

AIRCRAFT FLEET RECYCLING ASSOCIATION

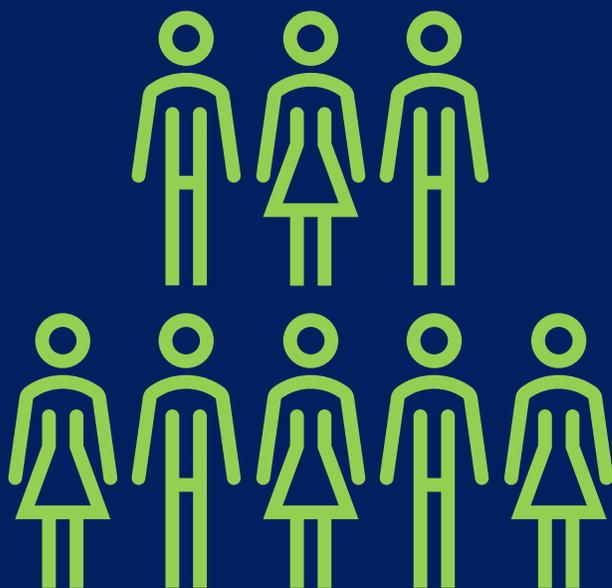
AFRA R&D workshop session
2024 annual meeting



AGENDA

- Committee and mission statement
- R&D needs, project formation and execution
- Review 2023 787 material acquisition and status
- Review of Shredding and Sorting Tech – Pete George
- Fluidized bed CFRP recycling update – Iain Bomphray and Jill Liu, NMIS
- Thermoplastic recycling – Hans Luinge, Spiral RTC
- Workshop Brainstorm sessions for project formation
 - Interiors Recycling
 - CFRP Structure size reduction and sorting
 - Materials Location and ID
- Reconvene for group report outs





R&D Committee Members

Pete George	Boeing Commercial Airplanes; (Chairperson)
Brent Webb	CAVU Aerospace, Inc. (AFRA President)
Bryan Hancock	CAVU Aerospace, Inc.
Christin Datz	Boeing Commercial Airplanes
Daniel Hofsaess	Roth International GmbH
David Murphy	ComAv Asset Management
Derk-Jan van Heerden	AETHOS
Eric Langlois	CAVU Aerospace Inc.
Kai Wicke	EREA
Karlene McCauley	Boeing Commercial Airplanes
Kevin Flynn	VAS Aero Services LLC
Ligeia Paletti	EREA
Michael Roth	Roth International GmbH
Ron Haber	Aerocycle
Simon Upton	Air Salvage International
Steffen Opitz	DLR/EREA
Torsten Müller	Fraunhofer Institute for Chemical Technology
Michele Dickstein	ASA
Sam O'Connor	AFRA
Tricia McFadden	AFRA
Karin Webb	AFRA

AFRA R&D Committee Mission and 2024 Goals

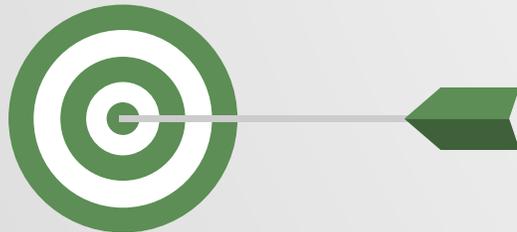
Identify and advance technologies for maximizing the environmentally responsible realization of a circular economy

Goal 1



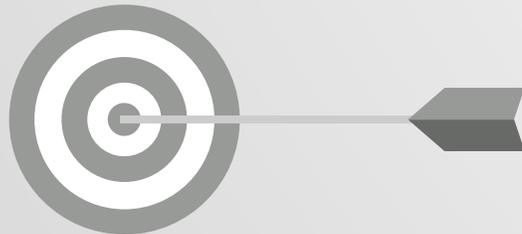
Identify, Review and Support 1-2 AFRA member proposed collaborative R&D Activities

Goal 2



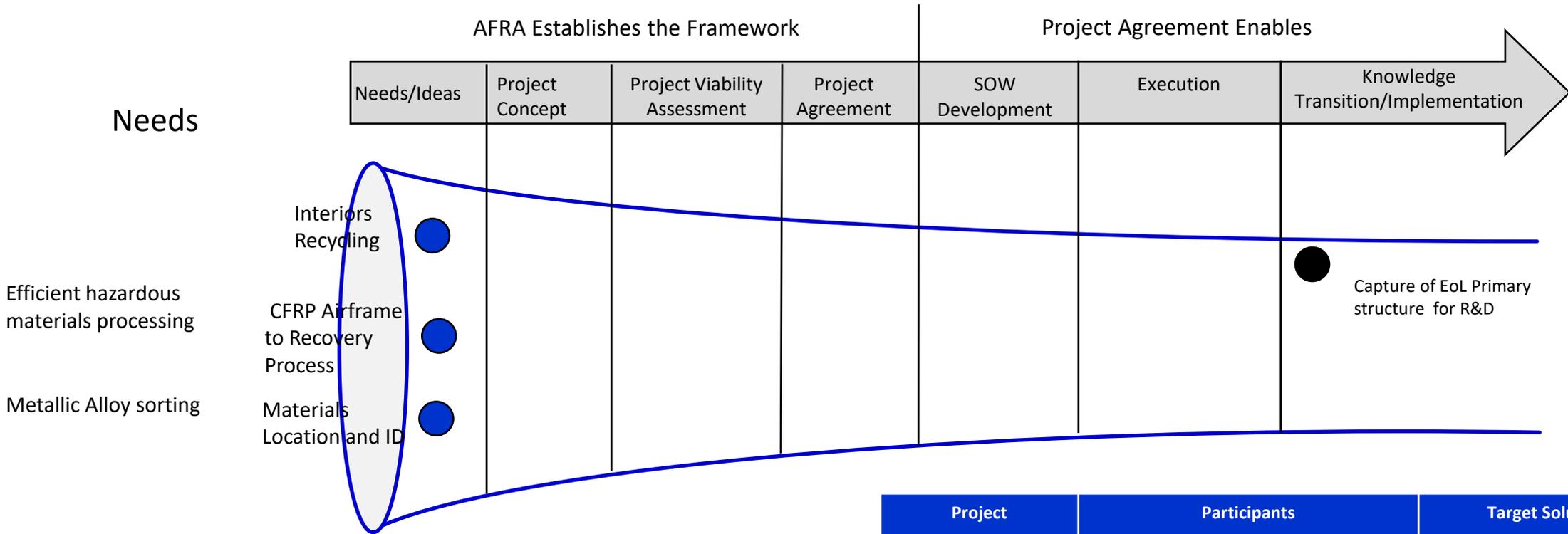
Arrange for trials using existing shredding and sorting technology with carbon fiber composite primary structure

Goal 3



Establish connections with allied industry organizations

R&D project identification and execution



Needs

Efficient hazardous materials processing

Metallic Alloy sorting

Interiors Recycling

CFRP Airframe to Recovery Process

Materials Location and ID

Capture of EoL Primary structure for R&D

- Concept
- In work
- Completed
- Closed or lower priority

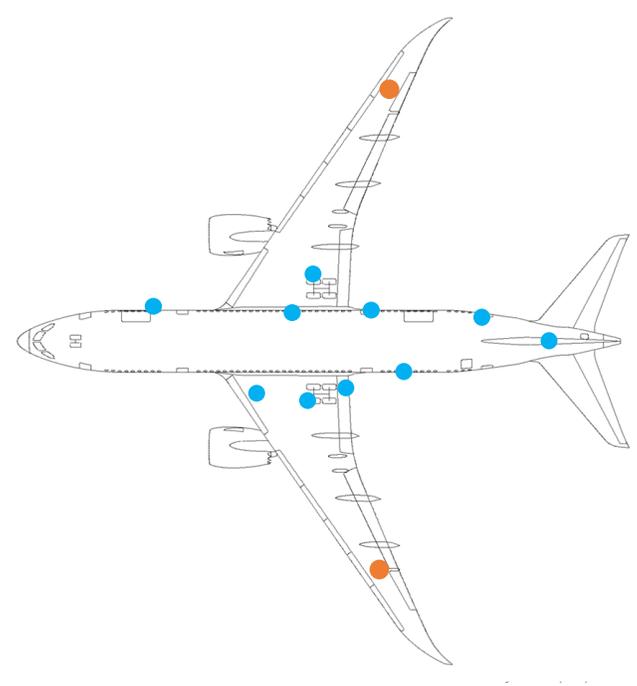
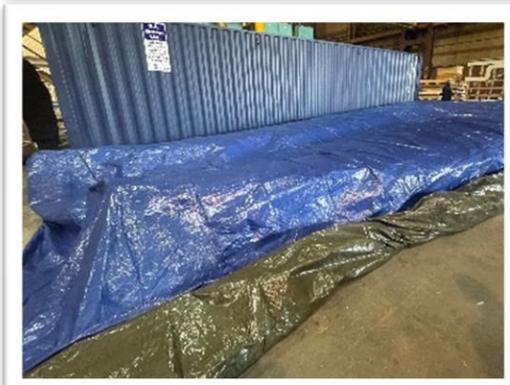
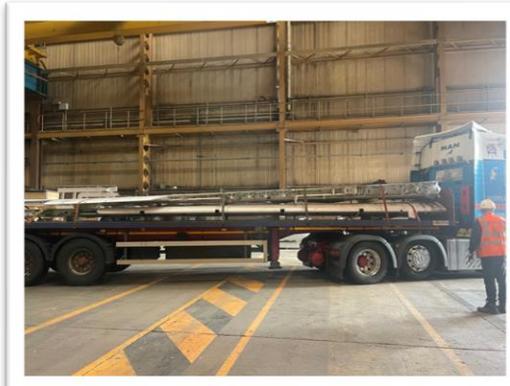
Project	Participants	Target Solution
Capture of EoL Primary structure for R&D	Boeing, Ecube, U of S, TBD	Industry Relevant Material Source for R&D
?		
?		
?		

787 CFRP Airframe Harvested Sections



- First Shipment: 2 Flatbed Trucks Carrying Total of 4 38ft Section Wingtips
- Storage at University of Strathclyde

- Second Shipment: 2 Containers Carrying total of 10 Articles
- Storage at Ecube in Whales



ROM estimates of location to visually depict article location coverage only

1. Wing Root RH
2. Wing Section I/B
3. Wing Section I/B
4. Fuselage to aft bulkhead
5. Aft fuselage cabin
6. Aft fuselage cabin
7. FWD fuselage cabin
8. Vertical Fin
9. Wing Section
10. Wing Section





Mobile Asset
(Hammel D.E.)
Portable
Configurable
10s of Tons/Hr

<https://recyclinginside.com/>





Fixed Asset
(Albuquerque Metals Recycling)
High throughput
Broader cost amortization
100s+ Tons/Hr

SIZE REDUCTION PROCESSES

- Hammermill
- Dual shaft shredder
- Single shaft shredder
- Eccentric disc
- Ring Flaker (used to make flakes for Oriented Strand Board)
- Dual Disc Refiner (Fibrillate wood for MDF)



SIZE SORTING PROCESSES

- Manual
- Drum screen
- Vibration/shake sieve/screen
- 3D shape (Optical)



COMPOSITION SORTING PROCESSES

- Magnetic – Ferrous/non-ferrous
- Eddy Current – Induced Conductivity
- Dense Media Separation (DMS)
- X-ray transmission (XRT) – Density Variation
- X-ray fluorescence technology (XRF)
- Color (Optical)
- 3D shape (Optical)



CHALLENGES FOR AIRCRAFT WASTE EVALUATIONS

- Potential that by removing all metallics from CFRP heavy inputs remaining material may be close to purity for fiber recovery processes
- Potential to leverage existing efficiencies, infrastructure
- Accumulate and process 777, A3XX, 787 CFRP for critical mass
- Identify technology gaps
- Consider waste to energy and low-cost fillers as interim to fiber recovery



AGENDA

- **Fluidized bed CFRP recycling update – Iain Bomphray and Jill Liu, NMIS**
- **Thermoplastic recycling – Hans Luinge, Spiral RTC**



WORKSHOP GROUP TOPICS

Split into three groups:

- Interiors Recycling
 - Assess recycling path potentials
- Materials Location and Identification
- Efficient means of useful dismantler/recycler identificationCFRP Airframe to Recovery Process
 - Efficient means of deconstruction, size reduction and sorting for second use material recovery process inputs
- Brainstorm:
 - NEEDS/PRIORITIZATION
 - DELIVERABLES
 - RESOURCES
 - CHALLENGES
- Report out