

AIRBUS

SUMMIT

2022

30 NOVEMBER – 1 DECEMBER

The
flight path
towards
greater
sustainability

AIRBUS

THE DECADE OF CHANGE

In 2021, the Airbus Summit discussed the ambition of the aviation industry to decarbonise. Central to achieving this would be collaboration across the entire aviation ecosystem – including policymakers and regulators – to support a shift to new technologies, for example the scaling up of hydrogen fuels and the infrastructure requirements that would accompany this transition.

In 2022, the Airbus Summit focused on the steps achieved and progress made towards this bold ambition.

The Summit was held over two days at Airbus sites in Toulouse and Munich and brought together a diverse mix of aerospace experts, NGOs and policymakers all united by the pressing need to progress on decarbonisation and emissions reduction.

In this summary of the Airbus Summit 2022 you can read about the paths being taken towards the emergence of a new ecosystem including the scaling up of sustainable aviation fuel (SAF), new and exciting developments in hydrogen and its infrastructure requirements, as well as new technologies to streamline aircraft operations for reduced fuel burn. In these Summit Proceedings you will discover how the industry's decarbonisation plans have received valuable scrutiny from the Environmental Defense Fund.

The Summit also addressed technologies to improve aircraft performance through hybridisation, the progress being made towards achieving electric vertical flight, and the connection between sustainability and defence.

It also revealed advances in urban air mobility (UAM) and Space exploration including an introduction to Airbus's newly selected ESA astronaut, Pablo Álvarez Fernández.

In the Airbus Summit opening remarks, Airbus CEO Guillaume Faury said "the clock is ticking" and concluded that Airbus is committed to making the 2020s the decade of change.

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↑ The latest ZER0e fuel-cell engine design



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MAKING PROGRESS ON DECARBONISATION

While progress is being made to reduce emissions, the aviation industry is not moving quickly enough and must accelerate. In order to achieve this acceleration, the industry can and should explore multiple options and look into both short- and longer-term initiatives. Cross-industry and cross-border collaboration is key, and agreed frameworks and regulations within which the industry can operate on a level playing field will be vital to the success of this endeavour. Initiatives like the UK's Jet Zero strategy demonstrate how a wide-ranging package of measures is needed to facilitate progress.

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JOINT THINKING ON SUPERCONDUCTING TECHNOLOGIES

Airbus has launched a demonstrator with the European nuclear research organisation CERN to adapt superconductivity technology into future aircraft systems. CERN will be collaborating with Airbus in developing thin (4 cm) cryogenic superconducting cables to allow the transfer of large amounts of electrical power with maximum efficiency at ultra-low temperatures (as low as -190°C).

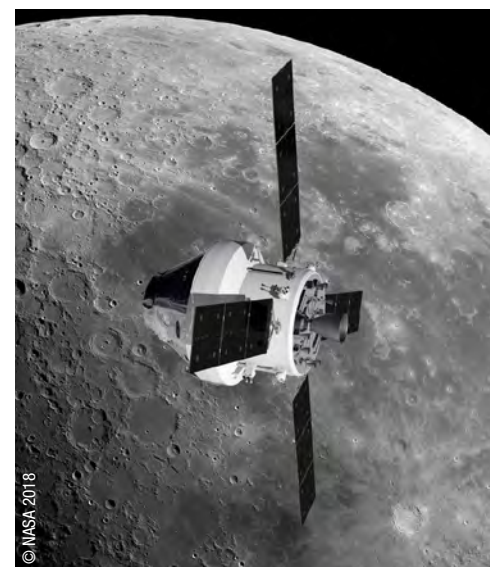
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AIRBUS SIGNS R&D AGREEMENT WITH RENAULT

For the aerospace industry to benefit from the advantages of electrification and hybridisation, it needs to learn from other industries. One such sector with clear synergies that present learning opportunities is the automotive industry.

With this in mind, Airbus has signed a Research and Development agreement with Renault, to help accelerate their combined electrification roadmaps, and in particular support the development of Airbus' future hybrid-electric aircraft.

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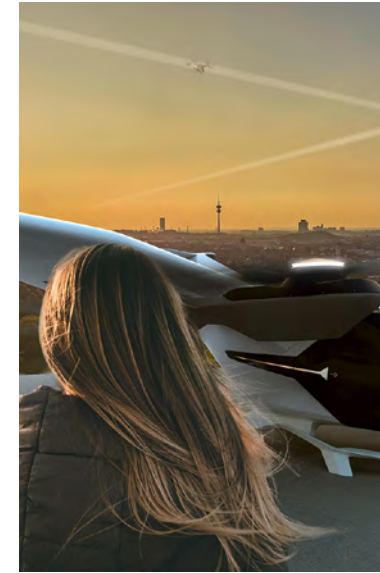


AIRBUS SHOOTS FOR THE MOON

A new era in Space exploration has begun. Investing in Space exploration is important, not least because it has in the past been the catalyst for significant breakthroughs in medicine, science and technology.

However, no single organisation or country can do it alone, and the launch of the Artemis programme – in which Airbus is playing a key role by manufacturing the European Service Module – is a tangible example of how cross-border, multi-organisation collaboration is vital for future success.

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INNOVATIVE eVTOL SOLUTION FOR LIFESAVING MISSIONS

Airbus, in collaboration with International SOS, has unveiled LifeSaver, an innovative concept that combines ground, sea and airborne means of transportation to deliver critical lifesaving services.

UAM has the potential to transform our towns and cities, but electric vertical take-off and landing (eVTOL) aircraft are set to become major assets for essential missions beyond urban settings. The first country to explore their application for medical services missions is Estonia, which has a dispersed population living on more than 2,000 islands.

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NESTE-AIRBUS COLLABORATION SUPPORTS SAF TRANSITION

Sustainable aviation fuel (SAF) is one of the aerospace industry's key decarbonisation solutions as it can be used in both in-service fleets and the flying fleets of tomorrow. With this in mind, Airbus has announced a partnership with Neste, the world's leading SAF producer, to advance production and encourage greater take-up of SAF.

The focus of the collaboration will be on technical developments, fuel approval and testing production technologies, whilst fully cognisant that the industry is already "at the eleventh hour" according to Neste Executive Vice President Renewable Aviation, Thorsten Lange.

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DEFENCE 'RE-RECOGNISED' AS KEY INGREDIENT FOR SUSTAINABILITY

The war in Ukraine has prompted a reassessment of the defence industry: rather than being perceived as 'non-sustainable', the conflict on Europe's borders has demonstrated that safety, defence and sustainability mutually reinforce each other.

The events of this last year have also demonstrated the benefits of a diversified supply chain, and provided a stark warning that dependence on a single country, partner or technology can be a risky strategy. As modern battlegrounds extend all the way to the frontiers of Space, new technologies and ways of thinking are needed to promote peace and stability – and therefore sustainability.

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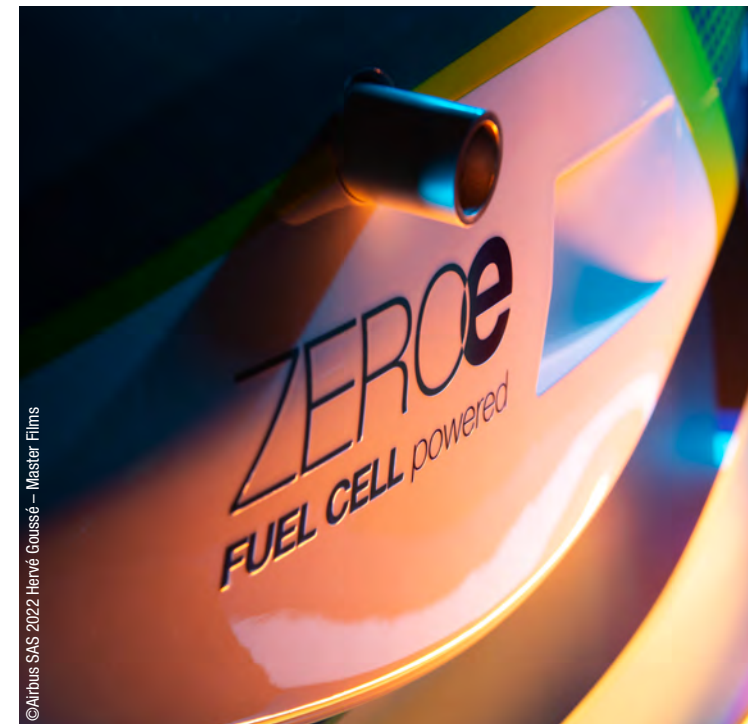


HYDROGEN FUTURE REQUIRES THE RIGHT ECOSYSTEM

A new hydrogen-powered fuel cell is to be tested on Airbus' second ZEROe demonstrator – a concrete step by Airbus to advance hydrogen as a future propulsion technology. But the hydrogen ecosystem also needs to mature for it to be a viable fuel source for the commercial aviation industry.

Work on this ecosystem is already underway, marked by initiatives such as a programme with HyPort to develop one of the world's first airport production and distribution stations for hydrogen at Toulouse-Blagnac Airport. Developing the right volume of hydrogen, at the right price, from the right sources and delivering it in the right locations are essential considerations.

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TIME FOR ACTION

Airbus CEO Guillaume Faury opens the 2022 Summit, outlining the industry's progress on sustainability and the challenges it still faces.

↑ SAF is one of the aviation industry's key decarbonisation solutions



↑ Guillaume Faury, Airbus CEO

As an industry, we must stand up and be transparent on sustainability. We've seen stark evidence of the scale of the climate crisis, from wildfires in Europe to flooding in Pakistan. At COP27, we've heard influential voices raising concerns about the environmental impact of aviation. So the 2022 Summit was about showing how Airbus and the aviation industry are acting on sustainability.

Overall, it's a mixed picture. But I am deeply impressed by how this sector has come together since our previous Summit. I've observed a shared resolve to use this economic and energy crisis to accelerate progress on sustainability.

Undeniably, there has been strong progress. In 2022, for the first time, the sector has united around a viable decarbonisation roadmap. The Toulouse Aviation Summit in February 2022 saw 42 countries set a goal of 'achieving carbon neutrality in the air transport sector by 2050'. Later in the year, the International Civil Aviation Organization (ICAO) adopted a long-term aspirational goal for 'net-zero carbon emissions by 2050' for the first time.

What this means is that governments are now in line with decarbonisation targets set by the aviation industry.

This is a vital step towards a coherent global policy framework for a global industry.

And the energy picture is changing too. We are seeing more airlines around the world acting to secure supplies of sustainable aviation fuel (SAF). At Airbus, we've announced a SAF fund to enable our partners to invest with us. And since spring 2021, three Airbus aircraft types have flown with at least one engine running on 100% SAF, most recently the A380 at the end of March. At the Summit this year, we announced a new partnership with Neste which will help foster the SAF ecosystem that we need to achieve our climate goals.

The defence sector is also embracing sustainability. In the UK, the Royal Air Force, Airbus and other industry partners carried out the world's first 100% SAF flight using an in-service military aircraft. An RAF Voyager – the military variant of the Airbus A330 – took to the skies above RAF Brize Norton in Oxfordshire, powered by 100% SAF on both engines.

Meanwhile, this year Airbus has announced partnerships to develop Direct Air Carbon Capture technology, not only to remove CO₂ from the atmosphere, but also as a source of Power-to-Liquid (PtL) synthetic fuels. Hydrogen Hubs have been appearing around the world, bringing together airlines, airports and energy providers.

Our 2022 Summit was also about showcasing the progress we are making with our partners. Hydrogen remains one of

the most promising fuel solutions for the future. We're well on our way to building an ecosystem that will make it possible to develop Hydrogen Hubs at airports around the world, and at the 2022 Summit we announced new initiatives that will help us achieve this through collaboration with airport, energy and industry partners. We also unveiled our plans to mature technologies associated with hydrogen-powered fuel-cell engines, which we will flight-test later this decade on our ZEROe demonstrator, A380 MSN1.

And we are also forging ahead with innovation in our Helicopters and Defence and Space divisions. The Summit offered a prominent platform to take stock of recent achievements in the field of Space exploration during the Artemis I mission, for which Airbus built the European Service Module. And we launched our latest Helicopter demonstrator, DisruptiveLab, which aims to reduce CO₂ emissions by 50%.

So this is proving to be a time of action and innovation; a time of speed and acceleration. But is the world moving fast enough and is the aerospace industry on track to meet its targets?

The realistic answer is 'not yet'.

By 2030, SAF will need to be produced at many times the level of today. Ambition is not yet matched by action.

There needs to be more investment in new refineries and production facilities. And more ambitious mandates for SAF. Similarly, the infrastructure for producing and distributing renewable hydrogen is still in the early stages of development.

However, in the face of multiple crises, governments and the aerospace industry are taking collective action to tackle climate change and improve energy availability and energy security. The pace of change may not feel comfortable, but radical change seldom is.

At Airbus we will push for greater speed, energy savings, alignments and investments in the next twelve months. The time for excuses is over. The time for action is upon us. **A**

THE SKY IS NOT THE LIMIT

Exploring the potential of the Moon's resources for future sustainability.

Panellists

Pablo Álvarez Fernández

Airbus, Project Management Officer – and newly selected European Space Agency (ESA) astronaut

Siân Cleaver

Airbus Defence and Space, Industrial Manager for the Orion European Service Module (ESM) programme

Laura Todd

Airbus Defence and Space, Vice President of Space Exploration Future Programmes

Moderator

Alex Lepa

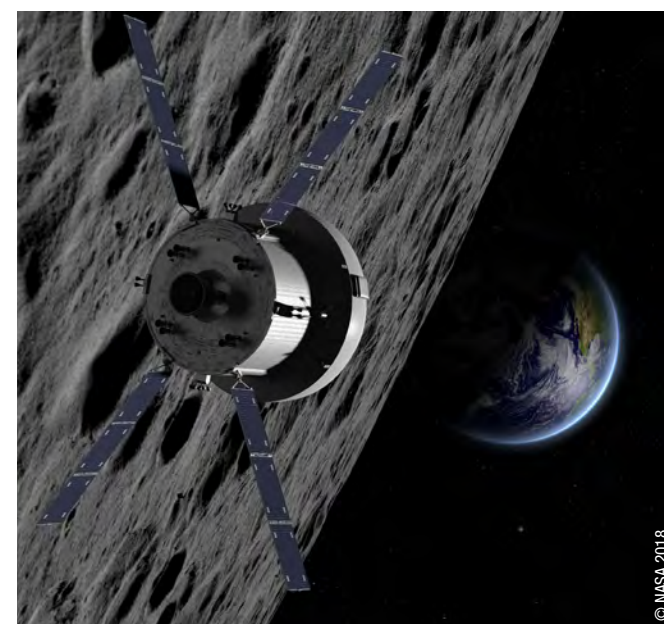
Airbus, Head of Connect and Engage Employees

A new chapter of Space exploration is underway. The Artemis programme, which comes fifty years after humans last went to the Moon, began with an uncrewed test flight in November, which returned to Earth in mid-December. NASA intends for Artemis to take humans back to the Moon in 2025 with the third Artemis launch.

This new chapter brings with it an incredible opportunity for collaboration; for the first time NASA has entrusted a company primarily based outside the US to provide a mission-critical element of a crewed spaceflight mission. Working under a European Space Agency (ESA) contract, Airbus has been entrusted with building and testing the European Service Modules (ESM) for NASA's Orion spacecraft.

Siân Cleaver, Industrial Manager for the Orion ESM at Airbus Defence and Space, explains that the ESM is one of the most critical elements of the Artemis missions as it provides the propulsion, power and thermal control: "The ESM will also have everything the astronauts need to keep them alive on their journey to the Moon. Not just water, but other life-giving essentials such as the oxygen and nitrogen that forms the air that the astronauts will breathe."

Airbus' expertise is giving Airbus Project Management Officer Pablo Álvarez Fernández the confidence he needs as he steps into his new role as one of 17 newly-selected ESA astronauts: "I won't have any fears," he says. "It's built by the best engineers in the world."



↑ An artist's rendering of Orion orbiting the Moon

IN SUMMARY

- Scientific discovery is the principal reason for returning to the Moon.
- The Moon is our geological twin and can also provide us with energy and mineral wealth that will be key to our future prosperity. But its natural resources need to be carefully and responsibly managed.
- Investing in Space exploration is important, not least because it has always been the catalyst for significant breakthroughs in medicine, science and technology.
- Today our endeavours in Space have further significance, as a way to monitor and measure the impact of climate change.
- Returning to the Moon now will help lay the groundwork for future human exploration of Mars and other planets – inspiring a new generation of explorers and creating a new global pool of scientific and engineering talent.
- But no single organisation or country can do it alone. The launch of the Artemis programme – in which Airbus is playing a leading role – is a tangible example of how cross-border, multi-organisation collaboration is vital for future success.



↑ Pablo Álvarez Fernández



↑ Laura Todd



↑ Alex Lepa and Siân Cleaver

© AIRBUS SAS 2022 photo by Jean-Vincent Reymondon

ENABLING THE HUMAN EXPERIENCE IN SPACE

Airbus' role in the Artemis programme builds on its proud heritage in Space exploration. Airbus is harnessing its experience from previous programmes where it has led in human spaceflight including the Automated Transfer Vehicle it designed to deliver supplies to the International Space Station (ISS) between 2008 and 2015. Airbus also collaborated in designing the Columbus Science Laboratory, which is the largest European module of the ISS.

Airbus is looking to the future and Laura Todd, Vice President, Space Exploration Future Programmes at Airbus Defence and Space, knows Airbus is prepared: "Airbus is ready to provide a sovereign capability for the delivery service to the Moon, for rovers, for scientific payloads, any cargo that needs to go," she says.

"We've got ground-breaking technologies that we've demonstrated in the extraction of oxygen and metal from simulated moon dust, which again is going to be a critical element for human survival."



↑ Walking on the Moon again!

UNLOCKING INNOVATION BACK ON EARTH

Going back to the Moon in the shadow of the climate crisis, conflict in Europe, and a global economic slowdown may seem to be a distraction, and perhaps even unnecessary. With so many issues to solve back on earth, there is some question as to whether this is the right time and worth the investment.

However, the rationale is clear: the significant advances in technology that resulted from exploring Space in the past are enabling us to live better lives today.

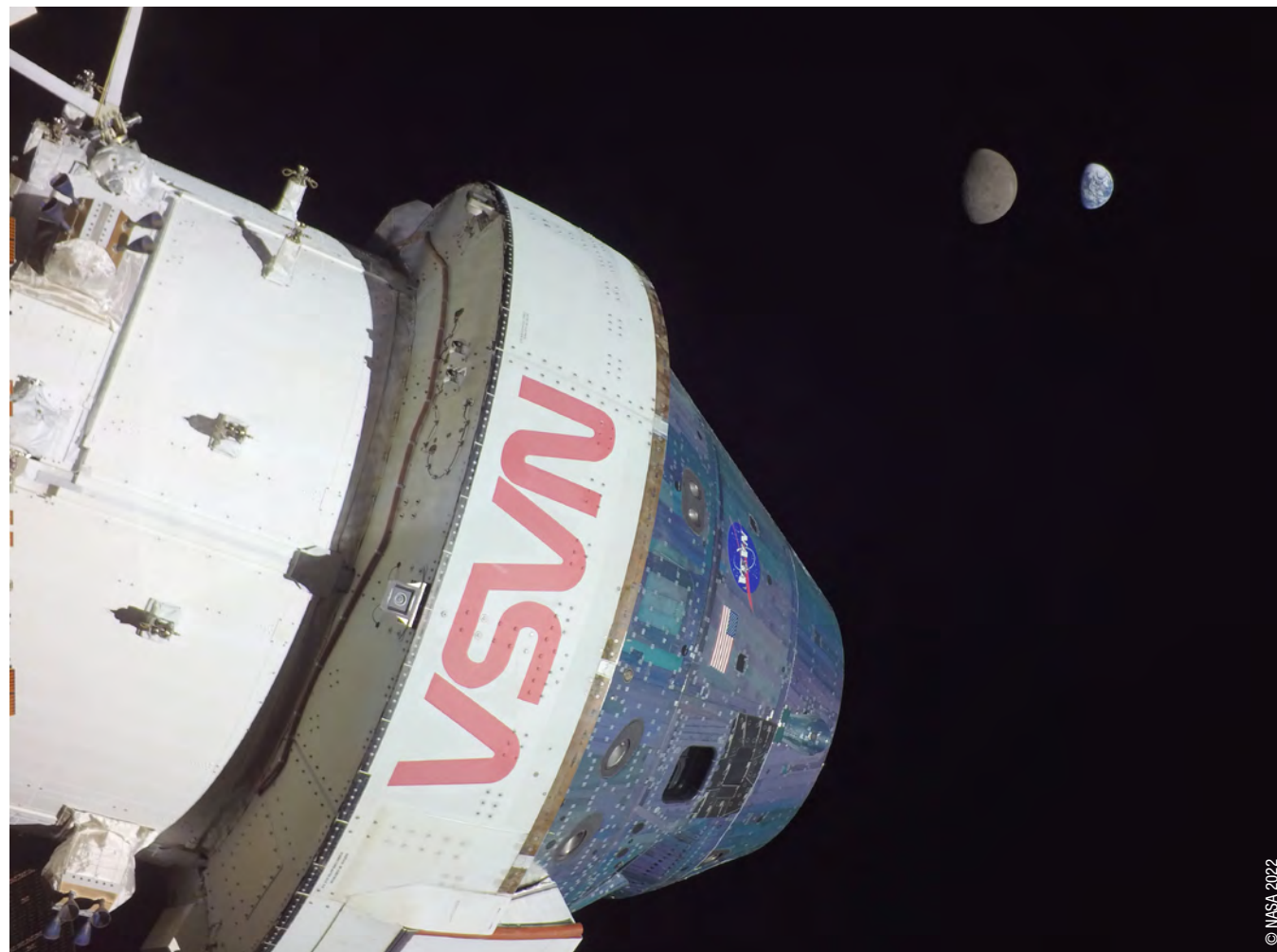
Siân continues. "If we have mastered all the technologies that we need to live on the Moon, then there will undoubtedly be a number of benefits that we can bring back here to Earth in terms of technology and processes.

"It's only by having this pioneering spirit that we open the door to more possibilities, and then, of course, [to] the returns that come with that in the future."

The hope is to replicate the innovation that resulted from the Apollo missions, which started the computer revolution and accelerated breakthroughs in other areas of science and medicine.

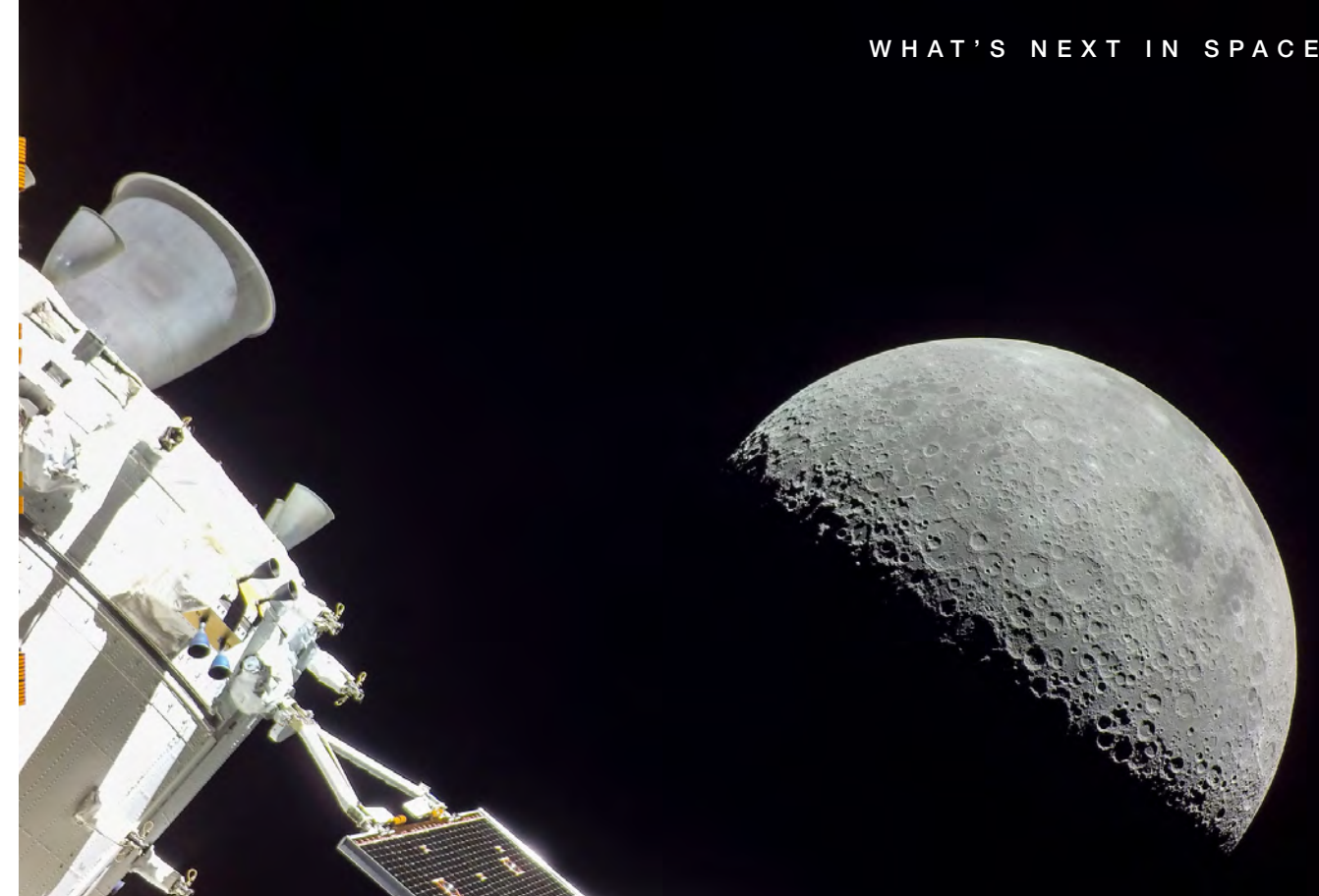
Adopting the same pioneering spirit seen more than fifty years ago should help us to answer Earth's climate crisis: "Necessity is the mother of invention," Laura adds. "By getting ourselves up there, we can start to drive new technologies. We can start to look at new manufacturing processes. I can't tell you what it will be, but I do know that humanity is capable of discovering and locking onto the potential that exists."

In terms of costs per European citizen, the ESA spends the equivalent of just one cinema ticket per person per year to fund the entire Space programme. It is money well spent in the context of the enormous potential that human spaceflight and Space exploration has to stimulate technological innovation and uncover critical resources that can accelerate sustainability on Earth.



↑ The Airbus-built European Service Module for NASA's Orion spacecraft

© NASA 2022



© NASA 2022

↑ Exploration brings new possibilities

EARTH'S RESOURCE-RICH GEOLOGICAL TWIN

Scientific discovery is the principal reason for returning to the Moon. But in line with Airbus' purpose to pioneer sustainable aerospace for a safe and united world, Laura says that this chapter of Space exploration is not the Space race of a bygone era: "It is about the human race," she says.

And arguably, it is a human race against time. As our geological twin, the Moon can provide us with energy and mineral wealth that will be key to our future prosperity.

Lithium, for example, is a metal that is heavily in demand. With the rise of electric vehicles and other new technologies that use lithium-ion batteries, this requirement is set to increase. There is only enough lithium on Earth to last until later this century. Similarly, we are likely to exhaust supplies of uranium on Earth within the next fifty years at the current rate of consumption. However, the Moon is rich in metals and minerals including lithium and uranium – presenting a viable alternative once our own supplies are depleted.

The priority will be to carefully and responsibly manage the Moon's natural resources so its sustainability is not compromised. Another priority is to create the legal and compliance framework that ensures equitable distribution of these resources.

The aim, as Siân describes it, is to make use of the Moon's resources in a smart way that benefits everybody, and not the few. "We can work together collaboratively with other nations and build from scratch. We can define the rules ourselves. Rules that will define the lasting success of this new chapter of Space exploration."

And there is a further benefit in returning to the Moon. Space exploration, and the opportunities presented by Mars, will also inspire a new generation of explorers and help to create a new pool of scientific and engineering talent.

And as one of the next explorers, Pablo no doubt speaks for all of us when he says: "Everything about it is super exciting." **A**

"Space missions also stimulate technological innovation. They widen our scientific knowledge base. They create industrial know-how. They attract young talent, and they help us to avoid a brain drain. Space offers us enormous economic potential. It is definitely something worth being a part of. Investment in Space really does give Europe a leading edge for worldwide competition."

Siân Cleaver

POSITIVE CHANGE IS HAPPENING

Several different pathways support the journey to decarbonisation.

Panellists

Nicolas Chretien

Airbus, Head of Sustainability and Environment

Vincent Etchebehere

Air France, Director of Sustainability and New Mobilities

Thorsten Lange

Neste, Executive Vice President Renewable Aviation

Moderator

Jennifer Newlands

Airbus, Head of Brand and Content



↑ A SAF sticker is displayed on the side of a C295 military aircraft

Aviation is one of the most challenging industries to decarbonise. And yet, progress is being made. There is no single answer to the challenge, but rather a combination of pathways that will create incremental change over the course of this decade, allowing technologies to be developed which will pave the way for significant progress.

BECOMING A CATALYST FOR SAF

Airbus is steadfast in its commitment to supporting SAF and wants to act as a catalyst for SAF becoming 10% of the aviation fuel mix by 2030. It is working with all stakeholders – including airlines and SAF producers.

It announced at the Airbus Summit 2022 a new SAF partnership with Neste. The partnership aims to advance production and accelerate the aviation sector's transition to SAF. The focus of their collaboration will be on technical developments, fuel approval and testing of current and future production technologies and investigating how the use of 100% SAF can be achieved by 2030.

"We will be looking at where we can cooperate, share knowledge between our engineers, and we are looking at education and training," Thorsten says. "We are doing this today – not in 2025. We are already at the 11th hour."

IN SUMMARY

- Sustainable aviation fuel (SAF) in the aviation fuel mix is currently 1% of all operated flights. The aim is to reach 10% SAF by 2030.
- All Airbus aircraft are already certified to fly with a fuel-mix of 50% SAF and Airbus is aiming for 100% SAF readiness by 2030.
- Airlines such as Air France are observing noticeable changes in passengers' booking habits that reflect increasingly climate-sensitive consumers.
- Airbus and leading SAF producer Neste announced a new partnership to accelerate this transition to SAF by advancing technical developments and testing production technologies.
- Investment in SAF production is dependent on demand certainty, and demand certainty can only come through establishing an appropriate regulatory framework.
- Consideration also has to be given to the affordability of SAF and how the cost of SAF is shared across the value chain, and not borne by the airlines alone.



↑ Thorsten Lange



↑ Nicolas Chretien



↑ Jennifer Newlands and Vincent Etchebehere

PROMISING PATHS

Airlines have two promising pathways for reducing carbon emissions already available to them today: fleet renewal to increase fuel efficiency, and the use of sustainable aviation fuel (SAF) to reduce carbon intensity.

Vincent Etchebehere, Director of Sustainability and New Mobilities for Air France, says the airline is already investing in the renewal of its fleet at pace, with new generation aircraft accounting for 7% of its fleet in 2021. The aim is to reach 45% in 2025, and then 70% in 2030.

The benefits of a more fuel-efficient fleet are amplified by

increasing deployment of SAF. "We have the ambition to incorporate more than 10% of SAF worldwide by 2030," he says. "And for that we took quite a critical step at the end of October, when we signed our first two massive offtake agreements for a total of 1.6 million tonnes of SAF in the coming years."

One of these agreements is with Neste, securing one million tonnes of SAF between 2023 and 2030.

Vincent believes that SAF opens a new era for the aviation sector which has only ever used kerosene for fuel: "It's a huge lever that we can lean on, which we have not leaned on yet."



↑ An A320neo refuelling with SAF

RAMPING UP

Air France is not alone in its thinking. There are strong signals across the aviation sector that SAF, as a ‘drop-in’ fuel that can be used both for in-service fleets and for the flying fleets of the future, is one of the most important drivers for CO₂ reduction. This is evidenced by the work that Airbus is doing, and the ecosystems that Airbus is helping to create around the world.

Some 40% of Airbus’ Scope 1 and Scope 2 emissions come from mobile operations, which include flight tests, logistics operations through Beluga transport aircraft, and the maritime transportation of main component assemblies between Europe and the US. Airbus has already advanced to using 5% SAF in its fuel mix for the Beluga, compared to a 1% global average. Nicolas Chretien, Airbus’ Head of Sustainability and Environment, says the intention is to continue leading by example: “Next year we are looking at ramping up to 10% for Beluga and flight test operations.” Airbus intends to progressively increase the share of SAF used in its internal operations up to 50% SAF by 2030.

Nicolas emphasises that Airbus is on the same journey as its airline customers: “We are also confronting the difficulty of bringing SAF safely at the gate and the local/global challenge that SAF represents.”

SUPPLY AND DEMAND

The challenges in the sustainable fuel space that Nicolas highlights are ones of investment, production, and distribution. The SAF supply market carries a high cost of entry, and investment in SAF production is dependent on there being a degree of certainty in demand from airlines.

Despite this, Nicolas remains optimistic that the fuel mix used by the global sector will reach 10% by 2030: “The full line-up of take-up commitments from the industry today is amounting to something that is getting closer to 30 million tonnes between now and 2030. So, we’re getting that momentum as well.”

However, Thorsten Lange, Executive Vice President Renewable Aviation at Neste, would like to see faster momentum, and fears that airlines will only commit to SAF usage when there is a regulatory framework – mandates or incentive schemes – in place that pushes this agenda, especially in Europe.

So, while the airlines wait, are producers like Neste willing to invest to create the supply?

That’s difficult, Thorsten says, when they have their own shareholder needs to satisfy: “How are the returns secured?” he asks. “Only by having demand certainty. And where is demand certainty coming from? It’s coming from regulation, regulation, regulation.”



↑ A Beluga being fuelled with SAF



↑ Testing SAF on our family of aircraft

SHARING THE COST

As SAF adoption grows there will also be questions around cost allocation. Vincent says that Air France customers – corporate and individual passengers alike – are willing to contribute because they are more sensitive to their climate impact: “They are demanding full transparency on this, and they are willing to contribute to the mitigation of their consumption,” he says.

But Nicolas warns that the rising fuel costs cannot be borne by customers and airlines alone, and there is a need to share the cost throughout the value chain.

CONVICTION

With the focus largely on Europe, there is the question of whether aviation can decarbonise in the face of the significant growth in demand for air transport in other parts of the world such as Asia.

Thorsten sees Europe’s role as leading the way: “We have a huge responsibility here to show the way forward with ambitious targets. And again, we forget it’s not only for SAF,” he says. “Some 65% of the greenhouse gas reductions are expected to come from SAF in 2050, meaning there’s another 35% coming from technology improvement, from higher efficiency, from hydrogen flying, from electric flying, but also from air traffic management.”

This commitment is echoed by Vincent: “For me, it’s not a question of is it feasible or not. It’s a question of doing it and being determined to do it.” **A**

FUTURE-PROOFING WITH FLEET RENEWAL

Airbus has been paving the way for SAF usage by developing the required technology and accelerating tests on its family of aircraft. All Airbus aircraft – including helicopters and military products – can fly with a fuel-mix of up to 50% SAF, and it is aiming for 100% SAF readiness by 2030. So no matter how fast the pace of SAF adoption, Airbus customers are buying future-proof technology.

“The aircraft that we will be delivering at the end of this decade will still be flying in 2045, 2050. And we want to make sure that those aircraft are capable of flying with more than 50% SAF,” says Nicolas.

“The full line-up of take-up commitments from the industry today is amounting to something that is getting closer to 30 million tonnes between now and 2030. So, we’re getting that momentum as well.”

Nicolas Chretien

DISRUPTIVE TECHNOLOGIES

The subtle art of powering an aircraft with hydrogen.

Panellists

Glenn Llewellyn

Airbus, Vice President, Zero-Emission Aircraft

Karine Guenan

Airbus, Vice-President of ZEROe H₂ Ecosystem

Mathias Andriamisaina

Airbus, Head of ZEROe Demonstrators and Tests

Hauke Lüdders

Airbus, Head of ZEROe Demonstrators and Tests

Chris Redfern

Airbus, Head of ZEROe Manufacturing and Propulsion Industrial Architect

Moderator

Jennifer Newlands

Airbus, Head of Brand and Content

IN SUMMARY

- Hydrogen remains one of the most promising fuel solutions to power future aircraft.
- Developing the right volume of hydrogen, at the right price, from the right sources and delivering it in the right locations are all key considerations.
- Airbus is developing a hydrogen-powered fuel-cell engine to be tested on its second ZEROe demonstrator, A380 MSN1. This complements the already announced hydrogen combustion demonstrator, announced in February.
- A new initiative between Airbus and ArianeGroup will support the liquid hydrogen fuelling system necessary for Airbus' ZEROe demonstrator aircraft.
- Airbus and HyPort, a leader in the development of hydrogen in France, are developing one of the world's first airport production and distribution stations for hydrogen at Toulouse-Blagnac Airport.
- Airbus is developing partnerships and the ecosystem that will make it possible to develop Hydrogen Hubs at airports around the world.

In 2020, Airbus unveiled its concepts for a hydrogen-powered commercial aircraft, as part of its demonstrator entitled ZEROe. Alongside its designs for a future aircraft, the project also set out Airbus' ambition to create a complete ecosystem capable of supporting a new hydrogen-based future. Two years on, the team behind ZEROe takes stock of the progress made and explores the challenges and opportunities ahead.

DRIVING PROGRESS THROUGH PARTNERSHIPS

Considerable progress has already been made in the development of a hydrogen ecosystem. Airbus has signed Memoranda of Understanding (MoU) with airports, airlines and technology providers across Asia-Pacific, the US and Europe, collaborations that Karine Guenan, Vice President ZEROe H₂ Ecosystem says are essential to delivering the best possible hydrogen-powered aircraft for its customers: "We need to secure the right volume of renewable and low-carbon hydrogen to power our aircraft – at the right price, at the right quantity, and from the right sources."

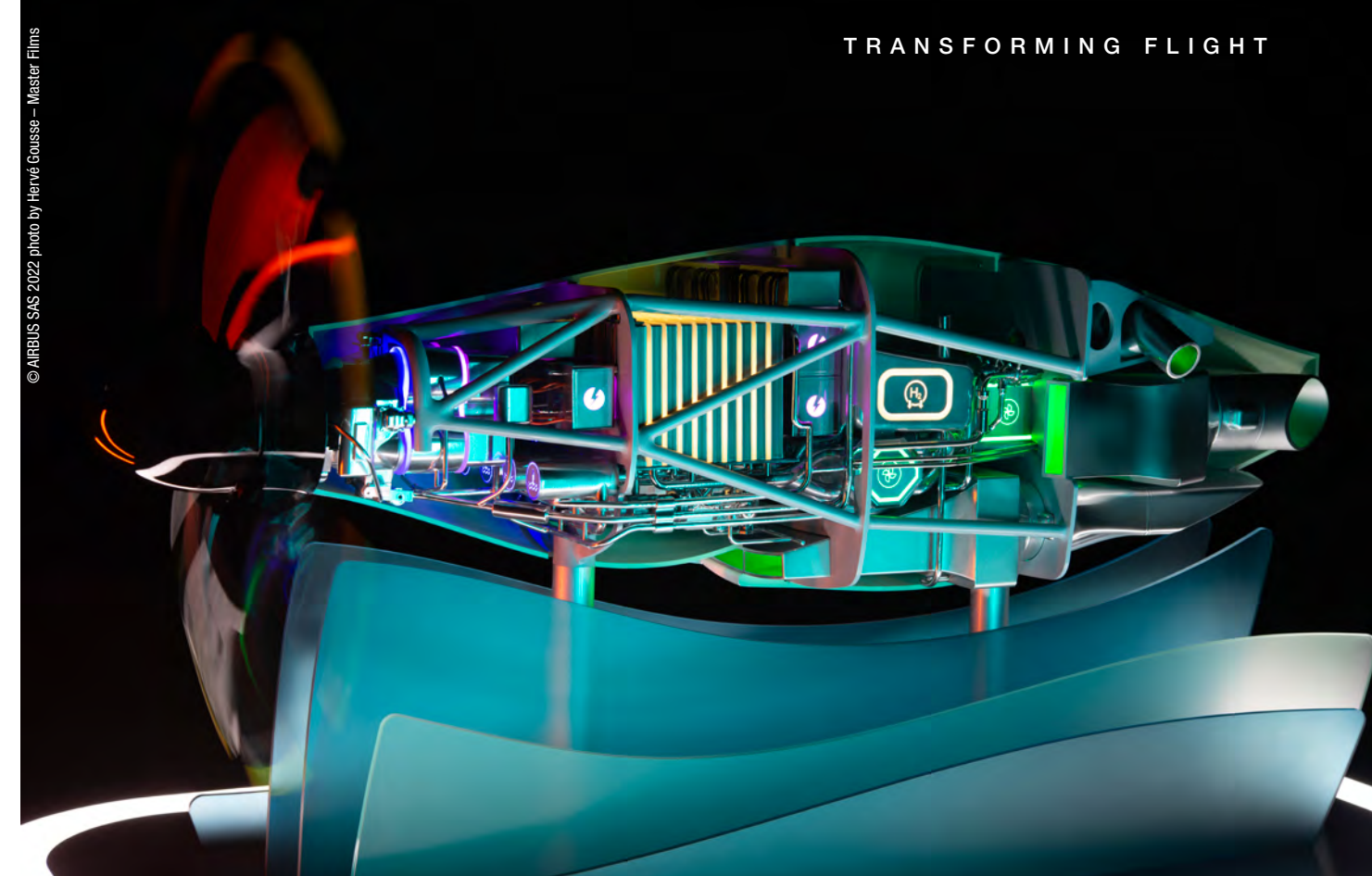
Airbus has partnered with leading hydrogen suppliers like Linde, Plug Power and Fortescue Future Industries, as well as with SNAM to study how existing gas pipelines could be used, or reused, to distribute hydrogen.

"Securing hydrogen is not enough for us," Karine continues. "Securing an entire end-to-end hydrogen value chain is absolutely key. There is also no point in having a hydrogen aircraft if airports can't host and operate that aircraft."

Airbus is also making considerable progress thanks to several partnerships. With Groupe ADP and Air Liquide, designs are being drawn up for a complete hydrogen infrastructure suitable for a large airport, comprising a water electrolysis facility, hydrogen production plant, a liquefaction unit, storage space, and an entire distribution system. It anticipates a phased approach, first supplying liquid hydrogen to the airport via ground vehicles and then, from 2040 onwards, to begin liquefying and storing liquid hydrogen on site.

Airbus is also partnering with HyPort to create one of the first airport production and distribution stations for hydrogen, which will be at Toulouse-Blagnac Airport. And the PHARE project is a new initiative between Airbus and ArianeGroup which will support the liquid hydrogen fuelling system necessary for Airbus' ZEROe demonstrator aircraft.

These initiatives are just the start, and demonstrate that deploying a hydrogen ecosystem is within reach if we have collaboration and a shared vision.



↑ A model of Airbus' ZEROe hydrogen-powered fuel-cell engine

HUGE POTENTIAL OF FUEL-CELL TECHNOLOGY

While significant progress is being made in developing the hydrogen ecosystem, the industry is also advancing several key technological developments.

In February 2022, Airbus announced a partnership with engine manufacturer CFM International with the objective of converting the A380 MSN1 testbed into a hydrogen combustion demonstrator. There are essentially two ways to use hydrogen in its 'raw' state on board an aircraft: one is to combust hydrogen in a gas turbine engine; another is by using fuel cells to convert hydrogen into electricity in order to power a propeller or a fan.

Hydrogen fuel cells are of particular interest because they may allow flight that generates neither Nitrous Oxide (NOx) nor contrails. This is an area where the aviation industry is already benefitting from the experience of its counterparts in the automotive sector. While there is still plenty to overcome to achieve something scalable and commercially viable, this work could usher in a new generation of aircraft that do not produce emissions during flight.

Glenn Llewellyn, VP Zero-Emission Aircraft, Airbus, says that hydrogen fuel cells have enormous potential to help Airbus achieve its decarbonisation ambition: "We believe we can ready this technology in time for a 2035 entry-into-service of a hydrogen-powered aircraft," he says. This is why Airbus has

been working on fuel-cell powered engines. It has unveiled a concept study of an engine with 2.5 MWs of power, and showcased an initial prototype at the E-Aircraft System House in Ottobrunn, near Munich.

Hauke Lüdders, Head of ZEROe Demonstrators and Tests at Airbus, says that the launch of a new hydrogen-powered fuel-cell engine is a very important milestone: "In record time we have been able to design and develop the first fuel-cell engine demonstrator at lab-scale basis, which is already reaching the megawatt class," he explains. "And this demonstrator will bring us significant learnings with regard to the integration, operation and control of a fuel-cell engine."

Airbus will start ground and flight testing its new fuel-cell engine architecture onboard its ZEROe demonstrator aircraft towards the middle of the decade. The A380 test aircraft is currently being modified to carry a liquid hydrogen tank and its associated distribution systems.

There are, unsurprisingly, a number of challenges, the most significant being the need to create sufficient power without adding disproportionate weight. Fuel-cell 'stacks' have potential, which is why in October 2020, Airbus created Aerostack, a joint venture with ElingKlinger. Together they are building and testing the first fuel-cell stack for the aviation industry, with the aim of having flight-qualified equipment by the end of 2023. Airbus expects to test a scaled version of a hydrogen fuel-cell propulsion system from 2026 onwards.



↑ Mathias Andriamisaina, Glenn Llewellyn, Karine Guenan, Hauke Lüdders and Chris Redfern

CONSIDERING THE FULL LIFECYCLE OF EMISSIONS ACCELERATE BY LEVERAGING EXISTING EXPERTISE


There are challenges also in the manufacture: while the fuel-cell technology will address the Scope 3 emissions of the aircraft, the emissions generated by the manufacturing process itself also need to be addressed. This is an essential consideration of the ZEROe project.

Chris Redfern, Head of Manufacturing at Airbus, explains: "If you take, for example, the hydrogen fuel system, there are similarities with the fuel system on launcher applications or rockets. But for our aircraft, we have to make the fuel system operate over many thousands of flight cycles, not just one, and we also need to be able to scale up the manufacturing to produce the aircraft at commercial aerospace rates."

To accelerate progress on the use of liquid hydrogen, Airbus has research hubs in France, Germany, Spain and the UK. Leveraging the expertise of these development centres in Bremen and Nantes – Bremen has close links with ArianeGroup and Airbus Defence and Space and Nantes has considerable expertise with metallic structures – Airbus completed the first test of the prototype cryogenic tank in a little over a year.

Chris explains: "The intention of these sites is to scale up the production of hydrogen storage systems so that we can increase production to something like 50 tanks over the coming years, whilst ensuring that we continue to implement the strict manufacturing controls necessary."

While the initial focus of the development centres will be on the hydrogen fuel system, the plan is to develop a network of innovation hubs so that Airbus can develop additional capabilities. For the development centres to succeed, further partnerships will be needed: "Since collaboration will be key to our success over the next few years, we will strengthen our connections with both the supply chain and the research ecosystems, working hand-in-hand with companies that have both relevant technologies and a shared interest in our climate ambitions," adds Chris.

Glenn concludes that with the developments in ZEROe, Airbus has arrived at one of the most exciting moments in aviation history: "Of course, there are still huge challenges ahead – technical and regulatory – but these are the right challenges for our industry and for us at Airbus to be trying to solve. We are fully committed to making hydrogen-powered aircraft a reality!" 

"I remember saying at the last Airbus Summit in 2021 that I believed this was one of the most exciting moments in aviation history. And everything we are doing now allows me to reiterate that thought here today. Of course, there are still huge challenges ahead. But we are making good progress and we're dead set on making hydrogen-powered aircraft a reality!"

Glenn Llewellyn, VP Zero-Emission Aircraft, Airbus

MOVING TO HYBRIDISATION

Improving aircraft performance through hybridisation.

Panellists

Jane Amilhat

European Commission, Head of Unit Low Emission Future Industries

Patrick Bastard

Renault Group, VP Research

Frank Haselbach

Airbus, SVP Propulsion Engineering

Sabine Klauke

Airbus, Chief Technical Officer

Karim Mokaddem

Airbus, VP of Electrification

Jean-François Salessy

Renault Group, VP, Advanced Technologies and Expertise

Moderator

Jennifer Newlands

Airbus, Head of Brand and Content

If the aviation industry is to reach the target of ‘net-zero carbon emissions by 2050’, as set by IATA, ATAG and ICAO, there is no time to waste. Focusing purely on one pathway, or one technology, is unlikely to drive the far-reaching change the industry needs.

Airbus’ approach is to explore multiple options in parallel. As its VP of Electrification Karim Mokaddem observes: “We don’t have time to think sequentially.”

ESTABLISHING AN ELECTRIFICATION ROADMAP

There are three hybridisation ‘trends’ that Airbus is actively pursuing:

- 1. Making incremental improvements.** Airbus Helicopters is already exploring how to use an electric motor as a back-up system to increase safety.
- 2. Modular electrification ambition.** Airbus is exploring shared building blocks around a common voltage of about 800 volts, and an electrical building block of 300/500 kW, leveraging cross-divisional synergies. The ambition is to help fulfil the needs of all Airbus divisions in a modular way. Airbus Helicopters is again leading the way with electrification, with a hybrid helicopter combining an electrical part and a part linked to a thermal engine [read more about this on pages 24–27]. Airbus is also testing this modular approach with its EcoPulse demonstrator, a light aircraft that is being developed with Safran and Daher to explore distributed propulsion.

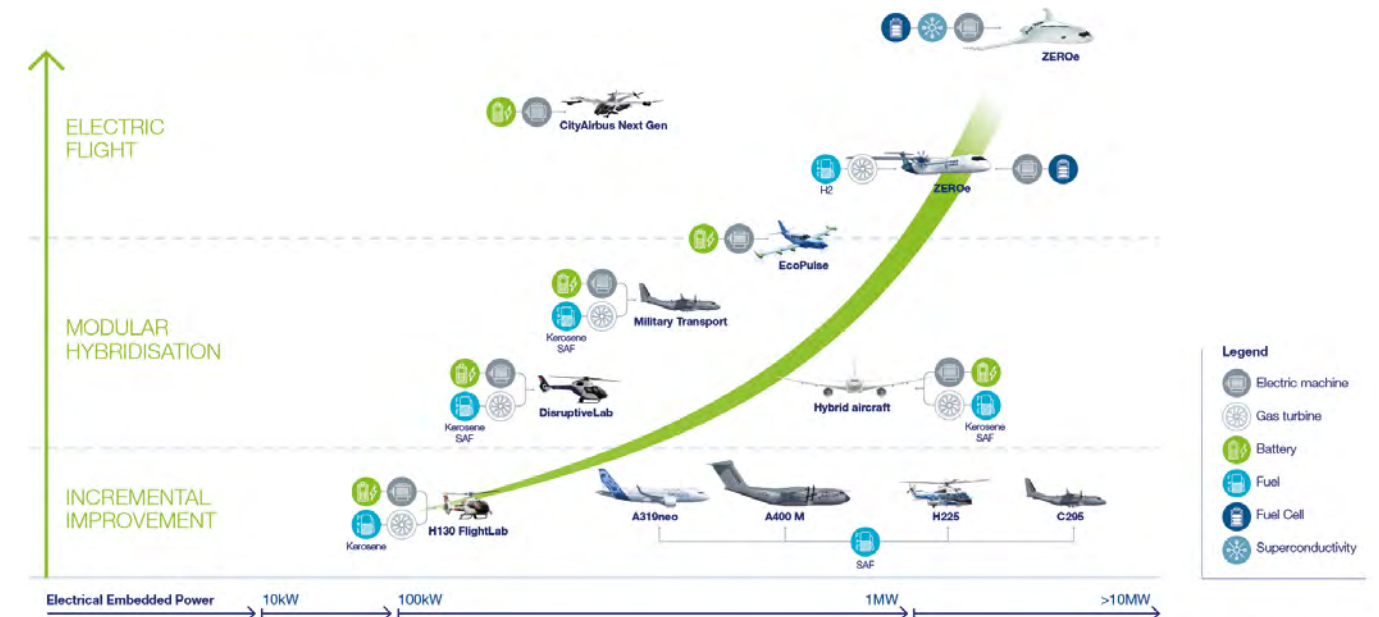
For transport and military aircraft, Airbus is also exploring the benefits of hybridisation, but this time with twice the power, at around 600 kW to 1 MW of onboard power.

The same building block could be used for all of Airbus’ next-generation aircraft, and could reduce fuel consumption by up to 5%. For example, it could assist thermal engines during pushback and take off, and power some aircraft systems.

- 3. Hydrogen-powered and electric flight.** Airbus is exploring hydrogen-powered flight through its ZEROe programme, which had its own dedicated panel discussion at the Airbus Summit [see pages 16–19], as well as electric flight through its CityAirbus NextGen urban air mobility programme.

“This is why we are approaching this as a group team with Airbus Helicopters, Airbus Defence and Space, and Airbus Commercial,” Karim Mokaddem says. “We will do it together.”

ENERGY-RELATED TECHNOLOGIES TO REDUCE AVIATION'S CARBON FOOTPRINT



© AIRBUS SAS 2022 photo by Airbus. Concept design by Multimedia Studios – 20221829.

EUROPEAN FUNDING AND PARTNERSHIPS

Airbus recognises that partnerships with other industry players, as well as support at a government level, are key to success in this endeavour. In Europe, the European Union’s Clean Aviation Joint Undertaking is bringing the industry together and providing funding to support the development of disruptive technologies. Sabine Klauke, Airbus’ Chief Technical Officer, says the European Commission’s role is crucial: “Investing in research and development for disruptive technology is essential if you want to meet the European Green Deal objectives. So the European Clean Aviation programme is helping the aviation ecosystem to align with these objectives.”

Jane Amilhat, Head of Unit Low Emission Future Industries at the European Commission, adds, “I’m happy to see that the industry is really committed towards this change and towards the European Union’s aim to be ‘climate neutral by 2050’.” Collaboration will be key to achieving these aspirations. “It’s about having all the stakeholders working together. It’s not

only about Airbus, it’s also the airlines and the airports. It’s the entire ecosystem working together.”

Frank Haselbach, SVP Propulsion Engineering for Airbus, is pleased to be working with other major engine manufacturers across a number of active projects: “The engine manufacturers are absolutely vital for us to actually make progress on this journey,” he says.

These projects include the SWITCH programme, involving MTU Aero Engines, Pratt & Whitney, GKN Aerospace and Collins Aerospace, to develop a novel propulsion concept built from two revolutionary and synergetic technologies: Water Enhanced Turbofan (WET) and hybrid-electric propulsion, with the ambition of saving up to 25% of fuel consumption.

Airbus is also working with Rolls-Royce and other partners on HE-ART, a consortium developing hybrid-electric technology for regional aircraft. In addition, Airbus is working with CFM International on RISE, an Open Fan concept which will be a demonstrator on the A380.

5%

Hybridisation leads to better energy management with the benefits of reducing fuel consumption by up to 5% compared to a standard flight.

SUMMARY

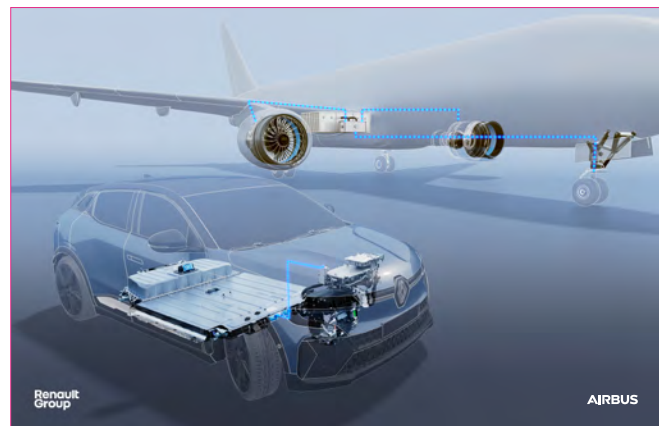
- Hybridisation can improve aircraft efficiency and will play an important part in our efforts to reduce emissions.
- Hybridisation has been a stepping-stone towards electrification in the automotive industry and there are clear synergies between hybrid-electric driving and hybrid-electric flight.
- Airbus and Renault have signed a partnership agreement to share knowledge and expertise, which will focus on energy management and battery research in particular.
- Airbus is following a group-wide electrification roadmap, with a number of exploratory hybridisation projects running concurrently.
- Several of these projects are being run in conjunction with Airbus’ aerospace partners; some are also supported by the European Union, as part of its Clean Aviation Joint Undertaking.



↑ Frank Haselbach, Karim Mokaddem and Sabine Klauke



↑ Jean-François Salessy



SYNERGIES WITH THE AUTOMOTIVE INDUSTRY

Airbus is also studying progress made in the automotive sector in the electrification of vehicles, in order to accelerate progress.

Synergies between the aviation and automotive sectors can be found in energy storage, electrical motors and energy management. Patrick Bastard, VP of Research for Renault, says that when it comes to electrification “energy storage is probably the toughest challenge we have to face.”

In the automotive world, lithium-ion batteries were instrumental in making electric vehicles a reality, and improvements in this field have resulted in the energy density of automotive batteries more than doubling in the last ten years.

But Patrick points to the weight of batteries as the current barrier to further progress. “And the weight for sure,” he says, “is even more critical for a plane compared with a car.”

There is still a lot of testing and research to be done in order to scale up the availability of these technologies. Challenges like the durability of the batteries, their power delivery and fast-charging capabilities, and their industrial feasibility will need to be addressed.

Dedicated teams within Airbus are closely following the latest technological trends, actively testing cells and prototyping batteries in its internal testing facility.

Karim concludes: “It is not an easy game, but the future is there, and we need to be ready for it.” **A**

CROSS-INDUSTRY PARTNERSHIP

Driven by a shared ambition to innovate and reduce their carbon footprints, engineering teams from Renault and Airbus are working together to focus on improving energy management and storage. They are also exploring how to move beyond today’s lithium-ion battery designs to a more radical disruptive technology: the solid-state battery. This partnership will help Airbus mature technologies associated with future hybrid-electric aircraft.

Teams are working together around eight different domains including cell-to-pack integration, and the battery management system.

Jean-François Salessy: “We have two different industries, aerospace and automotive, and we have leaders of those industries coming together and pooling knowledge and capabilities to shape the future of transportation.”

Sabine Klauke: “We have a common ambition. We have a plan. We have motivated engineers who want to make it happen. So let’s go for it.”



HOW WOULD A HYBRID AIRCRAFT WORK?

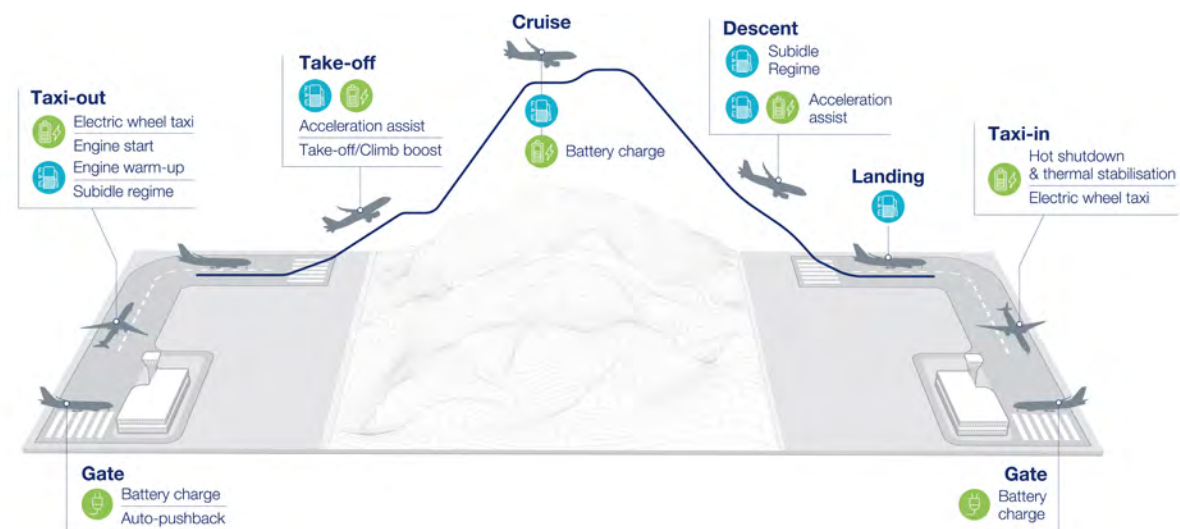
As passengers board, the batteries are charging.

A battery-powered electric motor located in the undercarriage allows the aircraft to complete its autonomous pushback phase when it moves away from the terminal. The aircraft continues to operate under battery power while taxiing to the runway – the engines are not switched on, so no fuel is consumed. The engines start running in preparation for take off and operate at full throttle to get the aircraft off the ground but electrical energy is used to generate thrust, reducing fuel consumption.

Once the aircraft reaches cruise speed, the batteries are deployed to temporarily relieve the engines and to power certain functions of the aircraft. While at cruising speed, energy from the engines can also be used to recharge the batteries.

When it comes to the descent, the aircraft may enter phases that require engine thrust, but electric power takes the strain off the engines (and therefore reduces fuel consumption). Then, once on the tarmac, the aircraft taxis to the terminal with the electric motor taking over from the turbo fans again.

AIRCRAFT HYBRIDISATION PRINCIPLES DURING DIFFERENT PHASES OF FLIGHT



Concept design by Multimedia Studios – 20221829.

A RISE IN EFFICIENCY

Progressing with electric vertical flight.

Panellists

Tim Boyle

Blackcomb Helicopters, General Manager and Accountable Executive

Bruno Even

Airbus Helicopters, Chief Executive Officer

Jaspal Jandu

LCI, Chief Executive Officer

Tomasz Krysinski

Airbus Helicopters, Vice President Research and Innovation

Moderator

Alex Lepa

Airbus, Head of Connect and Engage Employees

IN SUMMARY

- A reduction of CO₂ emissions from fuel consumption could unlock significant improvements in the future sustainability of helicopters.
- Improvements will also be found in enhanced aerodynamic design, more efficient propulsion systems and smarter operational performance.
- To test and develop these new technologies Airbus has launched DisruptiveLab – its newest concept helicopter demonstrator.
- DisruptiveLab will pursue the implementation of a fully parallel hybrid propulsion system.
- DisruptiveLab complements Airbus' FlightLab demonstrator launched in 2020, which continues to test technologies related to enhanced autonomy and safety.

The desire for greater sustainability in helicopter flight is being driven by multiple stakeholders, including investors and corporate customers who are making investment and purchasing decisions based on sustainability- and ESG-related criteria.

Helicopter operators and lessors share Airbus' ambition to decarbonise vertical flight. Helicopter lessor LCI recently placed an order with Airbus Helicopters for up to six fuel-efficient H175 helicopters. LCI CEO Jaspal Jandu says that sustainability is becoming increasingly central to how investment is allocated within the helicopter industry: "Everything is pushing in one direction," he says. "If you want to access capital you have to prove your credentials as regards Scope 1, 2 and 3 emissions."

Helicopter operators are also looking closely at their carbon footprints. Tim Boyle, General Manager of Blackcomb Helicopters – a helicopter touring and utilities company in the Pacific Northwest – describes how it is assessing all aspects of its business including the transport taken by its own crews, installing electric vehicle charging at facilities and modernising its own fleet of vehicles to electric. Following a recent audit, Blackcomb is offsetting 100% of its helicopter emissions by working with the Nature Conservancy of Canada to protect a large area of forest in the West Kootenay Mountains: "For now, it's the first step. We all know offsetting isn't perfect, but it's what's available to us at this time."

ADDING TO THE MIX

Both Tim and Jaspal agree that sustainable aviation fuel (SAF) is the next big opportunity.

All Airbus helicopters are already certified to run with a blend of up to 50% SAF but for this to be meaningful to operators the whole ecosystem has to catch up: "Next is the ability to have a locally available supply of SAF," says Tim. "This will have the biggest impact on our greenhouse gas emissions."

Some LCI customers are already using SAF, and others are interested, but Jaspal echoes Tim's view: "You need the entire network to develop to make it really efficient."

To make this a reality, there are logistical challenges and supply challenges to overcome.

COMMITTED TO THE CAUSE

Helicopters only represent a tiny proportion of the aviation industry's total emissions, but this has not reduced the drive and commitment of the industry to reduce emissions. And Jaspal sees the position of manufacturers like Airbus, who can look both upstream and downstream, to be instrumental: "At the product level, clearly Airbus and Airbus Helicopters have



↑ Tim Boyle, Bruno Even, Alex Lepa, Jaspal Jandu and Tomasz Krysinski

made tremendous advancements in hybridisation and battery technology, aerodynamics, systems and propulsion. That's their job. So, we need them to carry on doing their job. We will provide friendly input where we can, of course," he says. "But there's a broader, possibly more important role."

That role or mission, as Jaspal sees it, is to help correct the perception of what aviation can realistically contribute to global efforts to reduce overall greenhouse gas emissions when it contributes only a fraction of total global emissions – and significantly less than some other industries.

It is a worthy point, but the immediate focus remains on the areas where Airbus is already influencing positive change, and that comes from Airbus Helicopters' commitment to innovation, testing and bringing mature technologies into service as quickly as possible.

DRIVING PRODUCT INNOVATION

Over a helicopter's lifetime, kerosene consumption accounts for the majority of its CO₂ emissions. But Airbus is also searching for sustainability improvements that will be realised through enhanced aerodynamic designs, more efficient propulsion systems and smarter operational performance.

Bruno Even, Chief Executive Officer of Airbus Helicopters, points to three areas of focus where improvements can help to unlock greater efficiency. In 2016, Airbus Helicopters revealed the H160, a new generation of helicopter with improved turbine designs, which deliver a 15% fuel reduction on the previous generation. Additionally, there is a focus on alternative

propulsion systems bringing electrical power capability and in due course hybridisation. Finally, sustainable aviation fuel is also an avenue of exploration.

The Airbus Helicopters team also used the occasion of the Airbus Summit to announce the launch of a new concept helicopter: DisruptiveLab. The new demonstrator, which aims to reduce CO₂ emissions by 50%, features a new architecture which optimises rotor and fuselage aerodynamics and a more efficient propulsion system. At a later stage it will incorporate a fully parallel hybrid propulsion system that enables the battery to be recharged in-flight.

In describing DisruptiveLab, Tomasz Krysinski, Airbus Helicopters' Vice President of Research and Innovation, says the demonstrator has been designed deliberately for hybridisation when the time comes: "We learned from automobiles that hybridisation is very strategic, and the design must be done deliberately," he says. "We have introduced reversible hybridisation, allowing transmission of the power from the turbine to the batteries and vice versa. It will allow a strong reduction of CO₂ emissions."

DisruptiveLab complements Airbus' existing FlightLab demonstrator, which is testing technologies that could be retrofitted onto existing helicopters.

Bruno summarises: "Innovation is clearly at the core of the strategy of Airbus Helicopters and CO₂ reduction and the environment is at the core of our innovation roadmap. So, this roadmap is based on a clear deliverable demonstrator to show what we can deliver with ambition." **A**

DisruptiveLab

Airbus has revealed a new helicopter demonstrator – DisruptiveLab. This new concept features an aerodynamic aluminium and composite fuselage with a streamlined Fenestron tail rotor, and a more compact rotor head with integrated blades.

These architectural innovations will test technologies that have been designed to improve aircraft performance and energy efficiency, and reduce fuel consumption and the perceived noise level. DisruptiveLab will be testing a fully parallel hybrid propulsion system which would not have been possible on the previous FlightLab demonstrator.



A COLLABORATIVE JOURNEY

Partnerships are key to the decarbonisation of the aviation industry.

Panellists

Sabine Klauke

Airbus, Chief Technical Officer

Fred Krupp

Environmental Defense Fund, President

Ben Smith

Department for Transport (DfT), UK Government, Director, Aviation

Moderator

Jennifer Newlands

Airbus, Head of Brand and Content

IN SUMMARY

- For the first time, there is now agreement at an aviation industry and ICAO Member State level behind the long-term aspirational goal to reach 'net-zero carbon emissions by 2050'.
- Real progress requires creating agreed frameworks and regulation within which the industry can operate on a level playing field.
- When it comes to new energies all options should be explored.
- Investment in SAF should not be at the expense of food, forests or other biodiversity.
- Airbus is working closely with educational institutions to evaluate the challenges and opportunities presented by different energy alternatives.

The world is at a critical moment when it comes to making progress against its climate objectives. There is now an unprecedented opportunity to turn ambition into action. But will the sum of the sector's actions, such as sustainable aviation fuel (SAF) partnerships, technology investment, air traffic management and fleet replacement, be enough to keep the industry on track to reach the long-term aspirational goal of 'net-zero carbon emissions by 2050', as set by ATAG, IATA and ICAO? Is the industry focusing its efforts in the right areas and what are the possible unintended consequences of its actions?

53%

Over the last three decades aircraft efficiency has improved by 53%.



↑ Fred Krupp and Sabine Klauke



↑ An H225 powered by 100% sustainable aviation fuel

THE NEED TO ACCELERATE

President of the Environmental Defense Fund, Fred Krupp, believes that while the general direction of travel is right, the industry needs to accelerate: "The speed is nowhere near fast enough," he says, "and the challenge is in the detail."

Sustainability is a key requirement for SAF, and Fred raises the point that SAF must not be produced at the expense of food, forests or biodiversity. He adds that we need to take similar care with hydrogen: "We need to be very, very careful. How hydrogen is produced, how it's transported, how it's used."

Consensus needs to be reached by policymakers, industry and scientists about how to make sure SAF and hydrogen are genuine steps forward. "If we're still having all these coal-fired power plants in South Africa and the country decides it can make money supplying the world with hydrogen, so they build

solar fields but haven't replaced their coal, that's not a good thing. It would be better for them to replace their coal first and not get sucked into making hydrogen for aviation fuel. And that's true around the world," adds Fred.

Picking up on Fred's theme of the need to go faster, Sabine Klauke, Chief Technical Officer at Airbus, says that having a global, level playing field is key to accelerating progress: "The ICAO Assembly was just the starting point," she says. "We need governmental frameworks. SAF, for example, is all about implementation and deployment, so we need the right levers in terms of taxation, targets and incentives."

"Having the best aircraft is not enough. We cannot do it alone," Sabine says. "We need long- and short-term levers and to understand their impact. There are things we have to build, and we have to build them together."



↑ An Airbus A321XLR

GOVERNMENT AND INDUSTRY COLLABORATION

In the UK, the focus on collaboration is already evident. The Jet Zero strategy is a tangible example of government and industry (including Airbus) coming together behind a shared objective. Its importance is such that it is chaired by both the UK Government’s Transport and Business Secretaries.

Globally, the UK Government is also working with its partners in industry to support other regions of the world that need assistance to progress on decarbonisation, says Director of Aviation at the UK Government Department for Transport, Ben Smith: “In the UK we have recently started offering support for CORSIA implementation to six states in East Africa, working jointly with our partners in Kenya. The UK also intends to participate in ICAO’s ACT-SAF capacity building programme.”

The UK Government feels that ICAO’s existing technology standards and the CORSIA offsetting scheme will help draw investment into aviation decarbonisation schemes, and improve accountability, by allowing progress to be measured against a single common goal.

CORSIA

The Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) is a global offsetting scheme, whereby airlines and other aircraft operators will offset any growth in CO₂ emissions above 2020 levels. This means that aviation’s net CO₂ emissions will be stabilised, while other emissions reduction measures, such as technology, sustainable aviation fuel, operations and infrastructure options, are pursued. It is anticipated that CORSIA will mitigate around 2.5 billion tonnes of CO₂ between 2021 and 2035.

DELIVERING IMMEDIATE BENEFITS

In terms of momentum, Sabine is keen to highlight the work that has already been done to deliver immediate progress on the journey to decarbonisation: “Every change from an old aircraft to a new one is having an immediate effect,” she says.

Fleet renewal is just one measure that can be deployed relatively quickly, but we do not need to choose between short- and longer-term initiatives that we can lean on. We can, and should, be exploring multiple options.

For example, Ben believes, and the panel concurs, that it’s not a case of choosing between alternative fuels or hydrogen: “It’s definitely a case of exploring what we can achieve with both,” he says, “and what we can do in the short term to start bringing about those emissions reductions as quickly as we can. But it’s also about looking ahead to the longer term

and finding ways to really maximise the opportunities that are out there, working with academia and with the science community to ensure that where there are opportunities they are fully explored.”

Sabine agrees. She says that as with all developing technologies, it is important to be thorough in terms of exploring the positives and negatives. Airbus is working closely with educational institutions such as MIT in the United States and Cranfield University in the UK to better understand the opportunities and challenges presented by hydrogen.

“We need to be sure we are doing the right things,” Sabine concludes. “We need to continually look at different ways in which we can engage with others around the world who are also looking at these issues, understand them more deeply, and start to develop some clearer plans.” **A**



↑ A rendering of a bus refuelling at a hydrogen station, to be built at Toulouse-Blagnac Airport

A SAFER WORLD

The connection between safety, defence and sustainability.

Panellists

Ian Bond

Centre for European Reform, Director of Foreign Policy

Camille Grand

European Council on Foreign Relations (ECFR), Distinguished Policy Fellow

Sientje Möller

Federal Ministry of Defence of Germany, Parliamentary State Secretary

Mike Schoellhorn

Airbus Defence and Space, Chief Executive Officer

Moderator

Alex Lepa

Airbus, Head of Connect and Engage Employees

For too long, defence has been perceived as being a 'non-sustainable' industry. But the war in Ukraine has led to a different lens being cast over defence.

State Secretary of Defence in the German Federal Ministry of Defence Sientje Möller says that perceptions and public support for the armed forces within Germany, for example, have improved significantly over the last 12 months: "We have an abundantly clear need of armed forces and securing our own territory, securing our own values, but also NATO territory," she explains.

"We have observed a clear shift in interest and also in the public debate. We see the great majority of German people are in favour of the armed forces, and also in favour of raising the final financial budget for defence."

CEO of Airbus Defence and Space, Mike Schoellhorn, agrees there has been a 'collective awakening' when it comes to defence: "The importance of defence has been re-recognised," he says. "As an industry, it was stigmatised as being non-sustainable, whereas actually safety and defence and sustainability need to be reinforcing each other."

€100bn

In June 2022, the German government approved the creation of a special fund to upgrade its armed forces with the aim of becoming the 'best-equipped in Europe'.

Mike goes further: "If you don't work on sustainability, chances are through water scarcity, climate change, streams of refugees, and tensions between countries and people, your level of conflict goes up and there's a greater likelihood of having an unsafe and non-secure situation."

IN SUMMARY

- Sustainability requires peace and stability.
- Defence has been considered a 'non-sustainable' industry, but with the war in Ukraine its importance has been 're-recognised' across Europe.
- The European Peace Facility is being used to purchase the equipment and replenish stocks required for Ukraine.
- Investment in Ukraine has been substantial, but still only represents a fraction of the EU's total defence budget.
- The future of Europe requires a more diversified supply chain and less or even no dependency on a single country, partner or technology.
- Present-day battlegrounds can stretch from the deepest ocean to the frontiers of Space.
- Strength is key and perceived weakness can provoke aggression.



EMERGING FROM NAIVETY

Ian Bond, Director of Foreign Policy at the Centre for European Reform, believes Europe has emerged from a naive assumption that it didn't need to worry too much about defence.

"If we're thinking about sustainability, it's got to be built on a foundation of our own security," Ian explains. "I don't suppose that there are many people in Ukraine now who are thinking about climate change. We have to be able to preserve our security, to deter the kinds of conflicts that might arise within Europe and that is always going to involve the defence sector."

But how do you have security, given the Ukraine crisis? "We should look at the experience of the last 14 years since Russia attacked Georgia in 2008, and we should ask ourselves whether negotiations have brought security. Regrettably, they haven't. Putin has taken each round of talks as an opportunity to pause for rebuilding and then to start again. Unless Russia is decisively defeated, and not in a position to relaunch an attack either on Ukraine or on any other neighbouring country in the foreseeable future, it's very hard to see how to achieve peace in Europe," Ian reflects.

Distinguished Policy Fellow at the European Council on Foreign Relations and former NATO Assistant Secretary General for Defence Investment Camille Grand sees the war in Ukraine as opening a new chapter in Europe's security history: "There are now 40,000 troops on the eastern flank of the alliance under secure direct command, which is something that hadn't happened in Europe since the Cold War," he says.

He believes that with significantly changing risk profiles, NATO needs to accelerate its defence spending: "If you do spend more, it's also about spending better and investing

in the future, in capabilities, in research and development. 'Collective defence' is more demanding financially and means continuously adapting our system."

Collective defence, as Mike points out, also demands greater connectivity and interoperability between platforms.

Camille talks about rebuilding a European military that is fit for purpose for the new risks it faces. The EU has successfully used the European Peace Facility (EPF) to buy the equipment and replenish stocks required for Ukraine, and while the investment in Ukraine has been substantial, it still only represents a fraction of the EU's total defence budget.

EUROPEAN PEACE FACILITY

The EPF is an off-budget instrument aimed at enhancing the Union's ability to prevent conflicts, build peace and strengthen international security, by enabling the financing of operational actions under the Common Foreign and Security Policy (CFSP) that have military or defence implications.

"The EU has been quite successfully using the EU toolbox," he continues. "There is also a broadening of the effort through the European Defence Fund and the other tools that support the industry to incentivise acquisition in common and joint cooperation amongst EU Member States. This will make a difference when it comes to research and development and also, to a degree, when it comes to making the backfilling of capacities faster."



↑ The world's most modern swing-role combat aircraft, the Eurofighter

THE IMPORTANCE OF EUROPEAN SOVEREIGNTY

A key theme running through the debate was the importance of European sovereignty, and to avoid having to unilaterally depend on one country or technology. This was demonstrated by the supply chain disruption that resulted from the pandemic and has been underscored by the present situation in Europe. A diversified supply chain as well as duplicate or native technologies allows countries to reduce their dependency on other nations.

Minister Siemtje Möller says a strong Europe is essential for future sustainability: "A strong Europe within the European pillar of NATO means that we have a sovereign Europe and more capabilities to defend Europeans and the values that we stand for."

But she says it is essential that the money invested in defence is spent more efficiently. Well spent money on defence, combined with a co-operative and collaborative mindset from the key players, will spark innovation that not only benefits the defence sector, but also other industries.

NEW BATTLEFIELDS ARE EMERGING

Some of the spending needs to be channelled into new areas of risk, not least in protecting satellites. Ukraine appears to mainly be a land war, because no-one has achieved dominance of the air. New battlegrounds have emerged, from gas pipelines to high-flying satellites on the frontiers of Space.

Mike says satellites were key in monitoring the build-up of Russian forces prior to the invasion, as well as maintaining secure communications despite Putin's best efforts.

Indeed, they are proving so useful, that Putin threatened to attack them: "Space has become a battle domain and that is recognised in our technologies, and in our collaboration within Europe," he adds.

"That's why we need to reinforce our Space capabilities, not only for sustainability, but also for defence."

And Mike underscores the need for greater resilience in how European nations master and develop their own innovations, rather than being reliant on other countries. "We mustn't make ourselves unilaterally dependent on one power or one force, even if it's a partner," he adds.

With almost everything now being weaponised, including infrastructure, there are many learnings to come from Europe's response to the war in Ukraine. Ian concludes that we must learn from what we did wrong, and not simply focus on what we did right: "Europe needs a learning culture. Too often we congratulate ourselves on the things that we do well but we need to be able to learn from our mistakes."

Nations need to continue to appraise the evolving situation and learn if we are to preserve both security and sustainability. **A**

SAVING LIVES

Urban air mobility offers new possibilities to serve society.

Panellists

Hubertus Groepper
Airbus, LifeSaver Programme Manager

Nick Peters
International SOS, President and Chief Executive Officer,
Government Services Division

Balkiz Sarihan
Airbus, Head of UAM Strategy Execution
and Partnerships

Joonas Vääto
Invest Estonia, Director of Estonian Investment Agency

Henrik Hololei
Director-General for Mobility and Transport,
European Commission

Moderator

Alex Lepa
Airbus, Head of Connect and Engage Employees

IN SUMMARY

- UAM has the potential to transform our cities and change the way we live.
- UAM is defined as an 'urban' air mobility technology but it is also well suited to large rural areas with a low population density.
- Emergency medical services (EMS) will be a key application for eVTOL aircraft – helping medical services reach people in the critical 'golden hour' in ways that are not currently possible.
- LifeSaver is a new solution from Airbus, developed in collaboration with International SOS, using eVTOL UAM aircraft to complement existing in-service aircraft in a wider lifesaving ecosystem.
- The Government of Estonia is the first to explore LifeSaver's potential to improve patient outcomes.
- The solution is non-domain and non-geography dependent.

Sustainability in its broadest sense means the sustainability of life. While many will be familiar with the concept of urban air mobility (UAM), and its potential to transform our cities and the way we live, it also has applications in more rural areas, particularly in the context of its potential in lifesaving missions.

UAM could help medical services reach people with critical aid and it could also, with careful thought, transform the way in which whole countries approach their healthcare response.

VERTICAL POTENTIAL

Electric vertical take-off and landing (eVTOL) UAM aircraft – such as Airbus' 100% electric CityAirbus NextGen – are a familiar concept, and often discussed in terms of being urban taxis or delivery vehicles. However, LifeSaver, a new concept from Airbus developed in collaboration with International SOS, takes its potential to another level.

Balkiz Sarihan, Head of UAM Strategy Execution and Partnerships at Airbus, says that sustainability is not just about reducing carbon emissions: "It is also about creating social welfare and LifeSaver creates an opportunity for us that adds value to society, that complements existing medical systems, and that really tests the use-cases of how eVTOLs can and will be introduced to our communities."

LifeSaver is a new concept for governments worldwide that want to improve their emergency medical systems (EMS) by deploying eVTOLs to help first responders deliver medical care. But far from replacing conventional helicopters, which have a greater payload and longer range, Balkiz describes eVTOLs as a complementary technology:

"What the 'e' brings in vertical take-off and landing is electrification," she explains, "and electrification brings new market opportunities. Because the noise profile is so low, it means emergency operations are not limited to only daylight hours, which is the case in some cities and communities around the world. They offer a perfect blend of a classic helicopter, with the new capabilities that an eVTOL can add."

WHAT IS THE AIR MOBILITY INITIATIVE (AMI)?

AMI is an Airbus-led consortium of more than 30 partners dedicated to advancing air mobility services. Supported by the Free State of Bavaria and the Federal Republic of Germany, the initiative looks at ways to build a minimum viable product for UAM, and how it can support future living. The interconnectivity between the aircraft design, Vertiport design, and Vertiport operations is essential to building an effective UAM 'community'.



BETTER PATIENT OUTCOMES

Nick Peters, President and CEO of Government Services at International SOS, believes that eVTOLs and the LifeSaver concept can complement existing EMS: “The primary motivator behind developing any new healthcare system is about better patient outcomes,” he says.

LifeSaver can also have an impact on the economic reality of healthcare delivery: “Every healthcare system is being asked to become more effective and more efficient,” he explains. “But at the same time, it’s not clear how you do that. One of the key premises of LifeSaver is that we will be able to dissect the entire EMS process, end-to-end, to actually see where the system can be optimised.”

A PIONEERING PROJECT

Estonia is the first country to explore the possibilities that LifeSaver can deliver as part of a wider innovation programme focused on delivering tangible social benefit. It expects to launch the LifeSaver programme in the first half of 2023.

The director of the Estonian investment agency Invest Estonia, Joonas Vanto, says that while the country is small, around 50% of it is covered by forest, and has a very dispersed population living on more than 2,000 islands. “Through LifeSaver, we can map out how we can find new ways to reach people and transport patients more quickly.”

While Estonia has an extremely sophisticated, well-developed healthcare system, Joonas believes there is always room for improvement. The first step to implementing LifeSaver will be a review of the current EMS system, to better understand the role that UAM can play, and scenarios in which eVTOLs can operate.

ABOUT URBAN AIR MOBILITY:

- UAM is a safe air transportation system for cargo or passengers in urban environments.
- UAM is expected to be a reality by the second half of the decade.
- By 2030, 340 million people will live in EU cities and will be able to experience UAM.
- Transportation is performed by electric aircraft taking off and landing vertically, either with a pilot on board or piloted remotely.

ATTRACTING GLOBAL ATTENTION

The collaborative work being done between organisations and governments is attracting global attention. Henrik Hololei, Director-General for Mobility and Transport, European Commission, joining the panel via a pre-recorded video, believes innovative e-mobility will bring significant opportunities and benefits: “It is estimated that by 2050, over 70% of the world’s population will be living in cities, and this calls for innovative forms of transport,” he says. “Public services – and the health sector in particular – see great potential in eVTOL aircraft, as illustrated by the LifeSaver programme.”

Regulation, he acknowledges, is a key priority, and in Airbus’ case, work towards appropriate regulation and certification regarding its eVTOL aircraft is a concurrent process.

“The Commission intends to adopt rules addressing the airworthiness of drones subject to certification, as well as the operational requirements applicable to manned VTOL-capable aircraft,” Henrik continues. “The experience and knowledge base of Airbus in this regard is fundamental, and I can only encourage [organisations] to continue working closely with

EASA and us to make sure that the vision also becomes a reality.”

Henrik sees how UAM can integrate and complement existing transportation systems, by providing an alternative to more carbon-intensive vehicles. Developing the appropriate ground and air infrastructure is vital: “The aim, of course, is a full integration of cities and municipalities to the urban air mobility concept. The sooner the cities get familiar with their role, the sooner they will be able to use this technology for the benefit of their citizens,” he concludes. **A**

PRIMARY BENEFITS OF CITYAIRBUS NEXTGEN

- No local CO₂ or NOx emissions.
- Targeted missions to answer local communities’ needs on a customised basis.
- Additional layer of mobility to offer complementary transport services alongside traditional ground and airborne means of transport.



↑ A rendering of a CityAirbus NextGen flying over a city

PARTNERING WITH CERN

Collaboration to drive progress.

Speakers

Sandra Bour Schaeffer
Airbus UpNext, Chief Executive Officer

Raphaël Bello
CERN, Director for Finance and Human Resources



↑ Raphaël Bello

© AIRBUS SAS 2022, photo by Stefan Krueger



↑ A close-up view of a superconductor

© Getty Images / Lawrence Berkeley National Library

Across the two days of discussions at the Airbus Summit, a theme that emerged was collaboration: from public-private sector partnerships we can achieve great steps forward by combining our knowledge and experience.

To close out the Airbus Summit, Airbus UpNext, a wholly-owned subsidiary of Airbus, signed an agreement with CERN, the European laboratory for particle physics. Inked by Airbus UpNext CEO Sandra Bour Schaeffer and Director for Finance and Human Resources of CERN, Raphaël Bello, the agreement solidifies a partnership which will explore how superconducting technologies could be applied to future electric or hydrogen-powered aircraft.

One of the areas of focus for the Super-Conductor for Aviation with Low Emissions (SCALE) demonstrator is whether the combination of cryogenics and superconducting materials can allow many megawatts of energy to be transported in small cables – of 4cm in diameter – which will unlock weight savings and therefore greater fuel efficiency when deployed in an aircraft. By connecting researchers in fundamental physics with aeronautical engineers, we can advance the boundaries of human knowledge regarding cryogenics and superconductivity.

“Partnering with a leading research institute such as CERN, which brought the world some of the most important findings in fundamental physics, help push the boundaries of research as we pioneer sustainable aerospace for a safe and united world,” said Sandra Bour Schaeffer, CEO Airbus UpNext. **A**

IN SUMMARY

- Collaboration is vital for driving forward progress. In order to make substantial technological leaps we need to work with the very best partners.
- Airbus UpNext was pleased to sign a collaboration agreement with CERN to explore how superconducting technologies could be applied to future electric or hydrogen-powered aircraft.
- The Super-Conductor for Aviation with Low Emissions (SCALE) demonstrator aims to promote the adaptation and adoption of superconducting technologies in airborne electrical distribution systems.

FINAL THOUGHTS

A springboard for future action.

During this year’s Airbus Summit we have seen that our sector is gathering pace on sustainability and making concrete, tangible progress.

The sector has set itself some tough deadlines, and the issues we need to address won’t go away. This is our challenge, and we must face it head-on.

I hope that we and our partners can use this Summit as a springboard for further action and alignment and to accelerate the pace of change.

I’m excited for what the future will bring, and to see what we do next.

Julie Kitcher

Executive Vice President Communications, Corporate Affairs and Sustainability, Airbus

