

TECNOPOLO

Innovazione sostenibile

Composite materials recycling

Perché MUSP a Piacenza?



UCIMU-SISTEMI PER PRODURRE

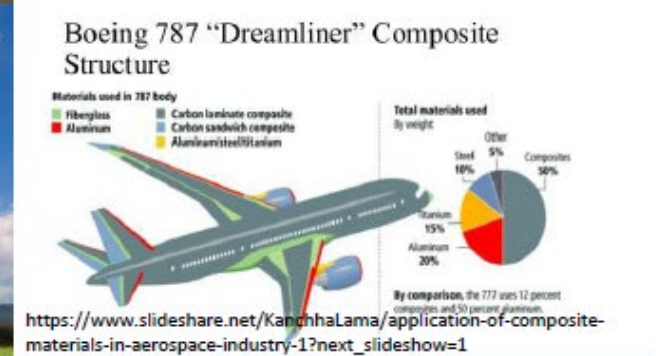
Nasce nel 2005 come Consorzio

Sede indipendente da quelle dei soci

- **Obiettivo: supporto alla competitività delle imprese**
- Sviluppo di soluzioni ad alto livello di innovazione tecnologica



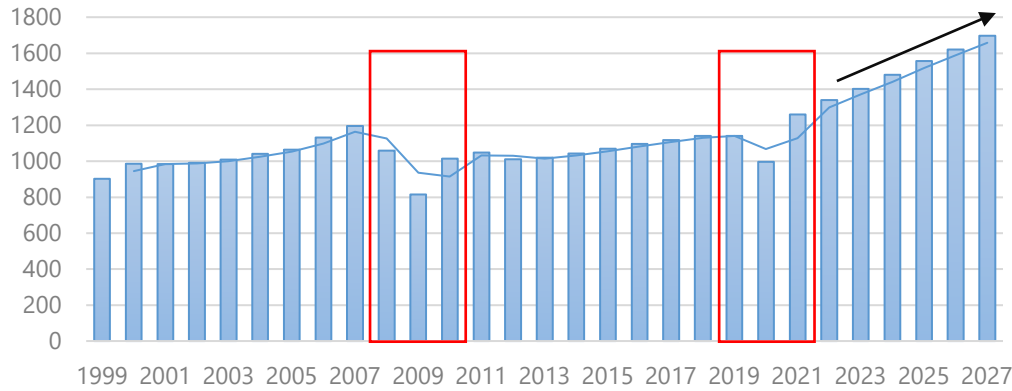
Composite materials recycling



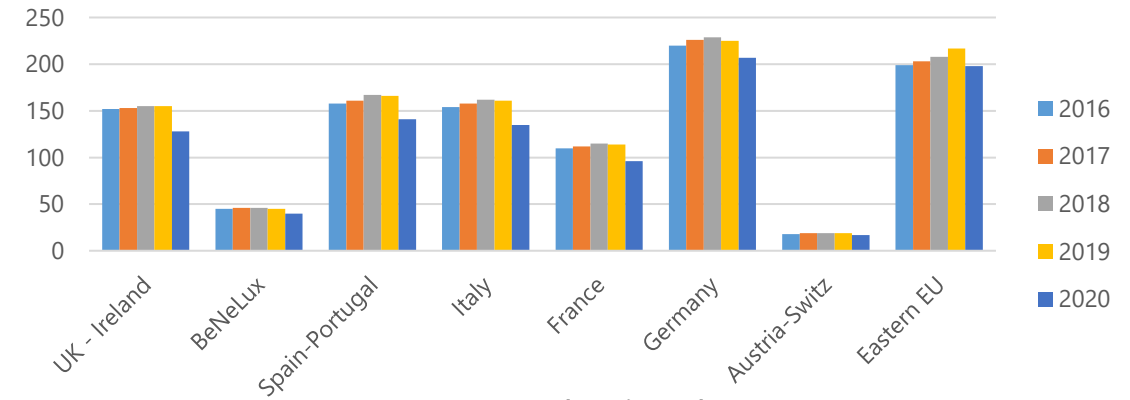
GFRP general trend

Il mercato mondiale dei compositi è in rapido aumento. Il 95% di questo mercato è composto da compositi rinforzati con fibra di vetro (**GFRP**).

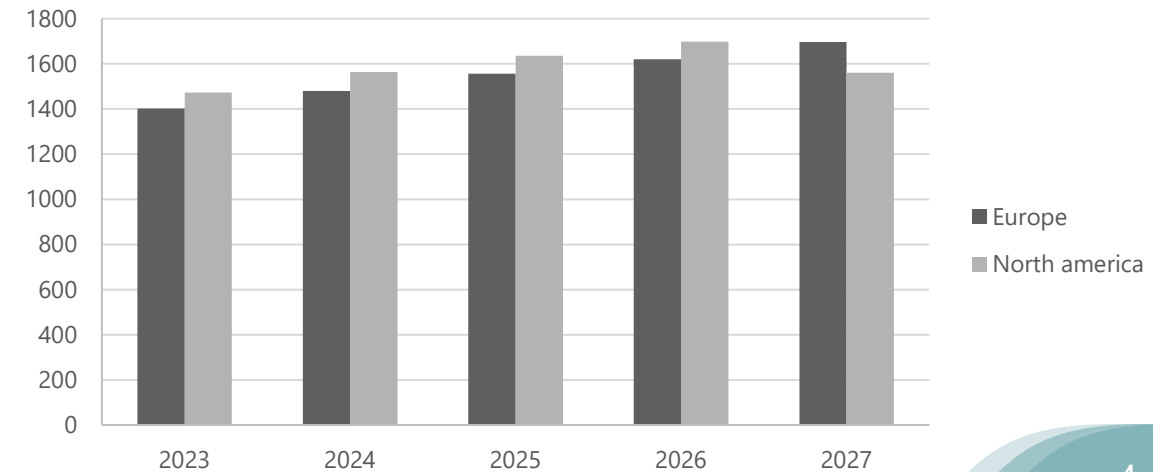
Produzione (kton)



Produzione GFRP by EU countries (kton) - 2016 - 2020

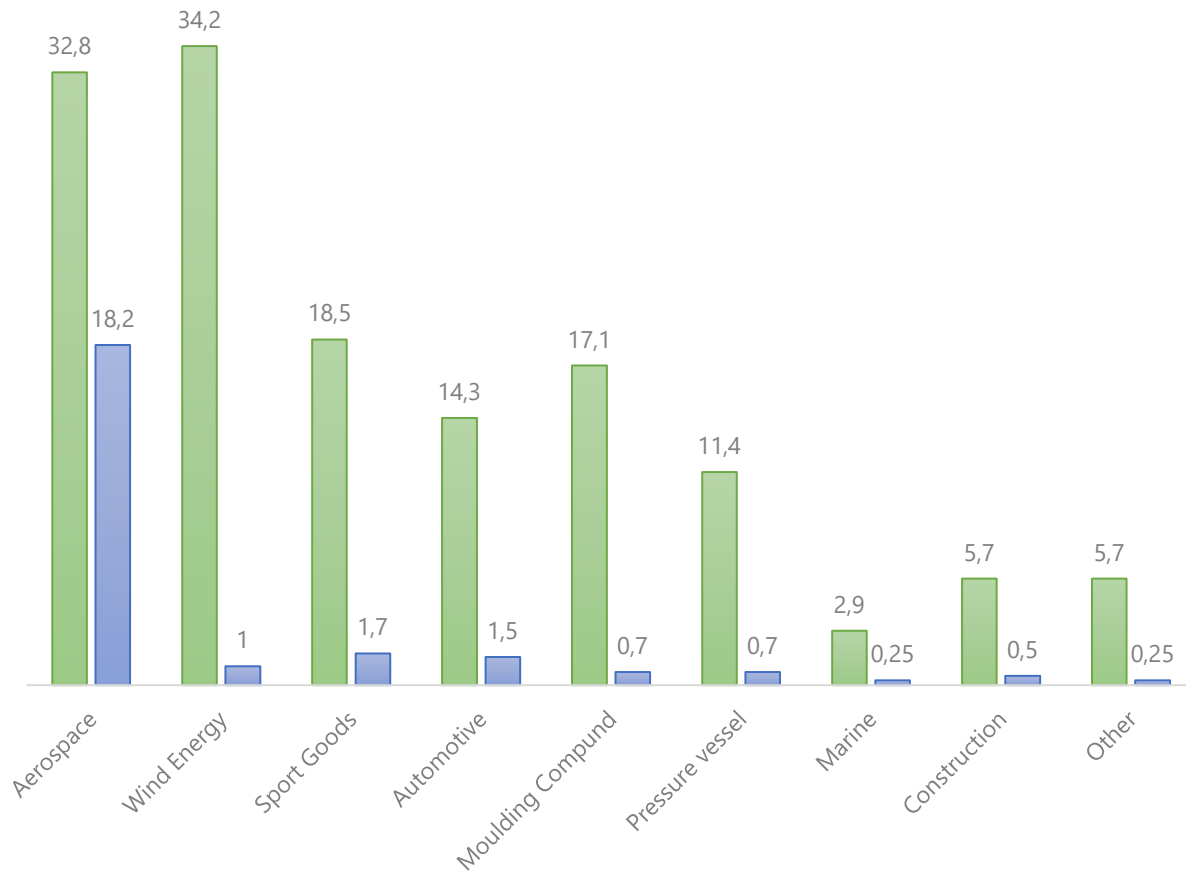


GFRP production (kton)

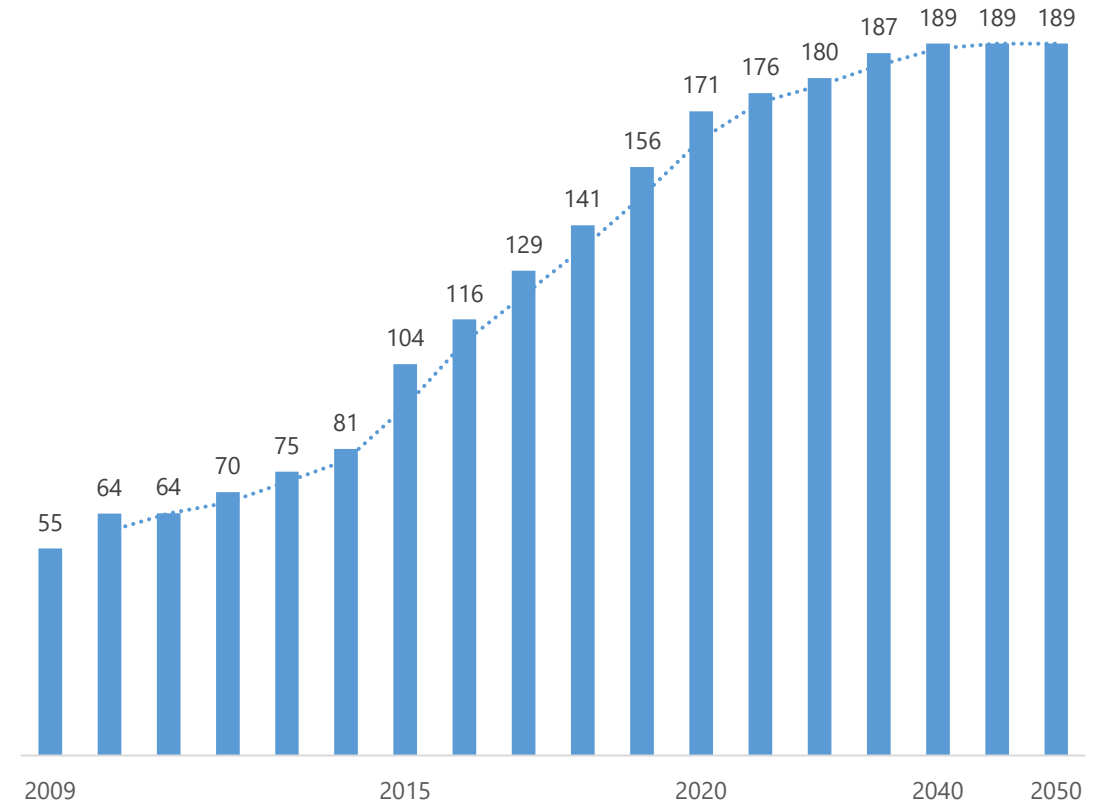


CFRP general trend

- Domanda - applicazione (kton) - 2018
- Domanda - vendita (US \$ billion) - 2018

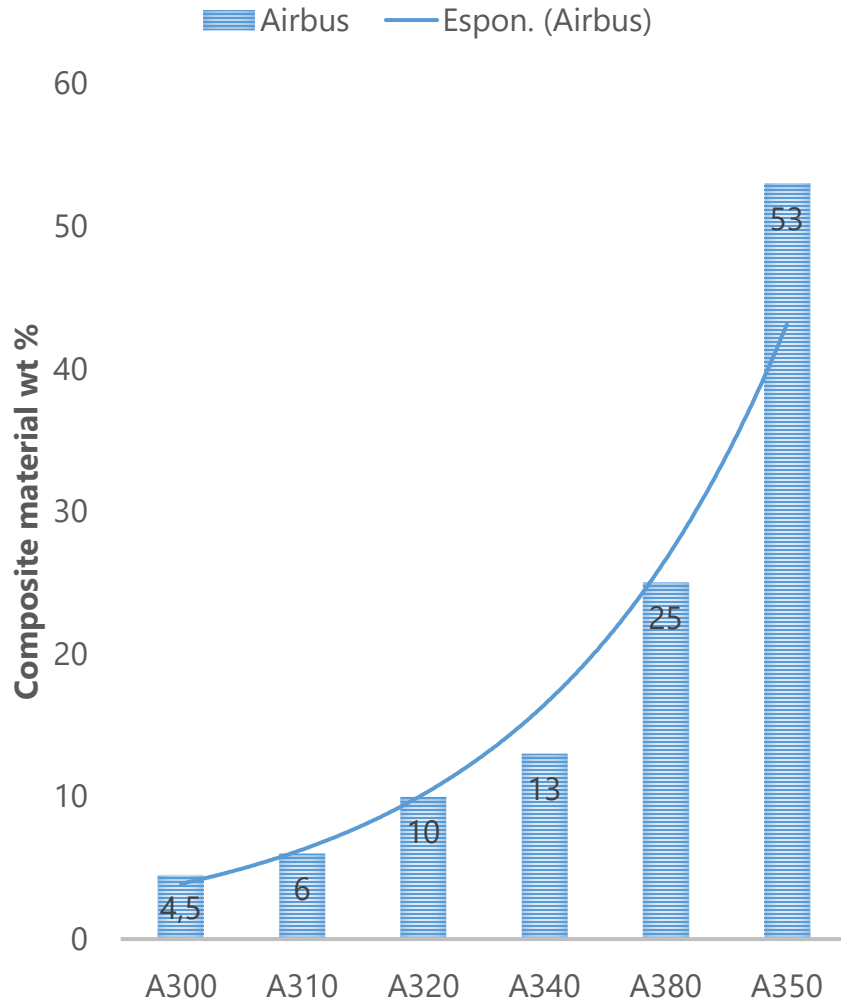


Previsione della domanda (kton) – 2009 - 2050





Aerospace

AIRBUS



The Xtra innovative technology

The A350 XWB makes all the difference in airline efficiency

ADVANCED TECHNOLOGY

- 6 identical, interchangeable **SCREEN DISPLAYS** → More comfort & clarity for the pilots
- Optimised **ELECTRICAL ARCHITECTURE** → Weight savings
- LITHIUM ION BATTERIES** → Weight savings and easier maintenance
- CONNECTED AIRCRAFT** data-ground → Efficient in-advance maintenance operations that support better air traffic management

CABIN

- State of the art in-flight entertainment
 - Fibre optics
 - High-definition video
 - Individual seat monitors
- Advanced **air conditioning technology** → Multiple cabin zones for optimised temperature control
- LED mood-lighting** → Reduced jetlag effect & greater passenger comfort

AIRFRAME

- 70%** advanced materials combining **COMPOSITES, TITANIUM AND MODERN ALUMINIUM ALLOYS** → Corrosion-free and fatigue-free → 25% lower operating cost
- New **CARBON FIBRE REINFORCED PLASTIC** fuselage → Lower fuel burn & easier maintenance

ENGINE

- NEW ROLLS-ROYCE TRENT XWB ENGINES** → -25% CO2 emissions per passenger than current generation aircraft → **LOWEST CARBON EMISSIONS** of any wide-body power plant

AERODYNAMICS

- 4 PANEL CONCEPT** associated with ultra-long panels → Weight savings & easier maintenance
- Nearly **ALL-COMPOSITE 32-METER** wings → More lift & less drag and fuel burn

WINGS CHANGE THEIR SHAPE

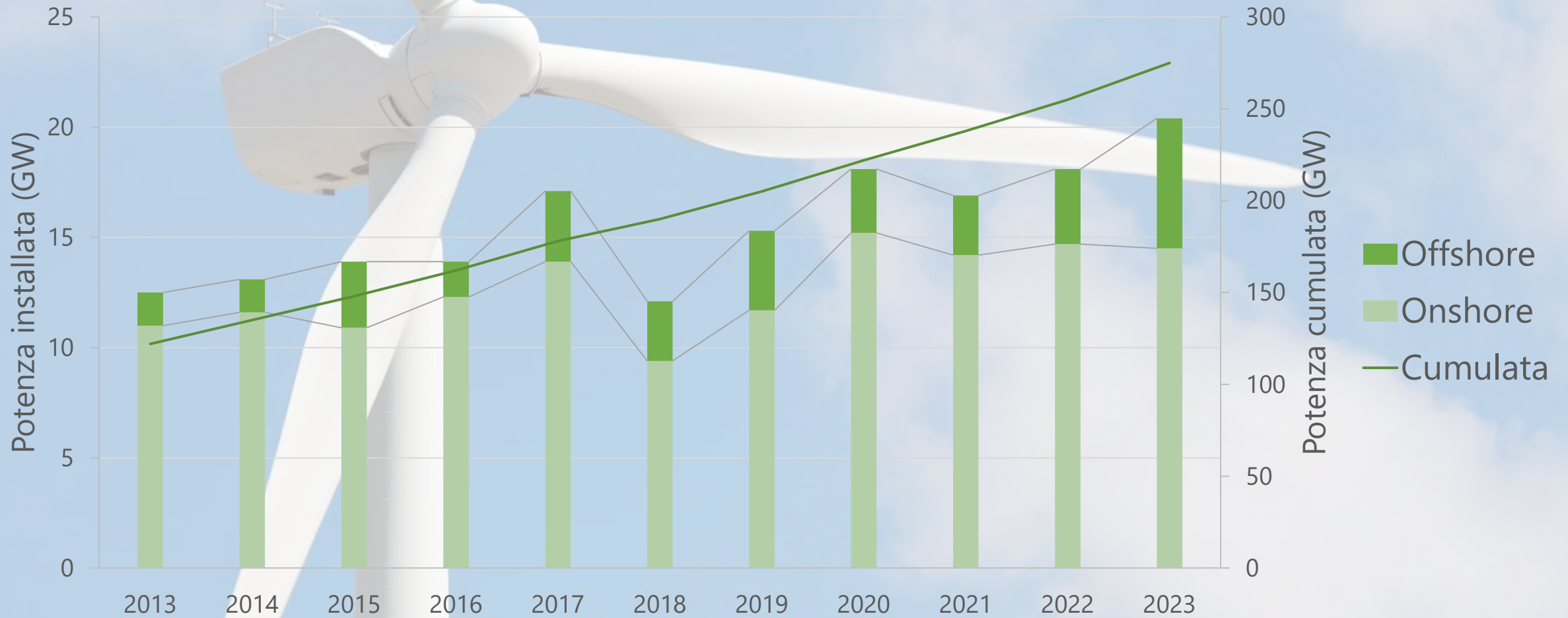
for maximum aerodynamic efficiency throughout the flight → **Reduce wing drag**

A350 XWB

The Xtra that makes the difference

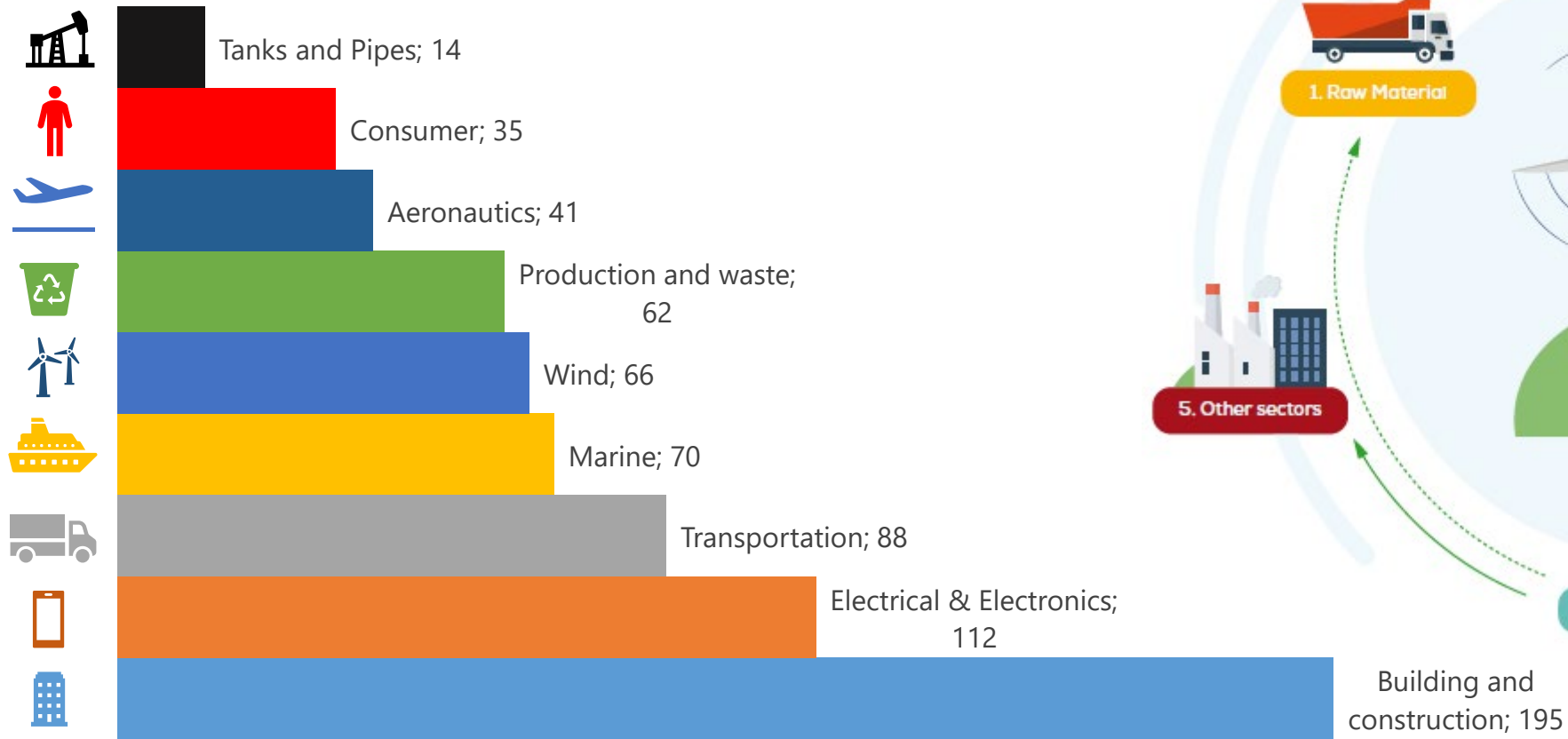
Wind energy

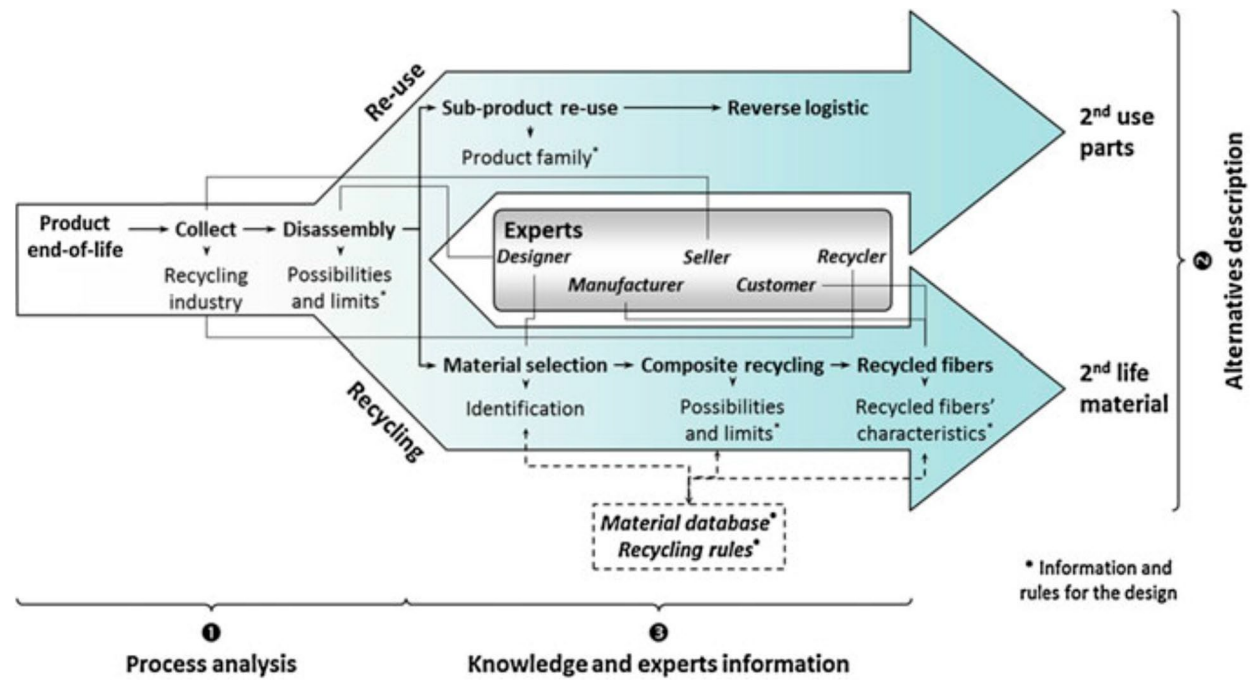
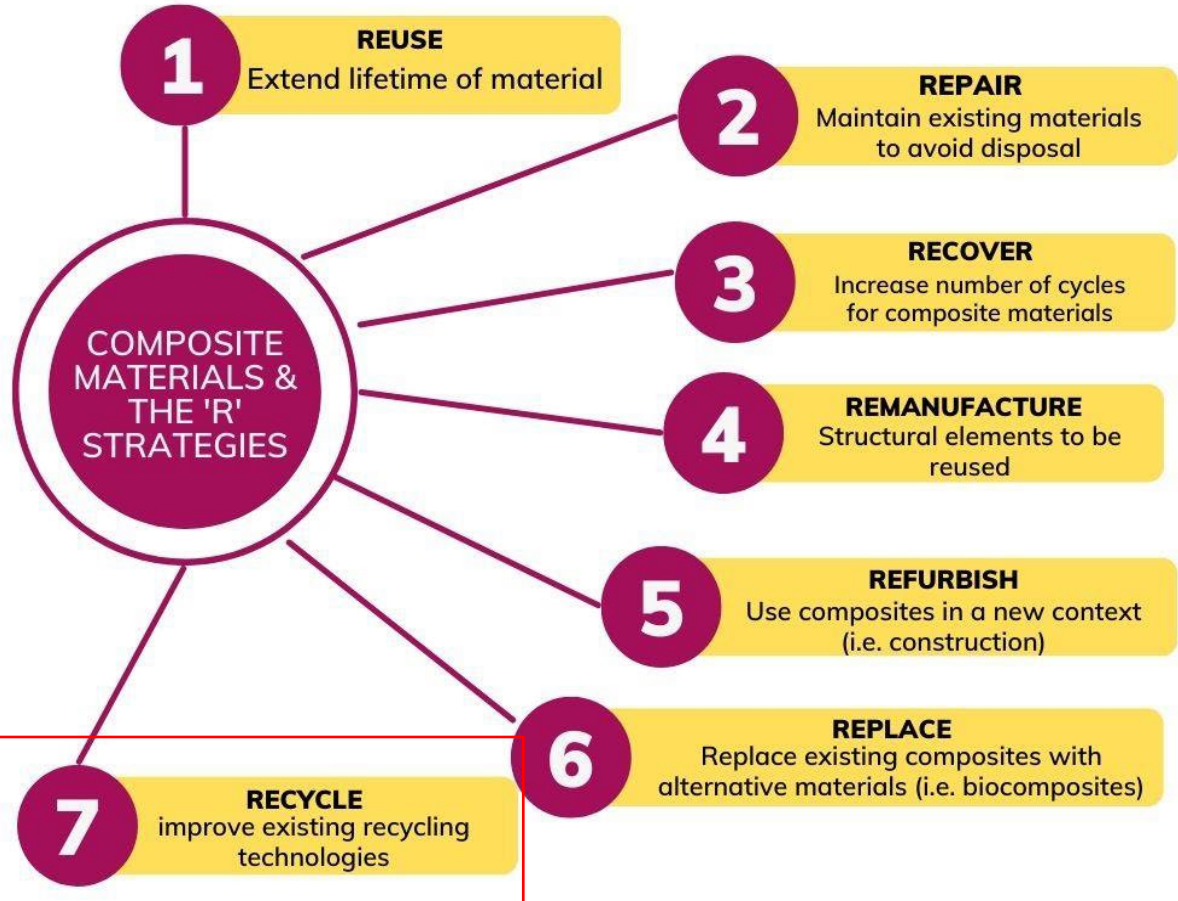
Gross annual wind turbine installations in Europe



Fonte: <https://windeurope.org/wp-content/uploads/files/about-wind/reports/WindEurope-Accelerating-wind-turbine-bladecircularity.pdf>

Volume di materiale composito in migliaia di tonnellate nel 2025

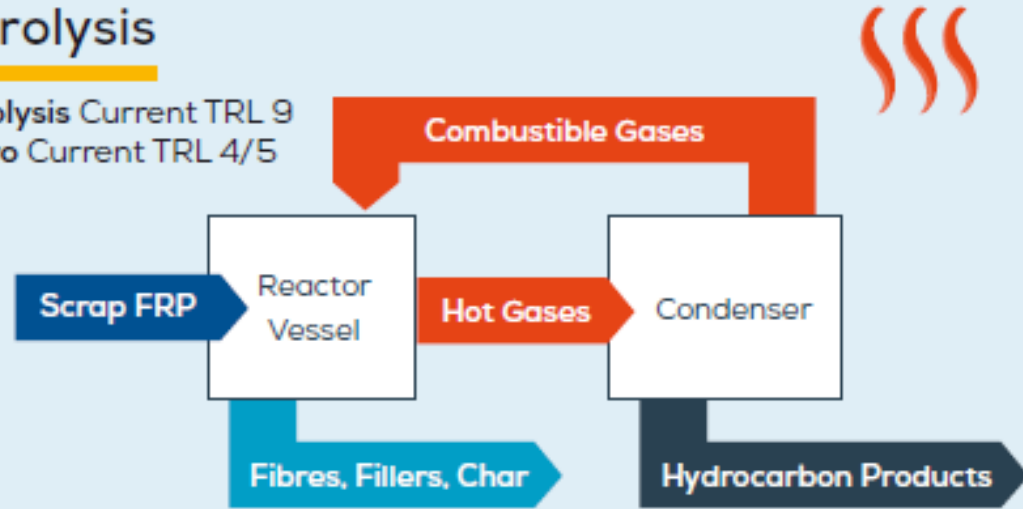




Processi e tecnologie

Pyrolysis

Pyrolysis Current TRL 9
Micro Current TRL 4/5



Strengths:

- Pyrolysis gas and oil can be used as energy source in the same process or in chemicals production;
- Easily scaled up;
- Microwave Pyrolysis: easier control. Lower damage to the fibre.

Limitations:

- Fibre product may retain oxidation residue or char;
- Degradation of the chemical structure of fibres;
- Not yet economically viable.

Point of attention:

- Potential leaks of gases from waste treatment chambers.

Mechanical Grinding

GFRP Current TRL 9
CFRP Current TRL 6/7



Strengths:

- Efficient and high throughput rates.

Limitations:

- Cost efficiency;
- Low quality of recyclate. High content of other materials;
- Up to 40% material waste.

Point of attention:

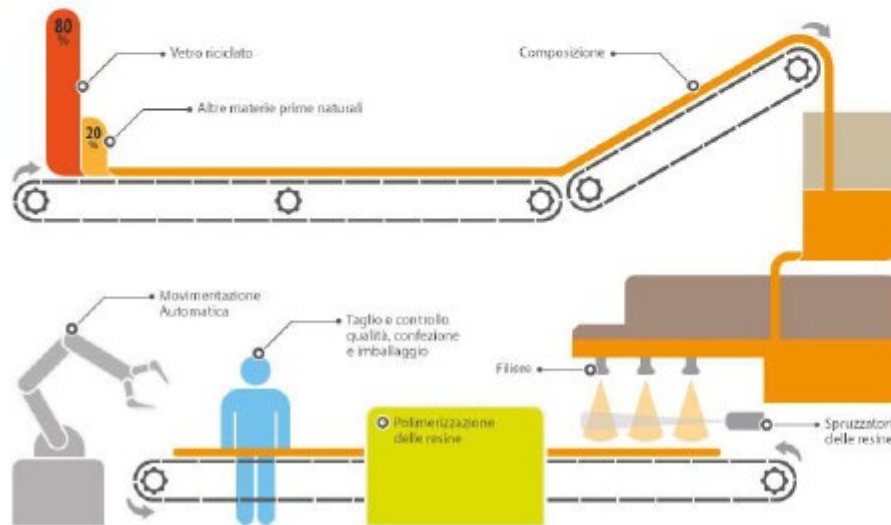
- Requires dedicated facilities with closed protective area to limit environmental impacts.

Riciclo

Come riusare le fibre ottenute dopo pirolisi del materiale composito?

FIBRE IN VETRO RICICLATE:

- per ridurre il ritiro nel calcestruzzo aumentandone così la durata;
- come riempitivo nella resina;
- per isolanti in edilizia (lana di vetro)...



Riciclo

Mechanically recycled fibres from wind turbine blades added as short reinforcing fiber to concrete



Precast concrete LEGO type blocks



Precast concrete manhole module



Precast concrete New Jersey barriers



Grazie per l'attenzione



Francesco Perotti, PhD francesco.perotti@musp.net