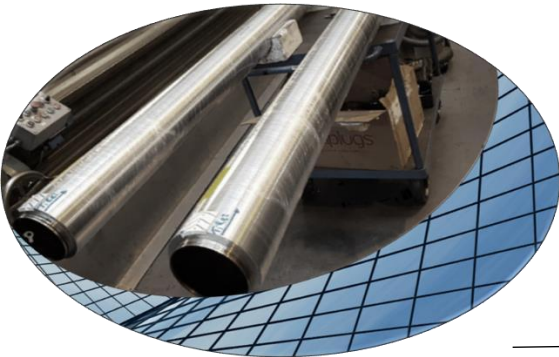
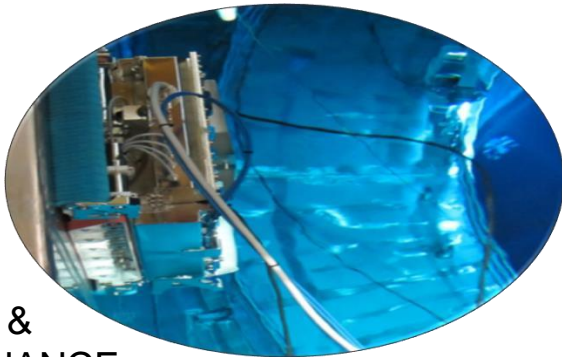


**GLASS INDUSTRY**



SPUTTERING TARGETS

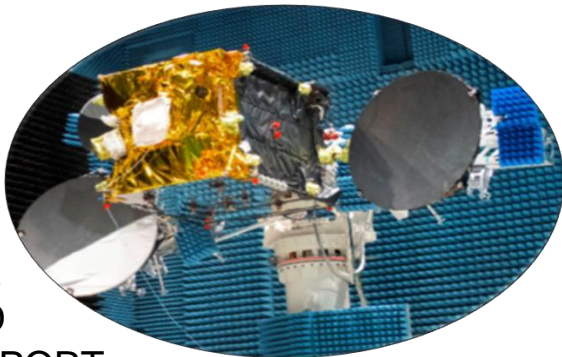
**NUCLEAR**



CLEANING, HANDLING & MAINTENANCE, EQUIPMENT

**SUSTAINABLE BALANCE FOR ECOLOGY & ECONOMY**

**SPACE & DEFENCE**



MECHANICAL GROUND SUPPORT EQUIPMENT

**LIGHTWEIGHT SPECIAL VEHICLES**



UAM  
SPACE  
LOGISTICS  
ARCHITECTURE  
AVIATION  
SEATS  
DEFENCE

# All our Activities contribute to solve global problems



Global Warming



Responsible Consumption



Good Jobs & Economic Growth



Innovation & Infrastructure

NUCLEAR



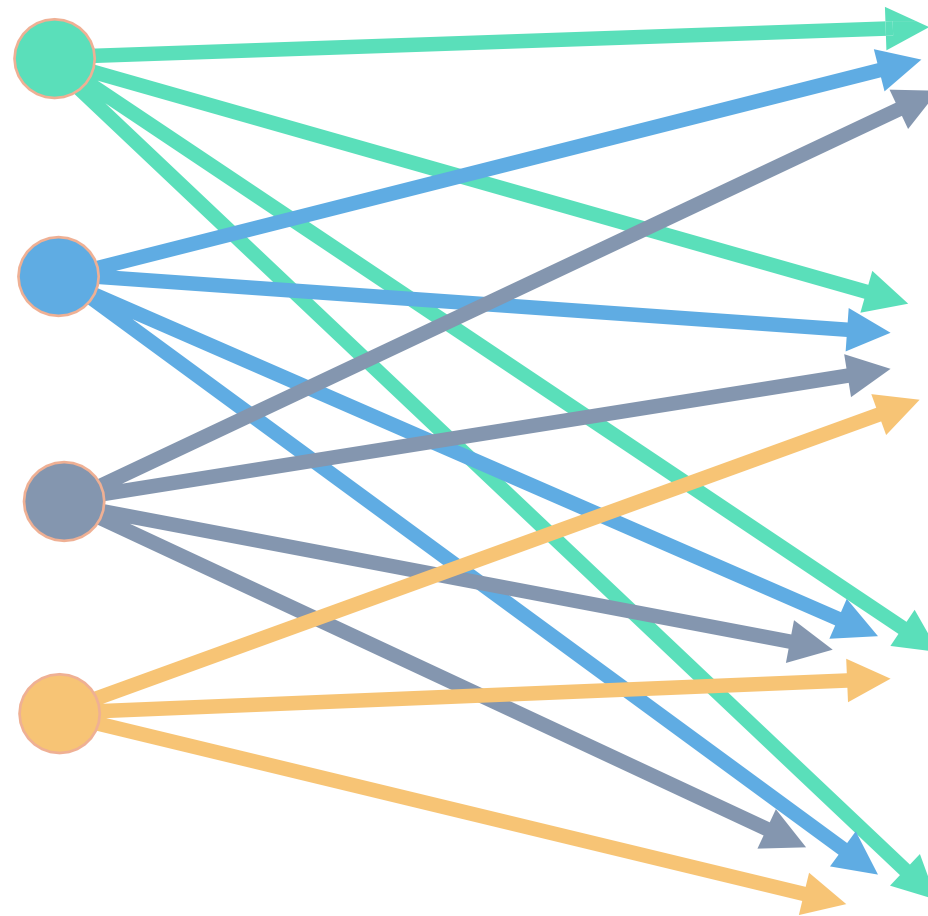
LIGHTWEIGHT



SPUTTERING TARGETS

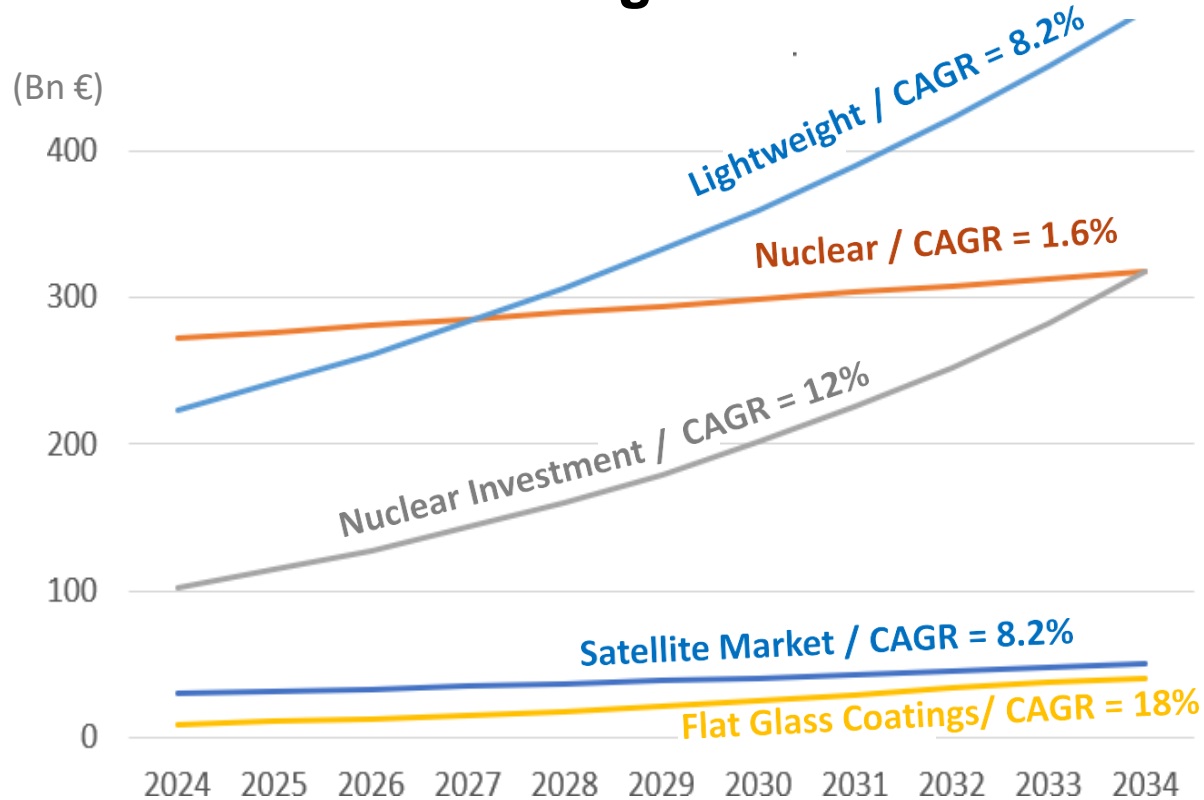


SPACE & DEFENCE



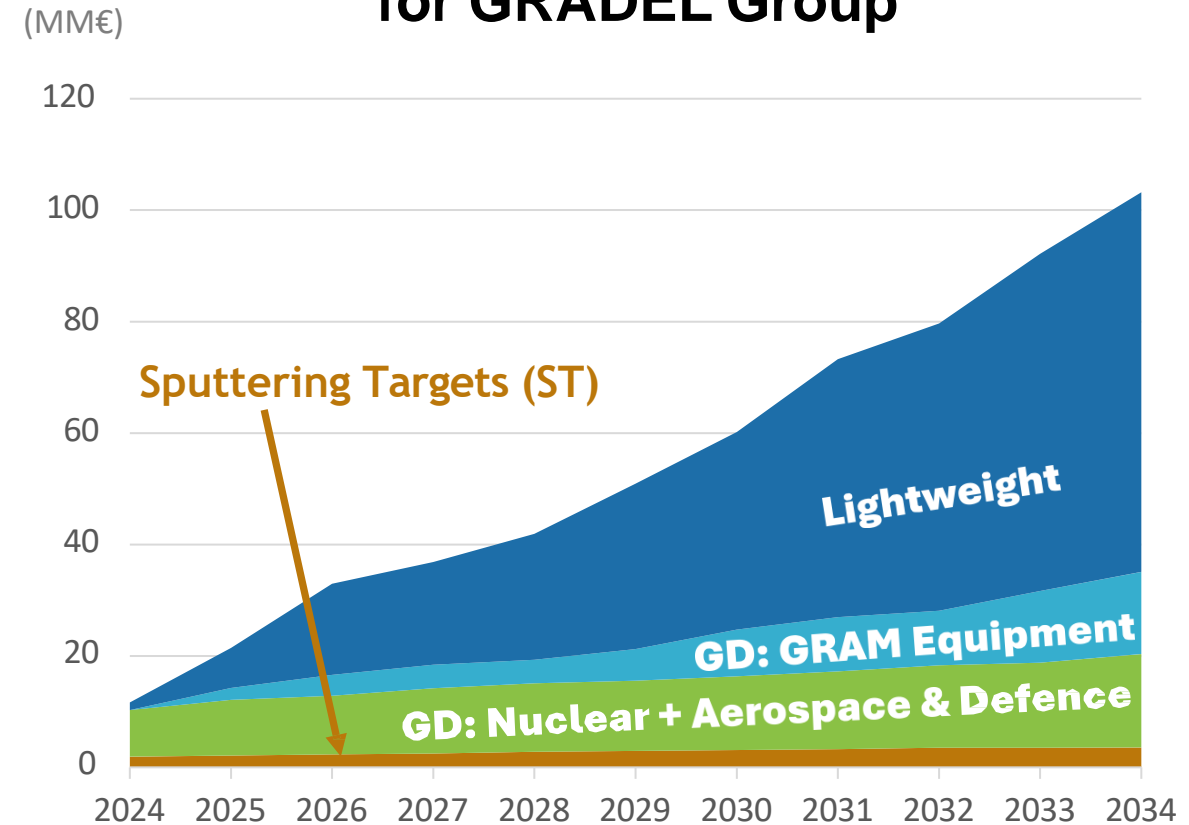
## Official Market Forecast for GRADEL's

### Market segments



## Forecast of Consolidated Revenue

### for GRADEL Group



**Lightweight will dominate for the next decades our activities.**



# Sustainable Lightweight Solutions for multiple Market segments

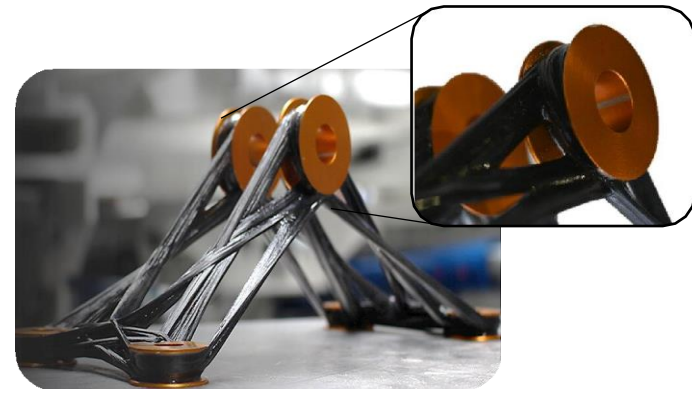
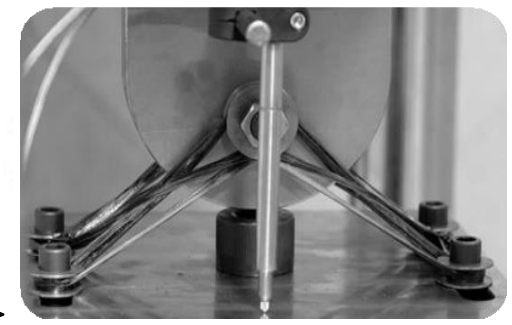
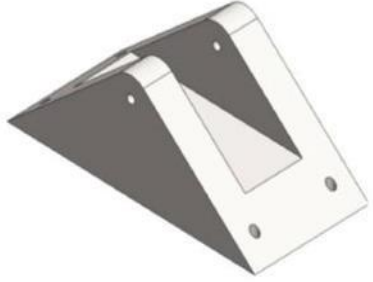
**GRAM**

**G**radel **R**obotic **A**dditive **M**anufacturing

- enables to build extremely light and sustainable 3D structures with weight savings up to 70%
- recyclable materials in combination with a simulation driven process technology powered by AI

**GRADEL**  
LIGHT WEIGHT

## how GRAM works



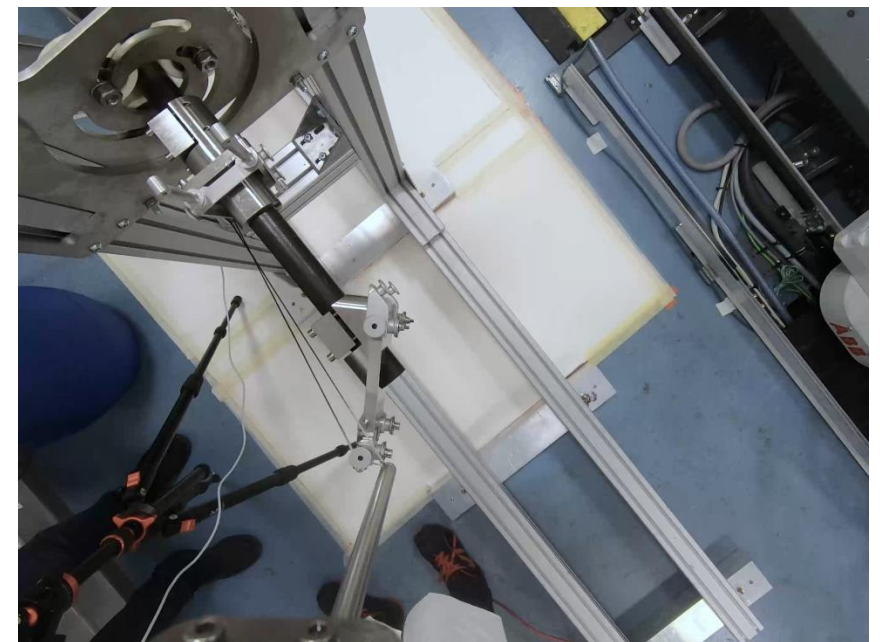
**PRIMARY DESIGN**

**TOPOLOGY OPTIMIZATION**

**WEIGHT SAVINGS UP TO 70%**

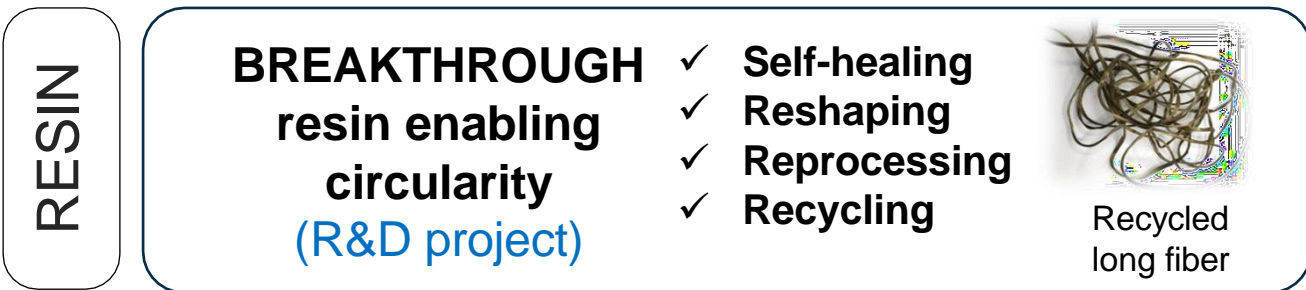
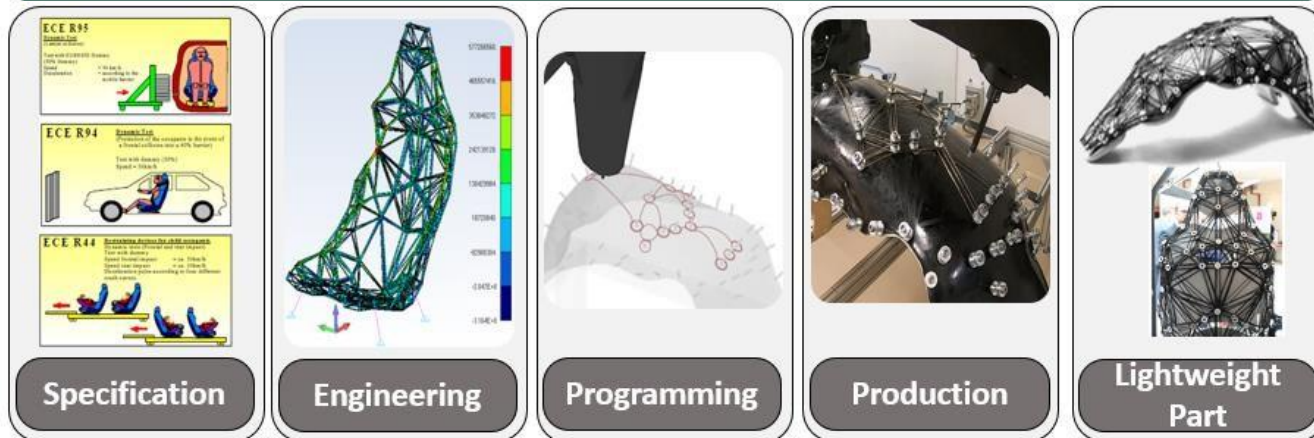
**188 g TOTAL MASS**  
**9300 kg Breaking Load**

**PRINCIPLE**  
Form connection by winding around points > 5 x stronger



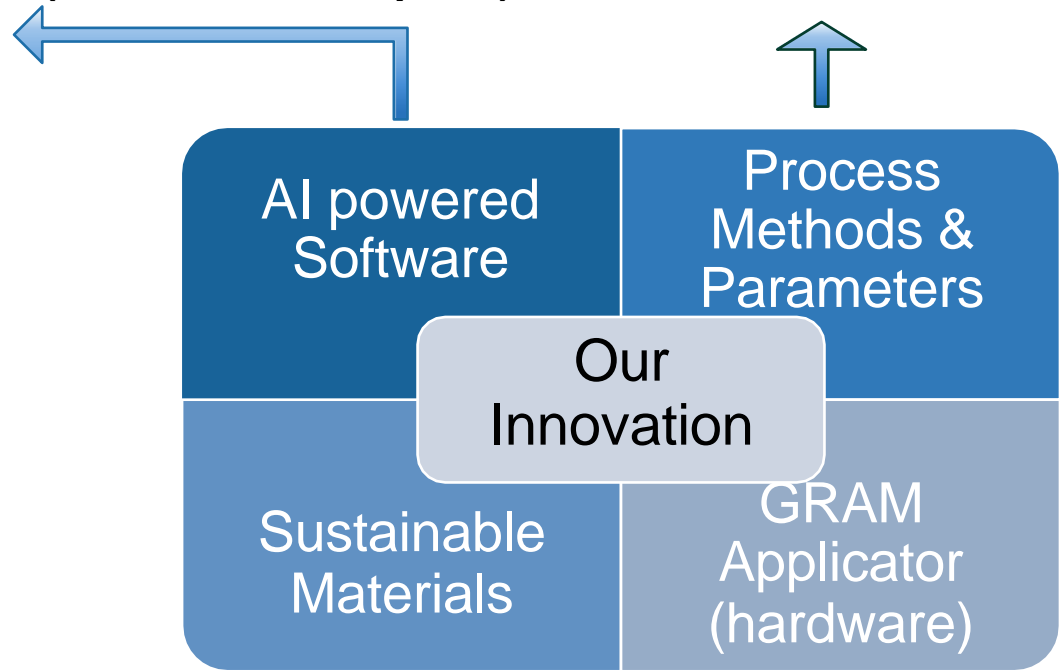
# THE 4 PILLARS OF GRAM TECHNOLOGY

Fully simulation driven, AI powered **DIGITAL PROCESS CHAIN**.  
R&D project funded 80% by LSA, functional in 2027



AI powered software developed with Data Design Engineering Sàrl (data scientist experts)

GRADEL Core Knowledge (to be kept confidential, developed inhouse)



Sustainable Material R&D project with LIST  
Access to IP rights

GRAM production cell, developed and manufactured in-house  
**Patented IP**

# UNIQUE BENEFITS OF OUR GRAM TECHNOLOGY TO TRANSPORTATION SECTOR

## SPECIAL VEHICLE IN TRANSPORTATION SECTOR



SPACE DEFENCE LOGISTICS SPECIAL VEHICLES SEAT UAM AVIATION

### PROBLEM

- Increasing **fuel & energy cost**
- Increasing **carbon footprint**
- Intensive **use of natural resources** and metals
- Composite parts end up in **landfill**

### SOLUTION

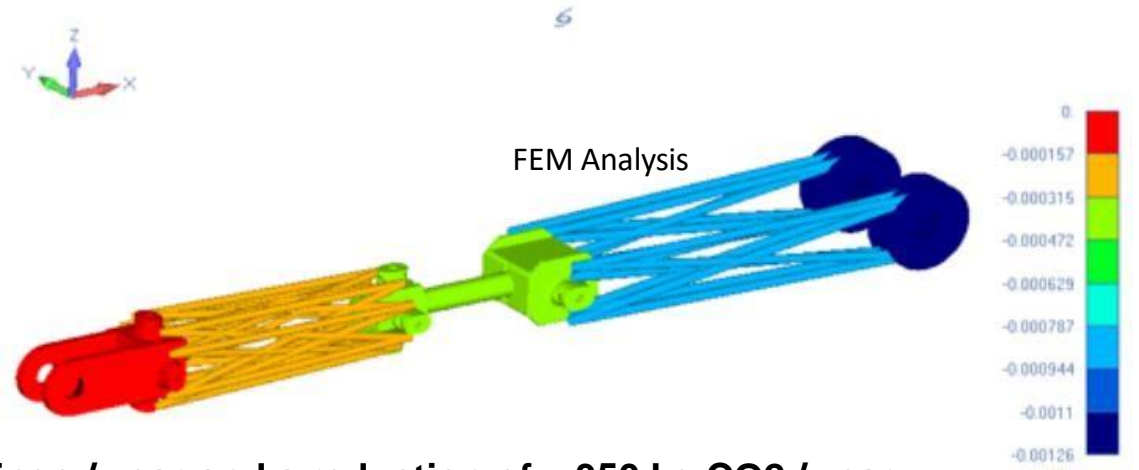
- ✓ Significant **weight reduction up to 70%**
  - $\frac{1}{2}$  mass requires  $\frac{1}{2}$  energy
  - Massive **reduction of emissions**
- ✓ **Responsible** use of **Resources**:
  - During manufacturing, use phase & end-of-life
- ✓ **Recycling of fiber & resin**

### CUSTOMER VALUE

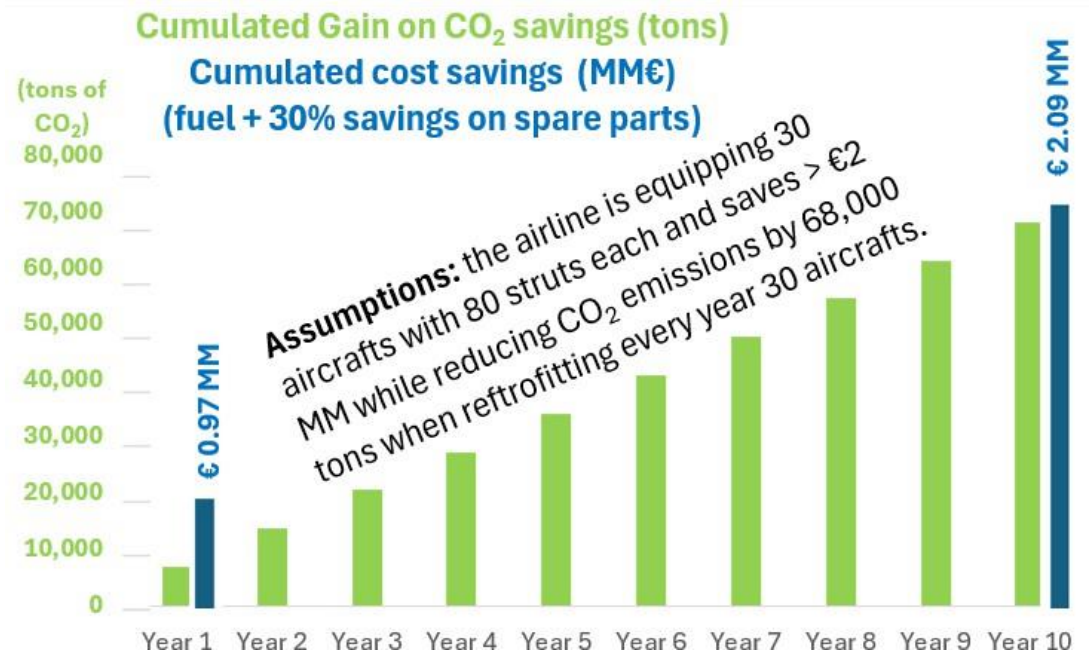
- ✓ **GEO space launch**: 1 kg less weight saves \$ 5000 cost
- ✓ **Aviation**: 1 kg less weight saves \$95 in fuel and 350 kg of CO<sub>2</sub> per year → \$75 taxes per ton
- ✓ **Automotive**: 100 kg less weight saves 4% of fuel
- ✓ **70% reduction** in resources (manufacturing + recycling)

## USE CASE 1: European Airline

- Adjustable tension strut case study
- 22% lighter compared to industrial standard
- 30% cheaper compared to actual solution
- 80 parts/aircraft ; total fleet = 710



According the airline, 1 kg weight saving leads to ~ 100 kg fuel savings / year and a reduction of ~ 350 kg CO2 / year



In 2026 CO<sub>2</sub> taxes of \$75/ton ~68000 x75 = **\$5.1 MM** will be charged on top at full scale.







### FULL CIRCULARITY:

- ✓ EPP removed with a solvent for new EPP structures
- ✓ The structure is re-used for a new EPP-EURO-Pallet
- ✓ If mechanically damaged, the reinforcement structure is recycled:
  - ✓ Dry long fibers chopped fibers
  - ✓ Resin for being reprocessed by the resin manufacturer

**Shock resistant    Operator health-promoting**  
**Cleanliness criteria    RFID tagged**

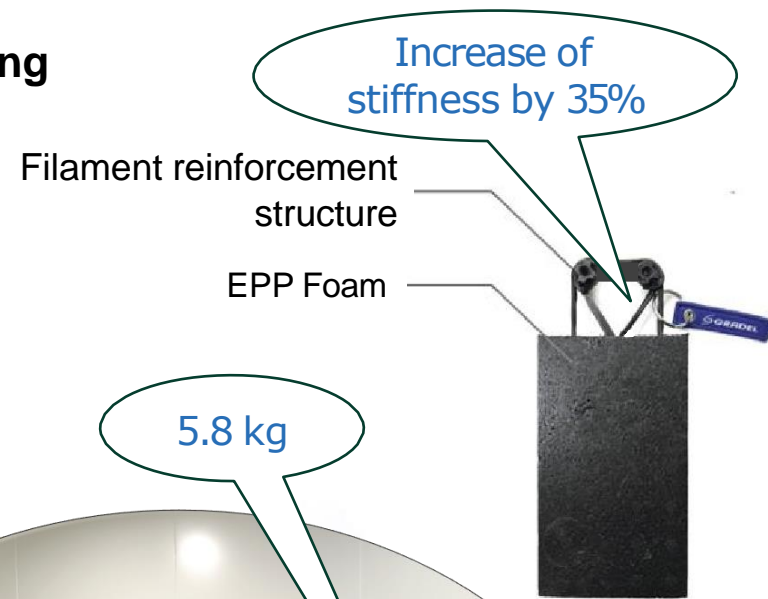


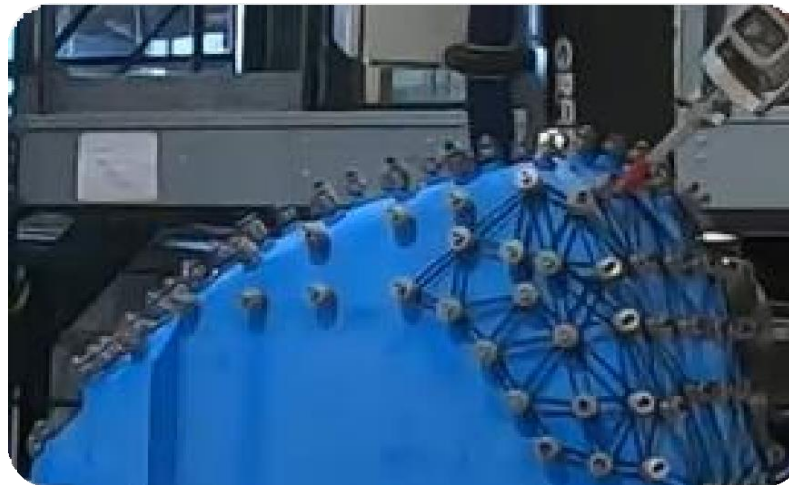
**14.2 kg mass reduction** compared to a wooden Euro-Pallet (20 kg).

IMPACT potential on road and in air	Impact on cost and CO2 savings when using 33 EPP pallets on a 5 years lifetime of a pallet during the use-case	
		
Assumptions	200,000 km/year	1100 take-off / landings per year
fuel cost + CO2 taxes savings	2.8 k€	293 k€
CO2 savings	5.8 ton	660 ton



**GRAM Structure inside**





## AUTOMOTIVE INDUSTRY'S ONLY AWARD DEDICATED TO LIGHTWEIGHTING AND SUSTAINABILITY

GRADEL Lightweight supplied the GRAM structure for the BMW M Visionary Material Seat, which was awarded on **6th of August 2024** with the Altair ENLIGHTEN AWARD 2024 in the "Sustainable Process" category during the "Centre for Automotive Research" seminar in Michigan USA.

### Statement by BMW M GmbH:

The seat's CO<sub>2</sub>e footprint is 90% lower than a BMW M carbon bucket seat made today.

**Our innovative end-to-end solutions of all our activities are focusing on sustainable solutions by bringing Economy with Ecology into Harmony.**

**Contact:**

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CEO

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[c.maack@gradel.lu](mailto:c.maack@gradel.lu)

[www.gradellw.com](http://www.gradellw.com)



**“SUSTAINABILITY ENABLERS IN LUXEMBOURG”**

**BRITISH CHAMBER OF COMMERCE**

**25<sup>TH</sup> SEPTEMBER, 2024**

# **SUSTAINABLE COMPOSITE MATERIALS & MANUFACTURING INNOVATION CENTRE**

LUXEMBOURG  
INSTITUTE OF SCIENCE  
AND TECHNOLOGY



SUSTAINABLE COMPOSITE  
MATERIALS & MANUFACTURING

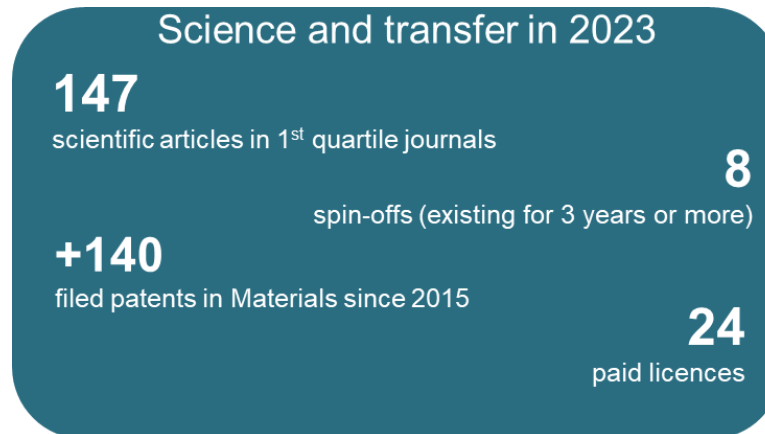
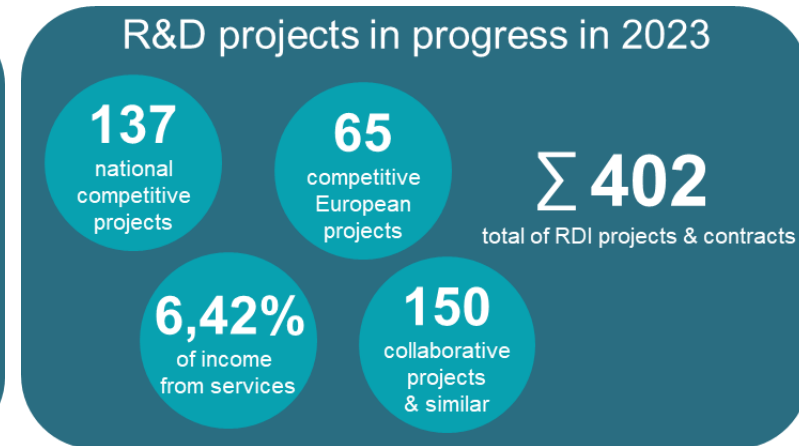
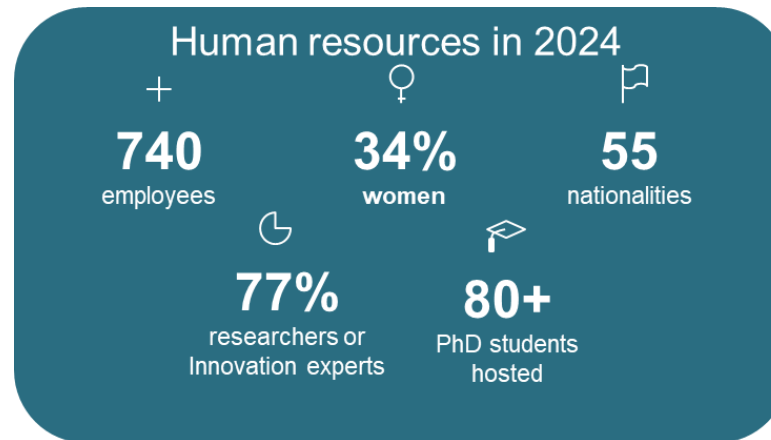
INNOVATION CENTRE

# THE LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY

A REFERENCE IN RESEARCH AND INNOVATION FOR A DIGITALIZED, RESILIENT & SUSTAINABLE SOCIETY



August 2024 Figure



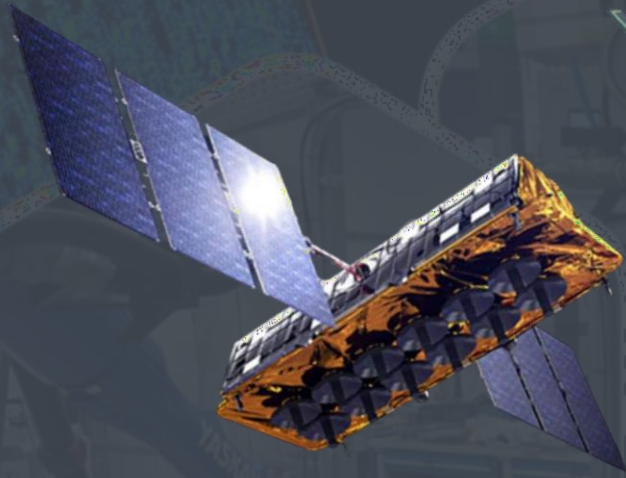
*“Pushing the frontiers in research for high-impact innovation”*

LUXEMBOURG  
INSTITUTE OF SCIENCE  
AND TECHNOLOGY



SUSTAINABLE COMPOSITE  
MATERIALS & MANUFACTURING

INNOVATION CENTRE



Source: Thales Alenia Space



Source: Airbus



Source: Alstom

# SCMM MISSION

ACCELERATE THE ADOPTION OF INNOVATIVE SUSTAINABLE & LIGHTWEIGHT COMPOSITE MATERIAL TECHNOLOGIES IN THE TRANSPORT SECTOR



Source: Volocopter



Source: Toyota

# SCMM CONCEPT

RAPID INTEGRATION OF NOVEL RESEARCH OUTCOMES INTO **CRITICAL DEMONSTRATORS** MEETING THE NEEDS OF THE VEHICLES OF THE FUTURE

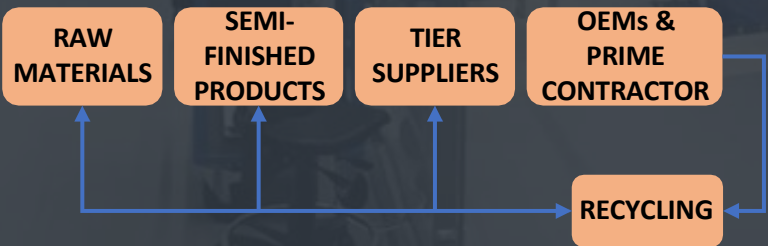
SCMM DEMONSTRATOR INTEGRATING LIST AND MEMBERS TECHNOLOGIES  
Production and testing by LIST



TECHNOLOGY BRICKS DEVELOPED AND TESTED IN LAB / RELEVANT ENVIRONMENT

Material technologies, provided by LIST / SCMM members, customized to reach performance requirements

*Demonstrator specified by OEM/ Prime Contractor  
Project team with LIST and partners active throughout the whole composites value chain*



MATERIALS CRITICAL FUNCTION / EXPERIMENTAL PROOF-OF-CONCEPT

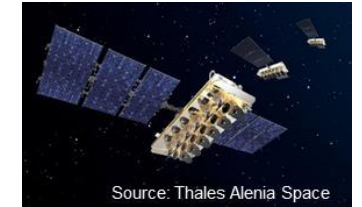
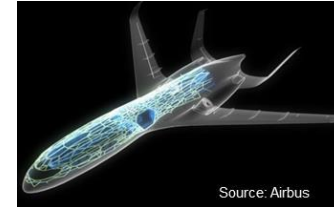
Material technologies developed by LIST in the context of low-TRL research projects

# DEFINITION OF DEMONSTRATORS THROUGH TOP-DOWN APPROACH

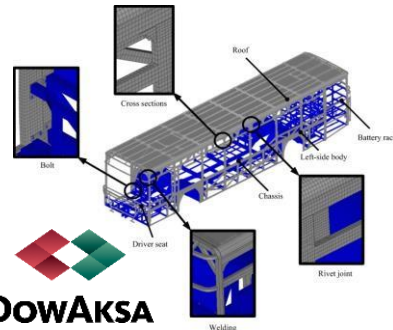
Integrate rapidly the research outcomes into critical **demonstrators** triggering innovations



*Modular Lightweight load-bearing part for road, rail and logistic applications*



*Sustainable automotive parts made of secondary or bio-based materials*



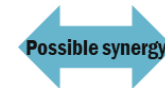
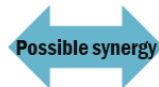
*Recyclable panels for interior applications*



*Easy assembling / repairable satellite panels*



*Sustainable body panels (Natural Fiber)*



*Recyclable high-pressure tank*



*Ultra-lightweight bracket for aeronautic and space application*





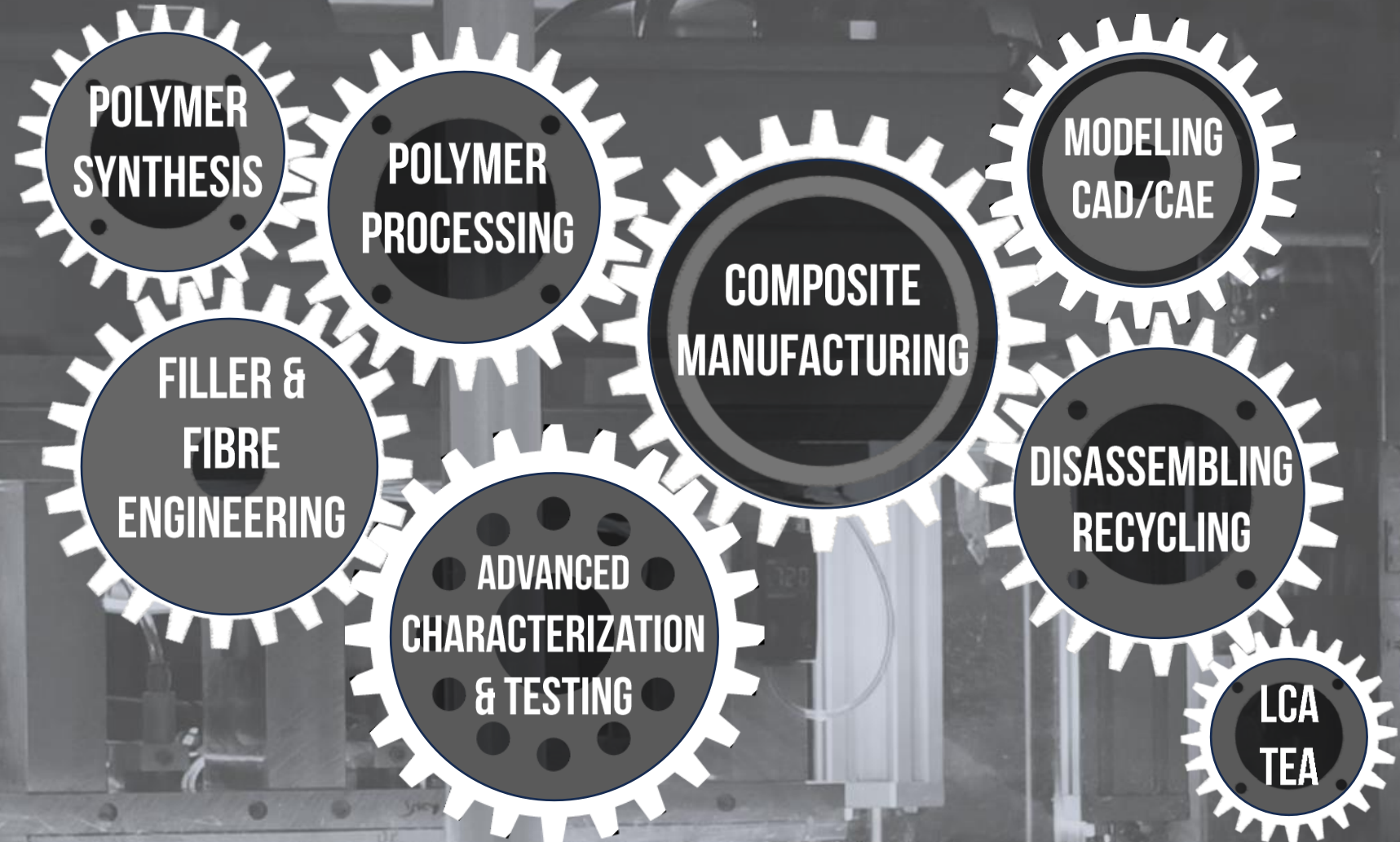
# RESEARCH PILLARS

## High-Level View



# A ONE-STOP SHOP FOR THE DEVELOPMENT OF SUSTAINABLE & LIGHTWEIGHT COMPOSITES PARTS

Solutions throughout the entire composites value chain



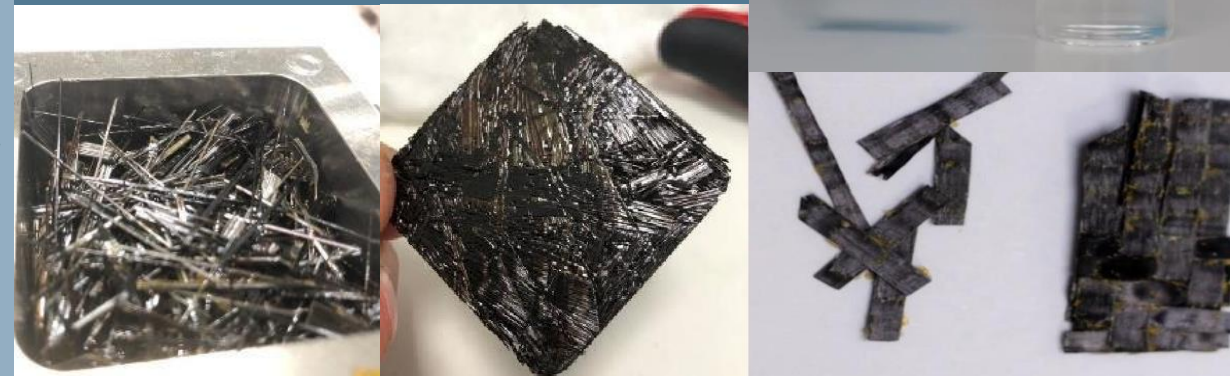
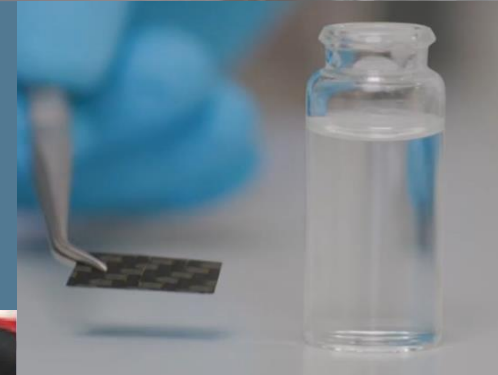
# RESEARCH EXCELLENCE IN LIST

## Bio-based benzoxazines resins



## Vitrimer composites

*Enabling reprocessing, repairing & recycling*



## Bio-based composites

### 1. Sustainable components

*Composite processing*



### 2. Sustainable design & (re-) manufacturing

*Monomers & resins*

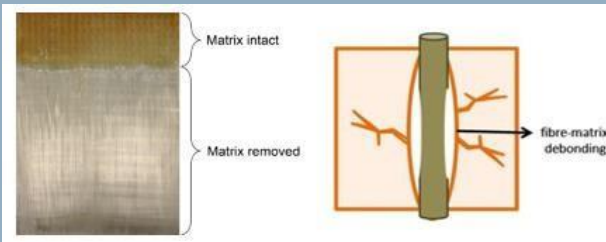


*Reinforcement*



*Recycling & recovery*

*Disassembly on demand*



*Inexpensive, safe, bio-based recycling agents*

### 3. Regeneration of high value components

*Fine chemicals*

# RESEARCH INFRASTRUCTURE CURRENT STATUS

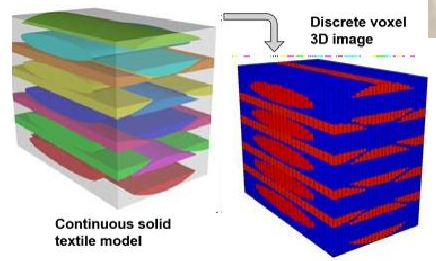


Development of novel polymers and formulations

Processing of polymeric materials

Advanced characterization and testing

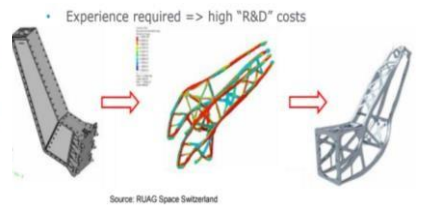
From materials & process modelling to CAD to CAE



Micro compounders



Twin screw extruder



## Advanced Composites Manufacturing

# WORKING ALL TOGETHER



PROPOSE / DEVELOP TECHNOLOGIES & DEMONSTRATORS

SCMM MEMBERS  
MAT. & TECH. PROVIDERS, TIER SUPPLIERS, OEMS



STRATEGIC RESEARCH & INNOVATION  
AGENDA  
MANAGED BY LIST

LUXINNOVATION  
#MakingInnovationHappen  
SUPPORT INTERNATIONAL PROMOTION

Total investment:  
**11 M€** for 6 demonstrator projects

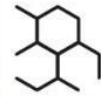
ENDORSE THE SRIA



CO-FUND SRIA RDI PROJECTS



LUXEMBOURG  
INSTITUTE OF SCIENCE  
AND TECHNOLOGY



SUSTAINABLE COMPOSITE  
MATERIALS & MANUFACTURING

INNOVATION CENTRE



# LET'S WORK ALL TOGETHER

## Contacts

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[thierry.girot@list.lu](mailto:thierry.girot@list.lu)

Dr. Levent Kirkayak  
[Levent.kirkayak@list.lu](mailto:Levent.kirkayak@list.lu)

An initiative co-funded by



LE GOUVERNEMENT  
DU GRAND-DUCHÉ DE LUXEMBOURG  
Ministère de l'Enseignement supérieur  
et de la Recherche



GOUVERNEMENT  
DU GRAND-DUCHÉ DE LUXEMBOURG  
Ministère de l'Économie



Co-funded by  
the European Union



Luxembourg, 25-09-2024 - British Chamber of Commerce

## REMONDIS Luxembourg Sàrl – Sustainability Enabler

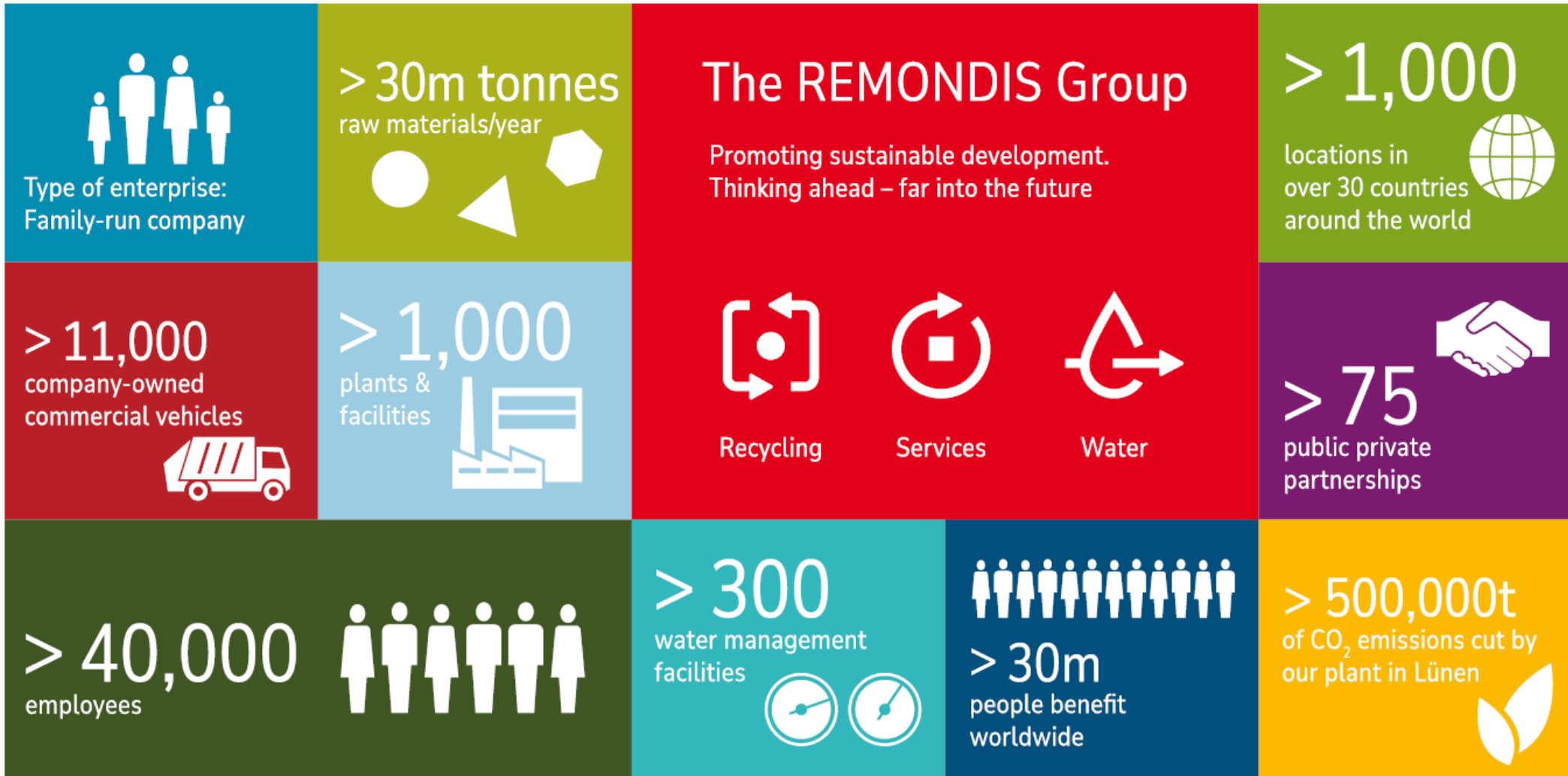
**REMONDIS**<sup>®</sup>  
IM AUFTRAG DER ZUKUNFT

# Contents

- 1/ The REMONDIS Group
- 2/ REMONDIS Luxembourg Sàrl
- 3/ Focus on Sustainability action



# The REMONDIS Group

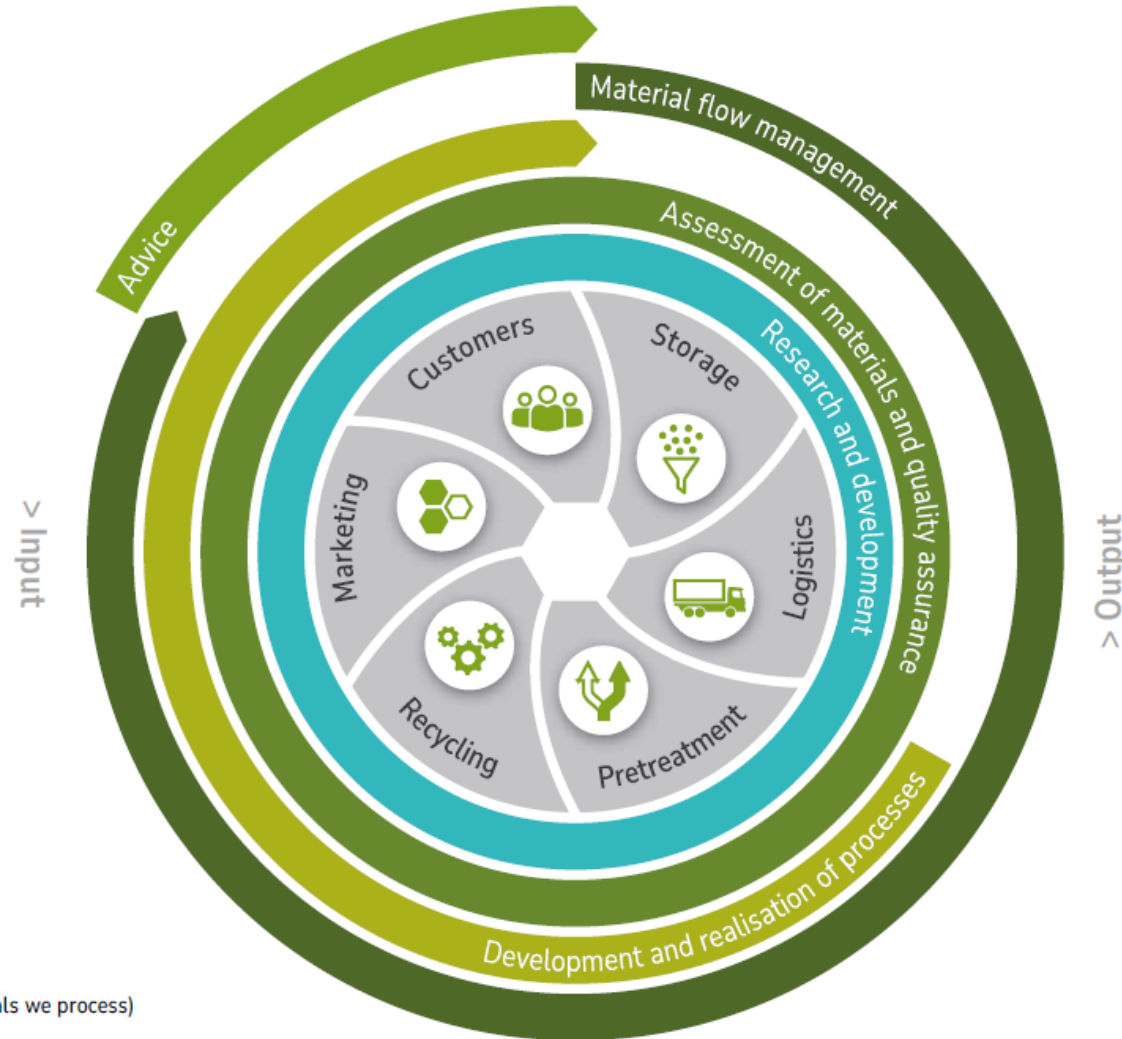


# REMONDIS

## Recycling

- \_ Alkalis
- \_ Batteries
- \_ Chemical gypsum
- \_ Construction waste
- \_ FGD gypsum
- \_ Hazardous waste
- \_ IBA slag
- \_ Light sales packaging
- \_ Metal slag
- \_ Old glass
- \_ Old paper
- \_ Old plastic
- \_ Organic waste
- \_ Photographic chemicals
- \_ Residual waste
- \_ Scrap metal
- \_ Waste electrical devices
- \_ Waste electronic devices
- \_ Waste wood

(these groups are just a selection of the materials we process)



- \_ Calcium sulphate binders
- \_ Composts
- \_ Energy
- \_ Fertilisers
- \_ Glass
- \_ Iron
- \_ Mercury
- \_ Metal salts
- \_ Non-ferrous metals
- \_ Paper
- \_ Plastic
- \_ Plastic pellets
- \_ Precious metals
- \_ Recycled aggregate
- \_ Refuse-derived fuel
- \_ Solvents
- \_ Stainless steel
- \_ Steel
- \_ Substrates
- \_ Timber



25 SEPTEMBER 2024

REMONDIS Luxembourg Sàrl - An international team of 52 employees  
– Sustainability Enablers in Luxembourg

**REMONDIS®**

IM AUFTRAG DER ZUKUNFT

# Remondis Luxembourg Sàrl: „Sustainability Enabler“

## What are we doing ?

We recover raw materials and recycle them  
or send them to the most appropriate recycling facility

We take care of more than 130.000 tons of waste per year. We are a major actor  
in the Luxembourg circular raw material economy

## Who are our customers ? Who relies on us ?

Many companies and firms (of the private sector)  
and lots of councils and their local residents (in the public sector)

**„We offer innovative, sustainable products and solutions for nearly all kinds of waste  
- Let’s say, solutions for all types of waste, except radioactive and explosive waste“**

# Key information about Remondis Luxembourg Sàrl

- Authorization: „Collection, Transportation, Storage, Recovery and Treatment of waste, Destruction of confidential documents“ Positive-Catalog: around 650 EWC codes
- Main activities: **Waste separation + Waste conditioning + Waste (pre-)treatment + Waste recycling**  
**Notification and shipment to the best adapted recycling facility (into neighbour countries)**
- Container-Service with 30 special trucks (for all different types of waste)
  - Hazardous Waste
  - Resources / recyclable waste
  - Contaminated soil
  - Organic waste (Refood)
  - (Mobile-) Destruction of data and confidential documents & Recycling
  - Household waste collection in Luxembourgish communes
- Team / Staff : 70 people (End of 2024)
- ISO Certifications: ISO 9001 - ISO 14001 - ISO 50001

# New Facility in Luxembourg - Foetz with 2,2 ha – started in January 2022



# March 2024: Photovoltaic System - Company use of own produced energy = 25 %

Solar collectors on the roofs of the buildings



Electric excavator and shredder



Electric baling press



# Photovoltaic System - Electrification of our Vehicle Fleet

Household waste collection with the first electric truck - Start in January 2025



Electric company cars: customer service







# Thank You !

REMONDIS Luxembourg S.à r.l.

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