



NAVEO
CONSULTANCY

Air Transport Fleet & MRO Trends

30 September 2024

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Foreword

The travel recovery continues, translating into continued demand for MRO services. It took five years, but 2024 started well, with hours 103-109% of January 2019. Since July 2023, air transport flying hours have been at or very close to 2019 levels. Total flying hours in 2023 were ~97% of full-year 2019 flying hours and a substantial increase on the ~79% of 2019 flying hours seen in 2022. This August saw flying hours that were 107% of August 2019 hours.

So far in 2024, flying hours from January to the end of August have been 106% of those flown from January to August 2019. International flying hours in August 2024 were up an impressive 11% on August 2023, and domestic flying hours were up 3% on August 2023. Domestic travel has been leading the recovery, with utilization already above pre-COVID levels, but international flying is now above pre-COVID levels, with utilization at ~102% of pre-COVID levels. It's good to see international flying back.

Supply chain challenges persist and cause frustration for airlines, MROs and OEMs. Shortages of talent, raw materials, production and maintenance capacity continue to manifest in new aircraft delays, part delays and extended maintenance lead times. In-service durability issues, particularly with some engines, are being addressed, but as we work through these remedies, retirements have been delayed, and supply-chain bottlenecks continue.

Production and MRO capacity remain tight. In recent years, relatively higher interest rates have made it harder and costlier for some sub-tier suppliers to obtain working capital to fund the production and MRO market ramp-up. Long payment terms with OEMs aren't helping smaller supplier cash flow or their appetite to invest in air transport production or aftermarket to meet demand.

The aviation conference season is upon us once again, each offering the chance to learn, network, and discuss ideas on how to address the many challenges our industry faces. I've just moderated panels at AeroEngines Europe and MRO Asia. There are more to come, and provide a welcome forum to debate solutions. We certainly aren't short of issues to discuss.

Most of the challenges we face are not new. For instance, we've been aware of the labor issue for years, a trend accelerated by COVID. It's not clear to me that we have a good enough industry plan to address this acute issue of retaining, developing and attracting the talent that we need to manufacture and repair aircraft, engines and systems over the next decade and beyond.

Airbus has just released its latest market forecast. Over the next 20 years, they forecast global demand for ~690,000 new technicians, 620,000 new pilots and 950,000 new cabin crew, totaling more than 2.26 million additional skilled people. That's a lot of people to attract, train and retain!

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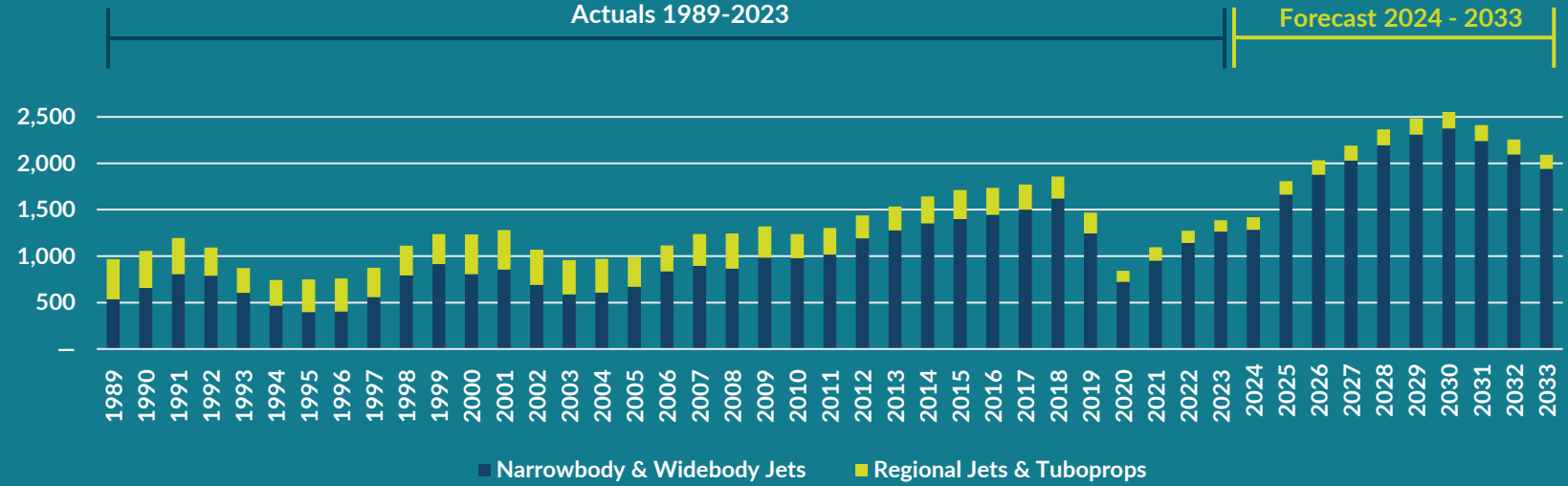
Air Transport Aircraft Delivery Forecast

Air Transport Aircraft Delivery Forecast

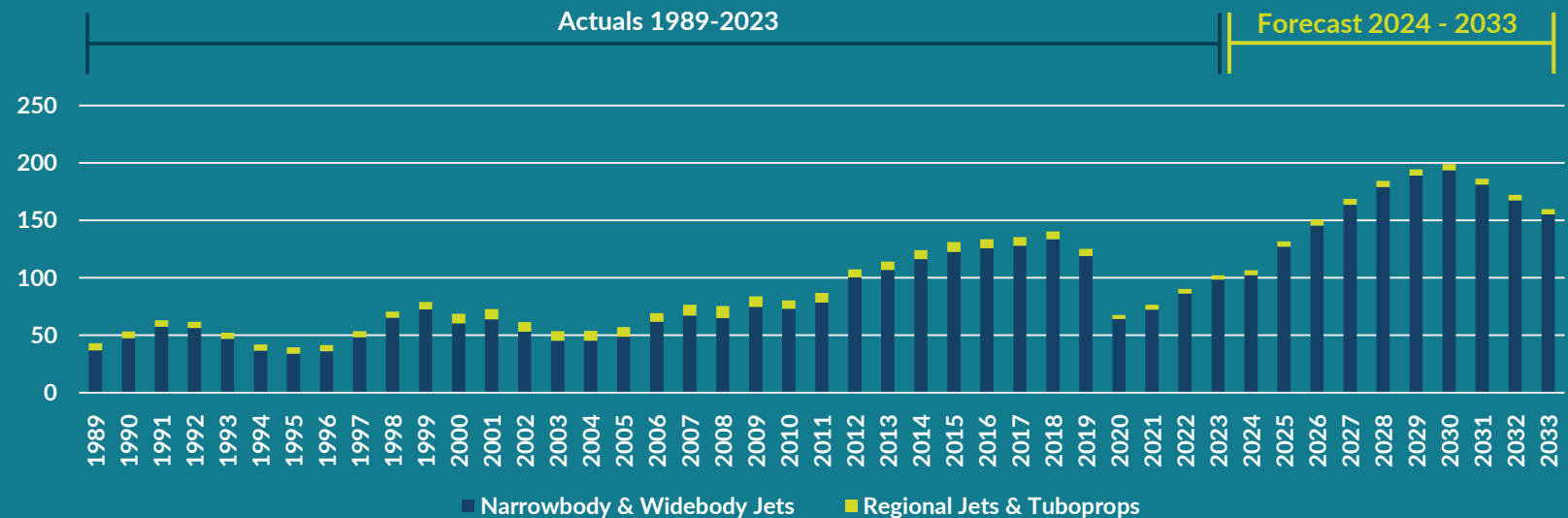
It will likely take until 2026 for air transport new aircraft deliveries to exceed 2018 levels

- Between 2024-2033, there are ~21,614 forecasted new air transport deliveries valued at ~\$1,654B
- These are made up of ~20,007 narrowbody and widebody aircraft and 1,607 regional aircraft (jets and turboprops)
- Deliveries will likely take until 2026 to exceed 2018 levels (the previous peak). 2019 deliveries were lower due to the 737 MAX grounding
- Supply chain challenges, including the availability of skilled labor, strikes, raw materials, production capacity, durability and regulatory issues, continue to impact production ramp-ups
- Demand is strong, but manufacturers are struggling to meet that demand

Air Transport Annual Deliveries - History & Forecast (Qty of Aircraft)

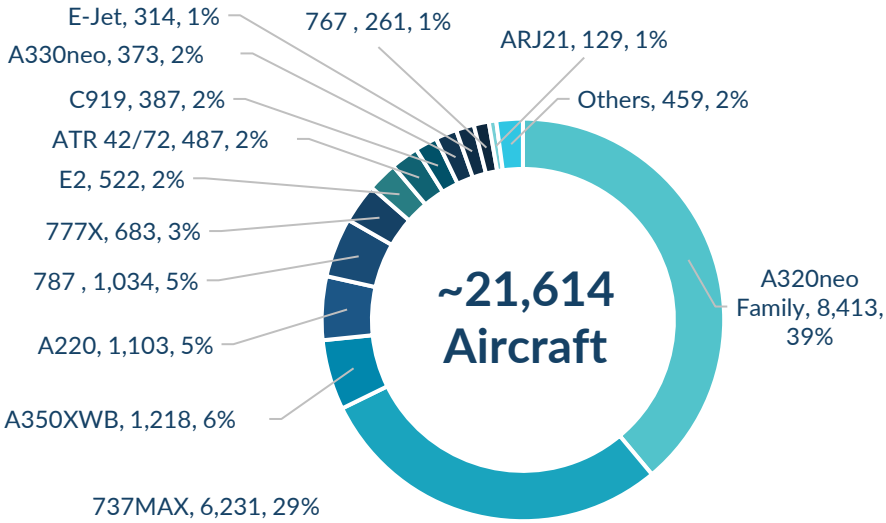


Air Transport Deliveries - History & Forecast Value (2024 \$B)

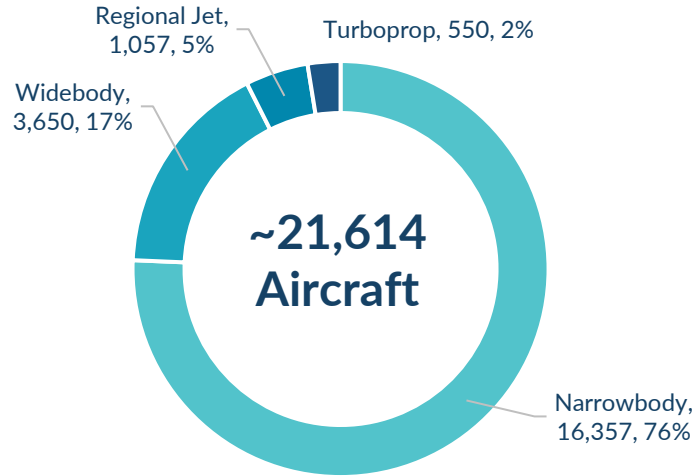


Air Transport Aircraft Delivery Forecast

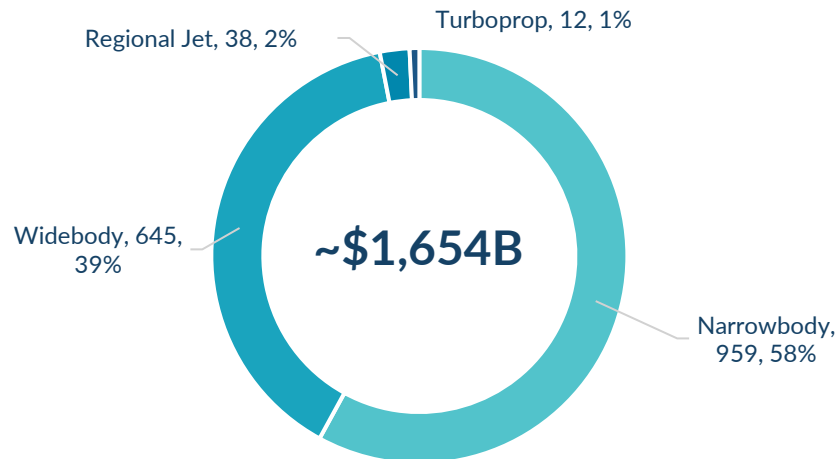
**Aircraft Delivery Forecast Qty 2024-2033
(By Aircraft Family)**



**Aircraft Delivery Forecast Qty 2024-2033
(By Aircraft Size)**



**Aircraft Delivery Forecast 2024-2033
(Value of aircraft in 2024 \$B)**

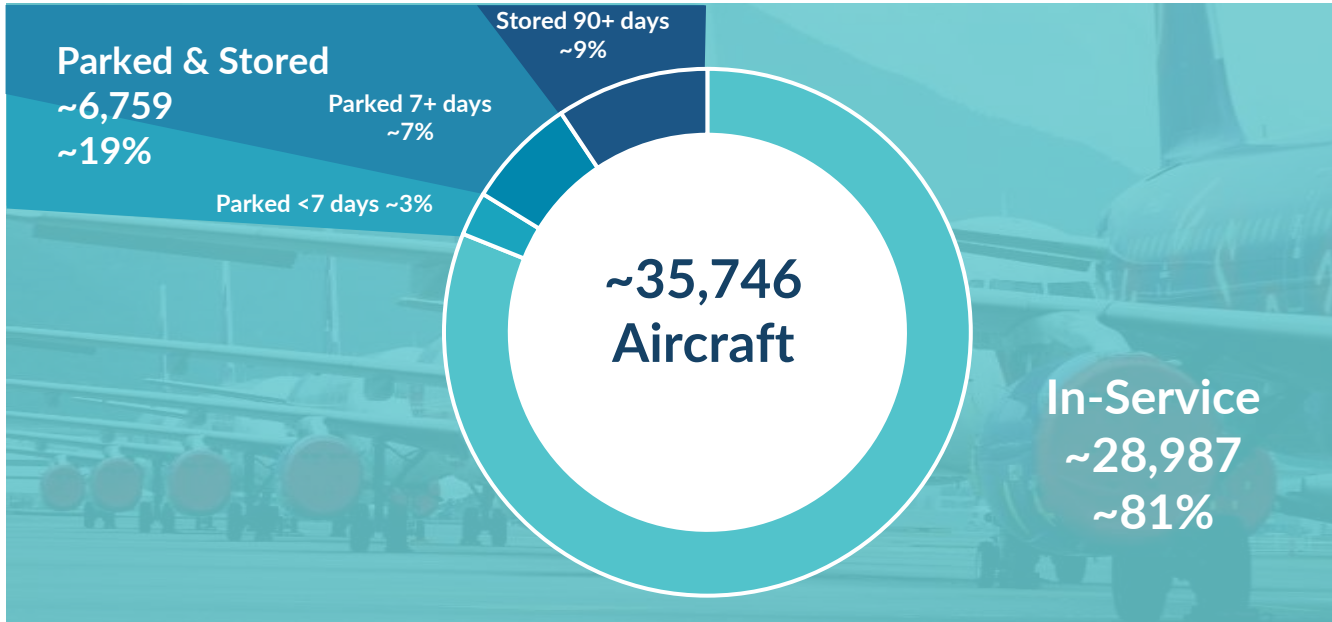


- Of the ~21,641 new air transport aircraft that are forecasted to be delivered between 2024 and 2033, the A320neo family and 737 MAX represent ~68% by quantity (~14,644 aircraft)
- The demand for fuel-efficient replacements for aging aircraft (e.g., 737 Classics, 737NG, A320ceo family, 757s, 767s) is driven by fleet renewal, continued passenger growth in emerging markets, and demand from low-cost carriers. This is driving demand for the new A320neo family, 737 MAX, A220s, A350s, 777Xs, and 787s
- Of the ~8,413 forecasted A320neo family deliveries, the A321neo comprises 63% (~5,306 aircraft)
- Narrowbody aircraft represent ~76% of deliveries by the quantity of aircraft (~16,357 aircraft). Widebody aircraft are forecasted to represent ~17% of future deliveries, with regional jets and turboprops comprising the remaining 7% of deliveries
- However, in terms of \$ value, due to the higher cost of widebodies, they make up a larger share, with widebody aircraft comprising ~39% (\$645B) and narrowbodies ~58% (~\$959B)

Air Transport Fleet Status

In September 2024, ~81% of the global air transport fleet is in active service, and ~19% is parked/stored

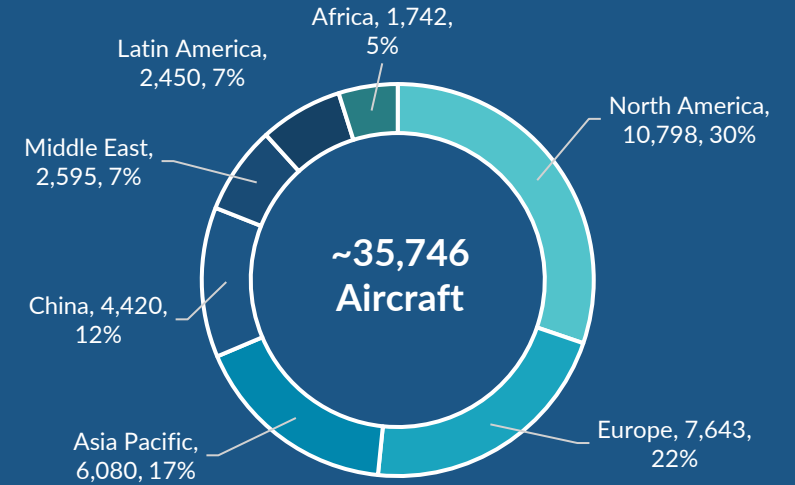
Air Transport Fleet Status September 2024
(Qty of Aircraft In-Service and Parked/Stored)



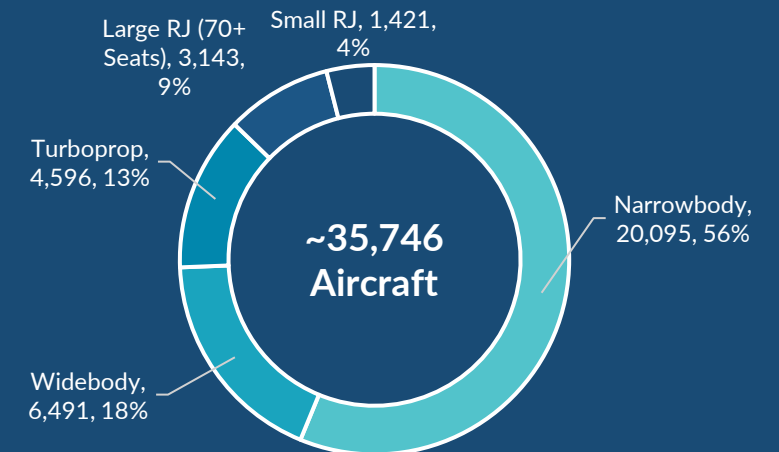
- ▲ ~81% of the air transport fleet is in active service (~28,987), and ~19% (6,759) are parked or stored
- ▲ This is the same % as July and an improvement from June, when ~80% of the fleet was in active service, and May when the fleet was ~79% active
- ▲ September 2023 saw ~80% of the fleet in-service, so there's a slight improvement with today's ~81%, but the fleet situation remains fluid
- ▲ There are many short-term aircraft parked for less than seven days (~965), and a further ~2,446 parked for more than seven days and less than 90 days (down 197 aircraft from June 2024)
- ▲ There are ~3,348 aircraft that have been stored for longer than 90 days. That's down from 3,482 aircraft stored in June 2024 and 3,598 stored in May. There were ~3,806 stored aircraft in September 2023. This trend indicates that the recovery is continuing as aircraft return to service and also retirements are occurring

Source: Aviation Week Fleet Discovery. September 2024. Naveo analysis

Air Transport Fleet By Operator Region
(Qty of Aircraft In-Service, Parked & Stored) – September 2024

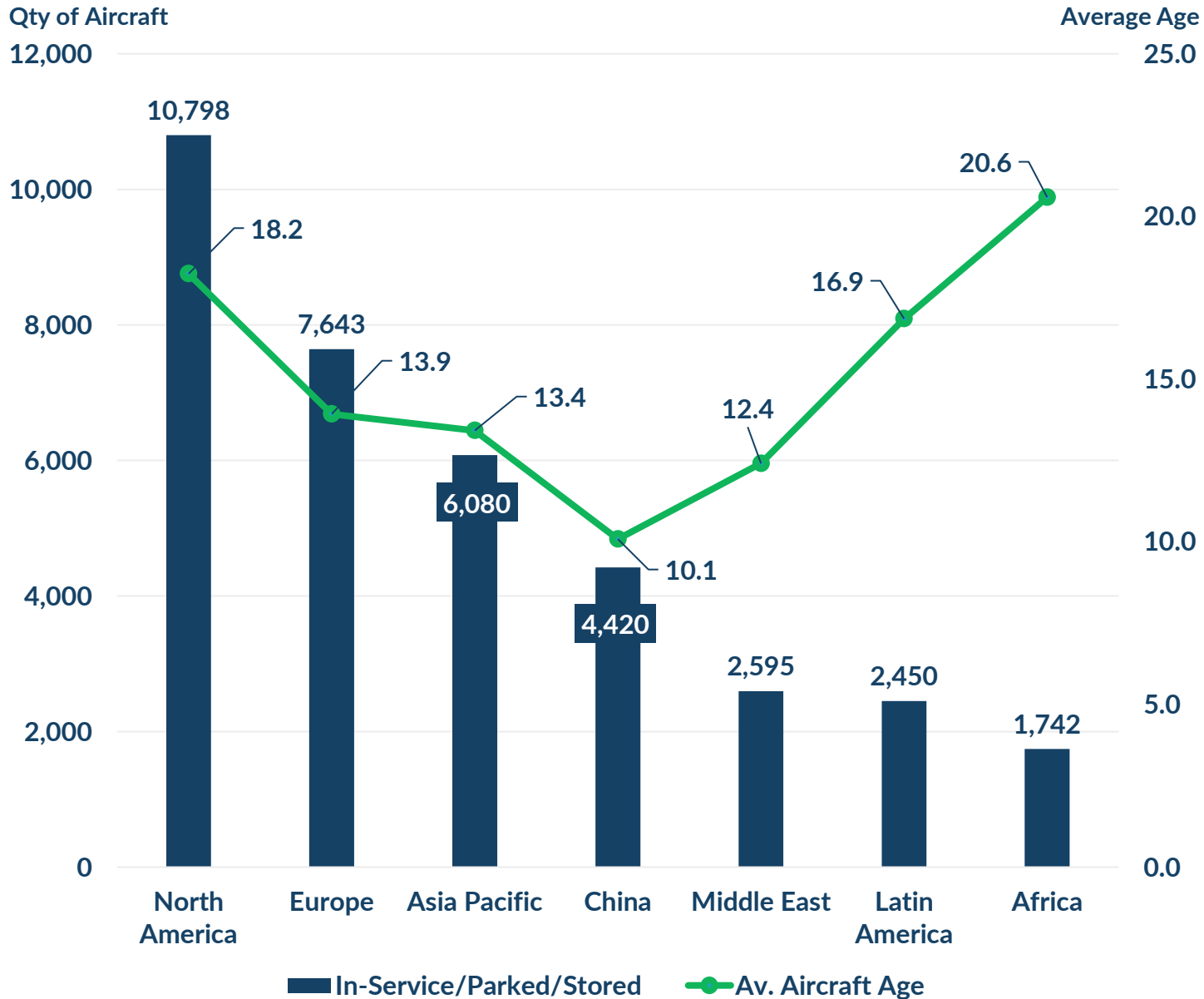


Air Transport Fleet By Size
(Qty of Aircraft In-Service, Parked & Stored)



Air Transport Fleet In-Service/Parked/Stored & Average Age by Operator Region – September 2024

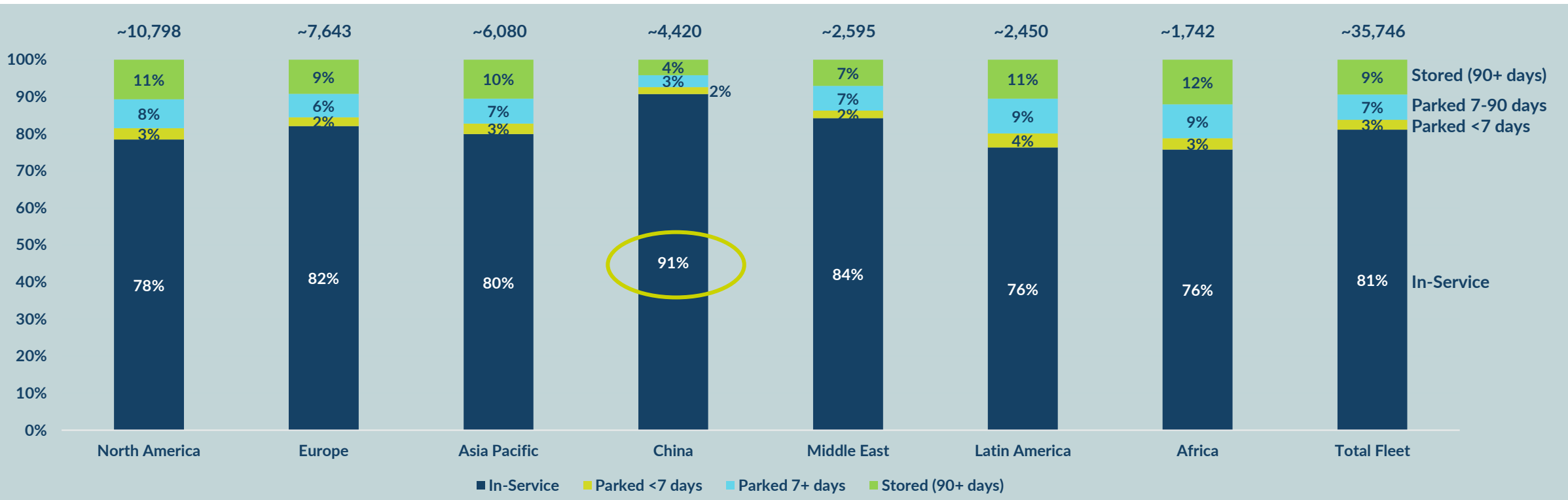
Quantity of Aircraft Ranked By Largest Fleet Size Left to Right



- ▲ The average global age of the current air transport fleet is ~15.1 years of age
- ▲ However, the average age varies by operator region
- ▲ China has the lowest average fleet age at ~10.1 years
- ▲ Asia Pacific's fleet is also relatively young at ~13.4 years
- ▲ Africa has the oldest fleet at ~20.6 years
- ▲ The North American fleet is also mature at ~18.2 years of age

China continues to lead the way with ~91% of its fleet in active service

Air Transport Fleet Status by Operator Region – September 2024
 % Aircraft In-Service/Parked/Stored – Ranked By Largest Fleet Size Left to Right

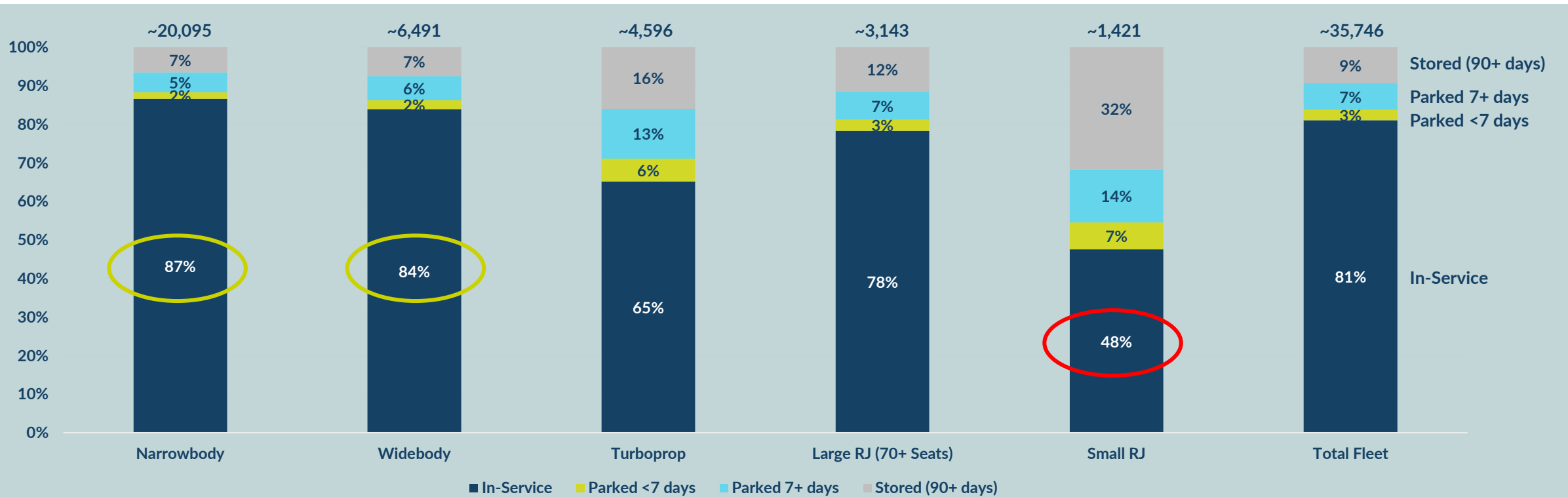


- Overall, ~81% of the global air transport fleet is in active service in September 2024, yet there are some regional differences
- China has the highest percentage of its fleet in active service (91%), up from 89% in May but down from the 93% seen in September 2023. Latin America and Africa have the lowest at 76%. That's up from the 75% seen in June and 73% that Africa saw in September 2023
- The Middle East fleet is doing well, with ~84% in active service. That is up from ~83% seen in June and the 82% active in-service fleet seen in September 2023
- North America, at 78%, is the same as seen in June and July and up 1% on February 2024. September 2023 saw the North American fleet have ~79% of the fleet in active service. Engine durability issue groundings are likely playing a part here. We await the North American fleet to reach ~80%+ in active service
- Europe has ~82% of its fleet active, up on the 80% seen in June, 77% seen in May and 72% seen in February. Back in September 2023, the European fleet was ~80% in service, so it's good to see continued improvement

Source: Aviation Week Fleet Discovery. September 2024. Naveo analysis

Narrowbody aircraft continue to lead the traffic recovery, with ~87% actively flying

Fleet Status by Aircraft Size – September 2024
 % Aircraft In-Service/Parked/Stored – Ranked By Largest Fleet Size Left to Right

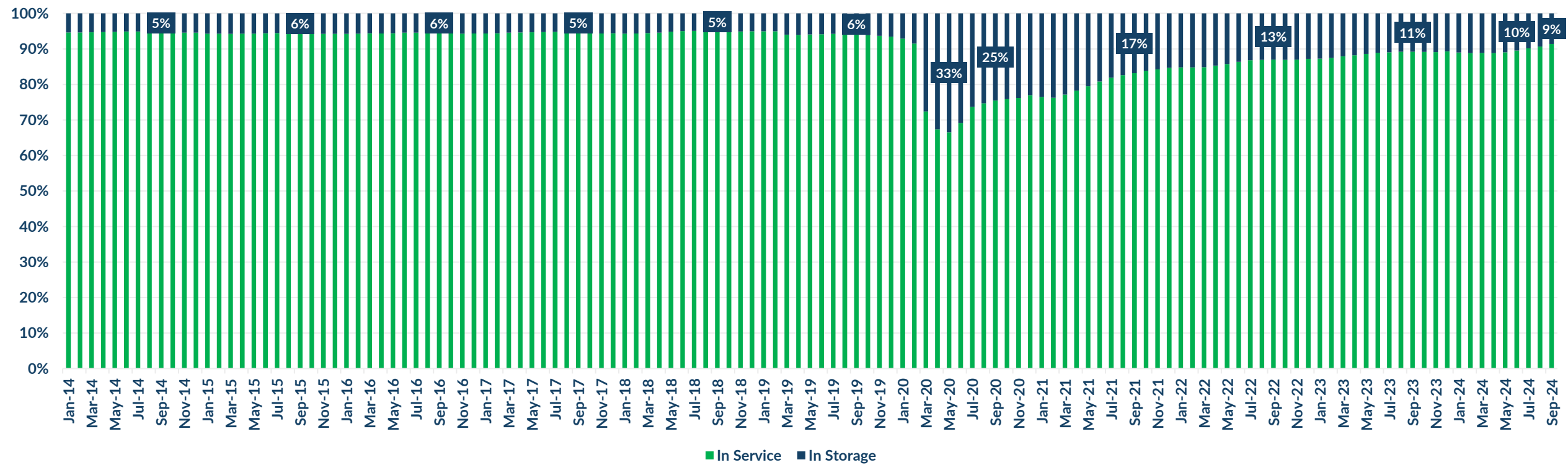


- ▲ Narrowbody aircraft such as 737NG/MAX and A320ceo/neo family have been vital to the traffic recovery and continue to lead with ~87% in active service (up from 86% in June and 83% in May and the same as the ~87% seen last year in September 2023)
- ▲ ~84% of widebody aircraft are in service (up from 83% in June and 81% in May and above the 82% seen in September 2023), showing that international traffic is, thankfully, rebounding

- ▲ Smaller regional jets (e.g., Embraer 145 family and CRJ200s) continue to struggle with a large proportion (~48%) of the fleet parked/stored. This is primarily driven by airlines upgating to larger aircraft (e.g., E-Jets, E2s, A220s) and relatively higher fuel prices
- ▲ Note how widebody aircraft now have a higher % of the fleet in service compared to turboprops or larger regional jets – which shows the continued recovery of international traffic and continued new aircraft deliveries

The % of stored aircraft for 90+ days has slowly reduced since April 2020. It's currently at ~9%, still above the September 2018 level of ~5% and September 2019 level of ~6%

Air Transport Stored Fleet and In-Service/Parked Fleet as % of Total
January 2014-September 2024

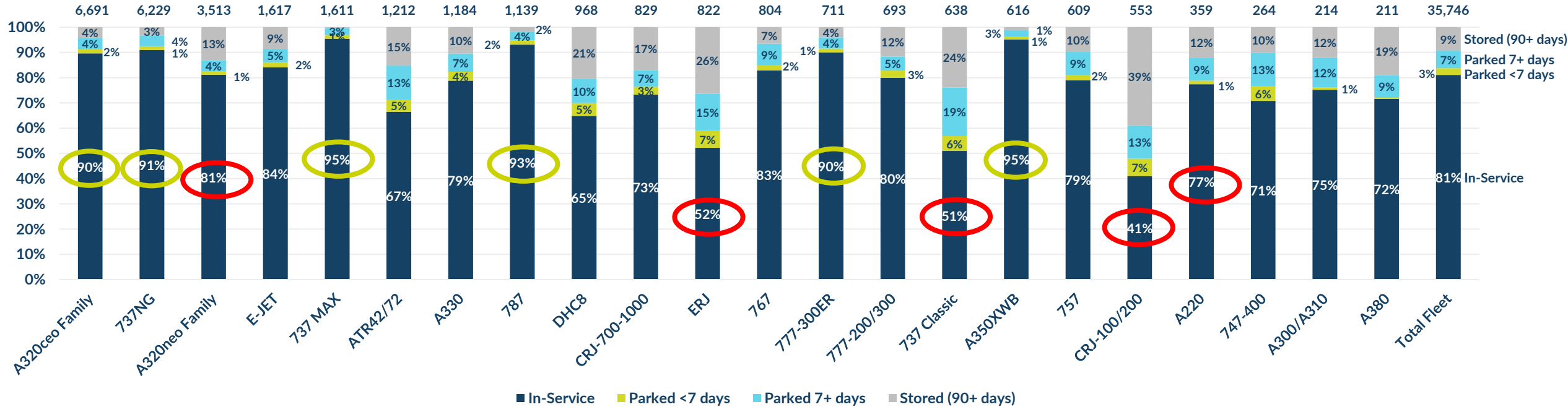


- ▲ Before COVID, approximately 5 to 6% of the air transport fleet was stored (inactive for at least 90 days) at any one time
- ▲ In September 2019, ~6% of the air transport fleet was stored
- ▲ The stored fleet peak was in April and May 2020, when ~33% of the fleet was stored
- ▲ It's been a long recovery since then, with the in-service active fleet hovering above 10% until it actually hit 10% in June this year
- ▲ In August 2024, ~9% of the fleet was stored (the lowest level of stored aircraft since COVID), and it has remained at ~9% stored during September, though this is still above the ~5-6% of the fleet stored before COVID. Hence, there's still further improvement to come as aircraft retire and others return to service

Source: Aviation Week Fleet Discovery. September 2024. Naveo analysis

The 737 MAX, A350XWB and 787 lead the way with the highest % of their fleet in active service

Top Air Transport Aircraft Families Fleet Status – September 2024
 % Aircraft In-Service/Parked/Stored – Ranked By Largest Fleet Size Left to Right

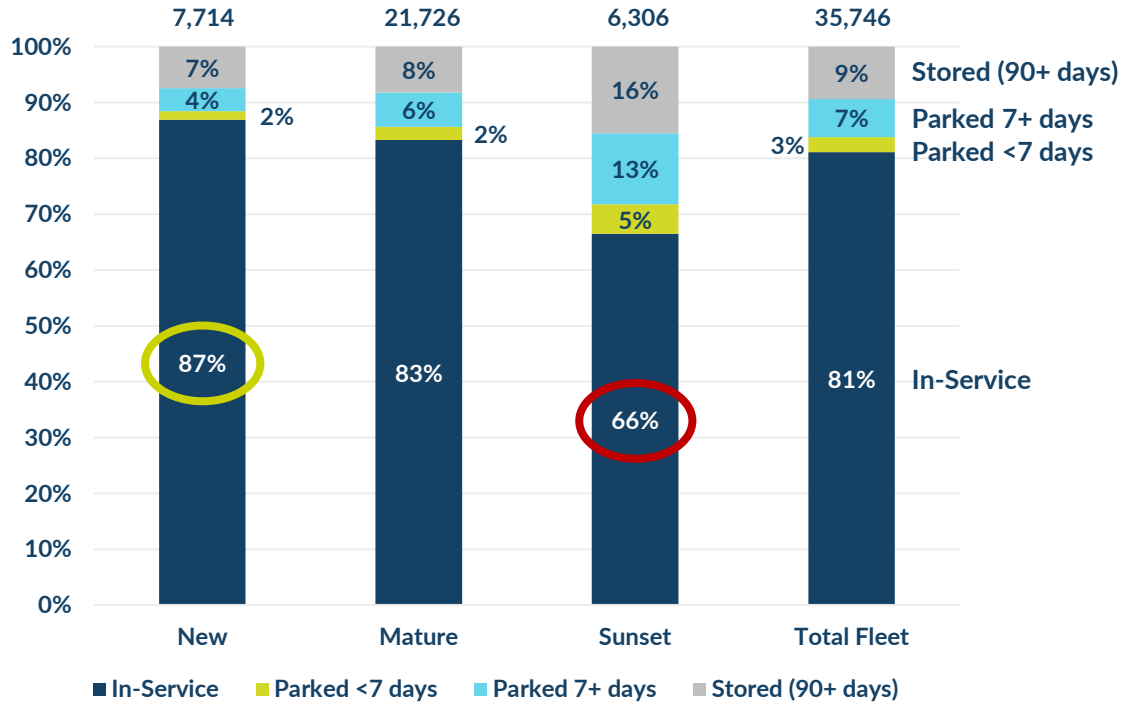


- ▲ The fleet recovery continues, with ~81% of the air transport fleet being in active service
- ▲ However, as can be seen, there are differences between the different aircraft families where the likelihood of an aircraft being in service varies, and there continue to be winners (e.g. 737MAX, A350XWB and 787 leading the pack) and those that are struggling (e.g., A320neo family, A220, 50-seater regional jets)
- ▲ The Boeing 737 MAX remains the overall fleet leader (shared with A350XWB), with ~95% of the fleet active in service (same as May but down 1% on June)
- ▲ Compare this to the A320neo family, where only ~81% are in active service (same as February and up 1% on June). This is due primarily to engine durability issues. The A320neo family has fewer aircraft % in service than the A320ceo family. Also impacted by engine issues is the A220, where ~23% of this new aircraft is parked or stored, up 1% from June

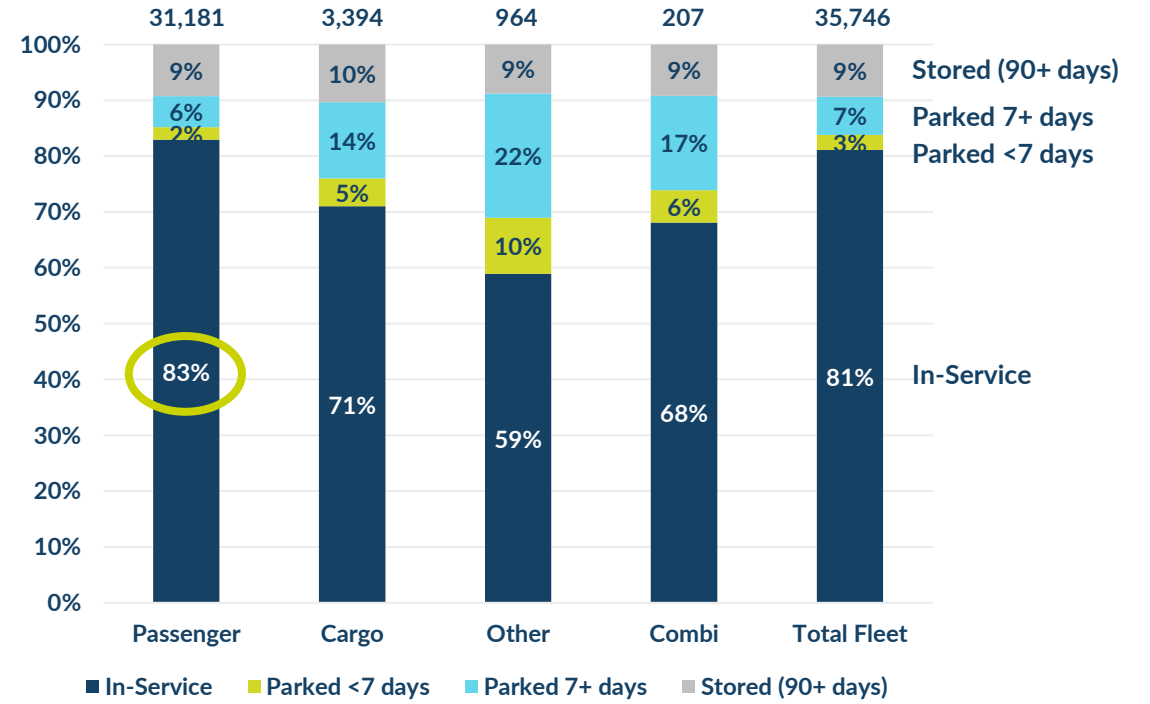
- ▲ The widebody leader is the Airbus A350XWB powered by Rolls-Royce Trent XWB engines, where 95% are in service (up from 93% in May and 94% in June), just ahead of the also popular Boeing 787 (93% in service, the same % as in June)
- ▲ Those new technology aircraft that are not in service are likely undergoing maintenance (including waiting for parts or engines) or lessor-owned aircraft waiting for their next operator
- ▲ The 777-300ER remains popular, with ~90% in-service (up from 86% in November 2023 and 89% in June), emphasizing that long-haul traffic is returning and it remains a key part of the fleet
- ▲ The A330 continues its comeback as ~79% of the fleet is in service (up from 75% in June, 74% seen this past February and 73% seen in November 2023)
- ▲ The 737NG workhorse has 91% of its fleet in-service (up from 89% in May and 90% in June), higher than the rival A320ceo family at ~90%

The newest technology aircraft are also most likely to be actively flying

Fleet Status by Aircraft Technological Maturity – September 2024
% Aircraft In-Service/Parked/Stored



Fleet Status by Aircraft Role – September 2024
% Aircraft In-Service/Parked/Stored

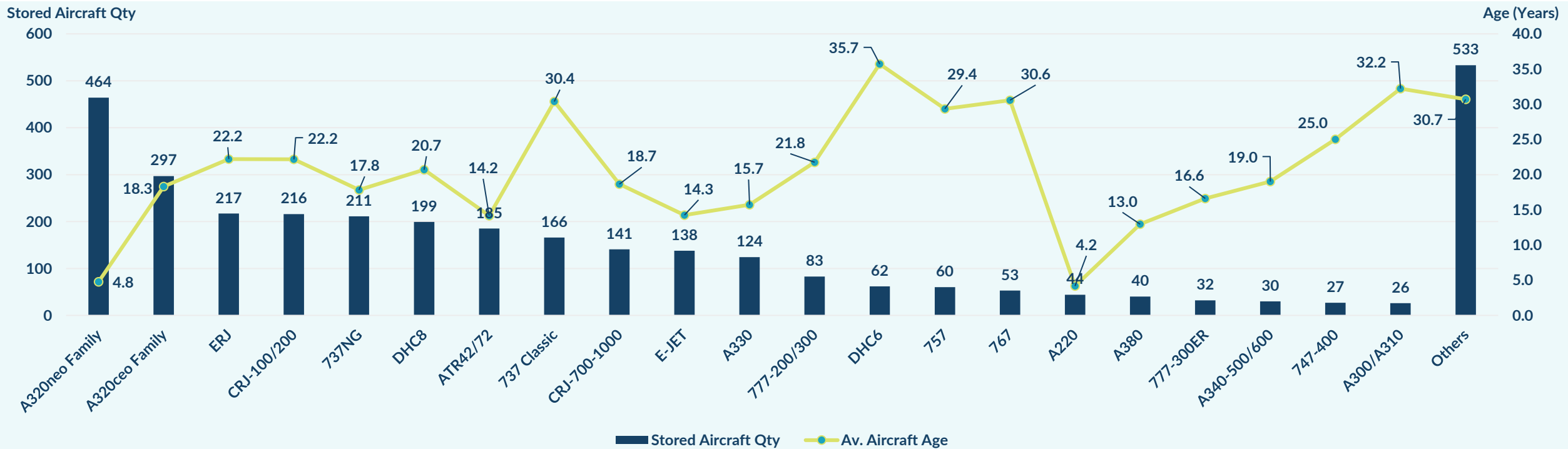


- Overall, 87% of the latest new technology aircraft such as 787, A220, A320neo, 737 MAX, A350, etc.) are in-service (down from 88% last November) because they are the most efficient in terms of fuel burn and are potentially under warranty
- Yet, there have been some frustrating groundings due to engine durability and regulatory issues. Hence, not all latest-gen aircraft are in active service (e.g. A320neo family)
- Mature technology aircraft such as the 737NG, A320neos, A330, 777 and E-Jets are the backbone of the fleet and comprise ~61% of the air transport fleet. Approximately 83% of mature tech aircraft are in service (up from 79% in February, 81% in May and 82% in June)

- The older sunset technology aircraft (e.g., 747, 757, 767) are less efficient and more maintenance intensive, so they are more likely to be parked/stored (unless they fly cargo) until retired or demand returns. Hence, ~66% of these older aircraft are in active service (down from 67% in June). Softness in the cargo market could explain some of the recent reductions
- Passenger aircraft have a higher % of their fleet in service (83%, up from 79% in February 2024 and 80% in November 2023 and up on the ~82% seen in September 2023)
- The re-entry of passenger aircraft provides belly cargo capacity alongside dedicated freighters. Combined with some softness in air cargo, the cargo fleet has 71% in-service (down from 73% in June). This is also lower than the ~74% in-service seen in September 2023

There are ~3,348 air transport aircraft currently in storage (inactive for 90+ days)

Top Stored Air Transport Aircraft Families & Average Age. September 2024
Qty of Aircraft & Average Age (Years). Ranked By Largest Fleet Size Left to Right

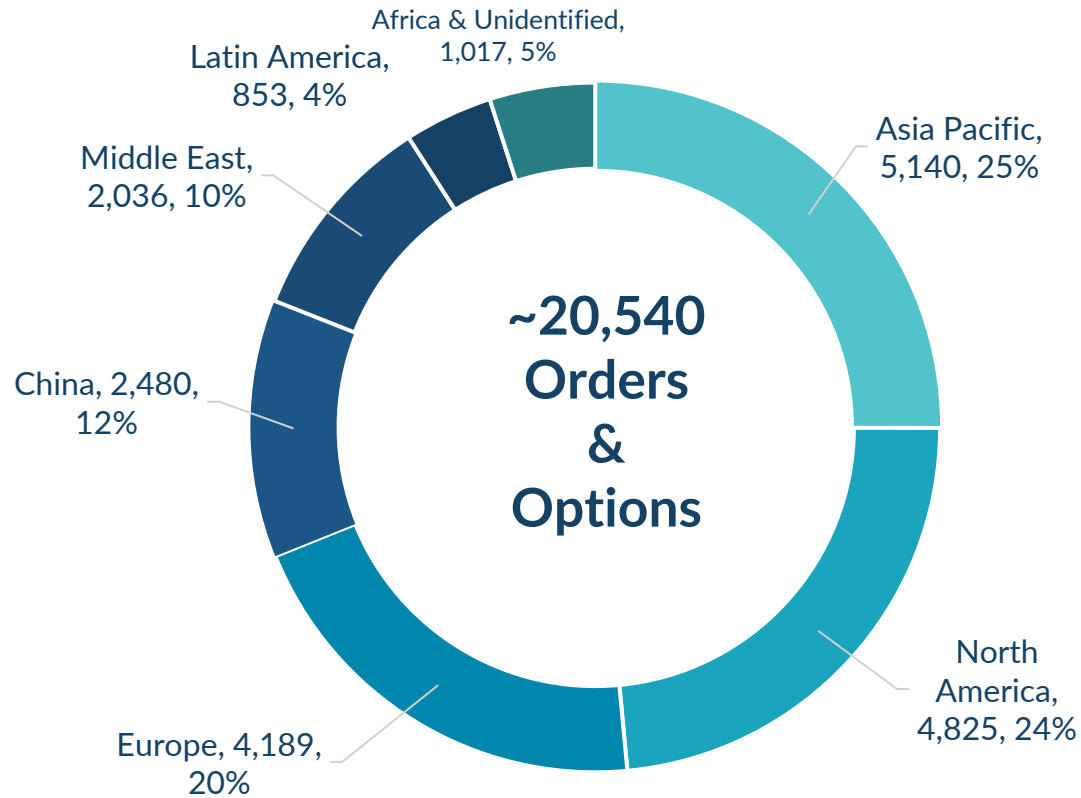


- ▲ 9% of the air transport fleet has been stored for over 90+ days. The A320neo is the leader with ~464 aircraft in storage (not flown for 90+ days), up from 424 in June but slightly down on the ~468 stored in September 2023. The average age of these aircraft is a young 4.8 years. They are likely stored due to engine-related durability issues and will return to service in due course
- ▲ Once aircraft reach 16-18+ years, they become vulnerable to retirement, particularly if the owner/operator doesn't want to perform the significant airframe maintenance check or engine shop visits
- ▲ The A320ceo family has the second most stored aircraft, with ~297 that haven't flown for at least 90 days (down from 349 aircraft in June). The average age is 18.3 years, indicating that many are vulnerable to retirement, and A320ceo family retirements do continue

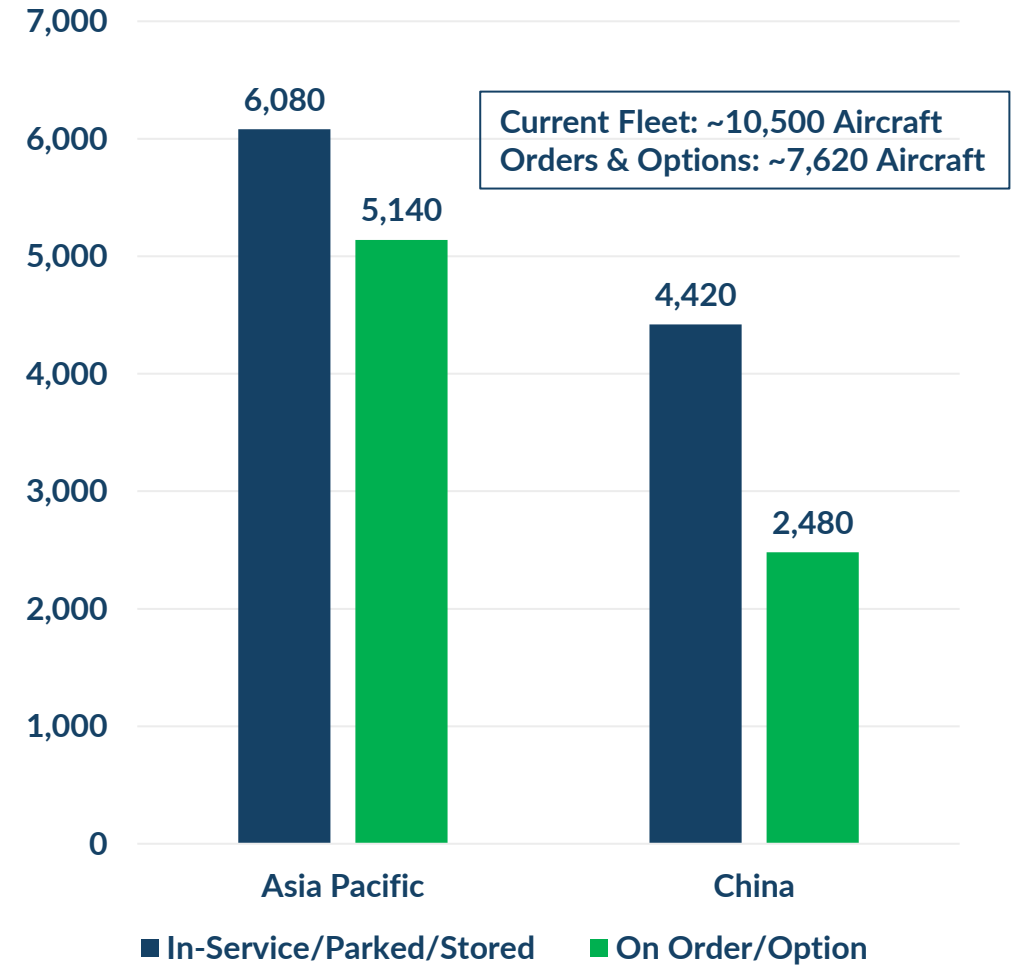
- ▲ There are ~211 737NGs in storage with an average age of 17.8 years. Some of these aircraft may be waiting for cargo conversion. The 737NG stored fleet size is slightly up on the ~207 aircraft stored in June
- ▲ The 777 is increasingly heading to storage with ~83 777-200/300s and ~32 777-300ERs in storage. Some of these will be converted into freighters. Some will return to service, and others will be retired
- ▲ There is a long tail of ~533 other aircraft with an average age of 30.71 years, many of which are vulnerable to retirement
- ▲ Overall, ~3,348 aircraft in the air transport fleet are stored. This is down from the ~3,482 stored aircraft seen in June. The difference is accounted for by retirements and aircraft returning to service

Asia Pacific and China account for ~37% of the air transport orderbook

Air Transport Fleet Orders & Options by Operator Region – September 2024
Qty of Aircraft On Order/Option

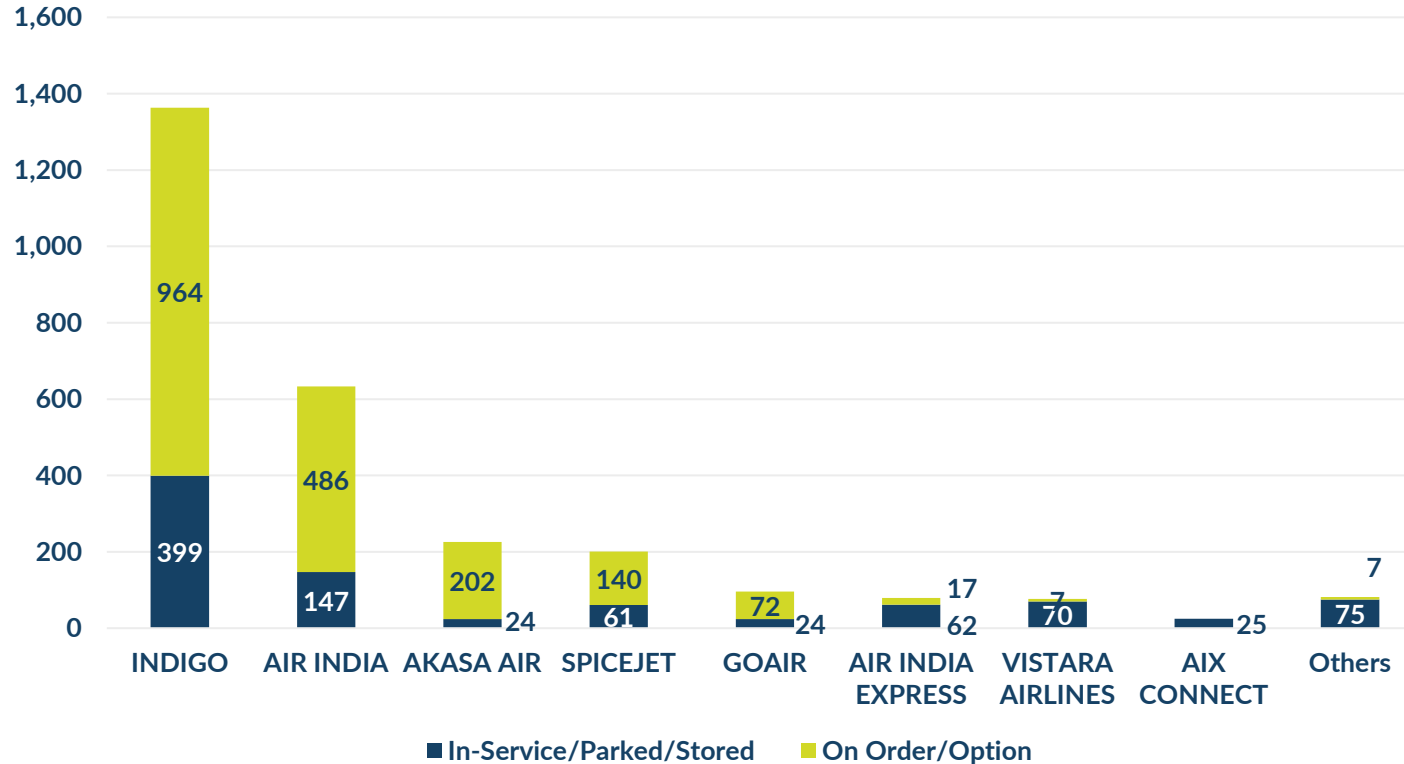


Asia Pacific & China Air Transport Current Fleet and Orders/Options
September 2024 Qty of Aircraft On Order/Option



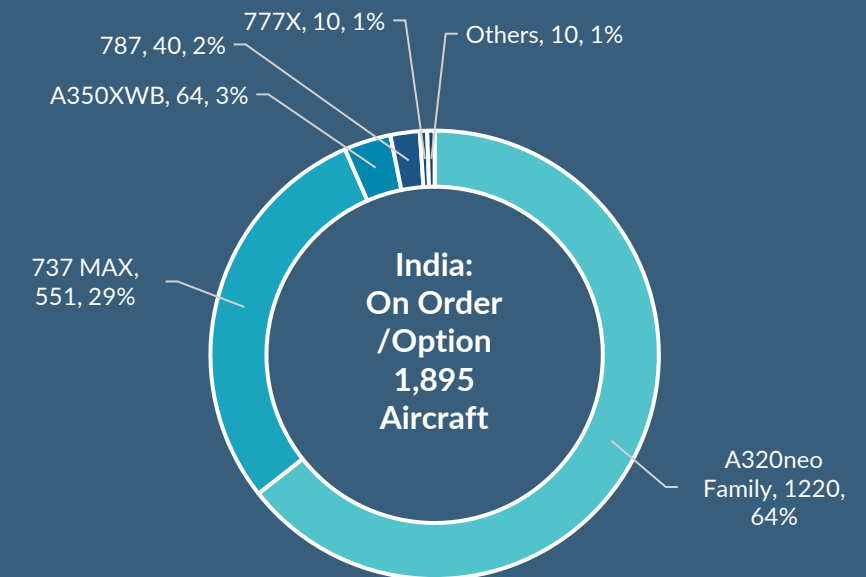
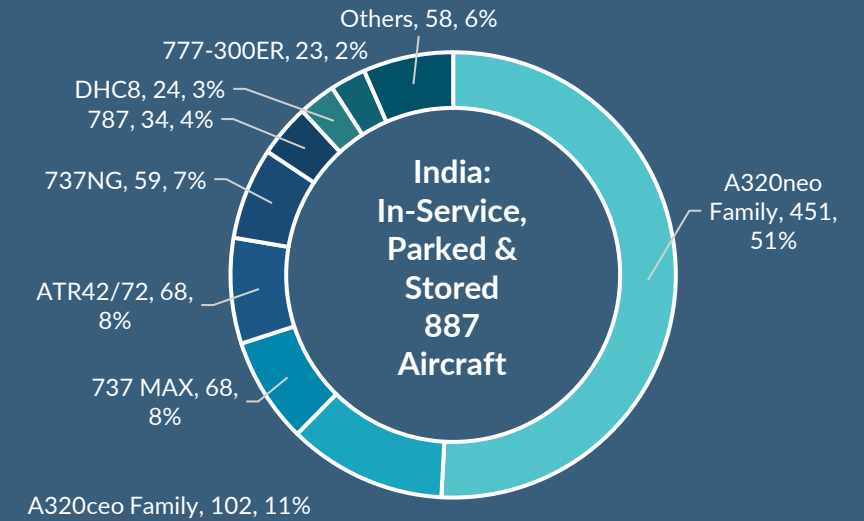
India is powering the air transport orderbook with ~1,895 aircraft currently on order/option, 93% of which are narrowbodies

India Air Transport Fleet Status – September 2024



- ▲ India is realizing its potential as a major player in air transport
- ▲ There are currently ~887 air transport aircraft in India (77% narrowbody)
- ▲ Orderbooks have swelled for India carriers to ~1,895 aircraft (~94% narrowbodies). India represents ~9% of the global orderbook

Source: Aviation Week Fleet Discovery. September 2024. Naveo analysis



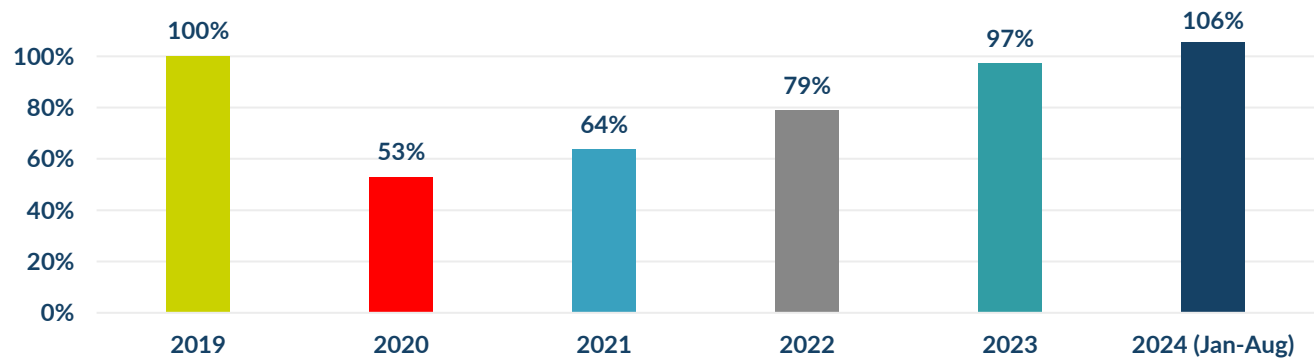
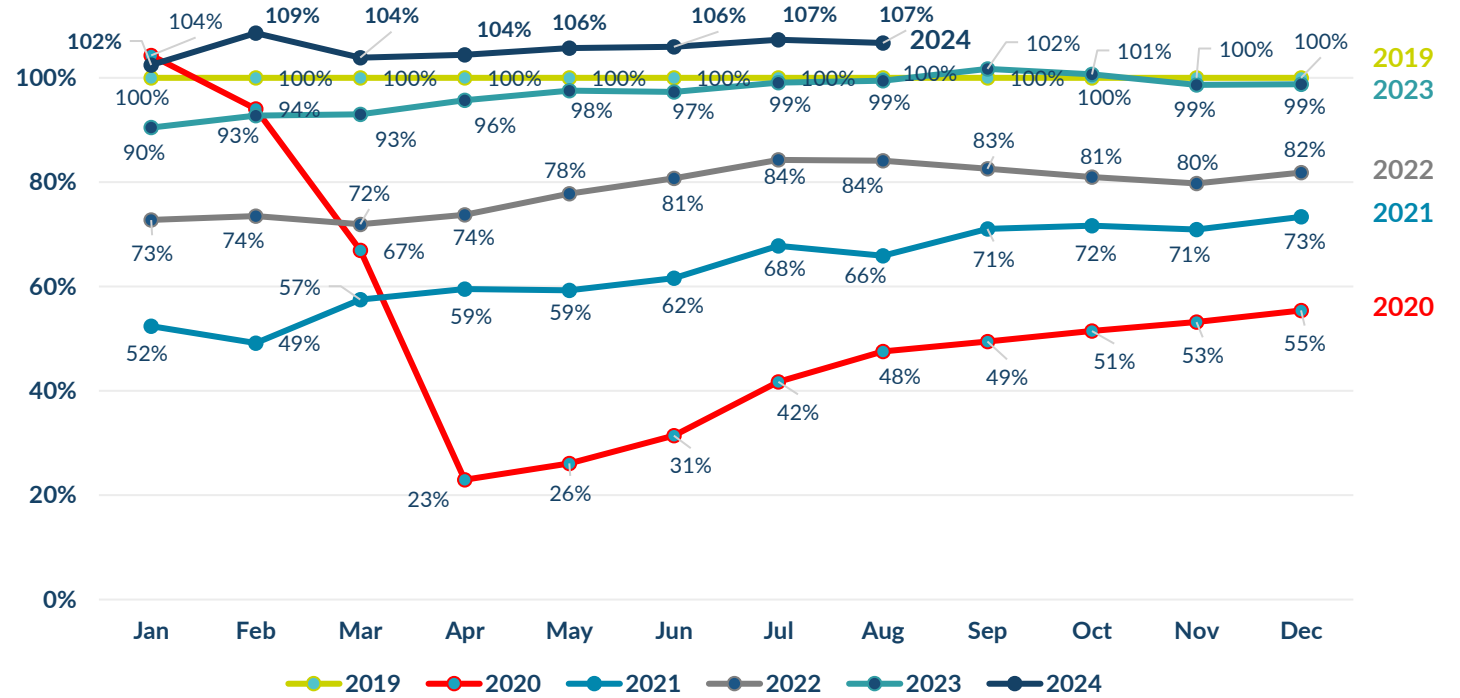
A photograph of a Singapore Airlines aircraft on a tarmac. The aircraft is white with a blue and gold livery. The tail features the airline's logo. The text "SINGAPORE AIRLINES" is visible on the fuselage. The aircraft is parked on a wet tarmac with several orange traffic cones around it. A person is visible near the tail of the aircraft.

Air Transport Utilization Recovery

Global air transport flying hours continue to be above pre-COVID levels

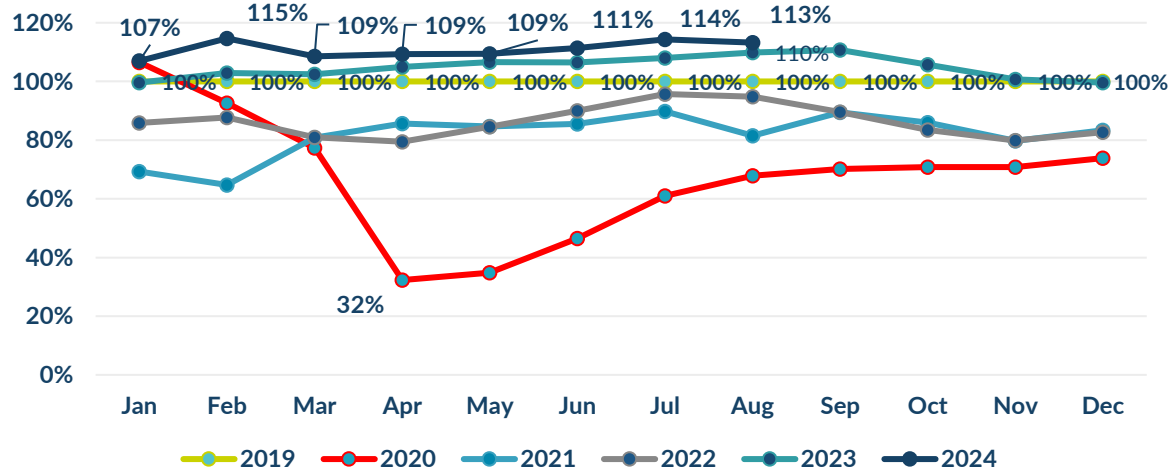
- It has taken five years, but 2024 has started well, with hours so far above 103-109% of January 2019
- August 2024 flying hours were ~107% of August 2019 hours
- Since July 2023, air transport flying hours have been at or very close to 2019 levels
- Total flying hours in 2023 were ~97% of full-year 2019 flying hours and a good increase on the ~79% of 2019 flying hours seen in 2022
- So far in 2024, flying hours for January to the end of August have been 106% of the hours flown from Jan to August 2019

Global Air Transport Aircraft Utilisation 2019 to August 2024
Indexed to Same Month in 2019. Flying Hours. 2019 = 100%

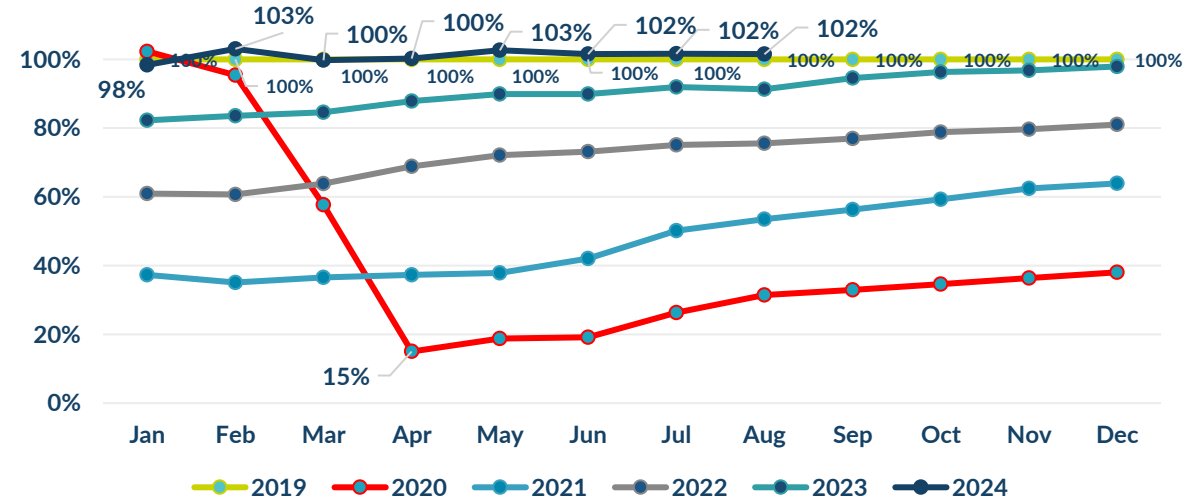


Domestic travel has been leading the recovery, with utilization already above pre-COVID levels. International flying hours are at ~102% of pre-COVID levels

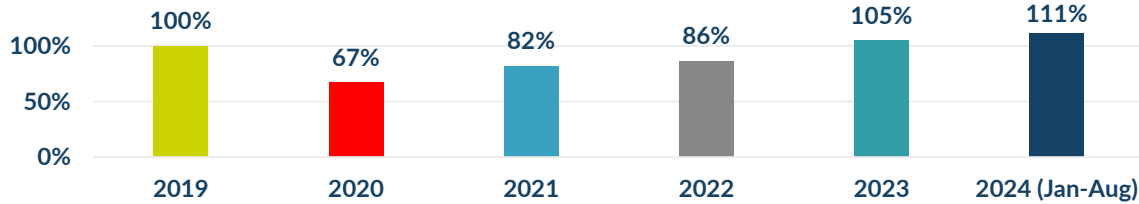
Global Domestic Aircraft Utilisation, 2019 to August 2024 Indexed to Same Month in 2019. (Hours). 2019 = 100%



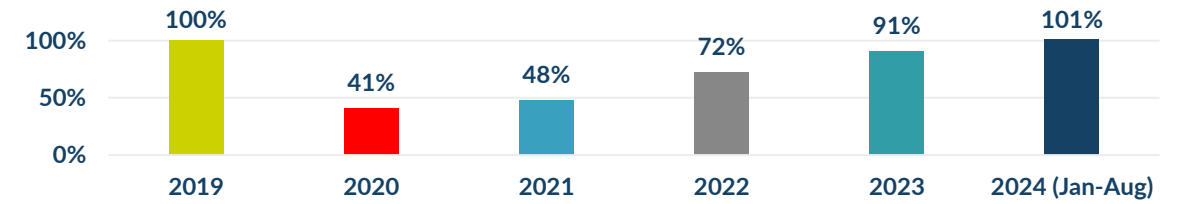
Global International Aircraft Utilisation, 2019 to August 2024 Indexed to Same Month in 2019. (Hours). 2019 = 100%



Domestic Flying Hours as % of 2019 Hours



International Flying Hours as % of 2019 Hours

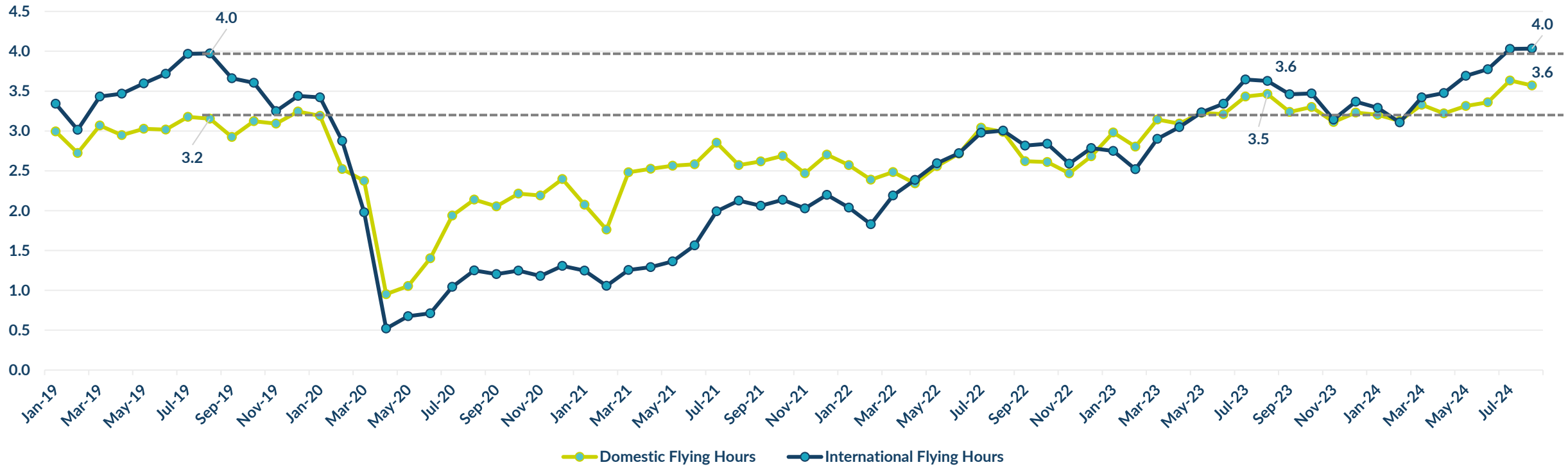


- In 2019, Domestic flights were ~46% of total aircraft flying hours and international flights 54%. This flipped in 2020 and 2021, when Domestic hours were 58-60% of total flying hours
- Domestic travel has led the recovery since it's been easier to travel closer to home, and there are some sizeable domestic travel markets, such as the United States, China and Japan
- So far in 2024, Domestic flying is 48%, and international is 52% of total Jan to August flying hours
- Domestic aircraft utilization exceeded pre-COVID hours in January 2023 and has continued to grow apart from dropping back to ~100% of 2019 hours in December 2023

- Domestic travel has been 107-115% of the equivalent month in 2019. February had an extra day this year, accounting for ~115% of February 2019. Overall, so far this year, domestic flying (January to August 2024) was 111% of pre-COVID hours (taking into account one extra leap-year day)
- International traffic has slowly been climbing up to pre-COVID hours, and international flying hours continue to exceed pre-COVID hours. August 2024 was ~102% of August 2019 for international flying hours

August 2024 flying hours were up ~3% for domestic and ~11% compared to August 2023

Air Transport Monthly Flying Hours by Aircraft Size
January 2019 to August 2024 (Millions Hrs)

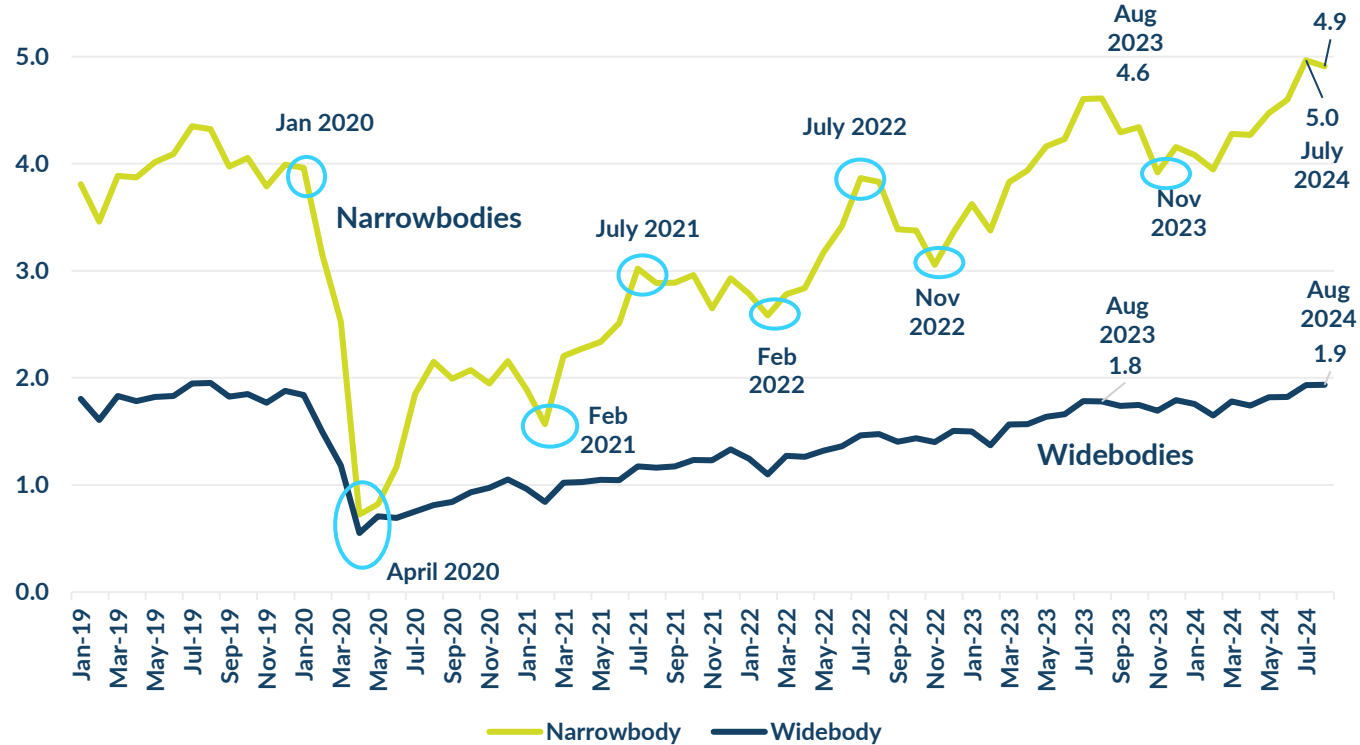


- ▲ It took until February 2024 for international flying hours to exceed the pre-COVID hours of the same month in 2019, (February 2019)
- ▲ Domestic flying hours returned to pre-COVID levels one year earlier, in January 2023
- ▲ International flying hours in August 2024 were up an impressive 11% on August 2023, and domestic flying hours were up 3% on August 2023

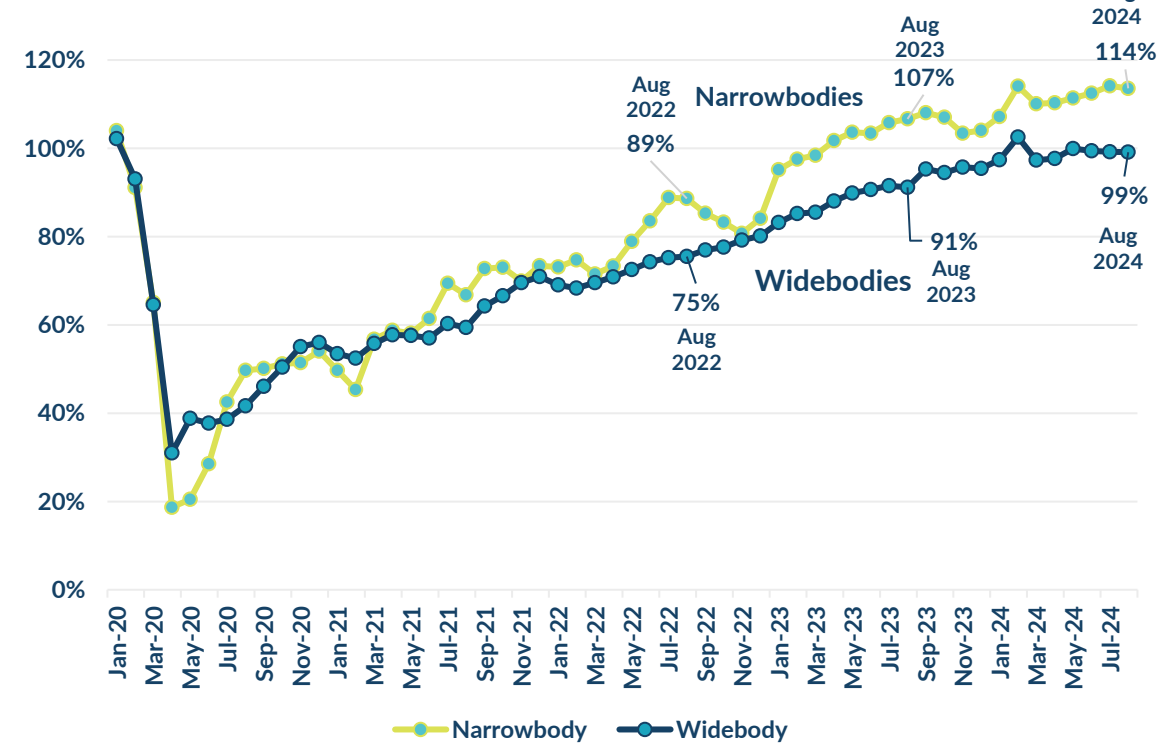
Narrowbody aircraft utilization continues to be above pre-COVID levels.

Widebody flying hours in August 2024 were ~99% of August 2019 hours

Air Transport Monthly Flying Hours by Aircraft Size
 January 2019 to August 2024 (Millions Hours)

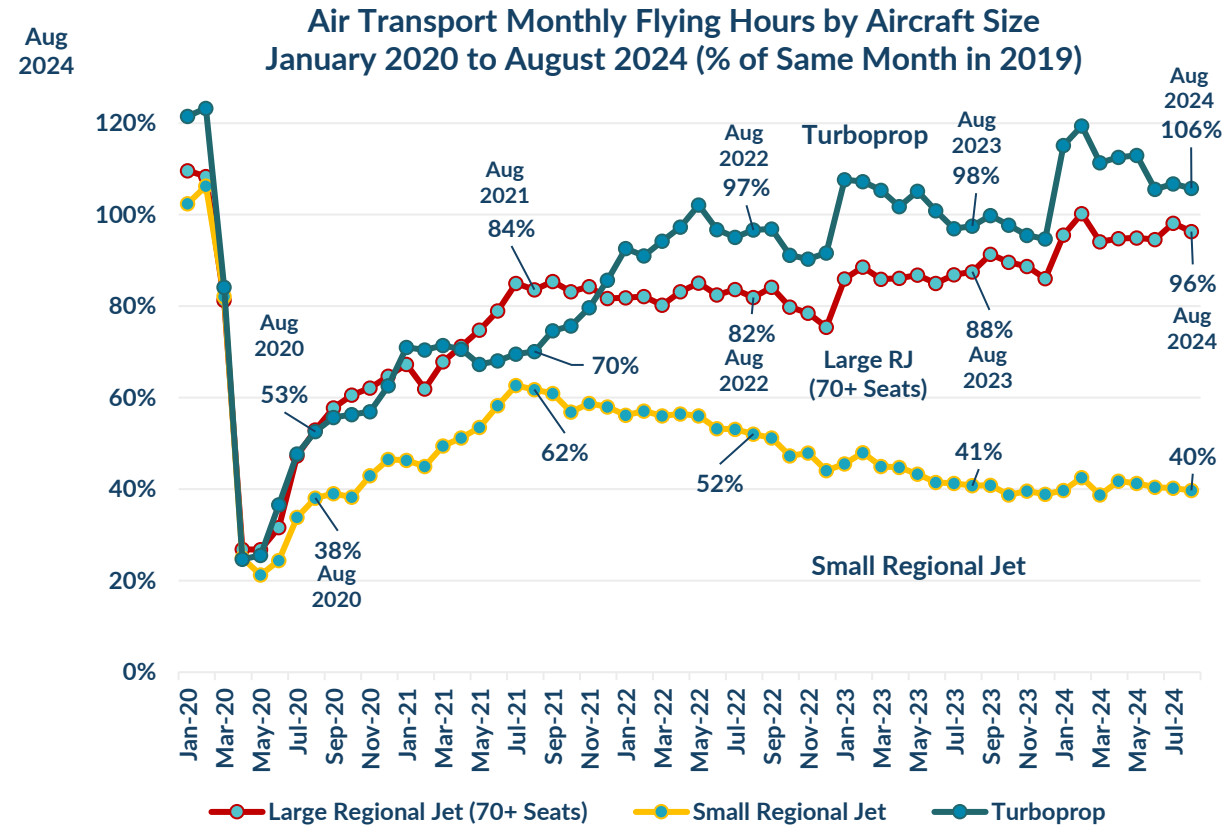
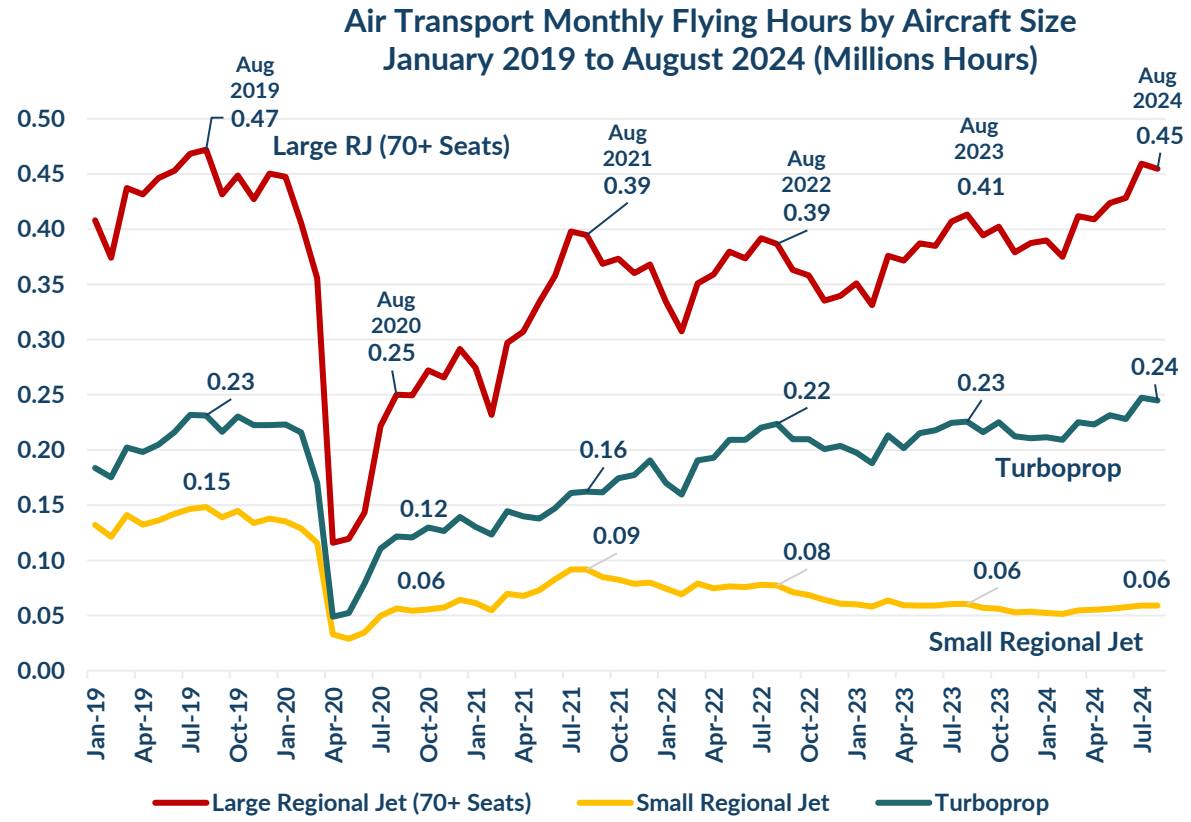


Air Transport Monthly Flying Hours by Aircraft Size
 January 2020 to August 2024 (% of Same Month in 2019)



- ▲ Narrowbody aircraft flying hours, driven by the A320ceo/neo family and 737NG/MAX, have continued to recover strongly. By April 2023, they were above pre-COVID hours and have kept growing since then
- ▲ August 2024 narrowbody flying hours were 114% of August 2019. August 2024 narrowbody flying hours were an improvement on the 107% seen in August 2023
- ▲ Widebody flying hours, driven predominantly by international traffic, have continued to climb. They exceeded pre-COVID hours in February 2024, but this month had the extra leap day. In reality, widebody hours reached pre-COVID hours in May, with May 2024 being 100% of May 2019. However, June, July and August widebody hours were ~99% of June, July, and August 2019, so we have to wait for another year for the northern hemisphere Summer to have widebody hours above pre-COVID

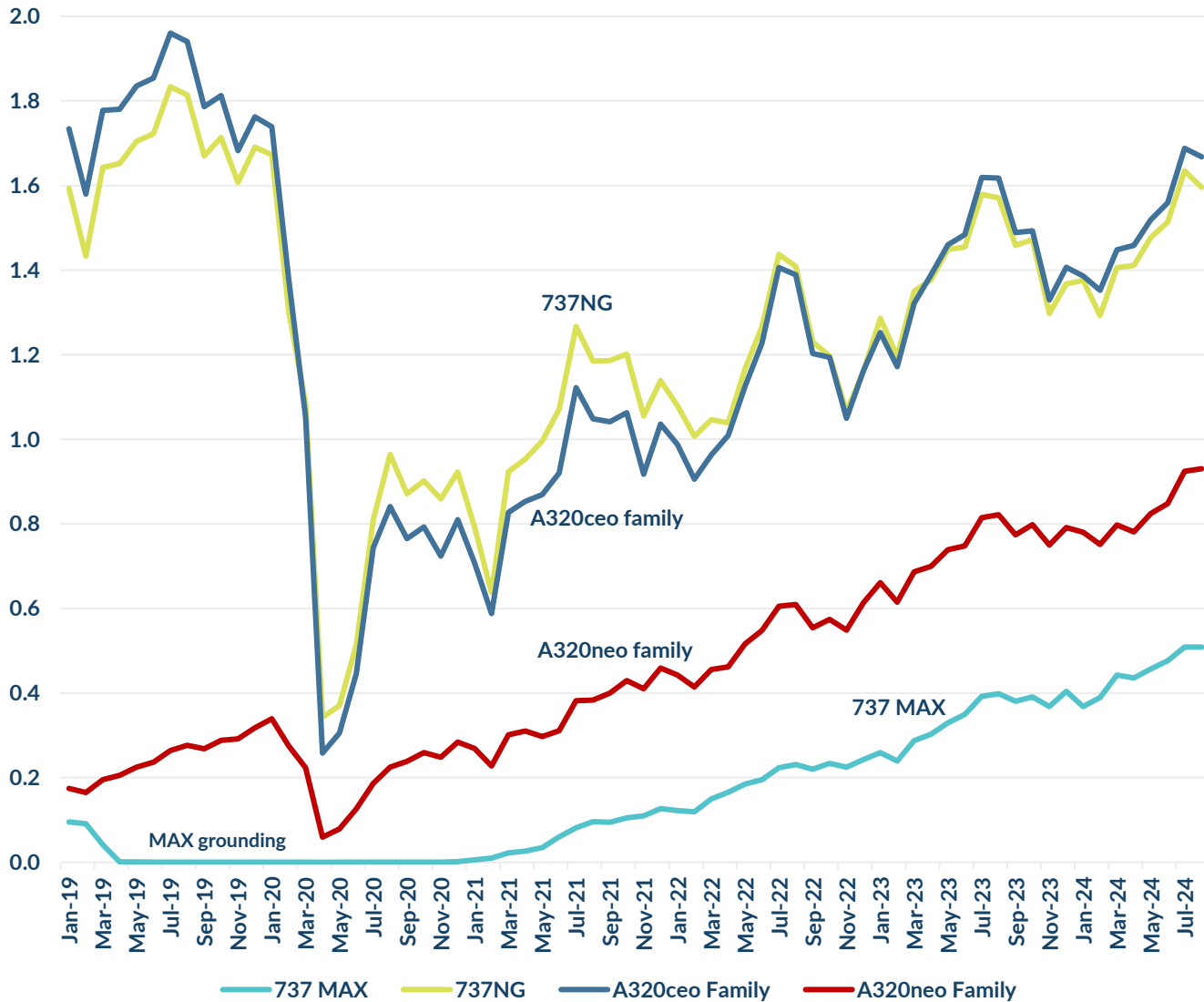
Turboprop aircraft have been ahead of pre-COVID hours in 2024 but RJs are still below



- ▲ In the regional market, the recovery has been led by turboprops, where flying hours have been above pre-COVID for most of 2023 and so far for 2024. Turboprop flying hours in August 2024 were ~106% of August 2019
- ▲ However, larger regional jets such as E-Jets, E2, and CRJ700-1000s have total fleet flying hours ~1.9X that of turboprops. Larger RJs are still not at pre-COVID levels and have been impacted by parking, storage, and retirements, with new deliveries insufficient to offset the reduced flying hours. In August 2024, larger RJ flying hours were still below pre-COVID at ~96% of August 2019 hours
- ▲ Retirements of smaller regional jets such as the ERJ 145 family and CRJ100/200 show that flying hours in August 2024 were only 40% of August 2019. Retirements and an inactive parked/stored fleet resulted in August 2024 flying hours for larger RJ hours that were ~7.7X those of smaller RJs

Source: Aviation Week Fleet Discovery, September 2024. Naveo analysis

Global A320ceo/neo family, 737NG & 737 MAX Monthly Flying Hours
January 2019 – August 2024 (Millions Hours)



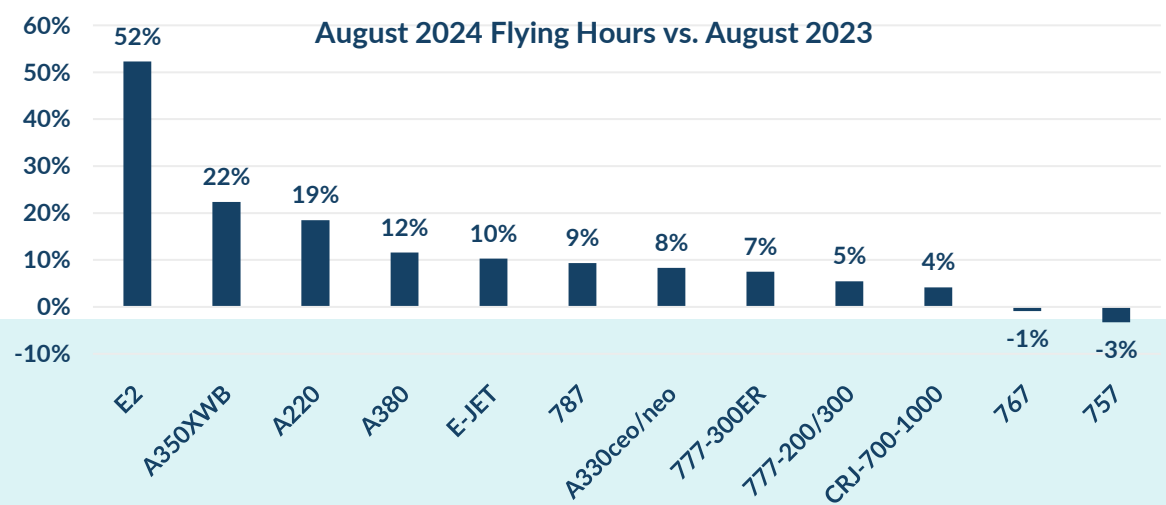
Source: Aviation Week Fleet Discovery. September 2024. Naveo analysis

The A320neo family and 737 MAX are above pre-COVID hours (due to deliveries)

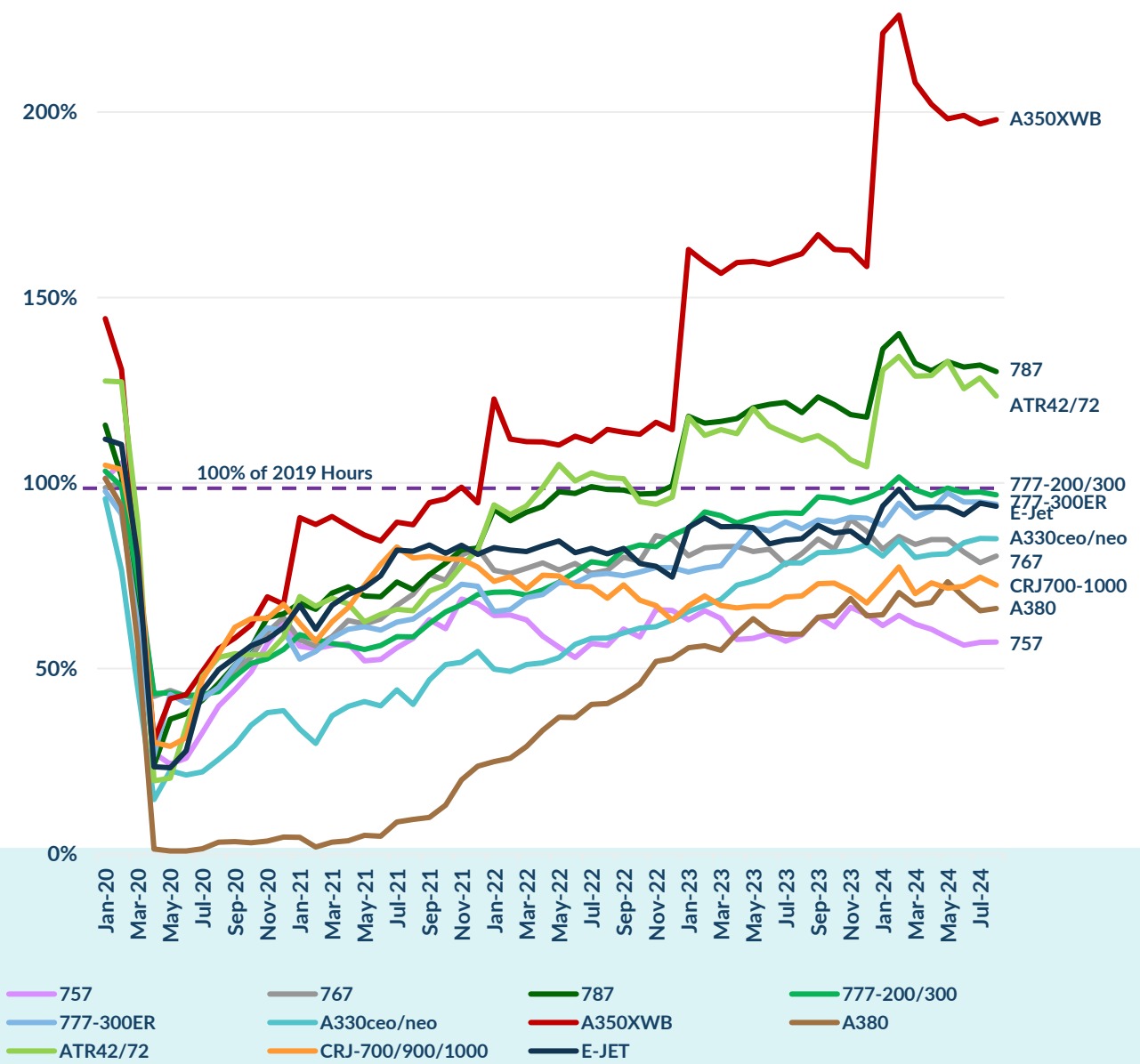
- ▲ The 737NG and A320ceo family, the backbone of the Air Transport fleet, are the vital in-service narrowbodies driving the recovery. They account for ~36% of the current air transport fleet
- ▲ It's pretty remarkable how the hours of the A320ceo family and the 737NG have tracked each other since spring 2022, though since mid-2023, the A320ceo family has taken a slight lead
- ▲ There are ~5,666 Boeing 737NGs in active service in September 2024 and 5,999 Airbus A320ceo family aircraft. The larger active fleet size of the A320ceo family now has a slight edge. Hence, the slightly higher A320ceo family flying hours overall compared to the 737NG
- ▲ However, neither the 737NG nor A320ceo family have reached pre-COVID hours. Since neither is in air transport production and retirements have occurred since 2019, hours for 737NGs and A320ceo family are below pre-COVID and will remain so going forward
- ▲ Comparing August 2024 with August 2023, A320ceo family hours are up 3.1%, and 737NGs are up 1.6%. 737MAX hours are up 28% and A320neo family are up 13%. Of course, the 737 MAX and A320neo family aircraft are in production, so hours naturally increase
- ▲ The A320neo family fleet, due to a larger fleet (~2,852 in-service aircraft) compared to the 737 MAX (~1,537 in-service aircraft), flew ~1.8 times the total hours of the 737 MAX fleet in August 2024

The A350XWB, 787 and ATR42/72 aircraft continue to be above pre-COVID hours

- ▲ Comparing the monthly flying hours of key aircraft (excluding the A320/737 analyzed previously), the Airbus A350XWB, Boeing 787 and ATR42/72 are above pre-COVID flying hours
- ▲ That makes sense since deliveries of these aircraft have continued, whereas the other aircraft have all seen retirements since 2019; hence, hours will naturally fall
- ▲ The Boeing 777-200/300 and the 777-300ER are close to pre-COVID monthly flying hours. Compare this to the 757, 767, A380 and CRJ700-1000, which have seen many retirements
- ▲ The Airbus A380 suffered during 2020 as aircraft were stored. It's been climbing back up, and August 2024 flying hours were 66% of August 2019 and up 12% on August 2023
- ▲ Comparing August 2024 flying hours for these aircraft models with August 2023 shows that E2 flying hours are up 52% (the aircraft continues to be delivered, so hours will naturally grow) as with A350XWB (+22%) and A220 (+19%). The 767 and 757 fleet flew fewer hours in August 2024 compared to August 2023, down -1% (767) and -3% (757)



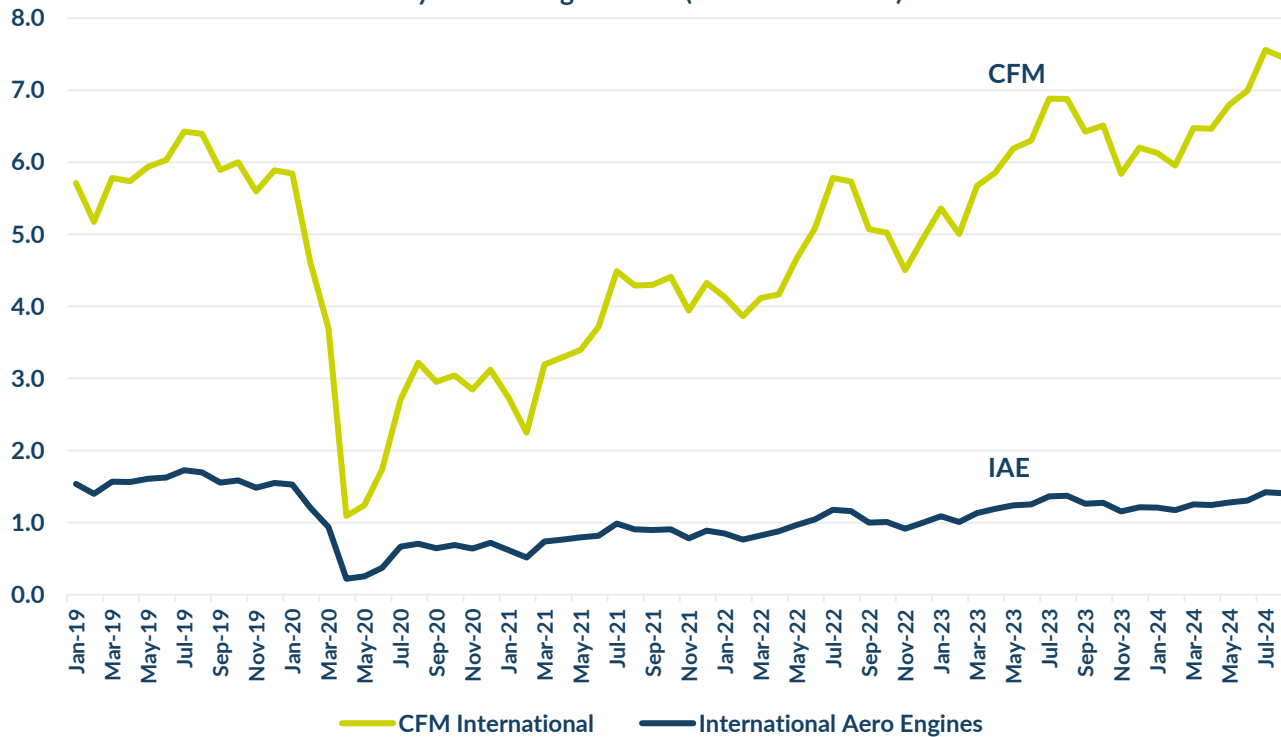
Air Transport Key Widebody Monthly Flying Hours Indexed to Same Month in 2019



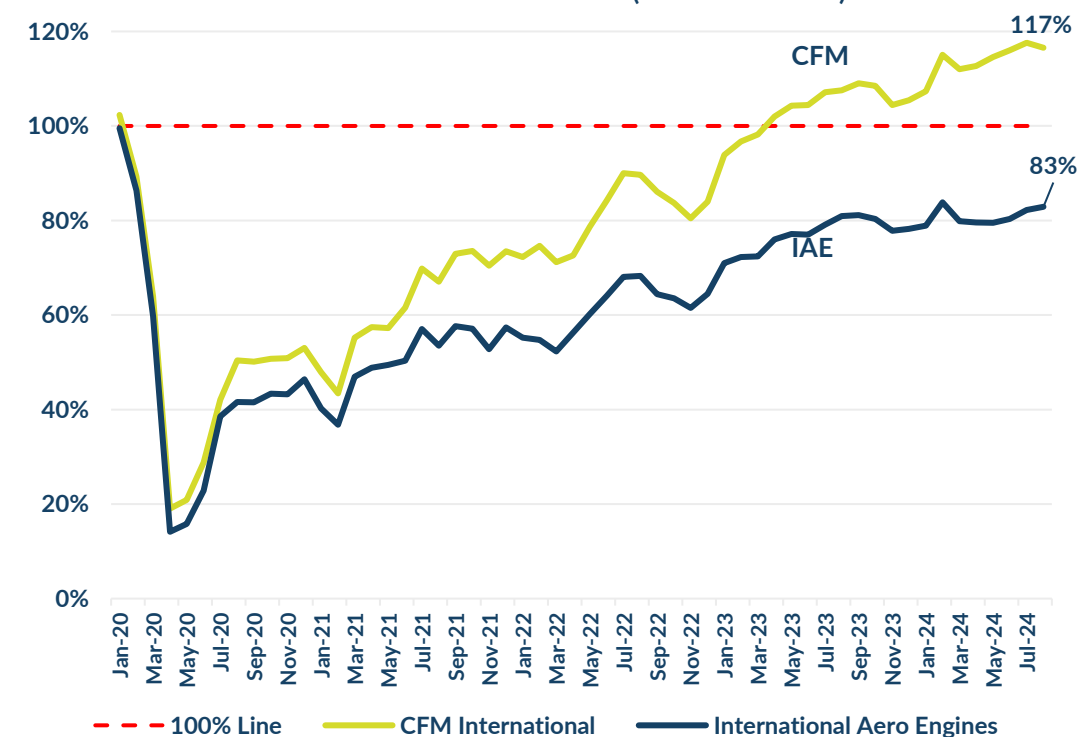
Source: Aviation Week Fleet Discovery. September 2024. Naveo analysis

CFM, driven by strong CFM56 and LEAP utilization, is well above pre-COVID engine hours. IAE, due to retirements of the V2500, is at ~83% of pre-COVID hours

Air Transport Engine Monthly Flying Hours by Engine OEM
January 2019 - August 2024 (Millions of Hours)



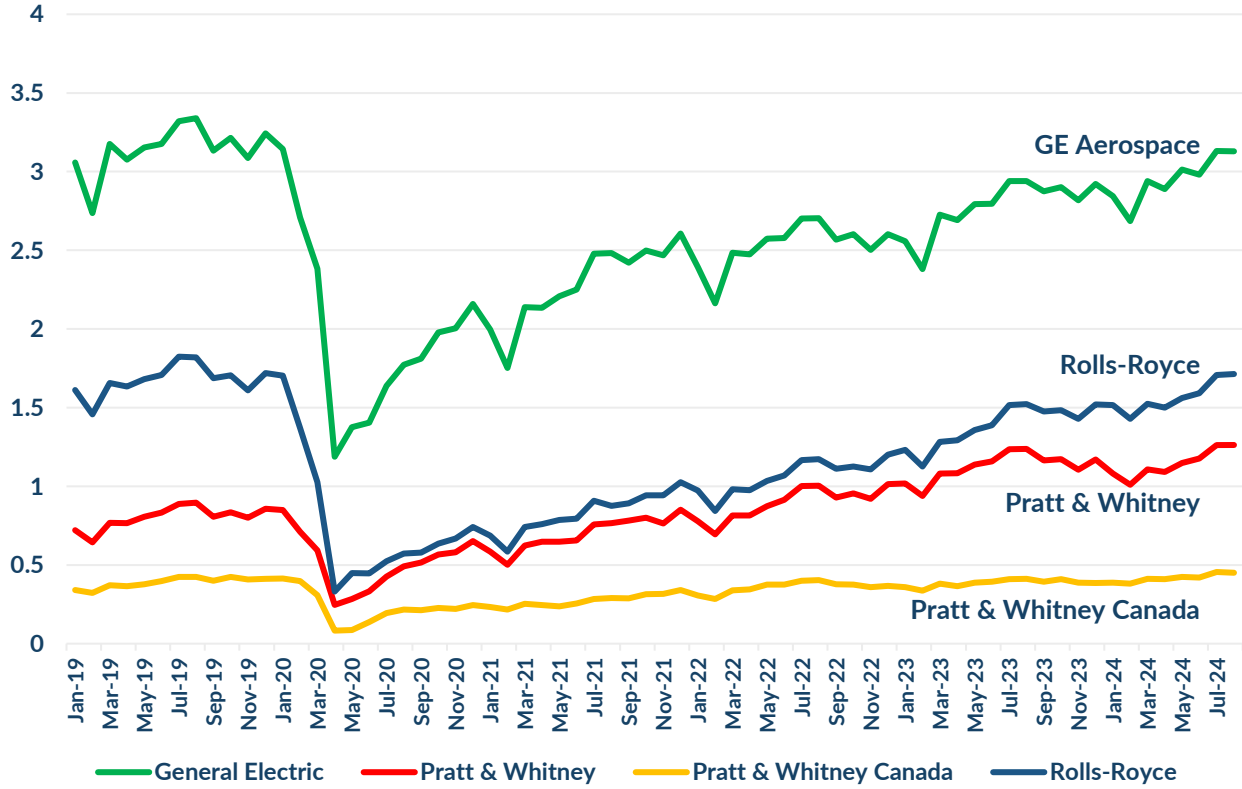
Air Transport Engine Monthly Flying Hours by Engine OEM January 2019 - August 2024
Indexed to Same Month in 2019 (% of 2019 Hours)



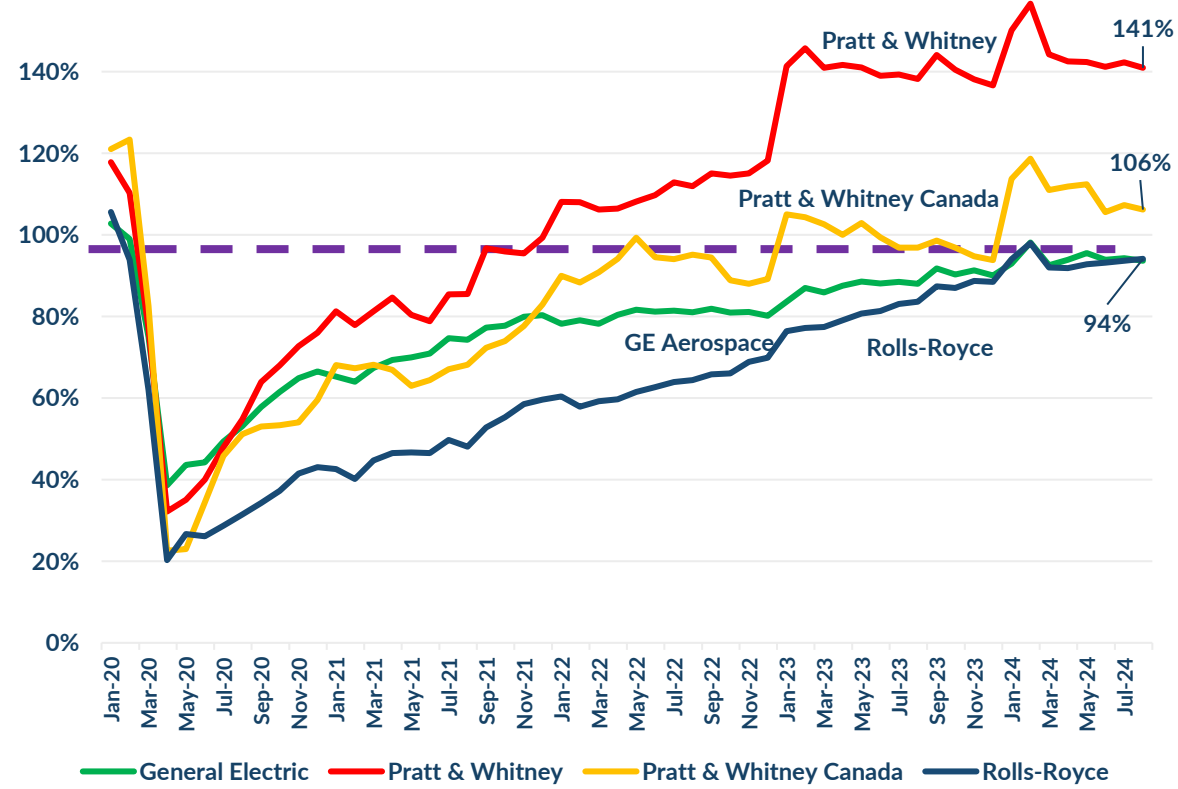
- CFM International engines power the key narrowbody aircraft driving the recovery (e.g. A320ceo family, 737NGs, 737 MAX and A320neo family). In August 2024, CFM-powered engine flying hours were up 17% on August 2019. CFM flying hours have exceeded pre-COVID hours since April 2023. August 2024 hours were up ~8% on August 2023
- The V2500, which powers part of the A320ceo family fleet (but not the A320neo family), saw engine flying hours in August 2024 at ~83% of August 2019 levels but up 2.4% on August 2024. IAE-powered A320ceo family aircraft have been retiring. The GTF hours are not included in the IAE data but are included in the Pratt & Whitney data shown separately
- CFM hours continue to climb due to ongoing A320neo family deliveries, the re-introduction and deliveries of the 737 MAX and substantial 737NG/A320ceo utilization

Pratt & Whitney continues to lead the recovery in engine flying hours –boosted by a solid exposure to new narrowbody aircraft

Air Transport Engine Monthly Flying Hours by Engine OEM
January 2019- August 2024 (Millions Hours)



Air Transport Engine Monthly Flying Hours by Engine OEM January 2019 - August 2024
Indexed to Same Month in 2019 (% of 2019 Hours)



- ▲ The recovery in engine flight hours depends, of course, on the aircraft type that the engine powers, the demographics of that aircraft, its role (passenger and cargo), whether it's still in production and whether it has reliability/durability in-service issues
- ▲ Overall, only Pratt & Whitney and Pratt & Whitney Canada are above pre-COVID flying hours, driven by new engine deliveries

Comparing August 2024 engine hours to August 2023, things are improving: GE-powered air transport engine flying hours were up ~6.4%, Rolls-Royce up ~12.6%, Pratt & Whitney (including GTF) was up 2% (so virtually the same given the GTF groundings), and Pratt & Whitney Canada was up ~10%

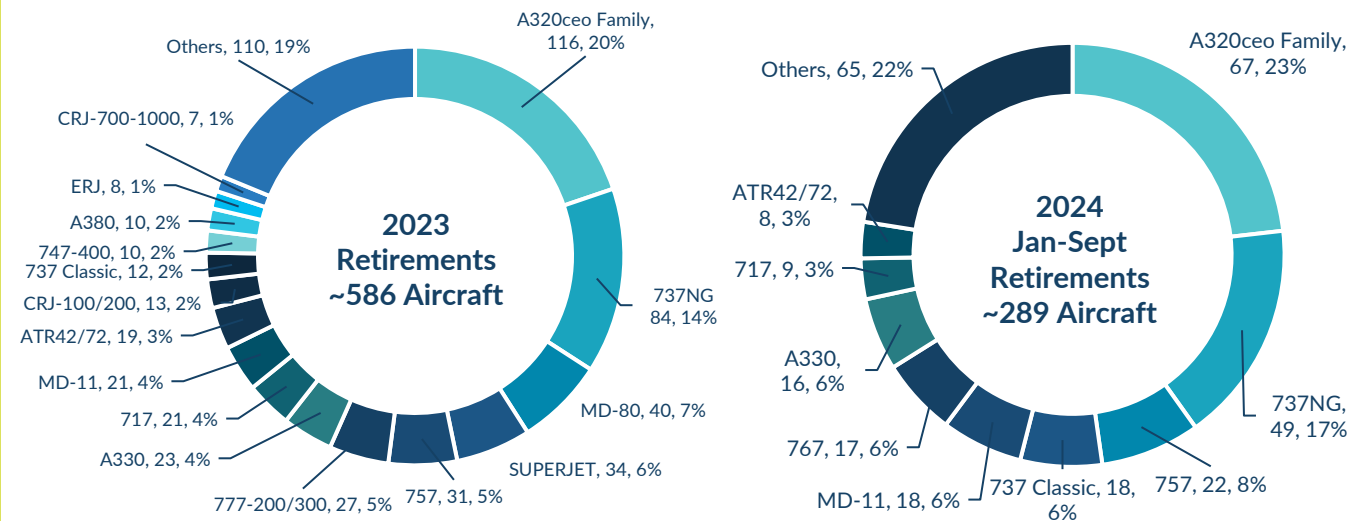
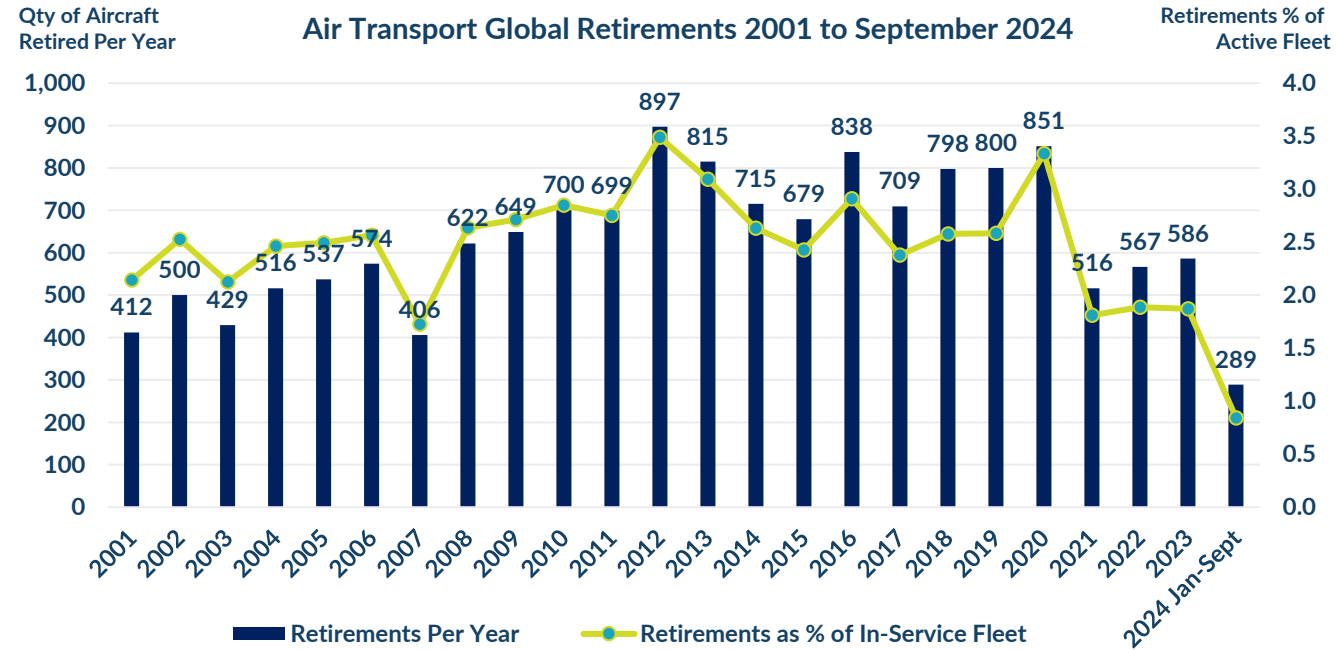
▲ GE Aerospace (~94%) and Rolls-Royce (~94%) are close to pre-COVID hours but not there yet

Air Transport Aircraft Retirement Analysis



~586 air transport aircraft have been identified as having retired in 2023

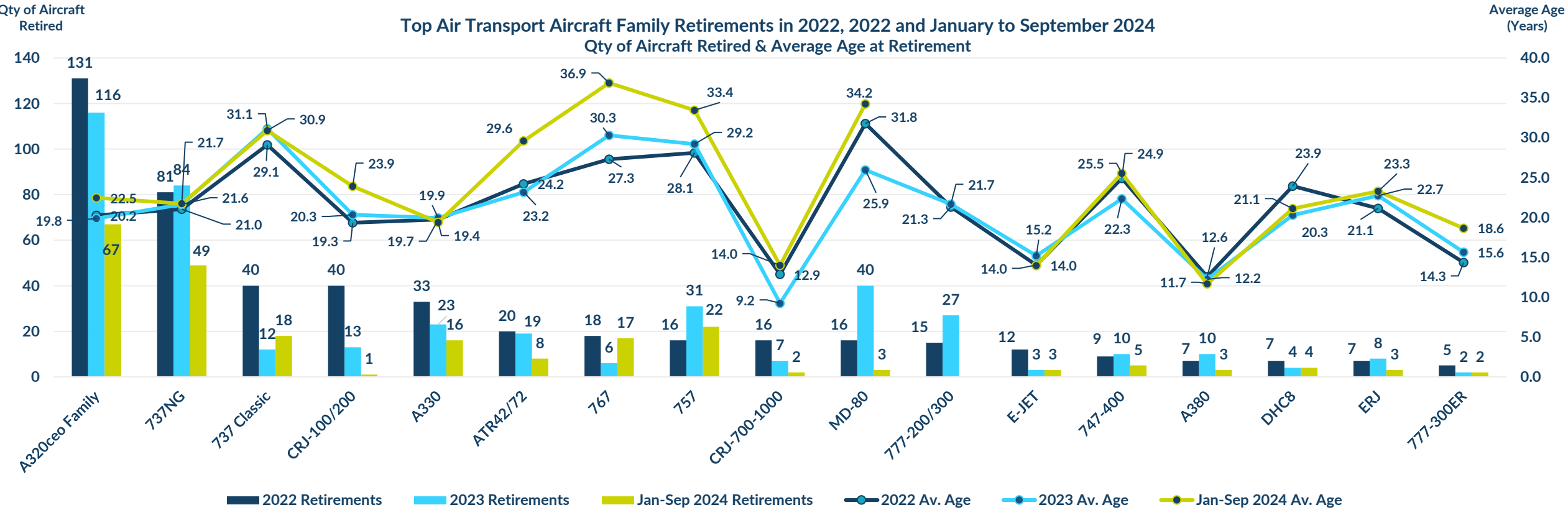
- ▲ ~586 aircraft that retired in 2023. This is up on the ~567 aircraft that retired in 2022 but still below the ~851 aircraft that retired in 2020
- ▲ So far, in 2024, we can identify ~289 aircraft that have been retired
- ▲ There's a lag in the data, so some aircraft described as "parked/stored" will likely already have been retired, so the total number will increase as the data catches up with reality
- ▲ The key factor keeping aircraft in-service is continued strong traffic demand, aircraft production issues causing delivery delays, and in-service durability issues, mainly related to the latest narrowbody engines such as GTF
- ▲ There's some softness in the cargo market, so some older cargo aircraft will likely head to retirement now that belly capacity from passenger aircraft is back online
- ▲ As the in-service fleet normalizes and returns to service, and new aircraft production/reliability issues are addressed, aircraft retirements will increase
- ▲ As a % of the active fleet, retirements have typically hovered between 1.7% and 3.5%. However, the average has been 2.5%. The rate in 2022 was ~1.9%, and in 2023 it was also ~1.9%
- ▲ Naveo forecasts increased retirements in the coming years as the new aircraft production issues get resolved. But, in the short term, retirements have remained lower than expected. Growth in aircraft retirements depends upon new aircraft production issues being addressed, fuel price, the pace of the recovery, geopolitics, GDP growth rates in developing regions, cost of capital, etc.



The average age of all of the air transport aircraft retired in 2023 was ~24 years

Top Air Transport Aircraft Family Retirements in 2022, 2023 and January to September 2024

Qty of Aircraft Retired & Average Age at Retirement



▲ The average age of the ~516 aircraft retired in 2021 was ~24.1 years. Then, in 2022 (where the chart above starts), the average age of the 567 aircraft retired in 2022 was 24.3 years. It was 24.0 years for the 586 retired in 2023, and so far this year, for the ~289 aircraft identified as having retired by September 2024, it was 26.7 years. Of course, this is a smaller dataset of aircraft since the data lags, and the numbers retired in 2024 will grow as the data catches up

▲ COVID-19 impacted some aircraft more than others. For instance, the A380 was prematurely retired by several operators (with an average age of ~12.2 years for aircraft retired in 2023), and the Embraer E-Jet has seen young aircraft retired with an average age of 14.0 to 15.2 years

▲ Some retired aircraft had long lives. 767s (30.3 years for those retired in 2023 and 36.9 years for those retired so far in 2024), 737 Classics (~29 to 31 years) and 757s (~28 to 33.4 years)

▲ The 737NGs and A320ceos have had similar retirement ages. In 2022, the average age of the ~ 81 737NGs retired was 21.0 years of age. The A320ceo's average retirement age for the 131 aircraft retired in 2022 was 20.2 years

▲ In 2023, 737NGs had an average retirement age of 21.6 years, and the A320ceo family was 19.8 years. So far in 2024, the average age of the 737NGs retiring has been 21.7 years, and the A320ceo family aircraft has been 22.5 years of age

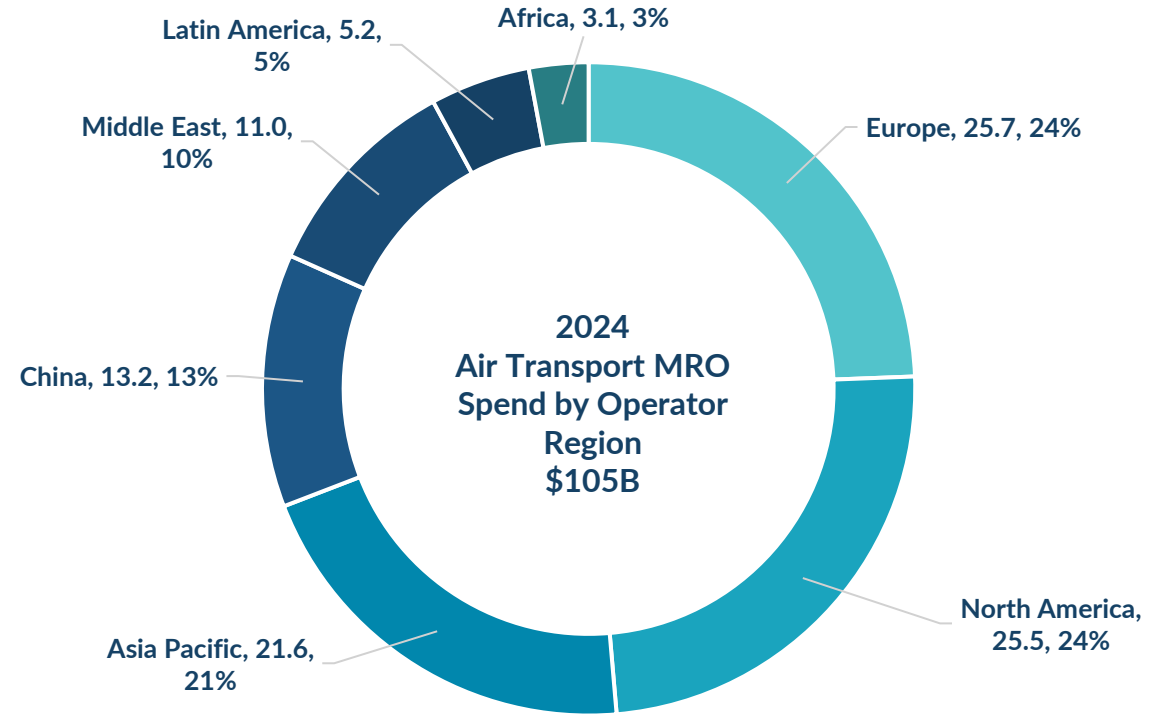
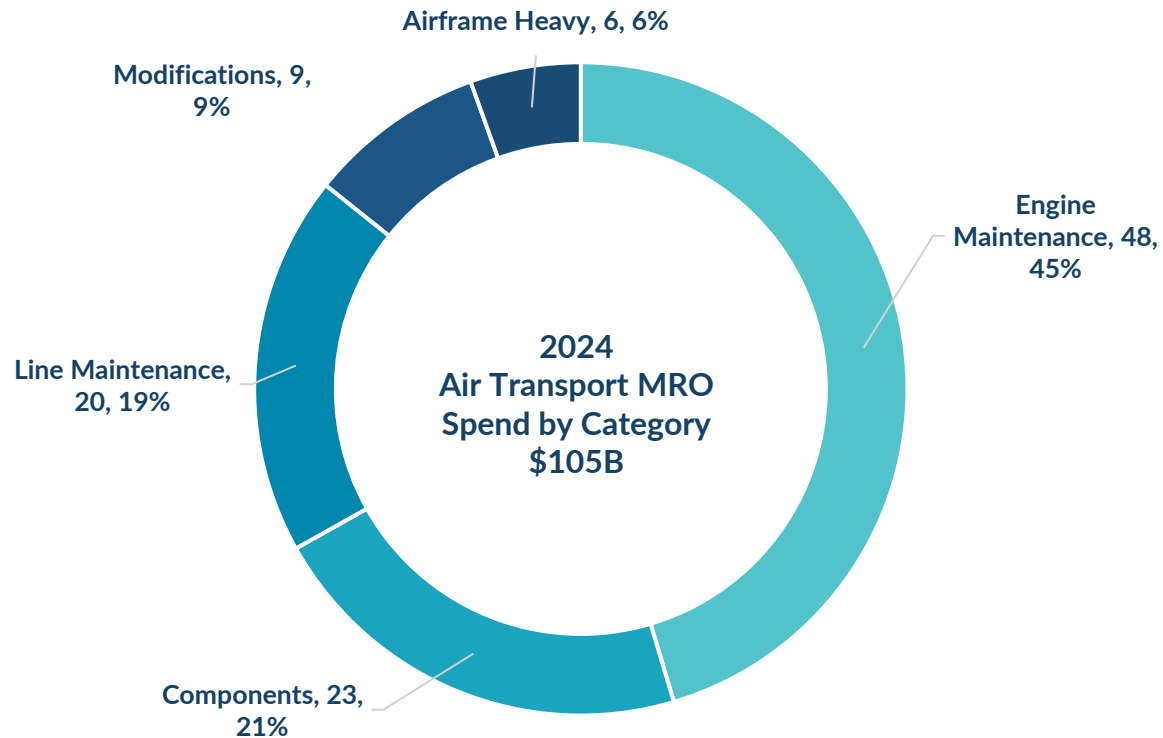
Source: Aviation Week Fleet Discovery. September 2024. Naveo analysis



Considerations

2024 air transport MRO spend is forecasted to be ~\$105B. Of this spend, airframe and line maintenance comprise ~26%. Europe is the largest region

Air Transport MRO Market Spend 2024 \$

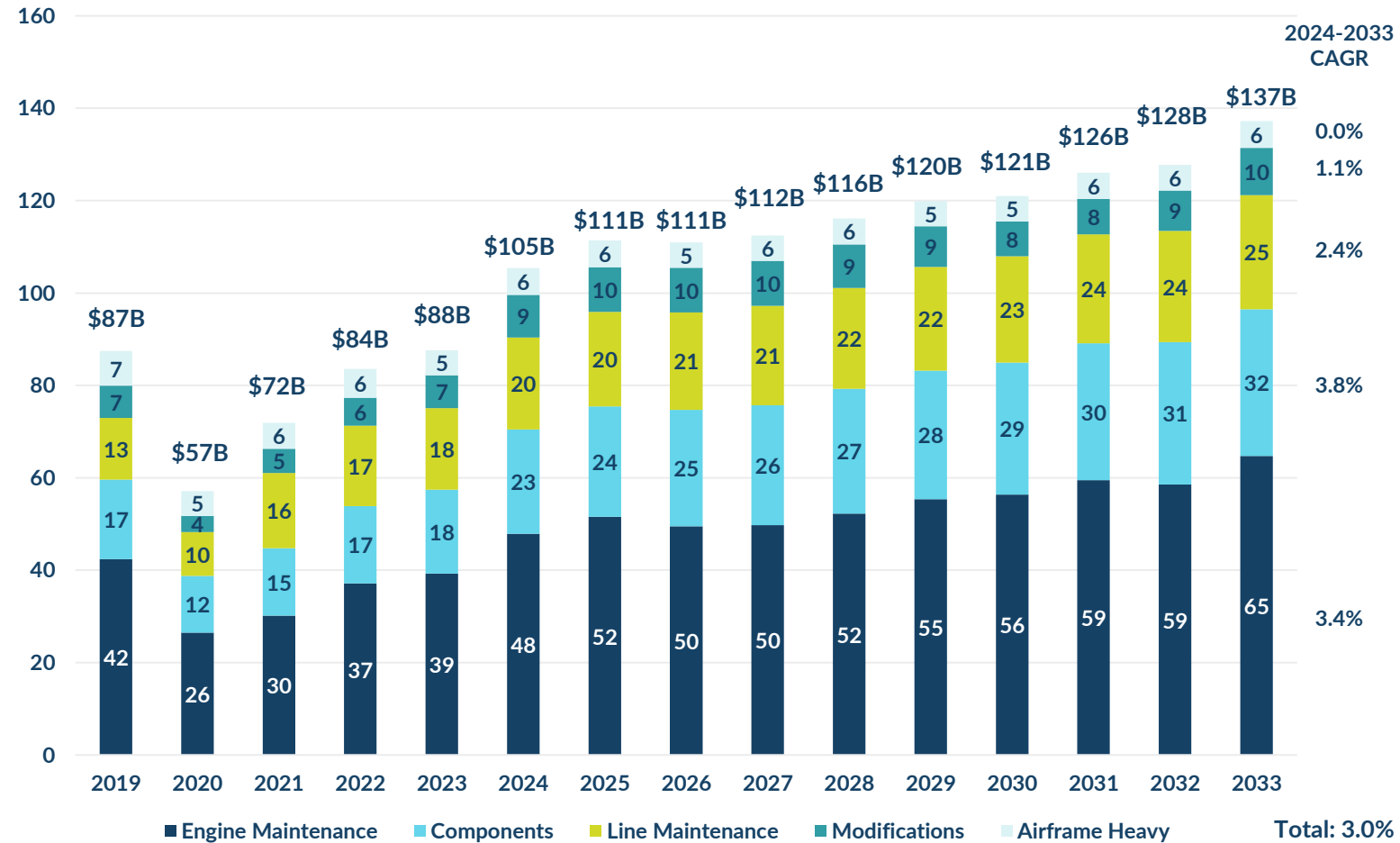


- 2024 air transport MRO spend is forecasted to be \$105B. This is driven by engine maintenance, the largest spend category, at \$48B (45%), followed by component maintenance at \$23B (21%). Next is line maintenance MRO at \$19B (19%) of spending, followed by modifications (\$9B) and heavy airframe maintenance (\$6B)
- European operators generate the most MRO at \$25.7B (24%), but it's very close to North America at \$25.5B (24%). Asia Pacific operators (excluding China) generate \$21.6B, followed by China's operators at \$13.2B

MRO spending has returned to pre-pandemic levels

- ▲ The MRO market is forecasted to reach \$88B by 2023, exceeding 2019 pre-COVID levels
- ▲ 2024-2033 CAGR growth rate (constant 2023 \$) is forecasted to be 3.0%
- ▲ Engine maintenance is the largest spend, followed by components, line, modifications and airframe heavy maintenance
- ▲ Airframe maintenance is forecasted to grow at the slowest rate (0%) due to the retirement of maintenance-intensive aircraft and their replacement by less maintenance-intensive aircraft. Line maintenance is forecasted to grow at 2.4%, modifications at 1.1%, and engine MRO at 3.4%
- ▲ The fastest-growing segment is components, which are forecasted to grow at 3.8%

Air Transport MRO Market Forecast, 2019-2033 By MRO Category
 (All Air Transport Aircraft) – Forecast from 2024 Constant US\$



Air Travel demand has returned, but the aftermarket and production supply chain has struggled to keep up

Production & MRO Market Issues



Labor Constraints

COVID caused talent to leave OEMs, MROs and airlines, exacerbating skills shortages. Recruitment is occurring, but new workers might be less skilled and take time to train



Parts & MRO Capacity Shortages

Shortages of key parts (e.g., castings), assemblies (e.g., engines), engine, part and component repair shop capacity are constraining MRO and causing longer turn times



Reliability & Regulatory Issues

Engine durability (e.g. GTF) issues and regulatory issues (e.g. Boeing) are requiring early removals and hospital visits, grounding aircraft, constraining engine slot capacity, and causing older aircraft to remain in-service longer



Inflation, Interest Rates & Payment Terms

Higher interest rates have made it harder and costlier for some sub-tier suppliers to obtain working capital to fund the production and MRO market ramp-up. Long payment terms with OEMs aren't helping smaller supplier cashflow

Considerations

AIRCRAFT UTILIZATION



- ▲ Global flying hours in August 2024 hit 106% of August 2019
- ▲ Compared to August 2023, flying hours are up an encouraging 7%
- ▲ Domestic travel has led the recovery, with utilization already above pre-COVID levels. August's domestic flying hours were 13% above pre-COVID hours, and international flying hours were 2% above pre-COVID levels of August 2019

AIRCRAFT ORDERS



- ▲ The order book has swelled this year with announcements from the Middle East, Asia Pacific (including large orders from Air India) and North America
- ▲ Global air transport order book in September stands at ~20,540 aircraft
- ▲ Asia Pacific accounts for the most orders (~5,410 and 25% of the orderbook), North America accounts for ~4,825 orders (24%), Europe ~4,189 (20%), China ~2,480 (12%), Middle East ~2,036 (10%), Latin America ~853 (4%) and Africa and unidentified ~1,017 (5%)

SUPPLY CHAIN & TECHNICAL ISSUES



- ▲ Supply chain challenges persist and cause frustration for airlines, MROs and OEMs
- ▲ Shortages of talent, raw materials, production and maintenance capacity result in new aircraft delays, part delays and extended maintenance lead times
- ▲ In-service durability issues with engines (particularly GTF) have resulted in immense frustration, delayed retirements and supply-chain bottlenecks

MRO CAPACITY & EXPANSION



- ▲ MRO facilities are busy battling supply chain bottlenecks, in-service issues and long repair lead times
- ▲ Capacity is tight, with MROs selling capacity for years ahead
- ▲ MRO expansion and partnerships continue to be announced/considered. Examples include ST Aero at Singapore Changi, Delta Tech Ops GTF, Standard Aero & MTU in Dallas, Saudi/SAEI, Air France/Airbus A350, ST Aero and SF Airlines at Ezhou, Air Asia at Johor Bahru, SIAEC in Malaysia, Cambodia and Fujian, and Air India's future MRO requirements

NAVEO's consultancy expertise is broad.

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- ▲ Additive manufacturing and 3D printing
- ▲ Aerospace cluster strategy planning and support
- ▲ Aftermarket value proposition research, design, and testing
- ▲ Airframe, component, engine, and cabin interior market
- ▲ Big data and connectivity, aircraft health monitoring, prognostics and diagnostics
- ▲ Competitor analysis
- ▲ Customer satisfaction research, implications and action plans
- ▲ Customer segmentation and buying behavior
- ▲ Engine parts repair market Operations and supply chain improvements
- ▲ Mid-life to end-of-life aircraft market
- ▲ Original equipment production and MRO aftermarket forecasting
- ▲ PMA parts market
- ▲ Surplus parts / used serviceable material (USM)

M&A TRANSACTION SUPPORT SERVICES

- ▲ Acquisition search
- ▲ Due-diligence advisory
- ▲ Market assessment and trends
- ▲ Demand and supply outlook
- ▲ Competitive positioning, strengths, and weaknesses
- ▲ Independent revenue and margin commentary
- ▲ Expansion growth vectors
- ▲ Potential bolt-on acquisitions (or divestitures)
- ▲ Exit considerations



Air Transport



Business Aviation



Rotary Wing



Military Aviation



NAVEO is led by experienced aerospace consultant, Richard Brown

*Richard Brown -
Managing Director,
NAVEO*

Business Strategy. Richard regularly provides strategic advice to a broad range of aerospace clients including original equipment manufacturers (OEMs); maintenance, repair, and operations (MROs); and financial institutions. He is an expert at communicating the key aftermarket and manufacturing trends that affect the aerospace industry and which have implications for business planning and strategy.

Due Diligence. Richard works with companies and investors to evaluate market opportunities and forecast a target's potential revenue and competitive environment.

OEM and Aftermarket Forecasting. During his career, Richard has developed a variety of OEM and aftermarket forecast models in a wide range of areas from business aviation, used serviceable parts, PMA, engine parts repair and aircraft retirements. He has helped clients improve the accuracy of their forecasting processes to understand and prepare for revenue growth and better respond to market opportunities.

Market Segmentation. Richard helps clients better understand customer needs and buying behavior. By identifying groups of customers with similar needs, he has helped clients develop value propositions better aligned to the needs of customer's therefore increasing revenue and market share.

Customer Needs and Satisfaction. Richard has managed a variety of projects for aerospace manufacturers and suppliers to understand customer satisfaction and evolving needs. Insights have led to targeted improvement opportunities, enhanced satisfaction and customer loyalty.

- ▲ Richard has over 24 years of experience in aerospace, including 19 years of focused aerospace consulting. He is based in London
- ▲ Prior to Naveo, Richard led the ICF Aerospace consulting practice, leading a team in London, New York, Boston, and Singapore and managing a global roster of aerospace clients
- ▲ Before ICF, Richard was part of the European practice at AeroStrategy – a boutique aerospace consultancy. Before consulting, he spent five years at Goodrich (a component OEM) in various marketing and strategy roles
- ▲ Expertise in strategy and market analysis projects with a broad global client base, including airlines, manufacturers, and financiers
- ▲ Areas of particular interest include OE and aftermarket strategy, market sizing and forecasting, aircraft, engine and component manufacturing, business aviation, aftermarket repair and support, big data analytics, and health monitoring
- ▲ Mr. Brown has a BSc. in International History from the London School of Economics and an MSc. in Air Transport Management from Cranfield University
- ▲ A regular conference chairman, presenter, moderator at events including AviationWeek Conferences, Royal Aeronautical Society, African Aviation, MARPA, Aviation Suppliers Association, and internal strategy sessions, and offsites with clients. He is regularly called upon by the media for his insights into aviation issues

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Available Seat Kilometers (ASK) capacity forecasts and analysis against historical data by key geographic region.



Air transport & business aviation flight hours/cycles analysis

Hours/cycles flown by aircraft type, engine type, operator region.



Aircraft production forecast

Forecast of new aircraft production, systems, raw materials.



Aircraft retirement forecasts

Forecast of aircraft retirements and analysis against historical data.



Maintenance, Repair and Overhaul (MRO) forecasts

Forecast of MRO spend by type of maintenance (e.g. engine, component, airframe, line, modifications), type of aircraft/engine, region, etc.



Used Surplus Material (USM) forecast

Forecast of USM market (\$) by key part types (e.g. engine, components, airframe), aircraft, engine, etc.



NAVEO

CONSULTANCY

Naveo is a focused aerospace consultancy dedicated to serving the needs of global clients, large and small. Highly responsive and backed by timely, relevant thought leadership and in-house intellectual property. We support revenue growth and business optimization across the production value chain – from raw materials to operators and financiers – and aircraft lifecycle – from entry-into-service to retirement and part-out. Our team is led by the experienced aerospace management consultant, Richard Brown

Aerospace is fast-moving, so we understand how your in-house analytical, operational, and strategic resource is challenged with constantly evolving issues. Naveo provides fresh, dynamic, and relevant advice to help you understand the critical issues that impact revenue growth, efficiency savings, and strategic options



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