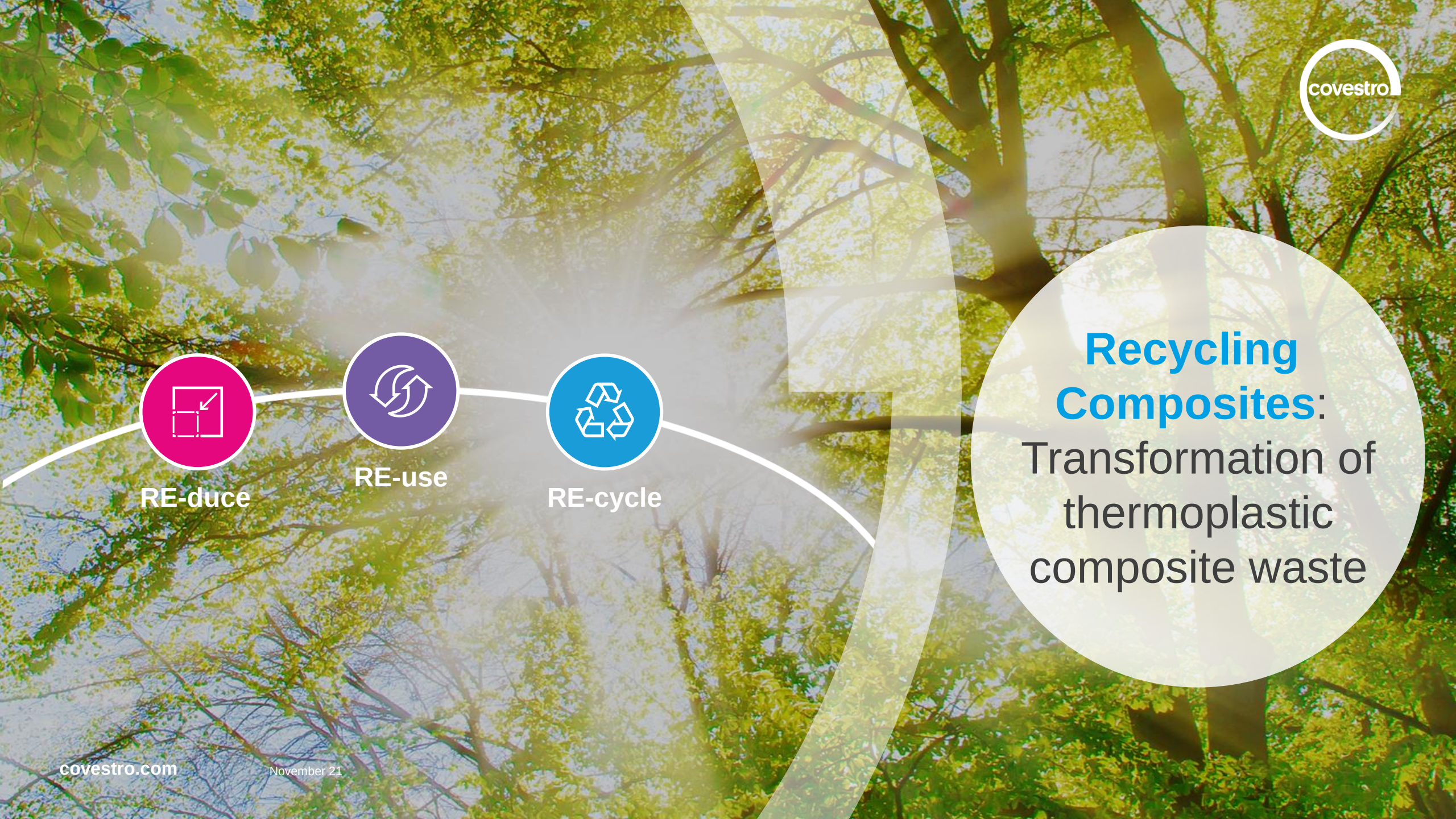

Recycling Composites: Transformation of thermoplastic composite waste

covestro

Forward Looking Statements

This presentation may contain forward-looking statements based on current assumptions and forecasts made by Covestro AG.

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The company assumes no liability whatsoever to update these forward-looking statements or to adjust them to future events or developments.

Who is presenting today?

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Maezio® Continous Fiber-Reinforced Thermoplastic Composites (CFRTPs)

Short Fiber

Long Fiber

Continuous Fiber

FIBER MATERIAL

Aramid

Carbon

Glass

Mineral fiber

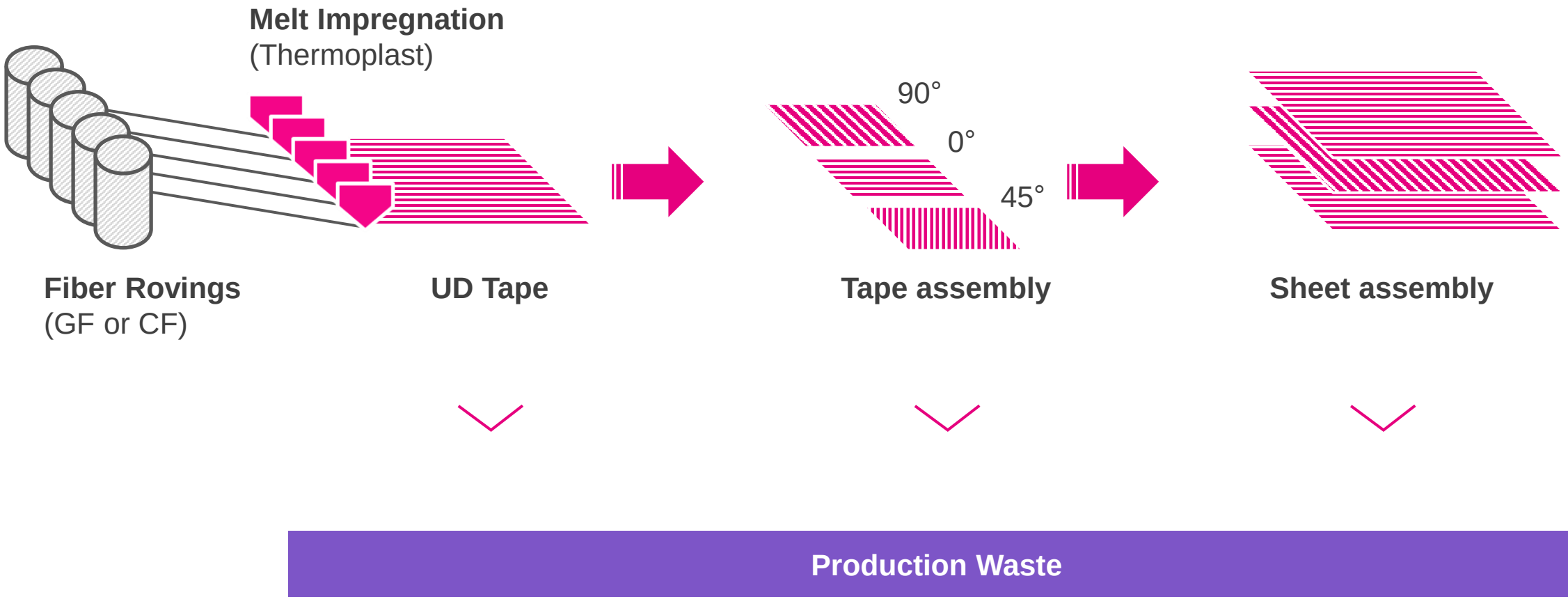
Natural fiber

MATRIX MATERIAL

Thermosets

Thermoplastics: PC, TPU

Composite Production



Sustainable Waste Management

Prevention

Reuse

Recycle
- Mechanical
- Thermal
- Chemical

Recovery

Disposal

Most Preferred

Least Preferred

Advantages

Of Thermoplastic Composites

Thermosets	Thermoplastics
• E.g. epoxy-based with GF or CF • Fiber recovery by **pyrolysis** • Reclaimed fibers are reused by cutting or milling. • **Energy intensive**, technically complex, and costly.	• E.g. Polycarbonate-based like Maezio® • Mechanical recycling by cutting or milling • **Fiber and polymer recovered** • low technical barrier and more cost-effective. • **Reduced energy consumption** and carbon emissions compared to thermoset recycling

Waste Management is Key

Quality of waste
defines recycling route(s) and limits post processing

Proper waste management increases **recycling efficiency**

Avoiding **incineration & landfill**

Partnering with local recyclers

Ways of Mechanical Recycling

Shredding

- \+ Broad range of scrap qualities
- \+ Sheet molding possible
- – Compounding can be challenging

Granulating

- \+ Broad range of scrap qualities
- \+ Sheet molding possible
- – Compounding very challenging

Milling

- \+ Broad range of scrap qualities
- – loose fibers
- – conductive dust
- o Compounding possible
- – Severe fiber breakage

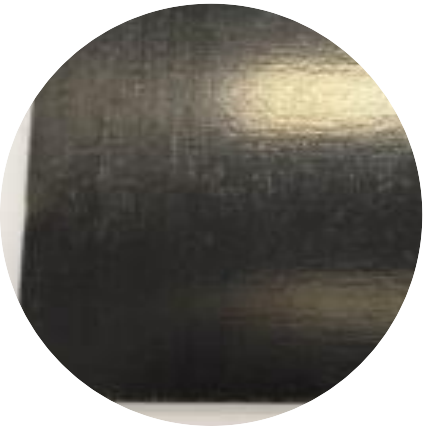
Guillotine cutting

- o Requires specific scrap quality
- – Post processing (sieving)
- \+ Fiber length retention
- \+ Sheet molding possible
- \+ Compounding possible

New Life Cycle Possibilities

Sheet core material

- Limited mechanical requirements
- Composite cost reduction



“Marble” products

- Structural parts
- Aesthetic applications

Compounds

- Tailored products for
  - Injection molding
  - Extrusion
  - 3D Printing

Compounds

With Tailored Properties

Size reduction:

- Balance between maximum fiber length and **optimal „chips“ size**

Compounding:

- Special fiber **feeding equipment** needed
- Processing setup limits **maximum fiber content**
- Fiber- **masterbatch** or final product
- Final fiber length determined by **compounding setup & molding**
- Additive and Blend Polymer selection to **tailor material properties**

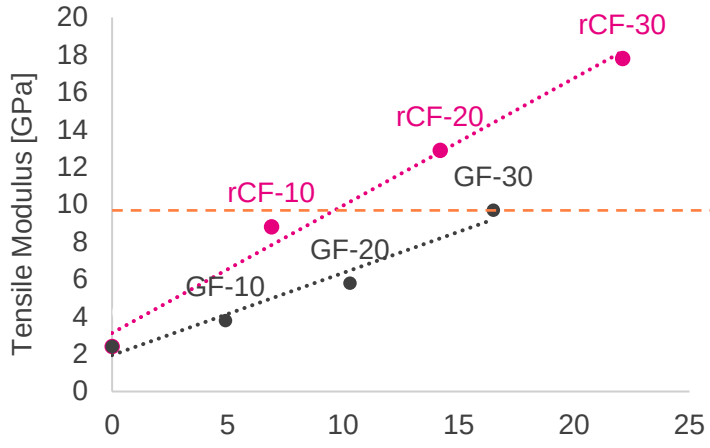
Carbon-Fiber Reinforced Polycarbonate Compounds

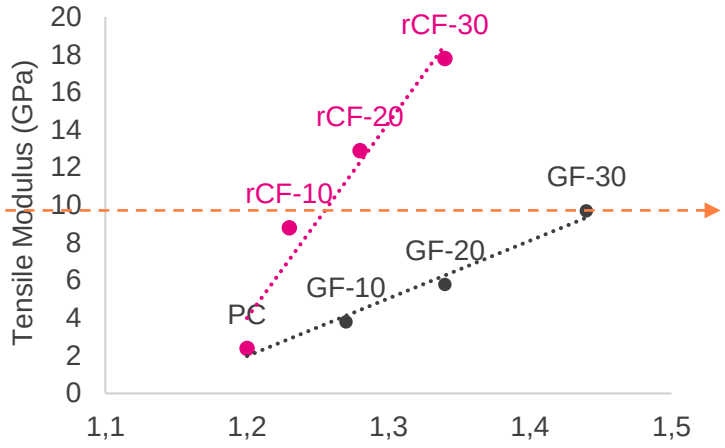
High stiffness & low density

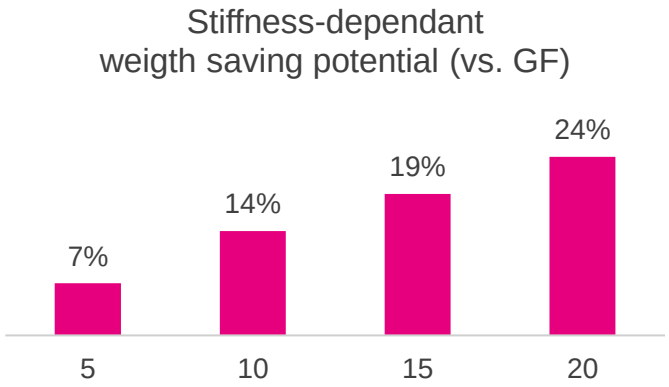
- **Lighter** and **thinner** parts possible

Polycarbonate based for

- Good **toughness**
- High **dimensional stability**
- High **heat resistance**

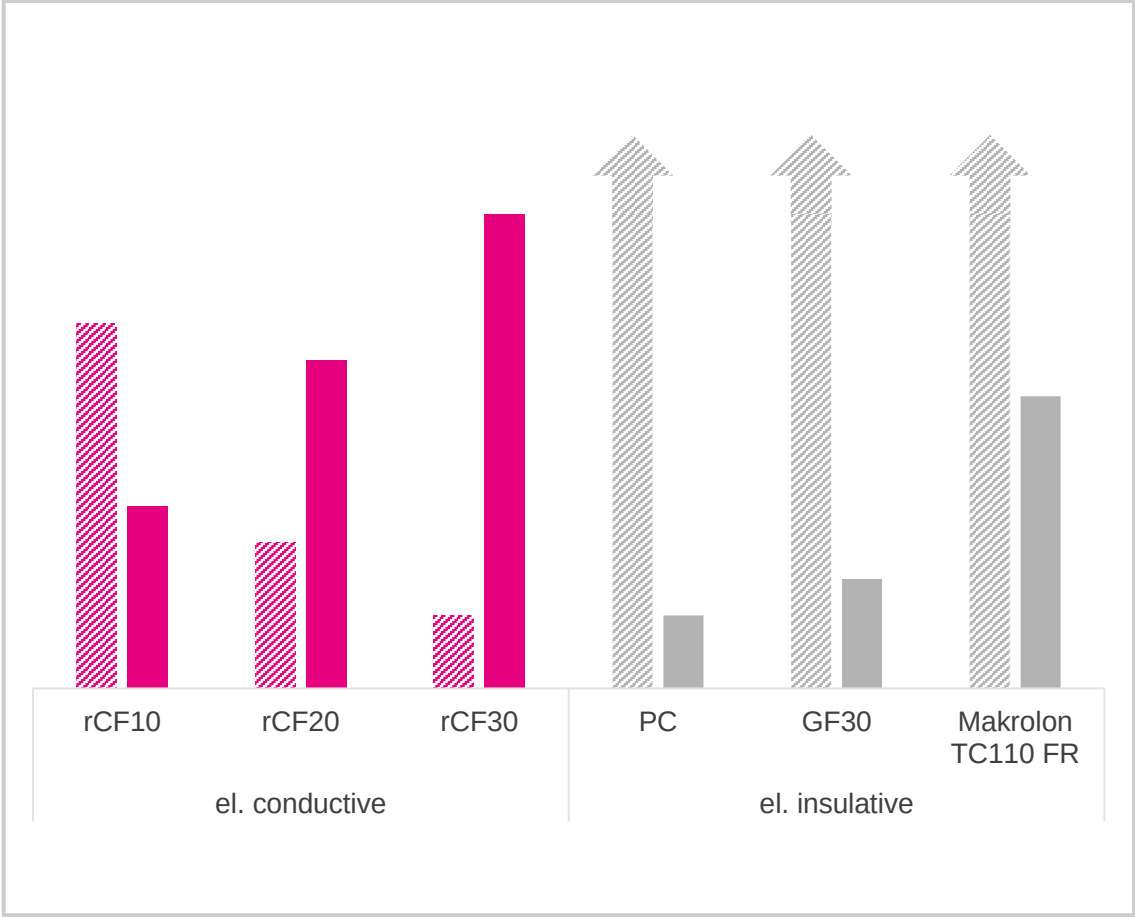






Conductivity

Of Carbon Fiber Reinforced Compounds



CF reinforced Polycarbonate offers additional **thermal conductivity**, similar to mineral filled Makrolon® TC110 FR, while beeing **electrically conductive.**

Additional property – Design

High perceived value material

Anthracite graining

Cool touch

Special glossiness of carbon fibers

Marble

The other route

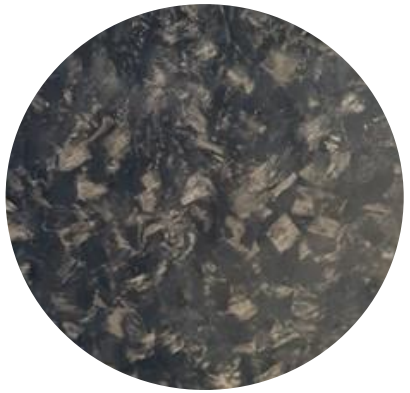
Marble PIR **structural**

- Material for thick walled cavities
- Varying wall thickness possible
- Long cycle times

Source: Nägeli Swiss AG

Marble PIR **aesthetic**

- Recycled carbon look
- Flakes with varying sizes
- Challenges: reproducability, coatability



Marble aesthetic

- Novel carbon look
- Flakes with clear sizes
- Challenges: processing knowhow required

Where can it help?

- Reduce weight and wall thickness of…
  High stiffness and good flowability
- Save space of…
  High stiffness and good flowability
- Dimensional accuracy of…
  Low CLTE
- Anti static…
  Electric conductive
- EMI shielding…
  Electric conductive
- Cool touch & heat dissipation of…
  Thermal conductive

Structural parts

What kind of applications?

High-end hand-carry parts	Transportable battery cases	Reduce weight and space
Protect batteries	Battery covers	(Limited) EMI shielding
Display backcover	Laptops, screens	Reduce weight and space
Stiff-thinwall parts	Propeller, lamella	Increase size

Advantages

In a nutshell

Stiffness Tensile/flexural modulus	+20 - 50%
Dimensional Stability Shrinkage/CLTE – flow dir.	+55 - 90%
Thermal Conductivity In plane (x/y)	+60 - 85%
Electric conductivity 1/Ohm*cm	EMI
Flame retardancy UL94V	similar

Makrolon® PC-GF average properties

Makrolon® PC-rCF average properties

Advantages

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YOUR REQUIREMENTS	**Lets tailor together**	

Makrolon® PC-GF average properties

Makrolon® PC-rCF average properties

Thank you for your attention

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RE-duce

RE-use

RE-cycle