EMPHASIZING

(Enhancing Material Properties of recycled glass fibres through SIZING)

Recycle, refabricate, repurpose

Project Close-out Summary

Longworth (Lead Partner)

Hybrid @ Longworth & MS Teams

01.11.24

Jen Hill, Director

8th Quarterly Review and Close-out

Consortium-wide summary for IUK

Detailed QRM progress report by each partner

- Longworth
- TWI
- Gen2Plank Ltd
- EMS
- Autotech UK (Gestamp)
- Brunel
- Ford

Comments from MO

In short…

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One man's trash…

…is the next man's treasure

- Timing - 24 months
- Successes
  - Dissemination
  - Commercialisation
  - What went well
- Challenges
  - Risks
  - PCRs
  - What didn't go well
- Overall spend
- The future – What's next?

Deviations

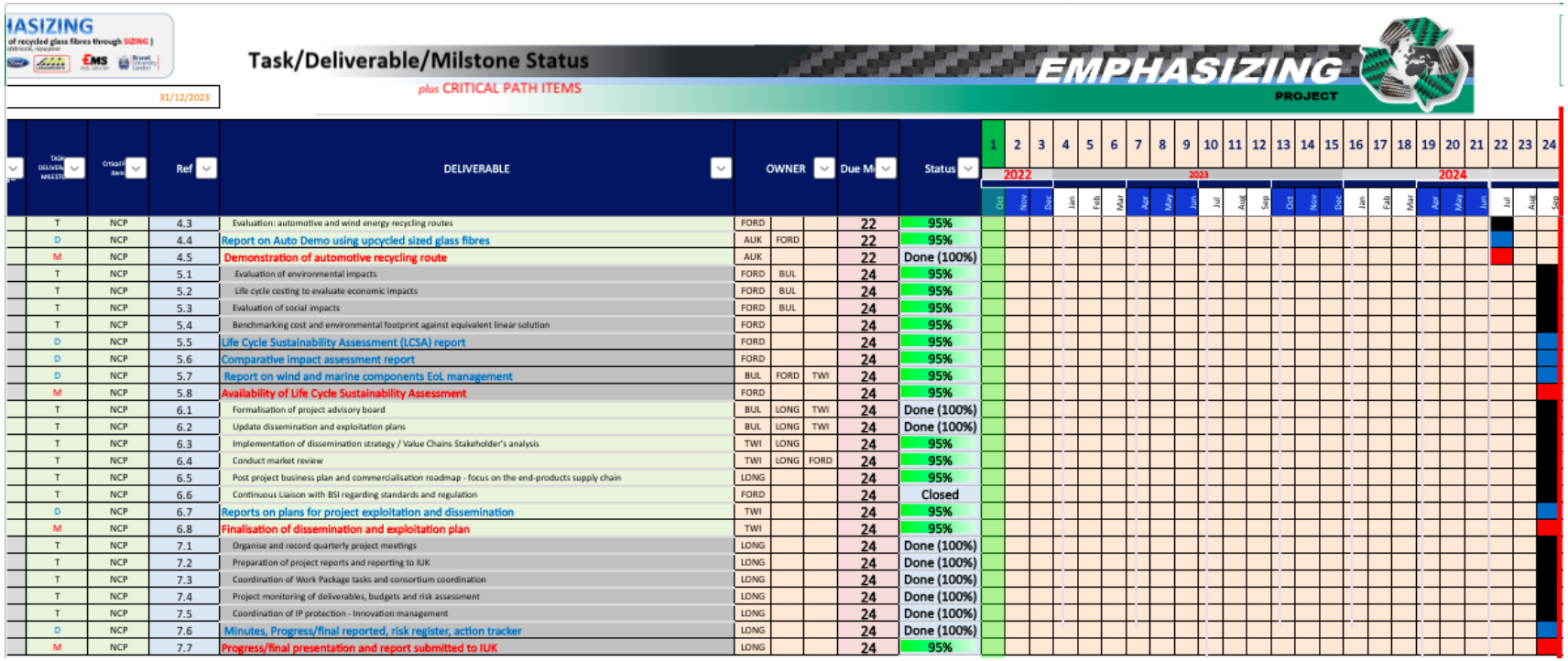
PCRs
BSI

Deliverables:

D1 CEAP
D2 SOP
D3 Data card
D4 Performance Eval for Auto
D5 Demo Testing Report
D6 LCA & LCC
D7 Wind industry report
D8 Plan for exploitation

Post-project:

Exploitation
Dissemination/Awards
Post-project write-up
Future planning (EMPHA II)



Task/Deliverable/Milstone Status

plus CRITICAL PATH ITEMS

31/12/2023

EMPHASIZING PROJECT

		Ref	DELIVERABLE	OWNER			Due M	Status
T	NCP	4.3	Evaluation: automotive and wind energy recycling routes	FORD			22	95%
D	NCP	4.4	Report on Auto Demo using upcycled sized glass fibres	AUK	FORD		22	95%
M	NCP	4.5	Demonstration of automotive recycling route	AUK			22	Done (100%)
T	NCP	5.1	Evaluation of environmental impacts	FORD	BUL		24	95%
T	NCP	5.2	Life cycle costing to evaluate economic impacts	FORD	BUL		24	95%
T	NCP	5.3	Evaluation of social impacts	FORD	BUL		24	95%
T	NCP	5.4	Benchmarking cost and environmental footprint against equivalent linear solution	FORD			24	95%
D	NCP	5.5	Life Cycle Sustainability Assessment (LCSA) report	FORD			24	95%
D	NCP	5.6	Comparative impact assessment report	FORD			24	95%
D	NCP	5.7	Report on wind and marine components EoL management	BUL	FORD	TWI	24	95%
M	NCP	5.8	Availability of Life Cycle Sustainability Assessment	FORD			24	95%
T	NCP	6.1	Formalisation of project advisory board	BUL	LONG	TWI	24	Done (100%)
T	NCP	6.2	Update dissemination and exploitation plans	BUL	LONG	TWI	24	Done (100%)
T	NCP	6.3	Implementation of dissemination strategy / Value Chains Stakeholder's analysis	TWI	LONG		24	95%
T	NCP	6.4	Conduct market review	TWI	LONG	FORD	24	95%
T	NCP	6.5	Post project business plan and commercialisation roadmap - focus on the end-products supply chain	LONG			24	95%
T	NCP	6.6	Continuous Liaison with BSI regarding standards and regulation	FORD			24	Closed
D	NCP	6.7	Reports on plans for project exploitation and dissemination	TWI			24	95%
M	NCP	6.8	Finalisation of dissemination and exploitation plan	TWI			24	95%
T	NCP	7.1	Organise and record quarterly project meetings	LONG			24	Done (100%)
T	NCP	7.2	Preparation of project reports and reporting to IUK	LONG			24	Done (100%)
T	NCP	7.3	Coordination of Work Package tasks and consortium coordination	LONG			24	Done (100%)
T	NCP	7.4	Project monitoring of deliverables, budgets and risk assessment	LONG			24	Done (100%)
T	NCP	7.5	Coordination of IP protection - Innovation management	LONG			24	Done (100%)
D	NCP	7.6	Minutes, Progress/final reported, risk register, action tracker	LONG			24	Done (100%)
M	NCP	7.7	Progress/final presentation and report submitted to IUK	LONG			24	95%

EMPHASIZING Technical Activities - Summary (WP1 – WP7)

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WP1
- CEAP
- Partners assessment of existing technology ‘gap’ and opportunity
- Technical requirements for reclaimed glass
- Industrial requirements for reclaimed glass
- Commercial requirements for reclaimed glass

WP2
- Secure variety of feedstock from a range of sources
- Trials confirming of DEECOM® processing parameters for optimal reclaim of glass fibre
- Glass fibre preparation for compounding
- Address challenges re handling, re-sizing and chopping
- Yield challenges
- Scale up challenge of reclaim from c50g to 200kg - consistency
- Analysis and testing in lab
- Compounding and raw material batch production

WP3
- Coupon manufacturing
- Material characterisation against standards
- Creation of material data characterisation card
- Performance report for automotive

WP4
- Sub-con of part manufacture to ATS for injection moulding
- Yield challenges
- Test lab readiness for rig testing of parts
- Evaluation and conclusions for automotive and wind industries (+ marine, glass, leisure. Auto etc)

WP5
- LCA model creation
- Dummy data to actual data inputs
- LCC evaluations
- Purchasing of Coil and Box

WP6
- High impact dissemination across composites and automotive industry(s)
- Low impact dissemination across wind industry and in government
- Strategic awards entry programme
- Variety of partners and presenters
- Exploitation high on agenda throughout = our why?

WP7
- Project management
- Cohesion
- Travels allows inter-partner understanding
- Flexibility from TWI/ BUL
- Major resource challenges overcome

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- Pre-processing of GRP feedstock for reclaim by DEECOM® pressolysis
- Separation of glass from resin and sizing polymers and contaminants
- Post-process chopping and re-sizing of reclaimed fibres
- Compounding of re-sized pellets
- Testing and characterisation throughout each stage
- Injection moulding of compound into demo part (Ford link)
- Testing to auto industry standards
- Assessment of material for future uses in automotive

Achieved	*Comments*
✓	Shredding vs chopping/grinding, identified contaminant
✓	Confirmed 100% clean glass with market use
✓	Chop first vs size first, drying, yield
✓	Yield challenges, materials x 4
✓	Standards, minimum yield, performance
✓	ATS sub-con from Ford. 40 parts x 4 materials
✓	GES report
✓	GES & EMS list of possible parts for usage

Analysis of DEECOM® Reclaimed Fibres

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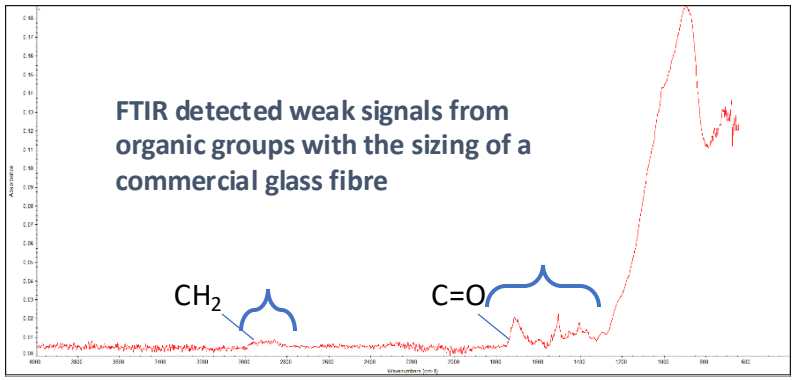
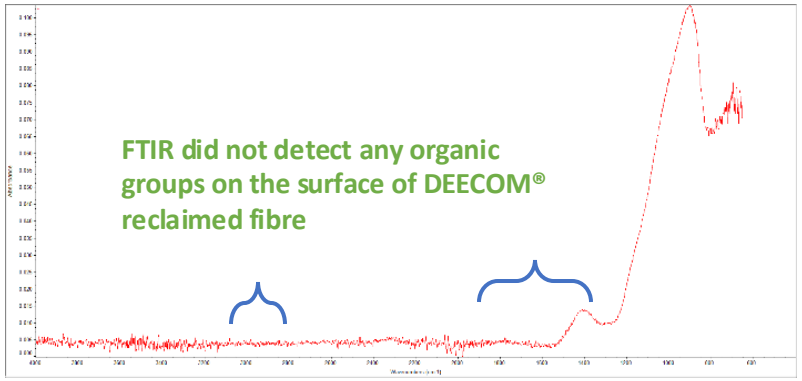
An evaluation of the surface appearance and chemistry of DEECOM® reclaimed fibres demonstrated that the process was capable of clearing all traces of organic residues from the fibre surface.

Optical Microscopy of DEECOM® Reclaimed Fibre

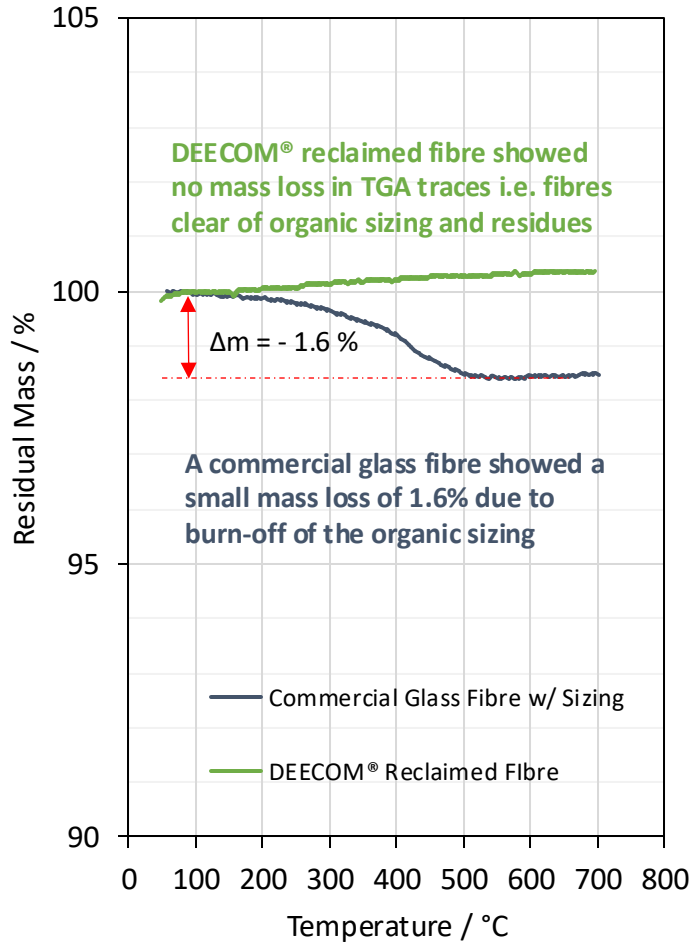
FTIR Analysis of a Commercial Glass Fibre



FTIR Analysis of DEECOM® Reclaimed Fibre



Comparison of Thermo-gravimetric Analysis of a Commercial Glass Fibre & DEECOM® Reclaimed Fibre



Glass Fibre Resizing & Compounding

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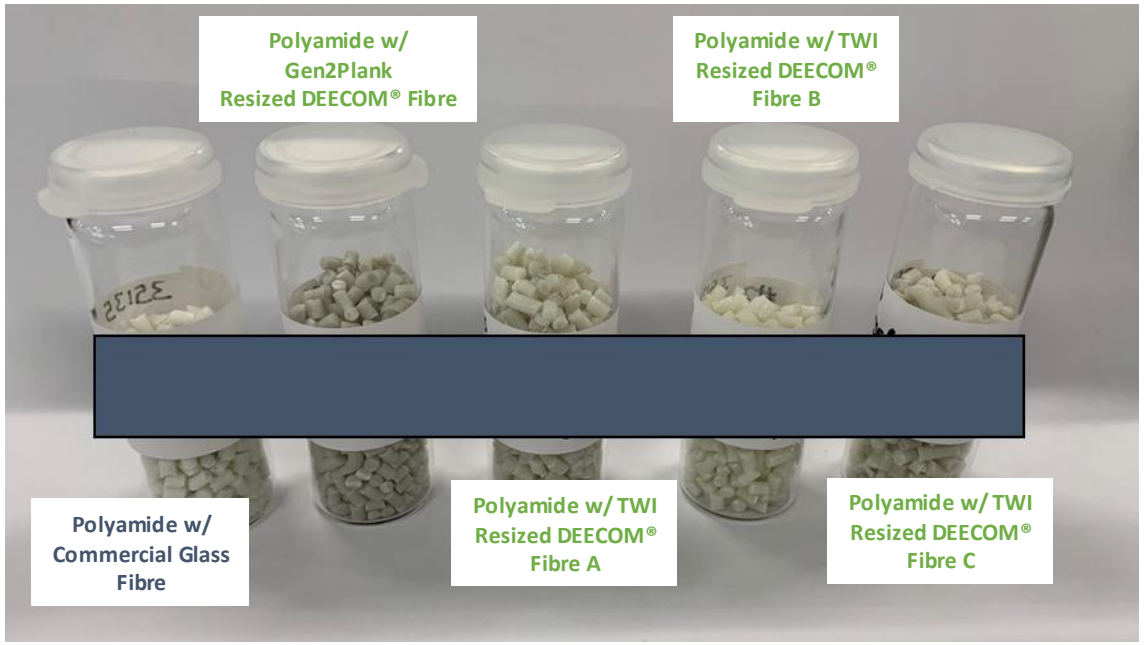
TWI developed polyamide compatible sizing formulations in order to resize DEECOM® fibres. Sizings were applied at lab and pilot-scale by TWI and Gen2Plank. Using a commercial polyamide resin provided by EMS-Grivory, TWI was able to melt-compound small batches of resized DEECOM® fibre achieving up to 45 %w/w loading and confirm the viability of the process.

TWI Twin-screw Extruder/Compounder

EMPHASIZING Composites w/ resized DEECOM® GF



Technology Roadmap

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Concept ✓

Phase 1; Lab scale reclaim of glass from a range of sources including EoL wind blades and marine waste. Feasible as feedstock for second life advanced materials if 'upcycled' to valorise

IUK and consortium funded project **EMPHASIZING** ✓

Phase 2; EMPHASIZING Scale from lab to small pilot. Address challenges in scale, unknown feedstock, pre and post processing, sizing chemistry material choice, H&S and re-manufacture. Create material data sheet.

Additional funding; Company? IUK?

Overcome Technical Challenges

Phase 3; Address LCC through industrial pilot scale-up. Identify future uses and prove across a number of industries and components. Include resin polymer reclaim and reuse to shift business case in line with market forces

Commercial investment

£ £ £

Phase 4; Commercialisation at pilot scale as viable materials processing plant addressing waste challenge and low-cost, low-LCA supply of advanced materials to wide range of sectors

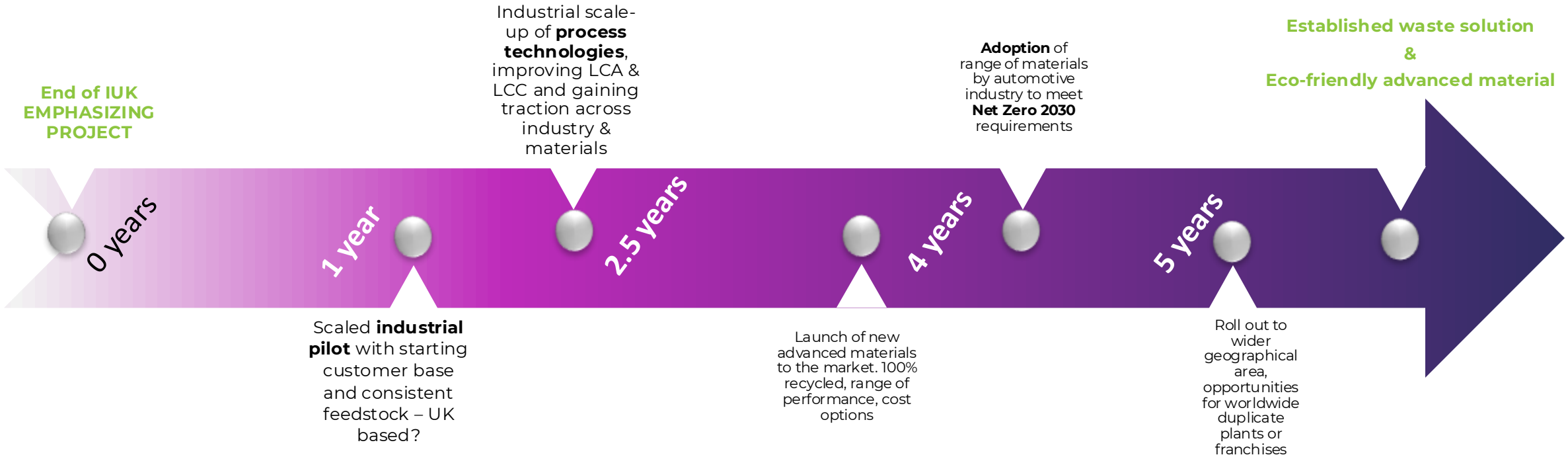
First ever UK plant

Phase 5; Industrial scale production of recycled advanced materials (fibres and polymers) for a range of industries. Funded through waste producers, CR&D and ready for roll-out.

LONGWORTH Gestamp GEN2PLANK TWI Ford EMS EMS-GRIVORY Brunel University London

EMPHASIZING
UPCYCLING THROUGH SIZING

Exploitation Timeline



Main RISKS at Outset

EMPHASIZING was an innovative and ambitious project which inherently carried risk, the main risks identified at start of project :

- TECHNICAL RISK – DEECOM® pressolysis fails to remove all resin and sizing polymers, leaving only clean glass
  - TWI have confirmed within the project that post-pressolysis glass fibres are 100% clean and free of all contaminants

- TECHNICAL RISK – Fibres are impossible to chop, re-size and handle
  - G2P have successfully chopped. Re-sized and dried reclaimed fibres consistently over the project.

- TECHNICAL RISK – Required yield not met due to wastage and creation of 'fluff'
  - G2P achieved an impressive 47% yield (target was 60%) at lab scale on unoptimized equipment.

- TECHNICAL RISK – re-sized pellets would not feed through extruding kit for compounding
  - TWI and EMS successfully produced a PA compound which in turn created more finished parts than expected

- COMMERCIAL RISK - Lack of business case for 'glassene' or similar recycled materials:
  - EMPHASIZING shows huge potential but uptake is limited by the low cost of virgin alternatives. The collection and reuse of resin polymers and sizing chemistry MUST be included in future development to address this and play to market forces. Along with the waste levy continually rising and the demand for recycled content and 'good' LCA, this shifts the case in favour.

- MANAGEMENT RISK - Resources not available when needed:
  - Several partners have seen staff changes throughout the project for various reasons, causing delays and need for re-education. At times equipment and/or staff resources caused delays but were always made good within the following quarter.

EMPHASIZING by numbers

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96+ meetings

1 JEC international award

£2.4M **7 partners**

1 C2i award

2 wind blades

24

4 feedstocks

3 Composites UK awards

months

1 gov

1 NAA award

roundtable

1 Make UK award

40 brand new car parts

LONGWORTH Gestamp GENZPLANK TWI Ford EMS EMS-GRIVORY Brunel University London

EMPHASIZING

UPCYCLING THROUGH SIZING