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ENVIRONMENTAL REPORT 2024

Content

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Editorial

DAMIEN CAZÉ

French Civil Aviation Director

Following the 2022 announcement of the aviation sector's decarbonisation goals and the 2023 adoption of the 'Fit for 55' package, 2024 saw the practical implementation of the basket of measures that will allow the sector to reach its objective.

The years 2022 and 2023 have set a clear framework for the sector to reduce its impact on the climate and the environment. At an international level, the 41st Assembly of the International Civil Aviation Organisation (ICAO) in October 2022 adopted a resolution for international civil aviation setting the ambitious Long-Term Aspirational Goal (LTAG) of achieving carbon neutrality by 2050. The European Union (EU) also laid out its climate objective in the "European Climate Law" published in July 2021: to reduce EU emissions by at least 55% by 2030 (compared to 1990 levels) and achieve carbon neutrality by 2050.

This evolution of both the international normative and the European regulatory frameworks provides visibility to stakeholders and requires significant efforts in terms of implementation on the part of Member States. From 2024 onwards, the Member States have therefore organised the practical implementation of the levers that will enable them to achieve their goals.

Consequently, within ICAO and more specifically, within the Committee on Aviation Environmental Protection (CAEP), the task of studying and quantifying the measures for implementing the LTAG has been assigned to the "LTAG Monitoring and Reporting (LMR) methodologies - LMR-TG" working group, while the subgroup dedicated to fuels "Fuel Task Group - FTG" is focusing on implementing the objective of reducing fuel carbon intensity by 5% by 2030, as set out following the 3rd edition of the Conference on Aviation and Alternative Fuels (CAAF/3). Finally, the CAEP organised a symposium dedicated specifically to the non-CO2 effects of aviation.

"This evolution of both the international normative framework and the European regulations provides visibility to stakeholders and requires significant efforts in terms of implementation on the part of Member States."

At a European level, almost all of the regulatory proposals concerning the aviation sector in the "Fit for 55" package were adopted in 2023, except for the revision of the Energy Taxation Directive. The following changes to the regulatory framework required significant efforts for implementation by Member States in 2024.

The EU is also focusing on Non-CO2 effects and enforces requires aircraft operators to monitor and report them for intra-EEA (European Economic Area) flights for the years 2025 and 2026 within the EU Emissions Trading System (EU-ETS). The EU-ETS also evolved significantly in 2024 by integrating, through implementing and delegated acts, its relationship with the CORSIA (Carbon offsetting and reduction scheme for international aviation), the valuation of Sustainable Aviation Fuels (SAF) through accounting methods called "zero-rating", and the possibility of free allowances for the incorporation of certain SAF, known as "Fuels eligible for EU ETS support".

"The study conducted at Paris-Orly Airport (...) will soon lead to strengthening of environmental requirements that will benefit local residents."

These incentives for the uplift of SAF implemented in the EU-ETS overlap - in a complex manner - with the SAF shares obligation of the ReFuelEU Aviation Regulation applicable since the 1st of January of 2024. According to this Regulation, a deadline was set for the requirements to incorporate a minimum share of SAF in the fuel made available to aircraft operators at EU airports. These came into effect on the 1st of January of 2025. Thus, while SAF shares for 2024 had to be declared by fuel suppliers in February 2025, the first penalties relating to SAF uplift in 2025 will not be imposed until 2026.

In terms of AFIR and RTE-T regulations, airport managers in almost all the airports concerned complied with their obligations to supply electricity to stationary aircraft at gates by the 31st of December of 2024. In addition, several airports have already complied with the requirement to supply electricity to stationary aircraft at remote standsby 31 December 2029.

The subsequent ecological planning efforts enable us to implement the EU's objectives on a national scale. The French National Biodiversity Strategy (SNB) adopted in November 2023 is celebrating its first year. The French national compensation scheme set up under article 147 of the Climate and Resilience Act has enabled to offset 1,036,070 tCO2 thereby financing the afforestation and reforestation of 1,014 hectares of forest - equivalent to almost 1,500 football pitches - and supporting almost 190 farmers in their efforts to reduce emissions.

Lastly, 2024 is a continuation of the previous year, with major efforts to reduce noise pollution as part of the balanced approach impact studies deployed jointly at six major French airports, a first in Europe.

The study undertaken on Paris-Orly airport, the conclusions of which were delivered in the first half of 2024, will soon lead to a tightening of environmental requirements for the benefit of local residents. This will be overseen by the Aviation Noise Pollution Control Authority (ACNUSA), whose current board was recently appointed. The conclusions of the other studies will follow in 2025.

2024 has therefore demonstrated to be a real turning point: after commitments and regulations, concrete action now needs to be taken to secure a more sustainable future for aviation.

KEY EVENTS IN 2024

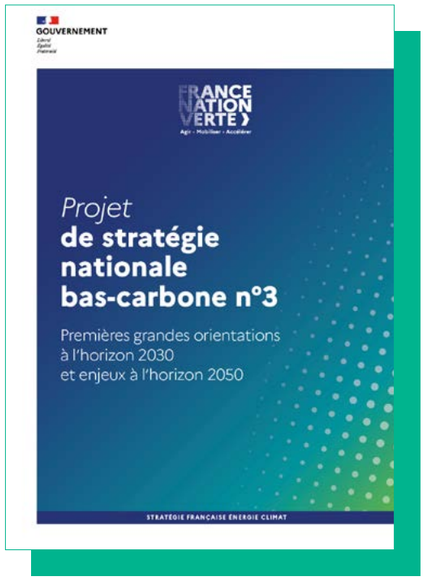
From SNBC 2 to SNBC 3: **An ongoing review of the national low-carbon strategy**

The French Energy and Climate Strategy (SFEC) is subject to review every 5 years. The SFEC is France's updated roadmap to achieve carbon neutrality by 2050 and ensure our society's adaptation to the impact of climate change. Issues around trade-offs between sectors and conflicts of use are addressed within the framework of the SFEC, notably through the study of scenarios for implementing emission reduction measures for all sectors of the French economy, including aviation, and through a detailed analysis of their energy needs (sorted by type of energy). The forward-looking energy-climate-air scenarios which serve as a reference for drawing up the SFEC, and more particularly for two components of the SFEC, the Multiannual Energy Programming (PPE) and the National Low-Carbon Strategy (SNBC), were the subject of extensive discussions between administrations in the first half of 2024.

The political context has however caused these efforts to slow down, and the major "post-2030" pathways of the SFEC could not be set. In this context, a major public consultation was launched for 6 weeks on the 4th of November of 2024. This followed the presentation, which allowed Agnès Pannier-Runacher, the Minister for the Ecological Transition, Energy, Climate and Risk Prevention, François Durovray, the Minister Delegate to the Minister for Territorial Development, responsible for transport, and Olga Givernet, Minister Delegate to the Minister for the Ecological Transition, Energy, Climate and Risk Prevention, responsible for energy, to recall the ambition of the SFEC, which reflects the alignment of national climate objectives with the European objectives set out in the European Green Deal (the "Fit for 55" package):

- In terms of climate change, the SNBC was updated with a new GHG emissions target of 50% by 2030, compared to 40% previously;
- In terms of energy mix, the PPE was updated with an objective of 60% carbon-free energy consumption by 2030.

The opinions of citizens, institutional stakeholders, and businesses shared during this consultation will feed into the finalisation of the SNBC in the first half of 2025.



The Sustainable Aviation Observatory (OAD in French): the cycle of Decarbonisation Meetings continues

Air transport accounts for approximately 2 to 3% of global CO_2 emissions, a figure that is constantly changing. Aware of these challenges, the French Civil Aviation Authority (DGAC) created the Sustainable Aviation Observatory in 2022 to better understand and raise awareness of aviation's impact on the climate.

Faced with growing environmental challenges, the aviation sector must be resolutely committed to a major transformation of its ecological model. The acceleration and multiplicity of international, European, and national regulations make interpreting prospective pathways increasingly complex. The growing number of publications and reports with differing timeframes and scopes, whether by industry, NGOs, or institutional stakeholders, is a reality to contend with. Finally and above all, the legitimate societal expectations of our fellow citizens reinforce our duty to provide clarity on operational and innovative solutions, available within a short space of time.

In 2024, the Sustainable Aviation Observatory (SAO) updated its digital output with the publication of twelve new reports, broadening the sharing of knowledge on decarbonisation.

In 2024, the DGAC supported innovation by providing support for startups developing technological solutions for a more sustainable aviation sector. By facilitating access to testing infrastructure and collaborating towards certification, the DGAC enables young companies to accelerate their deployment, and contributes to the sector's ecological transition. Cooperation with the Transport Innovation Agency (AIT) has been improved. Now a member of the AIT's operational committee, the SAO supports the PROPULSE programme, both as a jury member and as a startup advisor.

In 2024, the cycle of Regional Decarbonisation Meetings continued, including a meeting with the start-up ASCENDANCE, whose work is focused on the energy transition. Combining a modular hybrid propulsion system patented in 2021 with batteries, electric motors, and internal combustion engines using sustainable aviation fuels, the longer-term goal is to use hydrogen as an energy source. A field meeting with teams from Groupe Europe Handling (GEH) also provided a practical insight into the innovations that are accelerating the transition to low-carbon airport operations. GEH supports airlines and their partners via its electrification capacity for all runway equipment (passenger buses, baggage loaders, and aircraft push-back tractors, etc.). Research and innovation are at the heart of this transformation.

The Europe Handling Group aircraft "pushback" © Groupe Europe Handling (GEH)

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Sustainable aviation fuels (SAF), the main lever for decarbonisation

An important day for sustainable aviation fuels: on 18th May 2021, the first French aircraft flying with biofuels (used cooking oil) connected Roissy to Montreal © Airbus-SAS

LEAD: 2024 is the year in which all the preparatory work has been completed to implement the European incorporation order. 2024 was the year in which effective efforts were made to meet the European obligations set out in the ReFuelEU aviation Regulation. This follows the major steps taken in recent years at national, european and international level towards the use of sustainable aviation fuels (SAF). France has been able to capitalise on the national momentum it has created in this area (roadmap, TIRUERT aviation, calls for projects).

0,75%

NATIONAL SAF INCORPORATION MANDATES (TIRUERT) ACHIEVED IN 2024 (0.5% IN 2023)

2%

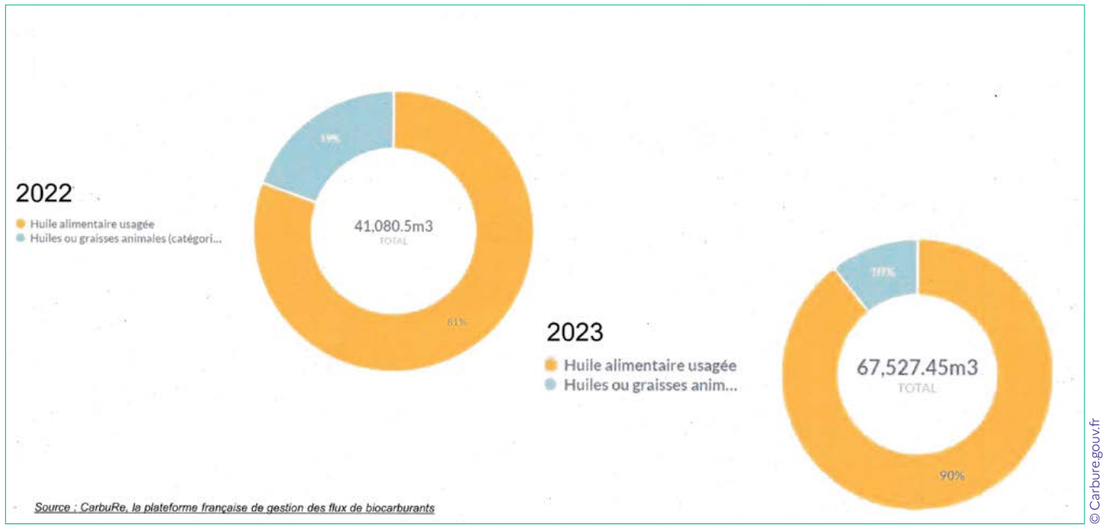
REFUEL EU AVIATION SAF INCORPORATION MANDATE IN 2025.
Objective: 6% in 2030, including 0.7% synthetic fuels.

SAF **National Incorporation Mandate**

Sustainable aviation fuels (SAF), which include advanced biofuels and synthetic fuels, are one of the major levers for the decarbonisation of air transport in the short and medium terms. As they benefit from robust sustainability criteria, their use enables significant emissions savings compared with kerosene.
From 2020 onwards France played a pioneering role by implementing policies that reflected the combined aims of creating a market (met by incorporation mandates) and developing the most mature production technologies for second-generation biofuels or sustainable synthetic fuels.
The implementation of this incentive mechanism for SAF incorporation through the TIRUERT (incentivising tax pertaining to the use of renewable energies in transport) has yielded encouraging results over its first two years. This has helped boost national efforts and presents a real turning point for SAF in France.
With physical incorporation mandates of 0.5% in 2023 and 0.75% in 2024 successively implemented at around 98%, and in the absence of a Europe-wide solution, France has developed digital tools adapted to the requirements of SAF suppliers and airlines that allow simple, monitored data transfers related to SAF sustainability. In partnership with the Directorate General for Energy and Climate (DGEC), the DGAC has developed a section dedicated to the aviation sector as part of CarbuRe[1], the national platform for biofuel flow management. This tool allows aircraft operators to access information from purchased SAF, such as production technology, type of raw materials, and origins. All this information is key to enable airlines to meet their obligations under the ReFuel EU Aviation Regulation and the European Union Emissions Trading System (EU-ETS).
Throughout the country, SAF incorporation continues unabated: Annecy Haute-Savoie Mont-Blanc airport joins the growing list of regional airports that now offer a permanent supply of fuel containing SAF. Some platforms even offer blends, made up of 35% SAF. Like other manufacturers, ATR - in partnership with Nordic Aviation Capital (NAC) - also uses SAF to deliver its aircraft from Toulouse airport.

1. metabase.carbure.beta.gouv.fr/public/dashboard/7850c353-c225-4b51-9181-6e45f59ea3ba?annee=2024

Raw materials used to produce SAF and growth in SAF production in France



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The SAF **European incorporation mandate**

Almost all of the regulatory proposals concerning the aviation sector in the "Fit for 55" package have been adopted in the last two years, with the exception of the revision of the energy taxation Directive. This evolution of the European regulatory framework for the decarbonisation of the sector raises visibility to stakeholders and has required significant implementation efforts by the UE Member States in 2024. As the bridgehead of the ReFuelEU Aviation Regulation, the DGAC is committed to overseeing the harmonised implementation of this Regulation within the EU and to supporting stakeholders during this year of transition.

The DGAC played an active role in the technical work carried out by experts from EU Member States and European Commission departments. This was a large-scale essential programme, which encompassed the following objectives: identifying the EU airports concerned by the Regulation and the various obligated parties, drafting guidelines detailing the implementation of temporary exemptions from tankering obligations, drawing up a guide for the implementation of penalties, and even developing, alongside the European Aviation Safety Agency (EASA), an online reporting tool for aircraft operators.

As France is of strategic importance when it comes to air travel, ReFuelEU Aviation Regulation are wide-ranging across the country: they applied to 17 airports and 46 aircraft operators in 2024 for the first year of reporting. This scope will be extended from the 1st of January of 2025, with the inclusion of Brest Bretagne airport, the request by Paris-Le Bourget Airport to fall under that umbrella, and the identification of a dozen or so additional aircraft operators.

The implementation of the ReFuelEU Regulation also requires the adoption of national legislative and regulatory provisions that specify the type and level of penalties imposed on obligated parties who do not comply with ReFuelEU' various obligations: SAF shares, tankering in airports covered by the Regulation, and reporting, amongst others. The DGAC oversaw the inclusion of these details in article 34 of the DDADUE bill (covering various provisions for adapting to the EU's legal framework in terms of the economy, finance, the environment, energy, transport, health, and the movement of people fields) no. 529. The text was validated by the Council of State in the summer of 2024 and submitted to the National Assembly at the end of October 2024. The law was finally promulgated on April 30, 2025 and published in the French Journal Officiel on the 2nd of May of 2025.

Location of airports providing SAF in France

Valorization of sustainable aviation fuels (SAF) and FEETS **in the EU-ETS**

The EU-ETS evolved significantly in 2024: through implementing and delegated acts, it has integrated the promotion of sustainable aviation fuels (SAF), as well as the possibility of free allowances for the uplift of some SAF called FEETS. These incentivizing measures for the SAF uplift into the EU-ETS, applicable since the 1st of January of 2024, overlap with the SAF sharesn obligation of the ReFuelEU Aviation regulation, which comes into force on the 1st of January of 2025.

"Zero-rating"

The claiming of SAF in the EU-ETS will be based on the 'zero-rating' principle. In their annual declaration to the EU-ETS, aircraft operators will be able to distinguish between 16 types of fuel. Depending on the category selected, the volume of fuel concerned will be multiplied by a zero emission factor or by the fossil fuel emission factor. This is the 'zero-rating' principle. Thus, an aircraft operator using SAF one year will reduce the quantity of allowances to be returned or reallocated the following year.

Free allowances for the use of FEETS

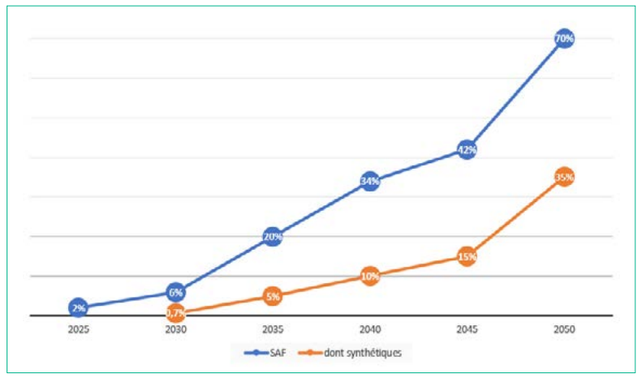
20 million new free allowances are reserved for the period extending from 2024 to 2030 to cover all or part of the price differential between fossil kerosene and FEETS (Fuels eligible for EU-ETS support). These free allowances for FEETS are to be distinguished from the 'historical' free allowances that will be allocated until 2026 on the basis of 2023 emissions. The provisions relating to FEETS are set out in article 3c(6) of Directive 2003/87/EC and transposed into II of article L.229-18 and article R.229-37-4 of the French Environment Code.

Coverage of the price difference between fossil kerosene and FEETS is proportional to the quality of the fuel used.

- 95% of the price differential for renewable fuels of non-biological origin (RFNBO);
- 70% of the price differential for hydrogen produced from renewable energy sources and advanced biofuels;
- 50% of the price differential for other biofuels, low-carbon synthetic aviation fuels (SLC) and low-carbon hydrogen.

In addition, the coverage may be 100% of the price differential under certain geographical conditions. The fuel price differential will be calculated by the European Commission on the basis of the prices published by the European Aviation Safety Agency (EASA) for the year concerned. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM:C(2025)681. Free allowances will be allocated during the last quarter of the year following the reporting period.

Aircraft operators receiving free allowances for the incorporation of FEETS will have to ensure the visibility of EU funding in all their communication activities, including on passenger tickets and billboards. To this end, they will have to use the label '(co-)financed by EU-ETS', as well as the EU emblem and the amount of aid.



SAF incorporation trajectory under the ReFuelEU Aviation Regulation

© S.Ramadier/Airbus

Valuing CEFs in the CORSIA scheme

Under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), aircraft operators also have the option of claiming the use of CORSIA Eligible Sustainable Aviation Fuels (CEFs). The use of CEFs reduces the offset obligations determined at the end of each 3-year compliance period.

CEFs include CORSIA sustainable aviation fuels (CORSIA SAF) and CORSIA lower carbon aviation fuels (LCAF). CORSIA LCAF is a fossil-based aviation fuel. CORSIA SAF is a renewable or waste-derived aviation fuel. Both types of fuel meet the CORSIA sustainability criteria defined in the document 'CORSIA Sustainability Criteria for CORSIA Eligible Fuels'. In particular, the life-cycle emissions (LCE) of these fuels, calculated taking into account indirect land-use change (ILUC), are 10% lower than those of fossil jet fuel 89 gCO2e/MJ.

The calculation used by aircraft operators to claim CEFs is detailed in part 3.3 of the ICAO Annex 16, reproduced at EU level in article 4 of Implementing Regulation (EU) 2024/1879 implementing Directive 2003/87/EC of the European Parliament and of the Council in regards to the calculation of offsetting requirements for the purposes of CORSIA.

Although the CEF declaration is made for a compliance period of three years, it is recommended that the aircraft operators submit claims for the use of CORSIA Eligible Fuels (CEF) on an annual basis to ensure that all documentation is processed in a timely manner.

Designing, building, and commissioning a sustainable aviation fuels (SAF) plant

Designing, building, and commissioning a sustainable aviation fuels (SAF) plant is a costly project, estimated at between €1 and €2 billion. The process requires studies and key stages to ensure its technical, economic, and environmental viability. These are detailed in the diagram on the following pages. Capital expenditure (CAPEX) and operational expenditure (OPEX) requirements are specified at each stage. CAPEX is generally financed by bank loans, public grants and subsidies, private investors or the company's own funds. OPEX are often financed by revenues generated by the sale of finished products (SAF), long-term supply contracts ('offtake agreements'), or voluntary contributions from customers. DEVEX (Development Expenditure) is the cost of developing the project up to the final investment decision (FID). These costs include all expenditure relating to design, engineering, obtaining permits and feasibility studies.

Offtake agreements, long-term supply contracts, strategic tools

Offtake agreements are strategic tools for setting up a SAF plant. They are agreements under which a customer undertakes to purchase all or part of the SAF production at a predetermined price and under predetermined conditions for an agreed period.

Offtake agreements ensure the economic viability of SAF production projects by stabilising revenues and reducing risks, while offering customers a reliable supply of SAF. Customers can be airlines or fuel suppliers. The agreements set a purchase price for SAF, often indexed to market fuel prices. The volumes of SAF to be purchased are defined in advance, enabling the plant to plan its production accordingly (planning operations, raw material supplies, and labour requirements). The duration of the agreement can vary, but is generally several years, providing long-term visibility for both parties and reducing the risks associated with market fluctuations and economic uncertainties. These agreements are an important element in attracting investors and obtaining financing.

Horizontal diagram of the creation of a SAF production unit

FEASIBILITY STUDIES

- **Objective:** To assess the technical, economic, and environmental viability of the project.
- **Costs:** Include market research, site selection, preliminary engineering studies and environmental impact assessments. Administrative costs and salaries of the planning teams.

FRONT-END ENGINEERING DESIGN (FEED)

- **Objective:** To provide more detailed engineering work, including process flow diagrams, equipment specifications, and preliminary drawing.
- **Costs:** Engineering services, process design, equipment selection, and more detailed cost estimates. Engineering team salaries and design fees.

[IN PARALLEL TO STAGE 3] LAND ACQUISITION AND PERMITTING

- **Objective:** To acquire the necessary land and obtain planning permission.
- **Costs:** Land acquisition costs, building permit fees, and environmental impact studies. Legal and administrative costs of obtaining the necessary permits.

CONSTRUCTION

- **Objective:** Actual construction of the plant.
- **Costs:** Construction and commissioning. Construction supervision costs, salaries of project management teams, and site safety costs.

Approximately 40% of the project cost envelope tallies with the financing of this stage 6 of construction.

COMMISSIONING AND TESTING

- **Objective:** Carrying out initial tests and adjusting equipment.
- **Costs:** Initial tests, necessary adjustments, and compliance certifications. Salaries of test teams, energy costs for testing, and initial maintenance costs.

These cost ranges are estimates and may vary according to project size, location, and technical specifications.

1 — 2 — 3 — bis — 4 — 5 — 6 — 7 — 8 — 9

PRELIMINARY FRONT-END ENGINEERING AND DESIGN (PRE-FEED)

- **Objective:** To define the project baseline and evaluate different process technologies.
- **Costs:** Detailed market analysis, process simulation, preliminary equipment sizing and initial cost estimates. Design team salaries and modelling software costs.

FINAL INVESTMENT DECISION (FID)

- **Objective:** To definitively validate the project after securing all financial, technical, and regulatory aspects.
- **Costs:** Finalising contracts with suppliers, financial partners, and regulatory authorities. Negotiation, due diligence, and contract preparation costs.

[NOT NECESSARY IF TECHNOLOGY LICENCES ARE ALREADY BASED ON TRL 8-9 LEVELS] INDUSTRIAL DEMONSTRATION PHASE

- **Objective:** To test and validate technologies and processes on an industrial scale.
- **Costs:** Construction of the demonstration unit, purchase of pilot equipment, and initial tests. Energy costs for testing, salaries of test teams, and initial maintenance costs.

Approximately 10% of the project cost envelope tallies with the funding of stages 1-2-3-4 from feasibility studies to the final IDF investment decision.

PROCUREMENT AND EQUIPMENT INSTALLATION

- **Objective:** Procurement of equipment and materials. Installing production machinery and equipment.
- **Costs:** Purchase and installation of equipment, control and safety systems. Staff training in the use of new equipment and commissioning costs.

Approximately 50% of the project cost envelope tallies with the financing of this stage 7 of equipment supply and installation.

START-UP AND PRODUCTION LAUNCH

- **Objective:** Launch production at full capacity.
- **Costs:** Final investment to launch production, including initial raw material stocks. Ongoing operating costs, including salaries, raw materials, energy, and ongoing maintenance.

Financial assistance to overcome the risk

At national level
The high-level working group on SAF, officially launched on the 14th of February of 2023 by the ministers for energy, industry, and transport, aims to create a sustainable fuel industry in France that will enable the aviation sector to achieve its objectives of reducing greenhouse gas emissions and decarbonising by 2050.

This dual objective led to the launch of a call for projects dedicated to upstream technological building blocks between 2021 and 2022, which resulted in the support of 5 projects for engineering studies and the setting up of demonstrators (totalling €18M).

At the Paris Air Show in 2023, the French President announced that public aid would be extended, with a €200M budget to support the industrialisation of a sustainable aviation fuel industry, via a second call for projects entitled 'Development of a French production industry for sustainable aviation fuels - Support for preliminary Front-End Engineering Design studies' (so-called 'pre-FEED' studies, required before a decision is taken on industrial investment). This call for proposals closed on the 28th of June of 2024, with more than ten projects submitted. Appraisal began immediately, and the winners are expected to be announced in the first half of 2025.

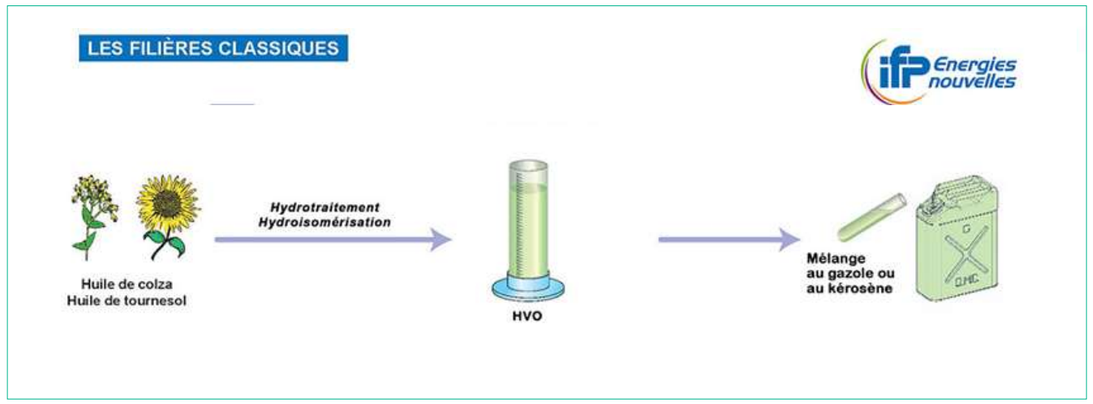
A working group dedicated to SAF has been set up within the French New Energy Systems Strategic Industry Committee (CSF NSE) to ensure the development of the industry and competitiveness of national airlines and the industrial and energy sovereignty. It takes place in a State-Industry alignment to achieve the ambitious medium and long-term objectives. These committees are designed to establish effective and regular dialogue between the State and companies and enable them to coordinate and identify shared approaches around common issues. This action will be included in an amendment to the CSF NSE which specifies the key actions to be carried out to horizon 2027.

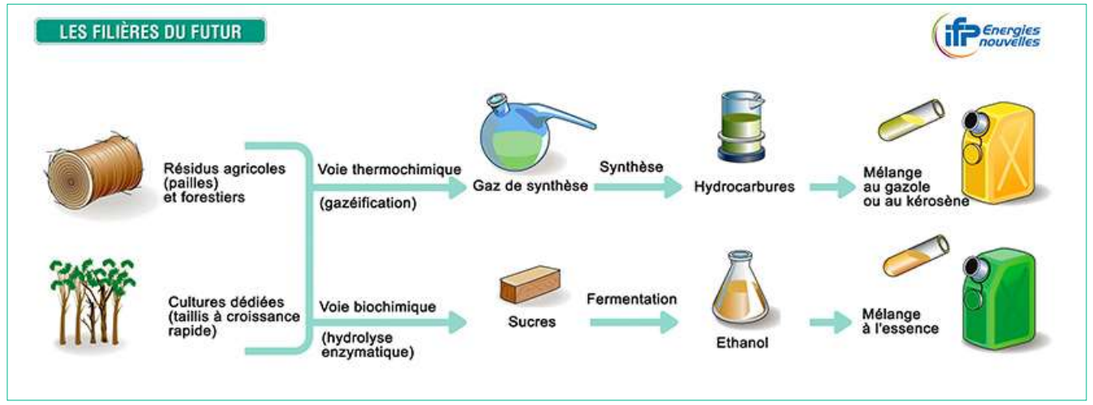
At European level
The Renewable and Low-Carbon Fuels Value Chain Industrial Alliance (RCLF) was formed on 6th April 2022. It is open to all key actors and is made up of two chambers, one dedicated to air transport and led by Safran, and the other to maritime transport. France was the first Member State to join and actively take part in this initiative. This alliance completes the regulatory framework coordinated by the ReFuel EU Aviation Regulation. It aims to focus on accelerating the production and marketing of SAF at affordable prices. The key issues identified by the alliance include access to finance, availability of resources, and synergies between sectors.

In addition, EU Regulation 2024/1735 for a 'net-zero industry' (or NZIA) was adopted on the 13th of June of 2024 and aims to support a clean European reindustrialisation to accelerate the transition to climate neutrality by 2050. The text targets technologies that will make a significant contribution to decarbonisation, and specifically strategic 'net-zero' technologies available on the market and with significant potential for rapid development. Experts from Member States and the various sectors concerned are currently working on detailing more specifically the technologies and identifying the technical components. The DGAC is ensuring that the production of SAF and synthetic fuels (e-fuels) made with low-carbon electricity are taken into account, to ensure harmonisation between European texts and to support diversification of the solutions available to achieve decarbonisation.

At international level
As illustrated in the diagram above, the development stages of a SAF production unit require substantial fundings at every stage. Building a production unit is expensive: several billion euros for all the construction stages. Although public subsidies can send a positive signal, private investment will be essential. To make investment in SAF attractive, the challenge is to 'de-risk' private investment in the construction of a production plant. To this end, the ICAO is also developing the Finvest Hub, a platform bringing together project promoters and investors. It is studying the feasibility, particularly the legal aspects, and the implications of an international financing mechanism that would be managed at the level of the organisation.

Update on biofuels **used in aviation**





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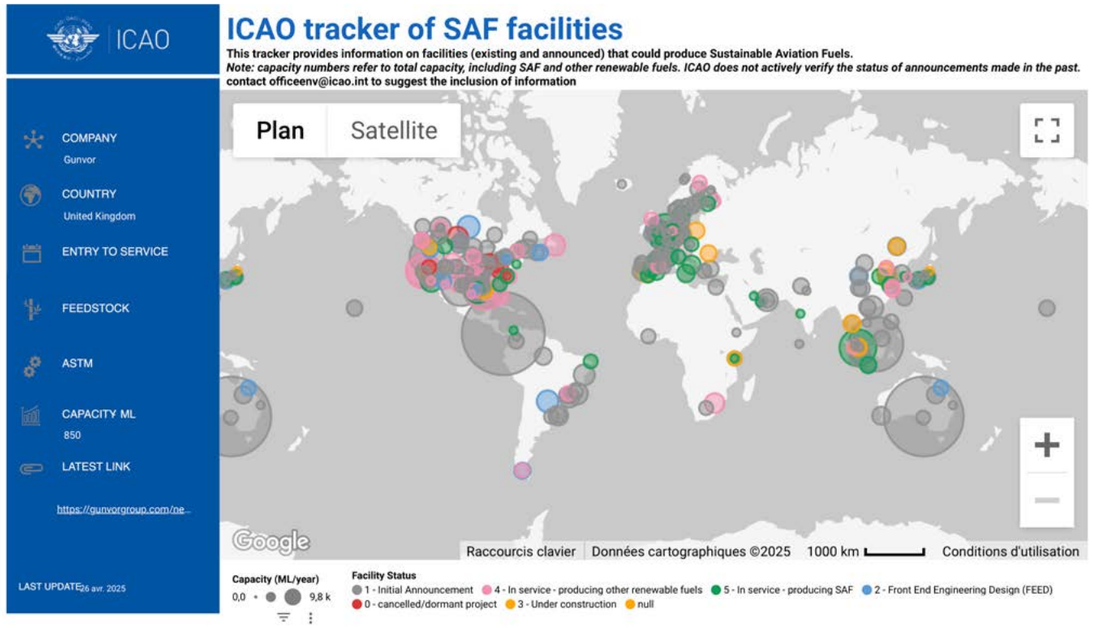
Maps of French and international **SAF productions**

The French e-fuels observatory[2] has drawn up a map showing SAF production announcements for 2024.The European Aviation Safety Agency (EASA) report on SAF prices in 2023 provides a map of production capacity by EU country[3]. Internationally, the ICAO provides an observatory of SAF production around the world[4].

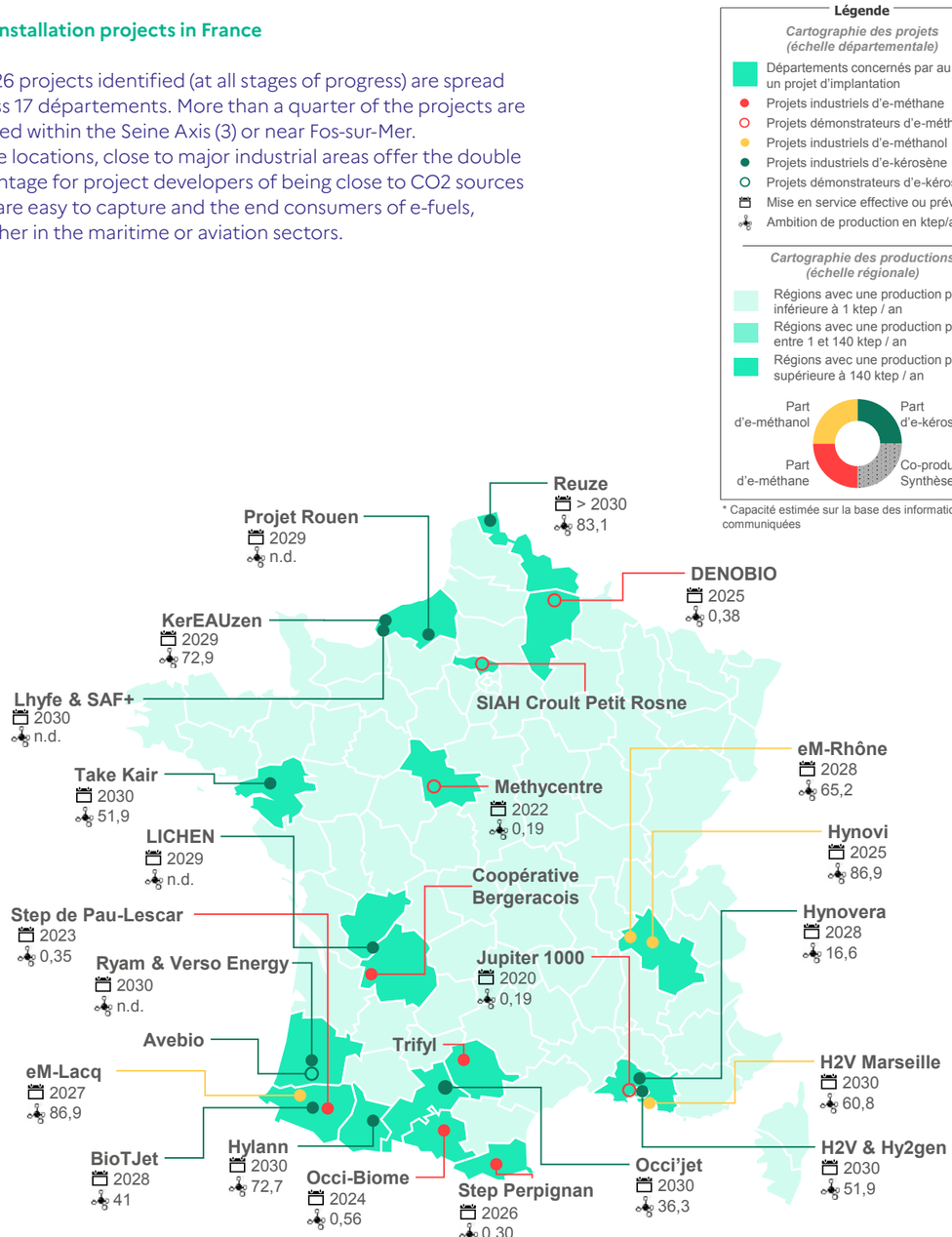
ICAO map tracking infrastructure providing SAF worldwide



2. https://www.bureau-efuels.com/wp-content/uploads/2024/10/Observatoire-francais-des-e-fuels_edition-2024_Fr.pdf (p26)
3. https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-publishes-report-european-union-sustainable-aviation-fuels
4. https://www.icao.int/environmental-protection/SAF/Pages/Production-Facilities.aspx

SAF installation projects in France

The 26 projects identified (at all stages of progress) are spread across 17 départements. More than a quarter of the projects are located within the Seine Axis (3) or near Fos-sur-Mer.
These locations, close to major industrial areas offer the double advantage for project developers of being close to CO2 sources that are easy to capture and the end consumers of e-fuels, whether in the maritime or aviation sectors.



* Capacité estimée sur la base des informations communiquées

Cartographie Sia Partners des projets annoncés dans le périmètre de l'étude ou rapportés à celui-ci d'après les données publiques communiquées par les porteurs des projets ou relayées dans la presse

DGAC • ENVIRONMENTAL REPORT 2024

2 —

CLIMATE & DECARBONISATION

Photovoltaic panels at Aubenas airfield.
© Richard Metzger/DGAC-STAC

2024 saw the alignment of national policies with European objectives to achieve carbon neutrality by 2050. This ambition has led to increased support for airports in their energy transition and adaptation to climate change. These efforts highlight the determination of all actors in the sector to sustainably transform aviation in response to the current climate challenges.

11

AIRPORT OPERATORS ARE REQUIRED TO CARRY OUT A VULNERABILITY STUDY AND A CLIMATE CHANGE ADAPTATION PLAN BY 2025 AS PART OF THE THIRD PNACC.

1st Symposium

THE NON-CO_2 EFFECTS OF AVIATION AND THEIR IMPACT ON THE CLIMATE HELD IN MONTREAL AT THE INSTIGATION OF THE ICAO, WHICH BROUGHT TOGETHER MORE THAN 400 PARTICIPANTS (SCIENTISTS, AVIATION EXPERTS)

1st

COMPLIANCE WITH THE REQUIREMENTS OF THE AFIR REGULATION.

Airports adapting **to climate change**

A transport system is resilient if it can cope with disruption by adapting or transforming itself to preserve its infrastructure and services. As part of the third National Climate Change Adaptation Plan (PNACC), the DGAC and the Union of French Airports and Associated Francophone Airports (UAF & FA) have defined the content of studies needed to assess the vulnerability of airports. The results of these studies will be used to determine the costs of adaptation and strategic investment choices.

Infrastructures exposed to the consequences of climate change

Climate change is reflected in rising average temperatures and rising sea levels, but also in the occurrence of extreme weather events, such as heat waves, hail, rainfall, drought, storms and, in the French West Indies and Indian Ocean, cyclones and tropical storms.

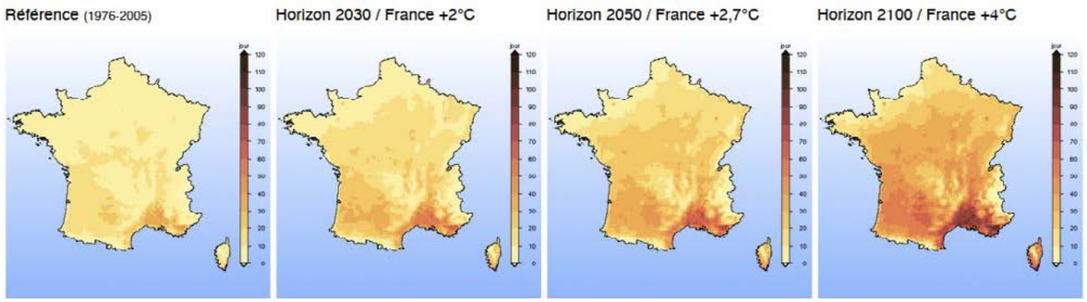
The effects of climate change cover a broad spectrum: disruption of flight operations, deterioration of runways and buildings (due in particular to shrinkage/swell of clay), closure of airport access or interruption of ground operations (in the event of flooding), passenger safety, working conditions for staff, disruption of logistics chains, etc.

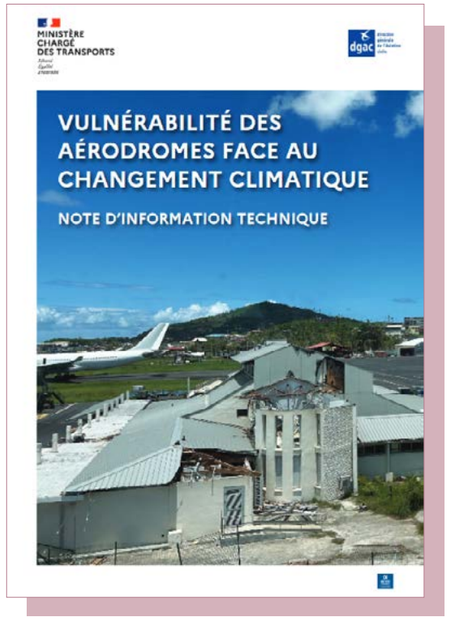
The close link between climate change risks and operating risks explains the need for airport operators to commit to the climate change adaptation process in order to maintain the infrastructure, equipment, and services under their responsibility in operational condition.

5. https://www.stac.aviation-civile.gouv.fr/fr/outil-devaluation-vulnerabilite-au-changement-climatique

THE DEVELOPMENT OF A VULNERABILITY ASSESSMENT TOOL BY THE DGAC

To this end, in 2011 the DGAC's Civil Aviation Technical Service (STAC) developed the VULCLIM[5] tool, which enables operators to assess the vulnerability, both groundside and airside, of French airfields to the effects of climate change. This pre-diagnosis tool is a first step in the overall adaptation process.





Carrying out vulnerability studies and drawing up adaptation plans as part of the third PNACC

The third PNACC, for which public consultation ended at the end of 2024, includes the measure 30 intitled 'ensuring the resilience of transport and mobility'. It aims to adapt transports to climate change effects by drawing up adaptation plans for transport infrastructures and services based on vulnerability studies.

As part of this, the ministers for the environment, transport, and finance have asked several airport operators[6] to carry out a vulnerability study and to draw up an adaptation plan containing costed proposals for the infrastructure and services under their responsibility. The cost of the vulnerability studies is supported by each operator.

The approach of the DGAC and the Union of French Airports (UAF) to support airports

The DGAC and the UAF have set up a governance structure to support the airports involved in carrying out a vulnerability study and designing an adaptation plan. On the DGAC side, the competent departments in the fields of regulatory, technical, real estate, and air navigation are mobilised (DTA, STAC, SNIA, DSNA and DSAC). This work has resulted in a set of basic specifications, which will support the launch of consultations on vulnerability studies in early 2025.

Three airport components have been selected to define the scope of the vulnerability studies: infrastructure (including car parks, aircraft aprons and manoeuvring areas, access roads and airport services); buildings (towers, technical blocks and buildings used for crisis management); operations (e.g. fuel storage areas, aircraft rescue and fire-fighting areas, groundhandling equipment, air navigation assistance).

The studies will be carried out using the reference warming trajectory for adaptation to climate change (TRACC), which is based on a combination of warming levels at different timescales: +2°C in 2030, +2.7°C in 2050 and +4°C in 2100 compared with the pre-industrial era for mainland France.

For the French overseas territories, the local variations in global warming levels have not yet been set. In the absence of a TRACC for ultra-marine airports, it was decided that the IPCC climate scenarios were to be used as a reference. For studies launched on the basis of the IPCC 'RCP 8.5' scenario, with a median scenario where appropriate, the results of the studies were to be assessed in light of the TRACC in order to measure the differences and assess whether they should be updated.

Prospects

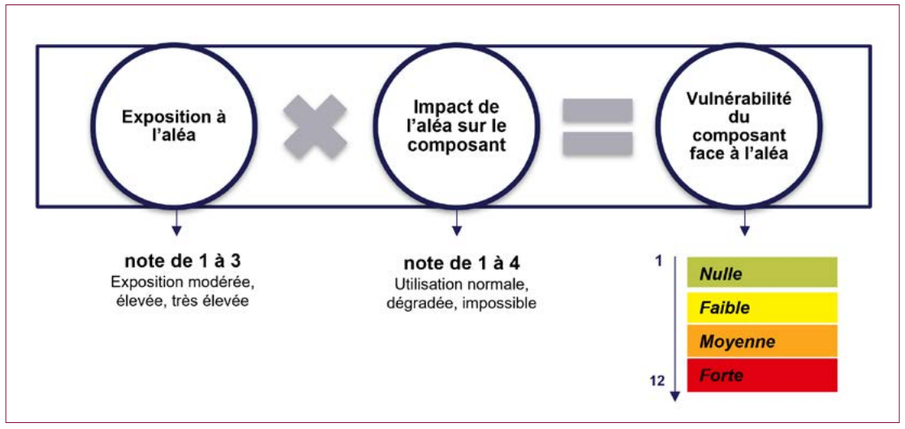
Eventually, the aim will be to provide feedback to all airports. In addition, airports operating under concession agreements will see the obligation to carry out a vulnerability study added to their contracts upon renewal. Changes will need to be made to technical guidelines, standards and regulations, which specify the climatic conditions under which equipment, infrastructure, and services operate nominally, in particular to prevent maladaptation.

The costs arising from adaptation plans will make it possible to decide upon a resilience strategy, investments, and priority adaptation measures for each airport.

Together with the decarbonisation project, adaptation to climate change represents one of the major challenges for the aviation sector.

6. Airports of Paris, Strasbourg-Entzheim, Lyon-Saint-Exupéry, Nice-Côte d'Azur, Marseille-Provence, Montpellier-Méditerranée, Toulouse-Blagnac, Bordeaux-Mérignac, La Réunion Roland-Garros, Martinique Aimé-Césaire, Guadeloupe Maryse-Condé.

Schematic diagram to determine the vulnerability of an airport to climate change



AFIR and TEN-T regulations: decarbonisation of ground operations is improving

The European regulations on the deployment of alternative fuels infrastructures (AFIR Regulation 2023/1804 and on the trans-European transport network (TEN-T Regulation 1315/2013, amended by Regulation 2024/1679) have introduced obligations for airport managers located across the TEN-T to supply electricity and pre-conditioned air to stationary aircrafts. The main aim is to replace the use of the auxiliary power unit (APU), which is thermal, with carbon-free solutions when the aircraft is stationary. The AFIR Regulation also required each Member State to draw up, by the 31st of December of 2024, a national framework for action detailing the figures of the stations equipped to meet the regulations' objectives. It also describes the prospects and progress for the deployment of infrastructures for the electric recharging and hydrogen refuelling of aircraft. At the end of 2024, the DGAC carried out a survey of existing and future infrastructures at the 27 French TEN-T airports subject to these obligations. These airports have largely embarked on the energy transition and taken the necessary measures to meet these obligations.

Of the roughly 1,200 aircraft stands targeted, nearly 1,040 fixed (400Hz electrical sockets) and mobile (ground power unit, GPU) electrification systems are already operational, and more than 40 stands are equipped with pre-conditioned air (PCA).

A bill containing various provisions for adapting to European Union law (DDADUE) is currently being examined by Parliament to specify the procedures for implementing the above-mentioned provisions and introduce an appropriate penalty system. A decree and an order are also currently being drafted, which will detail, for the coming years, the methods for transmitting the required data to the DGAC, as well as the penalty procedure.

⊕ For more information on the regulations applicable to airports : https://www.ecologie.gouv.fr/politiques-publiques/reglements-europeens-afir-rte-t-aeroports

100% electric PCA air conditioning unit at Roissy-CDG airport. © Richard Metzger/DGAC-STAC

Deployment of a 100% electric refueling truck at Cannes Airport.
© Aéroport de Cannes-Mandelieu ACA/BP

Electrification of **airport platforms**

Electrification of runway equipment
The energy transition at airport hubs involves the greening of the many runway vehicles, most of which are still powered by combustion engines. In 2023, the proportion of electrified runway equipment reached 46%, compared with 44% the previous year, according to the CSAE (French Trade union of ground handling assistants). It aims to reach 90% of equipment running on clean electricity by 2030, a threshold already crossed for baggage loaders. However, this momentum is reaching a plateau for several reasons, from which the high costs of electric runway vehicles adoption compared .with internal combustion models (+30% on average) and uncertainty of electricity costs.

To try and tackle this issue, the government is planning to introduce a level of tax support. "Article L. 39 decies F" of the French Tax Code provides for a tax overpayment on runway equipment between 2024 and 2026. It allows airfield operators and ground handlers to deduct part (40%) of the cost of new electric or hydrogen-powered non-road runway equipment purchased between 2024 and 2026 from their operating income subject to tax.

In addition, the French Finance Act introduced the principle of a reduced rate of domestic tax on the final consumption of electricity (TICFE) supplied by aerodromes to stationary aircraft. The European Commission and the Council of the European Union have approved a tariff of €0.5 per megawatt-hour for electricity consumed for the needs of economic activities and €1 for the needs of non-economic activities.

In addition, the AFIF 'Alternative Fuels Infrastructure Facility' call for projects, intended to help deploy electric infrastructure to decarbonise transport along the TEN-T, has led to the development of recharging stations for these vehicles. There are more than 1,500 recharging stations for electric ground vehicles in the 27 TEN-T airports, including 500 airside, as well as 9 hydrogen refuelling stations for these vehicles.

100% electric refuelling truck in Cannes
On the 12th of June of 2024, Cannes airport inaugurated the first 100% electric refuelling truck built in Europe by AirBP, an additional step in the airport's decarbonisation strategy.

Developing hydrogen and biofuels **on runway vehicle platforms**

Mobilising European public aid to develop hydrogen recharging stations for runway vehicles
To support their energy transition, and since 2021, airports located along the TEN-T have been able to answer the 'Alternative Fuels Infrastructure Facility' (AFIF) call for projects under the Connecting Europe Facility (CEF) (in order to benefit from up to 30% funding for their electrical infrastructure deployment project (400 Hz and 50 Hz sockets, PCA, GPU, hydrogen refuelling stations, power supply, etc.). Nine French airports have already received funding for a total of €65 million during the first phase of this call for projects between 2021 and 2023. A second phase was launched in 2024 under the same conditions (application deadlines in September 2024, June 2025 and certainly March 2026). Within this framework, the HyLandAir project (Hydrogen on landside and airside), led by ENGIE at Paris-Charles de Gaulle airport and the MOBHYLYS project (MOBilité HYdrogène LYon Saint-Exupéry), developed by ADL (Aéroports de Lyon) at Lyon Saint-Exupéry airport have been able to benefit from funding. This funding will allow airports to install hydrogen refuelling stations for ground handling services and the general public, as well as electrolysers and photovoltaic panels to power these stations.

Sustainable fuels in addition to electrification and hydrogen in Nice and Cannes for runway vehicles
Since 1st January 2024, the last thermal vehicles and equipment operating at Cannes Mandelieu airport have been fuelled by XTL-HVO100 biodiesel: refuelling lorries, "follow-me" vehicles, agricultural tractors, and runway vehicles. A study is underway to include SSLIA vehicles. With a consumption of around 20,000 litres per year, the switch to this 100% renewable biofuel has resulted in an annual saving of 42 tonnes of CO2 equivalent.

Following a feasibility study carried out in 2024, Nice airport also decided to switch to HVO100 for its runway vehicles and equipment, with an expected saving of 140 TCO2eq. A tank was installed and distribution will begin in March 2025.

Switch to HVO biodiesel for all vehicles and ground equipment at Côte d'Azur airports. © Aéroports de la Côte d'Azur-ACA

XTL-HVO100 is a synthetic paraffinic diesel that is compatible with diesel engines. HVO stands for Hydrotreated Vegetable Oil. It can be made from vegetable oils such as rapeseed or sunflower oil, to which hydrogen molecules are added. It can also be made by reprocessing waste products such as used cooking oil or animal fats. HVO is part of the XTL family. XTL stands for 'X To Liquid', i.e. a biomass or gaseous product transformed into a liquid.

Installing photovoltaic panels on airport platforms

The challenges of photovoltaics for biodiversity
Articles 40 and 43 of the French 'Acceleration of Renewable Energy Production' Act (APER) of the 10th of May of 2023 provide a framework for the installation of photovoltaic panels on airport buildings and car parks. These provisions are supplemented by article 101 of law no. 2021-1104 of 22 August 2021, known as the French 'climate and resilience law'. The implementing decrees for these provisions were published in December 2023 for article 101 of the Climate and Resilience Act and in November 2024 for article 40 of the APER Act.

In regards to the installation of photovoltaic panels on the ground, scientific studies exploring the links between the development of photovoltaic energy and its impact on biodiversity have progressed in recent years. The effects of photovoltaic power plants on terrestrial environments can be of several kinds: destruction of ecosystems (breeding or feeding habitats for certain species), reduction in light and rainfall, impact on the species present under the panels and modification of the ecological functions of the soil, etc.

On the basis of these observations, the French National Council for Nature Conservation (CNPN), in its assessment of the 'Photovoltaic deployment policy and its impact on biodiversity'[7], set out a number of recommendations for integrating biodiversity conservation issues into the deployment of photovoltaic energy in France:

- put an end to the construction of ground-mounted photovoltaic power plants in protected areas and semi-natural spaces;
- increase the Regulation of the installation of photovoltaic power plants on sites described as 'derelict';
- improving research and knowledge (monitoring programme of potential mortality for ground-based photovoltaic power plants).

On the ground, the installation of photovoltaic panels is taking shape
Over the last few years, airport operators have put considerable effort into renewable energy production. In line with the above-mentioned regulations, photovoltaic panel installation projects are multiplying in and around airport platforms, across car parks, the roofs of buildings and hangars and also on the ground. At a national level, and based on completed and ongoing projects, the UAF estimates a production potential of 600 GWh over the next few years.

7. https://www.avis-biodiversite.developpement-durable.gouv.fr/IMG/pdf/2024-16_avis_deploiement-photovoltaique-impacts-biodiversite_cnpn_du_19_06_2024_vf.pdf


Photovoltaic panels at Nice Airport.
© Aéroports de la Côte d'Azur-ACA

Assessment of the domestic offsetting obligation under Article 147 of the Climate and Resilience Act for 2023

In 2023, the equivalent of 1,036,070 tCO2 was offset under the national offsetting scheme set out in the article 147 of the Climate and Resilience Act. This makes up 70.54% of the domestic GHG emissions of aircraft operators subject to the scheme this year.

This concerned 26 aircraft operators. In all, the offsetting of their domestic GHG emissions for 2023 has enabled afforestation/reforestation funding of 1,014 hectares of forest, equivalent to almost 1,500 football pitches, and to support around 190 farmers in their efforts to reduce emissions.

The total potential emissions reduced or sequestered by projects located in the European Union for the year 2023 was 402,831 tCO2, or 38% on average. Almost all the projects selected to comply with this provision are located in France (99.9% of emissions) and have been awarded the French Label Bas Carbone certification. With an average price of €30.7/tCO2, this is equivalent to €12.35 million invested by aircraft operators to finance the Label Bas Carbone.

The total potential emissions reduced or sequestered by projects located outside the European Union for 2023 was therefore 633,239 tCO2. With an average price of €4.8/tCO2eq, this is equivalent to €3 million invested by international projects outside the EU.

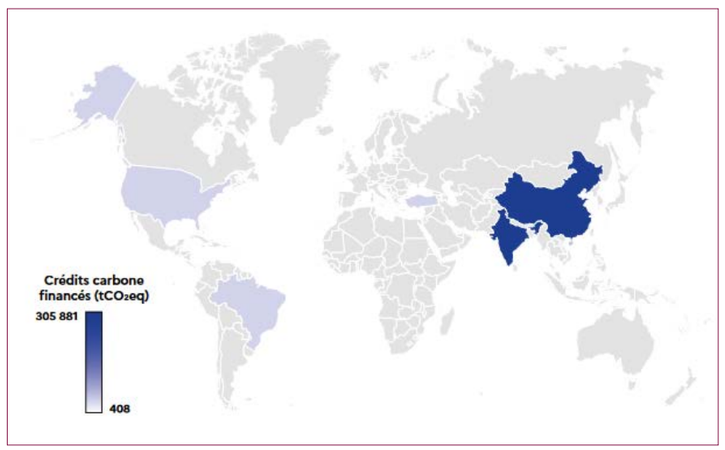
The map below shows the origin of the projects selected in France and the tonnes offset by region[8].

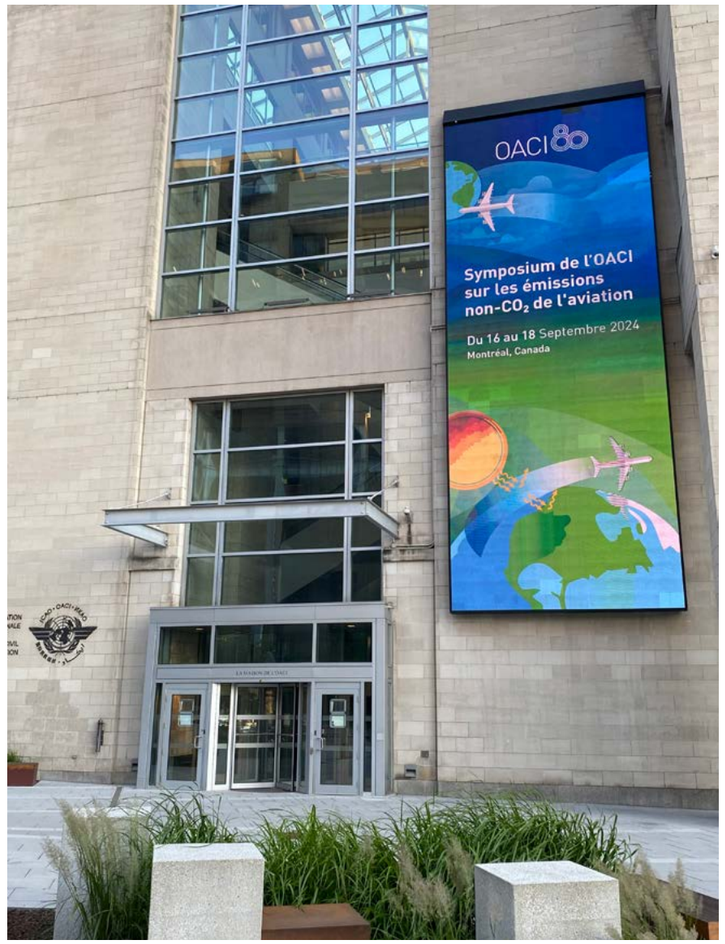
From the 1st of January of 2024, aircraft operators will be required to offset all their domestic GHG emissions under the national emissions offsetting scheme introduced by Article 147 of the Climate and Resilience Act, compared with 50% in 2022 and 70% in 2023. In addition, the proportion of potential emissions reduced or sequestered by projects located in the EU must be at least 50%.

The international projects selected by the airlines for offsetting outside the European Union have been chosen from amongst the offsetting programmes eligible under the CORSIA offsetting scheme for international aviation implemented by the ICAO. Carbon credits certified by these standards are deemed to comply with the provisions of article R. 229-102-1 of the French Environment Code.

8. https://www.ecologie.gouv.fr/sites/default/files/documents/Compensation%20vols%20interieurs_light.pdf. Cf p. 8 to 10.

Regional distribution of internationally financed offset projects in tCO_2eq





Non-CO_2 impacts, a research topic

ICAO symposium on the non-CO_2 impacts of aviation emissions.
At the instigation of the French Permanent Representation to the International Civil Aviation Organization (ICAO), the first symposium on the non-CO_2 effects of aviation and their impact on the climate was held in Montreal from the 16th to the 18th of September of 2024. The event brought together more than 400 participants, including government representatives, scientists, climate and meteorology specialists, and aviation experts represented by manufacturers, airlines and air navigation services. The discussions focused on 3 themes: increasing scientific knowledge, ways of reducing the impact on the climate (technology, operations, fuels), and the next steps to take.

Why this symposium?
Our knowledge of the non-CO_2 effects of aviation remains incomplete, despite research work such as CLIMAVIATION in France. Their impact on the climate in particular is less well understood than that of CO_2. However, scientists agree on their overall impact in terms of global warming and the prevalence of the impact of condensation trails. The ICAO's objective was therefore to raise awareness amongst its Member States and aviation stakeholders on this subject, by sharing existing scientific knowledge and mitigation measures to consider the next steps in dealing with non-CO_2 globally.

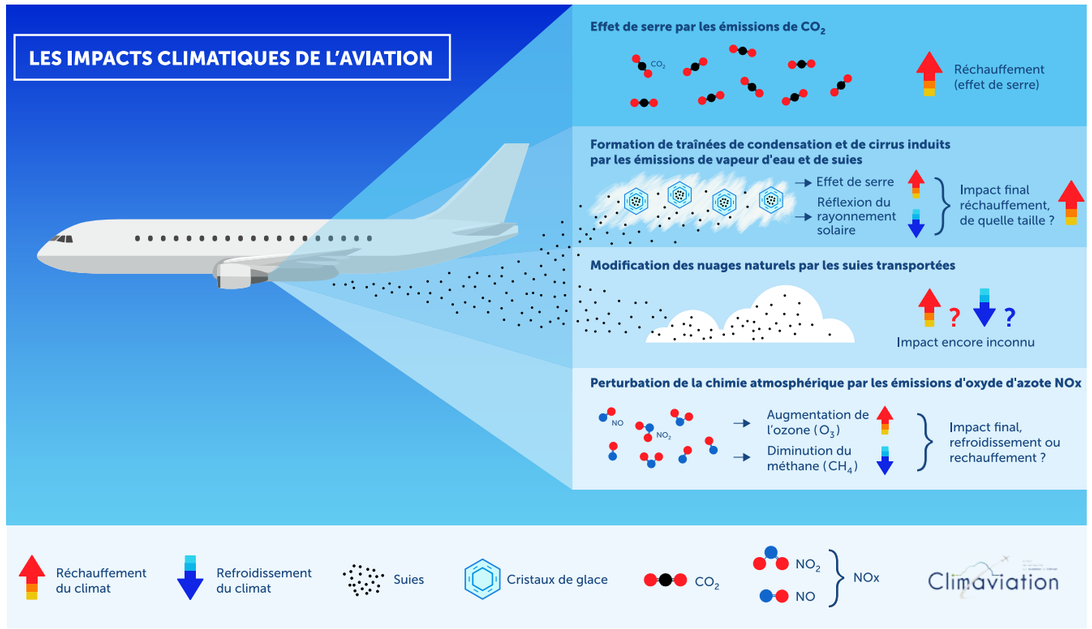
Increased knowledge is essential if the right mitigation decisions are to be made, given the multifactorial complexity of non-CO_2 emissions: diversity of emissions and effects (water, nitrogen oxides, particles, condensation trails), nature of the impact (direct or indirect), effect on the climate (warming or cooling), location (mainly in the northern hemisphere in the case of trails), temporality (season, day/night). For example, nitrogen oxides are involved at different levels in the physico-chemical mechanisms occurring in the atmosphere. They have a warming effect through the formation of greenhouse gases such as carbon dioxide and ozone, and a cooling effect through the destruction of molecules such as methane.

The symposium also served as a reminder that the ICAO, via the Committee on Aviation Environmental Protection (CAEP), has been addressing the issue since the 1980s from the air quality point of view by setting standards for certain emissions, notably nitrogen oxide (NOx) and carbon monoxide (CO) concentrations, and more recently for non-volatile particulate matter (nvPM).

For the future, CAEP is working towards strengthening the NOx standard for local air quality and is exploring the feasibility of a NOx standard for the cruise part of the flight, as well as the relevance of establishing a standard for non-volatile particulate matter during cruise. The committee is also closely studying the effects of sustainable aviation fuels on non-CO_2 emissions. Experiments have shown that while their use reduces nvPM emissions (and therefore, a priori, the risk of condensation trails forming), a different chemical process occurs, which can lead to the formation of condensation trails.

Monitoring and reporting of non-CO2 effects in the EU-ETS

At European level, the monitoring and reporting of non-CO2 effects will be imposed on aircraft operators within the EU-ETS for intra-EEA (European Economic Area) flights in 2025 and 2026. Voluntary reporting on extra-EEA flights will be possible during these two years. The European Commission is currently developing a digital tool called NEATS (non-CO_2 Aviation Effects Tracking System), which will use data supplied by aircraft operators to quantify non-CO2 emissions per flight in terms of CO2 equivalents. The tool should be available in July 2025.



© Chaire Climaviation

3 — Limiting noise pollution

Flyover of Villeneuve-le-Roi. © DGAC/DTA/SDD

2024 saw the renewal of the board of the Airport Nuisance Control Authority (ACNUSA), with the appointment of the new chairman on January the third. The balanced approach studies (EIAE) initiated in 2023 continued throughout the year at the airports concerned and should be completed in 2025.

A+

A NEW CALIPSO CLASS CREATED for aircraft with a Performance Index (IP) threshold above 90.

11%

DIFFERENTIATED INCREASE IN THE RATES OF TAX ON AIRBORNE NOISE POLLUTION, enabling airfield operators to contribute to the soundproofing of homes near major airports.

83 000 €

ALLOCATED BY THE DGAC TO THE FFA for the development of light aviation.

Balanced approach studies
– News in 2024 –

Airbus Beluga on approach over Toulouse.
© Richard Metzger/DGAC-STAC

Towards a sustainable balance between environmental imperatives and air transport activity
The public policy of controlling noise pollution around airports is based on the principle of the 'balanced approach', defined by the International Civil Aviation Organization (ICAO), which is based on 4 pillars, taking into account both environmental and economic factors:

1. Reducing noise at source, in particular by replacing fleets with more acoustically efficient aircraft;

2. Planning and managing the use of the land surrounding the airport,

3. Improvement of flight operations through the development of better trajectories;

4. Operating restrictions, which limit access to an airport or reduce its operational capacity.

If it turns out that the measures taken under the first three pillars are insufficient to solve the specific noise issue, Regulation (EU) no. 598/2014 provides for the possibility of conducting an 'impact assessment' based on the balanced approach , that aims at assessing whether operating restrictions on the platform concerned would make it possible to respond to the noise problem identified, and whether the solutions envisaged are proportionate to the economic and social consequences that would ensue.

Since the publication of the 16th of May of 2023 decree on noise pollution at airports, which designates the prefect of department as the new competent authority according to its definition in the European Regulation (EU) No. 598/2014 to conduct and supervise the balanced approach study, the conditions required to initiate the process of introducing noise-related operating restrictions have been met at airports where a noise problem has been identified.

It is in this context that such steps have been undertaken for Paris-CDG, Paris-Orly, Toulouse-Blagnac, Bordeaux-Mérignac, Marseille-Provence and Lille-Lesquin airports.

The EIbalanced approach study carried out at Paris-Orly
The situation of Paris-Orly airport, enclosed in a dense urban fabric, is unique in France. The aerodrome is already subject to a series of environmental constraints that are strictly monitored by the local civil aviation authorities. Since 1968 (ministerial decision of 4 April 1968 regulating night-time use of Orly airport), a curfew has been in place between 11.30pm and 6am.

The process of introducing operating restrictions at Paris-Orly airport, which began in June 2023, has largely continued in 2024, and could be completed in the very near future.

The conclusions of the Paris-Orly balanced approach study were presented to all stakeholders in February 2024, enabling the next phases of the process as per the European Regulation to be initiated. On this basis, a draft restriction decree was drawn up and submitted for public consultation from from the 29th of April to the 29th of July 2024, then for approval by the airport's Consultative Commission on the Environment (CCE) in January 2025 and finally the Airport Nuisance Control Authority (ACNUSA) in February 2025.

The main aim of the draft decree is to tighten environmental requirements for aircraft operating at night on the airport, by imposing restrictions on acoustic performance that are unprecedented in Europe, and to tighten the conditions for granting exemptions from the curfew, which will now be limited to specific cases relating exclusively to air safety or public order.

Momentum is building across the other airports.
At the same time, the balanced approach study for Paris-Charles-de-Gaulle, also launched in June 2023, is underway. At the end of 2024, the Prefect of Val-d'Oise chaired a plenary meeting at which he presented the initial stages of the study, and announced the launch of an electronic public consultation on the Ministry's website for a period of two months until the 14th of March of 2025. The purpose of this consultation is to foster draw up operating restriction scenarios that will then be studied.

The departmental prefects presented the outcomes of the studies of Bordeaux-Mérignac, Toulouse-Blagnac and Lille-Lesquin airports during 2024 and early 2025. On the basis of these outcomes, the competent ministers for civil aviation and the environment may introduce new operating restrictions for these airports. Draft ministerial orders likely to introduce restrictions for these airports that will have to be submitted for public consultation and to the CCE of the airport concerned, and the ACNUSA.

The balanced approach studies carried out in 2024 present a major step forward in improving the way in which public health issues are taken into account for people living near airports. By seeking to reconcile environmental imperatives with the economic activity of air transport, which is necessary for the economic development of the regions, these measures should make it possible to guarantee a sustainable and united balance.

Limiting noise pollution **in general aviation**

Fleet improvement
In 2024, ongoing improvements were made to light aviation fleets in various ways.
The DGAC maintained its annual support fund of €30k to improve the acoustic performance of the noisiest aircraft by supporting the installation of propellers or silencers. This equipment makes it possible to move up one or two CALIPSO classes. In addition, the Ile-de-France region and ADP have jointly made available an exceptional budget of €500k to improve the acoustic performance of the region's light aviation fleets, covering in particular 25 aircraft based at Lognes.
The DGAC continued its support for the development of electric light aviation, with the backing of the FFA (€83k allocated). At the Aix-les Milles airfield, 4 Virus SW121s and 3 Velis Electro are now in operation, having logged a total of 2,250 flight hours by 2024.
The fleet of internal combustion-powered aircraft is gradually being replaced with quieter (CALIPSO A or A+) and more fuel-efficient aircraft. Examples include the arrival of 2 Bristell B23s and the order for 4 Elixirs for the Paris-Saclay-Versailles airfield, and the order for 2 DA 42s for the Aix-les-Milles airfield.
At the same time, flying clubs and schools are equipping themselves with simulators, reducing the number of hours flown.
Lastly, access to unleaded fuel is gradually being developed (with supplies to Lognes and Paris-Saclay-Versailles in 2024), encouraging the deployment of more environmentally-friendly aircraft powered by rotax engines.

The KRISTAL Challenge Tour de Piste LFPN 2024
The 'KRISTAL Challenge Tour de Piste LFPN 2024' was set up in 2024 at the Paris-Saclay-Versailles airflied in order to improve observation of runway laps. It's a fun challenge that rewards pilots with prizes for sticking as closely as possible to the published trajectories. The GPS system makes it possible to check accuracy. This competition is open to everyone, from school pilots who do laps to private pilots. It is managed by Kristal Aéro, which should be organizing other competitions of this type in 2025 at the Paris-Saclay-Versailles airfield and other airfields in the Ile-de-France region.

A concern shared by ENAC
The ENAC has implemented several measures to reduce noise levels during its flight training courses.
For ground operations, the departure briefing is now carried out with the engine off before take-off, and the flight plan is also entered before take-off, to minimize the time spent with the engine running on the ground. Next, the low-noise take-off procedure is applied to the Be58, one of the noisiest models in the school's fleet.
Once the aircraft is airborne, the long-range procedure must be applied to TB-20s and Be58s, outside training flights. This reduces fuel consumption during cruise.
Finally, use of the VELIS electric aircraft is mandatory for the first 10 hours of "airline pilot" training. This will save 33 t of CO_2 in 2023 and 25 t in 2024.

Helicopter noise abatement guide in DSAC OI
On Reunion Island, noise pollution generated by helicopter overflights is the subject of numerous complaints.
With the support of Airbus Helicopters under the DGAC MOTUS project and DSAC inspector pilots, DSAC-OI has drawn up a "less noise" piloting guide[9] for helicopter pilots (instructors, professionals and private pilots).
It details the measures to be taken to reduce nuisance for the populations overflown, for each phase of flight: flight preparation, ground operations and hovering, climb phases, overflight, approach and landing.
The guide describes the specific role of terrain in noise propagation, but also identifies a number of general recommendations, such as :
- Climbing as quickly as possible on take-off;
- Avoiding S-shaped trajectories on overflight;
- Maximizing descent rate on approach.

A new effort for the airport residents financial aid scheme for soundproofing
The TNSA (tax on air transport noise pollution), supported by the airlines in accordance with the "polluter-pays" principle, finances the soundproofing policy for local residents living in the vicinity of France's 11 principal airports[10].
To make the current scheme more attractive and reduce the remaining costs by local residents, the flat-rate ceilings on the amounts allocated for soundproofing work were raised by 25% at the start of 2024[11].
This increase in ceilings has been coupled with a differentiated increase in TNSA tariffs of 11% on average over a full year, to offset the mechanical rise in the average cost of the insulation work.
The aerodromes targeted are those with the greatest financing needs : Bordeaux-Mérignac (due to the recent revision of its noise pollution plan), Lille-Lesquin (in order to have sufficient resources before it leaves the scheme at the end of 2024), Nantes-Atlantique, Paris-Charles-de-Gaulle and Paris-Le Bourget.

9. https://www.ecologie.gouv.fr/sites/default/files/documents/241209_Guide_bruit_helico_DSAC-OI.pdf
10. Beauvais-Tillé, Bordeaux-Mérignac, Lille-Lesquin, Lyon-Saint-Exupéry, Marseille-Provence, Nantes-Atlantique, Nice-Côte d'Azur, Paris-Charles-de-Gaulle, Paris-Le Bourget, Paris-Orly et Toulouse-Blagnac. Due to its binational status, Basel-Mulhouse Airport is financed through a specific non-tax revenue source, distinct from the Noise Pollution Tax (TNSA).
11. Environmental report 2023 (Cf p.23).

Developments in CALIPSO, the classification of light aircraft according to their noise performance index

CALIPSO is a French classification system that complements the acoustic certification of light aircraft. It estimates the level of noise they produce during circuits based on measurements taken in actual flight situations.

In 2024, the DGAC implemented a major change to the CALIPSO system with the publication of the new Order of the 17th of July of 2024 classifying light aircraft according to their noise performance index. This order repealed and replaced the order of 11 June 2013 which had introduced this classification.

In practice, a new 'A+' class was created in order to differentiate more precisely between the least noisy aircraft on the runway, by adding a new Performance Index (PI) threshold of 90. In addition to the creation of this new class, the responsibilities of the pilot and the measurement laboratory specified in order to carry out again the measurement of light kit aircraft (CNSK) or amateur-built aircraft (CNRA). Finally, the meteorological conditions valid for measurements have been extended, based on the corrections defined by the ICAO. These changes should enable more aircraft to be measured each year.

As soon as the new order was published, aircraft already classified with a PI of over 90 were able to receive an A+ classification certificate. This change has also enabled around thirty applications for CNSK and CNRA aircraft to be released from the queue; the complete files have now been sent to the DGAC's STAC noise measurement laboratory. More generally, in 2024, 123 new aircraft obtained a CALIPSO classification, including 15 aircraft measured at 5 sites across France. In addition, these CALIPSO campaigns were an opportunity for the STAC to carry out 6 noise certification measurements for new aircraft in accordance with the ICAO Annex 16 protocol.

Today, the CALIPSO protocol is used at various aerodromes to objectivise aircraft noise and thus promote dialogue between users and local residents. Operating decrees or local charters have already been put in place to regulate runway traffic at certain times of the year and during certain periods, based on the CALIPSO classification. This trend is continuing, and new agreements of this type are already being prepared, generating new requests for classification.

CALIPSO website: https://calipso.dta.aviation-civile.gouv.fr/application-externe/

CALIPSO measurement campaign. © Denis Weber/DGAC/STAC

CALIPSO breakdown by acoustic class

Répartition des classements sur les plus de 1500 avions classés en février 2025

Air trajectories, **another lever for reducing environmental pollution**

Changes to DSAC SO flight paths
On the 17th of October of 2024, the "Air Navigation Service West (SNA O)" presented an initial feedback report to the Technical Commission of the French Air Nuisance Authority (ACNUSA) following the implementation of RNP AR and RNP VPT procedures on runway 05 at Bordeaux-Mérignac airport.

These procedures came into effect on the 25th of January of 2024. For the record, the environmental benefits were assessed in the corresponding Air Traffic Impact Assessment (ATIS). In terms of visual impact, the new procedures introduce a third concentrated flow of trajectories. The impact on the population is low, as the areas overflown are very sparsely populated. The noise impact on the population is also low: the main changes compared with the status quo situation are observed with a reduction, albeit small, in the populations impacted in the communes of Audenge and Lanton. The main environmental gains are in fuel consumption and gas emissions: thanks to the introduction of RNP-AR and RNP-VPT procedures, trajectories are shorter and descent profiles smoother than with GNSS procedures. The use of this procedure makes it possible to consider the following gains:

- an annual reduction in fuel consumption of 44 tonnes, which is equivalent to approximately the fuel consumption of 6 round trips by an A320 aircraft between Bordeaux and Paris. This reduction in consumption is mainly due to the transfer of half of the traffic from the GNSS status quo (42% of arrivals north of runway 05, i.e. 959 flights a year) to the RNP AR and RNP VPT procedures, which are shorter in terms of distance travelled and have a smoother profile.

- an annual reduction in CO2 emissions of 135 tonnes ;

- an annual reduction in NOx emissions below 3,000 ft of 221 kg.

Progress on the Orly PBN to ILS project
In 2025, the PBN to ILS procedure is due to be introduced at Orly. A public enquiry was held in 2024, followed by a favourable opinion from the ACNUSA and from the Airport Environmental Committee in early 2025. The procedure makes it possible to produce lateral separation between flights, regardless of altitude. It is therefore no longer necessary to force flights to level off in order to separate them. Continuous descents become possible even under dense traffic conditions. The aim of these descents is to reduce the length of approach stops as much as possible. This allows aircraft to be at reduced power for as long as possible during the descent, which results in lower fuel consumption. It also increases the average altitudes of flights, which, combined with the reduced engine power, reduces noise pollution for the populations overflown. Finally, this procedure reduces the dispersion of trajectories and therefore the number of people overflown.

2024, a year of transition for ACNUSA

The Airport Nuisance Control Authority (ACNUSA) is an independent administrative authority created by law no. 99-588 of 12 July 1999 to ensure the sustainable development of airport activity.

Working alongside the French government and the air transport stakeholders, it contributes to the fight against airport nuisance by issuing recommendations on any issue relating to environmental nuisance (noise or atmospheric emissions) caused by air transport on and around French civil airports. It ensures that the public is properly informed, so that information on noise resulting from aviation activity in the general sense is objective, and that public action is transparent.

It also provides input to the civil aviation authorities when it is consulted on draft noise nuisance plans and noise exposure plans for the main France airfields and, more generally, on any draft regulatory text setting out, for the aerodromes concerned, measures to ensure the protection of their environment.

Since 2009, the Authority has also been responsible for imposing penalties on legal entities and individuals who fail to comply with the environmental regulations in force at French airports. In 2023,ACNUSA issued 637 fines for a total amount of €11.7 million, which was allocated to the general state budget.

In 2024, half of the Authority's ten members were replaced.

In this regard, o, Pierre Monzani, a former prefect, succeeded Mr. Gilles Leblanc as president of the Authority on the 3rd of January of 2025, after an eight-month vacancy in the post.

This appointment is an opportunity for the new president to support ACNUSA in its role as an independent and impartial authority, to ensure that airport pollution is kept under control and that quality dialogue is maintained between the stakeholders.

To support him in this demanding mission, Mr Monzani can count on the expertise of seven members of the “college” appointed for their skills in acoustics, noise pollution, atmospheric emissions, the impact of airport activity on the environment, health, aeronautics and air transport.

Pierre Monzani,
ACNUSA President

4 — Air, water and soil quality

Wetland area at Bastia Airport. © Aérobioidversité

Preserving the quality of air, water and soil is a major issue at airfields. Airport operators are taking decisive action to significantly reduce the impact of the aviation sector on health and the environment. At the same time, new European standards, setting limits on the concentration of pollutants or restricting the use of certain chemicals, mark a significant step forward in the fight against various forms of pollution.

300

CHECKS ON APU (AUXILIARY POWER UNIT) operating times carried out by the Gendarmerie des transports aériens (GTA) in 2024

15,9 millions

OF RAINWATER TREATED AT PARIS-CHARLES DE GAULLE AND PARIS ORLY AIRPORTS using efficient on-site pollution control and treatment systems

An update on the use **of APUs**

One year after the publication of the decrees restricting the use of Auxiliary Power Units (APUs), what has been achieved?
In order to reduce emissions of atmospheric pollutants, since the 1st of December of 2023 decrees restricting the use of aircraft APUs during stopovers at the 12 main French airports have been published. In conjunction with the Gendarmerie des transports aériens (GTA), the Direction de la sécurité de l'aviation civile (DSAC) has drawn up an operational procedure to ensure harmonised monitoring of this type of infringement. After communicating with airport operators, airlines and ground handling staff and updating aeronautical information, the GTA carried out an unannounced inspection phase to raise awareness of the new restrictions. Surveillance was then undertaken on all the platforms concerned according to a control plan defined on the basis of their traffic levels. In 2024, 180 inspections were carried out at Paris-Charles de Gaulle and 120 at Paris-Orly and Nice. A total of around thirty breaches were identified. These will be submitted to the ACNUSA plenary session in the first half of 2025. As a reminder, the ACNUSA can issue a penalty of up to 20,000 euros in the event of an infringement.

Thermal camera tests continue in Toulouse
The APU is a turbojet engine located at the rear of the aircraft fuselage which supplies electricity and air conditioning, to start the engines when the aircraft is on the ground. Significant energy savings can be made by using alternative means, such as powering the aircraft with 400Hz or with mobile or fixed alternative means.
As part of an experiment, the DGAC's Civil Aviation Technical Service (STAC) is conducting a measurement campaign at Toulouse Blagnac airport in 2023 and 2024 to evaluate the use of thermal cameras to monitor the time spent by APUs on the ground. These initial measurements, carried out on most of the aircraft models present on the platform on a daily basis and in different spatial and meteorological configurations, are rather encouraging regarding the technical feasibility of using thermal cameras to monitor APUs on the ground. The tests demonstrated the reliability of the thermal cameras and their ability to detect temperature changes on the different aircraft models present at the airport, whatever the weather. In 2025, the experiment will continue at Toulouse Blagnac airport with tests to automate processing using fixed cameras.

Thermal camera testing by STAC at Toulouse-Blagnac Airport.
© Maxandre Coulon/DGAC-STAC

Additional experiments at Nice
In 2024, Nice airport experimented with a system for monitoring the use of APUs by installing cameras and using multispectral imaging (visible and infrared). This system, developed by WaltR, enables automated and systematic measurement of APU usage time and associated emissions, as well as real-time transmission of data to a mobile application. One of the cameras has been installed on top of a lamppost, enabling several parking stands to be monitored simultaneously. Following a successful trial,the airport has decided to gradually roll out the monitoring system, with a target of 17 monitored stands by 2025.

Testing of the multispectral imaging system with cameras from the company WaltR in Nice. Location of the APUs and the camera, focus on the camera installed high and at a distance below. © DR

Improving air quality

Europe adopts new air quality rules
The revised Air Quality Directive (2024/2881 of 23/10/2024) sets new air quality objectives that are significantly more protective of people, to be achieved by 2030, and provides for alignment by 2050 with the latest recommendations published in 2021 by the World Health Organisation (WHO). These new standards include limit values for pollutant concentrations to be achieved by 1st January 2030, such as : an annual limit value for fine particles with a diameter of less than 2.5 µm (PM2.5) of 10 µg/m³ (compared with 25 µg/m³ in Directive 2008/50/EC); a limit value for fine particles with a diameter of less than 10 µm (PM10) of 20 µg/m³ (compared with 40 µg/m³ in directive 2008/50/EC); a limit value for nitrogen dioxide of 20 µg/m³ (compared with 40 µg/m³ in Directive 2008/50/EC).

The revision of the Directive also merges the two directives on ambient air quality (Directive 2008/50/EC and Directive 2004/107/EC) into a single European legislative text. Member States have two years from the date of entry into force of the Directive to transpose it into national law. They are expected to take strong action to keep concentrations below the new air quality standards. Under certain conditions specified in the Directive, Member States will be able to ask the Commission to postpone the 2030 deadline for achieving the limit values for particulate matter (PM10 and PM2.5), nitrogen dioxide, benzene and/or benzo(a)pyrene.

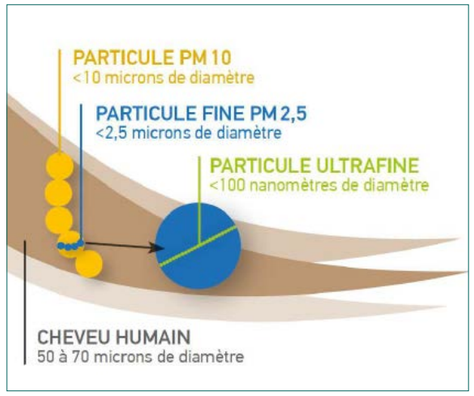
Conclusion of the study on ultrafine particles (UFP) around Nantes-Atlantique airport
The 4-year study on air quality in the vicinity of Nantes-Atlantique airport, carried out by Air Pays de la Loire, an approved air quality monitoring association (AASQA), responded to a concern expressed by local residents.It aimed to assess concentrations of ultrafine particles (UFP) near the airport and in the urban area of Nantes, and to study the influence of air traffic on concentration levels. Several reports were published by the association. The study continued until the beginning of 2024 so as to analyse, in a post-covid context, the influence of the resumption of air traffic on PUF concentrations. The final report confirms the influence of air traffic

©Getty Images

on ultrafine particle concentrations between 500 m and 3.5 km along the airport runway. This influence diminishes with distance from the airport runway. The extension of the measurement campaigns showed that the increase in air traffic is not correlated with the amplitude of the elevations measured: no accumulation phenomenon was observed. It also confirmed the influence of meteorological conditions on the concentration levels observed from one year to the next.

Strengthening mobility plans in and around Paris airports

The aim of these mobility plans is to reduce the impact of road travel by passengers and employees on air pollution. In 2024, the connectivity of the Orly hub was greatly improved by the extension of line 14 to the south of Paris, linking central Paris to the airport in 25 minutes. In addition, the membership of the main companies located in and around the CDG and Orly airports to the CDG-Pro-Mobilité and Orly-Pro-Mobilité associations means that an inter-company mobility plan can be implemented, providing stronger incentives for car-pooling, car-sharing and the use of bicycles in conjunction with the development of the cycle path network.



Stepping up monitoring of the presence of PFAS in soils and aquatic environments

Faced with growing concerns about the impact on human health and ecosystems of per- and poly-fluoroalkylated substances (PFAS), commonly referred to as 'eternal pollutants' because of their persistence in the environment, efforts are being stepped up to diagnose any pollution at airports. Used for their many properties (non-stick, fire-retardant, waterproofing, heat-resistant), these chemical substances are found in certain aircraft components and mainly in the fire-fighting foams used by the Aircraft Rescue and Firefighting Service (SSLIA).

Firefighter from SSLIA in action at Tahiti-Faa'a airport.
© DGAC - SEAC Polynésie française

In recent years, the European Union has stepped up measures to reduce the risks associated with exposure to PFAS under the European REACH (Registration, Evaluation, Authorization CHemicals) Regulation. In addition to the ban on PFOAs from the 4th of July of 2025[15] (Regulation no. 2019/1021), PFHxAs and their derivatives, another PFAS subgroup, will be banned from 10 October 2029 for use in fire-fighting foams intended for civil aviation (Regulation no. 2024/2462). A proposal for a general restriction on all PFAS in fire-fighting foams, submitted by the European Commission at the end of 2023, is also being considered by the expert committees of the European Chemicals Agency (ECHA). As a result of the development of alternatives, the vast majority of French airports now use fire-fighting foams without PFAS, and tests and training are mainly carried out with water. The DGAC's Civil Aviation Technical Service (STAC) is finalising the drafting of a technical guide to support the transition of all airport platforms to the use of these products, which are more respectful of health and the environment without compromising safety.

At national level, the approach was structured by the 2023-2027 ministerial action plan of the Ministry for Ecological Transition (MTE), supplemented by the interministerial action plan published in April 2024. The DGAC, which is a member of the steering committee (COPIL) and technical committee (COTECH) for this plan, is firmly committed to implementing action no. 7: inventory, identify, prioritise and diagnose sites potentially polluted with PFAS due to the use of fire-fighting foams in order to target groundwater monitoring, in particular water intended for human consumption', alongside the General Directorate for Risk Prevention (DGPR), the General Directorate for Civil Security and Crisis Management (DGSCGC), the Ministry of the Armed Forces and the French Geological and Mining Research Bureau (BRGM).

Within this framework, the BRGM has developed a methodology for prioritising airport platforms, in order to propose to the DGAC a list of priority sites to be subjected to diagnostics, with the implementation of investigations mainly of soil and groundwater, and in particular the monitoring of the quality of water intended for human consumption (EDCH). The DGAC is also involved in action 16 of the interministerial plan to 'regulate and reduce the release of PFAS into the environment'. To this end, with the help of the STAC, it has identified the volume of products containing PFAS in airports (emulsifiers carried in response vehicles or stored in tanks, rinsing water, residues from SSLIA training) and took part in a campaign to take samples of emulsifiers in order to better characterise the types of PFAS present in fire-fighting foams.

15. Date probably postponed to December 3, 2025.

Water depollution at airports

Rainwater treatment at ADP
While wastewater is simply monitored (pollutant levels measured) before being sent to treatment systems via the public sewage network, airports have to clean up rainwater, which is laden with dust, hydrocarbons, tyre residues or winter de-icing agents as it runs off. Rainwater must therefore be collected and treated in rainwater treatment systems (STEP). The rainwater passes from one depollution basin to another (screening basins to filter out bulky objects, flotation and flocculation basins to isolate certain solid pollutant particles, settling basins), depending on the type of pollutant, with a system of valves regulating the quantities transferred to avoid blockages.

At CDG and Orly, the stakes are high, given the volume of water to be treated. As a result, the entire system is controlled by a real-time, continuous, 24-hour monitoring and measurement system. At CDG, a continuous "dynamic management" system was set up, based on an actual "water control tower". At Orly, a plant-based treatment system (a 6,500m2 filtering marsh planted with reeds) complements the STEP.

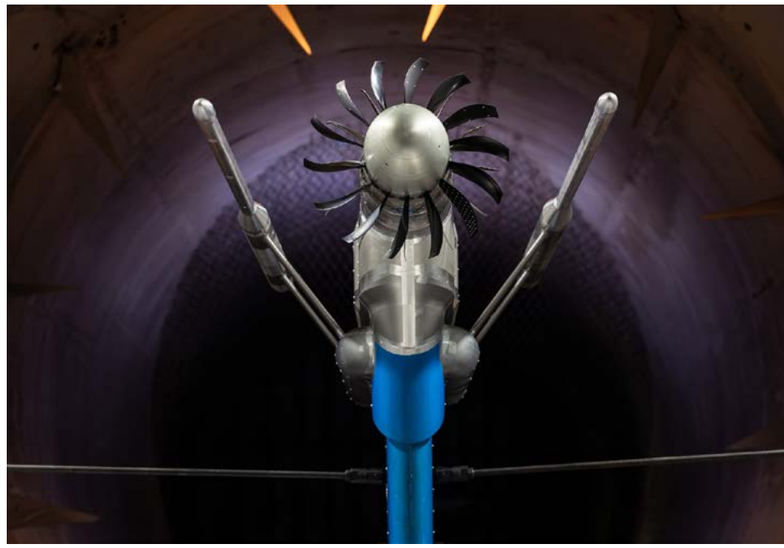
Some of this purified rainwater is recycled at Orly in 3 forms: cleaning exterior and interior surfaces, producing chilled water for air-conditioning (some of which requires tap water) and sanitary facilities (toilet flushes supplied 100% by purified rainwater). The next step will be to reuse it for washing buses and runway equipment, or even to sell the surplus treated water to other companies.

In the long term, studies are underway to enable ADP to "return (part of) this depolluted water to nature", in order to compensate for the impermeabilisation of soils inherent to any airport: when leaving the STEP, part of the water could then reach the water table, thus improving soil quality, biodiversity and combating the risk of drought.
Volume of rainwater treated:
- at CDG: 8.5 million m3 (for 2.7 million m3 of wastewater)
- at Orly: 7.4 million m3 (for 0.9 million m3 of wastewater)

Hydrocarbon separators to prevent hydrocarbon discharges
An increasing number of airfields are also equipped with hydrocarbon separators at their fuel stations. The purpose of this installation is to recover any fuel that may spill onto the ground during refuelling operations. This system is located upstream of the sewage system and enables water to be discharged with an extremely low residual hydrocarbon content. Hydrocarbons and water are separated by gravity: hydrocarbons with a density close to 0.85 rise to the surface and are recovered, before being transferred to a suitable treatment area.

Filtering marshes for winterizing products (glycol), Stormwater treatment system (STP) at Orly. © Zoo studio/ADP

5 — Innovations



The Open Rotor, currently undergoing validation, is a disruptive propulsion architecture aiming for more efficient aviation. This ECOENGInE project (see pages 46 and 47) by Safran, supported by the DGAC and tested at ONERA in 2024, symbolizes the industry's commitment to mastering major technological challenges in aerodynamics and acoustics—crucial steps toward more sustainable propulsion. © Safran

The multi-year funding trajectory announced in July 2023 in support of the Civil Aviation Research Council (CORAC) roadmap ensures continuity in the momentum initiated by the French Recovery Plan and then France 2030. In 2024, a €286 million budget - still managed by the French Civil Aviation Authority (DGAC)- has enabled the continuation of R&D efforts across the sector, with a strong focus on enhancing the competitiveness and environmental performance of the next generation of aircraft.

373
COLLABORATIVE PROJECTS SUPPORTED BY THE DGAC SINCE 2020, involving more than 329 companies and public bodies as direct beneficiaries.

286 M€
SUPPORT FOR THE INDUSTRY IN 2024.

Wind tunnel testing for commercial aviation

Launch of wind tunnel testing of the ECOENGInE demonstrator: a key milestone in the development of the Open Fan engine

The year 2024 marked a breakthrough in the field of aeronautical propulsion, with the start of wind tunnel testing of the ECOENGInE, a reduced-scale demonstrator of the future Open Fan engine (non-ducted fan). These tests, conducted by Safran Aircraft Engines and ONERA (the French Aerospace Lab), were carried out in the S1MA wind tunnel at Modane, the world's largest transonic wind tunnel.

With a total duration of 200 hours, this initial test campaign aims to comprehensively assess the performance of the Fan module by simulating real flight conditions (with speeds reaching Mach 0.8). By subjecting the fan blades to extreme stresses, these tests will validate their design, study their mechanical and vibratory behaviors, and quantify the noise level generated. The experimental data collected will be used to refine the design of the Open Fan engine and ensure its energy and acoustic efficiency.

The Open Fan engine, a cornerstone of the RISE program, is designed to significantly reduce the aviation's environmental footprint, with over 20% lower fuel consumption and up to 80% reduction in CO2 emissions thanks to sustainable aviation fuels.

These tests represent a crucial step towards more environmentally-friendly commercial aircraft engines. Safran aims to demonstrate the effectiveness of this ultra-high bypass ratio architecture, with a non-ducted variable-pitch fan, to power the next generation of low environmental impact aircraft.

Launched in 2021 and supported by the French Civil Aviation Authority (DGAC) as part of the France Relance and NextGenEU plans, the ECOENGInE research program will continue in 2026.

The Modane wind tunnel in operation. © Safran

ONERA's S1MA wind tunnel: an ecological laboratory at the heart of innovation

ONERA's S1MA wind tunnel at Modane-Avrieux (Savoie) plays a crucial role in efforts to decarbonize civil aviation. This unique facility makes a significant contribution to this objective, thanks to its outstanding technical capabilities.

How a wind tunnel works

A wind tunnel allows researchers to recreate aircraft flight conditions in a controlled laboratory environment. Thanks to a model and precise control of the airflow, it is possible to measure aerodynamic forces and study the influence of various parameters (speed, angle of attack). These data are essential for optimizing aircraft design and improving overall performance.

S1MA, atruly unique infrastructure worldwide

With its impressive dimensions – a test section of 14 meters long and 8 meters of diameter- S1MA is the largest transonic wind tunnel in the world. It can accommodate large-scale aircraft models (up to 3.5 meters wingspan) and test them at supersonic speeds, making it a unique tool for studing complex aerodynamic phenomena.

S1MA can reach the speed of sound (Mach 1, i.e. 1200 km/h) and, thanks to its 24-meter-diameter tunnel, generates an exceptional airflow of 10 tons per second. Its acceleration capacity is equally remarkable, going from Mach 0 to Mach 0.8 in just 3 minutes.

By simulating real flight conditions with extraordinary precision, the S1MA I enables the evaluation of the aerodynamic efficiency of the most innovative concepts, such as the Open Fan engine, ultra-high aspect ratio wings and flattened fuselages.

ONERA's expertise also extends to the design of high-precision measurement instruments. Its custom-built balances are renowned for their accuracy and ability to withstand extreme mechanical stress, ensuring reliable data for every project.

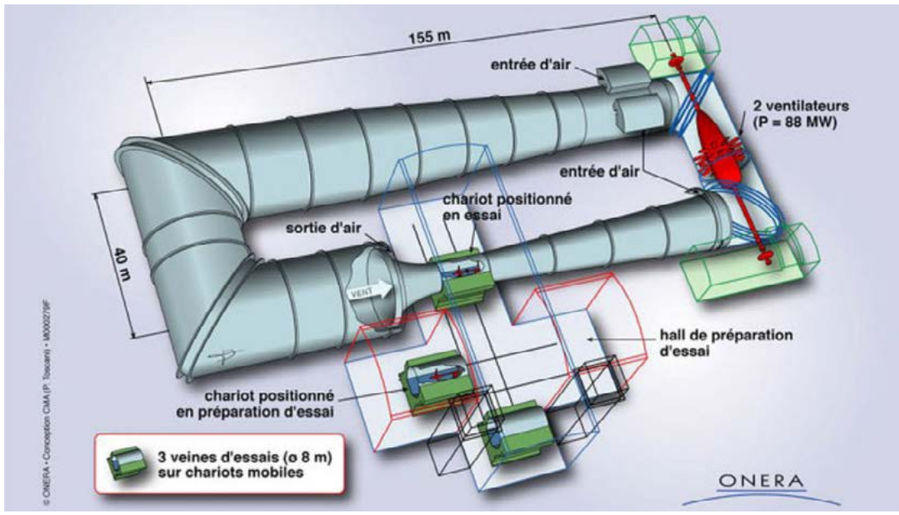
Beyond it's technical performance, S1MA stands out for its particularly environmentally friendly operation. A legacy of the World War II, the facility is powered by hydroelectric energy from nearby dam reservoirs in the valley, significantly s reducing its carbon footprint.

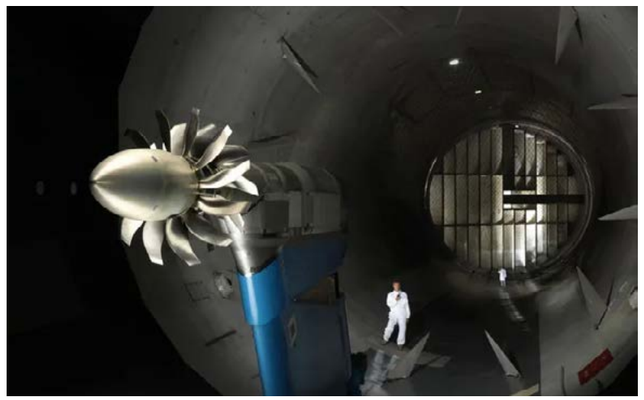
Wind tunnel testing and numerical calculation: a vital duo for models validation and designs optimization

Although numerical calculation is essential for aerodynamic design and optimization, wind tunnel testing remains indispensable -especially for breakthrough technologies like the Open Fan engine. These tests are crucial for validating computational models and investigating complex phenomena, such as low-speed configurations, engine-aircraft interactions, and behavior under extreme conditions.

Despite continuous advancements in simulation capabilities, wind tunnels remain gold standard in aerodynamic research. Their synergy with increasingly powerful digital tools opens new avenues for optimizing designs and reduction development costs. Together they form a complementary and robust approach to shaping the future of aviation innovation.

Operation of Modane's S1 wind tunnel





Wind tunnel test. © Onera

Sustainable Aviation Fuels: **Promising preliminary results from the VOLCAN project**

Launched in 2020, the VOLCAN (Vol avec Carburant Alternatif Nouveau) project, supported by the French government's Investment program for the future (PIA), has produced highly promising preliminary results for the development of sustainable aviation fuels (SAF).

Led by Airbus, in collaboration with Safran, Dassault Aviation and ONERA, the aim of the project was to validate the compatibility of SAF with the entire aircraft system – including engines, pumps, valves and seals- on commercial airlines. It also contributes to assessing the environmental footprint of these fuels by analyzing their pollutant emissions and their impact on the formation of condensation trails (contrails).

To carry out this project, 21 test flights were conducted using A319neo and A321neo aircraft powered by CFM LEAP-1A engines. Thirteen of these flights were specifically designed to study contrails formation. The tests involved four types of fuel, including JET A-1 and HEFA blends derived from used cooking oil and other waste fats, with varying aromatic content.

During the tests, a Dassault Falcon 20E aircraft operated by the German Aerospace Centre (DLR) flew less than 100 meters behind the Airbus aircraft to collect emissions data for detailed analysis. This data is being processed to quantify the potential benefits of using 100% unblended SAF compared to traditional jet fuel.

Wind tunnel test. © DLR aviation

Initial findings suggest that using 100% SAF lead to a significant reduction in non-volatile particulate matter (nvPM) emissions from the LEAP engine. Airbus plans to conduct further testing to better understand the mechanisms behind ice crystals formation, which contributes to contrails development.

The flights also confirmed the full compatibility of 100% SAF with all aircraft systems, from engines to the most sensitive components. These positive results strengthen the case for certifying the use of pure SAF in commercial aviation.

Building on the insights gained from VOLCAN, the DECARBJ project was launched in 2024 to gather additional data and anticipate necessary design and maintenance adaptations for regular 100% SAF use. Supported by the DGAC, this initiative involves Dassault Aviation, Safran Power Units, Safran Aerosystems, ONERA, IFP Énergies nouvelles (IFPEN) and TotalEnergies. It also aims to assess the full environmental impact of SAF beyond reducing CO_2 emissions. Flight tests on a Falcon 6X were carried out between July and October 2024, with results expected in 2026.

These projects are part of the broader CORAC and industry objective to certify aircraft for 100% SAF use by 2030. The ongoing research is essential to understand how SAF affect aircraft performance and their overall environmental impact.

Hydrogen propulsion system for commercial aviation reaches major milestone

After months of intensive development, Airbus has reached a major milestone in the development of its hydrogen aircraft with the successful testing of the Iron Pod.
On the 16th of January of 2024, Airbus announced that it had powered up this hydrogen propulsion system designed for future hydrogen-powered commercial aircraft. The Iron Pod, which combines a hydrogen fuel cell with electric motors and control units, reached full power during testing- demonstrating its capacity to generate the energy needed to propel an aircraft.
The Iron Pod integrates several key technological innovations for hydrogen-powered flight:

- hydrogen fuel cell system: the Iron Pod houses a fuel cell capable of generating 1.2 megawatts of power, representing a significant advance in power output for an aeronautical application;
- integrated electric motors: the nacelle includes electric motors specially designed to drive a propeller, powered by electricity from the fuel cell;
- advanced control units: the system features sophisticated control units to manage and regulate the entire propulsion system;
- innovative cooling system: A dedicated cooling system ensures optimal operating temperatures, which is critical for efficiency and durability.

Airbus hydrogen aircraft concept, featuring a six-nacelle configuration. © Airbus

A key innovation lies in the architecture that integrates all these components - fuel cell, electric motors, control systems and cooling – into a single,compact nacelle, optimized for aviation l use.
Together, these advances enable the Iron Pod to function as a complete, self-contained propulsion system, showing a crucial step toward hydrogen-powered commercial aircraft by 2035.
The next steps will focus on optimizing the system's size, weight and compliance with aviation standards, followed by more extensive ground testing. Flight tests are scheduled for 2028 aboard a modified A380, equipped with liquid hydrogen tanks to supply the fuel cell.
The DGAC has played a key role in supporting these innovations by funding several research projects focusing on developing the technological modules that make up the Iron Pod. This support is in line with CORAC's broader goal of accelerating aviation's environmental transition .
This technological demonstration highlights Airbus's significant progress in hydrogen propulsion and offers a promising path toward zero-emissions aviation.

Innovations **for light aviation**

BANKSIA: Designing a compact flight recorder for light aircraft to enhance aviation safety
The BANKSIA project, led by SERMA INGENIERIE and FREYSSINET AEROEQUIPMENT, has been supported since 2020 by the aeronautical R&D part of the DGAC's Stimulus Plan. The aim of this project is to design a flight recorder for light aircraft - LFR (Lightweight Flight Recorder).

Since 2010, accidents and serious incidents occurring on the territory of a Member State of the European Union Aviation Safety Agency (EASA) must be subject to a safety investigation. However, until the publication of Commission Regulation (EU) 2019/1387, light aircraft and light helicopters were not required to carry flight recorders – despite their critical role in reconstructing the sequence of events leading to an incident. To date, no off-the-shelf solution exists for current and emerging aircraft manufacturers focused on low-impact air mobility.

To address this safety gap, BANKSIA brings two innovative SMEs, working in close collaboration with Airbus Helicopters to develop a fully integrated solution capable of recording flight parameters, 4K video and audio in a hardened memory unit. The system's electronics and memory access have been optimized to minimize heat dissipation and achieve the most compact design possible. Its reinforced casing, produced using additive manufacturing, significantly reduces both volume and weight by optimizing raw materials.

Thanks to advanced multi-physics modelling, the project successfully converged on a design that passed the ED –155 "Crash Survival Test" requirements – including impact, crush, and fire resistance - on the first attempt. The project was honored at the sixteenth edition of the "Assises de l'Embarqué" held on the 11th of January of 2024 at the French Ministry of the Economy and Finance, where SERMA Ingénierie received the Embedded Critical Systems Award for its work on BANKSIA.

In addition to financial support from the DGAC, the project benefited from the expertise of the BEA (Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile) to validate audio recordings quality, and support from the DSAC (French Civil Aviation Safety Directorate) for certification preparation.

TRAMPOLINE 2 : Lighter aerostructures: a key lever for decarbonizing general aviation
By replacing traditional materials with thermoplastic composites and adopting induction welding, the TRAMPOLINE 2 project (TheRmoplAstic coMPosite for hOrizontal tall plaNE), supported by the DGAC as part of the France Relance plan and Next GEN EU, piloted by Daher, is opening new horizons in the field of lighter aerostructures.

A central innovation of this project is the introduction of thermoplastic induction welding as an alternative to conventional riveting. This welding technique enables a significant 15% weight reduction compared to traditional assembly methods. Induction welding works by heating and fusing the interface of components using an electromagnetic field. This not only reduces the weight of horizontal stabilizers by 15%,but also enhances aircraft durability thanks to recyclability and repairability of the materials used.

Moreover, the use of thermoplastics allows for greater automation in the manufacturing processes, leading to more efficient and less energy-intensive production.These advances represent a major step forward in the development of lighter, more sustainable aircraft structures, contributing directly to the decarbonization of General Aviation.

By demonstrating the benefits of thermoplastic composites and induction welding for the manufacturing of horizontal stabilizers, this project paves the way for a new generation of lighter, greener and more efficient aircraft. The results of TRAMPOLINE 2 are fully in line with CORAC's objectives to decarbonize aviation by 2050.

BANKSIA project: compact and lightweight black box for helicopters. © Serma Ingéniérie

Airbus Flightlab: a hybrid helicopter flying tested to trial Airbus Helicopters innovations. © Airbus

...and also in the world **of helicopters**

HELYBRID: Airbus Helicopters and Safran 's hybrid innovation
Launched in 2020, the Helybrid project is led by Airbus Helicopters in partnership with Safran Helicopter Engines, Safran Electrical & Power and Airbus Defence and Space. It is supported by the DGAC as part of the France Relance plan and Next GEN EU. This ambitious initiative aims to radically transform propulsion systems for light helicopters by developing and validating an innovative hybrid engine power architecture through flight testing.
A hybrid helicopter combines a traditional internal combustion turbine with an electric motor. These combination targets a 40% reduction in fuel consumption, lower noise emissions, and enhanced aircraft's performance through greater operational flexibility. Hybrid propulsion could offer helicopters new capabilities, including extended range for long-duration missions and significantly reduced noise levels for urban operations .
However, integrating batteries that are both powerful and energy-dense enough to power electric motors - while keeping the aircraft's weight within acceptable limits – remains a major technical challenge.
Another key challenge is the certification of single-engine hybrid helicopters, which must meet stringent safety standards to ensure reliability and airworthiness.
Airbus Helicopters, supported by the DGAC, is playing a key role in the development of these new technologies, which will benefit the entire helicopter industry.

Terra Preta and Tarmac take up the challenge **of recycling materials and aircraft**

Terra Preta: Innovation serving the recycling of aeronautical materials
The aeronautical manufacturing industry generates large volumes of production scrap, particularly carbon-based composites that are notoriously difficult to recycle. These material losses pose an environmental challenge - but also represent an opportunity to develop more sustainable materials.

The Terra Preta project, led by Safran Seats in partnership with Airbus Operations, Aviacomp, CETIM, Daher Aerospace, Hutchinson, Hutchinson SNC, Safran Aircraft Engines, Safran Landing Systems and Safran, aims to recycle aeronautical industry waste by creating innovative composite materials.

This initiative is part of a broader circular economy approach focusing on the recovery and reuse of composite and metallic materials used in aircraft engine manufacturing. Thanks to a successful collaboration between CETIM and SOGECLAIR , the Thermosaic process has enabled the transformation of over 70 % of production scrap into new functional parts. The industrial feasibility and cost effectiveness of this technology were validated through the production of an aircraft component: a technical access hatch made from recycled composite materials.

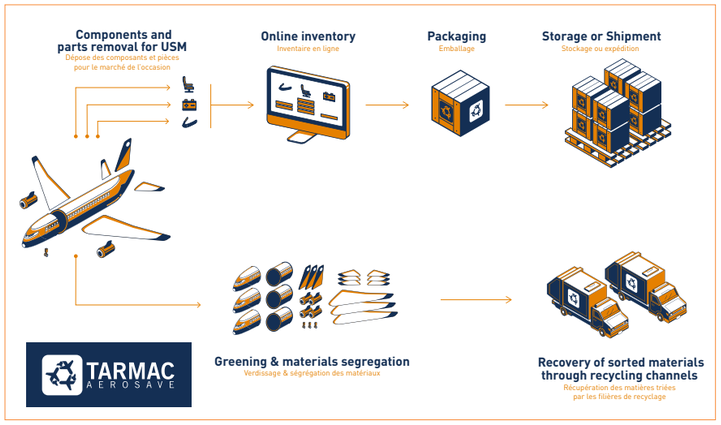
Launched in 2021, this project is supported by the DGAC as part of the France Relance plan and Next GEN EU.

Tarmac: a company that can recycle aircraft
Tarmac is a French company based in Toulouse-Francazal, Tarbes and Tarruel in Spain, in which Airbus, Safran and Suez are shareholders. Recognised by EASA for its expertise in aircraft maintenance and recycling, using environmentally-friendly processes, its recycling activity follows the following stages:

1. Removal of parts that the owner wishes to keep for the second-hand market: high-value parts such as landing gear, engines, certain avionics equipment, etc.
2. Dismantling and sorting of cabin equipment and materials: textiles, plastics, cables, etc. This stage is known as 'greening', to describe the return of the aircraft to the green colour it had when it was built, before the cabin was fitted out and painted.
3. Cutting out the wings and fuselage. The wings and fuselage are cut using a cutting gantry that is sprayed with cold water to avoid dust emissions and the risk of fire. The water needed for this spraying is recycled.
4. The sorted materials are sent for recycling.

SINCE 2019, TARMAC HAS RECYCLED
325 AIRCRAFT
AND 225 ENGINES, RECOVERING MORE THAN 90% OF THE AIRCRAFT'S WEIGHT.

Aircraft recycling process at Tarmac Aerosave



The Directorate of Air Navigation Services (DSNA) **awarded the CANSO Green ATM label**

On 13 November 2024, the DSNA was awarded the CANSO Green ATM environmental label, an internationally recognised environmental accreditation programme for air navigation service providers. This label awarded to the French air navigation service provider (ANSP) rewards the DSNA's efforts to reduce CO2 emissions, reduce noise pollution in the aviation sector and improve its energy performance, as well as integrating environmental issues into its operations to improve its overall ecological footprint. Following on from the ANSPs in Switzerland, the Netherlands, Belgium and Ireland, the French ANSP is the 5th to be awarded the label, the first on this scale and the first to cover all twenty-four subjects assessed. The DSNA has been awarded label level two out of five possible levels reflecting increasing objectives and degrees of maturity.

The process leading to the award of the label involved compiling a file of responses to all twenty-four subjects, supplemented by documentary evidence. Nearly a thousand documents, produced by nearly seventy highly committed DSNA contributors, were submitted to the independent auditors.

At the end of their evaluation, the auditors produced a full report validated by the CANSO jury. This report assessed the efforts made by the DSNA.

The auditors were particularly impressed by the DSNA's work in managing airspace changes and air traffic procedures. They underlined the efforts made by the DSNA to assess the potential impact in terms of emissions and noise pollution before modifications are made, and the quality of the dialogue with local communities on these projects. The very advanced level of Air Traffic Flow Management (universally abbreviated to ATFM) and radar coverage, as well as the DSNA's involvement in research and development, are also strong points. Areas for improvement were also identified by the auditors.

In 2024, DSNA participated in the first meeting of the Green ATM User Group. This working group aims to foster collaboration between CANSO Green ATM-certified ANSPs by sharing feedback and best practices on various thematic topics.

The working group also aims to maintain and improve the label by updating the questionnaires to strengthen their relevance and alignment with the environmental challenges of the aviation sector.

Frédéric Guignier, Director of Air Navigation Services (DSNA), receives the CANSO certification. © DR

ENAC:
Still resolutely committed to the ecological transition of aviation

Through its teaching and research missions, the French National School of Civil Aviation (ENAC) contributes to the ecological and sustainable transition of the aviation sector.

In the field of research,
in 2024, the ENAC, in association with its European academic and industrial partners, won 17 European projects to contribute to the ecological transition of air transport (for the most part within the framework of the SESAR program). These projects include:

- The GEESE project, which aims to introduce the concept of formation flight to recover wake energy and reduce the environmental impact of flight paths.

- The SMARTS project, which attempts to implement the principle of intelligent dynamic sectorisation of airspace to offer an optimal compromise between airspace capacity and environmental impact of flight paths.

In 2024, as in 2022, the ENAC was again awarded the first "outdoor" prize in the international IMAV "Micro-air vehicles" challenge aimed at optimising the environmental performance of drones in the deployment of new air transport services, such as parcel delivery. In this area, the ENAC also partnered with the French National Centre for Scientific Research (CNRS) as part of the ANR-Firefly project on the use of drone fleets to analyse the behavior of forest fires.

The ENACy is also pursuing work around:

- the analysis and simulation of ecological taxiing;

- the analysis of the impact of extreme temperatures on airports;

- the analysis of the impact of using new fuels (eg: hydrogen);

- the generation and optimal control of trajectories reducing contrails;

- formation flights;

- the identification of non-compliant and non-optimal trajectories from an environmental point of view;

- the design and evaluation of artificial intelligence-based models for decision support aimed at reducing the environmental impact of flight trajectories, taxiing, gate-to-gate routes and, more generally, all traffic and their integration into a multimodal transport system.

Finally, the ENAC's research laboratory is aiming for the DD&RS (Sustainable Development & Social Responsibility) label in 2025.

For its part, ISAE-SUPAERO has published an 'Aviation and Climate Reference Guide'. This is a general review of the current extent of understanding of the impact of aviation on the climate, as well as the scientific innovations and aeronautical techniques that are capable of reducing this impact. Its aim is to provide readers with the scientific information they need to understand aviation and climate issues.

For more informations:
https://www.isae-supaero.fr/projets/Synthese_ReferentielAviationEtClimat2021_ISAE-SUPAERO/HTML/index.html

© Richard Metzger/DGAC - STAC

Environmental and societal issues at the heart of the ENAC's training courses

For several years now, the ENAC has also been progressively strengthening its teaching on the sector's ecological and energy transition, which is now at the heart of all its training courses:

- in 2020, it set up the TETA programme (Ecological Transition of Air Transport) aimed at integrating awareness of environmental issues into all courses of study;
- since 2022, the 'Climate and Societal Issues Back-to-School' programme has been running: these are modules lasting several days, with courses and interactive workshops on these issues, offered 3 times a year. It involves more than 70 ENAC teachers and staff;
- in 2024, a general and proactive action plan has been agreed (to be applied at the start of the 2025 academic year), subdivided into 4 very comprehensive action plans (initial training, master's degrees, continuing education, and a cross-disciplinary plan) to strengthen students' skills and knowledge on environmental and societal issues, with the aim of also obtaining the DD&RS label;
- in 2024, the NoVAero chair was created: This is a course open to engineers, specifically dedicated to the environmental, energy, and societal transitions, leading to the award of a 'NovAero' certificate;
- 2024 also saw the continuation of discussions on the creation in 2026 of a new degree course for professionals in the sector, such as a specialised master's degree in "ecological transition in aeronautics", in partnership with ISAE-SUPAERO ;

Finally, in 2024, the ENAC will also be participating in the French National Research Agency's (ANR) "Skills and Professions of the Future" call for expressions of interest (AMI) on the subject of "Producing the first low-carbon aircraft", as part of a consortium of institutions. The response is expected in 2025.

6 —

Protecting and valuing biodiversity

Orly Airport. © Richard Metzger/DGAC - STAC

Biodiversity is at the heart of our societal debates, as show the voluntarist commitments made at international level at COP15, and at European and national levels through the National Biodiversity Strategy (SNB). This awareness is also growing in our airport hubs, through increasingly detailed knowledge of the ecosystems and through various actions undertaken to reconcile biodiversity and air safety.

74%

OF SNB ACTIONS STARTED IN 2024, of which 11% are ready to start, 5% are completed, 2% are blocked, 8% have no information

75

SITES SURVEYED BY THE AÉRO BIODIVERSITÉ ASSOCIATION in 2024

4 400

PLANT AND ANIMAL SPECIES and 36,000 figures inventoried on airport platforms

SNB 3: SNB 2030 celebrates its first anniversary

In 2023, France adopted its 3rd National Biodiversity Strategy (SNB). The year 2024 was an opportunity to assess the measures and actions undertaken by this strategy up to 2030. Leaders of each SNB action were subjected to a reporting exercise using a dedicated 'GRIST' tool. It aimed to report on the progress made towards achieving the targets set for each action by 2030 to the relevant bodies and stakeholders, to enable an annual assessment of the strategy, and to inform the general public . Airport biodiversity has also contributed to this reporting as it is part of two SNB measures. The DGAC took part in the reporting exercise as the leader of the action: 'Maintaining and restoring natural grasslands', promoting the deployment of the aéroBio label and the development of the Aéro Biodiversité association.

Towards a new version of the aéroBio label

In 2021, the Aéro Biodiversité association, in collaboration with the scientific committee of the Muséum National d'Histoire Naturelle (MNHN), created an 'aéroBio'[16] label to reward the work and commitment of airports pursuing a long-term approach to protecting and enhancing biodiversity. It was awarded for three years by an independent committee of the Scientific Council of the MNHN. Eight airports have been awarded the label between 2021 and 2023.

In 2024, following feedback from these first awards, the association carried out major changes to the label, mainly to refine the assessment criteria and to add two extra levels. Emerging issues such as beehives preservation and soil artificialisation have also been included in these changes.

The label is now based on four themes: 1. biodiversity, 2. staff investment, 3. communication, 4. local roots; and rewards three levels of commitment: 1. understanding biodiversity, 2. monitoring and taking better account of biodiversity, 3. integrating and promoting biodiversity.

From 2025, the label will be raised from 3 levels to 5 levels, for a duration of 5 years instead of the current 3 years. A guide will provide practical details of the various possible approaches for complying with the specifications.

16. https://aerobiodiversite.org/le-label

The four themes that make up the Aerobio label

The 'BIODIVERSITY' **seminar: a forward-looking vision**

In 2024, the seminar was held on 21st March under the title 'Biodiversity in tomorrow's airports'. It brought together more than 150 key players from the aviation sector to address the wide diversity of topics related to the biodiversity. The event was introduced by the Director General of Civil Aviation, Damien Cazé, followed by a presentation on the trajectory of the SNB. The airports of Caen-Carpiquet and Tarbes-Lourdes spoke about the issues involved in switching to a zero-phyto policy at their respective hubs. With management methods at the heart of the debate, Nice and Ajaccio airports presented the actions implemented to promote biodiversity and their importance in terms of endangered species. On this occasion, the protective measures put in place for the Corsican Helix, present at Ajaccio airport, were highlighted. This is one of the most endangered snails in Europe and is endemic to Corsica. The seminar was also dedicated to emergent and more sensitive topics,such as the debate on 'photovoltaics and biodiversity' or the new challenge of the carbon capture by airport grasslands tackled from a scientific point of view. Grasslands are net sinks of atmospheric CO_2, storing between 500 and 1,200 kgC/ha/year depending on management methods, and on average around 1,000 kgC/ha/year.

Combining biodiversity protection and safety

An airport is made up of a vast area of green spaces. These are often more or less ancient meadows, but there are also some special and original environments. These are enclosed areas, protected from many human activities for security reasons. As a result, nature is often preserved and, to a large extent, protected from urban development. Simple practices can be put in place, on a case-by-case basis, to preserve or enhance biodiversity while complying with very strict security/safety requirements. Here are a few examples: reducing and/or delaying mowing; increasing mowing heights or protecting rodent-regulating carnivores. An experiment was launched at the Perpignan airfield, where the fences were regularly damaged by small mammals. A calibrated access was created in the fence, monitored by a camera. An analysis will then be carried out to confirm the benefits of the system in terms of safety, security, and biodiversity.

Faucon crécerelle, aérodrome de Cognac. © Richard Metzger/DGAC - STAC

Morel mushroom, Semur-en-Auxois .aerodrome
© Aérobiodiversité

Cauliflower fungus, another mushroom at Semur-en-Auxois aerodrome.
© Aérobiodiversité

Fungi: learning more about ecosystems

Fungi refers to the diversity of fungal species. Often overlooked, fungi play an essential role in ecosystems. Teams from the Aéro Biodiversité association have looked into the identification of fungi in order to present some of the species in their annual report for 2024. Certain species known as 'saprophytes' can feed on dead or decomposing plant organic matter. In this way, they play an essential role as recyclers of organic matter in the ecosystem they occupy. Other species called 'mycorrhizae' participate in the underground flow of water and mineral elements between plants on the surface, thanks to the networks they develop in the soil.

STAC technical sheets: **adopting good techniques**

Initiatives to promote biodiversity have increased in recent years, including on airport platforms. Particular attention needs to be paid to some of these initiatives in order to preserve the ecosystems into which they are integrated. To this end, the Civil Aviation Technical Service (STAC) is offering a series of technical fact sheets outlining the issues for biodiversity and the best practices surrounding these initiatives.

Four fact sheets are already available on the STAC[18] website: pollinators and beehives, insect hotels, eco-grazing, and invasive alien species.

18. https://www.stac.aviation-civile.gouv.fr/fr/environnement/aeroports-et-biodiversite/fiches-techniques

GOOD TO KNOW

As far as beehives are concerned, it is necessary to plan for a density of three hives/km² and a distance of more than one kilometre between hives. The management of the platform should also be adapted, giving priority to refuge strips and areas rich in melliferous plants.

Regarding the insect hotels, in order to guarantee good installation conditions, it is worthwhile recreating natural micro-habitats, by making the management of the areas more flexible, for example by leaving low walls, trunks standing or on the ground, large branches, piles of earth, etc.

As far as eco-grazing is concerned, it seems essential to carefully determine the airport's eco-grazing sites and the appropriate animal species, as well as defining the maximum grazing load to limit pressure and fertilisation of the soil.

In regard toexotic species, it is preferable to favour local plants in the green spaces (on the city side and airside) and to be vigilant about bringing in soil from outside.

Spotlight on wetlands

Airport wetlands are also home to frogs! © Aérobiodiversité

2024 was marked by high rainfall, with an excess of around 15% compared with the average.
Against this backdrop, the Aéro Biodiversité association intended to put the wetlands present on airport platforms into perspective in its annual report for 2024[19]. They can take various forms (ponds, peat bogs or flooded meadows) and play an important ecological role in the ecosystem services they support.

Issues, regulations, and management at airports

Wetlands are reservoirs of biodiversity, home to between 12% and 15% of the world's animal species. Despite their importance, wetlands are under threat today, with both a reduction in their surface area (development of watercourses, urbanisation) and a deterioration in their quality (spread of invasive exotic species, various types of pollution).

Wetlands are governed by a number of texts.

At international level, the Ramsar Convention, to which France is a signatory, commits the country to preserving wetlands of international importance, to halting the disappearance of wetlands, and to promoting their conservation and wise use.
At European level, the protection of wetlands is part of the overall framework of the European Union's environmental policy. This is embedded into three official texts: the Water Framework Directive, the Habitats Directive, and the Natura 2000 network.
At national level, there are specific regulations, in particular those relating to works impacting wetlands.

Wetland area of Castelnau-Magnoac. © Constance Anelli/DGAC-STAC

The wetlands found at airports are diverse (natural, semi-natural or artificial). However, some are more prevalent on airport platforms, particularly the 'continental' ones located off the coast. They are characterised by stagnant or running water, such as ponds. They may be temporary, with a period of complete dryness in summer, shallow water (around 40 cm) and vegetation capable of adapting to alternating flood and dry phases. In comparison, permanent ponds have water all year round and can be up to 2 m deep.
Wet meadows are also common in airport areas. They are characterised by herbaceous vegetation adapted to soils that are temporarily or periodically saturated with water.
The issue at airports is the absence of rules or recommendations specific to airport areas due to safety constraints. The management of wetlands is therefore left to the initiative of each platform. It should therefore be considered as a means of striking a balance between operational imperatives and the preservation of biodiversity. It is advisable to identify the challenges facing each wetland and adapt its management accordingly. To do this, an ecological diagnosis must be carried out.

However, the recommendations for the day-to-day management of wetlands include dredging and mowing. Dredging involves removing the sediment and organic matter that have accumulated at the bottom. Mowing involves cutting and removing aquatic plants when they are growing too fast in rivers, ponds, lakes, and canals. This technique helps to maintain the ecological balance and proper functioning of aquatic ecosystems. In both cases, these operations have an impact on biodiversity. To limit their impact, they should be carried out between September and January and on a third or half of the surface area in order to conserve refuge areas.

19. https://aerobiodiversite.org/resultats

Local seeds

A digital platform to develop the planting of local seeds

Today, natural grasslands are still in decline in our country. Yet these environments provide valuable services and fulfil numerous ecosystem functions.
Since 2015, the French Office for Biodiversity (OFB)'s 'Végétal local' brand has guaranteed the traceability of wild plants used to restore ecosystems, thanks to a dozen local players able of harvesting the wild seeds that will be reused in restoration projects.
However, the time needed to explore harvesting sites is holding back the development of this sector.
To help with this, an interactive platform was set up, listing potential harvesting sites.
At the same time, collaboration between the industry and aerodromes has also developed in view of the quality of these sites.
Several wild seed collections were organised at airfields in recent years, notably at Poitiers-Biard airport, which until recently was the only airfield registered on the interactive platform.
To help develop links between aerodromes and their local communities, in 2024 the DGAC launched an information campaign aimed at operators to encourage them to register on the platform.
The campaign was a resounding success, with twenty-nine aerodromes now listed throughout mainland France.

For more information, visit
https://parcellessources.gogocarto.fr/ and www.vegetal-local.fr.

Harvesting of local seeds at Poitiers-Biard airport.
© Conservatory of Natural Areas (CEN) of Nouvelle-Aquitaine

Planting local seeds at Toulouse-Francazal: an experiment studying the links between soil richness and the carbon cycle

The STAC launched an experiment with the operator of Toulouse-Francazal airport to compare, on a plot of land, the effect of planting commercial grass seedlings and a mixture for flower meadows with the 'Végétal local' label. Regular assessments are planned over a 3-year period. This experiment caught the attention of EGIS, which included it in an overall research project entitled 'Biodiversity and carbon in soils, green areas and transport infrastructure'. This project was selected for one of the calls for research projects launched by the Infrastructures, Territories, Transport, Energy, Ecosystems and Landscapes (ITTECOP) programme. It aims to gain a better understanding of infrastructure soils, their diversity, and the links between the structure of microbial communities and the carbon cycle by taking samples from dozens of infrastructure sites (roads, motorways, railways, airports). This is done alongside the implementation and monitoring of experimental Nature-based Solutions (NBS) systems on grassy green areas, including airport meadows, in order to assess their impact on biodiversity and carbon storage.

Separation of local seeds for future sowing. © Conservatory of Natural Areas (CEN) of Nouvelle-Aquitaine

Drying of harvested seeds to prevent insect presence before storage and new sowing. © Conservatory of Natural Areas (CEN) of Nouvelle-Aquitaine

Map of platforms using local seeds (source: Végétal Local website)

For more informations, visit https://parcellessources.gogocarto.fr/%20et%20www.vegetal-local.fr.

7 — The SPE, a new environmental challenge

Creation of a mini-forest at the SIA in Bordeaux: oyster bags are used to protect the trees from rabbits, which are found in large numbers in this area. © Michaël Colorado/DGAC-DSNA-SIA

As part of the French government's Ecological Transformation Plan, the DGAC is committed to developing its 'Eco-responsible Public Service' (SPE) from year to year, to ensure that the administration operates in a way that is as respectful as possible of environmental and social concerns. In 2024, more actions were taken around the 15 major measures set out in the Plan, with the aim of involving staff in this transformation of the DGAC's public service, as well as raising awareness of environmental issues affecting their daily lives.

15

THE MAJOR MEASURES OF THE STATE'S ECOLOGICAL TRANSFORMATION PLAN, broken down into 50 actions based on 5 themes.

Some noteworthy SPE projects

As the central administration of the Ministry of Transport, the DGAC aims to set an example through the Eco-responsible Public Services (SPE) initiative. Formalised by Prime Ministerial Circular no. 6425/SG of the 21st of November of 2023, this scheme is based on the State's Ecological Transformation Plan (PTE), and is structured into 15 measures broken down into 50 actions around 2 cross-cutting themes and 5 thematic themes.

In 2024, the SPE mission launched a number of major initiatives. Among the most noteworthy are the following:

As part of the **Buildings and Energy project,** the DGAC Energy Committee was created on the 23rd of April of 2024. It enables the various directorates - DSNA, DSAC, SNIA, GTA, SPE, SDF, Mission Logistique - to work together on the energy strategy applied across DGAC buildings.

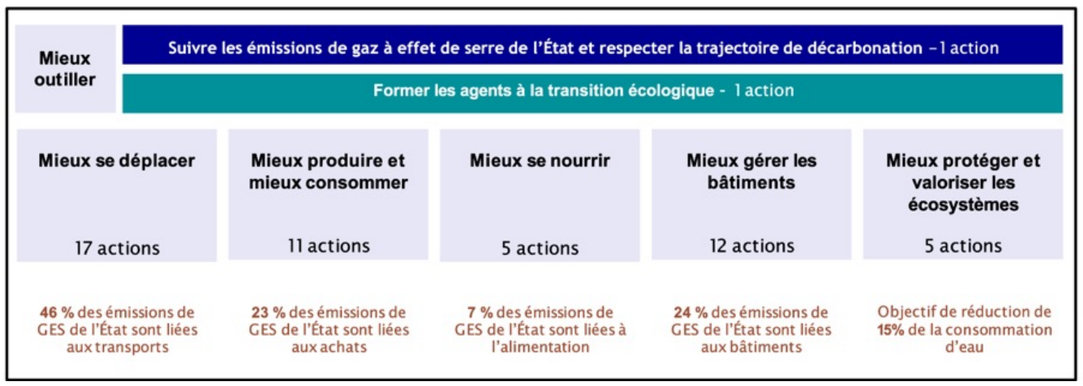
The DGAC's results in the CUBE 2023/2024 competition were also very good. The DGAC Paris Farman headquarters won gold with 24% energy savings, or 1.38 GWh saved, ranking 1st out of 42 in its category (over 5,000 m^2). The other two candidates, the SNIA headquarters in the 20th arrondissement of Paris and the SNIA's Pelus building in Mérignac, also achieved energy savings of over 20%.

The **Digital Responsibility initiative** has raised awareness amongst various departments of the impact of digital technology, and encouraged the donation of IT equipment. In fact, an event was organised on the 14th of March of 2024 during the webinar launching Digital Cleanup Day. This webinar introduced good practices to be followed on a daily basis to reduce the environmental footprint of digital technology.

In regards to **modal shift and compensation**, an appropriate purchasing structure was implemented.

In 2024, the General Secretariat worked actively on setting up a framework agreement for the provision of services to offset the CO_2 emissions generated by the air travel of DGAC employees in the course of their professional activities. This system applies to all DGAC directorates and departments, as well as to the BEA and the GTA, for the period 2022-2027. In 2025, the DGAC will compensate the flights of its agents for 2022, 2023 and 2024.

Overview of SPE policy initiatives



Bike battle at the DGAC headquarters in 2024, one of the events of 'May by Bike' 2024. © DGAC - SG Com

Focus on sustainable mobility and biodiversity projects

Focus on the sustainable mobility project

The sustainable mobility project has seen a lot of activity. Key initiatives include the partnership with the BlaBlaCar Daily car-sharing platform, the reduction and greening of car fleets, and a host of events focusing on cycling, the ultimate star of the year!

The 'Mai à vélo' 2024 event, also supported by the Communication department, was a great success: the challenge, which involved cycling the greatest number of kilometres during the month of May, brought together 25 DGAC departments, with a total of 20,219 km covered, including 6,259 km on the home/work route. This represents a saving of 1,362 kg of CO_2.

At the end of September, the MOBILOR association came to the Farman hall for a bicycle repair workshop. Employees were able to learn how to repair their bikes on the spot.

Focus on the Biodiversity in the workplace project

For the second consecutive year of participation in the 'Our nature, our solutions' call for biodiversity projects, organised by the Directorate for Water and Biodiversity (DEB), all the projects proposed by the various DGAC departments were both rewarded and financed. A ceremony was held on the 4th of October of 2024 to award the prizes to the 6 winners. The Biodiversity Project also organised a photo competition on the theme 'Biodiversity at home: Share your vision around your workplace' in spring 2024. A travelling exhibition of the 11 winning photos began in October 2024 at Farman and is continuing at 5 other sites: Strasbourg, Toulouse, Lyon, Aix, and Athis.
The SPE section of the DGAC photo library[20], managed by the STAC, was supplied with most of the competition photos (around 90).

20. http://phototheque.aviation-civile.gouv.fr/Main.htm

THE SIX AWARD WINNERS AND THEIR PROJECTS

- DSAC Sud-ouest: development of a wilderness area, a green zone, and a pond
- CESNAC: respectful management and small-scale developments
- DSAC Nord: greening a roof
- DTI: de-waterproofing a car park surface
- STAC: participative science and identification protocol in the workplace
- SIA: reforestation of 300 m^2

Planting of 140 trees in 2024 at the DSNA/DTI in Toulouse. More plantings are planned for 2025. © DGAC-DSNA-DTI

Focus
on training and purchasing

Focus on the Training project.
In 2024, the DGAC joined the ministry's eco-responsible training programme, which is structured around three areas: training for DGAC senior managers in the ecological transition, and the continuation of Fresqu'Aéro training and Instants durables, awareness-raising initiatives launched in 2023. The training programme for the DGAC's senior managers (A+ and A) includes two workshops on ecological crises and their levers for action, three lectures by CNRS experts, an educational visit to an area or company in transition, and time dedicated to practical application.
In 2024, more than 80% of the 354 DGAC employees identified for training followed at least one of the phases of the course.
Following on from the 2023 actions, the DGAC deployed the Fresqu'Aéro and Fresque du climat at all sites in mainland France, via internal DGAC trainers, identified as 'fresqueurs' by the associations concerned. 67 people attended at least one Fresqu'Aéro in 2024.

In addition to these workshops, many regional sites are setting up awareness-raising training courses (generally workshops and conferences) for employees. France Overseas are particularly active. In 2024, the SEAC in French Polynesia organised conferences to raise awareness of climate change, with observations in the field, as well as a workshop on the State's Ecological Transformation Plan with a view to drawing up a local SPE plan. The DAC Nouvelle-Calédonie also organises awareness-raising sessions on the various areas covered by sustainable development.

At the same time, the Instants durables - monthly 45-minute awareness-raising webconferences open to all staff - were continued. The aim of the Instants durables is to shed light on the DGAC's SPE approach and, much more broadly, on the issues involved in the ecological transition, with a particular focus on the transition in air transport.

Focus on the Responsible Purchasing project
The DGAC's Sub-Directorate for Finance (SDF), which is leading the Responsible Purchasing project, has ensured that the Interministerial Purchasing Strategy and Coordination Division (SIAC) is leading the Responsible Purchasing community, by organising 4 meetings in 2024. Indicators and actions were defined for 2025 in accordance with the indicators in the Prime Minister's circular of 21/11/2023.

Discussions were stepped up with the MTE's ministerial division on the implementation of environmental and social performance in public purchasing: revision of the guide for the Ministerial Purchasing Manager (RMA), opening of discussion forums for buyers. SDF is taking part in the working groups organised by the MTE, as part of the implementation of the 'Responsible Supplier Relations and Purchasing' charter (RFAR) signed on the 19th of June of 2024.

8 — Glossary

ACA: Airport carbon accreditation, label developed by the Airport council international (ACI)

ACNUSA: French authority in charge of preventing and controlling airport nuisances

EASA : European Union aviation safety agency

AFIF: Alternative fuels infrastructure facility

AFIR: Alternative fuels infrastructure Regulation

APER law: The French renewable energy acceleration law

APU: Auxiliary power unit

ATM: Air traffic management

CAAF: Conference on aviation and alternative fuels

CAD: French equivalent for SAF, Sustainable aviation fuel

CAEP: Committee on aviation environmental protection

CALIPSO: French classification of light aircraft according to their noise performance index

CEF: Corsia eligible fuels

COP: Conference of the parties

CORAC: French Council for civil aeronautics research

CORSIA: Carbon offsetting and reduction scheme for international aviation

DADDUE law: The DDADUE Law contains a unified legal framework to adapt to EU law in France

DSAC: French Direction for Civil Aviation Safety

DSNA: French Direction of air navigation services

DTA: French Direction for air transport

DGITM: French General Direction for infrastructure, transport and mobility

EIAE: Impact study according ICAO balanced approach principle

ENAC: French national civil aviation school

EU-ETS (or SEQUE-UE): European Union-emissions trading system

FEETS: Fuels eligible for EU-ETS support

GHG: Greenhouse gases

GPU: Ground power unit (EN)

IATA: International air transport association

LCAF: CORSIA Lower carbon aviation fuels

NZIA: Net-Zero industry act

OACI: ICAO: International civil aviation organization

OAD: Observatory for sustainable aviation

ONERA: French national aerospace research centre.

NGO: Non-governmental organisation

PBN to ILS: Performance based navigation to Instrument landing system

PFAS: Per- and polyfluoroalkyl substances

PIA: French government's investment program for the future

PPA: Atmosphere protection plan

PPBE: French environmental noise prevention plan

PUF:UFP: Ultrafine particles

RTE-T:TEN-T: Transeuropean transport network

SAF: Sustainable aviation fuel

SESAR: Single european sky ATM research

SFEC: French energy-climate strategy

SPE: Eco-responsible public service

SNB: French national biodiversity strategy

SNBC: French national low-carbon Strategy

STAC: French civil aviation technical Service

TICFE: Domestic tax on final consumption of electricity

TIRUERT: French incentive tax on the use of renewable energy in transport

TNSA: French tax on air traffic noise pollution

TRAAC: Reference warming trajectory for adapting to climate change

EU: European Union

direction
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civile

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