European Commission

Air Traffic Management

and the Green Deal

A PROJECTS INFO PACK BY CORDIS

Research and Innovation

CONTENTS

The SESAR Joint Undertaking (SESAR JU) is a European public-private partnership set up to accelerate the delivery of the Digital European Sky. To do so, it is developing cutting-edge technological solutions to make Europe the most efficient and environmentally-friendly sky to fly for conventional aircraft, drones, air taxis and vehicles flying at higher altitudes.

Building on the work of the first SESAR JU, this SESAR JU has a 10-year mandate (2021-2031), to complete the work outlined in its Multiannual Work Programme with support from the Horizon Europe programme.

The European Green Deal, launched by the European Commission in December 2019, aims to create the world's first climate-neutral bloc by 2050. This ambitious target calls for deep-rooted change across the aviation sector, and places significantly stronger focus on the environmental impact of flying. Multiple technology pathways are required, one of which is the digital transformation of air traffic management, where SESAR research and innovation plays a central role.

The SESAR JU is integral to several EU policy areas, including the Single European Sky, of which SESAR is the technological pillar, the sustainable and smart mobility strategy, digital transformation of transport modes for connected and automated mobility as part of Europe Fit for the Digital Age, the European Green Deal and the Fit for 55 package.

The JU also creates synergies with several other work areas. These include efforts to cut CO_2 and non-CO_2 aircraft emissions with the Clean Aviation Joint Undertaking, advancing space-based solutions for European air traffic management with the European Union Agency for the Space Programme (EUSPA), developing multimodal solutions for rail and aviation with Europe's Rail Joint Undertaking, and collaborating with the European Climate, Infrastructure and Environment Executive Agency on using the Connecting Europe Facility for Digital Sky Demonstrators.

FOREWORD

"Innovation thrives on collaboration – it's the catalyst that propels us beyond boundaries, generating novel ideas and amplifying impact. In a world where challenges such as climate change demand collective action, collaboration becomes not just a choice but a necessity."

Andreas Boschen
Executive director, SESAR Joint Undertaking

Air traffic management (ATM) has an important contribution to make towards the overall effort supporting climate-neutral aviation. In the SESAR Joint Undertaking (SESAR JU), we have united the entire ATM community – airports, air navigation service providers, civil and military airspace users, industry, professional staff organisations and academia – to ensure a comprehensive response. Together, we have set ourselves the ambition of making Europe the most efficient and environmentally-friendly sky to fly in the world.

This brochure provides insights into our work in this area with a collection of 10 projects from our Digital European Sky research and innovation programme. Grouped under our programme flagship 'Aviation Green Deal', these projects are harnessing the latest digital technologies to address both the CO_2 and non-CO_2 impacts of aviation – a critical dual priority for a sustainable tomorrow. The projects take a holistic look at ATM, addressing operations across all phases of flight – from taxiing and take-off to cruising and preparing to land – targeting environmental inefficiencies throughout.

Our projects are contributing to the aviation sector's climate-neutrality commitment as well as to the ambitions set for aviation in the European Green Deal, sustainable and smart mobility strategy, European Climate Law, and Fit for 55 plan for a green transition.

Funded within the framework of Horizon Europe and the Connecting Europe Facility, the projects captured in this brochure represent together an innovation pipeline spanning exploratory research, industrial research and demonstrators, ensuring that great ideas are nurtured and developed, and ultimately transformed into tangible solutions for market uptake.

Over the next 24 to 36 months, we look forward to seeing the results that will unfold and the transformative effect that these projects will have on the aviation community at large.

No single entity can navigate the complexities of our time alone. By leveraging the power of collaboration, we can address formidable challenges, usher in transformative change and create a sustainable future for all.

Enjoy the read!

sesar
JOINT UNDERTAKING

EDITORIAL

Blues skies ahead: Sustainable innovation powered by SESAR

Aviation has a significant role to play in Europe's transition to carbon neutrality and its wider environmental sustainability goals. While a shift to sustainable fuel sources offers the greatest potential for decarbonisation, emissions savings can be achieved in the short term by introducing new technologies and procedures into air traffic management. Changes here can also significantly reduce non-CO_2 impacts such as noise and particulate pollution. This Projects Info Pack showcases the work of the SESAR Joint Undertaking (JU) to advance the environmental sustainability of air transport in the European Union through 10 groundbreaking projects.

The European Green Deal launched by the European Commission in December 2019 aims to create the world's first climate-neutral bloc by 2050. This ambitious target calls for deep-rooted change across the aviation sector and places significantly stronger focus on the environmental impact of flying.

Multiple technology pathways are required to achieve this, one of which is the digital transformation of air traffic management. This is where SESAR innovation comes into play.

Over the past decade, the SESAR JU has worked to improve the environmental footprint of air traffic management, from CO_2 and non-CO_2 emissions to noise and local air quality. The unique public-private partnership is looking at every phase of the flight and airspace use, developing technologies to eliminate fuel inefficiencies and investing in synchronised data exchange and operations on the ground and in the air.

The ambition is to reduce average CO_2 emissions per flight by 0.8-1.6 tonnes **by 2035**, roughly equivalent to planting 500 million trees. This target takes into account the entire flight, from gate to gate.

The SESAR JU is conducting fundamental and industrial research as well as large-scale demonstrations to advance new concepts and innovations and accelerate their implementation, represented by the 10 projects highlighted in this Pack. The projects are co-funded by Horizon Europe and the Connecting Europe Facility, and are carried out within the framework of the Digital European Sky, the ambitious research and innovation programme of the SESAR 3 JU.

Their focus includes improved air traffic management for more efficient flights (GALAAD, p. 18 and CONCERTO, p. 14), better aircraft positioning technology to allow dynamic approach patterns, advanced route planning (DYN-MARS, p. 20) and low-fuel profiles (Green-GEAR, p. 8), better understanding of the conditions that lead to persistent contrails (E-CONTRAIL, p. 10 and CICONIA p. 22), wake energy retrieval (GEESE, p. 16), as well as broad investigations into how climate change will impact aviation – and vice versa (AEROPLANE, p. 6).

Two demonstrators, ECHOES (p. 28) and HERON (p. 26), launched in 2021 and funded within the framework of the Connecting Europe Facility and the European Climate, Infrastructure and Environment Executive Agency (CINEA), are supporting the ambitions of the Green Deal and enable energy-efficient flying, gate to gate.

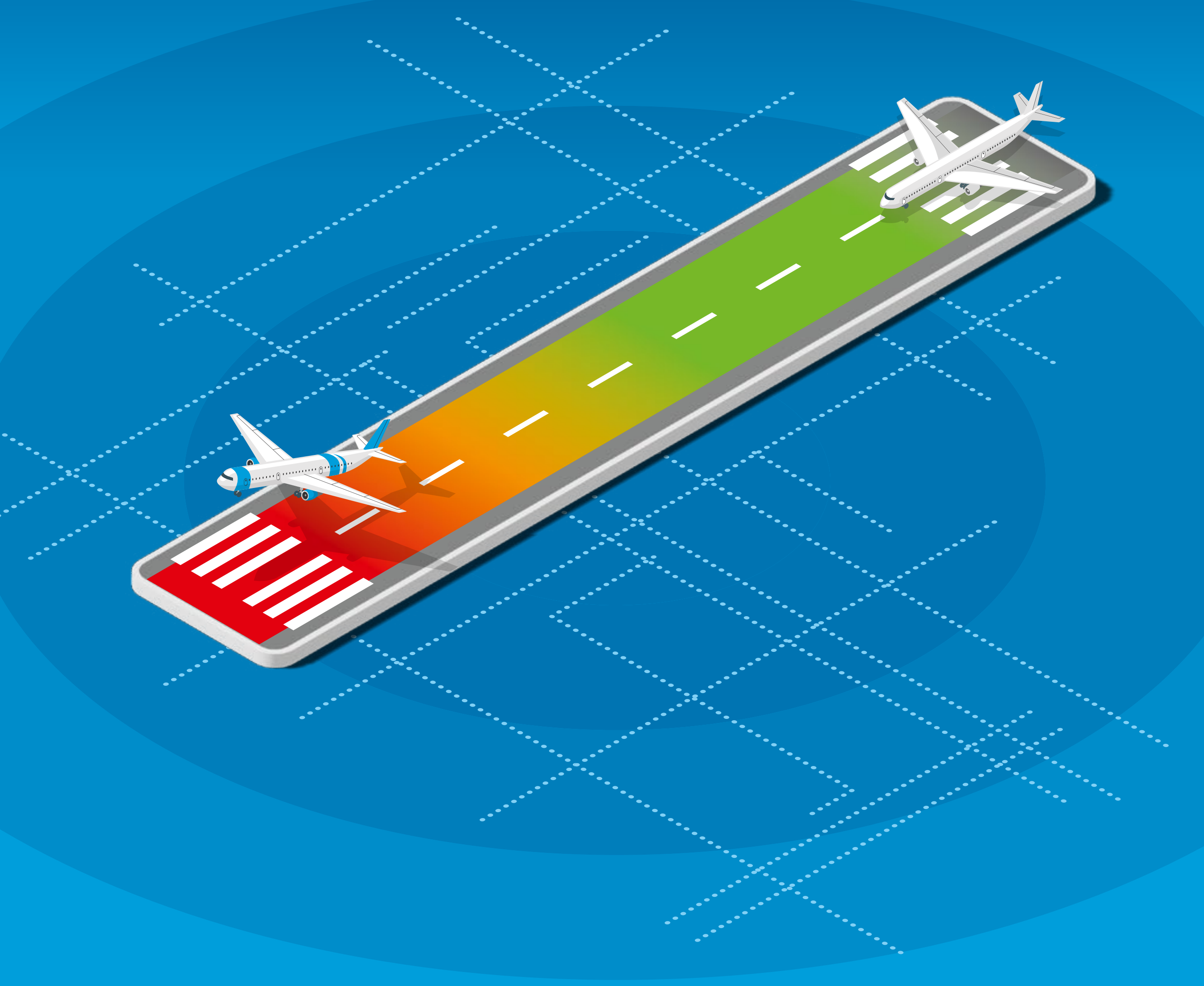
To date, the partnership has delivered over 136 solutions for implementation, many of which offer direct and indirect benefits for the environment, with more solutions in the pipeline. The SESAR Solutions Catalogue, now fully digital, outlines these solutions.

Further SESAR calls for projects are expected, building on existing achievements and delivering a continuous flow of tangible solutions for the environment. Together, they will help make Europe the most efficient and environmentally friendly sky to fly in the world.

EXPLORATORY RESEARCH

"AEROPLANE will help air traffic controllers visualise the climate impact of flight trajectories."

Carlo Abate, AEROPLANE project coordinator



PROJECT ID CARD

Full name: Advancing mEasures to Reduce aviatiOn imPact on cLimate and enhAnce resilieNce to climate-changE

Project dates: 1 September 2023 – 28 February 2026

Coordinated by: Deep Blue in Italy

Funded under: HORIZON 2.5 – Climate, Energy and Mobility

CORDIS factsheet: cordis.europa.eu/project/id/101114682

Project website: sesarju.eu/projects/AEROPLANE

Total budget: EUR 810 918

EU contribution: EUR 659 000

AEROPLANE

Mitigating the impact of aviation on climate change – and vice versa

The AEROPLANE project is working to reduce harmful emissions from aircraft, while making the aviation industry more resilient to environmental change.

Aviation and climate are intricately linked. Emissions from air transport contribute to climate change, and in return the changing climate impacts air travel too. Extreme weather events such as heatwaves, blizzards, high winds and heavy precipitation can affect infrastructure and aircraft performance, causing delays and cancellations.

"Traditionally, the concepts of mitigation – of the impact of aviation on climate – and adaptation – of aviation operations and infrastructure to make them more resilient to climate change – are investigated separately, but they are very much intertwined," says Carlo Abate, head of environment & energy at Deep Blue in Italy, and AEROPLANE project coordinator.

In the AEROPLANE project, funded by the SESAR JU, researchers are using theoretical and computational modelling to investigate the aviation industry's impact and resilience in relation to climate change. The project will also create a toolset to visualise the model's predictions and help air traffic controllers, airport operators, manufacturers and airlines better understand the impact of their decisions.

"AEROPLANE will help air traffic controllers visualise the climate impact of flight trajectories, for example, or tell airport operators the consequences of high temperatures for operations, so they can plan countermeasures," explains Abate.

Simulated environments

The team will develop a set of metrics that combine the effects of CO_2 and non-CO_2 emissions, and measure the impact of contrails formed within existing cirrus clouds on the climate – an aviation contribution to climate change that has never been quantified. AEROPLANE will also develop a set of services to evaluate the effects of heatwaves on reduced aircraft performance and noise in the surrounding area.

"One obvious solution to the temperature problem would be to postpone flights until night, when the air is cooler," adds Abate. However, night flights typically have a greater warming effect on climate, as contrails formed in the late evening trap outgoing radiation from Earth. "Thus, this is not a good solution," he notes.

The findings will be validated in an exercise at the end of the project. Members of the advisory board will use the toolkit in a simulated but realistic environment, and evaluate how the tool predictions can be used to inform their decision-making processes.

"One of the strengths of AEROPLANE is the stakeholder-centred approach," says Abate. "We aim to produce innovative and scientifically sound results, but we want to make sure that they address real needs of aviation stakeholders."

“Knowing an aircraft’s precise altitude could help pilots and air traffic controllers plan more efficient approaches, descents and climbs.”

Tobias Bauer, Green-GEAR project coordinator

PROJECT ID CARD

Full name: Green operations with Geometric altitude, Advanced separation and Route charging Solutions

Project dates: 1 September 2023 – 28 February 2026

Coordinated by: German Aerospace Center in Germany

Funded under: HORIZON 2.5 – Climate, Energy and Mobility

CORDIS factsheet: cordis.europa.eu/project/id/101114789

Project website: sesarju.eu/projects/GREEN-GEAR

Total budget: EUR 1 534 395

EU contribution: EUR 1 245 006

Green-GEAR

Aircraft efficiency starts with having the right altitude

More accurate data on an aircraft's position can help pilots fly more efficient routes, cutting the fuel consumption and emissions of today's fleet. The Green-GEAR project aims to quantify the impact of this change.

Aviation is a significant source of greenhouse gases, responsible for 2.5 % of global energy-related CO_2 emissions. Greener aircraft and sustainable fuel sources will take time to deploy. "Solutions such as sustainable aviation fuels and hydrogen or battery-powered electric aircraft are in the early stages of development, and their full roll-out will take decades," says Tobias Bauer, a researcher with the German Aerospace Center (DLR).

In light of this reality, Bauer says, the best way forward is to help existing aircraft types avoid generating unnecessary CO_2 and to minimise aviation's non-CO_2-related climate impact. With the support of the Green-GEAR project, funded through the SESAR JU, Bauer is leading an effort to do both.

"By increasing the efficiency of the existing aircraft fleet, we hope to already help decrease aviation's climate impact in the short to medium term," he explains.

Mapping a route to sustainability

For the Green-GEAR project, making an aircraft more efficient starts with altitude. Researchers are investigating the impact on airspace capacity, safety and the environment offered by shifting from traditional barometric altimetry to more precise geometric position-finding, supported by satellite data.

"Knowing an aircraft's precise altitude could help pilots and air traffic controllers plan more efficient approaches, descents and climbs – all of which would reduce emissions, not to mention noise, in the airport vicinity," adds Bauer.

The new technology could also allow for a smaller vertical separation requirement between aircraft travelling within the same airspace. "This would enable more aircraft to fly at their preferred altitude, an achievement that would not only increase capacity but have the added environmental bonus of reducing fuel burn," notes Bauer.

Researchers also hope to explore whether airspace user charges could be used to incentivise eco-friendly behaviour. "There could be an opportunity here to prevent detours flown just for the sake of saving charges and to reward such sustainable behaviour as avoiding congested airspace or climate hotspots," remarks Bauer.

The Green-GEAR project's work will be exploratory in nature, meaning researchers will not yet deliver ready-to-use solutions, but instead demonstrate ideas.

"We are starting from scratch, so our main outcomes will be operational concepts validated in workshops, computational studies and fast-time simulations, each of which will compare our ideas to the status quo in terms of operational feasibility as well as their impact on the environment and safety," concludes Bauer.

"By modifying aircraft manoeuvres, it is possible to avoid emission-sensitive regions and significantly decrease non-CO_2 effects."

Manuel Soler, E-CONTRAIL project coordinator

PROJECT ID CARD

Full name: Artificial Neural Networks for the Prediction of Contrails and Aviation Induced Cloudiness

Project dates: 1 June 2023 – 30 November 2025

Coordinated by: University Carlos III of Madrid in Spain

Funded under: HORIZON 2.5 – Climate, Energy and Mobility

CORDIS factsheet: cordis.europa.eu/project/id/101114795

Project website: econtrail.com

Total budget: EUR 997 500

EU contribution: EUR 997 500

E-CONTRAIL

Blue skies ahead thanks to cloud computing

Researchers in the E-CONTRAIL project are using artificial intelligence to help air traffic managers predict and prevent long-lasting clouds generated by aircraft exhaust.

The climate impacts of aircraft emissions such as CO_2 are well-documented. Recent research has also highlighted other potentially negative effects, including the creation of persistent contrails, and human-made cirrus, or ice clouds, in the atmosphere.

"Recent estimates suggest that non-CO_2 emissions, particularly nitrogen oxide and cirrus contrails, can contribute two thirds of the global radiative forcing from aviation, making them twice as harmful as CO_2 emissions," explains Manuel Soler, director of the PhD in Aerospace Engineering programme at the University Carlos III of Madrid and coordinator of the E-CONTRAIL project.

The effects of contrails on climate change are not yet fully understood. The variables involved are linked to medium to high uncertainties, and in-depth research has been limited.

In the E-CONTRAIL project, funded through the SESAR JU, researchers will use artificial intelligence and state-of-the-art satellite imagery to carry out a comprehensive investigation on contrails and aviation-induced cloudiness, and measure their environmental impact.

"The possibility of using artificial intelligence can help us examine the geographical location of the aircraft, its altitude and the time of the flight to understand the climate impact of non-CO_2 emissions and, therefore, develop mitigation strategies," says Soler.

Reducing climate impact

E-CONTRAIL is developing new artificial neural networks, which will take advantage of remote sensing technology and satellite data that identifies and categorises clouds. By synchronising air traffic information with these technologies, the team will be able to differentiate contrails and aviation-induced clouds from natural ones.

The team expects to obtain contrail detection accuracies greater than 90 %, significantly reducing the current uncertainties in research regarding the non-CO_2 aviation-induced impacts on the climate. In the longer term, the project will provide information tailored to aviation stakeholders' needs to support them in moving towards a climate-neutral air traffic management system.

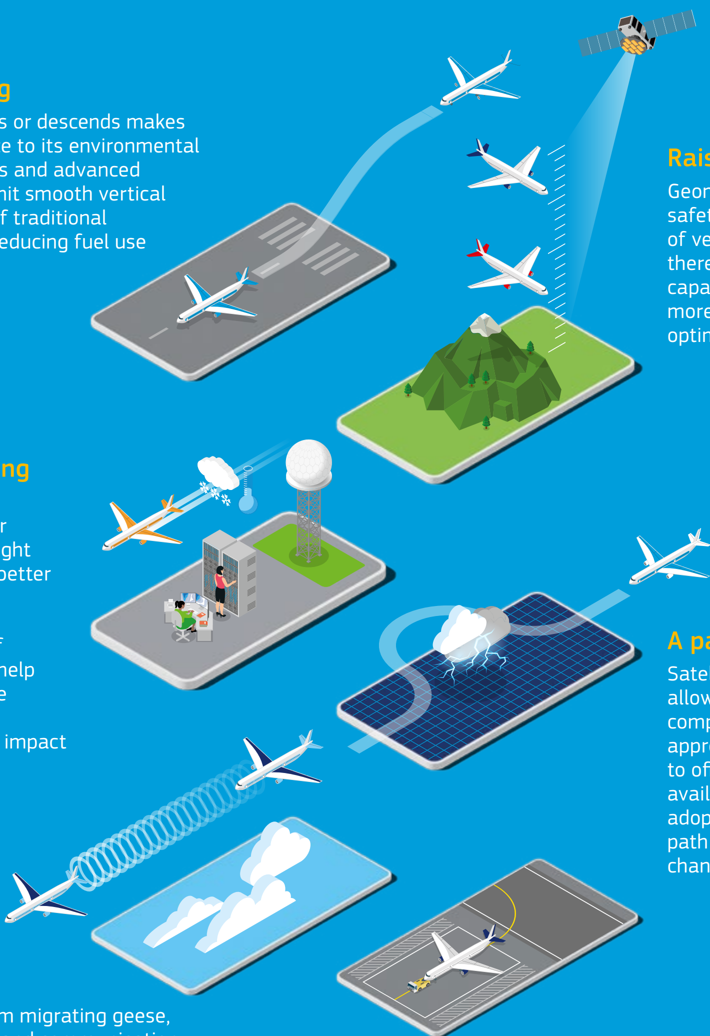
"By modifying aircraft manoeuvres such as departure time, altitude, lateral trajectory, and speed profile, it is possible to avoid emission-sensitive regions and significantly decrease non-CO_2 effects," notes Soler.

He adds that the related FlyATM4E project, also funded through the SESAR JU, has shown this approach could reduce climate.

Innovation takes flight

Over 10 million flights were made in Europe last year, a figure predicted to grow. This presents a challenge to meeting Europe's environmental ambitions, including the transition to carbon neutrality by 2050, as set out in the European Green Deal.

The Single European Sky ATM Research Joint Undertaking (SESAR JU) aims to enhance the sustainability of air traffic by reducing carbon and non-carbon emissions, as well as other environmental impacts such as noise. Through a range of innovative technologies, operational concepts, and procedures, the SESAR JU is helping to make Europe the most efficient and environmentally friendly sky to fly in the world.



A smooth landing

How an aircraft climbs or descends makes a significant difference to its environmental impact. Novel avionics and advanced communications permit smooth vertical flight paths in place of traditional step-wise descents, reducing fuel use and aircraft noise.

Raising the bar

Geometric altimetry can increase safety and allow a reduction of vertical separation minima, thereby increasing airspace capacity. This will allow more aircraft to fly at their optimal altitude.

Contrail computing

Vapour trails left by aircraft can persist for hours, reflecting sunlight and trapping heat. A better understanding of the balance of warming and cooling effects of aircraft contrails will help reduce the occurrence of warming contrails and reduce aviation's impact on the climate.

A path less travelled

Satellite-based navigation allows increased flexibility compared to traditional approaches, making it possible to offer a range of procedures available. Aircraft are free to adopt the most appropriate path and respond to changing conditions.

Leading the way

Taking inspiration from migrating geese, improved positioning and communication technology can allow commercial airliners to fly in close formation. The trailing aircraft benefits from a buoyant 'upwash', reducing fuel consumption by up to 5 % per journey.

Ground rules

Fuel isn't only burned in the air. Developing procedures for aircraft to taxi with one or both engines off, and optimising ground movements to reduce waiting times on taxiways and parking stands can all cut fuel use.

Source data: Horizon Dashboard, Directorate-General for Research and Innovation, European Commission

INDUSTRIAL RESEARCH

"Our approach could help reduce CO_2 equivalent emissions in EU airspace by millions of tonnes."

David Antonello, CONCERTO project coordinator

PROJECT ID CARD

Full name: dynamiC cOllaboration to geNeralize eCo-friEndly tRajecTOries

Project dates: 1 July 2023 – 30 June 2026

Coordinated by: Thales LAS France

Funded under: HORIZON 2.5 – Climate, Energy and Mobility

CORDIS factsheet: cordis.europa.eu/project/id/101114785

Project website: sesarju.eu/projects/CONCERTO

Total budget: EUR 9 039 267

EU contribution: EUR 5 054 856

CONCERTO

Eco-flying gains altitude, thanks to smarter air traffic tools

Supporting the European Green Deal ambition of net zero emissions by 2050, CONCERTO is developing smart and scalable air traffic management solutions that balance capacity demands with environmental performance.

CONCERTO's digital solution piggybacks on current air traffic management infrastructure, using decision-making algorithms and cutting-edge climate science, to optimise both traffic capacity and environmental performance, aided by new climate monitoring and mitigation measures.

"Our approach could help reduce CO_2 equivalent emissions in EU airspace by hundreds of thousands of tonnes short term, then by millions longer term if the system is widely deployed," says David Antonello, green operations project leader at Thales, and coordinator of the CONCERTO project.

Supported by the SESAR JU, the CONCERTO project will develop two complementary tools.

The 'Orchestrator for Eco-friendly Operations' focuses on reducing CO_2 emissions, automatically suggesting eco-friendly time slots to air navigation service providers (ANSPs) during route planning. This allows airspace users, such as airline operations control centres and flight planning providers, to schedule emission-reducing flight paths.

Secondly, the 'Traffic Flow Optimiser' will address a long-standing issue for greener aviation: that alongside CO_2 reductions, non-CO_2 pollutants – such as engine particles (nitrogen oxides) and persistent contrails – need to be minimised. The tool will help operators monitor and make decisions about air traffic flow balancing likely environmental benefits against operational costs and capacity concerns.

A greener flight path

"The challenge will be forecasting, finding and then managing the highest contributors to climate impacts across multi-ANSPs," adds Antonello. This involves estimating the climate impact of aircraft in a given area, as well as identifying climate-sensitive areas and the most polluting aircraft, and proposing mitigation plans.

"It won't be necessary to modify all trajectories. We know that 80 % of contrails-related climate impacts from transatlantic flights could be avoided by acting on 12 % of flights," Antonello explains.

The system's success will rely on data supplied by project partners, who represent a range of industry stakeholders and climate scientists. Tests will simulate the relaxation of air traffic constraints during eco-friendly time slots over large areas of European airspace, to assess the environmental benefits, as well as investigating the degree to which modified flight paths could reduce contrails.

"We will deploy our solutions in tandem with current systems. Longer term we will need strong support from aviation industry regulations to accelerate deployment at scale," concludes Antonello.

“An updraft is available to be used bya follower aircraft during cruise as a formof additional lift.”

Philippe Masson, GEESE project coordinator

PROJECT ID CARD

Full name: Gain Environmental Efficiency by Saving Energy

Project dates: 1 June 2023 – 31 May 2026

Coordinated by: Airbus in France

Funded under: HORIZON 2.5 – Climate, Energy and Mobility

CORDIS factsheet: cordis.europa.eu/project/id/101114611

Project website: sesarju.eu/projects/GEESE

Total budget: EUR 8 791 343

EU contribution: EUR 5 356 611

GEESE

Chasing the slipstream for more efficient flights

The GEESE project is developing the science, technology and protocols for wake energy retrieval, a flying pattern that allows one aircraft to ride the buoyant wake of another.

For many years, pilots and air traffic managers have viewed the turbulent wake spun behind aircraft as a risky place to fly, and best avoided. However, these areas of unsettled air also present an opportunity, with a lot of potential energy to be harvested from the vortex.

"Since the rotating air is moving upwards on each outboard side, an updraft is available to be used by a follower aircraft during cruise, as a form of additional lift," explains Philippe Masson, air traffic management and rulemaking at Airbus, and GEESE project coordinator.

This practice is known as wake energy retrieval (WER), a relatively new and potentially revolutionary operational procedure for international air transport. WER could significantly reduce fuel use and the associated CO_2 emissions. Extensive flight testing by industry bodies such as Airbus has found fuel reductions of more than 10 % available for the following aircraft.

Flying in formation

Airbus has developed experimental technology on board aircraft to put WER into practice, and the GEESE consortium is now analysing how this technology can be brought to operations, and scaled up across Europe.

GEESE will define the necessary operational tasks for pilots adopting technology that automatically manages different WER positions, including flight management systems and new WER cockpit functions that capture and track the wake vortex. The GEESE team will also explore a 'pairing assistance' system for dispatchers at airline operations control centres.

The project, which is funded through the SESAR 3 JU, will run a series of simulations to validate the pairing procedures, involving Air France, French bee, Delta and Virgin airlines. The project will also further investigate wake science, to advance the underlying concepts and consider the impact of formations. This includes defining the wake generated by the second aircraft in a pair, safe positioning behind the pair, and how to ensure the safety of surrounding traffic.

"We will propose recommendations to speedily embody this concept into aviation's standards and regulations, which will help contribute in the short term to achieving aviation emissions reduction targets," says Masson.

"GALAAD will focus on achieving greater fuel efficiency and environmental sustainability without compromising capacity, safety, human performance and cost-efficiency."

Fabio Mangiaracina, GALAAD project coordinator

PROJECT ID CARD

Full name: Green Aviation – Lean Arrivals And Dynamicity
Project dates: 1 September 2023 – 31 August 2026
Coordinated by: ENAV in Italy
Funded under: HORIZON 2.5 – Climate, Energy and Mobility
CORDIS factsheet: cordis.europa.eu/project/id/101114736
Project website: sesarju.eu/projects/GALAAD
Total budget: EUR 7 075 172
EU contribution: EUR 3 848 817

GALAAD

Steering aircraft towards a more flexible – and green – final approach

By transitioning rigid arrival procedures to a more dynamic system able to respond to local conditions, researchers with the GALAAD project hope to bring greater sustainability to air transport.

Airports and the surrounding terminal airspace are busy and congested places. "With congestion comes more flight inefficiencies, which results in significant excess fuel consumption and carbon emissions," notes Fabio Mangiaracina, senior project manager and air traffic management (ATM) expert at ENAV, Italy's civil air navigation service provider.

As Mangiaracina explains, these inefficiencies can be either variable (e.g., air traffic operation contingencies and severe weather conditions) or the result of the airspace itself. "At least part of these inefficiencies can be attributed to the fact that most terminal areas are designed for high traffic conditions," he says, with the management of arrivals requiring the ability to extend the approach path and absorb delays.

With the support of the GALAAD project, funded through the SESAR JU, ENAV is leading an effort to address these inefficiencies. To do so, it aims to enhance the sustainability, responsiveness and adaptability of such ATM factors as traffic density, airspace availability, environmental constraints and weather conditions.

"GALAAD will concentrate its efforts on enhancing operations within the terminal area airspace, with a specific focus on achieving greater fuel efficiency and environmental sustainability without compromising capacity, safety, human performance and cost-efficiency," adds Mangiaracina.

Go with the flow

The main goal of the project is to transition ATM away from the rigid use of required navigation performance (RNP) arrival route structures towards a dynamic, more flexible approach to managing arrivals and departures.

To achieve this, the GALAAD project proposes a concept that will allow RNP route structures to be activated or deactivated depending on, for example, the time of day, for noise control purposes, or traffic demand.

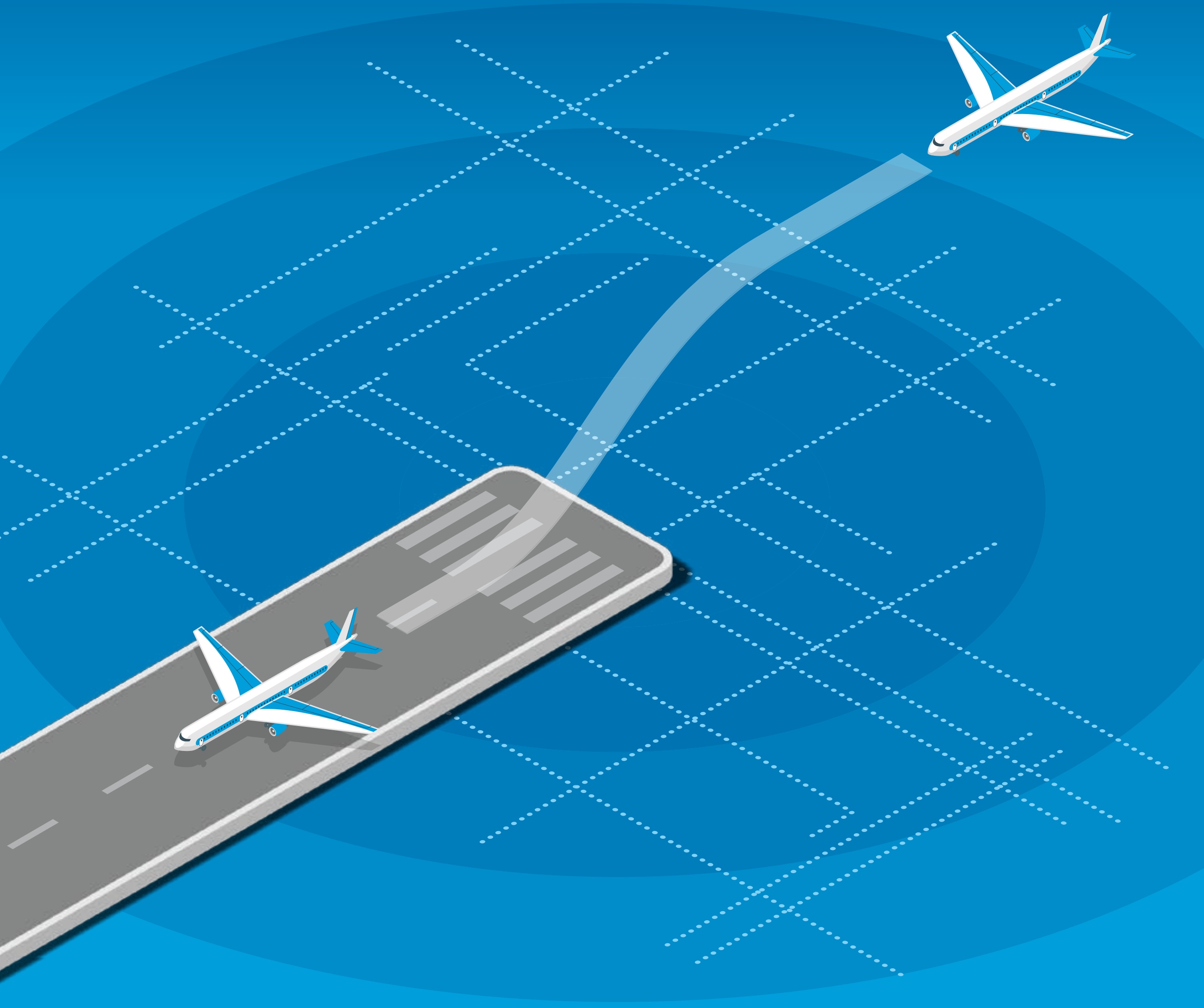
"This will avoid the use of more complex route structures during periods of low demand, enabling agile responses to variations in such terminal area operational conditions as traffic density, airspace availability or environmental constraints," remarks Mangiaracina.

GALAAD aims to reach its goals by investigating the decision support tools needed to facilitate the dynamic use of RNP routes. Dynamic allocation of arrival route structures will allow managers to exploit different trade-offs between capacity, efficiency and environmental impact, depending on the level of traffic.

"This will allow air traffic control to relax the constraints designed for high traffic conditions in lower traffic scenarios, resulting in a significant improvement in fuel and environmental performance," concludes Mangiaracina.

"Fuel burn is determined more by how an aircraft is operated than the propulsion system itself."

Fethi Abdelmoula, DYN-MARS project manager



PROJECT ID CARD

Full name: DYNamic Management of Aircraft Configuration and Route Structures

Project dates: 1 September 2023 – 31 August 2026

Coordinated by: German Aerospace Center in Germany

Funded under: HORIZON 2.5 – Climate, Energy and Mobility

CORDIS factsheet: cordis.europa.eu/project/id/101114627

Project website: sesarju.eu/projects/DYN-MARS

Total budget: EUR 6 192 794

EU contribution: EUR 3 770 315

DYN-MARS

Dynamic routing and aircraft configuration for greener aviation

How an aircraft climbs or descends can make a significant difference to its environment impact. The DYN-MARS project combines novel avionics and advanced communications with improved arrival routes and procedures to increase the efficiency of aircraft during descent and approach.

"The EU's Flightpath 2050 ambitions to reduce aircraft CO_2 and noise emissions won't be met by advances in engine technology alone – all aspects of the air transport system need to be redesigned," says Fethi Abdelmoula, project manager of DYN-MARS.

The project, hosted by the German Aerospace Center (DLR) and funded through the SESAR JU, is developing an enhanced flight management system, complemented by revamped air traffic management (ATM) methods, to increase fuel efficiency and reduce emissions and noise levels.

Inbound innovations

"Fuel burn is determined more by how an aircraft is operated than the propulsion system itself," explains Abdelmoula. Taking advantage of advanced communication technologies, the DYN-MARS project will also improve air-ground data sharing, to optimise aircraft trajectories and speeds. This has to be achieved while maintaining high volumes of runway traffic, and without compromising safety.

DYN-MARS aims to allow pilots to better plan their optimum vertical and speed profile during descent and approach, while maintaining the required runway throughput. The ability to transmit the aircraft's computed trajectory to air traffic managers on the ground allows for further optimisation of flight paths.

The project builds on previous SESAR work, in particular the flight management system developed by the DYNCAT project, which analysed mismatches in aircraft and ATM procedures and proposed technical and regulatory amendments to support improved 4D trajectories.

Building on the collaborations established during the DYNCAT project, the DYN-MARS consortium includes aviation value chain representatives from six countries, all contributing unique specialisms, from avionics to environmental impact modelling.

Getting airborne

The whole DYN-MARS solution will be validated through five specific exercises, addressing each of the system's components across a range of use cases. "We estimate around a 10 % reduction in CO_2 emissions and fuel consumption per flight, during descent and approach, with noise pollution decreased by at least 1 dB(A)," adds Abdelmoula.

DYN-MARS's work could also benefit efforts to standardise the European aviation network, offering recommendations for airspace navigation, flow management and performance-based arrival and departure.

"For the first time, a large European scientific and operational consensus will be proposed to address non-CO_2 mitigation with concrete solutions."

Philippe Masson, CICONIA project coordinator

PROJECT ID CARD

Full name: Climate effects reduced by Innovative Concept of Operations - Needs and Impacts Assessment

Project dates: 1 July 2023 – 30 June 2026

Coordinated by: Airbus in France

Funded under: HORIZON 2.5 – Climate, Energy and Mobility

CORDIS factsheet: cordis.europa.eu/project/id/101114613

Project website: sesarju.eu/projects/CICONIA

Total budget: EUR 8 690 598

EU contribution: EUR 4 971 224

CICONIA

Assessing aviation's climate impact, one journey at a time

CICONIA aims to describe, measure and forecast the climate impacts of aviation, including contrails, and provide recommendations on how they can be reduced further.

Over the past decade, efforts have been made to detect and avoid the conditions that generate contrails, as well as reducing other non-CO_2 effects of air traffic. The CICONIA project, funded through the SESAR JU, aims to go further by improving European knowledge about the environmental impacts of air traffic. The project aims to accurately describe, measure and forecast these effects, and integrate this information into climate-efficient route planning.

To achieve this, the CICONIA project will involve a broad spectrum of the European aviation industry, including airlines, air traffic management and network managers. The project will develop operational strategies and provide recommendations to regulatory bodies for sustainable aviation.

The first step is to improve weather forecasting capabilities, including conditions that give rise to contrails, and generate more accurate and tailored climate impact assessments.

"CICONIA will combine emission data on an individual flight basis with operational weather forecasts in order to compute the expected climate impact with dedicated tools," explains Philippe Masson, air traffic management and rulemaking at Airbus and CICONIA project coordinator.

Concrete solutions

The CICONIA team will then define new Concepts of Operations (ConOps) guidelines for European air travel, including contrail avoidance. This will provide policymakers with recommendations and integrate climate metrics, economics and impact on operations.

"Among the various mitigation approaches currently proposed, the use of sustainable aviation fuels appears as a promising solution to reduce CO_2 emissions and some direct non-CO_2 emissions," adds Masson.

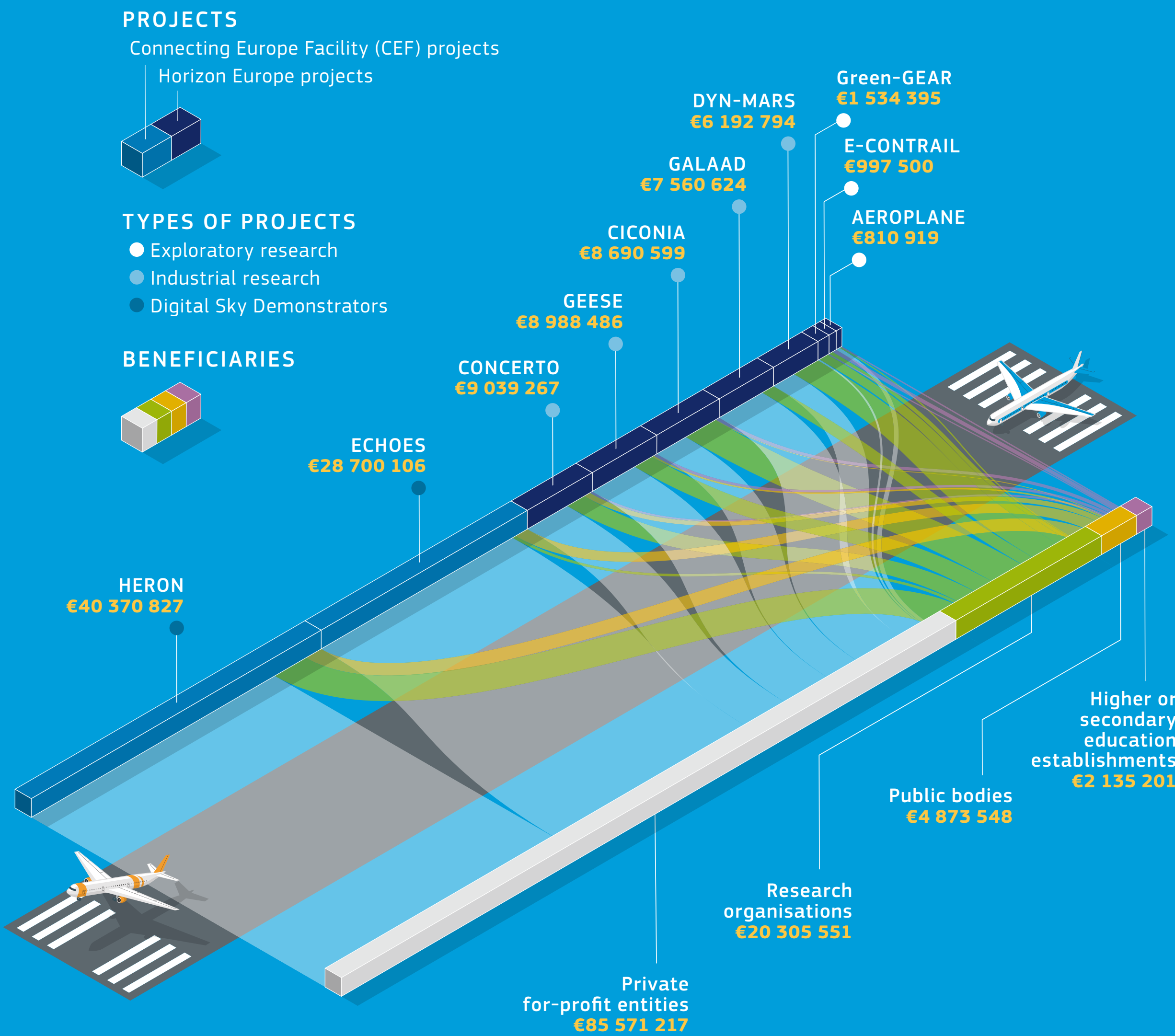
The operational feasibility of the ConOps will then be demonstrated through simulations, and also with some real-world flight trials. The findings will help demonstrate how the generation of persistent and high-impact contrails can be minimised – this can be applied during both the flight planning stage and the journey itself.

CICONIA, through its concrete recommendations and requirements, aims to mitigate aviation's contribution to total anthropogenic climate warming, currently estimated to be around 3.5 %. "For the first time, a large European scientific and operational consensus will be proposed to address non-CO_2 mitigation with concrete solutions," says Masson.

Charting a course for the future

The Single European Sky ATM Research Joint Undertaking (SESAR JU) is a public-private partnership established to modernise air traffic management in Europe and deliver the Digital European Sky. Funding by Horizon Europe is matched by industry and Eurocontrol, for a total budget of over €1.6 billion. Additional funds are provided through the Connecting Europe Facility.

Of 58 ongoing projects, the 10 highlighted in this brochure representing an investment of over €110 million toward the goals of the European Green Deal. Beneficiaries include researchers working across more than 280 institutions, including universities, independent research centres, public bodies such as civil aviation authorities and meteorology centres, and industry partners such as airports, airlines and aerospace businesses.

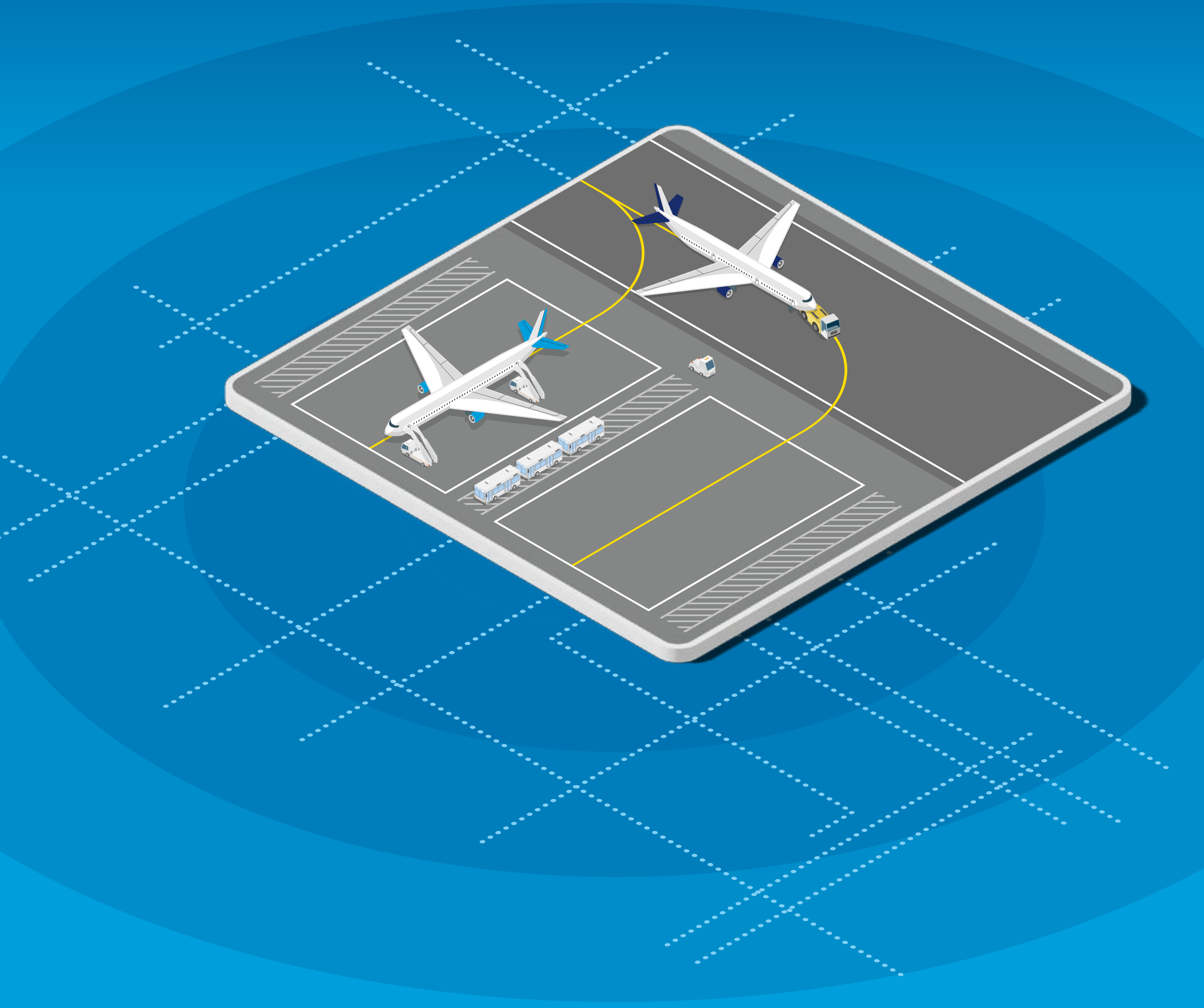


Source data: Horizon Dashboard, Directorate-General for Research and Innovation, European Commission; The European Climate, Infrastructure and Environment Executive Agency (CINEA)

DIGITAL SKY DEMONSTRATORS

“These solutions are already helping aircraft fly more optimal flight profiles and reducing fuel consumption.”

Benjamin Tessier, HERON project coordinator



PROJECT ID CARD

Full name: Highly Efficient Green Operations

Project dates: 1 November 2022 – 31 October 2025

Coordinated by: Airbus in France

Funded under: Connecting Europe Facility (CEF) – Transport

Factsheet: europa.eu/!mkRgTQ

Project website: research.dblue.it/heron

Total budget: EUR 40 370 827

EU contribution: EUR 18 108 094

HERON

Reducing aviation's carbon footprint through improved traffic control

By making aircraft operations more efficient and optimising air traffic management, the HERON project is demonstrating how aviation's environmental footprint can be reduced.

Much has been made of the potential for sustainable fuels and electric hybrid aircraft to reduce aviation's carbon footprint. But addressing inefficiencies in air traffic management (ATM) could deliver a 10 % reduction in carbon emissions, without the need to overhaul the fleet.

As a SESAR JU demonstrator project, HERON looks to deploy and accelerate the market uptake of mature solutions that could make both on-ground and in-flight aircraft operations more energy-efficient. "HERON will not revolutionise ATM, but instead aims to encourage an entrepreneurial approach, promoting promising solutions, delivering performance and safety assessments, and carrying out live demonstration trials," says Benjamin Tessier, ATM & engineering project manager at Airbus, the project's coordinating partner.

The project is set to conduct more than 20 demonstrations over the course of the next three years. This work will include procedures to allow aircraft to taxi using a single engine, or – assisted by ground vehicles – none at all. The project will also investigate how to optimise aircraft movements on the tarmac so as to avoid waiting times on taxiways andat parking stands – all of which burn unnecessary fuel.

"Our Green Apron Management demonstration is set to use emerging technologies such as sensors and artificial intelligence to enable more predictable and efficient aircraft handling during airport stopovers," remarks Tessier.

Airborne efficiencies

In the sky, the HERON project looks to implement efficient flight paths. "More optimal flight paths, less air traffic control intervention and a better use of airspace mean less energy used, leading to fewer emissions and lower costs for airlines," explains Tessier.

The project is working to improve management of in-flight trajectories through enhanced network coordination by air traffic managers. It also seeks to implement smoother, more continuous climb and descent profiles, in place of the more fuel-intensive traditional stepped patterns.

The HERON project isn't just talking about what can be done – it's delivering results. These include improving network management services and collaborating with air navigation service providers to set up a more flexible use of airspace by removing unnecessary altitude constraints.

"These solutions are already helping aircraft fly more optimal flight profiles and, in doing so, are reducing fuel consumption and CO_2 emissions," concludes Tessier. "And we're just getting started."

"Our approach will replace procedural routes with optimal ones."

José Alberto, ECHOES project coordinator

PROJECT ID CARD

Full name: Extended Communications in vHf Over Enhanced Satellite segment

Project dates: 1 March 2022 – 28 February 2025

Coordinated by: Startical in Spain

Funded under: Connecting Europe Facility (CEF) – Transport

Factsheet: europa.eu/!jGXBfV

Project website: sesarju.eu/projects/echoes

Total budget: EUR 28 700 106

EU contribution: EUR 14 841 250

ECHOES

Seamless airspace heralds greener flights, thanks to satellites

By deploying aviation's critical communications, navigation and surveillance infrastructure in space, the ECHOES project can further optimise global airspace, benefiting passengers and the planet.

Effective communications, navigation and surveillance (CNS) systems are crucial to the safe and efficient operation of air transport. To date, the underlying infrastructure has mostly been ground-based, limiting potential environmental, cost and efficiency gains.

"To ensure safety when there is no CNS coverage, in oceanic airspace for example, controllers must predefine air routes and increase the distance between aircraft, leaving no room for flexibility," explains José Alberto, programme manager at Startical, and coordinator of the ECHOES project.

ECHOES is pioneering the use of space-based technology to provide very high frequency (VHF) aircraft communications (voice and datalink), combined with aircraft locating surveillance (ADS-B). As a SESAR JU demonstrator project, ECHOES will also aim at accelerating the market uptake of space-based CNS.

To develop a platform for air navigation service providers (ANSPs), ECHOES will design, build and launch dedicated low Earth orbit satellites. The demonstrator will develop some bespoke parts, while others will be sourced from existing market solutions.

After launch, the technical feasibility and parameters of the VHF voice and datalink and satellite-based ADS-B will be tested through use cases in the South Atlantic corridor, including southwest European oceanic airspace.

Coordinated by the project host Startical in Spain, researchers will demonstrate how successfully oceanic airspace capacity is increased by reducing the minimum separation between aircraft, and assess non-CO_2 environmental benefits, such as reduced fuel consumption, using sensors, satellite imagery and meteorological data.

Faster journeys, fewer emissions

Additionally, ECHOES will look at '4D trajectories', which add time to the three spatial dimensions, to optimise flight trajectories.

The tests will involve the participation of ANSPs such as NAV Portugal and ENAIRE, alongside airlines, a communication service provider and regulatory advisors.

By allowing pilots and air traffic controllers to take advantage of variables such as the weather, flight efficiency can be increased, benefiting passengers with shorter journey times and more reliable flights, alongside environmental gains of reduced fuel consumption and CO_2 emissions.

"Our approach will replace procedural routes with optimal ones, without major changes to current aviation infrastructures or additional controller training or certification," says Alberto.

ECHOES will develop an environmental impact assessment and a cost-benefit analysis to quantify the system's potential.

Glossary

4D trajectories enable accurate tracking and prediction of an aircraft's position, facilitating efficient planning and safe navigation, by computing a continuous path in latitude, longitude, altitude and time.

Air navigation service provider (ANSP) is an organisation responsible for providing air navigation services, including air traffic control, navigation aids and communication facilities.

Air traffic management (ATM) refers to the integrated management of aircraft and airspace to ensure safe and efficient transportation. It involves coordination between air traffic control, communication systems, navigation aids and various other elements.

Avionics refers to the electronic systems and devices used in aircraft. It includes instruments, sensors, radar systems, communication equipment and other electronic components that contribute to the aircraft's functionality.

Communications, navigation and surveillance (CNS) collectively refers to the systems and technologies used in aviation for communication between aircraft and ground facilities, navigation for determining aircraft position, and surveillance for monitoring and managing air traffic.

Contrails is short for 'condensation trails', visible lines of condensed water vapour or ice crystals that form when hot engine exhaust cools rapidly at high altitudes.

Flight paths represent the three-dimensional trajectories followed by aircraft during their journey. These paths are determined by a combination of factors, including air traffic control instructions, navigation procedures and the aircraft's performance capabilities.

Geometric altimetry is the measurement of altitude above a reference point using geometric principles, such as triangulation or the calculation of angles and distances. In aviation, altimetry is used for determining an aircraft's vertical position relative to Earth's surface.

Low earth orbit satellites are spacecraft positioned in orbits relatively close to Earth's surface, typically at altitudes below 2 000 kilometres. These are used for various purposes, including Earth observation, communication and scientific research.

Required navigation performance (RNP) is a performance-based navigation concept, represented by a family of navigation specifications which allow aircraft to operate along a precise flight path. It gives the aircraft the ability to determine its position with both accuracy and integrity.

Vertical separation refers to the maintenance of a minimum vertical distance between aircraft. It is a key element of air traffic control for preventing collisions and ensuring safe and orderly airspace management.

Wake energy retrieval (WER) is the possibility of harnessing the energy generated by the vortices or wakes created by aircraft during flight. Aircraft leave a wake of disturbed air, creating an updraft that allows a following aircraft to reduce engine thrust, fuel use and emissions.

Published
on behalf of the European Commission by CORDIS at the
Publications Office of the European Union
L-2985 Luxembourg
LUXEMBOURG

cordis@publications.europa.eu

Disclaimer

Online project information and links published in the current issue of the CORDIS Projects Info Pack are correct when the publication goes to press. The Publications Office cannot be held responsible for information which is out of date or websites that are no longer live. Neither the Publications Office nor any person acting on its behalf is responsible for the use that may be made of the information contained in this publication or for any errors that may remain in the texts, despite the care taken in preparing them.

The technologies presented in this publication may be covered by intellectual property rights.

This Projects Info Pack is a collaboration between CORDIS and the SESAR Joint Undertaking.

@SESAR_JU
@company/sesar-joint-undertaking

Print	ISBN 978-92-78-43856-2	doi:10.2830/835882	OA-06-23-021-EN-C
EPUB	ISBN 978-92-78-43858-6	doi:10.2830/648306	OA-06-23-021-EN-E
HTML	ISBN 978-92-78-43859-3	doi:10.2830/81376	OA-06-23-021-EN-Q
PDF	ISBN 978-92-78-43855-5	doi:10.2830/45523	OA-06-23-021-EN-N

Luxembourg: Publications Office of the European Union, 2024

RESULTS PACK ON AI IN AIR TRAFFIC MANAGEMENT

Artificial intelligence offers great potential to improve automation and efficiency in air traffic management, allowing human operators to focus on safety-critical tasks. This Results Pack highlights advances made by 15 projects supported by EU funding through the SESAR 3 Joint Undertaking. The benefits address all phases of flight, from strategic and pre-tactical planning to tactical operations themselves. Through work like this, the EU aviation industry will be more scalable, economically sustainable, environmentally efficient and resilient.

Check out the Pack here:
cordis.europa.eu/article/id/442211

Follow us on social media too!
facebook.com/EUresearchResults
x.com/CORDIS_EU
youtube.com/CORDISdotEU
instagram.com/eu_science

Publications Office
of the European Union