



# Aircraft Metals Recycling - Process, Challenges and Opportunities

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# AiMeRe - Objectives

- Closer look on a/c recycling industry and challenges faced by recyclers
- Assessment of current dismantling and recycling process, collection of LCA data and to propose improvements

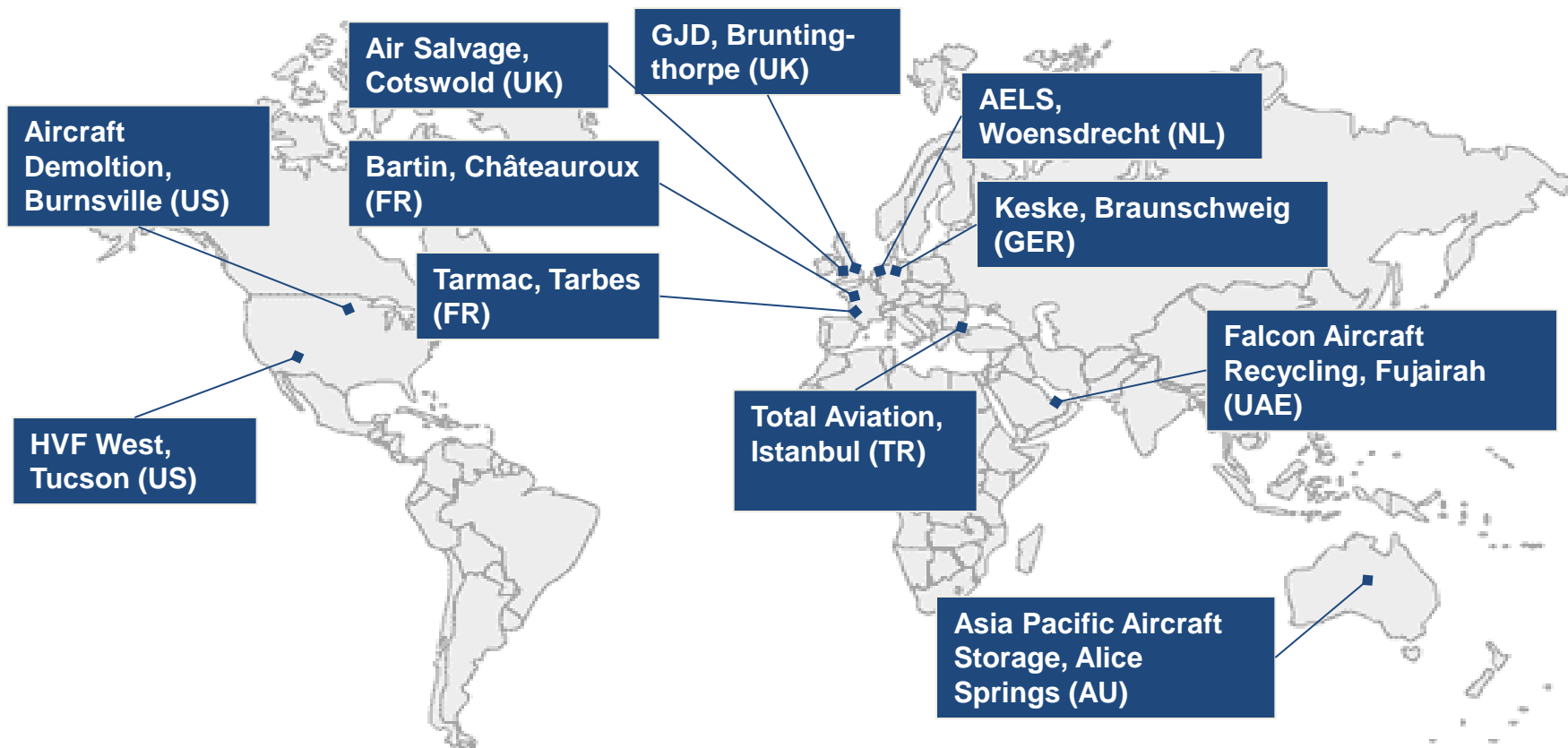




# End of life of an aircraft

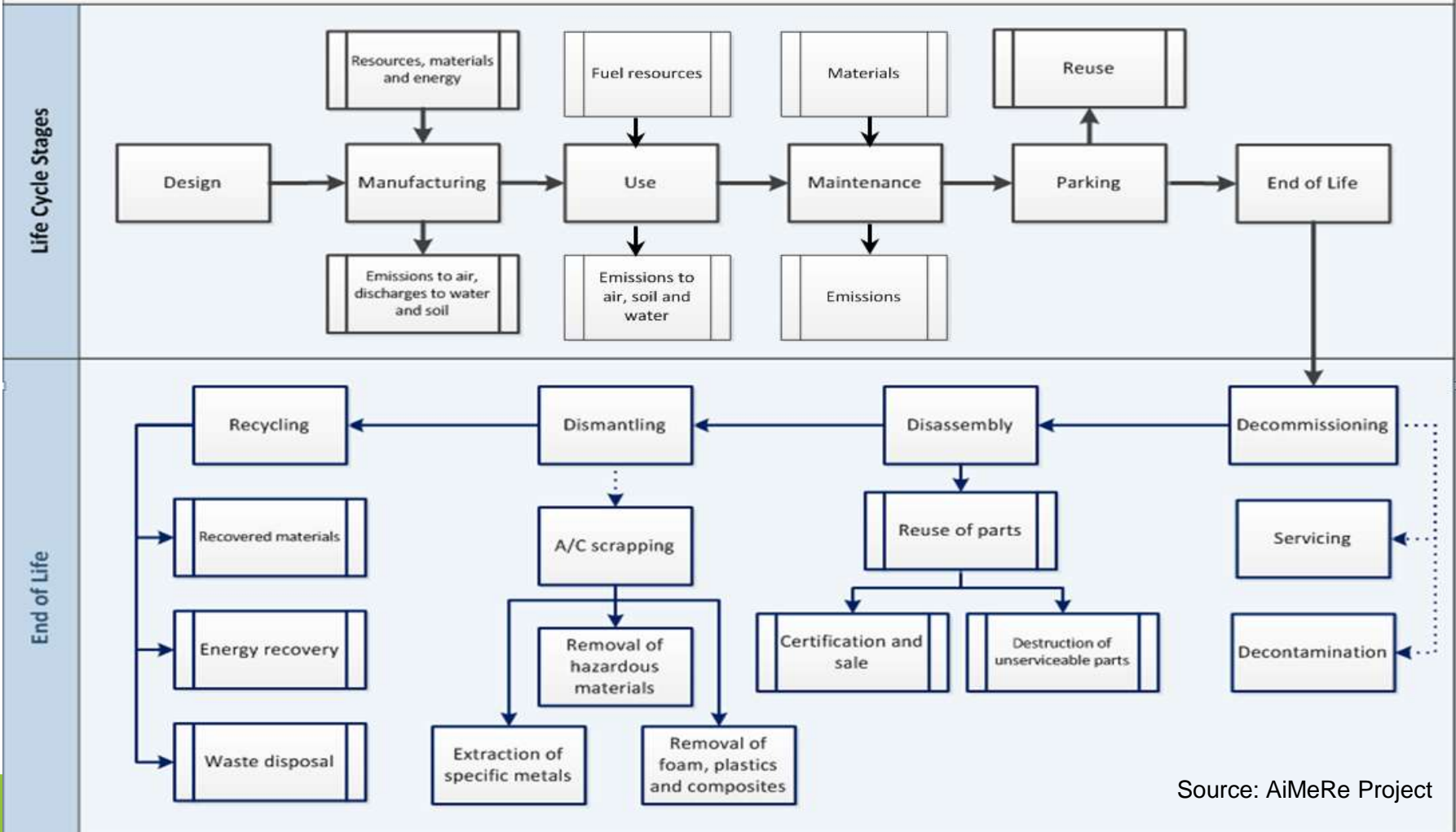
- From 2012 till 2032 estimated 35.000 aircraft will go into service and approx. 14.000 out of service
  - ➔ Per year up to 700 aircrafts are going to be put out of service
- Average lifetime:
  - passenger aircraft 25 years;
  - for cargo aircraft 30-40 years
- Actual solutions:
  - Disposal in desert graveyard
  - Rough dismantling
    - Engines (up to 80% of the total price)
    - Other spare parts e. g. landing gears, avionic parts
    - Valuable metals (e.g. Au, Pt, Cu, Al, Ti, etc. )

# The business of aircraft recycling



# State of the art in aircraft recycling

## Aircraft Life Cycle



Source: AiMeRe Project



# State of the art in aircraft recycling



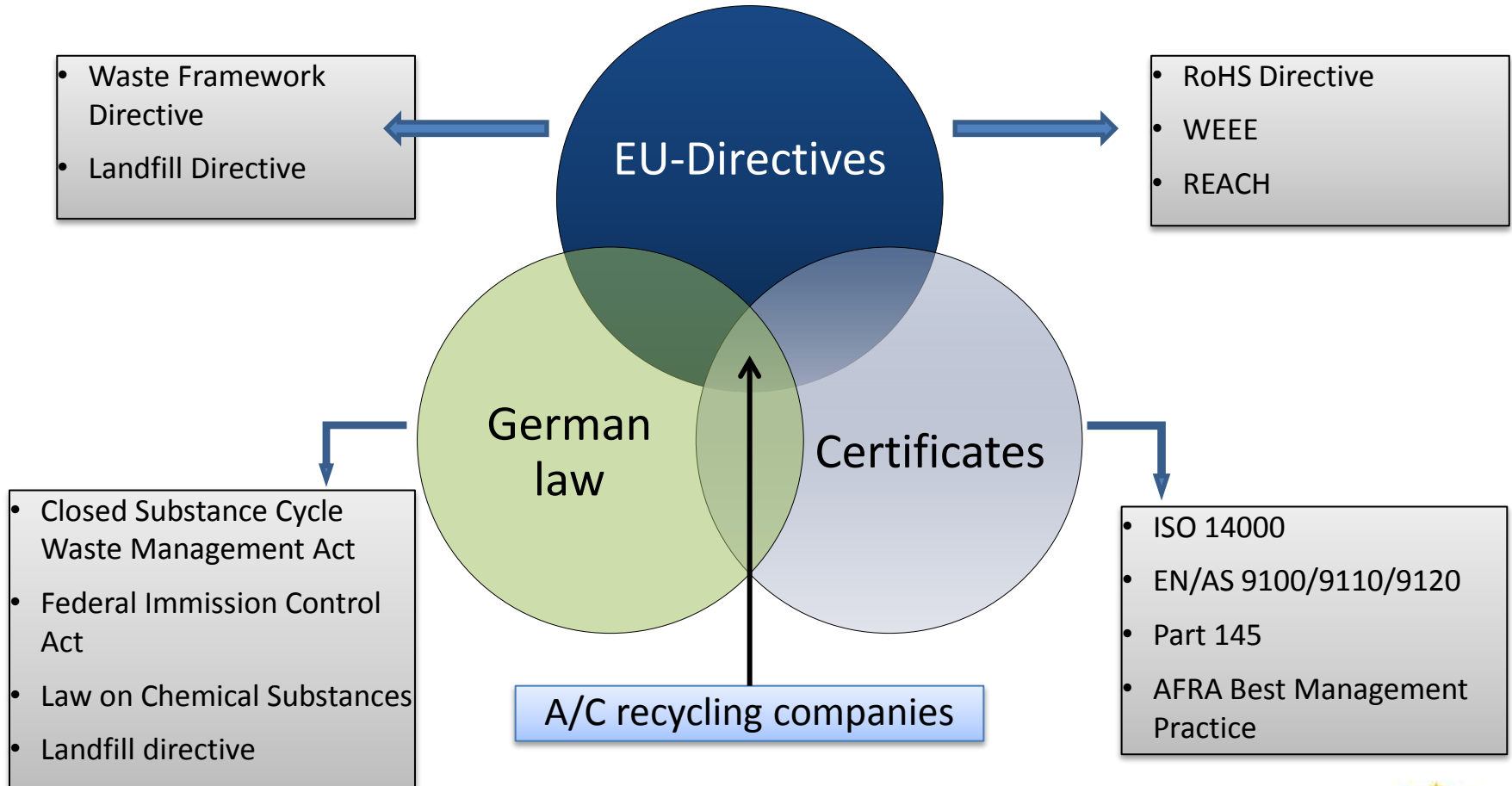
Source: AiMeRe Project

# Metal recycling – traditional ways

- The *Aircraft Fleet Recycling Association (AFRA)* was founded in 2005 to enhance aircraft recycling and define best management practice for aircraft recycling companies to reduce negative impacts caused by recycling activities.
- The recycling rate of (old) aircrafts by „shredding & melting“ could be up to 80 %
- Metals and alloys can be reused to produce amongst others engine blocks for cars, bicycle frames, cans or furniture
- Constraints: Purity of alloys (identification and separation from other alloys and materials like polymers, composites, coatings)

# Challenges in aircraft recycling

No specific regulation for aircraft recycling existent





# Challenges in aircraft recycling



- Removal of hazardous elements: asbestos, glass fiber insulation, Beryllium, liquids, etc.
- Recycling rate dependent from material market value
- Mainly valuable metals (super alloys, Titanium, Gold, Rhenium, Platinum are recycled,
- Polymers, composites, ceramics etc. are incinerated or landfilled

Source: AiMeRe Project

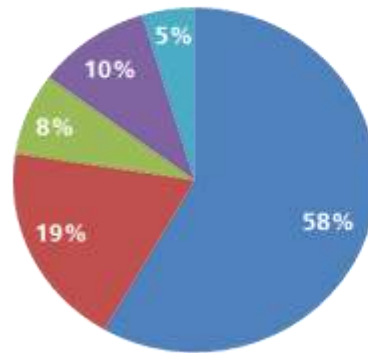
# Challenges in aircraft recycling

Aluminium alloys		Stainless steel	Magnesium alloys	Copper alloys	Polymers
AI 2024 T3 AL-ALY, A356 CAST	AI 7075 - O AI 7075 - T62	30NCD16 Z15CNT17-03	MG-ALY,ZE41A	Cu19ZnAl6 CuBe1.9	Epoxy Polyetherimid (PEI)
AL- ALY,7475	AI 7075 - W	Z2CN18-10	<b>Titan alloys</b>	CuNi3Si	Phenolics
Alodine 1200	AI, 5052	X1C2NiMoAlTi12-9-2 (Marval X12)	Ti-6Al-4V	Beryllium Copper C17200	Polyphenylensulfid (PPS)
AlI2024-T3 (AU4G1/T3)	AI 5056	Z8CND17-04	T40		Polymethylmethacrylat (PMMA)
AI 2024	AI 7175	STL-ALY,4130	TA3V2.5		
AI 2219	AI AS7G0.6	STL-ALY,4140	TA6V		<b>Fibers</b>
AI 5086	AI EN AW 5083	STL-ALY,4340			Carbon
AI 6061	AI EN AW 5086 H111	CRES	<b>Nickel alloys</b>		Glass
AI 7010	Aluminum Bronze C63000	CRES 17-4PH AMS5604	Inconel		Aramid
AI 7040	Aluminum Lithium	CRES302	Inconel x750		
AI 7050		inox	Inconel 625		
AI 7075		17/4 PH	Inconel 718		

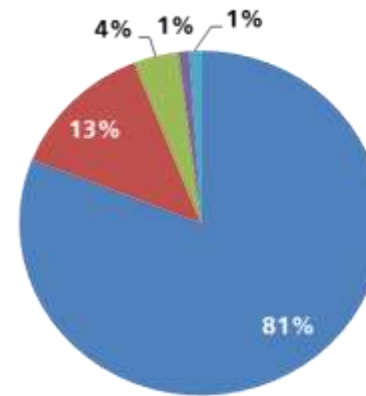
# Challenges in aircraft recycling

Old generation

Airbus A330-200



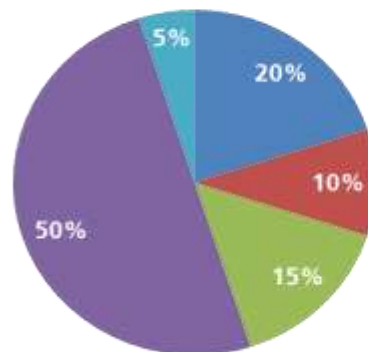
Boeing 747



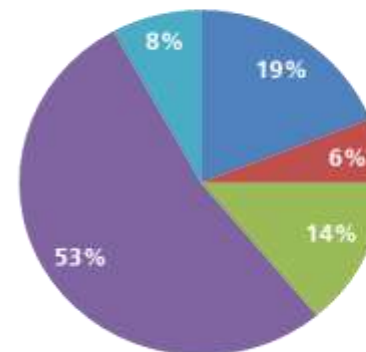
- Aluminum
- Steel
- Titanium
- Composites
- Other materials (e.g. ceramics)

New generation

Boeing 787



Airbus A350



# Challenges in aircraft recycling

- Challenges in specific material recycling processes:
  - The more composites inside, the more material is incinerated or landfilled, due to low market value and a lack of application for recycled materials
- In some are recycling costs are higher than costs for landfilling (70-120€/t)
- No defined recycling technologies and structured logistic for low value aviation materials
- Even recyclable materials (e. g. PU, PC) are landfilled
- **↑**Number of materials in a mix = **↑**Separation costs = **↓**Recycling quality/rate

# Re-use of aircraft materials in other products/applications

- High value spare parts
- Customer cuts are very common, use of aircraft parts e.g. for decoration, furniture, ...



Source: both [www.aero-1946.com](http://www.aero-1946.com)



Source: <http://recyclenation.com>







# Future recycling challenges

- Logistic for End of Life materials needs to be developed/improved e.g. by increase of material volumes transported/treated by collection from all life phases
- Legal framework for the treatment shall be harmonized all over Europe
  - No landfilling of recyclable materials
  - No landfilling of organic materials
- Applications of recycling materials needed
  - Supported by implementing design for recycling in aircraft design
  - Cooperation with other industries: automotive and chemical industry
- Promotion of best recycling practice should be pushed
- Recycling processes needed for new materials e.g. CMC
- Higher percentage of reworking to close the loop

# Save the date

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AND SAVE THE DATE



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# Thank you for your attention

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