

A light blue world map is centered in the background of the slide, showing the outlines of continents and countries.

Worldwide Market Forecast (2024 – 2043)

June 2024

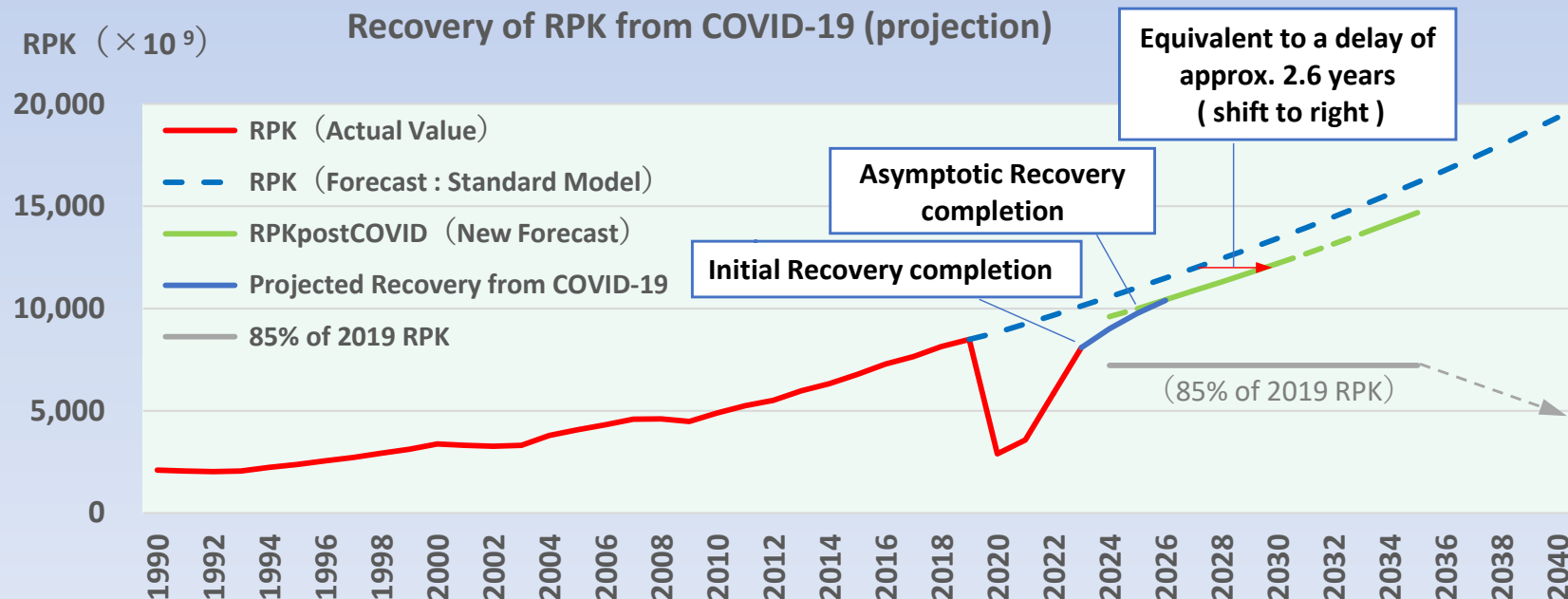
Strategic Planning & Market Analysis Department
Japan Aircraft Development Corporation

Briefing (1/4)

- With the vaccination progress in 2021, the RPK in the world has shown its initial recovery in 2022. The RPK will exceed 2019 levels in 2024.
- In the short to medium term, RPK is affected by lower forecast levels of GDP due to inflation and other disruptions in the global economy.

At the end of 2021, institutions were forecasting a sufficient recovery of GDP with vaccine propagation. The current decline in the level of the GDP forecast (and RPK forecast due to its impact) is mainly due to the political and economic turmoil starting with the invasion into Ukraine in the spring of 2022.

- In the long term, RPK may be limited by the impact of CO2 emission control measures.



Briefing (2/4)

[Recovery from COVID-19]

- In the second half of 2021, GDP and other forecasts were revised upward, and medium- to long-term passenger transport demand forecasts approached pre-COVID-19 levels.
- In 2022, passenger transport demand showed an initial recovery from the damage caused by COVID-19, and the full-year RPKs recovered to 68.8% _(IATA) of 2019 levels, as expected.
- In 2023, the global RPK has reached 95.2% _(IATA) of the 2019 level, and is expected to exceed the 2019 level in 2024.
- Airlines' losses also narrowed significantly and turned profitable in North America, Europe, Middle East region in 2022.
- New aircraft orders have recovered to the average level of 2011-2018 by 2022, and a record number of airplanes were ordered in 2023.
- Many airlines are currently struggling with staffing shortages in ground positions, due to a lack of return of employees who left during COVID-19, which could be essentially the last aftereffects of COVID-19.

Briefing (3/4)

[Turbulence on the Global Security and Economy]

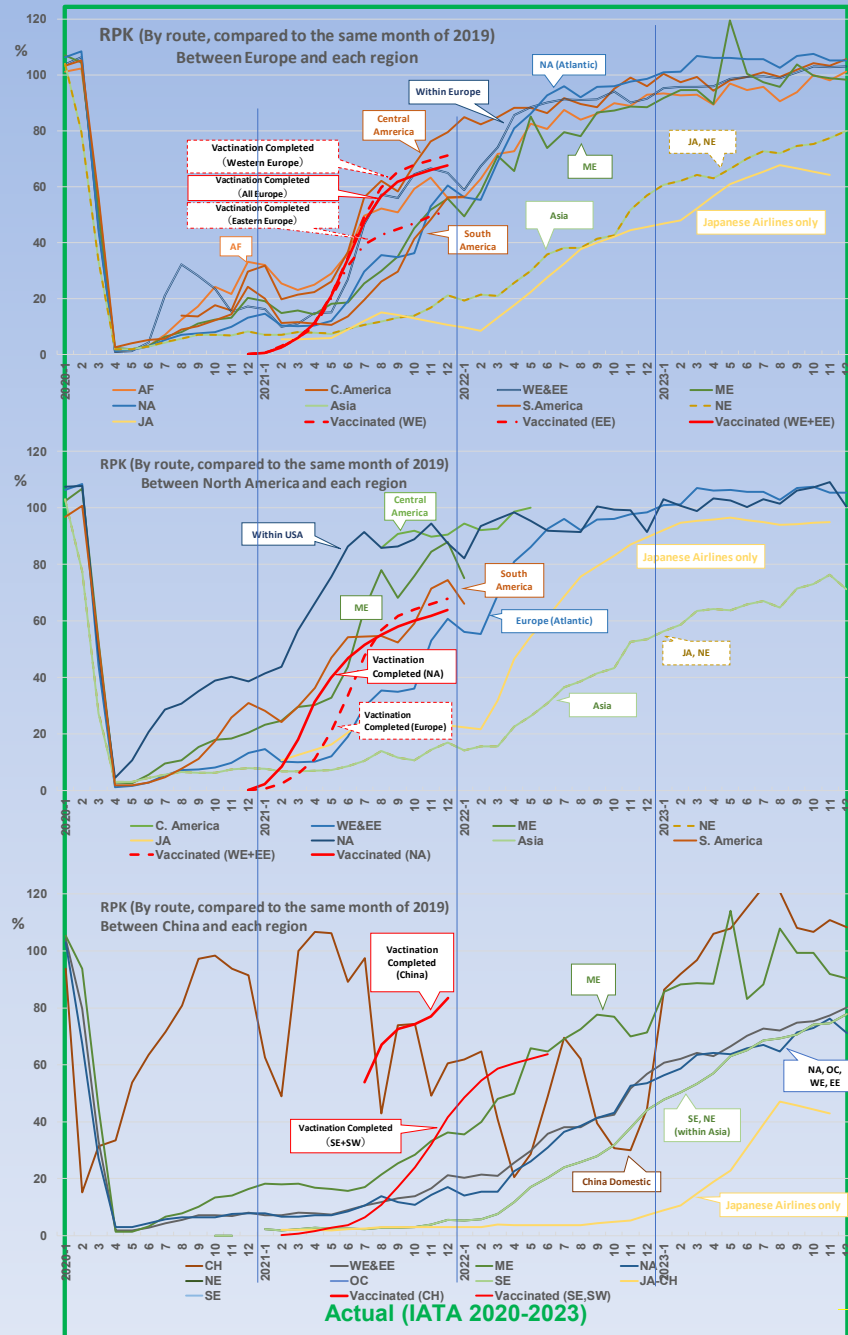
- The negative effects caused by COVID-19 are almost over. However, since 2022 spring, a series of factors have emerged to impede the stability and growth of the global economy, for example soaring energy prices and food prices and semiconductor shortages and their impact on production activities. Therefore, the economic outlook for 2024 and beyond was revised downward.
- Compared to the 2019 forecast, which was studied before COVID-19, the revised GDP and RPK are expected to lag by 1.3 to 1.6 years and 2.6 years respectively, in the medium to long term.
- Quantitative calculations for the number of passenger aircraft delivered in the future are based on this revised RPK. The number of jet airliner deliveries over the next 20 years will be approximately 35,700.
- In order to control the inflation that emerged in connection with the invasion into Ukraine, monetary policy authorities in various countries have started to increase policy rates from 2022. The increase in policy/market interest rates could affect airlines' future airplane procurement.

Briefing (4/4)

[Reduction of CO₂ emissions]

- Furthermore, at the ICAO General Assembly in 2022, a resolution was agreed for global airline industry to set the baseline for CO₂ offsets after 2024 at 85% of 2019 levels.
 - For airlines, while continuing to improve fuel efficiency through fleet renewal, the use of alternative fuels (SAF) in the medium to long term and the use of carbon credits in the short term are expected to be the measures to be taken. However depending on the availability of them, direct restrictions on ASK may occur.
 - Quantitative calculations using price data of these alternative fuels are difficult because of uncertainties about future prices of these fuels. Therefore, a parametric study was conducted using assumed prices.
-
- This report^{*1} is a brief version to be excerpted from the full version in Japanese. (*1 : <http://www.jadc.jp/en/data/forecast/>)
 - The full version^{*2} in Japanese has already been published on the JADC website. (*2 : <http://www.jadc.jp/data/forecast/>)

Recovery from COVID-19 : RPK (Section 3.3)

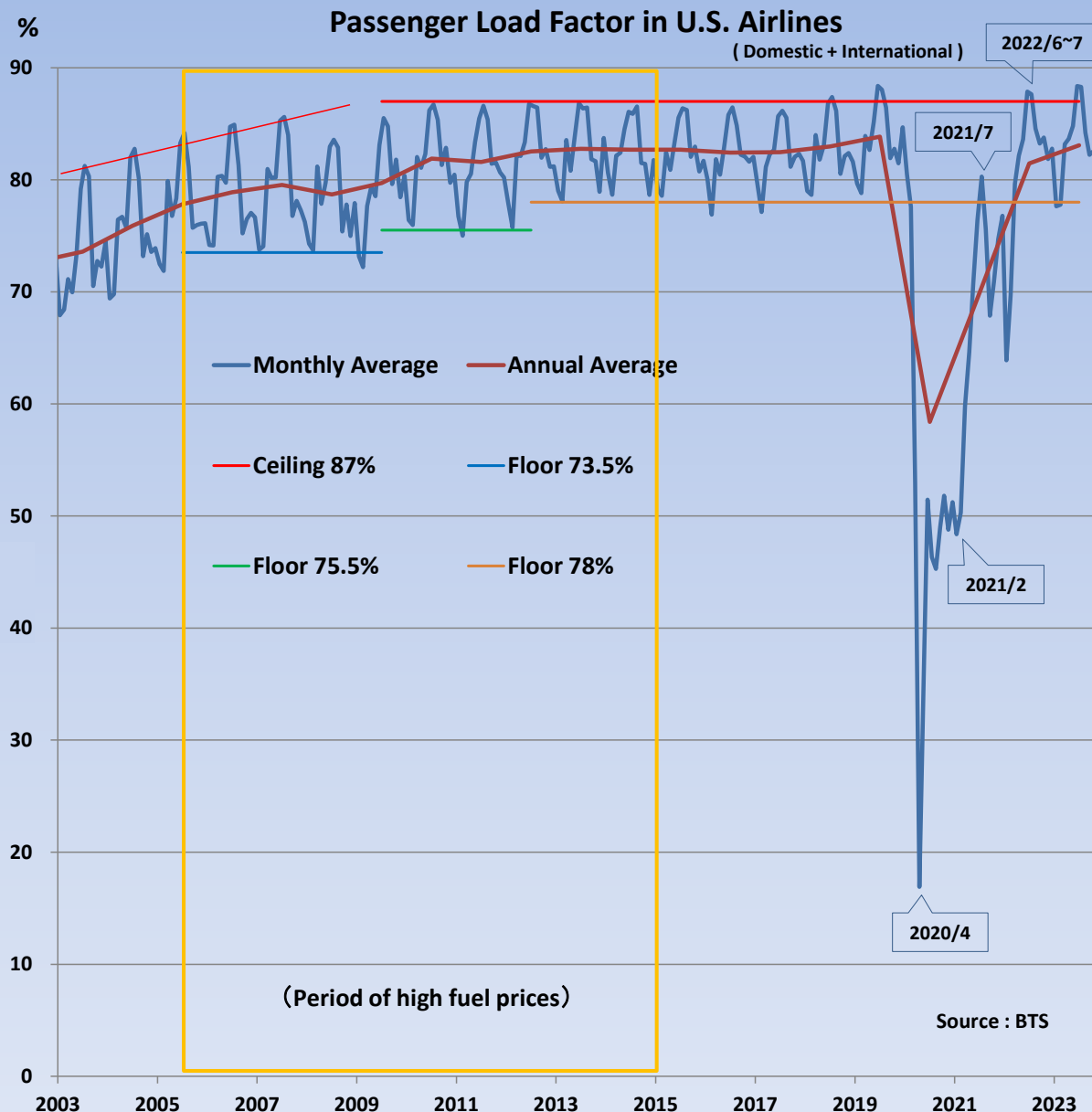


In 2021, with the inoculation of the long-awaited COVID-19 vaccines, the RPK recovery has begun in sync with the progress of vaccination.

Global RPK has shown a clear recovery in 2022 (initial recovery) and achieved 95% of 2019 levels in 2023, and will exceed 100% in 2024.

RPK₂₀₂₂ recovered 68.8%* of RPK₂₀₁₉.
 RPK₂₀₂₃ achieved 95.2%* of RPK₂₀₁₉.
 RPK₂₀₂₄ will exceed 100% of RPK₂₀₁₉.
 (* : IATA)

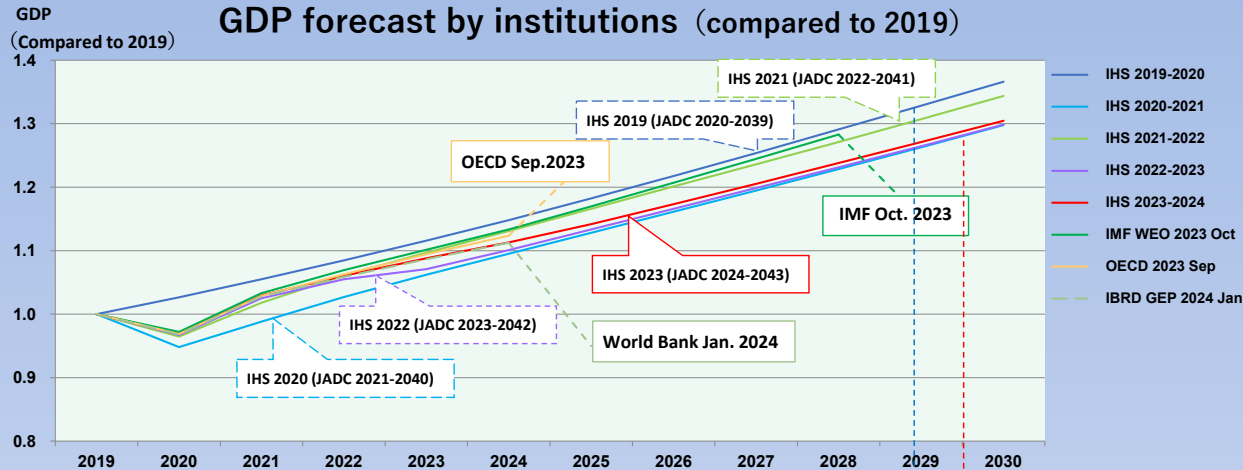
Recovery from COVID-19 : Load Factor (Section 5.2.4)



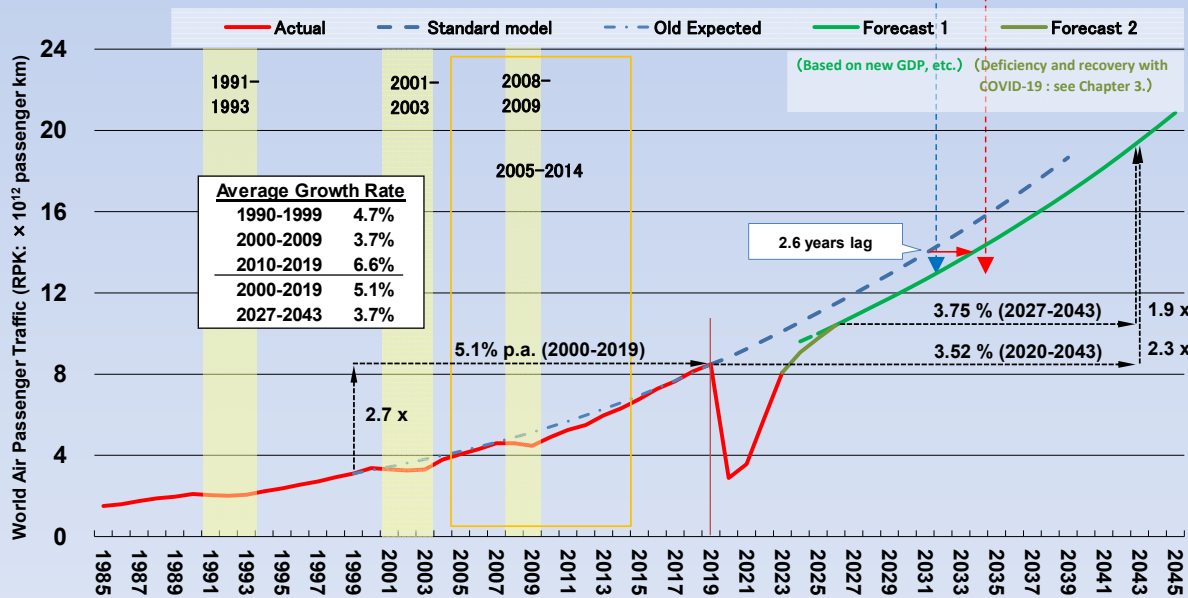
In 2020, COVID-19 caused a sharp drop in passenger demand and in LF.

By the end of 2020, LF had recovered to about 50%, and by the end of 2021, LF had recovered to about 75% as the vaccination progressed .

In the following year, 2022, LF reached 88% from June to July, recovered to the pre-COVID-19 level, and also regained its characteristic shape of seasonality.



Trend in World Air Passenger Traffic (RPK)



Source : IATA, ICAO, JADC

Yellow hatch shows recessions of Airline industry.
Orange frame shows Soaring period of crude oil price.

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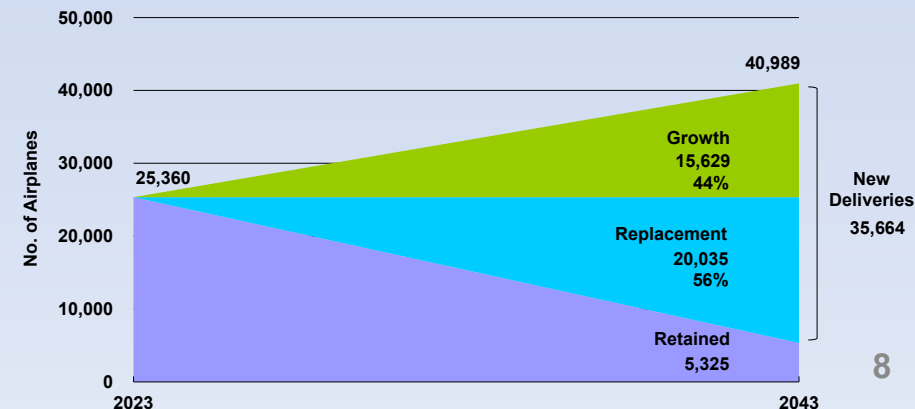
A number of institutions have published GDP forecasts that incorporate the impact of political and economic disturbances since 2022.

JADC uses IHS's GDP forecast, which is about 3.5 to 4.5% lower than the GDP forecast before COVID-19. (Fct₁₂₃₄ : Forecasted in 1234)

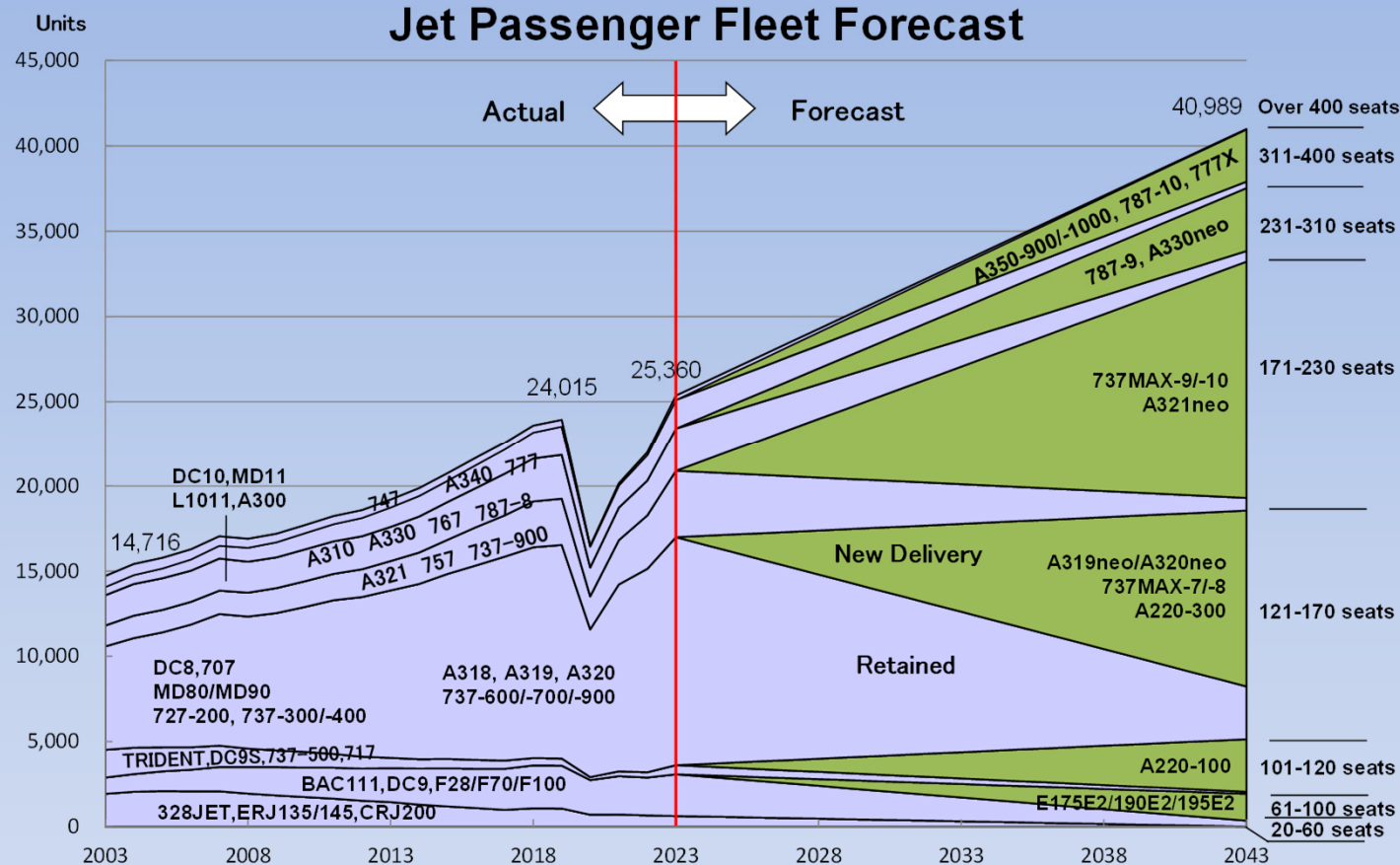
With this new data, we updated our RPK forecast, which is about 9% lower, or about 2.6 years behind, than that made before COVID-19.

$$\begin{aligned} \text{RPK}_{2025} &: \text{Fct}_{2023} / \text{Fct}_{2019} = 0.907, \\ \text{RPK}_{2030} &: \text{Fct}_{2023} / \text{Fct}_{2019} = 0.908 \end{aligned}$$

With this RPK forecast, our projection is that 35.7 thousands passenger jets will be delivered in the next 20 years. This is almost the same level of our 2020 projection, just before COVID-19 pandemic.



Post COVID-19 : Fleet Forecast



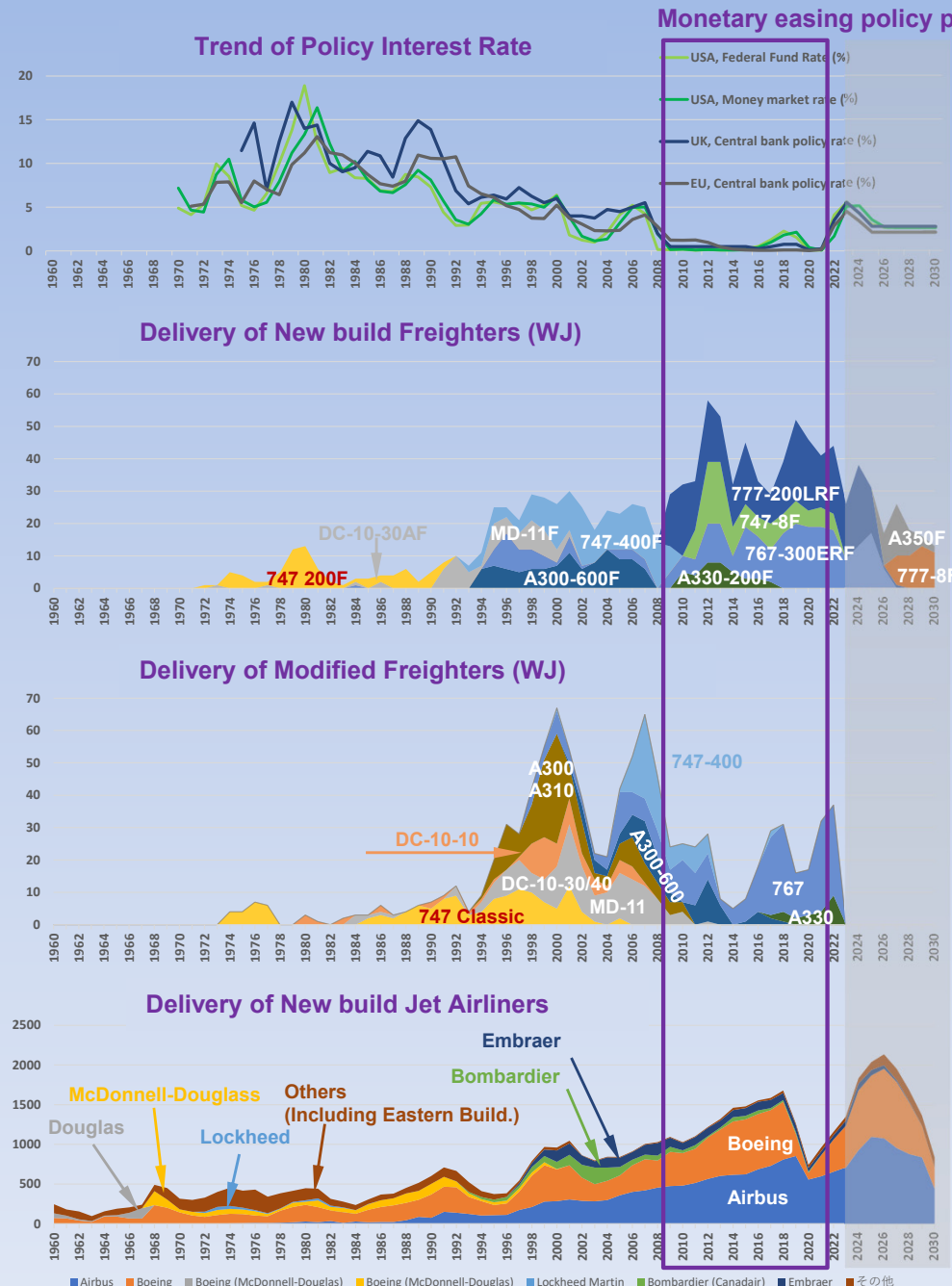
Under COVID-19, airlines made many airplanes grounded and operated a reduced fleet.

Many of the grounded (stored) planes are expected to return to service. In our forecast above, the 25,360 planes at the end of 2023 includes both current in and expected* return to service.

(*: Planes stored after 2020 by COVID-19 pandemic and 737MAX after 2019)

25,360 is more than the 24,015 "in service" at the end of 2019, which means airlines have enough planes to fully resume operations after COVID-19.

End of monetary easing policy



Interest rates affect airlines' airplane procurement plans.

When the global financial crisis broke out in 2008, the US Government/FRB adopted an easy monetary policy and lowered policy rates. Other countries adopted similar policies.

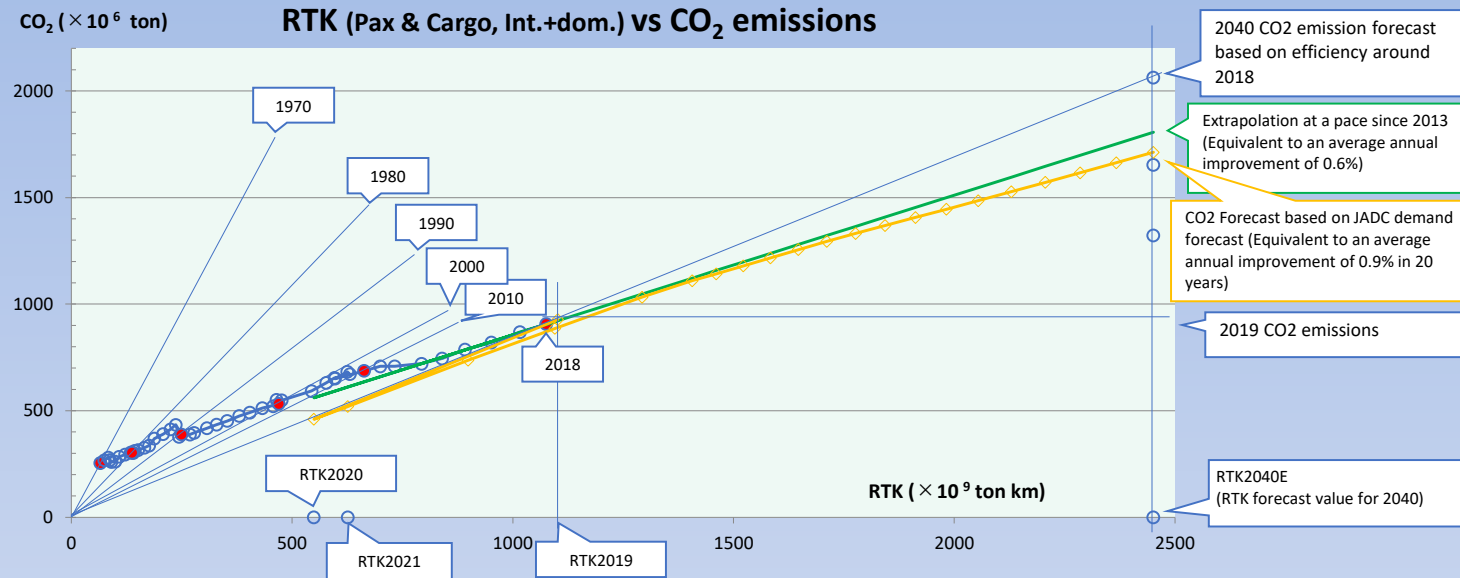
The impact of this low interest rate environment was particularly evident in the procurement of freighters, where the number of expensive new build freighters procured greatly exceeded the number of inexpensive converted ones during the monetary easing policy period.

This monetary easing – low interest rate environment lasted for 14 years, but the Fed started to raise interest rates to counter the inflation that emerged in connection with the invasion into Ukraine. The resulting increase in financing costs could affect the procurement of new planes in the future.

For freighters (widebody jet), procurement of new freighters is expected to decline and supply of converted ones to increase. All narrowbody jet freighters are still supplied by conversion.

For passenger planes, the number of planes delivered increased at a fast pace from 2011 onwards. The increase in deliveries during this period is usually explained as a result of airlines rushing to procure new, more fuel-efficient planes to cope with rising fuel costs, but it could also have been due to the favorable effect of lower financing costs due to lower interest rates. Even after interest rates rise, airlines will continue to procure new planes to reduce CO₂ emissions, etc., but the depreciation period could be extended to absorb the increase in funding costs, and the pace of medium- to long-term passenger plane procurement could slow down, for example.

Examining the impact of CO₂ emission credit burden (Section 5.3.1)



Airlines have been working to reduce fuel consumption for a long time and have achieved great improvement, but in the future, further improvement is required to reduce CO₂ emissions.

Airlines will continue to introduce new airplanes with better fuel efficiency, but this will contribute to 0.9% CO₂ emissions reduction per year on average.

Therefore, alternative fuels and other measures are imperative.

(For the calculations in Sections 5.3.1.1 through 5.3.1.3, we used the RPK forecast at the end of 2021 which has an average growth rate of 3.98%. It is somewhat conservative condition with respect to CO₂ reduction requirements.)

Examining the impact of AF burden (Section 5.3.1.4)

Many airlines have stated that they will use 10% alternative fuels (AF) in 2030.

In this case, the annual usage of AF in the 2020s is not huge, and the impact of expensive AF on fares is relatively small.

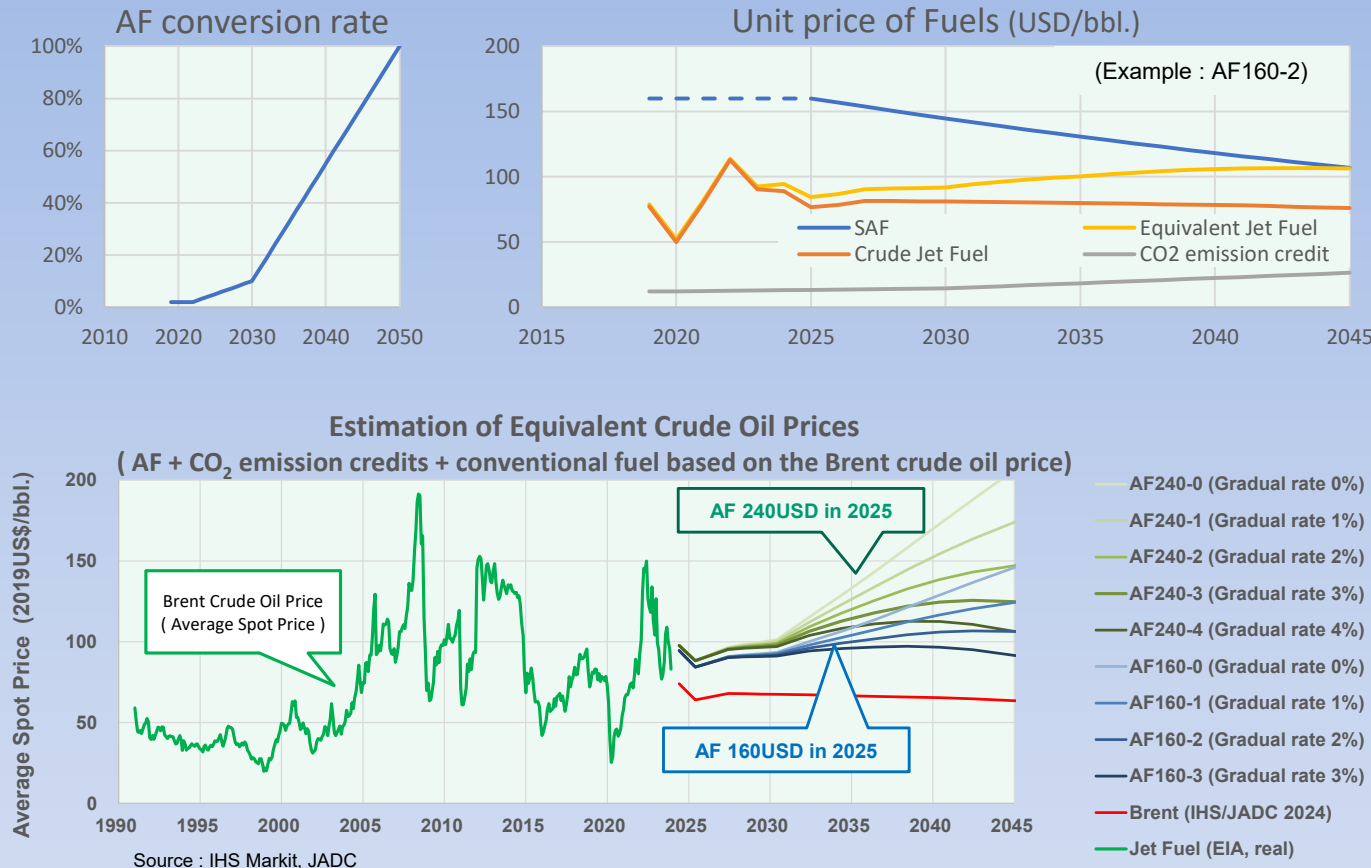
To supply AF to meet the goal, 10% in 2030, 1.3% annual AF production increase is required in 2020s.

By replacing old airplanes with new built fuel efficient airplanes, CO₂ emissions can be reduced by 0.9% annually.

Combined with the above-mentioned*, it is equivalent to reducing CO₂ emissions at an average annual pace of about 2%. (* Page 11)

The average growth rate of RPK for the next 20 years derived from GDP etc. is predicted to be 4%** , therefore it is necessary to make up for the gap between 4% and 2% by some means in order not to constrain the growth of airlines.

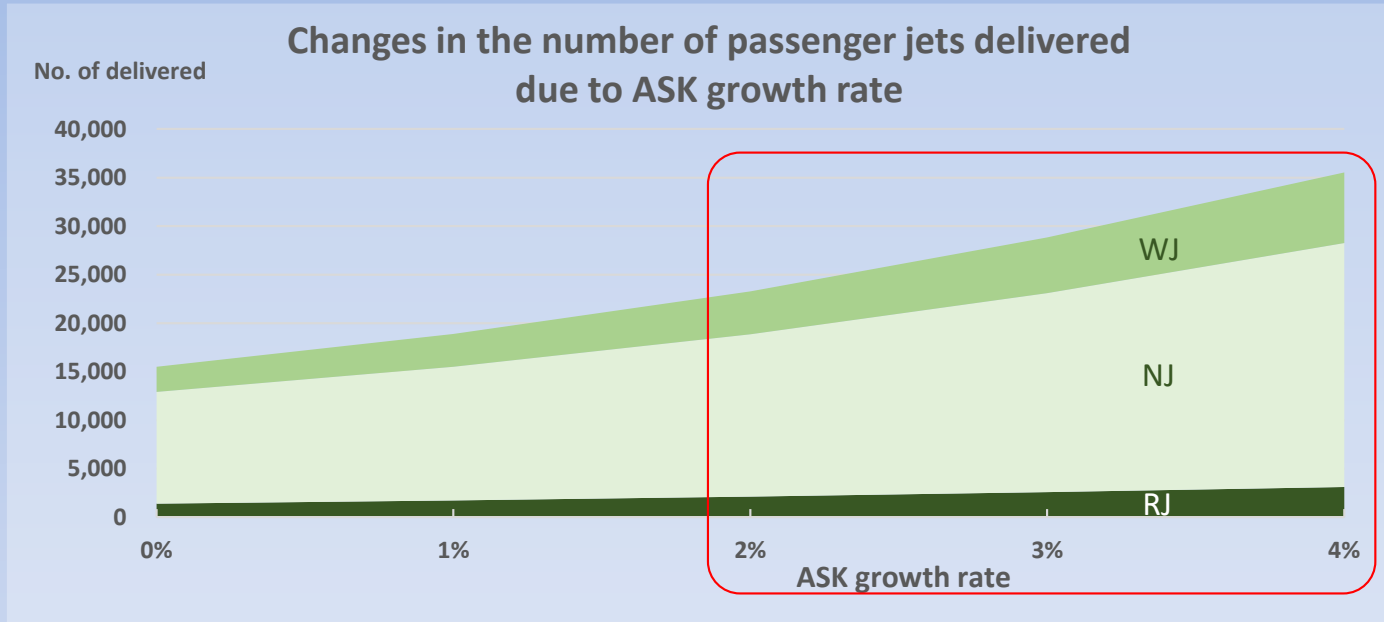
(** just before COVID-19)



(* : 'Alternative fuels' means e-Fuel or SAF etc.)

(** : With the contribution of vaccines, etc., the recovery of GDP and RPK is expected to be accelerated, and CO₂ emissions in 2030 are also expected to increase than the previous forecast.)

Impact of CO₂ reduction on ASK and Deliveries (Section 5.3.1.4)



In a situation where a reduction of CO₂ emissions is mandatory, CO₂ reductions will have an impact on ASK growth, which in turn will have an impact on the number of aircraft deliveries. Based on this relation, we forecast the number of aircraft deliveries over the next 20 years.

Methodology : Assuming that CO₂ emissions are proportional to the size of ASK, the rate of reduction of CO₂ per unit ASK leads to the rate of increase in ASK under the assumption that total CO₂ emissions are fixed at a constant value.

With 4% of ASK growth rate case, 35.5 thousands new jet planes will be delivered in the next 20 years, and this case needs 4% of CO₂ emission reductions per year. Similarly, only 23.3 thousands planes with 2% case.

We believe it is necessary to supply sufficient and more affordable Alternative Fuels, and for that purpose, it is important to make sufficient investment in a timely manner for the future prosperity of the aviation industry.

- Jets and turboprop covering
 - ✓ Passenger jet 20 seats and above
 - ✓ Passenger turboprop 15 seats and above
 - ✓ Jet freighter
- Regions of the world
 - ✓ 13 regions (passenger)
North America, Latin America, Western Europe, Eastern Europe, Middle East, Africa, Japan, China, Northeast Asia, Southeast Asia, South Asia, Oceania and CIS
 - ✓ 7 regions (freighter)
North America, Latin America, Europe, Middle East, Africa, Asia-Pacific and CIS
- Including scheduled and non-scheduled flight

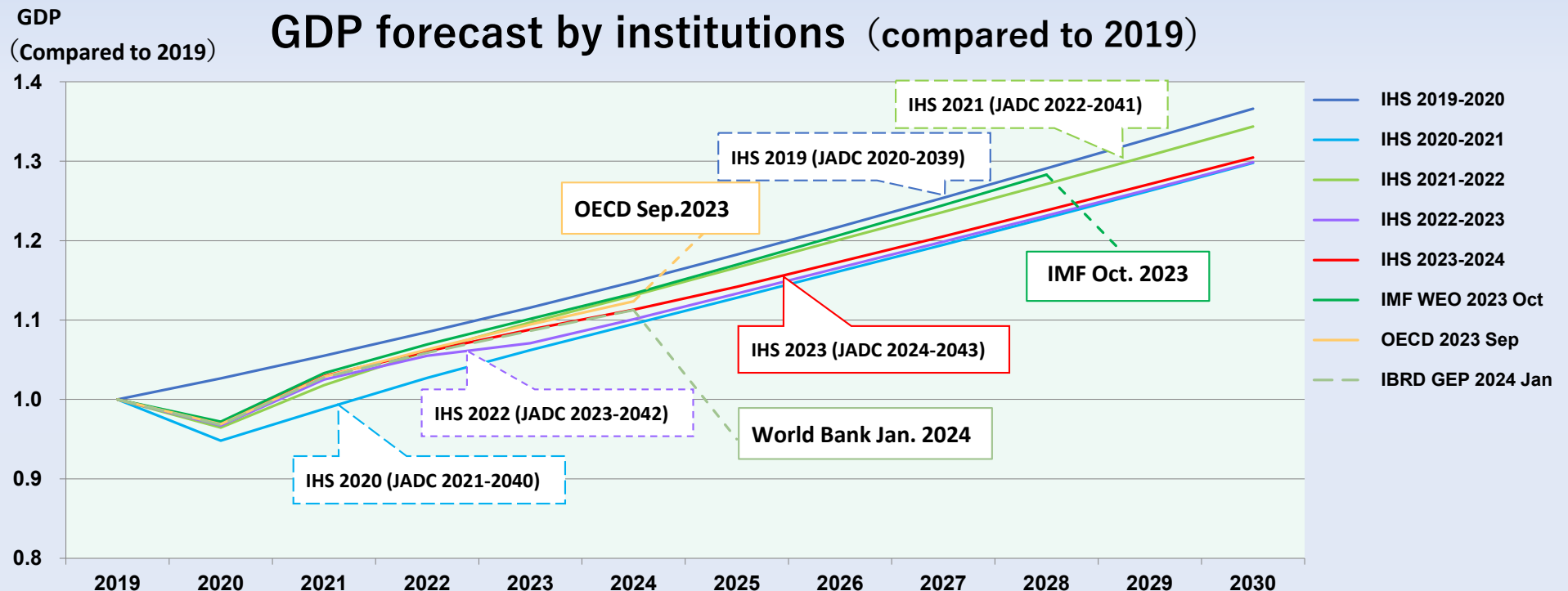
World Economic Forecast

By 2021, the world began to regain its vitality with the practical and widespread use of vaccines, and GDP projections were revised upward, approaching pre-COVID-19 levels.

However, from the spring of 2022 onward, the world's economies and industrial sectors were disrupted by soaring energy and food prices and shortages in the supply of semiconductors.

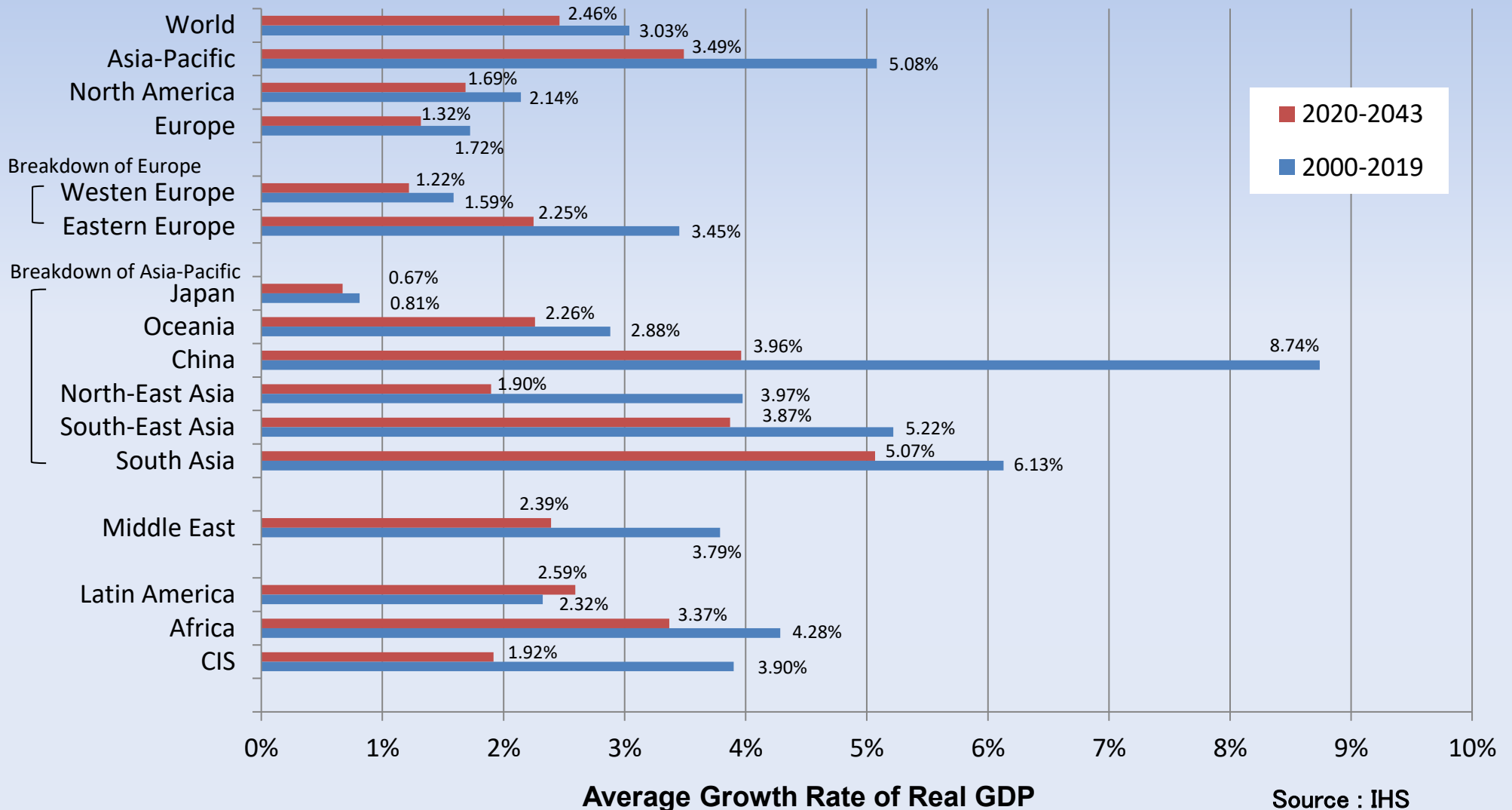
According to GDP projections published after 2022, GDP growth will remain somewhat low until around 2025; a recovery is expected from 2026 onwards, but the impact of low growth until 2025 are not expected to be resolved much thereafter.

In the medium to long term, the GDP forecast can be seen as 3.5 to 4.5% lower than the pre-COVID-19 forecast, or 1.3 to 1.6 years behind.



World Economic Forecast by Region

Global Economy (Real GDP) to grow by 2.46% per year.



Crude Oil Prices and effects on RPK

The oil prices have heavy impact on RPK.

Crude oil prices are expected to be stable over the long term.

However, the forecast price level has risen due to uncertainty of natural gas supply after 2021 and the impact of the invasion into Ukraine.

(Moreover, the cost for reducing CO₂ emission will be a primary burden on yield in future.)

Transition and Forecast of Crude Oil Prices (Brent Crude Oil)

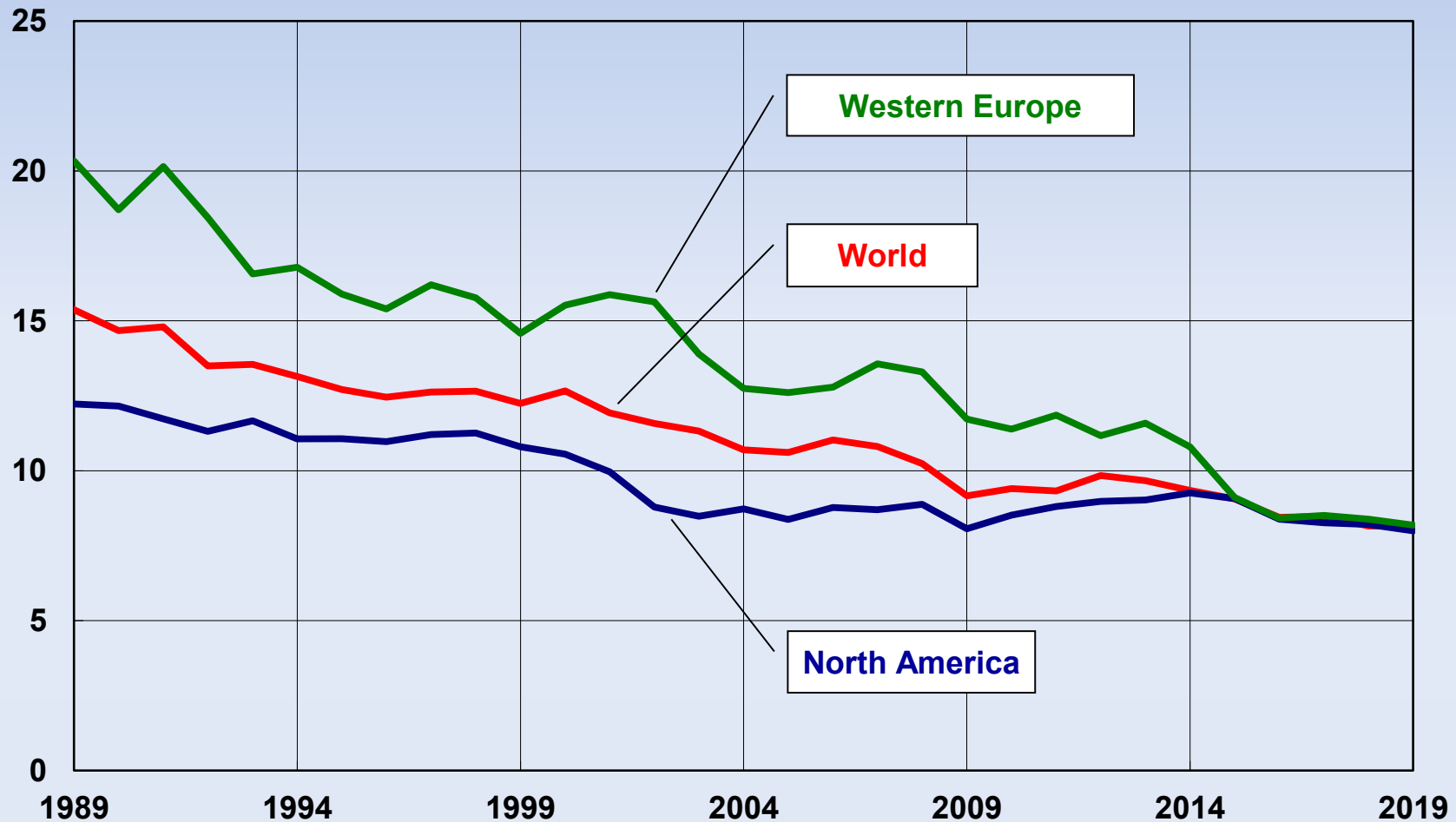


A light blue world map is centered in the background of the slide, showing the outlines of the continents.

Air Passenger Traffic and Passenger Fleet Forecast

Based on the data, the real passenger yields so far have been declining by an average of 0.8% per year.

2015 US cent/RPK

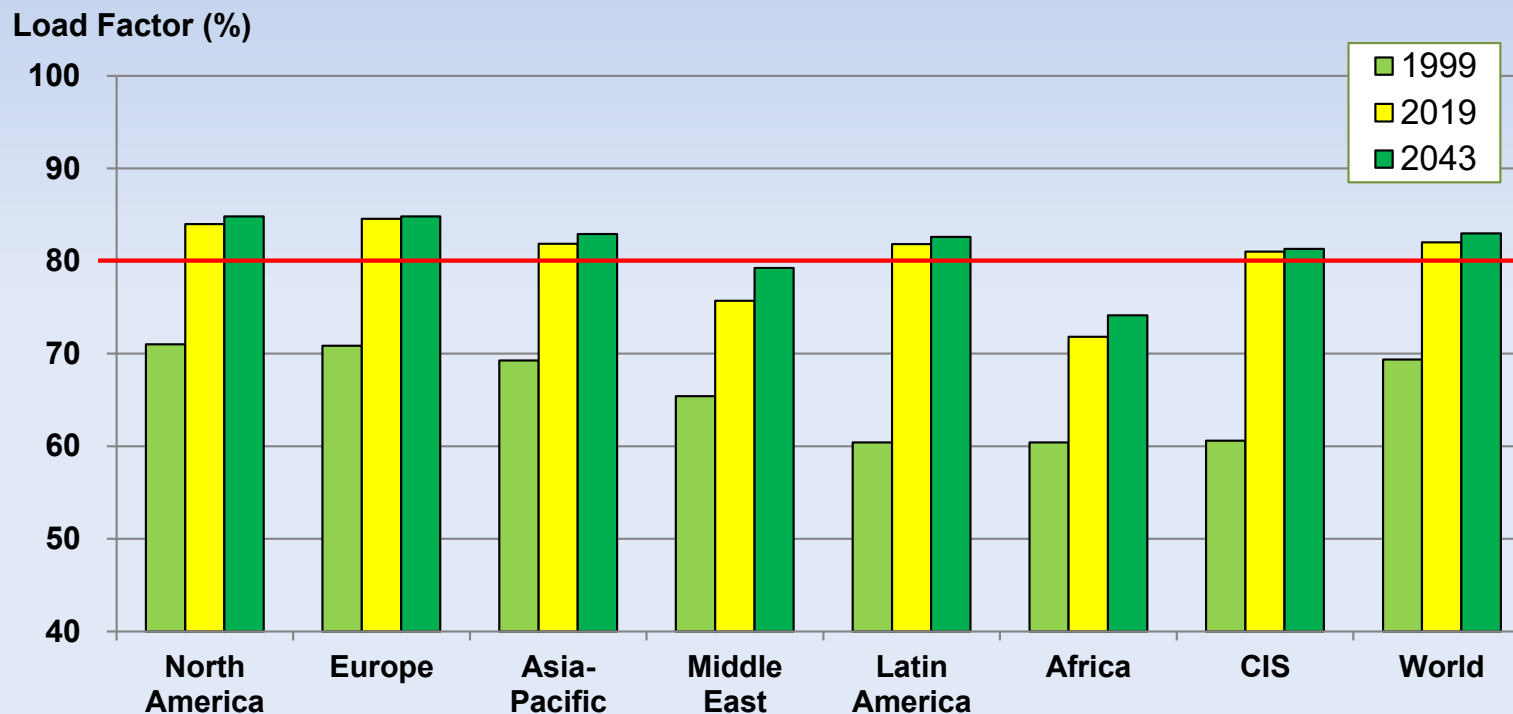


source: AEA, A4A, ICAO, IATA, CIRIUM

This analysis uses actual data up to 2019 as a reference.

Development of Load Factor

Pax. LF had risen rapidly in the past 20 years, reaching an average of 82.0% in 2019 and to reach 83% in 2043.



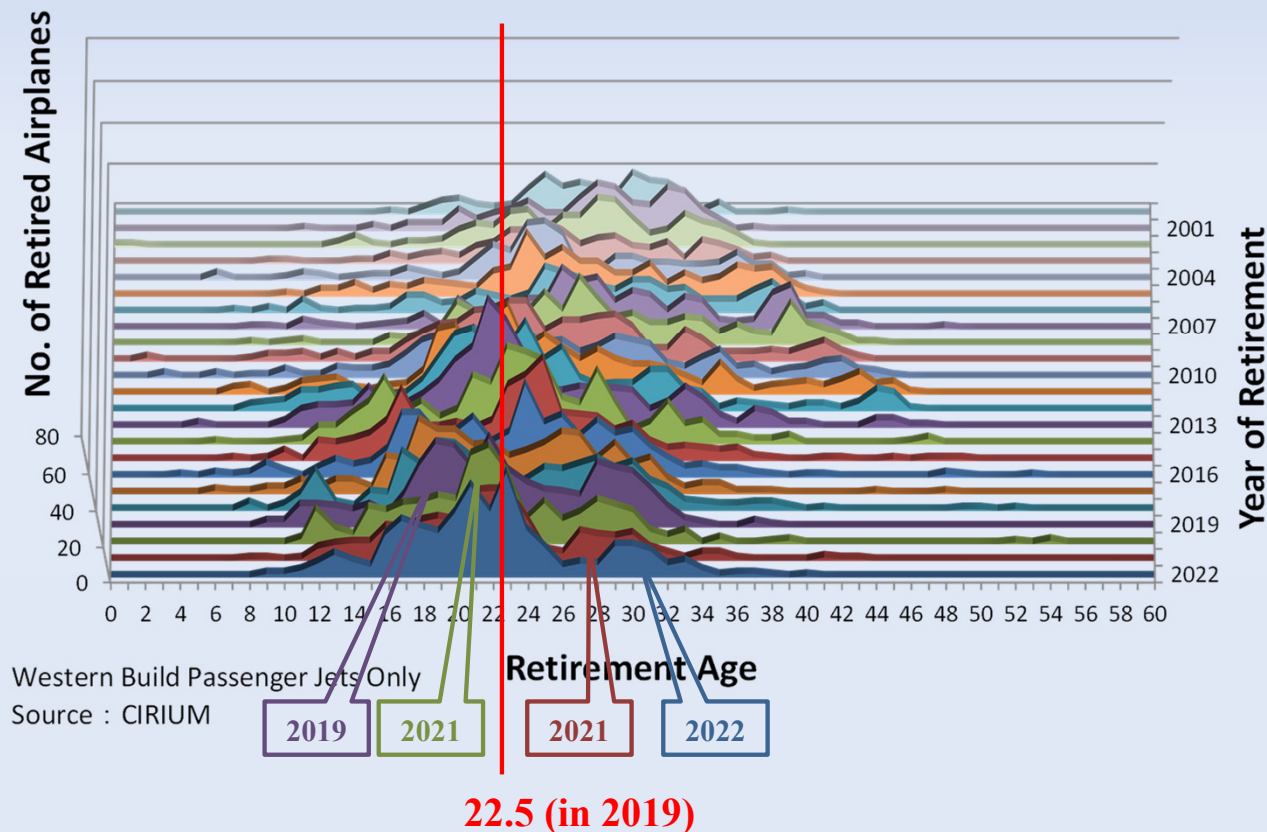
This analysis uses actual data up to 2019 as a reference.

Trend of Retirement (Passenger Jet)

Averaged age of passenger jet retirement is 22.5 in 2019.

Although airlines grounded a large number of aircraft during the pandemic, few aircraft were abruptly retired, and the number of aircraft retired in each year after 2020 is not significantly different from that around 2017-2018.

The average age of retired aircraft in each year has consistently declined since 2012 (24.2 years) and was 22.0 years in 2022.

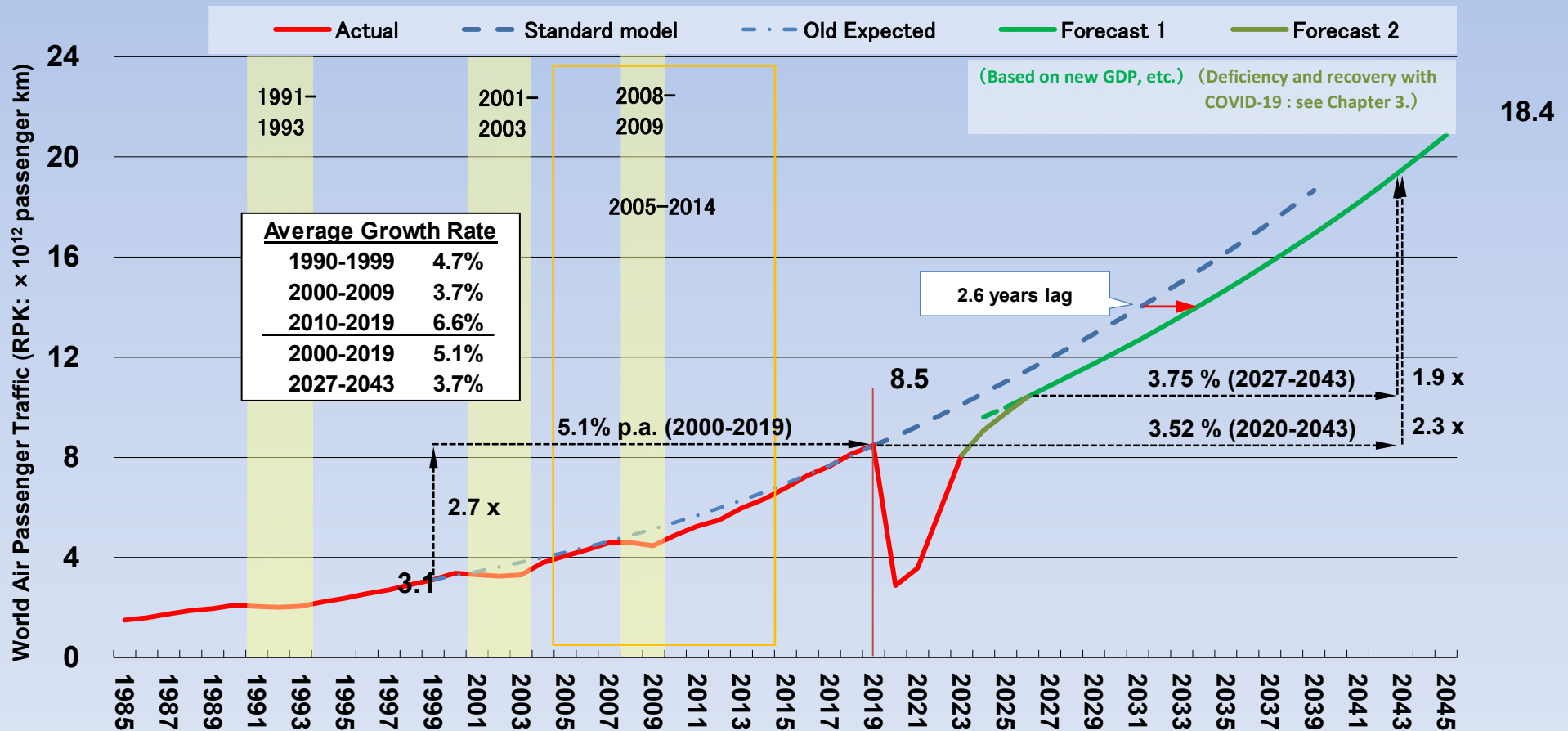


[RPK] World Passenger Traffic Forecast

Global RPK to grow at an average of 3.52% per year through 2043.

It will have a lag of about 2.6 years behind the prediction made before COVID-19.

However, this decline is not due to the aftereffects of COVID-19, but to lower GDP due to global economic turmoil, including inflation caused by the war in Ukraine from 2022 onwards.



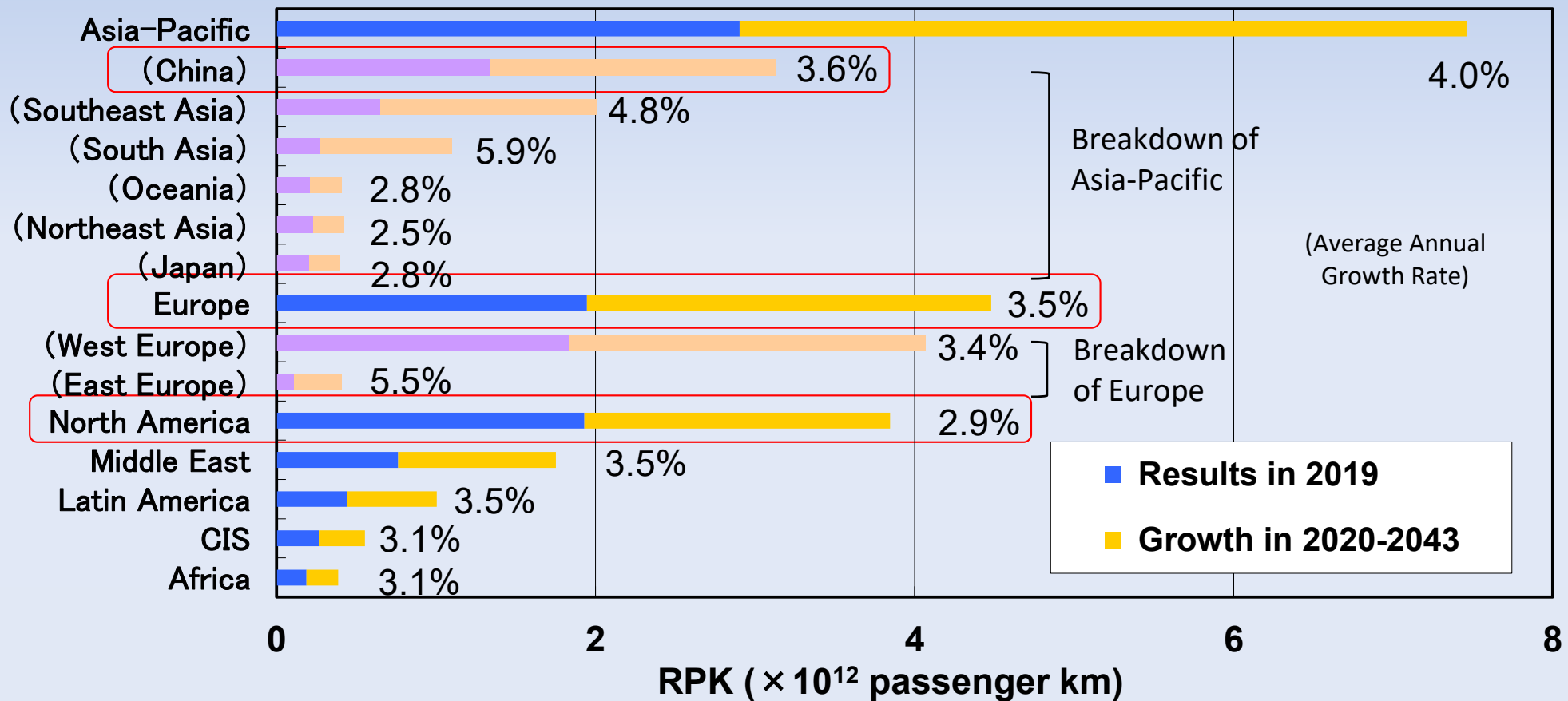
Source : IATA, ICAO, JADC

Yellow hatch shows recessions of Airline industry.

Orange frame shows Soaring period of crude oil price.

[RPK] Passenger Traffic Forecast by Region (2020 - 2043)

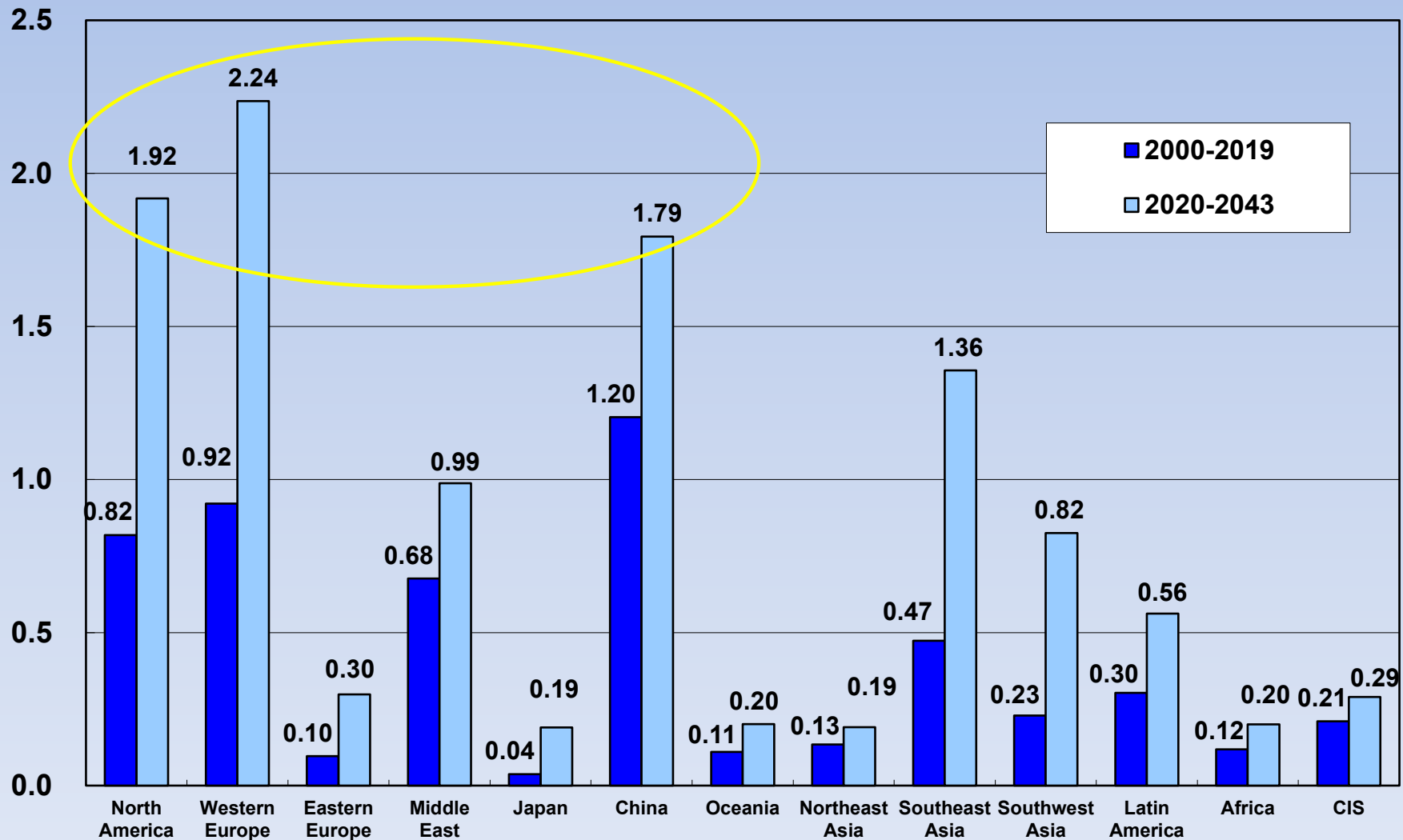
Europe, North America and China to constitute
three pillars in RPK of the world.



[RPK] Increment by Region (2020 - 2043)

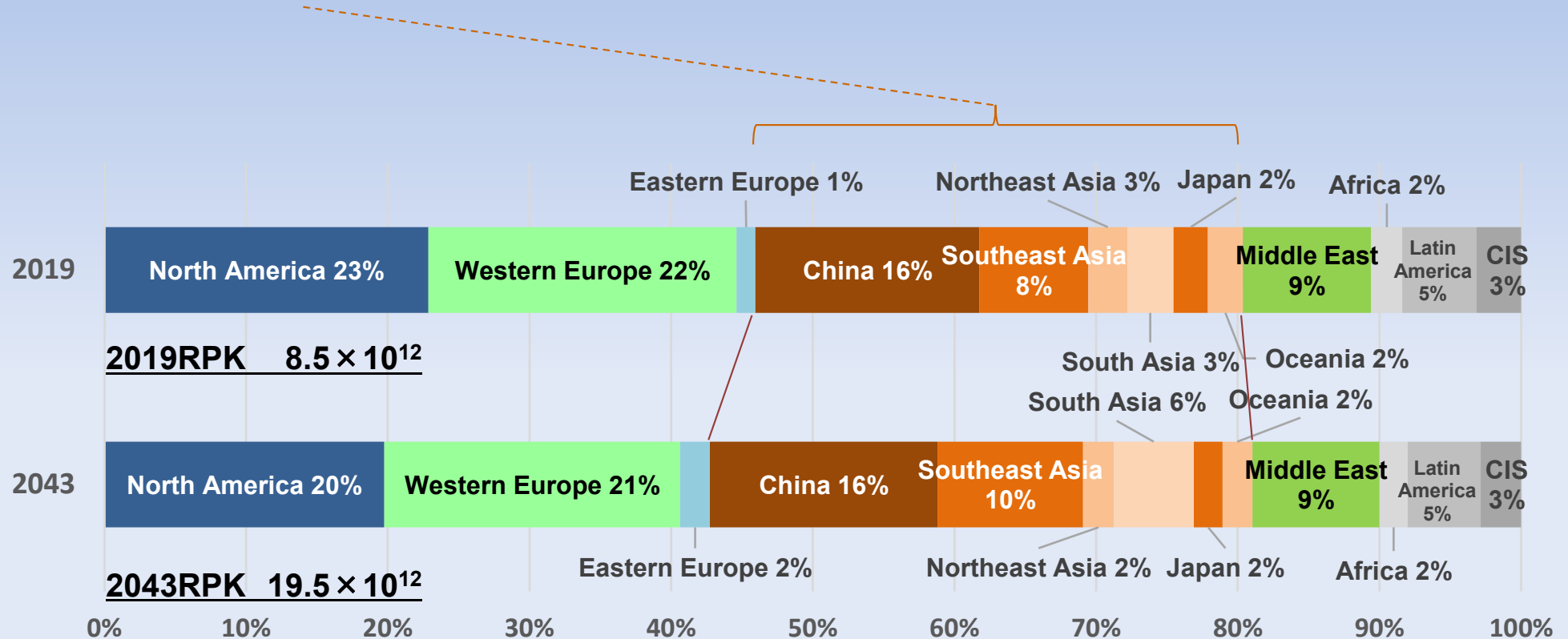
The increment of Europe, North America and China to be still large.
Middle East and Southeast/Southwest Asia to follow.

RPK increment ($\times 10^{12}$)



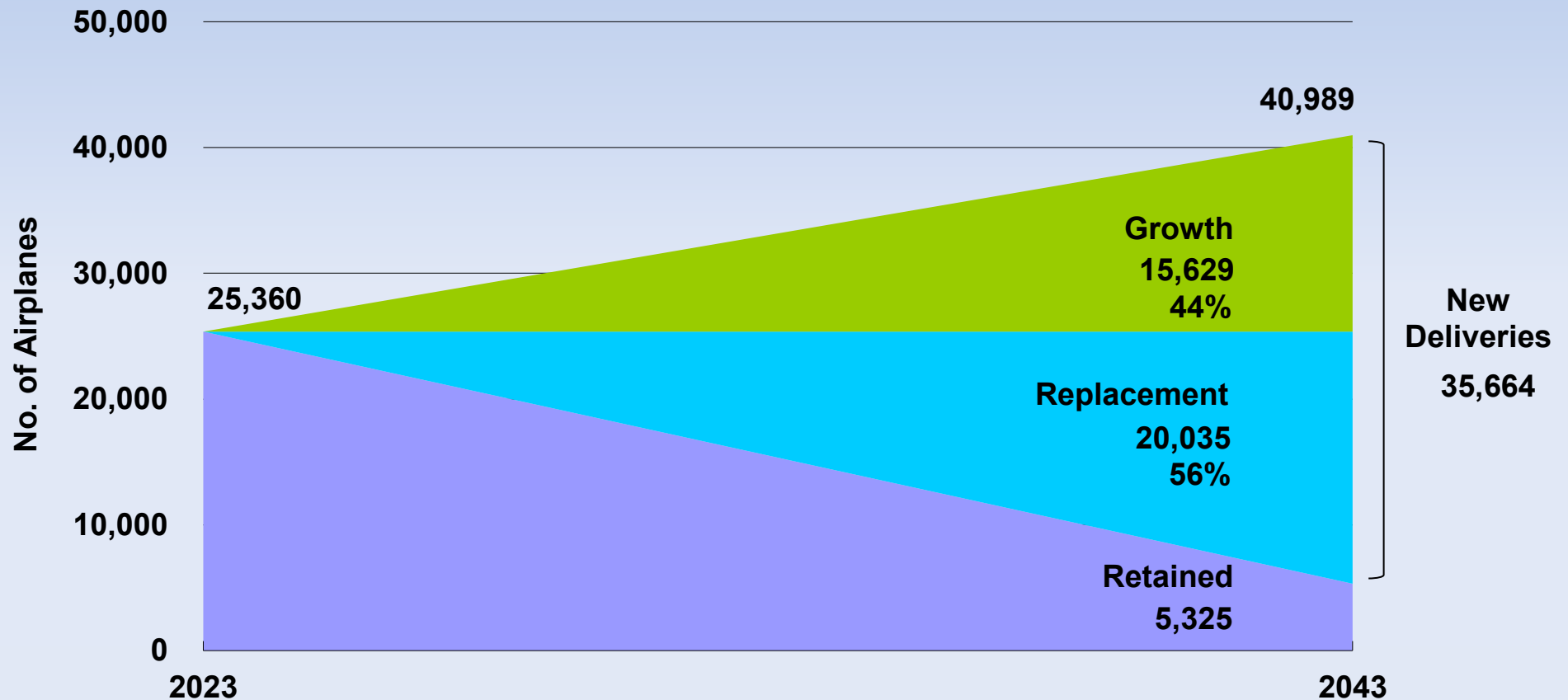
[RPK] Comparison of Shares by Region

Asia-Pacific Airlines to have more market shares. Middle East to slow down.



World Passenger Jet Fleet Forecast

Airlines will need 35,644 passenger jet planes, valued at \$ 5.7 trillion in the next 20 years,



The 25,360 aircrafts in 2023 includes the number of young aircrafts in Storage status. They are likely to return to In-Service status.

World Passenger Jet Fleet Forecast by Seat category

Primary market to be found in 171-230 Seats class.

No. of
Airplanes

18,000

16,000

14,000

12,000

10,000

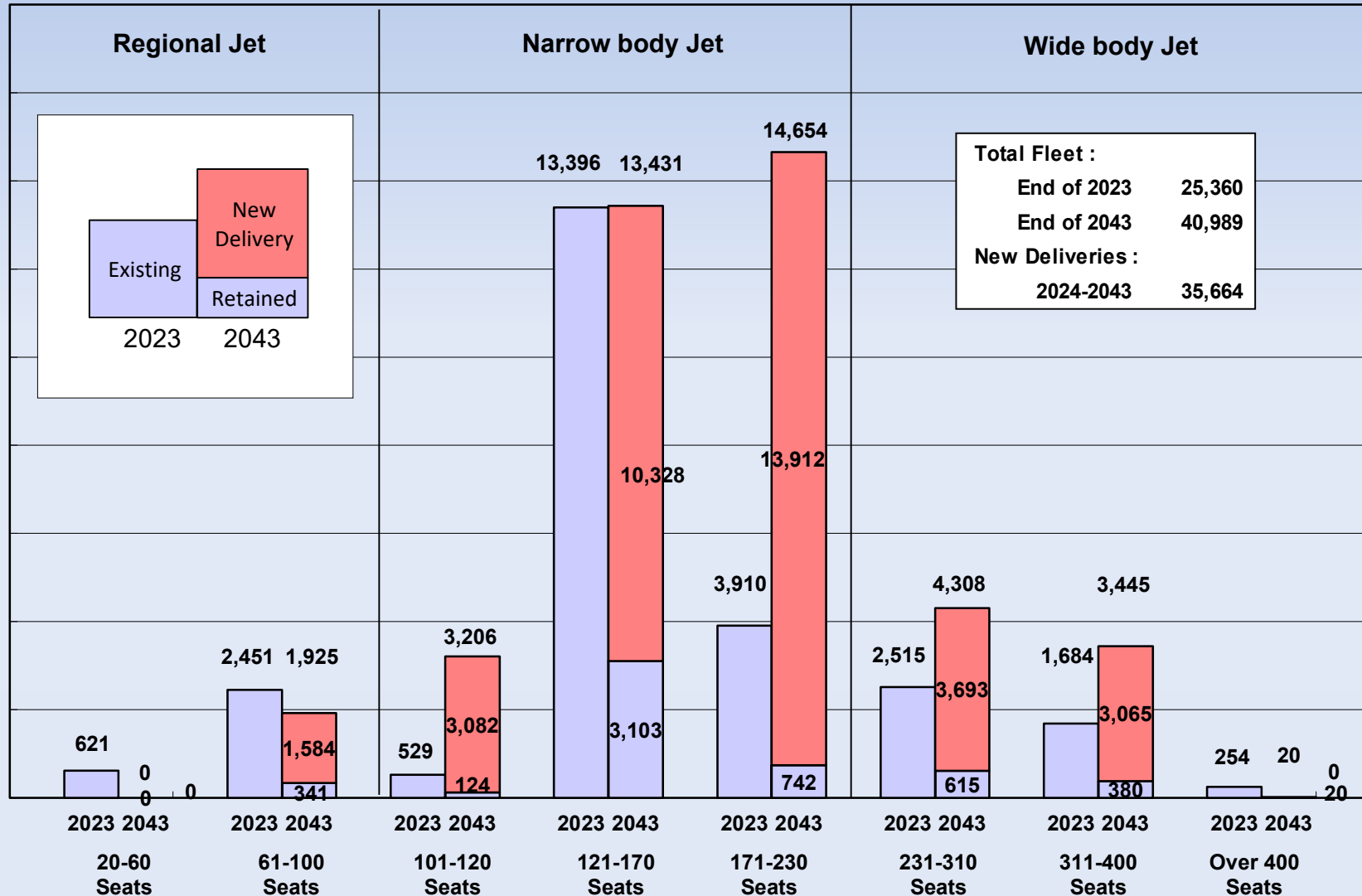
8,000

6,000

4,000

2,000

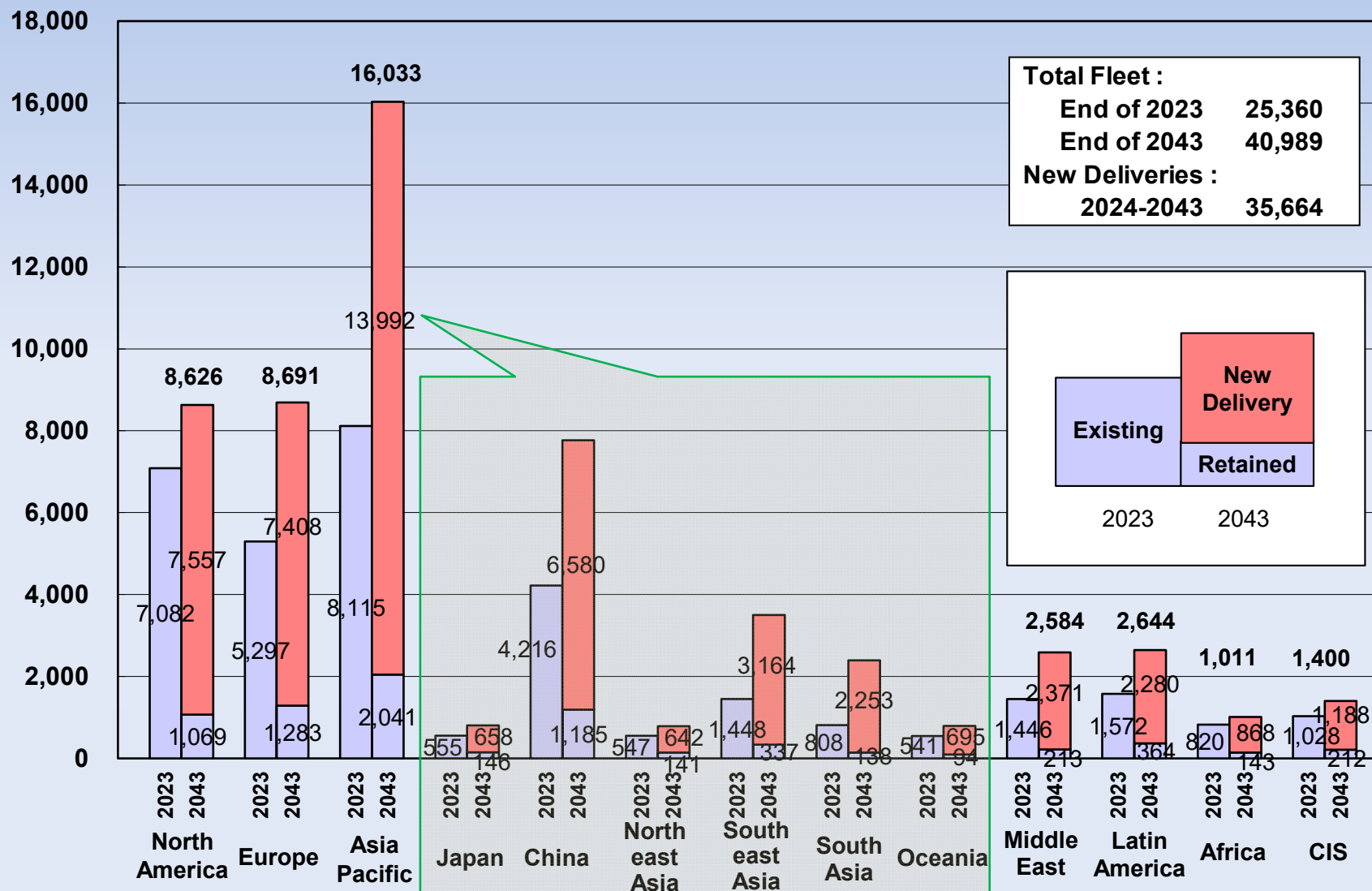
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World Passenger Jet Fleet Forecast by Region

Europe, North America and China
to constitute three pillars for the world market.

No. of Airplanes

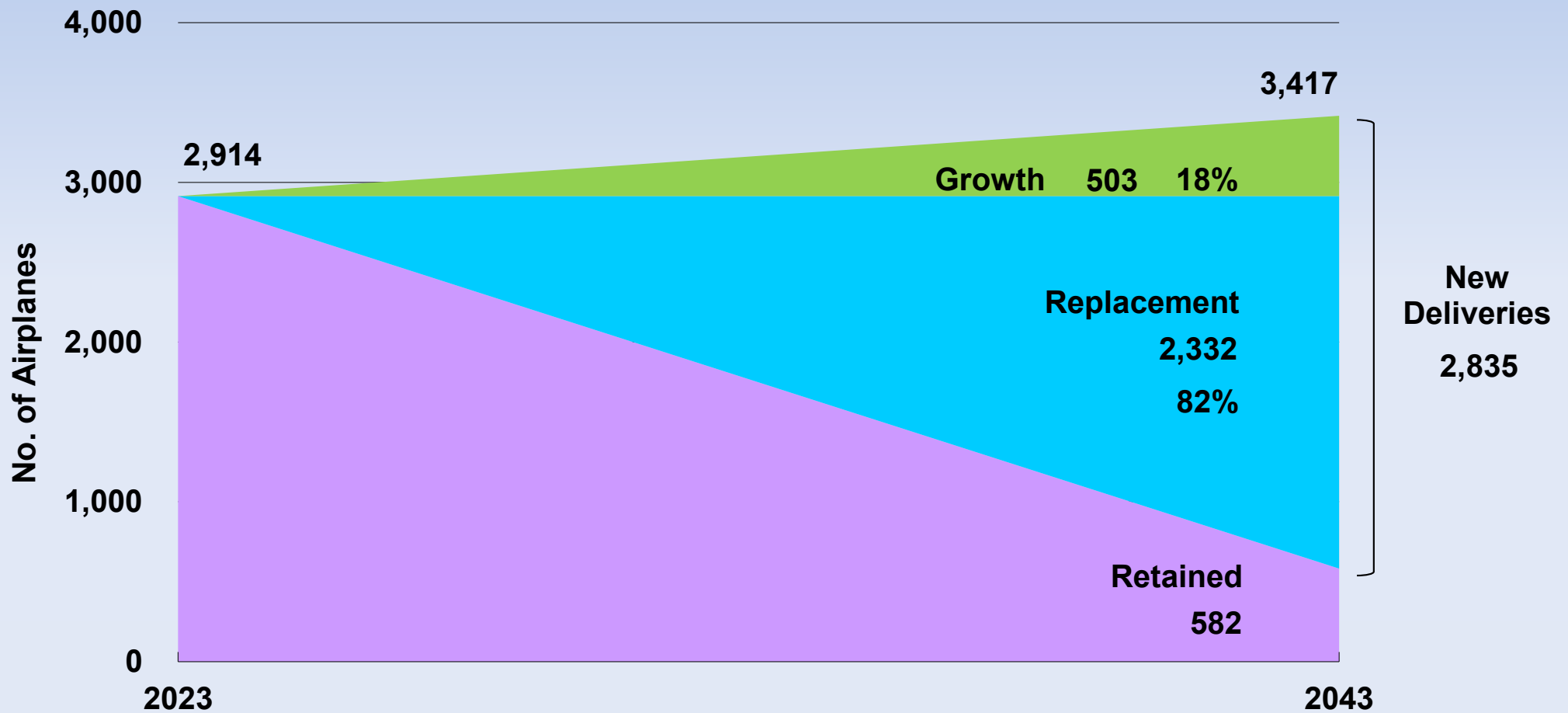


Classification of main passenger planes

Category	Size (seats)	Aircraft
Turbo prop	15-40	DHC6-400, Do228, SkyCourier, ES-30
	41-80	ATR42/72, DHC8-400
	81-100	(ATR92)
Jet	20-60	CRJ200/440, ERJ135/140/145
	61-100	CRJ700/900/1000 E170/175E2/190E2, ARJ21, SSJ100,
	101-120	A220-100, E195E2 A318, B737-600
	121-170	A319ceo/neo, A320ceo/neo, A220-300, B737MAX-7/-8, C919
	171-230	A321ceo/neo, B737MAX-9/-10 B757
	231-310	A330-800/-900, B787-8/-9 A300-600, B767-300/-400
	311-400	A350-900/-1000, B777/X, B787-10 A340
	401-500	B747
	>500	A380

World Turboprop Fleet Forecast

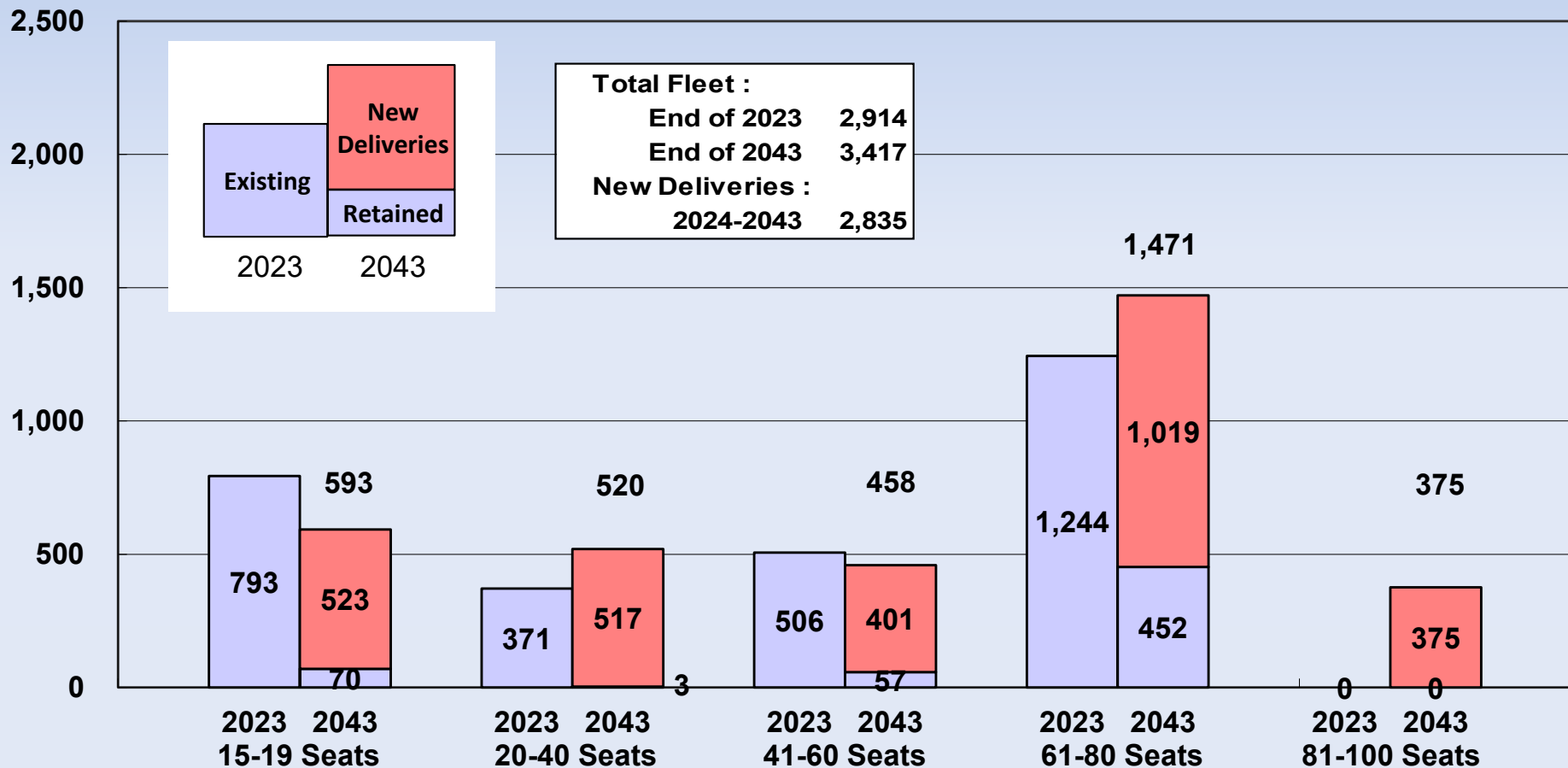
Airlines will need 2,835 passenger turboprop airplanes, valued at \$66 billion in the next 20 years.



World Turboprop Fleet Forecast by Seat category

The 15-19 seats category will have New Type of plane, 408 SkyCourier. This is the first new aircraft in this class in a long time. In the 20-40 seat class, EIS for the ES-30 electric aircraft is scheduled in 2028. It is expected to replace aging planes.

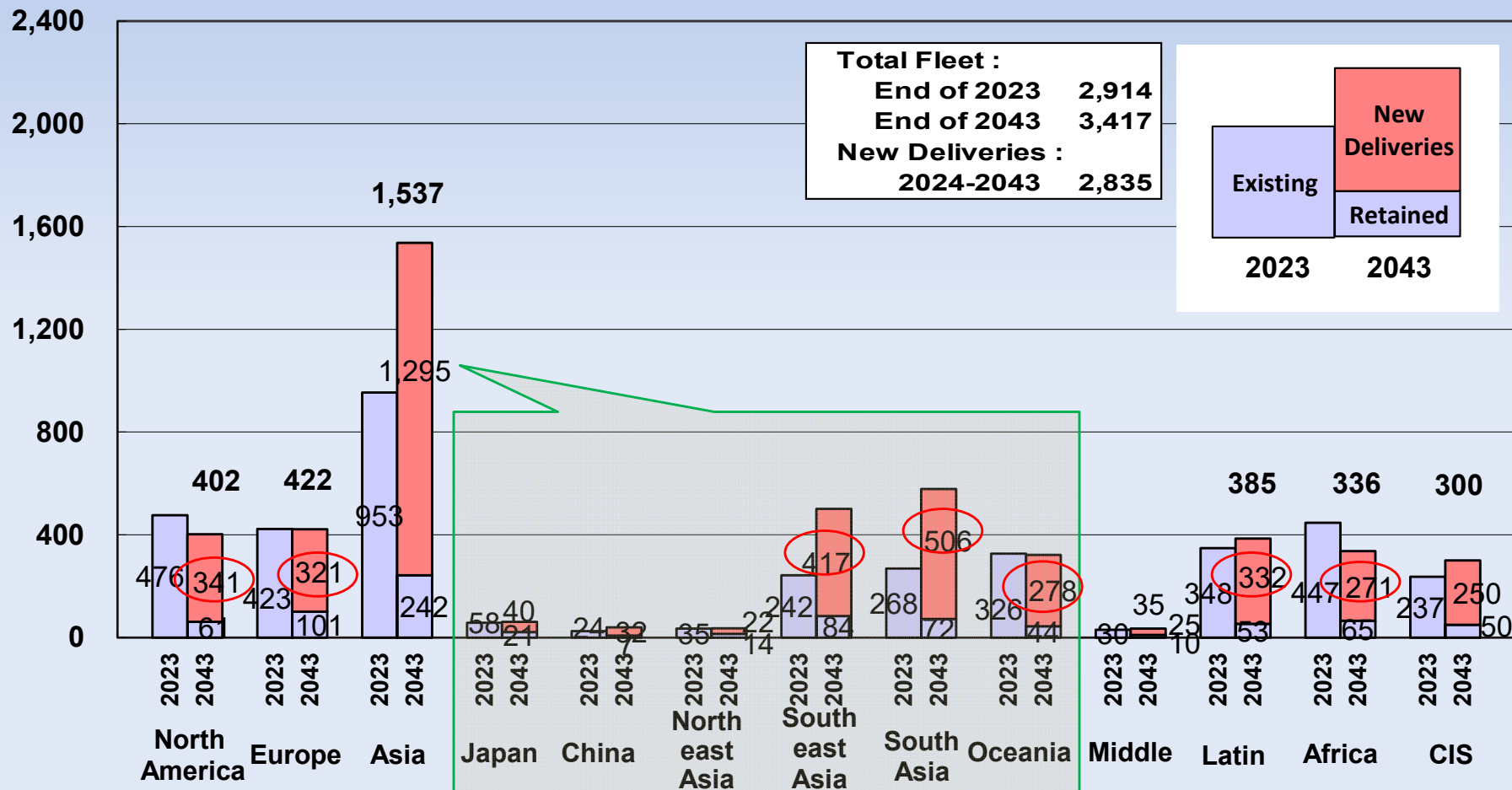
No. of Airplanes



World Turboprop Fleet Forecast by Region

The demand for turboprop planes to be widespread in many regions.

No. of Airplanes

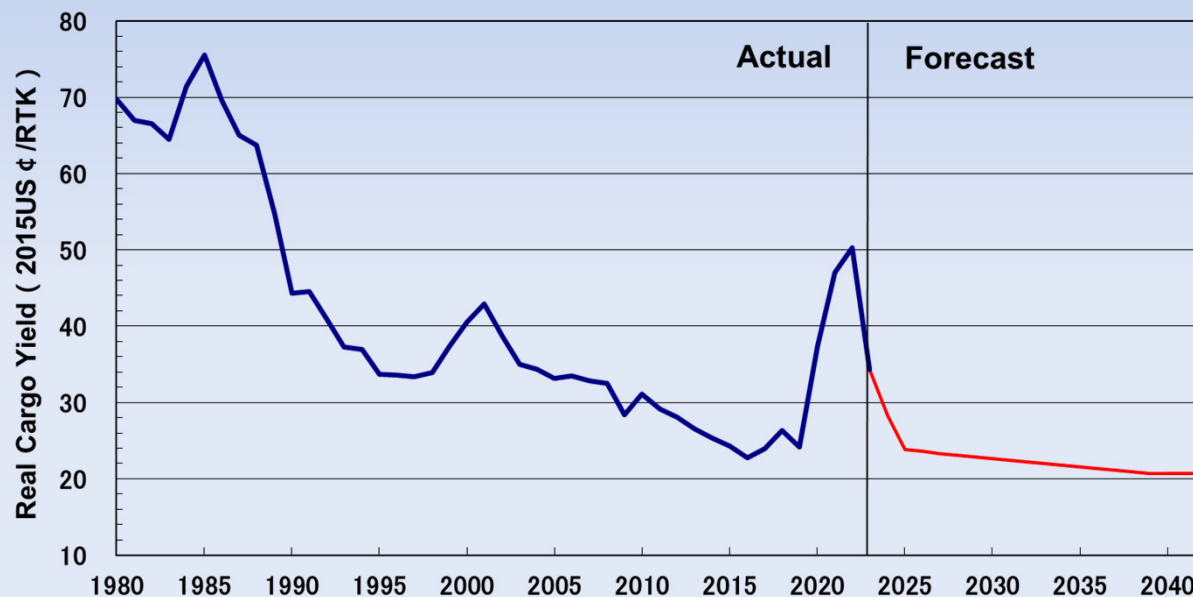


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Air Cargo Traffic and Freighter Fleet Forecast

Parameters Used for Freighter Fleet Forecast

Trend of Real Cargo Yield

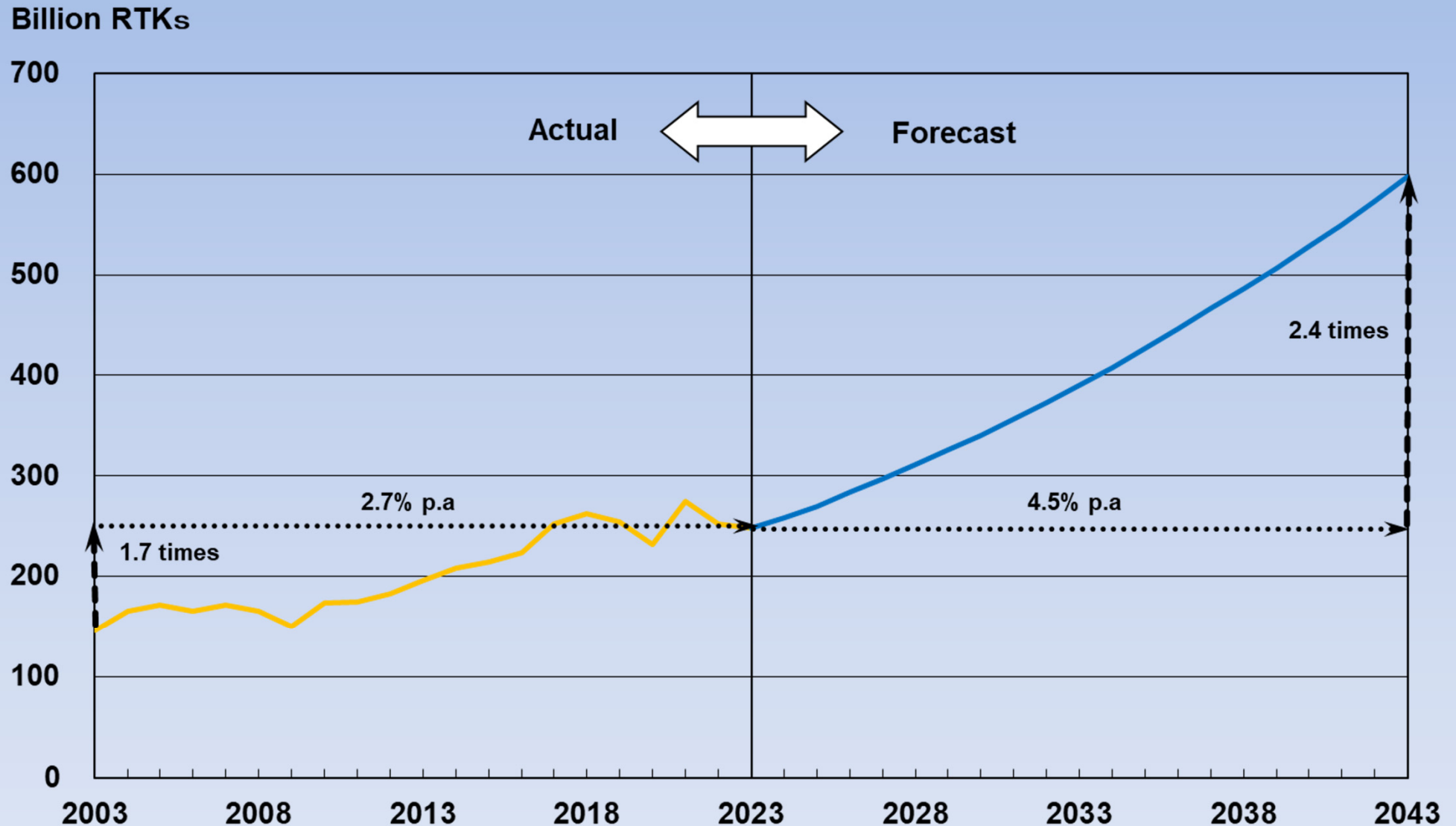


World average real cargo yield will decline by 0.82% annually.

Narrowbody (<50 tonnes)	Medium Widebody (50-70 tonnes)	Large (>70 tonnes)
BAe-146	DC-10-10	DC-10-30/40
CRJ100/200	767	MD-11
DC-8	A300	777
DC-9	A310	747
MD-80	A330	A380
MD-90	IL-76	An-124
727		
737		
757		
A320		
A321		
Tu-204		

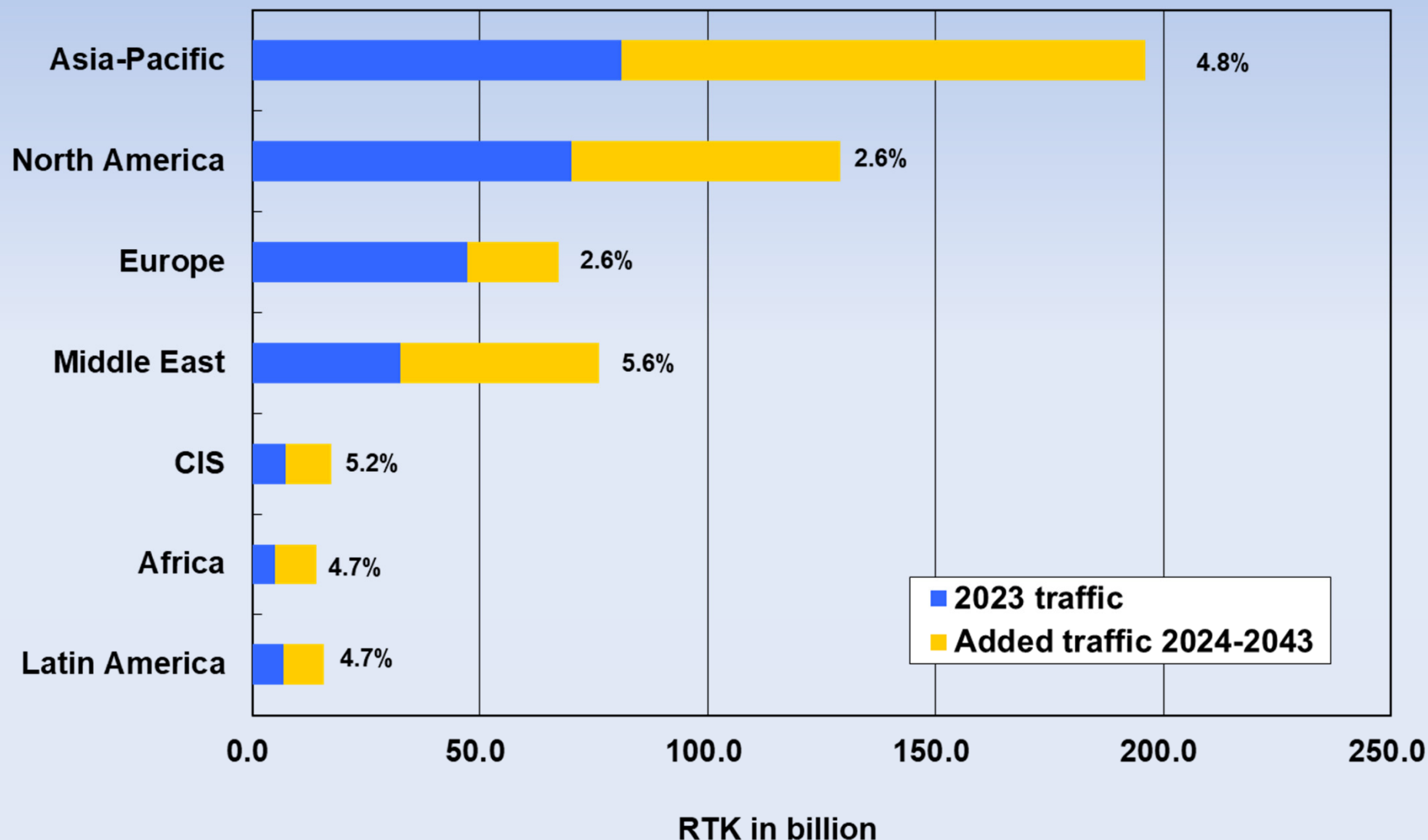
[RTK] World Air Cargo Traffic Forecast

World air cargo traffic forecast to grow 4.5% per year through 2043.



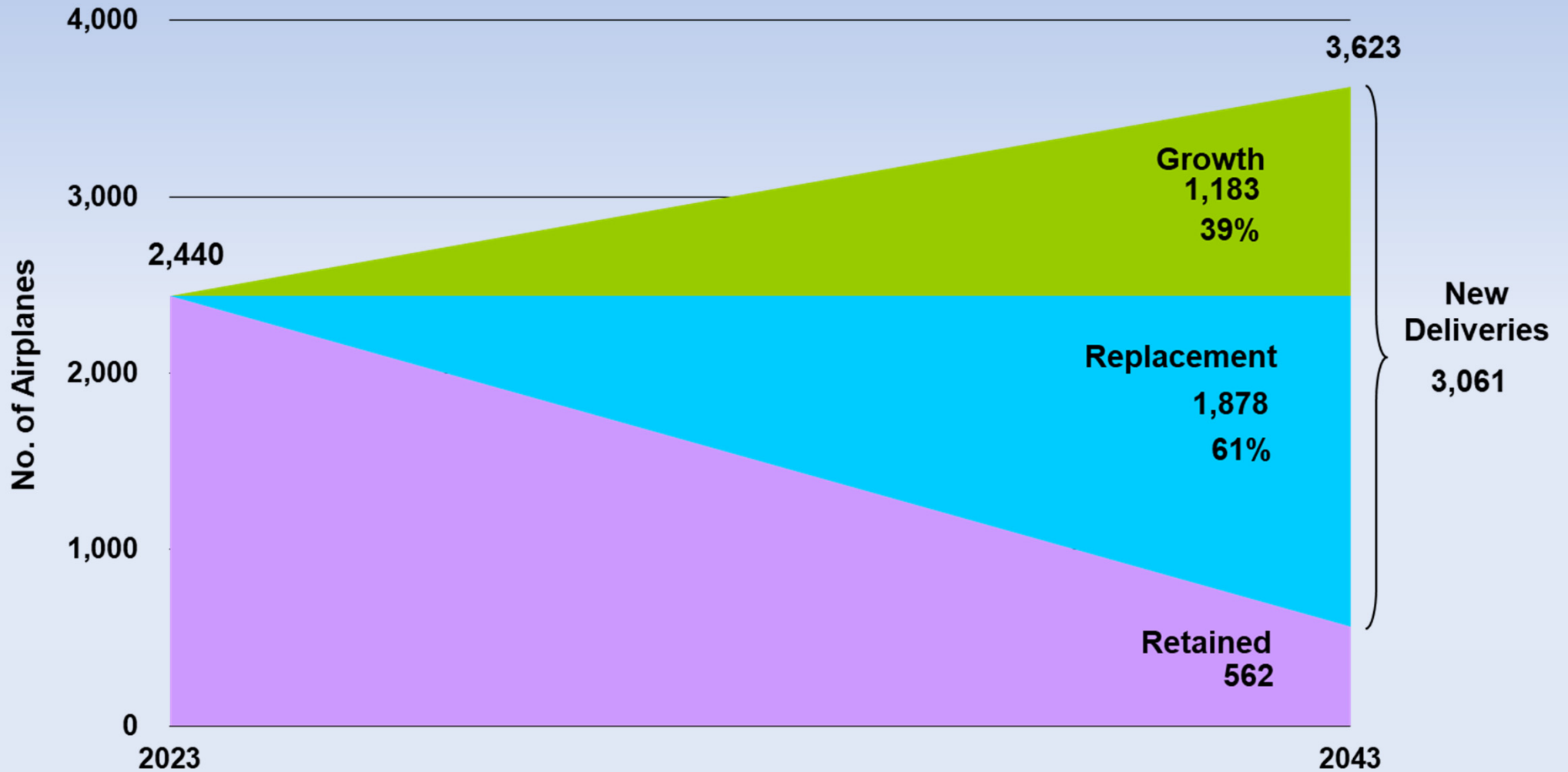
JADC [RTK] World Air Cargo Traffic Forecast by Region

Growth rate of air cargo demand varies by region.



Jet Freightier Fleet Forecast

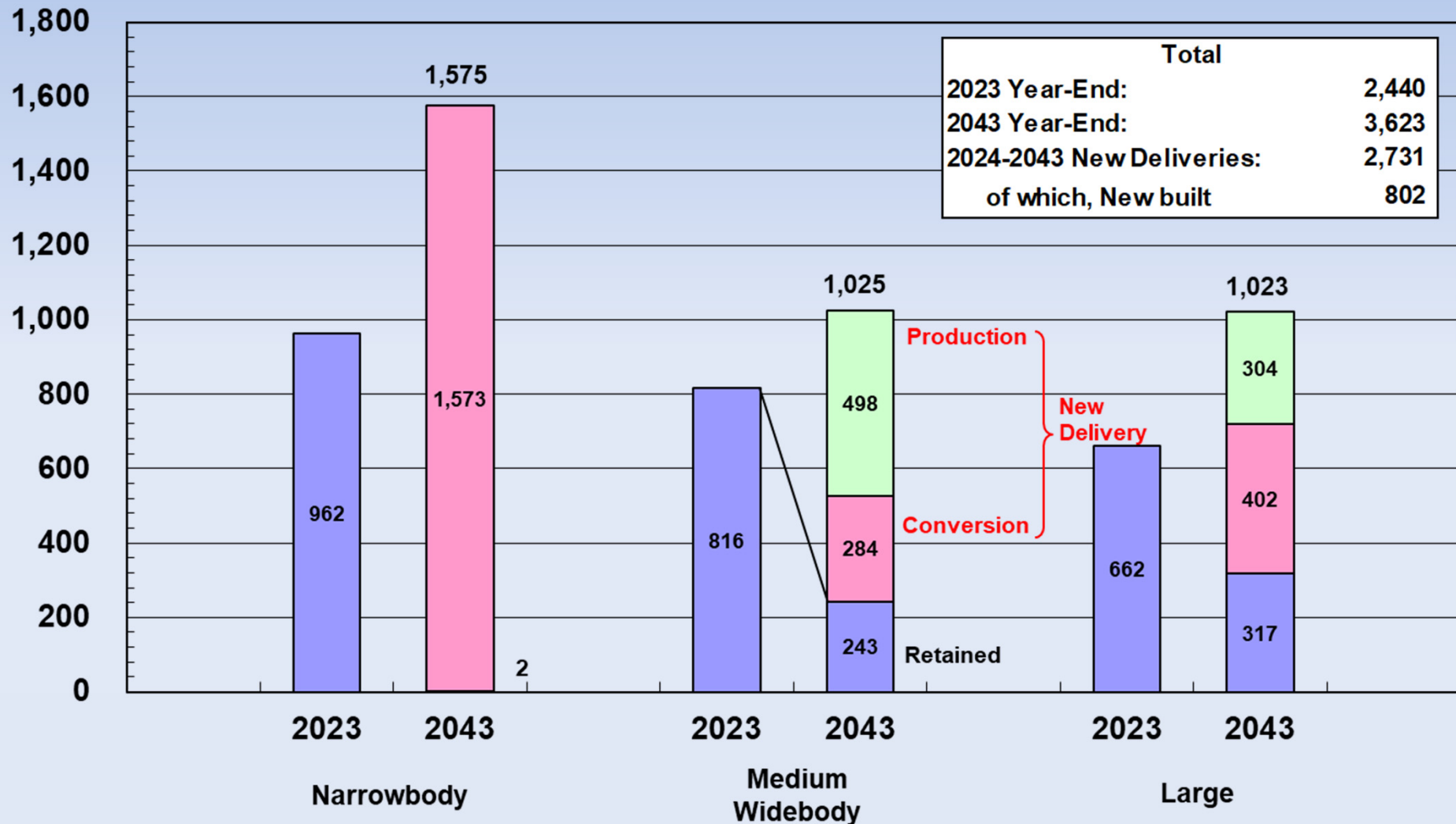
New deliveries will be 3,061 planes.
Of which, Growth 1,183.



Jet Freightier Fleet Forecast by Size Category

New built freighter will be 802 planes. Widebody planes only.

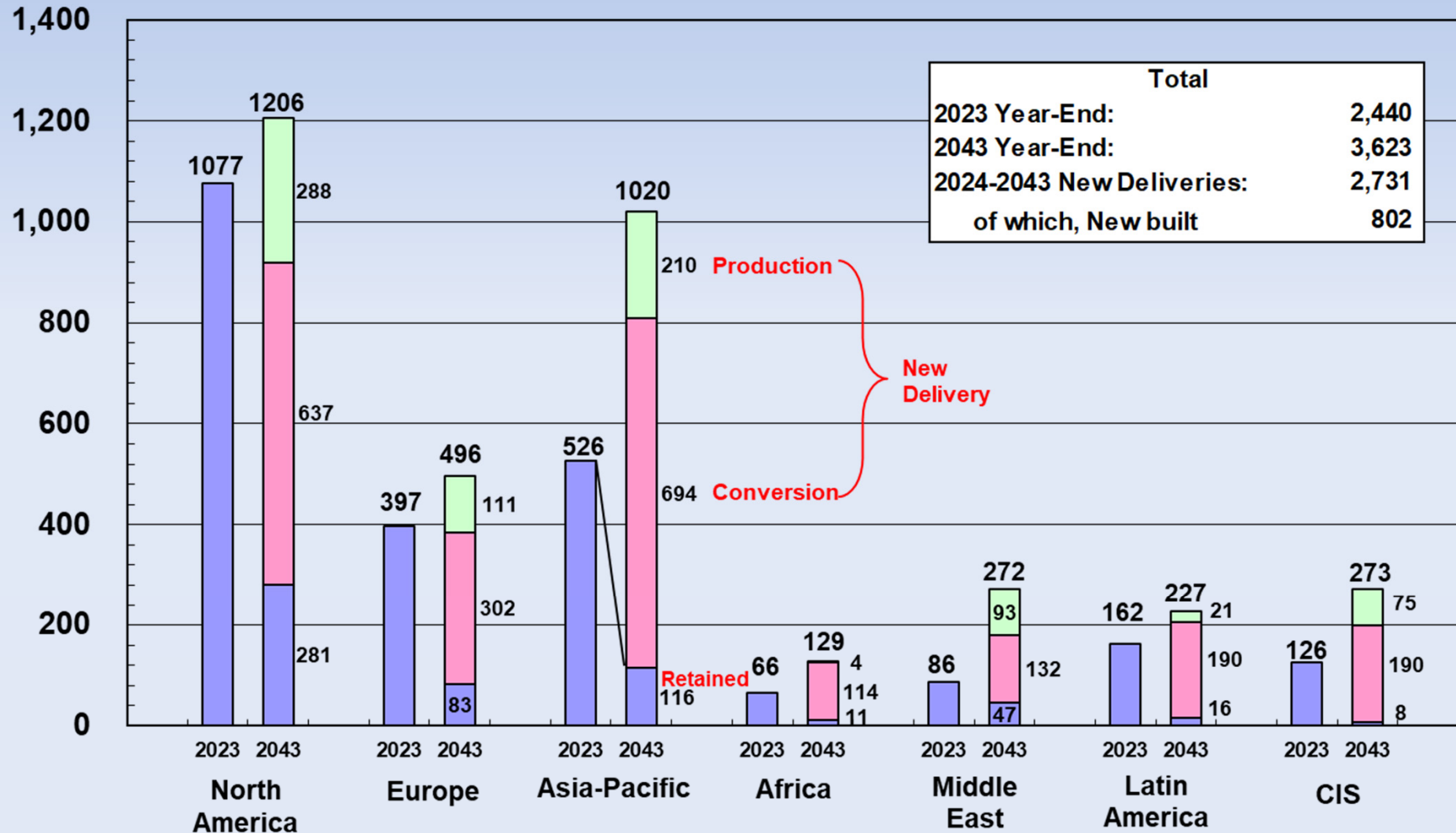
No. of Airplanes



Jet Freightier Fleet Forecast by Region

North America, Asia-Pacific Airlines will need more new built freighter planes.

No. of Airplanes



Summary

	2019 actual	2023 actual	2043 forecast	Growth Rate	Sales (2019 US\$billion)
World Economic Growth (GDP)				2.46%p.a. *2043	
				2.53%p.a. *2443	
Passenger Demand (RPK : × 10 ⁹ passenger km)	8,486	8,079 * I	19,479	3.5%p.a. *2043	
Passenger Jet Airplane Fleet	24,015 *	25,360 * +	40,989	2.4%p.a. *2443	
New Passenger Jet Airplane Deliveries			35,664		5,736 *2443
Cargo Demand (RTK : × 10 ⁹ ton km)	253	240 * I	562	3.4%p.a. *2043	
Jet Freight Fleet	2,023 *	2,440 *	3,623	2%p.a. *2443	
New Jet Freight Deliveries			802		308 *2443
Total New Jet Airplane Deliveries			36,466		6,044 *2443
Passenger Turboprop Airplane Fleet	3,583 *	2,914 * +	3,417	0.8%p.a. *2443	
New Passenger Turboprop Airplane Deliveries			2,835		66 *2443
New Engine Deliveries			87,459		1,315 *2443

(* : A numerical value with * are based on the database of Cirium.) (+ : A numerical value with + includes part of aircraft of Storage in addition to that of In Service.)

(*2043 : A numerical value with *2043 indicates a figure for the period 2020 to 2043.) (*2443 : A numerical value with *2443 indicates a figure for the period 2024 to 2043.)

(*I : A numerical value with *I is based on a preliminary figure by IATA.)

For more information, visit our website:

<http://www.jadc.jp/en/data/forecast/> (English)

<http://www.jadc.jp/data/forecast/> (Japanese)



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