CF24 CARBON FIBER

PRESENTED BY:

CW CompositesWorld

GARDNER Business Media

Outlook: Carbon fiber in the aerospace industry

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Counterpoint is a market intelligence firm that specialises in aerospace manufacturing and supply chains

Market Reports + **Consultancy Services**

WRITTEN BY SUBJECT MATTER EXPERTS

BUILT FROM DETAILED INDUSTRY MODELS

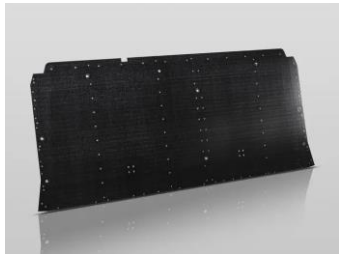
CLOSELY CONNECTED TO THE AEROSPACE INDUSTRY

Where are composites used in aircraft today?

AEROSTRUCTURES

- Carbon fibre composite
- Glass fibre composite
- Other composite
- Aluminium
- Other metal (titanium, steel, etc)

INTERIORS



Floor panels

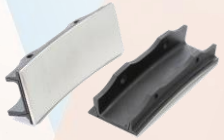
Seat structures

Decorative CFRP for business jets

ENGINES

Casing, nose cone spinners, annulus fillers, bypass ducts

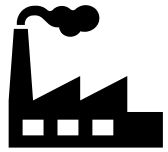
Fan blades



Nozzles/shrouds (ceramic matrix composites)

Contents of today's presentation

Aerospace demand situation

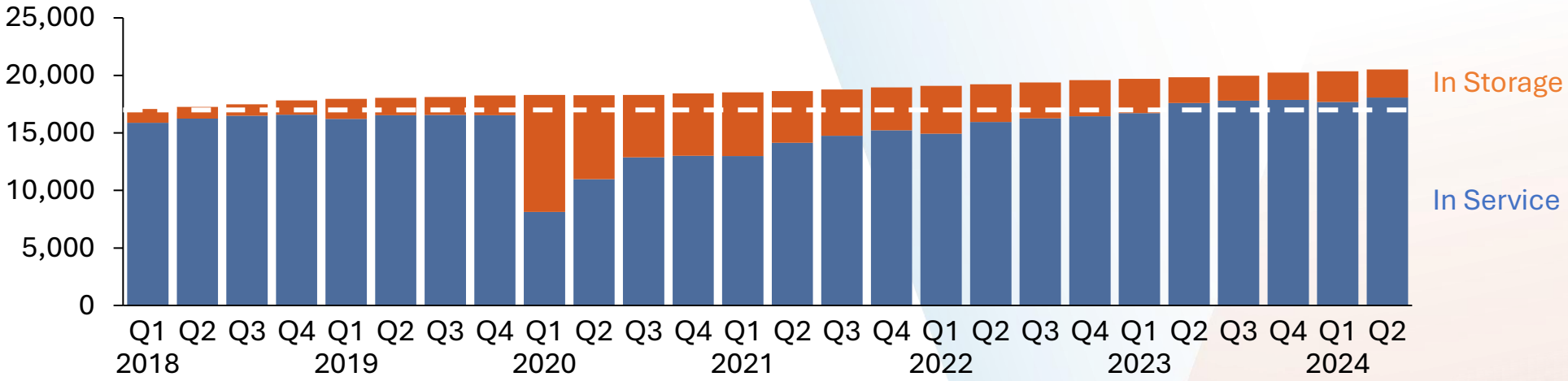


Current supply chain dynamics

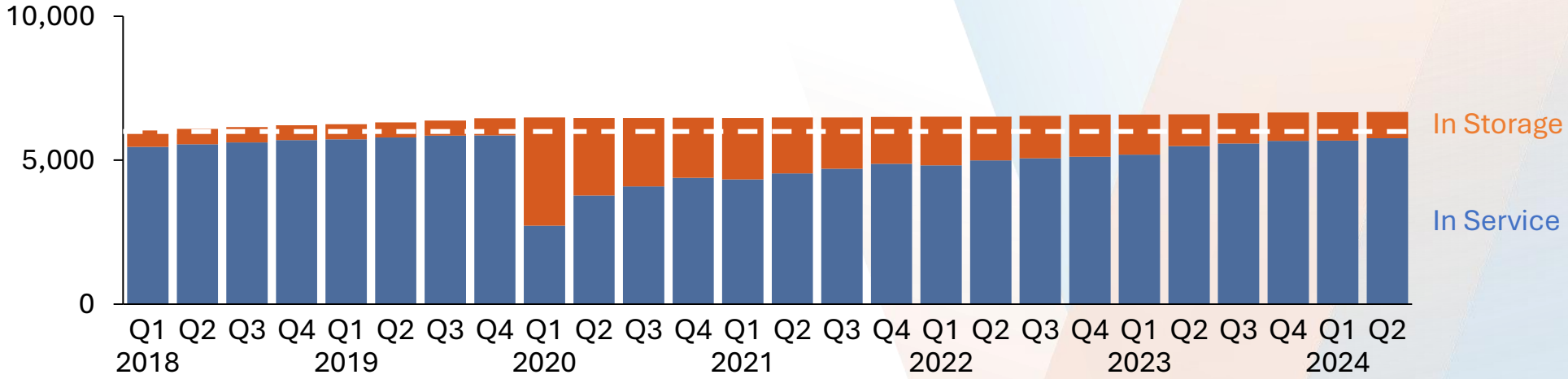
Next generation single-aisle

Aircraft have largely returned to service as traffic recovers

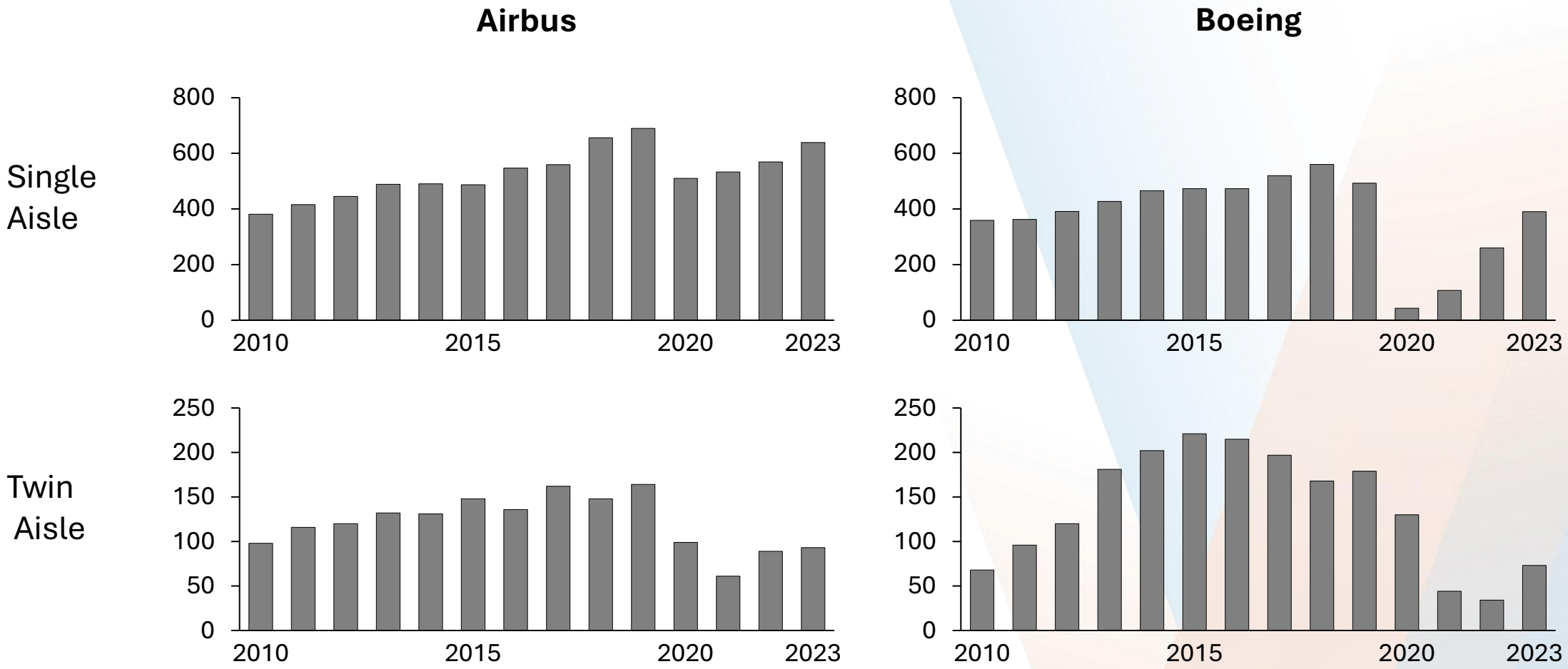
Global Narrowbody Fleet



Global Widebody Fleet



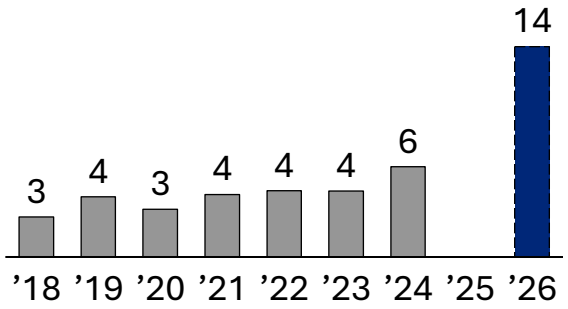
Production rates are picking up but have not fully recovered



Composites-intensive aircraft production rates will continue to increase over the next few years

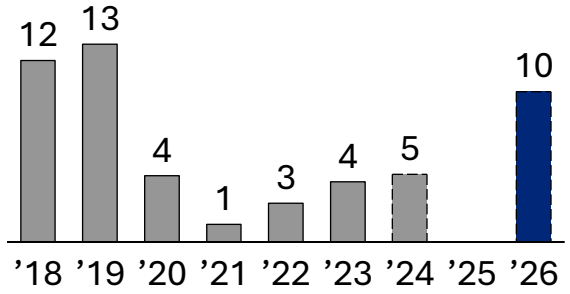
Airbus A220
- Composites: 46%

Monthly production



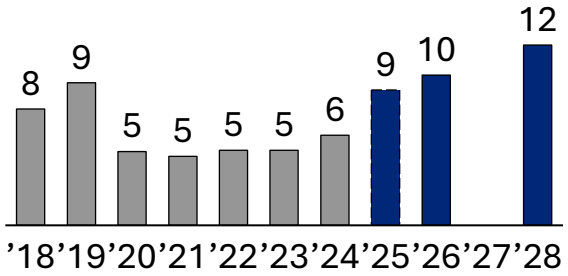
Boeing 787
Composites: 50%

Monthly production



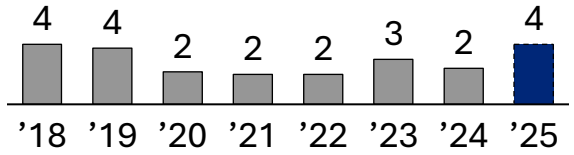
Airbus A350
- Composites: 53%

Monthly production

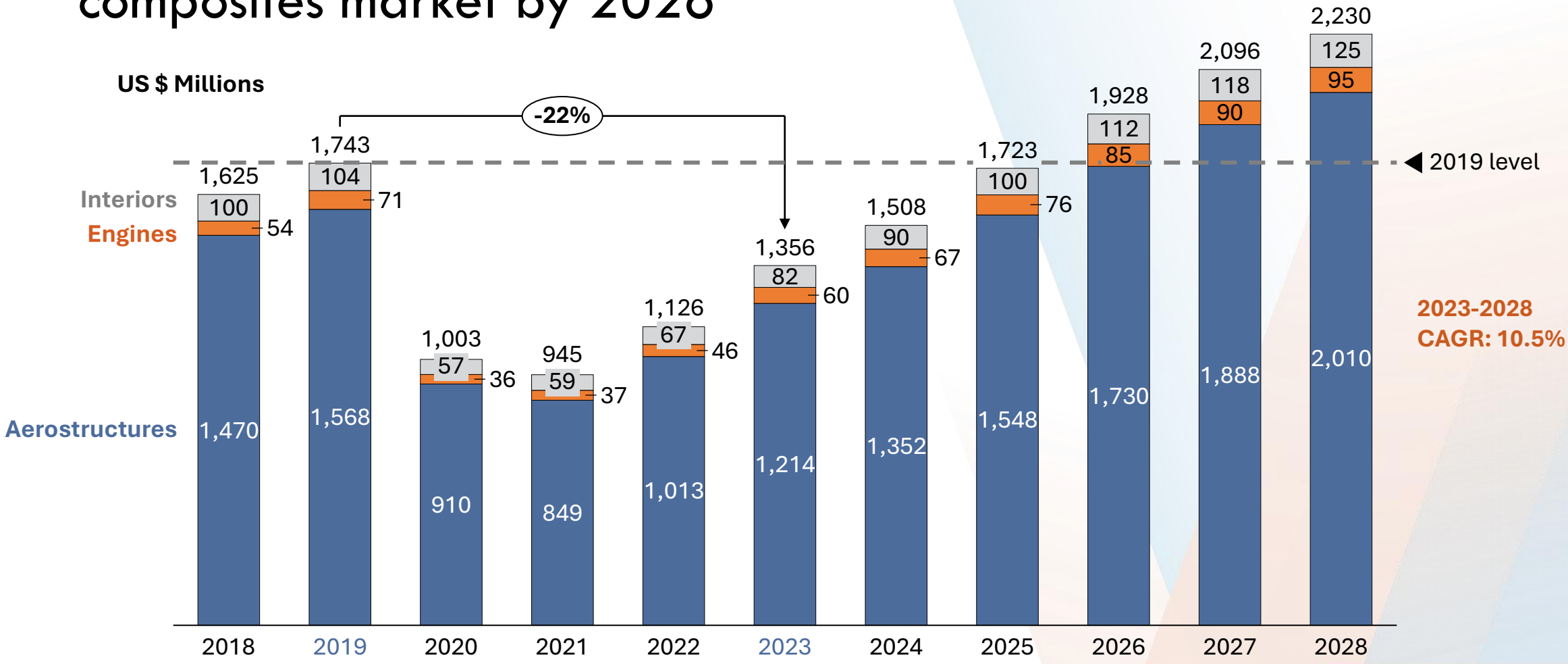


Boeing 777/X
- Composites: 30%

Monthly production

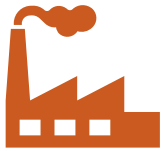


Counterpoint forecasts recovery of the aerospace carbon fibre composites market by 2026



Contents of today's presentation

Aerospace demand situation



Current supply chain dynamics

Next generation single-aisle

Current high-level aerospace supply chain dynamics

737 MAX crashes cause supply chain issues

Boeing's 737 MAX (and some 787) issues continue

2019 — 2020 — 2024

COVID causes disruption, a lot of skilled workers left the industry

AEROSTRUCTURES

Improving but labour and material shortages persist

INTERIORS

Continuing supply problems with passenger seats, particularly Business class

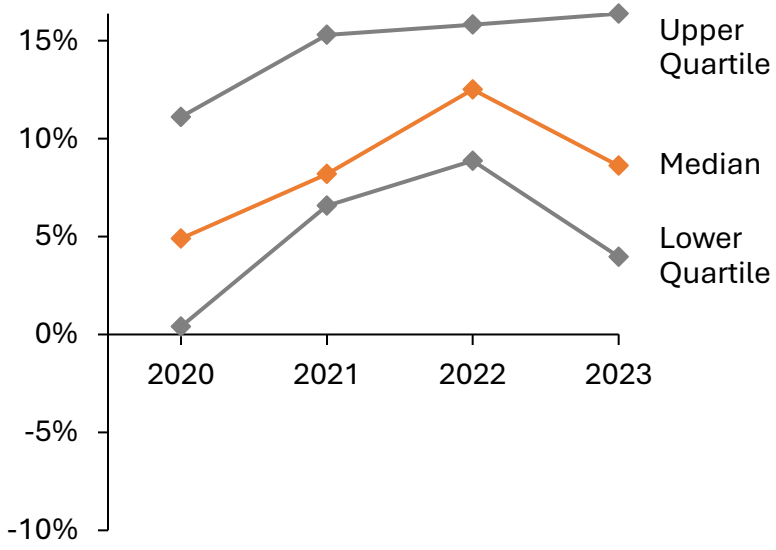
ENGINES

Modern engines haven't been durable, so more spares are required

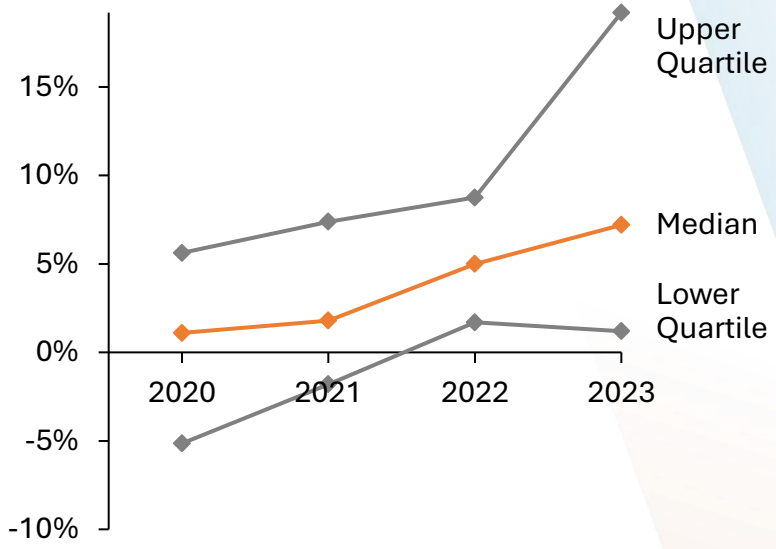
Today: Neither the supply chain nor the industry's profitability has fully recovered

Aerospace CFRP supply chain profitability

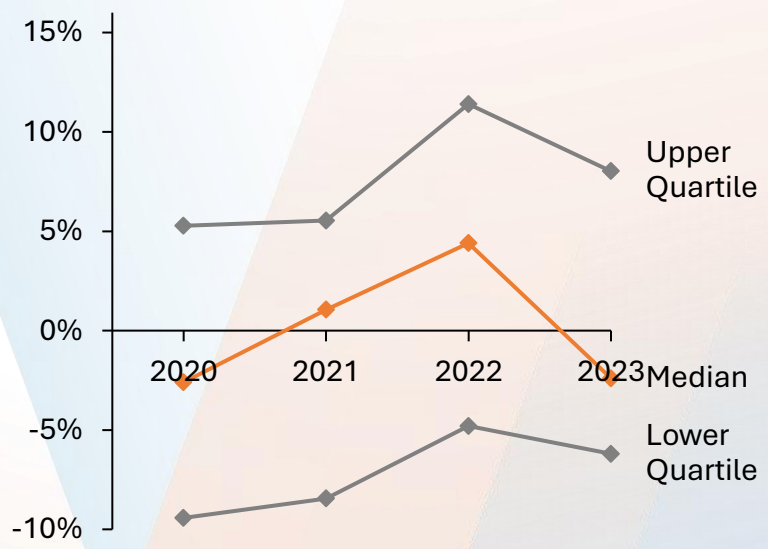
Carbon Fiber & Intermediates
Operating margin



Tier 2 Aerostructures*
Operating margin



Tier 1 Aerostructures*
Operating margin



*Both metallic and composite

Why is profitability difficult for the aerostructures industry?

- **Very limited aftermarket (apart from nacelles)**
- **A fragmented market; competition is intense**
- **Design & build contracts can be challenging; achieving desired profitability is dependent on**:
  - Not overspending on non-recurring costs at programme beginning
  - Programme timing not slipping significantly
  - Achieving the expected learning curve reductions in unit cost (e.g. Spirit on composites structures)
- **Doesn't often benefit from economies of scale**
  - Specialised tooling and equipment
  - Qualified production – sites and processes
- **Fewer opportunities to differentiate**
  - Processes - less IP intensive
- **Composite processes are mostly capital intensive**

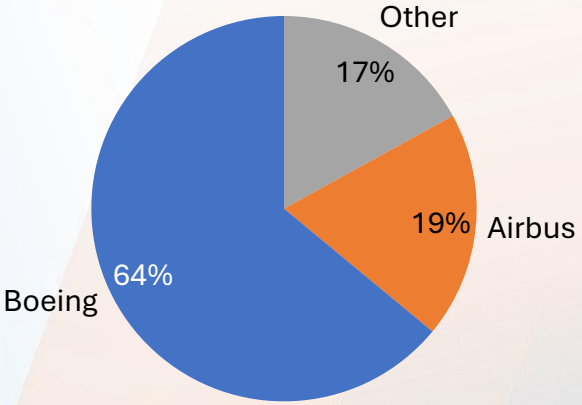
As a result, we have seen a decline in ‘Super Tier 1’ suppliers in aerostructures

TRIUMPH	SPIRIT AEROSYSTEMS	GKN AEROSPACE	LEONARDO
Exited the aerostructures business	Being acquired by Boeing	Specialised and diversified into engines	Has not been profitable for many years

What are the implications for the aerospace supply chain?

- **OEMS are taking more production of aerostructures in-house**
  - Airbus's recent creation of **Airbus Atlantic** brings together many aerostructures groups in-house
  - Boeing has decided to make much of the **777X wing in-house**
  - Boeing's **acquisition of Spirit** will bring more operations in-house for both OEMs
  - **Gulfstream** has brought a lot of aerostructure in-house
- **Engine OEMs are expanding in-house composite production**
- **We expect aerostructures producers to continue to specialise**
  - Several manufacturers have **focussed** on a portion of the aircraft or **specific technologies**
  - This specialisation provides opportunities for **efficiency** and **differentiation** in the value chain
- **Automation and de-skilling will play a key role – particularly with composites**
  - Aerospace composite structures is currently largely a **'craft' industry**, and many manufacturers have had difficulties introducing cost efficiencies over time
  - Current **lack of skilled labour** is forcing manufacturers to re-think production methodologies and training

The acquisition of Spirit by Boeing will be a major shake-up of the aerostructures industry



Spirit revenue breakdown 2023

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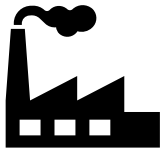
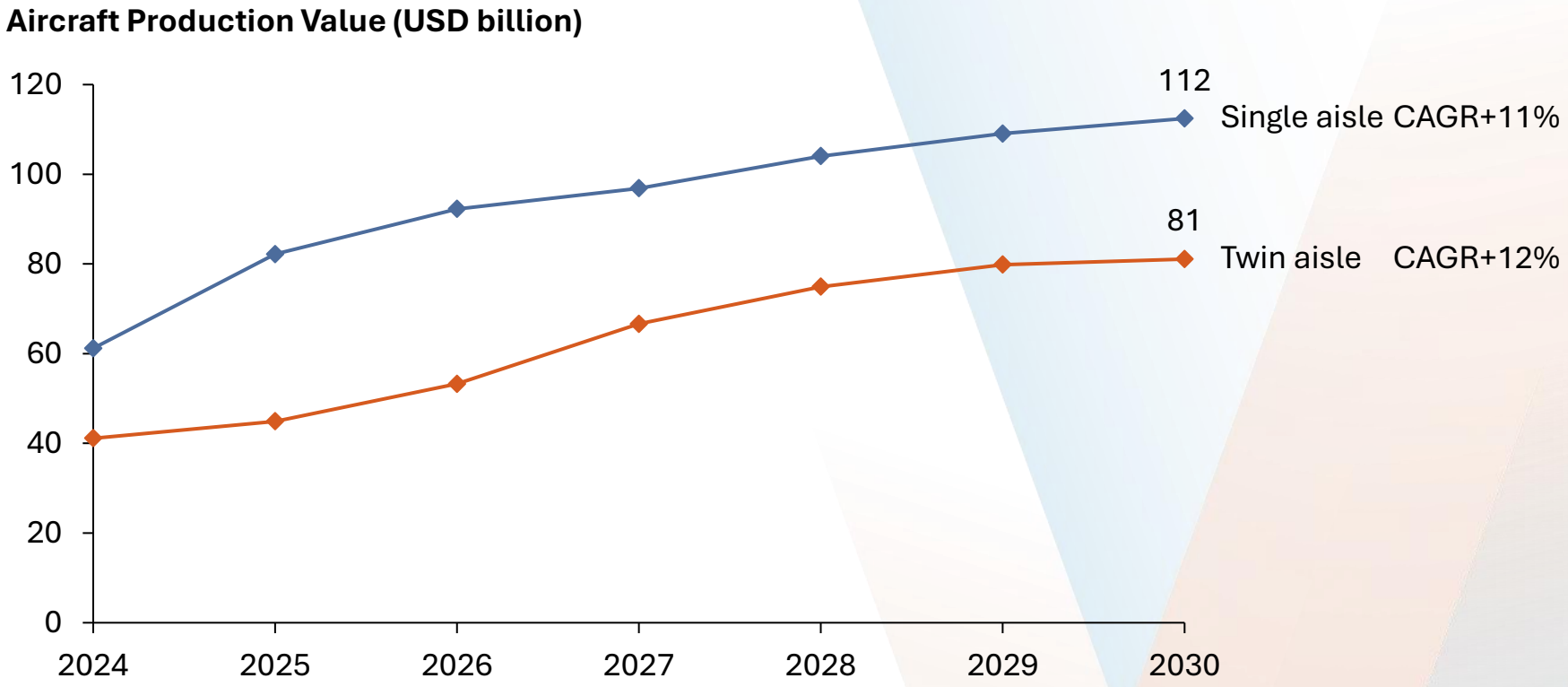


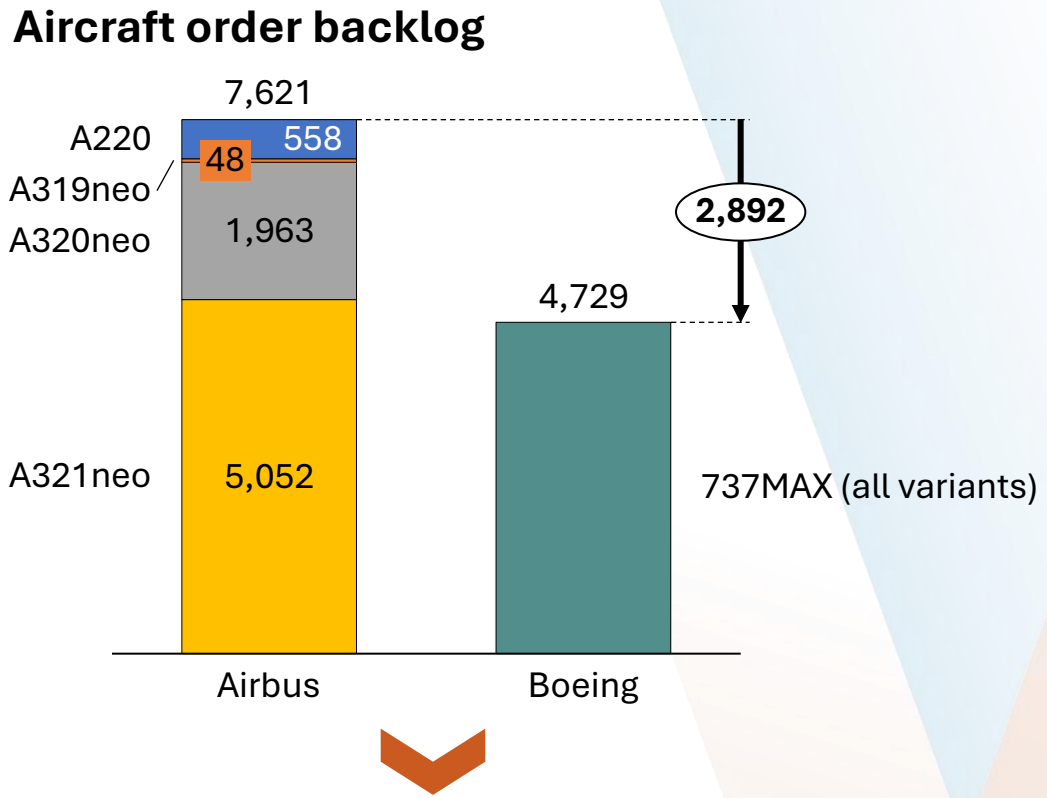
Current supply chain dynamics

Next generation single-aisle

The single-aisle segment represents a huge opportunity for the OEMs

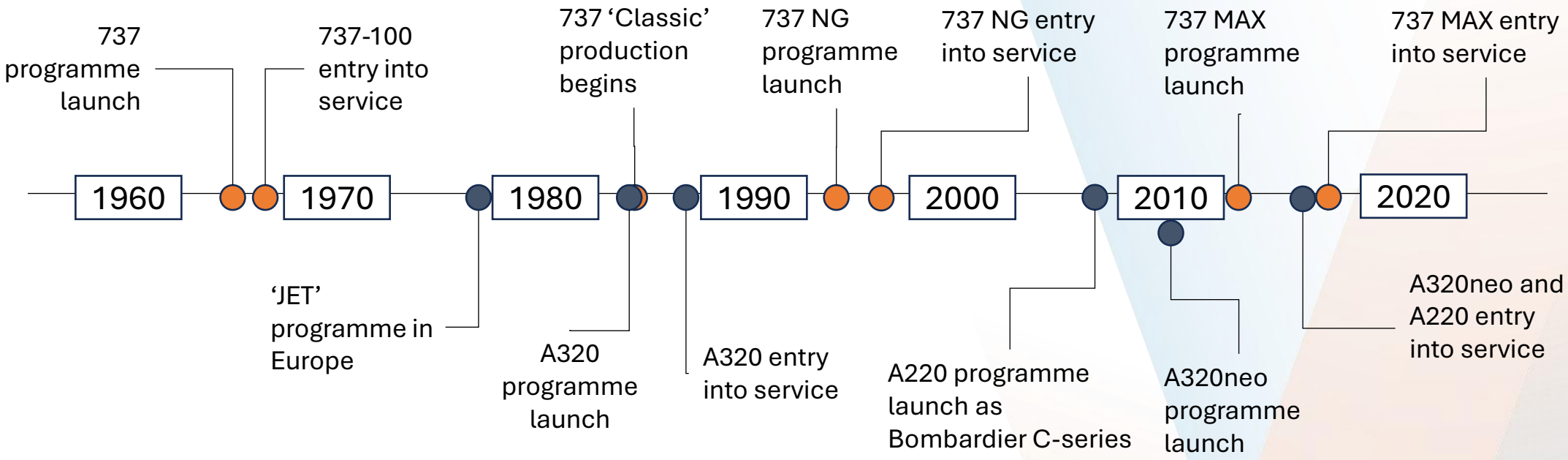


Airbus currently has a dominant position in this segment over Boeing



Airbus currently has more orders for the A321neo than for all Boeing MAX variants combined

Airbus and Boeing's single-aisle aircraft is based on designs originating from the 1960s and 1970s



Each generation of aircraft has improved, but current aircraft would likely fall short of a clean-sheet design uninhibited by legacy design decisions

Future of Single-Aisle Aircraft: OEM Perspectives

AIRBUS

Guillaume Faury, Chief Executive, Airbus

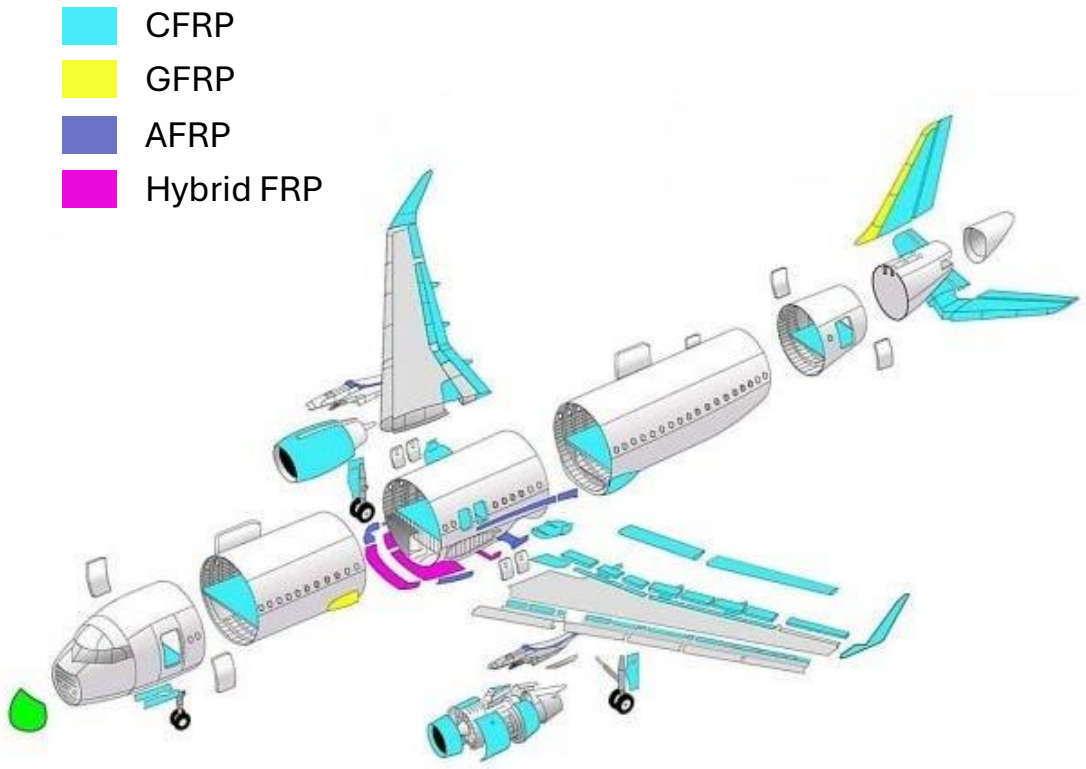
"The next-generation single-aisle aircraft would arrive over the **second half of the 2030s**." It will be based on a "new platform" and **will not be a stretch of an existing variant**. He adds that the airframer wants it "to serve as an enabler to drive **sustainable-fuel consumption**. The successor to the A320 will be a short- to mid-range [aircraft] relying on burning **100% [sustainable fuel]**".

BOEING

There has been no official announcement at Boeing due to continuing turmoil.

Single-aisle jets make up **80%** of the next **20 years** of projected deliveries, meaning Boeing will have to make a move to **remain competitive**, but there are no easy options.

Both the A320 and 737 families are mostly metallic designs



- A320 contains about 15% of composite material
- Boeing 737MAX contains about 10% of composite material

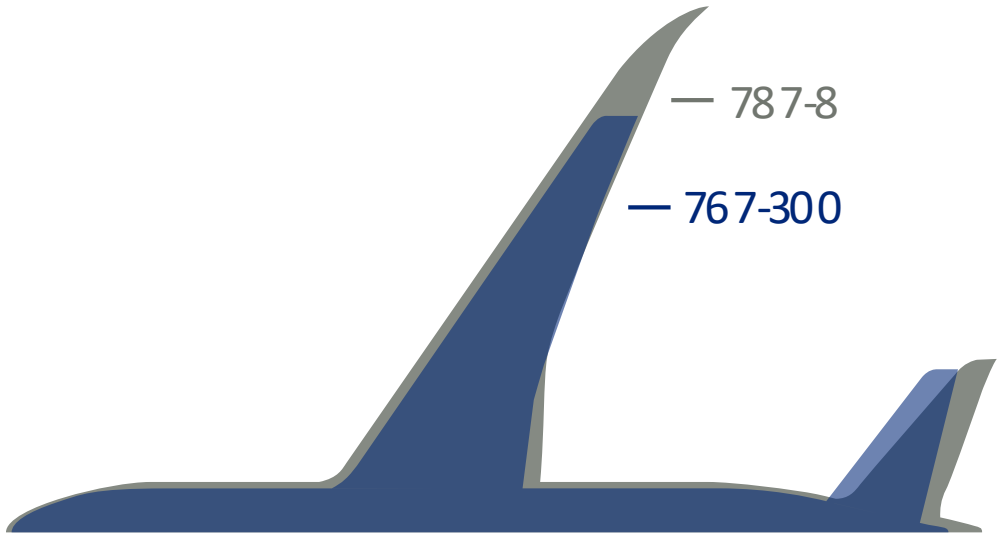
CFRP

Control surfaces, secondary structures, engine cowling

GFRP/AFRP

Radome and fairings

Counterpoint believes the next generation single-aisle design will almost certainly feature a composite wing



Boeing 787-8
Entry into service: 2011
Max passengers: 359
Max take-off weight: 500,000 lbs
Empty weight: **265,000 lbs**
Range with 95,000 lbs fuel and 65,000 lbs payload: **~4,000 nautical miles**

Boeing 767-300
Entry into service: 1982
Max passengers: 351
Max take-off weight: 350,000 lbs
Empty weight: **190,000 lbs**
Range with 95,000 lbs fuel and 65,000 lbs payload: **~3,400 nautical miles**

The 787 is a heavier airplane, but has considerably more range with the same fuel burn

Composites in aerospace isn't just about reducing weight – it is about optimising the entire design

Counterpoint believes the next generation single-aisle design will almost certainly feature a composite wing

Airbus A321neo

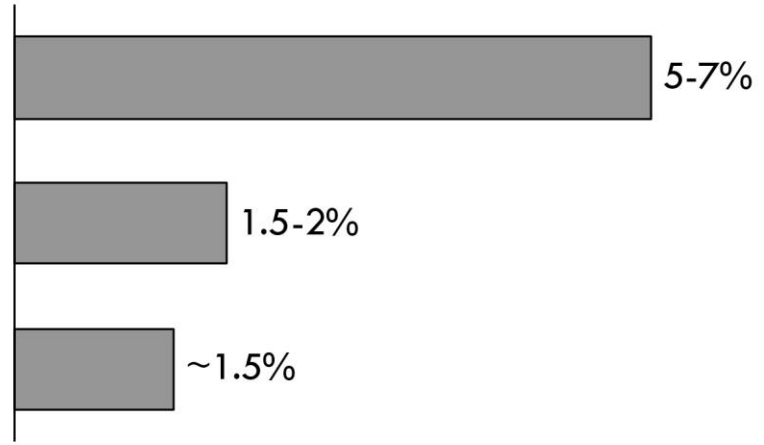
Thinner longer wing → 5% improvement in lift to drag ratio

Lighter wing with same geometry → 20% reduction in wing weight

20% reduction in fuselage weight

Indicative fuel burn improvements

% mission fuel burn

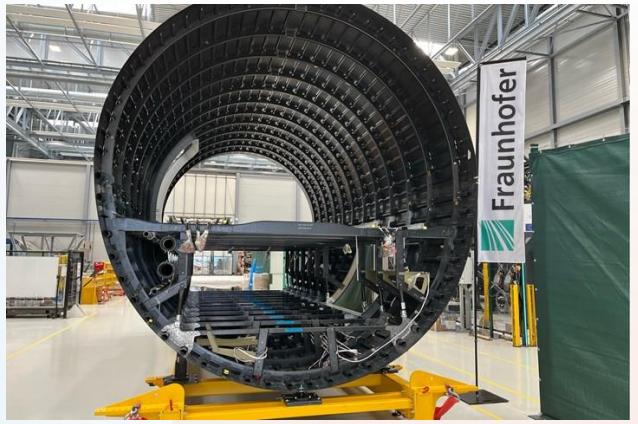


Composites in aerospace isn't just about reducing weight – it is about optimising the entire design

It is less certain whether the next generation single-aisle will have a composite fuselage

- Lower cabin pressure and structural loading make thinner fuselage skins seem possible. However, numerous take-offs, landings, and hail, bird strikes, requiring thicker and heavier panels that offset the benefits of using composite materials.
- Cost is sensitive as single-aisles' profit margins narrower compared to wide-bodies. Production costs of composite aerostructures are 40%-100% higher than metal components.
- 20% reduction in fuselage weight using composites would result in a 1.5% drop in fuel consumption.

HondaJet HA-380

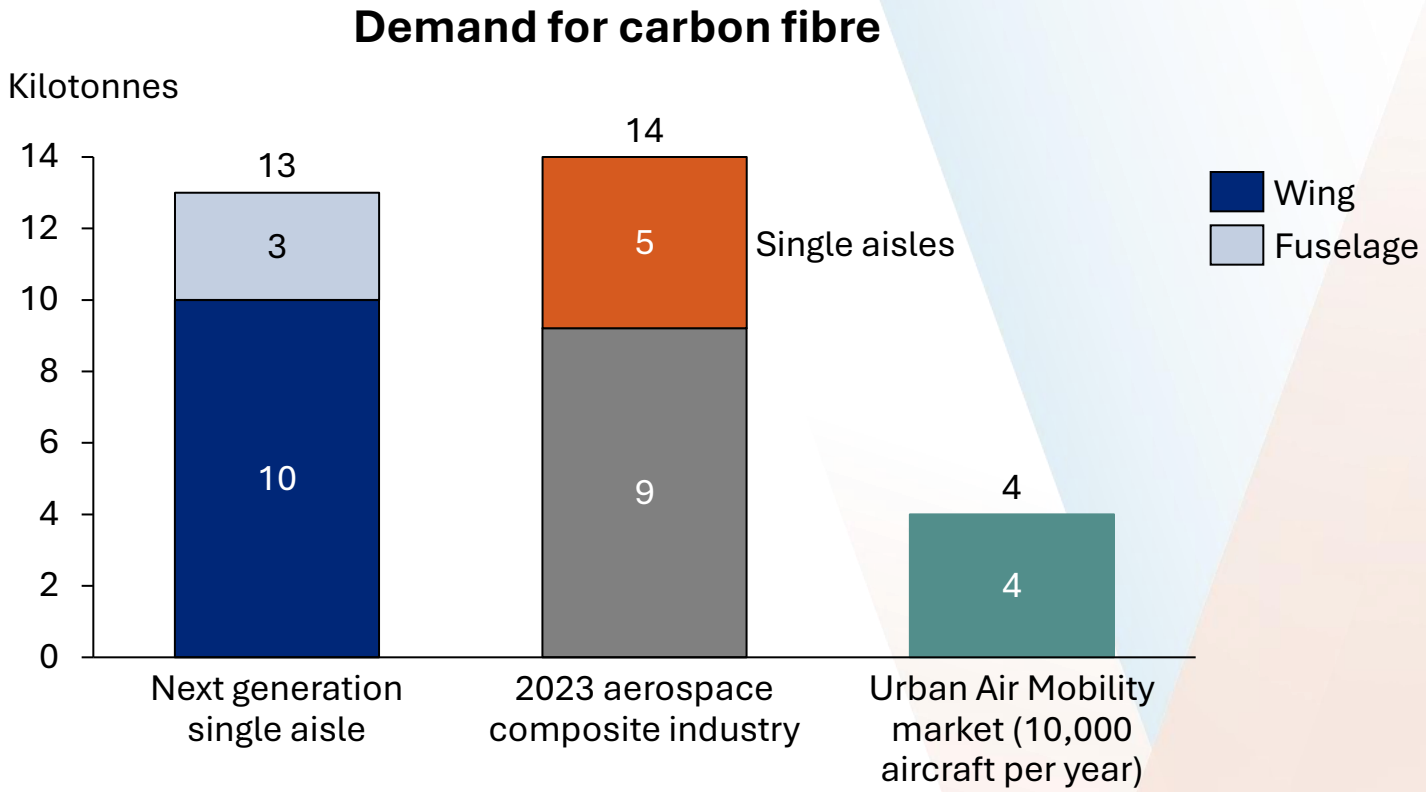


Echelon

Multi-Functional Fuselage Demonstrator

The fuselage may depend on the timing of the programme and the maturity of technology

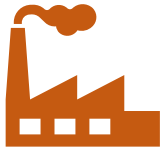
The next generation single aisle could be the next major opportunity for the carbon fibre industry



Conclusions

Aerospace demand situation

- Demand has now recovered to pre-Covid levels
- But aircraft manufacturers are still struggling to ramp up production
- We forecast recovery of the aerospace carbon fibre composites market by 2026



Current supply chain dynamics

- Currently failing to meet aircraft OEMs' requirements
- Engines are the biggest issue, compounded by poor durability of latest engines
- Labour and material shortages and poor profitability, particularly in aerostructures

Next generation single-aisle

- Boeing 737 and A320 are due for replacement
- The big issue is when? - Engines are a key factor. Our best guess is programme launch end of the decade; EIS 2035-2040
- Carbon fibre wings are almost certain. Volumes will be significant – a major opportunity for the CF industry

Thank you!

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