



Keen to be Green

**Increasing sustainability in
composite resins manufacturing**

Introducing AOC

Composite Resins and Solutions for Multiple End Use Markets

**Transportation, Industrial, CIPP/Relining, Wind, Consumer,
Building & Infrastructure, Marine**



Keen to be Green

**Working Together as
Composites Industry**



**European
Green Deal**

**General pressure
on Greenhouse
Gas Reduction**

**Desire for
Increased Product
Circularity**

**Interest for
investing in Green
Companies**

**Consumers want
more Sustainable
products**

**Increasing cost of
Electricity, Gas,
Carbon**

Composites are Great in Sustainability

**Composites save weight, reduce fuel
and emissions, insulate heat, minimize
maintenance**

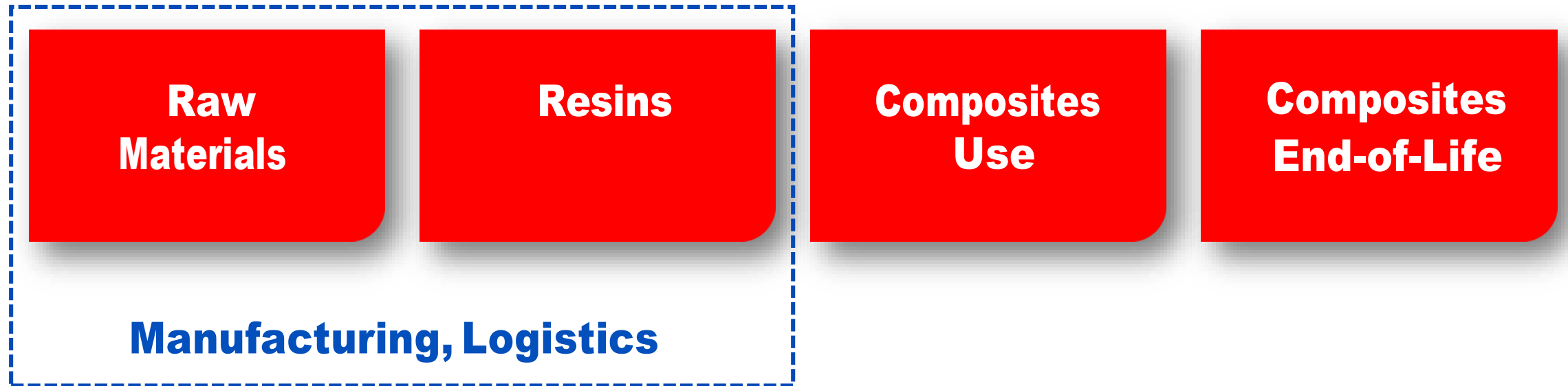
**Enabling technologies for sustainable
platforms like Wind energy, CIPP/Relining**

A photograph of an industrial facility, likely a refinery or chemical plant, with various pipes, tanks, and structures under a blue sky with white clouds. The image is partially obscured by a blue semi-transparent box containing text and a red diagonal graphic at the bottom right.

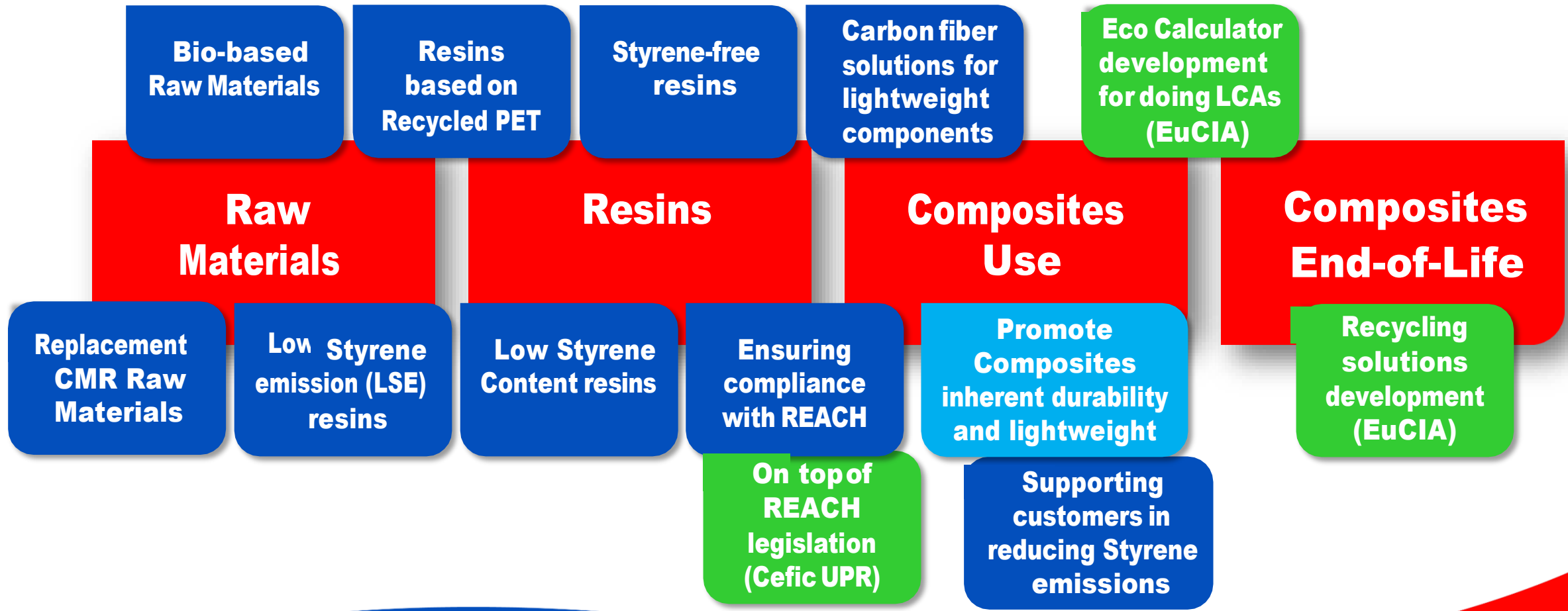
Sustainability also key for long-term continuity of business operations in the entire value chain

- **Keeping our people and our customers' employees healthy**
- **Minimizing waste generation and GHG emissions to the environment**
- **Saving cost associated with lower energy and water usage, and with lower GHG emissions**

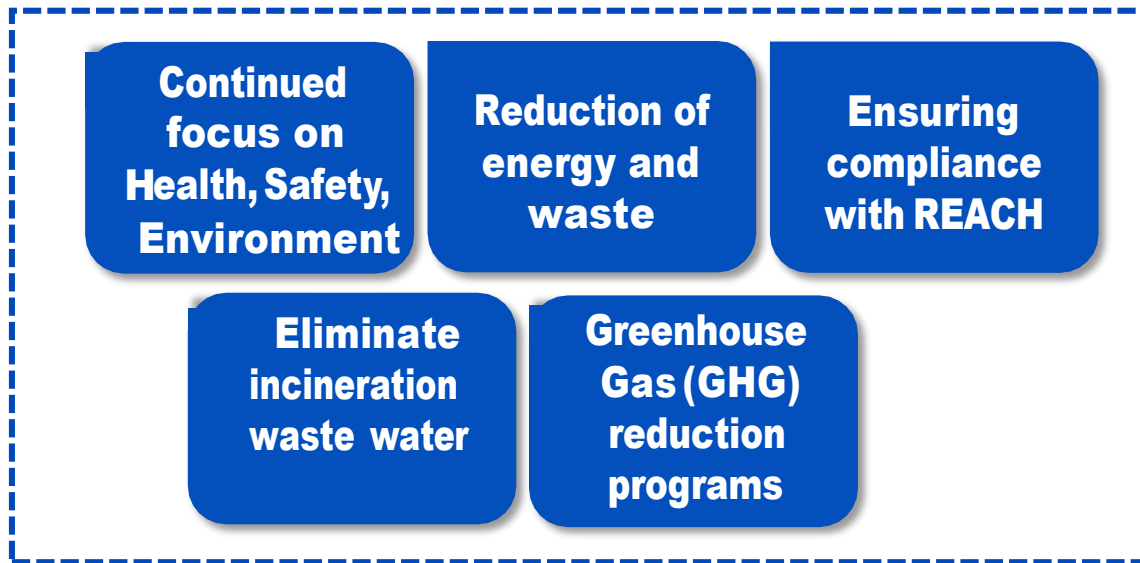
AOC Actively Involved in Increasing Sustainability Throughout the Supply Chain



Many Actions and Programs in Place



Multiple Programs to Improve Sustainability of Operations



Manufacturing, Logistics

External Certification by EcoVadis

- **EcoVadis is independent company providing Sustainability Ratings**
- **Have been rating AOC's ESG performance (Environment, Social, Governance)**
- **Comparing with Chemical Industry benchmark**
- **Assessment based on evidence provided by AOC**

Great Result:

- **In 2021 rating AOC Europe received Gold Rating**
- **Within the Chemical industry, AOC was in the top 5 % (!)**



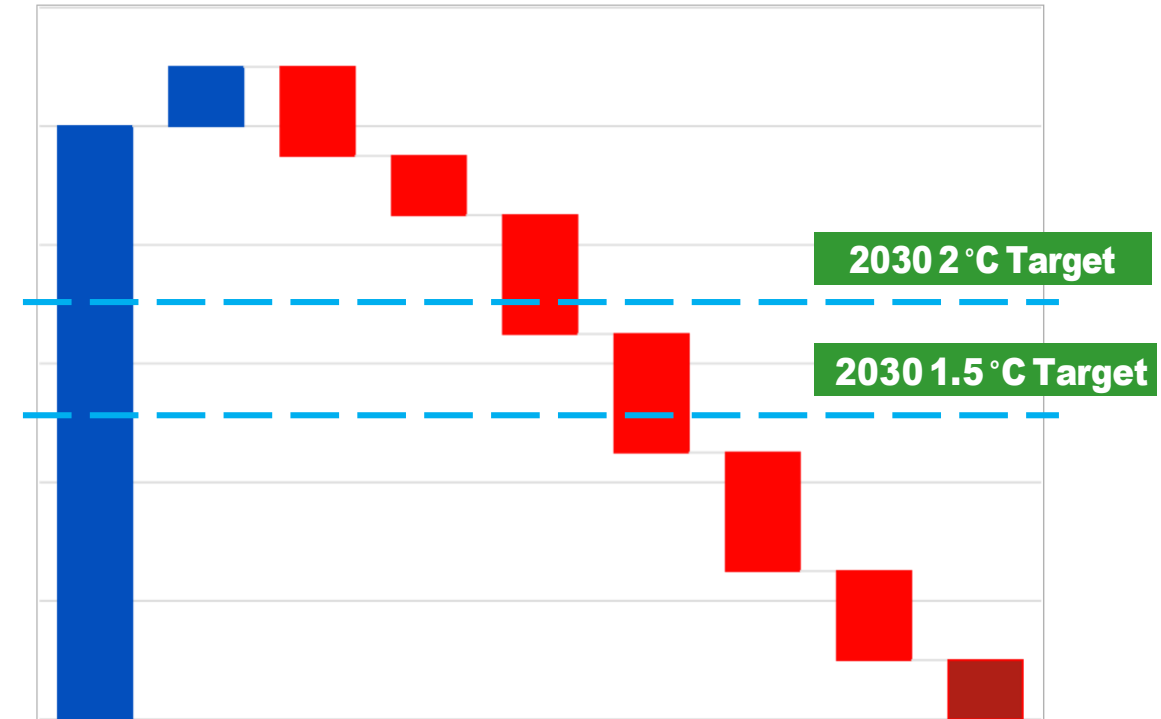
Great Example: Saving Energy, Reducing Emissions in Filago Operations

- **Project team to identify opportunities for reduction of energy GHG emissions Filago site**
- **Digital measurement devices installed in main power units**
- **External company to audit the operations**
- **Reducing energy and emissions:**
 - **Invested in a new Co-generator unit, supplying both electrical and thermal power to Filago site**
 - **Replaced light sources by energy-efficient LED lighting,**
 - **Installed pump inverters enabling to better regulate power in line with actual pump volume demand**
 - **Better heat insulation of steam and oil distribution pipes**



Ongoing Actions for Reducing Greenhouse Gas Emissions

- **Identification of GHG Emissions for Scope 1 (AOC Operations) and Scope 2 (Purchased Energy)**
- **Definition of measures and investments to reach 2 and 1.5 °C targets**
- **Also, what is required to close the gap to zero**
- **Clearly, long term focus is required**
 - **This includes looking at Scope 3 (Suppliers and Customers)**



Introduction Next® Eco-label

- **Sustainable resins from AOC**
- **For better identifying products that help to reduce emission of VOCs, use feedstock from bio-sources or recycled waste streams, or minimize environmental footprint**
- **Includes Styrene-free, bio-based, recycled raw materials (e.g. PET), VOC-free**



Many Next™ Products Already in Place

Beyone™ 120-Q-01 Styrene-free Vinyl ester resin with photo-initiator system	Beyone™ 410-N-01 Multi-purpose Styrene-free VE resin for making formulated resin systems	Beyone™ 420-A-01 Styrene-free resin for putty applications	Beyone™ 620-Q-01 MgO thickenable Bisphenol-A free, styrene free ORTHO/NPG resin for UV-cure CIPP/ Relining	Beyone™ 650-Q-01 Styrene-free Vinyl ester resin used for UV-cure CIPP/ Relining of laterals/ house connections
Beyone™ 700-T-01 FC Styrene-free Vinyl ester resin used for Hot cure CIPP/ Relining of Drinking water	Beyone™ 805-N-01 Styrene-free MgO thickenable VE resin for structural SMC applications	Contact Us For More Products We will help you choose the perfect resin solution. CONTACT US	Beyone™ 806-H-01 Styrene-free, modified solution of PVAC for low profile surface applications	Beyone™ 820-H-01 Modified solution of polystyrene in styrene, for low shrink applications
F421-TMA-30 Terephthalic resin based on recycled PET for Filament winding	H432-WZBG-10 Terephthalic resin based on recycled PET, used in Sanitary applications	L050-LCW-03 FC Styrene-free Vinyl ester resin for UV-cure CIPP/ Relining of drinking water pressure pipes	Palapreg® H 2700-01 Solution of a Saturated Polyester in styrene for Premium Class A SMC	Synolite™ 0513-N-0 Monomer free unsaturated polyester resin for Pigment paste
Synolite™ 1112-G-1 Unsaturated polyester Casting resin for Cultured marble and Polymer concrete	Synolite™ 1275-A-1 UPR casting resin for Cultured marble and Polymer concrete	Synolite™ 9193-N-0 Free-flowing molding powder used for electrical and consumer appliance		



And many New
Next™ Products
will Follow

Increased Use of Bio-based Resins

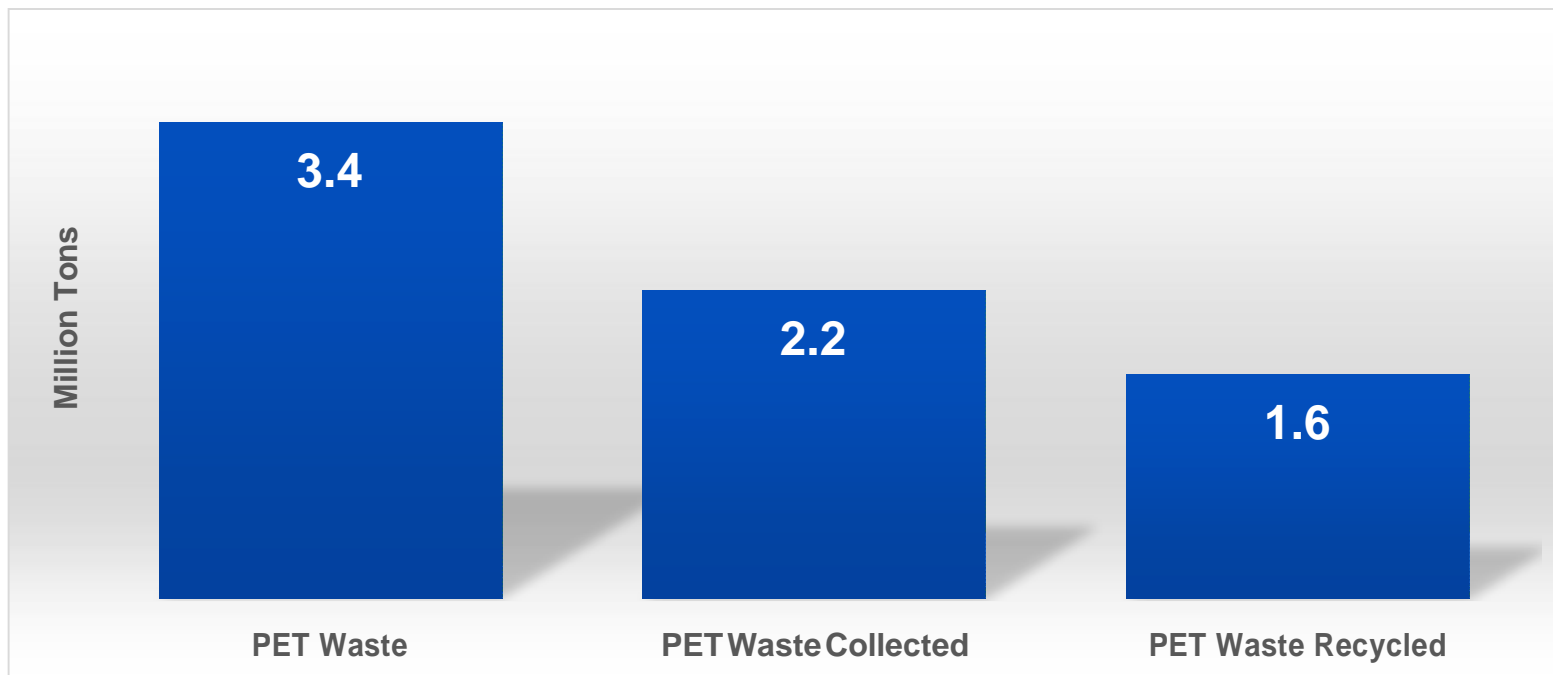
- **Reduce dependence on fossil-based raw materials**
- **Additional opportunities for sourcing security and in some cases performance improvement**
- **Bio-sourcing sometimes brings lower Eco-footprint, not always**
- **Our experience: customers like better performance**
- **But are reluctant to pay just for “bio feature”**

Resins Based on Recycled PET



Opportunity in Europe to Better Use Recycled PET

Valuable resource for making synthetic resins



Source <https://www.icis.com/explore/resources/news/2020/12/30/10590184/insight-european-plastic-bottle-recycling-held-back-by-structural-shortage-of-feedstocks>

Re-Use of rPET into Quality Resin Formulations

- **Giving these valuable resources a second life**
- **Improving material circularity**
- **Reduction of consumption of virgin raw material, with associated reduction of energy and GHG emissions**
- **Meeting the performance requirements of our customers**
- **Creating sustainable products using AOC manufacturing technology**
- **Combination of post-consumer waste and industrial waste**

Increasing Circularity

Building Up Volume Since 2015



**25 kTons of
resins based on
Recycled PET**



**Equivalent to
105,000,000
PET bottles**

Potential Changes for Styrene Occupational Exposure Limit (OEL) in Europe

- **At present, the legally defined OELs for Styrene differ between EU member states**
 - Ranging from 10-100 ppm
 - 20 ppm is most common
 - 20 ppm is also the DNEL in Styrene dossier (Health-based)
- **EU Commission and ECHA are to develop a single, EU-wide OEL for Styrene**
 - Consultations are expected to start in 2022, completion anticipated in 2-3 years
- **Cefic UPR committed to ensuring safe use of UP/ VE resins throughout supply chain**
 - Support the industry in applying the correct safety precaution measures and technologies
 - Example: series of Safe Handling Guides available in several languages (<https://www.upresins.org/safe-handling-guides/>)

Styrene Emissions Survey by Cefic UPR

- **Cefic UPR is conducting a survey of UPR/VE resin uses among downstream Industrial and Professional users across EU**
- **Important for the UPR/VE industry to provide data supporting the safe use of styrenated resins across all uses supported under the REACH regulation**
- **Data will be used to build a picture of UP resin use in EU, to confirm safe use, and to identify areas where future support may be required**
- **Please participate in the Survey through this [link](#)**

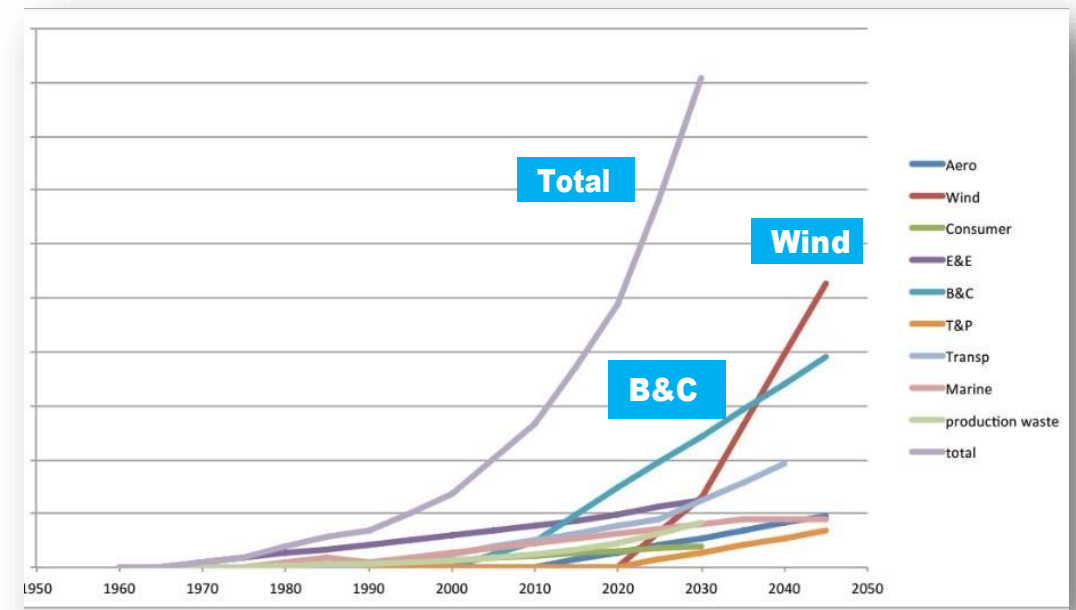
AOC Actively Participating in EuCIA Sustainability Working Group



- **Estimating overall composite waste streams across markets and applications**
- **Define routes for true recycling**
- **Understand differences waste management legislation across Europe**
 - **Local legislation differs for cross-border transport and waste management**
- **Identify new technologies for Composites recycling**
 - **Make better use of material benefits at affordable cost**

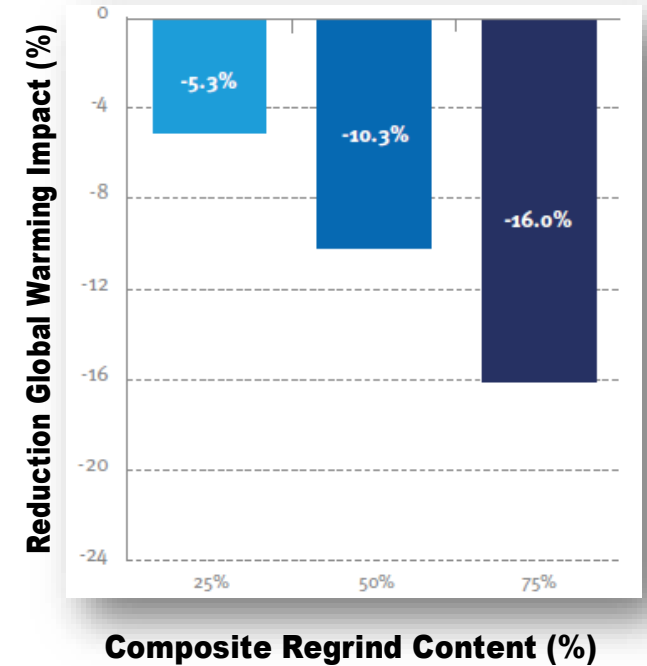
Composite Waste Predicted to Grow Significantly

- **EuCIA is developing model based on GDP growth, application start, life expectation**
- **Different dynamics per industry and end-use market**
- **Still work in progress: data validation is ongoing with different stakeholders**
- **Composite waste only fraction of total waste streams**



Recycling through Cement Co-Processing is Commercial at Industrial Scale

- **Re-use of valuable raw materials plus energy recovery: reduction of CO₂ footprint**
- **Easy to manage regrind, also in scale up**
- **Economically viable at present**
 - **Process in operation at Neowa and Holcim (D)**
- **So far only suitable for glass reinforced composites**
- **Early studies indicate positive LCA effects**
- **Desire to better recuperate composite waste stream**
 - **Combine into larger quantities**



Size Reduction On-Site vs. Size Reduction at Recycling Operation



From Parts to Small Chunks to Cement



Using Composites in Cement Co-Processing can Make Cement Manufacturing Greener

- **Use of composite waste in cement production reduces the amount of primary raw materials (replaced by glass fiber and other fillers in composites)**
- **Presence of CaO in glass fiber reduces the CO_2 emission during the cement production where normally CaCO_3 is used that needs to be de-calcinated (under the forming of CO_2)**
- **Use of the caloric value of the composite waste avoids the use of primary fossil fuels**
- **Intimate mixing of the fuel (resin) and the raw material (glass fiber + fillers) for the cement production increases efficiency of the fuel substantially and therefore reduces CO_2 emission**

Mechanical Recycling Well Established, Yet Small in Volume

- **Conversion of composite parts and components into fine fibers and powders**
 - **Already in use for over 30 years**
- **Re-use as small percentage in new formulations**
- **Also use in non-traditional Composites applications, with positive LCA effect**
- **Knowledge built up through Ercom experience**
 - **Commercial recycling company ~25 years in operation**
- **Difficult to manage powders and fibers: risk of creating waste**
- **Not competitive (yet) with use of virgin raw materials**
 - **E.g. in high speed thermoplastics compounding**
 - **Re-use in critical applications like Wind Turbine blades not envisioned**

New Recycling Solutions under Investigation, including Pyrolysis, Solvolysis

- **Bringing back cured resins into new raw materials**
- **At different stage of investigation and scale up**
- **Key challenge is to handle fibers**
 - **Ensure fiber length and properties can be maintained**
- **Requires separation of liquid fractions that can be reused**
- **Potential recycling routes for carbon fiber**
 - **For glass not competitive (yet) with use of virgin raw materials**
- **LCA impact not yet understood (likely higher energy requirement)**



Keen to be Green

**Working Together as
Composites Industry **Now****

AOC

Trusted Solutions

Contact us for more information

We will help you choose the right resin solution.

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