

Boeing Technology & Market Outlook

Amy Bann

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Boeing Commercial Airplanes



All of the above approach to technology / emissions reduction

Airframe



Engines



Alternative Fuels



Electric/
Hybrid Electric



- Attaining industry's ambitious 2050 emissions reduction target will require innovative solutions
- Boeing is researching and developing solutions in all areas - each solution has unique opportunities, challenges and limitations

Boeing Airplane Family

15 to 25% more fuel efficient with each new generation



737 MAX

20% reduction
in fuel and CO₂

50% smaller
noise footprint

Compared to
original Next-Generation 737

787

20% to 25% reduction
in fuel and CO₂

60% smaller
noise footprint

Compared to 767-300ER

777X

20% reduction
in fuel and CO₂

30% smaller
noise footprint

Compared to 777-300ER

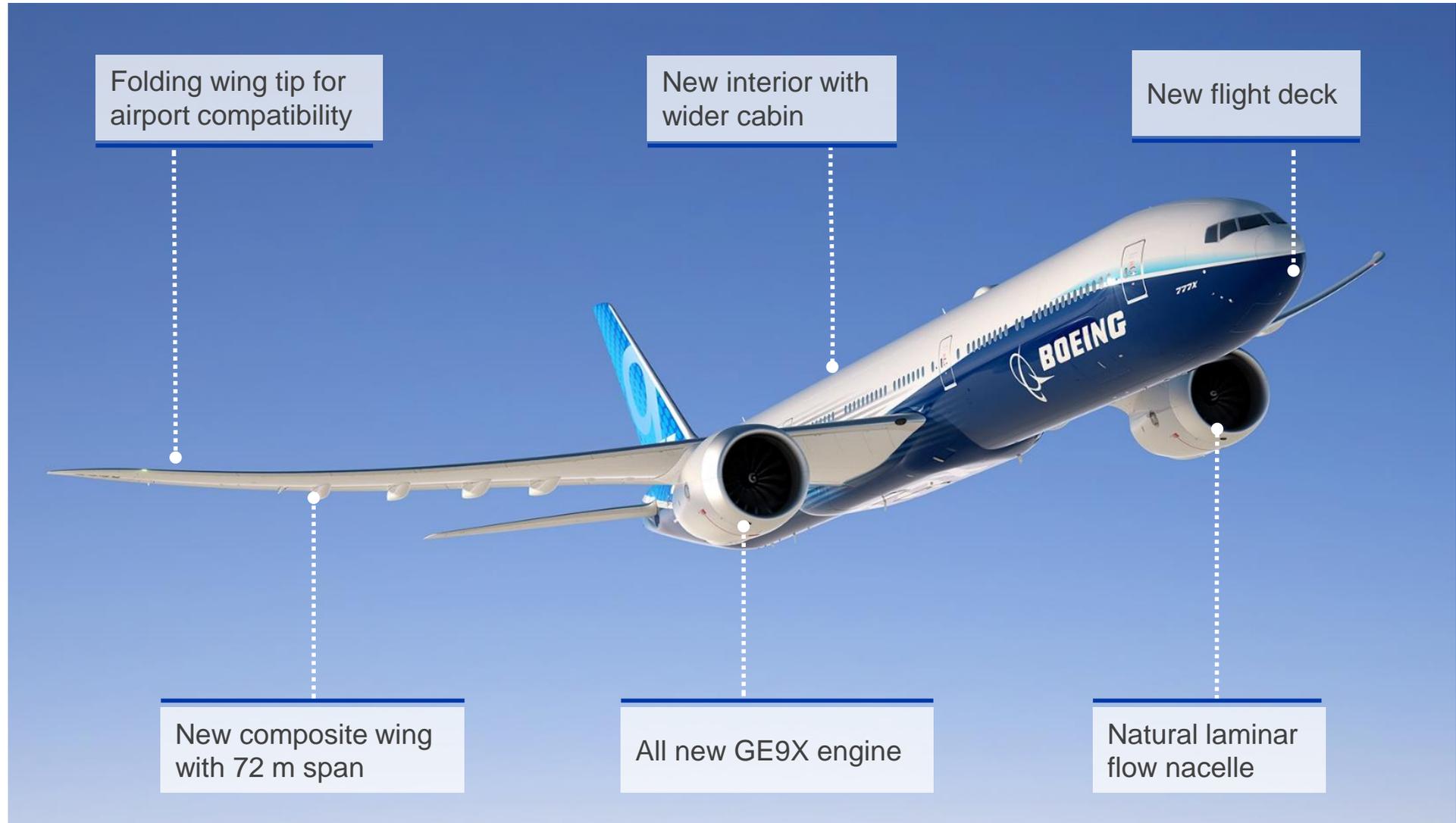
747-8

18% reduction
in fuel and CO₂

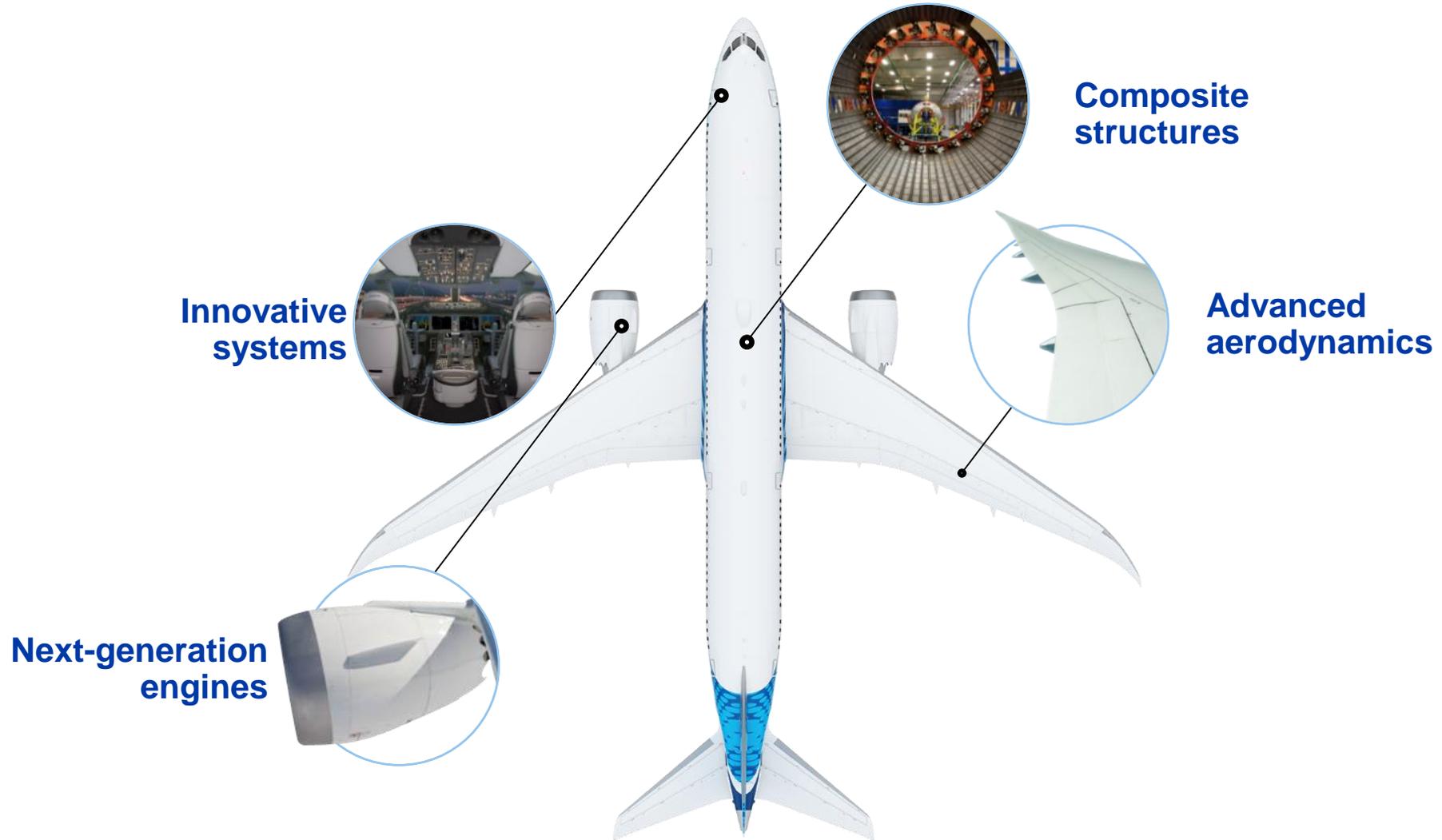
30% smaller
noise footprint

Compared to 747-400

777X Benefits from key technologies



Continued innovation in airframe and engine technology will deliver future efficiency improvements



ecoDemonstrator Program

Innovate, Collaborate, Accelerate

Innovate

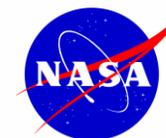
- Learn by doing, fail fast, discover quickly

Collaborate

- With airlines, government, suppliers, academia & industry

Accelerate

- Speed path to products, services and production



Alternative Energy - significant opportunity and challenge



Key opportunity: 60 to 80% life cycle emissions reduction

Key challenges: Production scale & economics



Key opportunity: Potentially zero direct emissions*

Key challenge: Energy/power density, limited mission capability, market penetration

*TBD net emissions

Boeing electric aircraft studies

Advanced Concepts – active and realistic approach for over a decade



SUGAR VOLT
Boeing / NASA 2008-2018+



Fuel Cell Demonstrator
BR&T Madrid 2008-2009



PAV eTaxi
Aurora 2017-



**Ongoing Internal
and Competitive
Studies 2006+**



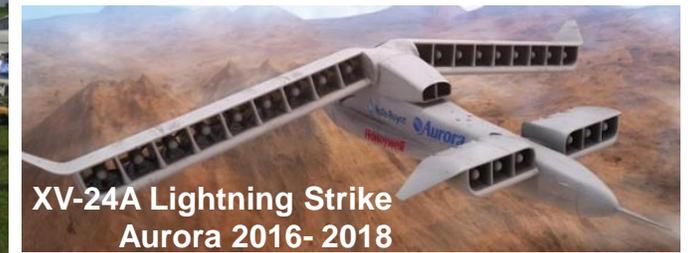
ecoDemonstrator Fuel Cell
Boeing / IHI 2012



Hybrid Electric Demonstrator
Cambridge / Boeing 2015



CAV Cargo
Boeing 2017-



XV-24A Lightning Strike
Aurora 2016- 2018

BOEING HORIZONX

Exploring what's possible

- Focus on investments, partnerships and business model strategies
- Transform disruption to opportunity
- Experiment with early test and learn concepts

- Build and incubate new mobility solutions
- Advance modeling and simulation, as well as airspace integration
- Lead development of the next generation ecosystem

BOEING NEXT

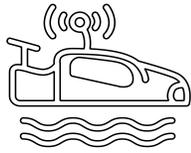
Making the possible a reality

Two organizations working together to shape the future for Boeing and the aerospace industry.

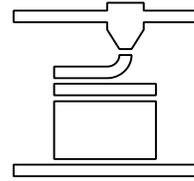
BOEING



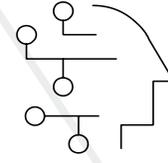
INVESTMENT **FOCUS AREAS**



DISRUPTIVE
MOBILITY



ADVANCED
MANUFACTURING



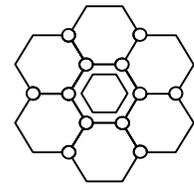
ARTIFICIAL
INTELLIGENCE /
MACHINE LEARNING



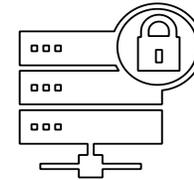
AUTONOMY



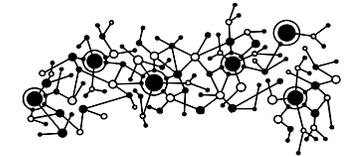
ADVANCED LOGISTICS



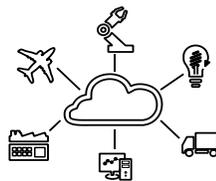
ADVANCED
MATERIALS



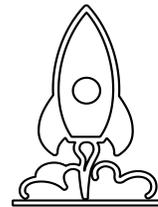
A&D GRADE
CYBERSECURITY



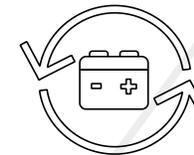
CONNECTIVITY



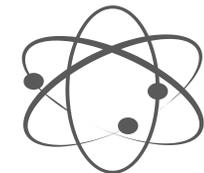
INDUSTRIAL IOT



SPACE



ALTERNATIVE ENERGY
SYSTEMS



QUANTUM
COMPUTING

VENTURES **PORTFOLIO**



RoboticSkies

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REACTION ENGINES



DIGITAL ALLOYS



TYPICAL CHECK SIZE

\$1 – \$10 million

STAGE

Seed through Series C

RATIONALE

Strategic & Financial Investor

LOCATIONS

Silicon Valley, LA, Austin, Seattle,
Chicago, Washington D.C.,
St. Louis, Israel

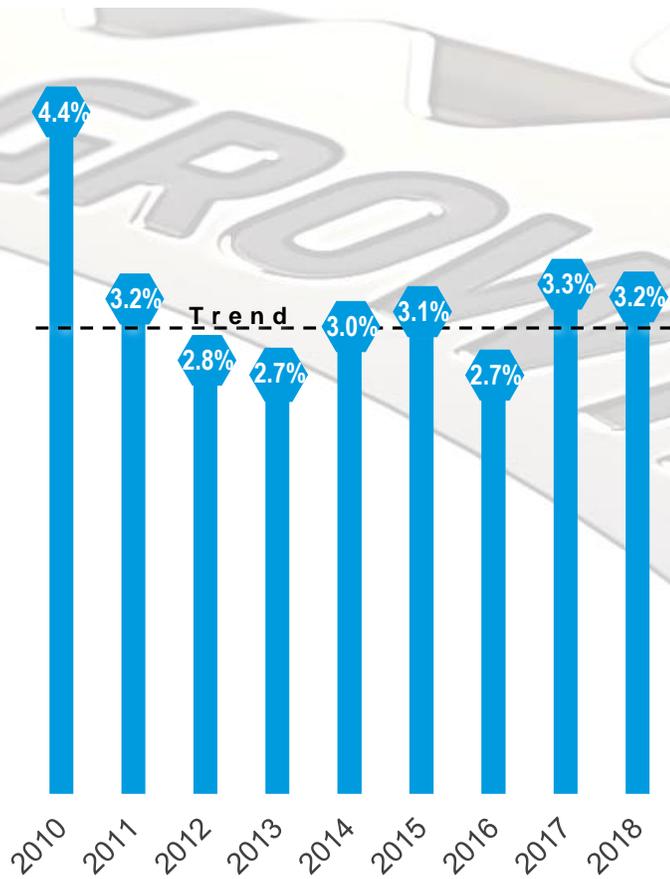
Long-term forecast of global air travel, new airplane demand and commercial services



Nine years of profitable growth for our customers

INTERNATIONAL PARIS AIR SHOW 2019

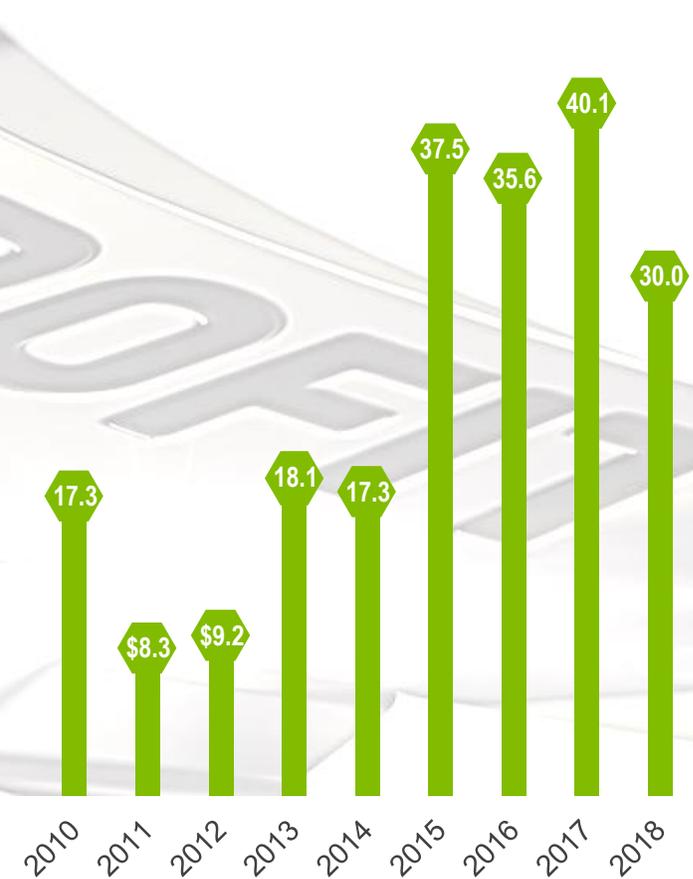
Global GDP growth



Traffic growth rates (RPKs)



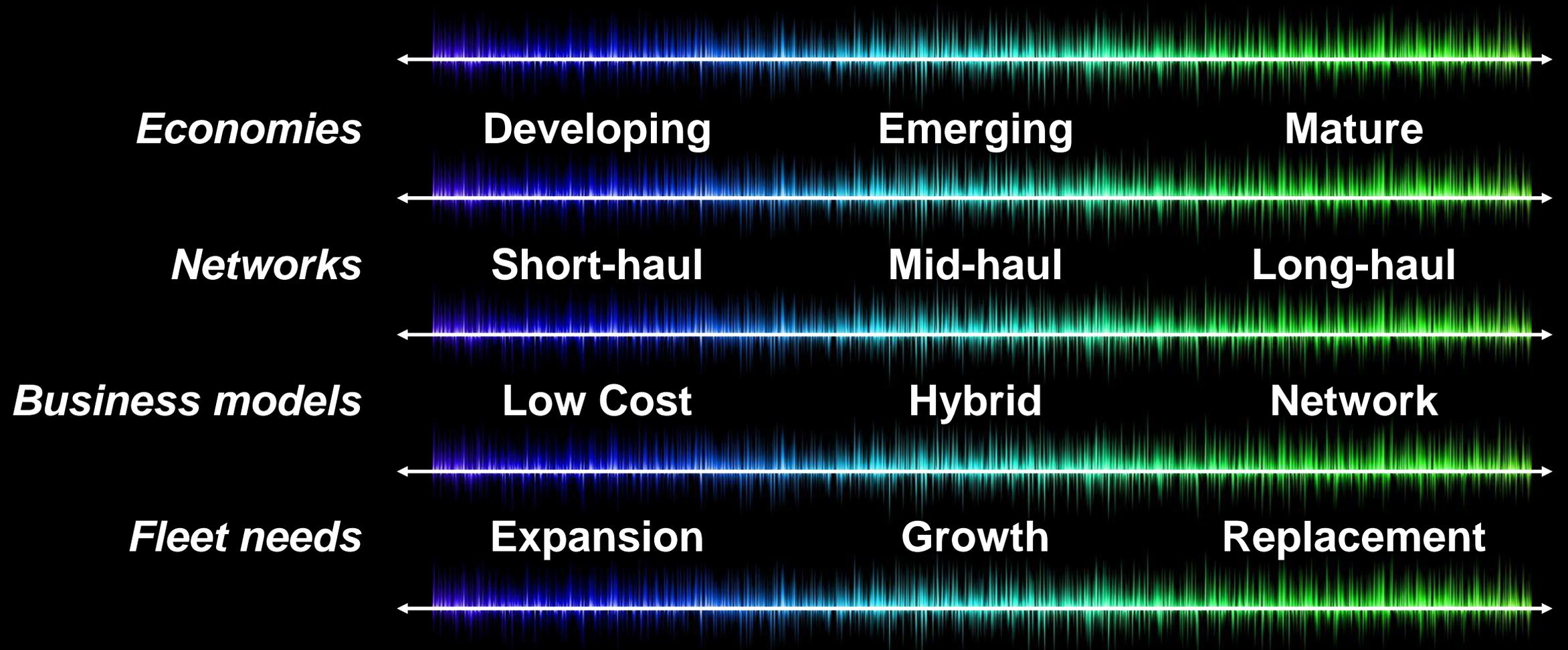
Net profit (\$billions)



SOURCES: IHS Markit, ICAO, IATA and Cirium Fleets Analyzer

Most diverse market in history

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Technology



Efficiency



Value



Commercial aviation will demand \$9.1 trillion in services over 20 years

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Commercial Aviation Services: \$9.1T

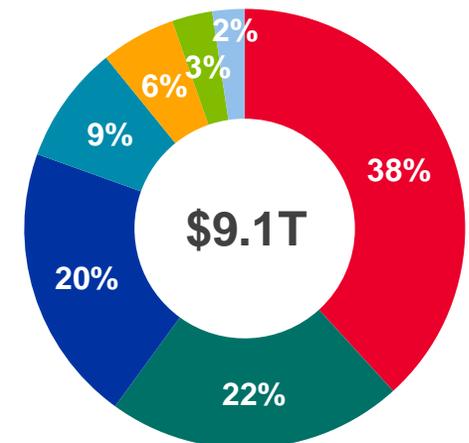
2019 - 2038



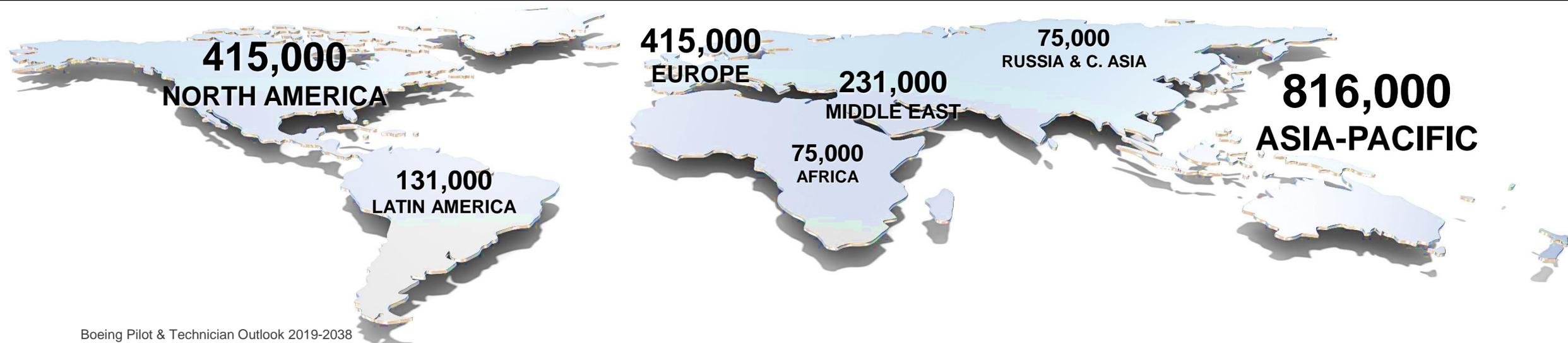
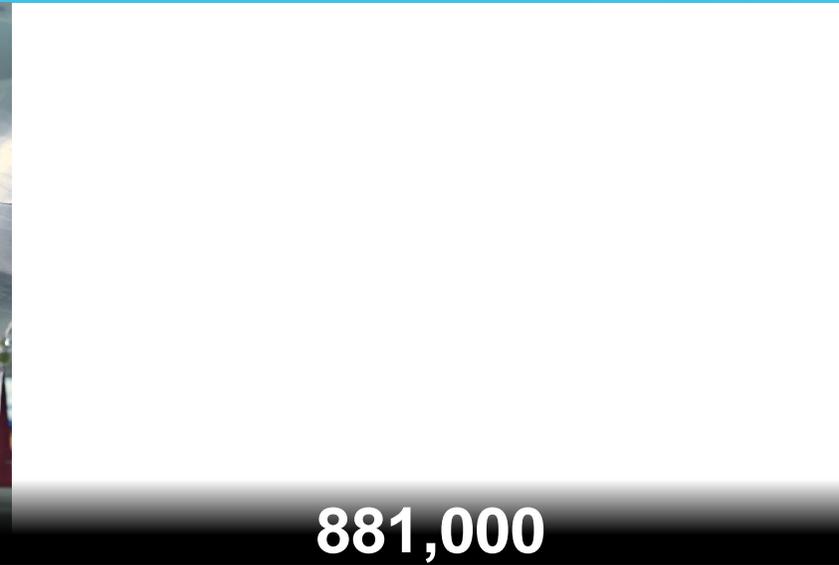
Services by Region

2019 - 2038

Region	Services	CAGR
Asia Pacific	3,480	5.1%
Europe	1,980	3.3%
North America	1,865	2.8%
Middle East	790	4.7%
Latin America	500	4.7%
Russia/CA	270	2.7%
Africa	215	5.0%
World Total	\$9,100B	4.1%



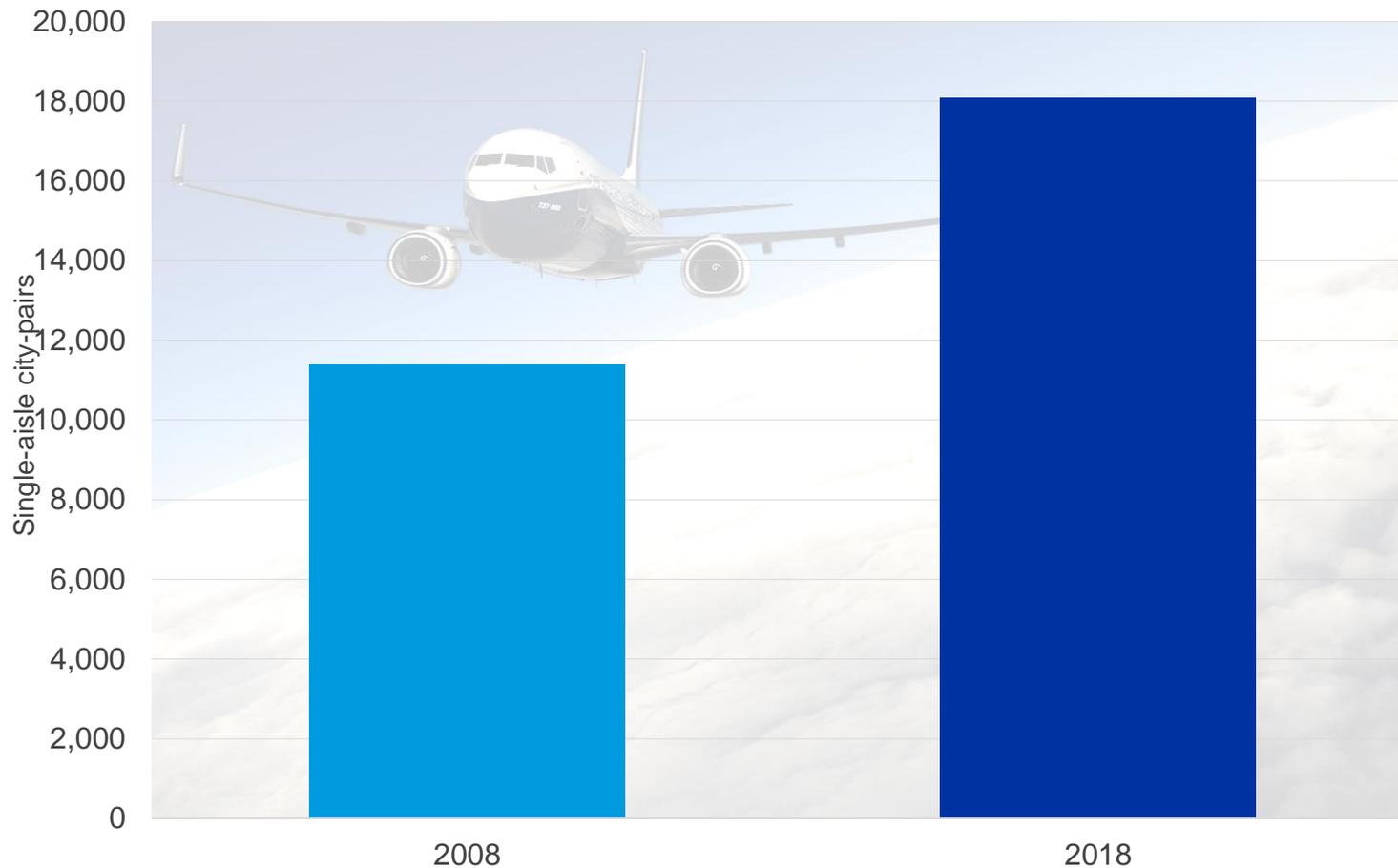
2.2 million commercial aviation personnel needed to fly, maintain world fleet INTERNATIONAL PARIS AIR SHOW 2019



Boeing Pilot & Technician Outlook 2019-2038

Single-aisles driving global network expansion

INTERNATIONAL PARIS AIR SHOW 2019



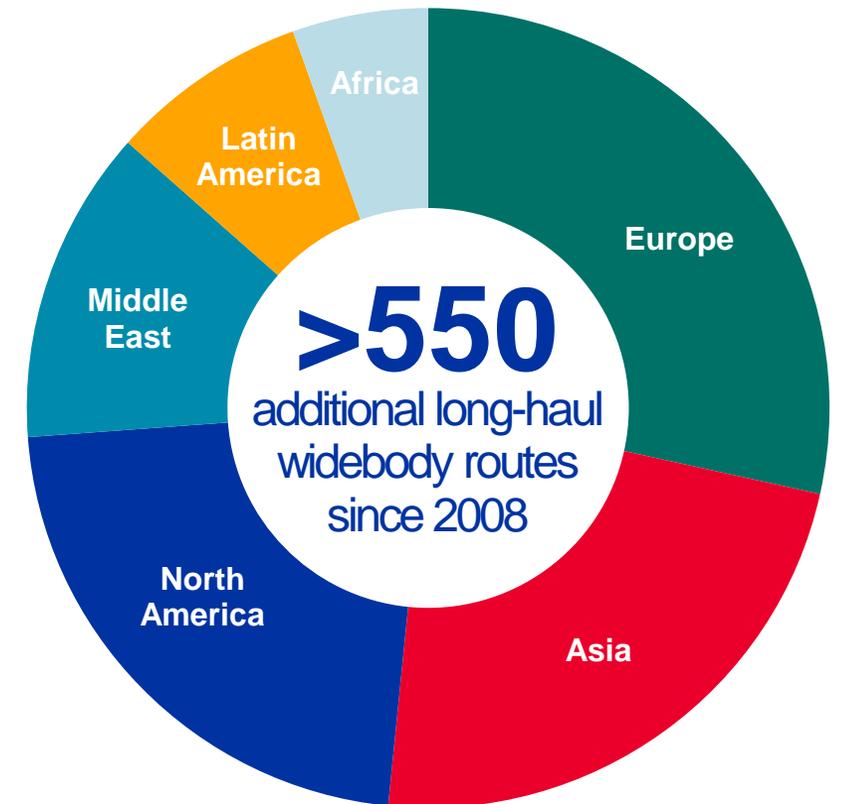
~7,000
nonstop markets
added past 10 years

60%
Network increase
since 2008

SOURCES: FlightGlobal August schedules, Boeing analysis

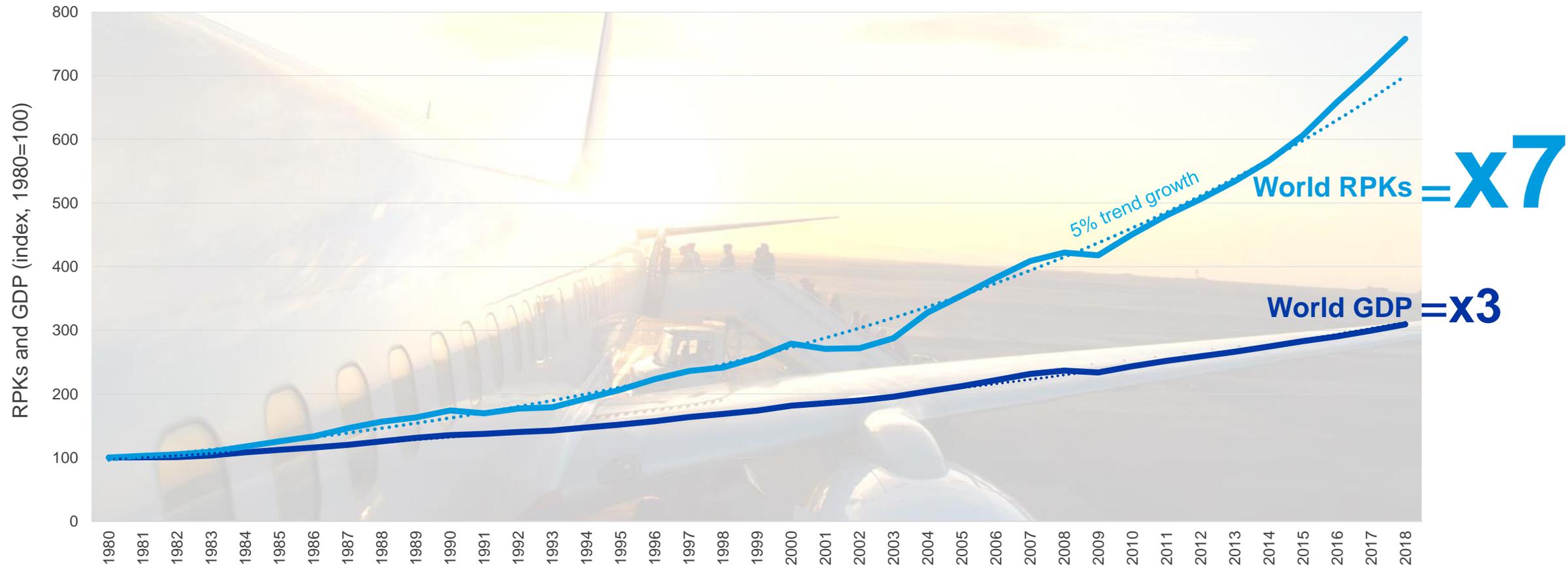
>30% of long-haul network is new in last decade

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Resilient growth market continues

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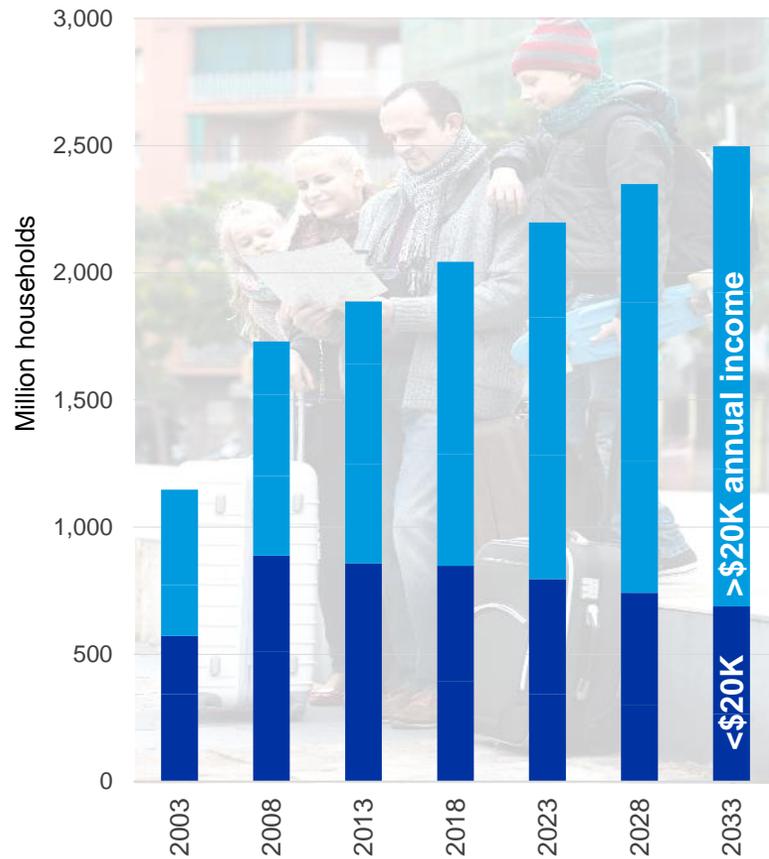


RPKs = Revenue Passenger Kilometers

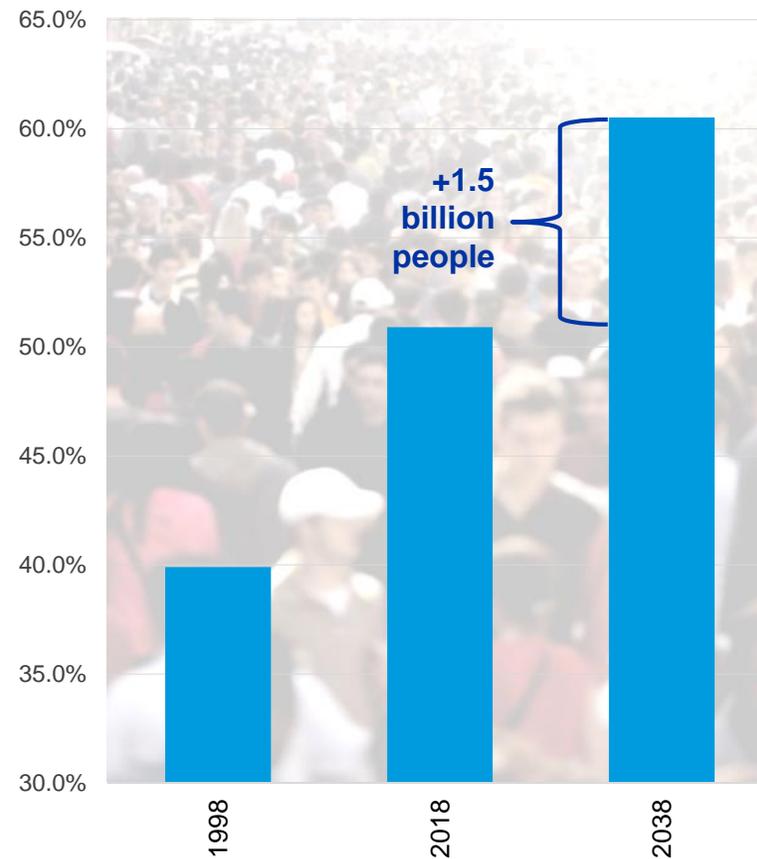
SOURCE: ICAO scheduled traffic / 2018E/202019F IATA December 2018, GDP (constant \$ and exchange rate) from Oxford Economics

Structural factors driving sustainable growth

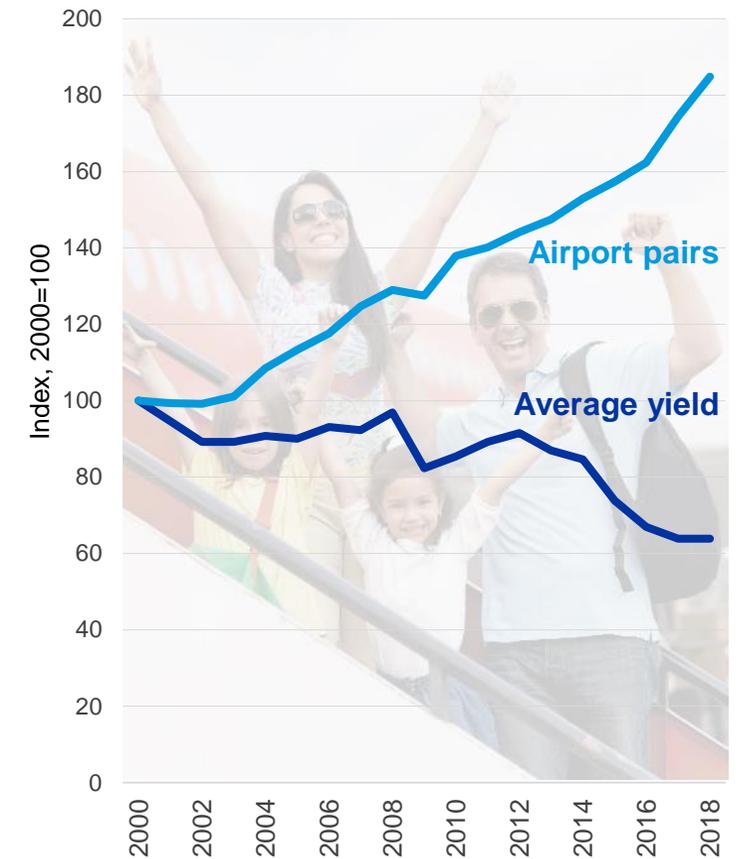
Global middle class expanding



Emerging and developing market urban population rising

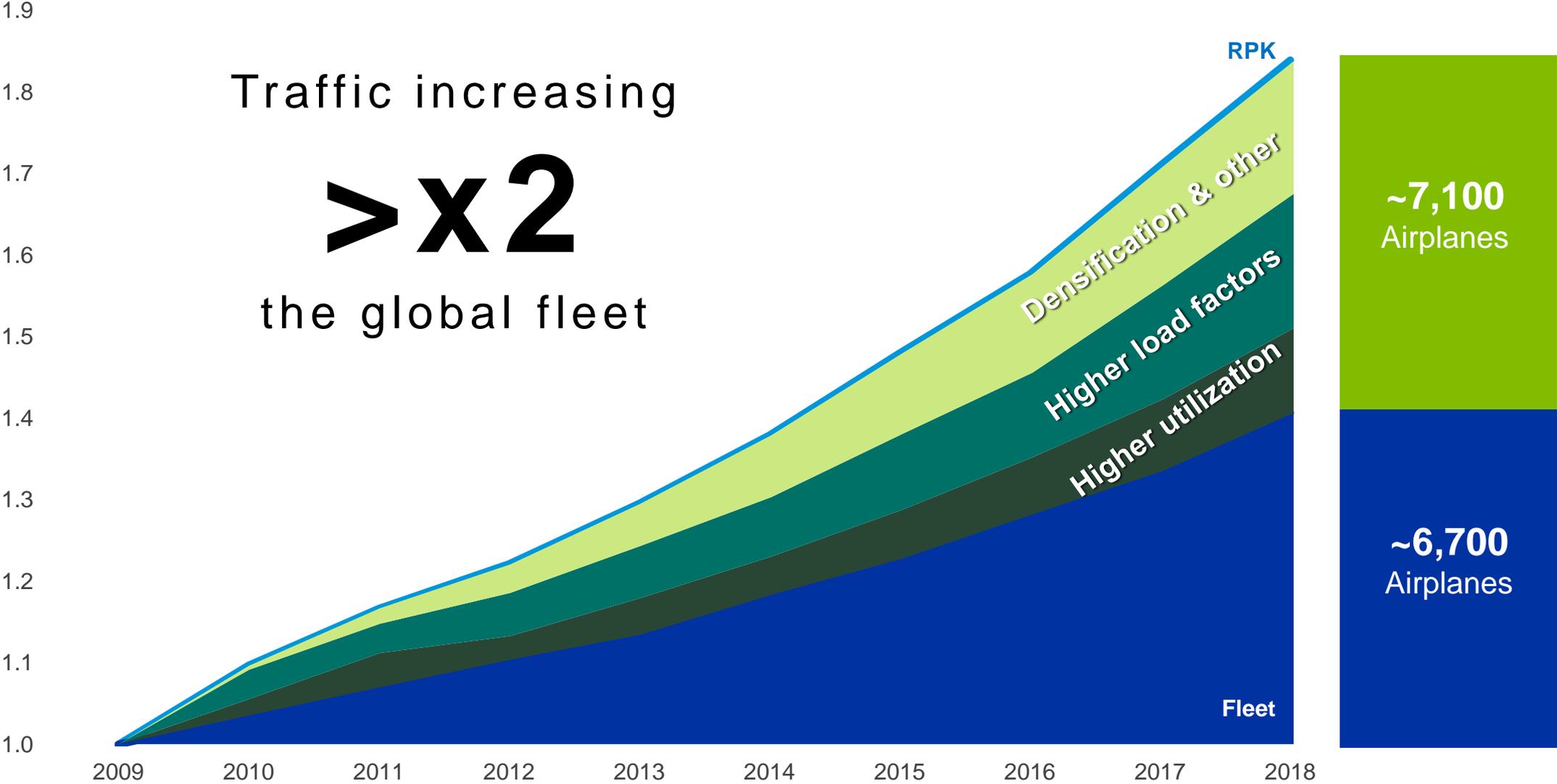


Accessibility and affordability improving



Productivity driving sustainable growth

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20-year forecast: continued long-term growth

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World
Economy
(GDP) **2.7%**

Passenger
Traffic
(RPK) **4.6%**

4.2% Commercial
Services
(\$)

4.2% Cargo
Traffic
(RTK)

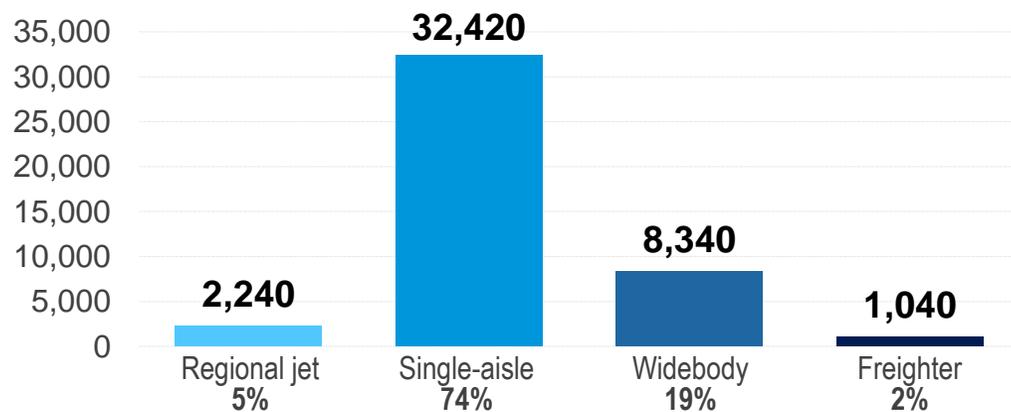
Airlines will need 44,000 new airplanes valued at \$6.8 trillion

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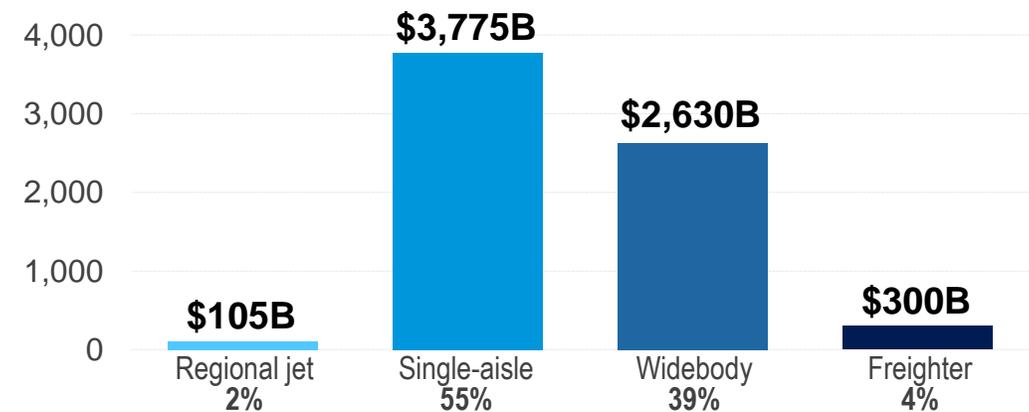
Airplane deliveries: 44,040

2019 - 2038

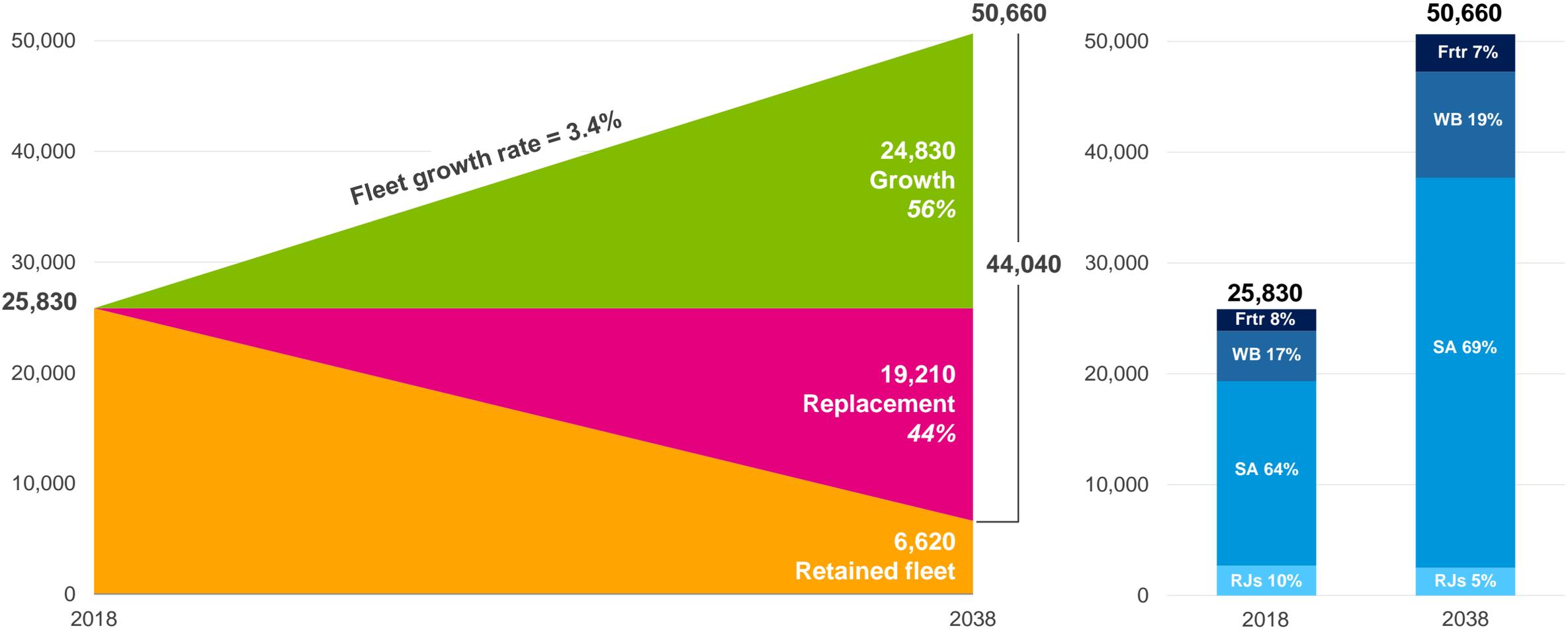


New airplane values: \$6.8T

2019 - 2038



Fleet will double, composition to shift



SOURCES: Fleet Analyzer & Boeing CMO

Asia Pacific responsible for 40% of future airplane demand

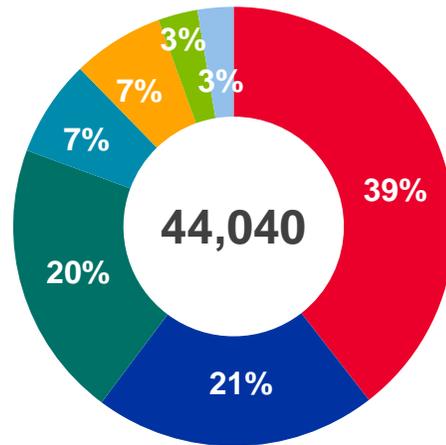
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New airplane deliveries by region

2019 - 2038

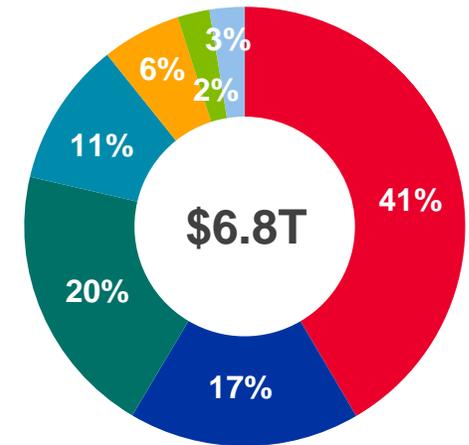
Region	Airplanes
Asia Pacific	17,390
North America	9,130
Europe	8,990
Middle East	3,130
Latin America	2,960
Russia & Central Asia	1,280
Africa	1,160
World Total	44,040



Market values by region

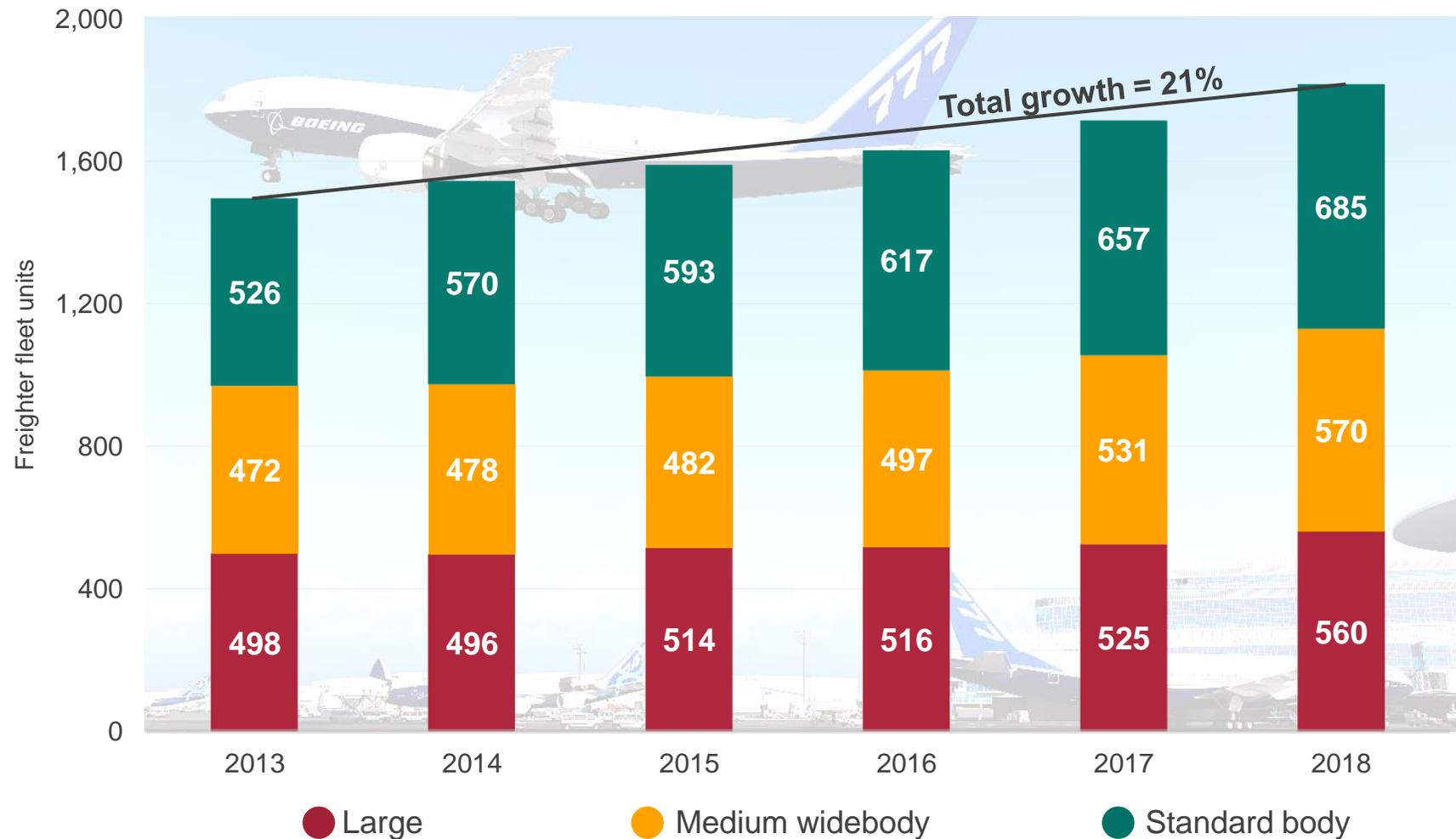
2019 - 2038

Region	Values
Asia Pacific	\$2,830B
North America	\$1,155B
Europe	\$1,370B
Middle East	\$725B
Latin America	\$395B
Russia & Central Asia	\$160B
Africa	\$175B
World Total	\$6,810B



Freighter fleet is growing

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5.4%
annual growth

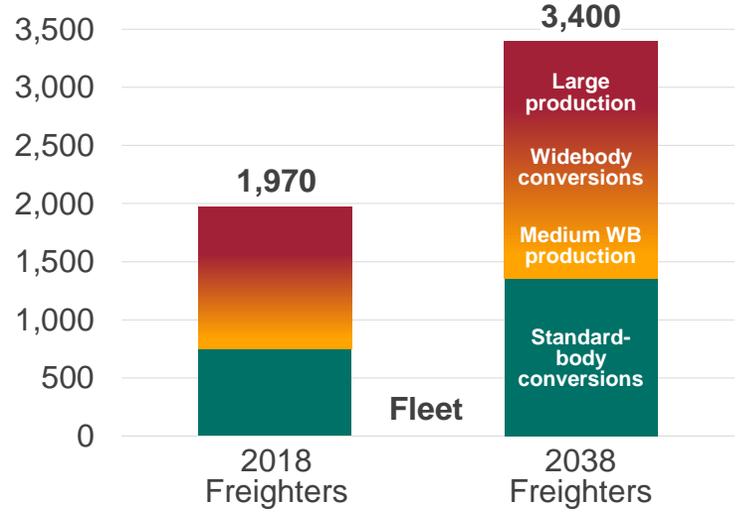
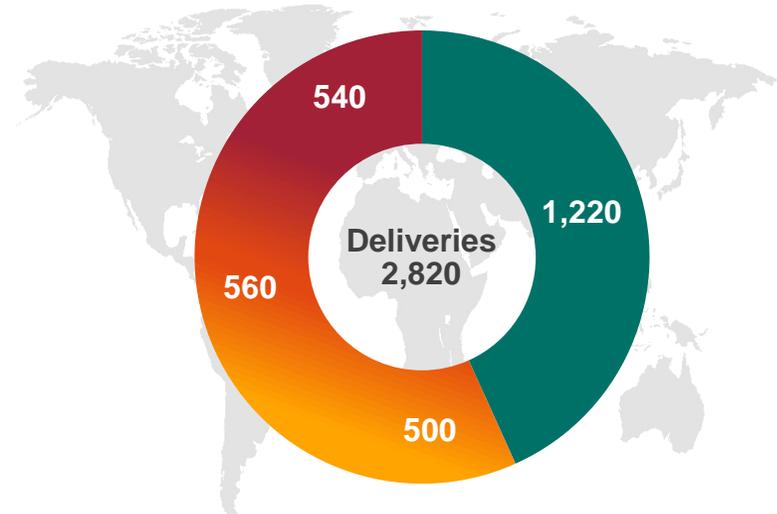
3.8%
annual growth

2.4%
annual growth

Western only

Freighter demand – 1,040 new, 1,780 converted

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BOEING'S MARKET OUTLOOK

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