AVIATION WEEK Fleet&MRO FORECASTS

AVIATION WEEK MRO EUROPE

European Commercial Outlook

2022 Fleet & MRO Forecast

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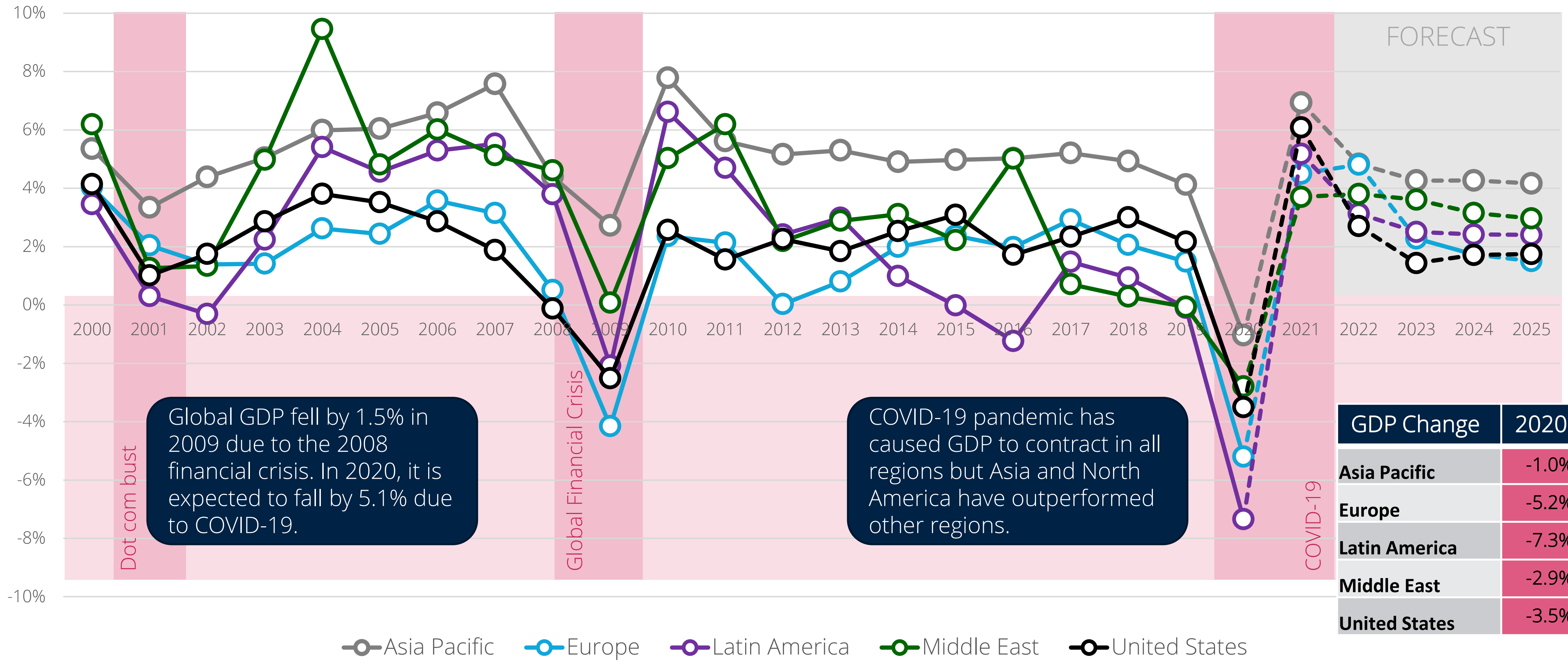
Intelligence & Data Services | Aviation Week Network
Washington, D.C.

October 2021

Economic Impact of COVID-19

Most severe global economic contraction since WWII with all regions affected, strong recovery expected.



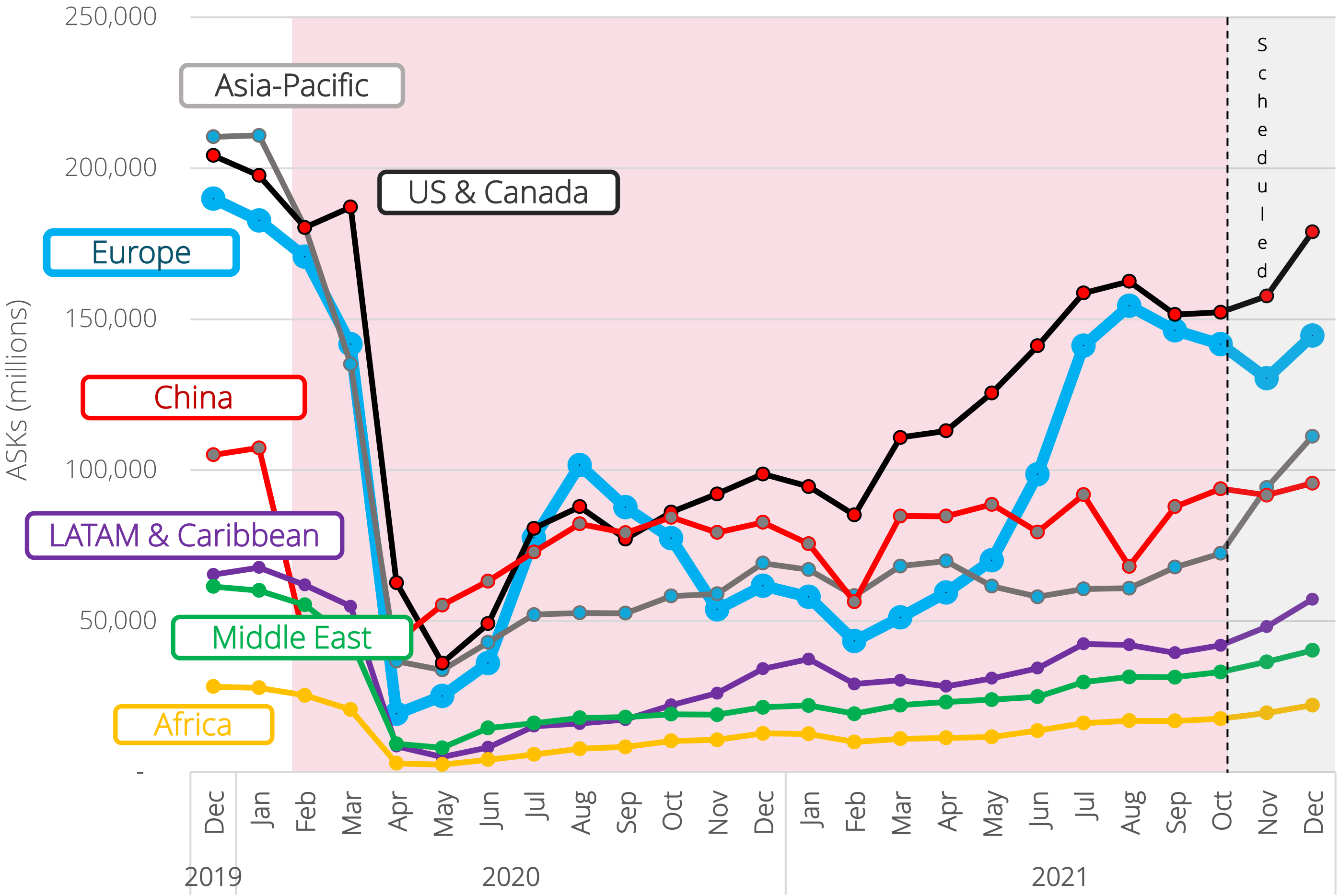
GDP Change	2020	2021
Asia Pacific	-1.0%	6.9%
Europe	-5.2%	4.5%
Latin America	-7.3%	5.2%
Middle East	-2.9%	3.7%
United States	-3.5%	6.1%

Source: IMF, Oxford Economics

Scheduled & Historic Available Seat Kilometres – By Region

Scheduled airline capacity through December 2021 (as of 7 October 2021)

ASM GLOBAL ROUTE DEVELOPMENT

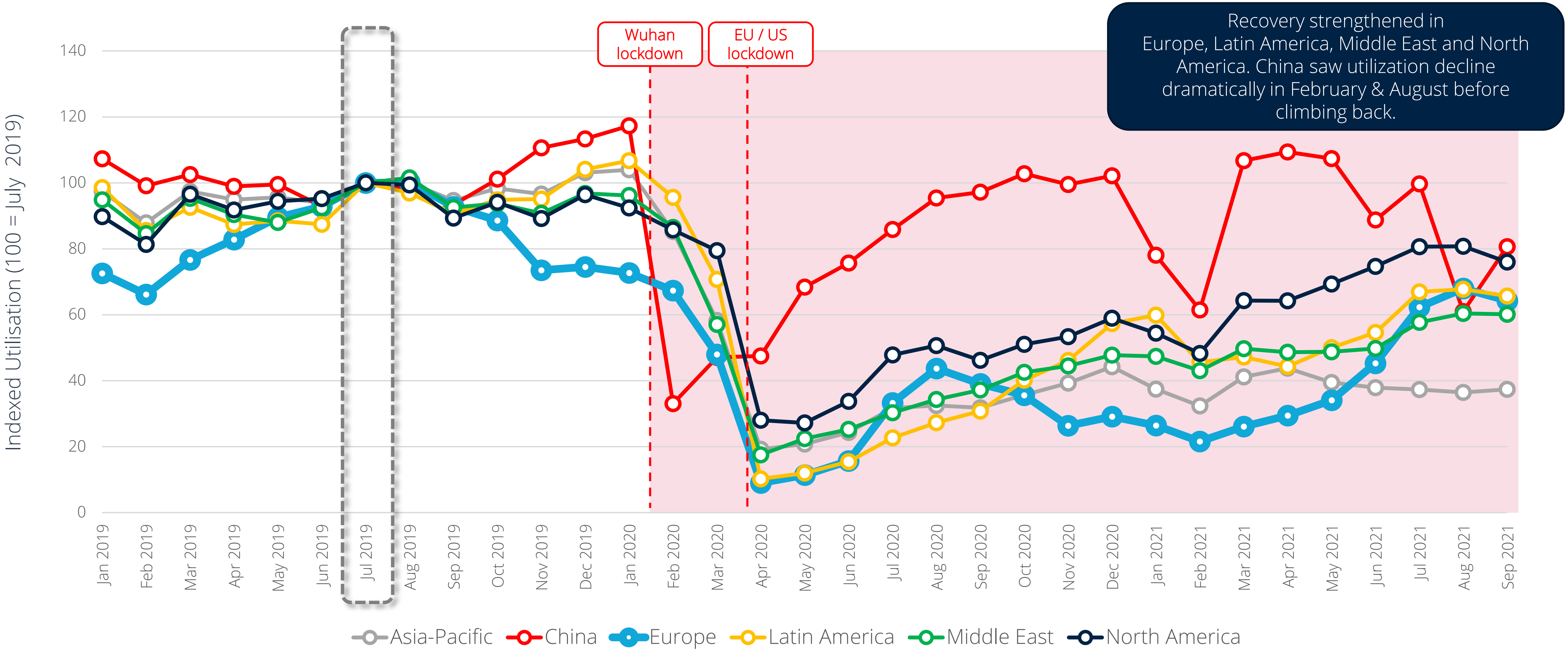


Region	Q4 2021 vs. 2020 % Change	Year Jan-Dec 2021 vs. 2020 % Change
Europe	116%	20%
Asia-Pacific	49%	-14%
U.S. & Canada	77%	32%
China	14%	19%
LATAM & Caribbean	79%	37%
Middle East	84%	12%
Africa	75%	29%

Analysis: Airport Strategy & Marketing (ASM) Consulting, Aviation Week Network

Utilization Change – Region

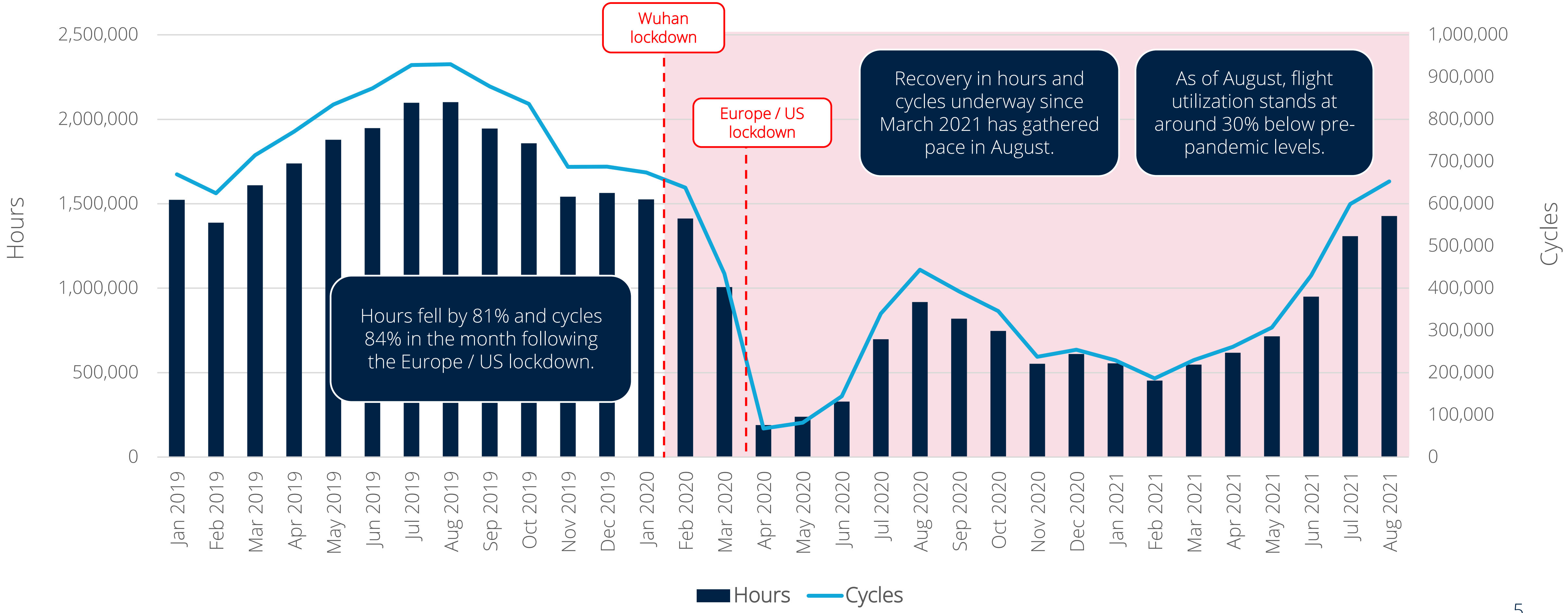
Indexed flight hour utilization for commercial aircraft fleets by operator region vs. July 2019



Source: AWIN Flight Tracking Data, Copyright 2021

Aircraft Utilization – Major European Airlines

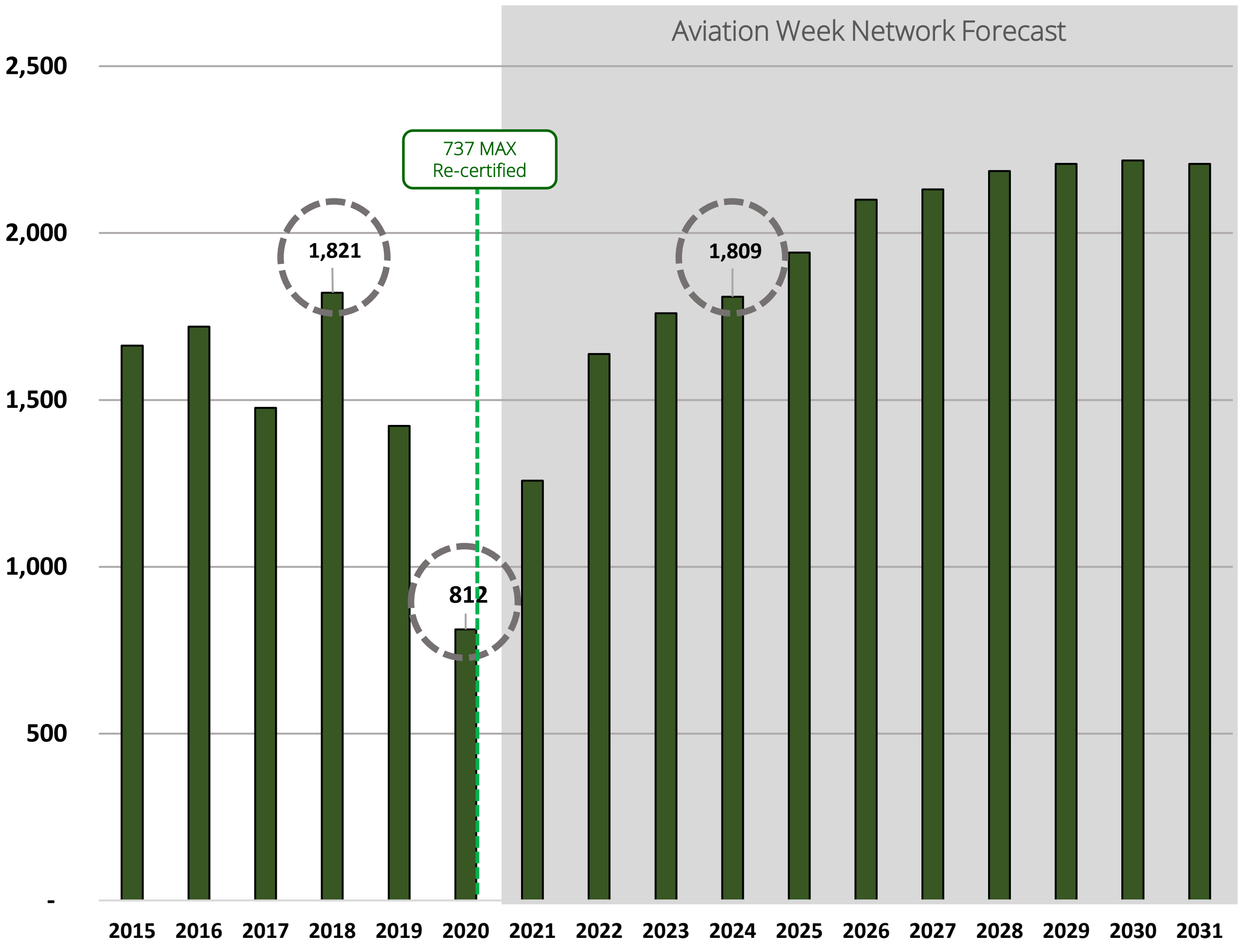
Utilization rates in hours and cycles for major European airlines, including LCCs – January to August 2020



Source: AWIN Flight Tracking Data, Copyright 2020

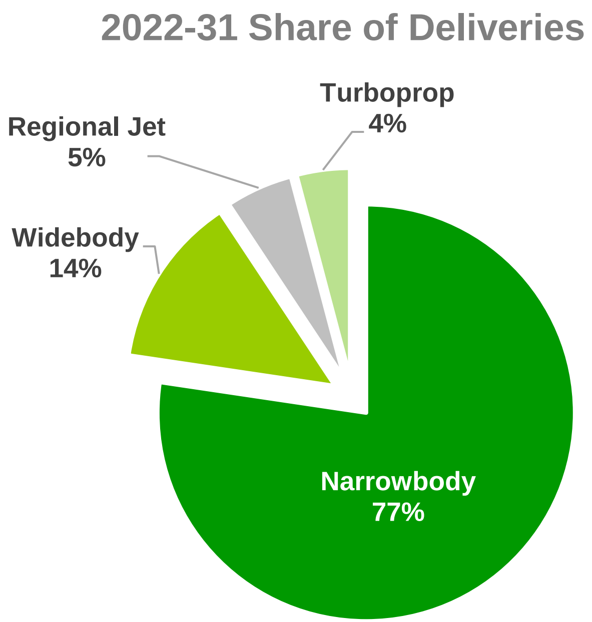
Forecast: New Deliveries Commercial Aviation

Global annual deliveries historical & forecasted



Highlights

- 20,000+ worldwide deliveries over 10-year 2022-31 period.
- Narrowbodies lead recovery efforts, 77% share of deliveries – Airbus A320 outpaces Boeing 737.
- MAX delivery status since MCAS grounding March 2019: 143 delivered to date out of 447 built, 304 awaiting final delivery.
- Wildcards: A220-500, Boeing 5X, Embraer CPX, 777X & A350 freighters.



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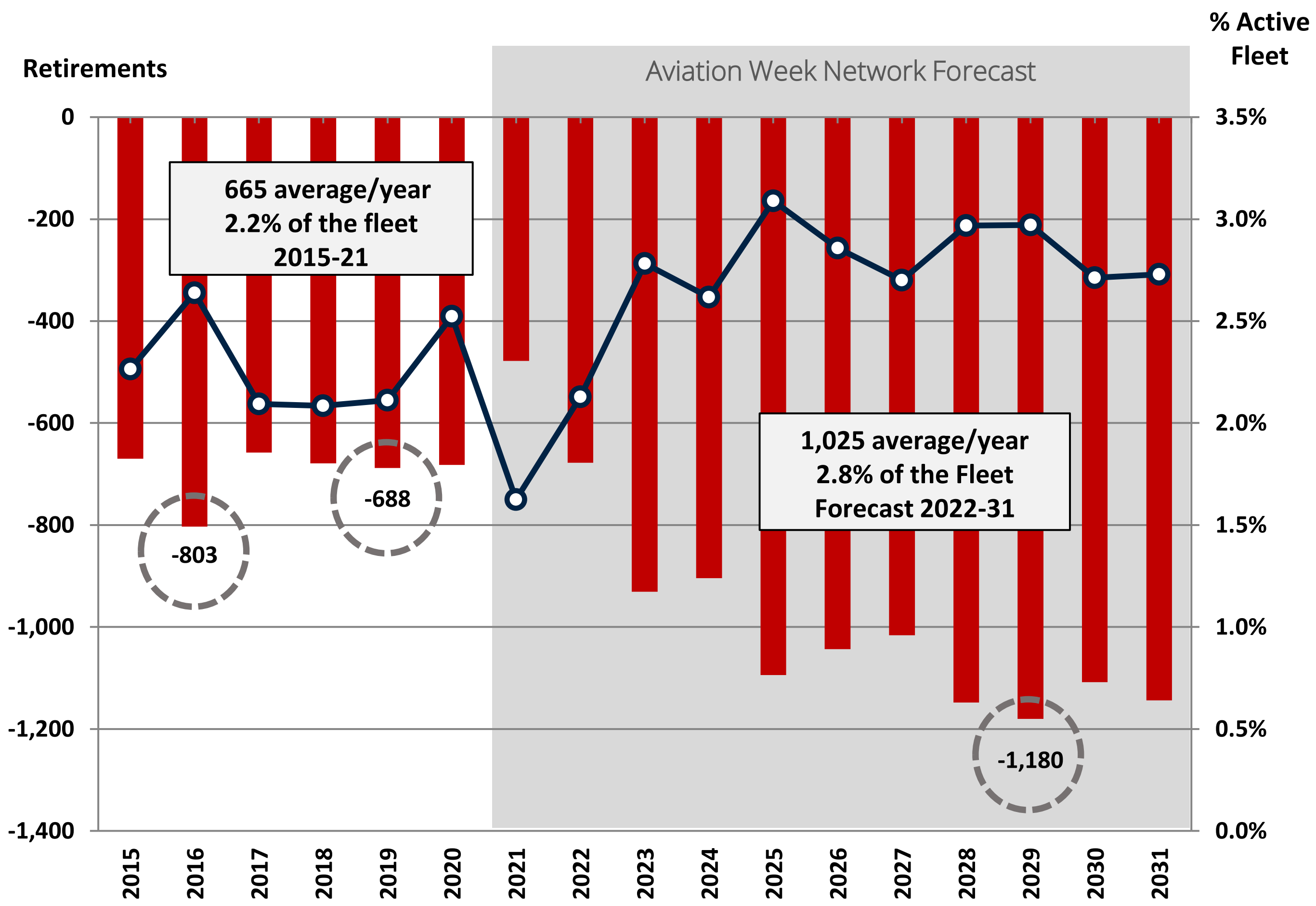
Forecast: Aircraft Retirements

Annual retirements historical & forecasted



Highlights

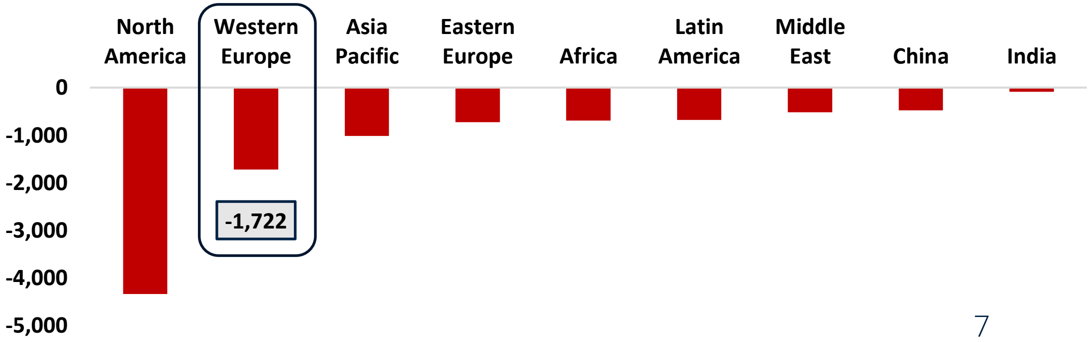
- Retirement projections top out at 1,180 in year 2029.
- Contrary to impressions, 2019 & 2020 were NOT record years.
- Historic high percentage of fleet rates dominate the 2H decade.
- Used spare parts/green time engines may flood markets for popular legacy types depressing pricing.

~10,700 retirements over 2022-2031

Up ~500 previous period

Credit: Nigel Howarth, Aviation Week

Regional Retirements 2022-31



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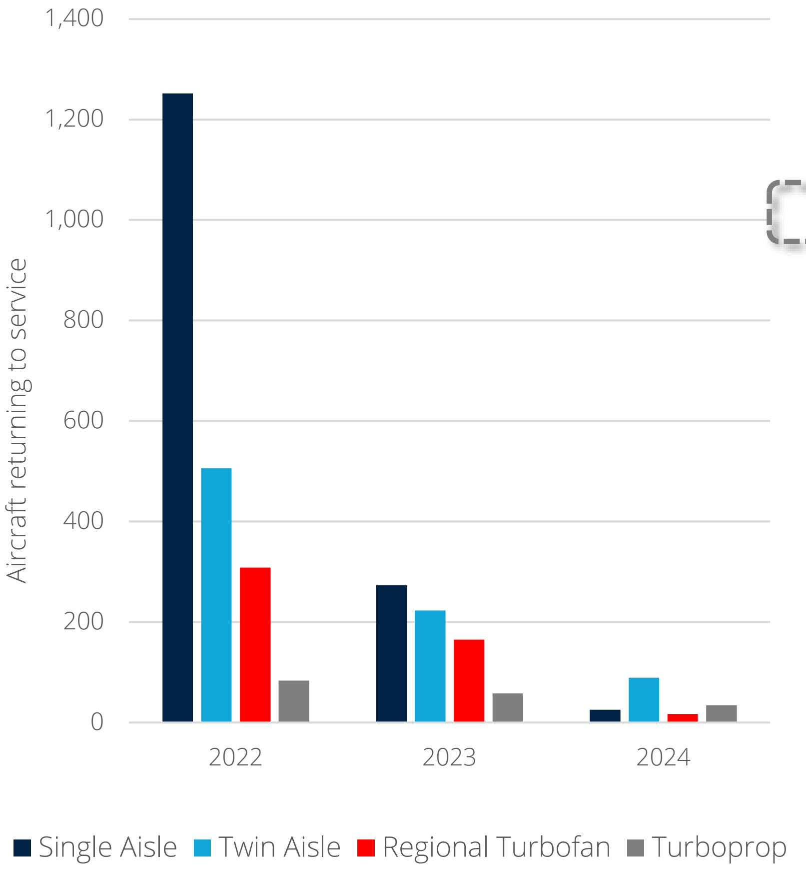
Aircraft Returning from Storage

Aircraft forecast returns from long-term storage post-pandemic



Historical Commercial Aircraft In Storage	
Jan 2020	3,096
Feb 2020	3,631
Mar 2020	10,062
Apr 2020	11,749
May 2020	**12,057**
Jun 2020	11,152
Jul 2020	9,641
Aug 2020	9,302
Sep 2020	9,065
Oct 2020	8,907
Nov 2020	8,773
Dec 2020	8,501
Jan 2021	8,656
Feb 2021	8,727
Mar 2021	8,389
Apr 2021	8,014
May 2021	7,561
Jun 2021	6,923
Jul 2021	6,404
Aug 2021	**6,069**

Highlights

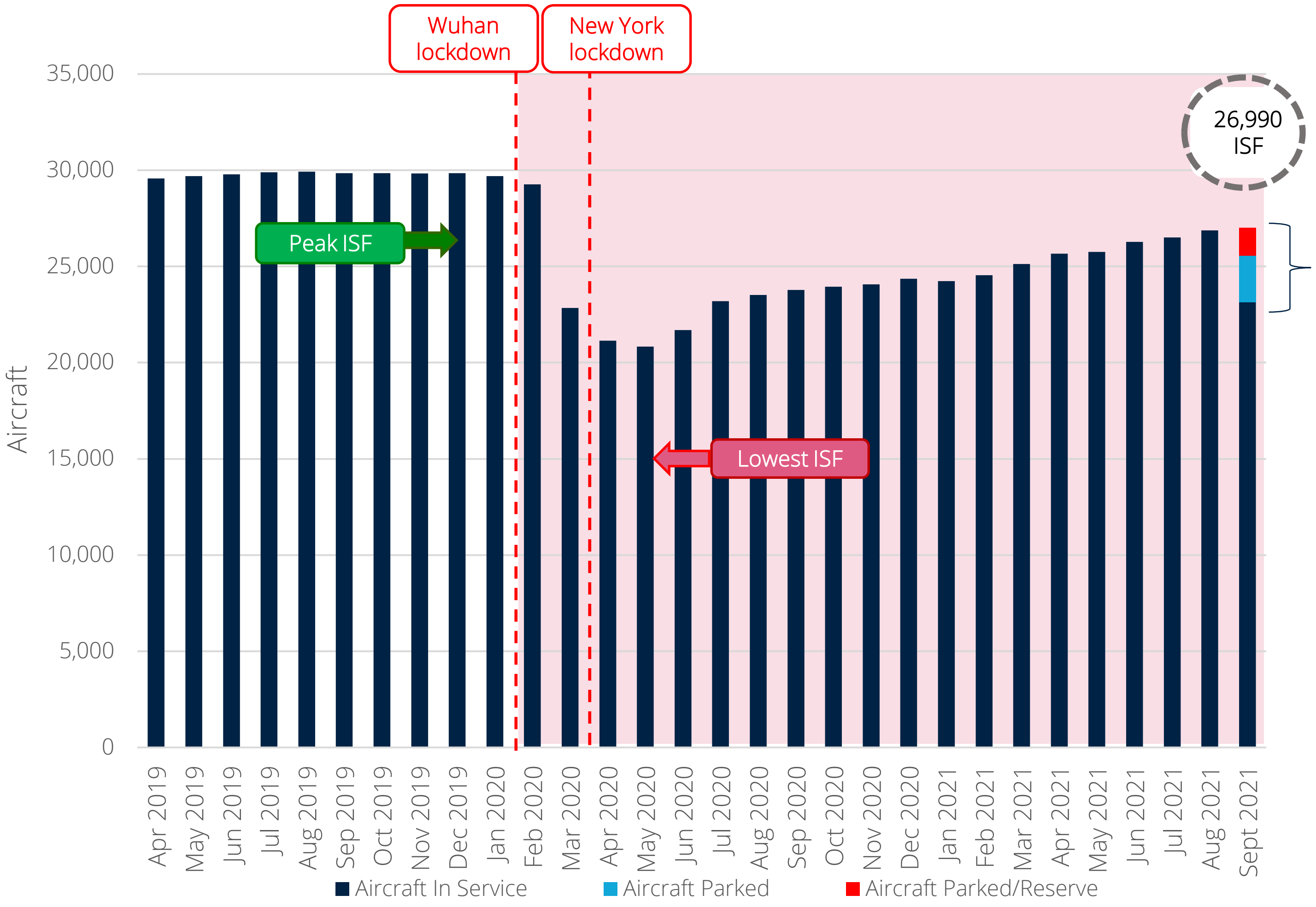
- 12k aircraft stored in May 2020, 6.7k in July 2021.
- Almost two thirds of the aircraft returning from storage in the forecast period will return by the end of 2022.
- International travel associated with widebody aircraft will be the slowest to return to active service.
- Through the first three years of the forecast, a total of over 3,100 aircraft are expected to return from storage as passenger demand increases.

Long range widebody fleet will see the slowest return to service with aircraft gradually leaving storage over the next five years.

Source: 2022 Commercial Aviation Fleet & MRO Forecast, Fleet Discovery, Aviation Week Network, Copyright 2021.

Historic In-Service Active Aircraft

Commercial jets and turboprop aircraft in-service, by month (includes parked, excludes stored)



15% parked or parked/reserve of the current, active in-service fleet by flight activity observed vs. 26% parked in March 2021.


Credit: Brian Kough

10%, (-3k) fewer active aircraft than December 2019. Commercial aircraft in-service seeing a gradual but steady recovery since June 2020.


Credit: Nigel Howarth

Long range widebody fleet will see the slowest return to service with some aircraft gradually leaving storage over the next 1-3 years.

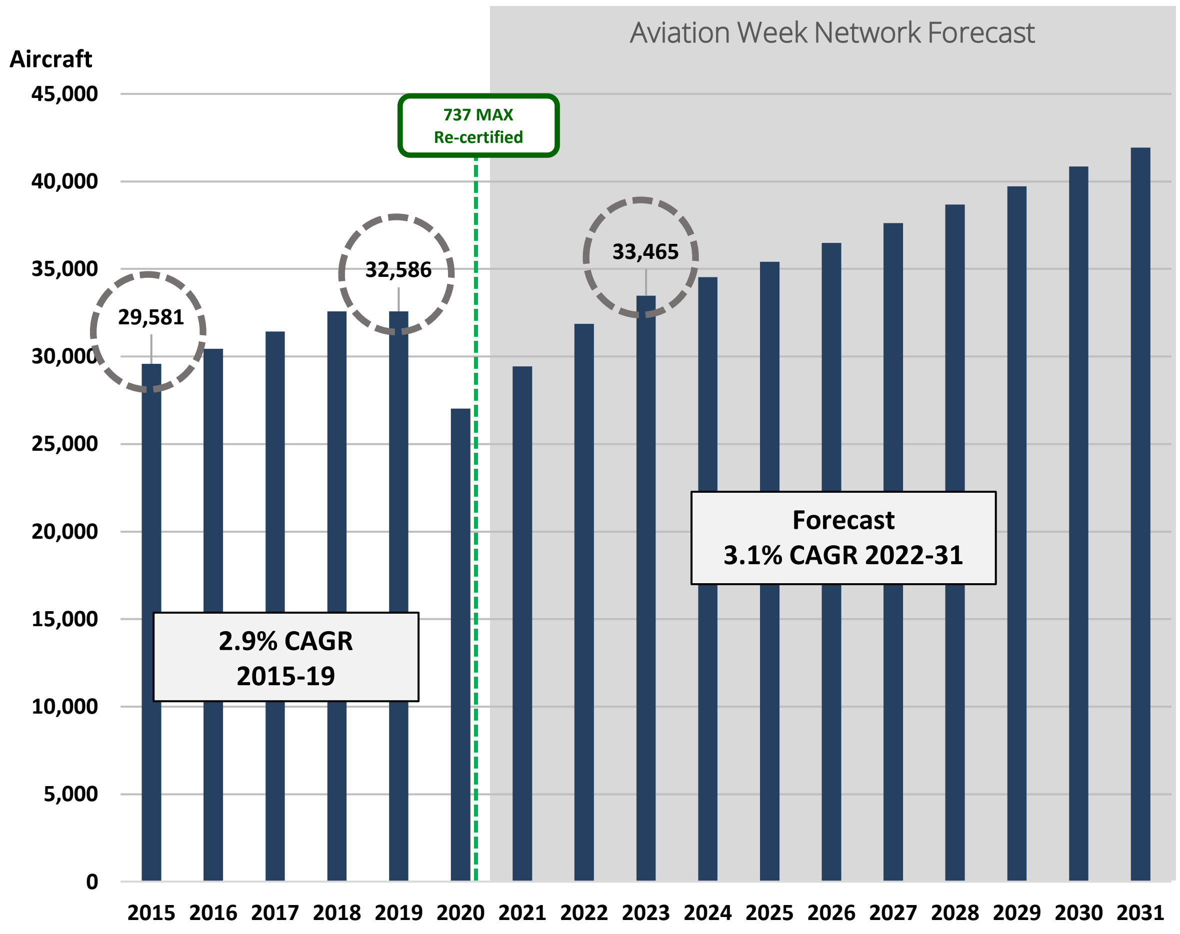
Credit: Mike Hopwood

Note: In-service totals for months prior to Sep 2021 include parked and parked/reserve aircraft. Excludes stored aircraft

Source: Fleet Discovery, Aviation Week Network, Copyright 2021

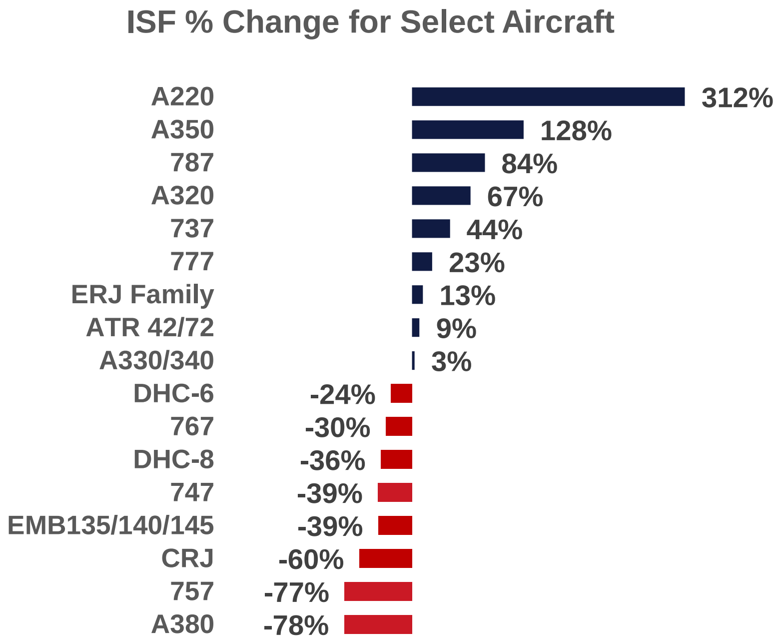
Forecast: World Trends In-Service Aircraft Fleet

Annual count of active commercial aircraft, historical & forecasted



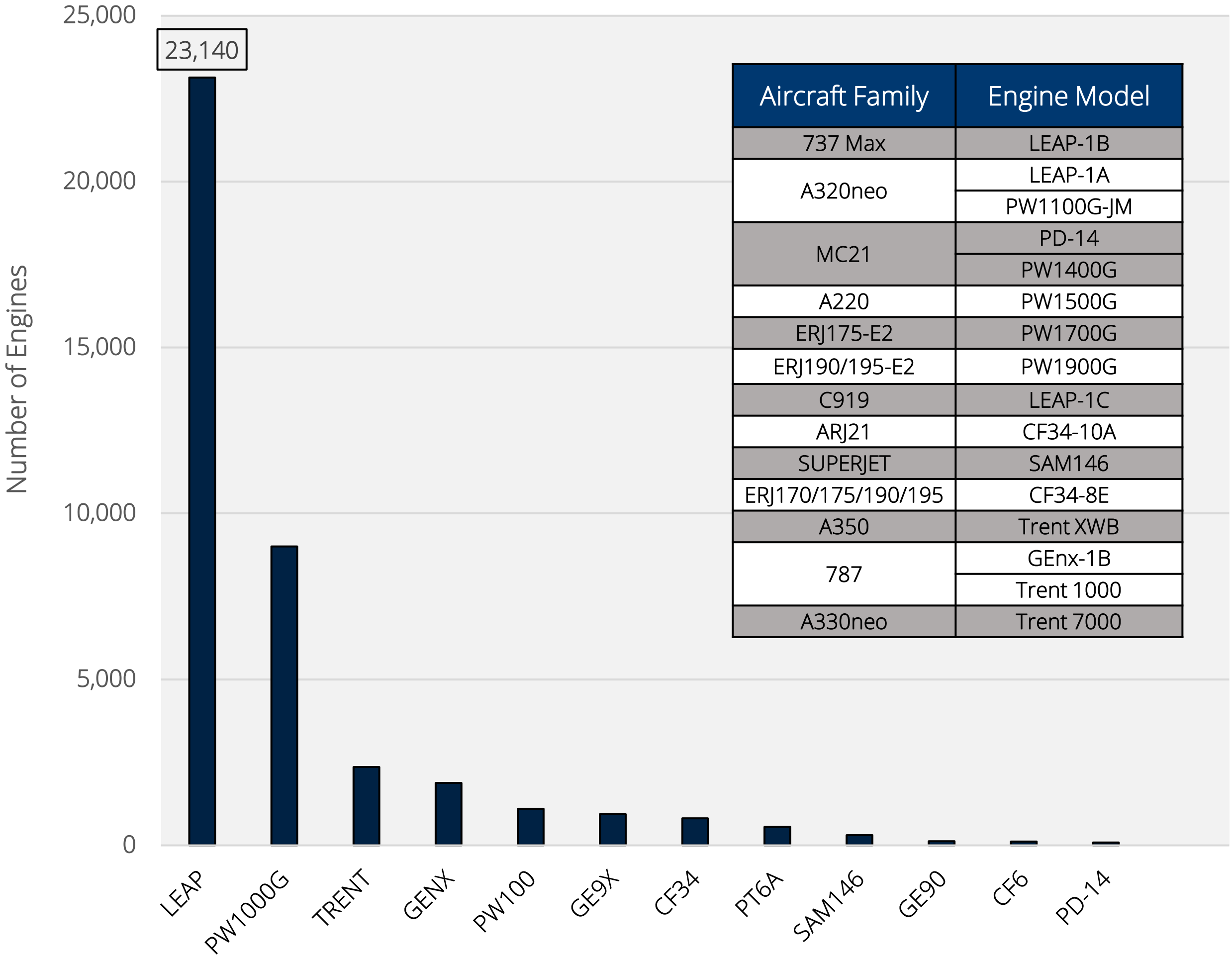
Highlights

- 3.1% future CAGR expected after 2.9% historical fleet growth.
- Pandemic influences: return from stores (3-4k), P2F freighters (1K). In May 2020, 12k aircraft were in storage!
- In-service fleet in mid-2021 recovers to more than 29,000 aircraft in line with 2015 levels.
- Narrowbodies are key growth driver over decade: MAX recertified + A320s take delivery lead.



Source: 2022 Commercial Aviation Fleet & MRO Forecast, Aviation Week Network, Copyright 2021.

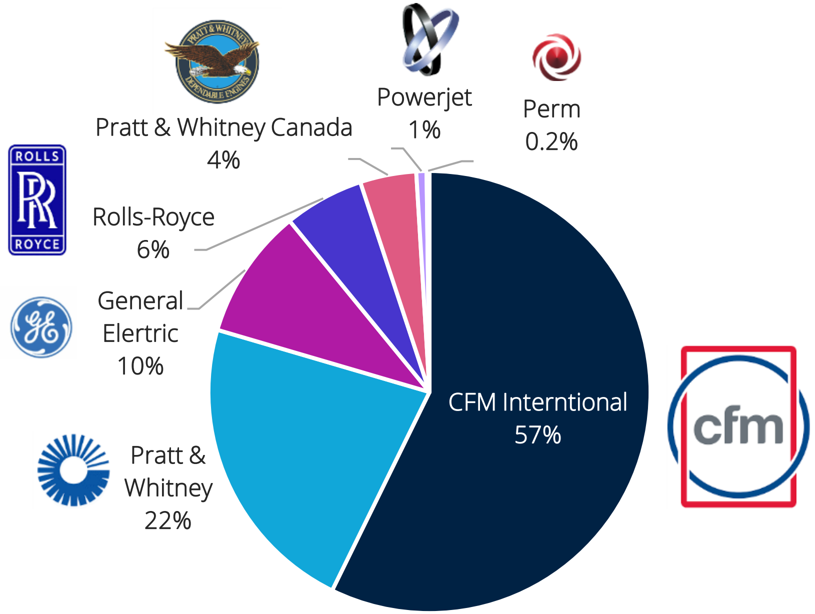
Forecast: New Build Engine Deliveries: 2022-31



Aircraft Family	Engine Model
737 Max	LEAP-1B
A320neo	LEAP-1A
	PW1100G-JM
MC21	PD-14
	PW1400G
A220	PW1500G
ERJ175-E2	PW1700G
ERJ190/195-E2	PW1900G
C919	LEAP-1C
ARJ21	CF34-10A
SUPERJET	SAM146
ERJ170/175/190/195	CF34-8E
A350	Trent XWB
787	GEnx-1B
	Trent 1000
A330neo	Trent 7000

CFM's LEAP engine alone is projected at over 23,000 engine deliveries.

CFM International engines account for 57% of all engine deliveries (not including spares…)



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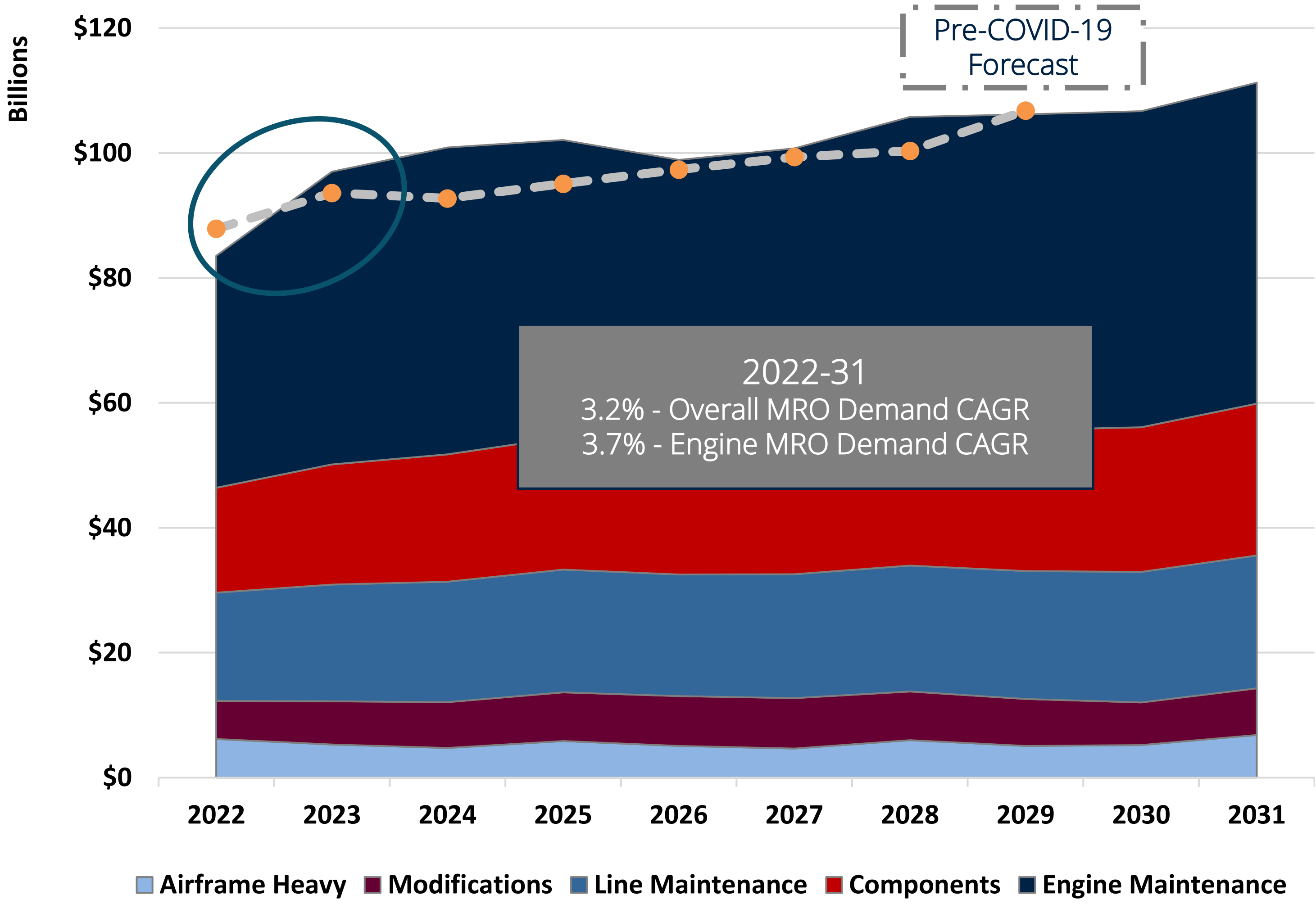
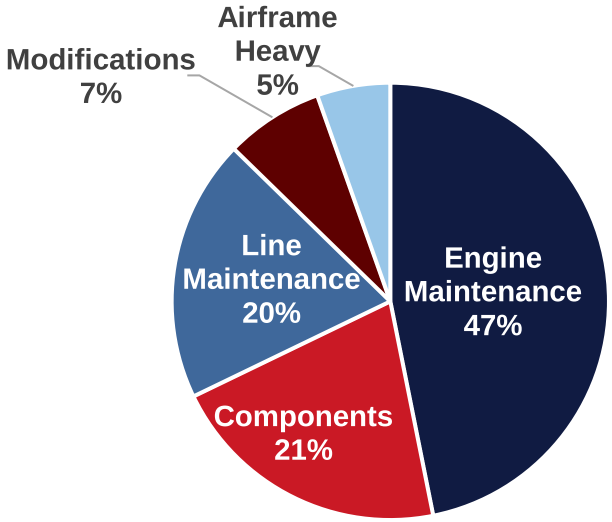
MRO Demand - Analysis

Global MRO aftermarket and the impacts from the pandemic



Highlights

- MRO grows at 3.2% CAGR 2022-31, worth $1.013 trillion, without inflation.
- Engine MRO demand is $474 billion over decade and grows at 3.7% CAGR. Green time/USM influences…
- Components MRO grows fastest at 4.2% CAGR.
- Airframe work expected to be cyclic.
- Recovery rates vary by region, role, and by aircraft category (NB, WB, regionals, turboprops, etc.)



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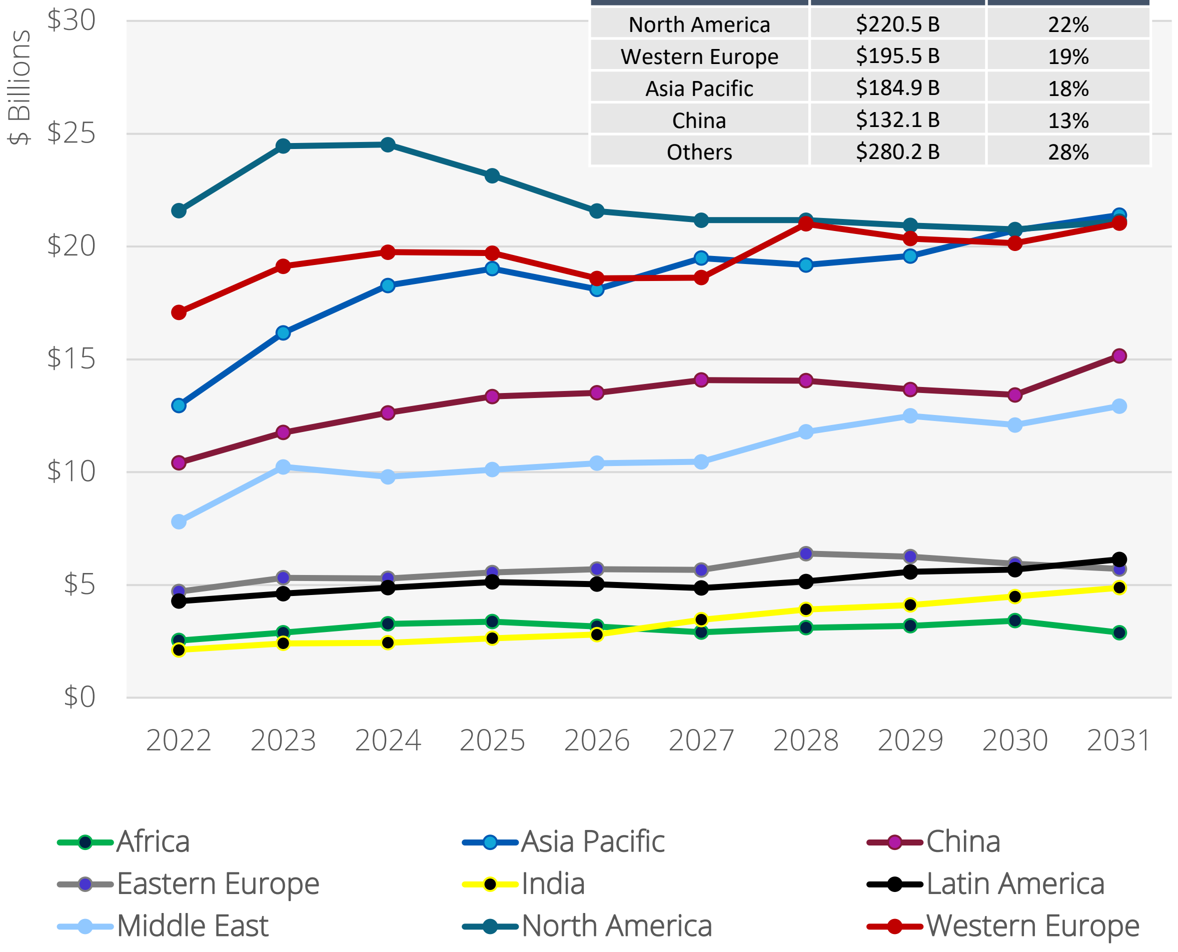
MRO Demand by Region & Aircraft Category

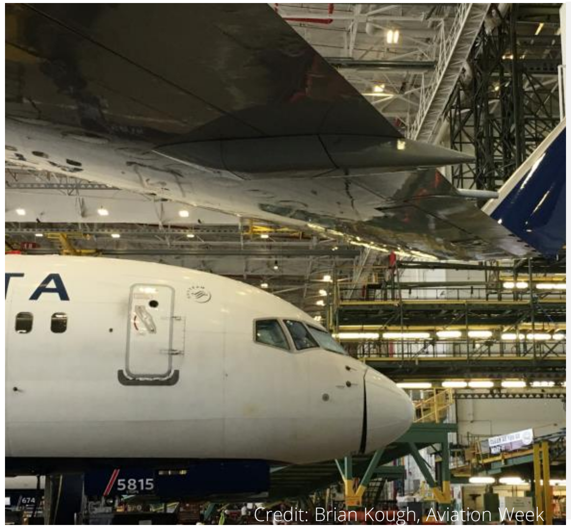
Region	MRO Demand 2022-31	Share
North America	$220.5 B	22%
Western Europe	$195.5 B	19%
Asia Pacific	$184.9 B	18%
China	$132.1 B	13%
Others	$280.2 B	28%

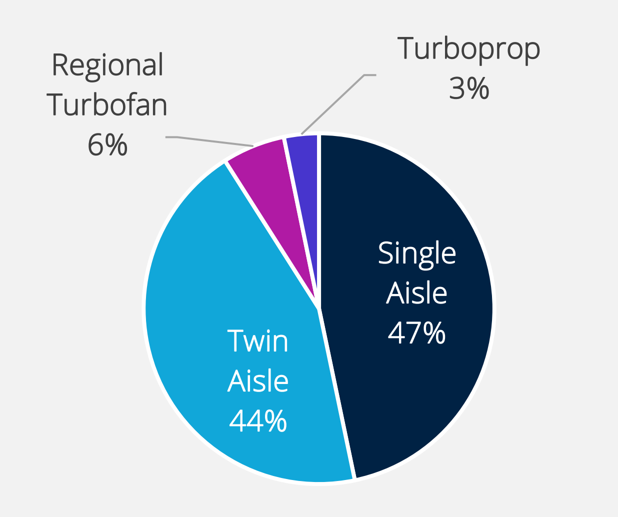


Highlights

- North America alone is expected to generate $220.5 billion.
- Fastest growth in China and Asia-Pacific; expected to expand at a 4.3% and 5.7% CAGR respectively.
- Eastern & Western Europe combined generate a total of $252 billion MRO demand.
- Single Aisle MRO will dominate the global fleet despite the higher costs associated with larger twin aisle aircraft.
- A320 family alone is expected to generate $257 billion demand, equivalent to almost 25% of all MRO activity.

By Aircraft Category (2022-31)





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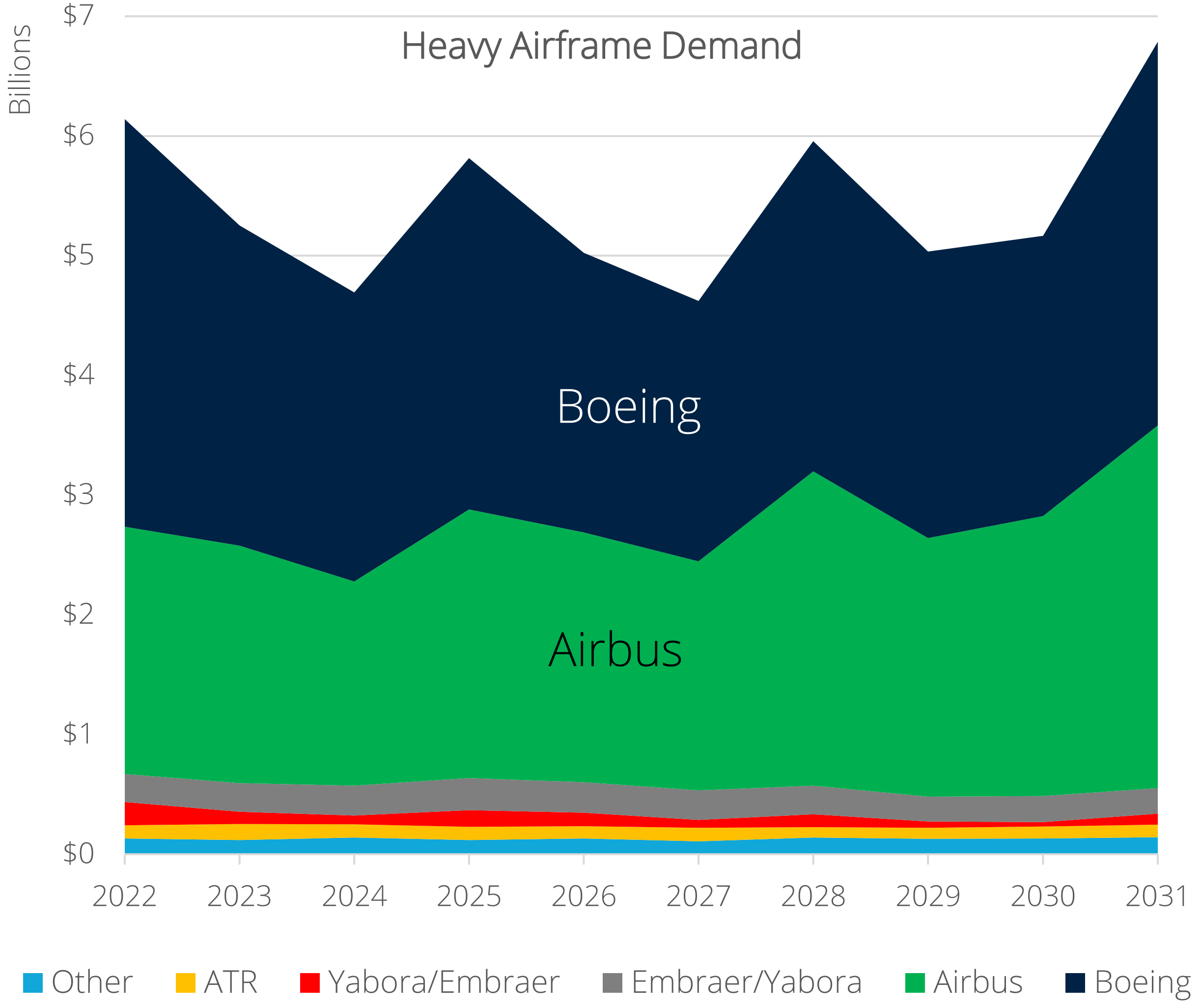
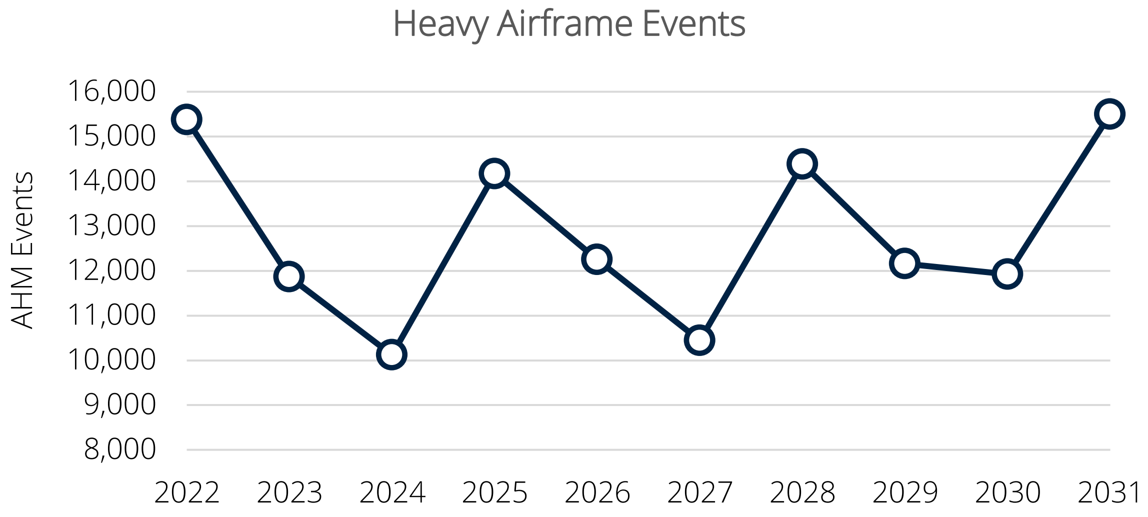
MRO Demand Shift – Airframe Heavy Maintenance Global



'MRO-Roller' Coaster?

- Grounding and storage of commercial aircraft created deferrals of thousands of calendar/utilization airframe checks.
- As aircraft return to service needing required checks, they'll create sine wave demand cycles – roller coaster…
- ~15,400 checks needed in 2022, falling to around 10,100 by 2024 before increasing again.
- $55 billion is expected to be spent on C & D Checks over decade.
- Demand increasing at a 1.1% CAGR – the slowest growth rate.



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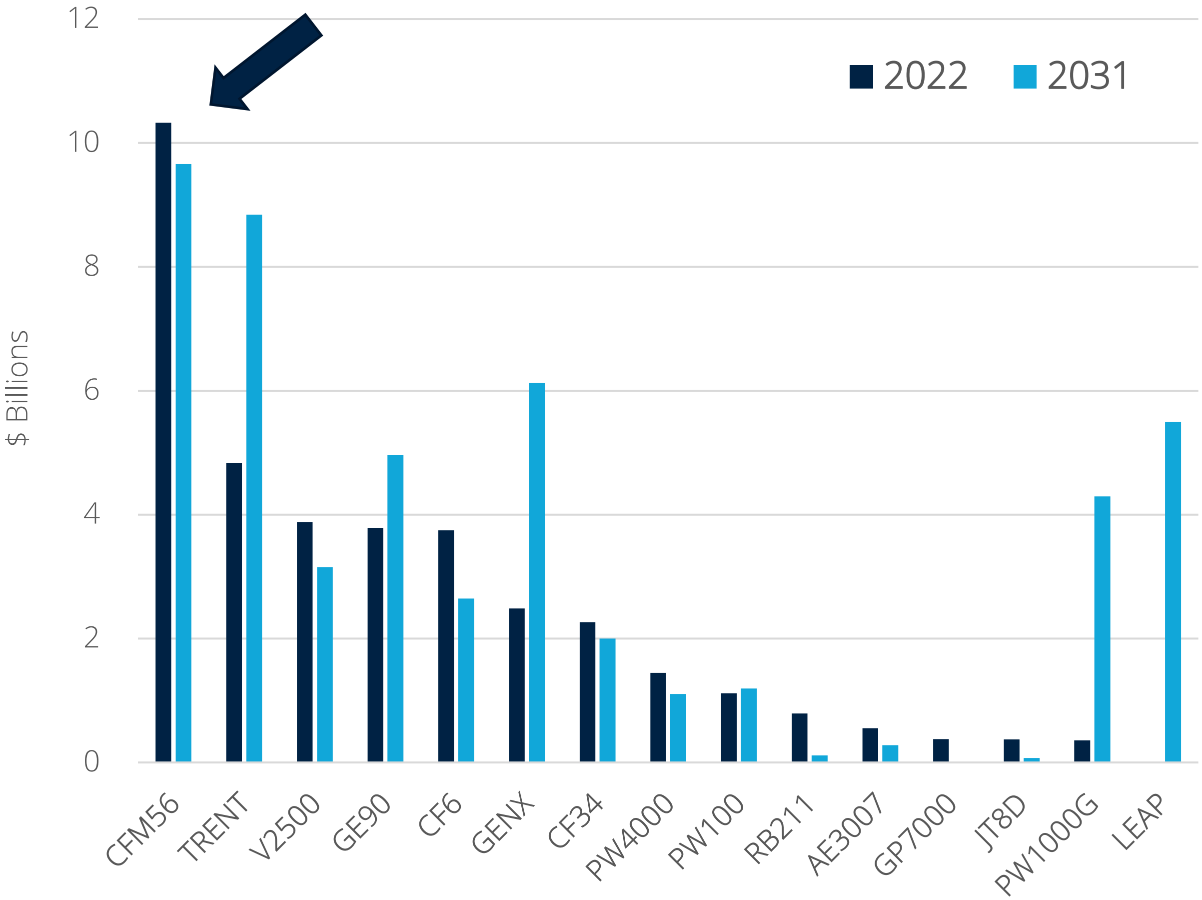
MRO Demand Shift – By Engine Family Global

World MRO Demand by Engine Family



Highlights

- CFM56 accounts for almost a quarter of all demand, ~$113B.
- TRENT family sees rapid growth: TRENT 1000 (787) & TRENTXWB (Airbus A350) maintenance spend rises from $4.8B to $8.8B for Rolls Royce.
- Demand for V2500 MRO declines before the end of the decade.
- GEnx (787) demand more than doubles over the decade rising from $2.5B in 2022 to over $6.1B by 2032.
- PW1000G & LEAP shop visits ramp up in the latter half decade generating $4B and $5B in annual demand respectively.
- Decline in demand for CF6-80 (767, A330), GP7000 (A380) maintenance linked with decline of widebodies & RB211 (B757).


Trent 1000


GEnx


RB211

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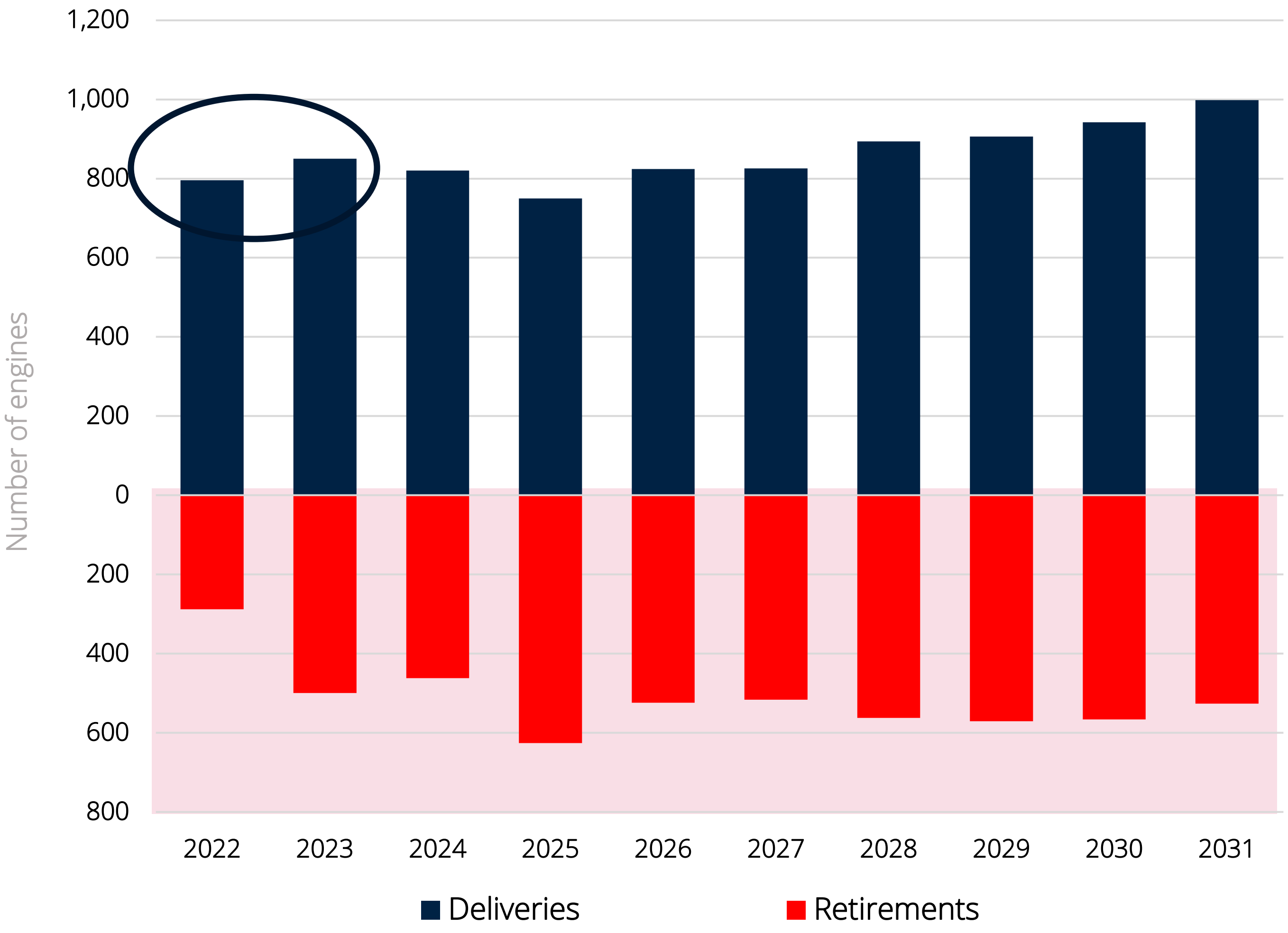
Europe's Engines

Deliveries vs. retirements in Europe 2022-31

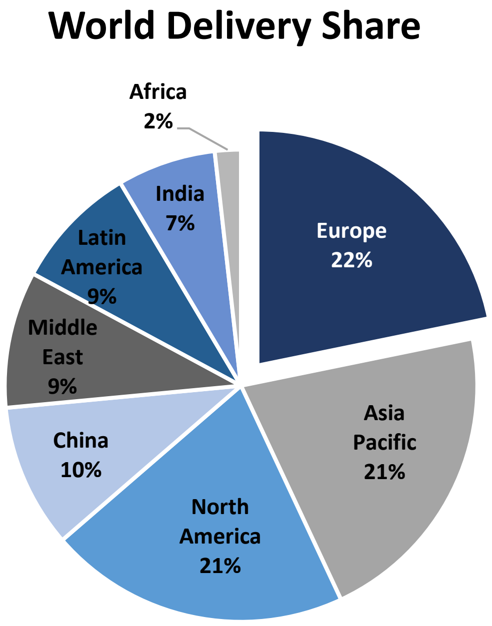


Highlights

- Europe (west + east) projected for 22% of world's delivery share of firm and expected orders.
- Retirements peak in 2025 at +600/year.
- Deliveries outpace retirements 1.7:1

PW1100G/NEO

~8,600 new engines required in next 10-years
~5,140 retirements expected



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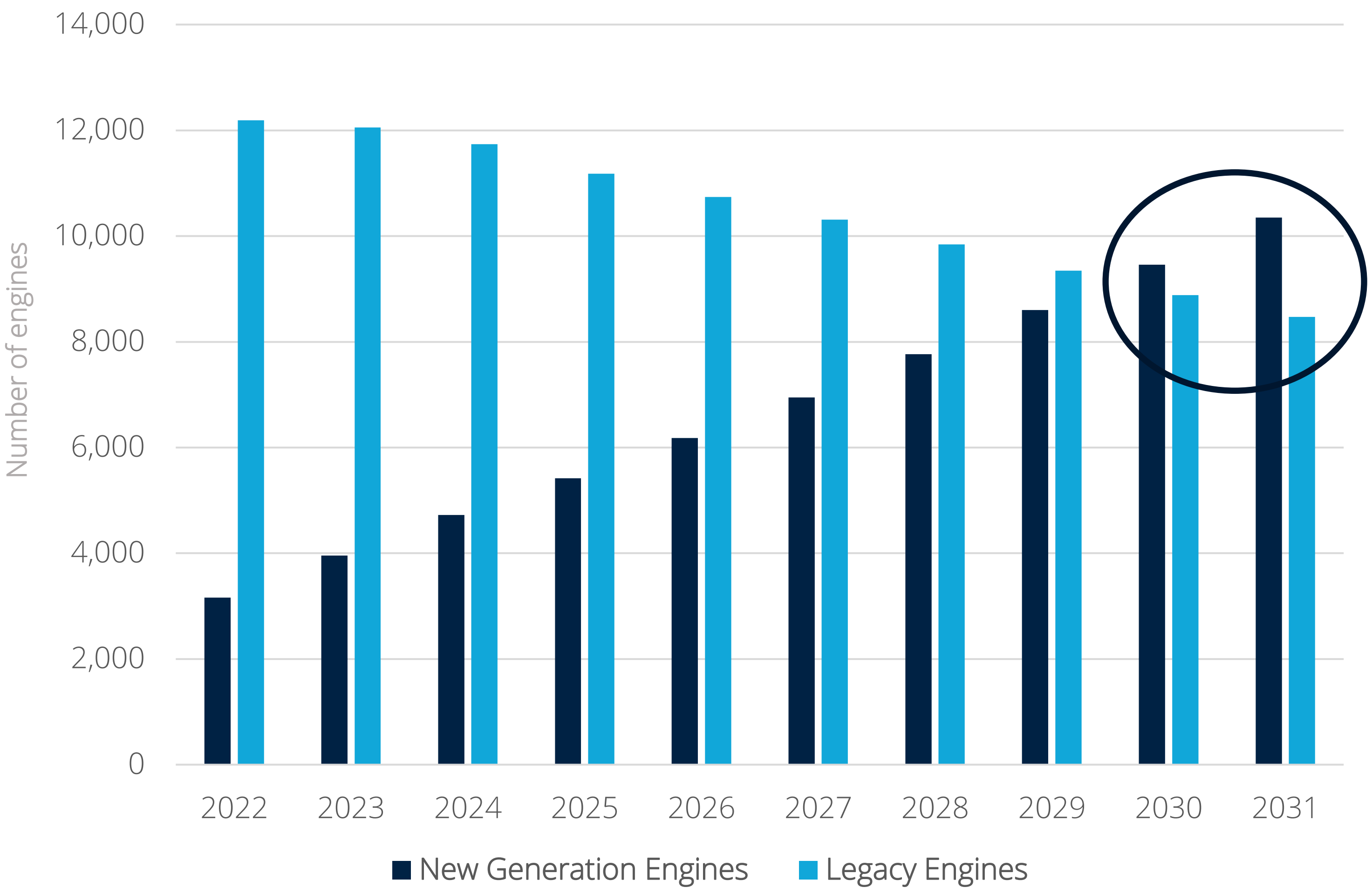
Engine Fleet Europe

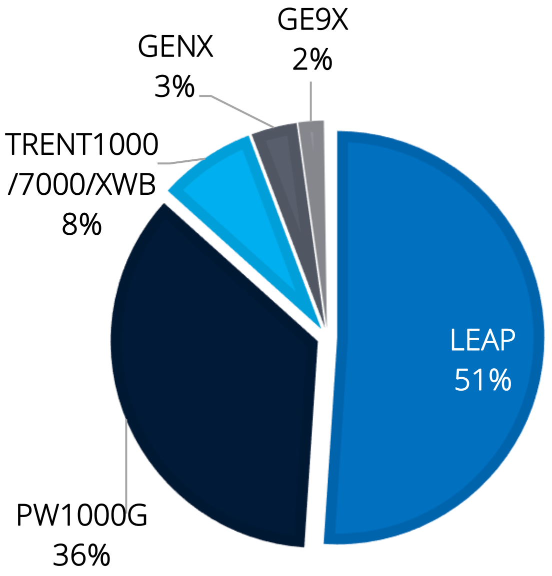
New generation vs. legacy in-service fleet share & deliveries forecast



Highlights

- New generation engines will exceed legacy types by 2030.
- LEAP family will hold 51% share of new deliveries (A320 + B737).
- Europe's fleet grows below average at 2.3% CAGR.
- Legacy engine fleet holds +50% share at the end of 2029.
- Fleet ends 2031 at ~18,800 engines.

NEW GEN DELIVERIES

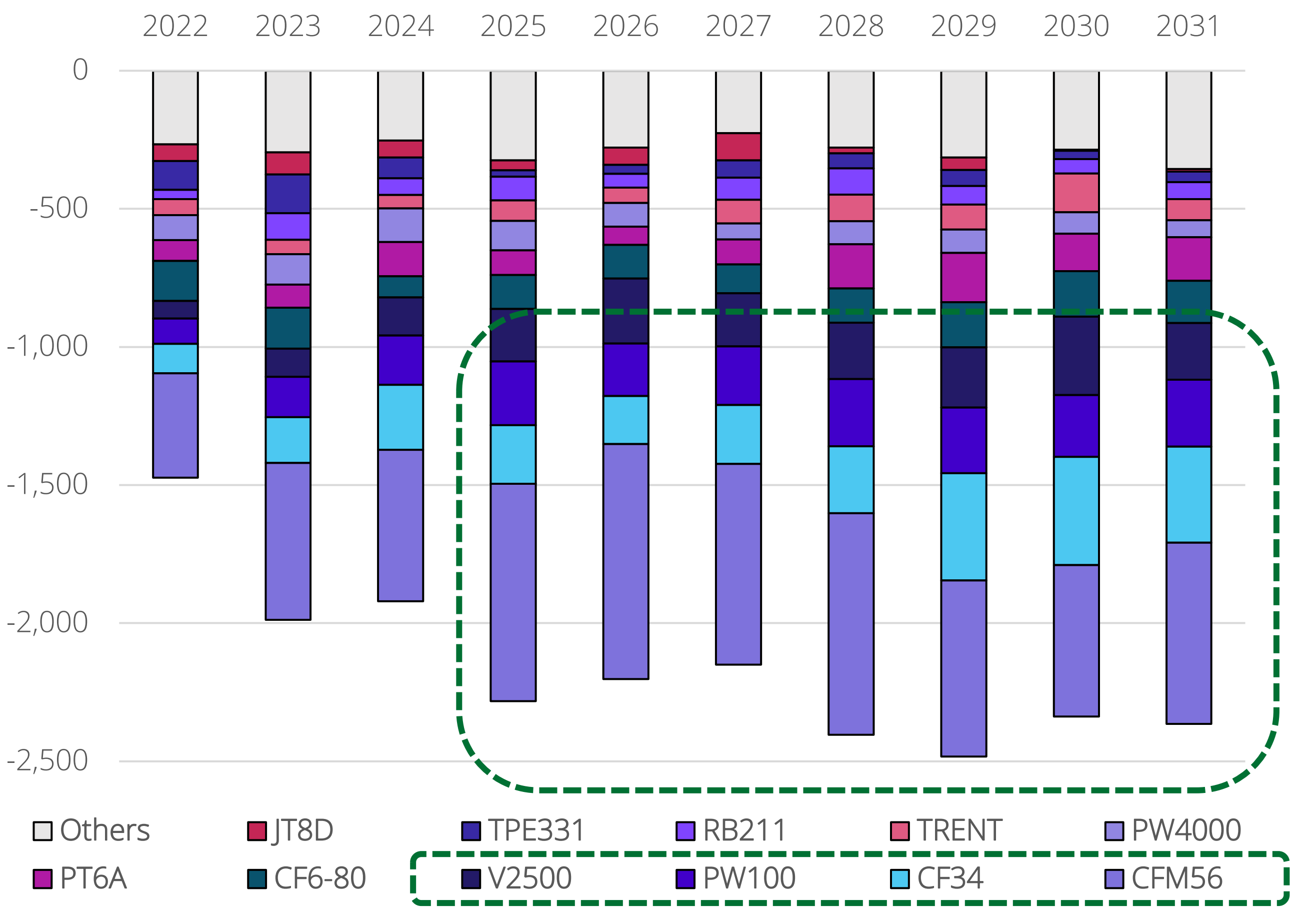


Lead by LEAP, new generation engines will account for over half of the active fleet in Europe by 2030

Source: 2022 Commercial Aviation Fleet & MRO Forecast, Aviation Week Network, Copyright 2021.

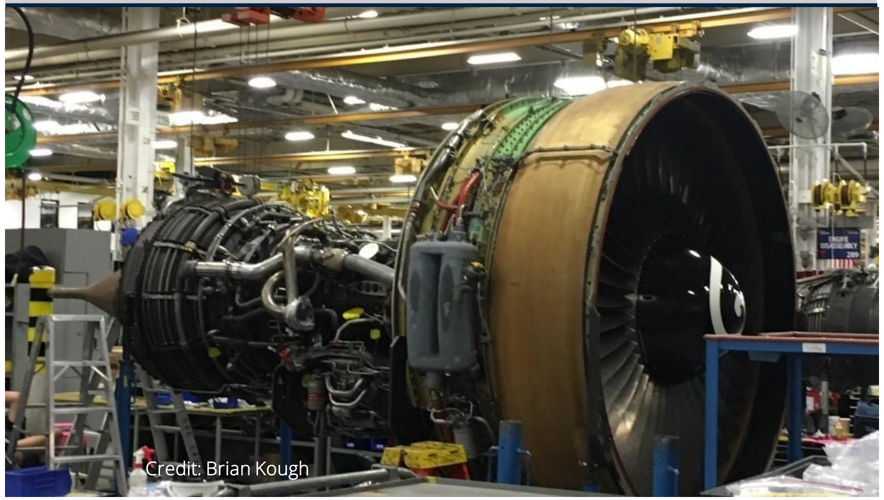
Commercial Engines/Parts with Green Time?

Engines worldwide associated with retiring aircraft: available as spares/USM?



Highlights

- Retirements of legacy aircraft significantly impacts engine MRO market demand.
- Topping the list: 6,400 CFM56, 1,800 CF34 and 1,700 V2500 powerplants
- Trends through 2021 suggest that both airframe and engine maintenance events avoided by switching aircraft between parked and active fleet as well as green time swaps to delay maintenance events/costs.
- Assuming these aircraft remain in service, this deferred maintenance may delay retirements or accelerate some.
- Potential to apply downward pressure on the cost of spares or shop visits as USM becomes available.


Credit: Brian Kough

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