Presented by:

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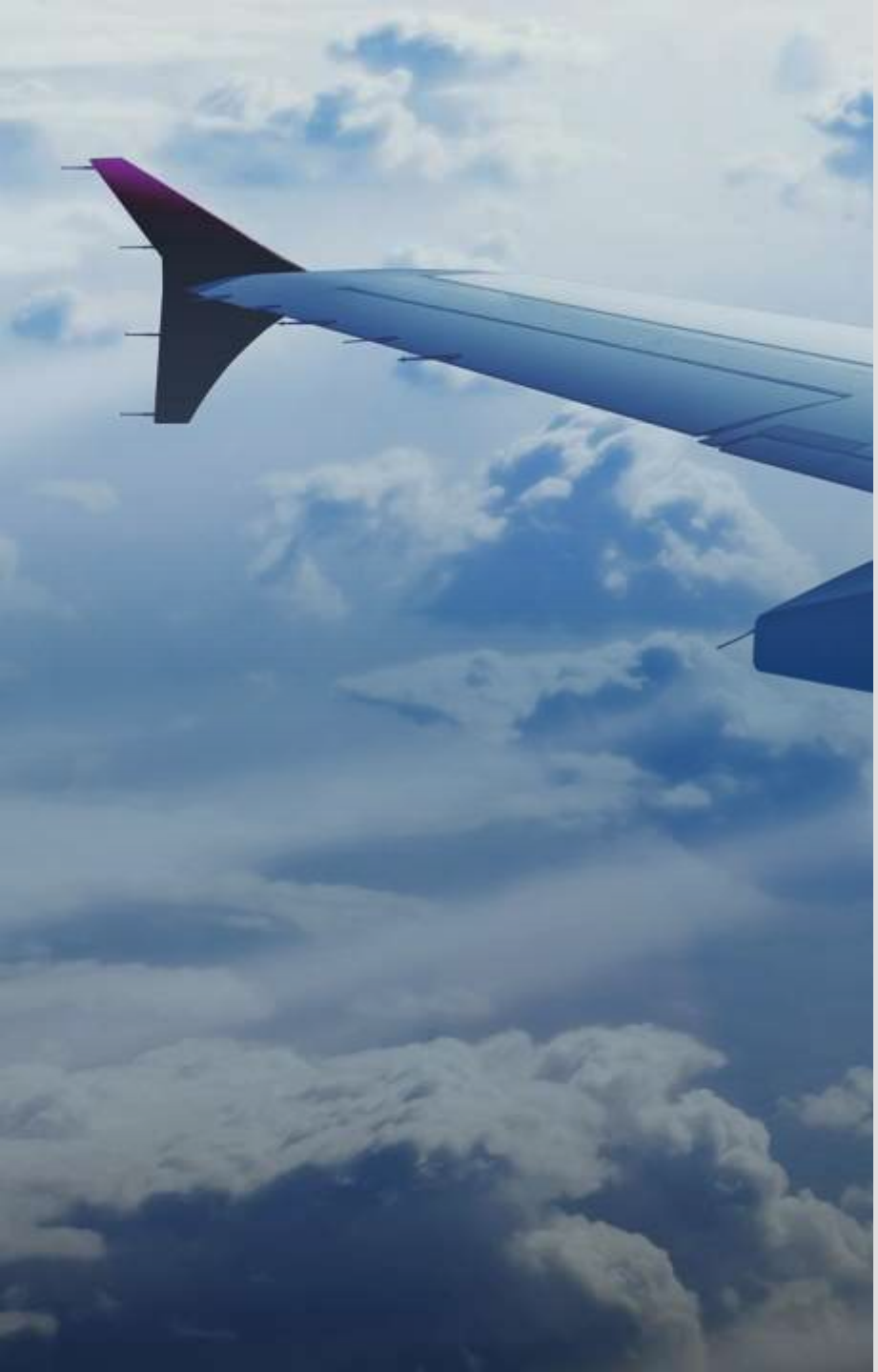
Industry Outlook & Trends



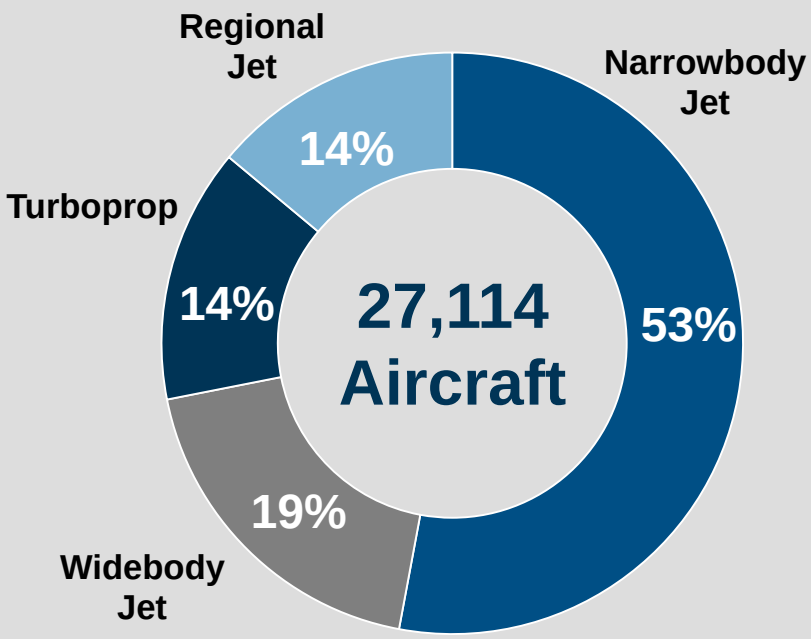
Today's Agenda

- **MRO Forecast**
- **MRO Trends:**
  - ***The Mod Squad***
  - ***New Technology Aircraft***
- **Alternative Materials**

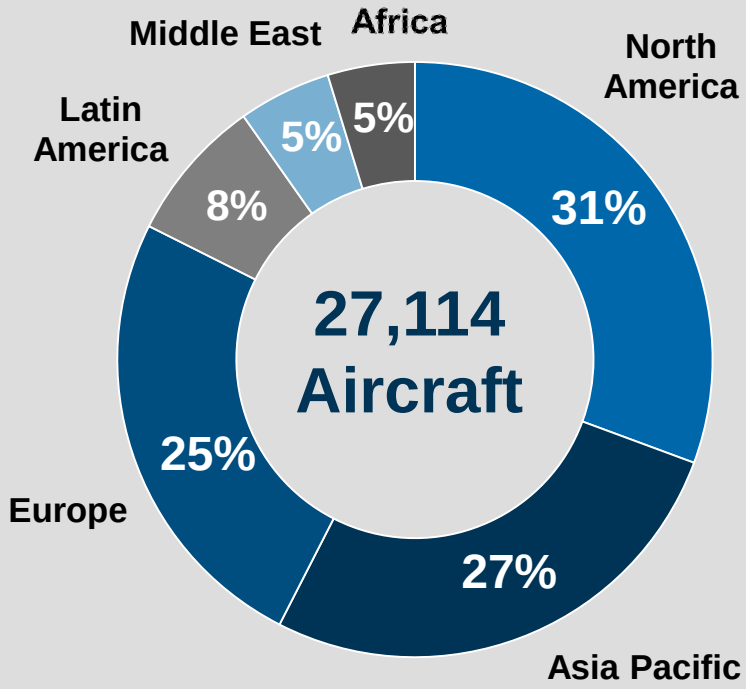
MRO Forecast

The current commercial air transport fleet consists of over 27K aircraft; over half are narrowbody aircraft

2015 Global Commercial Air Transport Fleet



By Aircraft Type

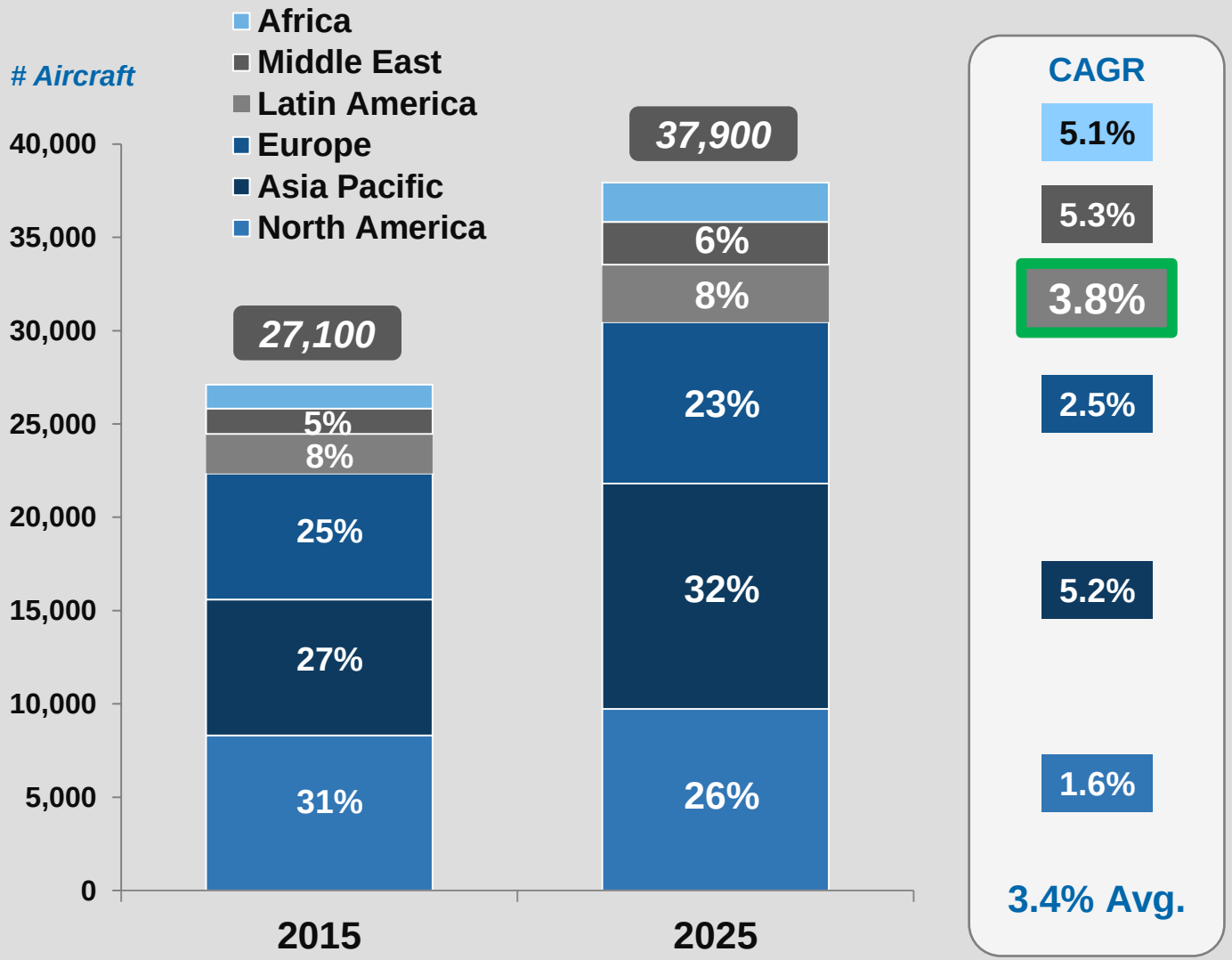


By Global Region

Source: CAPA 2015

The combination of strong air travel demand and the need to replace ageing aircraft will drive fleet growth at a healthy 3.4% annually

10 Year Global Air Transport Fleet Growth



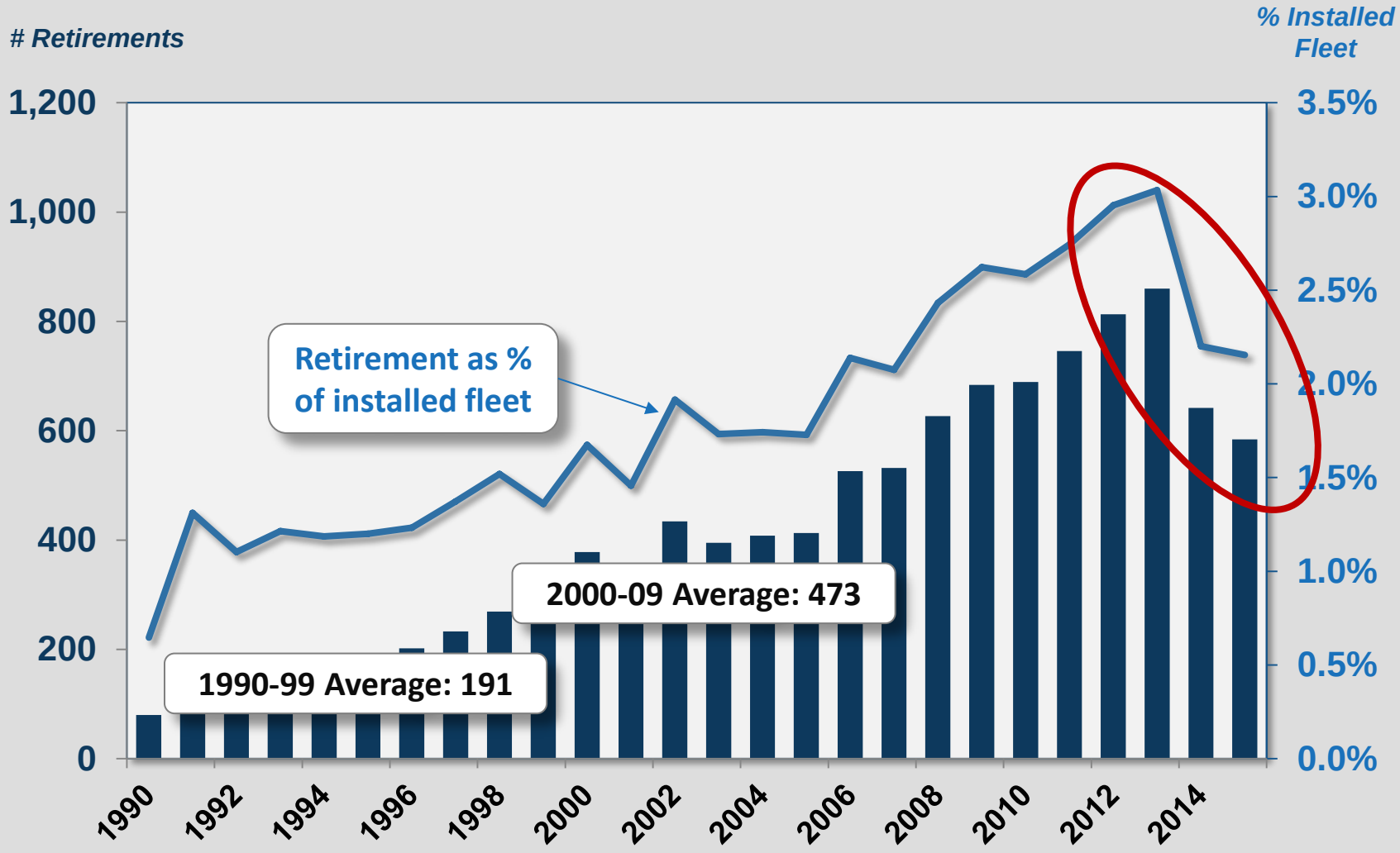
Source: ICF analysis: CAPA 2015

Continued low fuel costs could reverse aircraft retirements trends

Potential Impact:

- **MRO Suppliers: Increased spend on older airframes & engines**
- **Surplus Market: Reduced part-out "feed stock"**
  - **OEMs: Improved new part sales**
  - **Distributors: Improved used part values / pricing**
  - **Operators: Increased material costs**

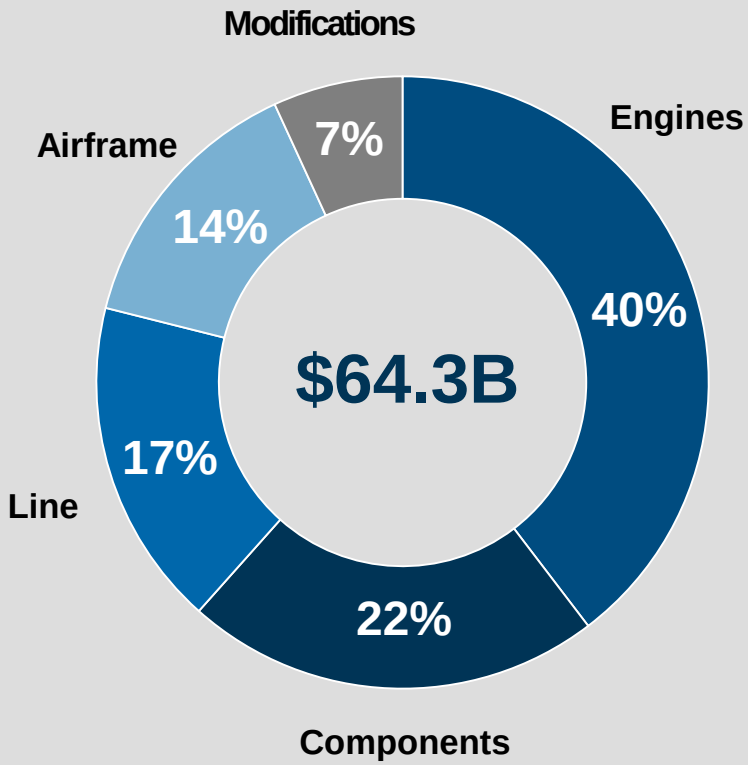
Commercial Air Transport Annual Aircraft Retirements



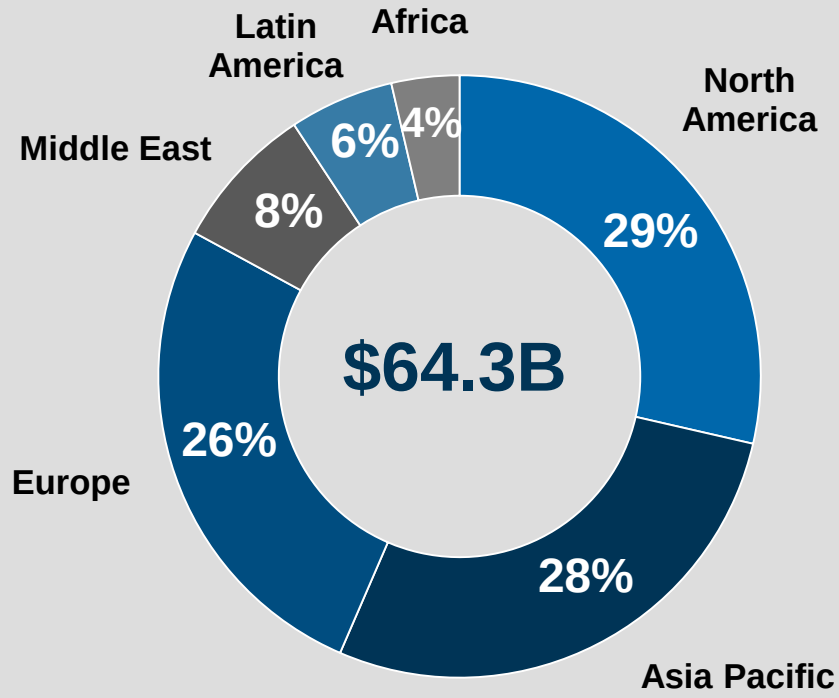
Source: CAPA, Airline Monitor, ICF analysis

Current commercial air transport MRO demand is $64.3B; with Asia equivalent to North America and Europe in market size

2015 Commercial Air Transport Global MRO Demand



By MRO Segment



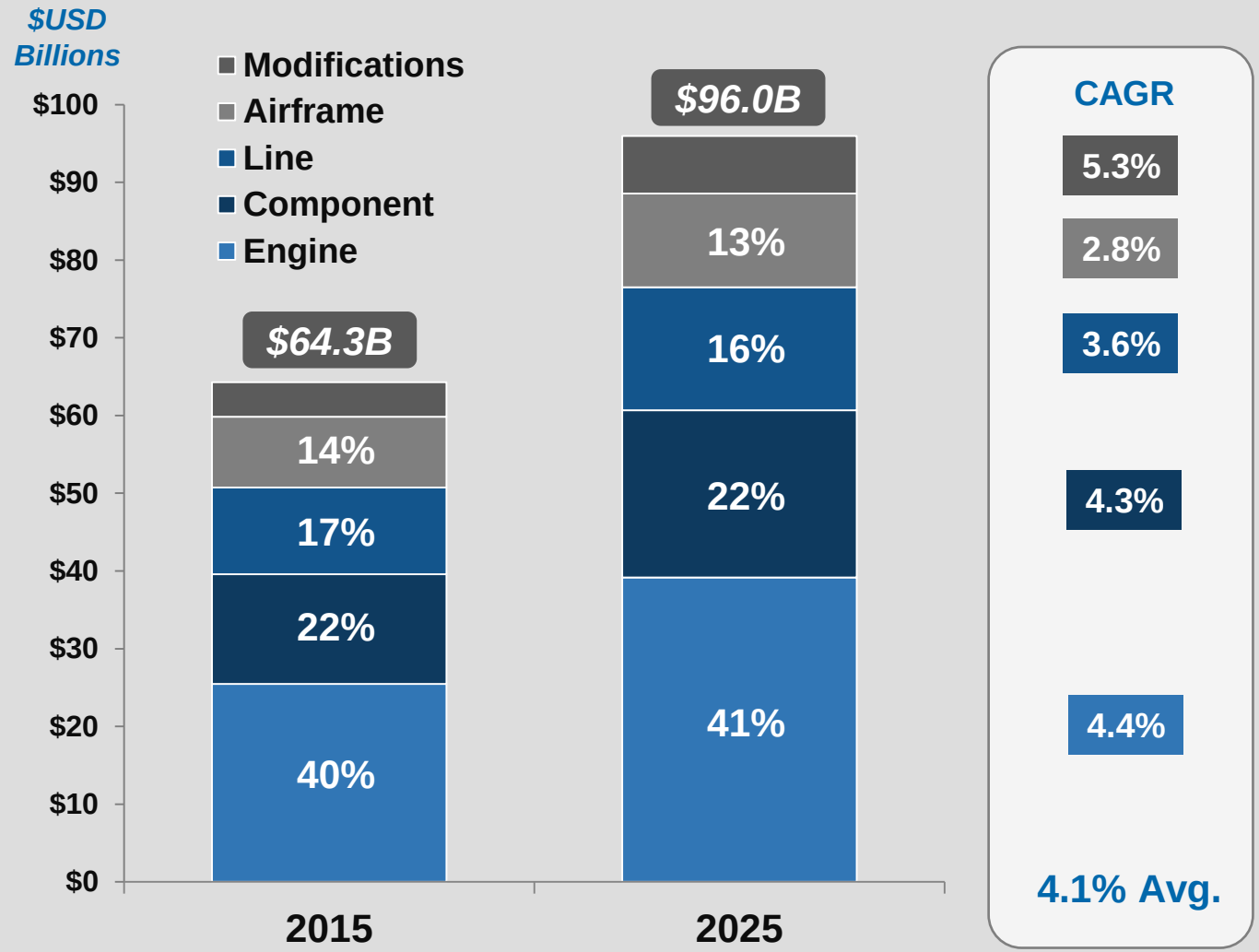
By Global Region

Source: ICF analysis; Forecast in 2015 $USD, exclusive of inflation

The global MRO market is expected to grow by 4.1% per annum to $96B by 2025

- Engine and component MRO markets remain the largest segments
- Modifications market will see the strongest growth (e.g. interiors, connectivity)
- Airframe market slows due to reduced man-hour intensity and increased check intervals as new fleets are introduced

10 Year Global Commercial Air Transport MRO Demand Growth



Source: ICF analysis; Forecast in 2015 $USD, exclusive of inflation

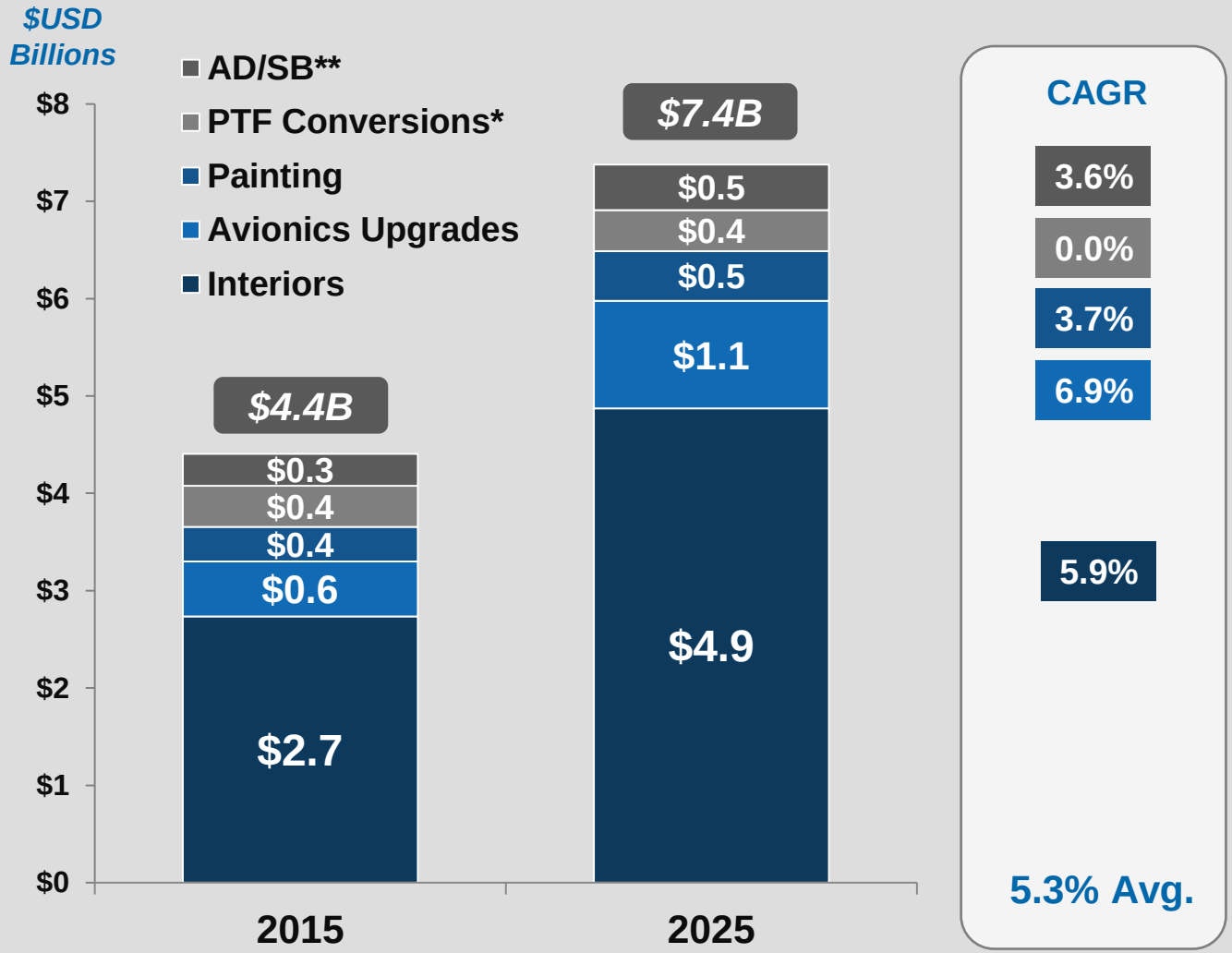
Trend Watch:
The Mod Squad

Modifications growth is driven by airlines seeking differentiation in the cabin and customer experience

MRO modification market growth drivers include:

- **Latest lie-flat seats are now the minimum standard**
- **Premium economy**
- **Wi-fi, on-board connectivity**
- **Coming soon: ADS-B Mod program**
- **Capacity (ASM/K) increase**

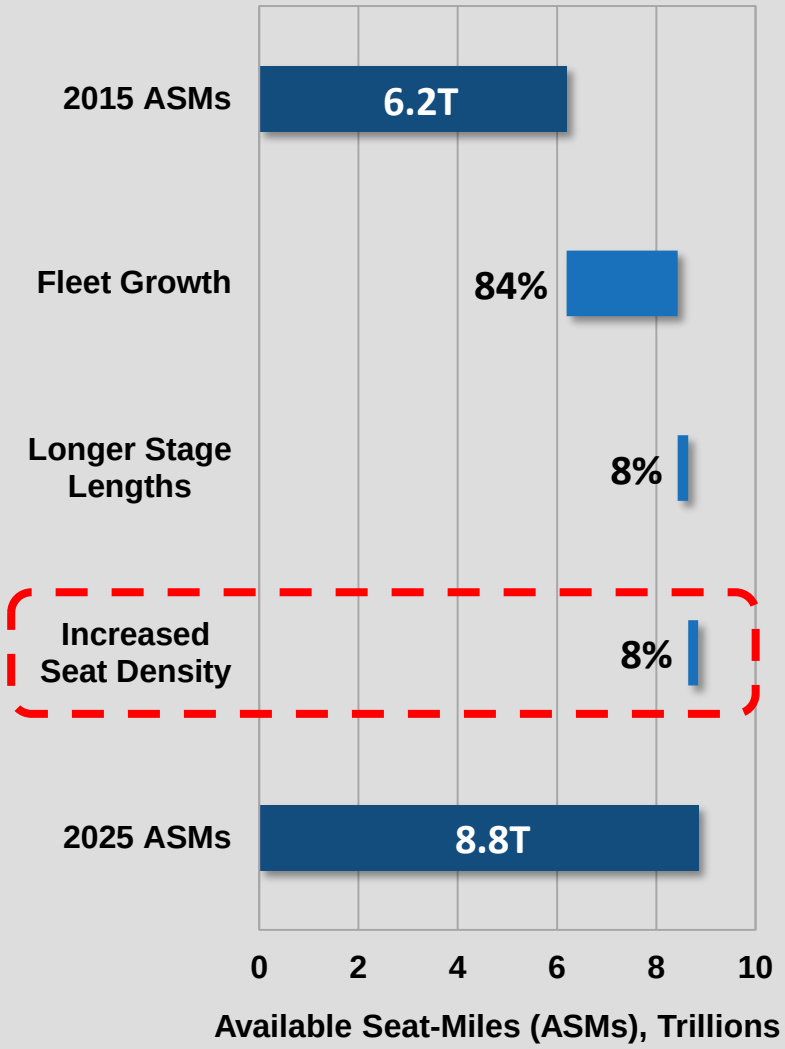
Commercial Air Transport Modifications Forecast



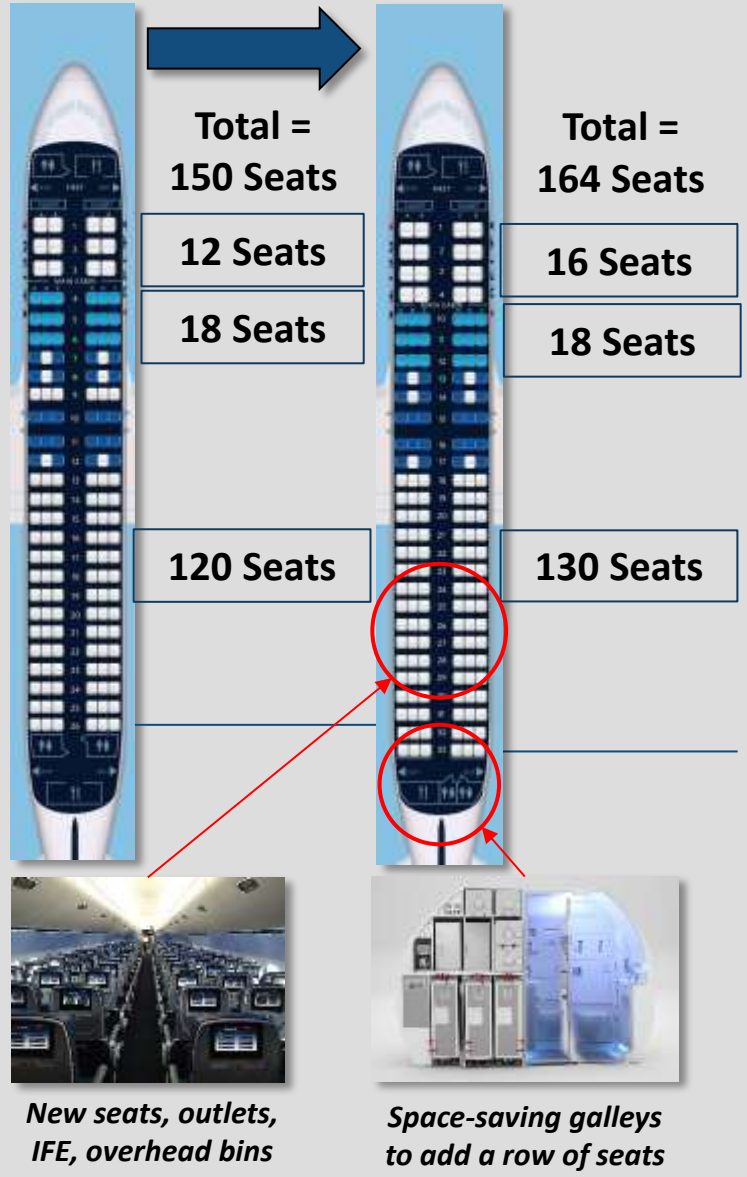
Modifications demand includes labor and material spend
*Passenger-To-Freighter Conversions
**Airworthiness Directives / Service Bulletins
Source: ICF analysis, constant 2015 US$

Cabin "*densification*" has emerged as cost effective strategy for airlines to increase capacity and drive bottom line growth

2015 - 2025 Capacity Bridge



Example: Delta A320 Interior Modification Program

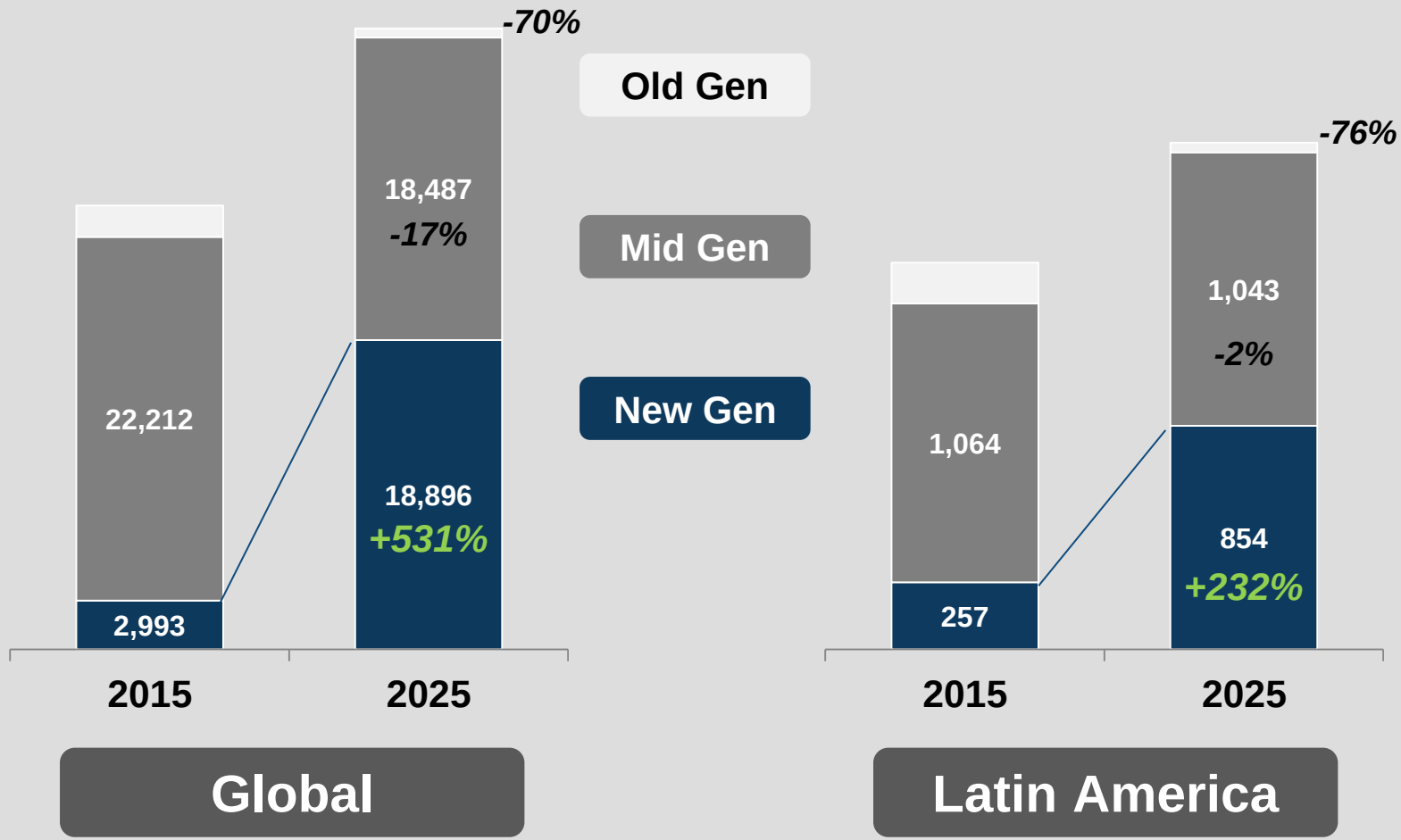


Source: ICF analysis, delta.com

Trend Watch:
New Technology Aircraft

Over the next decade, the global fleet of new generation aircraft fleet will grow by approx. 531% to nearly 19,000 aircraft

10-Year Fleet Forecast by Aircraft Generation

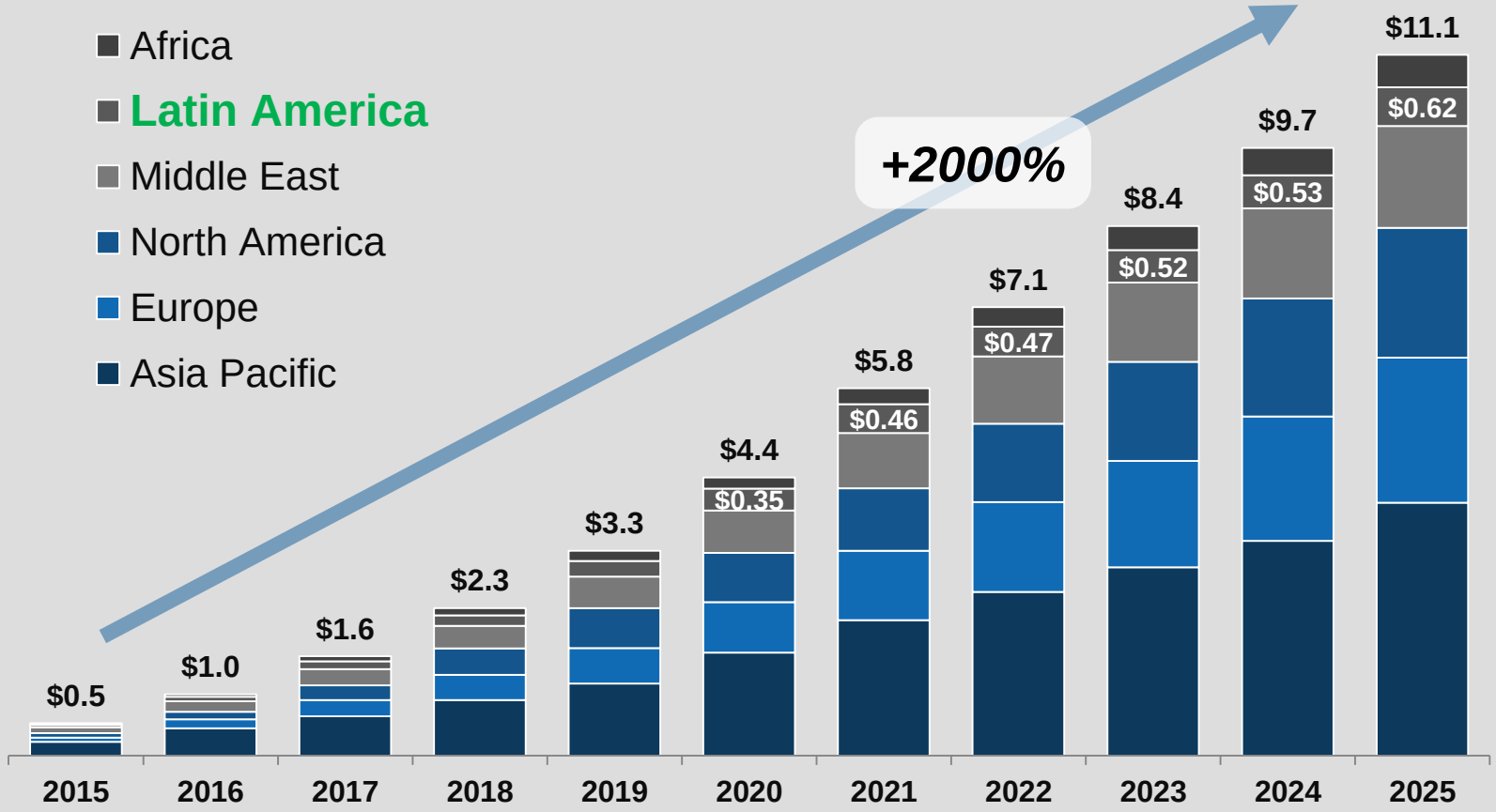


Old Gen: 727, 737 Classic, 747 Classic, DC10, L1011, A300
Mid Gen: 757, 767, 747-400, A320 Family, A330/A340, 737NG, 777, ERJ, CRJ
New Gen:, 777X, 787, A350, A330neo, A380, E170/175/190/195, CRJ-7/9/1000, 737MAX
Source: ICF analysis

Over the next decade, MRO spend on new technology Airbus A350 & Boeing 787 aircraft will double every three years

10-Year MRO Spend for New Technology A350 and 787 Aircraft

$ USD Billions

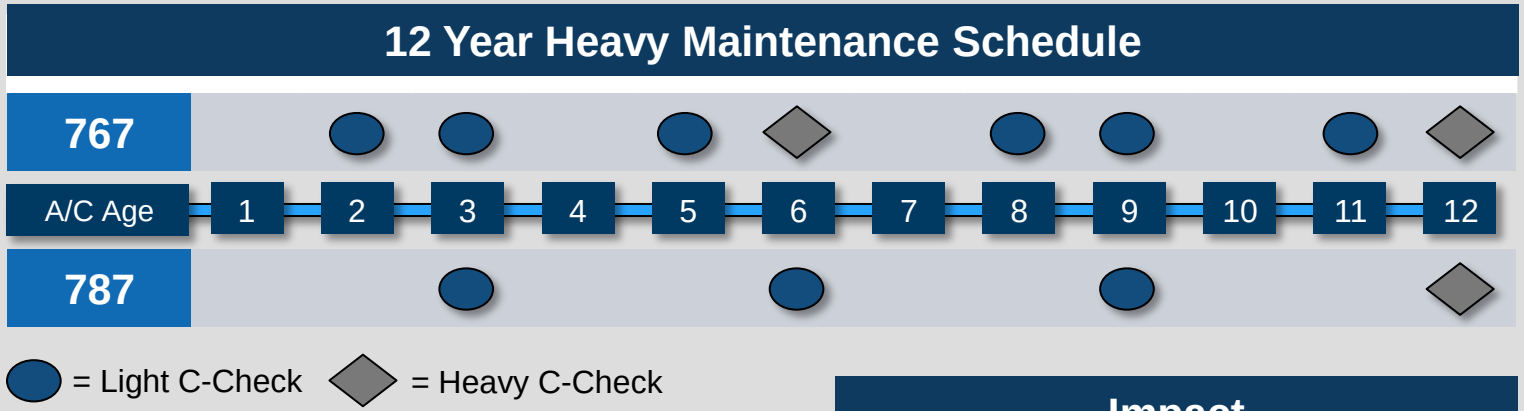


Source: ICF analysis; Forecast in 2015 $USD, exclusive of inflation, includes Boeing 787 and Airbus A350

New technology aircraft challenge traditional MRO sourcing strategies

Return on investment challenges:

- **Facilities**
- **Tooling & Equipment**
- **Training**
- **IT Systems**



	Impact		
	Volume *(C-checks)*	**Intensity** *(man-hours)*	**Days** *(Hangar)*
767	**8**	**95,000**	**136**
787	**4**	**33,000**	**47**

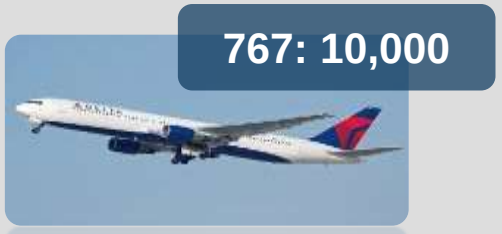
- **Cost Savings:** *~65% fewer routine airframe heavy maintenance man-hours drives an estimated savings of ~$3.5M*
- **Asset Utilization:** *~90 additional available flying days enables increased revenue generation potential*

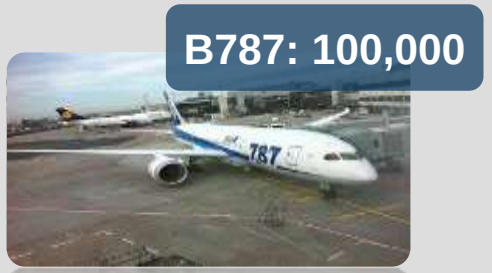
*Based on 4,000 FH/yr utilization
767 C-check = 18mo, 4C = 72mo; 787 C-check = 36mo, 4C = 144mo
Assumed industry standard labor man-hour rate
Aircraft out of Service (AooS) calculated for C/4C/8C checks assuming industry standard MRO hangar productivity
Source: ICF analysis

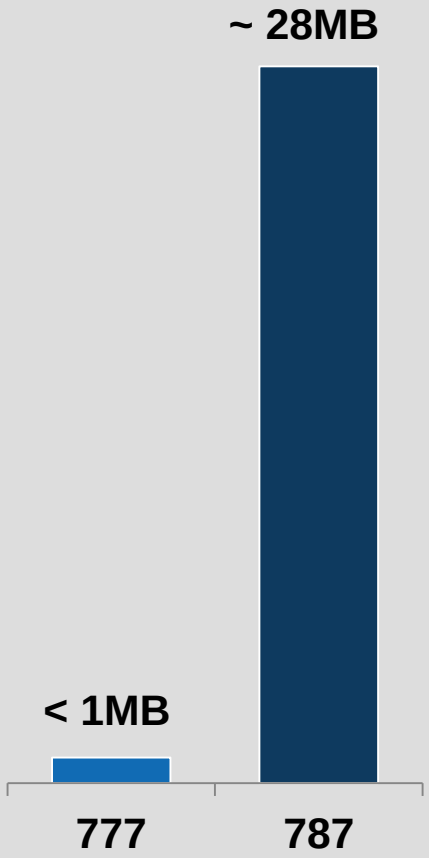
Challenge: How best to realize value from the disparate terabytes of data generated by new technology aircraft

- ***Stakeholder Battle:*** **Who will control and benefit most from the operating data IP?**
  - **Operators**
  - **Lessors**
  - **OEMs**
  - **MRO Suppliers**

Aircraft Health Monitoring and Data Generation Outlook







Number of AHM Parameters

Transmittable Data *(MB/Flt)*

A/C Data Generated *(TB/Year)*

Source: ICF analysis

Alternative Materials

There two primary reasons operators are aggressively seeking non-OEM supplied parts;

1. **Cost savings**
2. **Part availability**

Three alternatives to purchasing OEM-supplied parts:

Surplus

Three types of surplus material:

1. **Used Serviceable Material (USM)**
2. **New Material**
3. **Used, unserviceable material**

DER Repair

- **DER (Designated Engineering Representatives), FAA approved engineers who can approve technical data for repairs and modifications outside the CMM**
- **Design Organization Approval (DOA), a blanket approval for an MRO organization to develop internal repairs**

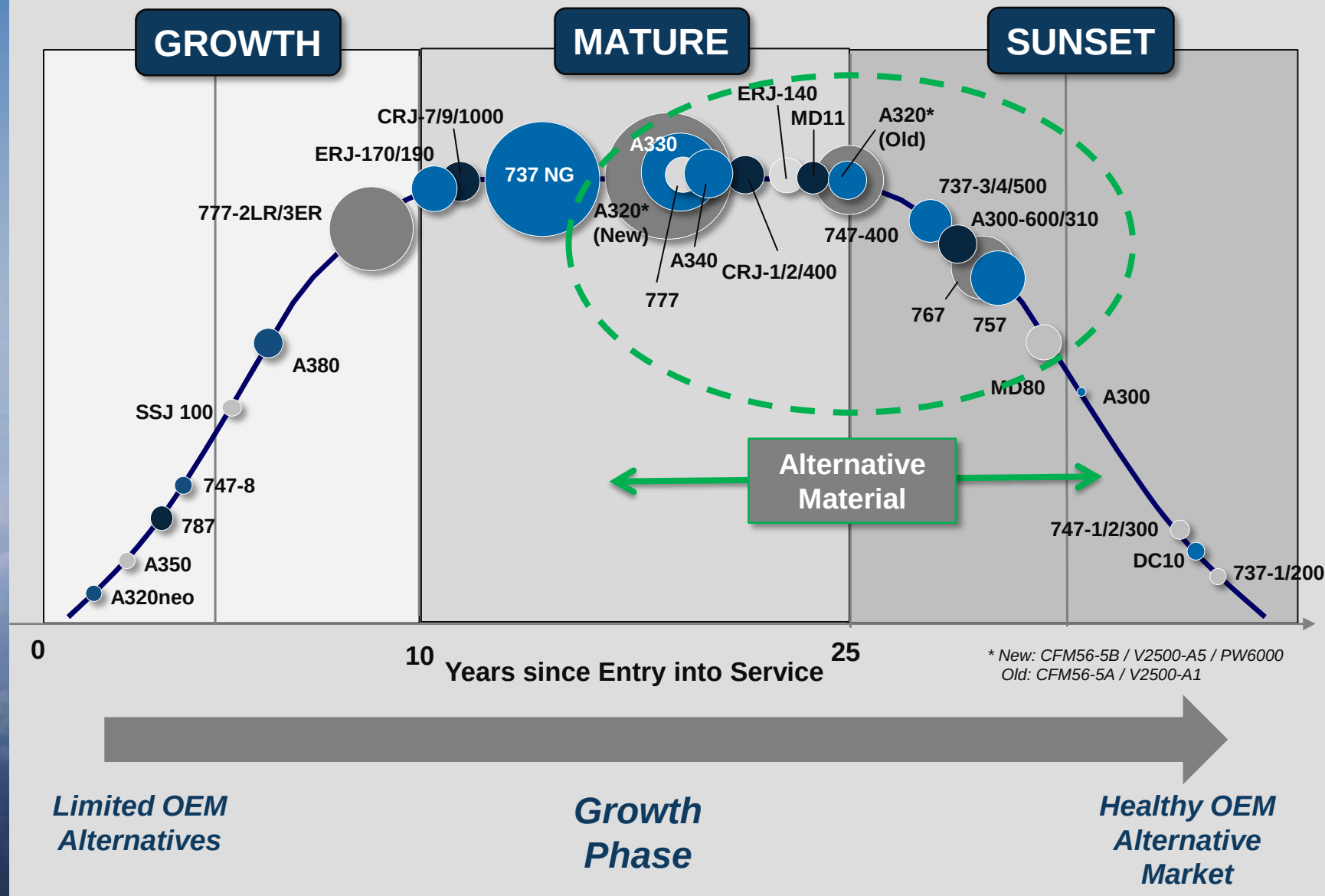
PMA

- **PMA (Parts Manufacturer Approval) is approval granted by the FAA to a non-OEM manufacturer of aircraft parts**
- **Two types of PMA:**
    1. **Licensed**
    2. **Competitive**

Lower ***Perceived Risk*** ***Higher***

Source: ICF analysis

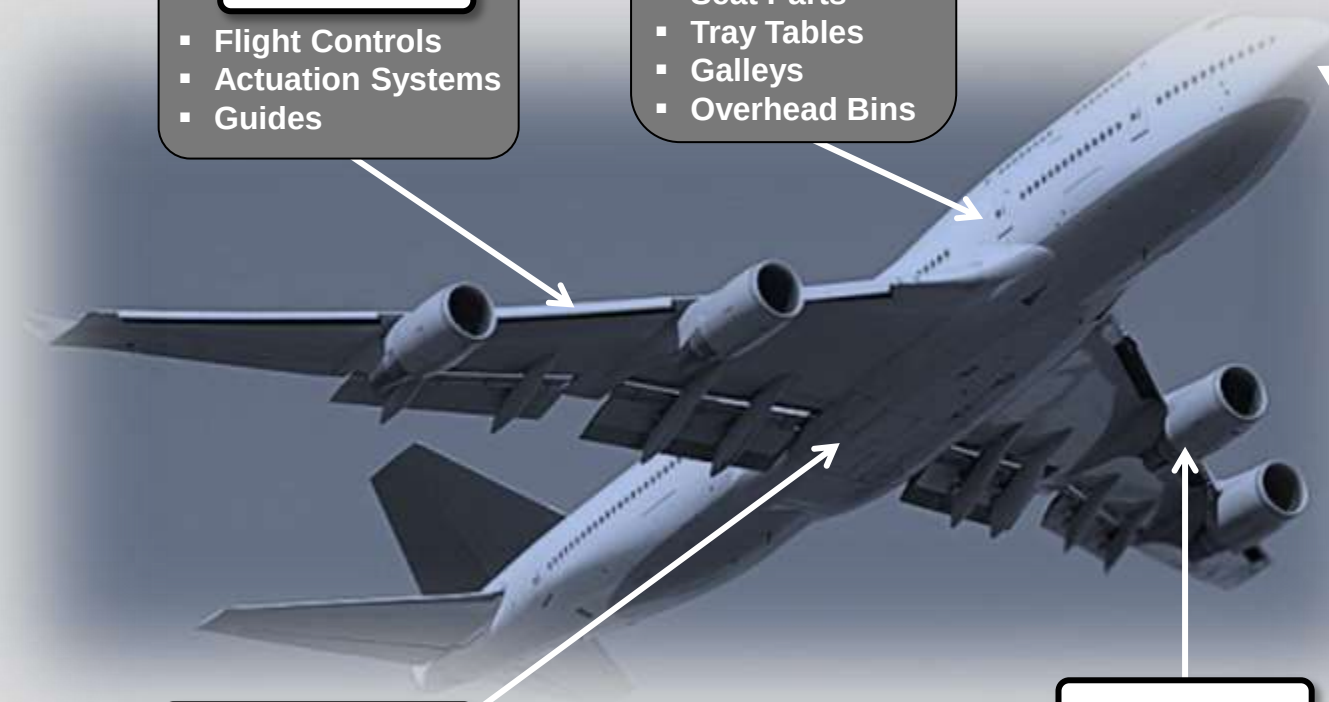
The alternative material market is concentrated on the back half of mature aircraft lifecycle (17-25 years old aircraft) and early sunset aircraft



Bubble size proportional to MRO spend

Source: ICF analysis

PMA parts and DER repairs have can be found on virtually every ATA chapter on an aircraft



Interiors

- IFE
- Lavatories
- Seat Parts
- Tray Tables
- Galleys
- Overhead Bins

Wings

- Flight Controls
- Actuation Systems
- Guides

Cockpit & Avionics

- INUs, IRUs
- Display Units
- DGAs
- Instruments
- Autopilots
- Radomes
- Nose Cowls
- Battery Packs
- Cockpit Paper

Components

- Electro-Mechanical
- Hydraulic Pumps
- ACMs, CSD/IDG
- Batteries
- APUs
- Wheels & Brakes
- Landing Gear

Engines

- Combustion chambers
- Blades & Vanes
- Fan Exit Guide Vanes
- Shrouds
- Thrust Reversers
- Acoustic Panels
- Pneumatic/Bleed/Anti Ice Valves
- Heat Shields
- Insulation Blankets
- Fuel Pumps
- Nozzles
- Gears
- Shafts
- Bearings
- Starters
- Rings
- Spacers
- Expendables

Source: ICF analysis

In 2015, operators spent over $32B on OEM new parts and an additional $13B on alternatives

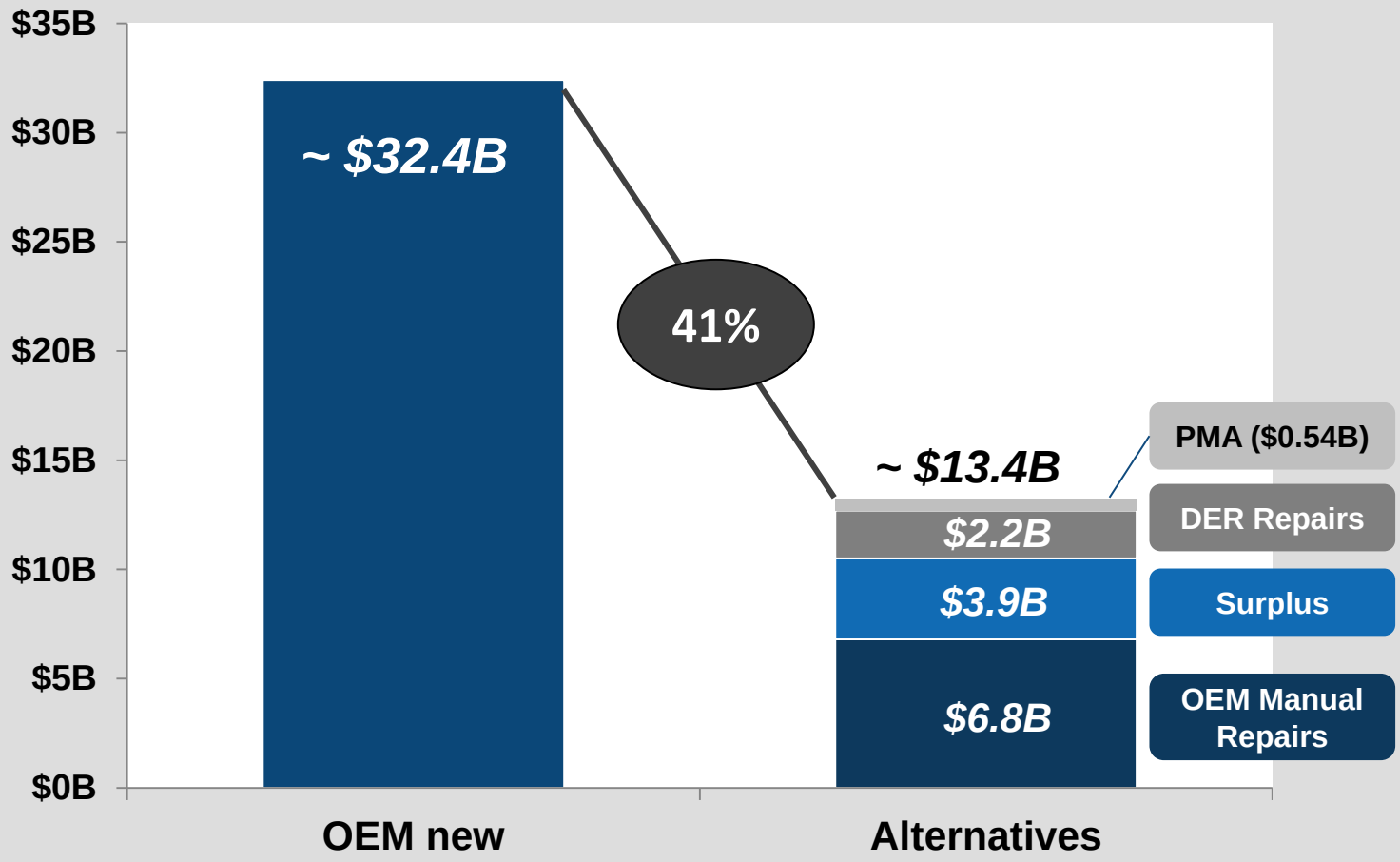
"…the OEM's increasingly tight grip on the aftermarket means Delta's spares costs double about every seven years."

"Without TechOps parting-out engines to bolster spares and coming up with other alternatives to OEM-supplied support, that increase could be even steeper…"

…"We're pretty good at sourcing outside the OEMs…and we're always working to develop those alternatives."

- Richard Anderson
CEO Delta Air Lines
Keynote Speech, MRO Americas
April 2013

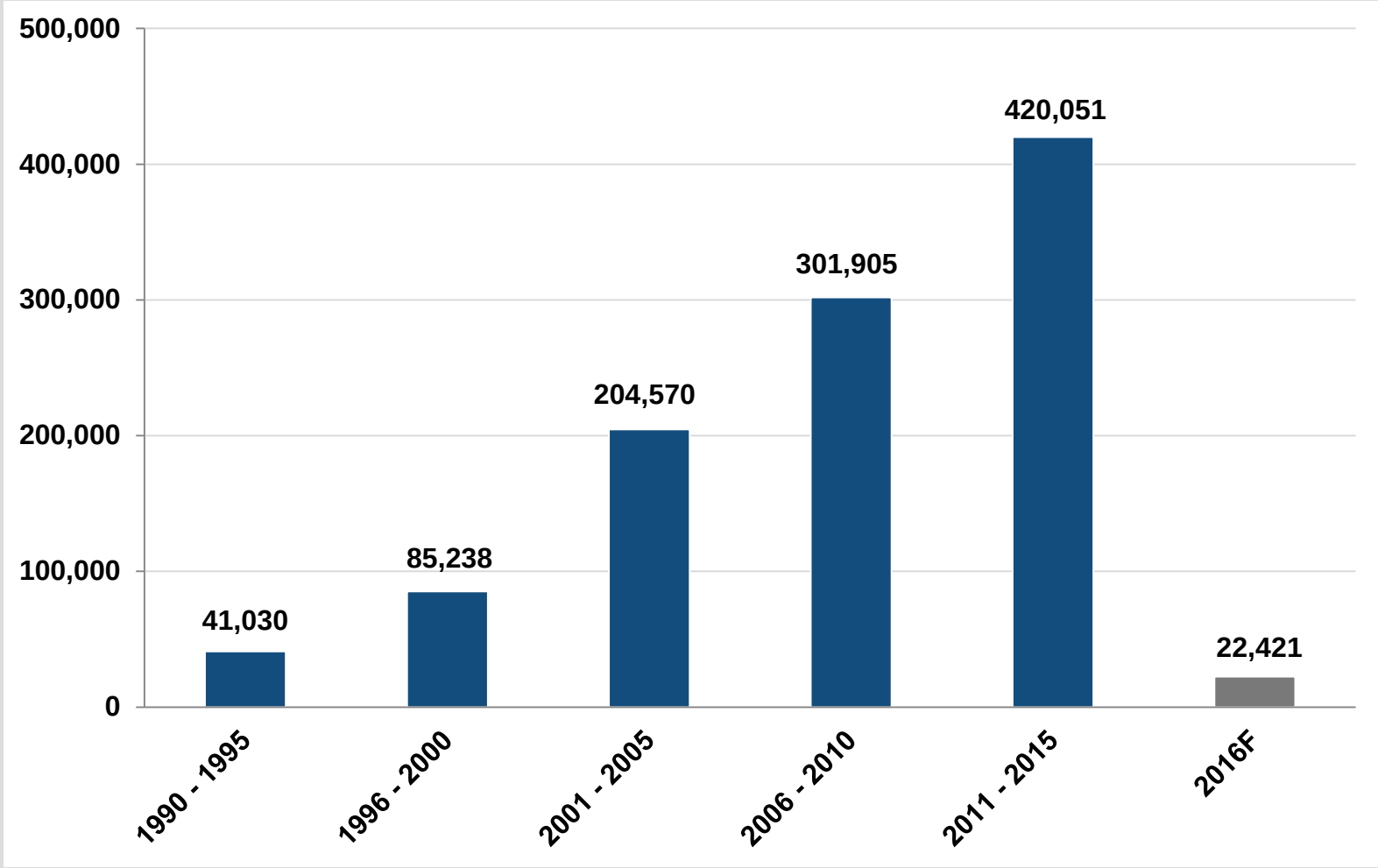
2015 OEM New Material Demand vs. Alternatives



Source: ICF analysis

The volume of PMA approvals has been steadily growing since 1990, with over about 440,000 new approvals granted since 2011

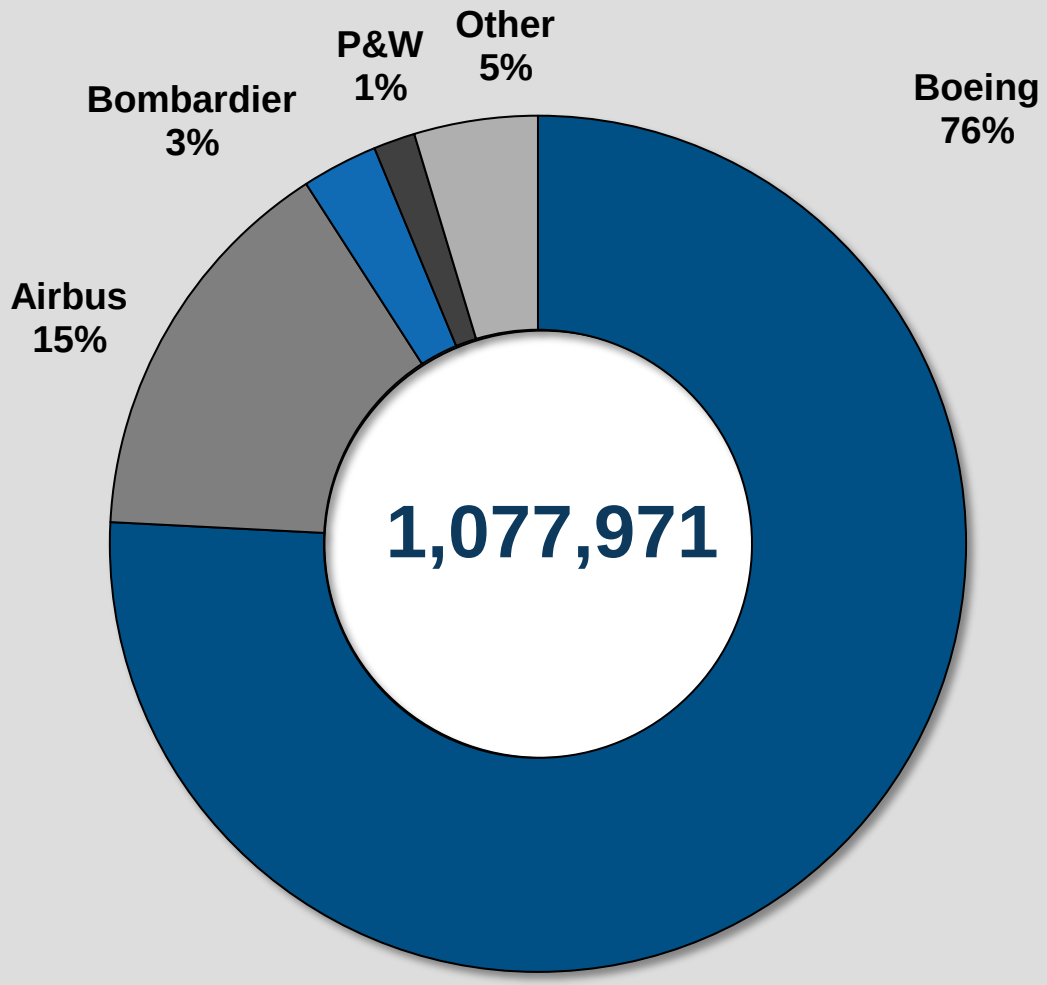
FAA Approved PMA Part Numbers, by Year Approved



Source: Federal Aviation Administration

There are nearly 1.1 million total PMA parts that are FAA approved, of which over 75% are for Boeing aircraft

FAA Approved PMA Part Numbers, by OEM



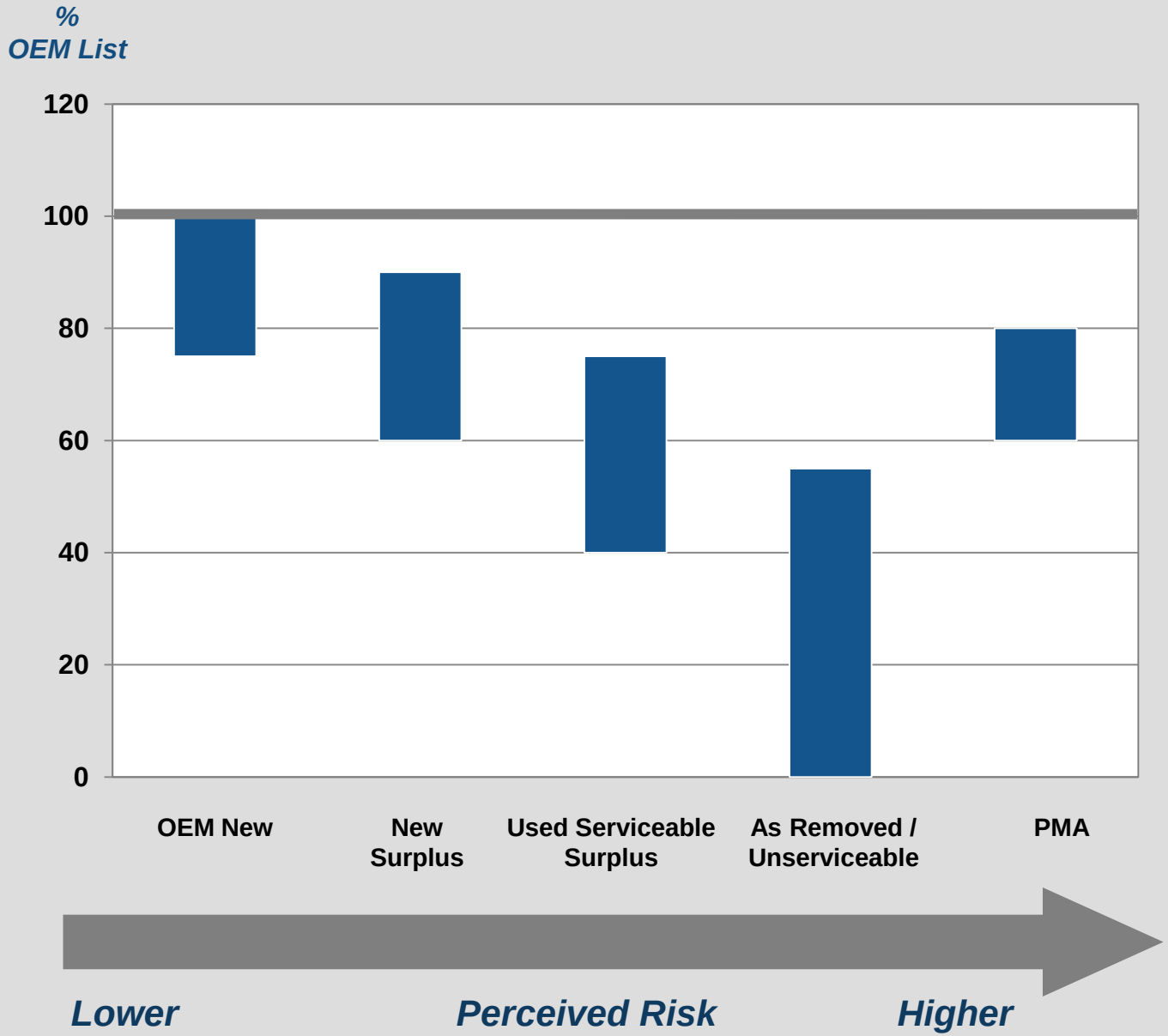
Source: Federal Aviation Administration

Surplus material usage has risen sharply over the past few years, driven by tangible cost savings and minimal perceived risk

"Surplus parts have increased the demand for component DER… because the unserviceable surplus parts must repaired. The biggest customer for DER is ourselves."

- Major PMA / DER Supplier

Typical Material Type Price Bands, By Part Condition



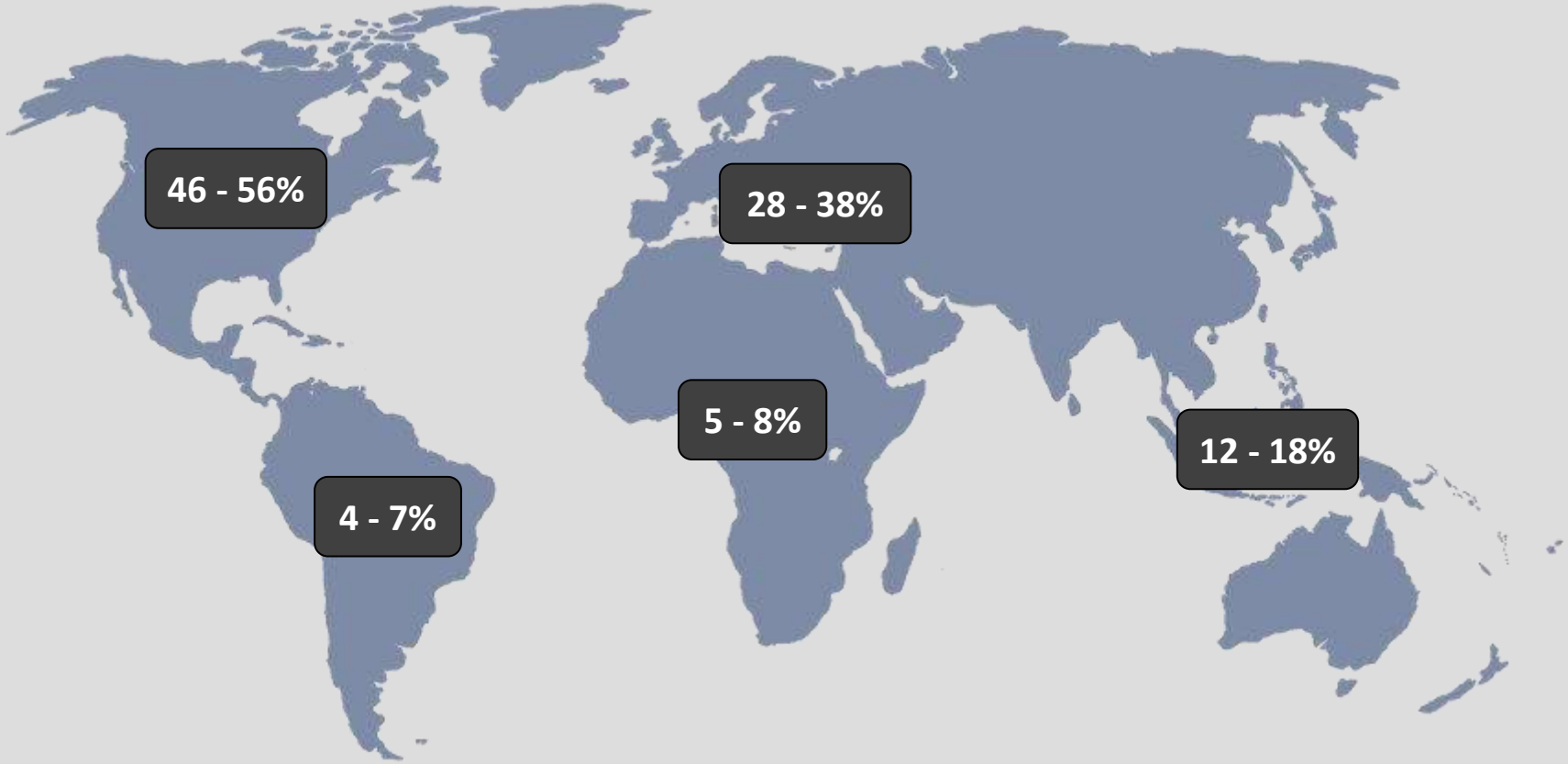
Source: ICF analysis

Virtually every major carrier leverages PMA parts as an OEM alternative

Numerous regional factors influence operator PMA consumption to include:

- Fleet age
- Mix of lease vs owned aircraft
- Technical capability & experience
- Airline procurement historical practices and culture

Estimated PMA Demand by Major Region



Source: ICF analysis

There are four key constraints to PMA/DER market growth

1. Lessor Restrictions
2. OEM Strategies
3. Availability of surplus parts
4. Operator's technical capability & capacity

Lessor Restrictions

Operator Technical Capability & Capacity

PMA & DER Material Demand

TRUEngine™ program

Rolls-Royce TotalCare®

OEM Strategies

Availability of Surplus Parts

Source: ICF analysis

In Summary…

- In order to control and reduce material spend, airlines must have a comprehensive OEM alternative strategy
- PMA parts, DER repairs, and surplus material are valuable material sourcing solutions that drive tangible cost savings and improve part availability
- Safety concerns with regards to PMA and DER repair usage have been proven meritless; yet clearly perceptions of risk remain
- As long as certain airlines continue to have restrictive PMA policies, Lessors will continue to include conservative language in their lease agreements
- Education is the only solution

THANK YOU!

For questions regarding this presentation, please contact:

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