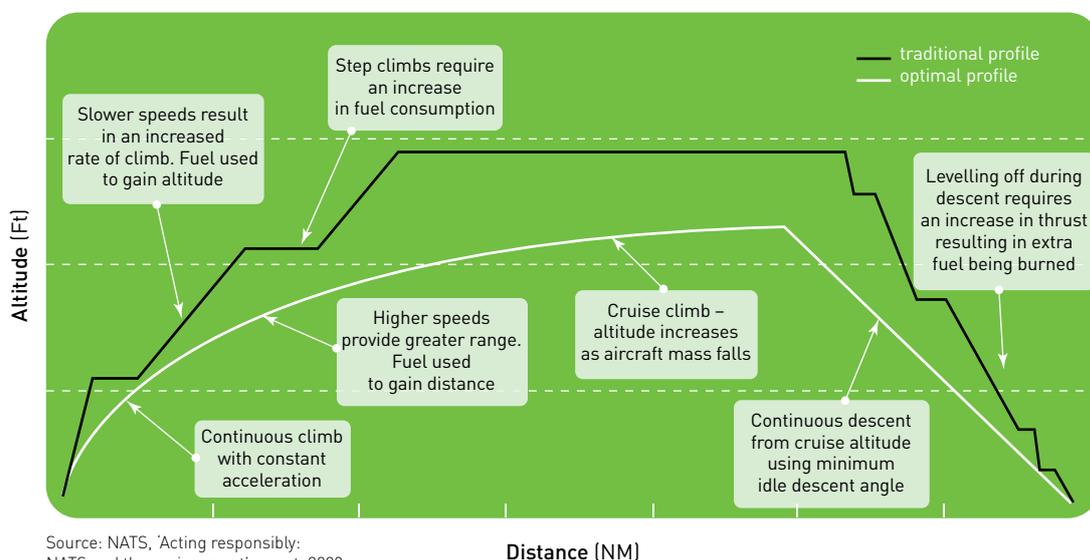
### Where can we save?

Optimised air traffic management will lead to emission savings in all phases of flight. Through coordination between the airport, air traffic controllers and the pilot, aircraft movements on the ground can take place in a continuous manner and minimised holding time.

Continuous climb and descent paths will allow an aircraft to use only as much thrust as is needed, which means burning less fuel at the best moment. Today, for example, when the airspace is congested, aircraft are often constrained to 'wait' in the air, or at control speed, which again leads to the use of additional fuel. A fuel-efficient descent profile includes for example when best to leave cruise level without risking to 'wait' due to congested airspace.

The height, speed and route of the aircraft when cruising also affects fuel efficiency and CO<sub>2</sub> emissions. The optimal flight profile includes exploiting maximum benefits from e.g. wind conditions and, as the optimal altitude changes throughout the flight, climbing or descending to more fuel-efficient flight levels.

## Fuel-efficient flight profile



# Partnership with the AIRE programme

The Atlantic Interoperability Initiative to Reduce Emissions (AIRE) is a programme designed to improve energy efficiency and lower engine emissions and aircraft noise in cooperation with the FAA. The SESAR JU is responsible for its management from a European perspective.

Under this initiative ATM stakeholders work collaboratively to perform integrated flight trials and demonstrations. These will validate solutions to reduce CO<sub>2</sub> emissions for surface, terminal and oceanic operations in order to substantially accelerate the pace of change.

The strategy is to produce constant step-wise improvements, to be implemented by each partner in order to contribute to reaching the common objective. The programme is continued in 2010. In 2009, the SESAR JU directly supported 1,152 trials in operational conditions with the following 18 partners:

ADACEL, AENA, Aéroports de Paris, Airbus, Air France, AVTECH, DSN, Egis Avia, Iberia, Icelandair, INECO, Isavia, LfV, Nav Portugal, Novair, TAP Portugal, TERN Systems and Thales .

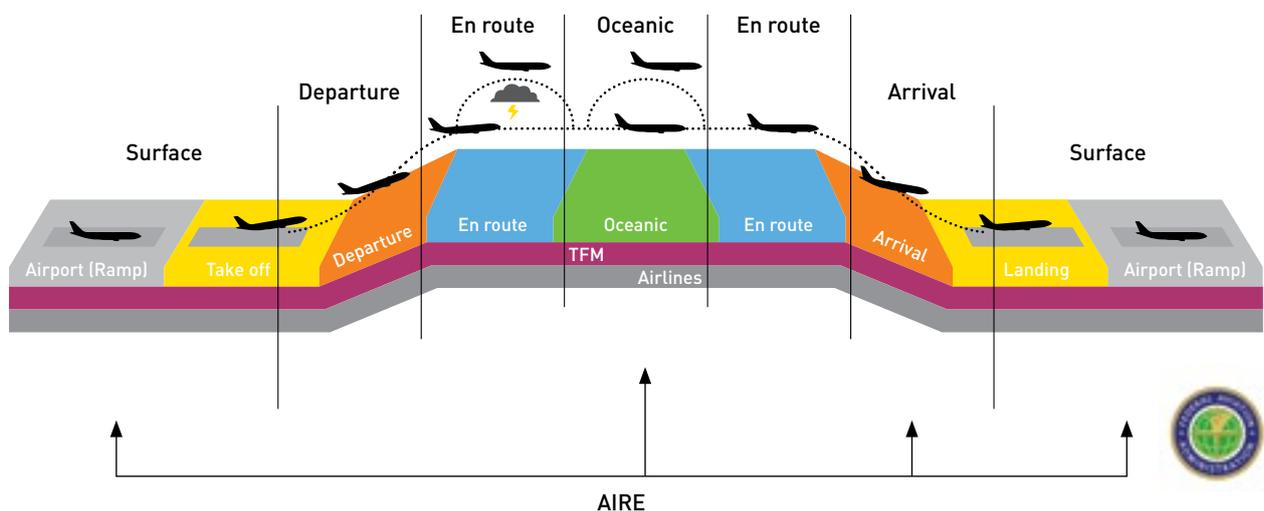
## ✦ Collaboration on the ground and in the air

The AIRE programme is currently conducting trials for 'green' surface, terminal and oceanic procedures. Sometimes the outcomes of trials are coupled together in order to achieve a 'gate-to-gate' view of flights.

## Gate-to-gate

The two first complete (gate-to-gate) green transatlantic flights were operated on 6 and 7 April 2010 from Paris-Charles de Gaulle to Miami airports. The flights were carried out by Air France (6 April) and American Airlines (7 April). This marks a new milestone for the AIRE programme.

During the approximately nine hours flight, enhanced procedures were used to improve the aircraft's energy efficiency. These procedures, applied at each flight stage and coordinated among all project participants, reduced fuel consumption (and hence carbon dioxide emissions) throughout the flight, from taxiing at Paris-Charles de Gaulle to arrival on the parking stand in Miami. During the departure and arrival phases, the procedures helped minimise noise levels. Air France estimates that applying these optimisations to all Air France long-haul flights to and from North America, would result in a cut of CO<sub>2</sub> emissions by 135,000 metric tons per year, with fuel savings of 43,000 metric tons. Air France Captain Claude Godel said after his first transatlantic green flight that flying AIRE is like the pilot's dream come true. Although more pre-flight preparation is needed, once off-block the pilot can expect to fly the best track at the best speed and the best altitude.



1. According to ICAO Circular 303/AN 176.



✦ **AIRE 2009 results**

SESAR presented the first results of the AIRE project for the 2009 trials in March 2010. Green ground movement trials performed at Paris Charles De Gaulle airport demonstrated the effectiveness of a new collaborative decision support system which minimises taxi time and allows for reduced engine taxi operation.

'Green' approach (such as Continuous Descent Approaches – CDA) or green climb trials at Madrid, Paris and Stockholm airports

were conducted achieving significant CO<sub>2</sub> savings. The 'Required Navigation Performance' (RNP) based CDA approach in Europe was performed for the first time at Stockholm's Arlanda airport.

Trials for green oceanic procedures and techniques (speed, horizontal and lateral flight profile optimisation) were also carried out with success on selected routes between Europe and North/Central America and the Caribbean's.

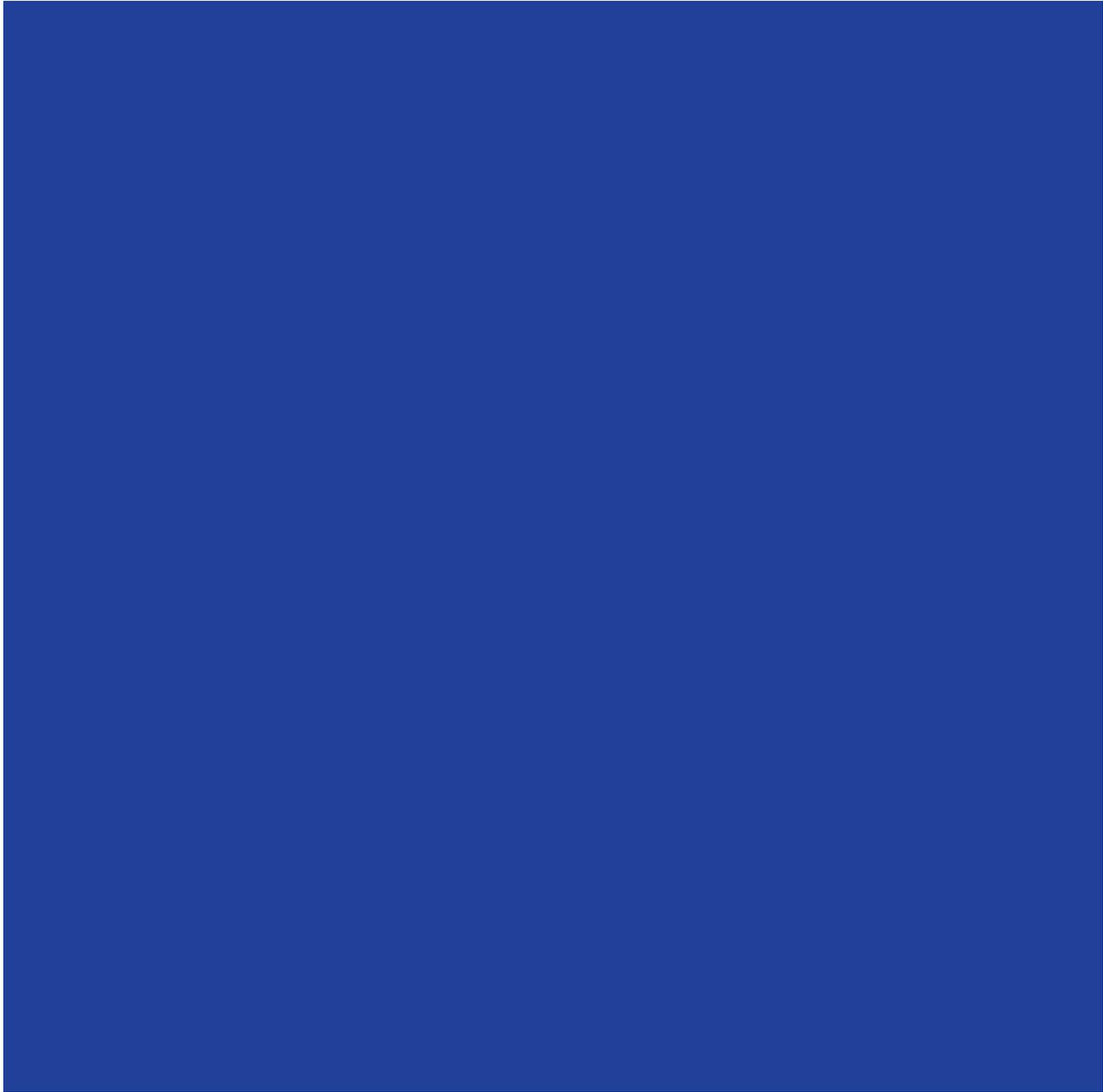
These are encouraging results. It is now essential that we try to transform them from "flight trials" to "day-to-day operations", in order to realise the full benefits of AIRE. This is the philosophy of the 2010 activities that the SESAR Joint Undertaking would like to perform with its AIRE partners. AIRE has also proven that, without major technological investments, the value of working together with common goals can be enormous. This is the partnership spirit in practice.

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 SESAR, by introducing new technologies and procedures, will reduce noise and decrease fuel burn, which will, in turn, further curb aviation's environmental impact.  
 Savings on the order of 50 Million tons of CO<sub>2</sub> emissions over the 2008 to 2020 period are envisaged.  
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Domain	Location	Nr of trials performed	CO <sub>2</sub> benefit/flight
Surface	Paris, France	353	190 – 1,200 kg
	Paris, France	82	100 – 1,250 kg
	Stockholm, Sweden	11	450 – 950 kg
Terminal	Madrid, Spain	620	250 – 800 kg
	Santa Maria, Portugal	48	90 – 650 kg
	Reykjavik, Iceland	38	250 – 1,050 kg
Oceanic	<b>Total</b>	<b>1152</b>	<b>390 tons</b>



[www.sesarju.eu/environment](http://www.sesarju.eu/environment)



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