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Costing the earth?

Commercial aviation is promising to re-invent itself as a less-polluting industry, with 2050 as a goal to reach net-zero carbon. But no-one has worked out who picks up the tab

The current narrative runs like this: shaken to its core by the damage wrought by coronavirus travel bans, the commercial aviation industry is emerging from this once-in-a-lifetime shock with a more sober, reflective and even responsible mindset.

Rather than simply returning to the pre-Covid-19 status quo, the industry instead intends to make a concrete contribution to reducing greenhouse gas emissions.

In the short term, that will mean expanded uptake of sustainable aviation fuel (SAF), while in the future new propulsion technologies will come to the fore.

With aerospace development timelines being what they are, work has now begun in order that a zero-emission narrowbody passenger aircraft can enter service by the middle of next decade.

Hitting milestones

Under this scenario, a series of milestones are crossed off without a hitch: tick, tick, tick. For the aircraft and engine manufacturers, a new fuel type – probably hydrogen – is selected by around 2025; around two years later a programme is launched; and another seven years down the line, the new type enters service.

Airlines, meanwhile, as part of their commitment to hit net-zero by 2050, successfully abate the modest total of 21.2 gigatons of carbon despite carrying more passengers each year than they ever have before.

SAF production also rises unhindered: growing from 2% of the industry's total requirement in 2025 to 65% by 2050. Plot that increase on a graph and you can see the mountain the fuel producers need to scale.

In the background, all the complicated infrastructural changes – fuel storage and production, and meaningful reform of air traffic management – are delivered as promised.

Willie Walsh, IATA director general, notes that aviation has a "history of realising what was thought to be impossible – and doing so quickly".

He acknowledges that the move to net-zero is "challenging", but believes that "provided governments and the whole industry work together and hold each other accountable for delivery" then the 2050 goal can achieved.

The elephant in the room, however, is money. SAF is pricey – presently costing three to four times as much as jet fuel – and produced in tiny quantities. New propulsion systems and next-generation airframe development will require billions of dollars – trillions, maybe – in investment, and the airport infrastructure changes will also have to be paid for by someone.

Money matters

As ever, problems can be solved if enough money is thrown at them, but the question is where that funding will come from.

Airlines are still licking their wounds from the pandemic-driven downturn; IATA says the industry as a whole will not be back in the black until 2023 at the earliest. Airframers and their suppliers are also still in recovery mode. Still, they appear in robust health compared with governments wrestling with cratered public finances.

And that is not to mention the travelling public. How willing are passengers to pay more for an airline ticket now if it helps to solve problems in the future? Or, will they simply travel by air less often, thus exacerbating the problems carriers face?

At present there are no easy answers, but doing nothing is not an option. What is clear is that one part of the industry cannot shoulder all the burden; this must be a collective effort.

But the industry should take care not to let self-set milestones become future environmental or financial millstones.

See p20

Rather than simply returning to the pre-Covid-19 status quo, the industry instead intends to make a concrete contribution to reducing greenhouse gas emissions

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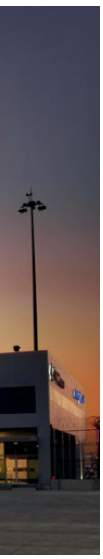

A321neo flew out-of-balance after passengers were seated for A320

EasyJet service operated outside centre-of-gravity envelope after departure control system did not identify aircraft swap

David Kaminski-Morrow London

UK investigators have revealed that an EasyJet Airbus A321neo operated from Bristol to Edinburgh while outside its centre-of-gravity envelope, after the aircraft was brought in to replace the smaller A320 that was originally scheduled for the service.

The condition was not detected until the aircraft was boarding at Edinburgh for the return service to Bristol, when the cabin manager remarked to the captain that passengers were not seated according to the loading form.

After the captain requested a manual zone count, the crew realised the passenger distribution was based on seating zones on the A320 rather than the A321neo (G-UZMI). The captain ordered reallocation of the passengers' seats to correct the problem before departure.

The UK Air Accidents Investigation Branch (AAIB) says the crew had flown the Bristol-Edinburgh sector believing the centre-of-gravity was towards the forward limit – but still permissible – after entering load figures into the electronic flightbag.

But an EasyJet investigation found that, unknown to the crew, the aircraft had been outside the operating envelope.

Its analysis concluded that, after the aircraft type was swapped, the change was not identified by the departure control system responsible for generating the information recorded on the load form.

Although the turnaround co-ordinator prepared the load form with the correct aircraft and registration, they unwittingly completed the form with invalid data from the departure control system.

As a result, the flight closed with a passenger distribution reflecting an A320 seating configuration, not that of an A321neo.

Airbus

Boeing seeks quicker return to service for P&W-powered 777s

Airframer asks regulator for exemption to requirement mandating simultaneous certification of all proposed changes in wake of February blade-out incident

NTSB

United Airlines 777 suffered engine failure after take-off from Denver in February

Jon Hemmerdinger Tampa

Boeing has asked US regulators to approve incremental modifications to the 777 intended to address the risk of blade-out failures on Pratt & Whitney PW4000 engines, rather than requiring simultaneous certification of all changes, as it pushes for an early return to service for the fleet. It is developing several modifications to PW4000-powered 777s, including changes to inlets, fan cowls and support struts.

PW4000-powered 777s have not flown in service since shortly after a United Airlines-operated example suffered fan blade fracture in February. Although not grounded, the jets remain out of service.

On 14 October, the Federal Aviation Administration (FAA) notified the public that Boeing had petitioned for PW4000-powered 777s to be partially exempted for five years from some powerplant-related rules.

"This exemption is required to allow certification and incorporation of the incremental changes as they become available to enhance safety and to meet the anticipated mandated compliance period of the planned airworthiness directives,"

Seating zone error was not spotted until A321neo was prepared for return flight

The AAIB notes that mitigation procedures introduced in response to the Covid-19 pandemic played a role in the 3 January 2021 incident.

It says the turnaround co-ordinator would normally hand the load form directly to the crew, providing an opportunity for the pilots to query any last-minute changes. But pandemic procedures minimised interaction with the pilots, and the load form was instead delivered via the cabin manager.

"As the [co-ordinator] was not on the flightdeck, the crew were more likely to accept changes presented to them without discussion," the inquiry states, pointing out that the error was detected at Edinburgh after the cabin manager checked the load form.

Investigators also found that the Covid-19 environment had resulted in a high number of changes to EasyJet's schedule, and a validation process for updating the departure control system was taking longer to run – with the result that some changes were not automatically detected.

"The various elements of the IT system architecture do not 'talk' directly to each other but operate through a variety of interfaces," the inquiry states, making errors and inaccuracies "more likely".

Although manual updates could be made after a swap of aircraft, this process had not accounted for a scenario involving an update after boarding had already started.

"This serious incident was caused by a combination of operating factors in a complex system interacting in a manner which had neither been designed nor predicted," the inquiry says.

EasyJet took several steps to improve safety after the incident, introducing procedures to conduct manual checks between IT systems when aircraft types are swapped, and for specific co-ordination between the chief pilot and duty pilot regarding type changes.

It is exploring the options for updating the IT system to cope better with communicating operational changes, and the carrier also requires a manual bay count to be completed before every departure to ensure that weight and balance calculations are accurate.

Boeing said in its petition to the regulator, dated 10 August.

"The exemption would... allow an earlier return to service of the 777-200 [and] 777-300 fleet powered by Pratt & Whitney engines," the petition says. "Returning these airplanes to service restores passenger and cargo air transport capacity which would be utilised to the benefit of the public."

In August, FlightGlobal reported that Boeing was seeking similar exemptions for 737NGs powered by CFM International CFM56 engines – a move following two fan blade failures.

Airlines pulled PW4000-powered 777s from service after the United incident in February – the third such event. The FAA immediately ordered engine inspections.

The agency did not respond to questions about Boeing's exemption request.

The National Transportation Safety Board (NTSB) continues to investigate the February incident.

Boeing "is working closely with the FAA, our customers and Pratt & Whitney to safely return PW4000-112-powered 777 airplanes to service," the company says. "We have identified design changes and are working to finalise them, including a robust certification effort."

The engine manufacturer says it backs Boeing's proposed exemption request: "We continue to support the ongoing NTSB investigation. We are co-ordinating all actions with Boeing, airline operators and regulators to support return to service of this fleet."

Complex fixes

Boeing's petition requests temporary exemption from several regulations, including one specifying that "no single failure or combination of failures will jeopardise the safe operation of the airplane". Others relate to engine support structures, vibrations, engine acceleration and rotation.

Meeting one rule requires meeting the others, Boeing writes. "A fully compliant design requires simultaneous certification of all changes".

Boeing says its fixes are complex and will not be available simultaneously. "Without an exemption, full compliance for the [fan-blade out] condition would require incorporation of all Boeing and Pratt & Whitney service bulletins at the same time," the document says.

Boeing requested a similar exemption – but for seven years – for its 737NG. That move stemmed from two incidents involving fan blade failures on CFM56s equipping Southwest Airlines 737-700s, the most recent of which took place in April 2018. Boeing is working on changes to the 737NG inlet, cowling and primary exhaust nozzle.

The PW4000 and CFM56 failures involved the release of fan blades, which damaged components surrounding the engine, causing inlet structures and fan cowls to break apart. In the 2018 Southwest incident, a component slammed into the side of the jet, breaking a window. A passenger died after being partly sucked out of the aircraft.

"Working closely with the FAA, CFM and our customers, we have asked the FAA to allow incorporation of a series of design changes to the 737 engine inlet, cowling and primary exhaust nozzle as they become available in order to further enhance safety," Boeing says.

NBAA's gamble pays off

Despite the threat of Covid-19 cancellation, business aviation's showcase took place in Las Vegas from 12-14 October, with Honda Aircraft's proposed 2,600nm-range concept jet the standout news

Jon Hemmerdinger & **Pilar Wolfsteller**
Las Vegas

In one sense, the news released at business aviation's biggest trade event was a sideshow: the real story was that BACE took place at all.

In the run-up to the NBAA's Business Aviation Conference & Exhibition (BACE) in Las Vegas, there were fears that a wave of coronavirus infections across the USA, driven by the highly contagious Delta variant, would torpedo any attempt to hold a face-to-face event.

But the show organisers pressed ahead and BACE went off without a hitch, save for a sandstorm that closed the static display on the first day.

It was not the largest-ever edition of BACE – notable absentees included Gulfstream, which chose to launch its new jets ahead of the show. And thousands of potential visitors from elsewhere in the world were prevented from travelling due to US travel bans.

But its occurrence was an important milestone for the industry, which had seen 2020's event cancelled due to the pandemic.

Honda Aircraft

The 10-passenger HondaJet 2600 builds on the HA-420 but features a new wing

Booming market

And BACE came at a good moment for business aviation: manufacturers are seeing strong sales activity and a sector that actually appears to be booming for the first time in over a decade.

But even if the show itself was the story, there was real news from the event too. Most notably, Honda Aircraft unveiled a concept jet – the HondaJet 2600, which builds on the technologies incorporated in its original HA-420.

Honda Aircraft has long hinted that it was looking at a larger aircraft and had pointed out that its over-wing engine configuration and natural laminar flow wing and fuselage were scalable.

While not a programme launch, the airframer says the unveiling of the concept at BACE was designed to "collect customer feedback and validate market demand".

Promising a range of 2,625nm (4,860km), Honda Aircraft boasts that the HondaJet 2600 would be "the world's first light jet capable of nonstop transcontinental flight across the United States". Speed is targeted as 450kt (833km/h), alongside a "class-leading" operating ceiling of 47,000ft.

In the cockpit, new automated systems should allow for single-pilot operations, it says, and will "offer the utmost operational safety by reducing pilot workload through an intuitive, high-tech interface".

Featuring a composite fuselage, the 10-passenger HondaJet 2600 would also feature a new wing with a 17.3m (56ft 7in) span. The cabin will be several inches wider at shoulder and foot level than the seven-passenger HA-420, and the centre of its cabin will be slightly higher, sales director Peter Kriegler says. The 2600's cockpit will also be larger than that of the HA-420.

While the jet would be manufactured at the same Greensboro, North Carolina facility as the HA-420, no details were released on whether the new type would also share its smaller sibling's GE Honda HF120 engines.

At this stage it is hard to say where the new jet will sit, but it appears to be a little on its own, straddling the space between the light and midsize segments. Assuming the concept specifications are shared by an eventual product, it will have longer range than the around 2,000nm boasted by the Embraer Phenom 300E or Pilatus PC-24 – each carrying four passengers - nudging up towards the 2,700nm with four passengers of Cessna's Citation Latitude. Honda Aircraft says the HondaJet 2600 will also achieve its full range with four passengers on board.

Crucially, though, the manufacturer claims the aircraft will burn 20% less fuel than other light jets, and 40% less than midsize jets.

Maximum take-off weight will be in the 8,000kg (17,500lb) range, compared with the Phenom 300E at 8,400kg and the Latitude at 14,000kg.

NBAA

Event was a milestone for the sector after its cancellation in 2020

Elsewhere at BACE, fractional provider NetJets – a company so oversubscribed last year that it temporarily suspended sales of its jet card – committed to expansion with an agreement for up to 100 more Phenom 300Es.

The deal stands to nearly double NetJets' fleet of the Embraer light jet, with the company having taken about 100 examples since receiving its first of the type in 2010.

Embraer Executive Jets chief executive Michael Amalfitano says the agreement demonstrates continued strong demand for an aircraft he calls the most advanced in the segment.

"NetJets is doubling down on Embraer, and recommitting to another 100 Phenom 300-series aircraft," Amalfitano says. The deal includes firm orders and options, though the airframer has not broken out the split; the 100 aircraft are worth more than $1.2 billion, Embraer says.

Deliveries are expected to begin in the second quarter of 2023, with aircraft going to both NetJets' US and European units.

Bombardier, like rival Gulfstream, released its big news ahead of the show, with the announcement of the upgraded Challenger 3500.

But in Las Vegas, the Canadian manufacturer disclosed that Les Goldberg, chief executive of Entertainment Technology Partners, has become launch customer for the twinjet. Goldberg already owns a Challenger 350.

Steve Spatafore/BillyPix

Honda Aircraft chief executive Michimasa Fujino in cabin mock-up

$1.2bn

Value of 100-aircraft Phenom 300E order from fractional provider NetJets, set to double its fleet of Embraer type

The 3500 is an updated variant of that aircraft, gaining a new cabin and technical features including the addition of an autothrottle and reduced cabin-pressure altitude. Service entry is expected in the second half of next year.

Bombardier brought to BACE a mock-up of the new cabin, which features Nuage leather seats derived from those in the cabin of the ultra-long-range Global 7500.

Meanwhile, Textron Aviation announced enhancements to its business jets in the light and midsize segments by launching updated "Gen2" variants of its Cessna Citation M2 and Citation XLS, mock-ups of which were on the static display.

Deliveries of M2 Gen2s will begin by the end of the first quarter of 2022, followed by XLS Gen2s by the end of the second quarter.

"The updates to the entry-level light jet and the midsize business jet usher in the next generation of aircraft design and technology, increasing comfort and productivity for passengers and pilots," Textron Aviation says.

"We've touched all areas of these aircraft in order to create the Citation M2 Gen2 and the Citation XLS Gen2 – from the cockpit to the cargo area and everywhere in between," says Christi Tannahill, Textron Aviation senior vice-president of customer experience.

Improved durability

Features new to the M2 Gen2 include wireless smartphone charging pads and USB-A ports at every seat in the cabin. The M2 Gen2's cockpit will also provide an additional 7.6cm (3in) of legroom for the co-pilot, and "cabin entry threshold materials have been improved for durability and maintainability".

Cessna introduced the Citation M2 in 2013. The seven-passenger jet, powered by Williams International FJ44s, has 1,550nm of range and a maximum cruise speed of 404kt.

Updates to the larger Citation XLS Gen2 include a "new lighted air-stair door" and new entry curtain. The curtain provides better protection from inclement weather when on the ground and "improves cabin acoustics in flight," the firm says.

The XLS Gen2 also gains a redesigned pedestal seat with "individual controls, new styling and optional quilting". The forward couch can be folded down, giving passengers access to their baggage.

For more coverage from the NBAA event, visit FlightGlobal.com/nbaa

Supersonic aircraft will serve as a mock opponent in live flight training exercises

Exosonic

Exosonic develops UAV aggressor

US Air Force contracts supersonic airliner developer to build low-boom vehicle for use during adversary training for pilots

Garrett Reim Los Angeles

Supersonic airliner developer Exosonic has been awarded a contract to design and build a low-boom unmanned air vehicle (UAV) prototype for use during US Air Force (USAF) adversarial training duties.

The company was granted a Small Business Innovation Research contract by the service's AFWERX technology accelerator, it announced on 7 October.

"Due to constrained training budgets and a pilot shortage, the USAF cannot efficiently produce new, fully-trained fighter pilots," Exosonic says. "As a result, a limited number of fighter pilots are receiving the adequate amount of live air training necessary to be prepared to defend our country against near-peer adversaries."

According to the company, its supersonic aggressor "Will serve as a mock adversary to stress fighter pilots in live flight training exercises. Equipped with various payloads and sensors, training can be conducted at a fraction of the cost of existing live air training solutions."

Exosonic claims that by using its UAV, the USAF could save millions of dollars and also reduce wear-and-tear on its operational fighters, which are sometimes pulled away from their primary missions to serve as aggressors.

The supersonic UAV will additionally be used by Exosonic to test its low-boom technology in flight. The company says the funding – the value of which has not been disclosed – will also help to finance its supersonic transport development effort.

Sophisticated combat

As the USAF transitions from performing counter-terrorism and counter-insurgency missions towards potential conflict with sophisticated foes such as China and Russia, the service is looking for ways to practice high-end aerial combat without breaking the bank.

In the short term, billions of dollars are being spent on contracting private companies to field fleets of earlier-generation fighters, such as Dassault Mirage F1s and Lockheed Martin F-16s, that pilots can practice dogfighting against.

The USAF also is investing in high-tech training equipment that it hopes will in time save money and improve the combat performance of pilots. Examples include networked ground-based simulators for multiplayer virtual combat training, adversarial UAVs and augmented reality pilot helmets that will project synthetic images of enemy aircraft into the vision of aviators.

As the USAF pivots towards so-called great power rivalry with China and Russia, it is emphasising combat training that includes larger numbers of aggressor aircraft. It also wants to train against assets that are more technologically advanced: for example, stealthy designs with low radar cross-sections.

In the case of Exosonic, the ability to field UAVs that can fly at supersonic speed, but without the loud noise of a sonic boom, might enable the service to train for aerial combat in a wider expanse of airspace than is currently possible using military ranges.

The US Department of Defense is also eyeing ways to practice aerial combat against stealth fighters. In 2017, the Director of Operational Test and Evaluation funded the development of the Fifth-Generation Aerial Target (5GAT); a UAV designed to mimic the low radar cross-section of aircraft such as the Chengdu J-20 and Sukhoi Su-57.

Built by Sierra Technical Services, the initial 5GAT prototype was lost in a crash in 2020.

USAF studies Wedgetail buy

Service funds Boeing to study changes needed for 737-based platform to succeed E-3s in airborne early warning mission

Garrett Reim Los Angeles

The US Air Force (USAF) has kicked off a study looking at buying Boeing E-7A Wedgetail airborne early warning and control (AEW&C) system aircraft to replace its ageing Boeing E-3 Sentry surveillance fleet.

In September, USAF chief of staff General Charles Brown said that the service was considering the Wedgetail and was discussing it with the Royal Australian Air Force. Canberra was the type's launch customer and operates six of the jets, which are based on Boeing's 737-700 increased-gross-weight airliner.

A new sole-source contract to Boeing, called the "E-3 Replacement Aircraft Studies & Analyses", shows the USAF is serious about acquiring the Northrop Grumman active electronically scanned array radar-equipped type, and is looking to move quickly.

Boeing is being paid to examine changes needed for the E-7A to meet the USAF's configuration standards and mandates, the service said in a contract award notice posted on 18 October.

This work will include supplying information about the platform's supply chain sustainment, systems engineering and cybersecurity, and integration with the US military's Mobile User Objective System satellite communication network and its M-Code GPS.

The USAF operates a fleet of 31 E-3s, with an average age of 43 years, according to Cirium fleets data.

"We are looking at the AWACS E-3s we have today, their mission-capable rates, and how much it costs to be able to maintain and keep those viable," Brown said during the Air Force Association's Air Space Cyber conference on 21 September. "This is why we are taking a look at the E-7."

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Number of E-3 Sentry surveillance aircraft in US Air Force fleet, with an average platform age of 43 years

In February, Pacific Air Forces commander General Kenneth Wilsbach advocated acquiring the E-7A, noting that the age of the E-3 fleet was making it difficult for the service to maintain the type.

The Wedgetail is attractive because it has "proven capability", said Brown. "It's already available. It's an option to be able to get capability much faster than if we had to start from scratch."

The USAF would prefer satellites to perform the air-moving-target indication mission, but the technology remains insufficiently advanced, Brown noted.

In addition to Australia, South Korea and Turkey are also operators of the system, with four examples each. The UK expects to field a trio of the type from 2023, and currently lacks a nationally-owned AEW&C capability, with the last Royal Air Force E-3D Sentry platforms having left service earlier this year.

Any future acquisition by the USAF could prompt interest in the E-7A from other operators of the aged E-3, which include France (4), Saudi Arabia (13) and NATO (14).

NATO has begun to assess options to replace its 707-based fleet with an Alliance Future Surveillance and Control capability, to be in use by 2035. It earlier this year contracted an L3Harris-led consortium to conduct a risk reduction feasibility study activity into a so-called "system of systems".

Additional orders for the E-7A would extend production of the 737NG commercial airliner platform, which is also the basis of Boeing's P-8A Poseidon maritime patrol aircraft. That derivative is based on the 737-800 airframe with -900 wings.

Boeing says it has 41 737-800s in its current backlog.

Launch user the Royal Australian Air Force has a fleet of six E-7A jets

Commonwealth of Australia

FLRAA rivals await next step

Bell and Sikorsky-Boeing team promote their candidates to succeed Black Hawk, as US Army targets 2030 service entry

Garrett Reim Washington DC

After flying its V-280 Valor tiltrotor for a total of 214h, Bell has picked apart the decommissioned aircraft looking for signs of unexpected wear and tear.

The company had flown the V-280 over a three-year period in support of technology demonstration and risk-reduction activities for the US Army, achieving a maximum speed of 300kt (555km/h).

Also involving the Sikorsky-Boeing SB-1 Defiant – a co-axial helicopter with a pusher propeller – the efforts are precursors to the Future Long Range Assault Aircraft (FLRAA) competition to replace the service's Sikorsky UH-60 Black Hawks.

"We really wanted to dig into the aircraft, tear it down and understand the inner workings," says Paul Wilson, programme manager for the V-280. Bell "took an especially close look at the rotor and drive systems. We broke those down and inspected them to see if there were any wear concerns," he adds.

After visual and non-destructive testing on the mechanics of the aircraft, the V-280 was found to have performed as expected, Wilson said during the AUSA exhibition in Washington DC on 11 October.

Bell

V-280 demonstrator has been decommissioned and examined

The company also demonstrated removing the aircraft's gearboxes and rotors using a US Army self-propelled crane aircraft maintenance and positioning vehicle, to show that it could be supported using standard service equipment.

The demonstrator has since been partially reassembled and is being used as a display model for visiting US Army delegations.

Meanwhile, Bill Fell, FLRAA principal test pilot for the Sikorsky-Boeing team, believes the SB-1 can go slightly faster than its demonstrated top speed of 247kt in level flight.

Noting that the aircraft still "had engine power available", he adds: "I think anything above 250[kt] is going to put a smile on my face when I get home".

The joint development team is continuing envelope expansion flight tests with their demonstrator, including testing the rotorcraft's angle of bank and load factor, despite having already submitted a bid with a production concept called Defiant X. This is designed to fly at 230kt in cruise, in line with the army's FLRAA performance requirement.

While this is slower than its rival's offering, the Sikorsky-Boeing team claims that the Defiant X will be more manoeuvrable during its final approach to a landing zone. Fell notes that the aircraft can reverse its propeller and slow from 200kt to a hover within a distance of about 800m (2,640ft).

The SB-1 also has demonstrated the ability to fly sideways at 56kt, says Jay Macklin, Sikorsky's business development director for Future Vertical Lift.

The US Army wants to equip its first unit with FLRAA rotorcraft no later than 2030, but has yet to lay out its timeline for awarding a production contract.

Sikorsky-Boeing

SB-1 team claim their design has the advantage in manoeuvrability

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Boeing green

While US airframer disagrees with European rival on feasibility of a zero-emission airliner by mid-2030s, it believes the two are nonetheless in alignment on climate goals

Graham Dunn Glasgow

Boeing's chief sustainability officer Chris Raymond is playing down differences between the US manufacturer and its European rival Airbus over how to achieve long-term net-zero carbon targets.

While Airbus chief executive Guillaume Faury has been promoting the virtues of bringing a clean-sheet, zero-emission narrowbody-sized airliner into service by "around" 2035, Boeing has distanced itself from such ambitions and instead put an emphasis on the role sustainable aviation fuel (SAF) will play in meeting targets.

"I think we have been clear that we don't think that launching a large-scale airplane by 2035 is viable – but I think we do have a lot of areas of agreement," Raymond said during a media briefing in Glasgow on 5 October as the airframer and Alaska Airlines highlighted innovations from the latest Boeing ecoDemonstrator aircraft – a 737 Max 9 bound for the Oneworld carrier next year.

AirTeamImages

Boeing showcased latest 737 Max 9-based ecoDemonstrator at Glasgow event

Same direction

"I think we are both talking about the same things, maybe [Airbus] with a bit more emphasis on hydrogen and us on SAF. But the reality is we are both saying the same things.

"I think we both agree we are going to need a lot of sustainable aviation fuel and we are going to pursue electrification and we have a lot to study on hydrogen."

But putting faith in SAF brings with it the challenge of making the fuel's use a reality. Part of that includes Boeing's commitment, outlined in January, to make all its new commercial aircraft able to burn 100% SAF by 2030.

"We have to do the work to figure out what has to change on our products, assuming there was an unlimited supply of SAF, to be able to go from the 50:50 [blend] limitations we have today, to flying 100%. We want to start figuring that out regardless of where supply is going to be. We thought that was our responsibility to do that work," says Raymond.

Boeing's ecoDemonstrator programme, in collaboration with FedEx Express, in 2018 flew a 777 Freighter using 100% SAF.

But the wider challenge facing Boeing – and the industry as a whole – is to turn aspiration into a functioning economic model.

"It is no longer a technological question, it's not even a safe certification question, and the reason the industry likes it is it's the least impact on the current infrastructure." says Raymond.

"Now the question is how do we scale it up and resolve the economic question.

"We've always thought as an industry if you could get to 2-3% – say three billion gallons a year – that does start to harmonise the economics. And I also think it will depend on what the regulation is saying. Everyone is saying 'it's so much more expensive than jet fuel', but if jet fuel gets more expensive because of carbon taxes or the elimination of the [emissions trading scheme] allowances, that delta cost might not start to seem that great anymore."

Boeing's vice-president of global sustainability policy and partnerships, Brian Moran, highlights a series of recent industry commitments which are demonstrating the seriousness of stakeholders.

Industry partners

Both Boeing and Airbus were among wide-ranging industry partners to in October sign the Air Transport Action Group's (ATAG's) commitment to achieve net-zero carbon emissions by 2050. That came as IATA members passed a similar resolution at the airline association's annual general meeting, while in the USA the Aerospace Industries Association – representing more than 320 manufacturers and suppliers – also committed to

work to achieve net-zero carbon emissions by 2050.

"The momentum in decarbonising aerospace has never been greater," says Moran.

He also points to supply and demand signals from the industry, such as Royal Dutch Shell's recent announcement that it is planning to produce two million tonnes of SAF per year by 2025.

"It will take a lot of announcements like that to get the total amount," acknowledges Moran. "But look at where we came from. You are already seeing exponential growth in the offtake commitments by the airlines and the demand signals that are being sent by companies like ourselves."

Boeing's efforts include its recent partnership with Dutch sustainable fuels specialist SkyNRG, through which the airframer is investing in SkyNRG's first dedicated US facility for SAF production.

Raymond also highlights the cross-sector momentum. "There is a confluence of trends that make me hopeful we can make it," he says.

"What I am encouraged by, is you can see the airline demand is there if you aggregate all the fuel offtake purchases or agreements to purchase. You are starting to approach 10 billion gallons – that's 10% of demand for fuel in 2019, so the demand side is coming."

> "I think we have been clear that we don't think that launching a large-scale airplane by 2035 is viable – but I think we do have a lot of areas of agreement"
>
> **Chris Raymond** Chief sustainability officer, Boeing

Enabling policy

"The money is starting to come because the demand is there, and if the enabling policy comes alongside of that, that can make someone's money look like quite a good long-term bet for a capital financing facility," Raymond says.

He also points to pressure on the oil and gas industry to increase its focus on renewable energy. "So now their view on this problem has shifted," he says.

Moran, meanwhile, highlights a report from ATAG, which estimates the SAF energy transition would require an investment of up to $1.45 trillion over 30 years.

"It takes about 6% of the current capital investment of oil and gas companies to reach the amount of capital needed," he says.

"While these are big numbers, that industry is big."

See p22

Changing local environment has driven sustainability policy

Alaska Airlines

Alaska stays a decade ahead of IATA target

While IATA collectively has committed to reaching net-zero carbon dioxide (CO_2) emissions by 2050, Alaska Airlines has a goal of hitting that milestone 10 years sooner.

The Oneworld carrier detailed its commitment in April to reduce the company's carbon emissions to net-zero by 2040, a stretch ambition also reflecting the acute awareness of environmental issues by partners and customers in its home markets.

Speaking at a joint ecoDemonstrator briefing with Boeing in Glasgow on 5 October, where an Alaska Airlines-liveried aircraft landed in Scotland for the first time, the airline's vice-president of public affairs and sustainability Diana Birkett Rakow outlined why the carrier had set the more ambitious goal.

"We did feel it was important to push ourselves. 2050 just seems that much further away," says Birkett Rakow. "We take goals that we set really seriously and we debated this one a lot."

The carrier has a five-part plan to achieve its target, including sustainable aviation fuel (SAF), operations, fleet renewal, new propulsion technologies and carbon offsets.

While the longer-term goal is to be net-zero by 2040, Alaska has some nearer-term ambitions. They include an aim to become the most fuel-efficient US airline by 2025.

"We have done that before in regards to fleet renewal and operational approaches, we know that we can do that again," says Birkett Rakow.

Alaska Airlines and Boeing brought the latest iteration of the ecoDemonstrator – a 737 Max 9 which will join the airline's fleet next year – to Glasgow, where the UN's Climate Change Conference (COP26) will be held.

The ecoDemonstrator is flight-testing 20 innovative technologies including new cabin sidewalls, 3D-printed cabin air vents, noise-reducing engine nacelles and an environmentally-friendly firefighting compound.

One example Birkett Rakor highlights is a new low-profile warning light that is being tested on the aircraft. "If you reduce the profile of the warning light, fuel efficiency improves, and if we can integrate into future airplanes we'll get a benefit in fuel efficiency," she says.

The Max is central to the airline's environmental efforts, following fresh orders for the type this year. The airline, which took delivery of its first 737 Max 9 in January, now has seven examples in service and firm orders for a further 86, Cirium fleets data shows.

"Each one of those [Max aircraft] as we retire other jets are 25% more efficient on a seat-by-seat basis," Birkett Rakow says.

But a major contributor to meeting its environmental targets is the use of SAF, although carbon offsets remain in the mix as a hedge against production not ramping up quickly enough.

Notably, the Oneworld alliance, which Alaska joined earlier this year, has issued its own aspiration for SAF to account for 10% of combined fuel volumes by 2030.

"We cannot do that now, there is simply not enough of it and it's not well-priced enough," she notes. "We need policy, both here and overseas to advance that."

But the airline is proactively working with its corporate partners to help create the necessary demand signals.

"We put together a deal where Microsoft is offsetting with us the carbon footprint of its business travel from Seattle to our hubs in California, using sustainable aviation fuel," Birkett Rakow says. "And we are looking to expand that programme with a number of companies, particularly tech companies on the West Coast, because we are other companies' carbon emissions."

Indeed, one of the factors behind the more ambitious target that has been set by Alaska Airlines is its location, which makes sustainability a key issue for the carrier's partners, customers and employees.

Alaska Airlines recognised for Corporate Social Responsibility

Alaska Airlines' leadership team was recognised in the Corporate Social Responsibility category at the Airline Strategy Awards, the annual event organised by *Airline Business – Flight International*'s sister title – together with the aviation practice of Korn Ferry.

The winners were announced in London on 27 September and the Corporate Social Responsibility award was collected by Diana Birkett Rakow during a media reception at the Glasgow Science Centre on 5 October.

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IATA eyes brighter future

Airline association insists it can see return of better times despite collective losses, and makes CO2 reduction commitment

Jon Hemmerdinger & **Pilar Wolfsteller**
Boston

Airline leaders left IATA's World Air Transport Summit and annual general meeting in October in a buoyant mood, sensing the industry's worst days are behind it, and that normalcy is months, not years, away.

At the Boston event – the organisation's first such gathering since 2019 – IATA also made firm commitments to reduce CO2 output, saying the industry is emerging from the pandemic-driven downturn with an invigorated dedication to environmental stewardship.

"My view is that we will have forgotten all about this, in terms of what [Covid-19] did to travel, by the end of next year," says Emirates Airline president Sir Tim Clark.

He is among numerous executives who said the crisis is nearly over; that the world is ready to move on.

United Airlines chief executive Scott Kirby – one of the first airline bosses to require all staff to be vaccinated – says the crisis is "in the rear-view mirror".

In North America, airlines have rapidly returned jets to service – and are now desperately seeking enough crew to staff them. Domestic flights are full, and schedules have largely recovered to near-2019 numbers. In Mexico, some airlines have raised capacity to levels that are more than 20% above those in pre-pandemic 2019, with load factors increasing steadily into the 70-80% range.

"Mexico did not interrupt air travel," says Volaris chief executive Enrique Beltranena. "The limitations to fly to Mexico were basically nothing... That has allowed the industry to continue operating, and recover faster."

But for all the bullish talk of recovery and rebound, IATA's financial forecasts still make for grim reading: airlines are now expected to lose $51.8 billion this year – $4.1 billion more than previously forecast – remain in the red as an industry next year, and rack up collective losses of more than $200 billion between 2020 and 2022. Profitability is not expected to return until 2023.

IATA

Walsh believes aviation can reach net-zero CO2 emissions by 2050

Crossing continents

International travel still lags, with little indication as to when full freedom of movement between countries and continents will return.

Those restrictions directly affect the association and its choice of venue for its next AGM and summit. Although Shanghai has been selected as the location – the third time the event has been held in China – for the 2022 event to go ahead with its usual large overseas contingent, the Chinese government must remove border restrictions.

IATA director general Willie Walsh is optimistic the organisation will be able to hold the event, which is being hosted by China Eastern Airlines, as planned.

"When we accepted the offer from China Eastern, we were very clear that the AGM had to be in-person," Walsh says.

With the global health crisis ebbing, IATA has pushed forward on a different – and arguably more challenging – long-term path: moving to clean energy.

IATA's 292 airline members passed a resolution pledging to reach net-zero CO2 emissions by 2050. The ambitious commitment reflects one already targeted by many – but not all – airlines under their own initiative in recent times.

It is worth noting that the 2050 target was not universally welcomed. China Southern

Airlines sought to amend the resolution, asking for recognition of the "common but differentiated responsibilities" principle, which says that while there is a shared responsibility for addressing sustainability, different degrees of economic development between countries also need to be recognised.

In response to that intervention and a string of comments by Chinese airlines, Walsh said he recognised the fact that China's government has an objective to achieve net-zero CO2 by 2060, 10 years later than that targeted by IATA, but that 2050 was the right choice for airlines.

China Southern's amendment was not seconded and was therefore not put out to vote.

But there is a general recognition that sustainability has become "more important post-Covid", says KLM chief executive Pieter Elbers. While "everyone was sitting inside, was locked up, the whole topic around sustainability [has] taken on a more-prominent position".

There are also sensible political reasons for its adoption, notes Robin Hayes, chair of the IATA board of governors and JetBlue Airways chief executive. He says a "failure to make this additional commitment will leave others to set targets for us and leave us without a credible voice in the discussions".

New propulsion technologies may help the industry meet its goals in the longer term, but for the here and now sustainable aviation fuel (SAF) is being touted as the only immediate solution.

But SAF currently accounts for only a fraction of the global airline industry's fuel usage. Although IATA aims for SAF to reach 2% of total fuel supply by 2025, and 5% by 2030, some executives are doubtful production can be ramped up sufficiently. There are also very clear price concerns – SAF can cost as much as four times more than regular jet fuel – and issues around food sustainability too.

"Sustainable aviation fuel is important to this industry," says Kirby. "But we should not be producing sustainable aviation fuel from farm products, we should not be using soy, palm oil and corn."

Nonetheless, Walsh remains undaunted. "Aviation has a history of realising what was thought to be impossible – and doing so quickly," he says. "We are launching a transition that is challenging. But in 30 years it is also within reach of human ingenuity, provided governments and the whole industry work together."

Compounding the challenge, the industry expects to grow beyond its pre-pandemic passenger traffic levels at the same time as reaching net-zero emissions.

"To be able to serve the needs of the 10 billion people expected to fly in 2050, at least 1.8 gigatons of carbon must be abated in that year," IATA says in a briefing on the resolution. "Moreover, the net-zero commitment implies that a cumulative total of 21.2 gigatons of carbon will be abated between now and 2050."

In the very short term, IATA sees its CORSIA offsetting scheme as serving to stabilise emissions at 2019 levels, but in future more concrete solutions will come into play.

All together

"A potential scenario is that 65% of [emissions in 2050] will be abated through sustainable aviation fuels," Walsh explains. "We would expect new propulsion technology, such as hydrogen, to take care of another 13%. And efficiency improvements will account for a further 3%. The remainder could be dealt with through carbon capture and storage, at 11%, and offsets, at 8%.

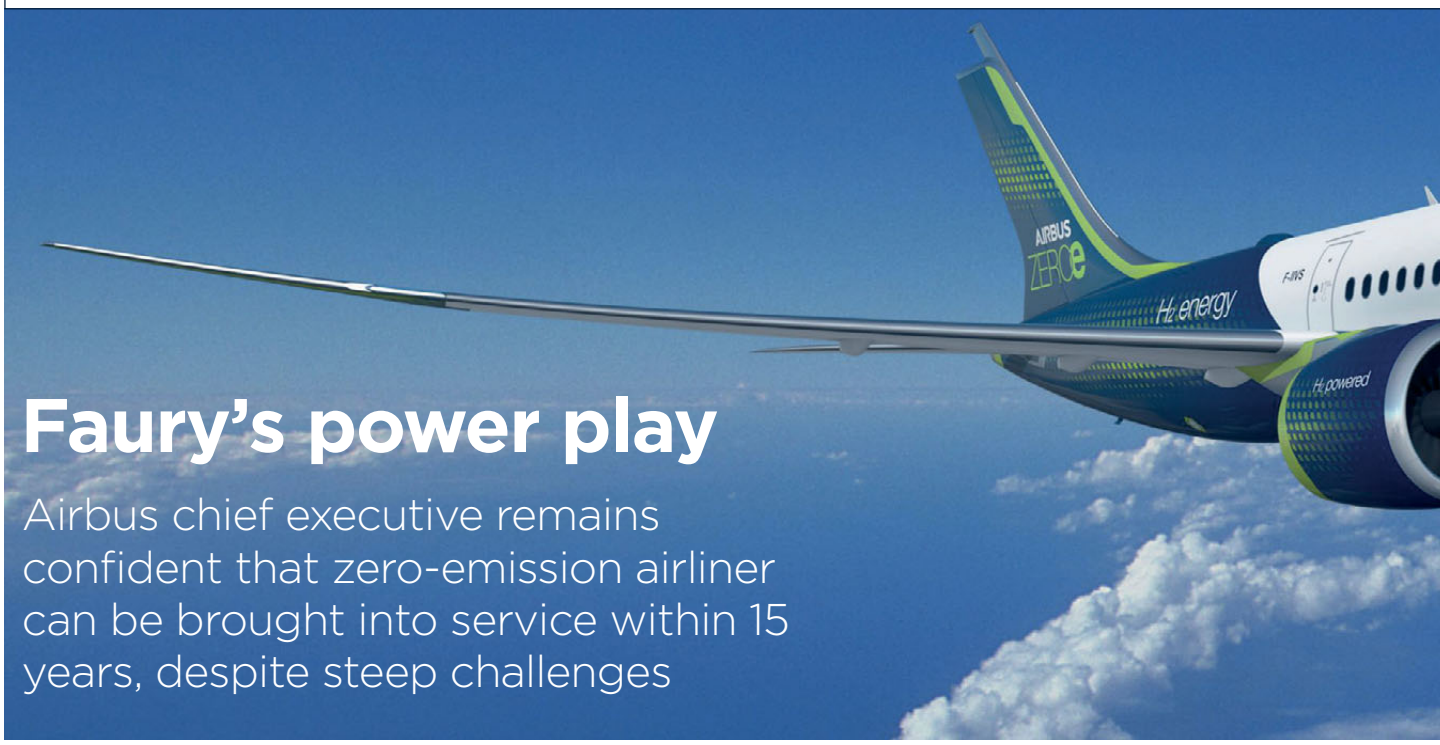
"The actual split, and the trajectory to get there, will depend on what solutions are the most cost-effective at a particular time."

Achieving the goal requires a collaborative effort between all stakeholders involved in aviation, says Walsh – governments, regulators, air navigation service providers, airport operators, fuel producers, aircraft and engine manufacturers, oh, and airlines.

All stakeholders are well aware that the journey to 2050 will be a complicated and expensive one. But who pays for this commitment remains an open question.

See p32

Additional reporting by Lewis Harper in London



Faury's power play

Airbus chief executive remains confident that zero-emission airliner can be brought into service within 15 years, despite steep challenges

Mark Pilling Toulouse

Timelines are incredibly tight, the technology is not there yet, the investment will be colossal, and the airport, fuel and related infrastructure questions are massive hurdles – but Airbus chief executive Guillaume Faury believes bringing a clean-sheet, zero-emission narrowbody-sized airliner into service by "around" 2035 is entirely feasible.

"I am more and more confident that is an achievable goal when it comes to the airplane," Faury said at the Airbus Summit in Toulouse in late September.

"But the plane is just one part of the challenge," he says, with many other elements of the supply chain at least, if not more, problematic. "This is not something aviation can manage alone," he says.

For its part, Airbus is pressing ahead. "2035 is tomorrow, therefore we have to be fast, and we have to go together," says Faury.

Airbus has put its faith in technology – especially hydrogen – and the entire summit, with its 'Pioneering Sustainable Aviation' tagline, promoted the notion that aviation must decarbonise.

Faury outlined Airbus's 2035 timeline to develop a likely hydrogen-powered airliner during a Eurocontrol webinar in March, and he stands by that promise.

"I am impressed by the momentum created by those technologies," he says.

The plan sees Airbus selecting the fuel technology it will use by 2025; there is enough time between now and then for industry to work on new fuels and propulsion systems and come up with solutions, he believes.

Then there will be two years of work to select partners and suppliers and bring the project to a position where it could be formally launched in 2027 or 2028, Faury says. It would then take seven years to reach service entry in 2035.

For Faury, the technology is a challenge, but the money needed is another matter. "The issue in 2027 is we will have to launch major investment, not only at Airbus but with our partners," he says. "And we need certainty on the regulatory environment" for airlines aiming to operate the aircraft in 2035.

2035

Airframer's target for service entry of likely hydrogen-powered airliner

"I am more concerned about this than the engineering," says Faury. "That's why we are engaging with governments and the energy sector" to seek solutions that will make zero-emission aircraft become a reality. "We are not limited by money today. We are more limited by the speed of the development of new technologies."

"Is it risky?" Faury is asked.

"Of course," he replies, acknowledging that many strands of activity must converge to make his strategy come off. However, the focus on hydrogen is clear, as its energy density is so much higher than other fuels or batteries. "We don't have to change the laws of physics here," says Faury. "Hydrogen is made for aviation."

Faury says the speed of hydrogen development reminds him of how fly-by-wire technology and later the introduction of electric cars was initially greeted with pessimism and judged as too risky.

"We are at a turning point when it comes to hydrogen," he says.

With the 2035 timeline becoming established, Faury was challenged during the summit by Andrew Murphy, director aviation at green lobby group Transport & Environment, to "at least phase out the problem", meaning to set a deadline to cease production of fossil-fuel burning aircraft. "By 2035 we should end the sale of jet aircraft for short-haul operations in Europe," he says.

There also need to be clear timelines and clarity on the amount of money required to develop such an airliner, he adds.

Not surprisingly, Faury rejects the phase-out idea. "We think we don't need to stop selling planes. On the contrary, we need to accelerate the replacement of old planes by new ones," he says, bringing more fuel-efficient models into service and thus contributing to emissions reduction.

"We don't have to change the laws of physics here. Hydrogen is made for aviation"

Guillaume Faury Chief executive, Airbus

Airbus

Airbus's hydrogen strategy contrasts with the views of Boeing, which has shown far less enthusiasm for the fuel. However, Faury believes "there are more convergences than you think" between the two OEMs, with both agreeing that sustainable aviation fuels are a short-term opportunity and priority.

The challenge Faury has set Airbus and its technology partners is huge. But two years ago, Airbus "took the bull by the horns" and put hydrogen at the forefront of its efforts to propel the company into a strategy that could eventually take it out of the business of making aircraft powered by fossil fuels.

For its airline customers though, cost and infrastructure hurdles clearly remain. EasyJet, for one, is calling for investment and support for the development of zero-emissions aircraft; chief executive Johan Lundgren told the summit that "the industry can't do it alone".

He notes significant challenges and questions with transitioning from a conventionally powered aircraft fleet to one with zero-emission aircraft, and for a period operating with both types and the complexities that brings. For instance, it could be that zero-emission aircraft are introduced on a base-by-base or route-by-route basis.

Current generation

With a zero-emission aircraft unlikely to be in service any time before 2035, EasyJet's growth in this decade and beyond will come from adding further current generation narrowbodies. "I think it's more likely there will be more orders for traditional technologies," says Lundgren, before its first order for zero-emissions aircraft.

Lundgren used the summit platform to urge industry and governments to work closely together to deliver on the zero-emission technology needed to transform the industry over the coming decade and beyond.

"This is an exciting time for the industry, where true zero-emission flight is coming within reach," explains Lundgren. "We all need to play our role to ensure that the infrastructure is ready for these exciting new aircraft."

The timeline Faury talks about is aggressive and the technology leap is probably unprecedented in peacetime. But Airbus is strapped in tight to the decarbonisation bandwagon, and while Faury is at the wheel it will not get off it.

Fully-electric vehicle has a fixed wing and eight propellers

Airbus

NextGen prototype will put Airbus in heart of the city

Airbus has unveiled the next phase in its development of electric air mobility solutions with the unveiling of the CityAirbus NextGen.

Bruno Even, Airbus Helicopters chief executive, says it aims to fly the prototype in 2023.

Joerg Mueller, head of urban air mobility (UAM) at Airbus, adds: "Our fully-electric four-seater is designed as our answer to the UAM market."

Learnings from two flight demonstration programmes – the original CityAirbus and its Vahana electric vertical take-off and landing (eVTOL) aircraft – converged to create CityAirbus NextGen.

As the "emerging UAM market begins to firm up" Airbus is betting that by the time it has flown and certified its prototype, which it is aiming for as early as 2025, this "innovation" project can move into series production.

Even says the aircraft will be certified under the European Union Aviation Safety Agency's special SC-VTOL category.

"We have learned a lot from the test campaigns with our two demonstrators," says Even. "The CityAirbus NextGen combines the best from both worlds with the new architecture striking the right balance between hover and forward flight."

The eVTOL vehicle is equipped with fixed wings, a V-shaped tail, and eight propellers as part of its distributed propulsion system. It is designed to be a zero-emission aircraft with a range of 43nm (80km) and a cruise speed of 65kt (120km/h). These performance figures will make it suited for operations in major cities, says Airbus.

The transition of the NextGen prototype into a production aircraft will depend on how fast the UAM sector develops.

"It is a market that could be larger than the existing helicopter market today. But the challenge is when?," says Balkiz Sarihan, head of UAM strategy execution and partnerships at Airbus.

Beyond developing the vehicle itself, Airbus says it is working with partners, cities, and city inhabitants in order "to create the ecosystem" that is essential to its operation.

Airbus

UpNext takes inspiration from nature for shape-shifting wing development

Although much of the airframer's decarbonisation efforts have focused on novel propulsion systems, Airbus has also disclosed the broad outline of a programme to significantly advance wing technology by developing a structure capable of adjusting its shape automatically in flight.

The "extra-high-performance wing demonstrator" is intended to drive a step change in wing aerodynamics to curb the carbon output of future aircraft.

The project will include flight tests using a Cessna Citation VII.

Airbus aims to fly the extra-high-performance wing demonstrator aircraft by mid-decade, says chief technology officer Sabine Klauke, and it could have a potential application on a next-generation aircraft.

Airbus hopes the wing can produce fuel-efficiency benefits greater than seen from its current sharklet wing-tips, she says.

Klauke says the "novel" technologies will allow the wing to adapt its "shape, span and surface" in ways similar to birds.

To achieve that, Airbus will evaluate "active" wing controls such as "gust sensors [and] pop-up spoilers or plates that are rapidly deflected perpendicular to airflow". Other possible features include "multi-functional trailing edges that dynamically change wing surface in flight, and a semi-aero-elastic hinge".

The programme sits within Airbus UpNext, a subsidiary that focuses on advancing "radical technological breakthroughs".

Airbus says the wing "would be compatible with any propulsion solution and aircraft configuration, and would reduce CO2 emissions, contributing greatly to Airbus' de-carbonisation roadmap".

A digital rendering released by the airframer shows a Citation equipped with the "extra-performing" wing that appears to have a high aspect ratio.

The project is in addition to Airbus's "Wing of Tomorrow" effort to develop wing technology for its next airliner. Assembly has begun of the first of three wing prototypes for the programme, which will evaluate composite materials and new manufacturing and assembly processes.

Concept shows a Cessna Citation VII using "novel" wing with high aspect ratio

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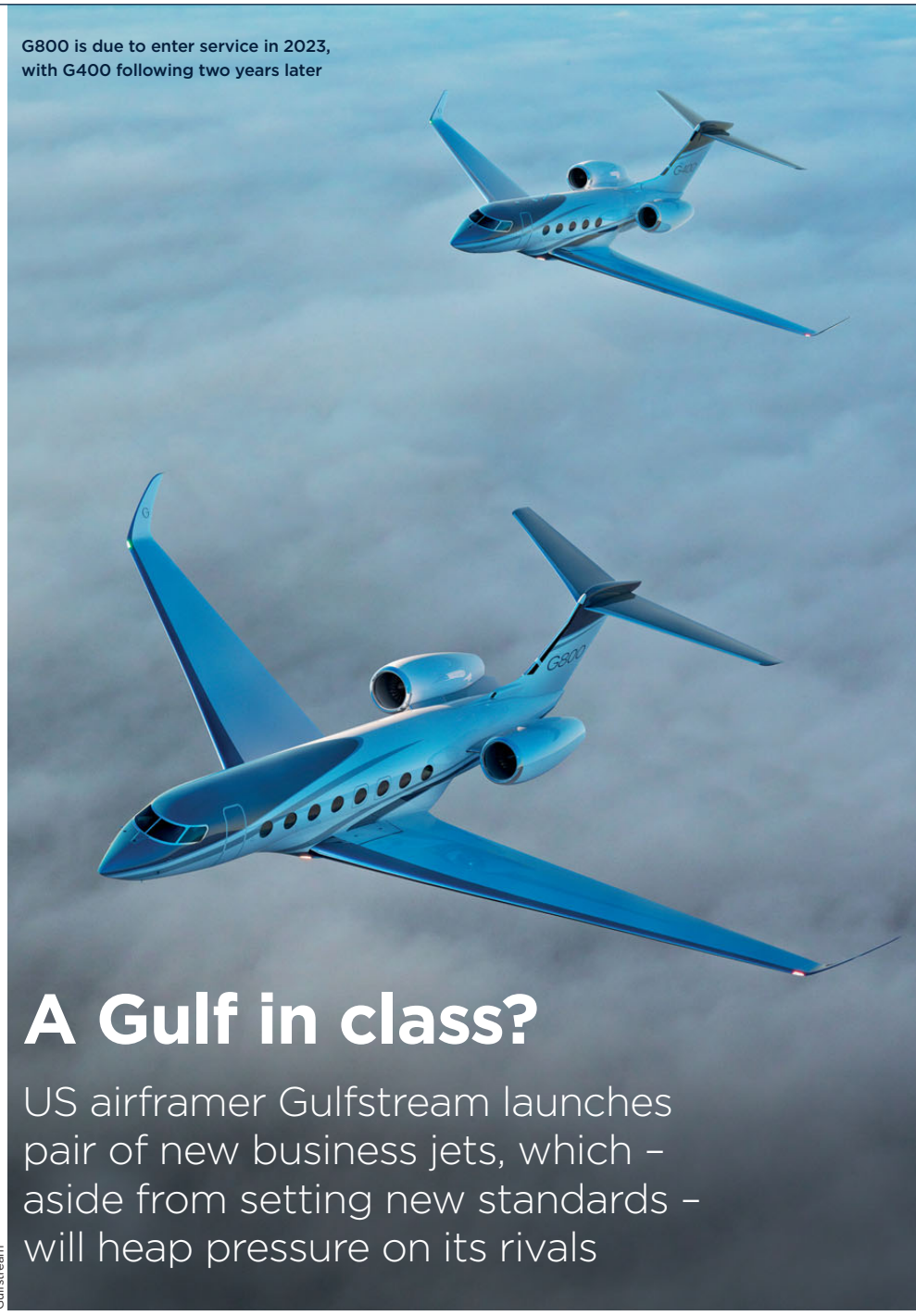

G800 is due to enter service in 2023, with G400 following two years later

Gulfstream

A Gulf in class?

US airframer Gulfstream launches pair of new business jets, which – aside from setting new standards – will heap pressure on its rivals

Dominic Perry London

With the simultaneous launch on 4 October of two new business jets – the ultra-long-range G800 and large-cabin G400 – Gulfstream also appears to be targeting twin objectives: to fortify its position at the top end of the market, and to apply still more pressure on its rivals – Bombardier in particular.

Unveiled with great fanfare at a live event at the airframer's Savannah, Georgia headquarters, Gulfstream president Mark Burns said the arrival of the new pair means that it now boasts "an aircraft for every mission".

Although the G400 was presented via a digital mock-up, the big surprise of the night was the public roll-out of the first G800 test aircraft – a prototype that had been assembled in secrecy.

But the fact that Gulfsteam was able to quickly and quietly assemble that flight-test vehicle – while simultaneously working on the G700's certification – points to a great strength of its strategy: both new aircraft are, to a greater or lesser extent, derivatives of existing models, sharing key components and therefore minimising research and development costs and risk.

Shared features

Take the $71.5 million G800 for example: it is essentially a shrink of the G700 (which itself was developed from the G650). As such, the G700 and G800 share a wing, winglets, tail and fuselage cross-section – with that last feature also shared by the G650. In addition, both newer jets are powered by the same Rolls-Royce Pearl 700 engines and have common cabin systems and the firm's Symmetry flightdeck and BAE Systems-supplied active sidestick controls.

The G400, meanwhile, shares the G500's wing and winglet, and has the same fuselage cross-section as the G500 and G600. Power comes from a pair of Pratt & Whitney Canada PW812GA engines – a lower-thrust version of the PW814GA on the G500. Again, the Symmetry flightdeck and cabin systems are common across the three jets.

Burns says that the G800's development has benefited from the "investment in design and manufacturing" for the G700. Parts are already being built for the test fleet, he says, with the initial example undergoing "instrumentation and calibration", which is "clearing the way [for it] to begin flying".

Gulfstream is confident that the rapid pace of development will see the G800 enter service in 2023. That timeframe is significant – putting the jet's arrival two years in front of Dassault Aviation's rival Falcon 10X, which will be powered by a higher-rated variant of the Pearl engine.

But how close are the two aircraft in performance terms? Gulfstream boasts that at 8,000nm (14,800km) the G800 will have the longest range of any purpose-built business jet, effectively a 500nm advantage over the Falcon 10X, and 300nm more than Bombardier's Global 7500.

However, Dassault has been very public that it is not chasing range records with the Falcon 10X, believing that 7,500nm will connect the vast majority of potential city pairs. Instead, to convince customers to wait, it is banking on the comfort offered by the twinjet's spacious

cabin, which is taller and wider than that of the G800 and G700.

Whether the additional range will sway buyers remains to be seen, however. "When you get up into that range category, is another 300nm going to make a difference? Maybe just for bragging rights," argues business aviation consultant Brian Foley of Brian Foley Associates.

It is a view shared by aerospace analyst Richard Aboulafia of Teal Group: "It is not going to result in more than a handful of additional sales," he says.

In a sense, Gulfstream has done to Bombardier what the Canadian airframer intended to do its rivals when it unveiled the Global 7000 – later renamed to reflect its improved range – and smaller, longer-range Global 8000 more than a decade ago.

While the Global 7500 entered service in 2018, development of the Global 8000 remains on ice. However, should Bombardier feel that its flagship is sufficiently threatened by the new Gulfstream then it can "escape to the Global 8000 for fairly low cost", says Foley.

Long heritage

But an easy solution is not immediately evident further down the Montreal firm's line-up, where the G400 could pose difficult questions for Bombardier's Challenger 650, an aircraft which has been in service since 2015, but whose heritage extends back to the early 1980s.

As well as providing an entry to the airframer's range, Burns says that the G400 addresses a "void in innovation" in the large-cabin market. "Our customers asked Gulfstream to re-envision a category of airplane that the rest of the industry has left a bit dull and dormant." The $34.5 million aircraft is set to enter service in 2025.

Both Foley and Aboulafia agree that Bombardier has run out of ways to further improve its 4,000nm-range jet. The only solution, they argue, is a clean-sheet design. But that is something "that Bombardier is not in a financial position to do," says Foley, who says the airframer is "a little bit trapped with the Challenger 650."

> "When you get up into that range category, is another 300nm going to make a difference? Maybe just for bragging rights"
>
> **Brian Foley Business aviation consultant**

Aboulafia says the G400 is "going to grab market share, mostly at the expense of Bombardier. And there is not much they can do about it given their financial weakness. Finding at least $500 million to replace the Challenger 650 is not an option right now."

Although he agrees that Bombardier does not have the money for a clean-sheet successor, George Ferguson, senior aerospace, defence and airline analyst at Bloomberg Intelligence, believes the airframer may not have to hit the panic button just yet.

Strong post-pandemic demand for private aviation means that backlogs for all aircraft types are currently strong. Fleet sales too will play a part – an area of the market Gulfstream has previously been reluctant to engage with – and although the Challenger may be older, as its development costs have long since been amortised, "you can still move airplanes with a discount", he says.

Response required?

Dassault may also feel some pressure on sales of its 4,000nm-range Falcon 2000XLS. With two development programmes currently on its books – the Falcon 6X and 10X – the airframer is not necessarily in a position to respond immediately. However, once certification of the Falcon 6X is achieved – due next year – engineering resources could be freed up.

Foley believes that the ultra-wide-cabin Falcon 6X could provide the basis of a response, if one is required. "It's not a tomorrow project, but they have a competitive response if they feel it's needed," he says.

But regardless of what the new jets will do to the ranges of its rivals, the launch of the G800 signals the beginning of the end for the G650/ER.

"Eventually, the G800 will replace the G650. The G650ER is still in high demand, so we have not determined when production will end," Gulfstream confirms.

How Gulfstream's new jets compare

	Range	Long-range cruise	Length	Wingspan	Cabin height	Cabin width	Cabin length*	Engines	Take-off thrust (each)
G800	8,000nm	M0.85	30.4m	31.4m	1.91m	2.49m	14.3m	2 x Rolls-Royce Pearl 700	18,250lb
G700	7,500nm	M0.85	33.48m	31.4m	1.91m	2.49m	17.3m	2 x Rolls-Royce Pearl 700	18,250lb
G650ER	7,500nm	M0.85	30.4m	30.3m	1.91m	2.49m	14.3m	2 x Rolls-Royce BR725	16,900lb
Falcon 10X	7,500nm	M0.85	33.6m	33.6m	2.03m	2.77m	16.4m	2 x Rolls-Royce Pearl 10X	>18,000lb
Global 7500	7,700nm	M0.85	33.8m	31.7m	1.88m	2.44m	16.6m	2 x GE Aviation Passport	18,920lb
G500	5,300nm	M0.85	27.8m	26.3m	1.88m	2.31m	12.6m	2 x Pratt & Whitney Canada PW814GA	15,144lb
G400	4,200nm	M0.85	26.3m	26.3m	1.88m	2.31m	11.1m	2 x Pratt & Whitney Canada PW812GA	13,496lb
Challenger 650	4,000nm	M0.85	20.9m	19.6m	1.83m	2.41m	7.8m	2 x GE Aviation CF34-3B	9,220lb

Source: Manufacturers
Note: *excluding baggage compartment

Beijing's show of strength

Delayed by the pandemic, Airshow China returned for a domestic-only audience, offering a tantalising glimpse of the nation's advancing military technology

AirTeamImages

Greg Waldron Singapore

This year's Airshow China event – rescheduled from last November due to the pandemic – offered many fresh insights into the country's military aviation ambitions, but as ever the true operational status of the systems on display in Zhuhai largely remains unclear.

Staged from 28 September-3 October and limited to residents of China because of coronavirus-related travel restrictions, the event prompted enthusiasts to flood Chinese social media with images of equipment involved in its flying and static displays, and within the exhibition halls.

Highlights included a debut show appearance by the Chengdu J-20 fighter equipped with indigenous engines, an electronic warfare (EW)-adapted version of the Shenyang J-16 and display flights involving multiple unmanned air vehicle (UAV) types.

While J-20s had participated in the 2016 and 2018 iterations of the show, those aircraft were powered by Russian Saturn AL-31FNs. For this year's event, Beijing's most advanced combat aircraft flew with WS-10C Taihang engines. These are viewed by observers as an interim step until the fighter can be equipped with in-development WS-15 Emei powerplants.

Likely to perform a similar electronic attack role as the US Navy's Boeing EA-18G Growler, the J-16D on static display was fitted with wingtip EW pods in place of the fighter's usual missile rails. Four jammer pods were also mounted beneath its wings and fuselage.

In operational service, the J-16D should give the People's Liberation Army Air Force (PLAAF) strong capability against enemy air defence systems. Beijing has already developed an EW-variant Shenyang J-15D, for use aboard its aircraft carriers.

New fighter

Meanwhile, state media quoted Sun Cong, chief designer of the J-15 and Shenyang FC-31 at AVIC, as indicating that a new carrier-borne fighter is close to being revealed.

"Once the new plane is ready for its debut flight, it will appear in front of all of you and also on the internet," he says. "You will get to see it before year's end."

For several years there has been speculation that China is developing a version of the FC-31 to replace its Sukhoi Su-33-derived J-15s. First flown in 2016, the new model has a maximum take-off weight (MTOW) of 28,000kg (61,700lb), AVIC has said.

Clearer progress was on show with relation to China's broad-ranging pursuit of advanced UAV technologies. Two notable highlights were flying display appearances by the AVIC Wing Loong II and Tengden TW-328A, both of which were flown in company markings.

Already in use domestically and supplied to several other countries, the Wing Loong II is an important export item for Beijing. With a 4,200kg MTOW, the long-endurance type can carry an electro-optical/infrared sensor, synthetic aperture radar and up to 10 air-to-surface weapons.

The TW-328A is powered by three turboprop engines. The example which took part in the flying display carried two large inert guided bombs, and four ground-attack missiles. In August, the Japanese defence ministry scrambled fighters after spotting a TB001 – on which the TW-328A is based – flying over the East China Sea.

In the static display, a CASC CH-6 – a large UAV with a T-tail and two turbofan engines mounted above the rear fuselage – was on show.

A report in the state-run *Global Times* gives the CH-6's wingspan as 20.5m (67ft 2in), with a MTOW

Chengdu's J-20 fighter made Zhuhai debut with indigenous WS-10C engines

of 7.8t and a claimed operating ceiling of 49,000ft. No details were given, however, about the type's development status.

Also appearing on static for the first time were the Guizhou WZ-7 and WZ-8. The WZ-7 is billed as a high-altitude, long-endurance system with a similar role to the Northrop Grumman RQ-4 Global Hawk. Believed to already be in PLAAF service, it has a joined-wing design which is claimed to improve its lift and performance.

Unmanned ambitions

Powered by rocket motors, the delta-winged WZ-8 first made an appearance on a truck during China's National Day parade in October 2019. It is believed the type is to be carried aloft by a host aircraft, probably the Xian H-6N bomber, before conducting a high-speed, high-altitude reconnaissance sortie and recovering to a runway.

AVIC displayed a model of its GJ-11 unmanned combat air vehicle (UCAV) design, which also featured in the October 2019 parade mounted on a truck. The design features two internal weapons bays, each capable of accommodating four glide bombs.

CASIC also showed its Tian Ying UCAV, which had appeared in the show's static area in 2018. Finally, the CASC stand featured a UCAV model designated FH-97, which strongly resembles the USA's Kratos Defense & Security Solutions XQ-58A Valkyrie "loyal wingman" platform.

In addition to the equipment on show, Chinese officials also gave some limited updates on several other programmes.

The development of new engines for the Xian Y-20 strategic transport is going well, according to the aircraft's chief designer, Tang Changhong.

Xinhua/Shutterstock

Global Hawk-equivalent WZ-7 has striking joined-wing configuration

"Two types" of domestic engine are in development for the airlifter, he told the *Global Times*, adding: "The Y-20 now has Chinese hearts."

Tang says the new engines – potentially variants of the Shenyang WS-20 – have undergone successful flight tests.

China's in-service Y-20As are powered by four Soloviev D-30KP-2s, with the indigenous WS-20 to eventually power a tentatively designated Y-20B.

A second variant of the WS-20 could also be used to power future derivatives of the transport, such as a Y-20U tanker which is currently in testing, and a KJ-3000 airborne early warning and control (AEW&C) platform.

In addition to reducing the Y-20 programme's reliance on Russian suppliers, new Chinese engines are expected to improve the aircraft's range, reduce fuel consumption, and boost its payload capacity.

Separately, Zhang Shaofeng, deputy manager of AVIC Shaanxi, detailed the importance of future AEW&C systems and network-enabled operations for the Chinese military.

4,200kg

Maximum take-off weight of long-endurance Wing Loong II UAV – an important export product for China

Global Times quotes Zhang as saying that AEW&C will be a "vital element" in future warfare and use "integrated clusters of various types of aircraft", including UAVs.

In July, Lu Jun, designer of the PLAAF's current KJ-500 – based on the Shaanxi Y-9 tactical transport – was quoted as saying that traditional AEW&C platforms and smaller aircraft would work together in an "information network".

Other active electronically scanned array radar-equipped AEW&C assets in current use are the Shaanxi Y-8-based KJ-200 and Ilyushin Il-76-derived KJ-2000. Beijing is also developing the KJ-600 for use from a future class of aircraft carriers equipped with electromagnetic aircraft launch systems. The design of the twin-turboprop closely resembles that of the Northrop E-2 Hawkeye.

A corporate derivative of Comac's ARJ21 regional jet made its debut

AirTeamImages

C919 absence subdues Zhuhai

Developmental narrowbody misses event, as Beijing's efforts to build up domestic industry are slowed by dispute with USA

Alfred Chua Singapore

Airshow China's organisers, and to some extent the Chinese government, were championing the nation's homegrown aerospace industry at this year's Zhuhai show – even though it was largely limited to a domestic audience and lacked headline orders.

The intended narrative was around how Beijing's fledgling aerospace industry is pushing ahead, but in the days leading up to the event it became apparent that the developmental Comac C919 would not be making an appearance.

The absence was significant, and prompted suggestions that the twinjet – touted as China's answer to the Airbus A320 and Boeing 737 – could miss a target of type certification and service entry with China Eastern Airlines by year-end.

While no official reason was given by the Shanghai-based airframer, a Reuters report citing unnamed sources familiar with the programme suggested that tightened US export rules – implemented late in 2020 – are causing delays.

The C919 is largely reliant on Western technologies, including its CFM International Leap-1C engines.

Comac instead exhibited a full-scale mock-up of the C919's cabin at the show, while a corporate CBJ derivative of its ARJ21 regional jet made a debut appearance. Registered B-001X, the twinjet took part in the flying display, and also featured in the static park.

Comac's Wechat account showed images of a luxurious interior including a stateroom with a double bed, while a promotional video featured a conference room and lounge area.

According to the airframer, the CBJ is equipped with an auxiliary fuel tank to boost its range to a maximum of 3,080nm (5,700km): about 50% greater than the type's standard range of 1,810nm. Comac previously said that the business jet can accommodate 12 to 29 passengers, depending on requirements.

Cirium fleets data indicates that the displayed CBJ is on order by Chinese corporation Yan Shang.

Turboprop doubts

AVIC, meanwhile, was noticeably quiet about its developmental MA700 twin-turboprop. The programme faces an uncertain future, due to issues with the export permits related to its Pratt & Whitney Canada PW150C engines.

While there were no headline orders for Chinese-developed airliners, Beijing emphasised that it is building industrial capability.

"The construction of a powerful civil aviation nation... highlights China's historical leap from a major air transport market to an air transport superpower," says the Civil Aviation Administration of China.

Rebutting suggestions of potential C919 delays, the state-owned *Global Times* noted: "China's jetliners have a bright future, no matter how much the supply chain landscape changes".

Western companies, including Pratt & Whitney, were also quick to emphasise the importance of the Chinese market, which they expect to recover from pandemic-driven constraints and remain the largest single aerospace market globally.

But such statements sit uneasily amid long-simmering geopolitical tensions between the West and China, some of which have had an effect on the latter's aviation industry.

Notably, Beijing has remained quiet about its plans to lift its grounding of the 737 Max. China – the first to remove the jet from service following a second fatal crash in March 2019 – is the only major economy yet to approve a return to operations, prompting speculation that geopolitics are behind its reticence.

Meanwhile, the show saw several key announcements regarding the aftermarket and services sector.

Boeing confirmed plans to establish two 767 freighter conversion lines with Guangzhou-based MRO provider GAMECO, which already has three for the 737-800BCF.

CFM disclosed aftermarket contracts with Chinese carrier Air Travel for its Leap-1A, which powers the Airbus A320neo family. The joint venture between GE Aviation and Safran also signed a letter of intent with Air China to build up in-country MRO capabilities for the Leap.

Additional reporting by Greg Waldron

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Emirates' love affair with A380 endures

Gulf carrier remains convinced of superjumbo's benefits as it awaits delivery of final three examples and returns mothballed fleet to service

Pilar Wolfsteller & **Jon Hemmerdinger**
Boston

Even though the final Airbus A380 has rolled off the production line in Toulouse, Emirates Airline – and president Sir Tim Clark – are still madly in love with the superjumbo, as the carrier looks forward to welcoming the last three of the type into its fleet later this year.

"We have what I think is one of the most beautiful aircraft that's ever flown," Clark says. "We created a Ritz Carlton, unashamedly, and we use all the tricks and gizmos and gadgets.

"What you see on the inside of that airplane was designed exclusively by us," he said at the IATA World Air Transport Summit in Boston in early October.

Emirates has 118 of the type in its fleet, 39 of which are currently in service, according to Cirium fleets data. The airline aims to have more than 50 back flying by the end of the year, under plans to restore 70% of its overall pre-crisis capacity.

Gradual reintroduction

A380s have been gradually reintroduced across the carrier's schedule, and it is looking to serve 27 destinations with the double-decker in the coming months, up from 16 currently. Among them will be gateways in the USA and Latin America – notably New York JFK, Los Angeles and Sao Paolo – plus European hubs such as Frankfurt, Amsterdam, Madrid and Zurich, and destinations in the Middle East and Africa including Johannesburg and Riyadh.

Emirates' customers cannot wait for the aircraft to return, either, Clark insists.

"The notion that the technocrats, the accountants who all say this aircraft is not fit for its purpose, it is environmentally unfriendly, et cetera – that doesn't resonate with our travelling public," he says. "They absolutely love that aeroplane."

The airline's final three A380s – among the last ever built – are set to be delivered in the coming weeks. Emirates' final airframe, MSN272, which will be delivered in December, was the last A380 to roll off the assembly line in March. Since then, it has been at Airbus in Hamburg for cabin outfitting.

Clark is wistful about the end of the superjumbo's run, especially since the aircraft was, in essence, a blank canvas for the carrier. In the early 2000s, when it was first conceived and developed, air travel demand was exploding, and Emirates needed a step-change in capacity – and quickly.

"We took some really bold moves with regard to redefining what kind of product we were going to offer, and always pushing out, cutting edge to cutting edge," he says.

"It's sad that it came to an end as it did," he says of the aircraft that at times accounted for 80% of the carrier's profits.

Best practice

Clark suggests that other A380 customers did not operate it in a way that brought out its best – ultimately contributing to its demise. "Many carriers couldn't seem to make the thing work – for the life of me, I couldn't understand why," he says.

Meanwhile, Clark insists that Emirates will not take receipt of 777Xs from Boeing unless the jets perform as advertised.

Double-decker has at times accounted for as much as 80% of airline's profits

"We will not accept or tolerate quality-control issues," he says. "If the [777-9] comes out, and we have problems with it – either airframe or engine – we will send it back to Seattle, and I don't care what happens to it."

Emirates is a major customer for the delayed 777-9, holding orders for 115 examples of the big-twins. Deliveries are now scheduled to begin in late 2023 – at least three years behind the original target of June 2020.

Clark says Boeing seems unable "to predict when this aircraft will be delivered".

That creates significant financial liability for Emirates. The airline faces a "very large spend on... initial provisioning" of equipment such as flight simulators and spare parts, including spare GE Aviation GE9X engines.

"All this is money going out... We cannot afford to put 60, 80, 100 million dollars out there not knowing when these aircraft are going to turn up," Clark says. "I need to know precisely."

Clark warns environmental gains will not come cheap

Jon Hemmerdinger Boston

Emirates Airline president Sir Tim Clark has warned that the commercial aviation industry will not be able to introduce radical new propulsion or airframe technologies without significant government support.

In addition, he cautions against airlines over-promising the likely environmental performance improvements they will be able to make in the coming decades.

"The cost of that aeroplane is going to be astronomical," Clark says, referring to a conceptual single-aisle aircraft powered by CFM International's RISE open rotor concept.

As well as a new engine, such a project would require a new wing, he says.

"Therefore, the ability to fly that [aircraft] under... a business model that deals with the kind of pricing points we've got in the market – that is going to be very difficult," Clark says.

His comments came in response to questions about the viability of industry-led projects aimed at helping aviation reach net-zero carbon emissions by 2050.

He highlights the huge cost of developing a hydrogen-powered jet, with Airbus, the biggest proponent of the fuel, currently working to bring such an aircraft to market in the mid-2030s.

As a fuel, hydrogen is ideally in liquid form, meaning it must be kept colder than -250°C (-418°F). That is partly why creating new infrastructure to support its use is so expensive, he says.

"But who is going to spend all this money? Is it the aircraft manufacturers?" Clark says. "What's the business case?"

Clark thinks significant carbon reduction requires investment by governments to the tune of, say, "half a trillion dollars". But with nations currently spending on the recovery from the Covid-19 pandemic there is little additional cash available to bankroll change in the airline industry, he notes.

With that in mind, Clark warns the sector not to make promises about environmental gains that it cannot deliver.

"People are expecting us, by the end of this decade, to take out 40% of our emissions. We are in la la land if you think we are going to do this," he says.

Hours before Clark spoke, at its annual general meeting, IATA adopted a resolution calling for the industry to achieve "net-zero carbon emissions by 2050".

While welcoming the move, he cautions against making unattainable promises. "If you create the expectation we are going to have electric A380s flying... We have to do something about that," Clark says, adding that the industry must "bring people back to reality".

IATA

Clark (*left*) says industry must set realistic goals

Fundamental changes to propulsion technology and fuel types may provide a route to significantly lower carbon emissions in the future. But in the short term, sustainable aviation fuel (SAF) is seen as a means of achieving immediate gains, not least because all engines are already certificated to burn a 50% blend.

However, SAF accounts for a sliver of the aviation industry's current fuel use; IATA aims to see that rise to 5% by 2030.

But Clark is also sceptical that SAF can be made economically viable, noting the fuel can now cost two or three times as much as regular jet fuel.

IATA hopes that, as SAF production increases, the sector will reach a "tipping point", after which costs will start declining.

Lockheed reins in F-35 build rate

Airframer and JPO agree to less ambitious ramp-up plan for fighter in wake of pandemic, peaking at 156 units per year

Garrett Reim Los Angeles

Following a difficult 2020, when the Covid-19 pandemic threw production of the F-35 further behind schedule, the US Joint Program Office (JPO) and Lockheed Martin have agreed to ramp up production of the stealth fighter.

While the planned number of aircraft to be built in the coming years has been reduced from prior goals, the new framework "ensures predictability and stability", the airframer says.

As part of the F-35 production "rebaseline" plan, Lockheed has agreed to deliver between 133 and 139 of the aircraft this calendar year. The company then aims to produce 151-153 examples in 2022 and 156 annually in 2023 and beyond.

At Lockheed's most optimistic moment – in January 2020, one month before the pandemic began to hit the USA – the company predicted that it would produce 140 F-35s that year. That record output would have been followed by 160 in 2021, 165 in 2022 and then as many as 180 aircraft annually in the following years.

Last year, as pandemic-driven health and safety restrictions disrupted manufacturing activities at Lockheed and its suppliers, production slowed. The global economic downturn also caused financial trouble for many of the company's small business vendors, exacerbating delays. As a result, the manufacturer delivered 120 F-35s in 2020.

US Air Force

Manufacturing was running behind schedule before disruption of Covid-19

In June, Lockheed said it was working on "production smoothing" – an effort to find the most-efficient way to again ramp-up output. The company added that it was aiming to come to an agreement with the JPO to spread out that backlog over several years.

"Think of that as levelling out the peaks and troughs year by year in the production quantities, which will bring a lot benefits to our factory, to our workforce, to our supply chain, to get that stability over the next four or five years," the company said.

At the time, Lockheed also said it expected annual production to level out at just below 169 units annually: 13 more than the maximum now agreed with the JPO.

Even prior to the pandemic, F-35 production was behind schedule. But the new reduced annual production rates mean it will take the US Air Force (USAF), US Marine Corps and US Navy even longer to receive their combined full programme of record, which totals nearly 2,500 aircraft. The US military services currently have 437 examples of the fifth-generation type in use, according to Cirium fleets data.

If the recently agreed 156 aircraft per-year figure represents a firm ceiling, deliveries to the US military could also be placed under pressure by new international orders. In the past couple of years, Poland, Switzerland and the United Arab Emirates have emerged as new buyers, with the nations seeking a combined 118 aircraft.

Lockheed continues to push hard to win other fighter deals, with the type currently in contention in competitions in nations including Canada and Finland.

Washington's formal programme of record for the F-35 has not been officially reduced. Indeed, talk of substituting future purchases with the in-development Next Generation Air Dominance aircraft were dismissed in May by USAF chief of staff General Charles Brown, who said that the top-secret fighter programme is aimed at replacing the Lockheed F-22.

"'Production smoothing' will level out the peaks and troughs year by year, which will bring benefits to our factory, to our workforce, to our supply chain"

Lockheed Martin

The US Air Force has 76 active examples of strategic bomber

Rolls-Royce powers to B-52 victory

North American unit will produce 650 F130 engines as part of modernisation effort, with updated fleet to serve into 2050s

Garrett Reim Los Angeles

The US Air Force (USAF) has awarded Rolls-Royce North America a $2.6 billion contract to replace the engines on its Boeing B-52H bomber fleet.

Announced on 24 September, the award is for 608 on-wing examples of the company's military F130 derivative of the BR725 business jet engine. These will replace the Pratt & Whitney TF33-103 turbofans that have powered the B-52 since its introduction in the 1960s.

Boeing will be responsible for integrating the F130 onto the eight-engined strike aircraft. The first two examples are due to be modified before the end of 2025, ahead of undergoing ground and flight testing. Work on a first lot of re-engined bombers will be finished by the end of 2028, with the entire fleet to be updated by 2035.

"The B-52 Commercial Engine Replacement Program [CERP] is the most important and comprehensive upgrade to the B-52 in over half a century," says Major General Jason Armagost, director of strategic plans, programmes and requirements at the USAF's Global Strike Command. "This modification will allow the B-52 to continue its critical conventional and standoff mission into the 2050s," he adds.

Air force bombers programme executive officer Brigadier General John Newberry notes that the CERP activity "Is a complex upgrade that not only updates the aircraft with new engines, but updates the flightdeck area, struts and nacelles."

R-R, which will manufacture the engines in Indianapolis, Indiana, describes the CERP process as a "vigorous multi-year competition" against GE Aviation and P&W.

Proven reliability

"The F130 is the perfect fit for the B-52, with proven reliability, superb life cycle cost, and low integration risk," the company says.

"Once installed, the F130 can stay on wing for the entire planned B-52 lifetime," R-R says. The replacement engines also "will provide vastly greater fuel efficiency, increased range, and reduced tanker aircraft requirements", it adds.

A version of the same engine already powers the USAF's Bombardier Global 6000-based E-11 battlefield airborne communications node aircraft fleet and Gulfstream GV C-37 transports, R-R notes. It also is used on the service's in-development G550-based EC-37B Compass Call electronic warfare platform, which was recently flown for the first time by L3Harris.

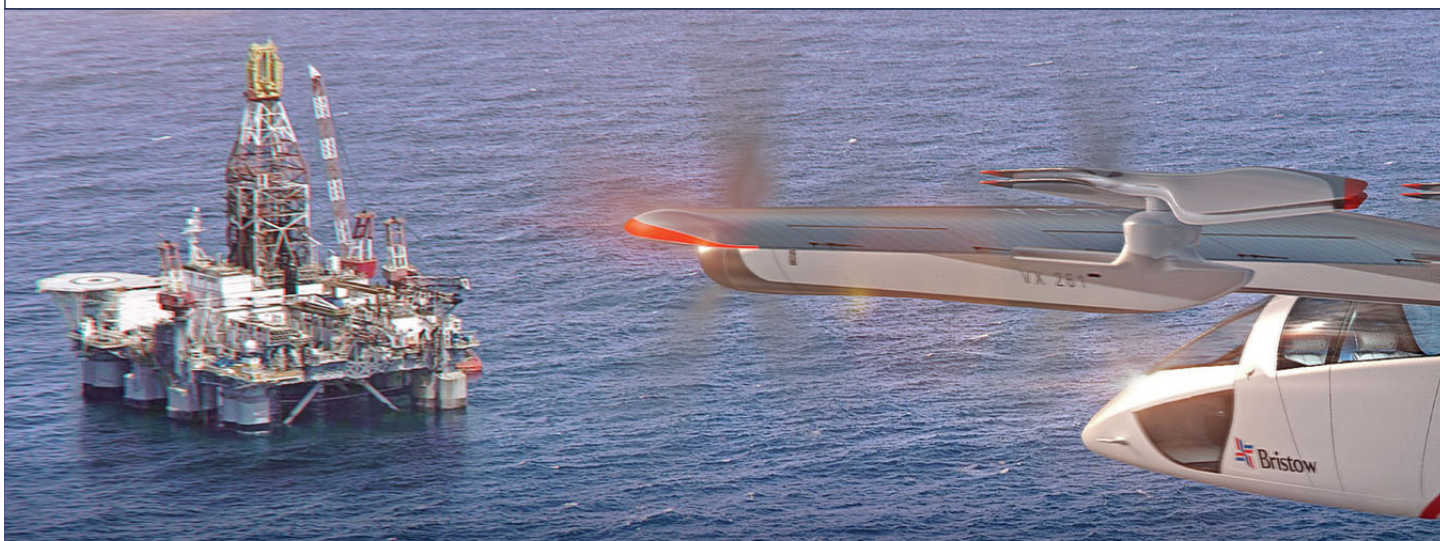
The USAF says its award also includes "spare engines, associated support equipment and commercial engineering data, to include sustainment activities".

"We've been planning and preparing for this outcome, and are ready to hit the ground running to prove that we are the best choice for the air force and the B-52," says Craig McVay, senior vice-president strategic campaigns for Rolls-Royce Defense. The company says the total CERP requirement will be for 650 engines.

"Our current virtual digital prototyping efforts are giving us an opportunity to integrate the engines and other changes to the B-52 before doing any physical modifications," Newberry says. "This has allowed us to develop the most cost-efficient solution while reducing the time from concept to production."

With 76 B-52Hs in its active fleet, the USAF launched the re-engining activity after determining that the type's TF33s could not be sustained beyond 2030. Cirium fleets data shows that the aircraft are aged between 58 and 60 years.

US Air Force



Vertical is looking up

Bristol-based developer stays confident on certification timeframe for VA-X4 as it adds to aircraft's orderbook

Dominic Perry London

UK start-up Vertical Aerospace remains confident that it can gain certification for its VA-X4 electric vertical take-off and landing (eVTOL) aircraft by 2024, although first flight has now slipped into 2022.

Meanwhile, the company's orderbook has now hit 1,350 units thanks to a recent trio of commitments.

While the modest delay is not critical, the news that the maiden sortie has moved into 2022 came just weeks after Tim Williams, Vertical's chief engineer, said the milestone was anticipated by year-end.

But Paul Harper, head of certification, said during an investor presentation in September that the first flight would now take place in early 2022. Initial sorties would be unmanned, he said, but would transition to crewed operations later that year.

Nonetheless, Harper says that he has "a lot of confidence in that [certification] timeframe", given that the programme has already been under way for three years.

Noting that the VA-X4 is "essentially a light aircraft with some specific complexities", Harper says the route to type approval is "well understood". Design organisation approval is also expected "in the near future", he says.

Initial certification will be from the UK Civil Aviation Authority (CAA), but will be in line with the European Union Aviation Safety Agency's (EASA's) sector-specific SC-VTOL regulations.

1,350

Current conditional orders for VA-X4 following latest commitments

Harper says there is "a huge amount of excitement within the CAA in supporting us.

"The CAA themselves have restructured their certification directly with specific support around eVTOL aircraft. And they have been wonderfully clear in signalling their intent with their detail as to what's expected of us."

Both the CAA and EASA have witnessed crash and thermal runaway testing carried out on the VA-X4's battery pack and Solvay-provided casing, adds Michael Cervenka, Vertical president.

Additional conviction that Vertical can hold to its timeline is provided by programme partners like Rolls-Royce and Honeywell – respectively supplying the propulsion system and flight controls

UK CAA seizes 'golden opportunity' to drive eVTOL safety culture

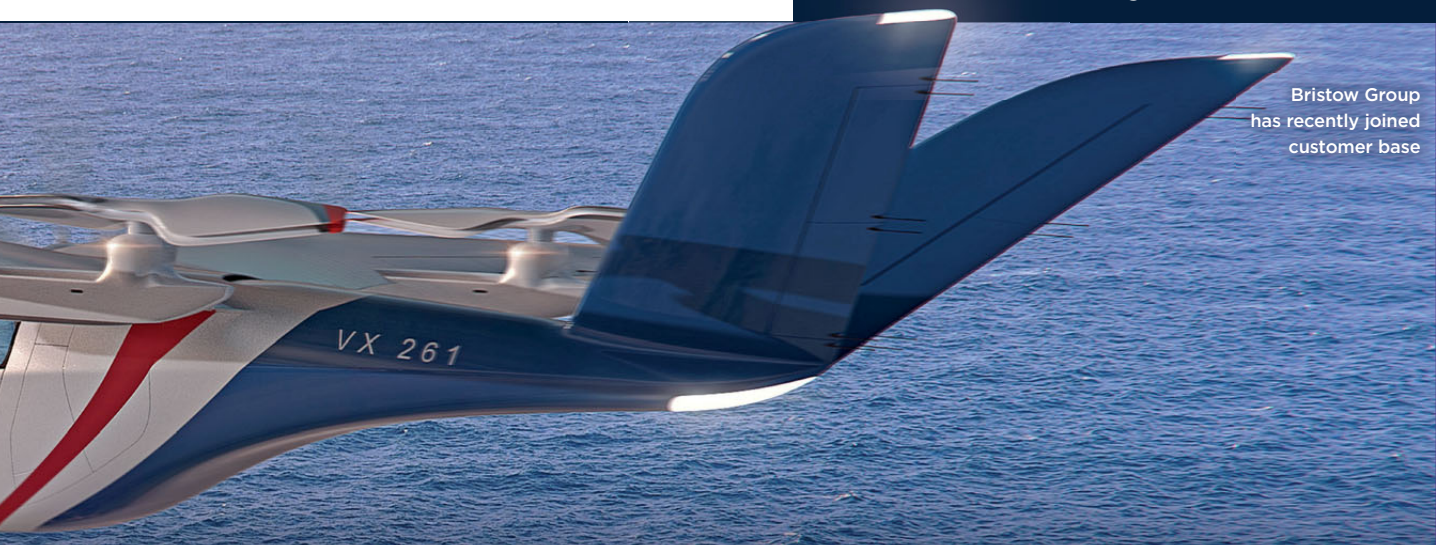
UK civil aviation regulators are attempting to shape the safety culture of advanced air mobility operations – a sector that will not begin carrying paying passengers for at least another three years – through the creation of a cross-industry forum.

Launched by the Civil Aviation Authority (CAA), the international consortium covers the nascent market for electric vertical take-off and landing (eVTOL) aircraft and brings together manufacturers, safety experts and current operators of fixed- and rotary-wing aircraft planning to move into the new segment.

The eVTOL Safety Leadership Group (eVSLG), includes aircraft developers Joby Aviation and Vertical Aerospace, alongside operators Bristow Helicopters and Virgin Atlantic Airways, both of whom have committed to Vertical's VA-X4.

Co-chairing the group is Rick Newson, head of the CAA's Rapid Capabilities Office, alongside Matt Rhodes, director of UK and Turkmenistan oil and gas at Bristow. Rhodes is also co-chair of the Offshore Helicopter Safety Leadership Group, on which the eVSLG is partly modelled.

Newson says the establishment of the eVSLG is a "golden opportunity to establish a safety culture in a brand-new sector of aviation". It will, he says, provide a forum for the sector's "future safety



Bristow Group has recently joined customer base

– which have "been working on this for years as well", says Harper.

Vertical says the vectored thrust VA-X4, which features eight sets of rotors, the front four of which tilt for forward flight, will achieve an initial operating range of around 100 miles (87nm/160km) with four passengers and one pilot on board. However, the range figure will grow as battery energy densities improve.

Several different variants of the VA-X4 are proposed, says chief commercial officer Eduardo Dominguez Puerta, including those for cargo and medevac missions. In addition, modifications such as floats are likely to be required for those operators seeking to perform overwater flights.

While production of the first prototype is in train, commercial activity is also ramping up. Recent agreements with Spanish airline group Iberojet, Marubeni in Japan and Bristow Group have added another 350 conditional pre-orders and options to previous commitments for up to 1,000 aircraft from carriers American Airlines and Virgin Atlantic, plus lessor Avolon.

Should those deals all be firmed up, and deliveries begin as planned in 2024, then production would be accounted for through to the end of 2026.

Vertical plans to build 50 aircraft in its first year of serial production, ramping to 250 in 2025, 1,000 in 2026 and 2,000 per year by 2028. A single factory will have the capacity to build 1,500 VA-X4s annually.

No location has been selected for the site of the assembly plants yet, although chief financial officer Vinny Casey says he hopes an announcement can be made shortly.

Production facility

Although Vertical's design office is currently located in Bristol in southwest England, Casey says the manufacturer is "in discussions" with three other countries "about locating a production facility" in those nations.

"So, we've got lots of good opportunities on the table. I expect we're going to be locking down the location of our production facilities in the coming months... wherever that will be," he says.

Casey says Vertical needs only to sell 100 aircraft per year to "be cash-flow break-even", with the total investment recovered by the 300th aircraft. EBITDA of $1.4 billion is forecast by 2026, he says.

And while the sale of whole aircraft represents a big part of forecast revenue, Stephen Fitzpatrick, founder and chief executive of Vertical, foresees another likely source of income.

He says that the VA-X4's battery pack will need to be exchanged every three to six months, depending on useage.

"So this will represent a long-term relationship with the aircraft owner. This is not something that can be delegated or outsourced to a different organisation.

"The batteries will be a certified part of the aircraft and so the maintenance and the delivery of new battery systems throughout the vehicle lifetime will represent a really important revenue stream for us as an OEM."

Meanwhile, Vertical has filled two more key posts on its team. Joining from rival eVTOL developer Joby Aviation as chief test pilot is Justin Paines, while Harry Holt takes the post of chief operating officer, moving from his current role of chief people officer at Rolls-Royce.

leaders" to meet and share potential risks and best practice in a proactive manner.

"The vertical-flight industry has evolved significantly over the last half century. Many of the lessons learned will undoubtedly read across into this new era of powered vertical flight," adds Rhodes, who hails the group's "collaborative approach".

The eVSLG's inaugural meeting will take place in November, says Newson, where it will hammer out its terms of reference and "start to identify how we can best share experiences and safety information".

While operational data will clearly be thin on the ground initially, Newson hopes developers will share information with the forum unencumbered by concerns around intellectual property.

Many eVTOL aircraft designs blend elements of both rotary- and fixed-wing flight and the inclusion of airline Virgin Atlantic – which operates nothing smaller than a Boeing 787 – will bring a unique perspective to the group, says Newson.

"I was keen to see a large airline involved because they have very robust safety systems," he says.

The CAA says the eVSLG is the first body of its kind for the sector globally, but Newson is keen to work with similar groups as they are established.

Other organisations represented within the eVSLG include the UK Air Accidents Investigation Branch, British Helicopter Association, fractional operator Flexjet, the General Aviation Safety Council, and air navigation service provider NATS.

Bristow Group

Markus Mainka/Shutterstock

Narrowbody operator Volotea will support flight tests of initial conversion project

Dante reveals electrification plans

Spanish start-up sets course to modify Cessna Grand Caravan in partnership with regional carriers Air Nostrum and Volotea

Dominic Perry London

Electric aircraft developer Dante Aeronautical intends to fly its first prototype within three years – a Cessna Grand Caravan converted to use both hydrogen fuel cells and battery power – in a project also involving Spanish regional carriers Air Nostrum and Volotea.

Under its plans, the aircraft will use the fuel cell system during the cruise, complemented by batteries for the take-off and climb phases.

Dante believes that it can secure supplemental type certification for the modification to allow service entry in 2024 or 2025.

While the identity of the battery and fuel cell suppliers have not been disclosed, the programme builds on work the company is carrying out for Australian operator Sydney Seaplanes, which sees the installation of batteries and a Magnix Magni650 electric motor on a Caravan amphibian.

"As we are using a common platform with the same electric motor both developments should share multiple common elements, therefore benefiting from each other," says Dante.

Projections suggest missions above 107nm (200km) with nine passengers on board will be achievable, the company says, although initial services may begin with less range or payload.

Air Nostrum, via its engineering and maintenance unit, will perform the conversion work on the prototype, while Volotea will provide the aircraft and support flight tests.

Dante has applied to Spain's CDTI agency for research and development funding for the initiative.

Also involved in the project are other Spanish entities such as artificial intelligence specialist Databeacon, consultancy CT Engineering and national research bodies CIDAUT (transport and energy) and CIDETEC (energy storage).

"We started our collaboration with Dante Aeronautical back in 2019 and are very proud to see how the project has grown and gained momentum with the support of new partners, including several Spanish technology companies," says Carlos Munoz, Volotea founder and chief executive.

Underserviced cities

"The development of an electric aircraft using hydrogen battery technology will reduce carbon emissions. It makes complete sense for Volotea to support this project since it's in line with our goal of connecting underserviced cities and doing so in more sustainable ways."

Carlos Bertomeu, chief executive of Air Nostrum, adds: "As a leading regional airline, Air Nostrum clearly had much to contribute to this exciting project, especially in regards to sustainability, which is something that we have been working on for many years."

Dante also has plans for an all-electric 19-seater conversion, "with two or three options" under consideration. But ultimately it plans to develop a clean-sheet aircraft called the DAX-19, which will arrive by the end of the decade.

Air Nostrum's fleet consists of Bombardier CRJ200, 900 and 1000 jets, alongside ATR 72-600 turboprops. Volotea, meanwhile, operates an all-Airbus fleet comprising 20 A319s and 20 A320s.

AirTeamImages

Air Nostrum will perform modification via its engineering and maintenance unit

Scout's honour

Zero-emissions initiative has revealed 27 concepts for future aircraft and selected liquid hydrogen as the most viable fuel

Dominic Perry London

ATI/FlyZero

Initial configuration studies will be condensed into three designs

UK government-backed initiative FlyZero is targeting next February for the unveiling of three concept aircraft that will address the challenges of zero-emissions aviation.

They will be developed from the 27 "scout" aircraft revealed by the organisation recently. These are initial studies designed to examine the potential of particular technologies, configurations, architectures or energy sources against criteria including payload, range, speed, materials, economics, operations and non-carbon dioxide emissions.

Project director Chris Gear says the "creative" designs were an attempt to "determine what was the right scout for the range and capacity" required and were assessed using "a complex matrix system".

Battery drawback

This allowed the team to highlight drawbacks with each design, as well as its advantages. For example, according to FlyZero's analysis, even with advances in battery technology, an all-electric 70-seater concept featuring a distributed propulsion system could achieve a range of only 500nm (926km). Batteries would represent one-quarter of the aircraft's 28.5t maximum take-off weight.

Another design, nicknamed "Calvin", is a twin-fuselage concept, with one of the two used solely for the storage of gaseous hydrogen. This would incur both drag and weight penalties, says FlyZero, cutting range with a 160-passenger load to 1,200nm. In comparison, an Airbus A320neo has a range of 3,400nm and can carry up to 180 passengers.

While none of the scouts will be taken forward in their entirety, many will feed key technologies into the concept aircraft designs, which will span the regional, single-aisle and mid-market segments.

"We are now focusing down on the three concept vehicles, developing them to [a higher level of] maturity so we can tell people why we think they are viable."

The trio of designs will be presented next February at the end of FlyZero's 12-month duration, and will also detail the challenges – whether infrastructural, industrial or technological – that need to be overcome if zero-emissions aircraft are to be introduced into service by 2030.

FlyZero is led by the Aerospace Technology Institute (ATI) and the project's findings will inform the ATI's next technology strategy document, which is due to be released next year.

Gear, speaking in a personal capacity, believes FlyZero should continue for another five years, allowing the initiative to begin testing some of the necessary technological bricks, eventually building to a flight-demonstration phase.

However, he points out that the UK cannot act in isolation, given the interconnected, global nature of the aerospace industry.

In addition, FlyZero has identified liquid hydrogen as having the highest potential as a future fuel, based on its high power-to-weight ratio and zero-carbon emissions.

The characteristics and performance of hydrogen, in both gaseous and liquid forms, were compared against those for batteries, ammonia and kerosene. Additional focus was also placed on the impact of the mass of the storage and distribution systems required for each on board the aircraft.

Although Gear acknowledges the significant technological challenges that need to be overcome to deploy cryogenic hydrogen, he notes that it is "the fuel that gives you zero carbon emissions".

Target zero

"It's not going to be easy – but that goes back to what we are trying to do," he says.

FlyZero was launched in 2020 with the aim of enabling zero-emissions flights in the UK by the end of the decade. Alongside the air vehicles themselves, the project will also build a business case for their operation and examine the industrial infrastructure required to bring them to market. Its staff of almost 100 have largely been seconded from industry.

Thanks to its conception at the height of the pandemic, FlyZero's staff have largely been working remotely. To counter any potential isolation, the organisation in late September held a three-day conference to allow employees to get to know each other and to discuss the project's next steps.

KinectAir

US start-up KinectAir intends to have the 330 variant on its books

VoltAero founder sets fast timeline for Cassio

Former Airbus chief technology officer details plan for trio of hybrid-electric models to be in use by the end of 2025

Mark Pilling Biggin Hill

Jean Botti, the founder and chief executive of VoltAero, is juggling design, production and attracting launch customers and investment as his firm pursues an aggressive timeline to prepare the all-new Cassio 330, a hybrid-electric, four- to five-seater, for service entry by the end of 2023.

The plan is to move quickly, with the second aircraft in the family – the six-seat Cassio 480 – to enter use at the end of 2024. A final model, the 10-seat 600, will be operational at the end of 2025, Botti told FlightGlobal at the Air Charter Expo (ACE) event at Biggin Hill airport in the UK in mid-September.

He believes the 200kt (360km/h) Cassio, with its range of 648nm (1,200km) in full hybrid mode, will be attractive to the regional air charter market.

Botti, an ex-chief technology officer of Airbus, had arrived in the UK from VoltAero's base in France on its Cassio 1 demonstrator aircraft; a Cessna 337 Skymaster featuring dual-power-source engines.

Showing off a scale model of the Cassio 330 to potential customers and investors at ACE, Botti was taking pre-orders for the first in the range, with letters of intent for 50 secured to date.

"There is no money at this point, it is all about engagement. Once we have the first prototypes rolling, we will get money," he says.

There are three announced customers with letters of intent for the Cassio 330, and more that have yet to be named, says Botti. Finistair, a small regional airline and air taxi operator based in Brest, France, and Montpellier-based air taxi and pilot training operator Airways Aviation each have 15 on pre-order, and start-up KinectAir plans to have a fleet of 20 for its US fractional aircraft ownership programme.

Fractional pioneer

KinectAir launched its "Pioneer" programme at the Oshkosh AirVenture show in July, and has already signed up 75 customers, says Botti.

KinectAir is aiming to obtain its US Federal Aviation Administration Part 135 certificate by year-end, says chief commercial officer Nick Rogers. It is aiming for a network of eight aircraft available for charter in the US market, booked via its mobile app, he adds. The company has signed an agreement with the owner of a Pilatus PC-12, based in Atlanta, to become the first KinectAir-operated aircraft in the programme.

"We start with conventional aircraft and then move into hybrid and then into electric. We believe the ability to offer customers an electric [aircraft] choice will be important," says Rogers.

Mark Pilling

Demonstrator is a Cessna 337 Skymaster featuring dual-power-source engines

Botti says VoltAero has letters of intent for 50 examples of lead model

Mark Pilling

Botti says VoltAero is targeting June 2022 for the first flight of the Cassio 330 prototype from its base at Rochefort airport in the Nouvelle-Aquitaine region of western France.

The Cassio family will be produced in a purpose-built factory at a greenfield site at Rochefort, which will be under construction from the end of 2021, he says. This plant is being built by the regional government and leased by VoltAero. At peak production rates, the company is aiming to build 150 aircraft annually across all three variants.

The design of the 330, which was undertaken by VoltAero in partnership with Dassault Systemes, is now frozen, with detailed manufacturing design execution undertaken by aerostructures specialist Sonaca.

Botti says VoltAero is close to finalising the contract with a European company to manufacture the fuselage, wings, and main structural components for the Cassio family. The modular design can be stretched easily from the smaller two versions to the larger model, he explains.

Extra range

The 330 will have a 330kW powertrain, the 480 a 480kW capacity and the 600 a 600kW limit. VoltAero's hybrid system operates with a parallel drive train combining electric motors and a thermal combustion engine. Botti says the latter serves as a range extender to recharge the batteries, and as a back-up.

The Cassio will take off purely using electric power, with the thermal engine at idle to provide a back-up in case of any problems. "Being a hybrid aircraft can help you increase range, but is also a safety feature," Botti says.

The company is close to selecting the thermal engine for its prototype and production aircraft. It will be adapted from an automotive engine. Safran will supply the electric motors.

Botti estimates that VoltAero will require €45 million ($52 million) to bring the first Cassio into series production. The firm has been awarded blended financing of €22 million as part of the European Commission's (EC's) Green Deal Horizon 2020 initiative, which provides research and development funding for sustainability-related projects. This arrangement features €11 million of equity from the EC, with the remaining funds to be matched by private investors that VoltAero must attract.

A further €2.1 million was awarded by the EC to VoltAero as a pure grant.

Investor interest in VoltAero and its Cassio range is strong, says Botti. "So far, we have concentrated our efforts in Europe, but now we are moving to the US and the UK. We think the UK is a very interesting country for this kind of aircraft, and it's also interesting because of the investor dynamics of the UK and London."

Although the Cassio began life as a hybrid aircraft, VoltAero is keeping an eye on future power source developments.

"This is an electric aircraft, but the thermal engine is very adaptive to biofuels," says Botti. The firm has looked at hydrogen fuel, but the technology is not ready yet.

"It would, however, be easy for us to adapt a thermal engine to hydrogen," he says.

150

Peak annual production target across all three variants in the Cassio range

"There is no money at this point, it is all about engagement. Once we have the first prototypes rolling, we will get money"

Jean Botti Chief executive, VoltAero

The hard cell

Although battery power is making inroads at the lighter end of the aviation industry, it will require a step-change in performance to electrify regional airliners

Garrett Reim Los Angeles

There is no shortage of hype about how electric aircraft will transform the air transport industry.

But do not expect electric propulsion to replace turbofans any time soon.

For that to happen, the industry must overcome a very real technical hurdle: to replace turbine-driven airliners with similarly sized electric aircraft will require a monumental leap in battery technology.

That is the conclusion of several Carnegie Mellon University researchers who created hundreds of thousands of design iterations to determine the battery energy density required for electric versions of three aircraft classes: regional airliners, narrowbody jets and widebody aircraft. The American Chemical Society published the results of the study in a 2020 paper called *Performance Metrics Required of Next-Generation Batteries to Electrify Commercial Aircraft*.

The bottom line: while all-electric power might work for small commuter aircraft, even today's best lithium-ion batteries have nowhere close to the energy density – the amount of electric power stored per kilogram – that large aircraft would require. As a number of start-ups and operators push forward development of electric aircraft, the conclusions suggest electric powerplants will not soon displace gas-burning engines on the wings of large commercial aircraft. The energy density of kerosene is simply unmatched, save for future fuels such as hydrogen (which has its own technological hurdles to overcome).

Even small regional aircraft would need batteries with significantly more energy density than exists with today's technology. Current-generation lithium-ion batteries have an energy density of about 250Wh/kg, according to the paper. For instance, electric vertical take-off and landing (eVTOL) developer Vertical Aerospace plans to use cells that are at 270Wh/kg, falling to 220Wh/kg at pack level.

Yet, it is not until around 480Wh/kg that a significant number of regional aircraft designs become viable, says Venkat Viswanathan, an associate professor in the department of mechanical engineering at Carnegie Mellon who co-authored the research.

Density doubts

If Viswanathan and his colleagues are right, the viability of larger electric-powered airliners is some way off. Even if new technology enables energy density to inch up 5% annually – the rate of recent improvement – batteries will not reach the threshold required for regional airliners until around 2033.

Not knowing what future electric airliners might look like, the Carnegie Mellon researchers calculated energy density requirements for hypothetical designs using historic data. The academics gathered empty weight fraction, wing aspect ratio, wing loading, drag coefficient and mechanical efficiency data from more than two dozen commercial aircraft types, such as the De Havilland Canada Dash 8-400 turboprop, Boeing 737 narrowbody and Airbus A350 widebody.

Using those parameters, they created 100,000 hypothetical design iterations for each class of aircraft, then simulated the performance of the designs when operating defined missions. Regional aircraft were assigned to fly 350nm (648km) with 30 passengers and a mass of 50,000kg (110,000lb), narrowbodies were evaluated on flights of 500nm with 150 passengers and a mass of 100,000kg, and widebodies on 1,000nm flights with 300 passengers and a mass of 250,000kg.

To put those figures into context, an ATR 42-600 – the smallest in-production regional turboprop – can fly around 700nm with a full load of 50 passengers and weighs in at 18,600kg. A similar performance disparity exists between current single- and twin-aisle jets and the electric equivalents that were modelled (an A320neo, for instance, can fly almost seven times as far).

The simulations showed that the average regional aircraft would require batteries with a density of 600Wh/kg, narrowbodies would need 820Wh/kg and widebodies a whopping 1,280Wh/kg.

Electrifying a typical regional jet – a Bombardier CRJ or Embraer E-Jet, for instance – seems unlikely in the near term. "That's not to say that there's no regional aircraft that would be satisfied," says Viswanathan. "You could maybe do 10 passengers, which is a very different part of the design envelope."

Many of today's electric aircraft development projects are focused on small commuter-type aircraft.

Electric car manufacturers such as Tesla have achieved sufficient battery performance

CanadianPhotographer56/Shutterstock

Most electric aircraft development is currently focused on commuter types such as Heart Aerospace's ES-19

Heart Aerospace

"Getting more cross-pollination of ideas between battery scientists and aerospace engineers is the way to go"

Venkat Viswanathan **Associate professor, Carnegie Mellon University**

For example, Harbour Air of Vancouver, Canada, is working to electrify its six-passenger DHC-2 Beaver floatplane, Italian airframer Tecnam is developing an all-electric version of its P2012 Traveller – the P-Volt – a nine-passenger aircraft, and Sweden's Heart Aerospace is progressing its 19-seat ES-19.

Those companies – and others – say their designs will cost less to operate than conventional aircraft and will have no carbon emissions. Electricity is cheaper than avgas, and electric motors are mechanically simpler than jet turbines, meaning lower maintenance costs, they say.

To capture such benefits, electric aircraft must be able to fly more than a few dozen miles before running low on a charge – meaning they need better batteries. That hurdle is the reason battery-powered aircraft appear, at least for now, suited only for niche routes and niche aircraft. An "eBeaver" might work for Harbour Air's 64nm hop over the Salish Sea between Vancouver and Victoria, British Columbia, yet current battery technology would be challenged to power a 300nm flight from San Francisco to Los Angeles, particularly with a meaningful passenger load on board.

Engineers can probably achieve more range through novel propulsion systems and by developing clean-sheet aircraft designed to take advantage of the benefits of electric power – distributed propulsion systems, for example.

In theory, some special combination of design attributes ought to allow regional aircraft to get by on lower battery energy density. Out of the 100,000 regional aircraft design iterations simulated by the Carnegie Mellon team, only a sliver – 17 hypothetical airliners – were able to fly with 30-plus passengers more than 350nm with batteries having density of 450-500Wh/kg, says Alec Bills, a graduate research assistant at Carnegie Mellon, who co-authored the paper.

Gradual gains

Viswanathan cautions that he has become less optimistic about the significance of distributed propulsion. He also notes that while new lightweight airframe designs may increase the efficiency of electric aircraft, those gains will take years to work their way on to new types.

"Early generation aircraft tend to be less efficient, not more efficient," he says. "Of course, later on it gets better."

Companies developing electric aircraft prototypes are benefiting from performance improvements and cost reductions driven by the use of lithium-ion batteries in the automotive industry. Yet to make electric flight viable, the aviation industry itself must advance battery technology, says Viswanathan.

That is partly because the automotive sector appears satisfied with existing battery performance. In June, Tesla cancelled plans for a 520 mile (837km)-range "Plaid +" version of its Model S, with chief executive Elon Musk saying 400 miles was sufficient for most drivers, according to a June report from electric transportation publication *Electrek*.

"The trajectory of automotive batteries basically relates to cost," says Viswanathan. "We have enough performance in terms of energy density."

Though lithium-ion batteries have made great strides in the past decade, there seems an upward limit to how much energy density they can achieve. Viswanathan says the projected maximum specific energy for lithium-ion batteries is around 400–500Wh/kg – less than a typical regional airliner would need.

"You need to move beyond current battery technology," he says.

One battery chemistry with high-energy-density potential is lithium/fluorinated carbon, Viswanathan says. Such batteries require more development but could theoretically power regional and narrow-body aircraft.

"Aviation batteries necessarily will look quite different from the automotive batteries in terms of the chemistry choices, but there's a lot of synergy that can be exploited in terms of the manufacturing facility," he says. "The manufacturing plants could be reused."

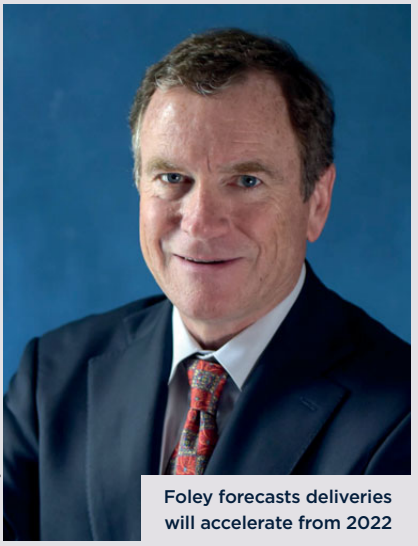
But the electric-aircraft sector must take the lead. And in doing so, companies now developing small electric aircraft are poised to push forward the battery sector.

"I think it really is the next playground for a large number of battery scientists," says Viswanathan. "Getting more cross-pollination of ideas between battery scientists and aerospace engineers is the way to go. Aviation is the next frontier."

Perhaps that is already happening: eVTOL developer Lilium intends to use silicon-anode lithium-ion cells, sourced from automotive supplier Custom Cells, which have a claimed energy density of 330Wh/kg. This, says the company, will allow its Lilium Jet to achieve a range of 135nm with seven passengers aboard.

Back in business

After a long period where sales were becalmed, corporate jet manufacturers are once again starting to see orders pile up, writes **Brian Foley**



Brian Foley Associates

Foley forecasts deliveries will accelerate from 2022

If patience is a virtue, then business jet makers are the most virtuous of all, having waited some 13 years to proclaim that business is booming once again.

Back in 2008, the industry delivered more than 1,300 new aircraft worldwide. Following the 2008-2009 recession, that figure atrophied to just half that amount annually, around where it still remains today.

But that is all about to change.

Call them one of the late beneficiaries of Covid-19. Although total deliveries fell by 20% in 2020, that period incorporated the depths of the pandemic and featured factory shutdowns, supplier hiccups and would-be buyers waiting for economic confidence to return.

However, while manufacturers were taking action to right-size their operations, other sectors of the industry suddenly began to flourish. Well-heeled travelers sought alternatives to crowded airports and cramped airliners, looking instead to private jet charter or fractional ownership. Data showed business jet travel quickly climbing back toward pre-pandemic levels, while airlines continued to languish.

This crush of first-time private aircraft users, which caused upwards of a 20% increase in business, coupled with increased jet utilisation by existing customers, led fractional provider NetJets to temporarily suspend further sales of its jet card charter service.

Concurrently, the number of pre-owned business jet transactions took off in the last half of 2020, setting all-time records and reducing used inventory to more or less nil.

Charter growth

The 2020 increase in charter activity and used aircraft sales were a harbinger of what was to come for business jet manufacturers. While early 2021 was still a little sleepy, by the end of the first half, most OEMs were reporting new jet orders outpacing shipments by a two-to-one margin, fattening depleted backlogs and giving hope that the long lost go-go days of the early 2000s may finally be returning.

Since aircraft production cannot be increased with the flip of a switch, overall 2021 deliveries will not be all that different from previous years. However, as OEMs gain confidence that the increased demand is real and that they can crank out more planes without the risk of amassing unsold inventory, the ramp-up will become steeper.

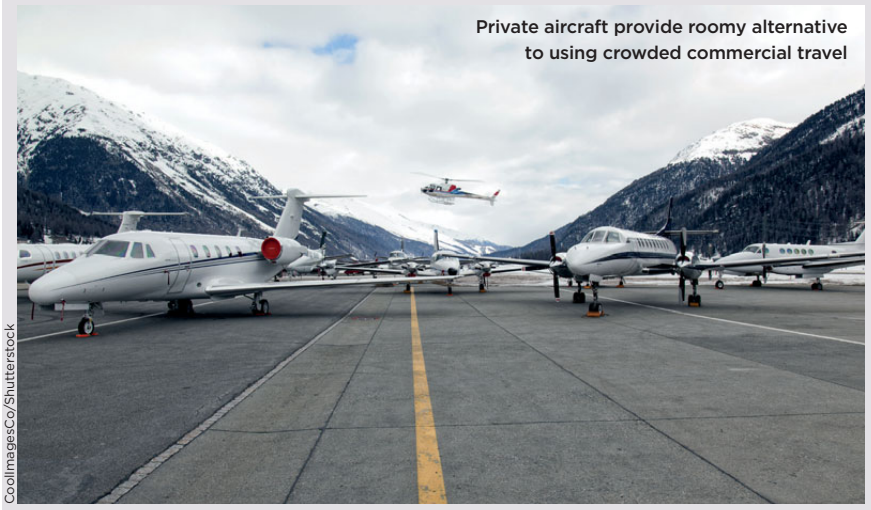
Our latest delivery forecast anticipates around 700 shipments in 2021 – in line with previous years. A meaningful ramp-up will begin in 2022 and continue unabated for several years, surpassing the 900-unit level for the first time since 2007. Demand will be driven by first-time owners and corporations that hunkered down during the pandemic but who are now ready to buy, and charter/fractional providers who need larger fleets, by the hundreds, to meet forecast growth.

All the big jet manufacturers stand to benefit from this trend, but the improving market has been particularly beneficial to Bombardier, which, as a recent convert to a pure-play business jet manufacturer, has its future tied to the segment.

For now, business jet makers will continue to happily take orders while replenishing their backlogs, and will finally have the luxury to contemplate future production increases. "It's a good time to be in the business," a phrase not uttered since 2007, will soon return to the industry's vocabulary.

As Aristotle said: "Patience is bitter, but its fruit is sweet."

See p10



Private aircraft provide roomy alternative to using crowded commercial travel

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Brian Foley is the founder of US-based aviation consultancy Brian Foley Associates


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Air France will on 31 October commence services with the Airbus A220-300, one month after welcoming its first of 60 examples at Paris Charles de Gaulle airport

Air France

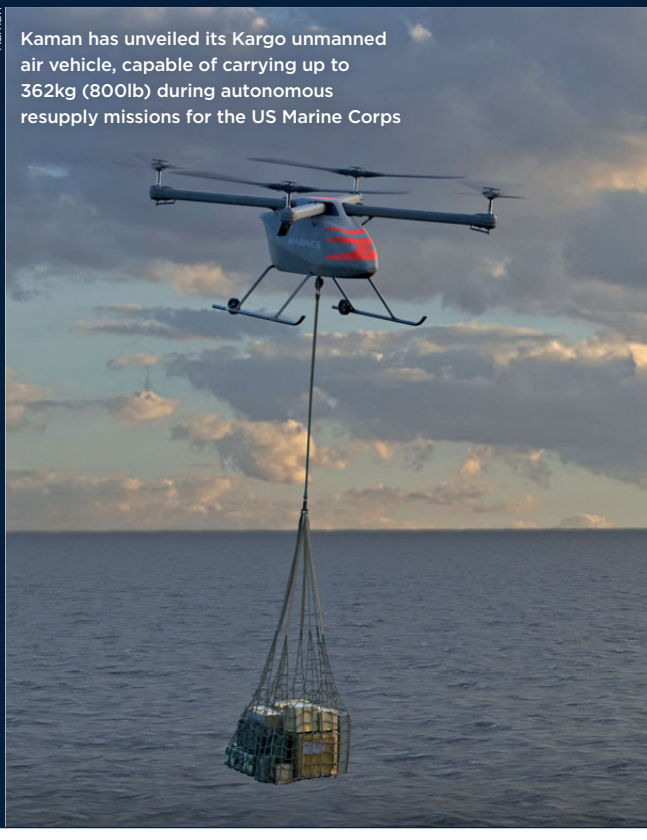
Best of the rest

We showcase some of the other notable events covered by the FlightGlobal team between issues

Piaggio Aerospace will supply another six P180 Avanti Evo turboprops to the Italian armed forces, under a contract worth almost $200 million

Johannes Kraak/Shutterstock

Kaman has unveiled its Kargo unmanned air vehicle, capable of carrying up to 362kg (800lb) during autonomous resupply missions for the US Marine Corps



Kaman

India has formalised its acquisition of 56 Airbus Defence & Space C295 tactical transports. Tata Advanced Systems will produce 40 locally

Airbus Defence & Space

Leonardo Helicopters has revived the Agusta name, adopting the legacy brand for VIP and corporate products including the AW609

Leonardo Helicopters

Air Belgium has received its first of two Airbus A330-900s. Configured in a three-class, 286-seat layout, they will replace aged A340s

Airbus

Greg K Ca/Shutterstock

Lufthansa Cargo retired its last Boeing MD-11 freighter in October, after operating the trijet type since 1998

Next month

Our World Air Forces directory details the global fleet

FLIGHT INTERNATIONAL

On sale
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Plus...

US Air Force
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Festive feel
Almost as slippery as the questions in Uncle Roger's brain-teasing annual quiz

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Gulf focus
Full coverage guaranteed as we report on events at the Dubai air show

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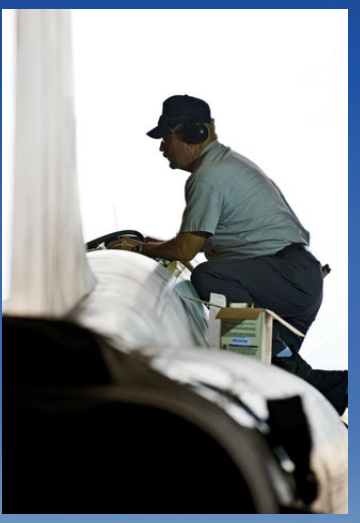
New beginnings

Airbus

November's Dubai air show represents a reboot for aerospace. Anticipation is high ahead of what will be the industry's first multi-sector gathering since Covid-19 all but shut the skies for passenger flights in March 2020. And fresh starts will be very much the key theme of the event, as our articles in the following pages make clear. The US-brokered Abraham Accords of August 2020 – the recognition of Israel by the UAE and other Gulf states – has led to moves unthinkable just two years ago. They include the USA clearing Abu Dhabi to purchase Lockheed Martin F-35 stealth fighters, after a past flirtation with two European-built types, the Eurofighter and Dassault Rafale. The detente has also spawned industrial partnerships

Sanad



EDGE

Etihad Engineering

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and air links between the major cities of Israel and the Gulf for the first time. EDGE, the UAE's new consolidated defence house, is taking the next steps on its ambitious growth path, two years after being unveiled. We take a look at the region's business aviation sector – enjoying a strong rebound in Dubai particularly, as an open economy, hot property market, and the Expo attract international visitors and investors. And what next for the Gulf's global connectors, whose wings were clipped severely by the pandemic? They also face deeper challenges after a decade of supercharged growth. We examine the prospects for Emirates, Etihad and Qatar Airways, as well as the region's smaller carriers, as they begin the process of rebuilding.

BillyPix

Al Bannai: EDGE follows 'one vision and one strategy'

Murdo Morrison Abu Dhabi

Since the foundation of the United Arab Emirates (UAE) 50 years ago, the oil-rich nation has become a formidable military power in the region, thanks largely to its ability to purchase top-end equipment and support from the USA and other friendly countries such as France and the UK. However, the UAE's relentless drive over the past two decades to diversify its economy from a dependence on fossil fuel exports has been coupled with an ambition to stand on its own two feet in terms of sovereign defence capabilities.

Centralised structure

This was the rationale behind the creation of EDGE, a holding group for the UAE's military industrial assets, almost all of them based in and controlled by the largest emirate, Abu Dhabi. EDGE was unveiled at an event in the capital ahead of the last Dubai air show, and its managers have spent those two years creating a centralised structure that consolidates 25 disparate entities into five clusters. EDGE's businesses range from a few years old to a handful that have been around since the 1990s, and had previously been loosely grouped under various state- and privately-owned entities.

Internal synergies and global name recognition were among the reasons EDGE was established, explains Faisal Al Bannai, a former telecoms entrepreneur appointed as the group's inaugural chief executive. EDGE gives Abu Dhabi and the UAE a single brand under which it can market its industrial and service offering to the export market. It also brings those 25 businesses, which employ a total of 13,000 people, "under one vision and one strategy, avoiding duplications and accelerating roadmaps", he says.

Combining the entities under a single management structure is paying off in a "dramatic acceleration in our technology offering", says Al Bannai. There are 10 times as many products under development today than there were when EDGE was founded, a result of its businesses becoming "more agile and faster to market". These include the launch of a family of battlefield-deployable loitering munitions at February's IDEX defence show in Abu Dhabi. "It showcased how fast we could deliver. We developed drone capabilities that did not exist before in record time," he says.

> "EDGE showcased how fast we could deliver. We developed drone capabilities that did not exist before in record time"
>
> **Faisal Al Bannai Chief executive, EDGE**

Two years ago, the UAE consolidated its industry into one grouping with the intention of achieving self-reliance in military industrial capabilities. Progress has been impressive

EDGE of ambition

EDGE

AMMROC is one of EDGE's MRO businesses, providing maintenance and overhaul services to the UAE air force and overseas customers

By exploiting economies of scale and encouraging EDGE companies to co-operate, "we are working on products that could not be created by individual companies", Al Bannai says. He gives an example from the growing field of loitering munitions – a hybrid of missile technology and expertise in unmanned, self-navigating platforms. EDGE has both an unmanned systems unit, ADASI, and one that produces airborne munitions, Halcon. "By putting together these different building blocks, working hand in hand, we can add value and create new categories of product," he adds.

EDGE's $5 billion revenues should put it in the upper half of the FlightGlobal Top 100 (which only considers aerospace turnover). The Stockholm International Peace Research Institute places EDGE 22nd among the largest 25 arms firms.

However, Al Bannai stresses that size is not all that matters. "We are a company with some scale," he says. "But we function like a start-up. We are supported by a government, so we are not going to go belly-up tomorrow. However, we have a start-up mentality in that we encourage agility and speed of decision making to come up with fresh product lines."

Home-grown capabilities

EDGE's extensive portfolio ranges from missiles to maintenance, repair and overhaul, and from armoured vehicles to ammunition. However, electronic warfare and autonomous capabilities are two areas where Al Bannai thinks EDGE can be a "key player on a global scale". For this to happen, it will need both the home-grown know-how to develop its own technologies and competencies, without having to rely on foreign-owned intellectual property, as well as the industrial capacity to adapt these into products both for its own domestic customer, and the export market.

So far, EDGE's legacy companies have co-operated largely with partners, such as Lockheed Martin, Denel of South Africa, and Germany's Rheinmetall. It developed its Al Tariq long-range missile family based on Denel technology and has worked with Rheinmetall to produce a short-range ›

MRO

Supportive Sanad

The Abu Dhabi-based services company is bringing the leasing and MRO parts of its business together this year, improving the options it can offer to customers

Murdo Morrison Abu Dhabi

Beckerlacour

Sanad says it lived up to its name – which means support in Arabic – during the crisis

Sanad means support in Arabic, and "the pandemic gave us an opportunity to live up to our name", says Mansoor Janahi, chief executive of the Abu Dhabi-based engine maintenance, repair and overhaul specialist Sanad Aerotech.

The company – owned by state investment house Mubadala and known as Turbine Services & Solutions (TS&S) until 2019 – kept working throughout the pandemic: "We didn't lose a single day," says Janahi. It also had enough reserves to see its customers through the worst of the crisis, as grounded flights led to a cash crunch at a number of airlines.

Under contract

Originally part of Abu Dhabi Aircraft Technologies but spun off when the airframe side became Etihad Engineering in 2014, Sanad carries out service contract work for CFM International, GE Aviation, Pratt & Whitney, and Rolls-Royce. However, a "growing percentage" of its revenue comes directly from operators, where effectively Sanad competes with the engine makers. It is here where the company had to step up during the pandemic, suggests Janahi. "We were able to reposition some long-term agreements and ultimately help a lot of people's survivability," he says.

Since the last Dubai air show, the business has marked several milestones. It carried out its 100th

counter-rocket, artillery and mortar missile called SkyKnight that will be part of the German company's wider air defence concept, Oerlikon Syknex. In 2010 it embarked on a military MRO joint venture with Lockheed and Sikorsky to provide maintenance services to the UAE's C-130H Hercules and UH-60 Black Hawk fleets.

However, thanks to a combination of recruiting defence industry professionals from around the world and nurturing Emirati talent, Al Bannai thinks it will not be long before EDGE is marketing much more of its proprietary technology. Its Halcon subsidiary, for instance, is planning to move by the middle of the decade from producing a range of unpropelled, gravity-launched guided-delivery systems for missiles into segments such as propelled air-to-surface weapons, a surface-to-air capability, and finally air-to-air, according to Halcon chief executive Saeed Al-Mansoori.

And, while EDGE still has a "good relationship" with Lockheed, it is no longer a joint venture partner, EDGE having last year bought out the US company's shares in military MRO AMMROC. That coincided with the opening of a 36,500sq m (393,000sq ft) hangar and workshop complex next to the airport in the desert oasis town of Al Ain, next to the Oman border. The site includes a paint hall, engine test rigs, and, according to EDGE, the most sophisticated helicopter blade repair facility outside the USA. It is set up for the Black Hawk, but could be modified for other types.

Diplomatic recognition

Israel is another potential partner. Similar in size to the UAE, the Jewish state has over seven decades created its own enviable defence industry, designing and producing almost everything itself except large manned aircraft platforms, and with some three-quarters of its revenues coming from exports. Last year's

service of a GEnx in 2020 and its tally has now reached 130. Sanad was the first independent shop outside GE's network to be accredited for the Boeing 787 engine in 2013, and it has since graduated from quick turn to full overhauls. Its first overhauled engine will be delivered this year.

The company also extended its contract with P&W for the International Aero Engines V2500, which Janahi calls a "sign of confidence in Sanad and our good relationship with the OEM".

However, the contract Janahi says "we are very excited about" is for the CFM Leap. Sanad is the first MRO in the Middle East and Africa authorised to service the engine that powers 737 Max aircraft and about half of all Airbus A320neo-family types. Under

130

Number of GEnx engines serviced by Sanad, with firm now accredited by GE Aviation to also provide full overhauls

the agreement with the GE Aviation and Safran partnership, signed at the 2019 show, Sanad will carry out quick turns on 237 Leap engines until 2030. The company is also increasing capacity on the other programme it is an authorised maintenance service centre for – the A330's R-R Trent 700.

Another key development for Sanad Aerotech this year is its full amalgamation with its sister business Sanad Capital into Sanad Group. Sanad Capital is a leasing business, which manages $1.2 billion of assets comprising engines, auxiliary power units and components. It was established in 2010, also as part of Mubadala's aerospace portfolio, but until 2019 had been run independently from the MRO operation. By bringing them together, the group hopes to be able to "bundle" attractive deals for third-party airlines.

Sanad has about 30 MRO and 12 leasing customers, and most of these would traditionally have had

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Lambeth: Many customers seek simplicity

separate contracts and relationships with MRO and finance providers, explains Troy Lambeth, chief executive of Sanad Capital, who has now taken on the same role at Sanad Group. "By integrating our two businesses, it means we can offer a catalogue of options to customers, many of whom are looking for simplicity when it comes to these sorts of arrangements. This has been an important strategic change of the past two years."

Long-term objectives

A push into the industrial services sector – both on maintenance and finance – is also on the cards for Sanad, although Lambeth says more detail on this will be announced by the end of the year. "We are a long-term player, and diversification is important to the business. That is why we are looking at this new market," he adds.

At the Dubai show, however, the focus will be firmly on aviation, with Sanad confident that the recovery in passenger traffic and aircraft deliveries should soon feed through to a rebound in demand for MRO services and asset financing solutions.

EDGE

Al Tariq missile family was developed from Denel technology

diplomatic recognition of Israel by the UAE opened the opportunity to team on defence technologies, and in March, EDGE and Israel Aerospace Industries announced they would work together on developing a counter-UAV system for the Gulf market.

So far, EDGE has been almost exclusively focused on supplying the domestic customer, but joining the world's elite club of defence technology exporting countries is very much on the radar for Al Bannai and the UAE's rulers. Al Bannai sees nations in Africa, Asia and South America as being among the target customers. And, rather than simply being a vendor of products, he believes EDGE can use its experience of developing an indigenous defence sector within Abu Dhabi to help these states build their own capabilities.

With a large presence planned for the show, Dubai will give the defence industry's newest name a chance to sell itself to the world.

The emirate has made a strong bounce back from the pandemic-driven downturn, with increased demand for private jet services forming part of the recovery

Destination Dubai

DC Aviation Al-Futtaim

Business aviation is thriving with the re-opening of the emirate's economy

Murdo Morrison Abu Dhabi

Anyone watching the series of sleek private jets descending into Dubai's Al Maktoum International airport during much of this year might have wondered if the emirate had somehow managed to sidestep the Covid-19 crisis that impacted global aviation so badly.

In fact, Dubai's pandemic policy – a comprehensive testing regime and vaccine roll-out, coupled with an early reopening of the economy and lifting of travel restrictions – has helped the city to bounce back. With the delayed 2020 Dubai Expo now open and bringing more visitors in, business aviation is thriving.

During 2021, the Gulf metropolis has once again become the leisure and investment destination of choice for many of the world's wealthy and powerful. "When things get bad elsewhere, Dubai often fares better," says Holger Ostheimer, managing director of DC Aviation Al-Futtaim (DCAF), which runs a fixed-base operation (FBO) and aircraft management business at the airport's Mohammed bin Rashid Aerospace Hub. "The real estate market in Dubai is on the up, with a lot of international individuals relocating here."

The hub – home to FBOs such as ExecuJet, Falcon Aviation, and Jetex – reported that private jet movements grew to 8,088 in the first half of this year, from 3,056 in the corresponding period in 2019 (movements in the first six months of 2020 fell to 1,811). While some of that was doubtless down to an increase in infrastructure, chief executive Tahnoon Saif believes government policy played a major part. "Dubai, given its quick recovery post-pandemic, has proved the ideal destination for tourism, living and, most importantly, conducting business," he says.

Not all areas of the sector have been doing so well. International travel restrictions meant the biennial 2020 Middle East Business Aviation Association (MEBAA) show was shelved until next year after

efforts to re-stage it last February failed. Likewise, other key business aviation markets in the region, such as Saudi Arabia, have been slower to recover. Abu Dhabi, too – which had a stricter and longer clamp-down than its neighbour Dubai – has still to return to 2019 levels of activity, says Rob DiCastri, chief executive of Royal Jet, the emirate's biggest charter operator.

Grounded flights

After sinking to just 10% of previous levels in the second quarter of 2020, with all but a handful of medevac and diplomatic flights grounded, Royal Jet's traffic has been growing for over 12 months, says DiCastri. However, Abu Dhabi's "conservative stand" on the virus meant movements stalled at a maximum of 50% of 2019 levels until about March this year. "Since then, we've seen a climb as vaccines have rolled out and quarantine restrictions have been reduced," he says. "We're at about 80% of 2019 now, but 2019 was a fantastic year so the bar is very high."

Royal Jet is the world's biggest operator of Boeing Business Jets, with a fleet of 10 – six are owned, with four under management, and nine are available for charter. It also operates two Bombardier Global 5000s. This gives the company a very different client base to many charter providers. During the crisis, Royal Jet took the opportunity to refurbish its flagship FBO at Abu Dhabi's international airport. "We wanted a wow factor that would help us emerge from Covid stronger and attract more customers," says DiCastri.

Royal Jet's core clients are Abu Dhabi's elite – a separate Presidential Flight operation handles official government flights. However, the firm has been diversifying by basing a BBJ in Moscow, and is trying to attract more Europeans to the region. Last year's peace accord with Israel has also opened new links. "There is a lot of business now between Abu Dhabi and Tel Aviv," says DiCastri, who even considered a VIP shuttle between the cities, but decided that "Etihad already does a great job with its first-class product".

Ostheimer also experienced a collapse in business when Covid-19 hit, but traffic began to improve from October last year, and "we had really good levels of activity up to July", he says. He is confident the six-month Expo, which began in October, will also boost demand for charter flights. But maintenance and aircraft storage remain DCAF's main activities at Al Maktoum. The oldest tenant in the business aviation zone, having opened its site in 2013, it is licensed to work on a number of types. It has two 13,500sq m (145,000sq ft) hangars, and these are 90% full, he says.

Maintenance activity

Maintenance is the sole activity now for another occupant of the Mohammed bin Rashid Aerospace Hub, ExecuJet MRO Services Middle East. Owner Luxaviation spun off the maintenance part of ExecuJet to Dassault Aviation last year, making the French manufacturer the latest of the big four business jet manufacturers to establish an arms-length maintenance business (Gulfstream parent General Dynamics owns Jet Aviation, while Bombardier has been taking large parts of its service network in house, including the former LBAS shop in Berlin).

BillyPix

Rob DiCastri heads Royal Jet, Dubai's biggest charter firm

In September, ExecuJet MRO Services Middle East won approval from New Delhi to carry out line and heavy maintenance on a range of Indian-registered Dassault Falcons, including the 7X and 8X. With many VT-registered jets coming to Dubai regularly, "India is a key market for us," says Nick Weber, the company's regional vice-president. However, despite its ownership, ExecuJet MRO Services will remain platform agnostic. It is an Embraer-authorised service centre and also certified to carry out heavy maintenance on most Bombardier aircraft.

Business aviation has always been a major feature of the Dubai show – perhaps more so than other air shows. According to the organisers, 30% of attendees are involved in the sector. Manufacturers lined up to take part this year include Airbus, Boeing, Dassault, Embraer, Gulfstream and Pilatus, alongside several service providers such as CAE, Comlux and Gainjet. While the market tends to favour heavier metal, many Middle Eastern business jets are older than average – perhaps because they fly less frequently than the typical corporate workhorses of Europe and North America.

Airbus sees this as an opportunity. "More than 60% of heavy jets and bizliners [airliner-derived types] are more than 15 years old," says Benoit Defforge, president of Airbus Corporate Jets. He believes this creates an opening for newer-generation platforms such as the ACJ TwoTwenty (based on the A220), and the ACJ350. "Both of these align well with customers' fleets from the Middle East," he says.

Traffic and confidence is on the up in Dubai and in much of the wider region. Whether this will translate to orders for Airbus and the other airframers at the show remains to be seen.

INTERNATIONAL RELATIONS

Bridging the Gulf

From flights between Gulf cities and Tel Aviv to co-operation on defence technology, a landmark diplomatic deal with Israel has led to a slew of new partnerships

Murdo Morrison London

This year's Dubai air show will feature exhibitors from a country that, at the time of the last gathering in 2019, the United Arab Emirates (UAE) did not even officially accept had a right to be on the map.

Events have moved quickly in the 15 months since the Abraham Accords – brokered by then-US President Donald Trump – saw the UAE and Bahrain follow fellow Arab states Egypt and Jordan in establishing diplomatic links with Israel. Aerospace and aviation businesses have been among the big beneficiaries.

Despite the backdrop of Covid-19, the airways between Israel and its Gulf neighbours have begun to fill with connecting flights, and liveries never spotted at certain airports are now a regular sight. Dubai airlines Emirates and Flydubai, as well as Bahrain's Gulf Air, have begun flying to Tel Aviv, and Israeli airlines Arkia and Israir in the opposite direction. Meanwhile, in July El Al and Etihad began a codeshare pact, offering customers of the Israeli flag-carrier a range of previously unavailable global connections through Abu Dhabi.

Travel restrictions

While on-off travel restrictions and a flare-up of the Israel-Hamas conflict earlier this year have been problematic, tourism and business travel should render those routes lucrative once the pandemic recedes.

Israel offers a rich heritage to adherents of the three Abrahamic faiths and, in Tel Aviv, the region's liveliest party spot; the UAE is the Arab world's commercial hub and a leisure destination in its own right. Both nations are keen to boost their high-tech and financial services sectors, and continue punching above their weights in the global economy.

There have also been moves in aviation services, with Etihad's training division providing simulator time to pilots from Israir. The chief executive of the Israeli leisure airline, Uri Sirkis, has pointed out that the 3h flight time from Tel Aviv makes the Abu Dhabi location

Noam Galai/Shutterstock

Abraham Accords saw UAE and Bahrain follow fellow Arab states Egypt and Jordan in establishing diplomatic links with Israel

attractive for him as a business, but he also has broader hopes about the potential of tourism between the two countries. In MRO, Israel Aerospace Industries (IAI) late last year signed a deal to provide line maintenance for Gulf Air at Tel Aviv's Ben Gurion airport.

But arguably the two most significant breakthroughs made since the signing of the accords in August 2020 are on the industrial and engineering side, with IAI central to both. In August, the state-owned Israeli aerospace and defence group said it was setting up two freighter conversion lines for Boeing 777-300ERs in Abu Dhabi, in co-operation with Etihad Engineering. IAI has already begun its latest programme to modify the large widebody type at its Ben Gurion site.

Defence collaboration

Meanwhile, IAI announced earlier this year that it was to partner with newly-established Abu Dhabi-based group EDGE on developing a range of anti-unmanned air vehicle (UAV) systems for the UAE and the wider Gulf market. It was the first – and remains the only – major collaboration between the two countries' defence sectors. Under the memorandum of understanding (MoU), EDGE's electronic warfare subsidiary SIGN4L will share technology with IAI, which has spent many years developing missile defence technology as part of its national security infrastructure.

The partnership with Etihad Engineering is one of several passenger-to-freight (P2F) collaborations signed by IAI in the past 12 months, as the growth of e-commerce and pandemic-induced decline in airline belly-hold capacity has boosted P2F demand. The Israel firm is setting up another conversion line for the 777-300ER and -200LR in Seoul, South Korea, as well as one for 767-300ERs in Addis Ababa with Ethiopian Airways. It is also teaming with Italian maintenance company Atitech to establish a 737 P2F facility in Naples.

Yossi Melamed, the general manager of IAI's Aviation Group, says the Abraham Accords meant managers from both outfits could meet for the first time, and explore ways of working together. He has described the partnership as adding "a significant tier to the relations between Israel and the Gulf states". For Etihad Engineering – formerly Abu Dhabi Aircraft Technologies – the attraction is a new business line that allows it to further diversify from in-house maintenance work for the Abu Dhabi flag-carrier and other airlines.

"We were very familiar with the Gulf maintenance operations but we couldn't work with them," says Melamed, who runs one of the world's most prolific freighter conversion businesses for Boeing aircraft. "The accords opened up a relationship, meaning we could visit each other's premises. They are great people, and we are really looking forward to working with them."

Work has already begun on establishing the conversion line, and Melamed expects the first passenger aircraft to arrive in the first quarter of 2023.

Intellectual property

On the counter-UAV tie-up, IAI and EDGE have said the final product will comprise detection and identification systems, "soft kill" solutions for jamming or cyber take-over, and "hard kill" capacity, such as missiles, electromagnetic equipment or lasers. EDGE chief executive Faisal Al Bannai insists that, despite IAI's many years of experience in the field, the MoU will be a partnership in which both companies will contribute intellectual property. "We want to add value in all our relationships," he says. "We will not just be a re-seller of someone else's products."

The Abraham Accords include a mutual recognition by Israel and the Gulf states of the regional threat posed by Iran, which remains hostile to Israel and suspicious of its Sunni neighbours. Although Israel is believed to have been tacitly co-operating on security matters with the UAE and even Saudi Arabia for years, and some trade links had begun to be established, until August 2020 it was difficult to enter the UAE with an Israeli passport. The accords make it possible for Israel and the Gulf countries to co-operate, with the USA and other allies, on wider security priorities.

The immediate visible sign of this for show-goers will be an Israeli representation at the Middle East's premium aerospace show – something that only the most optimistic observer of the region's politics might have thought possible just two years ago.

In fact, Israeli industry's public debut in the Gulf might have come even earlier. But for a travel ban prompted by concern over rising Covid-19 cases, Abu Dhabi's IDEX show – which took place just six months after the signing of the accords, in February – would have featured an Israeli pavilion.

Israel Aerospace Industries

IAI is setting up two freighter conversion lines for Boeing 777-300ERs in Abu Dhabi

Dubai-based lessor says it went into the crisis in good shape – thanks to a diversified customer base, strong liquidity, and an optimised fleet. Now, its chief executive insists it is well positioned for recovery

DAE delivers

Murdo Morrison London

Dubai Aerospace Enterprise (DAE) will be arriving at its local air show having ridden out the Covid-19 crisis relatively unscathed, and with chief executive Firoz Tarapore anticipating strong market recovery. Its performance has been helped by the strong liquidity that comes with being a state-owned concern, a diversified portfolio that has reduced the risk of major customer defaults, and a Boeing 777F fleet – DAE is the largest lessor of the freighter – in high demand during the pandemic.

"Broadly speaking, 2021 has been a very good year on the back of a strong 2020, despite all the challenges," says Tarapore, who has led DAE for eight years. That was partly due, he maintains, to the position the firm found itself in going into the downturn. "Last year was one in which we could play offence instead of defence. We didn't have a large overhang of orders. We didn't have crazy SLB [sale and lease-back] deals we had made that looked insane."

Reduced exposure

The fact that DAE's aircraft are spread among so many customers has reduced its exposure during the past 20 months, says Tarapore. At the three-quarter point of this year, DAE had a fleet of 425 aircraft, around 300 of which it owns, operated by 114 airlines. This gives an average of just over three aircraft per client. Take away equipment under contract for major client Emirates – ultimately a sister company and a rock-solid credit risk – and that ratio falls to about two.

"For the past decade or so, that has been a hallmark of how this franchise handled risk," says Tarapore. "Around 90% of our customers hold no more than 2% of the portfolio each. That distribution has been by design. In the good times, you have to run a lot harder, but in the bad times, it stops risk permeating. This is one of the reasons we didn't have to take an impairment [during the crisis]."

When we spoke to Tarapore ahead of the 2019 Dubai air show, he suggested that major aircraft orders, particularly of narrowbody aircraft, were off the cards, and that DAE was more likely to attain scale through organic growth or a further acquisition (in 2017 it more than doubled in size when it purchased Irish lessor AWAS). Prices of Airbus A320neo aircraft and even the then-grounded Boeing 737 Max were too high and delivery slots too distant, he said.

However, in April this year, DAE announced it was placing an order for 15 Max aircraft, its first for the re-engined narrowbody, although it has a 737 fleet of

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Tarapore: We have been able to play offence rather than defence

DAE

The ATR 72-600 has been a 'phenomenal product'

just over 100. It followed a sale-and-leaseback agreement last year with American Airlines for 18 new 737 Max 8s – the first of which was delivered at the end of 2020 – and a similar deal with Brazilian low-cost operator Gol for five of the same type.

Tarapore justifies the change of heart by saying that "2020 was a unique year that created new priorities for Boeing in particular". He adds: "For someone like us, with massive balance sheet capability, we were able to find the right deal for that small number of aircraft." All 15 aircraft have been placed, with some customers announced and others to follow. He says further "opportunistic" moves might follow, but "it's unlikely that we will place a 100- to 400-aircraft order."

Newer technology

Another large-scale acquisition is also not on the cards. "When we look at the world, we look at it from the vantage point of not having a large orderbook. For us, it wouldn't make sense to look at a large [acquisition] event, as all it would mean is acquiring 200, or whatever, current-technology assets. We are trying to gear our portfolio to newer assets, so it is better for us to wait two or three more years to buy something with a better mix of newer and older technology," he says.

Tarapore describes the 777F as a "gold dust asset" that will continue to be "the backbone of global e-commerce", even after a return of belly-hold capacity eases the squeeze for freight forwarders. However, he says DAE will stick to the factory-built version and not dabble in passenger-to-freighter programmes. He is also unconvinced about the A350 freighter, saying it has "attractive elements", but "we would have to be comfortable that the customer base will blossom".

ATR 72-600s – of which DAE has 70 in its portfolio – are also a "phenomenal product", which Tarapore describes as "purpose-built for that 70-seat market, with a low trip cost, and, as a turboprop, very environmentally friendly". DAE would like to have more examples in its fleet, he says: "We'd love to grow it, but ATR is not too happy at the moment with the growth of that market. When they figure it out, we'd be happy to grow with them, but we are content for now to be patient."

As well as AWAS, DAE's other major acquisition in the Tarapore era, in 2016, was Amman-based maintenance, repair and overhaul house Joramco, which forms the DAE Engineering part of the DAE Group. MRO had been part of the original vision of DAE when it was established in 2006. However, a move to develop a third-party MRO facility in Dubai fell by the wayside when DAE's ambitions were curtailed after the financial crisis of 2008.

Joramco's hangars are "full" and "our brand equity is strong with the quality and value combination we offer", says Tarapore, who has previously hinted at opening a second facility at Dubai's Al Maktoum airport. Is that still possible? "As I look around the clients we could have if we had a location here, the answer is, yes," he says. "And we definitely want to do something that takes that brand equity and allows us to grow the franchise. But I am quite conservative about deploying money to add hangar capacity on spec."

As far as next year is concerned, Tarapore is optimistic that a continuing global vaccine roll-out should send Covid-19 into reverse and restore both demand for flights and new equipment. "The thing about this downturn is that it was not a downturn of choice," he says. "Consumers didn't stop flying or businesses tighten their belt because they ran out of confidence.

"Recovery will be driven by how predictably we exit the pandemic conditions."

Backed by the Biden administration and Israel, the UAE's attempt to buy stealthy F-35As looks set to propel its air force to the next level of combat capability and give it an edge over potential foes

Worth the wait

US Air Force

Craig Hoyle London

In November last year, amid the tumultuous final days of Donald Trump's presidency, the US government gave its approval for what would previously have been an unthinkable arms sale to the United Arab Emirates (UAE).

Worth almost $23.4 billion, the proposed package includes 50 Lockheed Martin F-35As, 18 General Atomics Aeronautical Systems MQ-9B SkyGuardian unmanned air vehicles (UAVs) and a broad array of precision-guided weapons.

Selling a fifth-generation stealth fighter to the UAE only became a possibility following the signature of the Abraham Accords – a peace agreement between the Middle East state and Israel – just two months earlier. Brokered via the USA, the pact normalised relations between the nations, enabling direct commercial flights and the development of new trade links.

While the UAE has long been interested in the F-35A, which made its first Dubai flying display appearance two years ago, getting to this point took many twists. Over the past decade-plus, it had also flirted with potential acquisitions of the Dassault Rafale or Eurofighter Typhoon, and additional Lockheed F-16E/Fs.

Expectations of a Rafale buy grew around the Dubai show in 2009, but two years later a request for information linked to a planned 60-aircraft acquisition also considered the rival Typhoon. In November 2013, then-UK prime minister David Cameron visited the show, in the hope of getting an agreement for the Eurofighter over the line.

But in a disappointing twist for the European bidders, the requirement subsequently evaporated. In its place, the UAE sought a follow-on purchase of 30 F-16s in an advanced Block 61 standard, with a deal also to include the modernisation of its existing fleet of the type to the new configuration.

The UAE previously acquired 80 Block 60-standard F-16s, with Cirium fleets data showing that 78 remain in its active inventory, aged between 10 and 17 years. Its air force also operates 59 Dassault Mirage 2000-9 fighters, which have been in use for between 16 and 31 years.

Unusually, the outgoing Trump administration notified Congress of its approval for the mammoth arms package, rather than following the normal sales process, which first seeks its backing.

$23.4bn

Value of arms package including 50 F-35As, 18 MQ-9B unmanned air vehicles and precision-guided weapons

Mirage 2000-9 and F-16 operator will be adding F-35A to its inventory

"We anticipate a robust and sustained dialogue to ensure that any transfers meet our mutual strategic objectives"

US Department of State

Announcing the deal, then-secretary of state Mike Pompeo referred to "the UAE's need for advanced defence capabilities to deter and defend itself against heightened threats from Iran". Also made with the support of the Israeli government, the approval was intended to send a clear message to the authorities in Tehran.

Washington had previously ruled out selling the F-35 outside of Israel in the Middle East, in a bid to ensure that its ally's military maintains a qualitative edge over potential future foes.

Israeli endorsement

The Israeli air force has been using F-35I Adir strike aircraft operationally since December 2017. Cirium data shows that the service has built its active fleet to 27 examples, with a further six on firm order. Israel's current plans call for an eventually 50-strong fleet of the type.

In late January, current secretary of state Anthony Blinken confirmed that the proposed sale to the UAE was being assessed, noting: "it is typical at the start of an administration to review any pending sales, to make sure that what is being considered is something that advances our strategic objectives and advances our foreign policy."

Reports in mid-April indicated that Washington would proceed as planned.

"We can confirm that the administration is moving forward with these proposed defence sales to the UAE, even as we continue consulting with Emirati officials to ensure we have clear mutual understandings with respect to Emirati obligations and actions before, during, and after delivery," the Department of State says.

"Projected delivery dates on these sales, if implemented, would be several years in the future. Thus, we anticipate a robust and sustained dialogue with the UAE to ensure that any defence transfers meet our mutual strategic objectives to build a stronger, interoperable, and more capable security partnership," it continues.

"We continue to reinforce with the UAE and all recipients of US defence articles and services [that] US-origin defence equipment must be adequately secured and used in a manner that is consistent with respect for human rights and fully complies with the laws of armed conflict."

In addition to its $10.4 billion fighter purchase, the UAE's new arms package includes air-to-air and air-to-surface weapons worth $10 billion and Sky-Guardian UAVs valued at an estimated $2.97 billion, the US Defence Security Cooperation Agency says.

The General Atomics-produced MQ-9Bs would be equipped with Leonardo's Seaspray 7500 maritime search radar, and carry Lockheed AGM-114R Hellfire air-to-surface missiles and Raytheon Paveway II-series guided bombs. Other weapon options could include Boeing Joint Direct Attack Munitions and GBU-39 Small Diameter Bombs.

General Atomics Aeronautical Systems

General Atomics is to supply 18 SkyGuardians in an armed configuration, for almost $3 billion

Fielding the SkyGuardian will mark a capability jump for the UAE air force, which has previously acquired General Atomics' unarmed Predator XP. It also received approval from the US Congress in May 2019 to buy 20 Insitu RQ-21A Blackjack UAVs, under a deal worth a potential $80 million.

As a result of the Abraham Accords, major players such as Elbit Systems and Israel Aerospace Industries can this year exhibit their UAV products at a Dubai air show. This will provide stiff competition for China's AVIC, which has attended previous events to promote products including the armed Wing Loong I and II vehicles and U8EW unmanned rotorcraft.

But fielding F-35As will be a hugely more significant step for the UAE, which has waited while the other Gulf Cooperation Council (GCC) member states have embarked on major combat aircraft acquisitions over the past several years.

Spending spree

Bahrain is expected to receive its first of 16 new F-16Vs late this year, with the active electronically scanned array (AESA) radar-equipped assets to bolster its in-service fleet of 21 F-16C/Ds.

Long-term Boeing F/A-18C/D operator Kuwait is acquiring 28 examples each of the E/F-model Super Hornet and multi-role Typhoon, with the latter featuring a Leonardo ECRS Mk0 AESA array.

Qatar's combat aircraft expansion is the most dramatic fleet development in the region in recent years, with Doha's aged Dassault/Dornier Alpha Jets and Mirage 2000-5s already joined by Rafales and Typhoons, and Boeing F-15QAs to follow. In all, its air force will be introducing a combined 94 of the new models.

Saudi Arabia, meanwhile, has completed its introduction of advanced F-15SAs, which have joined earlier examples of the type, with its air combat fleet also including 72 Typhoons and Panavia Tornado strike aircraft.

Remaining GCC member Oman has no current fighter requirement, due to it already operating F-16C/Ds, Typhoons and armed BAE Systems Hawk 203s.

In addition to its future stealth fighters – which Cirium indicates could be produced in the 2025-2031 period – several further acquisitions are planned by the UAE. At the 2019 show, it announced plans to purchase another three A330 multi-role tanker transports (MRTTs), in a move that would double its fleet of the Airbus Defence & Space type. Its trio of Rolls-Royce Trent 700-engined and refuelling boom-equipped MRTTs were delivered between 2010 and 2011.

No deal has yet been signed, opening the potential for an order to be advanced at this year's event.

The US Air Force gave a Dubai show and Middle East-region debut to its 767-based KC-46A in 2019, and Boeing has previously suggested that the UAE could also acquire its Pegasus as part of a future strengthening of its tanker capabilities.

Also at the last event, Saab was awarded a follow-on deal to provide two more Bombardier Global 6000-based GlobalEye surveillance aircraft. The Swedish supplier – which finalised the just-over $1 billion contract last December – had brought one of its previously three on-order examples to make its show debut.

Selection by the UAE in 2015 – then as a two-aircraft deal – brought launch order success for the GlobalEye product, which combines airborne,

1,951

Total number of military aircraft operated by GCC nations, with the UAE accounting for 28% of the combined fleet

land and maritime surveillance capabilities. A third example was ordered in 2017.

The platform's primary sensor is its Saab Erieye ER AESA radar, while it also carries an electro-optical/infrared sensor and Seaspray 7500E maritime radar. The aircraft also has electronic warfare capability, with electronic support measures equipment installed on its wingtips. With five onboard operator stations, the type has an endurance of around 11h.

Saab performed GlobalEye deliveries in April and September 2020, and February 2021. The remaining two aircraft from the programme are at its Linkoping modification site. Bombardier announced in late August that it had transferred the final "green" airframe.

"The aircraft was delivered to Saab from Bombardier's Toronto manufacturing site and underwent interior completions work at Flying Colours in Peterborough, Ontario, prior to arriving in Sweden," the business jet supplier says. It describes this process as introducing "a practical, functional interior for the mission system operators".

In January, Saab said that work under its latest contract is due for completion by 2025.

The company has yet to secure a second customer for its GlobalEye, but has offered two examples to Finland as part of its HX fighter proposal, where it is proposing to supply 65 Gripen Es to Helsinki. The Swedish air force has also expressed interest in the modified business jet as a potential replacement for its two Saab 340-based airborne early warning and control system aircraft.

Country was the launch customer for Saab's GlobalEye surveillance aircraft

Arnold OA Pinto/Shutterstock

Fleet of A330 tanker/transports is likely to be doubled to six

AirTeamImages

Ten more AH-64s are on order for joint air command

BillyPix

Other potential UAE procurements could include in the airlift sector – in 2009 it gained approval for a potential 12-aircraft acquisition of Lockheed C-130Js; a deal which failed to progress. The service now operates four H-model Hercules, and the same number of commercial L-100s.

An advanced jet trainer need also could emerge, especially if the planned F-35A purchase moves ahead. The UAE currently uses a small fleet of Hawk 102s, along with Pilatus PC-21 turboprops, and several years ago expressed interest in the Leonardo M-346, including armed examples.

Beyond these prospects, the UAE's acknowledged procurement activity appears modest, with only 24 Calidus B-250 armed turboprops and 10 Boeing AH-64E attack helicopters on firm order.

Rapid expansion

However, it should be noted that the nation has completed a major fleet expansion over recent years. The 2011-2012 version of *Flight International*'s World Air Forces directory saw its in-service fleet stand at 373 aircraft, while Cirium data shows that it now has 553, split between its air force (322) and joint air command (231).

The most marked increase in its capability over the past decade has been seen in the combat helicopter category, where its active inventory has soared by 126 aircraft, from just 97. Its strength also has grown in all five of our other directory categories.

Cirium data shows that the UAE's current inventory accounts for 28% of the GCC group's combined 1,951 military aircraft. This puts it in second place behind Saudi Arabia: Riyadh's armed forces have 897 aircraft, or a 46% share. The rest of the regional fleet is made up with assets operated by Qatar (161/8%), Oman (128/7%), Bahrain (110/6%) and Kuwait (102/5%).

Looked at in terms of equipment mix, the UAE's 119 combat aircraft represent 22% of its total fleet, versus a 40% share for its 223 combat helicopters. Some 146 training aircraft/helicopters account for a further 26%, with the remainder split between transports (39/7%), special mission types (23/4%), and a trio of tankers; or less than 1%.

With its F-35A deal seemingly still on track, the UAE's future fleet mix looks set to become more potent, giving it a stealthy edge over potential foes, while satisfying the strategic requirements of both the USA and Israel.

For the Middle East's big hub carriers, major challenges existed even before the pandemic hit their operations. While services are being gradually restored, can they recapture vital market share?

Crisis recovery

Lewis Harper London

The devastating impact of the Covid-19 pandemic on the airline industry has left many people yearning for a return to how things were in 2019. But the past 20 months of upheaval make it easy to forget that all was not rosy in the industry going into the current crisis.

The Middle East region is a case in point – and its experience helps to frame its challenges coming out of the pandemic.

Towards the end of the last decade, the region's big hub carriers had conceded that years of double-digit growth were over. Among a raft of challenges, competitors were getting better at offering comparable alternatives to their products.

The region's geopolitical situation was unstable, notably amid a continuing blockade of Qatar by several of its neighbours. Tensions between the USA and China were impacting air cargo demand.

Ultimately, there was "a compendium of short-, medium- and long-term events which are affecting demand for air travel", Emirates Airline president Sir Tim Clark told FlightGlobal in September 2019.

All this was feeding through to airline bottom lines.

Etihad Airways was feeling the pressure particularly strongly as its equity partnership strategy fell apart and it worked through a transformation programme to become a "mid-sized airline".

All told, IATA data shows that Middle Eastern carriers recorded the biggest collective net loss among the global regions in 2019, at $1.5 billion, while the Asia-Pacific, Europe and North America were comfortably in profit. The region also recorded the weakest year-on-year passenger traffic increase, of just 2.3%.

Industry observers noted, with some prescience, that the region's airlines were particularly exposed to outside forces, given their relatively large reliance on international traffic and limited recourse to origin-and-destination passengers.

As 2021 nears a close, the impact of those details has been heightened by the pandemic.

Travel restrictions

Compounding the challenges, many Middle Eastern operators have a high reliance on the Asia-Pacific region for passengers, exposing them to countries with some of the strictest travel restrictions globally.

The domestic markets that have, at times, been the only significant air connectivity open during the Covid-19 crisis are small or non-existent in the region. Carriers such as Saudia, meanwhile, lost the business associated with what is, in normal times, the huge Muslim pilgrimage to Mecca on the annual Hajj.

At the same time, the big Gulf carriers' fondness for large widebody jets means that even as that connecting traffic returns, they are having to serve it with metal that is unsuited to low-load-factor environments.

On top of that, the Covid-19 recovery is being characterised by leisure and visiting-friends-and-relatives traffic significantly outpacing the high-value corporate travel that helps make expensive widebody jets viable.

Qatar Airways retained more of its network than other carriers – but grounded A380s

Vytautas Kielaitis/Shutterstock

IATA data for 2020 and its estimates for full-year 2021 both show the Middle East furthest down on 2019 passenger traffic among the global regions, at -72% and -75% respectively. Its forecast for 2022 – down 55% – predicts that the region will move off the bottom spot, but only at the expense of the small African market.

Some carriers have done their best to maintain global connectivity, including Qatar Airways, which sought to make a virtue of retaining a greater proportion of its network than most other carriers at the height of the crisis. But none have been able to hide from the financial realities of operating an airline during the pandemic.

Losses, where reported by individual airlines, have been large and worsened by aircraft impairments.

Thousands of employees have lost their jobs. Emirates, for example, said in July that it had cut its workforce by nearly one-third during the crisis, similar to cuts seen at Etihad but not quite as deep as those at Qatar Airways. Recruitment drives are returning, but pre-crisis staffing levels are some way off.

$4.6bn

Projected loss for Middle Eastern carriers in 2022 according to IATA – an improvment on the $6.8 billion loss in 2021

Helpfully, the biggest carriers have often found a sympathetic ear from governments when it comes to requests for financial help. But that has not always been the case.

"It is no secret that El Al is in the deepest crisis in its history," said the carrier as recently as September, as it demanded compensation of $100 million from the Israeli government to offset the effect of state decisions on the airline's operations.

Financial outlook

The pain is set to continue for some months yet.

"Middle Eastern carriers will see limited improvement in their financial performance from a $6.8 billion loss in 2021 to a $4.6 billion loss in 2022," IATA says in its latest outlook report. "Without large domestic markets, the region's major carriers rely significantly on connecting traffic, especially to Asia-Pacific, which has been slow to re-open to international traffic."

But the news is not all bad. Indeed, as much as the pandemic period has created new challenges for all airlines, it also saw the resolution of some of the pre-crisis issues that were weighing on Middle Eastern airline expectations.

First, concerns about geopolitical tensions affecting air cargo prospects are long forgotten amid a surge in demand for such services. That boost from cargo services has helped airlines to offset some of their lost passenger revenue and might be a trend that endures well into the future.

"We do not take a decision now to operate a flight or to resume a flight just because there is passenger ❱

"The corporate segment might diminish over time. But the same seats will be filled by people who have hitherto not been able to afford that seat"

Sir Tim Clark President, Emirates Airline

demand," said Qatar Airways chief commercial officer Thierry Antinori earlier this year. "What is very new [is that] we permanently think [about] the integration of cargo."

Emirates notes that nearly a third of its passenger aircraft have been used for cargo operations during the pandemic.

Indeed, FlightGlobal's latest World Airline Rankings data shows that while Middle Eastern carriers were hardest hit in terms of passenger traffic in 2020, their strong cargo activity meant the region did not lag in terms of revenues. Middle Eastern carrier income was still down 58% for the year, but this was not as pronounced as the 60% and 61% falls among leading European and Latin America carriers respectively.

Among other encouraging developments, the Qatar blockade was lifted following a reconciliation agreement reached at a Gulf Cooperation Council summit in January.

Diplomatic relations

Months before that agreement, the normalisation of diplomatic relations between Israel and several Arab states opened up new network opportunities for a number of carriers. Etihad's first scheduled flight to Israel touched down at Tel Aviv Ben Gurion airport on 6 April this year, for example.

That came on top of the easing in tensions between the US majors and Gulf giants over subsidies and fifth freedom routes, which had cooled enough just before the crisis for American Airlines and Qatar Airways to reinstate a codeshare agreement in February 2020, two years after it had been suspended.

And in terms of the operating environment amid Covid-19, most Middle Eastern carriers are no longer facing the border shutdowns in their home countries that had been making passenger operations all but impossible. Bahrain, Qatar and the United Arab Emirates (UAE) have been among the quickest vaccinators of their populations in the world, with Saudi Arabia not far behind.

The Middle East has also seen some interesting developments among low-cost carriers during the crisis – including rare airline start-ups.

Notably, Wizz Air Abu Dhabi launched flights in January, with its managing director Kees Van Schaick describing the airline as the pioneer of a "new model of air travel" for the UAE capital.

That launch created competition for Air Arabia Abu Dhabi, a partnership between the Sharjah-based carrier and Etihad that launched in mid-2020.

Emirates and UAE low-cost carrier Flydubai were already two years into a much closer relationship when the pandemic hit.

Speaking this year, Etihad Aviation Group chief executive Tony Douglas said that during the Covid-19 recovery, "the trick is to make sure that one has a blend of propositions that give choice to the marketplace" and that a tie-up with a low-cost carrier was a crucial part of that.

Air Arabia itself is a rare example of a carrier that has been able to record a profit during the pandemic. It has also been on the expansion path elsewhere, with plans to launch units in Armenia and Pakistan.

But while the region's budget carriers have sometimes faced better operating environments than their long-haul-focused peers, they have not been immune to the impact of the pandemic.

In July, Flydubai cut to 172 the number of Boeing 737 Max aircraft it has on order, after cancelling 65 of its firm commitments to the type following a review of its post-pandemic fleet plans.

Elsewhere in the Middle East, fleet make-up remains a point on which there are different opinions among airline chiefs as they consider how the region might emerge from the crisis – particularly with heightened scrutiny around sustainability challenges.

While Qatar Airways is expected to bring some of its Airbus A380s back into service this year to cover for the A350s that have been grounded amid concerns about premature surface degradation, the Oneworld carrier remains unconvinced about the type's utility in a sustainability-focused world.

Among various negative comments about the superjumbo, Qatar Airways chief executive Akbar Al Baker has described the type as "one of the worst aircraft, when it comes to emissions, that is flying around today".

In Abu Dhabi, Etihad's 10 A380s have been grounded "indefinitely".

Clark, however, insists that A380s will be an important part of Emirates' fleet into the 2030s.

The return of the business traffic that helps make such aircraft economically viable remains another point of debate. Airline chiefs will variously

Etihad has been operating flights to Israel since April

Etihad Airways

Air Arabia recorded a profit during the pandemic and is planning expansion

Anton Volynets/Shutterstock

say anything from the corporate market being structurally smaller for the foreseeable future, through to a belief that it will bounce back much more quickly than most dare imagine.

Helpfully for Emirates, the loss of some corporate customers might not mean fewer people flying, in Clark's view.

"The corporate segment might diminish over time. But the same seats will be filled by people who have hitherto not been able to afford that seat," he said earlier this year.

Price-conscious

Nevertheless, Emirates has brought forward deliveries of its final three A380s to later this year, which will double the number of its superjumbos to feature its nascent premium economy cabin – a product that might come into its own in a market featuring more price-conscious travellers.

Whatever the make-up of future demand, the chiefs of all the big hub carriers believe that the region's status as a connecting post for long-haul flights will not be fundamentally damaged by the pandemic.

Clark has previously stated that "people should be thinking about the upside, not the downside" of future traffic projections, as he outlined a vision for Emirates to eventually expand into thinner routes using incoming A350 and 787 jets.

Qatar Airways, meanwhile, recently noted that it had rebuilt its network from a low of 33 destinations to more than 140, helping to ensure it is "well-positioned to take advantage of the recovery of international travel".

Elsewhere, Douglas said in September that the "hub status of Abu Dhabi and the UAE in general, given the fact that we are six flying hours from two-thirds of the world's population, will continue to be a very significant part of our operating model".

And Etihad might rightly curse its luck that under the leadership of Douglas, its transformation effort was beginning to have a positive impact in the first few months of 2020, before the industry was plunged into its biggest crisis.

Half-way through a five-year transformation programme, the carrier had already taken out costs running into the hundreds of millions of dollars and cancelled orders for dozens of A350 and 777X aircraft in 2019.

Despite those developments at Etihad, Middle Eastern airlines retain some of the world's largest widebody orderbooks as they come out of the crisis.

Cirium fleets data shows that Emirates has some 197 outstanding orders for widebody aircraft, as of mid-October, including 101 777-9s, 50 A350-900s and 30 787-9s.

With 76 A380s still grounded and just 44 in service, the number of aircraft on order is more than Emirates' in-service fleet of 188 jets.

Qatar Airways has 106 widebodies on order, including 50 777-9s and 23 A350-1000s. It also has an outstanding order for 50 A321neo narrowbodies, Cirium data shows. The Doha-based carrier has 200 aircraft in service.

Meanwhile, Etihad has 72 widebodies on order, including 17 777-9s and 15 A350-1000s. It also has 26 A321neos on order. The Abu Dhabi-based carrier has 70 aircraft in service, Cirium data shows.

Outstanding orders

Saudia remains a big widebody player in the region, with 86 such aircraft in service in mid-October, alongside 60 narrowbodies. It has been adding 787-10s to its fleet and has outstanding orders for dozens of A320neos and A321neos – some of which will enter service with its low-cost unit Flyadeal.

Other carriers, including Gulf Air, Oman Air and Royal Jordanian, also have widebody deliveries currently outstanding.

The still-impressive orderbooks at the Middle East's airlines bring to mind what now looks like the golden age for the region's air transport industry in the early 2010s. Most memorably, on the first day of Dubai air show in 2013, Emirates, Etihad and Qatar Airways signed orders and commitments for a total of 225 777X aircraft. Etihad then added an order for 30 787-10s and Flydubai committed to buy up 100 737 Max aircraft and 11 737NGs.

In stark contrast, the early 2020s are likely to be charactised by the region's airline sector needing to demonstrate that despite going into the pandemic crisis on the back foot, the fundamentals of the business still stand up in a post-Covid-19 world.

Aviation's increasingly outdated use of magnetic navigation could be nearing an end, with Canada championing a so-called Mag2True adjustment, targeted for worldwide adoption from 2030

Changing course

David Learmount London

While professional mariners stopped using the earth's magnetic field as their primary directional reference some 50 years ago, civil aviation did not, because at that time accurate inertial navigation systems (INS) were too heavy and bulky for aircraft use.

Today, however, navigation by global navigation satellite systems (GNSS) – backed up by ring laser gyro-stabilised INS/attitude and heading reference system platforms, radio beacons and air traffic control surveillance using multiple technologies – means that aviation has no real need to use a magnetic reference.

The debate about changing from Magnetic to True navigation is now moving towards how to change, and when, with March 2030 the proposed date.

Modern civil and military aircraft have the capability to fly to a True North reference at the push of a button: the flight management system (FMS) is designed to identify True North at start up, and when a magnetic reference is required it is computed from True by applying local magnetic variation via embedded look-up tables.

With the ubiquitous use of GNSS, impressive capability of modern inertial reference systems, and the steady decommissioning worldwide of surface-based radio navigation aids, the decision to rely on the earth's constantly-changing magnetic field is increasingly hard to justify.

The International Association of Institutes of Navigation (IAIN), which has meticulously studied all the issues, comments: "The biggest single problem in trying to implement this change worldwide would be inertia – the large number of countries involved and the difficulty of finding the will to all change at once."

To work out how best to overcome this inertia, the IAIN set up a specialist working group, the Aviation Heading Reference Transition Action Group (AHRTAG), which has been meeting monthly since early 2021.

A Canadian-led multinational team of navigation experts from Australia, France, the Netherlands, the UK and the USA, the AHRTAG is chaired by Anthony MacKay, Nav Canada's director of operational safety. The group includes representatives from several national aviation authorities (NAAs), major aircraft manufacturers, pilot associations, and also the commercial air navigation charting and aviation information provider Jeppesen.

Updating systems

The migration of the geographic magnetic poles has accelerated in recent years, adding to the relentless task of updating systems and distributing the associated flight information.

The AHRTAG points out that updating aircraft declination look-up tables is a specialist and expensive maintenance activity that has no effect on the way an aircraft derives its directional information. It merely ensures the result is displayed as a magnetic value that is normally less accurate than the originally determined True heading.

And, if a future variation shift is sufficient to affect airport assets – such as runway and taxiway signage and markings, plus instrument procedures, landing

Global navigation satellite systems mean a magnetic reference is no longer required

Air Team Images

aids documentation, and FMS coding – at a major hub, the cost can top $20-30 million.

Moving from Magnetic to True reference is no more challenging than, for example, the periodic task of re-orientating VHF omnidirectional radio range (VOR) and TACAN radio navigation beacons for local magnetic variation changes. Across the industry, staff have the necessary skills and knowledge to make the move.

Canada is now actively concentrating on implementing the change: it already references True North in nearly half of its airspace because of its proximity to the (moving) surface location of the magnetic North Pole.

Aviators in the northern Canadian airspace have employed tried and tested procedures for both traditional radio navigation beacons and all types of performance-based navigation (PBN) systems. The country's air navigation service provider (ANSP), Nav Canada, working with the AHRTAG, has almost completed drawing up its concept of operations (CONOPS) for the switch.

ICAO has shown great interest in Nav Canada's "Mag2True" work, particularly since Canada presented a white paper on the subject to its 13th Air Navigation Conference in 2018, seeking agreement and proposing adoption by 2030. The conference agreed that a further study of Mag2True's cost/benefit should go ahead.

"The biggest single problem in trying to implement this change worldwide would be inertia – the large number of countries involved and the difficulty of finding the will to all change at once"

International Association of Institutes of Navigation

Implementation plans

The agency is hoping to be presented with "ready-made SARPS [standards and recommended practices] and implementation plans to move issues forward". Canada was due to present a formal Mag2True update during ICAO's high-level conference in October 2021, and a presentation by the AHRTAG on True North is on the agenda of ICAO's European PBN Task Force/Navigation Steering Group meeting in early December.

Assisting ICAO to overcome global inertia might work like this: one state – Canada – unilaterally files a difference from international heading reference standards, successfully transitions to True North within its entire airspace, and demonstrates that the new system works.

The US Federal Aviation Administration (FAA) is also warming to the idea. According to FAA sources, the body's thinking is moving in much the same direction as Canada's, recognising that pilots are accustomed to operating despite differences that

come into play at a border. For example, most of the world measures flight altitude in feet, but China, the Russian Federation and a few other states use the metric system.

To sceptics reluctant to abandon any heading reference system – especially one as familiar as the magnetic compass – despite the existence of proven alternatives, AHRTAG member Dai Whittingham points out that modern aviation rulemaking is risk-based. Risk can never be reduced to zero, but the introduction of any new system must be proven to be extremely low-risk.

Comparisons between the existing and proposed regimes are inevitable, but Whittingham – who is also chief executive of the UK Flight Safety Committee – believes it is wise when playing "what if" games with the proposed system to admit that the existing one has its faults, and to enumerate those.

Meanwhile, the AHRTAG, which continually seeks feedback from all parts of the industry, has been able to report that anticipated resistance to change in sectors like general aviation (GA) is softening to the point of disappearance, especially as GA is a now big user of GNSS systems, whether employing installed avionics, hand-held GPS devices specified for aviation, or tablet-computer electronic flight bags.

Proposed changeover

Similarly, airline pilot associations and the airlines themselves seem generally happy about the proposed changeover, for which the accepted shorthand has become Mag2True.

Canada's draft CONOPS offers a good indication of how the Mag2True task might be rolled out. There are three aviation arenas affected: aircraft operations, which implies inclusion of the airlines and original equipment manufacturers; aerodromes; and, finally, ANSPs. Overseeing this will be the NAAs, with ICAO keeping an eye on standardisation.

Questions remain about the timing, though. Should the switch to True be global and simultaneously made on a single date, or managed regionally, or by hemisphere?

Canada's proposed 2030 transition year would require NAAs, ANSPs and states to trigger the change. If an implementation date can be agreed, it would be entered in ICAO's Aeronautical Information Regulation and Control calendar in the normal way for promulgating changes.

The draft CONOPS proposes that, in the six to eight months ahead of Mag2True adoption, the state would not action any changes to its aeronautical information publication (AIP), freezing all but emergency changes to procedures. The only changes promulgated would be those needed to convert Magnetic to True.

During this time, the state would also need to enact a plan to rotate its VORs and ensure that surveillance systems and air traffic controllers are all ready for the change.

All states have a procedure in place for crews to adjust VOR radials (+/- bearing values) until publication of the corrected values once the VOR is rotated and calibrated. The Mag2True transition date would be the last such rotation, because once set to "0" – or True – they would never need to be adjusted again.

2030

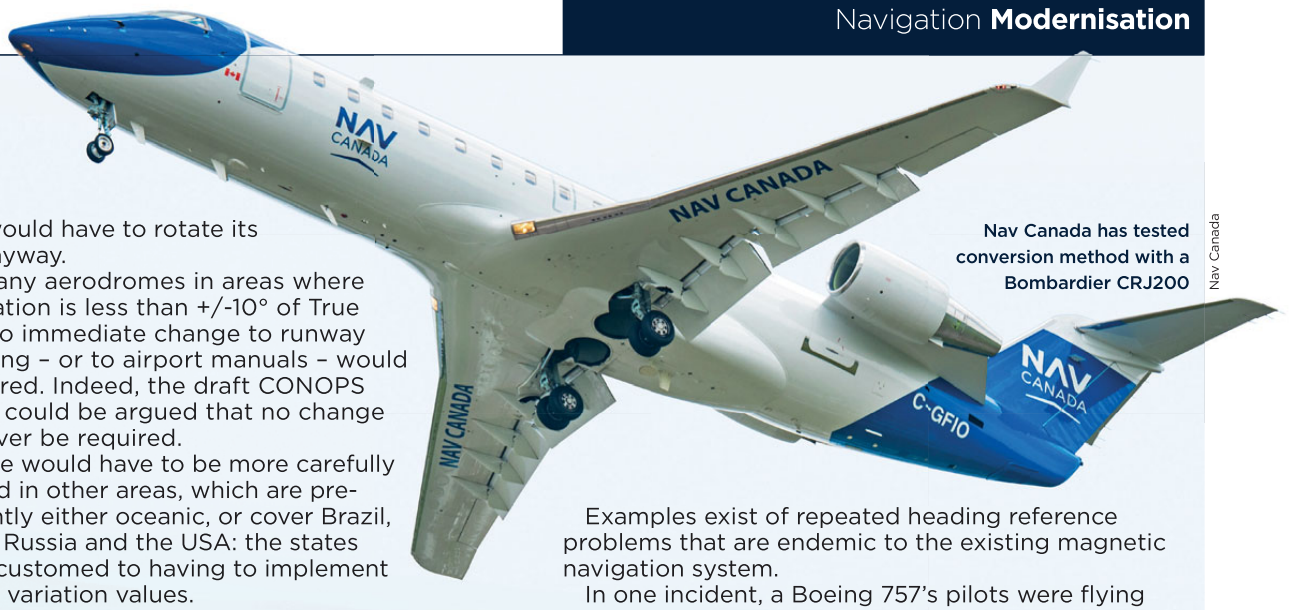
Target transition year proposed by Canada for switch to 'Mag2True' navigation, abandoning magnetic references

The ARINC 424 database that the state AIP feeds could be maintained with its current structure, with all magnetic variation values being set to "0". Jeppesen has successfully tested this conversion method, demonstrating it via a Bombardier CRJ200 flight test conducted with Nav Canada.

The draft CONOPS proposes a way of staging the changeover. For those regions of the world where existing magnetic declination is realtively small, VORs could safely be aligned today to within +/-4° of True North – a move that would still fall within the current tolerance of many states.

Canada uses +/-2° as a tolerance, but given the amount of magnetic variation change from coast to coast, the

Alex JW Robinson/Shutterstock



Nav Canada has tested conversion method with a Bombardier CRJ200

Nav Canada

nation would have to rotate its VORs anyway.

For many aerodromes in areas where the variation is less than +/-10° of True North, no immediate change to runway numbering – or to airport manuals – would be required. Indeed, the draft CONOPS notes, it could be argued that no change would ever be required.

Change would have to be more carefully managed in other areas, which are predominantly either oceanic, or cover Brazil, Canada, Russia and the USA: the states most accustomed to having to implement updated variation values.

Since most carriers already use True tracks during oceanic operations, there would be little or no change for the ANSPs managing oceanic areas, or those bordering them.

Admittedly, there would be a number of other small but important details that would need attending to. For example, airport air traffic services would need to ensure that adjusted vector headings for common procedures were included in any memory aids for controllers.

With the exception of NDB approaches and vector headings, most other conventional and PBN procedures are now track-based anyway, allowing correct tracks over the ground to continue during the change period. However, the heading error would appear as apparent wind drift, which could be misleading to aircrew.

Crew confusion also could arise from changes to routines, especially to oft-flown procedures. However, there is arguably already plenty of potential for confusion in a system that continues to use two heading references, one of which is variable.

+/-4°

Safe alignment of VHF omnidirectional radio range with True North in regions where magnetic declination is small

Examples exist of repeated heading reference problems that are endemic to the existing magnetic navigation system.

In one incident, a Boeing 757's pilots were flying a CAT II approach to runway 29 at St John's, Newfoundland, Canada. When it intercepted the localiser, the aircraft "rolled back and forth" across the localiser, trying to maintain the centreline. The cause was that the magnetic variation (mag var) of the published procedure differed from the out-of-date mag var tables in the aircraft's inertial reference unit (IRU).

Misaligned image

Also in Canada, a crew was testing the CAT III approach to Calgary's new runway 17L, when they observed that the synthetic runway image in the head-up guidance system was misaligned by 7° versus reality. The crew repeated the test after the aircraft had been fitted with new IRUs for which the tables had been updated from 2010 to 2015 information, and the synthetic and actual world aligned perfectly.

In the months that followed this event, many crews conducting autolands on 17R at Calgary reported their aircraft moving off the centreline when transitioning to autonomous flare mode. In all cases, their aircraft were found to have out-of-date mag var tables in their IRUs.

Canada's CONOPS for 2030 offers a route to modernity and the avoidance of needless costs for the aviation industry. Moreover, the case for embracing the Mag2True shift is likely to become unstoppable as the numbers of remotely piloted air systems and autonomous platforms – which navigate in True – increase globally.

As such, why would aviation want to persist with two systems of reference? ◗

Out-of-date mag var tables have affected autolandings at Calgary

From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

ACAS of mistaken identity

Perhaps the labour strife experienced by South Africa's aviation industry over the past few months was on the mind of someone at the country's accident investigation department when they wrote up the report on an August near-miss incident at East London airport.

Because both the report's glossary and narrative insist that the Boeing 737-400 involved was fitted with version 7.1 of the "Advisory, Conciliation and Arbitration Service (ACAS)".

Which would probably come in handy during those trickier rounds of pilots' collective bargaining talks. But not when trying to avoid a light aircraft that strayed into your approach path, when you'd rather have a different sort of ACAS – an Airborne Collision Avoidance System – to help steer you out of trouble.

Crown Copyright

XXX-plicit

If there wasn't enough potential for schoolboy sniggering over the name of Swedish regional airline BRA, when it unveiled plans for a sustainable fuel test flight on 16 September, the choice of backdrop added an extra source of playground-level mirth.

It depicted an ATR 72 turboprop – not a photo but an artist's impression. As such, it had been drawn with a dummy registration featuring the Swedish prefix but a blank suffix – reading SE-XXX.

Shut up at the back, or there'll be extra homework and environmentally-friendly detentions all round.

ATR

Delta blues

Earlier this year, the World Health Organization began assigning names to variants of Covid-19 after letters of the Greek alphabet. The previous convention – based on where the variant originated – had drawn complaints from the citizens of Kent and India, who were not particularly keen on the place they called home being associated with a deadly bug.

However, the WHO clearly failed to consult the chief executive of a leading US carrier when it christened the, so far, most virulent strain of the coronavirus. Since May, Delta Air Lines' Ed Bastian has steadfastly referred to the "B.1.617.2 variant" – scientifically accurate, but not exactly snappy.

From the archive

100 75

1921 Sans propeller

Mr. Macintosh had an uncomfortable experience on Tuesday while piloting an 0-400 from Paris. No aeroplanes had left Croydon, owing to fog over the aerodrome: and Mr. Macintosh, not having met any machines on his way from Paris, was beginning to wonder just how bad the fog at Croydon was. As he approached Lympne, therefore, he decided to fly low to read the ground signals telling of conditions at Croydon. Everything appeared "O.K.," but suddenly there was a noise like the humming of a big shell, and the machine swung round abruptly. A portion of the gears, together with the propeller, had fallen off one of the engines, and it was only with the greatest difficulty that he was able to get the machine safely to the ground.

1946 A bit more throttle

Bill Thorn had several exciting trips. One was a Puss Moth charter to Belgium with an eccentric rich man as his passenger. While they were in a bar the man gave Bill £180 and told him to start at once for Cairo. When Bill told the man you couldn't start just like that, he started a fight. This was exceedingly foolish because among Thorn's many accomplishments he had won the Officers' Open Light-Heavyweight Championship. On his passenger's recumbent form the bartender expended most of a siphon of soda water to bring him round. Later, on the way home, this passenger (in the back seat) put his arms round Bill's neck and tried to throttle him. The Puss Moth was left to its own devices while Thorn turned round and laid his passenger out a second time.

Water's that way

When at sea...

"I wonder if I could enlist the help of *Flight International* in my so-far unsuccessful one-man campaign to get the [Lockheed Martin F-35] Lightning renamed Sea Lightning when aboard either of the UK's aircraft carriers?" writes J McNeill of Glasgow.

"Thus far I have had little traction with the Royal Air Force or Royal Navy," he laments.

"If it was good enough for the Seafire, Sea Hurricane, and Sea Harrier, it's surely good enough for the Lightning!"

This reminds us of one rumoured justification for the selection of 617 Sqn – the RAF's legendary Dambusters – as the UK's first operational F-35 Lightning unit.

"They're very good over water", a service official is said to have quipped.

Casting a spell

Despite failing to land a trade agreement, UK Prime Minister Boris Johnson appeared to mention a surprising bit of transatlantic harmony after meeting President Joe Biden in Washington in September, at least if you were watching the subtitles of a Sky News interview.

According to the transcript, the two had sorted out the "spelling dispute that's been going on for ages".

To those wondering whether that means the US government will start using 'colour' rather than 'color', or rebrand the 'Department of Defense' as the 'Department of Defence', some explanation is probably in order.

The transatlantic dispute to which Johnson referred was actually the row over commercial aircraft subsidies.

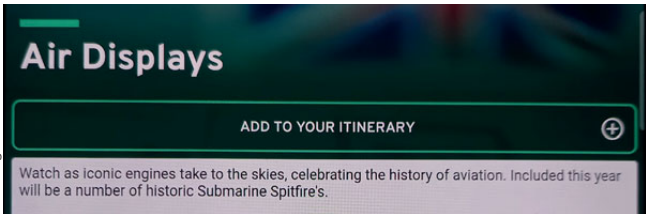
Clearly the subtitling system wasn't oven-ready enough to cope with the words 'Airbus-Boeing' and used a poor substitute instead of doing the job properly.

Much like Johnson did with a certain other trade deal.

Dive, dive, dive!

Clive Rogers sends in this screenshot from the app of this year's Goodwood Revival, the celebration of the glory years of British motorsport, highlighting one of the event's airborne stars. Or is it?

"It seems someone hasn't checked the spell checker, or the famous Battle of Britain aircraft was even more versatile than we thought," he says.



Clive Rogers

50

1971 Dual designation

Air transport history was made on November 1 when a second airline of one flag appeared on the London - Paris route. To Americans "multiple designation" has long been a way of life; they have four designated airlines on the North Atlantic, and some of their domestic routes sustain half-a-dozen or more carriers. Now European governments are responding to the needs of the public. The airline concerned is British Caledonian, the biggest British independent and the one chosen by its Government for dual designation alongside BEA or BOAC wherever appropriate. British Caledonian now has to live up to the independent airline advocacy of the last two decades and prove that dual designation makes life better for the passengers while being profitable for both airlines.

25

1996 Competitive rivalry

Airbus Industrie's plans to compete head-on with Boeing in the large airliner market are gathering momentum, with the consortium concluding the first agreement with an engine manufacturer to provide a powerplant for the new aircraft. Airbus and Rolls-Royce signed a memorandum of understanding specifying the Trent 900 for the A3XX, which Airbus says "...paves the way to make more detailed offers on A3XX performance to the airlines". In a move foreshadowing the competition brewing between Boeing and Airbus, the consortium's senior vice-president John Leahy revealed that the A3XX will be offered at "no more than $198 million". This would undercut the expected $200 million charge for Boeing's 747-500X and 747-600X.

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Saving UK airports from the chop

I am not sure how aware you are of plans to close Coventry airport as part of a proposed planning application to build an electric car battery "gigafactory", but it certainly deserves to be aired among the wider aviation community.

Anyone with an aeronautical heart needs to join our barricade, before the land grab of airports spreads uncontrolled across the UK.

Coventry was and still has the potential to return to being an excellent niche airfield. Its recent history included specialising in night freight and coverage for marine pollution spraying operations. Its excellent radar and ILS facilities also provided an ideal central location for business aviation, plus a very busy training network of flying schools. The site also contains a pool of expertise in maintaining classic aircraft.

The events unfolding remind me of a Turkish proverb which states: "The forest was shrinking, but the trees kept voting for the axe, for the axe was clever and convinced the trees that because his handle was made of wood, he was one of them."

The current sorry state of affairs was caused by the local council handing over control to Regional and City Airports (RCA) – a division of wealth creation and property development company the Rigby Group. Aviation businesses have watched in dismay as the ILS and radar were withdrawn, air traffic control and fire cover downgraded, and operating hours curtailed from 24/7 to five days per week, daytime only.

By backing redevelopment, Coventry airport is effectively trying to shut itself, so that a factory can be built on its 2,000m (6,600ft) of smooth runway tarmac – paid for not long ago by local taxpayers.

No car manufacturer or battery company is behind the scheme, and the change of use planning permission would allow the developers to revert to warehousing. That would be a dreadfully poor exchange for one of our best regional hopes to take part in any post-pandemic aviation revival.

The RCA board had pledged "to grow the airport's thriving corporate aviation, general aviation and MRO operations, and to support wider development projects on and around the airfield".

How this translates into demolishing the airport to maximise profits from redevelopment I am unclear.

Steve Clark
Director, Aerotech Aircraft Maintenance
Coventry airport, West Midlands, UK

Xalien/Shutterstock

Parting company

Your recent open letter of apology to a correspondent (*Flight International*, September 2021) brings shame on the editorial team.

The term you are giving abject apology for is wholly acceptable in the context of a serious aviation magazine – and yet you are apparently treating it as if it were published in some health or mental welfare context.

I had personally never heard the term before, so it clearly does not have only one meaning in the wider population.

This belittles the status of a once-great magazine that has lost its way in this digital world of woke.

For most of my life I read *Flight* weekly, and it has often been the source of world-leading research back more than 100 years.

The magazine has degenerated from one that covered a broad brush of aviation to one that focuses almost exclusively on restricted elements of the military and in particular airlines.

It has become – in all but name – *Airliner World*.

Sadly, the time has come to part company, after more than 50 years.

Bryn Elliott
Waltham Abbey, Essex, UK

Skyborne identity

In your Training and Development Guide report 'Pilot re-shortage' (*Flight International*, October 2021), Skyborne Airline Academy was incorrectly spelt with an extra 'u'.

Please can you fix this?

via email

Editor's reply: Our apologies for this editorial error, which unfortunately made it into print. The online article and pdf download version of the issue have been corrected.

We welcome your letters about our coverage, or any other aerospace-related topic. Please email flight.international@flightglobal.com, or write to: The Editor, Flight International, 1st Floor, Chancery House, St Nicholas Way, Sutton, Surrey, SM1 1JB. Letters should be no longer than 350 words in length, and supplied with the correspondent's name and location. Letters may also be published on FlightGlobal.com, and do not necessarily represent the views of the editor.

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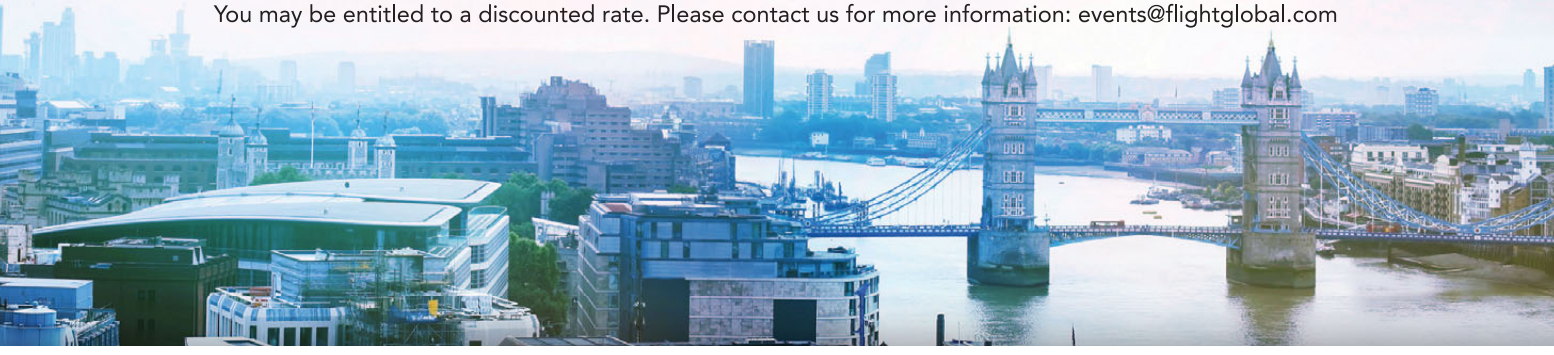

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As IATA's head of diversity, **Jane Hoskisson** champions the airline industry's standout women – and encourages all carriers to take a more proactive approach to equity and inclusion

Creating fairer chances for all

Lewis Harper London

Before becoming head of diversity at global airline association IATA, Jane Hoskisson already knew better than most what it was like to work in industries that lag wider diversity, equity and inclusion (DE&I) trends.

"My whole career could probably be described as 'heavily male-dominated industries' – so, tobacco, pharmaceutical, oil," she says of sectors where she previously worked in a variety of human resources roles.

Crucially, some of that pre-aviation experience gave Hoskisson exposure to "organisations who have been purposeful and deliberate in changing that balance".

Her role today is facilitating a similar change in an airline industry that is finally making progress on DE&I issues, but is still currently dominated by men in the best-paid jobs.

Surprising situation

Indeed, when Hoskisson moved to the industry eight years ago – initially as IATA's director of learning and development and since 2019 as its director of talent, learning, engagement and diversity – she was "really surprised it wasn't a topic we were talking about as much as I'd perhaps seen in other industries".

That surprise partly stemmed from Hoskisson's belief that embracing DE&I helps to create fundamentally better and more successful companies.

"Research will tell you that if you have true diversity, you have better business results," she says.

A need for change within the airline industry was formally recognised by IATA in 2019, when it launched two key initiatives under Hoskisson's guidance: the 25by2025 programme and the Diversity and Inclusion Awards that are handed out at the association's annual general meeting.

While the headline target of the 25by2025 initiative is to increase the number of women in top airline roles, Hoskisson says that the core of the programme involves regular meetings where airline members share "good practices" around making entire workforces more diverse and inclusive.

"One of the things we are trying to do is connect airlines," she says. "The mantra we have is that in the space of diversity and inclusion, we collaborate, we don't compete.

"The industry needs to be attractive to future generations – and it needs to be attractive to a diverse group in future generations," Hoskisson says.

Helpfully, an increasing number of airlines are being convinced by that argument.

Pandemic effect

"What's really surprised me about the pandemic is we went into it with about 48 airline signatories [for 25by2025]... we're at 77 now," she says. "During the 18 months of the pandemic we actually had a lot of people reach out to us and say 'we really want to build back with diversity and inclusion in mind'."

That is important, Hoskisson says, because research shows the pandemic has adversely impacted women far more than men, as they struggled to balance their work lives with other tasks such as home-schooling and caring for others.

"What I am so proud of is that airlines are recognising that," she says. "They are recognising that it is super important to build back and be mindful and purposeful about diversity and inclusion."

The Diversity and Inclusion Awards, meanwhile, have become one of the key events at IATA's annual gathering, as the industry seeks to highlight its progress on the issue.

And in 2021, more than ever, the stories of standout women and businesses – this year's winners were Air India executive director Harpreet A de Singh, McLarens Aviation aviation engineering consultant Lalitya Dhavala, and Japanese carrier All Nippon Airways – were a welcome example of positive aviation narratives.

"Despite all the bad news [during the Covid-19 crisis], it's really important that we celebrate the successes," says Hoskisson. "We always talk about how 'you can't be what you can't see' and of course that's why the

Jane Hoskisson is encouraged by growing support for 25by2025 initiative

IATA

"During the 18 months of the pandemic we had a lot of airlines contact us and say 'we want to build back with diversity and inclusion in mind'"

awards are so important, because it's highlighting these very inspirational people and companies that are doing this really strong work on furthering the diversity, equity and inclusion agenda."

While much of IATA's work on the issue focuses on gender, Hoskisson is also clear that diversity encompasses a much wider range of considerations.

"The reality is that you can't talk about gender without looking at the other elements of diversity and inclusion," she says.

Full representation

Hoskisson gives the example of "under-represented minorities" in an airline's particular geography, insisting that "if you haven't got that representation [within your workforce], you're not really looking after the whole gamut of diversity, equity and inclusion".

Ultimately, it is about "making sure you don't exclude anyone – that [employees] feel they can bring their best selves to the workplace", she states.

Hoskisson is also keen to stress – particularly to those sceptical about DE&I efforts – that progress on the issue "doesn't mean we're going to alienate" any groups. "It means we're going to be diverse and we're going to make sure everyone is brought in on the journey," she says.

Hoskisson highlights the work of one airline, that pitches its gender diversity target among senior leadership as being "not less than 40%" male or female.

"I like that mentality... because there may well be times where you have airlines that have more than 50% women in their senior leadership teams, and that shouldn't be the norm either."

And on the subject of senior leadership, Hoskisson is clear about who can make the biggest difference to the industry's progress on DE&I.

"None of this can happen without senior leadership looking in the mirror and really role-modelling the change," she says. "And that's about more than lip service – it's about proactively looking at their talent and making choices.

"The airlines that are doing this brilliantly have got really strong leadership with their CEOs, who are saying: 'This has got to change; I'm prepared to challenge and I'm prepared to ask questions'."

ATR

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