RE CREATE

Pivotal methodology to implement reused/reshaped CFRCs in A/C Seating improving in-service lifetime

- GEVEN case study in RECREATE Project -

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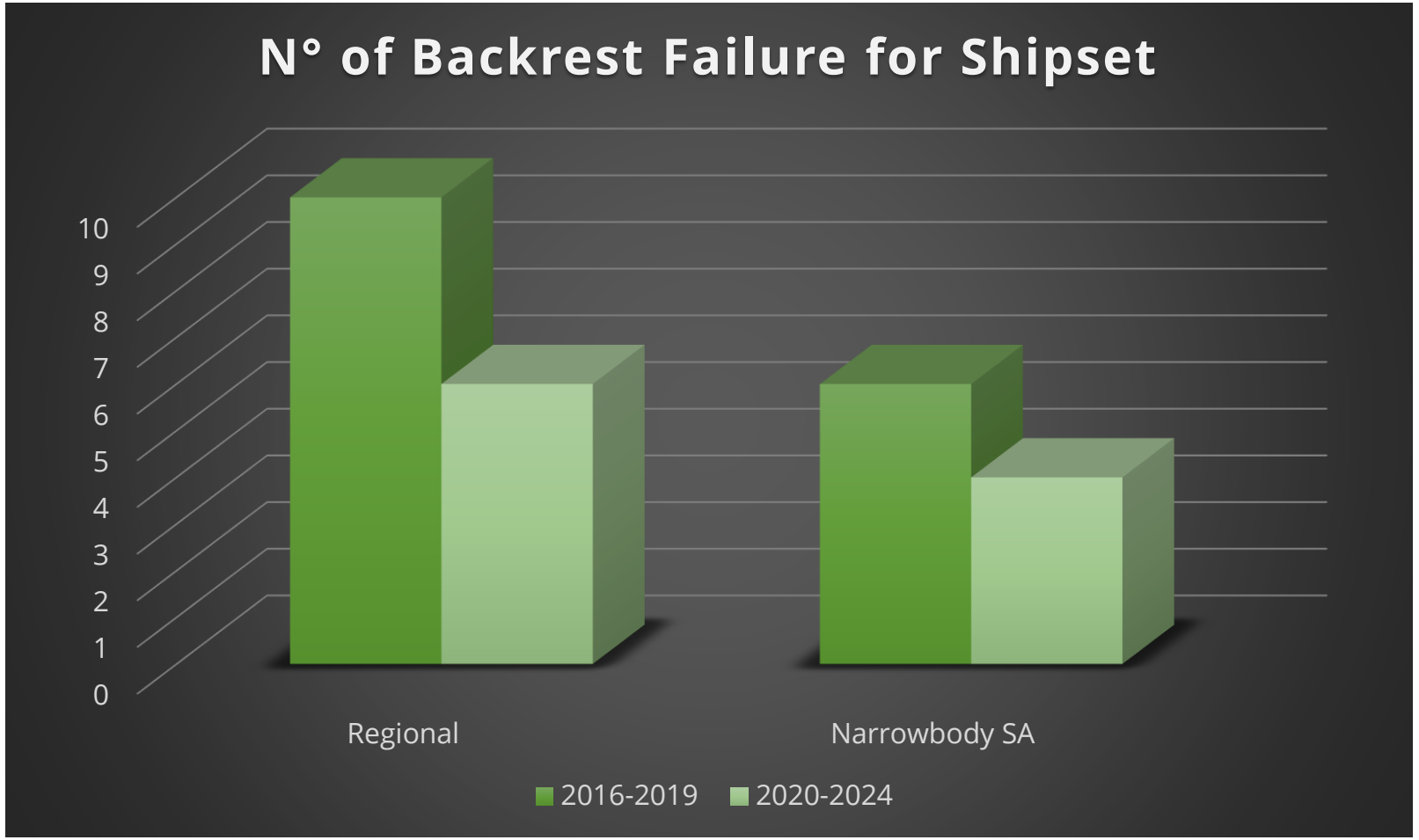
Hook - Problem

It may happen that a minimum number of aircraft seats are replaced for minor local damage.



...we have a problem

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Hook - Problem

But is it really a full replacement needed?

No, as explained below:

- 💸 **High operational costs** for airline companies closed to $ 60k per 6 hours of downtime
- 🌱 **Lower environmental impact** due to waste reduction and manufacturing of composite items
- ✅ **Safety not compromised** if the damage is aesthetic or non-structural
- 🛠️ **Efficient use of resources** by reusing CFRPs coming from EoL composite items
- ✈️ **Industry best practices** prioritizing repairs over non-structural damage

📌 *Conclusion: In the case of minor damages, repairing by reusing is the most logical, sustainable and cost-effective solution.*

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Who are your customer segments

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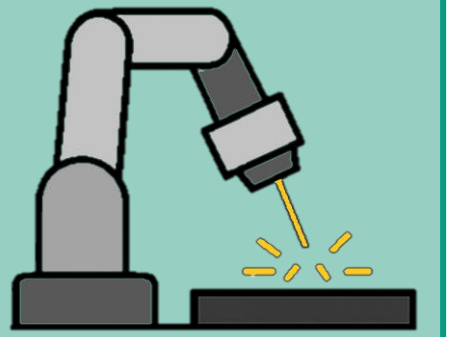
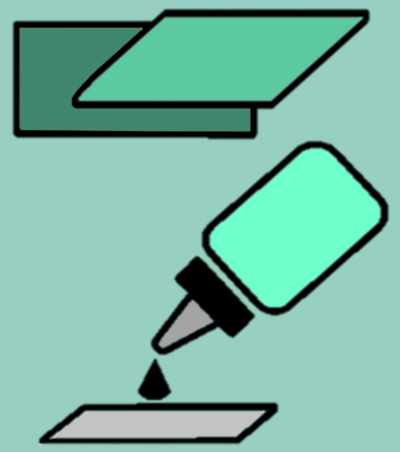
USP & UVP

Novel approach promoted in RECREATE project:

Recovery of composite panels at End of Life



Laser disassembly



Application of patch with reversible adhesive

Circular reuse

- **Recovery material**: UD CF from floor panels in **12k HTS tow**
- **Original seat back material**: Bi-directional CF in **3k twill**

✅ **Result**:

- 💡 **Structural and reliable** repair of minor damage
- 🌱 **Efficient and sustainable** solution

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USP & UVP

Novel approach promoted in RECREATE project:

1. **Reduced energy consumption**

With the implementation of laser dismantling technology, energy consumption is reduced by 30% compared to virgin CF extraction, making it the most environmentally friendly method with approximately **139.68*** MJ/kg (compared to approximately 200 MJ/kg of embodied energy in virgin carbon fiber) .

2. **Reduction of CO_2 emissions**

In total, recycling processes can achieve a representative GWP of -19 to -27 kg CO_2-eq and PED of -395 to -520 MJ per kg CFRP, ensuring superior environmental performance compared to conventional composite waste treatment practices (e.g. incineration of ground composite in clinker kilns).

3. **Optimization of the cost structure**

The reused materials are reintroduced into the same production process as the master product, without further passive consumption. No additional impact on the work activity is expected since the handling activities during the rolling phase are the same as for the master product. Reduction of landfill disposal costs by about 250-500 €/ton.

**The data on laser dismantling technology are based on values provided by Applus (partner in RECREATE project):*

- **Electrical power (E):** 3.5 Kw
- **Speed Process (V):** 0.05 m²/h
- **Specimen area (A):** 0.01m²
- **Specimen mass (M):** 18g = 0.018kg

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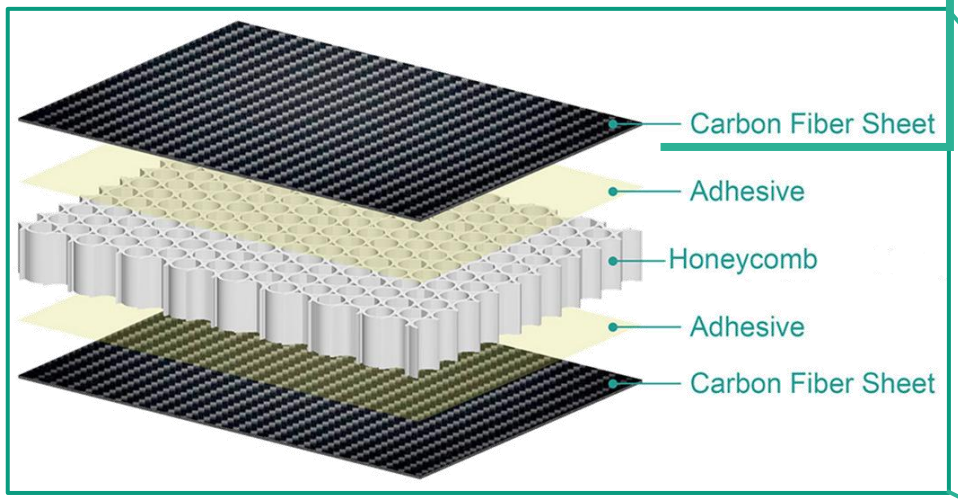
Solution



Reusing for

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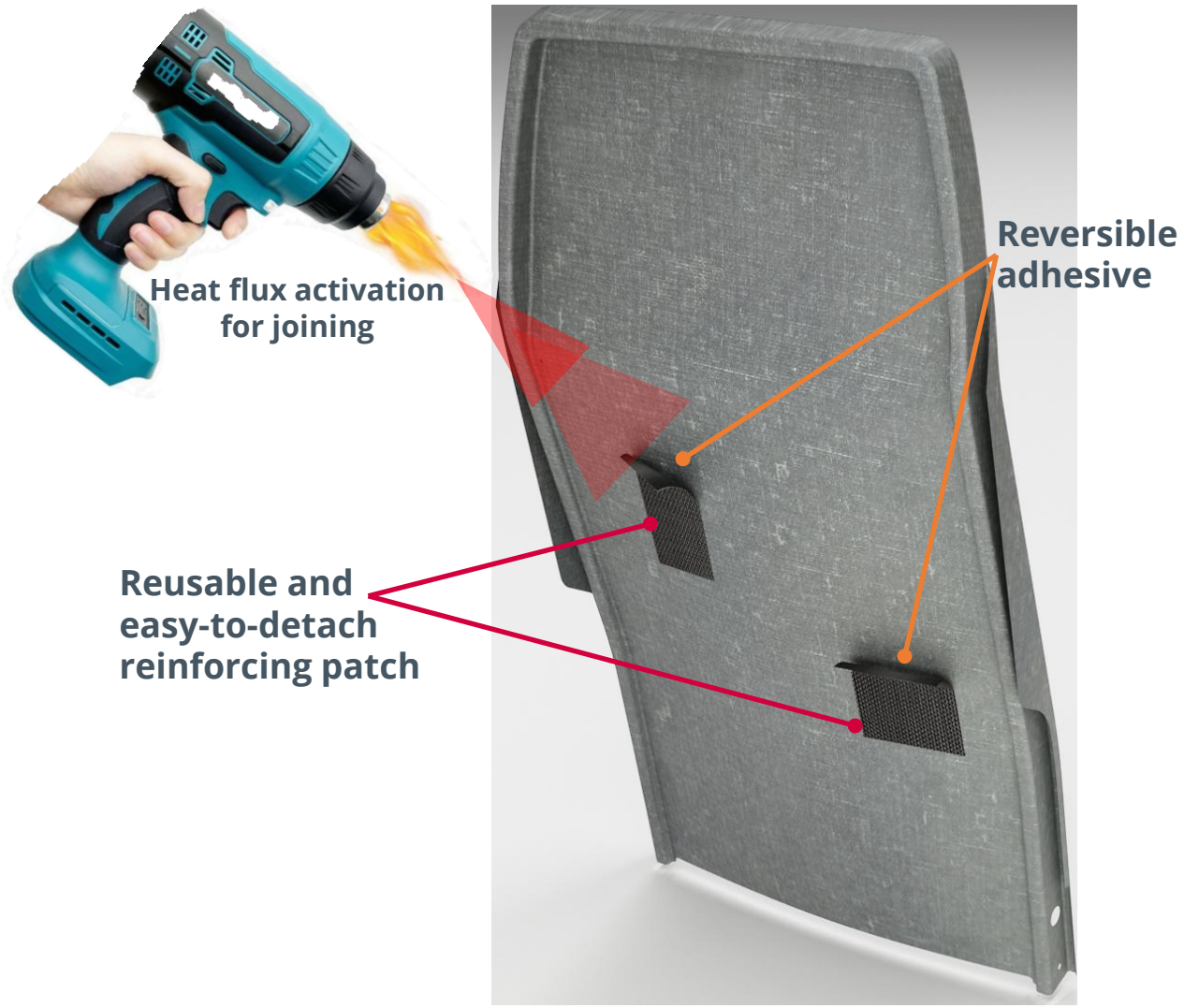
Solution



Characteristics of innovation:

- Novel design methods by implementing reusable reinforcement paths for lightweight composite backrest in aircraft seating
- Reversible adhesive principles utilizing heat trigger to separate components
- Set of methods to reuse CF layers from EoL composite interiors panels to achieve design for circularity
- Lase-shock dismantling technique for composite layers separation and sorting for circular use
- Establishing in-service repairing of damaged aircraft seating for airlines during air travels

Customer benefit:

Challenges

- Reuse and remanufacturing are not possible for current seat backrest design
- Due to thermosetting resins, the dismantling and recycling is not possible without compromising the mechanical behavior

Solution

- Lightweight reinforcement patch from reused composite waste
- Concept of remanufacturing utilizing detachable adhesives

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Competitors

Collins Aerospace

AIRLINER SEAT
PINNACLE®

RECARO

AIRCRAFT SEAT
SL3710

ACRO

AIRCRAFT CABIN SEAT
9

Expliseat

AIRCRAFT CABIN SEAT
TISEAT E2 S-LINE

HAECO

AIRCRAFT CABIN SEAT
VECTOR™ LIGHT

pitch

AIRCRAFT SEAT
ELESA

MIRUS
AIRCRAFT SEATING

AIRCRAFT SEAT
HAWK

AIRCRAFT CABIN SEAT
YC QUADRA

ZIM AIRCRAFT SEATING

AIRCRAFT CABIN SEAT
ZIMUNIQUE

JHAS

AIRCRAFT SEAT
AURORA 2.0

J&C AERO

AIRCRAFT SEAT

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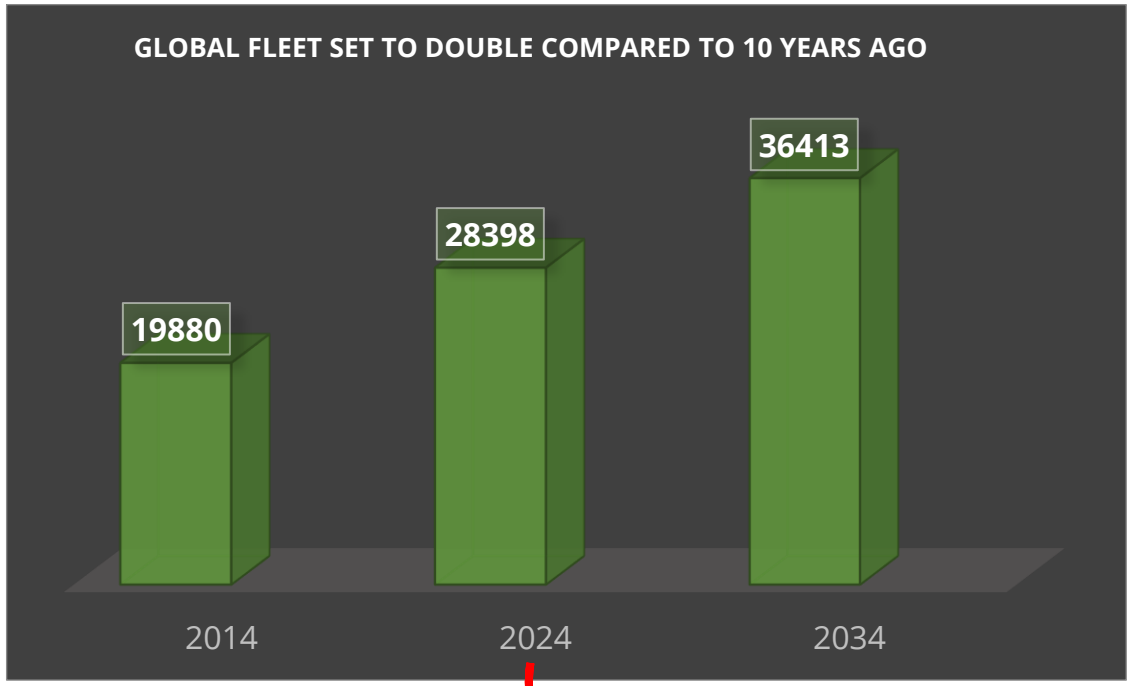
Market size



In Aviation

Growth

Global Air Transport Growth Rate 5% p.a.
= absolute doubling within 15 years

Densification → Efficiency

Reduction of Seat Pitch and Seat Width for more Efficiency

Focus Passenger

„You fly what you…."

- Active Role in Service Provision
- Human Centered A/C Cabin Design

In Society

Demographic Change

"More people travel more often?!"

Higher part of impaired passengers with different reasons → independence focus on mobility

Challenge: *"Keep'em travelling!!*

Set conditions to encourage e.g. older people to travel

Focus! Natural phenomenon age – with decrease of individual physical and mental mobility increase chances of personal fair participation in aviation.

Huge Group – don't miss them.

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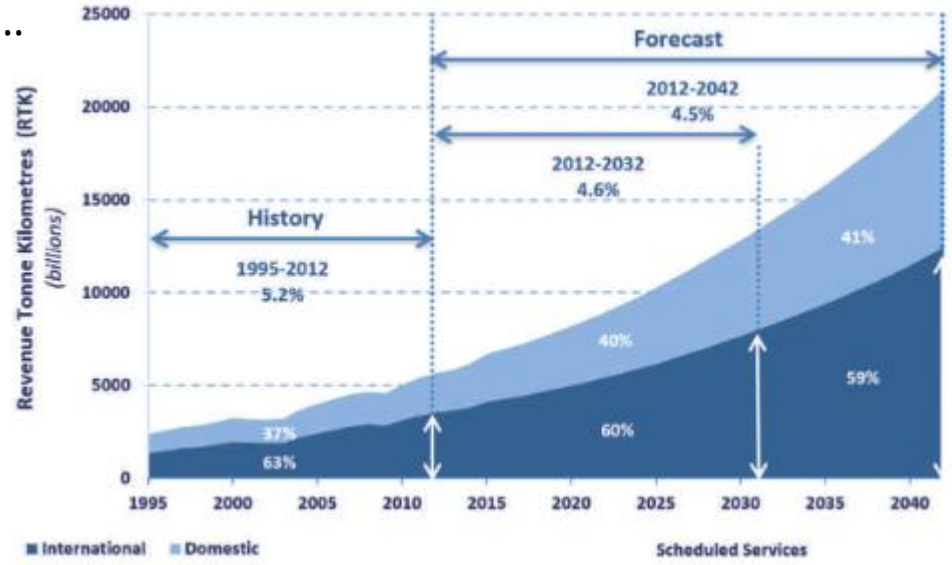
Financials & Growth Projections

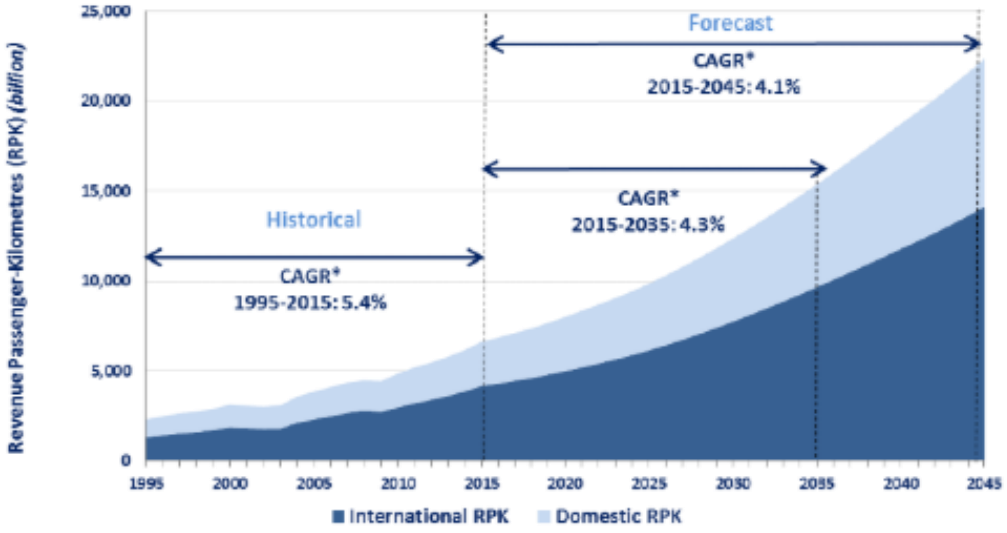
The aviation sector is growing fast and will continue to grow…



"If this growth path is achieved by 2036 the air transport industry will then contribute 15.5 million in direct jobs and $1.5 trillion of GDP to the world economy."

"Once the impacts of global tourism are taken into account, these numbers could rise to 97.8 million jobs and $5.7 trillion in GDP."

…and this growth is not limited to passenger traffic.



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RECREATE Project – IPT

Team

POLIMI Project Coordinator (G. Griffini)

GEVEN Project Coordinator (B. Vitolo)

WP5 Partner Democases

GEVEN Tech. Focal Point (D. Giannetti)

GEVEN Administr. Focal Point (D. Di Maio)

WP5 Leader

EDAG Deliverable/ Output (S. Caba)

LASER DISMANTLING (L. Berthe)
- CNRS
- *FRAUNH*
- *RSC*
- *IRIS*

REVERSIBLE JOINTS (R. Szymanski)
- RESCOLL
- *FRAUNH*
- *EDAG*

REVERSIBLE ADHESIVES (S. Eschig)
- FRAUNHOFER
- *RESCOLL*
- *EDAG*

PE - **SEATS** (G. Guadagni)

PE – **INTERIORS*** (D. Galloppo)

DESIGN (O. Pugliese)

DESIGN (A. Acampora)+ F. Iovino+ M.Madonna)

STYLING (M. Ungolo)

STRESS (A. Palvetti)

CERTIFIC. (A. Riviezzo)

LAB (S. Cicatiello)

HVF DISMANTLING (S. Torvi)
- POLIMI
- *TAU*

GREEN SOLVOLYSIS (M. Diani)
- POLIMI
- *TAU*
- *ICAM*

REVERSIBLE GREEN RESIN (M. Diani)
- POLIMI
- *RSC*
- *BENA*

Legenda

PE: Project Engineering

GEVEN S.p.A.

POLIMI

Correlations among Laser Dismantling, Reversibel joints & Adhesives, HVF Electrofragmentation, Green Solvolysis, Reversible Green Resin

***INTERIORS** includes: **Sidewall panels**

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Intellectual property of GEVEN in last 2 years

102019000019628	Supporto per dispositivi elettronici
102020000001798	Sedile con schienale reclinabile
102020000008956	Dispositivo di separazione per sedili adiacenti
102020000008959	Dispositivo di distanziamento per sedili
102020000018094	Sistema integrato di supporto per dispositivi elettronici in uno schienale
102021000000575	Sedile
102021000000501	Assieme di sedili
102022000012446	Sedile Reclinabile
102022000012449	Tavolino pieghevole e sedile con schienale che lo incorpora
102022000012452	Sedile Reclinabile

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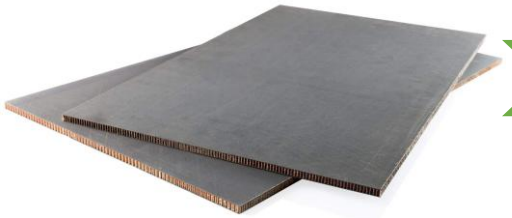
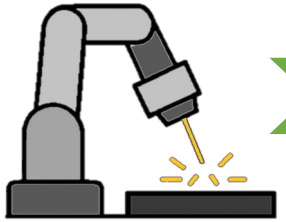
Investment needs

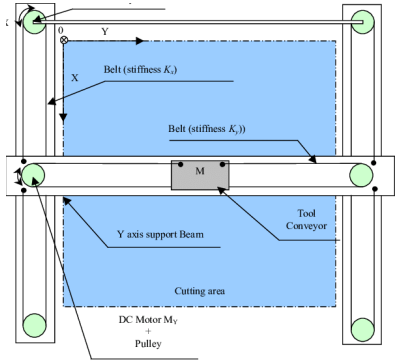
Pilot plant for reuse of CFRPs:



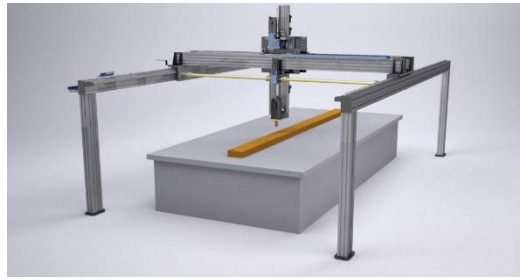
EoL floor panels of A/C cabin (large dimensions)



Laser dismantling for CF skins detouching



Cutting system in the x-y direction



Robot (x,y,z, and rotating wrist in the plane) for withdrawal and storage

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Questions?

Thank you for your attention!

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