



Manufacturing of complex parts **based on unidirectional tapes**

Raquel Ledo Bañobre
CTAG – Automotive Technology Centre of Galicia
raquel.ledo@ctag.com



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636860

About CTAG



Private and independent
development centre
focused on the automotive
& transport sector

4 Main Areas of Activity


MATERIALS AND PROCESSES

TESTING

PASSIVE SAFETY

ELECTRONICS & ITS

FIGURES




+800
80%
engineers



52
M
Total
investments



41
M
T.O. 2018



70
%
International
activity



49
%
OEMs

PROCESS
LAB 4.0

BATTERY
LAB

ITS
TEST TRACK

ELECTRONICS
& ITS

TESTING
VALIDATION

MATERIALS
& PROCESSES

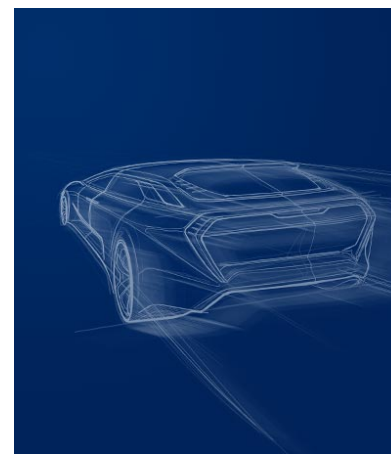
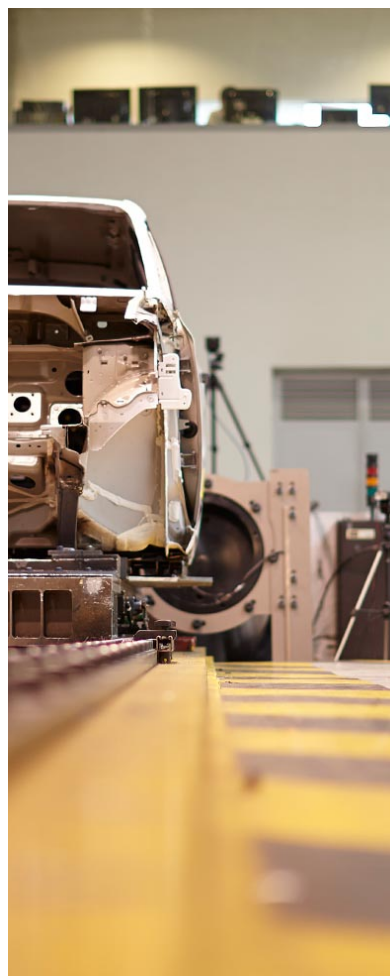
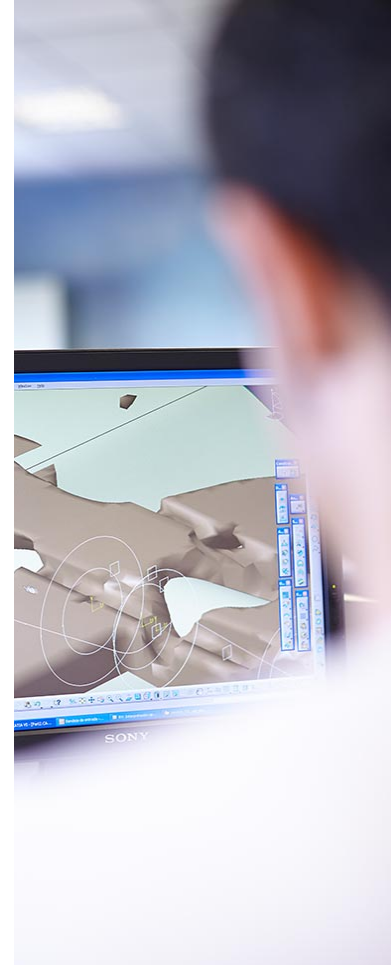
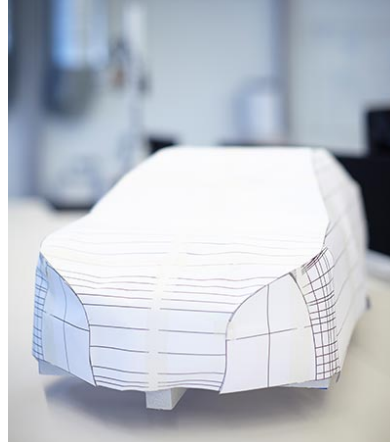
GENERAL
SERVICES

PASSIVE
SAFETY



COMPREHENSIVE PROJECTS

APPLIED RESEARCH
CONCEPT DEVELOPMENT
PRODUCT DEVELOPMENT
DEVELOPMENT TESTS
INDUSTRIAL PROCESS DEVELOPMENT
VALIDATION PRODUCT & PROCESS



R&D STRATEGIC FIELDS

AUTONOMOUS DRIVING

COMFORT

CONNECTED VEHICLE

INDUSTRY 4.0

NEW MATERIALS

VEHICLE ELECTRIFICATION

Participation in more than 250
collaborative projects
50 running, 25 at European level

European, national and regional programs

Excellence networks

Technology observation and awareness Centre

Integral project management and certification (UNE 166002)

Specialized training

Strategic studies

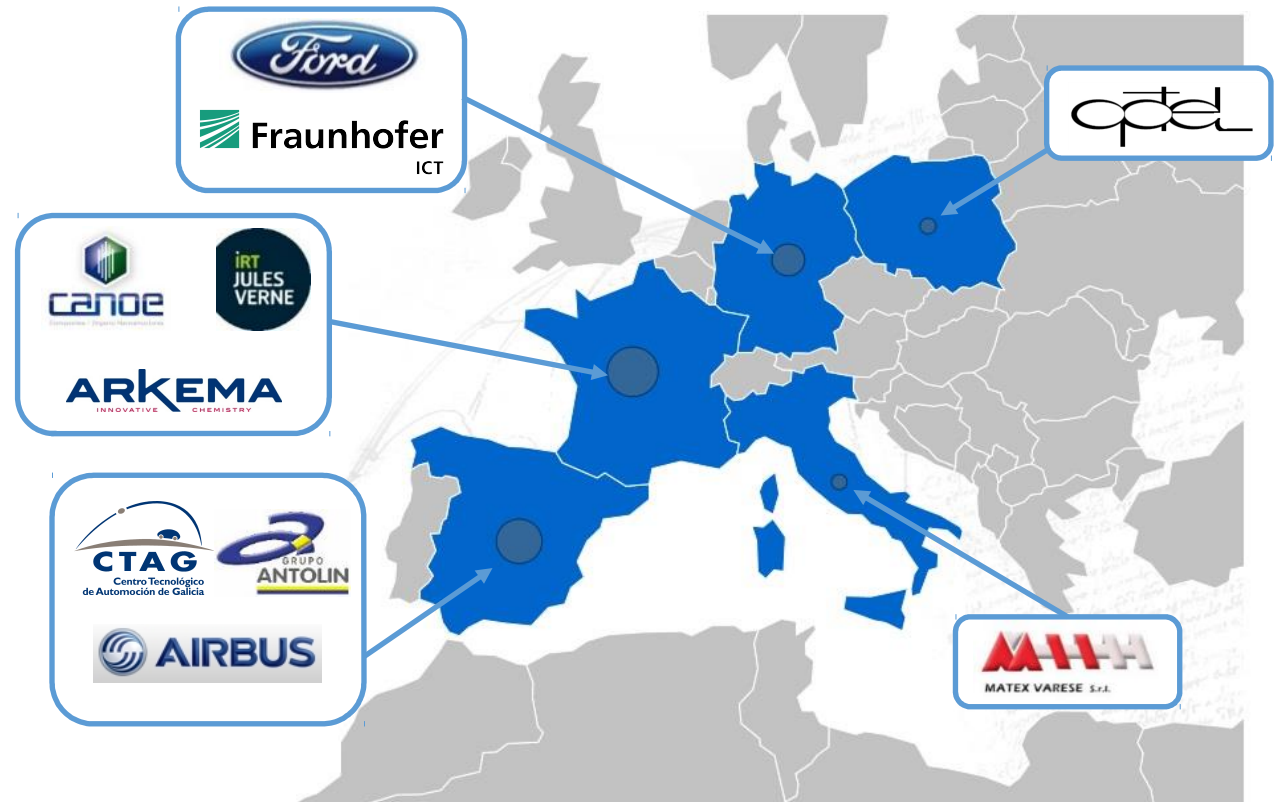
Technology congress and workshops organization

About FORTAPE



Research on efficient integrated systems for the manufacturing of complex parts based on unidirectional tapes for the automotive and aeronautical industry

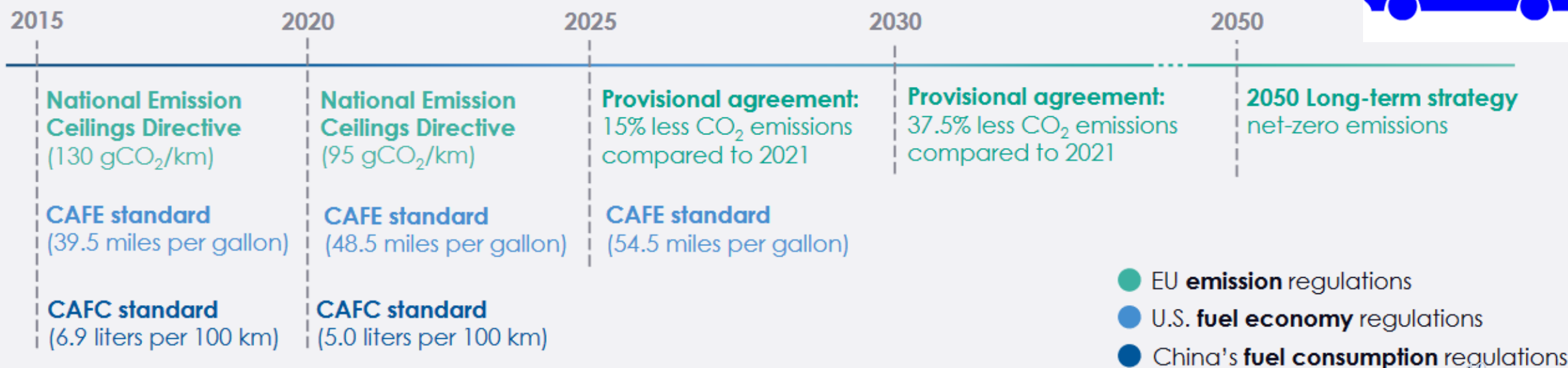
- FoF-02-2014 Manufacturing processes for complex structures and geometries with efficient use of material
- Research and Innovation action
- Total cost / EU Contribution: 5 030 003,96€
- Consortium: 10 partners from 5 countries



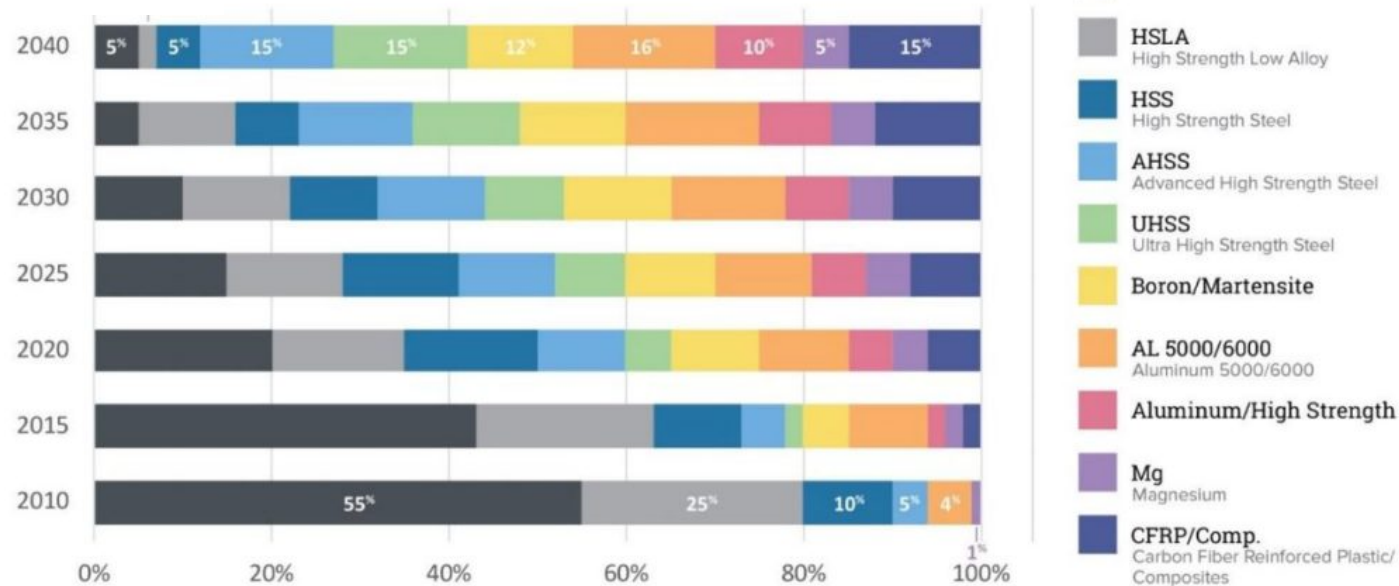
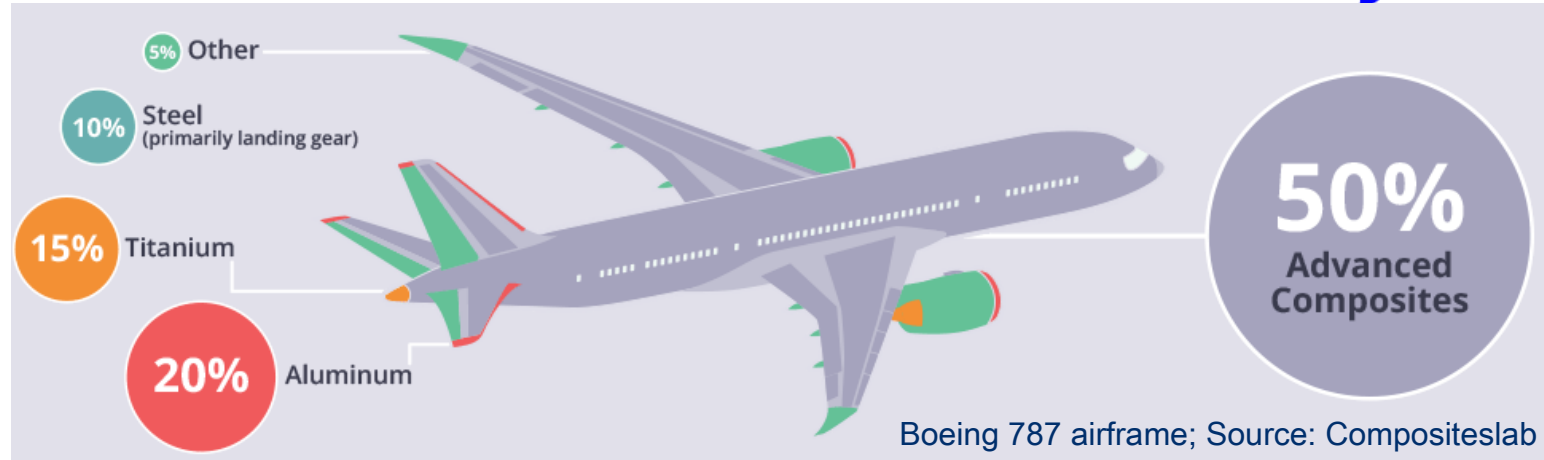
REDUCING CO₂ EMISSIONS

A CO₂ standard for aircraft

In February 2017, the International Civil Aviation Organization (ICAO) adopted the first ever global CO₂ certification standard for new aircraft. The standard sets limits to the CO₂ emissions from aircraft in relation to their size and weight. The standard is projected to save significant quantities of CO₂ once it comes into effect in 2020.



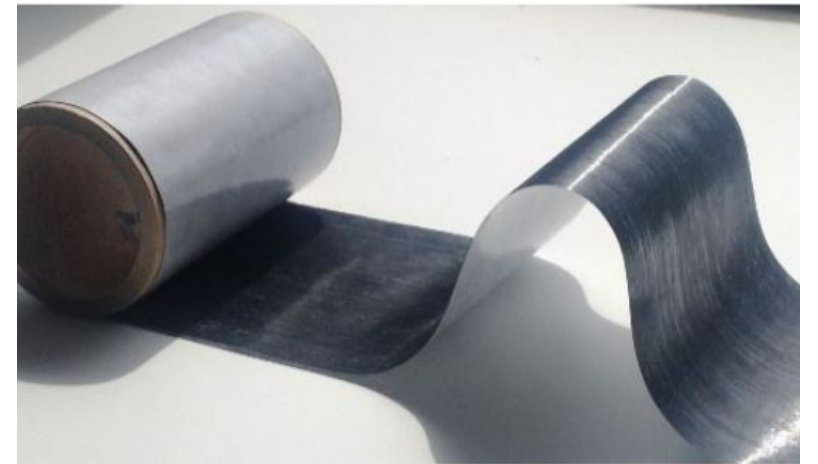
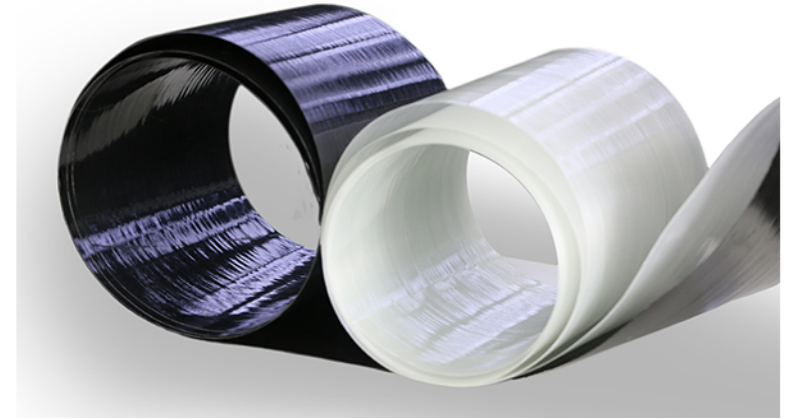
REDUCING CO2 EMISSIONS



UD tapes

Main advantages

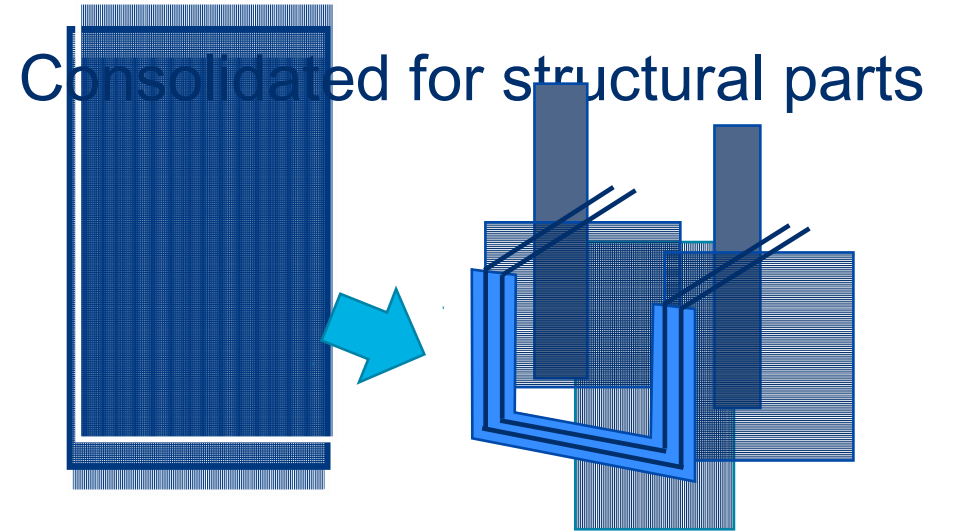
- Lightweight
- High tensile and flexural strength
- Impact resistant
- Recyclable



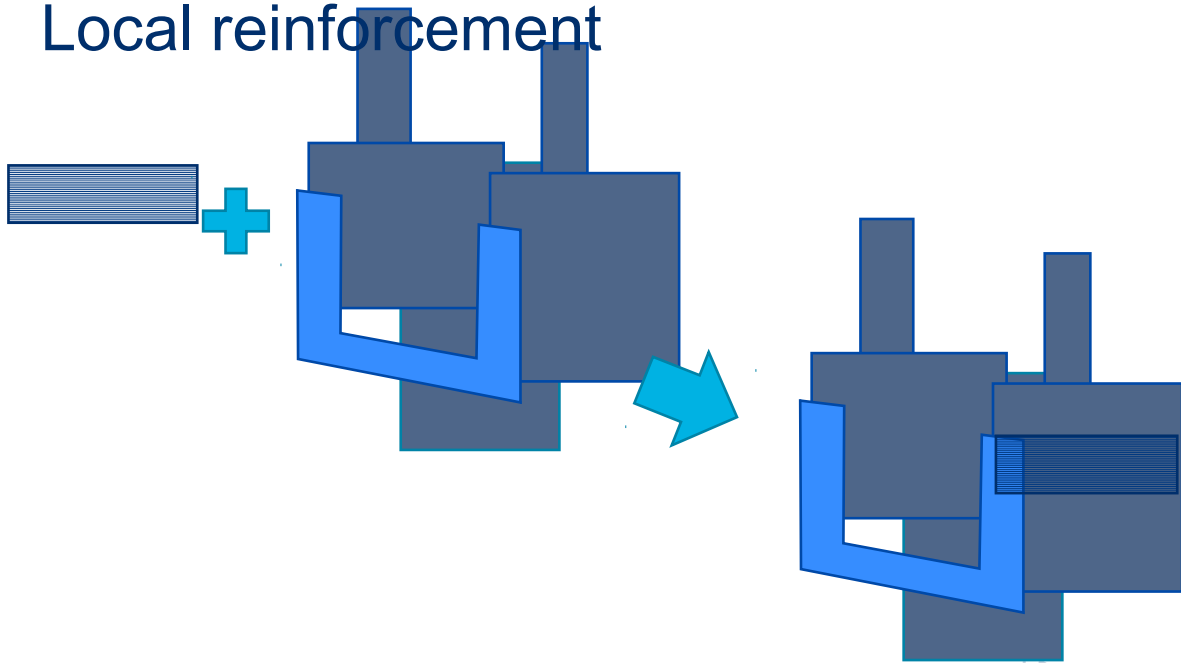
The unidirectional tapes (UD Tapes) market is estimated at USD 165.8 million in 2018 and is projected to reach USD 316.3 million by 2023, at a CAGR of 13.79%. The market is driven by the wide use of UD tapes in end-use industries, such as aerospace & defense, automotive, and sports & leisure.

Source: MarketsandMarkets Analysis, 2018

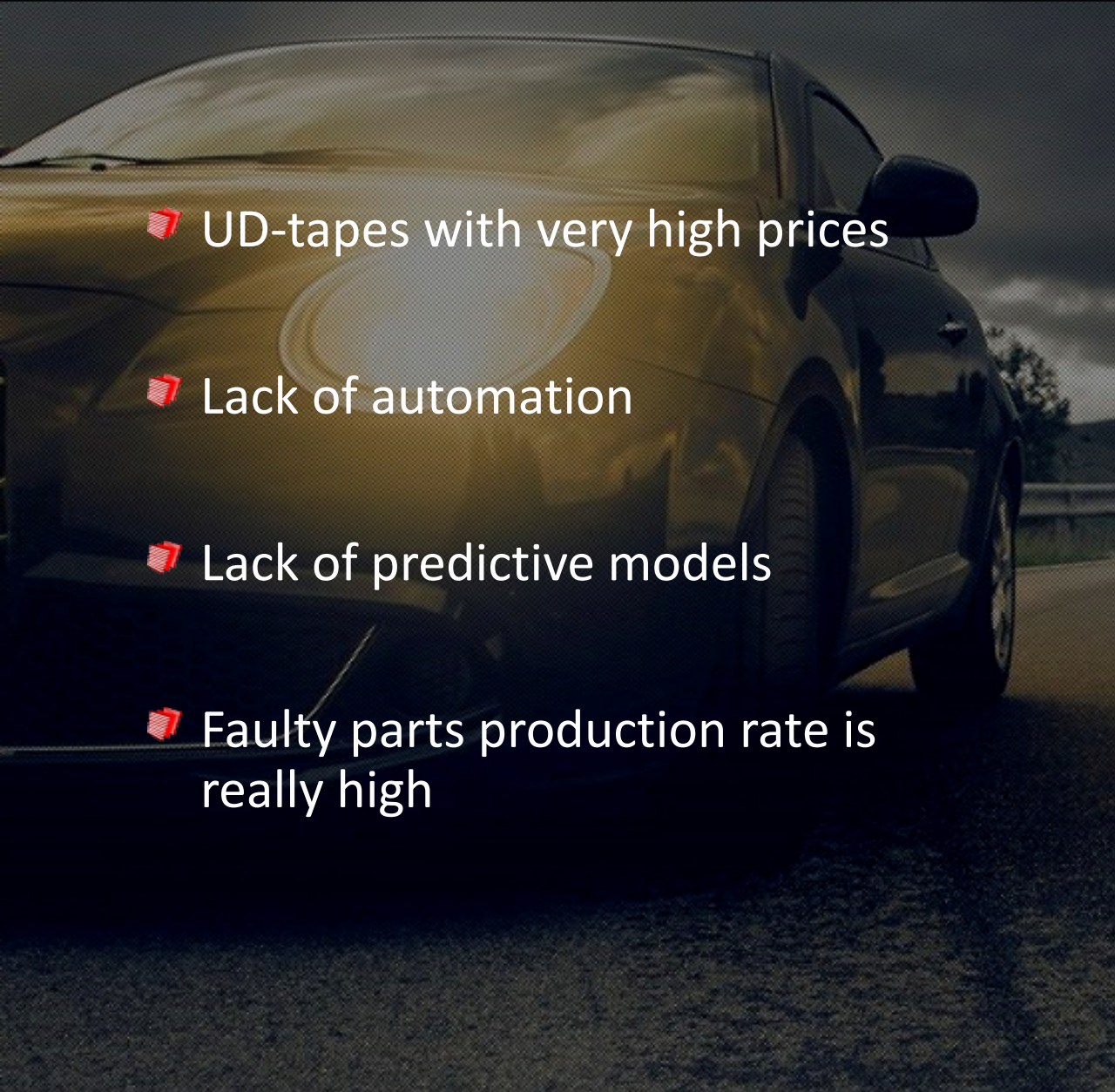
UD tapes: applications

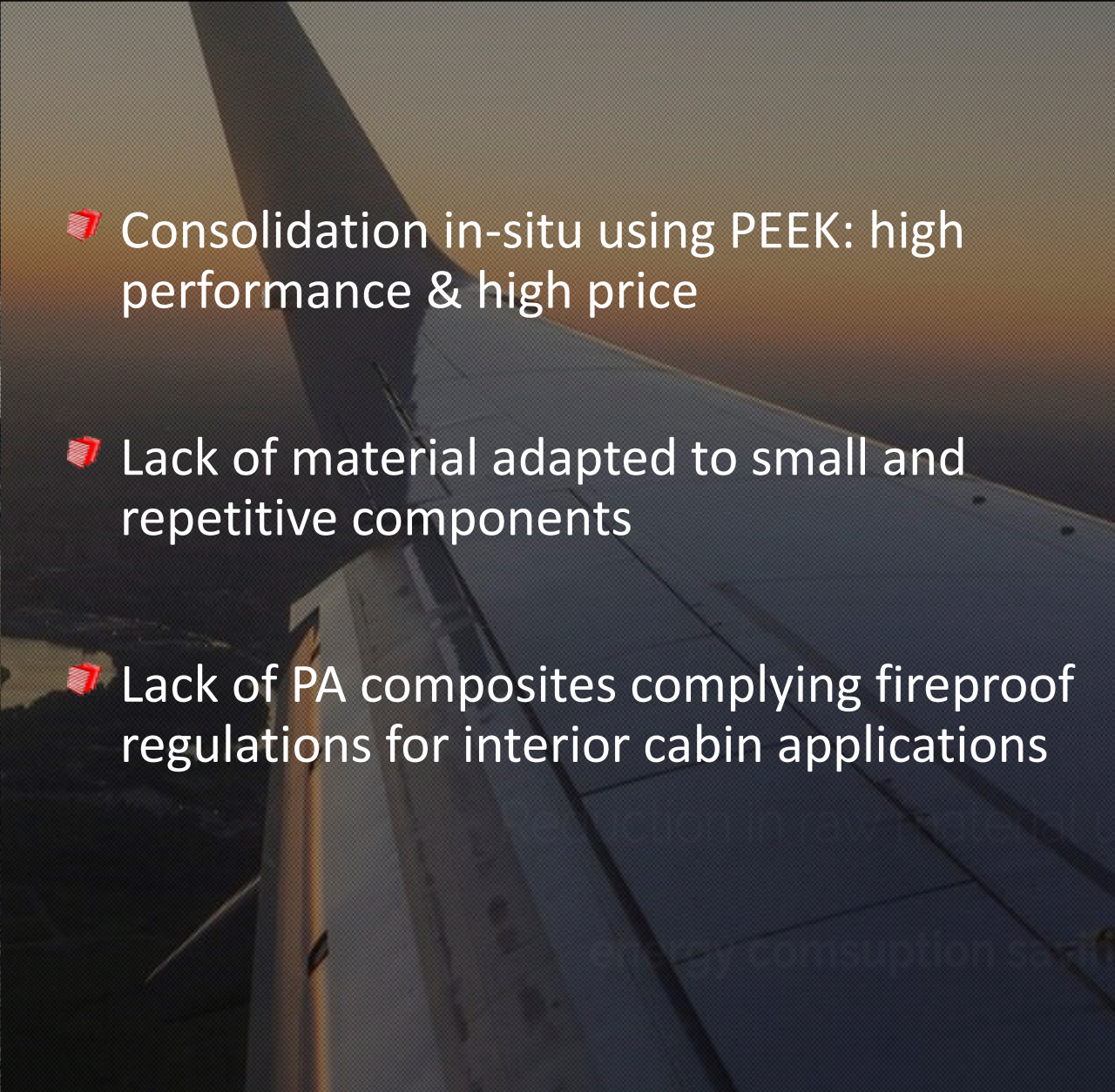


Local reinforcement



Main drawbacks

- 
- ❑ UD-tapes with very high prices
 - ❑ Lack of automation
 - ❑ Lack of predictive models
 - ❑ Faulty parts production rate is really high

- 
- ❑ Consolidation in-situ using PEEK: high performance & high price
 - ❑ Lack of material adapted to small and repetitive components
 - ❑ Lack of PA composites complying fireproof regulations for interior cabin applications

Main drawbacks

| Tapes manufacturing | Part manufacturing: structural part | Part manufacturing: local reinforcement |
|-----------------------------------|--|--|
| Impregnation is difficult | High Energy consumption | Lack of automation |
| Need to split and splice the tape | High scrap | Not proper modelling available |
| | Limited thermoplastic choice | Dimensional stability |

EXPENSIVE

UNRELIABLE

ENERGY AND MATERIAL CONSUMPTION

FORTAPE Innovations



Current situation

- ❑ UD-tapes with very high prices
- ❑ Lack of automation
- ❑ Lack of predictive models
- ❑ Faulty parts production rate is really high

Innovative solutions

- ❑ Reduce of 50% in material and energy savings for UD-tapes manufacturing → 30% cost saving
- ❑ UD tape automated placement
- ❑ New predictive models (crash & overmoulding process)

Current situation

- ❑ Consolidation in-situ using PEEK → high performance / high price
- ❑ Lack of material adapted to small and repetitive components
- ❑ Lack of PA composites complying fireproof regulations for interior cabin applications

Innovative solutions

- ❑ Consolidation in-situ using PA66 → medium performance / low price
- ❑ Reduction of production wastes
- ❑ New fireproof PA grade

FORTAPE Project: approach



UD tapes manufacturing

Three different technologies for fibre impregnation will be researched to develop the innovative process to manufacture unidirectional carbon and glass fibre tapes with increased fibre content.



Automotive parts based on UD tapes

Adaptation of the conventional overmoulding process; use of injection-compression moulding (ICM) technologies.



Aeronautic parts based on UD tapes

In-situ consolidation without the use of autoclave.

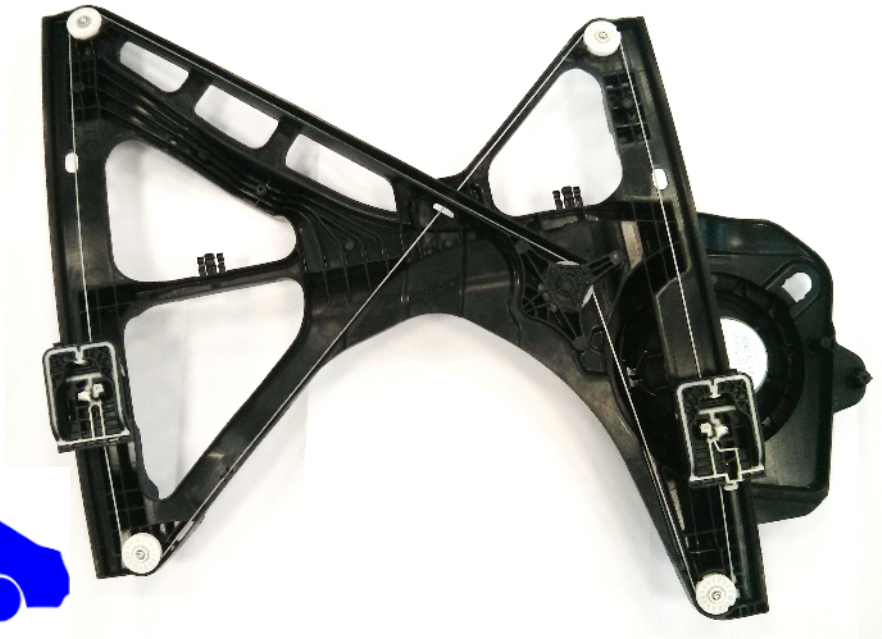


Simulation and mathematical modelling technologies

Simulation and mathematical modelling technologies will be used to assess the design of the complex composite parts as well as the manufacturing processes.

FORTAPE Project: case studies

DOOR PANEL WITH INTEGRATED FUNCTIONS reinforcing local areas in order to have a full-plastic component → lightweight



PP+Glass fibre

WINDOW FRAME based on a thermoplastic matrix instead of aluminum → lightweight and scrap reduction

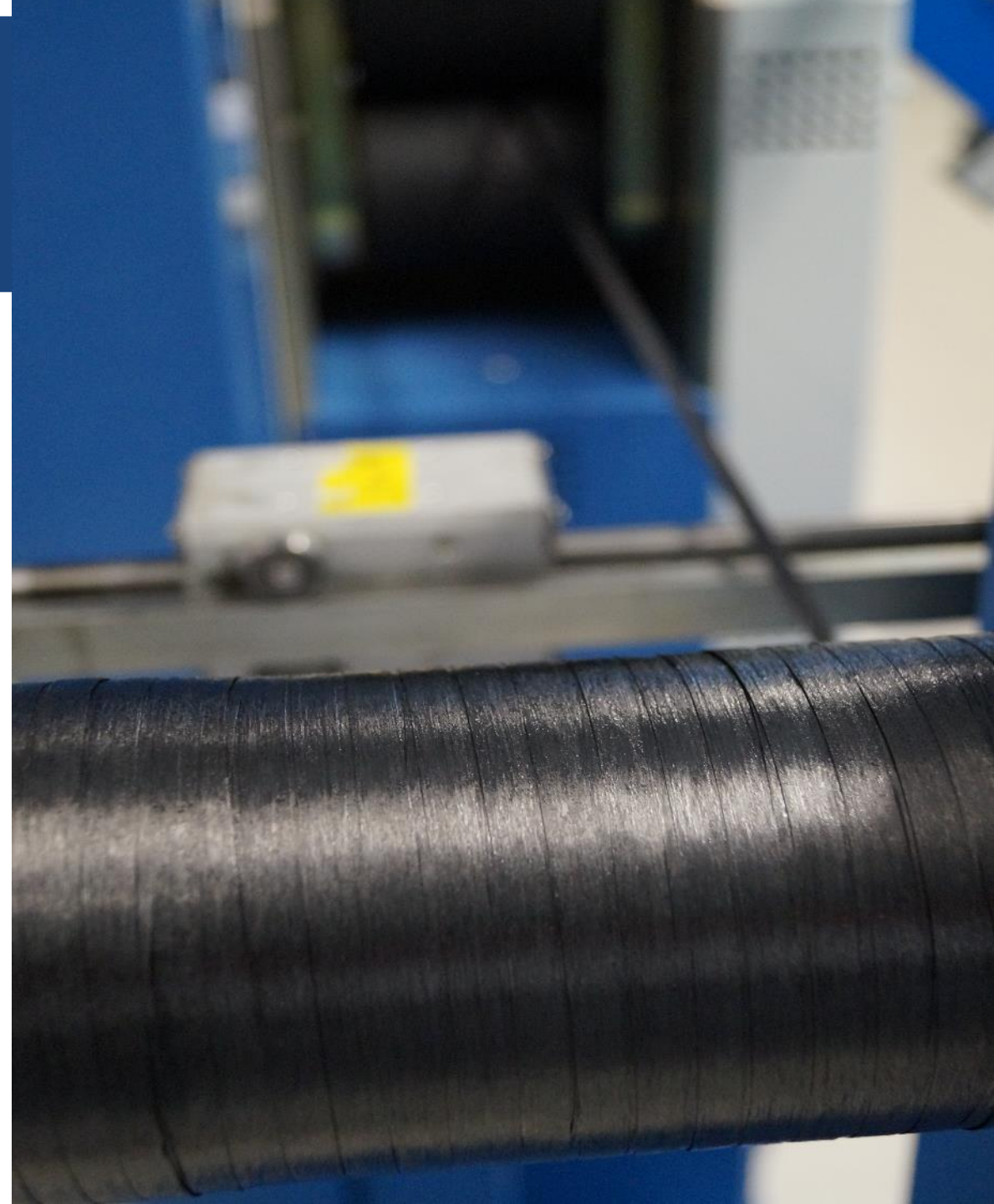


PA11+Carbon fibre

Challenge 1

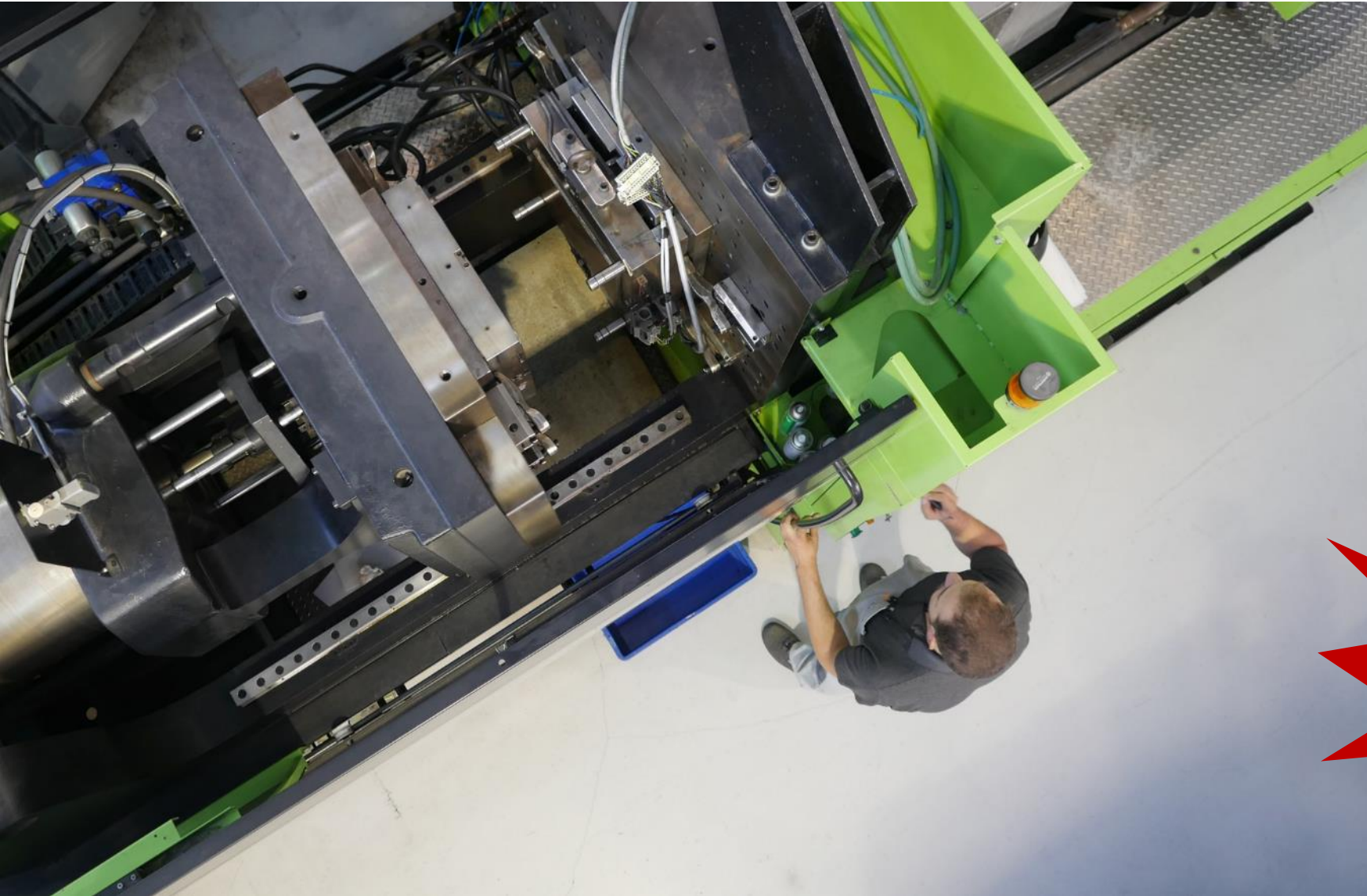
Development of an efficient process for carbon fibre and glass fibre UD tapes manufacturing with reduced material usage and increased mechanical performance

- 📖 Innovative impregnation systems:
 - Fluidized bed of thermoplastic powders
 - Melted supercritical fluid-aided thermoplastic polymer
- 📖 Replacement of the slitting and splicing stages
- 📖 Novel heating up techniques



Challenge 2

Development of an innovative overmoulding technology to manufacture complex composite parts locally reinforced with UD tapes



Injection-compression moulding

Automated tape laying

Online process control

**Automotive
cycle time**

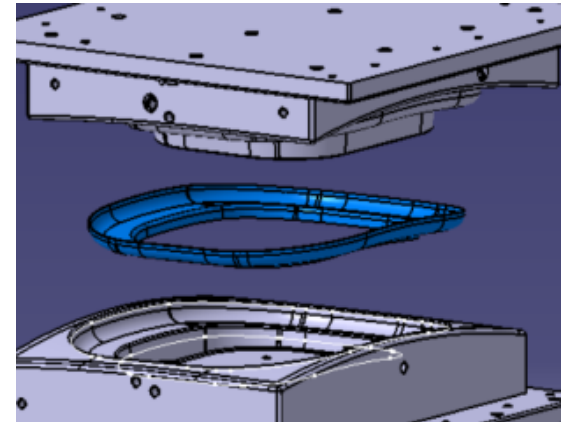
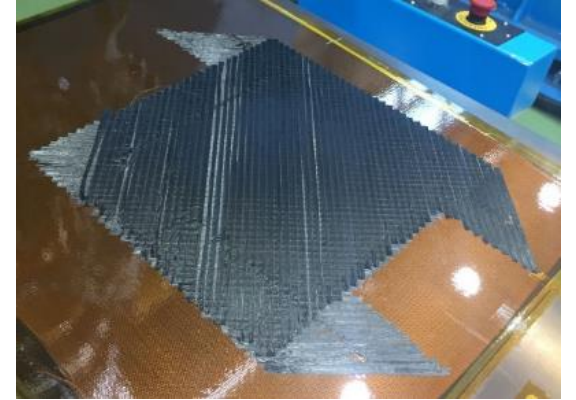


Challenge 3

Development of a novel in-situ consolidation technology to manufacture complex composite parts for secondary structure and interior cabin

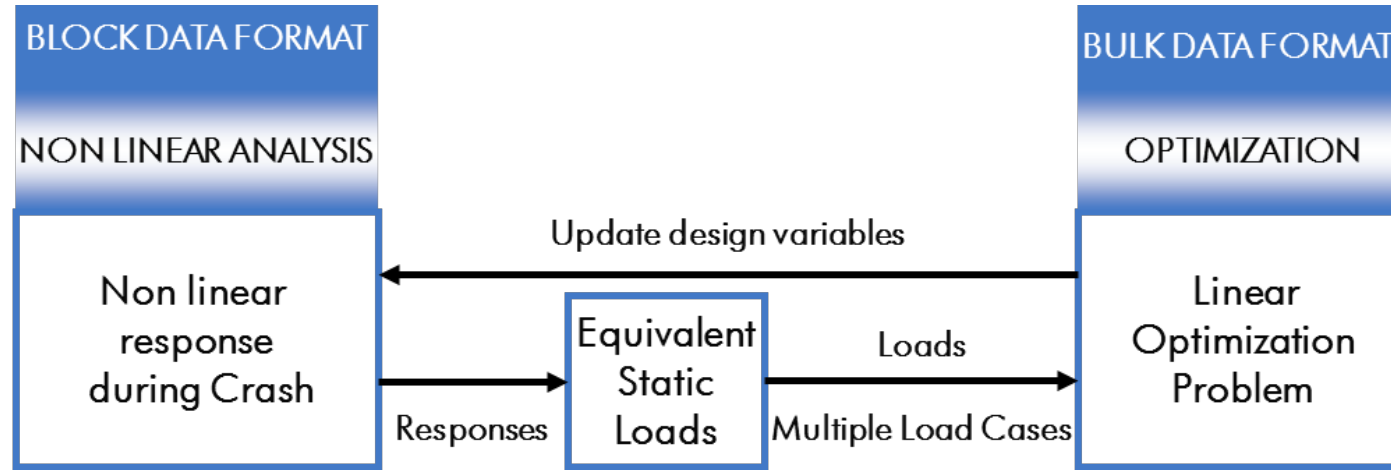
PA complying fireproof regulations

No need of autoclave

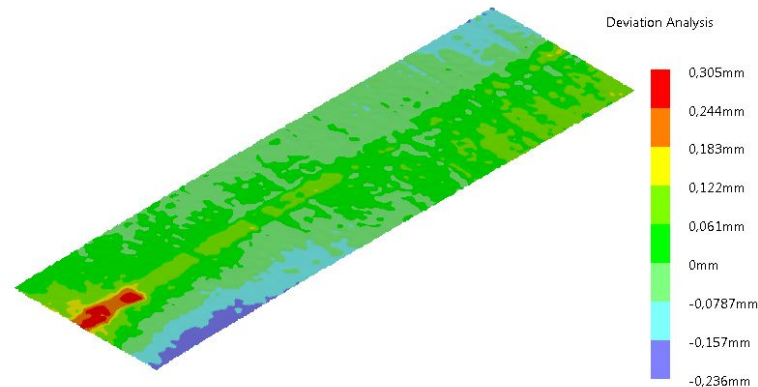
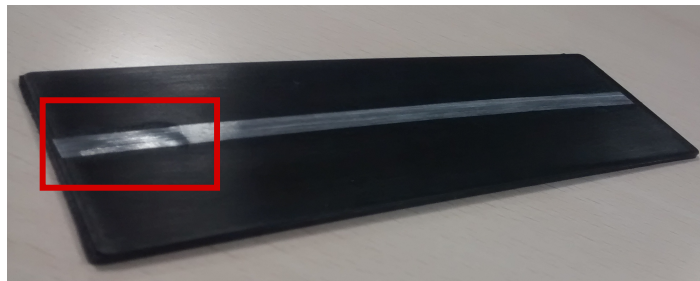


Challenge 4

Development of novel modelling concepts to assess the geometry design of complex parts and to select the best strategy for the part manufacturing



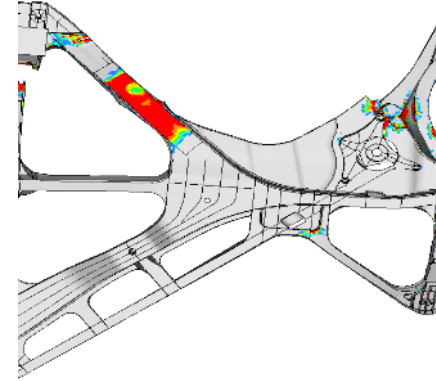
ESL modelling to support the structural design and crashworthiness behaviour



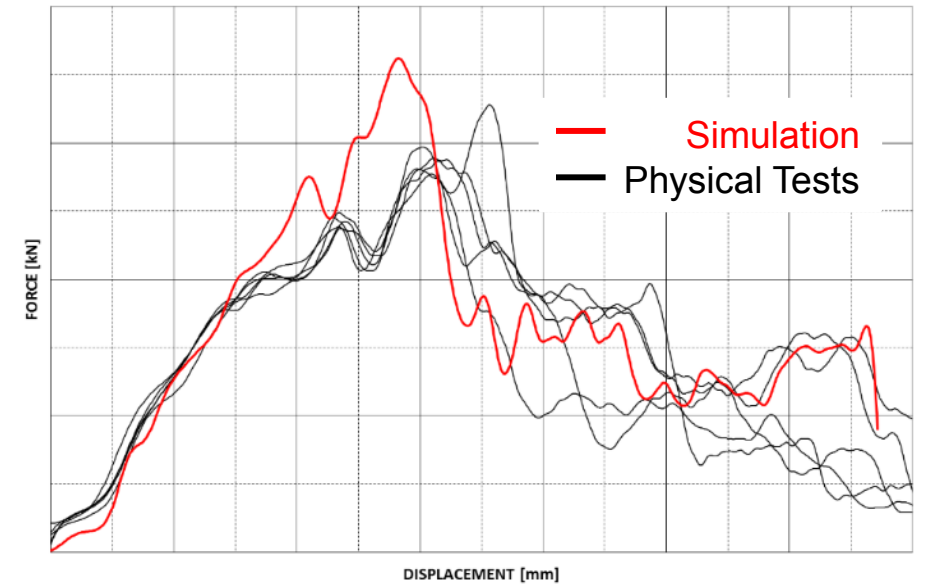
MOLDFLOW: Characterization of the UD tape as an orthotropic insert



**Crash simulation
methodology**

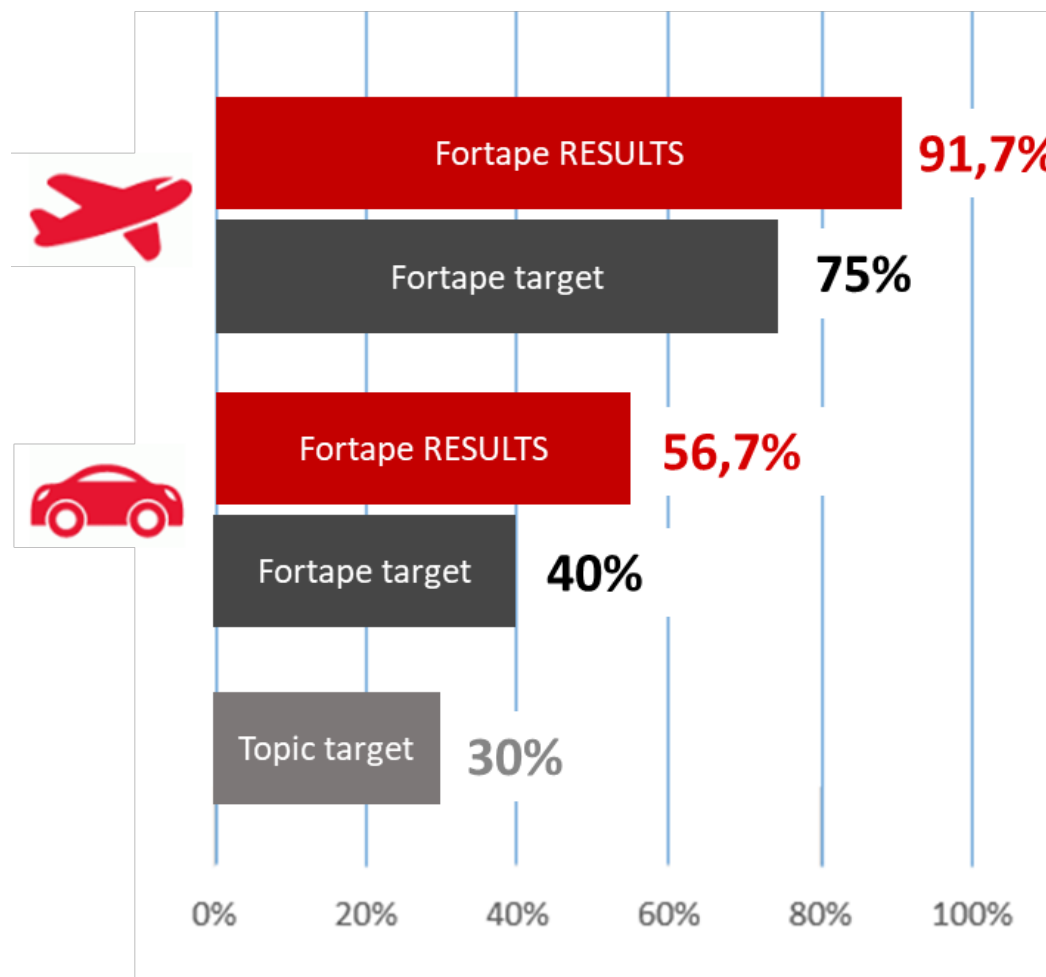


Physical Test

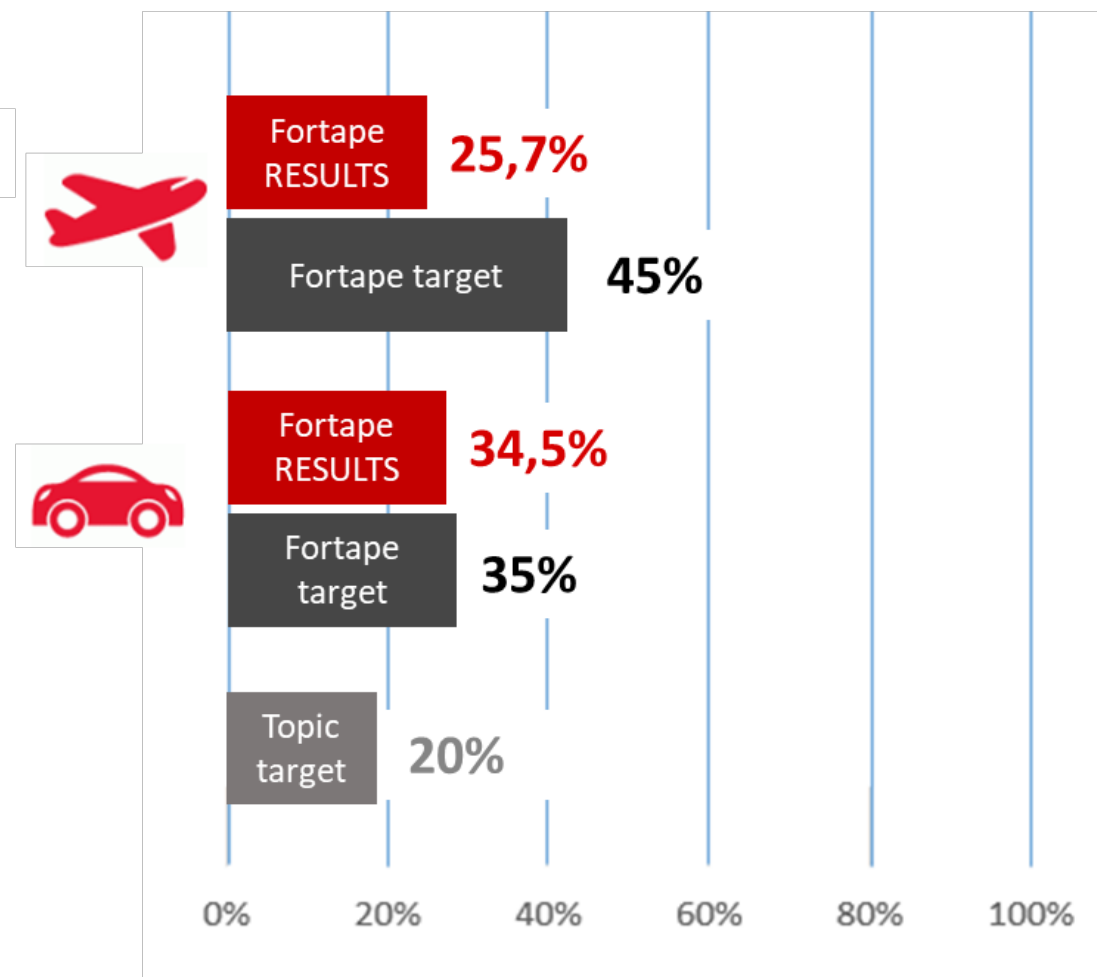


Results

MATERIAL SAVING %



ENERGY SAVING %





Thank you for your attention

www.fortapeproject.eu



Raquel LEDO BAÑOBRE
Head of Materials Innovation Area
raquel.ledo@ctag.com



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636860