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ENVIRONMENTAL REPORT 2022

Content

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Op-Ed

DAMIEN CAZE

Civil Aviation General Director

2022 was major in terms of international commitments to reach carbon neutrality. Why has this commitment been described as historic?

2022 marks a real turning point with the global commitment from industries and governments to reach carbon neutrality in the aviation sector by 2050.
The first semester of 2022 was marked by the EU's ambition driven by the French Presidency, as part of the negotiations of the 'Fit for 55' package. Thanks to its commitment, France was able to secure agreements between the various Council Member States over three out of the four texts concerning the aviation sector: the RefuelEU Aviation regulation aiming to create a regulatory framework to increase the uptake of SAF (sustainable aviation fuel), the revision of the ETS Aviation directive and the alternative fuel infrastructure regulation (AFIR). The latter's main objective is to ensure the deployment of an infrastructure network for the distribution of alternative fuels for each mode of transport. Only the negotiations around the Energy Taxation Directive (ETD) were left pending due to the required unanimity of the vote over tax matters.
France also helmed the Toulouse Aviation Summit dedicated to promoting decarbonised air transport, held on 3 and 4 February. The summit concluded with the adoption by 42 States and key sector players of the Toulouse Declaration to achieve carbon neutrality in the air transport sector by 2050.
This European and French initiative has paved the way for a historic step by the international community towards decarbonisation: the adoption, as part of the 41st ICAO Assembly, of a resolution for carbon neutrality by 2050 for international civil aviation as a Long term aspirational goal. To make this objective operational, the ICAO Council was tasked with specific initiatives, including the organisation - from 2023 - of the 3rd edition of the Conference on Aviation and Alternative Fuels (CAAF/3). This will prove to be a key step in the promotion of the production and use of sustainable aviation fuel on a global scale.

"The recovery in traffic must now more than ever meet climatic and environmental challenges."

2022 was also the year that saw air transport start up again. Is it fair to say that this recovery was complemented with concrete actions to reduce the climatic and environmental impact of the sector?

We, and other industry professionals, are delighted to see air transport pick up again after the health crisis that had heavily affected our sector. Air transport recovery must now more than ever meet the climatic and environmental challenges posed by the aviation industry.
In accordance with the European and international measures in place, the implementation of the provisions of the Climate and Resilience law has improved. Legislation fixing offsetting obligations for domestic flight emissions and limiting airport expansion has been passed. The French Civil Aviation Authority has also been actively working with players at every level of the air transport sector value chain to produce a roadmap setting out actions to reach the lower GHG emission objectives of the National Low Carbon Strategy (SNBC for Stratégie Nationale Bas-Carbone) 2022 was also the first year of the implementation of a compulsory (in France) mandate for SAF incorporation, ahead of the European calendar. The works undertaken should be continued to enable the implementation of a competitive national SAF production sector.
In the context of an energy crisis triggered by the Russian-Ukrainian conflict, the sector has also contributed to the energy sobriety plan launched by the government.
On a regional scale, we're pursuing efforts to protect the biodiversity of airfields and manage sound pollution levels caused by air traffic, in concertation with residents associations and sector professionals, and with the support of the French authority in charge of preventing and controlling airport pollution (ACNUSA).

"France's position in terms of innovation is a determining factor."

The sector relies heavily on innovation. What sorts of initiatives can we expect? What is their timeline?

We must bear in mind that France's position in terms of innovation is a determining factor, given the fact that its aviation industry is one of the largest in Europe. With half of the global market share of airliners, our industry holds a considerable weight when it comes to determining the global trajectories of air transport decarbonisation.
Due to the particularly long development cycles in aeronautics, we are working towards the decarbonisation of air transport along two specific timelines:
• A first one which relies on the launch of a first phase of SAF deployment and an increase of our efforts to renew airlines fleets (allowing emissions to be reduced by 20-25%, the Air France support plan was vigilant to preserve the airline capacity to renew its fleet) by 2030.
• The second timeline takes us to the end of the next decade, when the new generation of ultra "sobre" aircraft using new energy sources (SAF and hydrogen), based on the research and technology that we support, will have properly penetrated the market.
The second timeline is essential for the decarbonisation process because, given their high costs, those new energies can only be deployed on a large scale using technology that's much less costly. These aircraft will integrate disruption innovation, including hydrogen propulsion for regional, short- and medium-haul aircraft.
The objective of the sector, within the framework of the Council for Civil Aeronautics Research (CORAC - Conseil pour la recherche aéronautique civile), and with the support of the DGAC, is to reduce the energy consumption of future commercial aircraft by around 30%.
Beyond transport aviation, key players of the other sectors within aviation are also actively engaged in the decarbonisation process, working within the CORAC on new decarbonated aircraft, the more advanced of which will see the day from 2030.

41st Assembly of the ICAO in 2022: **carbon neutrality by 2050, a historic resolution**

The environment was at the very heart of the discussions at the 41st Assembly of the ICAO, held from 27 September to 7 October 2022, which resulted in a focus on a historic objective: carbon neutrality for international aviation by 2050, in accordance with the objectives of the Paris Agreement in terms of climate change mitigation.

This commitment is the result of a long process of negotiations, which relied on the work of the CAEP (see boxed text) and in particular its "Report on the feasibility of a long-term aspirational goal (LTAG) for international civil aviation CO_2 emission reductions" of February 2022. Only China and the Russian Federation have expressed reservations in regard to the ICAO Resolution.

The objective of carbon neutrality is so-called aspirational in the sense that the Resolution doesn't impose "any obligation or commitment in the form of national objectives of CO_2 emission reductions."

Nevertheless, this Resolution marks the beginning of a process that will mobilise the ICAO Council for the next three years, as the Assembly has tasked it with a number of actions that will make the carbon neutrality objective operational.

Given the importance of sustainable fuels to decarbonate aviation, the Council will have to organise from 2023, the 3rd edition of the Conference on Aviation and Alternative Fuels (CAAF/3) to flesh out the ICAO's ambitions for 2050 for sustainable fuels, by promoting production and use, and perhaps even define a trajectory of their use that's compatible with the carbon neutrality objective.

The section about financing will be key to the operational set-up, as the discussions on the subject during the Assembly made clear. The Council has a more specific role to play in terms of facilitating access to certain countries that can bring in private sector investments, and funding by financial institutions, such as development banks.

Finally, and without being exhaustive, we will have to work with governments and industry in the longer term to prepare for the arrival of new technologies and energies, such as hydrogen, which means adapting current Standards and recommended practices (SARPs) or developing new ones.

1. https://www.icao.int/environmental-protection/LTAG/Documents/REPORT%20ON%20THE%20FEASIBILITY%20OF%20A%20LONG-TERM%20ASPIRATIONAL%20GOAL_fr.pdf.

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… which relies on the work of the CAEP, a key committee for the protection of the environment

The LTAG of CAEP, a key component of the ambitious carbon neutrality objective

The report on "the feasibility of a long-term aspirational goal (LTAG) for international civil aviation CO_2 emission reductions" is the result of the efforts of about 300 experts over a two-years period.

This report presents three scenarios for decarbonisation, combining pro-active hypotheses for the three key in-sector levers: technological improvement of the aircraft, increased efficiency of air operations and sustainable fuels.

Although those scenarios all show major CO_2 emission reductions, none actually allow us to reach total carbon neutrality by 2050. In order to achieve this, we will have to complement them with measures from outside the sector, such as compensation or carbon capture and sequestration.

According to the most ambitious hypothesis (IS3), air traffic carbon emissions would be limited to 200 million tonnes (MT) by 2050, or a third of the 600 MT of CO_2 emitted in 2019, despite an increase in traffic. If no extra effort was to be agreed upon, other than the renewal of the fleet with the current technology, they would reach 1,500 MT.

Whichever the scenario, sustainable fuels will play an essential role in decarbonisation by 2050. According to the IS3 scenario, 55% of carbon emission reductions are linked to the use of sustainable fuels, 21% to aircraft technology and 11% to operational measures.

The CAEP has also assessed the costs and investments associated with the different scenarios along the air traffic chain.

THE COMMITTEE ON AVIATION ENVIRONMENTAL PROTECTION (CAEP)

CAEP *(Committee on Aviation Environmental Protection)* is a technical committee under the aegis of the ICAO Council tasked with assisting the Council with the development of environmental policy and the adoption of new standards and recommended practices (SARPs) in regard to aircraft noise and engine emissions, especially CO_2. Its field of intervention covers Appendix 16 of the Chicago Convention (noise, local air quality, emissions, CORSIA). It also looks into aircraft technology, air operations and sustainable fuels geared towards reducing CO_2 emissions.

CAEP is made up of 31 members representing member states, such as France, and observers from other states, NGOs, professional organisations, EU institutions and associations. Over 600 experts are involved in its work.

Another complex task for the 2022-2025 CAEP cycle: double standard

This "double standard" refers to the objective of simultaneously strengthening existing noise and CO_2 standards for subsonic aircraft. As these are not easily compatible, trade-offs between CO_2 and noise will need to be reached in view of adopting future norms.

Consultations to develop **the future French Energy-Climate Strategy (SFEC) are speeding up**

The air transport sector has published its decarbonisation roadmap

Article 301 of the Climate and Resilience Law stipulated that "each sector responsible for important GHG emissions" establishes a roadmap to present its action plan to "meet the objectives of a drop in GHG emissions set by the national low carbon strategy (SNBC). **The aviation sector was the first to submit its roadmap to the ministers concerned, on 14 February 2023,** following a year of work by all interested parties, airlines, manufacturers, airport managing bodies, ground handlers, energy specialists and SAF producers, under the leadership of the DGAC and the GIFAS (Groupement des industries françaises aéronautiques et spatiales, p.47).
A number of workgroups were set up according to the major levers of air decarbonisation, technological progress and fleet renewal (with a subgroup dedicated to the adaptation of airport infrastructure), the production and use of SAFs and ground and air operations. A workgroup was also dedicated to the various measures for CO_2 emissions offsetting.
Each one of these workgroups agreed upon quantitative hypotheses for the contribution of levers of decarbonisation by 2050. The roadmap showcases two more or less optimistic decarbonisation scenarios based on the mobilisation of these levers. For each scenario and hypothesis, industry professionals put forward the conditions for success, namely financial, regulatory or pertaining to access to resources.
Other than the presentation of the article 301 roadmap's recommendations, the meeting of 14 February was also the chance for ministers Agnès Pannier-Runacher, Clément Beaune and Roland Lescure to **launch a workgroup to encourage the development of sustainable aviation fuels,** bringing together key players from the aviation, aeronautic and energy sectors. The objective is to create a sector for SAFs in France that will allow the aviation industry to reach its objectives of GHG emissions reduction and decarbonisation by 2050. The three ministers introduced **the recipients of the call to project proposals** for the "Development of a French sector for sustainable aviation fuels" project (see p.14), launched in 2021, as part of the "Biosourced products and industrial biotechnologies national strategy - Sustainable fuels" for France 2030. Spearheaded by ADEME, this call to project proposals financially supports projects that demonstrate production processes for SAFs and pre-engineering works for processes necessary to engage a production project within the decision phase for industrial investment. In order to proceed to a phase of industrialisation and creation of fuel production units, a "flash consultation" of industry professionals was launched in order to identify the key obstacles and develop adapted support procedures ahead of the Salon du Bourget in June 2023.

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Presentation of the decarbonisation roadmap, 14 February 2023.

New administrative structures for more efficient environmental policies

Observatoire de l'aviation durable

The CNR for a collective reflection on the modes of transport of tomorrow
The Conseil National de la Refondation (CNR) was introduced by the President of the French Republic on 8 September 2022 in order to create a new mode of concertation and action to enable citizens discuss in a constructive manner, and introduce the solutions to the great challenges of our time.

The discussion over transport issues was launched on 8 November 2022 by transport minister Clément Beaune, to address the challenges posed by the ecological transition of modes of transport. It was structured around three workshops: daily mobility, long distance mobility and the transport of goods.
The identified levers will be transferred to CNR held locally all over the country in order to better define them within local institutions and organisations

... National coordination thanks to the SGPE
Via the decree of 7 July 2022, the President of the French Republic created the position of Secretary General for Ecological Planning (SGPE), under the authority of the Prime Minister. The Secretary's role is to ensure the coherence and monitoring of environmental policies set by all the ministries, and to coordinate current actions and negotiations to make decarbonisation a reality.

.... and a French energy-climate strategy (SFEC) currently in the making
The SGPE is also tasked with coordinating all the components to develop the French energy-climate strategy (SFEC, Stratégie française énergie-climat). The SFEC will make up France's roadmap to reach carbon neutrality by 2050. It will be made up of the climate and energy planning law (loi de programmation quinquennale sur l'énergie et le climat (LPEC)), which should be adopted in 2023 and adapted through the low carbon national strategy (SNBC 3rd edition), the National Adaptation Plan for Climate Change (PNACC 3rd edition) and the Multi Annual Energy Plan (PPE 2024-2033), which should be adopted early 2024.

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The Sustainable Aviation Observatory (OAD)
Given the fact that studies on aviation decarbonisation are still often too complex to fully grasp, analyse and compare, the OAD has made it its mission to make reliable data and information available to as wide an audience as possible. A dedicated webpage will allow visitors to quickly and efficiently locate reference studies.
In parallel, the OAD is organising regional meetings around decarbonisation and shedding light on key players on the ground, working across the various regions, at the heart of innovation and research (SMEs, start-ups, universities) by proposing concrete solutions that highlight France's commitment to this issue.

France’s sobriety plan

France’s energy sobriety plan

In a context of accelerating climate change and of conflict in Ukraine, the energy transition in France has become a fundamental priority. France must extricate itself from its dependency on fossil fuels and reduce its energy consumption by 40% by 2050.
In the spirit of consultation and dialogue, nine workgroups were created during the Summer of 2022, to put together propositions for energy sobriety measures for each sector, including government, industry and transport. Thus, a sobriety plan was consolidated and presented on 6 October 2022.

The roadmap is ambitious, setting out a 10% reduction in energy consumption over the next two years in comparison with 2019.
Each sector has defined a plan of action including quantified measures for reducing energy consumption.
For air transport, the measures put in place seek to optimise the energy consumption of terminals. These measures include initiatives to optimise heating, ventilation and air conditioning, as well as ground and air procedures limiting the consumption of kerosene: aircraft using one engine, optimising air routes, using electricity when the aircraft is on the ground, developing ecodriving.
As a guarantor of the energy sobriety plan, the government must both set the example and drive proposals and experimentation. It will play its full part to encourage a collective engagement, with the

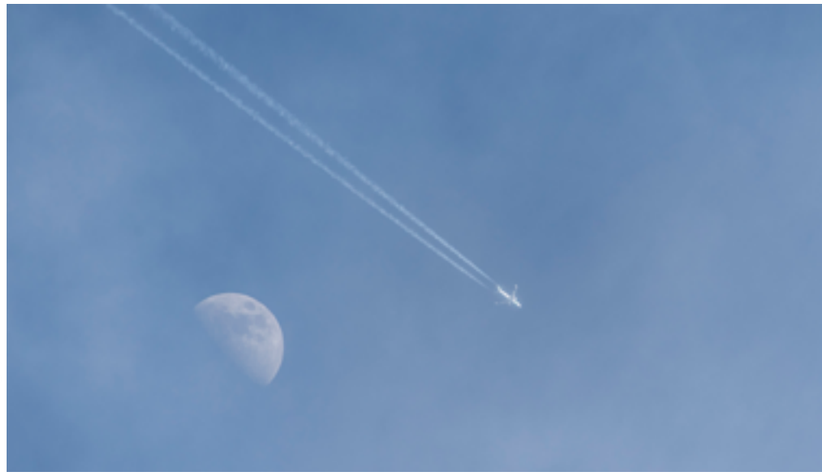
implementation of an ambitious plan of action, which will include better management of government buildings, support for the transition of mobilities, a reduction of its digital technology-related consumption and actions related to public procurement.

Key industry actors are getting involved

Airports have developed emergency plans: measures to reduce and optimise lighting inside airports, implementing reasonable use of air conditioning and heating, revising the energy procurement contracts and raising awareness amongst passengers and third parties. The group Aéroports de Paris (ADP) put in place an energy sobriety plan in September 2022. In terms of electricity, it set out: a reduction in lighting, limiting air renewal in certain zones, limiting open doors and windows, setting an air conditioning temperature at 26°C (summer). In terms of natural gas: maintaining the heating at a constant temperature of 19°C (winter) and a period of maximum heating restricted to mid-October to early April. The mobilisation of the various collaborators of the group has led to significant energy gains in 2022 in comparison with the reference year of 2019. Over its 3 Ile-de-France platforms, ADP improved internal energy performance in 2022 by 7% for electricity compared to 2019 and 31% for heat (numbers corrected to account for climatic evolutions).
The sobriety plan adopted by Air France following the announcement of the national sobriety plan on 6 October 2022 was presented to the executive committee and the board of directors of the airline in October 2022. A trimestrial committee - “Energy Sobriety” - was put in place to measure the results and identify new avenues for action. The measures, which mainly center around a reduction in lighting, the application of temperature instructions in all company buildings and raising awareness amongst employees in terms of personal measures, have helped reduce energy consumption by 17% over the period of May to December 2022 (date of the introduction of an action plan by the airline) against the reference year 2019.

1—

Accelerating the decarbonisation of air transport



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2022 saw an unprecedented global engagement on the part of industries and governments to reach carbon neutrality for the aviation sector by 2050, and a clear European ambition to reduce emissions by 55% by 2030. On a national level, the development of the decarbonisation roadmap created by the aviation sector in accordance with article 301 of the Climate and Resilience law has been the subject of valuable exchanges between all actors across the value chain. These efforts on the part of the sector will contribute to the work undertaken by the government and Parliament to define the new French strategy on energy and climate (SFEC).

5
PROJECTS CHOSEN
as part of the call for proposals for the “Development of a French SAF sector” project, with a total support fund of 18 M€

2026
THE END OF FREE ALLOWANCES AS PART OF THE ETS BY 2026

100 %
OF CO_2 EMISSIONS
of domestic airlines will have to be offset by 2024

Sustainable aviation fuels, a major global issue

In order for France to develop its own SAF production sector in the short term, whilst maintaining the current national dynamic, efforts in 2022 were mainly focused on European and international scales.

On a European level, the objective of the new French Presidency of the EU Council was to harmonise ambitions over SAF, by concluding the EU Council's negotiations over the ReFuel EU Aviation Initiative. The general approach agreed on in 2022 has achieved this target. Indeed, the document sets out an obligation for increased incorporation of SAF in the tanks of European and non-European air transport carriers refueling in EU airports used by over 1 million passengers per year (rate of incorporation of 2% in 2025, 6% in 2030, 20% in 2035 and over 50% in 2050 with subobjectives for the incorporation of synthetic fuels). Based on the proposition of the European Commission, the general approach affords the necessary flexibility for a harmonised and balanced position amongst the Member States. In fact, the EU Council's text offers a SAF definition, which includes e-fuels produced with low carbon electricity, a transitory period that's long enough to allow fuel suppliers to anticipate the adaptation of their logistical chain, as well as the exemption of airports that depend on important logistical restrictions in terms of provision. Following the European Parliament's position on the legislation, adopted in July 2022, the negotiations between the Commission, the Council of Ministers and the Parliament, named "trilogues", began under Czech presidency during the second semester of 2022. The three institutions came to an provisional agreement in April 2023 that proved more ambitious than the initial proposal of the Commission detailed above: the level of SAF incorporation will increase progressively. It should still reach 2% by 2025, then 6% by 2030...and 70% by 2050 (instead of 50%) including 35% of e-fuel. Low carbon synthetic fuels produced from nuclear hydrogen will be taken into account to reach these objectives in accordance with the wishes expressed by the French government. This provisional agreement must now be subject to a vote by the European institutions.

On an international level, 2022 saw the closure of the twelfth cycle of work of the CAEP and the definition of the priorities of cycle 13 for the period 2022-2024.
In regards to SAF, the stress is on e-fuels. Until recently, they had not been studied much within the CAEP subgroup working on fuels - the Fuel Task Group (FTG). They are nevertheless a determining lever for long-term decarbonisation, especially for airlines that won't be able to benefit from disruption technologies in terms of electrification or hydrogen. The FTG is currently working towards the definition of technical elements to add to the SARP (see boxed text p.7) that will ensure that e-fuels are given the same consideration as other SAF.

Combining efforts to support the development of SAF
On both European and international levels, various bodies have been created to combine efforts and harmonise actions to ensure the development of SAF, in accordance with the objectives that have collectively been laid out.
In Europe, the Renewable and Low-Carbon Fuels Value Chain Industrial Alliance - RCLF - was created on 6 April 2022. Made up of two chambers, one hosted by SAFRAN dedicated to air transport, and the other to maritime transport, the RCLF is open to all actors from the sector. France was the first member State to register and to actively participate. This alliance complements the regulatory framework standardised by the ReFuel EU Aviation initiative. Its aim is to concentrate efforts to speed up production and distribution of SAF at an affordable cost. The key themes identified by the alliance cover in particular access to funding, the availability of resources, and synergies to implement between sectors.

On an international level, a complementary initiative was introduced as part of the ICAO Assistance, Capacity-building and Training for Sustainable Aviation Fuels (ACT-SAF) programme presented on 1 June 2022.
This initiative illustrates the ICAO's ambition that "no country [is] left behind" (NCLB) in the implementation of SARP. It is first and foremost aimed at supporting ICAO member States in the development of a SAF value chain, which would help them achieve carbon neutrality objectives by 2050. France, armed with its pre-existing experience in the development of a national SAF sector, has chosen to invest in this action. It is the second country to join the programme. In a similar approach to that of the ACT-CORSIA programme, the first action of the programme was to supply participants with a knowledge base for SAF for participants. The first of the 7 "ACT-SAF series" took place on 25 November 2022. It introduced the programme and defined the SAF. The following ones will allow participants to develop skills on the subject of sustainable aviation fuels by broaching key thematics, such as the certification of new manufacturing processes, the sustainability of those fuels and feedback from the governments that have already implemented these policies for SAF development support. The content of these sessions is accessible on a dedicated page on the ICAO website.

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From the French roadmap **to achievements on the ground in favour of SAF**

Nationally, the process is in full force! 2022 saw the first wave of actions that helped reach the objectives laid out in the national roadmap.
Firstly, the call for proposals for the "Development of a French sustainable aviation fuels sector" project closed in September 2022. So far, 5 projects has been chosen to receive 18 million euros in funding (see page 8) as announced by ministers Agnès Pannier-Runacher, Clément Beaune and Roland Lescure during a high level reunion on 14 February 2023. Amongst those, four projects were dedicated to synthetic fuels: REUZE (Dunkerque), Hynovera (Gardanne-Meyreuil), AVEBIO (Tartas) and France KerEAUzen (Le Havre), and a project dedicated to advanced biofuels: BioTJet (France).
Secondly, an incentivising fiscal measure was put in place to encourage the incorporation of SAF in jet fuels currently on the market. Since 1 January 2022, jet fuel suppliers have been subject to an incentive tax on the incorporation of renewable energy in transport (TIRUERT), which imposes an SAF incorporation of at least 1% in the jet fuel that is being sold . The blended SAF has to meet very specific sustainability criteria. Suppliers will have to pay a penalty in case they don't reach the objective set. The compatibility of this measure with national objectives and the SAF market is assessed on an annual basis.
Finally, a new tool facilitating the monitoring of SAF flows sold in France has been developed in line with the minimal incorporation obligation set out in the roadmap. The national digital platform CarbuRe, initially dedicated to road transport, now hosts an entire section dedicated to aviation in collaboration with the DGAC and the DGEC. It helps meet the needs of the airlines, the final SAF consumers, in order for them to have access to the characteristics of the SAF they're buying (raw material used, level of GHG emission reduction) in a secured digital space.

Looking towards a 100% SAF use
The aim for the near future is to be able to use a fuel that is 100% sustainable (the certification of current aircraft engines being limited to 50% SAF). The work carried out as part of the CORAC (the French Civil Aviation Research Council, see p. 47) by a dedicated subgroup is geared towards lifting that limit and defining the solutions to implement. From drop-in to non-drop-in SAF, no scenario is left out. This question is the subject of analyses conducted by French industry professionals and the DGAC to continue working towards the production of aircrafts using 100% SAF.

2. https://www.gouvernement.fr/france-2030-annonce-des-laureats-de-l-appel-a-projets-developpement-d-une-filiere-de-production.

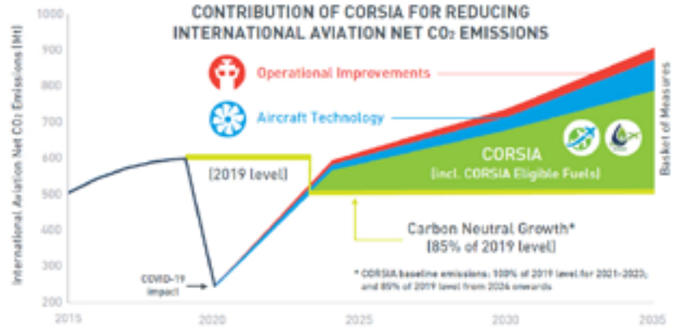
3. Objective calculated annually and in terms of energy, the biofuels produced from raw materials in appendix IX of the REDII directive count for double their real energy content in the TIRUERT

The reality of the EU-ETS and the CORSIA in 2022

Measures in place to reduce carbon impact
2022 was also the year national measures for offsetting of CO_2 emissions for domestic flights were implemented, as per the article 147 of the Climate and Resilience law. Nationally, these measures complement theEuropean Union Emission Trading System (EU – ETS) and the carbon offsetting and reduction scheme for international aviation (CORSIA). An air transport carrier may be subject to those three sets of measures simultaneously depending on the perimeter of its emissions, on the rules of application and on its activities.

Different mechanisms to reach the same objective

Although the EU-ETS relies on the principle of restitution of allowances following the "polluter/payer" approach, the CORSIA and the national schemes from the Climate and Resilience law's article 147 (see p.17) aim to compensate the emissions of the aviation sector through the financing of agricultural and forest projects.



Adjustments for CORSIA and ETS

The CORSIA embarked upon its first operational phase in 2021 for three years. The first offsetting requirements will be calculated at the end of this first triannual phase 2021-2023, for a first offsetting carried out in 2025.
During its 41st Assembly in October 2022 (see p.6), the ICAO confirmed that the emissions of 2019 will make up the baseline for the calculation of CORSIA offsetting for the current triannual phase 2021-2023. It also decided upon a more ambitious evolution by lowering the baseline to 85% of the 2019 emissions for later phases starting in 2024. Finally, it decided that, in the calculation of offsettings, it wouldn't take into account the growth of air transport carriers before 2032 and its weight would be limited to 15%. These adjustments are the result of negotiations that reached a balanced point while taking into account the LTAG.
The revision of the EU-ETS regulations has also been negotiated by the European institutions, in order to articulate the European Union system's with the CORSIA.
The revised ETS directive aims to:
- strengthen its ambitions by quickly removing the free allocation of "historical allowances", with a reduction of 25% in 2024 and 50% in 2025, to reach 100% from 2026 meaning all allowances being auctionned,
- articulate the EU-ETS market with the CORSIA by using the "clean-cut" option (an ETS application limited to intra-European flights and a CORSIA application limited to extra-European flights),
- encourage the uptake of SAF through the allocation of free allowances called "SAF allowances", which should make up for the difference in price between SAF and fossil fuels,
- and finally include the non- CO_2 effects of aviation through the ETS monitoring, reporting and verifying (MRV) framework.

The Climate and Resilience law is being implemented progressively

Articles 142 to 147 of the Climate and Resilience law of 22 August 2021, as well as article 12, dedicated to air transport, set out implementation decrees for a number of measures and reports for a number of others. Where are we at today?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On the decrees:

• A ban on the creation of new airports or expansion of an airport (made under article 46 of the law), from the moment that these works result in a net increase in emissions, became effective by the decree of 23 June 2022. Ultramarine airports in Bâle-Mulhouse and Nantes and helipads aren't concerned by this ban,

• The "2h30" decree (made under article 145 of the law) banning domestic flights when direct train travel is feasible in satisfactory conditions in under 2h30, was subject to discussions with the European Commission, which gave a favourable opinion on the compatibility of the measure with the rules of the market. Following a last assessment by the Council of State, the decree was published on 23 May 2023.
The satisfactory conditions will depend on the frequency and schedules of direct trains, in particular mornings and evenings, in order to allow for same day return trips, whilst being able to be at the destination for 8h. Three lines are currently concerned by this closure following the implementation of the decree: those linking Orly to Nantes, Bordeaux and Lyon. As train travel improves, with higher frequency and adapted schedules, more train links will be considered to meet the decree's conditions and other domestic flight lines will be canceled.

• Article 147 of the law sets out the obligation to offset all emissions from domestic flights by 2024 (see next page),

• Finally, article 12 of the law aims to oversee publicity for products and services deemed to be "carbon neutral". Thus, from 1 January 2023, advertisers are banned from stating that a product or service is carbon neutral without proving it (see decrees 2022-538 and 2022-539 of 13 April 2022).

Regarding the reports from the Government to the Parliament:

• In its article 142, the Climate and Resilience law asks the Government to send the Parliament two reports: one on how to fix a price for carbon that's "at least equivalent to the average price on the relevant carbon market" by 2025, the other on supporting the aviation sector in its decarbonisation strategy. These two reports are currently being finalised.

•Article 144 of the law requires the Government to tackle flight ticket dumping, namely through an evolution of the European regulation enabling the setting of a minimum ticket price. The General Inspectorate for the Environment and Sustainable Development (IGEDD), and the General Inspectorate of Finance (IGF) have handed in their conclusions to the Government. These proposals will be used to support debates over ecological planning.

Implementing carbon offsetting

The obligation for offsetting emissions of domestic flights came into effect in 2022


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This obligation set out in art. 147 of the Climate and Resilience law concerns aircraft operators that come under the ETS (see p.15), which operate domestic flights between two airports across the Metropole and generate 1,000 tons of CO_2 per year across the national territory. Flights between mainland France and the Overseas Territories are not concerned.
The obligation is progressive: the aircraft operators concerned had to compensate 50% of their emissions in 2022, rising to 70% in 2023 and all emissions in 2024.
This obligation must also meet certain conditions:

• A percentage of the projects selected by the aircraft operators must be located within the EU: 20% in 2022, 35% in 2023 and 50% in 2024. From 2025, this percentage will be determined by a new decree. An exemption is possible only if the aircraft operator proves his inability to find enough offsetting projects within the EU that meet the principles set out in the decree.

• The offsetting projects must be measurable, verifiable, permanent and additional (art R 229-102-1 environmental code), which is the case for French projects certified **by the "Label bas carbone**" (low carbon label) and the CORSIA projects.
A decree is currently in the process of adoption to enhance offsetting projects that introduce significant improvements in terms of biodiversity preservation and restoration. Aircraft operators will be able to benefit from these carbon credits within a maximum ceiling of 15% per aircraft operator and per year. In case of failure to respect the offsetting obligation, aircraft operators will be fined 100€ per ton of GHG not offset. The penalty also applies in case of non-delivery of the offsetting report that the aircraft operator must submit every year to the Ministry for the Energy Transition before or on 1 June, along with the verification report produced by a certified verifier.
Amongst the standards, the **Low-carbon label** created by the MTECT in 2018 aims to foster the emergence of a French and European offsetting market with high environmental standards and requirements, to meet the best international norms.

EMISSION OFFSETTING, CARBON CREDITS, WHAT IS IT ALL ABOUT?

The aim of the offsetting is to finance projects that enable the storage of CO_2 (forest renewal for example) or the reduction of GHG from other activities. To fulfill their obligation of offsetting, aircraft operators use carbon credits. These are documents delivered after an offsetting project, which certifies that the aircraft operator has either removed or avoided CO_2 emissions. A carbon credit is equivalent to one ton of CO_2 avoided or removed.
A number of European and international offsetting standards exist. They can be compared using 5 fundamental criteria (uniqueness, measurability, verifiability, permanence and additionality), as well as socio-economic and environmental criteria. The Ministry for the Ecological Transition and Territorial Cohesion (MTECT) has carried out a comparative study of the available standards on its website.

French airports are taking concrete steps towards decarbonisation

© Aéroports de la Côte d'azur

Solar panel-covered car parks, Nice airport

74

airports are taking part in the ACA programme.
Following the Cote d'Azur airport, it's Lyon's turn to be awarded the ACA4+ level

A strong commitment on the part of France's airports

French airports are currently in the process of decarbonising their infrastructure. Thus, amongst 86 countries represented by the Airport Carbon Accreditation (**ACA**), France is home to - by far - the largest number of airports currently committed to this process. Developed by the Airport Council International (ACI), the ACA is a voluntary certification programme that commits participating airports to reducing their carbon emissions. It involves 6 levels. The highest one involves the reduction of emissions of airports and third parties in absolute value, in line with the Paris Agreement, as well as the offsetting of residual emissions. Launched in 2020 by the French Airport Association (UAF), the French Airport Commitment to the Environment and Energy Sobriety (**EASEE**) offers technical and financial support for airports, especially small and medium platforms, to facilitate their integration and progress within the ACA. By the end of 2022, 74 French airports had joined the EASEE programme. 46 started with nothing: most of them reached level 2 while 27 airports reached level 3. French airports now make up nearly 30% of all European accredited airports and 15% of all international accredited airports. A EASEE 2 programme is currently being studied to help the largest number of airports to reach level 3

The 10 March 2023 law will enable the acceleration of the production of renewable energies

The law has a clear objective. It aims to deploy renewable energy two times faster than previously done, in order to catch up with the persistent delay that France is experiencing in that field. This objective relies on 4 pillars: to speed up procedures, to vacate the necessary real estate, to speed up the deployment of offshore windfarms and to improve the financing and attractivity of renewable energy projects.

Airport operations are essentially covered by article 11 regarding the installation of solar canopies. From July 1st, 2026 exterior car parks larger than 1,500 m^2 will have to be topped with sun shades producing renewable energy from at least the totality of their top parts. This should apply to at least half of the car park surface area.

Revision of the technical information note regarding the installation of solar panels near airports

The technical information note (**NIT**) regarding the installation of **photovoltaic panels** near airports was revised late November 2022 by the Civil Aviation Technical Service (STAC). This update considers the economic context, as well as the political drive to develop solar farms near airports. It should also simplify the dazzling study process performed by project leaders, and the processing of applications helmed by the DGAC. This NIT update is the result of a coordinated effort between European and American civil aviation authorities, the army institute for biomedical research (Institut de recherche biomédicale des armées (IRBA)), the UGE and French solar energy industry professionals. Studies on dazzling and the effects on pilots capacity are also underway with third party organisations.

This note is available on the ministry's website:
https://www.ecologie.gouv.fr/sites/default/files/3_2_NIT_Photovoltaique_V5_signee_10nov2022. pdf

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St Pierre Pierrefonds airport, La Réunion

Vulnerability of airports in the face of climate change

As part of the National Climate Change Adaptation Plan (**PNACC**), the STAC developed in 2013 an assessment **methodology for climate hazards and their potential impact on mainland airports** by 2100. In 2019, the methodology led to the creation of the VULCLIM. Following an online questionnaire, this tool creates a grid to evaluate the vulnerability of their platform to the impact of climate change. In 2022, VULCLIM was updated to take into account new climatic projections given by the DRIAS website, based on scenarios from the Intergovernmental Panel on Climate Change (IPCC). The NIT on that specific topic has also been updated.

The meetings of French and Francophone airports organised by the UAF, as well as the "Airport resilience" seminar organised by PROAVIA provided an opportunity for key players (airport managing bodies, Météo France, Eurocontrol, DGAC) to come together around this challenge. Reports from Nice and Kansai airports, and experts' advice, namely that of the DGAC, Météo France, Eurocontrol and Airbus, allow for discussions on the risks and strategies to put in place. Innovative companies and representatives from the projects OLGA, STRAGATE and TULIPS (winners of the European Commission's Horizon 2020 programme - "GREEN AIRPORT"), spearheaded respectively by ADP, Amsterdam airport and Brussels airport, presented their solutions and experiments to mitigate the environmental footprint of airports and make them more resilient to the effects of climate change and extreme meteorological risks.

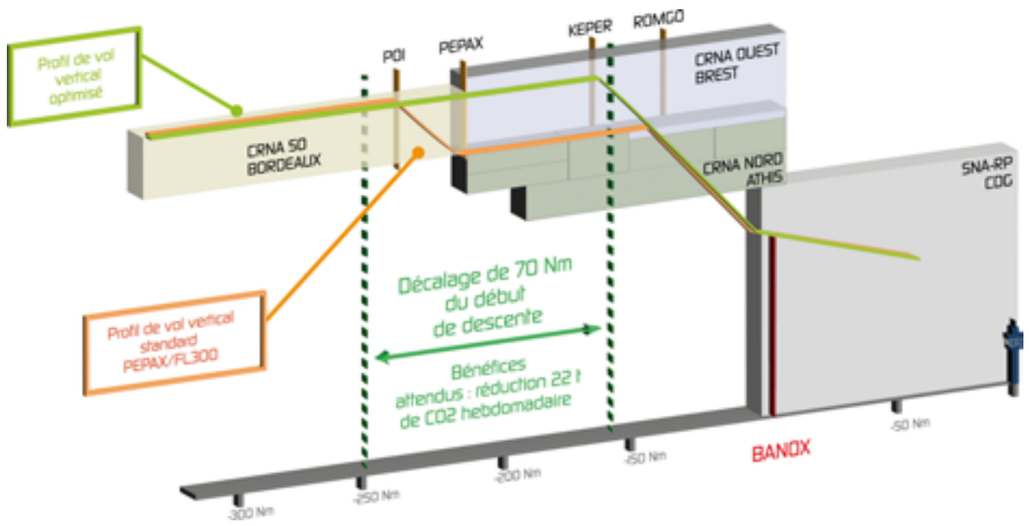
More environmentally friendly air traffic

Improvement of environmental performance

The implementation of new flight procedures, the spatial modifications, the dynamic adjustments of constraints are all important elements that have helped improve environmental performance.

The DSNA strategy tackles environmental performance on the scale of traffic flow,
and is not built on the basis of a perfect flight. Depending on traffic, the challenge here is to find the best balance between researching optimal trajectories and aiming to simplify the crossing of flows to decongest traffic. This relies on a more dynamic air traffic management system and a better understanding of the impact of the "Green Operations" concepts on capacity. The DSNA created a working-group called "Green Operations", with airlines to bring short term solutions to improve trajectories in the regions facing the most constraints. For example, Air France estimates that the vertical optimisation of flights going to Paris-Charles-de-Gaulle and Paris-Orly airports represents an annual economy of 12,000 tons of kerosene, which is equivalent to 3,000 flights from Paris to Nice. An initial operational assessment focused on the flow of night flights arriving from the South-West area to the Paris region, at the crossing of the CRNA 's South-West, West and North. This regions is considered to be the most penalising one of the entire Air France network in terms of environmental impact. Thus, from 1 December 2022, a procedure has been put in place to maintain each aircraft from this night flow on an optimised flight level (FL 360 instead of FL 300), as close as possible to the ideal Top Of Descent. The estimated gain is around 300 kg of kerosene per optimised flight. Moreover, the SESAR solutions, like the ones validated in the HERON project (see p. 46) should enable the extension of these improvements to the heavier day traffic. Beyond realtime management, it will be a question of defining the processes at a strategic and pre-tactical level by aiming for adapted work methods and by improving tools for an easier identification of possible optimisation timeframes.

CONTINUOUS DESCENT OPTIMIZATION SCHEME



"Green descents": more ecological and optimised descents
In the Paris region, procedures called "Green Descents" have been assessed since late 2020, whenever the level of traffic has allowed it. They aim to maintain flights at a higher level and to reduce the length of each level on approach during the transfer of control between the CRNA and the approaches. They contribute to a better optimisation of aircraft approach profiles, and consequently, to an emissions reduction. After undergoing various stages of fine-tuning and demonstrating real gains, the process will enter its sustainability phase in 2023.

Descent on Ajaccio from the North by satellite guidance
On 4 April 2022, an Airbus A320neo of Air Corsica inaugurated a new PBN (Performance Based Navigation) process to approach and land from the north at Ajaccio airport. This process, called « RNP AR » (Required Navigation Performance with Authorization Required) allows certified crew and aircraft to safely land facing the sea by overflying a mountainous region, even in adverse meteorological conditions (as low as 2,800 meters of visibility and 630 feet of ceiling.) This process, which requires high levels of performance, was subject to an operational authorisation delivered by the national supervisory authority (DSAC). This process, which relies on GPS guidance, offers a safe and short approach with an optimised descent profile. **It offers significant environmental gains in terms of noise and fuel consumption - and thus CO_2 emission - reduction.** The flight time is reduced by 10 minutes for this specific segment compared with an ILS approach from the South. Moreover, this RNP AR approach avoids flying over urban areas. It also improves airport accessibility by reducing diversions. As part of the SESAR programme, the RNP AR process was assessed around Europe in relation to other areas with equally limiting local configurations. In France, air traffic control organisations in Nice and Ajaccio played a major role in the success of the process' development, which won the Environmental award at the World ATM Congress in Madrid in 2017. This type of process will eventually be extended to the airports in Bordeaux, Marseille, Nice and Chambery. Meanwhile, a hybrid process called "RNP VPT", bringing together IFR and VFR, will soon be made available.

The DSNA has started the labeling of its services in accordance with the "Green ATM" process that CANSO launched in 2022.

CO_2 GAINS IN 2022

In 2022, the actions of air traffic controllers, namely around the optimal use of airspace, have helped reduce carbon emissions and costs due to the differences (in Nm) between the flights carried out and the flights planned:

Reduction in covered distances	**17 932 043 Nm**
Reduction in fuel consumption	**91 453 t**
Reduction in CO_2 emissions	**288 000 t**

© DSNA

Descent on Ajaccio

© Getty Images

Modernised tools **for a better environmental performance**

Technical modernisation will help improve environmental performance. The deployment of the "4Flight" tool, a new control environment and flight planning software for the navigation centres (Centres en route de la navigation) has proved particularly valuable. Other systems also contribute to these developments. Another is the SALTO tool.

SALTO, for traffic management optimisation support

In September 2022, the 5 French CRNA deployed a new version of SALTO. Used by the flow management position (FMP), it helps to anticipate traffic peaks and overrun of control centre capacity in the sectors over a specific time frame. Configuration and measurement change simulation functions are also part of the decision-making process. Each aircraft operator can send requests for regulations, more punctual measurements or sector configuration changes digitally to the Network Manager to match available control capacity and expected traffic flow. And so, by optimising flow management, SALTO helps build a greener aviation sector.

Acropole

The "ACROPOLE" (AirCRaft OPerations nOise & fueL Efficiency) tool helps define new performance indicators using artificial intelligence to determine fuel consumption for each flight. It allows users to analyse flight trajectories and identify potential inefficiencies in terms of consumption: fuel consumption for each monitored flight is compared to that of other flights on the same flow. An overview of 5 years is available.

SkyLab, an innovative tool to drive operational performance

This tool, developed by the DSNA, automatically registers key data linked to air navigation services. It presents users with a series of performance indicators regarding safety, environment, capacity and weather conditions at D + 1. This information provides a better understanding of situational awareness, decisions taken by the controllers, and support studies to improve performance in accordance with operational needs. Environmental performance is analysed through the rate of executed continuous climbs and descents operations (CCO/CDO), aircraft delivery altitudes by the approach controller in the Paris-CDG TMA, the rate of executed night approaches, the strict accordance with the procedures, fuel consumption and CO_2 emission reduction outcomes... Skylab is currently deployed across the operational units of Bâle-Mulhouse, Nice, Paris-Orly, CDG, Le Bourget, Toulouse, Lyon and Bordeaux. There are plans to deploy it across larger airports and a CRNA in 2023. Finally, the possibility of integrating ACROPOLE data into Skylab is currently being examined.

2 — Limiting noise pollution

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Limiting aircraft noise pollution is essential in order to preserve the quality of life of the people living under flight paths and to prevent the various associated health risks. The DGAC plays a key role in the management of aircraft noise pollution by developing and applying specific environmental regulation. Cooperation between the government, industry professionals and local residents is key in order to find sustainable solutions to both limit noise pollution and guarantee efficient and safe air mobility.

20 M€

IN PUBLIC FUNDS allocated to soundproofing for the 5 platforms with the highest needs (Beauvais-Tillé, Paris-Charles de Gaulle and Le Bourget, Nantes-Atlantique and Toulouse-Blagnac)

4 PPBE

APPROVED (Bordeaux–Mérignac, Nice–Côte-d'Azur, Paris–Orly et Toulouse–Blagnac).

3

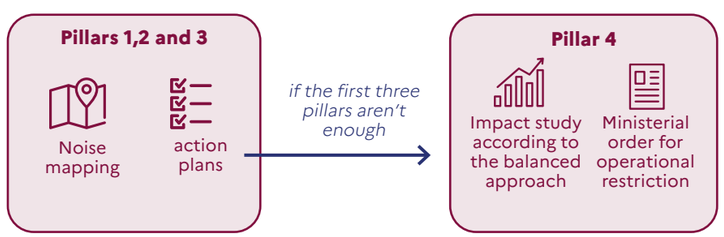
ENTRY INTO FORCE OF 3 NOISE-RELATED OPERATING RESTRICTIONS (Bâle–Mulhouse, Nantes–Atlantique et Lyon–Saint-Exupéry).

A balanced approach
to airport noise management, 2022 assessment

Noise pollution management policies rely on the four pillars of the ICAO Balanced Approach: the reduction of noise at source (operation of more acoustically performing aircraft), land-use planning and management (planning constraints set by the noise exposure plan and by the soundproofing measures of the noise plan), operating low noise procedures and noise abatement (trajectories planned to reduce noise pollution), operating restrictions in airports (curfews, capping traffic…)

Every five years, **strategic noise maps** give a snapshot of current and future noise exposure from major French airports. A diagnostic was drawn out and an associated plan of action introduced: **the Environmental Noise Prevention Plan (PPBE).**
The plan details all the measures pertaining to the first three pillars of the Balanced approach to be developed over the next 5 years. It translates the government's commitment to tackling noise pollution. Interested parties can put forward and support measures on a voluntary basis. A number of airlines have committed to speeding up the renewal of their fleet (especially Air France and FedEx), as part of the PPBE for Paris-Charles de Gaulle for 2022-2026.
These action plans are currently the subject of serious discussions. The DGAC along with prefectural authorities regularly take part in meetings with all stakeholders in a spirit of transparency and ongoing dialogue. This dialogue phase goes hand in hand with a public consultation around the PPBE project. The Paris-CDG project in fact received 1,600 comments, a summary of which was published in December 2022.
In 2022, the Bordeaux-Mérignac, Nice-Côte d'Azur, Paris-Orly and Toulouse-Blagnac PPBE were approved, those of Marseille-Provence and Paris-Charles de Gaulle (for the 2022-2026 period) were subject to a consultation prior to their adoption.

Although the measures considered don't fully prevent any noise issue from arising or don't necessary resolve the problems already identified, the PPBE may provide for the launch of an impact study according to the Balanced Approach methodology (**EIAE**) for the introduction of noise-related operating restrictions (fourth pillar of the Balanced Approach). This assessment is carried out according to the measures set in EU regulation n° 598/2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced approach. Studies carried out across three airports have led to the same number of restriction orders. Those at Bâle-Mulhouse and Nantes-Atlantique implemented in 2022 have improved the sound situation in the vicinity of the airport. In Nantes, the number of movements between midnight and 6 am was reduced six-fold with the introduction of a curfew, going from an average of 9 night flights to 1.3. In Bâle-Mulhouse, since the ban on departures scheduled between 11 pm and midnight, the airport managing bodies noticed a reduction of 75% in the surface area affected by noise during that hour.



AIRPORT	PUBLICATION OF THE ORDER	IMPLEMENTATION	CONTENTS
BÂLE–MULHOUSE	6 August 2021	1 February 2022	Ban on Chapter 3 aircraft with a cumulative margin of less than 13 EPNdB between 10 pm and 6 am. Curfew: Ban on departures programmed between 11 pm and midnight.
LYON–SAINT-EXUPÉRY	29 June 2022	1 February 2023	Ban on Chapter 3 aircraft with a cumulative margin of less than 13EPNdB between 10 pm and 6 am.
NANTES–ATLANTIQUE	28 September 2021	8 April 2022	Ban on Chapter 3 aircraft a cumulative margin of less than 13 EPNdB between 10 pm and 6 am. Curfew: Ban on departures programmed between midnight and 6 am.

The order for Lyon came into effect in the first trimester of 2023. A first assessment should be carried out soon. The French authority in charge of preventing and controlling airport pollution (ACNUSA) is finally able to sanction breaches of the noise-related operating restrictions. The penalty can reach 40,000 Euros (for legal entities).

Designation of a new competent authority in charge of the procedure to follow upon adoption of noise-related operating restrictions
Following pressure from residents associations, the Council of State ruled on 5 April 2022 that the DGAC did not present sufficient guarantees for independence through the regulation n° 598/2014 to properly act as a competent authority "in charge of overseeing the procedure to follow upon adoption of noise-related operating restrictions."
The DGAC is thus in the process of designating a competent authority that would meet the requirements set out by the Council of State.
Once it is chosen, an EIAE will be initiated for the airports of Bordeaux-Mérignac, Lille-Lesquin, Marseille-Provence, Paris-Charles-de-Gaulle (CDG), Paris-Orly and Toulouse-Blagnac.
2023 will see the various stages of development of the programmed EIAE, as well as "4th deadline" PPBE, covering the 2024-2028 period. Consultations will be at the heart of this drive to tackle air noise pollution.

4. According to the European Commission calendar.

"Studies carried out across three airports have led to the same number of restriction orders."

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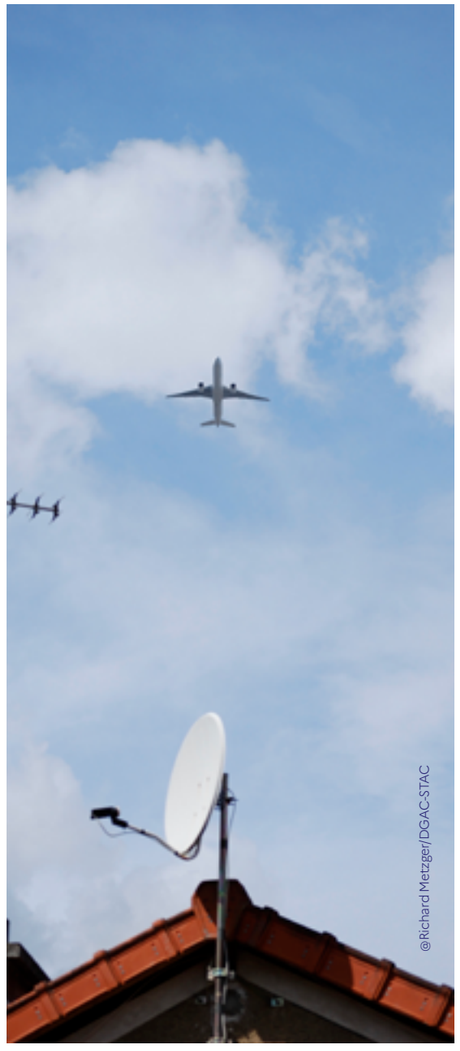
The Government is introducing exceptional benefits

to partially compensate the financing shortfall for **soundproofing work for residents** of the airports' neighbouring areas

The soundproofing policy introduced to support residents of areas around 11 major airports is financed through a special "noise tax" or TNSA that follows the polluter pays principle, paid for by the airlines.

Before the pandemic, the annual revenue generated by the TNSA was 45 M€ and yearly expenditure helped finance the soundproofing of around 4,000 homes.
Since March 2020, the global health crisis has caused a sharp drop in airport traffic and consequently in the income generated by the TNSA. During 2020-2022, it has experienced cumulative losses of around 74 M€.
The sound insulation scheme deteriorated substantially. The soundproofing works fell behind schedule to the point where the Parliament adopted, as a supplementary budget, a benefits package of 8 M€ in 2021 allocated to all airports that were part of the scheme.
The Government gave the Parliament a report about the impacts of the crisis on the insulation scheme and the corrective measures proposed, including the possibility of a total or partial budgetary compensation in the form of a public grant or advance.
In accordance with the solutions proposed in the report, the Parliament adopted a second benefits package totalling 20 M€ as a supplementary budget for 2022. It was allocated in such a way as to prioritise airports that needed the highest level of funding: Paris Charles-de-Gaulle, Paris-Le Bourget, Nantes-Atlantique, Toulouse-Blagnac and Beauvais-Tillé. These airports were home to a particularly high number of pending applications with the Consultation Commission for Assistance for Local Residents (CCAR, for Commission Consultative d'Aide aux Riverains) because of a lack of resources.
This decision means the Government's budgetary contribution will have an immediate effect by speeding up the allocation of support to residents.
It should be pointed out that these two exceptional measures break with the polluter pays principle and represent a strong gesture of solidarity with local residents that have felt the impact of noise pollution caused by air traffic.



5. Beauvais–Tillé, Bordeaux–Mérignac, Lille–Lesquin, Lyon-Saint–Exupéry, Marseille–Provence, Nantes–Atlantique, Nice–Côte–d'Azur, Paris–Charles-de-Gaulle (CDG), Paris–Le Bourget (LBG), Paris–Orly et Toulouse–Blagnac.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The environmental assessment of the PEB

The Noise Exposure Plan (PEB) is the name given to a series of urban planning documents that aim to prevent and limit exposure to noise pollution caused by air traffic in the airports' neighbouring areas. They have been developed with the technical support of the DGAC and approved by prefectural decree following a regulatory phase of consultations with the concerned local authorities, the ACNUSA and the public.

Through a decree from 28 October 2021, the Council of State decided that they should be subject to a preliminary environmental evaluation, which wasn't planned under current legislation.
The General Commissariat for Sustainable Development (CGDD) has been working with the DGAC to develop a decree setting out various measures pertaining to environmental assessments and public participation. It aims specifically to designate the competent environmental authority and organise an environmental assessment submission procedure for the noise plans.
This document will be presented in the coming weeks to the Council of State.
Finally, a workgroup will shortly be created by the General Inspectorate for the Environment and Sustainable Development (IGEDD), its local environmental authorities (MRAe) and the DGAC to supervise the assessments and guide the various French Interregional Directorates for Civil Aviation Safety (DSAC-IRs) in the implementation of this new procedure.

CIGALE: Improving the description of aircraft noise pollution

In order to better understand the impact of noise pollution felt by residents when an aircraft flies by, an interdisciplinary research project named CIGALE (Conciliation des études sur la Gêne Aéroportuaire en Laboratoire et des Enquêtes de terrain - lab studies and on the ground investigations into the impact of air noise pollution) was launched in 2019, bringing together researchers from the ONERA, the CNRS, the University of Cergy-Pontoise and the Environmental Psychology Research Office (ENVIRONNONS, bureau de recherche en psychologie environnementale).

The ultimate aim is to be able to offer innovative solutions to reduce nuisances.
One of the main objectives is a better integration of non acoustic factors in the management of noise pollution, in order to contribute to the wider objective of air traffic environmental impact reduction. A study conducted amongst 1,250 residents living near the airports of Toulouse-Blagnac and Paris-Charles de Gaulle helped draw a typology of six resident profiles according to their personal experiences to qualify and better understand the impact of noise pollution.
The next step will be to work on the possible integration of this typology into the implementation of operational tools. In 2022, the representatives of the various stakeholders (Airbus, ADP, Toulouse airport, DSNA, as well as all the other relevant departments from the DGAC) took part in workshops focusing on integrating this typology into operational tools. The results of these works will be presented to a specialised audience during a workshop organised by the DGAC in June 2023.

An important campaign for acoustic measures at La Reunion in May 2022

The largest campaign for acoustic measures in 2022 was deployed at Reunion Island, specifically targeting 7 different sensitive points, in order to objectify the emergence of air traffic noise, a currently very contentious matter.
The acoustic emergenceis assessed in terms of the difference in decibels (dB) between the specific noise we're characterising and the prevailing residual noise level (i.e. the background noise which exists in absence of the specific noise caused by air traffic). The results analysis will help establish a local noise management strategy in 2023, to better tackle the problems linked to the noise pollution the residents are currently enduring. The measures do confirm that there is noise pollution, although the situations differ geographically:

- The most affected region is that of Cilaos, even though the duration and level of exposure are moderate. The acoustic study confirms that the noise is a nuisance to residents, as the residual noise is very low. One of the solutions to reduce the impact is to modify the trajectories and height of the flight, with in return, a reduction in the level of nuisance confirmed by residents,

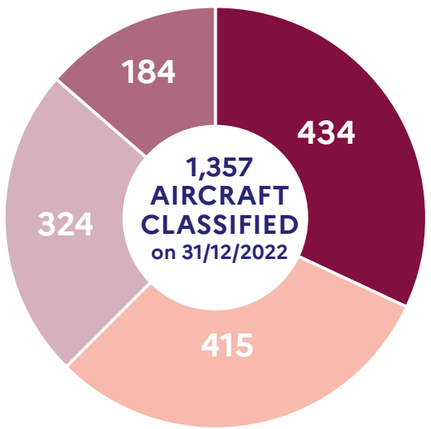
- In the West, the recent modification of the trajectories adopted by helicopters in response to the complaints has helped reduce the nuisance,

- In the South, data is less usable given the lack of movements at the time the measurements were taken, although the residual noise is higher.

Recap on **Calipso**

6th measuring centre in Aubenas. Created in 2013, the CALIPSO tool allows the classification of light aircraft according to their sound performance index (A, B, C or D). A, the index for the quietest planes, represents 30% of the classified aircraft. Although the South-East had been left out in the last few years, it now has its own CALIPSO measuring site: Aubenas, in Ardeche, which carried out its first measurements in March 2023.
The classification of these aircraft is freely available on the CALIPSO web app:
https://calipso.dta.aviation-civile.gouv.fr/application-externe/.

2022 ASSESSMENT



CLASSE : 434 aircraft
IP (sound performance index) ≥ 60
By measure: 80
(4 en 2022)
By equivalence: 354
(31 en 2022)

CLASS B : 415 aircraft
30 ≤ IP < 60
By measure: 80
(4 en 2022)
By equivalence: 335
(26 en 2022)

CLASS C : 324 aircraft
0 ≤ IP < 30
By measure: 55
(0 en 2022)
By equivalence: 269
(28 en 2022)

CLASS D : 184 aircraft
IP < 0
By measure: 43
(0 en 2022)
By equivalence: 141
(5 en 2022)

Review of helipads
following the Summer assessment in Saint Tropez

The decree of 27 April 2022, which modified the measures for take-off and landing of aircraft outside of airfields and created a set of sanctions, and the order from 24 April 2022 modifying the decree from 6 May 1995 regarding airfields and other spots used by helicopters, have deeply reformed the regulatory framework for the operation of helipads:
- prefects can submit a works declaration and regulate the use of helipads in a given territory,
- tools (to strengthen helicopter movement transmission obligations on helipads, rules around movement counting on the same helipad) enable better activity management,
- an administrative penalty system (up to 750 euros for a physical person and 3,750 euros for a legal entity) was introduced.

Cannes airport

The prefectural order of 21 June 2022 has introduced new legislation pertaining to helipads (helisurfaces) in a number of communes in the Var by imposing various obligations on helicopter operators and by strengthening the restrictions of helipad usage throughout the year, with specific limitations during the period of 15 June to 15 october. The local measures and the swiftness with which they were implemented in case of a breach have helped ensure from the start of the summer season that local helicopter operators stick closely to the new set of rules.

The expectations are high but the results are telling. Statistical data analysis from July to August 2022 shows a sharp drop in movements on the helipads of the peninsula (- 58 % compared to 2021 and - 67 % compared to 2019). Although a slight uptake in movement was noted at the airport of La Mole (+ 136 % compared to 2021 and + 59 % compared to 2019) and, to a lesser extent, the Grimaud helipad (+ 20 % compared to 2021 and + 15 % compared to 2019), the global drop in the number of movements across the peninsula remains significant (- 22 % compared to 2021 and - 38% compared to 2019).
During the summer of 2022, the Grimaud helipad offered helicopter operators as many movements as all the landing pads in the peninsula (respectively 2,564 and 2,579 movements).
The DGAC will continue to promote the creation of a number of helipads on specific chosen spots in coordination with the Communauté de communes du Golfe de Saint-Tropez (community representative group), which will host the aircraft that currently use the landing pads.

THE ORDER OF 27 JUNE 2022 limiting the conditions of use of the **Grimaud helipad** sets out that from 1 July to 15 September of each year, all movement between 1.15 pm and 3.45 pm is prohibited and that the number of daily movements is limited to 60.

The environmental charters,
highlighting the priority given to dialogue

With a view to improve the integration of airfields within their environment and encourage dialogue between local residents and passengers, environmental charters have been re-written to evolve with the times. Which is why it's always worth taking a closer look.

An environmental charter aims to "implement all the measures likely to reduce nuisances suffered by local residents (....) without either hindering or challenging the rights of passengers to go about their activities in accordance with the current legislation," to quote the Charter of the Chavenay-Villepreux airfield. It encourages dialogue between all the various stakeholders and aims to reach a compromise by avoiding the implementation of even more restrictive measures, which could lead to sanctions for light aircraft users. They have been signed by all stakeholders and validated by the CCE.

In 2022, 5 new airfields signed a charter: Lyon-Bron, Aix les Mille, Chavenay, Lognes and Valence-Chabeuil.

The measures implemented by the environmental charters are varied and have been adapted to meet specific local challenges.

For passengers, the commitments are geared towards things like progressively improving the fleets and updating the terms and conditions of the use of the platform. The charters mention, for example, the commitment to respect low noise measures, to carry out circling with the aircraft with the best acoustic performance during certain times, to regularly train and raise awareness amongst pilots.

In terms of airport managing bodies, the measures can apply to things like the complaint processing system (with for example the introduction of a management protocol ensuring their timely processing, like in DSAC Ouest) or the facilitation of dispute settlements, or conflict prevention with the introduction of a mediator (like in Lyon-Bron). Managing bodies can also install landmarks that help respect the airport traffic pattern, as well as measuring systems that enable the measuring of changes in noise pollution levels. Finally, through those charters, airport managing bodies can develop their commitment to limit carbon emissions, preserve air quality and develop the biodiversity of their platforms.

The conditions for implementation of these charters are regularly reviewed (usually once a year) by a review committee, which helps keep a constant dialogue going between the various stakeholders and facilitate regular assessments that may lead to new directions and evolutions for the charters.

3 —

Improving air quality

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Cannes airport

Air quality is a major public health issue. For about a decade or so, emissions and atmospheric pollutant concentrations have been diminishing but there is progress to be made. The aviation sector, although a minor contributor, is actively engaged in that effort.

41 %

ELECTRIC, HYBRID OR GAS GROUND SUPPORT EQUIPMENT IN 2021, 9% more than 2020. The aim is to reach 90% of sustainable ground support equipment by 2030.

100 %

AIRCRAFT CONTACT stands equipped to supply electricity to stationary aircraft from 2025, as per the objective of the AFIR European regulation.

Decarbonisation
of ground operations in airports

WHAT'S AN APU?
The Auxiliary Power Unit (APU) is a small turboreactor (heat engine) near the rear of the fuselage. When the aircraft is grounded, it provides the energy supply and air conditioning and helps start up the main reactors. However, during a stopover, it is possible to replace it with electrical or heat solutions that generate less noise, GHG and air pollutants.

e-GPU

New APU usage time limitation decrees

These decrees aim to limit the usage time for aircraft APUs during a stopover in the 12 main airports in France under the control of the ACNUSA. Until then, only 5 airports had such a set up (the airports in Ile-de-France, Nantes and Nice). The aim is to reduce pollutant emissions linked to engine usage, which is beneficial both to tackle climate change and improve air quality. The DGAC has made a real effort to initiate dialogue and consultations with the various stakeholders (airport managing bodies, airlines, residents associations, elected representatives...) since 2021. This work has resulted in the development of a decree specifically focused on reducing the usage time of APUs on platforms that are already subject to a restriction order, the generalisation of the APU time limits to the main airport platforms, consistency in the decree's formulation and the determination of the timings imposed whilst allowing for leeway to take into account local specificities.
The decrees differentiate between the APU usage time upon departure from that upon landing, according to the availability of substitutional means in terms of electricity, air conditionning and heating, as well as the capacity of the aircraft depending on their mass.
The decree projects were presented to the Environmental Consultation Committee (CCE) for every platform concerned in late 2022. They were then subject to public consultation and presented to the ACNUSA.
These decrees will be implemented in the Autumn of 2023, depending on the airports.
These regulations will be strengthened by the revision of the European regulations AFIR and RTE-T, which will add certain equipment-related obligations to airport managing bodies.

The APU-OFF solution

The APU-OFF (the APU is totally turned off when the aircraft is grounded) helps consume less kerosene and reduce GHG and pollutant emissions and noise pollution.
Having the APU off is possible thanks to the use of substitutional means that can be fixed or mobile. To supply electricity, the fixed equipment is the 400 Hz connector and the mobile equipment is the Ground Power Unit (GPU). To supply air conditioning and heating, the fixed equipment is the Pre-Conditioned Air (PCA) and the mobile equipment is the Air Conditioning Unit (ACU). The use of APU substitutions allows a considerable reduction in carbon footprint (between 6 and 10 tons of emissions per year against 408 to 1,166 tons with the APU) and in noise levels (75dB against 120 dB with the APU). Usage costs are much lower compared to the costs generated by kerosene consumption and APU maintenance. They offer better airport security and improve relations with neighbouring areas.

Electrical ground support equipment (GSE)

There is a lot of ground support equipment across airport platforms and the majority of that equipment uses heat engines but the transition is underway. According to the Chambre Syndicale des Assistants en Escale (CSAE) (trade association for ground handlers), the fleet in 2021 had 41% sustainable ground support equipment (electrical, hybrid or gas), more than 9% compared to 2020. The aim is to reach 90% of sustainable equipment by 2030. Sustainable ground support equipment also offers advantages compared with more traditional equipment thanks to accrued longevity and the modularity of its components. The electrification of the fleets must go hand in hand with the installation of electrical charging infrastructure and requires more collaboration between all the key actors of the aviation sector.

An electric and autonomous luggage transport solution for greener airports

TractEasy is an autonomous electric baggage handling solution, which aims to reduce pollutant emissions from airport ground operations by providing an intelligent, efficient and clean alternative. TLD, the company that developed this solution, was welcomed into the Solar Impulse foundation with its sustainable GSE solutions TaxiBot and TractEasy.

The first 100% electric de-icer in Clermont-Ferrand Auvergne

The Clermont-Ferrand Auvergne airport, managed by VINCI Airports, recently received the very first 100% electric aircraft de-icer to be made. The Elephant e-Mini MY Lite de-icer can be used for all small and medium-range aircraft (ATR, Airbus A320/321, B737) that transit through the airport. Equipped with a powerful battery, it can carry out 8 to 12 defrostings per charge depending on the state of the aircraft and can cover 40 to 75 km.

De-icer at Clermont-Ferrand airport

Regulatory levers
to accelerate the energy transition

The AFIR regulation revision
Following the EU Council's general political direction from June 2022 and the latter's adoption by the European Parliament in October 2022, the negotiations around the revision of the European regulation for the deployment of alternative fuels infrastructure (AFIR) have been the subject of a trilogue that concluded during the first semester of 2023. The document sets out an obligation for airport managing bodies belonging to the comprehensive and core Trans-European Transport Network (TEN-T) to ensure the electrical supply for stationary aircraft. This obligation concerns commercial air transport operations: by 1 January 2025 for all contact stands (gates) and by 1st January 2030 for all remote stands (outfield positions). Until 1 January 2030, the use of diesel ground power units (GPUs) is allowed to power contact stands. The aim is to encourage the use of electricity instead of kerosene.


© Guinault

The revision of the TEN-T regulation
The regulation around the general approach of the EU for the development of a Trans-European Transport Network (TEN-T) is currently being revised. It should compel airports managing bodies across the network's airports to supply preconditioned air to stationary commercial aircraft. As part of the general approach of the EU Council in December 2022, this obligation should concern airports whose annual passenger traffic is over 4 million. It should apply to contact stands at the latest by 31 December 2030 for airports belonging to the core network, and by 31 December 2040 for those belonging to the comprehensive network.

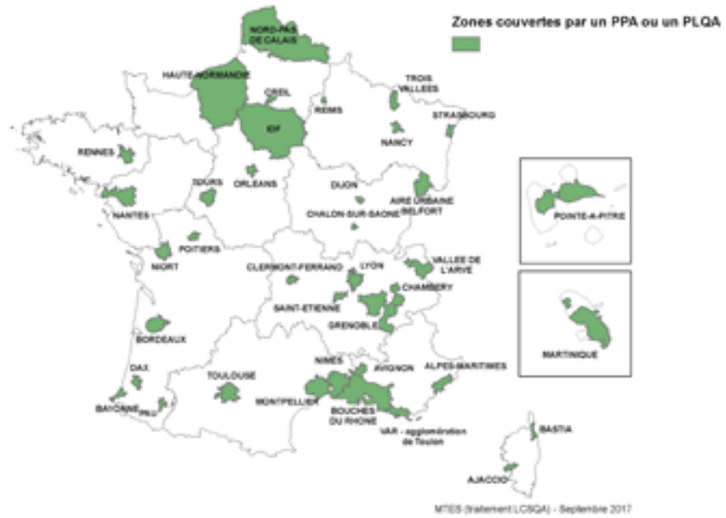
Creation of a TICFE reduced tariff for stationary aircraft
Electricity for stationary aircrafts is provided either through auxiliary GPUs that use kerosene or via a 400 Hz cable . In order to facilitate ground supply and reduce pollution, a change in the finance law of 2021 introduced a reduced tariff for the French domestic tax on final electricity consumption (TICFE) for the electricity supplied by airports to the stationary aircraft. The tariff is fixed at 0.5 euros/ megawatthour in accordance with that adopted via the finance law of 2020 for stationary ships. The European Commission was informed by the French authorities of this measure, which should receive the preliminary agreement of the Council.

The revision of the French National Air Pollutant Emission Reduction Plan (PREPA)

Every year, the French Government puts together a national air pollutant emission reduction plan (PREPA) in order to protect both people and environment. It sets out the various priority axes for emission reduction in accordance with the European commitments for 4 sectors: transport, industry, residential and agriculture.
The PREPA for the period of 2022-2025 has been applicable since 8 December 2022, the date the decree was issued. In regard to air traffic, the specific actions involve (i) limiting the use of APUs across the 12 main French airports, (ii) a reduced taxation on electricity for stationary aircraft via the TICFE, as well as (iii) the implementation of a series of actions by the airports managing bodies to reduce, in 2025 and by at least 20% (compared to 2010), the intensity of their platforms' GHG and pollutant emissions.

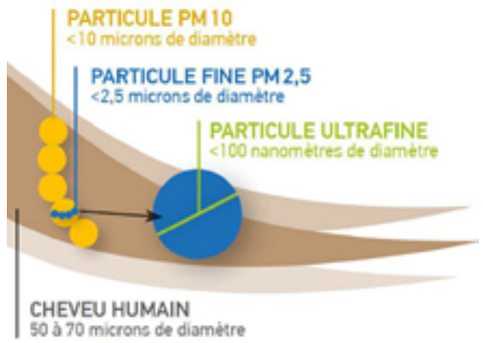
Atmosphere protection plans (PPA)

In France, air quality monitoring has been compulsory since 1996 and was established by the law on "Air Quality and the Rational Use of Energy" (LAURE). On a local level, in towns of more than 250,000 inhabitants, the law is applied via atmosphere protection plans (PPA) that detail the measures taken to improve air quality over a period of 5 years. At the end of that period, the plan is assessed and revised. The prefect, in collaboration with local partners and the relevant Government departments (including the DTA through the DSAC/IR), defines a new strategy and new measures to implement over the next 5 years that are compatible with the directions taken by the regional air quality plan (PRQA) and the territorial climate-air-energy plans (PACET). The aim is to pursue and speed up the improvement of air quality in cities in order to protect public health, amongst other things.
In 2022, the PPAs in the Lyon, Bordeaux and Paris conurbations had either been revised or were in the process of being revised. Local air travel industry professionals took part in the process. Their actions were specifically geared towards pollution reduction across airport platforms, the renewal of fleets in airports, the support for the development of mobility plans across airport platforms and the improvement of understanding and knowledge through air quality measurement procedures.



Areas covered by a PPA or a PLQA, subject to recent evolutions

Ultrafine particles
measurement campaigns



WHAT ARE UFPS?
The UFPs are particles that are less than 100 nanometers in diameter. The principal sources of UFP emissions can be natural (forest fires, volcanos, wind erosion…) or linked to human activity (industrial processes, road traffic, air traffic, central heating…).

The UFPs, a still little-known source of pollution

Ultrafine particle pollution is not particularly well documented. Consequently, unlike other types of pollutants (fine particles, nitrogen oxide) whose concentration levels are highly regulated, there is no current legislation that regulates UFPs' concentration levels.
According to a notice issued by the French Agency for Food, Environmental and Occupational Health & Safety (ANSES) from July 2019, these particles, due to their small size, can get deep into the human body and therefore have a bigger impact on health than the larger particles, such as fine particles. Such impact can not however be accurately quantified given the lack of available data. This is why the ANSES considers it essential to complete and regularly update data acquisition from ambient air given the public health issues at stake.

A long-standing study carried out at the Nantes-Atlantique airport

A long-standing study on air quality around the Nantes-Atlantique airport is currently underway. Spearheaded by Air Pays de la Loire, an association certified for monitoring the quality of the air (AASQA), it is a government's commitment following the preliminary consultation around the airport's refurbishment to meet the concerns expressed at that time about air quality.

The objects of the study:
- Assessing the UFP's levels of concentration in urban areas outside the airport's zone of influence and in inhabited areas near the airport,
- Studying the influence of air traffic on the level of UFP concentration by comparing the results obtained in the urban zone in Nantes and in the airport's surrounding area,
- Sharing the results obtained with all key actors of the scientific community in order to improve knowledge and understanding of UFPs and thereby shedding light on their health impact.

The set up is made up of 4 measurement campaigns lasting between 3 and 6 months, carried out using equipment such as SMPSs measuring concentration in terms of numbers of ultrafine particles per cm3 classified according to their sizes (7 classes from 5 nm, class 1 covers particles from 5 to 20 nm).

The results:
- In urban areas: 2 increases in UFP concentration that can last between 2 and 6 hours have been observed, one in the morning, linked to road traffic, and one in the evening, linked to both road traffic and central heating during the winter months,
- Near the airport: lower urban background pollution levels than in urban areas have been observed with, nevertheless, a number of peaks of concentration of particles smaller than 20 nm coming from the runway lasting from 5 to 10 minutes. A correlation was thus established between the daily profiles of the concentrations and the daily profile of the traffic, when winds come from the runway, which is 3% of the time.

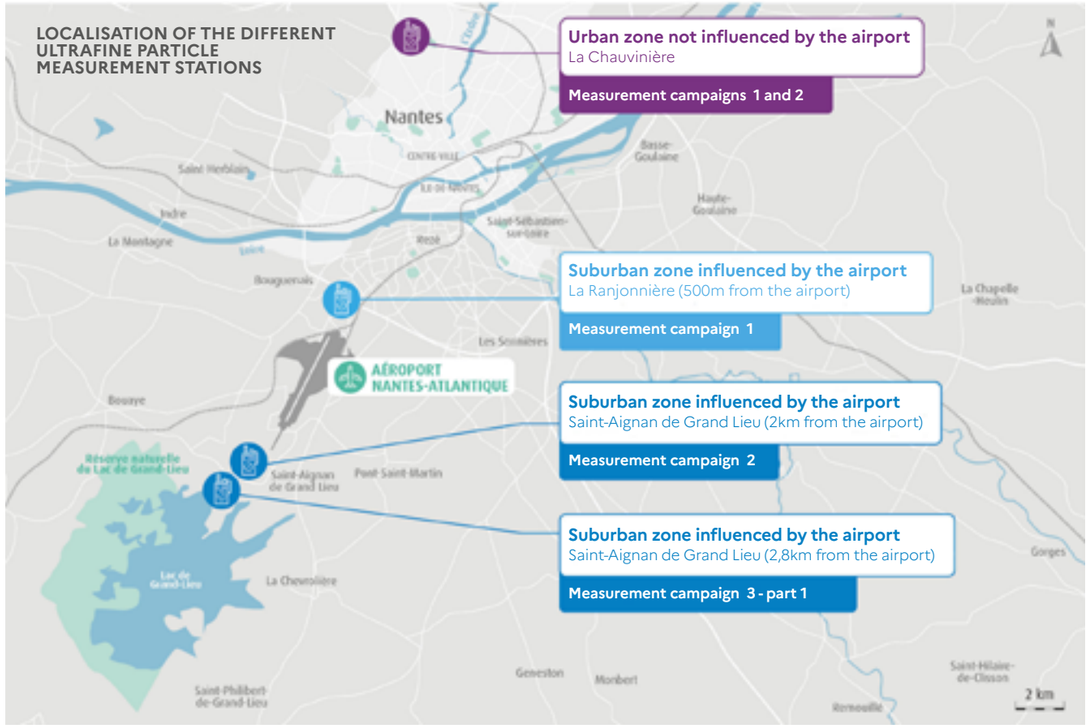
The study started in November 2020. It should continue until the end of 2023 in order to assess the impact of the resumption of air transport on air quality.

A study is underway in the Paris region

Airparif launched in December 2020 an exploratory study over 4 years to strengthen the operational monitoring of ultrafine particles. It helps assess the spatial and temporal variability of the UFPs (level in terms of numbers and granulometrical classification) in different environments: as background (far from specific sources of pollution), along road traffic and near Francilien airport platforms (Paris-CDG and Paris-Orly). The results of the first 2 campaigns on the first 2 environments are available on the Airparif website: https://www.airparif.asso.fr. The campaign around the Paris-Charles de Gaulle airport started in the summer of 2022 with results expected in 2023. The campaign along road traffic has highlighted UFP concentration levels 2 to 5 times higher along the roads than the Parisian reference site, with UFPs with an average diameter of 15 nm.

An increase in the number of studies is necessary to improve understanding

A number of AASQAs have initiated plans to document the levels of UFP concentration and their associated granulometrics in various French regions. A study of Nice airport was conducted and published in 2021 by AtmoSud, on top of the ones carried out in Nantes and in the Paris region. It concluded that airport activity did indeed have an influence on the number of UFPs but that it was difficult to link the number of UFPs specifically to the number of aircraft movements (the latter not being the only source of UFP emissions).
The results of these studies will enable a better understanding of UFP properties and will help carry out epidemiological studies to better characterise the health effects and the mechanisms at play.



Air quality monitoring
in and around airports

©Hawa-Mayotte

Air quality measurement station in Mayotte.

Airports have a mission to monitor air quality in and around their platforms. To this end, they regularly carry out measurement campaigns and atmospheric emission inventories. The campaigns assess the levels of pollutant concentration whereas the inventories assess the contribution of each source of pollutant emissions, allowing us to identify where reductions can be made. The ACNUSA recommends carrying out campaigns at least every 5 years (fine particles, nitrogen dioxide or NO2, COV depending on cases) and inventories every 2 to 5 years depending on the level of traffic at the airport. Airports are generally supported by the AASQA (see p.36) to carry out those studies.

Air quality study on the Ile de Petite-terre in Mayotte

One of the objectives of the regional air quality monitoring plan (PRSQA) 2017-2021 was to improve knowledge and understanding of ambient air pollution in Mayotte. As part of this, Hawa Mayotte, its air quality observatory, chose to assess the air quality on Petite-terre island in Mayotte where the airport is located, along with some of the territory's industrial and economic activities. The pollutants measured were M10, PM2,5, NO2 and C6H6. The campaign took 5 months and started in April 2022. The results showed that the annual average concentration levels have not exceeded regulatory values. However, we have spotted a few punctual peaks during the southern winter that could be due to the dry season and to road repairs carried out during the winter season.

Measurement campaign at the Bordeaux-Merignac airport

A measurement campaign was launched at the Bordeaux-Merignac airport (ADBM) as part of the platform's air quality monitoring activity. It was spearheaded by ATMO Nouvelle-Aquitaine which carried out measurements over 2 periods of one month each, in February-March and July-August 2021, within and around the airport. The campaign had a number of objectives: assessing pollutant concentration levels, verifying that the regulations are met, comparing the results with 2 reference stations from ATMO Nouvelle-Aquitaine's fixed network (urban background and traffic), assessing the monitoring of the previous similar campaign conducted in 2011 and suggesting modeling maps for the airport. The regulatory values were respected for all relevant pollutants. The thresholds recommended by the WHO were exceeded in regards specifically to particles PM10, PM2.5 and NO2 both at the airport's site and at the reference sites, which does signal that it is background pollution.

4 —

Innovation for the sustainable development of the aviation sector

© aura aéro

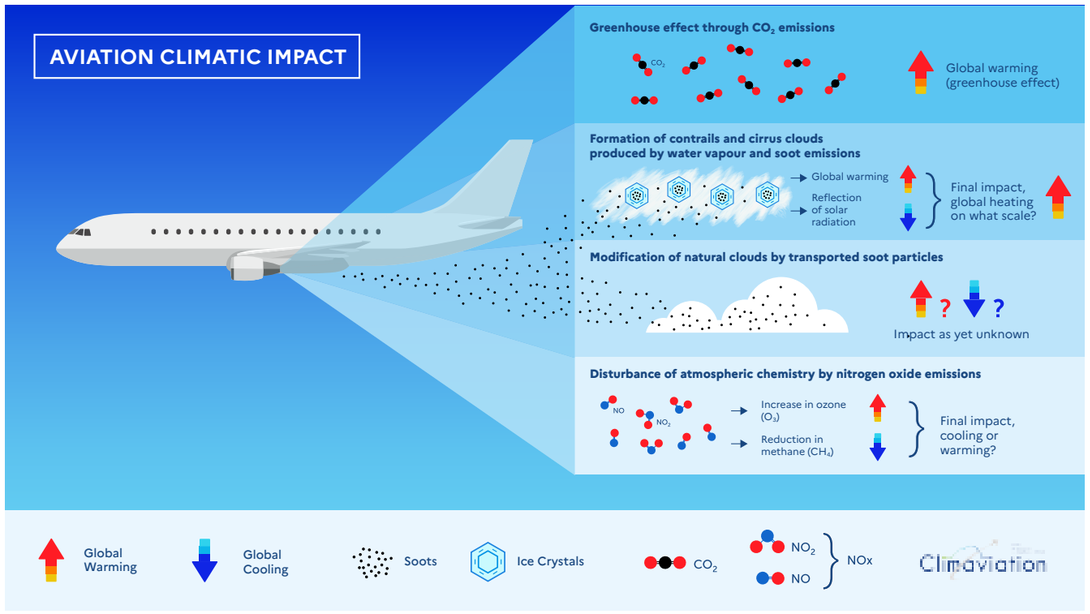
ERA model by Aura aéro

The CORAC section of the France 2030 plan is harnessing 800 M€ in funds operated by the DGAC, in order to push a dynamic R&D process kickstarted by the sector thanks to the France Relance plan, which has already supported over 230 projects representing 1.6 M€ between 2020 and 2022. For France 2030, 300 M€ have already been invested in alignment with CORAC partnership roadmap in 2022 to prepare major technological demonstrations of low carbon aircraft, by 2025-2030.

800 M€

THIS IS THE SUM ALLOCATED to the aviation section of the France 2030 plan.

What is the climatic impact of hydrogen-powered aircraft?



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Hydrogen-powered engines are increasingly looking like one of the most promising technological solutions to decarbonise aviation as hydrogen combustion doesn't produce any CO_2. However, compared with kerosene, hydrogen combustion increases the release of water vapour into the upper atmosphere by a factor of 2.6 and could therefore generate more contrails, a potentially major contributor to non-CO_2 effects of the aviation sector (see boxed text). Aircraft manufacturers and scientists are therefore trying to understand the mechanisms behind the formation of "hydrogen trails" and thereby reduce the uncertainty around their climatic impact.

Creating a scientific consensus

Research on the non-CO_2 effects of aviation has been carried out since 2021, as part of the Climaviation scientific programme, supported by the DGAC with 11.5 M€ in funds. Climaviation brings together the climatology expertise of the IPSL (Institut Pierre Simon Laplace) and aviation expertise of the ONERA. Thanks to this unprecedented collaboration, this programme aims to produce the scientific body of knowledge needed to create a global consensus on non-CO_2 effects. This knowledge should also help guide effectively the choice of aircraft manufacturer in terms of future "low carbon" combustibles (CADand H2). When it comes to contrails, the work carried out covers their entire lifecycles, from their initial formation in the field close to the plane through their evolution on a meteorological scale and finally their impact on a climatic scale.

Understanding the initial formation of ice crystals in the case of hydrogen

In the case of traditional fuels, water vapour condenses on engine-derived soot, creating droplets, which then freeze to form the ice crystals, which then results in contrails. In the case of hydrogen, combustion doesn't generate soot and the non-volatile particle emissions are drastically reduced. The only particles likely to play the role of "condensation nuclei" are therefore those already present in the atmosphere or the secondary aerosols formed in the wake of the aircraft.
This makes it necessary to analyse in detail the new microphysical mechanisms that may be involved in this particular case, then to integrate these mechanisms into modeling tools in order to obtain a reliable assessment of the number or even the size of the crystals formed.

Simulation the evolution of near field hydrogen trails on a meteorological scale

Once the ice crystals have formed, they evolve in the vortex wake of the plane, which depends on the configuration of the plane (shape of the wings, position of the engines, etc.). This near-field interaction will determine the evolution of the contrails up to a few minutes after the aircraft has passed. At these small scales, several numerical simulation tools have been developed to characterise the initial properties of contrails, but these tools still need to be properly adapted. Beyond that, depending on the atmospheric conditions, the contrails can evaporate quickly or persist for several hours, or even evolve into cirrus-type clouds extending over several tens of kilometres. To assess their impact, it is necessary to simulate the aging of contrails at these meteorological scales. However, modeling tools are still underdeveloped due to difficulties in our ability to take into account the behavior of the atmosphere and the potential influence of the near field on the properties of contrails in the far field.

Finally, to validate the models, it is necessary to have representative measurements on the condensation trails at the different scales, but the experimental data are rare and even non-existent in the case of hydrogen.

Assessing the climatic impact of hydrogen contrails

Understanding the formation and then the evolution of isolated hydrogen contrails is not enough to assess their climatic impact. To do this, it is also necessary to calculate their contribution to radiative forcing, taking into account in particular the properties of the ice crystals they contain, and then to model their spatio-temporal distribution on a global scale, by characterising the properties of the supersaturated regions conducive to their appearance, and finally integrating all this new knowledge on hydrogen contrails into planetary climate models to measure their impact on high cloud cover and radiation.

NON-CO_2 EFFECTS OF AVIATION

Non-CO_2 effects refer to a set of phenomena resulting from non-CO_2 emissions from aircraft into the atmosphere that lead to global cooling or warming. Unlike the effects of CO_2 emissions whose warming properties are well known, the effects of these phenomena remain uncertain. They include persistent condensation trails and emissions of nitrogen oxides (NOx), water vapour and fine particles. In the case of hydrogen, which produces 2.6 times more water vapour during its combustion than kerosene but no fine particles, the effects of persistent contrails, water vapour and NOx are predominant.

A revival
of light aviation driven by the necessity of decarbonisation

Like other aviation segments, light aviation (or general aviation) is subject to increasing environmental requirements and must accelerate its energy transition. This new context represents so many opportunities to create new light "low carbon" aircraft, while meeting new mobility needs. In addition to the historical aircraft manufacturers in the sector, new players are appearing in this segment, in Europe and around the world, thanks to a new certification regulatory framework, CS-23 Amendment 5 in Europe, which promotes innovation by delegating the development of appropriate means of compliance to manufacturers.

©Ascendance-Flight technologies

Ascent (Flight technologies)- Atéa model

To develop these new aircraft, light aviation builders can rely on the technologies developed by the major commercial aviation manufacturers, particularly in the fields of electrification of propulsion, the use of SAF and the hydrogen propulsion, which are equally relevant decarbonisation pathways for light aircraft.

Conversely, light aviation can, in some cases, serve as a technical and regulatory framework to reduce the risks posed by solutions potentially applicable to larger aircraft. In France, light aviation is experiencing a real revival, driven by the historic aircraft manufacturer Daher and emerging aircraft manufacturers, such as Elixir Aircraft, Aura Aero or Voltaero. CORAC (see p.47) supports this new momentum by bringing these key actors together around a shared technological roadmap, focused on the decarbonisation of light aviation, whilst promoting synergies with the major CORAC manufacturers (see p .47) and ONERA. These CORAC structuring efforts have already led to the emergence and support of several unifying projects, such as the EcoPulse™ distributed hybrid propulsion aircraft demonstrator project led by Daher in collaboration with Airbus and Safran, or the BeautHyFuel project design of a hydrogen propulsion system for light aircraft supported by Elixir Aircraft and the relatively new engine manufacturer Turbotech, in association with Daher, Safran and Air Liquide.

Beyond that, the France 2030 plan provides emerging industry actors with appropriate tools to accelerate the industrial scale-up of their "low carbon" light aircraft projects. In addition to new equity financing tools accessible to all industrial start-ups, the call for proposals for the «Producing low-carbon aircraft in France» project is offering support for development and industrialisation to the tune of €100 million, managed by Bpifrance. The first winners of this call for projects, which closed in December 2022, were announced at the start of 2023.

New air mobility:
the deployment of the VTOL

©Groupe_ADP

The French VTOL 2024 project, which aims to transport passengers to the Olympic and Paralympic Games via a new proof of concept (POC) electric vertical takeoff and landing (eVTOL) vehicle, is gaining momentum. 2022 saw the creation of a vertiport at Pontoise aerodrome.

Designed and developed by Skyports and the ADP group, this vertiport will serve as a test bed for all the aeronautical infrastructures and services of these future aircraft: access to the terminal, control areas, boarding, take-off and landing, hangar. This experiment will be used directly for the development of several vertiports in the Paris region to meet the 2024 deadline. 5 vertiports have been selected to offer connections to passengers: the Paris-Issy-les-Moulineaux heliport , the St-Cyr-l'Ecole airfield, the CDG and Le Bourget airports and a future barge located on the Seine in Paris at the Quai d'Austerlitz.

2022 was also a year of VTOL tests with flight demonstrations in a real environment, in order to measure their acoustic and vibration impact and their integration into the airspace.

Thus, in March, a campaign of acoustic measurements - a joint effort by the acoustics laboratories of BruitParif, ONERA, RATP and STAC (the DGAC's Civil Aviation Technical Service) was set up to characterise the sound radiated on the ground by this new type of aircraft in various flight conditions: overflight, hover, take-off and approach. Acoustic sensors were implanted at ground level on a 300-meter long straight line perpendicular to the direction of flight, on a 10-meter vertical arm, and at other critical locations. This acoustic set-up was supplemented by accelerometers, Meduse double video-noise sensors (developed by BruitParif), Ambisonic sensors and a weather station. The e-VTOL was also equipped with a D-GPS system to ensure precise 3D positioning relative to microphone arrays.

The results correspond to the level of 76 dB(A), which is the equivalent of the sound emissions of a bus. The Volocopter eVTOL is 4 times less noisy than a helicopter.

In September, the integration of these new aircraft, a drone and an electric aircraft was tested under the aegis of the European program SESAR for innovation in air traffic management. A series of flight tests successfully simulated evasive manoeuvres in real life situations.

© Groupe_ADP

Falcon 10X

innovation at the service of environmental performance

©Dassault

Dassault's Falcon 10X

The Falcon 10X is the new business jet developed by Dassault Aviation. Scheduled for launch at the end of 2025, a number of major innovations focused on environmental performance set it apart.

Firstly, the Falcon 10X will be certified to fly on 100% sustainable aviation fuel (SAF) once it is in service. Currently, aircraft are allowed to use up to 50% SAF. Depending on the feedstock , SAF reduce CO_2 emissions by 70% to 95% over their entire life cycle. With a "100% SAF" capacity, the Falcon 10X will thus offer major decarbonisation potential.

The new engine of the Falcon 10X (Rolls Royce Pearl 10X) will not only offer full compatibility with SAF but also improved energy efficiency, allowing a 5% reduction in emissions compared to previous generations. In addition, the Falcon 10X will be equipped with a particularly thin and optimised engine nacelle in order to reduce the impacts of engine integration on drag and noise.

The Falcon 10X also benefits from innovative designs for its wing and fuselage, which also help reduce its environmental impact. This new jet will be equipped with a large, high-swept airfoil with an active control system to improve cruise performance. This will be manufactured exclusively with composite materials using carbon fibers - a first on a Falcon, significantly reducing the weight of the aircraft and by extension its fuel consumption. By way of illustration, a weight reduction of 100 kg on a Falcon-type aircraft improves energy efficiency by approximately 1%. The aircraft's metal fuselage and empennages have also been optimised to reduce weight and improve high-speed cruise performance.

Finally, Falcon 10X flight paths will be optimised thanks to an innovative avionics system ensuring safe navigation, whilst reducing fuel consumption and CO_2 emissions, with an estimated potential gain of up to 15% on one mission. This system will also have a function that will allow the aircraft operators to use adapted landing and take-off procedures to minimise the noise footprint.

The Falcon 10X clearly thus incorporates significant technological advances, combining performance and environmental benefit. These innovations are the result of research work consistent with the environmental objectives of the CORAC roadmap (see p.47) and supported by the DGAC via the France Relance (included in Next Generation EU) and France 2030 plans.

New aviation fuels

ONERA adapts its combustion test benches to new fuels

New aviation fuels such as sustainable aviation fuels (SAF) or hydrogen (H2) have a major role to play in decarbonising aviation. Beyond the issues related to the supply of these fuels, their impacts on aircraft must be assessed, in particular during combustion, because their properties can differ significantly from those of conventional fuels.

The study of combustion phenomena is one of ONERA's long-standing skills. Specifically, the office has 4 unique research benches at national and European level to test the impact of fuels on the operation of combustion chambers, pollutant emissions or even the re-ignition of engines at altitude.

The BECAR project, supported by the DGAC, will make it possible to adapt these benches to new aviation fuels. These new experimental tools will be essential for future research on the use of these new fuels in aviation centres. Specifically, they will be used as part of the PHYDROGENE project, also supported by the DGAC, which aims to study the phenomena specific to H2 combustion and to establish a new methodology for the design of H2 injectors.

ATR carries out the first «100% SAF» flight of a regional aircraft and unveils a new generation of «low carbon» aircraft

On June 21 2022, the manufacturer ATR, in collaboration with the Swedish company Braathens Regional Airlines and the energy company Neste, successfully carried out a test flight on an ATR 72-600 powered with 100% SAF in its two engines. This flight is part of ATR's "100% SAF" certification process by 2025. The SAF provided for this flight was produced from used oil and reduces CO_2 emissions by up to 80% compared to fossil-based kerosene. On the back of this success, the aircraft manufacturer announced the launch of a new regional aircraft program in 2023, the ATR EVO, by boasting «100% SAF» compatibility objectives and 20% fuel savings for this aircraft, which should enter service by 2030. The technological preparation of this programme, which also ensures the growing maturity of key technologies (electric hybrid propulsion, ultra-efficient propellers, etc.) that contribute to these objectives, is supported by the DGAC, as part of the France Relance plan (included in Next Generation EU). Thanks to these new technologies, the ATR EVO will offer a potential reduction of 85% of CO_2 emissions over an entire mission.

©ATR

ATR's EVO model (2023)

Other innovative projects to decarbonise air transport

©AIRBUS

Airbus X WING

Airbus X-WING, an innovative demonstrator to test high-performance wings in flight

The Airbus X-WING demonstrator, supported by the DGAC, as part of the France Relance plan (included in Next Generation EU), aims to significantly improve the aerodynamic performance of the wings of future commercial aircraft, one of the major technological levers for achieving the objective of "ultra" sobriety. It is a reduced-scale flying demonstrator, based on a Cessna Citation VII modified to incorporate a high aspect ratio wing equipped with an active control system. This demonstrator, which should be launched in 2024 for initial tests, will validate technologies inspired by biomimicry to adapt the shape, span and surface of the wing to flight conditions and thus increase efficiency during the flight. This new concept requires breakthrough technologies to enable active control of the wing, including gust sensors, new moving surfaces (ultra-reactive spoilers, adjustable trailing edges) and new flight control laws. Airbus estimates that this flexible and deformable wing technology, applicable to any type of aircraft configuration, offers the potential to reduce fuel consumption by 5 to 10% compared to current aircraft.

©Airbus Hélicoptères

DisruptivLab demonstrator

Airbus Helicopters launches the «DisruptiveLab», a demonstrator to test in flight disruptive technologies focused on decarbonisation

At its 2022 annual summit, Airbus presented its new flying laboratory, the "DisruptiveLab", set up to assess the most advanced technologies to improve the performance of helicopters and reduce their environmental impact. This demonstrator will be used in particular to study the feasibility of a hybrid electric propulsion system capable of recharging the battery in flight, as well as to test an innovative aerodynamic architecture. This new architecture is composed of a streamlined central fuselage in aluminum and composite, designed to reduce drag and therefore fuel consumption, as well as a lighter rear fuselage, incorporating a fenestron-type shrouded tail rotor, and also contributing to improved aerodynamic performance. The blades are also integrated into the main rotor in a more compact manner, further reducing drag and the perceived noise level. By combining all these innovations, it is possible to achieve a 50% reduction in CO_2 emissions, a target set by Airbus Helicopters. With the DisruptiveLab, the helicopter manufacturer is preparing the successor to the Ecureuil, which will incorporate multiple positive innovations for the environment, while working on new disruptive approaches for the design, certification and operation of its future aircraft. This demonstrator is part of the CORAC roadmap and benefits from partial support from the DGAC via the France Relance (included in Next Generation EU) and France 2030 plans.

CORAC AND GIFAS

The CORAC, Council for Civil Aeronautical Research, is the State-Industry consultation body tasked with establishing the technological roadmap for the sector, on which are based the aviation research programmes supported by the DGAC. It is chaired by the Minister for Transport and brings together the various players concerned: major companies, equipment manufacturers, laboratories, SMEs, etc.
As a facilitator of the association of the entire sector with the work of CORAC, GIFAS is the professional union representing the French aviation sector. In particular, it ensures that the entire sector is properly taken into account in the work of CORAC, thanks to the Aeronautical and Defense Equipment Group, which deals specifically with equipment manufacturers, and the Aero-SME committee.

Research projects
to improve the environmental performance of air navigation

The ADSCENSIO project

The project led by the DSNA brings together 21 partners including AIRBUS, the company ESSP, manufacturers and the main European air navigation service providers (ANSPs).
It aims to develop the use by ANSPs of on-board trajectory data calculated by the aircraft's flight management system (FMS). Data transmitted by aircraft (ADS-C EPP) provides a better view of the future flight path on the ground, thus contributing to improved safety and reduced fuel consumption. 9 demonstrations will be carried out in 2022 and 2023 in Europe with equipped aircraft, including 2 in French airspace.
The CP1 European regulation (Common Project) plans for the implementation of a new functionality, which alerts the controller in the event of a deviation between the trajectory performed and the trajectory calculated by the air navigation systems and displayed by the controller (ground) . It will help avoid loss of separation between aircraft and to better detect penetrations by civilian aircraft in active military areas.
Between November 2022 and January 2023, the North, East, West and South-West ACCs as well as partner airlines (Air France, British Airways, easyJet) carried out assessments on the use of this data to optimise the management of arrivals in the Paris region. These evaluations also made it possible to test the display of flight data (4D trajectory, forecast speed). Thanks to this more precise data, the controller can visualise the predicted trajectory and take it into account if the situation allows it.

HERON Project

8 AIR NAVIGATION SERVICE PROVIDERS (ANSPS)
6 AIRLINES
5 AIRPORTS

ARE COLLABORATING ON THE «HERON» PROJECT SPEARHEADED BY AIRBUS

Its mandate is to seek solutions to improve the environmental performance of air operations in all phases of flight by using on-board or emerging technologies.
DSNA's participation in this project is multiple.
It contributes to:
- demonstrating the environmental optimisation of arrival flows at Paris airports thanks to the sharing of data on the 4D trajectory and on the pilot's intentions (En-Route, Extended TMA and TMA);
- studying the implementation of "greener" approaches based on satellite and RNP-AR procedures;
- improving trajectory planning, by dynamically refining route restrictions (RAD);
- preparing the deployment of services related to ADS-C (pooling of data collection and distribution via the air navigation intranet (SWIM) to customers, ANSPs and the EUROCONTROL Network Manager).

These 2 projects are being developed in collaboration with the joint venture SESAR.

Research projects at ENAC

In 2022, the ENAC research teams geared their work towards reducing the environmental footprint and strengthening the usefulness and societal acceptability of air transport, as part of the framework of 25 proposals submitted during the 3rd wave of the SESAR call for projects. There are many projects involved:

- **The AEON project:** based on the simulation capabilities at large temporal and spatial scales of airport traffic, aims to study the operational impact of the introduction of aircraft carrying out taxiing operations with engines switched off, using electric or hydrogen propulsion technologies.

- **ECHO project:** its objective is to model and analyse the role of air transport in a multimodal and integrated transport chain.

- **METROPOLIS 2 project:** it aims to define metropolitan airspace structures adapted to the implementation of the U-SPACE concept for very high density urban air traffic by integrating the constraint of reducing environmental pollution.

- **TRANSIT project:** centered on the planning, optimisation and reconfiguration of multimodal door-to-door journeys based on cooperative decision-making mechanisms, this project aims to develop resilient multimodal transport plans with a controlled environmental impact.

- **DESCARTES project:** the result of scientific cooperation between France and Singapore, it aims to develop hybrid artificial intelligence models for decision support in critical urban systems, in particular in the context of urban air mobility services and their analyses and management in terms of environmental impact and societal acceptability.

- **ANR Panache project with the CNRS:** it aims to deploy fleets of drones for the real-time monitoring and analysis of accidental atmospheric pollution.

- **The SESAR Artimation project** aims to bolster the explainability and transparency of artificial intelligence algorithms, particularly in the context of the management of trajectories under environmental constraints.

- **CPER project «MODUS»:** it aims to implement a software and hardware computer architecture that can help carry out simulations on a large spatial and temporal scale of multimodal transport systems and to formalise the adequate place of air transport in an integrated and sustainable chain of transport systems centered on users.

ENAC also won first place in **the International Micro Air Vehicles 2022 challenge,** aimed at optimising drone (specifically environmental) performance, as part of the wider deployment of new air transport services (parcel delivery for example).

Other briefs

Evolution of the fleet for flight training

ENAC, in partnership with the Fédération Française Aéronautique (French Aeronautical Federation), carried out a study in 2021 to assess the possible use of the electric aircraft Vélis Electro, the first and only light aircraft with 100% electric propulsion certified by the EASA. The study confirmed that this aircraft is suitable for the educational content of the first 10 hours of pilot training courses. As of 2022, ENAC has committed, under a leasing contract with the company Green Aerolease, to the rental of 2 aircraft intended for the training of Student Airline Pilots (EPL), one of France's sectors of excellence.
ENAC also plans to integrate this aircraft for the airline pilot training courses of customer airlines. 2 additional Velis should thus make it possible, from the second half of 2023, to train around a hundred pilots per year, EPL trainees included.
At the same time, ENAC is working on a project to renew its fleet, which should take place over the period 2026 to 2030. This fleet will meet strict requirements in terms of environmental standards. The objective in 2025 is to reduce CO_2 emissions by 23T per year.

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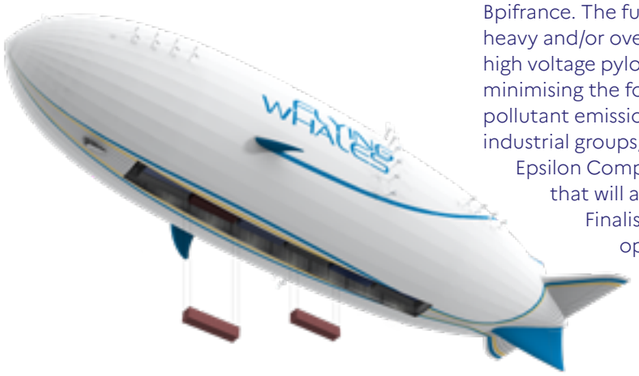
Vélis Electro

The Flying Whales giant airship project

The Flying Whales LCA 60T



In 2022, the giant airship project Flying Whales completed a third round of fundraising of €122 million, including capital involvement by the French government, via the new French Tech Sovereignty fund of Bpifrance. The future dirigible balloon will make it possible to transport heavy and/or oversized loads (wood, containers, wind turbine blades, high voltage pylons), in areas that are difficult to access, whilst minimising the footprint on the ground and reducing GHG and air pollutant emissions. Its development is supported by a consortium of 40 industrial groups, including Thales, Safran, the ADF engineering group, Epsilon Composite and the Réel group, the latter providing winches that will allow lifting or depositing up to 60 tonnes of freight. Finalisation of the design is scheduled for 2023, before the opening of an operational production plant in Laruscade in 2024.

Greener airfield pavements

Airstrips and taxiways are all made of compacted aggregates or bituminous surfacing. Hence the idea of **testing airfield pavements partly made up of recycled materials, drawing inspiration from what has been done for road transport, where roads can be made up of 40% recycled materials.** In 2022, the Bonneuil-sur-Marne STAC built a new test board representative of a flexible pavement structure, incorporating recycled materials. It is divided into 6 sub-planks composed of a different percentage of recycled aggregates, in order to compare their respective resistance and lifespan, and to better understand the use and behavior of recycled materials in airfield pavements. Aircraft traffic will be simulated there by subjecting the test strip to loading/unloading cycles carried out using a lift trailer and a jack simulating the repeated passage of aircraft. In addition, the STAC, along with the Ministry for the Armed Forces and the SNIA, has developed a project to carry out a detailed assessment and monitoring of the state of the infrastructure through a method called **Global Reasoned Diagnosis.** This experiment aims to improve methods for diagnosing and monitoring airfield pavements, with a view to optimising and better planning maintenance operations, as part of a wider asset management strategy. In 2022, a first test campaign was carried out at Air Base 105 in Evreux. It included soil bearing tests, core drilling, ovality tests, as well as HWD (Heavy Weight Deflectometer) monitoring. Finally, on October 4 2022, a **Wealth Management and ACR/PCR Symposium** brought together nearly 120 participants from the aviation community. Discussions focused on the importance of good asset management and the change in eligibility methods decided by ICAO. This new method, known as ACR/PCR (Aircraft Classification Rating/Pavement Classification Rating), implemented nationally by the STAC, will officially come into effect in November 2024. It completes the coherent package of rational methods that help optimise materials and integrate new greener materials (biosourced materials, low-carbon, or integrating recycled materials) during the design phase. The ACR/PCR method makes it possible to verify as accurately as possible that the pavements are well suited to the aircraft traffic received, and constitutes an optimised asset management tool. **The objective of all these experiments is to promote more virtuous pavements on a national scale.**

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Aerial view of the experimental test strip made up of 6 sub-strips (% of different recycled aggregates)

5 —

Protecting and enhancing airport biodiversity

© Sébastien Mirouze

St Pierre et Miquelon airport

Faced with the erosion of biological diversity, proactive commitments were made during «COP 15», defining a new international strategic framework for 2030. Nationally, the National Biodiversity Strategy 2030 (SNB) describes the trajectory needed to reverse the trend of the decline in biodiversity. The aviation sector is continuing its commitment to safeguarding airport biodiversity by joining forces with the SNB.

54
AÉROBIODIVERSITÉ SUBSCRIBERS
in 2022, representing 70 airfields

500 km²
OF AIRPORT GRASSLANDS IN FRANCE

70 %
OF THE SURFACE AREA OF THE 500 MAINLAND AND OVERSEAS AIRFIELDS
is made up of grasslands.

COP 15 Biodiversity **and SNB3**

©MTE, Ministère de la transition écologique

Biodiversity in danger: international solutions to preserve it

The UN Biodiversity Conference (COP 15) brought together the 196 signatory countries in Montreal from 7 to 19 December 2022. The situation is alarming for biodiversity: 1 million species are threatened with extinction, 75% of the land surface is significantly altered and 85% of wetlands have disappeared. We are talking about the 6th mass extinction.

The parties reached an agreement on the global framework for the conservation of biodiversity. It defines an ambitious strategic framework made up of a quantified protection objective called «30X30» - 30% of the land and 30% of the seas protected by 2030 - and 17 commitments, including: the reduction by half of all pesticides and excess nitrates; the restoration of 30% of degraded terrestrial and maritime ecosystems by 2030; the 50% reduction in the introduction of invasive alien species by 2050, as well as a stop to the extinction of protected species due to anthropogenic activities by that date. Finally, funding commensurate with the challenges to the tune of €500 billion/year by 2030 and the creation in 2023 of a global environment fund (GEF) have also been agreed upon.

SNB 2030: France's commitment under the convention on biodiversity

On a global scale, France is the 6th country hosting the largest number of threatened species on the red list of the International Union for Conservation of Nature (IUCN). Thus, out of more than 12,500 species assessed in France, more than 2,300 of them are threatened, including 660 endemic species. To fight against the erosion of biodiversity, France has adopted a National Biodiversity Strategy (SNB) which sets public policy targets to be achieved by 2030 in terms of biodiversity protection. Some targets stem from the global framework defined at COP 15 or from the European Union Strategy for Biodiversity (SUEB). The primary objective of the SNB is to: "Promote a socio-economic model favourable to biodiversity: change consumption patterns, support sustainable agriculture and integrate biodiversity issues into transport and energy transition". The SNB is divided into 5 axes, 15 objectives and 71 measures.

Airport biodiversity is part of four measures of the SNB 2030, which will be published in the 2nd quarter of 2023. As it stands, it is an integral part of:

- the acceleration of the protection and restoration of ecosystems (Measure 1.4), through the "Aéro Biodiversité" association's work on the preservation of the airport grasslands of the 500 French airfields;
- the bolstering of the fight against pollution (Measure 3.1), in particular soil, through the publication of a guide "Zero phyto airports" in 2023;
- strengthening the biodiversity angle of labels and standards in economic sectors (Measure 7.1), thanks to the development of the "Aérobio" label awarded to airport platforms by the "Aéro Biodiversité" association;
- encouraging nature-related awareness and experiences (measure 8.3), through the participatory science activities offered by the "Aéro Biodiversité" association.

The actions associated with these measures are developed in the following pages.

The DGAC adopts its biodiversity action plan

Launched by the DGAC during the National Strategy for Air Transport, the biodiversity roadmap defines a framework of actions to provide better protection and enhancement of airport biodiversity.
Five strategic measures were put forward :

- Changing the regulations pertaining to the wildlife hazard management on airport platforms to better take biodiversity into account;
- Supporting airport managing bodies to better articulate the safety challenges in terms of biodiversity;
- Promoting the establishment of animal reception facilities at airports;
- Raising awareness and communicating the challenges of preserving airport biodiversity to professionals and users;
- Promoting participatory science projects around airports.

The work undertaken on the roadmap has resulted in a «Biodiversity Action Plan» in line with the internal needs of the DGAC in terms of acquiring knowledge and disseminating information.
The DGAC's biodiversity action plan has been divided up into seven key pathways:

- Adapting the regulations pertaining to wildlife hazard management so as to make them compatible with a more virtuous management of airport grasslands that support ordinary biodiversity;
- Supporting the implementation of biodiversity development strategies at airports;
- Promoting the integration of airport biodiversity into the surrounding natural areas;
- Establishing an inventory and monitoring of biodiversity measures implemented on platforms and promote information sharing;
- Promoting the actions of 'Aéro Biodiversité';
- Developing training and access to information on biodiversity and, finally,
- Developing communication campaigns.

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It is intended in particular for regional DSACs which act as an key representative body for the airport biodiversity strategy. They are indeed an essential platform for feedback on environmental issues (populations concerned, local initiatives) and for integrating airport areas into local biodiversity protection plans.

PICTAGRAINES, A GROWING INITIATIVE!
The Conservatoire d'espaces naturels de Nouvelle Aquitaine (CEN-NA)'s Pictagraines project that began in Poitiers' airport in 2019 has now been extended to the platforms of La Rochelle and Niord, thanks to partnership agreements signed in 2022. Like the collective mark Vegetal local spearheaded by the Office français de la biodiversité (the French Office for Biodiversity - OFB), this project aims to harvest seeds from local plants from preserved grasslands, such as airport grasslands, to then replant them, as part of local rehabilitation or greening projects.
The advantage of these wild and local plants is that they have benefited from a lengthy co-evolution with local fauna and flora, which contributes to the healthy functioning of the ecosystems they have been integrated in. These are also beneficial to the resilience of the ecosystems.


© Aérobiodiversité

Aéro Biodiversité teams on the field.

LABEL AEROBIO
In 2022, the ecolabel had been opened to the association's member platforms for less than a year. Six applications were received and analysed at the end of 2022. The scientific committee of the association independently decides on the attribution of the label and the appropriate level (out of 3). As such, in February 2023, the airports of Bastia Poretta, Ajaccio Napoleon Bonaparte and Tours Val de Loire were given the level 1 label, Carcassonne Sud de France and Paris-Charles de Gaulle were assigned level 2.

Aéro Biodiversité, essential partner

The role of the Aéro Biodiversité association in the preservation and enhancement of airport biodiversity is now well established. For several years, it has supported airports in adopting good practices that enhance the surrounding biodiversity without compromising safety. Based on a participatory science approach whose protocols were developed by the French Natural History Museum, it helps better understand the different components of biodiversity on the platforms whilst raising awareness amongst staff. To do this, two to three times a year, the Aéro Biodiversité naturalists conduct an inventory of the various animals and plants present at each partner platform. This meticulous work makes it possible to collect precise data on the diversity of the species observed and to map their habitats. A few supporting key figures: over six years, 34,000 data points have been observed; 3,000 plant and animal species; 1,300 species of plants, including 45 species of orchids; 255 species of birds have been identified and 24 species of bats have been recorded in mainland France (out of 34 existing species). As a victim of its own success, the association continues to grow : in 2022, it counts 54 airports and airfields in mainland France and overseas. This number should increase in 2023. The launch of the "Aérobio" label in 2021, awarded by an independent and ethical committee from the scientific council of the National Museum of Natural History, is also a success: three airports were certified in 2021 (Paris-Orly, Tarbes and Perpignan) and five were certified early 2023 (Ajaccio, Bastia, Carcassonne, Roissy-Charles de Gaulle and Tours, see boxed text).


©Adobe stock

Bearded vulture

Areas of major sensitivity (ZSM)

In 2021, driven by the dual objective of protecting biodiversity and safety, the STAC initiated joint work with the Regional Directorates for the Environment, Planning and Housing (DREAL) and the Aeronautical Information Service (SIA) to improve pilots' awareness and consideration of areas of major sensitivity (ZSM) linked to breeding areas of large protected raptors, during flight preparation.
The work culminated in November 2022 with the publication of detailed maps indicating the active ZSMs by geographical sectors (Alps, Pyrenees, Massif Central), in the ENR 5.6-A section of the AIP and on the STAC website. Several communication campaigns were launched when the maps were put online, including specific information from aeronautical federations.
The work will continue in 2023 with the improvement of the maps distributed on the basis of initial feedback and an expansion of communication campaigns aimed at airspace users.

Exotic species are invading airport platforms

Invasive alien species (IAS) - both plants and animals - are one of the main causes of biodiversity erosion on a global scale. They are introduced accidentally or deliberately by human activity into environments they are not naturally found in. Their establishment and spread threaten ecosystems, habitats and species. In mainland France, 1,379 invasive alien plants and 708 species of fauna have been identified. Only 2 airport platforms out of the 36 in mainland France have dodged this phenomenon. In 2017, the Ministry for the environment published the «national strategy relating to IAS» in order to support the application of European regulations and respond to national issues.
National botanical conservatories have drawn up hierarchical lists of IAS throughout the territory, according to their degree of invasion. There are 3 main levels: proven, potential and to be monitored. In 2021, Aéro Biodiversité identified the main plant IAS present in airfields - around fifteen - the most widespread of which is "Canadian Fleabane". Other species are visible to a lesser extent: South African ragwort, Ragweed Sagebrush, Sporobolus Indicus. The eradication of an IAS is almost impossible once the species is widespread. However, the spread can be limited either by regulatory interventions or by appropriate management of the area concerned. The implementation of an action plan specific to the problem is currently being considered.


©Aérobiodiversité

Senecio Inaequidens


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Mowing tractor

Technical guides **to help airports enhance biodiversity**

Mowing at airports between wildlife hazard management and biodiversity enhancement
The Civil Aviation Technical Service (STAC) conducted a study on mowing practices at airfields with the aim of designing a technical guide for airport operators, air bases and managing bodies overseeing wildlife hazards and green spaces.
This technical guide addresses the subject from both the perspective of aviation safety and biodiversity, with the aim of committing airport stakeholders to more virtuous management practices for the environment.
It presents general information relating to airport grasslands and maintenance methods, shares good practices and ideas that should be adapted locally, as each airport has specific local flora and fauna. Finally, it provides a general methodology for designing a green space management plan.

Zéro Phyto airport guide
The «Zero Phyto Airports» project, launched as part of the Ecophyto II plan, carried on in 2022. This guide aims to support French airports in the implementation of a "zero phyto" plan and to make it sustainable and durable across all airport platforms. This tool, created for airport managing bodies, will bring together good practices in the form of technical sheets to be launched, in order to completely eliminate the use of phytosanitary products. The guide was published in May 2023.

New eco-friendly **emulsifiers**

New environmentally emulsifiers to extinguish aircraft fires
The aircraft rescue and firefighting services at airports (SSLIA) intervene in the event of an incident or an aircraft accident on a platform. They use extinguishing foams to extinguish kerosene fires. For nearly 50 years, the majority of foams used against hydrocarbon fires have contained fluorinated surfactants, recognised for their effectiveness, but harmful to human health and the environment, in particular to biodiversity. In 2011 and then in 2020, the European Union banned or restricted the use of certain families of surfactants. Emulsifier manufacturers have since been developing new formulas and ranges of fluorinated or non-fluorinated emulsifiers that are more respectful of the environment.
As a result, a «emulsifier» guide is being developed by the STAC. It aims to support airport managing bodies in the choice of high-performance fire-fighting products, whilst maintaining high standards for health and environmental protection. Its publication is scheduled for 2023.


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New emulsifiers designed by STAC and tested in Vernon

In brief

SHELTERS FOR HEDGEHOGS AT NIORT-MARAIS POITEVIN AIRPORT

As part of the biodiversity management plan for the Niort – Marais poitevin airfield, the city of Niort, owner and managing body of the airfield, implemented a number of strategies to shape mowing methods around the runways. It acquired equipment to collect clippings in order to limit soil acidification. These clippings are then placed at strategic points on the platform, in order to limit road movements and to allow the creation of shelters, with grass and branches, for certain reptiles, or small mammals, such as hedgehogs in particular. The grasslands of Niort airport are also a natural breeding ground for earthworms and other small animals that allow hedgehogs to feed.

©Museum d'histoire naturelle

©Association CPIE Corse

Helix ceratina at Ajaccio airport

THE PROTECTION OF THE CORSICA SNAIL: A RARE SPECIES, WHICH EARNED AJACCIO AIRPORT ITS AEROBIO ECO-LABEL

Long considered extinct, the Helix of Corsica is a micro-endemic snail of Corsica. Its habitat, restricted to 2 hectares of the Ricantu fluvio-marine terrace, is landlocked within the territory of Ajaccio airport. The species is on the verge of extinction (about 5,000 left).
In the past, the construction of a track and the redevelopment of the platform partially destroyed the habitat of the snail. Genetic studies have shown that they were isolated and found themselves on opposite sides of the track.
The challenge today for the DSAC SE/Corsica delegation, for the airport and for the environmental organisation CPIE (Permanent Centre for Environmental Initiatives), is to preserve the coastal strip where they live and to restore « a corridor», in order to ensure the continuity of the habitat and to maintain the genetic mixing of the population. A «National Action Plan for the Corsican snail» is currently being drafted.

TACKLING THE TRAFFICKING OF PROTECTED SPECIES

The fight against wildlife trafficking and the introduction of so-called "bushmeat" into national territory, particularly by air, is a major health and environmental issue for France.
In 2021, at Roissy-Charles de Gaulle airport, 19.7 tonnes of meat products were seized from passengers' luggage, including around 500 kg of bushmeat. Indeed, meat from species protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is regularly discovered in luggage.

Importing meat products via personal luggage is prohibited by European regulations, for health reasons. This practice is also prohibited with regard to safeguard protected species and biodiversity.
In order to design and implement coordinated, common actions, adapted nationally, against the trafficking of protected species, an interministerial working group was set up, which involves the DGAC.

6 —

Eco-responsible public service (SPE), a new environmental challenge

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Eco-grazing on the STAC fields in Toulouse

The Government's sobriety plan requires involvement and commitment from both citizens and Government departments. Let's see how this translates within our offices!

How is the SPE process organised at the DGAC?

Bike repair workshop at ENAC Toulouse

The eco-responsible public service (SPE) process

As a reminder, the SPE process aims to reduce the environmental footprint of the daily activities of Government departments. It was initially formalised by the circular of 25 February 2020 which, through a set of 20 measures, requires departments to make environmental responsibility reality in all areas of their work. It was supplemented by the circular of 10 November 2022, setting up **a Government energy sobriety plan** for all departments and divided up into 20 projects, including the energy renovation of buildings, the reduction of GHG emissions, public procurement, encouragement of soft mobility. All Government departments, including the DGAC, must draw up an annual report of certain indicators in order to concretely measure the progressive development of this process.

The application of the SPE approach at the DGAC:

• As part of this approach, structures have been put in place within the DGAC to significantly push forward the eco-responsible remit of the Government:

• **A «SPE network»** of over a hundred people, supported by a project team, was created in February 2022. In order to steer and coordinate the actions carried out within the DGAC, it brings together representatives from all departments and can be broken down into 16 projects (including sustainable purchasing, energy and buildings, greenhouse gas emissions, food, digital, biodiversity);

• At the same time, at the end of 2022, **a Sustainable Development Committee** was set up within the DGAC. Made up of representatives from the various departments and trade unions, chaired by the Chief Executive Officer, it meets at least once a year. Its mission is threefold: to ensure rigorous application of SPE commitments, to propose additional actions and to discuss local initiatives.

In addition, in her 22-55-SG note of 18 August 2022, the Secretary General of the DGAC called on all services to take the necessary measures to achieve quick and large-scale energy savings, as part of the energy sobriety plan, by setting a maximum temperature of 19° within their offices, using air conditioning from 26°, extinguishing unnecessary lights, using LEDs, encouraging carpooling and soft mobility. **Decarbonisation will be the major project of 2023.**

FOCUS ON THE CLOSURE "TRIAL" OF THE DGAC HEADQUARTERS ON 31 OCTOBER:

On 31 October 2022, the DGAC took advantage of the opportunity of an "extended" weekend during the 1 November public holiday to test the effectiveness of closing its headquarters on rue Henry Farman in Paris. The «wintering» mode was used: shutting down heating, car parks, lights, canteen and so on. The result was interesting with 26% energy savings compared to an "ordinary" day the previous week.

The energy renovation of building, a top priority!

Since 2020, the Government has successively launched massive energy renovation plans for public buildings to combine support for the economy, following the recent crises, a reduction in the environmental footprint and a reduction in energy bills. The energy used by Government buildings is the second item of expenditure in its operating budget, after salaries. In 2022, the war in Ukraine, and the energy crisis it caused, have further increased the need to reduce energy consumption and the energy bill of buildings. To achieve this, an energy sobriety plan (see p.10) mobilising all sectors of activity was presented on 6 October 2022, with an energy saving target of 10% within two years.

The SNIA, National Airport Engineering Service, manager of the DGAC building stock (including 502 tertiary buildings on around a hundred sites covering 687,000m² of net surface area), is at the heart of this energy renovation system for buildings and HQE (High Environmental Quality) design of new constructions, with an increasing number of sites over the years. As part of the recovery plan, 106 projects have been launched, 65 of which will be completed in 2022. The renovation programmes must be in line with the trajectory of the tertiary eco-energy system (DEET) provided for by the so-called «tertiary» decree of 23 July 2019, which imposes a gradual reduction in the final energy used in tertiary buildings, by 40% from 2030 and up to 60% in 2050, an objective in line with the ambitions of the aviation sector, responsible for ensuring a 50% reduction in GHG emissions by 2050.

The most common works in terms of energy renovation are the improvement of the regulation of heating and air conditioning systems, the thermal insulation of the envelope, the replacement of exterior joinery, and the increasing use of photovoltaic (PhV) electricity via self-consumption installations. For example, on the ENAC campus (Toulouse), PhV energy represents 17% of the energy consumed, 25% eventually.

Aside from these quite common measures, other initiatives should be highlighted:

GTA Ajaccio: installation of Triple C systems guaranteeing heating, climate control and a thermodynamic boiler

DAC Nouvelle-Calédonie: reduction of albedo effect and natural cooling of the premises through revegetation, the installation of a brise-soleil and the optimisation of natural ventilation

ENAC and DSAC Nord (Orly) partial use of geothermics or connection to heat networks

Focus on HQE construction: the extension of the DSAC Ouest buildings in 2022

The extension has reached level E3C1 (Energy 3-Carbon 1), reflecting excellent energy performance with, in particular:

- the significant use of wooden construction materials and recycled materials, via the "Le Relais" association (wool and wood fibers for insulation) in particular, or biosourced materials;
- the use of photovoltaic panels on the roof for self-consumption;
- an efficient and compact envelope (triple glazing, wood, adjustable sunscreen, improved sealing).

The innovative design of this new building should enable it to consume 40% less energy than a building designed using traditional methods.

Aerial view of the extension of the DSAC Ouest HQ in the foreground, high environmental quality construction

© wwf

Planting at the DAC field in Nouméa by DGAC agents, guided by volunteers from the wwf

Multiple initiatives to implement the SPE

Helped by national incentives, the SPE approach is now essential in all DGAC departments, and is divided up into 6 topics: energy and buildings, mobility, waste, food, biodiversity and awareness.
Some services were particularly innovative in 2022. Here are a few examples...

Mobility: still growing strong
The renewal of the fleet of service vehicles with electric vehicles or the encouragement of carpooling and soft mobility are widely deployed and promoted via, for example, participation in «(soft) mobility villages» at the DSAC Sud-Ouest (Bordeaux airport) or the "DAC by bike" campaign at the DAC New Caledonia.

The government's growing interest in territorial biodiversity.
The Toulouse STAC has developed eco-grazing, with sheep coming to graze on green spaces (see photo p.59). The DAC New Caledonia continues its virtuous partnership with the WWF, which is reflected in particular by regular campaigns to raise awareness amongst agents by, for example, involving them in the planting of trees and plants on DAC land with help from the association's volunteers. Vegetable plots, like the demineralisation of certain spaces where possible, are also being developed.

Agent awareness and training.
"Climate fresco" workshops are gradually being offered, alongside actions to raise awareness of solidarity and eco-responsibility or eco-gestures.
As part of its "Eco-citizen transformation at DSAC AG" project, the DSAC obtained funding for its training component from the CGDD following the "Eco-responsible innovation" call for project proposals.
For their part, the **ENAC** departments have set up a **"climate start"** in September 2022, 3 days of courses and workshops to provide the 400 students, future graduates, with a good knowledge of environmental issues. These 3 days include in particular the "climate fresco", the "aero fresco", modules on decarbonisation, energy issues, and even socio-technical controversies and new technologies. This innovative and comprehensive system mobilises 70 teachers and agents.

2 PRIZES FOR ENAC IN 2022:
the School, and in particular its SPE mission, was in fact the winner of two regional competitions, the «DD competition of the Federal University of Toulouse» and «the TISSEO trophies», thanks a dual initiative: the loan of electric bikes and cargo bikes to its users, students and agents (for 4 months) and the organisation of bike repair workshops on the Toulouse campus.

7 — Glossary

ACNUSA : French authority in charge of preventing and controlling airport pollution
ADEME : French Environment and Energy Management Agency
ANSP : Air Navigation Service Provider
APU : Auxiliary Power Unit
CAD : Carburant aéronautique durable / SAF: Sustainable Aviation Fuels
CAEP : Committee on Aviation Environmental Protection
CALIPSO : French classification of light aircraft according to their sound performance index
CCE : Environmental Consultative Committee
CDO : Continuous Descent Approach
CGDD : French General Commission for Sustainable Development
CNR : French National Council for Refoundation
CSB : Strategic noise maps
CORAC : French Council for Civil Aeronautics Research
CORSIA : Carbon Offsetting and Reduction Scheme for International Aviation
DSAC : French Directorate for Civil Aviation Safety
DSAC-IRs : French Interregional Directorates for Civil Aviation Safety
DSNA : French Direction of air navigation services
DTA : French Civil Aviation Authority
EIAE : Impact study according ICAO Balanced Approach principle
ENAC : French National Civil Aviation School
EU : European Union
EU-ETS : European Union-Emission Trading System, ou Système d'échange de quotas d'émission de l'Union européenne (SEQE)
eVTOL : Electrical Vertical Take-Off and Landing
GES : Gaz à effet de serre /GHG: Greenhouse gas
GIFAS : French Aerospace Industries Association
GPU : Groung Power Unit
IGEDD : French General Inspectorate for the Environment and Sustainable Development
MRAe : French local environmental authority
OACI : Organisation de l'aviation civile internationale / ICAO: International Civil Aviation Organization
OAD : Observatory for Sustainable Aviation
ONERA : French National Aerospace Research Centre
PEB : Noise exposure plan
PGS : Noise pollution plan
PIA : Future investments programme
PNACC : French National climate mitigation plan
PPA : French atmosphere protection plan
PPE : French Multi Annual Energy Plan
PPBE : French Environmental Noise Prevention Plan
PREPA : French National Air Pollutant Emission Reduction Plan
SAF : Sustainable Aviation Fuel, ou carburant d'aviation durable (CAD)
SARP : Standards and Recommended Practices
SFEC : French Energy-Climate Strategy
SGPE : French General Secretariat for Ecological Planning
SPE : Eco-responsible Public Service
SNB : French National Biodiversity Strategy
SNBC : French National Low-Carbon Strategy
STAC : French Civil Aviation Technical Service
TEN-T : Transeuropean Transport Network
TIRUERT : French incentive tax on the incorporation of renewable energy in transport
TNSA : French tax on air traffic noise pollution
UAF : French Airports Association
UFP: Ultrafine particles
UICN : The International Union for Conservation of Nature (IUCN)
ZSM : Areas of major sensitivity

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