



ICAO

UNITING AVIATION



# Composite Aircraft Recycling

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# Composite Aircraft Recycling

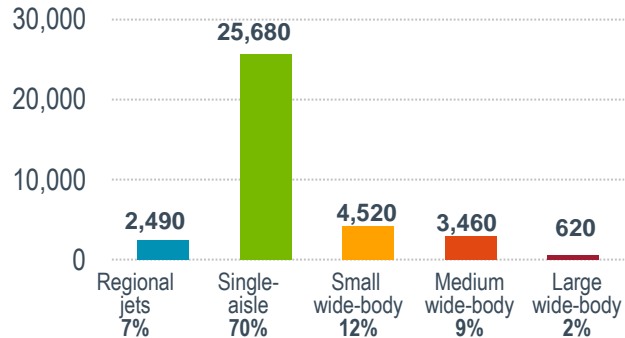
- The Coming Wave
- Why Recycle?
- The Technology Challenge
- Enabling Solutions Through Collaboration

# Boeing 20-year market forecast: Airlines will need nearly 36,800 new airplanes valued at \$5.2 trillion



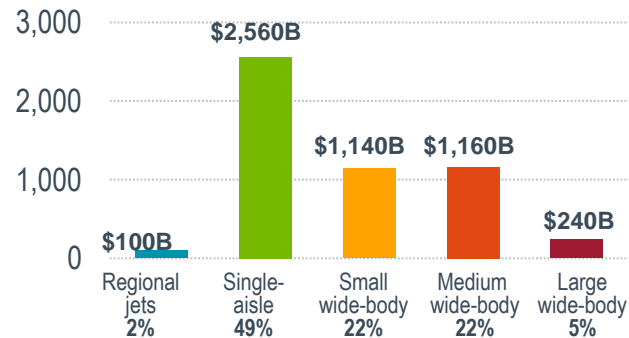
## Airplane deliveries: 36,770

2014 - 2033



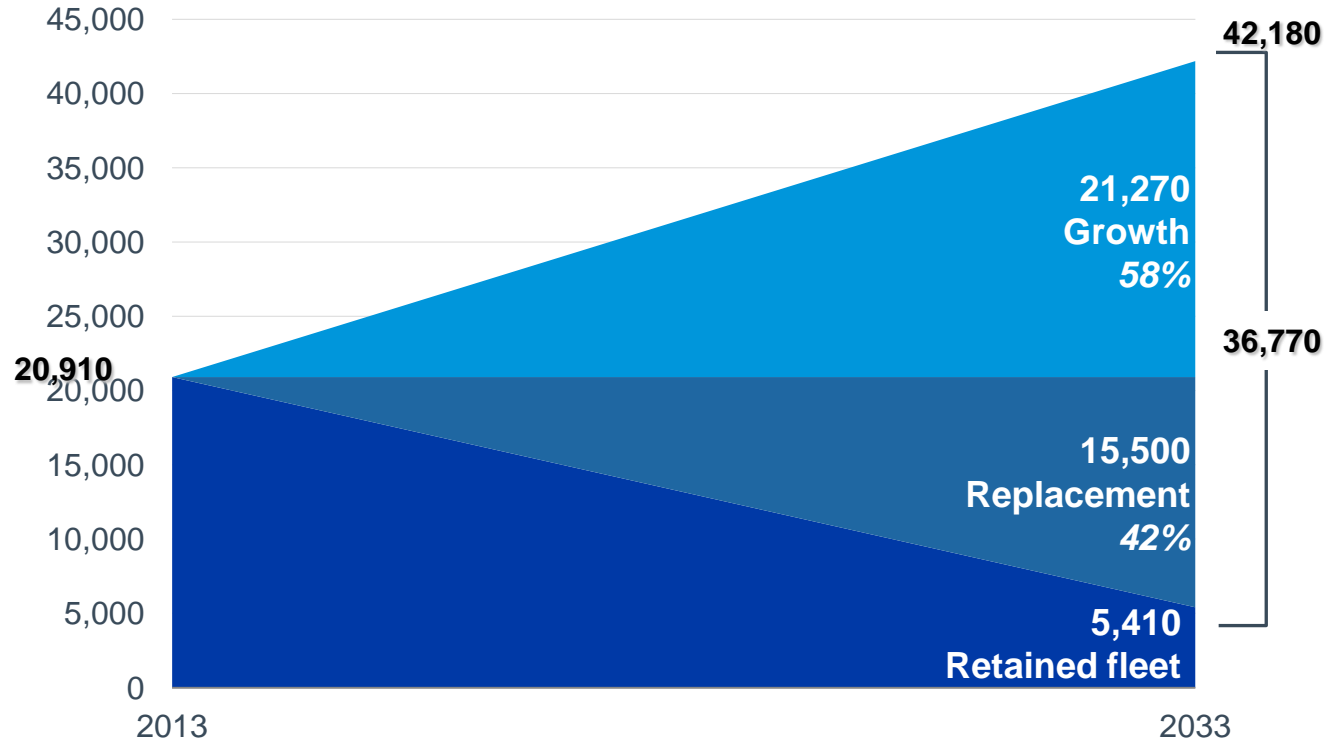
## Market value: \$5.2T

2014 - 2033



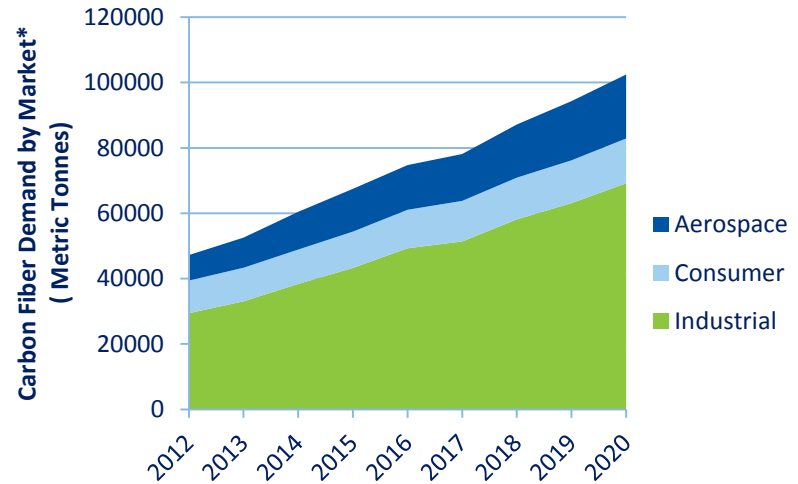
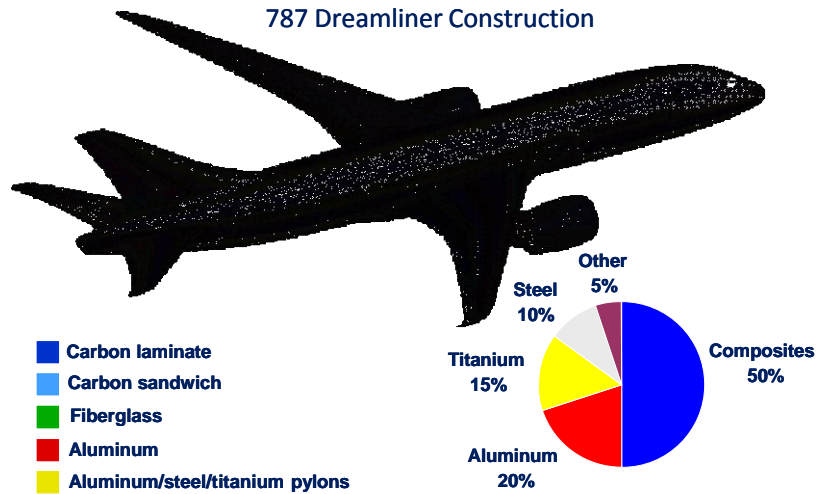
# Older, less efficient airplanes will be replaced with more efficient, newer generation airplanes

Units





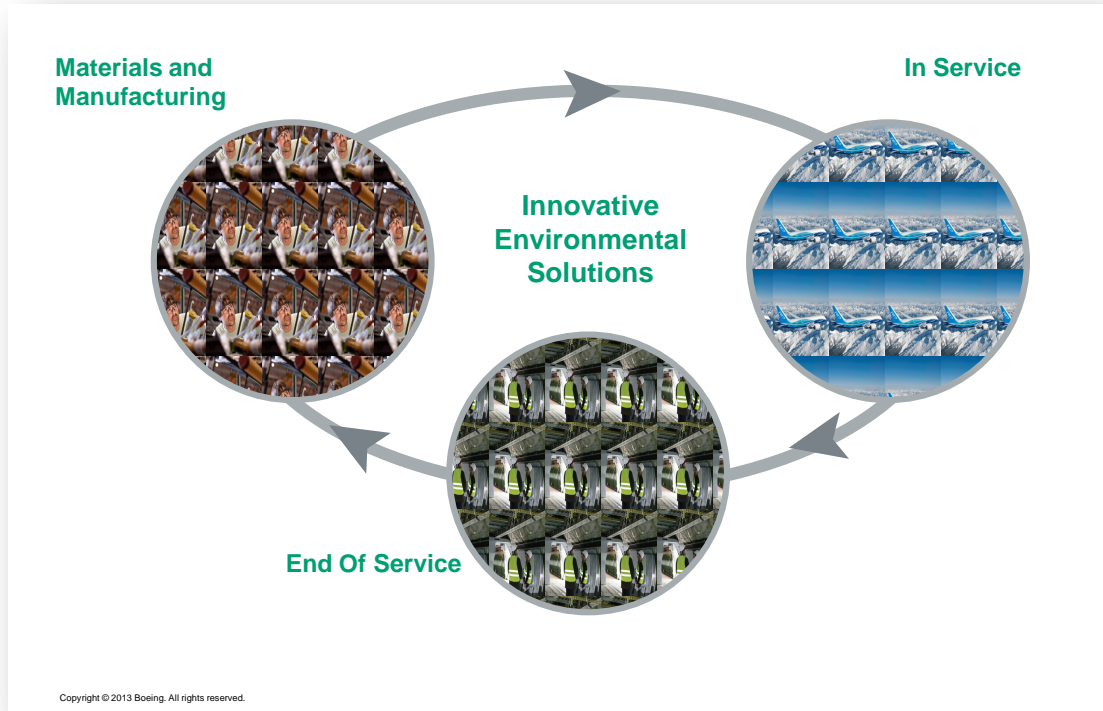
# Expanded use of composites to improve aviation's efficiency



\*Data from Composite Market Reports Presentation, Carbon Fiber 2012 Conference

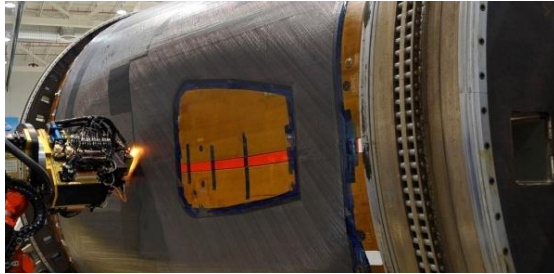


# Improving Environmental Performance Through the Airplane Lifecycle





## Increasing Recycling Throughout Lifecycle



### Recycled carbon fiber

- Exploring Interior and non-structural applications
- Global technology partnerships
- Goal is end-of-service solution



### Recycling metals

- Innovative program to recycle Titanium and aluminum from across supply chain
- Reducing energy consumption by using recycled content on products



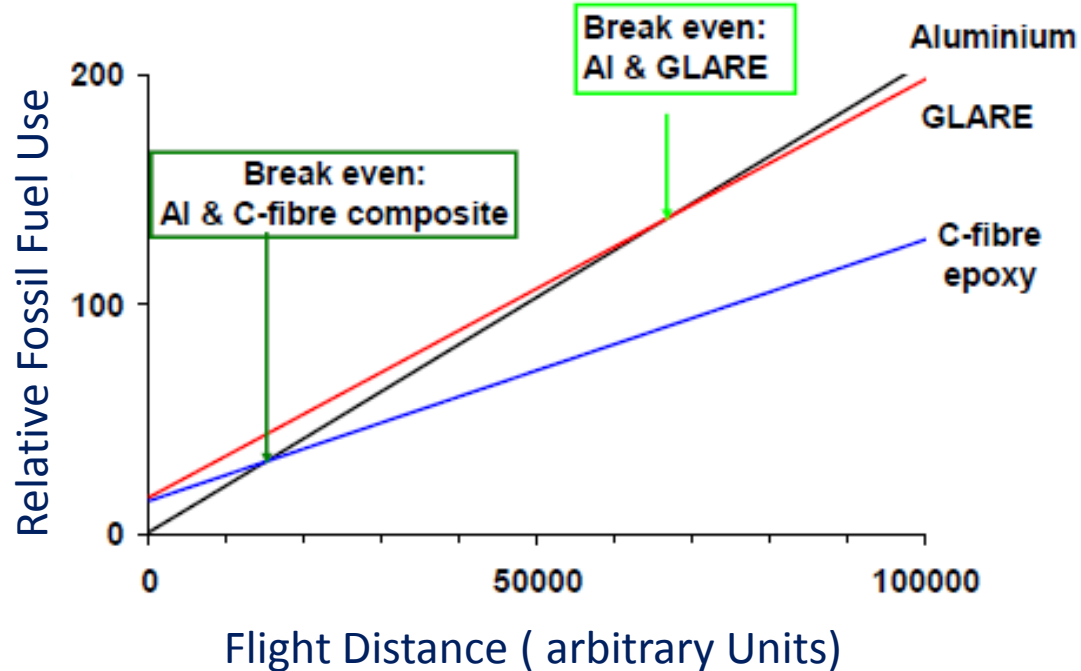
### Standards for aircraft recycling

- Founding member of Aircraft Fleet Recycling Association
- Elevate industry performance & increase commercial value for end-of-service



## Carbon fiber drives lifecycle efficiency

CFRP use in transport aircraft rapidly pays off in reduced energy consumption

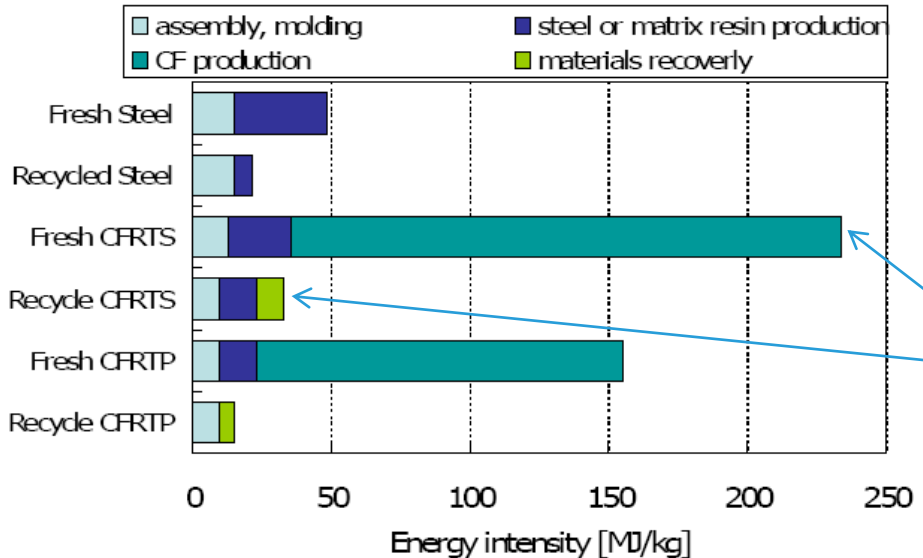


Source: University of Sheffield





# Recycling carbon fiber is more energy efficient than manufacturing new carbon fiber



Energy to recover carbon fiber is 1/10<sup>th</sup> that to make new fiber

T. Suzuki and J. Takahashi, Proceedings of 9th Japan International SAMPE Symposium, (2005-11), pp.14-19.



# Exploring processes for efficient recycling of Carbon Fiber

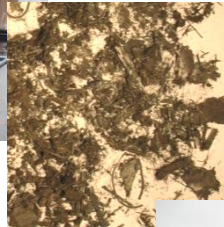
## Efficient size reduction and classification needed



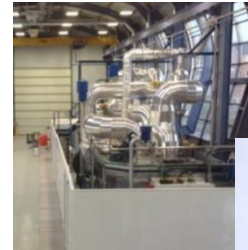
787 Test Barrel



Shredding  
Cured CFRP



As Shredded



Fiber Recovery



Recovered Fibers



F18  
Empennage



End of Service  
Contaminated Shred  
Challenge



After removal of fines



Milled CF



Compounds



Broadgoods

Value Added Materials



# Potential applications in aerospace and beyond

In Use

Exploration



Body Armor  
(Russell Athletic)



Kayak Paddle  
(Werner)



Eco Demonstrator Wing  
Access Doors (Boeing)



Aircraft Interior Components (Boeing)



Aircraft Seat Back  
(Boeing - AFRECAR)



Cryotank Prototype Part  
Tooling (Boeing NASA)



F1 Auto Parts  
(Boeing-Renault)



Automotive Structure  
(MIT-RCF)



Automotive Seating  
(Boeing - Ford-AFRECAR)



# Boeing collaborates to drive carbon fiber recyclability



• Processing Technologies, Application Exploration



• Loop Closures, End of Life Challenges



• Large Scale End of Service Trials, Process Commercialization



• Additive Manufacturing with Recycled CF



• Commercial Scale CF Recycling, Automotive Markets



• Explore Loop Closure Markets  
• 787 Eco Demonstrator Flight Hardware



• Develop Non- Aerospace Markets



• Explore Solar Powered Fiber Recovery with BR&T China and East China University



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