

The aeronautics industry faced with the challenges of competition and climate change

Introduction

Stéphane Molinier

Continuing the human adventure of air transport and offering the same travel opportunities to future generations, with the challenge of carbon neutrality in 2050, requires all stakeholders in the aeronautical sector to make massive investments in the production chain and in decarbonizing, against a backdrop of traffic growth and tension in the value chain resulting from health and geopolitical crises.

Achieving carbon neutrality by 2050 will require the mobilization of a number of levers: fleet renewal with more powerful, lighter, more efficient aircraft; the quest for sobriety and performance through technological progress; electrification; the development of alternative fuels to kerosene: sustainable aviation fuels and hydrogen; optimization of ground and in-flight operations; regulatory incentives; compensation for residual emissions; adaptation of the industry's skills; and finally, consumer involvement.

Markets and the impact of regulations

The challenges of traffic growth and ecological transition

Damien Cazé

The year 2023 confirmed the rebound in air traffic since its sudden halt in March 2020 caused by the health crisis. The announced return to pre-pandemic levels has only served to increase the criticism levelled at air transport by its detractors, who accuse it of being one of the main contributors to climate change. Yet considerable technological progress has been made in building aircraft whose fuel consumption per passenger kilometer carried and associated CO₂ emissions have been reduced by around 80% compared with the aircraft of the 1960s. Today, air transport accounts for 2.5% of human-made CO₂ emissions worldwide.

In view of the continuing growth in traffic over the coming decades, the air transport sector is mobilizing to achieve its objective of net-zero emissions by 2050. The International Civil Aviation Organization has defined a global strategy; the European Union's Green Deal includes an intermediate target of reducing CO₂ emissions from aviation by 55% by 2030; and France has drawn up a roadmap for sustainable aviation fuels, with the ambition of designing a low-carbon aircraft.

Global aerospace market outlook, decarbonization, and Airbus strategy

Guillaume Faury

The Covid-19 pandemic created an unprecedented crisis for global air transport, leading many observers to believe that aviation would never return to the growth of precedent years, and might even experience a certain decline.

This was to forget that air transport has become an irreplaceable asset of modern society, transporting goods and linking people, cultures, and territories – all factors in development and progress.

Following strict sanitary measures, air transport has gradually returned to its 2019 level, with growth now appearing to be picking up at a rate of around 3.6% a year. This strong demand is putting a strain on the production lines of Airbus and its subcontractors, weakened by the crisis. But the main challenge is to ensure sustainable growth in air transport, compatible with the objectives of the Paris Climate Agreement. This is the challenge that Airbus has set itself, with the ambition of pioneering totally carbon-free aviation, thanks to increasingly efficient aircraft in terms of emissions, disruptive technologies, such as hydrogen-powered aircraft, and the massive use of sustainable fuels.

And all this for sustainable aviation, but also for a safer, more united world.

Regulations, certification, and their impact

Luc Tytgat

The article discusses the challenges and transformative efforts needed in the aeronautics industry to address competition and climate change. It highlights the necessity for the industry to adopt sustainable aviation fuels (SAF) and explore electric, hybrid, and hydrogen aircraft technologies to reduce carbon emissions. The European Union's Green Deal and initiatives like ReFuelEU Aviation are mentioned as key strategies to decarbonize aviation by encouraging SAF integration. The European Union Aviation Safety Agency (EASA) plays a crucial role in overseeing this transition, ensuring safety, and adapting regulatory frameworks to support innovation and environmental sustainability. Collaboration among industry stakeholders, research institutions, and regulatory bodies is emphasized as essential for achieving a carbon-neutral future in aviation.

Air Traffic Management (ATM)

Raúl Medina

This paper provides a high-level overview of some of the principal challenges facing Air Traffic Management (ATM). It explains that air traffic control is a natural monopoly that nevertheless facilitates competition among the various actors in the air transport industry. ATM provides airspace capacity to meet traffic demand. The paper provides the latest historical and forecast air traffic statistics, confirming that it will take seven years for European air traffic to fully recover from the pandemic.

Airspace capacity must be provided in a safe, secure, cost-efficient, and sustainable manner to meet demand. Doing so is complex and becomes particularly challenging in the face of external events, such as Russia's invasion of Ukraine, whose impact on ATM is described. The long-term challenges of the decarbonization and digitalization of ATM are addressed, as well as the impact of Artificial Intelligence (AI), with some examples provided of how ATM is adapting.

The development of air traffic, airlines and the effects of their concentration

Pierre Cavé

With world GDP growth strongly correlated with air traffic growth, 2023 caught up with the 2019 level in passenger. Dynamics remain contrasted regarding to world areas: Europe stands out with a recovery driven by Southern European countries; North America shows a pre-crisis traffic level almost recovered; and Asia-Pacific remains dynamic with a third of world traffic. Airlines have not restored the net margins pre-COVID, but the aeronautic demand remains strong: Airbus maintains its leadership for the 5th consecutive year. In the long term, traffic should continue to grow, with environmental challenges to be met, coupled with an evolution in pre-crisis customer bases.

Decarbonizing air travel as part of a new economic paradigm

Augustin de Romanet

Since the 1970s, the air transport sector has enjoyed tremendous growth, slowed only by a global health crisis in 2020. However, the pandemic is not the only reason why the sector is now being called into question: for some years now, public opinion has been concerned about global warming, and air transport has become the ideal scapegoat. While the judgement is harsh, it does have the merit of having considerably accelerated the commitment of the airline industry to the fight against climate change. Since 2019, measures to reduce its carbon footprint have multiplied: fleet renewal, improved operations, deployment of disruptive technologies, use of sustainable aviation fuels.... As a major player in this far-reaching transformation, the ADP Group has adopted an ambitious roadmap to meet a major challenge: to remain a central player in mobility, but one that is reasoned and, above all, carbon-free.

Decarbonizing the industry and boosting competitiveness

DGE (Directorate General for Enterprise) support for the aeronautics industry

Thomas Courbe

Still reorganizing after the crisis triggered by the pandemic, the French aerospace sector is facing the triple challenge of ecological transition, innovation, and reducing its dependencies. In response to each of these challenges, the French Directorate General for Enterprise (DGE) is supporting the sector, as part of the reindustrialization policy supported by the "France Relance" recovery Plan and the "France 2030" investment plan. The support we provided during the health crisis enabled us to initiate a dynamic transformation of the sector, by speeding up the modernization of production facilities, from subcontractors to major principals. We are continuing to support the industry by promoting innovation, securing critical supplies, and building the value chain for carbon-free aircraft in France.

ATR designs tomorrow's responsible air connectivity today

Nathalie Tarnaud Laude

With globalization, aviation has taken on a predominant role in the world's economic activities. Ensuring accessibility to the most remote areas, regional aviation contributes to territorial cohesion, and opens up prospects for economic development.

At a time when climate change is forcing us to completely rethink our lifestyles, aircraft are often heavily criticized for their contribution to greenhouse gas emissions. But what about regional aviation? What are the challenges and prospects for this unique form of aviation? As the world leader in regional aviation, ATR has adopted an ambitious, yet realistic approach to maintaining responsible regional connectivity.

General aviation, a laboratory for decarbonizing air transport

Didier Kayat

As the world's seventh-largest general and business aviation manufacturer, Daher, heir to the legendary Morane-Saulnier company founded in 1911, is the world's oldest aircraft manufacturer still in business. Building on this pioneering spirit, Daher is now taking a proactive approach to decarbonizing its own aircraft, and making a significant contribution to the decarbonization objectives of its aircraft and engine manufacturer customers.

Hybrid propulsion for VTOLs: A solution that combines performance and low emissions

Jean-Christophe Lambert

To achieve carbon neutrality by 2050, aircraft manufacturers, leading OEMs (original equipment

manufacturer) and aeronautical start-ups are working together to develop more sustainable aircraft. Among the solutions they have chosen is the VTOL (vertical take-off and landing), a vertical take-off and landing aircraft positioned as an alternative to the helicopter and for new advanced air mobility. Powered by a hybrid electric motor, it reduces carbon emissions and noise, and offers a range of 400 km. Beyond its use, this helicopter-plane is a formidable technological catalyst for the decarbonization of the sector.

The challenges of carbon-free aircraft propulsion

Thibaud Normand & Éric Dalbies

The airline industry's commitment to achieving carbon neutrality by 2050 calls for an unprecedented effort in aircraft energy efficiency, in addition to the use of sustainable fuels. This challenge is at the root of a profusion of innovations currently underway in the field of aircraft propulsion. Electric and hybrid propulsion, in a variety of forms, will be used in all aircraft segments, with general aviation serving as a testing ground for technologies that will help reduce fuel consumption in future commercial aircraft engines. From a climate standpoint, the main challenge lies in the propulsion of the next generation of short-to-medium-haul aircraft, succeeding the Airbus A320neo and Boeing 737 MAX. Safran and its partner GE Aerospace are preparing for this through the RISE technology program, which covers the development of a number of breakthrough innovations, and is helping to mobilize the entire industry.

High-power propellers: High-performance solutions for responsible aviation

Jean-François Chanut

Long overshadowed by the faster, post-World War II revival of jet aviation, turboprops are poised to make a comeback on the aeronautical scene, against a backdrop of decarbonization of the sector and, more broadly, commitments to the environment. Indeed, they have many advantages to offer in terms of the mission profiles best suited to them, whether in commercial or military aviation. Collins Aerospace's Ratier-Figeac entity, located in the heart of the Lot department, has been investing for decades in the improvement of high-power propeller systems, both in existing aircraft and in the architecture of future platforms. Aerodynamics, efficiency, comfort, reliability, repairability, and recyclability – every aspect of a propeller's life is optimized to reduce the impact of systems on the environment, while guaranteeing operators the best possible operating costs. In addition to reducing the impact of the equipment it manufactures, the company is committed to reducing its local environmental footprint, notably by transforming infrastructures, and promoting soft mobility.

The aerospace industry on the road to carbon-free aviation

Frédéric Parisot

Although air transport is only responsible for around 2.5% of man-made CO₂ emissions, the issue must nevertheless be addressed to ensure that air travel remains accessible to as many people as possible, in complete safety. The aeronautical industry, federated by GIFAS, is committed to reducing this environmental impact in order to achieve carbon neutrality by 2050. The sector's players – manufacturers, airlines, and airports – have decided to take up the challenge of decarbonization together, being the first sector worldwide to have made precise and ambitious commitments in this direction.

Decarbonization thus represents a new revolution in the history of aviation, and relies on a number of complementary levers over time, detailed here. It is the sector's capacity for innovation that will enable aviation to decarbonize and become a means of transport that is safe, accessible to all, and sustainable.

Aerospace Valley and carbon-free light air transport

Philippe Lagarde

In the field of carbon-free aviation, Aerospace Valley considers that the development of technologies on the scale of light aviation, governed by CS23 certification, will be more rapid with aircraft entering commercial service in the next few years, and will therefore serve as a springboard for carbon-free commercial aviation (CS25), whose first achievements will not appear until the next decade.

The vast majority of aircraft currently in service were produced in the 1970s; the fleet is therefore aging, and the question arises of how to renew it. Making light aviation more eco-responsible and more acceptable to the public also means opening the way to new uses. This is all the more true, given that the operating costs targeted by manufacturers are drastically reduced (by a factor of 4) by the introduction of new technologies. Thus, the replacement of the existing fleet and the challenge of training future pilots point to the existence of a significant market, provided that the new aircraft are climate-friendly. In addition, Europe's high density of airfields and airports opens up new markets for passenger and freight transport, as well as opening up certain regions.

Several propulsion technologies are contributing to the decarbonization of light aviation: electric, hybrid electric, fuel cell... They are complementary, and many parameters are involved in their choice. The development of solutions adapted to small general aviation airfields is a prerequisite for the success of light aviation. Here too, Aerospace Valley has a role to play in connecting and federating the entire ecosystem!

Technological breakthroughs in the decarbonization of air transport

Airbus pioneers sustainable aviation for an open, environmentally-friendly world

Alain De Zotti & André Bourdais

Being a source of inspiration is deeply rooted in Airbus' DNA, and today our goal is to pioneer sustainable aerospace for a safe and united world. For more than 50 years, we have valued innovation to reduce the environmental footprint of our products and activities.

A tremendous effort has been made to promote the renewal of airlines' fleets towards new generation aircraft that are more fuel-efficient and environmentally friendly.

We are committed to developing and bringing to maturity the required technologies for decarbonization, particularly with research on new thermal propulsion engines, or more revolutionary like the use of hydrogen; flight testing will start soon on one of our flight test aircraft. Another important asset is the growing use of sustainable aviation fuels to achieve the objectives of reducing carbon emissions from air transport by 2030. A strategic partnership was recently signed between Airbus and TotalEnergies in order to accelerate their deployment; those fuels supplied by TotalEnergies should make it possible to reduce CO₂ emissions by up to 90% over the entire lifecycle, compared to their fossil equivalent.

Finally, "Being a pioneer in sustainable aeronautics" means, for us, fulfilling our responsibility as a recognized leader in our industry to create long-term value for our stakeholders and for society. Our ambition includes strong commitments to reduce our environmental impacts and footprint, by adopting a lifecycle perspective. This environmental responsibility starts from the design phase, continues during the manufacturing process and after delivery, and is also visible in each employee's daily life, in our industrial operations and the one of our supply chain.

All these key technological developments, coupled with the transformation of our company, make Airbus a major player in society with stimulating challenges to carry on.

CORAC: The Civil Aviation Research Council

Pierre Moschetti

The French civil aeronautics industry is recognized worldwide for its technological and industrial excellence. However, it faces major challenges, notably reducing its environmental footprint and its dependence on fossil fuels.

It was to meet these challenges that the original CORAC model was created in 2008, a government-industry consultation body dedicated to setting up the industry's national research program. This model has since been imitated many times, both in France in other industrial sectors (space, automotive, etc.) and abroad.

CORAC's strength lies in its ability to act as an effective and creative collective, driving the entire industry forward, in a continuous and concerted drive for innovation.

CORAC brings together all the stakeholders in the air transport and aeronautics industry, both institutional and industrial, to discuss the sector's major orientations in terms of innovation, decarbonization, and public support.

Decarbonizing aviation requires research!

Bruno Sainjon

ONERA – the French Aerospace Lab (ONERA for Office national d'études et de recherches aérospatiales) –, like the rest of the aeronautics industry, has not waited until recent years to work on reducing the environmental impact of aviation. Since the 1960s, aircraft efficiency gains over the decades are estimated at 80%. A key player in aeronautics, space, and defense research, ONERA, under the supervision of the French Ministry of the Armed Forces, is also a state expert for official bodies, such as the DGAC (the French Directorate General of Civil Aviation), notably on the subject of decarbonization, and is involved in numerous European projects as part of the "Clean Aviation" program (Horizon Europe).

ONERA is at the heart of the French, European, and international aeronautics industry, partnering leading manufacturers, such as Airbus, Dassault, Safran, and Thales. It boasts test facilities that are unique in the world, and essential to the development of carbon-free aviation.

Sustainable aviation fuels (SAF), an essential lever for decarbonizing the aviation sector

Florence Delprat-Jannaud, Jean-Philippe Héraud & Julie Lhomme-Maublanc

Sustainable aviation fuels (SAF) are an essential lever for decarbonizing air transport, whether they are sustainable biofuels produced from residues and waste that do not conflict with food use, or electrofuels produced from CO₂ and H₂. Not only do they present an opportunity to reduce CO₂ emissions and increase energy sovereignty, they also offer new outlets for the agricultural and forestry sectors by recovering waste products. Although SAF production processes are now being rolled out, there are still challenges to be met if we are to reach the targets set by the regulations.

With a world-leading aeronautics industry, low-carbon fuel production technologies developed by French players, and abundant lignocellulosic resources, France has many assets to play a leading role in SAF.

The challenges of electrification

Thomas Delsol, Lionel Bourgeois, Denis Descheemaeker & Magali Vaissière

In a statement released by the Air Transport Action Group (ATAG) in 2022, the aviation industry has committed to "net zero carbon emissions from international

civil aviation flights by 2050, through accelerated efficiency improvements, energy transition and innovation across the sector and in partnership with governments worldwide". The FILAE ("FILièrE Aéronautique Électrique") R&T project, supported by the French Institutes of Research and Technology (IRT), is part of this decarbonization process, addressing the key technological barriers to the electrification of aviation.

The ZEROe hydrogen aircraft: Technological challenges and impact on the ecosystem

Karine Guénan

Aviation, as a symbol of mobility and connection, must reinvent its future, to meet the requirements of carbon neutrality by 2050.

Hydrogen is a promising solution for decarbonizing many industries. However, its adoption in aeronautics will require major advances, from the large-scale production and distribution of green hydrogen, fueled by renewable energies, to the design of secure cryogenic tanks, and the adaptation of airport equipment and infrastructure.

Airbus is positioning itself as a champion of this transition, working with partners who are world leaders in their respective fields to make this ambition a reality. The innovative concepts of the ZEROe hydrogen aircraft, powered by fuel cells or hydrogen combustion engines, promise a significant reduction in CO₂ emissions.

The objective is clear: to transform the aeronautical industry, for a more sustainable, safe, and united future.

Electric hybridization to decarbonize the air transport industry

Régine Sutra-Orus, Dr. Christophe Viguier, Dr. Pierre-Alain Lambert, Dr. Stéphane Azzopardi, Dr. Thierry Lebey & Dr. Bertrand Revol

The air transport industry is resolutely committed to a decarbonization trajectory which will lead it to carbon neutrality in 2050. Since the advent of jet propulsion, the increase in the energy efficiency of transport aircraft has been considerable and for a large part driven by propulsion system technologies. Thermal propulsion technologies still have room for progress, but these must now be supplemented by reinforced action on all other available levers: introduction of disruptive concepts further reducing consumption through the use of electrification in particular; optimization of flight operations; use of substitute fuels for fossil hydrocarbons. Safran's action extends across all these areas simultaneously, but the article will develop some challenges to be addressed in the context of greater electrification, in particular the electric hybridization of engines.

Reducing aircraft energy consumption

Alain Cassier

Like all sectors of the economy, the air transport industry faces the challenges of reducing its greenhouse gas emissions.

In this context, finding ways to reduce its energy consumption is essential, and increasing its efficiency in terms of the energy needed per passenger and per kilometer travelled is a must, in order to prevent that this reduction is obtained only by limiting traffic. This improvement in energy efficiency can be sought at the level of aircraft operation (optimization of routes, aircraft filling, traffic management), but primarily at the level of the energy efficiency of the aircraft itself (i.e. by reducing the energy required to fly).

The main research programs currently underway to reduce aircraft fuel consumption in Europe and the USA are "Clean Aviation" supported by the European Commission, "Transonic Truss Braced Wing" supported by NASA, and "Jetzero Z5 BWB" supported by the US Air Force. This article analyzes the changes in airframe design that could result from those programs as well as the corresponding energy efficiency improvements.

"Cybersecuring" aviation: An essential challenge

Yannick Assouad

The world in which we live is increasingly connected, and aviation is no exception to this trend. Whether in the cockpit, in the cabin or on the ground, connectivity brings whole new dimensions to flight safety, airline operational efficiency, and passenger comfort and enjoyment. However, with these new capabilities come critical cybersecurity concerns, which need to be factored into the heart of the design of new products and systems, as well as throughout their operational life-cycle. In this article, Yannick Assouad, EVP Avionics at Thales Group, details the cybersecurity challenges associated with the rise of digital technology in aviation, outlines the regulatory framework in the making, and stresses the vital importance for players in the aeronautics sector to deliver equipment that is "cybersecure by design".

Playing together to boost our competitiveness through digital technology, and win together

Pierre Faure

Growth and the creation of wealth and jobs are possible in industry; all it takes is the will to play a collective game within the strategic sector committees (CSF in French), and to launch ambitious programs that will enable all sectors to embrace the digital revolution.

In a world where interconnection and collaboration are essential levers of competitiveness, innovation, and sovereignty, the digital transition has become a vital necessity to ensure the development of our industrial fabric and its ecological transition.

In twenty years, the Aerospace & Defense industry has succeeded in positioning itself as a world leader in the digitization of its sector, thanks to the BoostAeroSpace collaborative platform and the digital standards developed with the help of AFNeT.

This example illustrates the urgency and necessity of adopting a collective approach between CSF, major groups, SMEs and public authorities, to meet contemporary challenges.

Impact and usage of AI in aerospace

Pascal Tea et Guillaume Soulé

The aviation industry has been leveraging data for a long time, but it is only through a governed data landscape and a semantic data model (ontology for example) that operations can be optimized, and AI fully leveraged. AI has been used for advanced applications, such as predictive maintenance, quality issue analysis, and personalized customer experience, among others, but was successful only with the right data journey before. Large Language Models (LLMs) in AI are already transforming the airlines industry, but potential risks like error propagation and security must be addressed moving forward.

Skills & talents

Adapting training and research to the needs of the aviation industry, in a global context of ecological transition

Olivier Lesbre

This article looks at how training and research can be adapted to the needs of the aeronautical industry, in a context of ecological transition. It highlights the role of ISAE-SUPAERO and the ISAE Group in training engineers capable of contributing to the decarbonization of aviation. Emphasis is placed on the need to develop sustainable engineering skills, and on the importance of technological innovation to meet environmental challenges. Specific projects, such as the Mermoz UAV and research initiatives aimed at decarbonizing the sector, are also discussed.

Facing up to the urgency of the aeronautics industry: Boosting synergies so that all players adopt a common, shared vision

Francis Massé

The air transport sector must change in the face of evolutions in its environment, *i.e.* the transitions presented by ecology with climate change, energy, geopolitics, economic and social, societal and political developments, the digital revolution, and AI. The answers lie in transforming all the stakeholders of this complex ecosystem – and as much as possible in harmony.

The unique professional training “University of Air Transport - UTA”, with its specific educational format called “Logotique”, aims to promote these transformations, innovations, and technological breakthroughs by focusing on human resources.

UTA brings together high-potential individuals from each of the stakeholders in the sector (aircraft manufacturers, engine manufacturers, aeronautical supply chain, ground handling, airlines, airports, and relevant public administrations). To unite, to create a unique and shared vision on a common diagnosis of realities, to enrich everyone’s skills, and to build a common future in the service of society within the framework of a public-private partnership.

“Campus des métiers et des qualifications” (or campuses for professions and qualifications) and their contribution to aeronautics

Christophe Meyruey

Federating, convincing, training, organizing – these are the key words in the vocation of the “Campus des métiers”. The one I have the honor of chairing in the region Occitanie brings together companies in the aeronautics and space industries, two of the driving forces behind the French economy, and symbols (among others) of our country’s industrial excellence. These two major industries, particularly aeronautics, are at a crossroads.

In a world tempted to turn in on itself, they are, to varying degrees, being called into question. It’s up to us not to let this insidious little tune get the better of us, but rather to demonstrate that everything is in place to ensure that, technologically speaking, these sectors can invent a carbon-free future. To do this, we need to explain and convince the young and not-so-young to join them, and invent the training courses that will be indispensable in the future.

More immediately, we need to help ramp up deliveries of aircraft that are cleaner than those of previous generations. To meet this challenge, we need to provide training that is as close as possible to the needs of the industry’s large and small companies.

When, in order to achieve this, we need to bring together and train our forces so that, together, they grow stronger, we understand that this campus is a vocation for those who have the privilege of being part of the adventure.

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