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

Units

- Retained fleet: 5,410
- Replacement: 15,500
- Growth: 21,270

2013: 20,910
2033: 42,180

Growth 58%
Replacement 42%
Retention 0%
Expanded use of composites to improve aviation’s efficiency

![787 Dreamliner Construction](image)

**787 Dreamliner Construction**

- Carbon laminate
- Carbon sandwich
- Fiberglass
- Aluminum
- Aluminum/steel/titanium pylons

**Composites**
- Carbon laminate: 50%
- Carbon sandwich: 50%
- Fiberglass: 10%
- Aluminum: 20%
- Titanium: 15%
- Steel: 5%
- Other: 5%

**Carbon Fiber Demand by Market**

*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

Flight Distance (arb. Units)

Source: University of Sheffield
Recycling carbon fiber is more energy efficient than manufacturing new carbon fiber.

Energy to recover carbon fiber is 1/10\textsuperscript{th} that to make new fiber.

Exploring processes for efficient recycling of Carbon Fiber

Efficient size reduction and classification needed

787 Test Barrel

Shredding Cured CFRP

End of Service Contaminated Shred Challenge

As Shredded

After removal of fines

Fiber Recovery

F18 Empennage

Recovered Fibers

Milled CF

Compounds

Broadgoods

Value Added Materials
Potential applications in aerospace and beyond

In Use

Body Armor (Russell Athletic)
Kayak Paddle (Werner)
Eco Demonstrator Wing Access Doors (Boeing)
Aircraft Interior Components (Boeing)

Exploration

Cryotank Prototype Part Tooling (Boeing NASA)
F1 Auto Parts (Boeing-Renault)
Automotive Structure (MIT-RCF)
Automotive Seating (Boeing – Ford-AFRECAR)
Aircraft Seat Back (Boeing - 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