CHEMISTRY THAT MATTERS™

THERMOPLASTIC CONTINUOUS FIBER COMPOSITES: INNOVATIVE TECHNOLOGIES FOR MASS PRODUCTION

SABIC SPECIALTIES

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SABIC AT A GLANCE

1

SABIC AT-A-GLANCE

1976
Company established

33,000
Employees around the world

50
Countries of operations

3rd
Largest global chemical company*

122nd
Largest public company in the world*

3.96
US$ bn
Estimated Brand Value**

85
US$ bn
Total assets

5.7
US$ bn
Net income

45
US$ bn
Annual revenue

≈ 150
New products each year

11,738
Global patent filings

64
World-class plants worldwide

*Forbes 2018 **Brand Finance, 2019

WE ARE ONE OF THE WORLD'S MOST DIVERSIFIED CHEMICALS BUSINESS

BUSINESS PORTFOLIO

PETROCHEMICALS

- Polyolefins
- Polycarbonates and Blends
- PVC , Polyester and Polystyrene
- Functional Forms
- Synthetic Rubbers
- Specialty Polymers & Polymer Additives
- Fluids
- Glycols, Olefins, Oxygenates and Aromatics
- Chemical Intermediates & Industrial Gases

SPECIALTIES

- Specialty Engineered Thermoplastics
- Specialty Compounds
- Advanced Composites
- Additive Manufacturing
- Thermosets and Additives

AGRI-NUTRIENTS

Nitrogen
- Prilled Urea
- Granular Urea
- Ammonia

Phosphate
- DAP and Dark DAP
- MAP

Specialty
- NPK
- TGU

METALS*

Long Steel
- Rebar
- Wire Rod
- Rebar in Coil

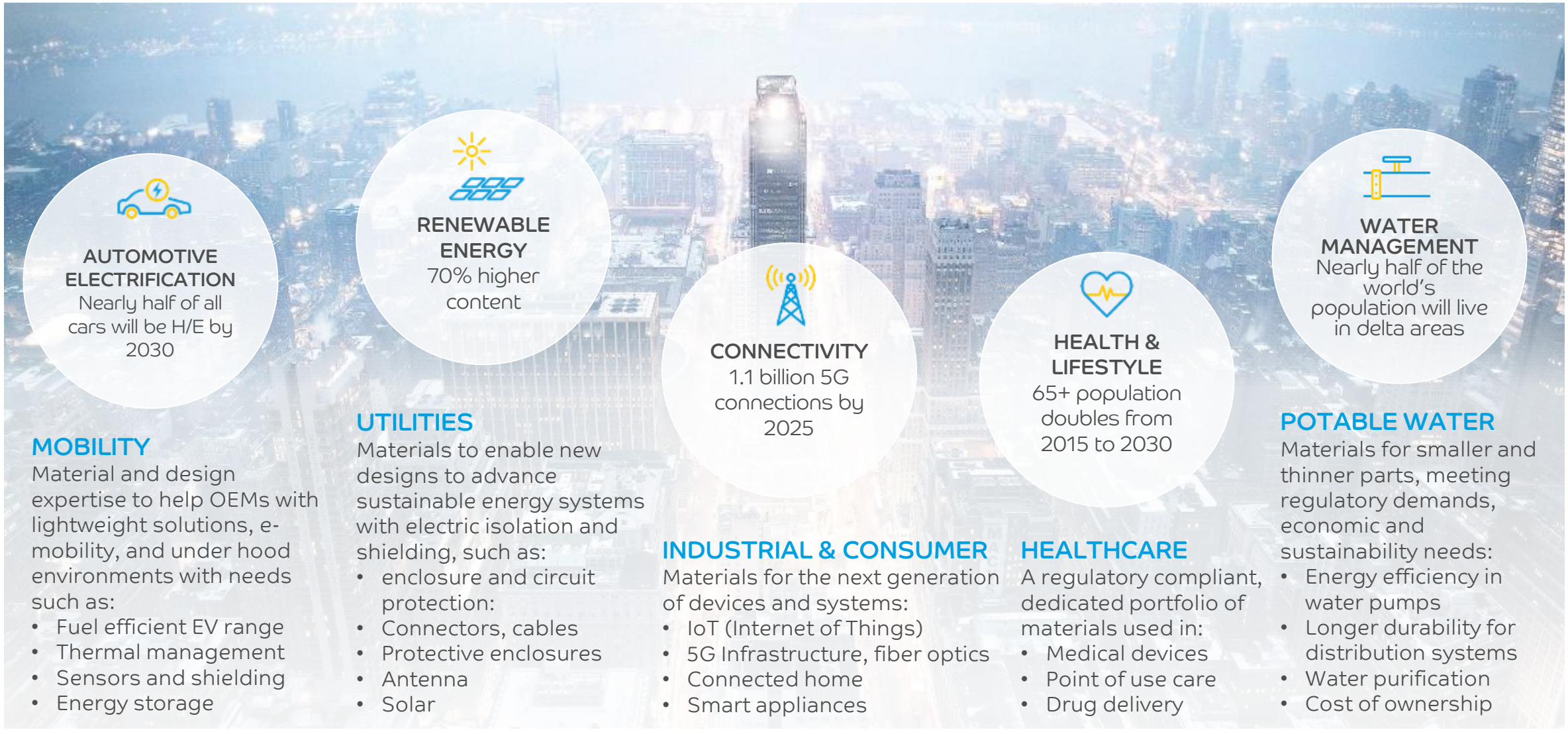
Flat Steel
- Hot Rolled Coils
- Cold Rolled Coils
- Galvanized Rolled Coils
- Pre-painted Rolled Coils

* Supplied under SABIC brand through Hadeed, a fully-owned SABIC Affiliate

THE HOME OF UNIQUE OFFERINGS

2

OUR PORTFOLIO AND GLOBAL MEGATRENDS



AUTOMOTIVE ELECTRIFICATION
Nearly half of all cars will be H/E by 2030

RENEWABLE ENERGY
70% higher content

CONNECTIVITY
1.1 billion 5G connections by 2025

HEALTH & LIFESTYLE
65+ population doubles from 2015 to 2030

WATER MANAGEMENT
Nearly half of the world's population will live in delta areas

MOBILITY
Material and design expertise to help OEMs with lightweight solutions, e-mobility, and under hood environments with needs such as:
- Fuel efficient EV range
- Thermal management
- Sensors and shielding
- Energy storage

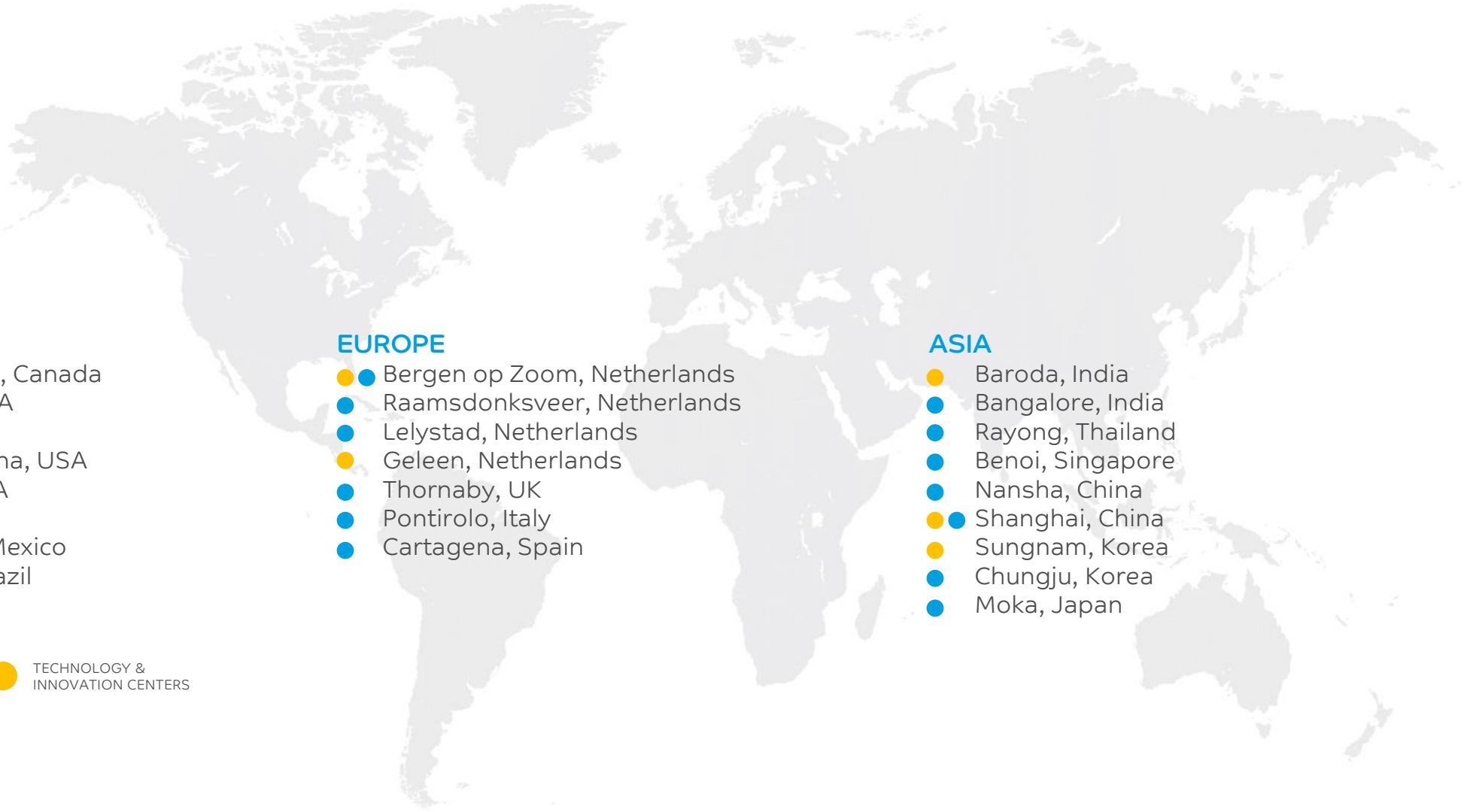
UTILITIES
Materials to enable new designs to advance sustainable energy systems with electric isolation and shielding, such as:
- enclosure and circuit protection:
- Connectors, cables
- Protective enclosures
- Antenna
- Solar

INDUSTRIAL & CONSUMER
Materials for the next generation of devices and systems:
- IoT (Internet of Things)
- 5G Infrastructure, fiber optics
- Connected home
- Smart appliances

HEALTHCARE
A regulatory compliant, dedicated portfolio of materials used in:
- Medical devices
- Point of use care
- Drug delivery

POTABLE WATER
Materials for smaller and thinner parts, meeting regulatory demands, economic and sustainability needs:
- Energy efficiency in water pumps
- Longer durability for distribution systems
- Water purification
- Cost of ownership

SABIC'S SPECIALTIES AROUND THE WORLD



MIDDLE EAST
SABIC Headquarters
Riyadh, Saudi Arabia

AMERICAS
- Cobourg, Ontario, Canada
- Pittsfield, MA, USA
- Selkirk, NY, USA
- Mt. Vernon, Indiana, USA
- Columbus IN, USA
- Austin, TX, USA
- San Luis Potosi, Mexico
- Campinas, SP, Brazil

EUROPE
- Bergen op Zoom, Netherlands
- Raamsdonksveer, Netherlands
- Lelystad, Netherlands
- Geleen, Netherlands
- Thornaby, UK
- Pontirolo, Italy
- Cartagena, Spain

ASIA
- Baroda, India
- Bangalore, India
- Rayong, Thailand
- Benoi, Singapore
- Nansha, China
- Shanghai, China
- Sungnam, Korea
- Chungju, Korea
- Moka, Japan

MANUFACTURING SITES

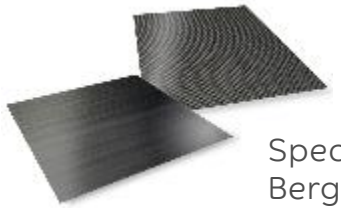
TECHNOLOGY & INNOVATION CENTERS

CENTER OF EXCELLENCE: NETHERLANDS

Part Processing App Center
Pittsfield, USA
- 1st Automated composites cell

SABIC FRT
Lelystad, NL
- UDMAX™ tape manufacturing

Airborne International
The Hague, NL
- Digital composites Manufacturing Line (DCML)



Specialties T&I
Bergen op Zoom, NL
- Resin development
- Application test centers

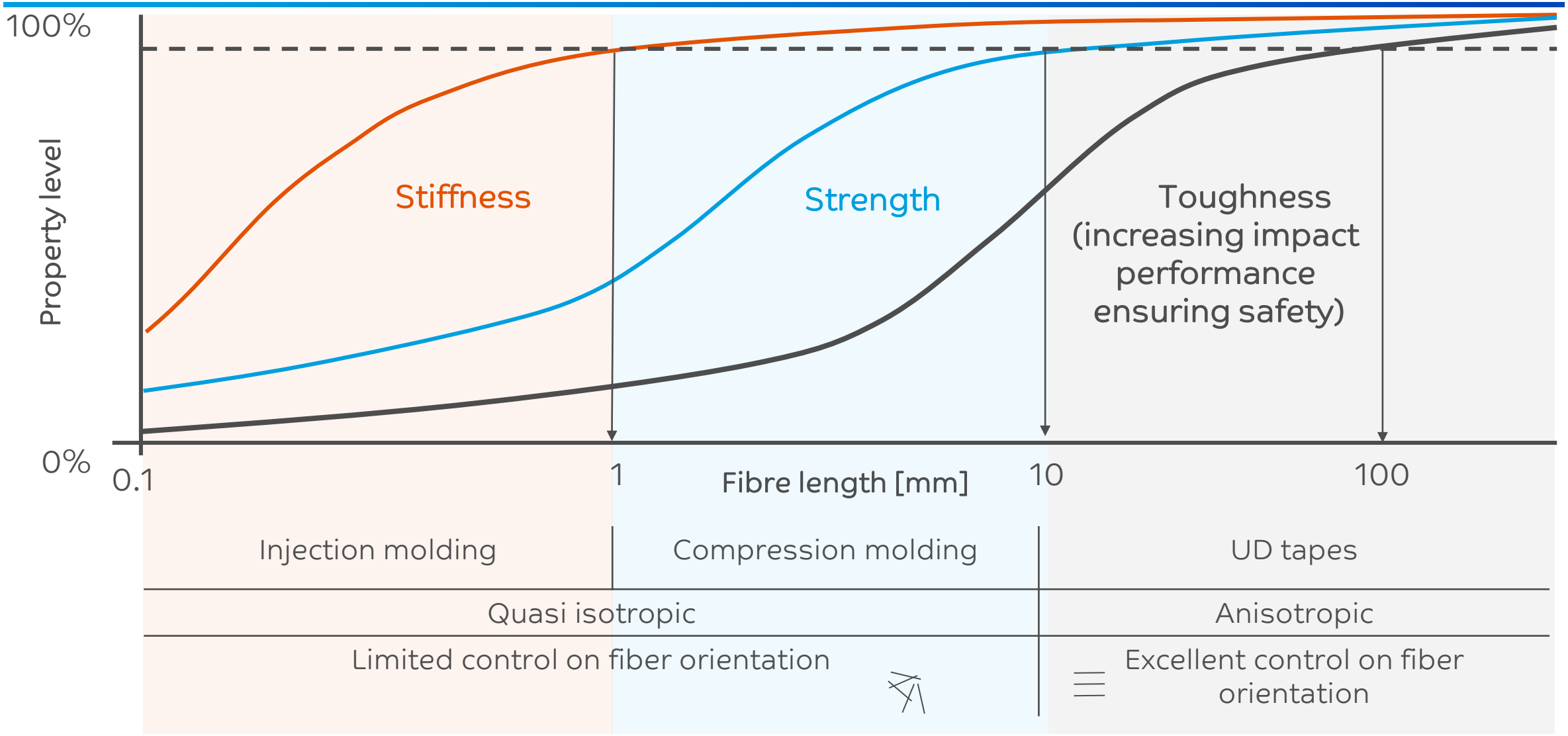
Composites Center of Excellence
Geleen, NL
- Material forms
- Continuous process & cost modelling
- Predictive eng. of continuous & chopped fiber systems

ENABLING DIFFERENTIATION WITH CONTINUOUS FIBER COMPOSITES

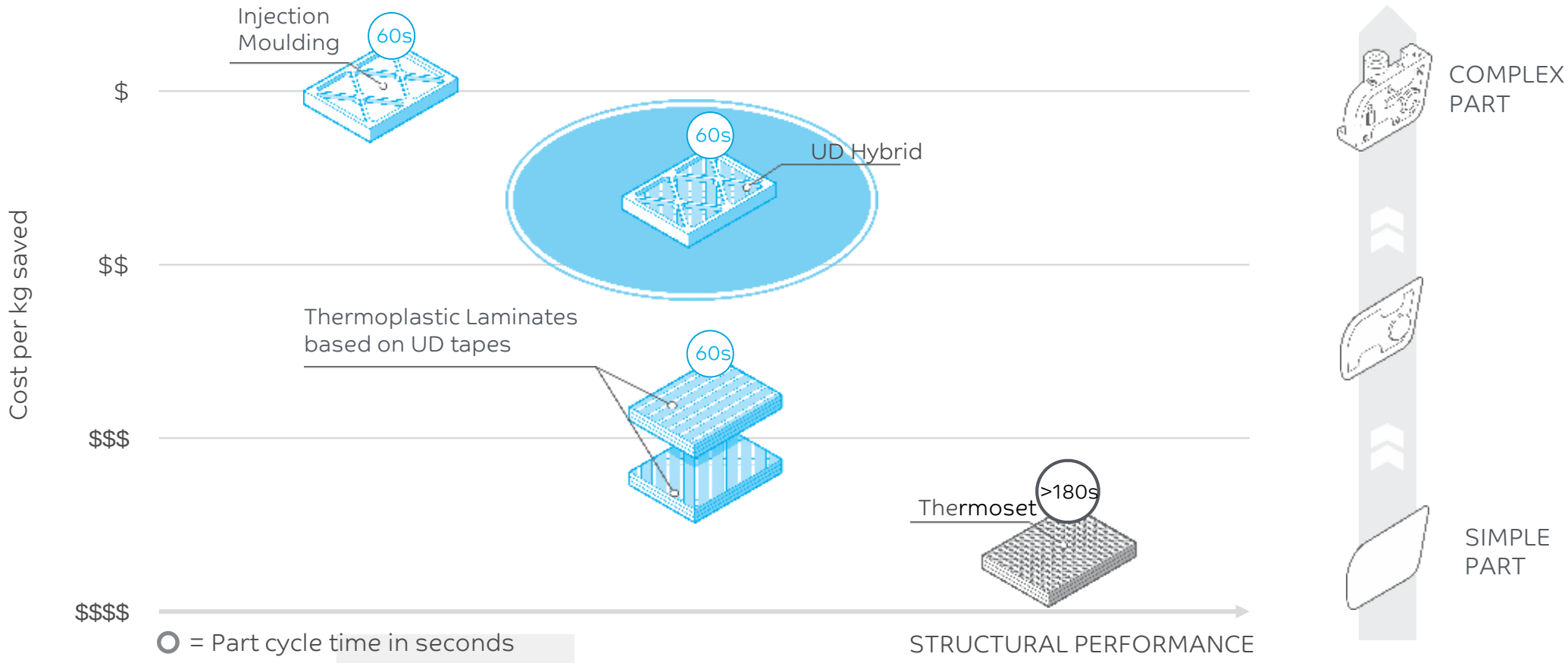
3

MARKET TRENDS AND PLATFORM VISION

ENABLING EFFECTIVE FIBRE UTILIZATION IN THERMOPLASTICS



OPPORTUNITY FOR THERMOPLASTIC COMPOSITES



Cost effective, mass production capable, structurally lightweight and recyclable.

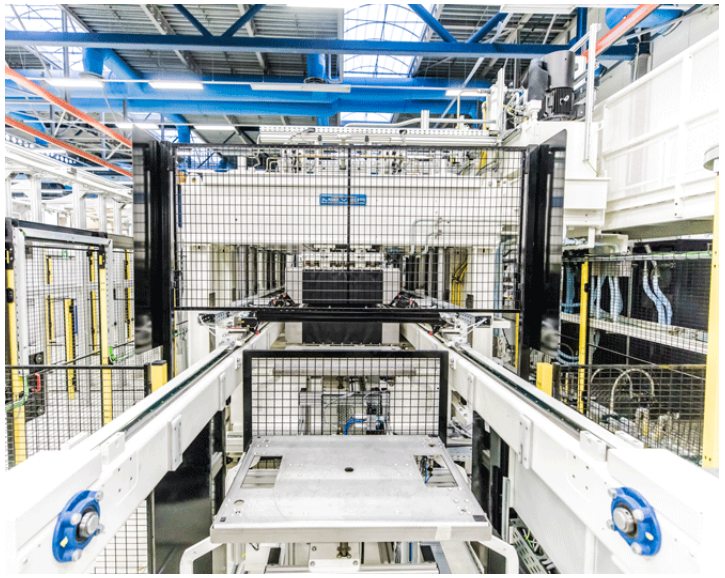
TECHNOLOGY COMPETENCIES

PRODUCTS (SABIC FRT)

Cross Section of UDMAX™ tape

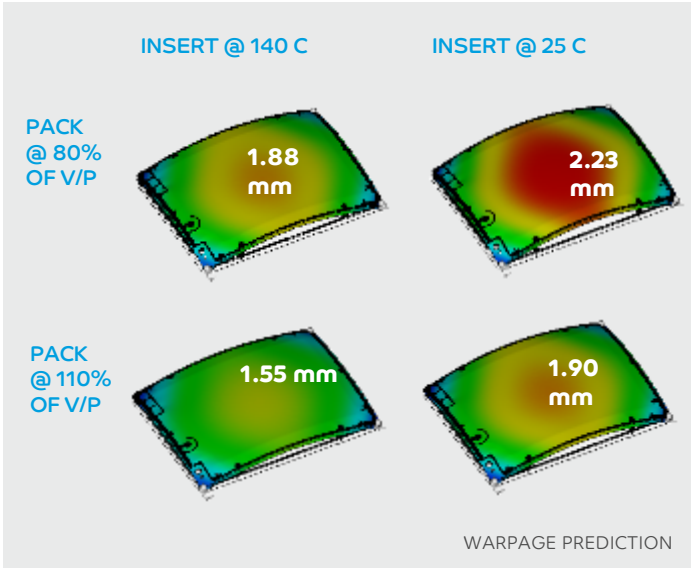
- HPFIT™ - a proprietary high pressure fiber impregnation technology
- Resin formulation to match industry requirements, e.g. Glass Fiber Polypropylene FR tape for rail sector

PROCESSES (Airborne, Kuka, Siemens)



Proprietary consolidation process with a 15-second cycle time per laminate

APPLICATIONS*



- Simulation-based part and laminate design assistance
- Guidance on hybrid moulding processes
- Customized lay up design
- Injection Moulding experience to mitigate warpage

*For consumer electronics applications

UDMAX™ PORTFOLIO

UDMAX™ GPP 45-70 TAPE

A glass fiber-reinforced polypropylene tape delivering excellent stiffness, strength and impact resistance. These material forms can be used for an array of applications, from transportation to building & construction markets.

UDMAX™ GPE 46-70 TAPE*

A glass-filled high density polyethylene tape designed to deliver one of the highest mechanical properties in the industry. It can be used to reinforce industrial pipes, boilers and storage tanks.

UDMAX™ CPC TAPE*

A carbon-filled polycarbonate tape designed for consumer electronics, sporting goods and industrial applications.

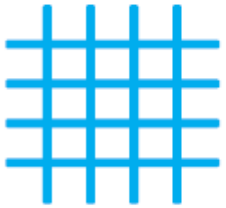
IN-HOUSE CUSTOMIZED TAPE SLITTING

SABIC's high end slitting equipment can slit UDMAX™ tapes precisely and in custom widths –starting at 5mm wide to larger sizes, as the customer requires.

* Under development

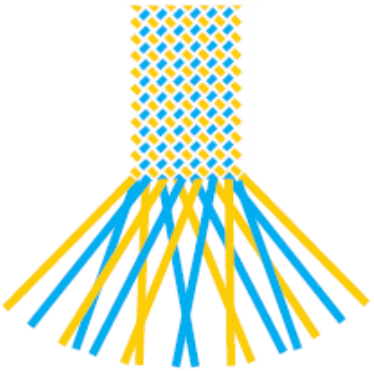
PROCESSING TECHNOLOGIES

From:
UDMAX™ Tape



Grid manufacturing

Weaving



Braiding

Tape laying

Tape winding

Lamination

AUTOMOTIVE AND COMMERCIAL VEHICLES

COMMERCIAL VEHICLES

LIGHTWEIGHT

- Increased payload
- Optimization of fuel usage
- Lower CO2 footprint

STRENGTH

- High impact strength and stiffness
- Durable
- Corrosion resistance
- Quick and easy to repair
- Excellent toughness and fatigue resistance

COMPOSITE BULKHEAD

A REVOLUTIONARY CHANGE IN VEHICLE PANEL PRODUCTION FEATURING SABIC'S UDMAX™ THERMOPLASTIC COMPOSITE TAPE

SABIC announced at JEC World 2019 a new, cutting-edge technology for producing lightweight, cost-effective and recyclable vehicle panels using its UDMAX™ tape, a unidirectional, fiber-reinforced thermoplastic composite. This innovative technology, which is designed to replace traditional panels made of metal and thermoset materials for interior and exterior automotive applications, will soon be commercialized in the bulkhead of a light commercial vehicle (LCV) produced in large scale for the global automotive market. The bulkhead was developed through an international collaboration among SABIC FRT; RLE International, an engineering services provider headquartered in the United Kingdom; AMA Composites, an Italian toolmaker; and Setex Textil GmbH, a weaver based in Germany.

Vehicle panels made with UDMAX tape combine strength and impact resistance with light weight, which can result in mass reduction of interior panels of up to 35 percent in comparison to metal parts. In case of exterior panels, the composite material can help reduce mass up to 50%. They are produced using a highly efficient, one-shot process of lamination and low-pressure molding.

This mass saving can be achieved without sacrificing the impact performance of the part, which is essential to protect occupants against injuries caused by shifting cargo. According to RLE International, the bulkhead complies with ISO 27956, the standard for securing cargo in delivery LCVs. The build-up of the process and the tensile strength of the UDMAX are the main factors in optimizing the impact resistance of the bulkhead.

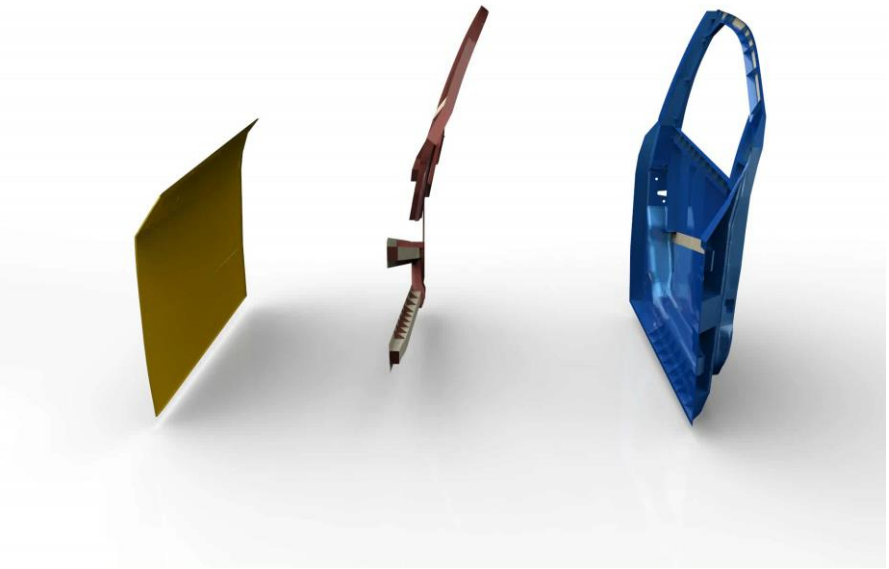
THERMOPLASTIC COMPOSITES FOR MASS MANUFACTURING

- Thermoplastic composites are now a reality for a number of interior parts in automotive
- Hybrid technology enables lightweight at an effective cost compared not only to thermoset composites but to metals as well.

HYBRID DOOR STRUCTURE AND CROSS CAR BEAM

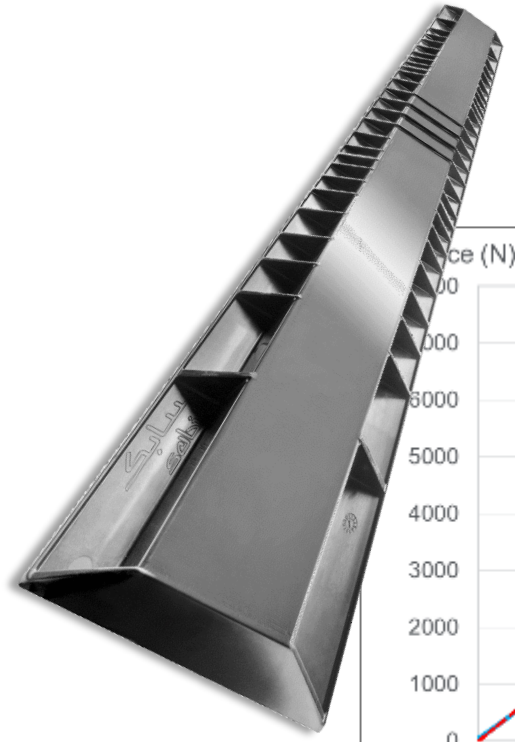
5kg/car saved vs steel*
Only one hybrid component

>20kg/car saved vs steel*
Only two hybrid components



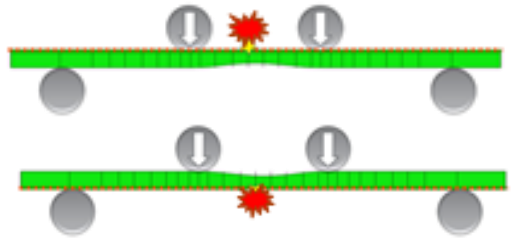
* The weight reduction is related to a specific automotive mass produced model

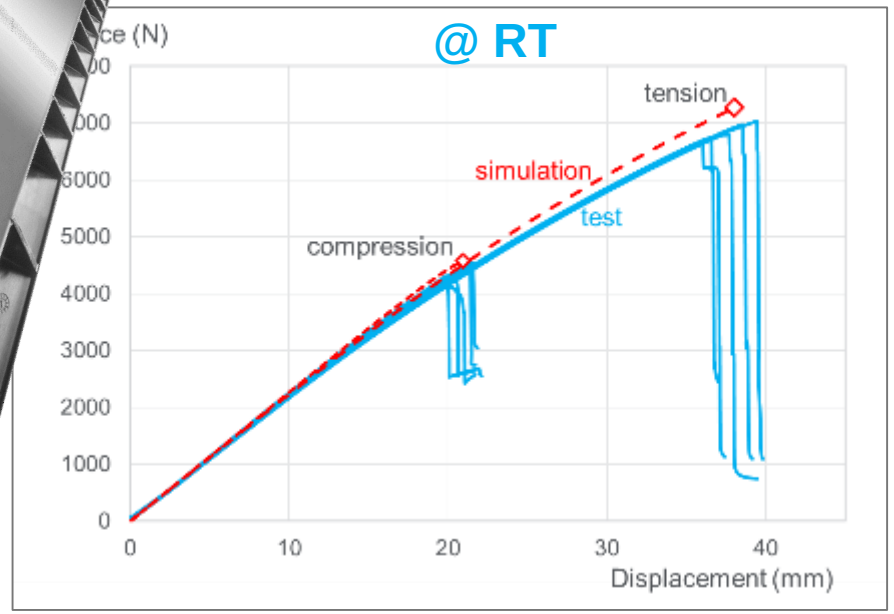
VALIDATION BEAM: GLOBAL STIFFNESS & FAILURE

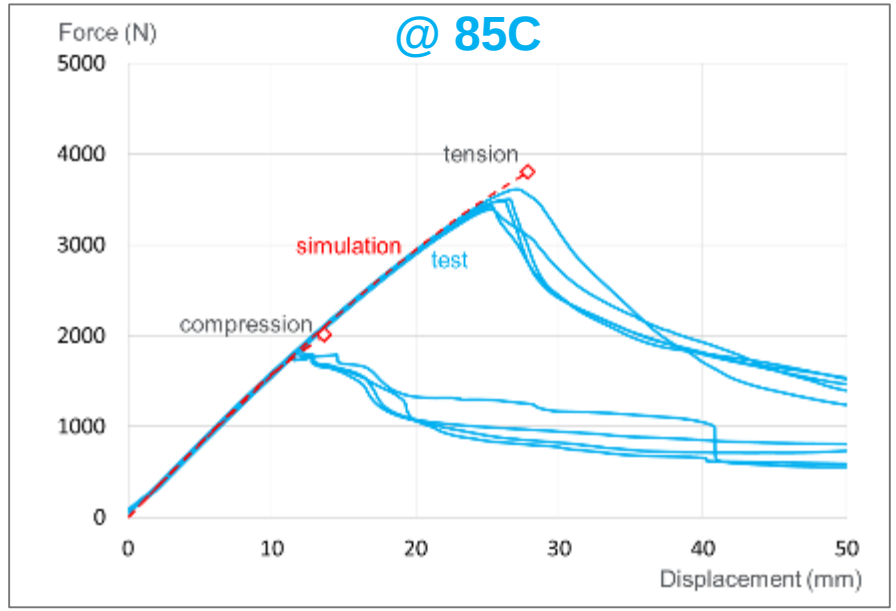


Failure in compression

Failure in tension

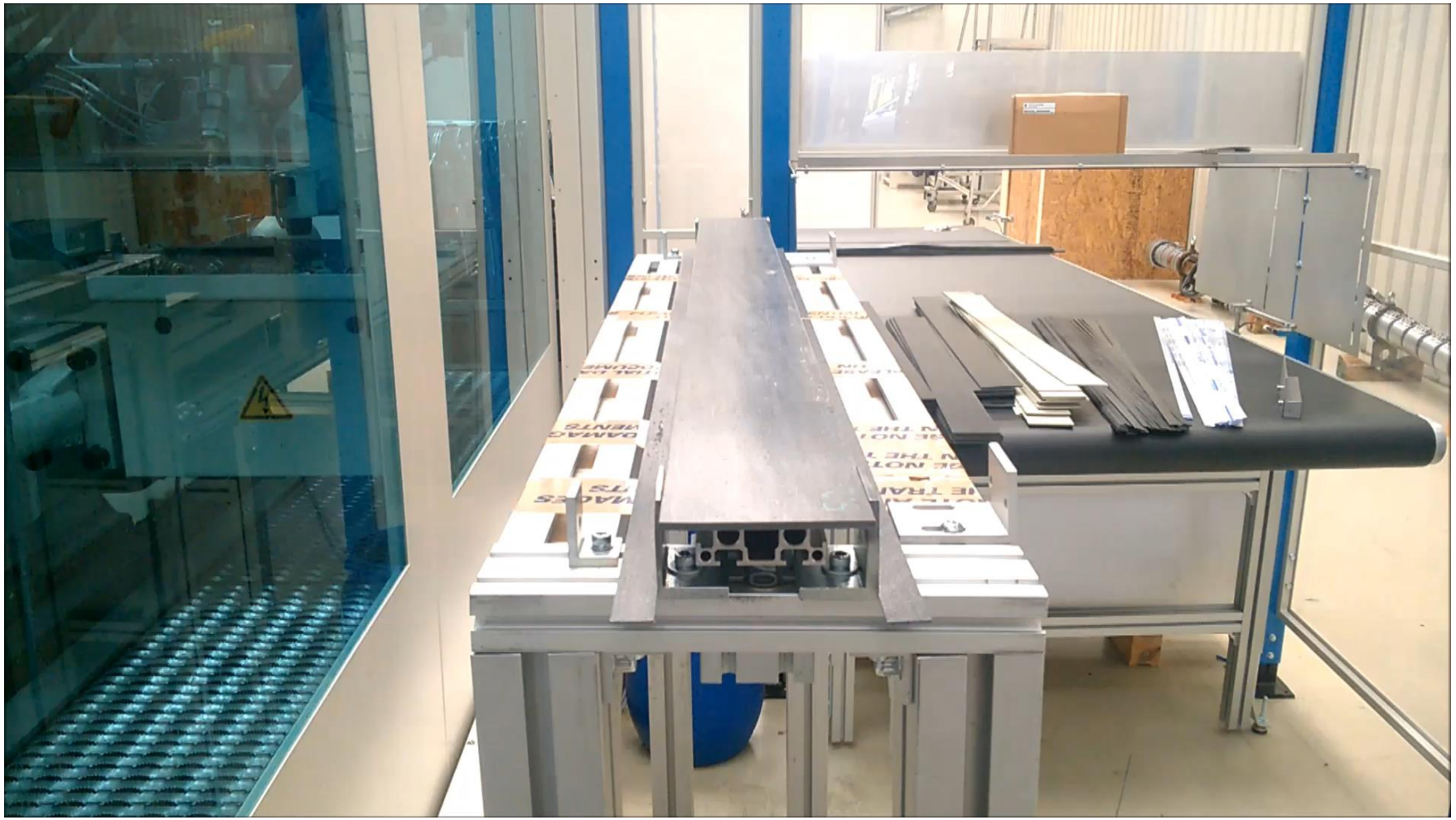






Providing good confidence for mechanical performance prediction (linear elastic and failure)

PRODUCTION AT OF THE VALIDATION BEAM



CONSUMER ELECTRONICS

THERMOPLASTIC COMPOSITES FOR MASS MANUFACTURING

- Thermoplastic composites are increasingly being considered for large volume-scale applications (e.g. consumer electronics)
- Consistent high quality
- Short cycle times for mass production (<1min)
- Low conversion cost
- Production line flexibility

THE INDUSTRIALIZATION OF THERMOPLASTIC COMPOSITES IS IN SIGHT

- FLEXIBLE: can produce different designs, other functionalities can be added
- HIGH QUALITY: leads to lower scrap and higher manufacturing yields downstream
- FULLY DIGITAL: adaptive process control by data analytics and advanced models
- LOW SCRAP: net-shape lamination reduces waste and cost
- AUTOMATED: 4 laminates every 60 seconds; producing up to 1.5 million laminates per year
- POTENTIAL APPLICATIONS: cases and covers for consumer electronics, aircraft inserts, automotive components and sporting goods

DIGITAL COMPOSITES MANUFACTURING LINE - Developed in partnership with Airborne, powered by Siemens (digitalization) and KUKA (robotics) technologies

SUMMARY

- SABIC Specialties – “Pushing the boundaries of physical properties”
- Continuous fiber composites can successfully replace metals for structural applications but mass productivity and cost are in many sectors a challenge.
- Thermoplastic composites can be the answer but the industry needs to develop new materials, be able to design and process them cost effectively.
- SABIC offers part design support, a range of UD tape solutions under the UDMAX™ brand and a wide portfolio of injection molding grades to create lightweight hybrid structure.
- In collaboration with AIRBORNE, and powered by SIEMENS and KUKA, SABIC developed the Digital Composites Manufacturing line. A fully automated system designed to mass produce laminates based on UD tapes for mass production.
- For more information contact JORIS WISMANS joris.wismans@sabic.com or GINO FRANCATO gino.francato@sabic.com


THANK YOU