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Is hydrogen the key to
carbon-free aircraft?

Some photos
in this issue were
taken before the
Covid-19 pandemic.

Publication director: Christine Orfila. **Editorial director:** Alexandre Keller. **Editor-in-chief and coordinator:** Morgane Palacios. **Written:** Jean-Pierre Alesi, Alexia Attali, Nicolas Bége, Marine Binet, Clara Chauvel, Christopher Constans, Caroline Coudert, Danaë Coulon, Benjamin Damgé, Mathilde Enixon, Stéphane Geffray, Inès Hamour, Julie Lenoir, Camille Mahuzier, Florian Maire, Laure Monge, Elodie Pages.

Design and production: BABEL

Photo credits: Front cover: A. Daste / Safran - Contents: ArianeGroup Holding / Pagecran / Safran ; A. Daste / Safran - P. 3: A. Lamachère / Safran - P. 4: A. Ojeda / CAPA Pictures / Safran - P. 5: K. Radulph / Safran ; R. Brives / Safran - P. 6-7-8: A. Daste / Safran - P. 9: A. de la Giraudière / Safran ; P. 10-11: P. Soissons / Safran ; P. Votion / Safran ; R. Bertrand / Safran - P. 12-13: A. Daste / Safran ; AMG / Safran - P. 14: C. Abad / CAPA Pictures / Safran, B. Vallet / Safran - P. 15: N. Campbell / Safran ; R. Alary / Safran ; R. Brives / Safran - P. 16-17: C. Abad / CAPA Pictures / Safran - P. 18-19: R. Alary / Safran - P. 20: A. Daste / Safran - P. 23: A. Daste / Safran - P. 24: J.-F. Galéron / Safran - P. 26-27: P. Soissons / Safran - P. 29: C. Sasso / CAPA Pictures / Safran - P. 30-31: Freelance's l'agence / Safran - P. 32: C. Sasso / CAPA Pictures / Safran - P. 33: C. Sasso / CAPA Pictures / Safran ; F. Lancelot / CAPA Pictures / Safran - P. 34-35: A. Daste / Safran - P. 37: Safran ; iStock / Safran - P. 38-39: C. Abad / CAPA Pictures / Safran - P. 40-41: Safran Cabin / Safran ; P. 42: Safran Seats / Safran - P. 44: R. Brives / Safran - P. 47: Freelance's l'Agence / Safran - P. 48: Freelance's l'Agence/Safran.

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Dear Colleagues,

I'm delighted to be addressing you in these pages for the first time as Chief Executive Officer. Safran and the entire aviation industry are going through a very complex time, to say the least. We are expecting the first half of the year to continue to be difficult, in line with what we experienced in 2020. Despite this, I would like to reaffirm my complete confidence in our Group. I am fully aware of the strengths and talent deployed across Safran, and of our adaptability. We will continue our efforts in the coming months to sustain our businesses. Safran boasts decisive assets that underpin my full confidence in our future. Because of our propulsion business, we wield a powerful growth driver that will be activated when air traffic recovers. This is based on the current LEAP® engine, the preferred choice of airlines, and a still-young CFM56® fleet, giving us an excellent outlook for our service business. We can also count on our leadership in a majority of our aircraft equipment businesses and the resilience of our defense and helicopter businesses. Not to mention our ability to deliver aircraft interiors on time and with the requisite quality, which enabled us to restore our customers' trust. Over the last few months, all of you, 79,000 strong, have demonstrated a remarkable sense of unity. Because of your engagement, Safran is now well positioned to take advantage of the recovery as soon as it occurs. Building on these assets, we must now focus on our three top priorities to ensure our future success: become a major player in the push for carbon-free aviation; carve out leading positions in programs to safeguard sovereignty; and accelerate our digital transformation. The unprecedented period that started a year ago has revealed our Group's agility and endurance. I am firmly convinced that we will emerge from this crisis stronger than ever.

OLIVIER ANDRIÈS
Chief Executive Officer of Safran



ONE
TEAM





SOLIDARITY

Thanks to the generosity of employees, in 2020 Safran Seats USA's Community Involvement Program donated \$60,000 to United Way, a network of local non-profit organizations.

GREEN MAKERS CHALLENGE

The Green Makers Challenge launched by Safran Transmission Systems in September 2020 mobilized staff to reduce the company's carbon footprint. It was a big success, with more than 100 ideas submitted. Fifteen of these projects were included in the company's 2021 low carbon roadmap, including "quick wins" as well as more ambitious initiatives, coordinated by teams with the support of management. This collaborative approach is part of greening our business.



R-SAFE MASKS NOW AVAILABLE

Created by a joint team of experts from Safran and Schneider Electric, R-SAFE is a reusable high-protection face mask that filters particles 30 times smaller than conventional masks. Made in France, the mask is available on the Group's e-Goodies store on Insite.



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Safran Electrical & Power Chihuahua recently celebrated its 30th anniversary! The site, which houses three buildings and employs 1,920 people, specializes in manufacturing wiring harnesses, electrical power distribution systems and components. It was Safran's first-ever facility in Mexico.

MAINTAINING CUSTOMER RELATIONS DURING THE PANDEMIC

Newsletters, webinars, "phygital" events, live site tours (via livestreams), demo videos —the toolbox created by Safran Data Systems is packed with useful materials for nurturing and cultivating customer relations at a time when most people are working remotely. By increasing touchpoints, these new communications tools enhance the effectiveness of marketing efforts. As digital interaction becomes the norm, they are a great way of engaging with customers.



CHINA

Ten years of growth

A decade after Safran China was set up, we take a closer look at the Group's prospects in what will soon be the world's biggest aviation market.

In 2020, we should have been celebrating the 10th anniversary of Safran China... but then the pandemic struck. China was the first country to be hit by the coronavirus outbreak, and went into lockdown on January 23. *"At the height of the health crisis,"* recalls Philippe Bardol, Chief Executive Officer of Safran China, *"we received valuable support from Safran in the form of protective equipment, including 10,000 masks sent by Safran India to our Suzhou plant. Within a few months, however, the epicenter of the pandemic had shifted and support flowed the other way. It was Safran China helping our colleagues by turning into a sort of distribution center to ship masks to facilities around the world."*

AN EARLY RESTART

After a few hectic weeks, Safran's business operations in China quickly resumed. Our facilities applied strict health and safety measures (working from home, shifts, etc.), and returned to virtually near-normal operations by May. This restart was needed to keep pace with our major programs. Despite the crisis, aviation remains a priority sector for China, and continues to log fast-paced growth. The fleet of commercial airliners currently stands at about 4,000 and should more than double to over 8,600 aircraft by 2040. Because of this long-term growth potential, China is a highly strategic market for Safran. In fact, we're already a major supplier across our entire product range: airplane and civil helicopter engines, landing and braking systems,

nacelles, wiring, avionics, power transmissions, interiors and more. Safran now has about 20 entities in the country, with approximately 2,000 local employees.

FORWARD-LOOKING PROGRAMS

The foundations of Safran's successful move into this country are built on solid partnerships established over the last 40 years with the Civil Aviation Administration of China (CAAC), the country's main airlines and key companies such as planemakers Comac and Avic, as well as the engine manufacturer AECC. According to Philippe Bardol, *"Over the years, Safran has earned its stripes in the Chinese market. We are now very familiar with the key players and we're widely recognized and appreciated."*

Building on this relationship of mutual trust, Safran has been chosen as a supplier on all of the country's major programs. For example, at the end of 2019 Safran Helicopter Engines and AECC earned CAAC certification for their WZ16® engine, also known as the Ardiden 3, to power Avic's AC352 rotorcraft. In the regional aircraft segment, Safran companies provide a wide range of equipment and systems to Avic's MA60, MA600 and MA700 turboprops, as well as Comac's ARJ21 regional jet. At the same time, nine Group companies are involved in the country's flagship program, the C919 narrowbody mainline jet powered by LEAP-1C® engines, slated to enter service in 2022 or 2023. *"These programs are extremely important for us, especially the C919,"* notes Philippe Bardol. *"LEAP® engines have already arrived in China for this plane; 2021 will be a pivotal year for the C919, with the end of flight testing and the start of production. We're also interested in upcoming programs, like the Chinese-Russian CR929 project for a widebody jet. Calls for proposals are already underway."*



› SUPPORTING AIRBUS AND BOEING

While China's programs are very promising, we shouldn't overlook Safran's second core business in the country, based on growing Airbus and Boeing fleets. Chinese airlines account for 20 to 25% of the two planemakers' total production, or more than 100 planes per year each. This is a major financial priority for Safran China.

Safran's third main business, maintenance, continues to expand apace, driven by demand for the Chinese fleet and the need for a truly local presence. Safran China already has two facilities dedicated to engine and landing gear repairs, and is looking at sites for other equipment, especially nacelles. *"Despite the increasingly fierce international competition, we're in a good position to take advantage of strong market growth,"* says Philippe Bardol. *"We're working actively alongside China to support its growth drive, in a country that will become the world's largest aviation market in the not so distant future."* ■



111 YEARS AGO...

In 1910, a delegation from China came to France to see a flight demonstration of the Bleriot XI, powered by a Gnome Omega rotary engine —the first business contact! Cooperation developed in the 1970s around China's major helicopter programs. Since about 2010, Safran has become a key strategic partner to the planemakers Avic and Comac, as well as the leading airlines, through both local operations and joint ventures.



SAIFEI, owned 51% by Comac and 49% by Safran Electrical & Power, is in charge of the development and production of the electrical wiring interconnect system (EWIS) on the C919, through a partnership signed in 2012.

AROUND THE WORLD OF SAFRAN

Introducing a team and different individuals from Safran companies, for a quick look at their career paths, areas of expertise and vision of Safran.



Safran Nacelles, proud to continue the A380 journey!

Safran Nacelles delivered the last nacelle for the Airbus A380 in January, but the story doesn't stop there. Teams will continue to support the nacelle, which is now considered a technological benchmark in terms of reduced weight and noise, thanks to advanced composite and metallic materials. It's also the world's first nacelle to feature an electrical thrust reverser actuation system (ETRAS®). Although Airbus has now ended production of its A380, the past 20 years of hard work and achievements have enabled Safran Nacelles to forge a reputation as a leading integrator of complete nacelles and services.

“Today more than ever before, our employees’ health is a top priority for Safran.”



Laëtitia Françoise

Health, Safety & Environment (HSE)
coordinator and risk manager,
Safran Electrical & Power

“I’ve been HSE coordinator for all Safran Electrical & Power sites for the past seven years. It’s my role to ensure that the policy developed with the Group is effectively implemented and addresses the challenges facing the company. We were called on extensively during 2020 to help manage the Covid-19 crisis. In liaison with the Facilities Management team, HSE correspondents did a tremendous job defining and implementing strict health and safety measures. Today more than ever before, our employees’ health is a top priority for Safran. In 2021, we’ll also be pursuing efforts to improve ergonomics and contribute to Safran’s low carbon project, aimed at reducing the environmental footprint of our activities, especially production. These new challenges go hand-in-hand with my new mission: risk management.”

Constantin Gochtovtt

Management controller,
Safran Data Systems

—

“Mobility at Safran is a great opportunity and incredibly rewarding. Following an international internship program at Safran Power Units in San Diego, California, I continued my focus on aerospace at Safran Engineering Services, working at the Paris-Saclay facility for four years as a management controller. It was a really interesting job and I also signed up as a Safran ambassador to help strengthen our teams. Despite the current situation, Safran offers some great opportunities. Recently, I transferred to Safran Data Systems, in Arcachon, southwest France, moving from services to production. With a new environment, new tools and new challenges, it’s certainly taken me out of my comfort zone!”

“With a new environment, new tools and new challenges, it’s certainly taken me out of my comfort zone!”

Edern le Ruyet

Ergonomist, Safran Helicopter Engines

—

“My role is to study how people work on a day-to-day basis and then analyze this data to improve workplace health and performance. At Safran, this involves monitoring both risk prevention and the quality of the work done. For each situation, whether it’s the refurbishment of a facility or the acquisition of a new tool, we use factual data to devise tangible solutions, in coordination with the stakeholders. Ergonomics is a powerful performance driver! In my opinion, ergonomists play an increasingly crucial role, especially when it comes to contributing to design or redesign projects. Safran’s talented workforce needs to be equipped with the best quality tools available. People should be at the heart of industrial processes so we can capitalize on their expertise.”

“People should be at the heart of industrial processes so we can capitalize on their expertise.”



INSIDE SAFRAN NACELLES' LE HAVRE PLANT

Well known for its port and modern architecture, Le Havre is also the home of Safran Nacelles. The company's main facility is located in the Port Industrial Zone in Gonfreville-Orcher. With 1,600 talented employees, it's the third largest industrial employer in the region.

Like the city of Le Havre, Safran Nacelles is a multifaceted jewel, combining industry and services in a resolutely future-facing organization. The plant spans aircraft engine nacelle research & development, production and support, with several specific areas of expertise: composite and metallic materials with acoustic treatments, assembly of thrust reversers and exhaust assemblies.

Le Havre took another step towards industrial excellence when it was chosen as a supplier for the Airbus A380 and subsequently added the A320neo, A330neo and other advanced planes to its roster. It's also developing the

nacelles for the new-generation Gulfstream G700, the latest long-range bizjet.

Safran Nacelles' Le Havre plant is state-of-the-art and an Industry 4.0 pioneer within the Group. By incorporating technologies such as an auto-industry-inspired assembly line, virtual reality modeling, robotics and assembly aids using augmented reality, the plant accelerated production cycles, cut costs and improved working conditions as early as 2015. According to Plant General Manager Olivier Aguilon, "Safran Nacelles has invested heavily, mainly in robotization, automation and digitalization. Over and above

the business benefits of these technologies, this type of state-of-the-art environment is also a decisive factor for all employees. It bolsters our attractiveness and our position as the region's third largest employer. In fact, we even founded our own management and production schools."

EXEMPLARY LOCAL RESPONSIBILITY

All of these investments drive the plant's local reputation. Safran Nacelles is highly involved in the region, for instance as a founding member of Normandie AeroEspace (NAE), the Normandy aerospace, defense and

Controlling a curing robot that's ready to bond the nacelle's honeycomb section to the composite structure for the LEAP-1A® engines powering the Airbus A320neo.

"Our excellent relations with local authorities help establish the plant as one of the pillars of the community and spread its influence."

OLIVIER AGUILLON
Plant General Manager



FACTS & FIGURES

- > **3rd** largest production plant in the Le Havre region
- > **3rd** largest local employer
- > **1,600** employees
- > **80,000** square meters floorspace (864,000 sq ft)
- > **68** hectares (168 acres)

Two training centers: management school; production school.

The Safran Nacelles plant is located in the Le Havre port zone.



security industries association, and active in its various task forces. Furthermore, operating in an area with a number of plants handling “Seveso” classified hazardous materials, it is working with Synerzip, the trade association for companies in the Le Havre Port Industrial Zone, to set up a personal security plan by October 2021, as part of the regional initiative to manage technology risks.

The plant also invests in a number of initiatives to make the region more attractive, such as the Seine Estuaire chamber of commerce and industry, and the Le Havre region metallurgical industries union. Safran Nacelles goes beyond these industry-level actions by investing in local culture, for example by supporting the city’s André-Malraux modern art museum.

“Being located in Le Havre means being part of an ecosystem that we also have to support and develop,” notes Olivier Aguilon. “Our excellent relations with local authorities help establish the plant as one of the pillars of the community and spread its influence. In late 2020, when the Covid testing program was launched by Olivier Véran, French Minister of Health, and Edouard Philippe, Prime Minister at the time, our employees were given priority for these tests.”

THE NEXT CHALLENGE

One of the major thrusts going forward is to improve environmental performance, and once again, the plant can count on its local presence. *“As part of the energy transition law, Le Havre is planning to generate heat by reusing*

wood waste,” explains Raphael Renouvin, head of the company’s low carbon project. “Safran Nacelles takes an active role in this project, which will connect it to an urban heating system in 2023. That means we can stop our gas co-generation process and save 4,250 metric tons of carbon dioxide per year. This initiative is the result of close teamwork between our infrastructures unit, plant facilities management and local authorities.” Set to be a real win-win initiative in conjunction with Le Havre, it addresses current concerns and also establishes Safran Nacelles among the “green industry” leaders in Normandy. ■

THE EXPERTS STREAM, A HOTBED OF TALENT

Safran has been developing its Experts stream since 2005 and it now counts 1,300 people, including 300 at Group level. But how do you become an “expert” and what’s involved? We look at some of their backgrounds.



DAVID PICOT
Head of Group Audits and Expertise

“Experts are at the heart of technical and technological innovation for Safran products. Working within operational teams, they create value through their know-how and in-depth knowledge of the company. They have the insight to leverage cross-disciplinary resources, integrate the latest technologies, and work across functions, always seeking to reduce risks. They prepare for the future by capitalizing on existing experience and expertise, while also planning ahead for the skills Safran will need to meet its technical challenges.

”In addition, they help broaden Safran’s international influence and reputation by sitting on academic boards and taking part in government think tanks. The Experts stream is structured to promote career development and enable members to move up to management positions or change functions. It’s tightly coordinated so that we can respond swiftly when a need arises for expertise in a given field.” ■

JÉRÉMY SEBAN

Company Expert in mechanical engineering and design, Safran Transmission Systems

“I was made an expert after working from A to Z on the development of the Rolls-Royce Trent 7000 power transmission system. I now coach teams in new developments and am responsible for approving technical solutions. For me, sharing knowledge is hugely important.

I’ve learned a lot myself through the Best Design Practices initiative, which collates a wealth of information about the expertise that goes into our products. I’m now working on the development of reduction gearboxes for our latest generation of engines. So, a new product and new technology —and another exciting challenge that will expand my scope of expertise!” ■



DEDICATED LEARNING FOR EXPERTS AND SPECIALISTS

Safran University recently introduced four new learning programs for specialists (non Experts) and company Experts. Whether you want to strengthen your skills or are eager to learn about the Experts stream, these one-day sessions will show you what’s involved and how the different networks operate. To sign up, simply go to the Training page on Insite.



SCOTT CAMPBELL

Safran Cabin Director of flammability engineering and Safran Fellow Expert

“You could say that fire is my business. Or, rather, avoiding fire. I’ve spent more than 25 years working on flammability issues, and I really love my job as an expert for Safran Cabin. The aim is simple: it’s all about saving lives by preventing fires on aircraft and, when one happens, retarding and containing it long enough to control it and/or take rescue measures. Flammability is a very complex and fast-moving domain, so you have to be 100% focused. As an expert, one part of my mission is to be up to date at all times and to bring my contribution on new technologies, regulations, and economic issues.

“The other part is sharing my expertise with all people involved, especially with regulatory authorities and, first and foremost, with Safran companies like Safran Aircraft Engines and Safran Nacelles, where flammability is a key issue. To achieve this, ongoing dialog is essential.” ■

AGNÈS MATHEVET

Technical auditor, Safran Aircraft Engines, and Safran Fellow Expert on RAMS



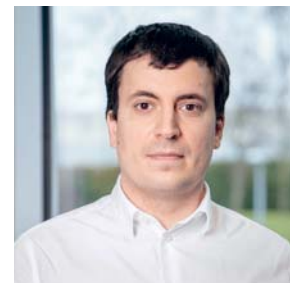
“After a PhD in nuclear physics, I started out at CNRS, the French scientific research agency. I then joined Safran Aircraft Engines, where I was made Senior Expert for RAMS (reliability, availability, maintainability, safety) in 1999. At the time, the Safran Experts stream was still in its infancy, and I was the first woman to join. Today, I’m a Fellow Expert, responsible for a wide range of tasks. I help the function achieve the highest standards, notably by identifying new methods to assist designers —models, statistics, probabilistic methods, etc. This is how we ensure projects are successful.

“Encouraging innovation is another part of my role, which involves training and coaching people. There are still too few women in the Experts stream, despite the fact that women make up almost 30% of Safran’s workforce. I say, go for it! Women have a full part to play in the Safran Experts community, and the Group needs their skills!” ■

THIBAUT PORTEBŒUF

Company Expert in programmable components and cybersecurity, Safran Electronics & Defense

“Being an expert is really stimulating and rewarding on both an intellectual and a personal level. We have a wide range of tasks, and do all our thinking as a team so we move forward together. As well as transferring our knowledge, we also aim to learn from others. I devote about 20 to 30% of my time to this mission, which entails liaising with facilities throughout France. When I left a microelectronics startup in 2016 to join Safran, I’d never have imagined that, four years later, at the age of 34, I’d be in this role! It was a natural progression —I was really keen and my managers suggested I get involved. Currently, I’m working on the EpsilonX terrestrial inertial navigation system, which is really exciting! You can become an expert at any age; what matters is having sound technical skills, a desire to pass on your know-how and a flair for collective innovation.” ■



CSR

Charlotte DIEUTRE

Charlotte Dieutre was made Vice President, Corporate Social Responsibility (CSR), in December 2019. Her mission is to get everyone on board to ensure the new CSR strategy is a success.



**“Whatever
your role,
everyone can
contribute.”**

Safran rolled out a new CSR strategy in 2020. What are the principles behind it?

C. D.: To begin with, it’s important to point out that, although it’s a new strategy, we didn’t build it from the ground up. On the contrary, Safran has long been aware of its social and environmental responsibilities. Furthermore, the new strategy was developed in close collaboration with local teams everywhere.

This involved discussions in the summer of 2020 with more than 160 people at all levels of the organization—from the shop floor to senior management—at all companies and in all regions where Safran operates.

We defined four core goals: decarbonize aviation, be an exemplary employer, embody a responsible industry, and assert our commitment to good corporate citizenship. We then established 12 commitments tied to these four pillars. However, what’s really important

Safran's CSR team (from left to right): Alice Pedersen (disability manager), Séfiane Thiam (intern), Valérie Grandin (CSR manager), Charlotte Dieutre (Vice President, CSR) and Anouk Perrier (intern).

is having a clear overview. These pillars are not silos. All of our commitments, initiatives and actions overlap to help make Safran a more responsible organization fully geared to sustainable development.

Decarbonizing aviation also means improving our industrial processes. Safran has embarked on an extensive effort to cut carbon emissions across its value chain. What are the targets, when can we expect to see real results and how can people contribute?

C. D.: Action is needed at two levels. First—and this is embedded in Safran's DNA—we need to help design planes that emit less CO₂. And second, we need to minimize the carbon footprint of our design and manufacturing processes and our supply chain. That's the goal behind the low carbon project launched in 2018. The Executive Committee recently approved a more ambitious target for 2025, which sets Safran on course to being carbon neutral by 2050. Whatever your role, everyone can contribute. In a collective effort like this, every little bit counts!

Safran is committed to being an exemplary employer, at a time when workplace wellbeing and doing meaningful work have never been more crucial. As head of CSR, how can you help meet these goals?

C. D.: To start with—and this is what matters most—we need to engage the entire organization on workplace wellbeing issues. We'll only succeed by bringing everyone together on this. Corporate Human Resources recently became the Corporate Human and Social Responsibilities department,



and a distinct CSR unit has been set up. Both will help achieve our goal and amplify everything we do in this area. A concrete example of our efforts is the deployment of a hotline to help employees in France and worldwide through the coronavirus crisis. Everyone at every level of the HR community is fully committed and engaged. We must now sustain this focus and resolve to ensure continuous improvement over the long haul.

You've had a fairly unusual career so far—film studies, journalism school, digital communications consulting, and even a stint at Galeries Lafayette where you helped launch the store's Fashion Integrity collection of sustainable, fully traceable clothes! How did you come to be involved in CSR issues for industry?

C. D.: Well, you know, I've also worked in industry! At Pechiney and then Alcan, to be precise. CSR was something that interested me very early on, from a personal standpoint and then with regard to my work. The Rana Plaza* disaster in 2013 triggered it for

me. Traceability in the textile industry has become a top priority. In aerospace, the main goal today is decarbonization. Naturally, a large industrial firm doesn't face the same day-to-day issues as a retailer, but the underlying challenges are the same. And both need to tackle them holistically. An effective CSR policy means addressing social, societal and environmental issues with equal vigor. ■

* On April 24, 2013, the collapse of the Rana Plaza building in Dhaka, Bangladesh, killed at least 1,134 garment workers. The building housed several garment factories working for international fashion retailers.

SAFRAN AIRCRAFT ENGINES

Gwenhael Hodin

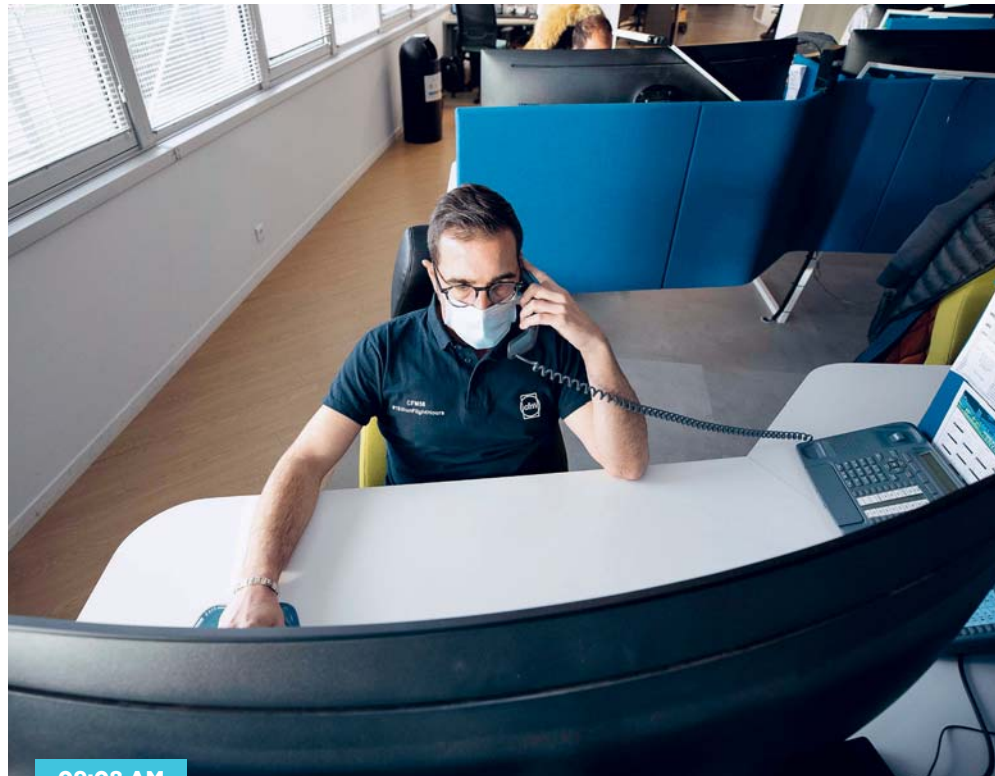
Technician, Customer Support Center

Gwenhael Hodin is a member of Safran Aircraft Engines' Customer Support Center team. These experts are in the front lines to answer customers' questions and help keep their airplanes in the air.

24/7, the Customer Support Center (CSC) fields customer requests, whether from operators or MRO shops, to provide recommendations for the maintenance, repair or overhaul (MRO) of our aircraft engines.



First call of the day, from a customer needing a spare part. When an aircraft is grounded because of a technical problem —AOG (Aircraft on Ground)— we have to respond within four hours to get the plane back in the air.



09:08 AM



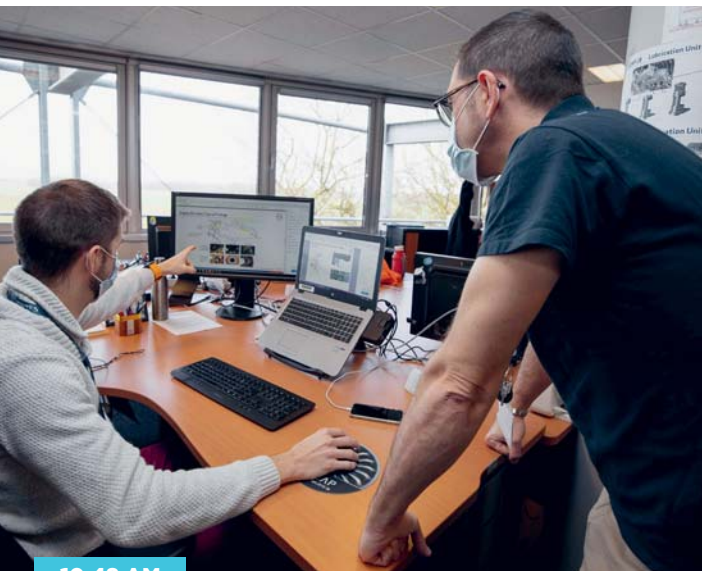
FACTS & FIGURES

> **40 000+** requests per year concerning all of our commercial engines handled by the CSC, or nearly 110 a day.

> **30%** increase in the number of daily requests since 2016, when the LEAP® entered service.

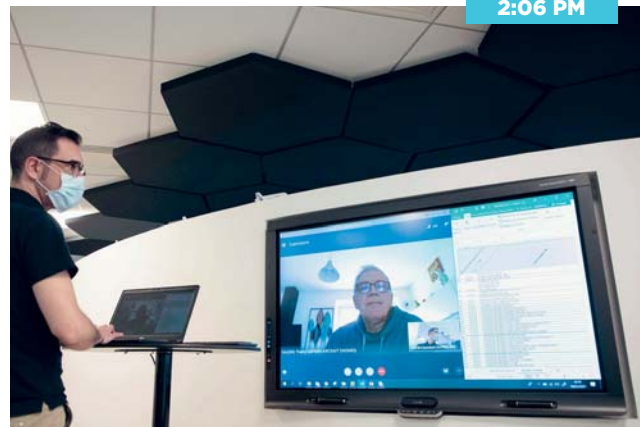


I have to be totally familiar with all parts of the engine under my responsibility, as well as the specific requirements of both MRO shops and airlines.



10:48 AM

I contact colleagues at the Customer & Product Support Engineering (CPSE) unit, specializing in the operational performance of engine parts and modules. They issue an extension of airworthiness criteria so that the customer can continue operating their engine.



2:06 PM

I add my feedback on the operation to our databases used to predict performance. This meticulous data gathering and analysis supports our top priority, namely flight safety!



ONE BUSINESS



737 MAX

At the end of 2020, the U.S. Federal Aviation Administration (FAA) cleared the Boeing 737 MAX to resume commercial flights, after it had been grounded since March 2019. The European Aviation Safety Agency (EASA) followed suit in late January 2021. The MAX is now gradually returning to service, excellent news for all companies involved!

MRO

In December 2020, Safran Helicopter Engines signed a support by the hour (SBH) contract with State Grid General Aviation Company (SGGAC) of China to support the engines on their Airbus H215 and H225 helicopters.

LEAP-1A

NEW SUPPORT CONTRACTS

Zhejiang Loong Air, launch customer for the LEAP® engine in China, has signed a 12-year Rate-Per-Flight-Hour Agreement with CFM for the LEAP-1A® engines powering its 19 Airbus A320 and A321neo twinjets leased by the Chinese airline. China Eastern Airlines, a CFM partner since 1985, signed a similar contract covering its fleet of 36 Airbus A320neo planes.

A350 XWB

SAFRAN SEATS

At the end of 2020 Ethiopian Airlines took delivery of two Airbus A350 XWB widebody twins fitted with Safran Seats. The airline opted for Optima® business class seats, which combine cabin density and seating comfort, along with Z300 economy class seats, personalized in Ethiopian Airlines' own colors.

PHANTOM PARACHUTE JUMP FROM 29,500 FT!

Safran Electronics & Defense has qualified its new Phantom parachute canopy for jumps from 29,500 feet,

the cruise altitude for many commercial jetliners. Designed for special forces, this engineered fabric is extremely thin yet strong, allowing use at temperatures down to

-45°C at altitudes where the shock on opening is especially brutal because of the thin air. This feat of technical prowess will let troops travel up to 80 kilometers in the air, allowing drops at standoff range, beyond the reach of enemy radar and ground-to-air missiles.

SAFRAN, SAFEGUARDING SOVEREIGNTY

Can a multinational enterprise with a global presence also be a preeminent actor in national or continental sovereignty? These two facets, seemingly contradictory, are in fact highly complementary. And they offer advantages to both governments and companies like Safran, which are leaders in strategic industries.

Aerospace and defense, electronics and telecommunications, raw materials and energy... A number of industries may also assume strategic responsibilities for national governments. In general, this implies a mutually-beneficial favored relationship. For governments, hosting the associated production and R&D centers on their home territories guarantees national independence when confronted with geopolitical issues. These capabilities also give them a powerful diplomatic tool when they carry out international trade negotiations, for instance, or when defining partnerships with international allies.

A VERY SELECT CLUB

For manufacturers like Safran, the sovereignty market opens access to major, long-term programs characterized by sophisticated technologies that help develop their own skills and expertise. Furthermore, these programs embody a certain prestige and enhanced credibility in export markets. The stakeholders involved in defending sovereignty form a very select club, anchored in excellence. Today, for instance, only four countries are capable of developing and manufacturing jet fighter engines: the United States,

France, the United Kingdom and Russia. Safran is in fact involved in a number of defense programs as a long-standing equipment supplier to armed forces. The latest success was

Only four countries—USA, France, UK and Russia—are now capable of building a complete fighter engine.

Greece's order for 18 Rafale fighters, powered by twin M88® engines from Safran.

FROM SEA TO SPACE

Safran Aircraft Engines, through its partnership with MTU Aero Engines of Germany, is a key player in the New Generation Fighter (NGF), expected to enter service by 2040. Safran Helicopter Engines powers a wide range of helicopters deployed by armed forces in France and other European countries, as well as police

and SAR (search & rescue) forces. More generally, through the expertise of Group companies such as Safran Electronics & Defense, Safran is fully capable of meeting multiple military requirements, on land, at sea and in the air. We already work with a number of governments and key industry partners on defense programs.

At the same time, Safran is a major player in the space sector, increasingly a key to national and regional independence, not only because of military capabilities (nuclear deterrence, surveillance, etc.), but also for civilian applications such as telecommunications and scientific research. Eleven Safran companies are heavily involved in a broad spectrum of space applications, from the launchers made by ArianeGroup (a 50/50 joint company of Safran and Airbus) to sophisticated space optics from Safran Reosc, satellite propulsion systems from Safran Aircraft Engines, ground stations for commercial satellites and scientific missions, launcher telemetry and space surveillance (Safran Data Systems). What do all these activities have in common? By bolstering the ability to make decisions and take action in France and the European Union, they help make the world a safer place. ■



EUROPEAN R&D PROJECTS

Over and above the joint European programs that have existed for a number of years, a European defense policy project has taken shape since 2016. In particular, this has resulted in the creation of a European Defense Fund, designed to finance joint R&D projects. Safran Electronics & Defense is taking part in four consortiums as part of the

European Defense Industrial Development Program (EDIDP): LynKEUs (missile navigation and optronics), EUDASS (European detect & avoid system for drones), IMUGS (Integrated Modular Unmanned Ground System) and GEODE (Galileo for EU defense), to test Galileo navigation solutions for defense applications.



ON TRACK WITH TOP FORMULA 1 TEAMS

Since the first victory of a Formula 1 car with carbon brakes in 1984, Safran's role in this demanding discipline has grown apace. Today, we supply this state-of-the-art technology to a number of top teams.



**Safran Landing Systems and Safran
Aerosystems** are suppliers on the Mercedes
AMG Petronas 44 driven by Lewis Hamilton.



2022 RULES JUST AROUND THE CORNER

While racecar design parameters were partially frozen for 2021, due to economic considerations resulting from the ongoing crisis, Safran's team are already looking ahead to 2022, when new technical rules and regulations will take effect. In particular, they stipulate that brake disks on the front axle will increase from 11 to 13 inches, meaning that Safran will have to rethink the disk design and even evaluate alternative materials.

In 1984, Alain Prost won the Brazilian Grand Prix in a McLaren-TAG F1 racer with carbon-carbon composite brakes developed by Safran Landing Systems (at the time, this business was part of Société européenne de propulsion, or SEP). In just a few short years, SEP became the brake producer with the best track record in F1, thanks to this revolutionary composite material, developed for rocket engines and first used in aviation on the Concorde supersonic jetliner at the end of the 1970s.

PERFORMANCE + ENDURANCE

Carbon brakes marked a disruptive advance over conventional steel brakes. Used in Formula 1 cars, carbon brakes are lighter, last longer and offer higher performance —resisting peak temperatures of thousands of degrees— while also maintaining their mechanical integrity. The company's skilled technicians tailor these remarkable high-tech components for F1. "We take into account each car's operating characteristics," explains Hakima Bengoua, head of the company's land

braking department in Villeurbanne, near Lyon. "For brake design, F1 teams can count on our own expertise, or develop their own, and in that case, we test it on our own rigs. We're a small team of 12 people, working like a startup, with developments solely for automobiles and very fast 'time to track'. It would be hard to match this agility in the aviation industry."

F1 cars account for about 70% of the land braking division's business; virtually all of the clutches in these race cars are also made from carbon. In 2020, Safran Landing Systems returned to endurance racing at the classic 24 Hours of Le Mans, with purpose-designed carbon brakes.

INNOVATION DRIVER

Safran Aerosystems is also involved in motorsport and is a long-time contributor to the pinnacle of this activity, Formula 1. From 1994 to 2010, when F1 cars still made refueling stops during the race, Safran Aerosystems (Intertechnique at the time) was asked by the FIA (Fédération International de l'Automobile) to become the official

supplier of refueling systems. The company's facility in Plaisir, near Paris, specializing in oxygen systems, supplies engine control components, especially high-pressure pneumatic regulators, a technology developed for aviation and then specially adapted for F1. Once again, development cycles are much shorter than in aviation, with new upgrades each year.

"A quick response is the key in our business, and each request is handled like an AOG (aircraft on ground) situation in the aviation industry," explain Rémy Lechelonn, product engineer, and Jaipyo Lee, sales & marketing manager for the oxygen systems product line. "This demanding requirement has driven significant improvement in our supply chain and pushed us towards higher performance in our aviation business, which shares the same processes and suppliers. Our contribution to motorsport accelerates innovation in our company. For instance, we recently developed a regulator that's half the weight and one-third the size of the previous generation. It has already won a first customer in MotoGP, and we're now offering it to other F1 engine manufacturers. It would have been hard to come up with this technological breakthrough so quickly in aviation!"

In short, Safran's involvement with the inimitable world of Formula 1 is just getting started! ■

FIRST AUTOMATED WIRING HARNESS LINE AT VILLEMUR

Wiring harnesses have long been assembled manually, but production is now gradually being automated. We take a closer look at this Safran Electrical & Power initiative at its Villemur-sur-Tarn plant.

Digitalization, automation, cobotics... Since 2018, these technologies have gained ground at the Safran Electrical & Power plant in Villemur-sur-Tarn, southwest France. The plant now features a specialized robot, touch screens and a number of associated digital applications.

For many years, aircraft wiring harnesses were assembled by hand. Operators had to follow printed assembly steps, with the resulting risk of error. As our Industry 4.0 project took shape, digital methods began to be widely adopted, resulting in better performance, reliability and traceability. Then Villemur took delivery of its first

robot, Rapid'share, an automatic system to prepare the wiring involved. This marked a first step on the path to automation, an integral part of the Industry 4.0 project.

FROM EVALUATION TO SUPPLIER SELECTION

"In 2018 we carefully analyzed all our processes and assembly lines to determine what could be automated," explains Didier Lhermelin, industrial development manager at Villemur. *"We started by robotizing the preparation of certain wires. But automating an entire assembly line was a challenge of a different order."* The original evalua-

tion came up with a clear candidate, the Airbus A350 electrical structural network, or ESN.

According to Michel Crozier, plant general manager, *"Assembling the ESN involved fewer operations and a limited number of parts: only two different types of wire and eight types of terminals."* The company drew up specifications and issued a call for bids. A Toulouse-based company called Laselec won the contract. *"They had already done a proof of concept, and they provided the most extensive guarantees concerning the project's real cost and feasibility"*, adds Crozier.

Mickaël Marques, process methods technician, keys in machine settings to start production of ESN wiring.



"We also have to think about our return on investment, and only automate a process if it improves working conditions or productivity."

DIDIER LHERMELIN
Industrial Development manager,
Villemur-sur-Tarn

PROVEN PERFORMANCE

The machine is capable of producing 150 ESN wiring harnesses a day, the original production rate targeted before the Covid-19 crisis. Today, we can already estimate a 60% improvement in productivity, with return on investment in less than three years.

The machine cuts wires to the right length, poses and crimps the ferrules, then coils and packages the wiring.



FIRST AUTOMATED LINE A SUCCESS

After many months of talks and work on the new machine, it was installed in January 2021. In the meantime, all the earlier steps involved in producing ESN harnesses were automated as well: no more sales administration, methods or logistics procedures needed, except for procurement. *“Today, the first person who receives the order is the operator, on a screen. Everything’s designed to ensure digital continuity,”* notes Michel Crozier.

Once the wire has been prepared and machine settings determined by the process methods technician, Mickaël Marques, the machine cuts the wire to length, applies the ferrule and packages it. *“The last step in the automation process is stripping and crimping the*

ends,” explains Marques. The machine is already capable of doing this, but an option has to be exercised.

“We also have to think about our return on investment, and only automate a process if it improves working conditions, productivity or competitiveness in France,” adds Didier Lhermelin.

AUTOMATING ALL PLANTS?

A question naturally arises: can we eventually automate all electric harness production plants? Alain Ferrero, head of operations at the Interconnection Systems Eurasia division, answers: *“To do that, we would have to rethink the entire production process and use a new design, with component selection based on harness specifications. Ideally, these compo-*

nents will have to be designed from the ground up for automation.”

In other words, manual assembly will still be with us for some years to come. However, the way forward is clear, as Alain Ferrero explains. *“We can now draw inspiration from this automation, a first for the company, to modernize the division’s other facilities and also focus on automating fiber-optic production.”* ■

ADAPTING TO COPE WITH THE CRISIS

As we all know, the Covid-19 pandemic has grounded a majority of jetliners since March 2020. To offset the drop in passenger revenue, airlines have reassigned or converted their planes to carry goods and medical supplies. We take a closer look at what this implies for Safran.

The worsening health situation worldwide since March 2020 has had a major impact on air traffic, grounding from 50% to 90% of commercial airliners worldwide, depending on size. Since then, airlines have had to turn more to air cargo to sustain their business. With 60% of the cargo bay used to carry the usual merchandise, airlines began reconfiguring empty cabin space to carry other goods. Furthermore, cargo conversions are a very attractive option because air freight accounts for nearly 35% of global trade.

AVIATION GETS A SECOND WIND

This type of “cargo conversion” means reconfiguring the passenger cabin to maximize its carrying capacity, via racks, pallets, etc. For instance, Finnair doubled the freight capacity of two Airbus A330s. It took two weeks for the carrier to convert each Airbus A330 by removing economy class seats, food and beverage carts and the crew rest space, thus creating 22 new cargo areas.

The exceptional challenges entailed by the pandemic have spotlighted the importance of air transport, with an

urgent need to carry medical supplies. This trend resulted in a 65% rise in transport costs between March and May 2020, underscoring the vital role played by air cargo.

REJIGGED CABINS

Several Safran companies have supported this shift in priorities. Safran Seats has worked with airlines to maximize cargo capacity on their jetliners without having to convert cabins —packages are stored on seats and in overhead bins. *“About 20 airlines called on Safran Seats’ Support & Services teams,”* says Sébastien Sancho, Vice President, Engineering, Product Support & Innovation. *“We guided them on the technical aspects, and also explained that this use of seats is obviously not covered by normal operating terms and conditions, so the seat-maker is not responsible for any damage incurred.”*

Another upshot was that several air-

“The usual demand for air cargo has been replaced by the transport of medical supplies. Our people’s swift reactions helped us fight the Covid-19 pandemic.”

SÉBASTIEN SANCHO
Safran Seats Vice President, Engineering,
Product Support & Innovation

lines with airplanes under construction in 2020 either cancelled their orders or postponed them. When this happened, Safran Electrical & Power transferred the originally ordered electrical wiring to other aircraft. The company re-





A Boeing 777 cabin being modified by a Safran Electrical & Power team member.

allocated equipment on about 60 aircraft, including Airbus A320, A330 and A350 models. Shifting this equipment and transforming an electrical cabinet can take from a week to two months! Because of the thousands of electrical connections, the process is very complicated. That's why the company's teams either work at the aircraft manufacturer's own premises, or take delivery of more complicated systems at their own plant for disassembly. In short, Safran's adaptability is a key to helping customer airlines limit their losses in these trying times. ■



HIGH-SECURITY TRANSPORTATION: VACCINES

Keeping medications cold is another challenge for the aviation industry. Some of these compounds have to be kept at very low temperatures, down to -80°C . This means that airports have to deploy special containers, freezer carts and dry ice to make sure vaccines retain their effectiveness while in transit.

BUSINESS CLASS: THE FUTURE TAKES SHAPE

To stay ahead in the fiercely competitive business class market, innovation is essential. From an improved passenger experience to additional airline services, here's a quick look at seven innovative solutions being developed by Safran Seats.



HEADSET-FREE AUDIO SYSTEM

The new "HeadsetFree" is an audio system built into the seat back. Part of the airplane's in-flight entertainment system, it offers an unrivaled audio experience, giving passengers greater freedom of movement.



THINNER COMPOSITE SHELLS

Some parts of seat shells absorb fewer impacts so they can be made thinner. That's why we can limit the thickness of shell skins to the strict minimum needed for strength, to reduce weight. By reducing weight, these new envelopes also reduce the plane's carbon footprint.





ADDITIVE MANUFACTURING

Making spare parts with additive manufacturing (3D printing) at partners located close to our customers will shorten delivery times. AM could also be used during business and first class seat development for short production runs. A first set of trim parts for a business class seat has already been certified.



CONNECTED SEATS

Sensors embedded in the seat will improve the passenger experience and provide data on the seat's condition, thus helping to anticipate maintenance needs. These sensors will enhance airline operations, for example by telling the crew that the plane is ready for takeoff and landing, with all seat belts attached, trays stored and seats upright.



ANTIMICROBIAL SOLUTIONS

Several solutions are being studied to develop virucidal materials for the surfaces most touched by passengers, including trays, first/business class passenger modules, armrests and seat cushions. Also being explored are films for plastic surfaces and surface treatments for fabrics.



RADIATIVE HEATING

Safran Seats is studying radiation heating panels around seats and integrated in the padding. In addition to allowing passengers to adjust their own heat, these panels will generate uniform heat that's more comfortable than current systems.



ELECTRIC DOOR OPENING

Business and first class seats now have doors that are opened manually, but will be electrically activated in the future. The idea is to improve the passenger experience, as well as facilitate remote control by the crew.

ONE
FUTURE





SEPCARB™IV BRAKES

In early 2021, the Boeing 777X and 737 MAX 10 began test flights with Sepcarb™IV brakes. This new-generation carbon composite, developed by Safran Landing Systems in Villeurbanne, near Lyon in southeast France, delivers improved wear resistance. The next step is service entry in 2023.

AGILITY

The personal protective fitment adopted on EROS® pilot oxygen masks, and offered by the Safran Aerosystems oxygen systems department during the public health crisis, has been selected by NASA for the Sofia flying observatory.

VIEW FROM THE STARS

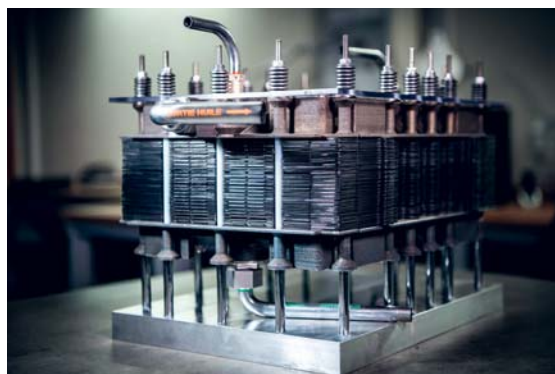
Safran Reosc has been chosen by the Korea Aerospace Research Institute (KARI) to produce a fourth primary mirror for KOMPSAT-7, South Korea's latest generation of high-resolution Earth observation satellites.

KEY MILESTONE FOR ECOPULSE™ DEMONSTRATOR

Set to fly for the first time in 2022, EcoPulse™ is a distributed hybrid propulsion demonstrator plane designed by Daher, Safran and Airbus, with the support of the French civil aviation research council Corac (Conseil pour la recherche aéronautique civile). EcoPulse™ has successfully passed its preliminary design review. This first key milestone was a chance to prove the project's feasibility and finalize the demonstrator architecture. With its innovative structure, EcoPulse™ will make it easier to develop new technologies to reduce the environmental footprint of future commercial aircraft and help achieve air transport's decarbonization goals for 2050.

FUEL CELLS: DUAL SUCCESS

Test programs as part of the PIPAA and Alcide projects have validated the performance of two complementary technologies: the high-temperature cell core and the Hycarus low-temperature technology demonstrator. Kudos to the Safran Power Units teams behind this two-pronged success!



LOW CARBON PROJECT: ALL OPERATIONS SET TO GO GREEN!

The climate challenge is crucially important for Safran. As well as helping decarbonize aviation, we're committed to transforming our industrial operations. And our low carbon project, launched in 2018, has now shifted into higher gear.



CARBON HAS A PRICE

—

Safran has introduced a new tool called internal carbon pricing (ICP). Its purpose is to assign a financial value to the CO₂ we generate. It's a guideline price that gives a clearly measurable form to the environmental impact of an investment or purchase decision. When there are similar options, ICP helps us make the choice resulting in the lowest greenhouse gas emissions.

In the global fight against climate change, aviation is ahead of the curve. Through the Air Transport Action Group (ATAG), our sector has pledged to halve flying-related CO₂ emissions between 2005 and 2050. The sector currently accounts for 2 to 3% of emissions from human activity. Safran is playing a lead role in this effort —both through our technological contribution to the future “carbon-free aircraft” and the transformation of all our industrial operations. In recent years, we’ve already been working to minimize the environmental impact of our activities. However, our efforts were given a real boost in 2018. *“At the request of Safran senior management, we have for the first time formalized a global Group-wide strategy,”* says Bertrand Fiol, Safran environment manager and low carbon project lead. *“We needed to mobilize so we can go further and faster by associating the efforts by each company with a set of shared goals and indicators.”*

AMBITION AND REALISM

The highly ambitious low carbon project concerns Safran’s 200 sites around the globe. It addresses the three types of emissions —called “scopes” for the purposes of the project— as generally defined in environmental management: Scope 1 covers direct emissions by our offices and factories. These are generated by gas heating, for example, but also by burning jet fuel on test stands. Scope 2 deals with “indirect” emissions —mainly related to the supply and use of electricity at our sites.

Scope 3 encompasses all “external” emissions caused by the activities of suppliers and subcontractors, logistics operations, consumables purchases, waste management, staff commuting, etc. It also includes emissions generated by Safran products throughout their lifecycles.

In late 2019, after in-depth feasibility studies, Safran published a realistic roadmap in line with the Paris climate accord, with initial quantified objec-

tives for 2025: reduce Scope 1 emissions by 8% and Scope 2 by 18% (compared to 2018). “At first glance, it might seem modest given the scale of the climate challenge,” says Bertrand Fiol. “But these absolute figures take account of how our businesses will grow, so in relative terms we’ll actually be cutting emissions by 30 to 40%.” Scope 3 is much harder to evaluate, because it’s based on external data. But studies are ongoing —and we’ll shortly be publishing our objectives.



› ALREADY MAKING PROGRESS

In 2020, Safran rolled out its action plan for Scopes 1 and 2. This plan is based on a six-pronged energy strategy to drastically reduce the carbon footprint of each site and process. It ranges from energy performance standards for all new buildings to analysis of CO₂ capture and storage technologies, low-carbon power purchase agreements, energy efficiency projects, disruptive actions for heat generation and local electricity production and consumption.

The low carbon project is overseen by the Executive Committee and implemented at each company with a roadmap and project manager. Wide-ranging progress has already been made. For example, Safran has signed a deal for the supply of solar-generated electricity for our companies in Mexico. Safran Helicopter Engines reduced CO₂ emissions at its

French sites by 200 metric tons in 2020, thanks to actions like better regulation of ventilation and heating. It's also buying solar panels, which will soon supply nearly 40% of the electricity at its Sydney site. Safran Aero Boosters has invested in solar roof panels generating 190,000 kWh in a year, and is now preparing to commission a wind turbine that will meet 10% of its electricity needs this year.

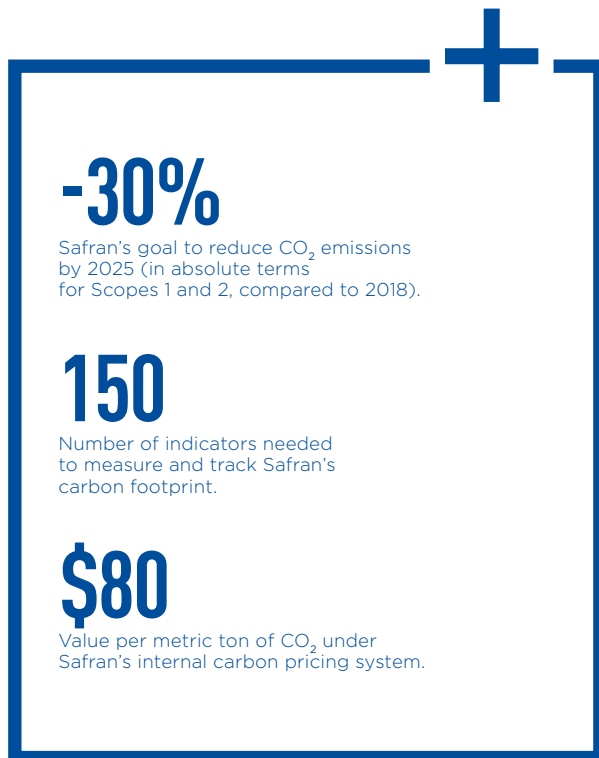
Safran Electronics & Defense's new facility in Valence, southeast France, is being built to the highest eco-standards, which will save 500 metric tons of CO₂ a year. Other actions include changes to organizations, processes and behaviors, generating benefits with little or no investment, like consultations at various sites to optimize the use of machinery. All colleagues are involved in the initiative, as reflected in the many participatory challenges launched in recent months.

GREATER INDUSTRIAL EFFICIENCY

A new chapter began in early 2021. Led by our new CEO, Olivier Andriès, the low carbon project has shifted into higher gear. Safran has now set an even more ambitious target and revised the objectives of Scopes 1 and 2 to 30% lower emissions by 2025 (compared to 2018). At the same time, our newly established Climate department is being structured to coordinate all actions to cut Safran's carbon footprint across all products and operations.

These recent announcements show that Safran is well on track despite the Covid-19 crisis. *"Events may have put us a bit behind schedule in some areas, but this in no way affects our ambition,"* says Bertrand Fiol. *"On the contrary, this endeavor is all about responsibility and responding to the expectations of our stakeholders —which includes our people. It's also about performance, because optimizing our processes and energy use will reduce our recurring expenses. Above and beyond the environmental imperative, this strategy has major benefits for industrial efficiency."*

In other words, Safran's ecological and energy transition is in motion. And nothing can stop it —not even a pandemic! ■



The Safran Additive Manufacturing Campus near Le Haillan (Bordeaux) in southwest France, opens its doors in 2021. This 12,500 square meter (135,000 sq ft) facility will be powered exclusively by electricity and waste heat recovery.



LOW CARBON AND CLIMATE CHANGE: HELP DRIVE THE ENERGY TRANSITION

As we step up to the environmental challenge, everyone has a role to play. Since 2018, Safran has been pursuing a host of real-world actions to cut emissions, with the formal definition and rollout of a Low Carbon plan. Since January 2021, Safran University has been offering an online Low Carbon and Climate Change training course. It covers all the Group's actions to protect the environment and explains the practical steps you can take in your daily work to help reduce our carbon footprint. The course is available on the 360Learning platform and on Insite.



INTRAPRENEURSHIP, ANOTHER WAY TO INNOVATE

Pursuing an innovation project from start to finish and creating value for Safran and our customers by doing things differently —that’s the aim of the “We Love Intrapreneurs” initiative launched in 2018. People taking part in this adventure reflect on their experience.

The team in charge of running the Intrapreneurs initiative (left to right): Virginie Coll, Valentin Orus and Olivier Leclerc.



12

Number of participants' nationalities in Intrapreneurs Season 3, launched in September 2020.

84

Number of intrapreneurs who completed the Bootcamp.



The Run[waiz] team (left to right):
Céline Colonna-Ceccaldi,
Christophe Bastide, Laurent Miralles,
Benoît Marty and Vincent Hupin.



WE LOVE INTRAPRENEURS : TESTIMONIAL FROM TEAM RUN[WAIZ]

Project sponsors: Martin Sion, CEO of Safran Electronics & Defense, and Cédric Goubet, CEO of Safran Landing Systems

How did the Run[waiz] project come about?

The idea came out of a cross-cutting R&T project. It's a software solution that maps the condition of an airport's runways with a high degree of accuracy. We Love Intrapreneurs is a chance to focus fully

on the project —as if we were building our own company.

What are the benefits of this initiative?

Intrapreneurship means we can work independently and full time as a team on a project we think is really important. We can call on any number of other Safran colleagues to help, and our sponsors are always on hand to provide support.

Where does your project stand today?

In late 2020, we signed a partnership with Boschung, the world leader in sensors, and our in-house investors have extended the project. What's more, a PoC (proof of concept) of our solution has been launched with Paris Orly Airport. It's a real team success —especially amid the Covid crisis.

Launched in November 2018, We Love Intrapreneurs —led by Olivier Leclerc at Safran's Research & Technology (R&T) and Innovation department—encourages colleagues in all areas of expertise to develop new value-creating business ideas and forge them into reality. First, they present their ideas. Then the unit helps them pursue their projects in-house, after a selection process inspired by the world of startups.

A lot of project ideas are collected during the initial phase. Then several proposals are chosen, in line with Safran and Group company strategy, and multidisciplinary teams are formed —a key success factor. Next, a panel of 20 people from the Safran Executive Committee and each Group company chooses seven teams to receive six months of intensive intrapreneurial support and prepare a credible and compelling business plan. After a final

presentation of the full-fledged projects, the panel designates one finalist team to join the intrapreneurship booster unit at the Paris-Saclay site, where they work on it full-time for one to three years.

A REMARKABLE COMMITMENT

Season 2 resulted in over 100 proposals. *"Despite the special circumstances in 2020, the seven teams of intrapreneurs went all out —doing their jobs at Safran, dealing with the crisis and pursuing their projects,"* says Olivier Leclerc. *"It's a vivid demonstration of their commitment and resilience!"* The Safe Air project emerged victorious this time, with a clever, low-cost concept to measure the efficiency of absorbent filters in an aircraft cabin. *"We also owe this success to the support we received, which changed our way of thinking,"* said Safe Air team members Sébastien Chapé and Warren Samba. *"Instead of*

starting with technology, we listened to the market and studied actual user needs." Intrapreneurship is a unique opportunity to innovate. Marcellette Cloche, a member of the CAMO team (continuing airworthiness management organization), which wasn't selected for the booster, is convinced: *"It pushes you to the limit in order to create value for our customers and Safran. This incredible initiative has opened my eyes to the importance of teamwork and how it's people who really make the difference."*

Season 3 of We Love Intrapreneurs began in the fall of 2020 and will continue until fall 2021.

Save the date: September 28 is when we hear the final presentations and learn which Season 3 team will join the booster. ■

For more about the Intrapreneurship initiative, go to the Innovation section of Insite.

TRAVEL SAFE BY SAFRAN: SAFE FLYING DAYS ARE COMING

Covid-19 has badly hurt commercial aviation: passengers are frightened to travel, international flights are severely limited and airlines are facing unprecedented difficulties. But our industry is fighting back and preparing for the future: Safran is developing innovative solutions to make aircraft cabins some of the most contagion-free environments on the planet.



Statistics are often a more graphic reflection of reality than words: in 2020, air travel was almost halved compared to 2019, to levels last seen in 1979, more than 40 years ago. Airline revenues are dropping, while costs continue to rise: even operational aircraft spend more time on the ground than before to undergo strenuous disinfection processes between flights. In the space of only a few weeks, the entire aerospace value chain was brutally slowed and has been idling ever since.

SPACE: A MAJOR ISSUE

Thankfully, this unheard-of industry crisis has a positive flip-side and has triggered an equally unprecedented stream of creativity and research, focused on a twofold certainty: first, someday, air travel will resume with some level of normality. Secondly, society's concern for potential onboard microbial contamination will remain very high. "Can we create a safe cabin environment for passengers and crew?" asks Ian Scoley, Vice President, Design and Innovation at

Safran Cabin. "Clearly the answer is 'yes', but it brings complex challenges to make that credible, evident and practical within the densely populated, interconnected ecosystem of today's commercial airline operations." This scarcity of space has a reason, which is profitability: the more passengers a plane carries, the more revenue it generates. However, optimizing space also means that passengers and crew are almost always located close to each other, multiplying occasional and uninten- ➤

3M : A KEY PARTNER

In June 2020, Safran Cabin and 3M, a long-time supplier to the Group, teamed up to develop aircraft cabin cleaning and protection from bacteria and viruses.

The co-developed products, being validated by the Cabin R&T team, are currently virus-tested by the Limoges university hospital (France), and should be available by the end of 2021.

Below: Contactless faucet in an Airbus A350 lavatory.
Bottom: An Airbus A350 lavatory featuring contactless technology, with faucets inside and out for better protection.





Safran Seats offers separation screens to help protect passengers' health.

› tional contact between them. *“Once you are onboard, you can’t avoid touching your surroundings, intentionally or otherwise, be it while loading the luggage compartment using the meal tray or casually brushing past other seats and passengers on the way to the lavatory, a notorious high contact hot-spot,”* reflects Ian Scoley.

CUSTOMER CENTRICITY

Clearly, some areas of the cabin present a higher potential for viral and biological contact than others. Adhi Tjandra, Sales Manager for the Galley & Lavatories division of Safran Cabin, points out that *“lavatories, for obvious reasons, are a particularly critical place on a aircraft, health-wise”*, while Quentin Munier, Executive Vice President, Strategy & Innovation at Safran Seats, explains: *“The coexistence of all these potential contamination areas like lavatories and seats means that, in a post-Covid context, we*

need to rethink the cabin as a whole, not as a juxtaposition of independent elements. We needed to structure the way the various companies within Safran could provide coherent, aligned solutions. Crucially, we needed to understand what our customers needed in order to start working on relevant innovations for today, tomorrow and for the future. Either technically or financially, what we can deliver on an existing aircraft platform is obviously going to be different from one under development, or even still in the future concept phase.”

Taking the customer as a pivotal figure is exactly what Safran started doing from the very beginning of the pandemic. *“We took a market-focused approach towards innovation by reaching out to the top 25 airlines worldwide and collecting their needs and concerns when it comes to cabin hygiene”*, says Tony Vaughan, Executive Vice President, Engineering at Safran Cabin.

One of the key elements that came out of this research was that both airlines and passengers alike didn’t just require increased health safety levels, but visibility regarding the efficacy of solutions put in place: *“There is no point in implementing solutions that do not visibly work: confidence is absolutely crucial for people who want to fly again and consequently for airlines too.”*

Meanwhile, Safran also worked on several projects directly with Airbus and Boeing, while also developing partnerships with trusted suppliers on specific issues, such as 3M for cleaning, disinfection and protection and Universal Movement for seats.

TRAVEL SAFE: SOLUTIONS FOR TODAY, AND TOMORROW

This coordinated outreach approach has ultimately resulted in Travel Safe, a global Safran initiative that established four distinct levels of protection across the entire catalog of touchpoints

within the cabin. The first, foundational level is to provide durable, easy-to-clean surfaces that are resistant to damage from today's more rigorous cleaning regimes. This involved research into selection of the best materials and sanitizers combined with a "clean by design" methodology to eliminate grime collecting features from our products and promote a "one wipe & clean" capability. In the case of seats, social distancing also played its part, with various types of screens between passengers to provide more health protection and privacy through separation.

Another solution that Safran has been working on is the use of disposable surfaces, such as seat covers. The second level is the use of biocidal surface treatments such as chemical applications and surface coatings, like antimicrobial foils and paints or exposure to UV light to continually deter or eliminate harmful organisms. The third level embeds biocidal solutions within manufactured materials, such as additives to structural plastics or nano-surface topography applied to metals to provide permanent, effective germ-killing capability. Ultimately, the fourth level is the application and development of contactless devices in critical, high contact areas such as lavatories or

seats, either by using sensors or by remote-controlling functionality through smartphone apps, or simply by hands-free mechanical actuation, such as adjusting a seat back by foot instead of by hand.

At each level, some solutions are already ready or under test, while others are more dedicated to future planes than to retrofits, as they can imply a global redesign of whole units. "Of course, we have been developing a range of conceptual solutions to address clean cabin aspirations for the future," sums up Ian Scoley, "but ultimately, we have a responsibility to provide safe, effective and durable solutions for our customers today that don't overburden their daily operations, but more importantly, enrich their customers' experience. And so, in the medium-term, solutions are well underway, as Quentin Munier explains: "Aircraft seats are replaced on a 7-to-10 year cycle, which means that some airlines could potentially adopt our solutions in the very near future." The post-Covid world might not be here yet, but one thing is certain: Safran is here to raise the bar and set new industry standards that enable stress-free journeys in a safe and healthy cabin environment for passengers and crew alike. ■

"The point is, can we create a safe flying environment for passengers and crew? Clearly, the answer is yes, but it raises very complex challenges, which mainly come from the fact that in a plane cabin, however large, space is at a premium."

IAN SCOLEY
Vice President, Design and Innovation,
Safran Cabin

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SEATS: A CRUCIAL FACTOR

QUENTIN MUNIER
Vice President,
Strategy and Innovation,
Safran Seats

In 2020, Safran Seats launched a challenge to promote innovations focused on post-Covid travel. Our teams came up with more than 150 ideas regarding three major themes: contactless interactions, clean surfaces, and privacy.

Many of them were packaged to create our Travel Safe offer and presented to more than 20 major airlines worldwide, garnering very positive feedback. Together with our partner, Universal Movement, we are developing solutions which range from quick-to-apply, long-lasting disinfectants, to pedal-actuated

seatback reclining and meal tray opening, or privacy wings and partitions to ensure social distancing for passengers in all classes. In addition to the benefits in terms of health, these solutions will ensure reduced on-ground times for planes between two rotations.

CYBERSECURITY

Michel CAUNES

**Vulcain project manager
at Safran Electronics & Defense**

As cyberthreats continue to proliferate, Michel Caunes and his team launched the Vulcain project in early 2020. Vulcain serves a threefold objective: secure Safran's products and systems, raise staff awareness and engagement, and protect the company's know-how and its proprietary and customer data.



What exactly does Vulcain⁽¹⁾ involve?

M. C.: Vulcain is more than a project —it's an accelerator designed to strengthen cybersecurity at Safran Electronics & Defense by the end of 2021. Its cross-functional actions apply to all our products, teams and information systems, the security issues we face and our supply chain.

The aerospace and defense industry plays a major role not only in flight safety but also in employment, the economy and the technological superiority and sovereignty of nations. Vulcain is vital because it addresses an increasingly serious problem posed by cyberthreats in this sector, such as industrial espionage, sabotage and ransomware attacks. From industrial stoppages to the theft of intellectual property and the identity of strategic colleagues, the risks are innumerable and constantly evolving —it defies the imagination! We need to be vigilant at all times. In this new paradigm, cybersecurity legislation is changing rapidly, standards are becoming stricter and customers are expressing ever more stringent requirements. What's more, our company's products and technologies are embedded in many of Safran's solutions, from Fadec engine control units to braking controllers. There can be no half measures: even if product safety isn't in question, the impact of a fault on Safran's brand image could be disastrous.

Could you give a few examples of products affected by cybersecurity issues?

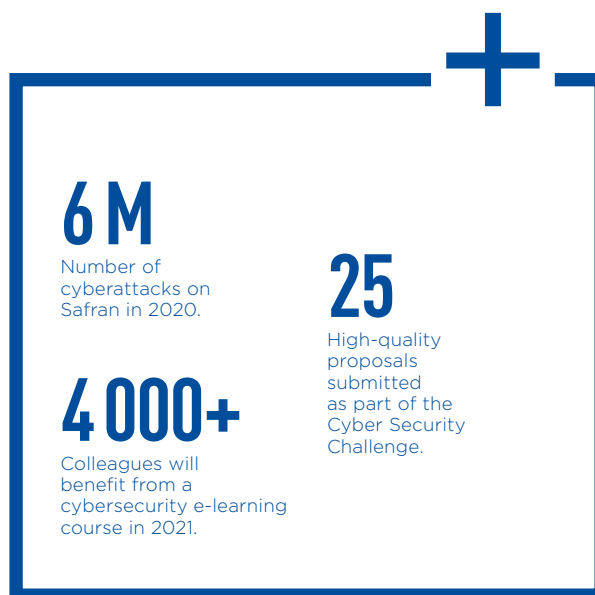
M. C.: The Safran ADLU (aircraft data loader unit), which updates a plane's onboard systems, is at the forefront of advances in cybersecurity. On the ground side, our FELIN⁽²⁾ soldier modernization system comprises state-of-the-art equipment and integrated links so that data can be exploited securely in the battlespace. This year, for example, the Vulcain team has stepped up the application of cybersecurity standards on the SkyNaute navigation system for aircraft, which now ticks all the boxes. And Fadex, our new-generation Fadec, is also benefiting from the project.

“A threat directed by a state or private actor only needs one loophole. One opportunity can have disastrous consequences!”

Practically, how do you ensure a product is secure? And more broadly, what levers does Vulcain have and what actions does it take?

M. C.: As far as products are concerned, Vulcain applies on three levels right from the development phase. We raise awareness and provide training and coaching for the teams involved throughout a product's lifecycle. Of course, we encrypt the data in the programs used in our solutions and perform a whole series of intrusion tests. At the same time, we apply rigorous processes at every stage, from development and manufacture to through-life support (risk analyses, specifications, tests, etc.).

As well as product security, the Vulcain teams rely on the skills of cyber experts, the IT department and the security systems already in place within the company to strengthen the security of our shared networks, sites and workstations. We've also deployed the Urbasec network segmentation solution at our sites, which protects against a major production stoppage in the event of an attack.



Vulcain is planning a mass employee awareness raising and training campaign to sharpen our vigilance. In 2020, the Cyber Security Challenge resulted in 25 high-quality proposals, which really inspired us. This year, more than 4,000 employees will benefit from an e-learning course, while a fun app called La Minute Cyber will soon be rolled out to raise awareness of these issues for each and every one of us. ■

1. No relation to the Vulcain engines powering the main stage of the Ariane 5 and 6 launchers, for which the prime contractor is ArianeGroup, a 50/50 joint venture between Airbus and Safran.

2. *Fantassin à Équipements et Liaisons Intégrés*, an integrated equipment suite for infantry soldiers.

IS HYDROGEN THE KEY TO CARBON-FREE AIRCRAFT?

The race to decarbonize aviation is picking up speed. Safran continues to lead from the front, especially through our work on future propulsion concepts. One of the solutions being considered is the use of hydrogen as a replacement for fossil fuels. While hydrogen is a promising energy source, it also presents a number of obstacles, both technological and industrial.

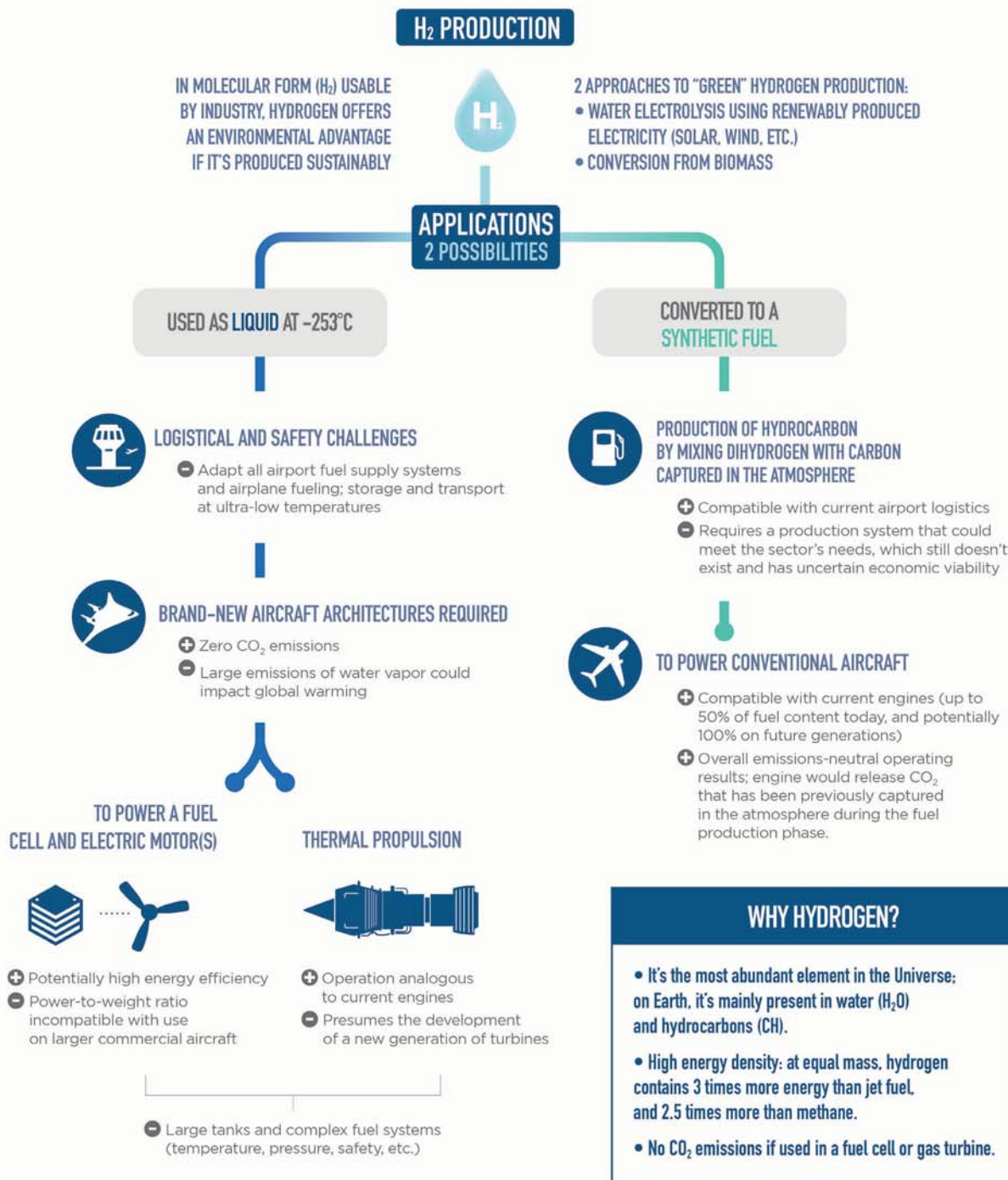
Among the possible changes to aircraft, engines and fuels, the aviation industry is delving into hydrogen as a potential replacement for conventional jet fuel. It's one of the solutions being explored by the European research project, Clean Aviation, as well as by Corac, the French civil aviation research council. Hydrogen is also a key to Airbus's ZEROe program, which aims to develop a zero-emissions commercial airplane. In France, a public investment plan has €7 billion euros to invest between now and 2030 to develop hydrogen production as a replacement fuel for industry and air transport, including €2 billion for the 2020-2021 economic recovery plan. Unlike jet fuel, the combustion of hydrogen does not produce any carbon dioxide (CO₂). While we can't find hydrogen directly in nature, it's still an abundant element that can be produced as dihydrogen, usable by industry, and made using eco-friendly processes —provided we have access to sufficient amounts of electricity generated via wind, solar and other renewable sources. Sounds like a miracle energy source, right? Well, it's not that easy, because there are significant technical roadblocks to using hydrogen for aviation.

THREE TECHNOLOGY PATHS

Perhaps the most frequently cited application today is hydrogen-based fuel cells that power electric motors. However, to be feasible, this solution would need a quantum leap in the power-to-weight ratio, and it will not be feasible for larger commercial airplanes for many years to come. Hydrogen could also be burned directly in gas turbines, but we would still need a new engine design. However the need to store large quantities of liquid hydrogen at -253°C entails tremendous challenges in terms of designing the fuel tanks and distribution systems. Another possible solution is using hydrogen to produce a synthetic fuel, offering a neutral emissions cycle if it is combined with CO₂ captured from industrial smokestacks or directly from the atmosphere, and produced using "green" electricity. The advantage of this process is that the fuel would be compatible with current and upcoming airplanes - but it's still far from capable of producing the huge quantities needed.

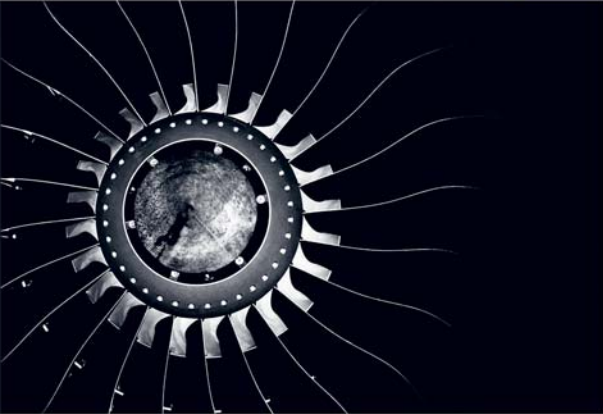
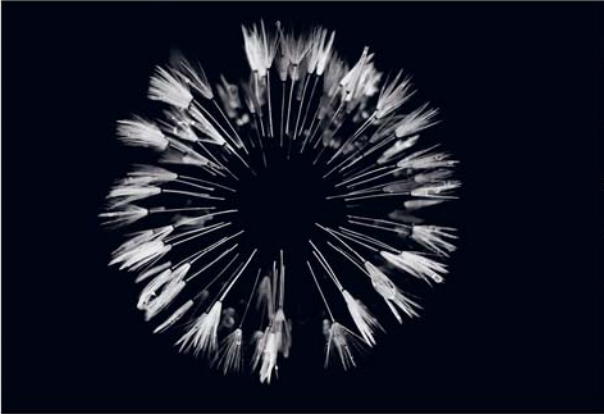
Safran is of course at the forefront of these investigations, and invests heavily in research to evaluate and develop these solutions. Several studies are already underway: with ArianeGroup and Airbus to identify the processes needed to produce liquid hydrogen (Hyperion); with the French aerospace research agency Onera, Airbus and Dassault Aviation on the availability of "green" hydrogen (Energia); and on the impact of contrails, since the combustion of hydrogen produces large quantities of water vapor, and we still have to measure its real impact on global warming. The next step will be validating the major technological and industrial options by 2025-27, with a hydrogen-powered aircraft possibly making a breakthrough service entry towards 2035. ■

HYDROGEN FOR TOMORROW'S AIRPLANES



MIMESIS CONTEST WINNERS

Our Mimesis photo contest, organized by Safran, asking for **“Photos of nature’s treasures that resonate with technology”** inspired hundreds of photographers worldwide. From September 2 to November 4, 2020, amateurs and professionals alike from 38 different countries submitted nearly 10,000 photos. Here are shots from the three prizewinning photographers.



Dandelion flower: © L. Montastier
Turbojet blower: © V. Borodine / Safran



Dragonfly in the sun: © T. Dufour
Carbon fibers: © C. Abad / Safran



Fractal fairy: © Smartx
Aircraft wiring: © C. Abad / Safran