

GFRP-waste reinforcing thermoplastic composite materials & products

What is ECOBULK?

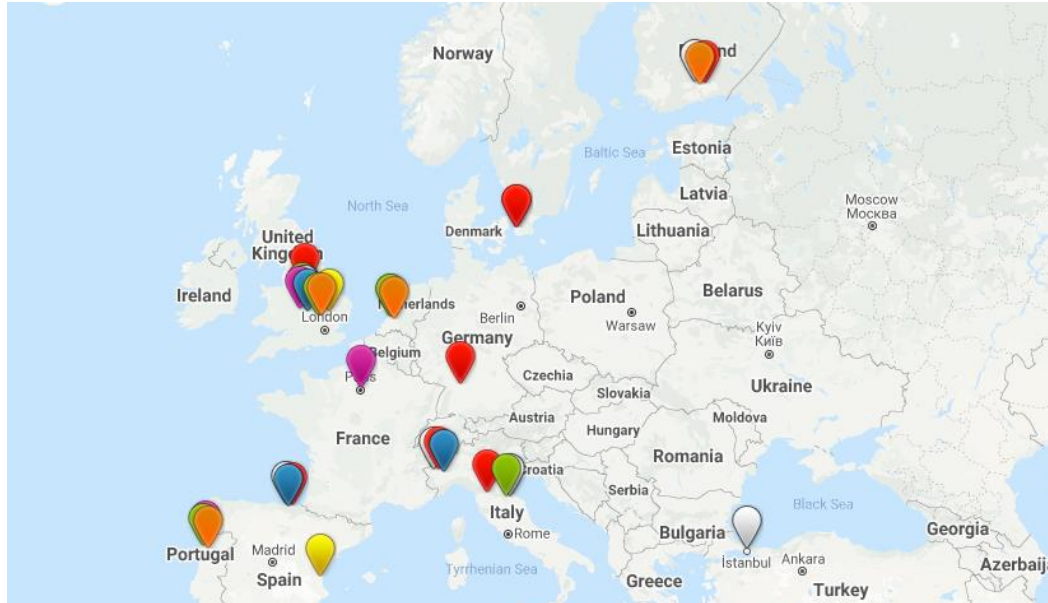
ECOBULK is

- A multi-disciplinary approach to closing the loop on composite products and materials coordinated by Universitat Polytechnica de Catalunya (UPC), Spain
- A **large scale demonstration** of circular economy solutions
- 26 beneficiaries from all over Europe
- Total budget 12,2 M€ (4,5/5 ranking points H2020)
- Duration 4 years + ½ year extension due Covid-19 (end Nov 2021)
- Dealing with three application and product areas;
 - Automotive
 - Furniture
 - **Construction (Conenor technology)**




This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 730456

Demonstrations



 Automotive

 Furniture

 Construction

 Platform

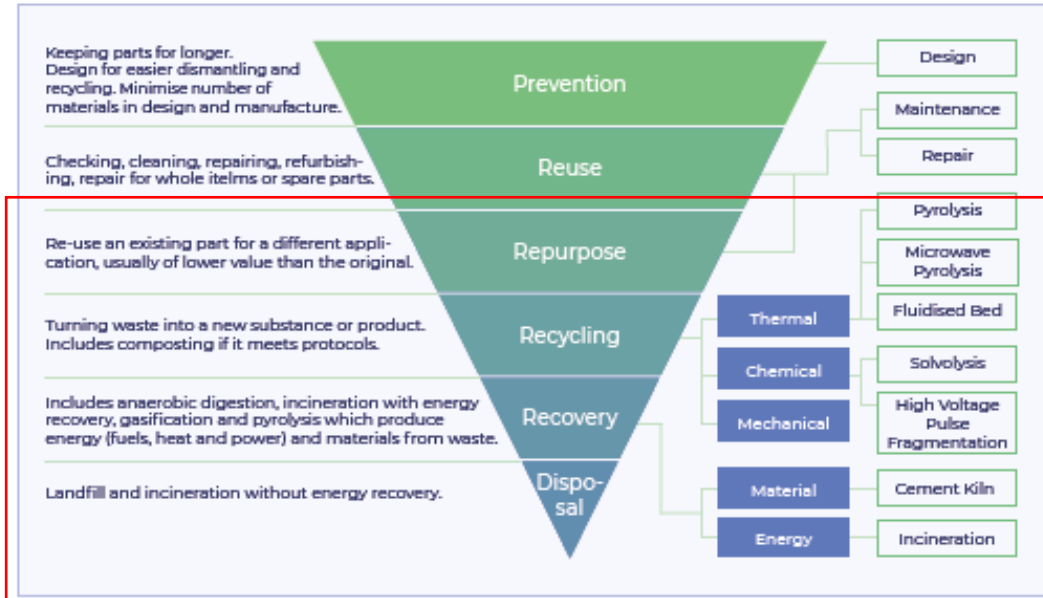
 Materials

 Manufacturing

 Design-Hubs

Waste Management Hierarchy w. Composites

Ref. SusChem; Polymer Composites Circularity – White Paper <http://www.suschem.org/publications>



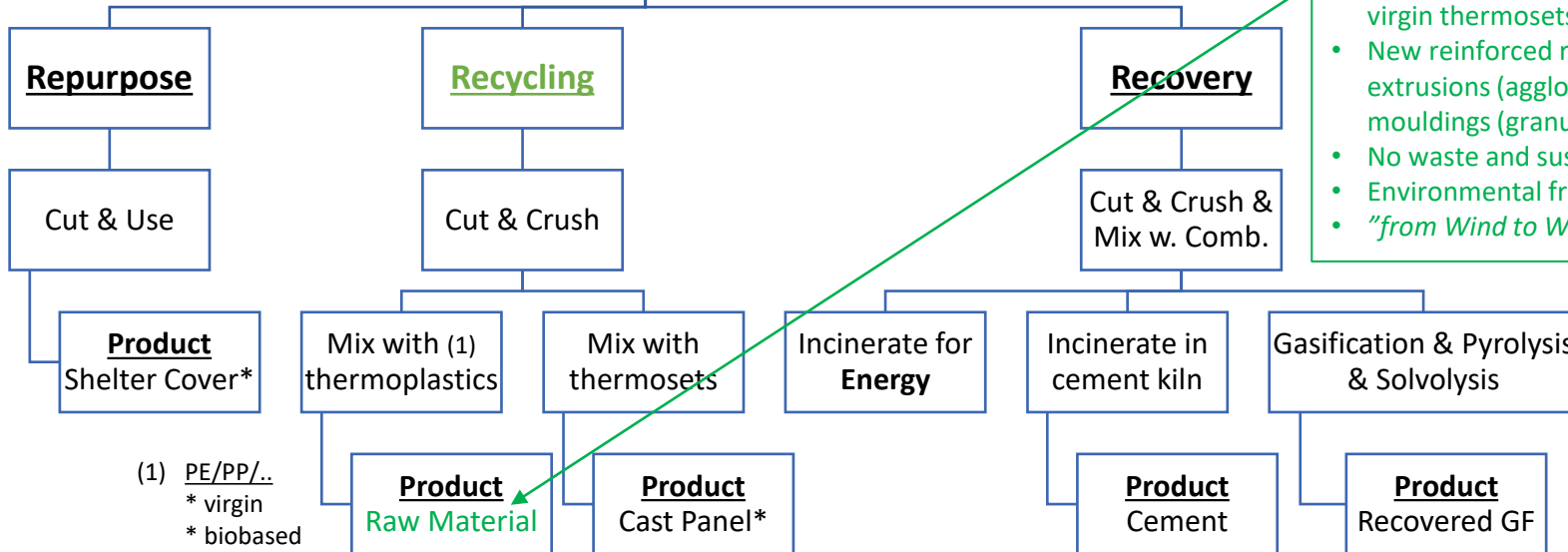
Waste management hierarchy

GFRP-waste in cement kiln is a co-process for energy and glass dust recovery process for cement and not recycling.

The outcome is not circular.

Recycling in a Circular way

Turning waste into a new substance or product.. while incineration in any form is recovery !



Sustainable & Circular & Scalable

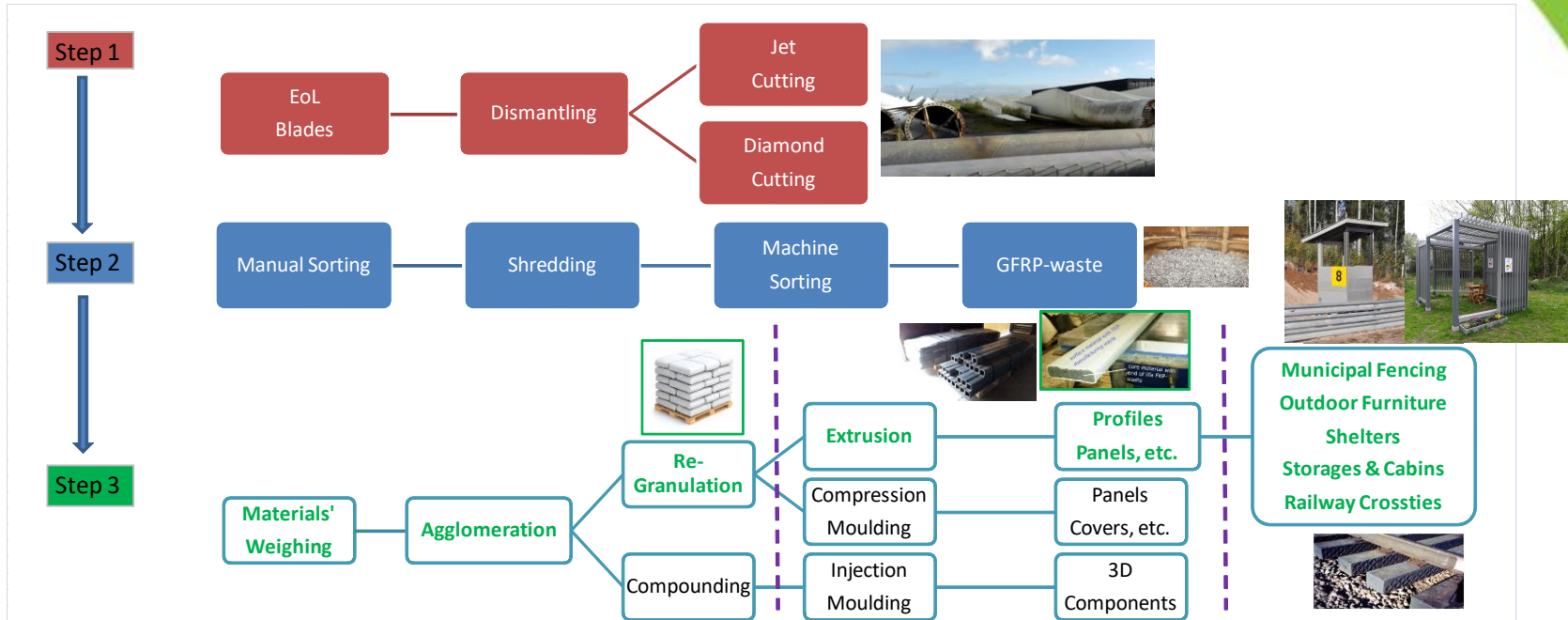
- Use of recycled thermoplastics vs. virgin thermosets in mixing
- New reinforced raw material for extrusions (agglomerate) and mouldings (granule/pellet)
- No waste and sustainable LCA/LCC
- Environmental friendly (CO₂)
- "from Wind to Wind"...

(1) PE/PP/..
 * virgin
 * biobased
 * recycled

* Typical example

Processing Steps w. EoL Blades

Patented low cost agglomeration technology to utilize FRP-waste as reinforcement in circular composite construction materials and products

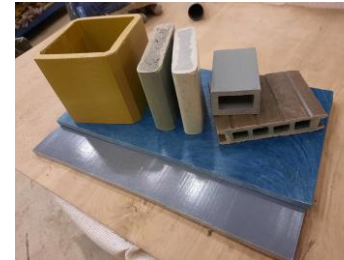
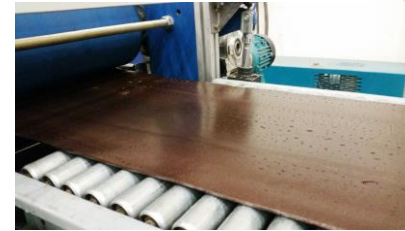


Conenor Components "Shopping List"

- I) Outdoor Furniture
- II) Building & Construction

Conenor composite components available ;

N.o	Name	Dimensions	Layers		Notes
			single	multi	
1	Solid Plank R	120x30mm	x	x	round corners
2	Solid Plank S	120x30mm	x	x	sharp corners
3	Solid Plank F-F	140x30mm	x	x	female-female edges
4	Hollow Board	120x28mm	x	x	
5	Hollow Board F-F	140x28mm	x	x	female-female edges
6	Solid Panel 5	390x5mm	x		straighth edges
7	Solid Panel 10	390x10mm	x		straighth edges
8	Solid Panel 10B	390x10mm	x		bevelled shi lap edges
9	Hollow Pillar 5	125x125mm	x	x	5mm wall
10	Hollow Pillar 10	125x125mm	x	x	10mm wall
11	Hollow Pillar 15	125x125mm	x	x	15mm wall
+	Feature "Fire Retardancy"		x	x	EN Class B



Conenor Components in Construction

GFRP-waste Reinforced Extruded Multilayer Materials

Recycled Composites is Patented Invention of Conenor having developed and produced both materials and demo products

Outdoor Constructions:

- Water and UV resistant
- No swelling, splitting nor rotting
- Colored at production – no painting
- Good mechanical properties
- Retain original properties
- Using recycled thermoplastics PE/PP
- Circular material for recycling



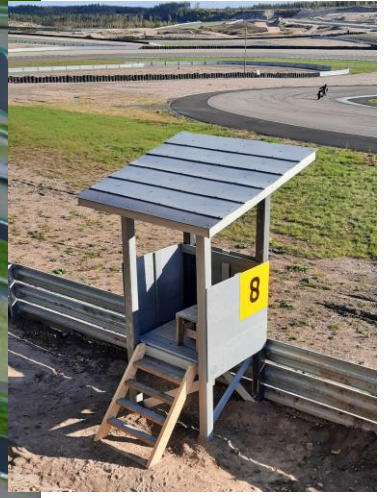
Construction Demo – KymiRing Finland

KymiRing – Outdoor Constructions at MOTOGP racing track

150m visitor benches around the track in nature



20 flagman shelters





ECOBULK

Construction Demo – Lipor Portugal

Lipor Park – Outdoor Constructions

Drinking fountain



Rest place around a tree



Waste bin





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Construction Demo – University UK

Three Universities – Outdoor Constructions

Gazebos in Warwick Coventry Cranfield





ECOBULK

Construction Demo – FCBA France

FCBA – Outdoor Constructions

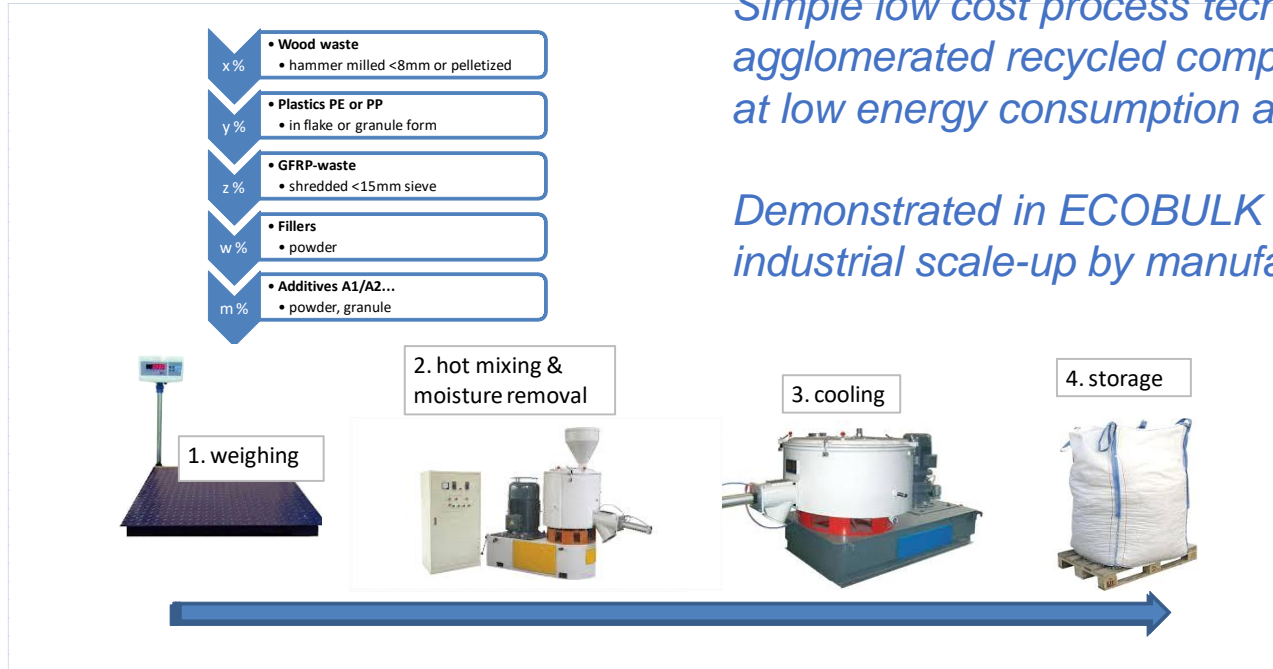
Benches

Seats



Agglomerates for Extrusions

Production of thermoplastic agglomerates with GFRP-waste from EoL and Manufacturing using existing equipment base in the market



Simple low cost process technique for agglomerated recycled composites at low energy consumption and no waste !

Demonstrated in ECOBULK and next industrial scale-up by manufacturers !



Typical Material Values w. 35%-w. rGFRP

Analysis of GFRP-waste containing extruded products

Analysis of the Conenor developed GFRP-waste reinforced circular composite PE/PP-materials and extruded products have been undertaken within ECOBULK by CNR in Italy, Muovipoli Ltd in Finland and through a Master Thesis at University of Eastern Finland (UEF):

- ✓ **Compared to quality commercial WPC decking boards:** ECOBULK hollow boards (140x28mm) with GFRP-waste are stronger and stiffer vs. quality commercial WPC decking boards in dry as well as wet conditions
- ✓ **Compared to commercial plywood panels:** ECOBULK composite panels 400x10mm with GFRP-waste remain stronger and stiffer vs. quality commercial plywood panels when getting into contact with water (EN-water soaking test method)

NOTE: Mixed GFRP-waste used from EoL wind turbine blades was highly contaminated grade without sorting but just ferrous metals removed !



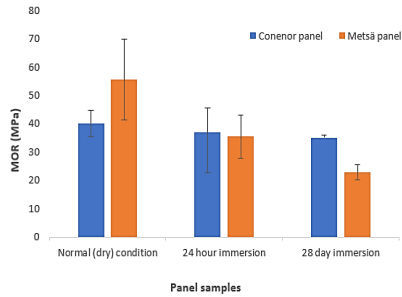
Typical material values:

- density 1.2 - 1.4 g/cm³
- moisture absorption & dimensional swelling (28d water soaking) +/- 0%
- surface hardness Brinell (HBS 10/3000) 60-100
- flexural strength (MOR) 30-50 MPa
- flexural modulus (MOE) 3-5 GPa
- EN fire rating class B-d0-s2 (optional)
- no rotting, no mould growth, no leaching, pesticide free, formaldehyde free

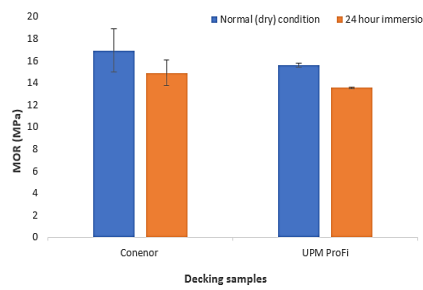
Material for Moist Conditions

Master thesis by Mr. Ramji Pandey at University of Eastern Finland (UEF)

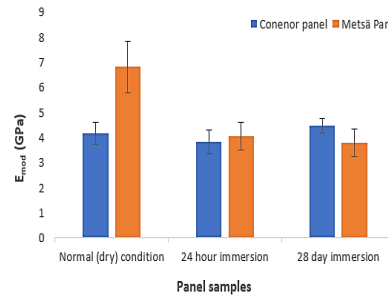
MOR



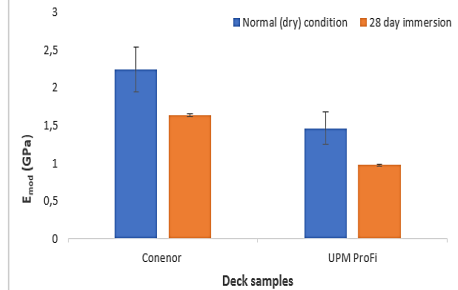
MOR



MOE



MOE

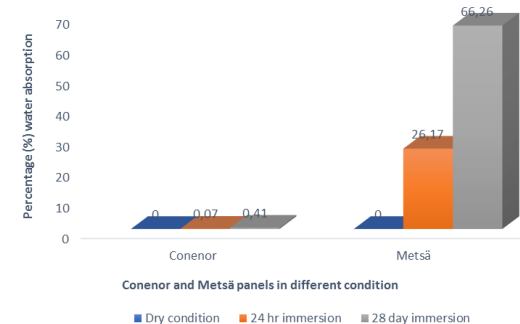


Main outcome:



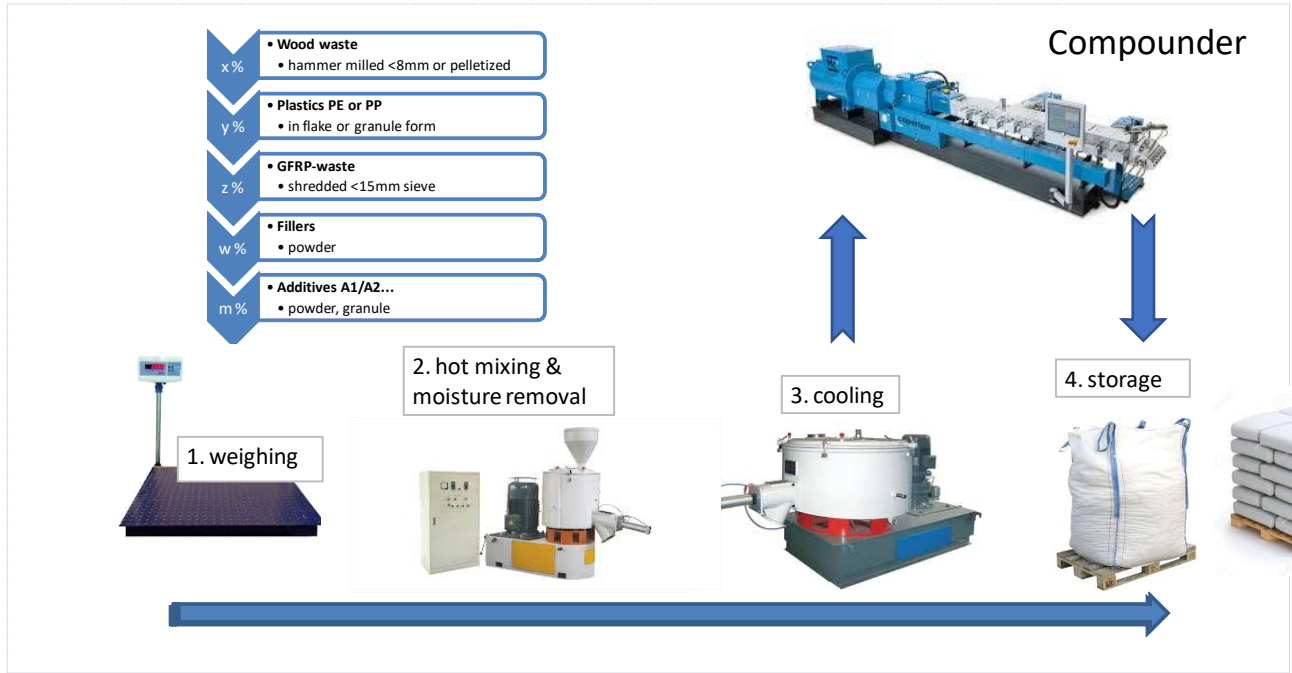
✓ Ecobulk hollow boards (140x28mm) with FRP-waste **are** stronger and stiffer vs. quality commercial WPC decking boards in dry as well as wet conditions

✓ Ecobulk composite panels 400x10mm with FRP-waste **become** stronger and stiffer vs. quality commercial plywood panels when getting into contact with water (EN-test method)



Compounding agglomerates into pellets

for Injection Moulding (automotive, aeronautics, transport etc.)



Compounding at Aimplas, Spain



Compounded pellets with 35%-w. GFRP-waste

- rPP + wood fibres + GFRP-waste from manufacturing
- rPE + wood fibres + GFRP-waste from manufacturing
- rPP + wood fibres + GFRP-waste from EoL wind turbine blades
- rPE + wood fibres + GFRP-waste from EoL wind turbine blades



Benchmarking LFT-G & SFT-G

Long-fiber-reinforced thermoplastic (LFRTs) is a type of easily mouldable thermoplastic used to create a variety of components used primarily in the automotive industry. LFRTs are one of the fastest growing categories in thermoplastic technologies. Leading this expansion is one of the oldest forms, glass mat thermoplastic (GMT) and two of the segment's newest: pre-compounded (pelletized) LFRTs (long-fiber-reinforced thermoplastics), also known as LFTs, and inline compounded (ILC) or direct LFTs (D-LFTs).

LFRTs differ from the composite structures used in the aerospace industry for components such as aircraft parts. The fibers in LFRTs are relatively short (6.35 mm/0.25 in. or greater) compared to the fibres contained in composite aircraft components. High performance composites usually contain fibers as long as the component itself (6 metres or longer).

Their structural properties and low cost per part have enabled LFRTs to replace metal parts in the automotive industry. In addition, some new organic fibers can even be recyclable. With the independence of choosing the reinforcement from a wide range of fibers and the matrix from a wide range of thermoplastics polymer in the LFRTs, its property can be changed according to customer needs. LFRTs have become an increasingly valuable and popular part of building envelope components such as windows and doors.



Fibremod GD577SF

Pos. 1 (Polymer type)	Pos. 2 (MFR range)	Pos. 3 (Filler content)	Pos. 4-5 (Numerical index)	Pos. 6-7 (Application index)	Pos. 8 (Production Location)
H – Homopolymer R – Random copolymer B – Block copolymer T – Terpolymer E – Elastomer modified G – Glass fibre C – Carbon fibre reinforced M – Mineral filled W – Other or combinations	B: > 0.8–2.5 C: > 2.5–5 D: > 5–10 E: > 10–15 F: > 15–20 G: > 20–30 H: > 30–40 J: > 40–100	O: 0–9% 1: 10–19% 2: 20–29% 3: 30–39% 4: 40–49% 5: 50–59% 6: 60–69%		AE: Automotive exterior AI: Automotive interior UB: Under the Bonnet HP: High Performance SY: Sustainability SF: Short Glass Fibre LF: Long Glass Fibre WG: White goods	B: South America C: Asia U: North America



Exterior



Interior



Under-the-bonnet

Matmatch

e.g. Aluminium

Materials ▾ For Suppliers ▾ Blog

Polymer > Thermoplastic > Polyolefin (PO) > Polypropylene (PP) > PP GF50 LFT-G ®

PP GF50 LFT-G ®

Alternative and trade names
LFT-G® PP-NA-LGF50, PP-LGF50 FR

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Descriptive text above from Wikipedia

Description

PP (HPP Polypropylene) with 50% long glass fiber reinforced. The key features are:

- Excellent anti creep and fatigue resistance
- Low warpage
- Chemical coupling
- High strength

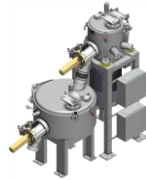
Heat resistant, UV resistant and flame retardant grades are available.

Scaling-up Agglomeration

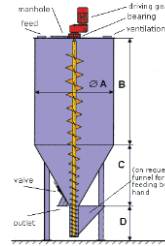
Weighing & Conveying



Hot Mixing & Cooling + Moisture Removal



Storage



- **Agglomerates for Extrusions**
- **Compounded pellets for Injection Moulding**



R&D and Piloting;

- Mixer size 100/200L
- Output 100kg/h
- Manual weighing & conveying

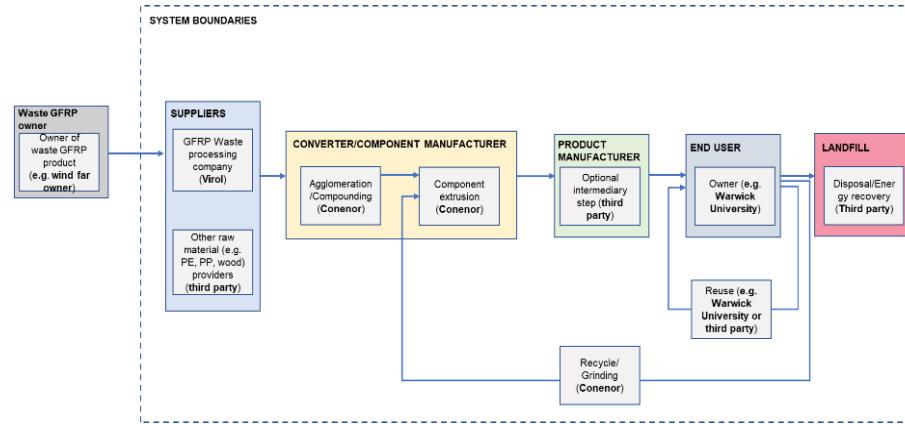
Manufacturing ;

- Mixer size 1000/2600L
- Output 1ton/h
- Automated weighing & conveying

- Mixer size 2000/5000L
- Output 2ton/h
 - **x5 units → 10ton/h**
- Automated weighing & conveying

Existing Solution for Market now at TRL7

- ✓ LCA/LCCA by FCBA



- ✓ Business Models & Value Chain by OakdeneHollins
- ✓ Reverse Logistics & Policy Recommendations by ITENE
- ✓ + other supportive and complementary activities within ECOBULK

...MoU in DK and KR, first Clients in the UK and NO* (* with GFRP-boating waste)

Conenor “Killer” Product Concept in Volumes

Multilayer Composite Railway Crosstie (“Sleeper”)



Click the icon above to download

Conenor has received several inquiries worldwide for deliveries in both volume quantities of sleepers as well as manufacturing equipment for such products ;

- Russia renovation of the Moscow metro track
- Kazakhstan national railway maintenance company
- India several polymeric product manufacturers
link <https://www.outlookindia.com/newscroll/railways-to-use-green-composite-sleepers/1402133>
- Australia 1700 km freight rail line being built between Melbourne and Brisbane
link <https://www.bendigoadvertiser.com.au/story/7092873/millions-from-inland-rail-project-to-flow-to-castlemaine/>

Conenor Business Model

- Conenor Ltd is the inventor and sole owner of the patented process technology to utilize GFRP- waste as reinforcement in recycled and/or virgin thermoplastic composites
- Conenor is a technology provider (SME) and not a manufacturer to make use of the technology
- The Business Model of Conenor is to offer its proprietary technology globally to all interested parties for material manufacturing thru License Agreements including technical training & know-how
- Licensees are given by Conenor a list of verified suppliers and their suitable grades of both GF- and GFRP-waste to ensure problem free use of The Licensed Technology
- Suppliers of GF- and GFRP-waste to Conenor Licensees must first have their grades tested and verified by Conenor for their suitability and best use prior to deliveries to the licensed manufacturers



GF- and GFRP-waste owners (manufacturing and EoL) contact Conenor now to have your grades verified in time for next year 2022 !

Get in Contact !

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Thank You !

