



Webinar : Recent Developments in Lightweight for Automotive

- organized by AUTOMOTIVE NL in cooperation with AVK –

Dr. Michael Effing, Volker Mathes

16. June 2020 – Online Webinar

Agenda

- **Introduction Lightweight in Automotive** - *Freek de Bruijn*
- **Lessons learned from the BMW I3 Carbon Composites Project-** *Michael Effing*
- **Q&A**
- **Robust and efficient Composite Processes and the Role of the AVK-** *Volker Mathes*
- **Q&A**
- **Recent Composite Applications: Interiors, Closures, E-Mobility, etc.-** *Michael Effing*
- **Outlook/ Trends-** *Michael Effing*
- **Q&A**

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- Outlook/ Trends
- Q&A



LV 2025 is an EU-funded cross-border project in the Euregio Meuse-Rhine (Wallonia and Flanders in Belgium, Limburg and Noord-Brabant in the Netherlands, North-Rhine Westphalia in Germany). LV 2025 connects and bundles technological competences in Automotive as well as global and local networks for the benefit of the entire industry in the Euregio Meuse-Rhine.

Project Partners



Co-Financers



Ministerie van Economische Zaken

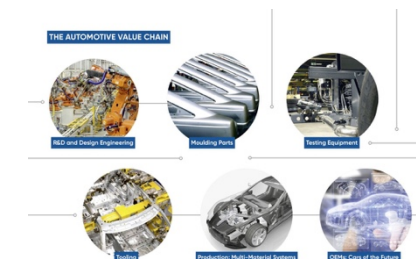
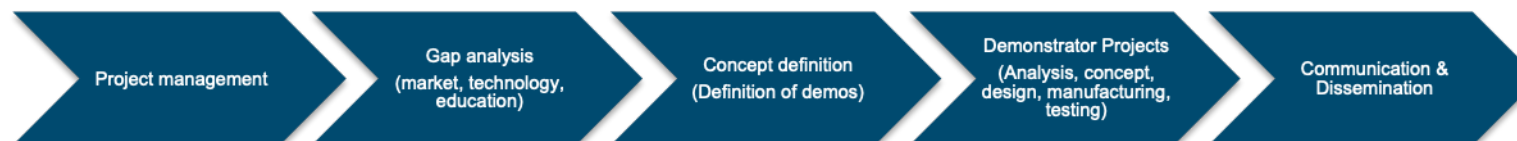
provincie limburg



Provincie Noord-Brabant



Wallonie



Framework:

Duration: 3 years
Budget: 2,4 Million EUR
6 Partners
Funded by Interreg

- Inspire cooperation and cross border clusters
- Raise awareness of coming market requirements

Aim:

- Platform of automotive competences
- Building a virtual technology center on automotive engineering for the future
- Strengthen the economy
- Secure working places
- Bundling technological competences
- Showcase design, manufacturing of components
- Manufacturing of selected prototypes (Demonstration of projects)

Deliverables:

- Identify and connect companies in the Euregio
- Create a database (Who is who)
- Connect the competences in workshops/seminars/symposium/match-making events
- Manufacturing and testing of 3 demonstrator components
- Provide gap analysis on technologies & training possibilities
- Select potentials
- Stimulate knowledge transfer
- Provide an up-to-date worker and engineer training framework

Shoulder to Shoulder Across Borders: Light Vehicle 2025 Demonstrators

1

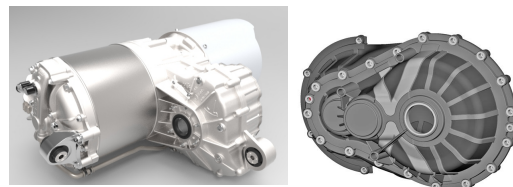


Body module

e.g. bonnet, door

Demo Leader:
Jean-Pierre Heijster, Automotive NL

2



e-Powertrain module

e.g. gearbox housing

Demo Leader:
Ioanna Koutla, Université de Liège

3



Suspension module

e.g. AM-consolidated parts

Demo Leader:
Jan Vandessande, Flanders Make

4



Hydrogen tanks

For fuel cells

Demo Leader:
Dr. Michael Effing, AMAC

✓ We have chosen four demonstrators

Project Partners

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Ministerie van Economische Zaken

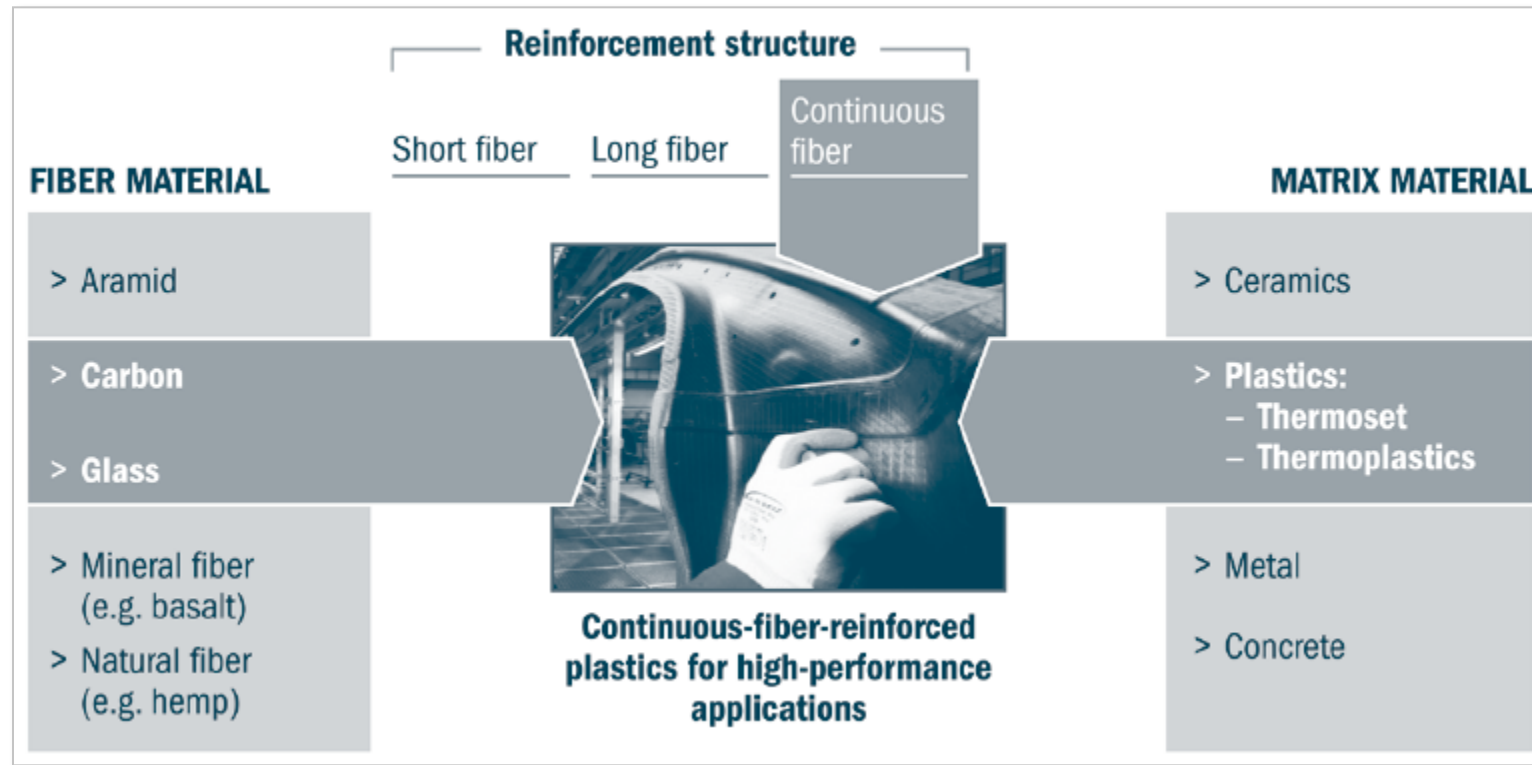
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Composites At A Glance



Composite are an-isotropic light weight materials

Source: Roland Berger Study – “Series production of high-strength composites” 2012

Composites- A Key Industry for High-Wage Countries in Europe

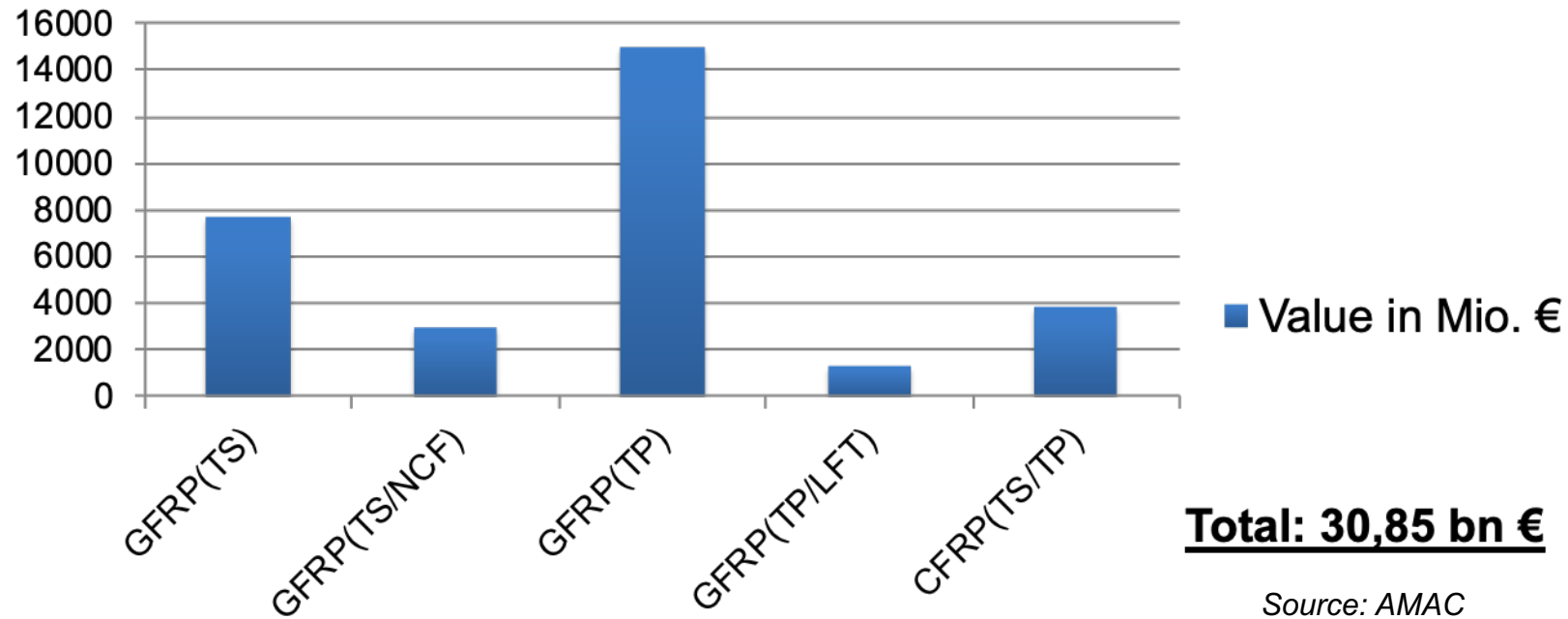


Advantages of Composites:

- Germany is the **leading supplier country** for lightweight applications
- Composites are a **key technology** to support the economic growth
- Composites have a high technological **performance** and **innovation** potential
- Composites allow **automated mass production**
- Composites are high **energy** and **resource** efficient
- Composites bring sustainable and high-quality **work places** in Europe

Composites are a very attractive industry for many markets and applications

The European Composites Parts Market in Value (2018)



- The EU composites parts market represents approx. 30 bn Euros (50 % of the European aluminum market for lightweight)
- The global composites parts market is 128 bn USD

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BMW - The Pioneer of Carbon Composites Structures for EV

- Carbon Fiber Composites Life Modul
- Aluminium Drive Modul
- Complete Carbon Composite Value Chain integrated into the BMW operation
- 500 composites experts recruited and transformed into Auto experts

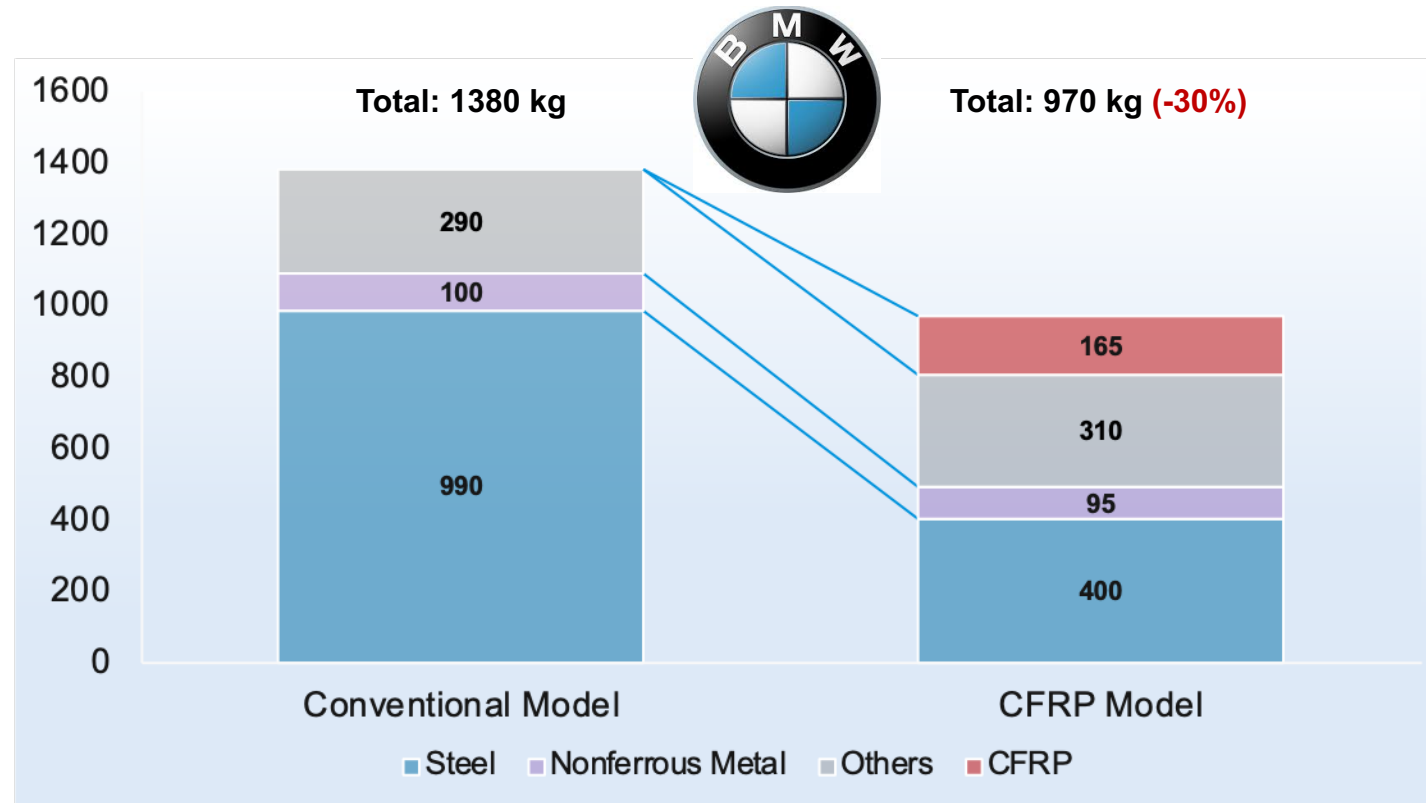


BMW i3
[IAA September 2013]

BMW I3 created a Hype in the Carbon Composite Market in 2012

BMW - The Pioneer of Carbon Composites Structures for EV

- 30 % weight reduction leads to significant CO2 reductions
- 3000 liters lower fuel consumption during a 250,000 km life cycle



- CO2 – Emission reduction
- During production (synthesis / carbonization): 20 tons
- During whole life cycle: 50 tons

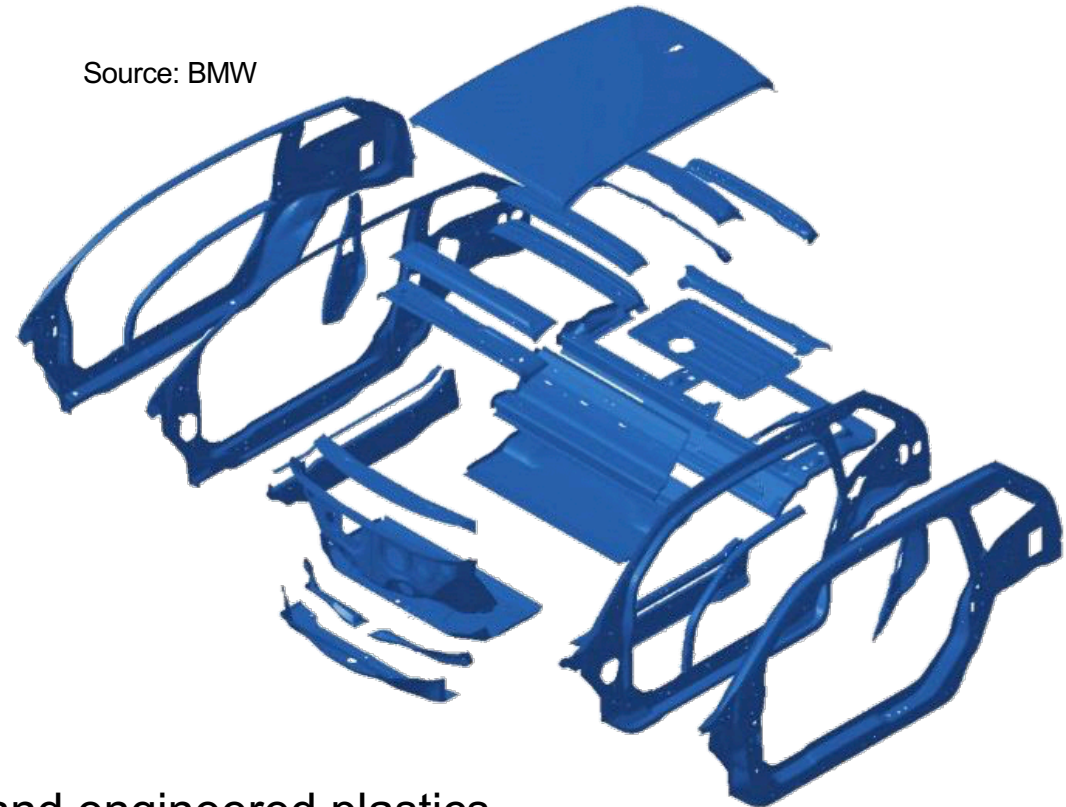


Source: Toray, Japan Carbon Fiber Manufacturers Association (JCMA), AMAC, MC Kinsey

BMW Life Module in Carbon Composites

- **34 Carbon Composites Components**
 - **15 monolithic RTM Parts**
 - **19 monolithic Wet Pressed parts**

Source: BMW



Issues:

- Waste – 1000 tons/ year in Carbon Fiber
- Cost
- Reproduceability/ QC
- Recycling- Carbon Fiber recycled in nonwovens and engineered plastics

Lessons Learned from the BMW i3 Carbon Project

- **Cost-efficient materials**
- **Cost-efficient processes**
- **No/ minimum scrap**
- **Robust processes**
- **Cycle times of few minutes**
- **Recycling / reuse of materials needed**



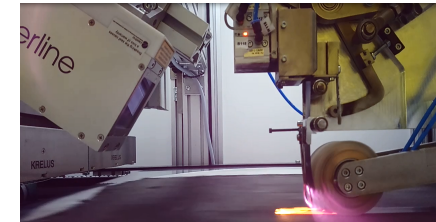
Source: BMW

- **Carbon fiber composites only for high-end cars**



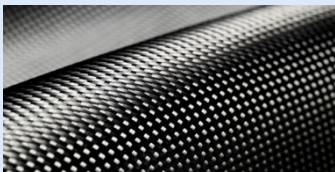

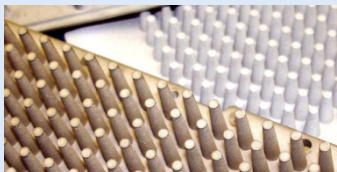

Source: BMW

- **Thermoplastics are in favour**



Lightweight is not the number 1 target anymore, due to E-mobility and Autonomous Driving, but still important

Mass Production Requires Further Innovation and Cost Reduction

	Carbon fibre	Glass fibre	Matrix	Production Method
				
Current Fields of Development	<ul style="list-style-type: none"> ➤ Modified conversion methods with reduced energy consumption ➤ Innovative precursor technology 	<ul style="list-style-type: none"> ➤ Energetic optimization ➤ Improved glass properties (tensile strength, stiffness) 	<ul style="list-style-type: none"> ➤ Quicker curing matrix systems ➤ Tailored properties ➤ Thermoplastics 	<ul style="list-style-type: none"> ➤ Process optimization ➤ Automation ➤ Near-end contoured preforms by means of textile technology ➤ Organo sheets
Cost reduction potential until 2020	15-25%	5-10%	8-10%	30-40%
Comments	<ul style="list-style-type: none"> ➤ Alternative precursors of sufficient quality are not to be expected before 2020 	<ul style="list-style-type: none"> ➤ Glass fibres as a commodity do not yield any significant further cost benefits 	<ul style="list-style-type: none"> ➤ Shorter cycle times yield additional savings in component manufacturing 	<ul style="list-style-type: none"> ➤ High potential on virtually all levels of the process chain



Source: Roland Berger Study – “Series production of high-strength composites”

Agenda

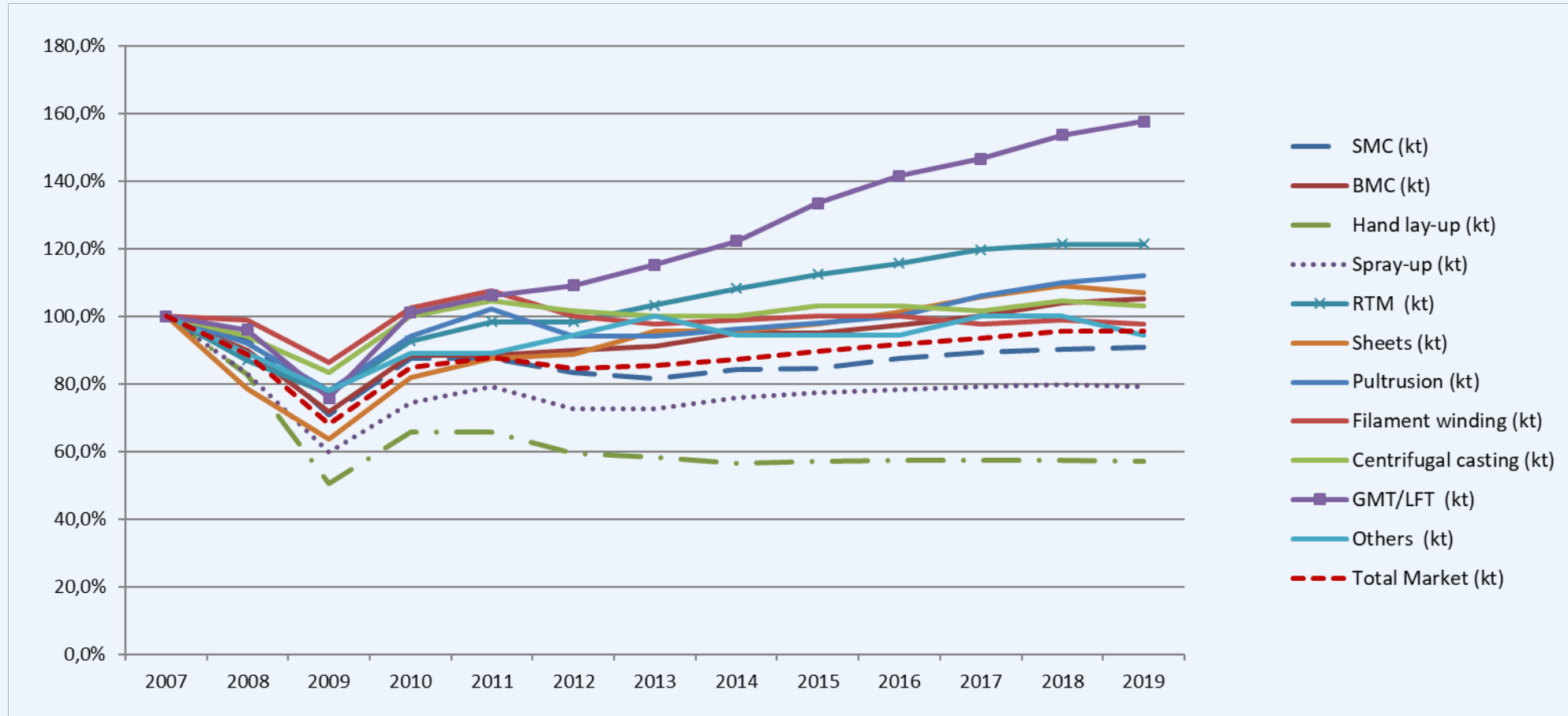
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AVK - The Organisation

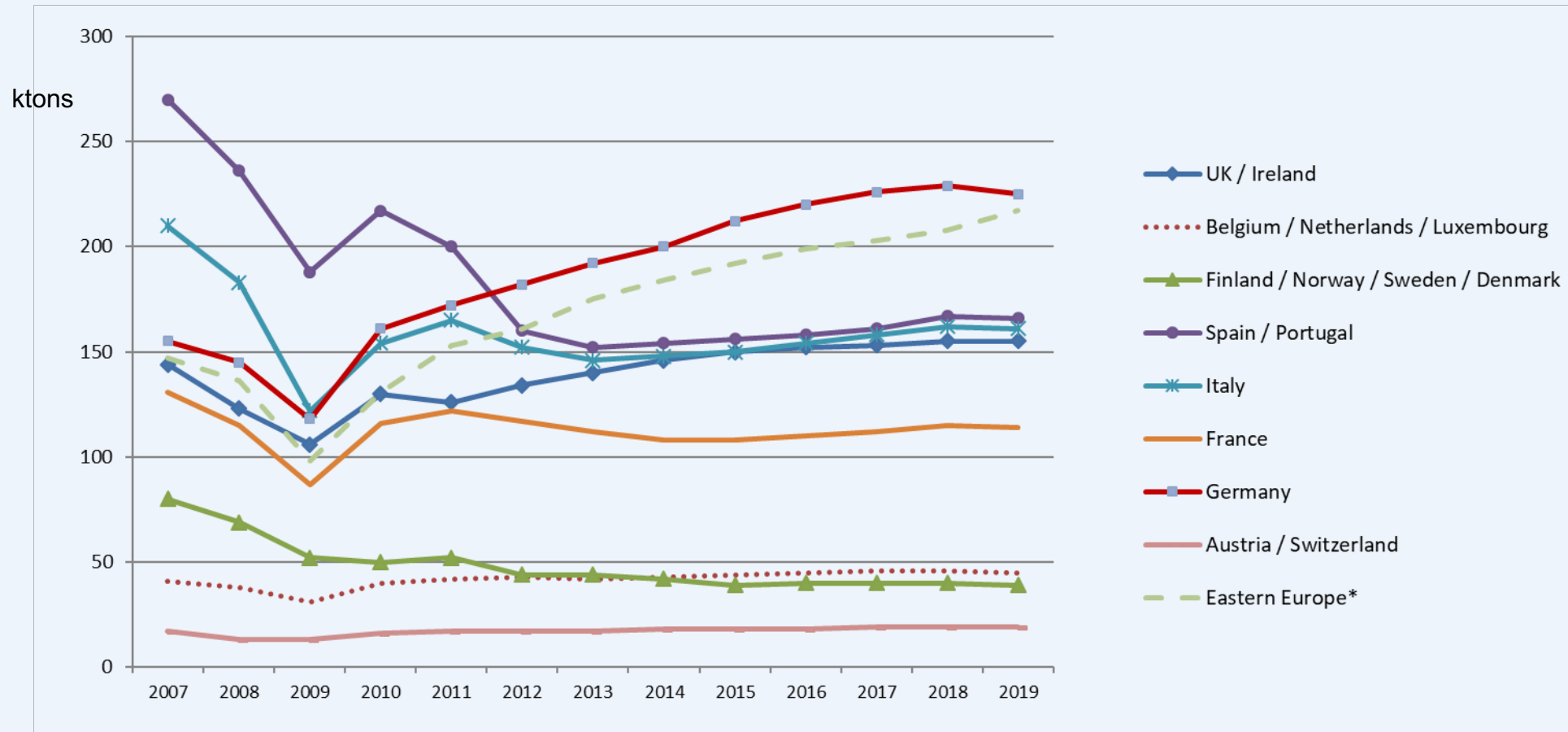
- **Founded in 1924**
- **Members along the entire value-added chain in the area of reinforced plastics**
- **~ 230 (inter)national member companies (1/5 non German); 7 Dutch companies**
- **> 1700 personal contacts inside the companies**
- **Founding-Member of „Composites Germany“**
- **Board Member of EuCIA**
- **Board Member of GKV**



GRP Production Europe – Market Segments



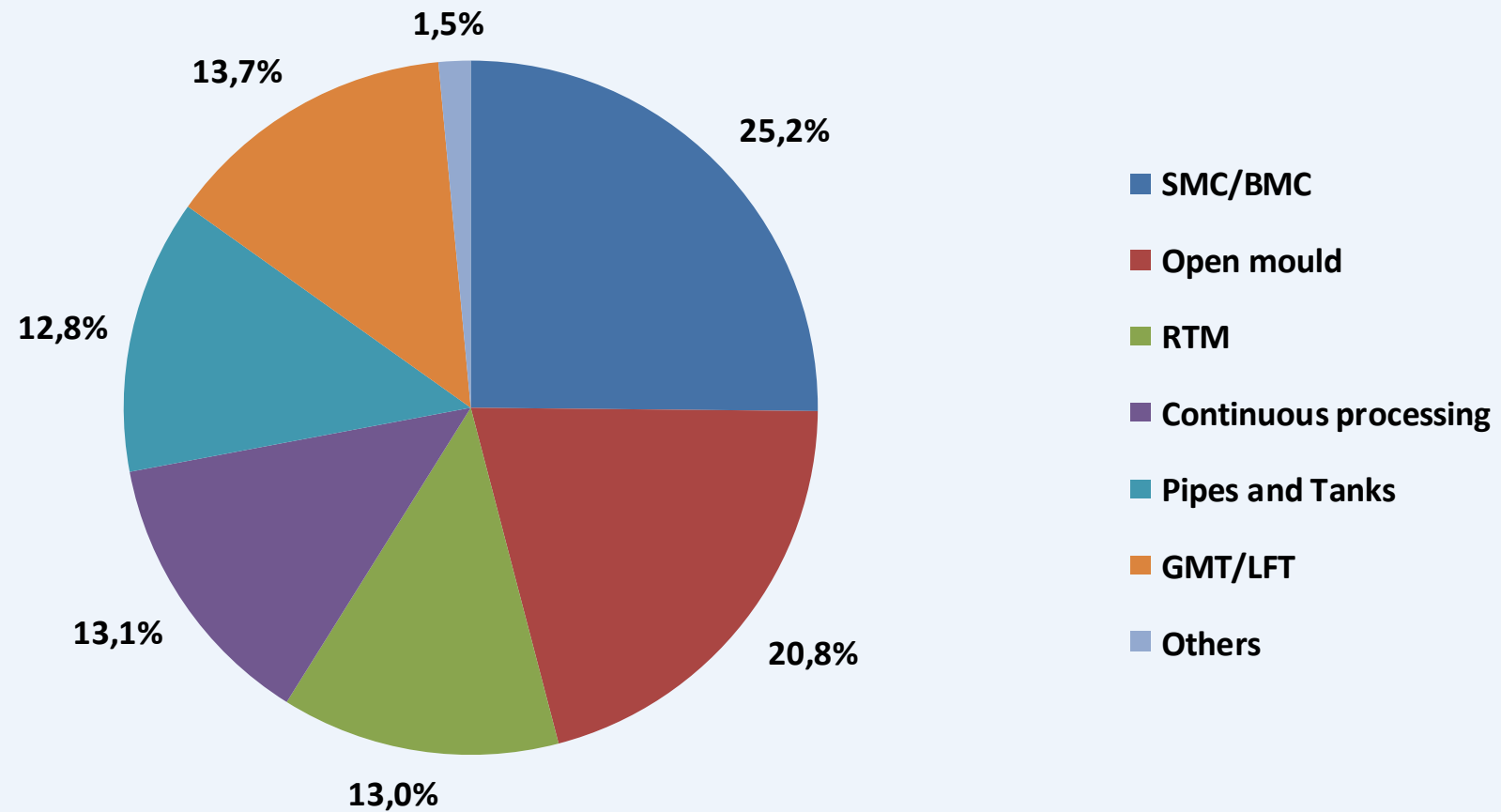
GRP Production Europe – Regional Development (ktons)



2019 = estimated

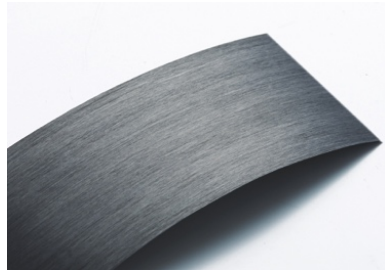
* Eastern Europe = Poland, the Czech Republic, Hungary, Rumania, Serbia, Croatia, Macedonia , Latvia, Lithuania, Slovakia, Slovenia

GRP Production Europe (2019) – Market Segments



The 4 Most Promising Manufacturing Technologies

Hybrid Thermoplastic Composites



High Speed RTM



High Performance SMC

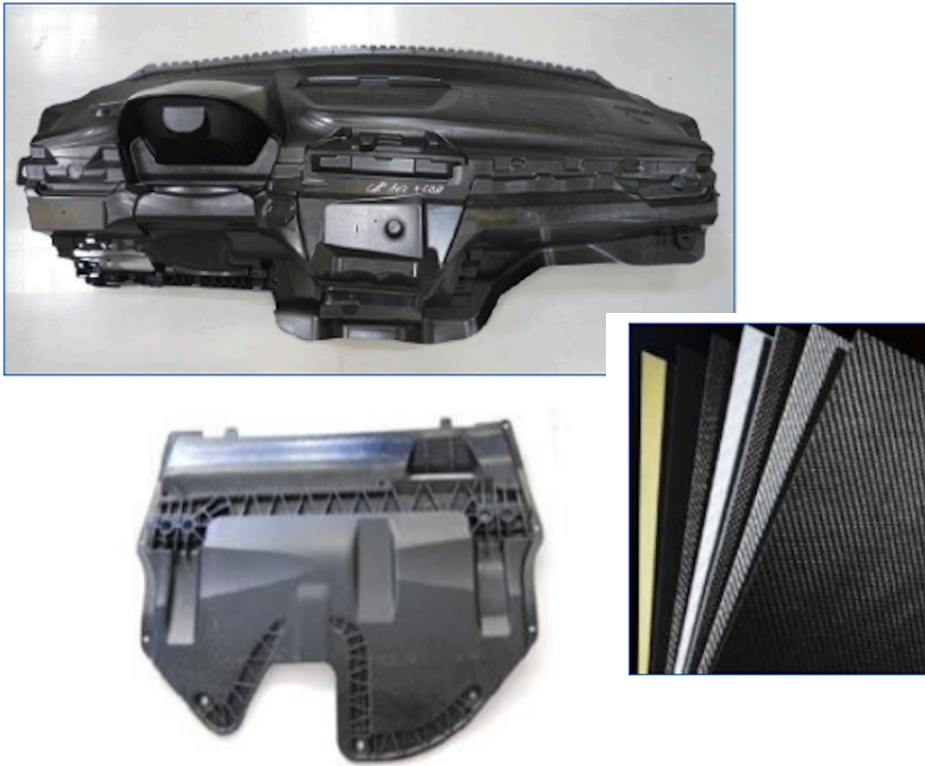


Composites Tubes & Pressure Vessels

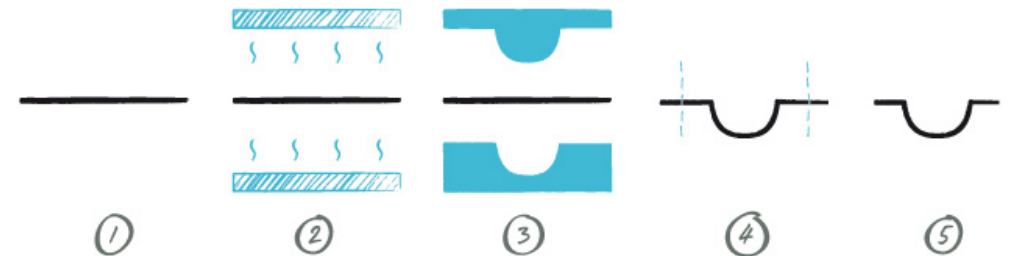


Hybrid Thermoplastic Composites (HTC)

➤ Reinforcement by Organosheets



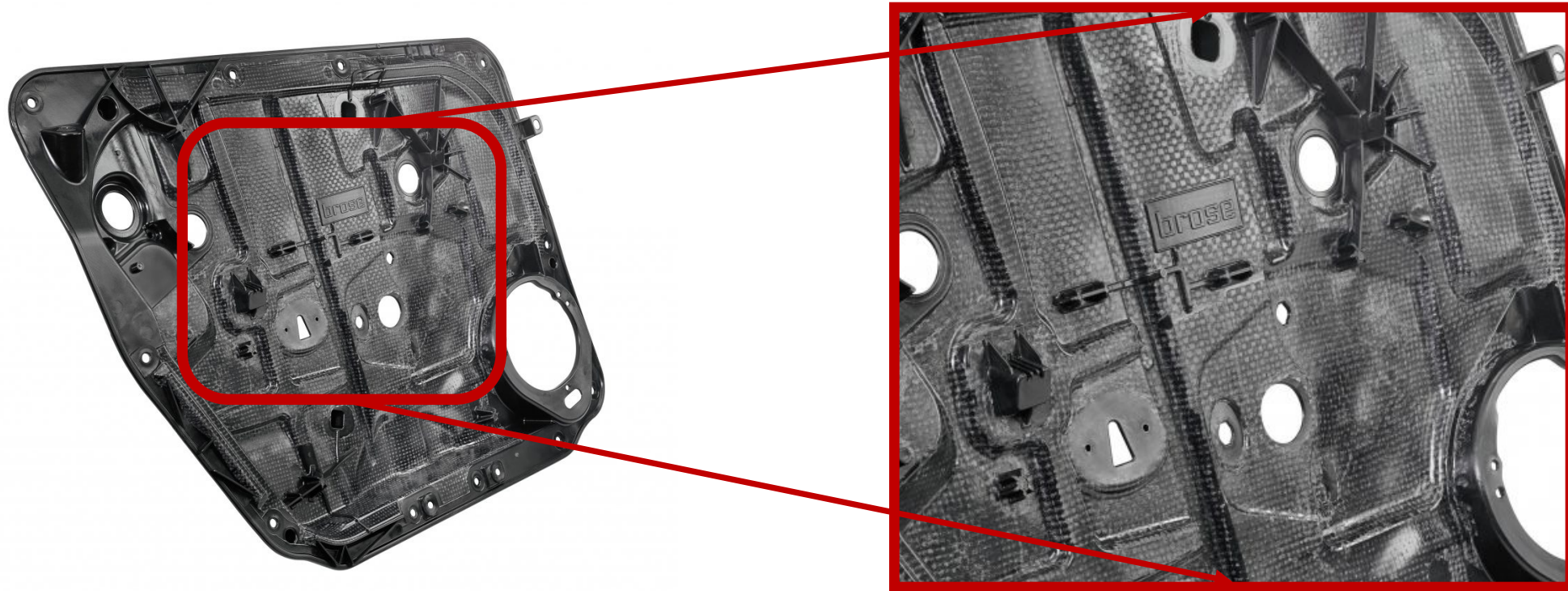
➤ Thermoforming



Source: Cato www.catoci.com

Example of Current Projects

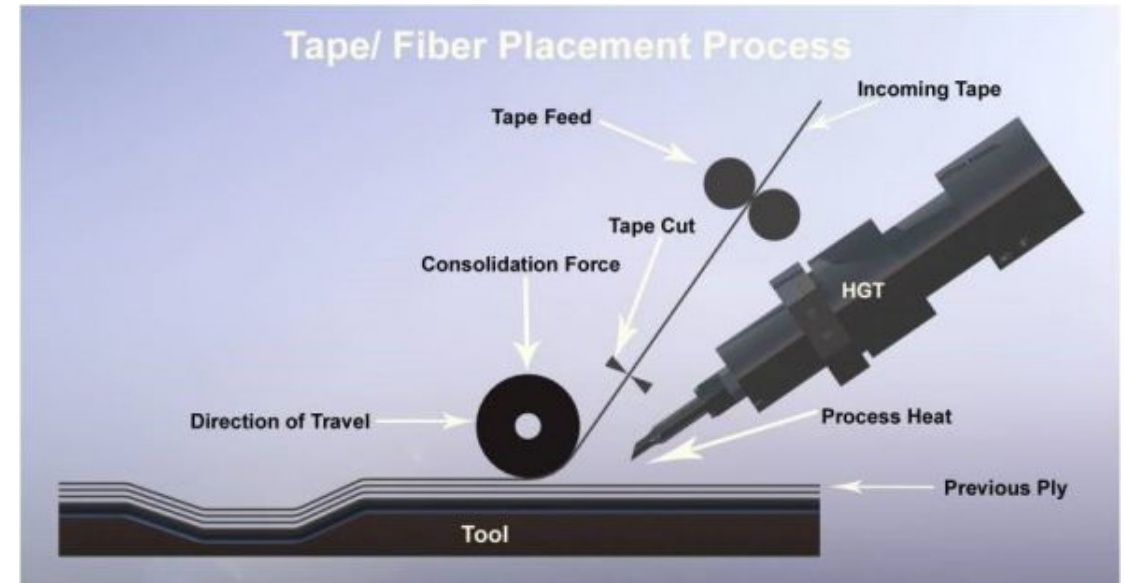
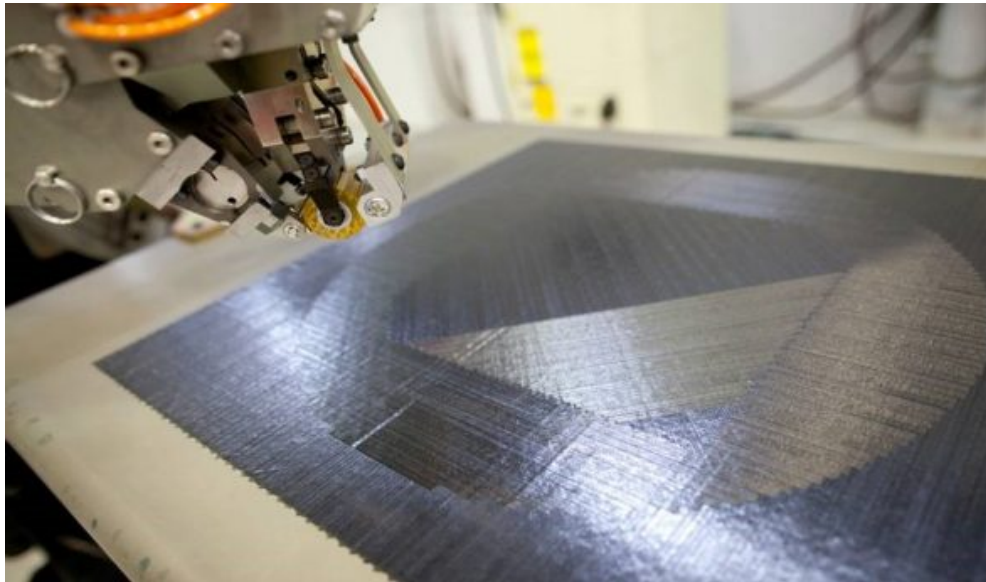
➤ Ford focus door module



Quelle: <https://www.plastverarbeiter.de/88054/variotherme-temperierung-fuer-organobleche/>

Tape Laying/ Tape-Placement instead of Organosheets

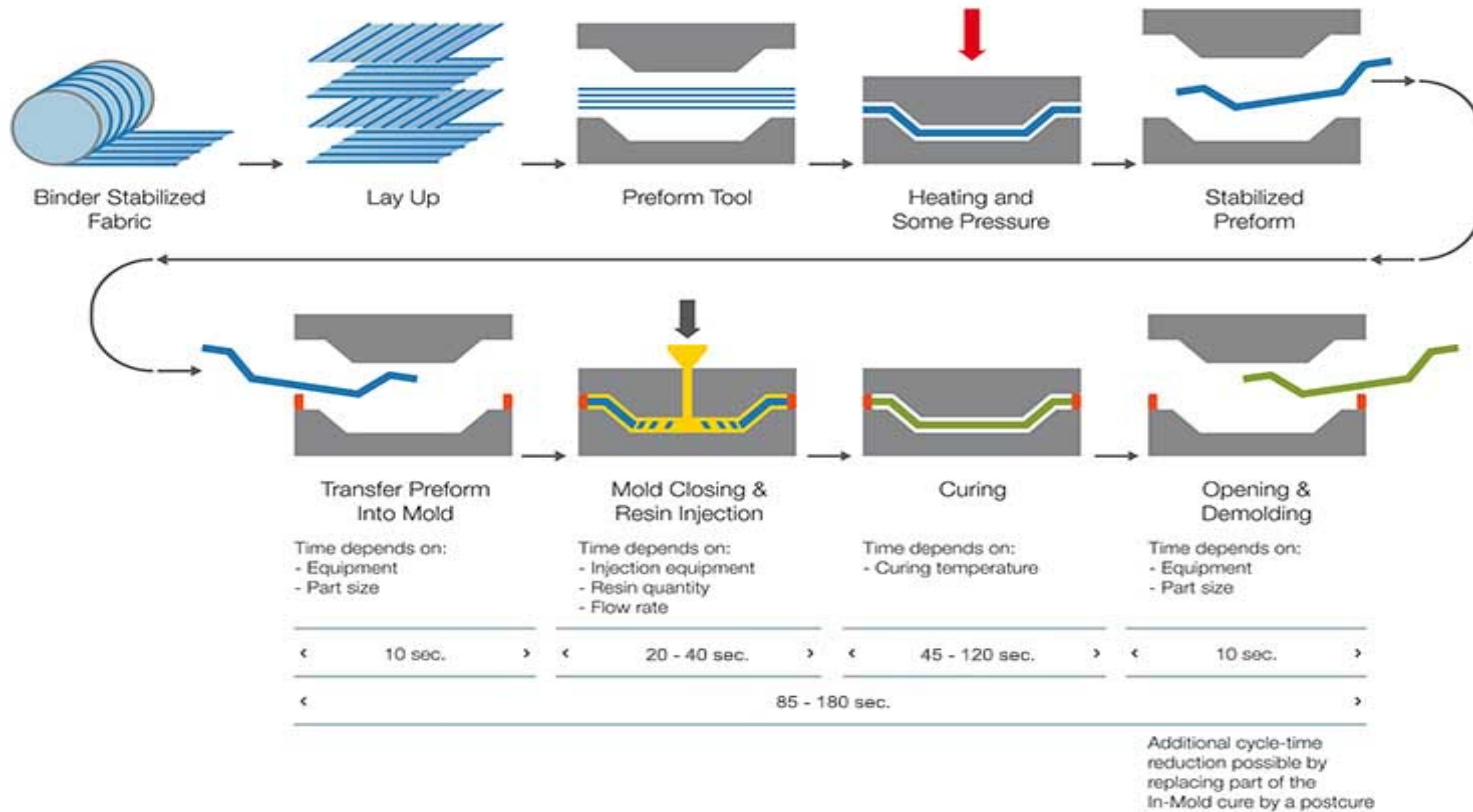
- **ATL/AFP: Automated tape laying (ATL) and automated fiber placement (AFP) are processes that use computer-guided robotics to lay one or several layers of carbon fiber tape or tows onto a mold to create a part or structure. Tape laminates are used in hybrid molding.**



Quelle: <https://www.youtube.com/watch?v=BZzfcJMYdLM>; <http://www.automateddynamics.com/article/thermoplastic-composite-basics/processing-methods/automated-fiber-placement>

High-Speed RTM

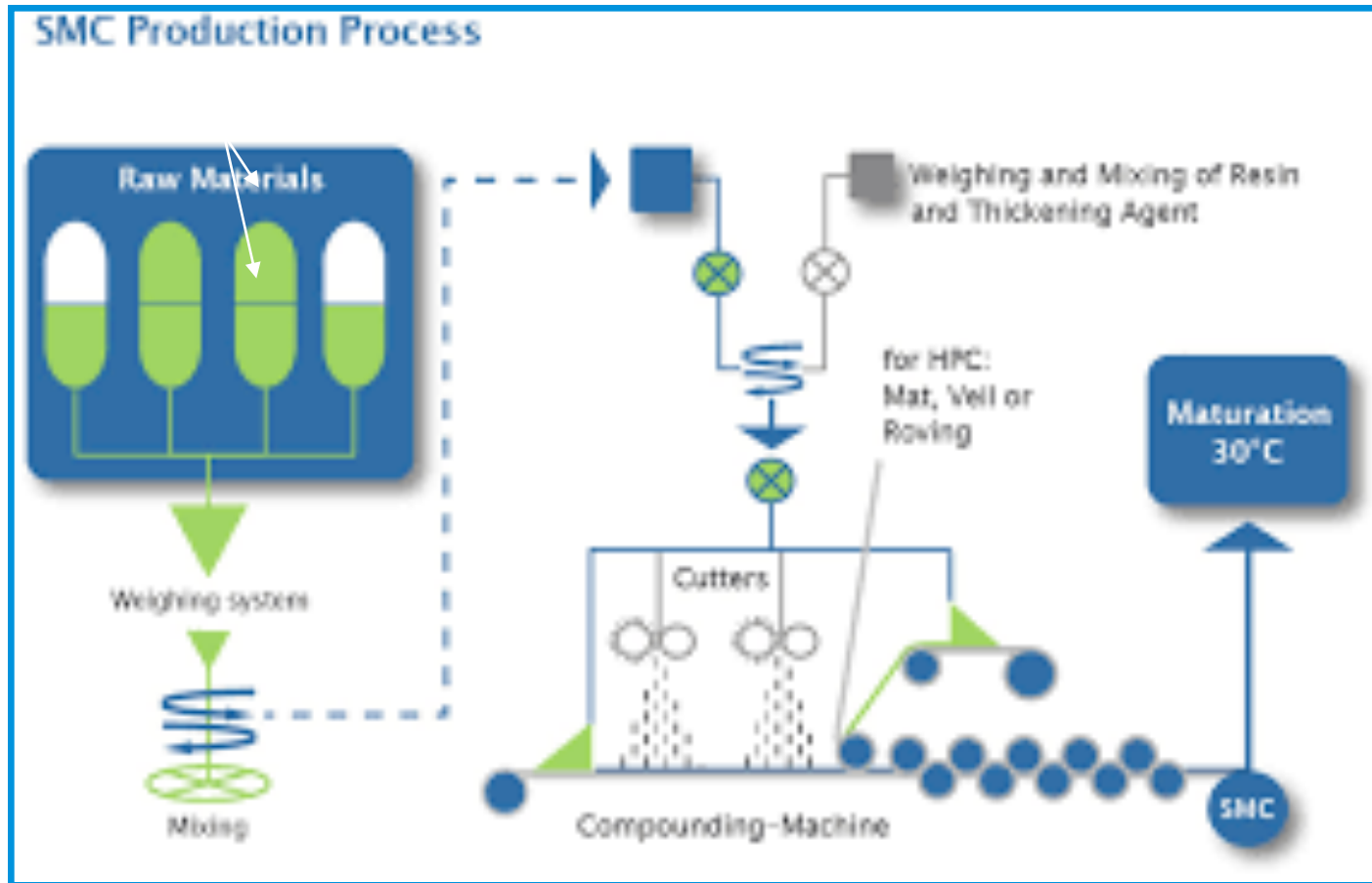
Resin Transfer Molding – Process Cycle



Source: BMW

Source: Hexion

High-Performance SMC

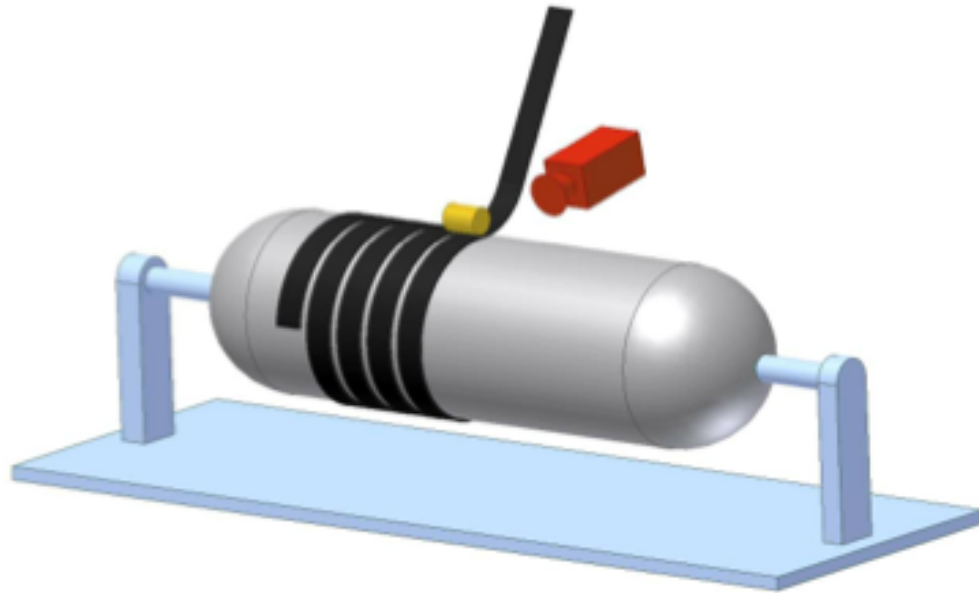


Source: Menzolit



Source: MAN

Tubes and Pressure Vessels



Source: R. Schmitt and A. Witte / *Proceedings in Manufacturing Systems*

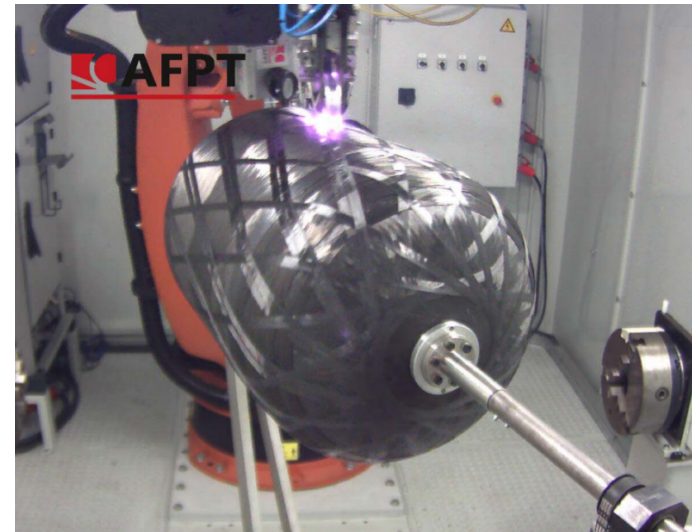
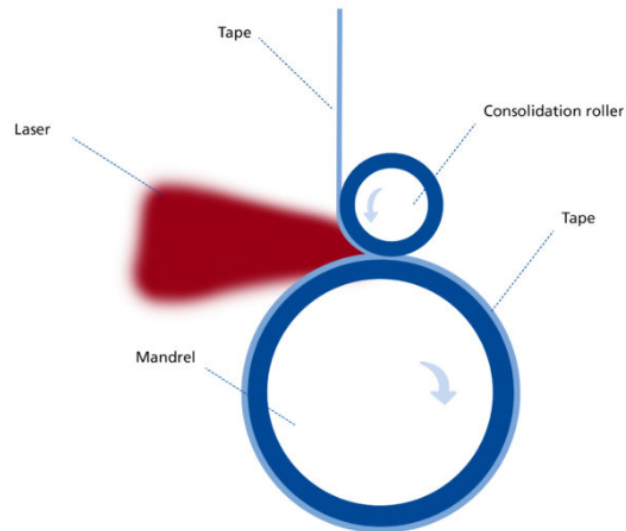


Source: Airborne (above picture), Plastic Omnium (below picture)



Thermoplast-Winding

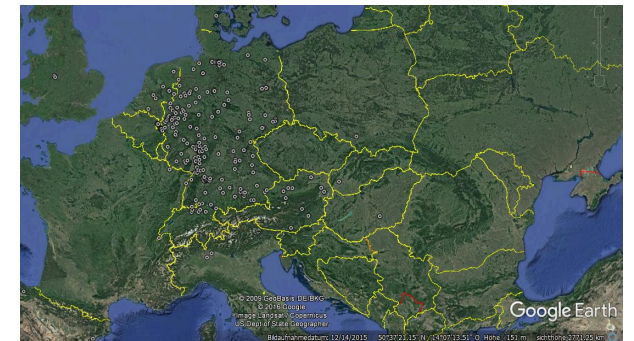
- As winding with thermoset resins, thermoplastic winding is particularly suitable for the production of complex three-dimensional components such as tanks.



Quelle: <https://thermoplasticcomposites.de/de/verarbeitung/tapelegen-und-wickeln/>; https://www.dlr.de/bt/Portaldata/35/Resources/dokumente/produktionstechnik-kolloquium/Automatisiertes_Legen_von_faserverstaerkten_Thermoplasten.pdf

AVK – What Can We Do For You?

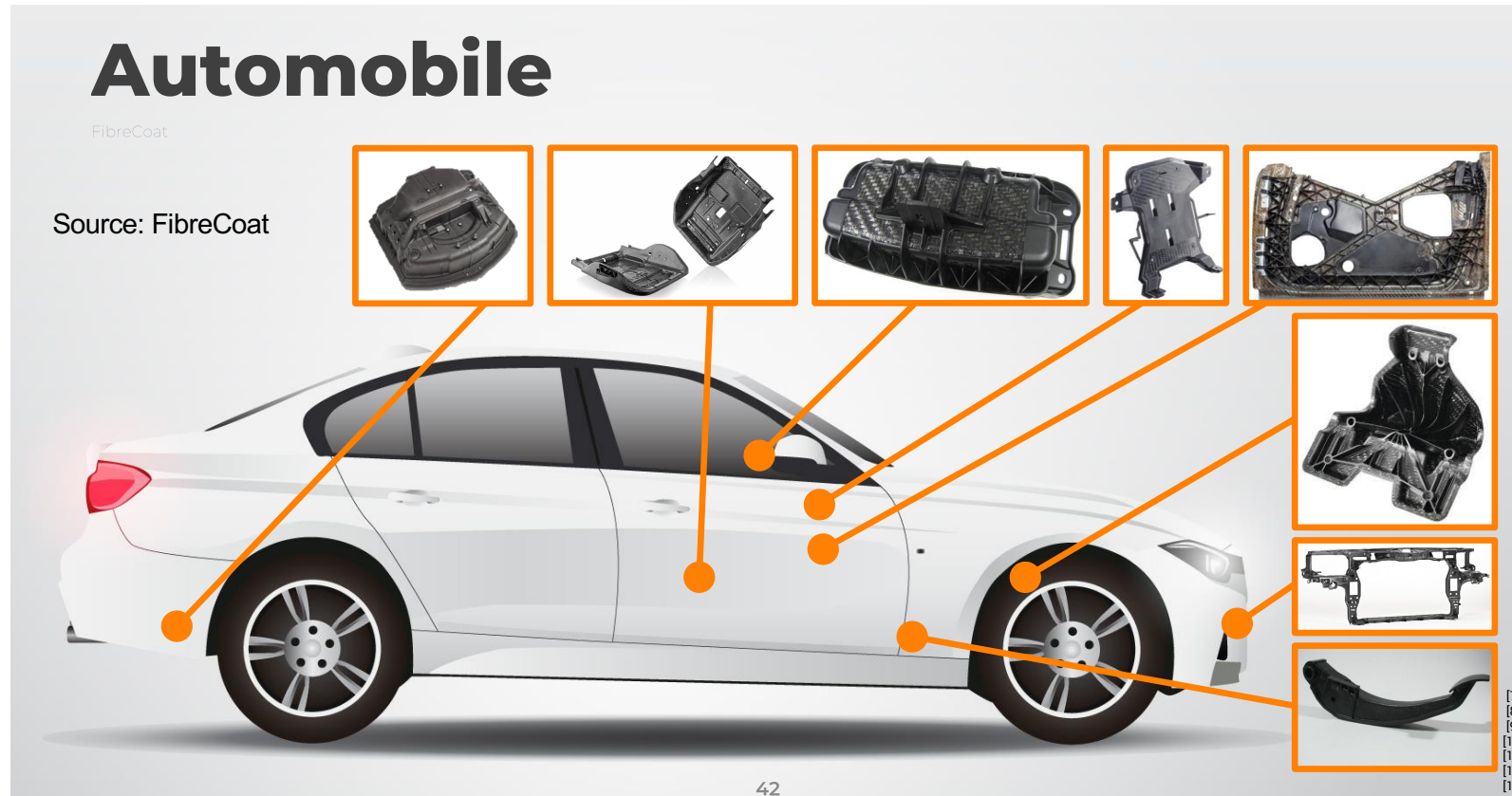
- AVK offers “Expert Task Forces” on many topics which may be interesting for the automotive industry:
 - EATC – European Alliance for Thermoplastic Composites
 - EPTA – European Pultrusion Technology Association (Secretary)
 - Continuous fibre reinforced thermoplastics
 - Joining of Composites
 - Natural fibre-reinforced plastics
 - SMC/BMC
 - ... **we are open for any new idea/project !**



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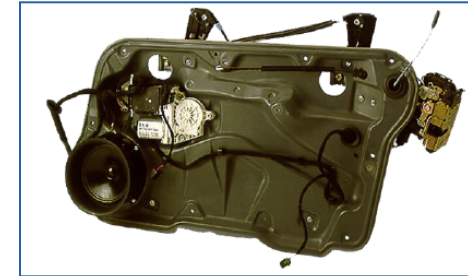
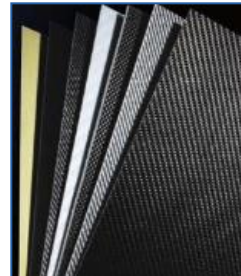
HTC has a high potential for Automotive



Hybrid Thermoplastic Composites is a combination of various thermoplastic technologies e.g. GMT; LFT; Tapes; Organosheets using press & injection molding

Ideal Applications for Organosheets

- Large areas (rectangular) , minimum scrap from cutting the sheets
- No scrap in forming, near net shape
- Only used with hybrid molding (overmolding)
- Functionalities by the injection molding process



Source: AVK-Seminare „Thermoplastic Composites“, EATC; Bond Laminates

Growth Projections: Example Ford Focus Door Module



Organosheet: GF/ PA6

Source: www.api.kraussmaffei.com,
AMAC

	Value
Sheet dimension:	0,8 x 0,6 meter
Thickness:	0,5 mm
Weight per sqm (1mm thick)	1.650 g/sqm
Number of parts/ year	2.0 Mio
Volume of TP (80%):	792 tons
Total materials:	990 tons
Revenue/ year in Materials (materials only, 6.5€/kg)	5.5 Mio €
Revenue / year in parts:	9.6 Mio €

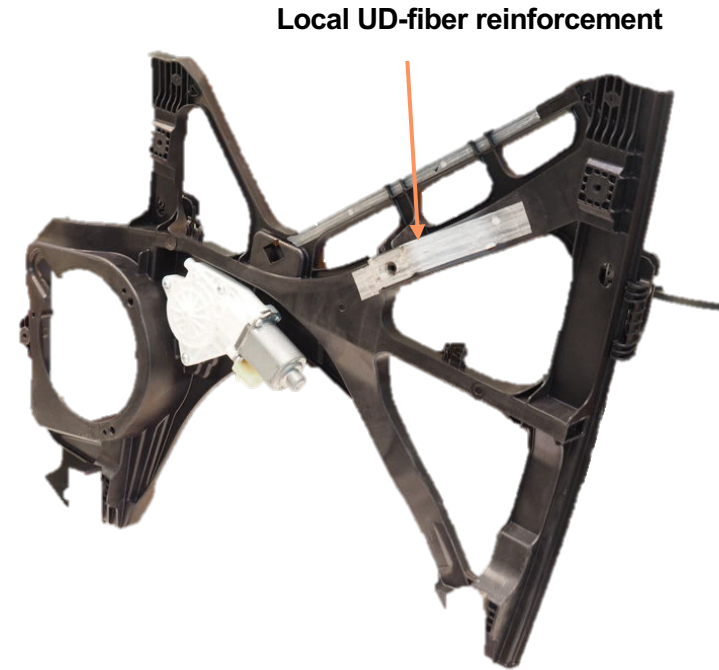
Note: 60 % of the business went to Lanxess/D, 40 % to Kingfa/ China

One single Automotive application in TP can add 500 to 1000 tons, but pricing is very competitive- Conversion factor 1.4 to 1.6 x material cost

Technology Examples- Tape in Favor of Organosheets



Source: Cockpit [Faurecia]



Source: Inner door module [Fraunhofer ICT, 2018]

Other Automotive Parts by Hybrid Molding

➤ Example: Seat Shell



- Hybrid Molding: Organosheet with Fiber Direct Compounding (FDC). By ICT Fraunhofer, Arburg and Dieffenbacher, March 2020

➤ www.arburg.com

➤ Example: Table, Interior



- Hybrid Molding: Organosheet by Covestro, weight 0,69 kg molded by Dr. Schneider. March 2020

➤ www.covestro.com; www.dr-schneider.com

Examples in Hybrid Thermoplastic Composites

➤ Holders



Audi, KM: Holder

Tataka: Airbag Housing

Examples in Hybrid Thermoplastic Composites



Thermoplastic composite construction. An insert made of the continuous fiber-reinforced thermoplastic composite Tepex dynalite from Lanxess and several tapes are used for the structure.

"The composite structure reduces the weight of the brake pedal by 50 percent compared to a comparable steel construction. The high load requirements on the structural component are met by the customized fiber layer structure of the Tepex insert and additional local tape reinforcement. Thanks to end-to-end automation, the geometrically complex safety component can be produced efficiently in large series," explains Dr. Klaus Vonberg, lightweight construction expert in the Tepex Automotive Group of HPM.

Porsche Taycan and Panamera

Manufacturer: Lanxess

Application: Battery Electric Sport Cars

Source: www.lanxess.com

Examples in HTC- Future Applications



Concept seat [Faurecia, ZF]

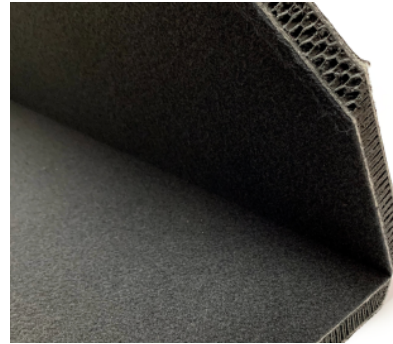
Principle:

- Autonomous mobility
- One system integrates seatbelt system, airbag system and seat
- Consequently designed to fit in

Characteristics:

- Packaging reduction
- Weight reduction

Trunk Floor in TP Sandwich Technology



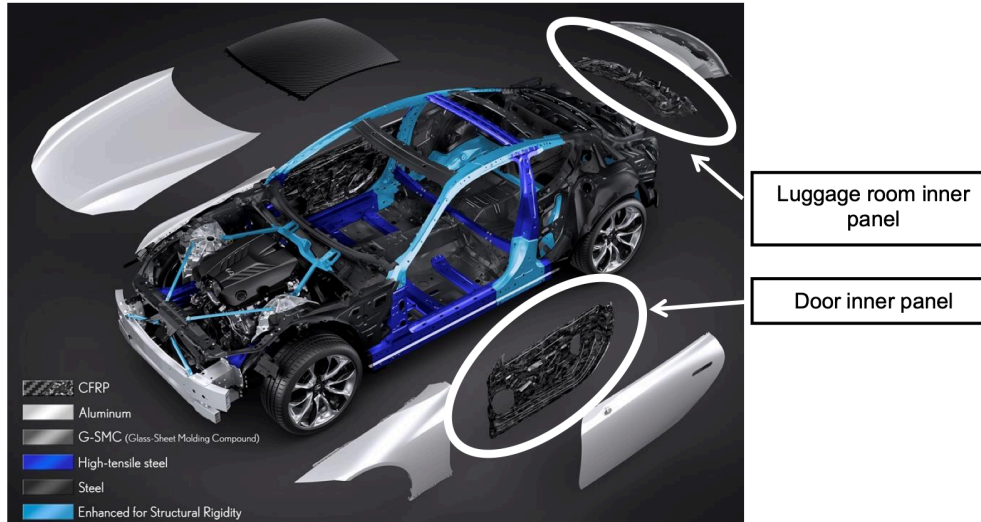
EconCore and **DPA Moldados**, a tier 1 automotive supplier, have developed an innovative technology which has reduced the weight of the Hyundai Creta's trunk floor by 20%.

The revolutionary thermoplastic composite, combining a sandwich panel of PP honeycomb and GMT composite skin.

OEMs are calling for weight reduction but unless motorsport are involved, they are not quite willing to accept it if the costs are higher than conventional solutions.

May 2020

Interiors & Closures in SMC



[Door and luggage room inner panels of Lexus LC500 using MCC's carbon fiber SMC]

Lexus LC500 (Door and Luggage room inner panels)

Toyota Prius (Tailgate)

Supplier: Faurecia

Process: Press Molding

Material: CF-SMC from Mitsubishi Chemicals

Source: www.m-chemical.co.jp
www.insidecomposites.com

Interiors & Closures in SMC



Source: BMW & Polytec

BMW M4 CS Tailgate

Supplier: Polytec Group

Outer part

Process: Compressing Molding/ IMC (inmold coating)

Material: GF-SMC

Inner part

Process: Compressing Molding/ IMC (inmold coating)

Material: CF-SMC

Growth Projections: Example Toyota Prius Tailgate



Tailgate inner part

Photo: Mitsubishi Chemicals
Source: AMAC

	Value
Metal design	25 kg
HP- SMC design	12 kg
Weight savings	13 kg
Number of parts/ year *	70.000
Cost of C-SMC material	12 €/ kg
Cost of moulded part:	201 €/ part
Revenue/ year:	14 Mio €
* sold in the USA	

Tailgates are a prime target for Carbon-SMC by Mitsubishi and Toray

- Structural application with scrap-free use of Material
- 50 % weight savings possible vs. steel, 25 % vs. aluminium

Interiors & Closures in SMC



Source: www.smcbmc-europe.org

Mercedes Benz AMG E-Class

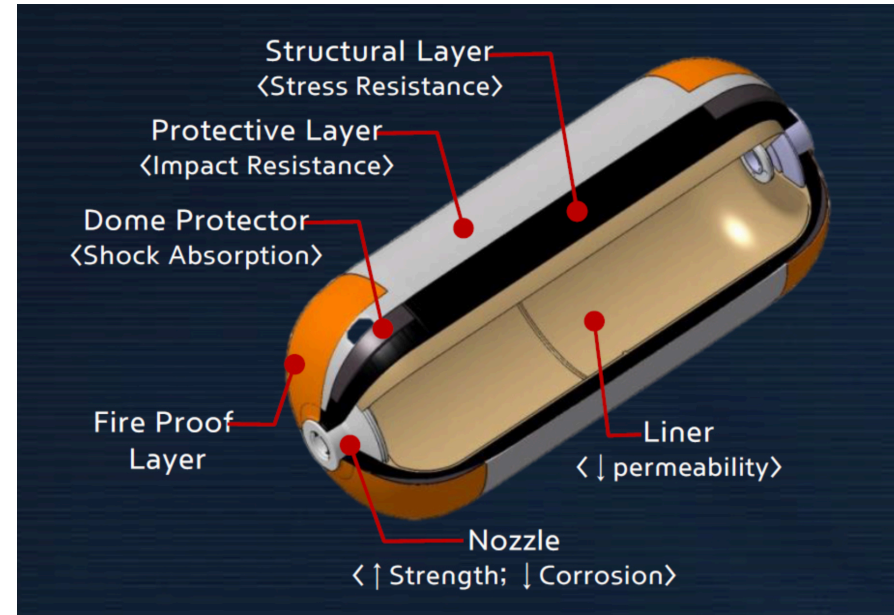
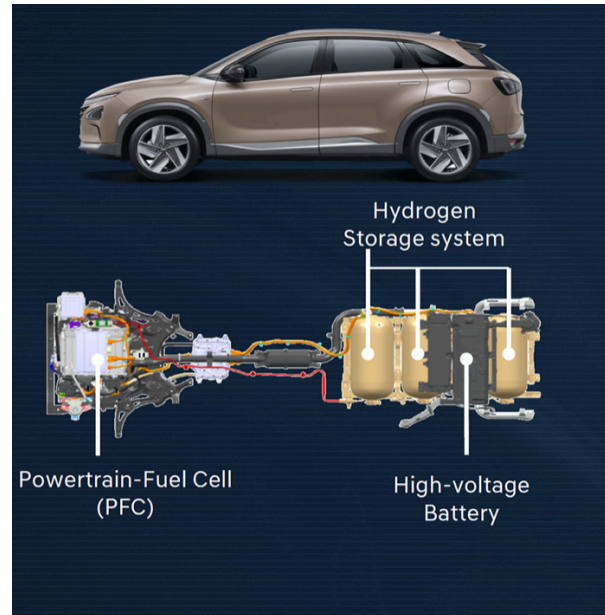
Multifunctional Spare Wheel Pan

Structural part in the rear structure of the vehicle

Supplier: EACC GmbH

Material: CF-SMC

Weight reduction compared to Steel: 45%



Source: SAE International

Hyundai Nexo

- Hydrogen tank Type IV (700 bar)
- Number of tanks per vehicle: 3
- Volume: 52 liters per tank
- Capacity: 2kg of Hydrogen
- **25 kg of Carbon Fiber per tank**

E-Mobility: Composites Battery Tray



“VW invests in affordable light-weight instead of battery cells”

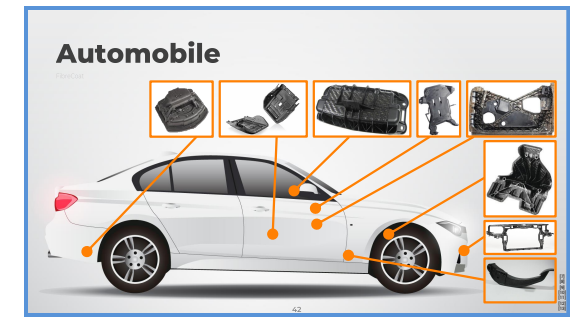
Source: Source: Volkswagen, March 2020

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Outlook

- **Automotive is a very attractive and large market for composites**
- **Hybrid Thermoplastics is the most promising route for the future**
- **C-SMC will find attractive niche applications**
- **E-Mobility has 2 very attractive applications with battery trays and hydrogen tanks, demanding carbon fiber solutions**
- **Further cost reduction and innovations are needed along the fragmented value chain**
- **Highly automated integrative production technologies are key to success**



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Q&A Session:

Light-weight in E-mobility: 2 Examples

BMW i3



Carbon Composites Life Module

Power:	125 kW
Consumption:	15,3 kWh/ 100 km
Reach:	270 km
Battery:	42 kWh
Weight:	1345 kg
Price:	39.000 €
Production/Year:	25.000

e.GO mobile



Alu space frame and ABS body panels

Power:	57 kW
Consumption:	15,5 kWh/ 100 km
Reach:	146 km
Battery:	21,5 kWh
Weight:	1231 kg
Price:	22.000 €
Production/Year:	5.000 (1 st year)

Thanks a lot for your attention

- let's stay in contact -

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