NATIONAL COMPOSITES CENTRE

Key factors affecting recycling and circularity: “What should we do” VS “What can we do”?

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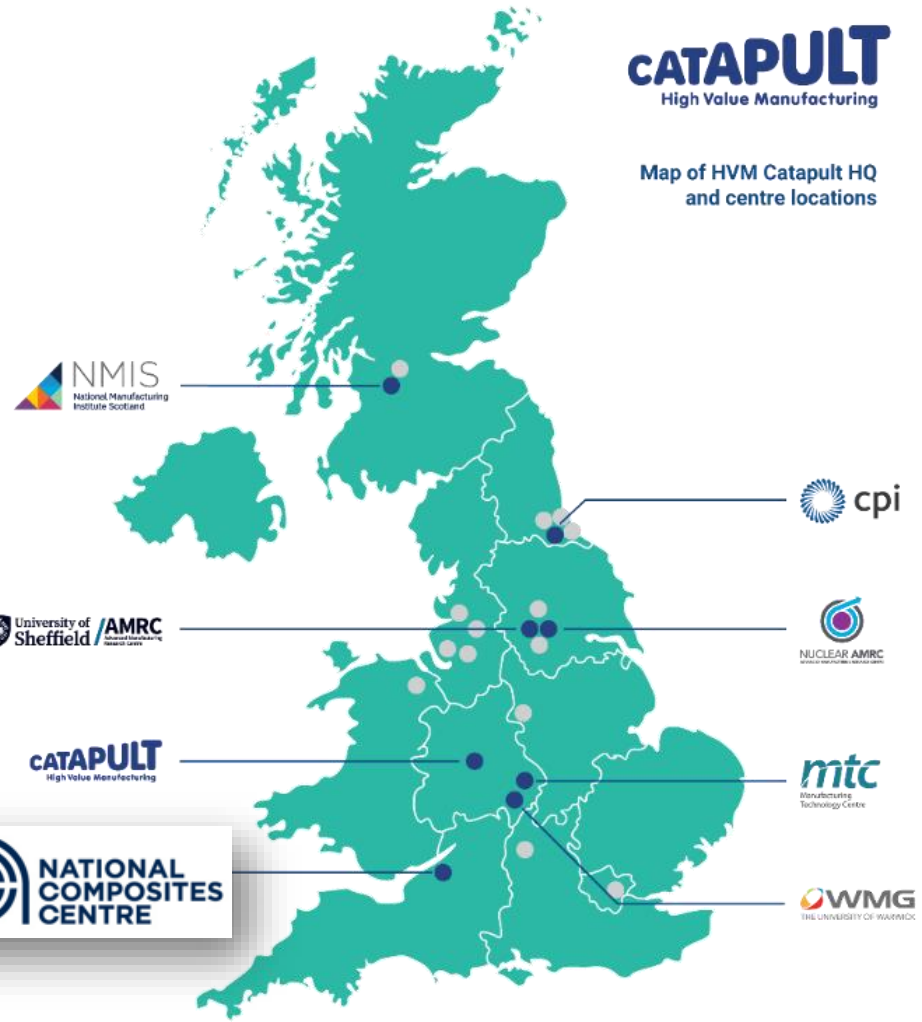
CATAPULT High Value Manufacturing

National Composite Centre

Established by **Innovate UK** in 2011

One of seven centres of industrial innovation across 25 locations
working together on the future of manufacturing in the UK.

Over 2,500 manufacturing specialists and £683m+ of state-of-the-art capability



Largest advanced manufacturing capability in Europe

We've worked with more than
25,000
companies

10,000+
projects

3,500+
staff

Delivering industrial transformation

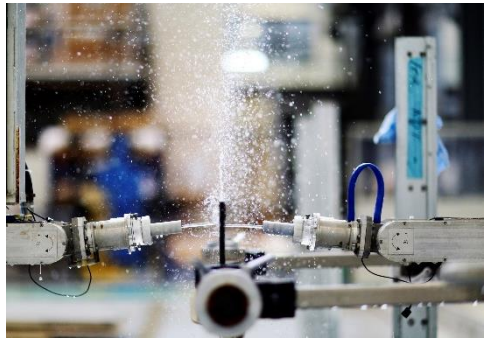
Addressing the three key elements in industrial transformation:

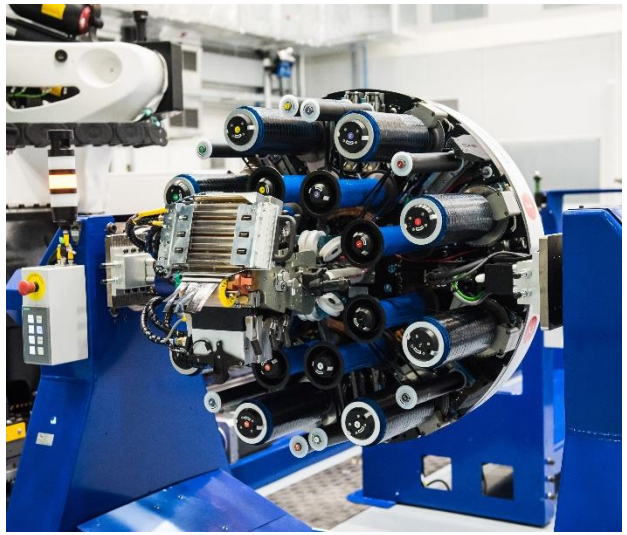
Solving **technology** problems

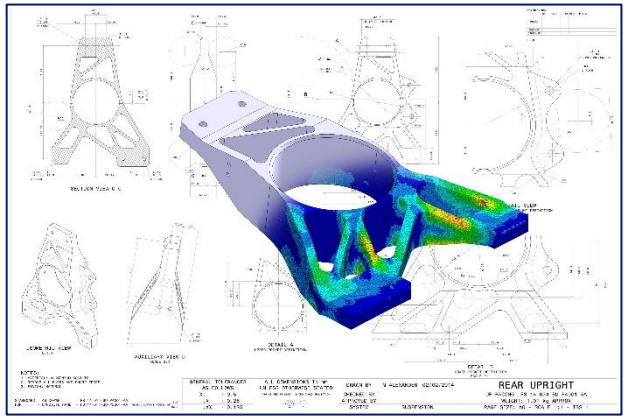
Providing future **skills**

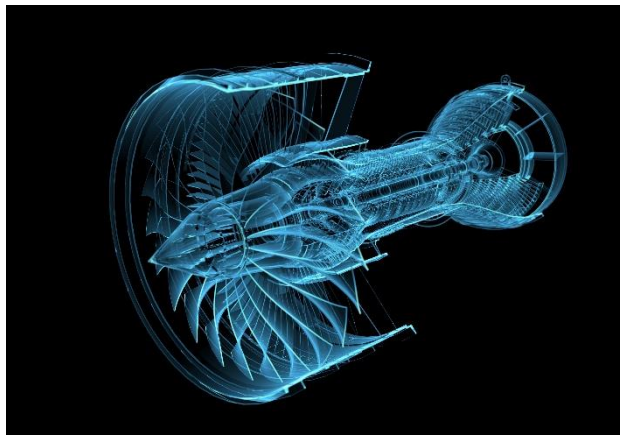
Developing **supply chains**

National Composite Centre





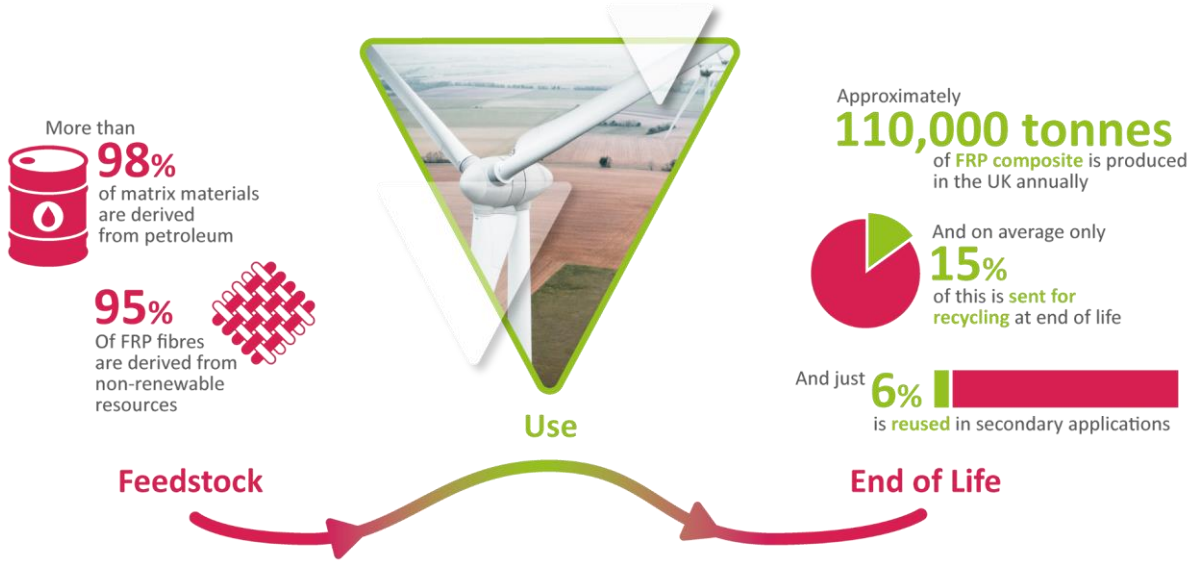




Sustainability challenge for Composite Materials

Composites are key materials to enabling Net Zero transformational technologies and delivering step changes in product and system level performances

- **Light-weighting** to **accelerate electric mobility**
- **Storage and distribution** technology to **enable hydrogen**
- **Performance step-change** to **scale wind energy**
- **Zero emission aircraft** to achieve **'jet zero'**
- **Energy efficient infrastructure** and **buildings**
- **Advanced multifunctional structures** for **defence**
- **High temperature, lightweight** materials to **unlock nuclear**
- **Accelerate growth** in new frontiers such as **space**



It is no longer acceptable to only focus on in-use benefits of composites

Questions we are trying to answer

What is the demand for Composite Materials?

- Wind turbines
- Hydrogen
- Transportation

What does UK composite waste look like – now and future?

- Decomissioning wind over next 30 years

What is the environmental impact of proposed solutions?

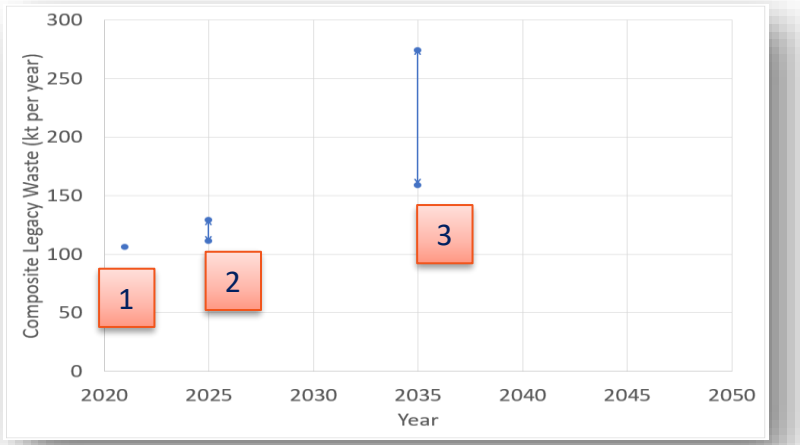
- Mix of materials, currently landfilled

→ **Is there a problem?**

→ **What can we do VS what should we do?**

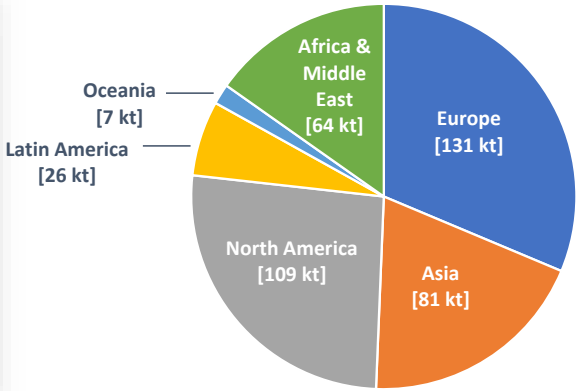
Retaining Value of Recycled End-of-Life CFRP Composites

Projected UK Total Composite Waste

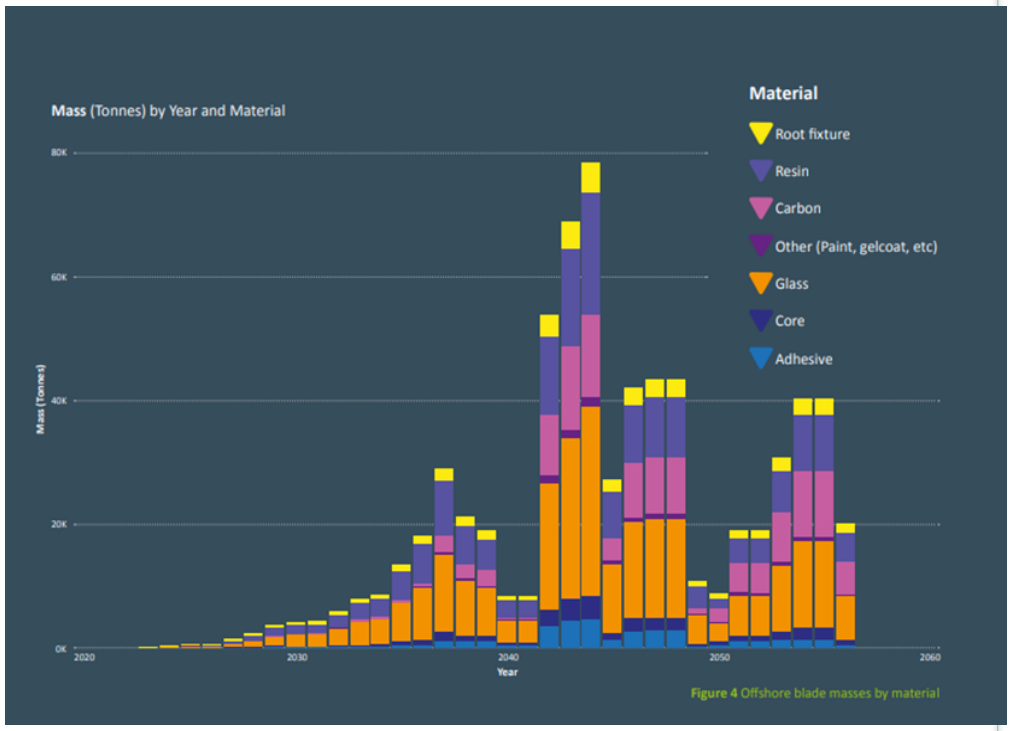


1. (2022~2030) includes legacy waste for example Wind Turbine Blades
2. (from ~2030 to ~2050) includes legacy waste and some new growth
3. (beyond ~2050) current components will reach end of life

2050 Cumulative Aerospace CFRP waste



Projected UK Offshore Blade waste



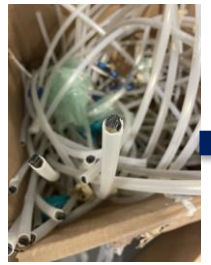
For Aero CFRP alone – Significant challenges in Europe and North America

For UK wind, GFRP dominates today… volume increases dramatically post 2030

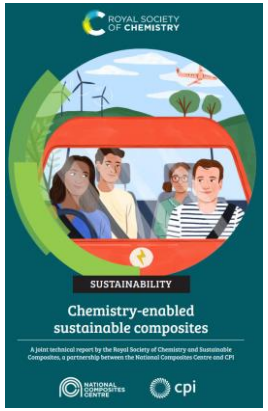
What Can we do?

ReDisCoveR: Network

4 Year Multi-Sectoral Programme on Circularity



Consumable Waste into viable product concepts



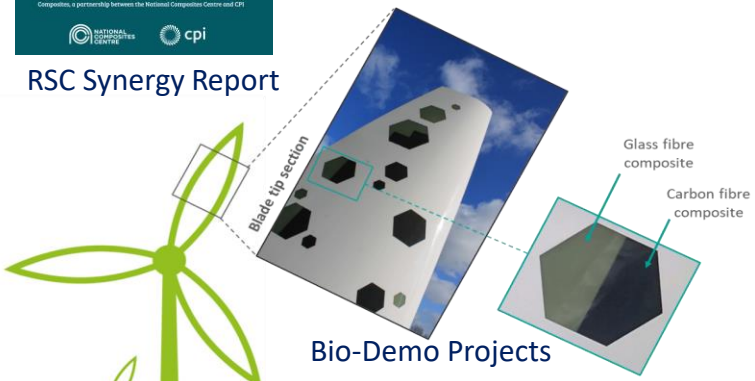
RSC Synergy Report

"Recyclable" resin demonstration

iCAST Joint Projects

Continuous Fibre Tank Recycling

Shredded wind blade material



Bio-Demo Projects

Pyrolysis
PyroCore

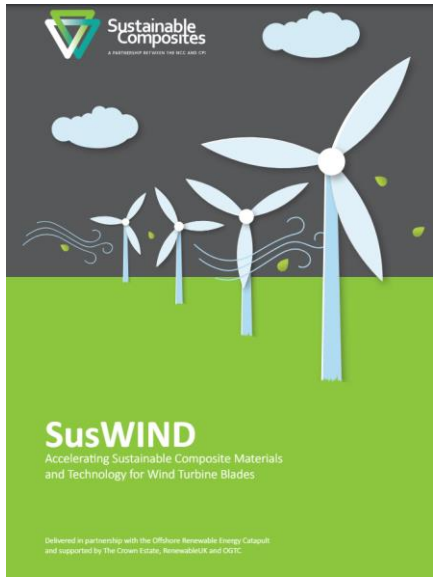
Solvolysis
Uni of Birmingham

Reclaimed glass fibres

High Voltage Fragmentation
Lightning Machines

Steam Pressolysis
B&M Longworth

Supply Chain and Technology Exploration



SusWIND Programme

Simplified Process Flow – EoL Aircraft Example

Current Typical Waste Management Routes for EoL Waste eg EoL Aircraft

Salvage Company

- Disassembly
- Chopping to transportable lengths

Waste Management Organisation

- Transport by Truck
- Shredding
- Separation of metals & composites
- Transport (Metals – sold for recycling)
- Transport (Composites, Plastics, Foam, Textiles etc.)

- Metals Recycling
- Landfill
- Energy from Waste

Recycling

1. Preparation & Separation
   e.g. Mechanical Chopping, Shredding
2. Reclamation
   e.g. Thermal, Chemical, High Voltage etc.
3a. Reformatting
   e.g. moulding compounds, non-wovens, highly aligned and other
4. Second Life Manufacturing
   Composite manufacturing with discontinuous fibre intermediate products

3b. Processing of polymer products
5. Recycled Chemicals

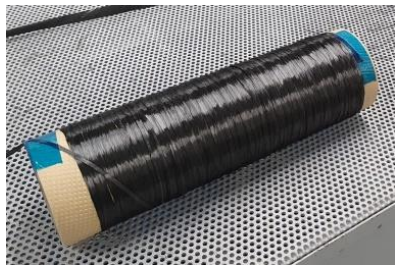
Quality Assurance to Enable Recycling of Continuous Carbon Fibre (CF)

Develop the inspection and characterisation capability to provide industry with the confidence to use recycled CF tows in high value applications

- CF demand outstripping supply, with no circular routes for waste that retain the high value of CF
- **Collaboration** between RTOs and industry to develop new capability that **enables** reuse of recovered CF

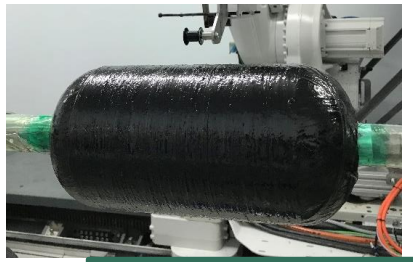
Waste composite tanks

Tank recycling and CF recovery



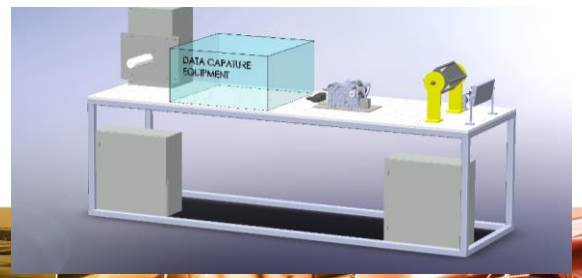
Recycled, continuous carbon fibre

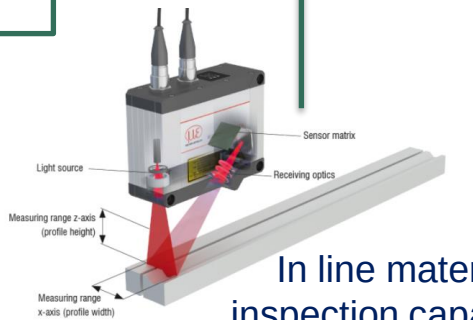
Material processing and manufacturing



Second life demos with RTOs & industry

Material and coupon characterisation capability





In line material inspection capability

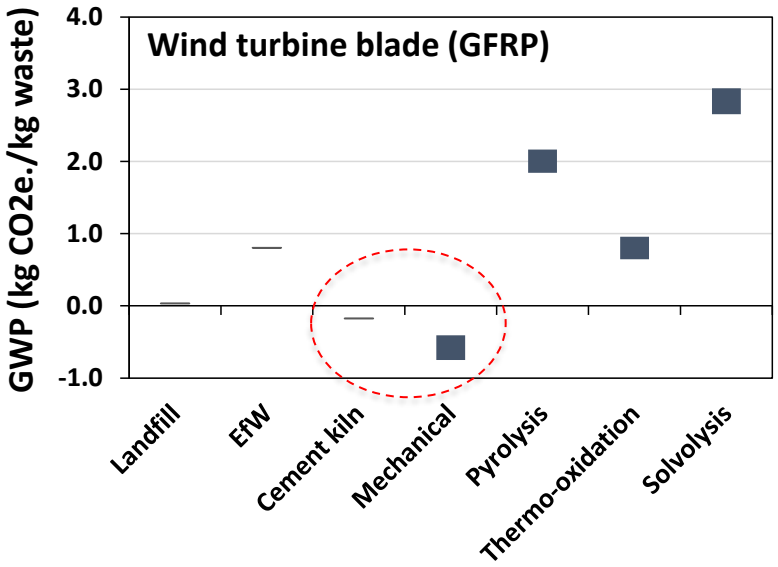
Polymer recovery investigation

What would happen IF?

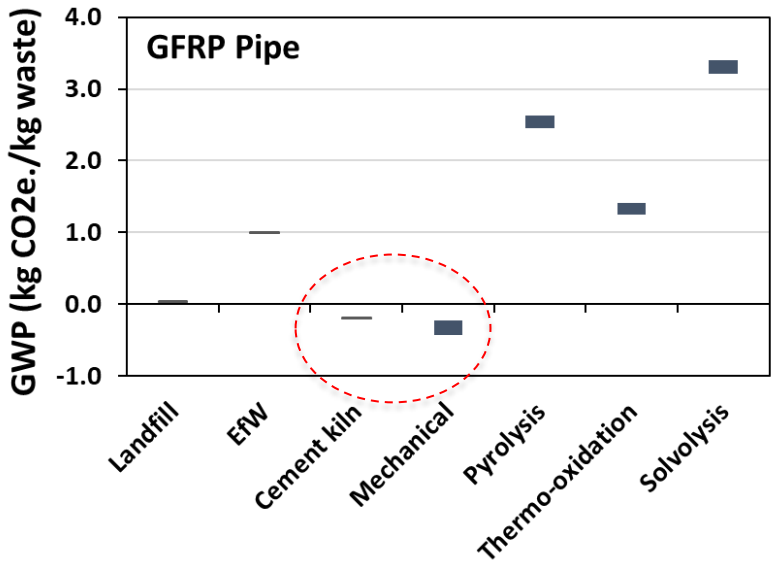
Glass polymer composite

Carbon polymer composite

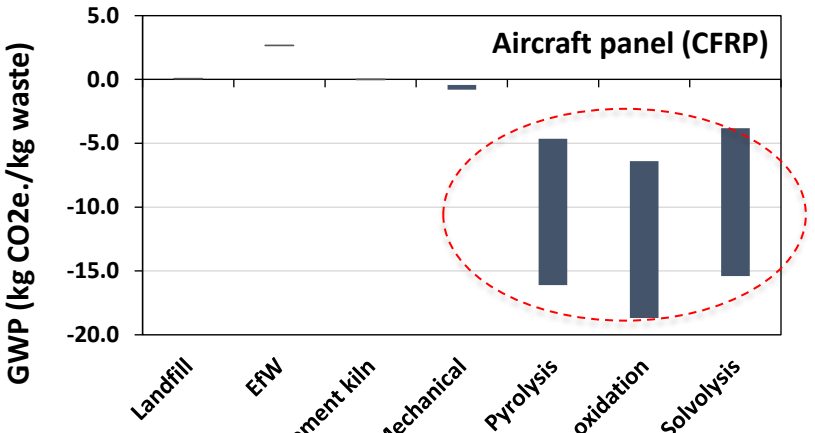
WIND



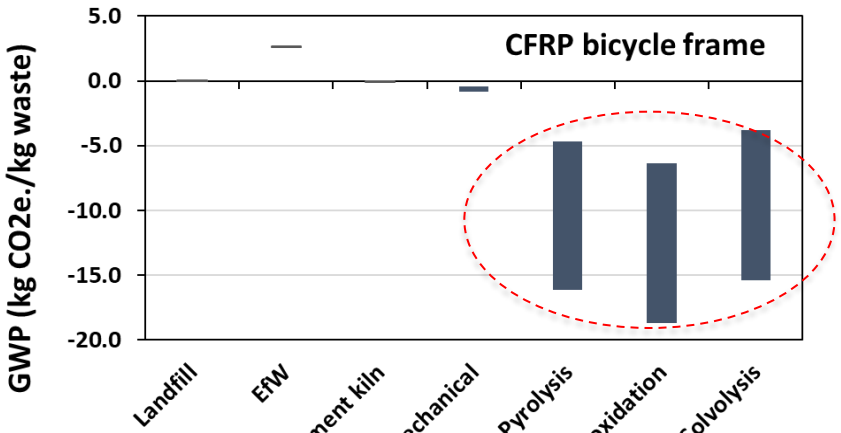
CONSTRUCTION



Aerospace



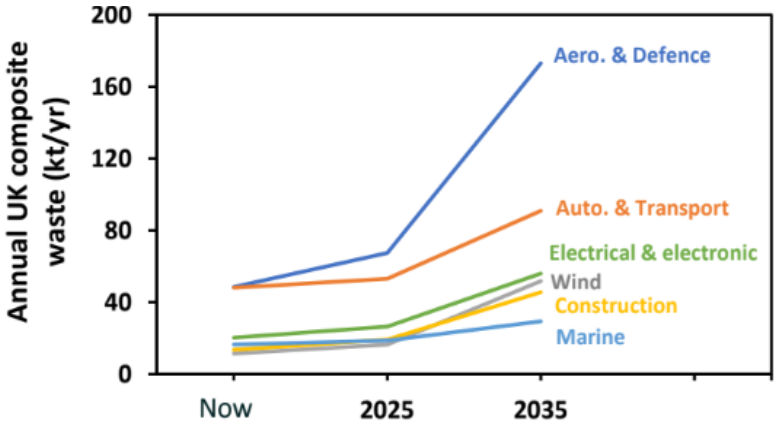
SPORTS & LEISURE



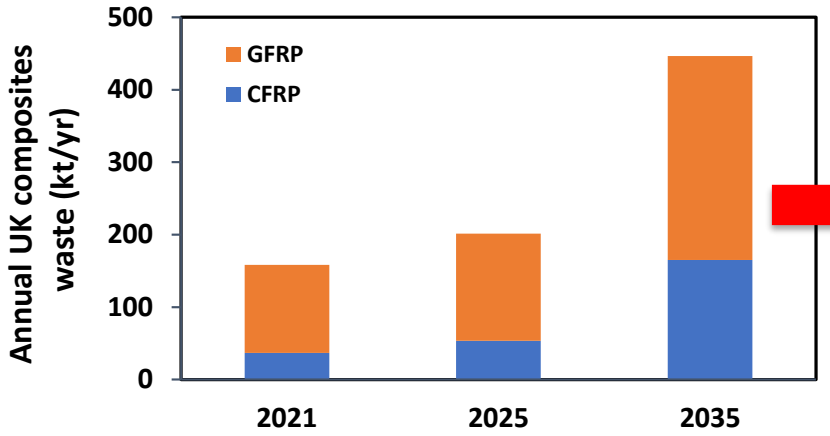
Recycling potential on UK CO2 emissions

Annual UK Composite waste

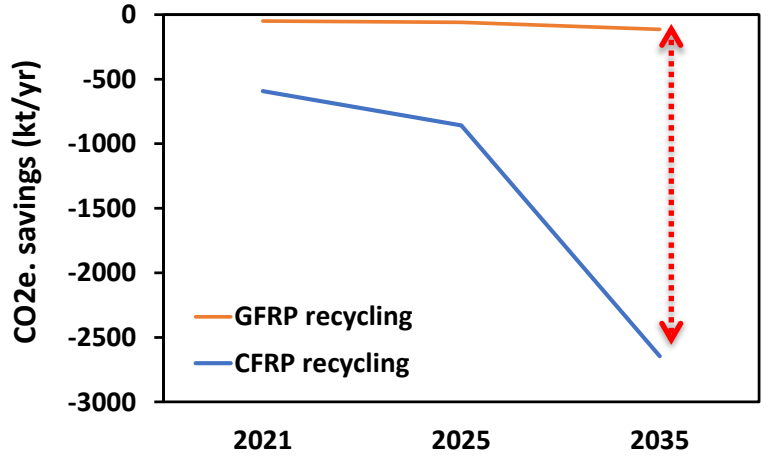
Waste volume by sector



Waste volume by fibre type



Potential for UK CO2e. savings enabled by composite recycling



Outcome derived potential

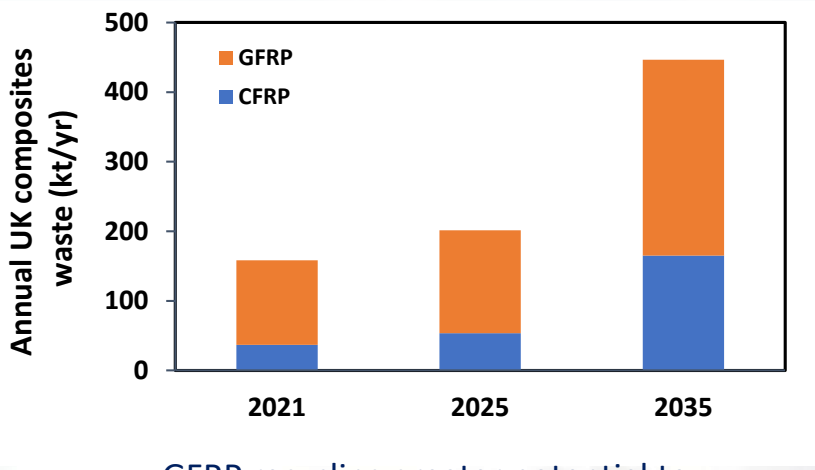
GFRP recycling greater potential to reduce UK landfill burden → CFRP recycling greater potential to reduce GHG emissions

[1] Kyle Pender Technology Strategies for Composite Waste: Quantitative Scenario Assessments of UK Composites Waste. Recomp Conference November 2022

Potential for recycling to decrease UK GHG emissions

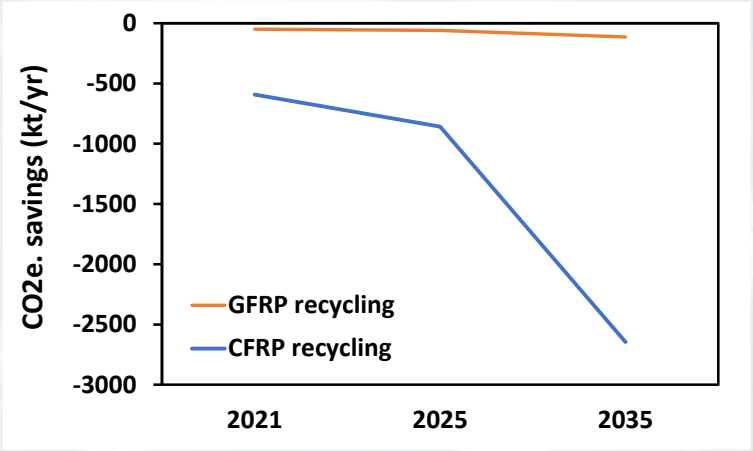
Recycling potential on UK CO2 emissions: 2022 snapshot

Waste volume by fibre type



GFRP recycling greater potential to reduce UK landfill burden

Potential for UK CO2e. savings enabled by composite recycling



CFRP recycling greater potential to reduce GHG emissions

These results are

- Based on available reported data
- Low TRL technologies
- Small lab/academic scale
- Not optimised for commercial operations

Developmental technologies are likely to:

- Efficiency increases through scale up
- Better utilisation of waste heat
- Potential to reuse reclaimed polymer
- Optimise for recycled fibre performance

Carbon footprint of recycling composites using different technologies

	Glass fibre composites	Carbon fibre composites
Landfill		
EfW		
Cement kiln	With Caveats	
Mechanical		
Thermo-oxidation		
Pyrolysis		
Solvolysis		

Technologies to recover glass and carbon fibre composites have a different carbon footprint. To minimize GHG emissions at EoL a combination of approaches is needed

Recycling of GFRP composite has a greater potential to reduce UK landfill burden and CFRP composite recycling has greater potential to reduce GHG emissions

Takeaways

Now

- Accelerate separation of glass & carbon materials as both need different routes
- Accelerate Cement (in specific circumstances) & Mechanical processes for GFRP laminates
- Accelerate development of CFRP recycling technologies
- Reduced energy consumption of development recycling technologies

Horizon

- Chase recovery of resins for both CFRP and GFRP products
- Explore the viability of adopting CFRP technologies for GFRP within a future state (e.g. where legislation prohibits current routes)
- Explore deployment of recyclable resin systems across sectors
- Support innovation at all stages and create collaboration across sectors and industires

Thank you for listening

Any Questions?

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