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# Performance materials enable sustainable mobility

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# Safe, cost-efficient and easy-to-use solutions for electric vehicles

The chemical content is **2.5 times higher (by value)** in a battery electric vehicle compared to a car with an internal combustion engine:

- **Powertrain**

(e.g., cathode active material as key component of any battery cell)

- **Coolants**

- **Plastics**

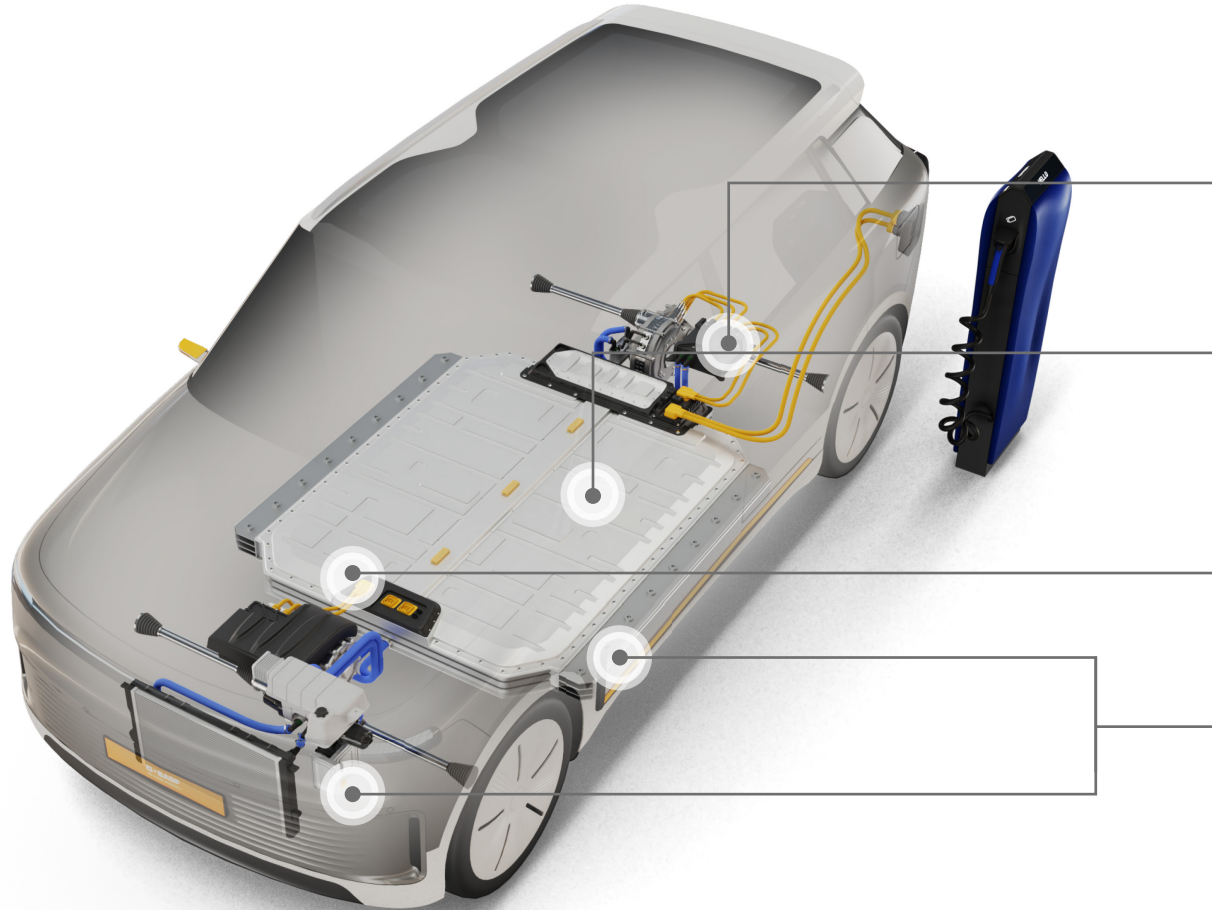
- **Coatings**

(e.g., to protect against corrosion)



Transformation of the powertrain affects the entire vehicle

# High-performance material solutions enabling sustainable mobility



High-voltage lines are the veins of an electric vehicle and enable **safe power distribution**

Thermally conductive adhesives enable **thermal management in batteries**

Long-term color-stable orange engineering plastics enable **safe handling of high-voltage cables**

E-mobility requires new safety concepts to enable **passenger safety**

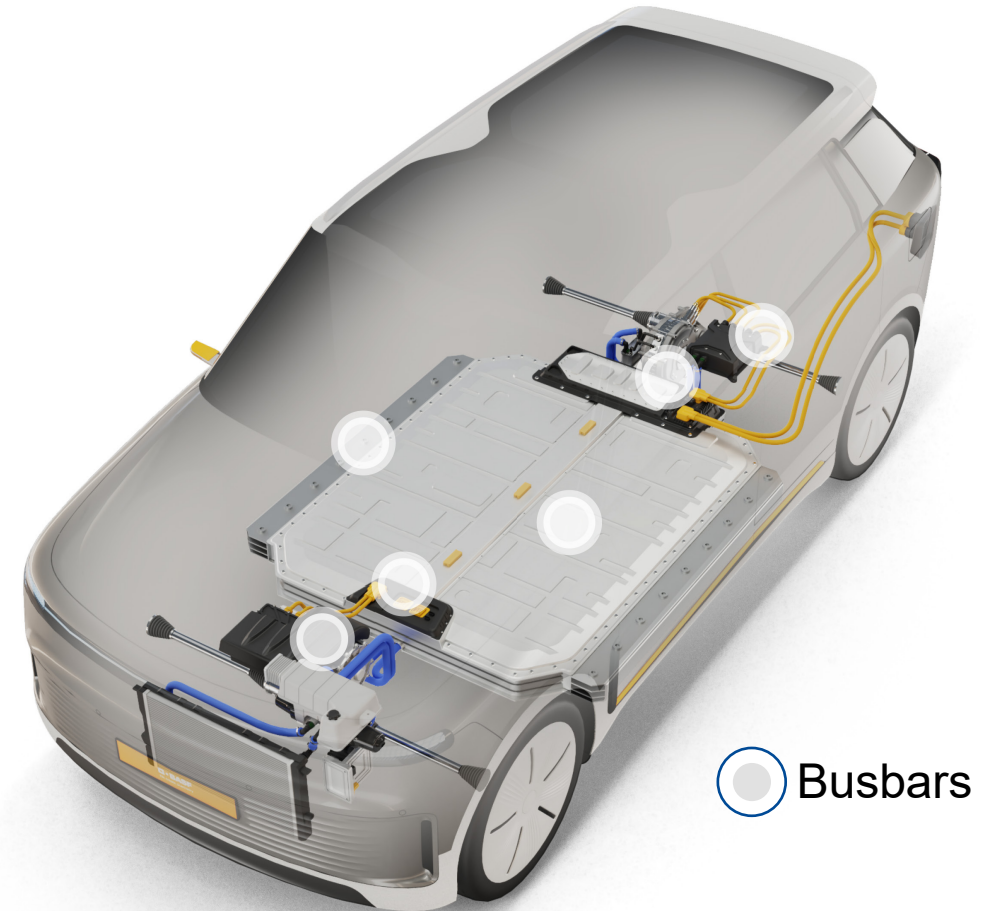
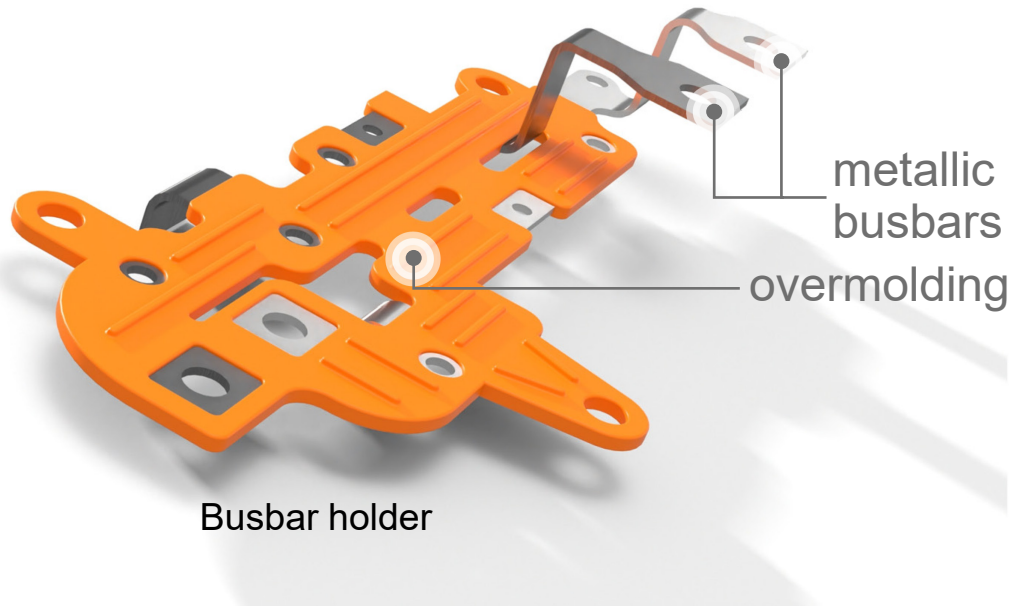
Plastic content will increase during the transformation to all-electric powertrains

# Enabling safe power distribution

High-voltage lines are the veins of an electric vehicle

Challenges and requirements:

- Busbars can be found in many parts of the battery electric vehicle:
  - ▶ Differences in thermal expansion of metal conductor and plastic can lead to cracks
  - ▶ High electric isolation and flame retardancy needed

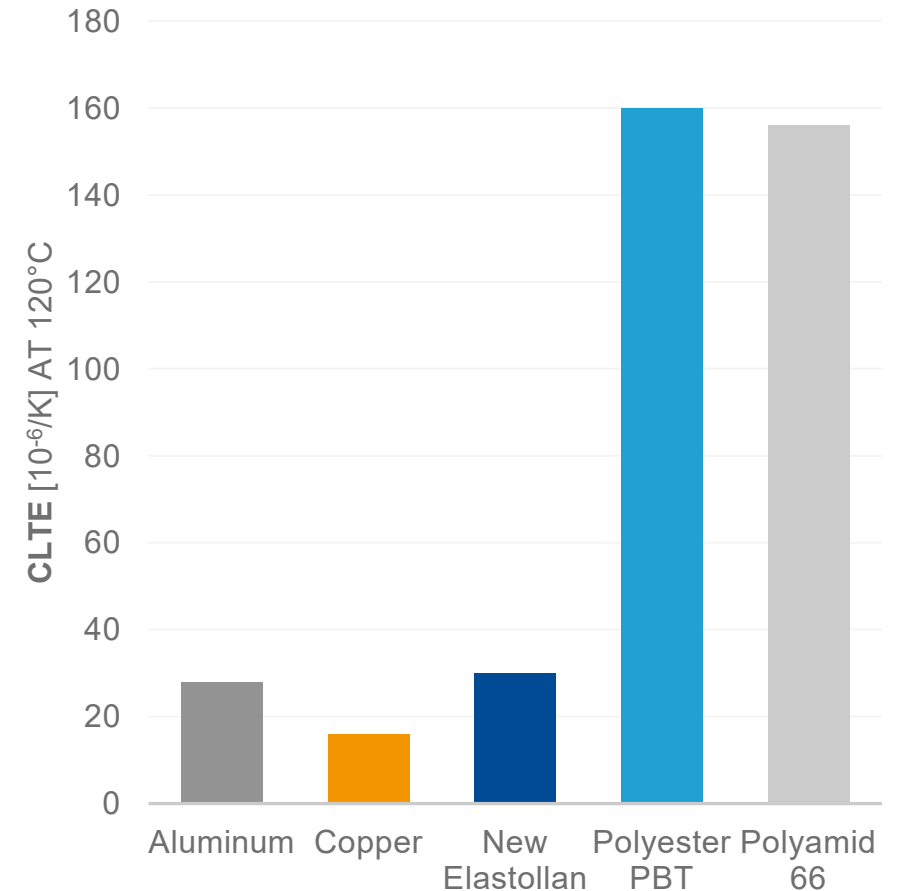


# Enabling safe power distribution

## New Elastollan® for busbars

### Solution:

- New Elastollan® is highly compatible with metallic busbars:
  - ▶ Coefficient of Linear Thermal Expansion (CLTE) close to metallic busbars (copper, aluminum)
  - ▶ No phase transformation in the relevant temperature range
  - ▶ Superior thermomechanical stress resistance between  $-40^{\circ}\text{C}$  and  $120^{\circ}\text{C}$  (>1,000 cycles)
- Easy to process and cost-efficient

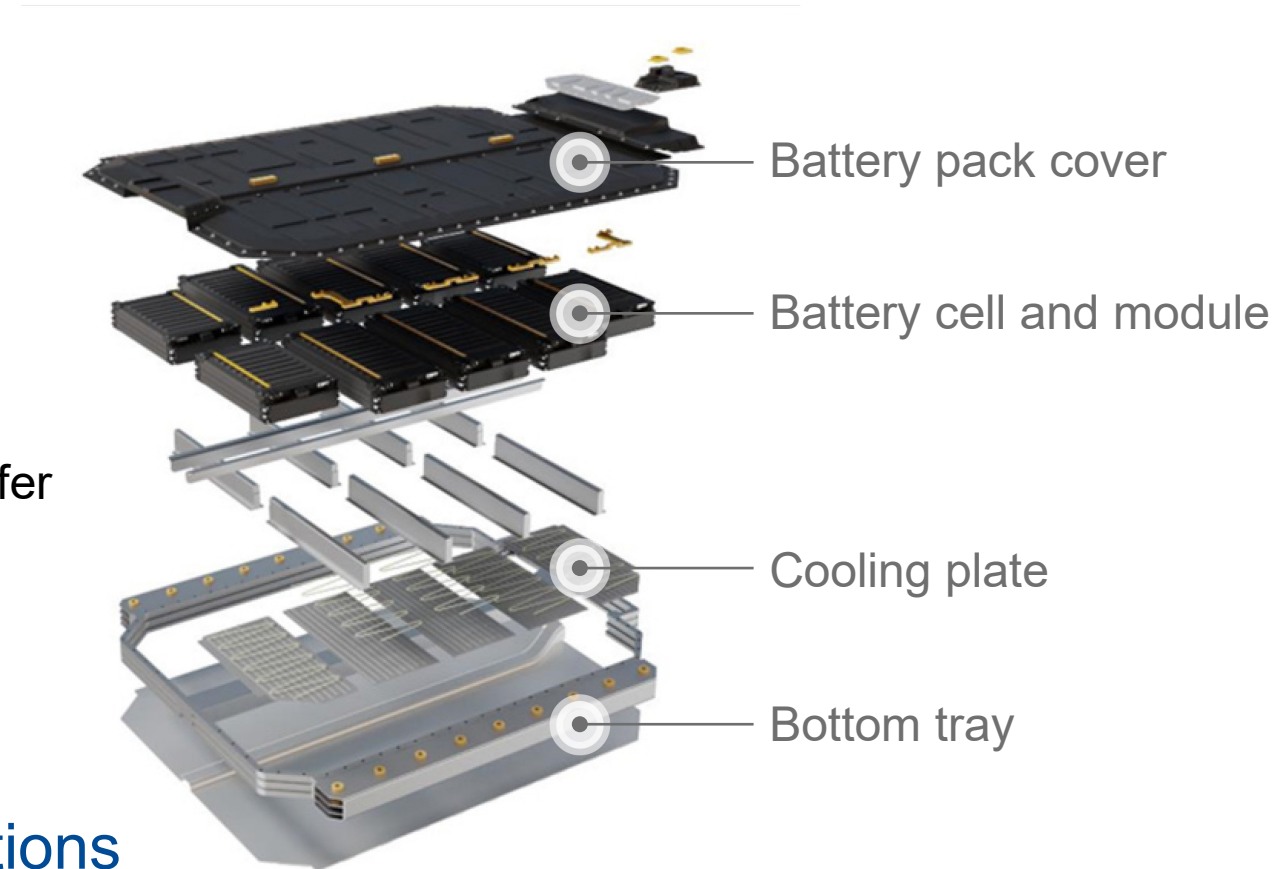


First series in realization with a French Tier 1

# Enabling thermal management in high power batteries

## Challenges and requirements:

- Cells heat up during (fast) charging and driving
  - ▶ Optimum operating temperature 20°C–40°C
  - ▶ Battery cells must not be charged below 0°C or operated above 80°C
- Increasing energy densities require a high heat transfer
- Adhesives connect the cells to the cooling plate
  - ▶ High thermal conductivity is needed (1-3 W/mK)



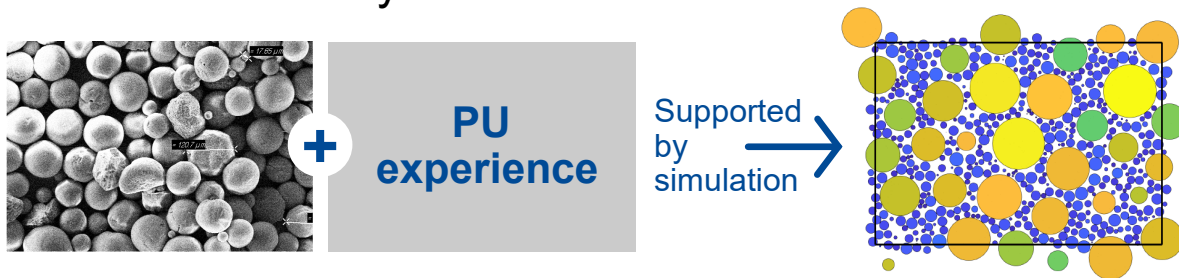
## Challenges that require new material solutions

# Enabling thermal management in high power batteries

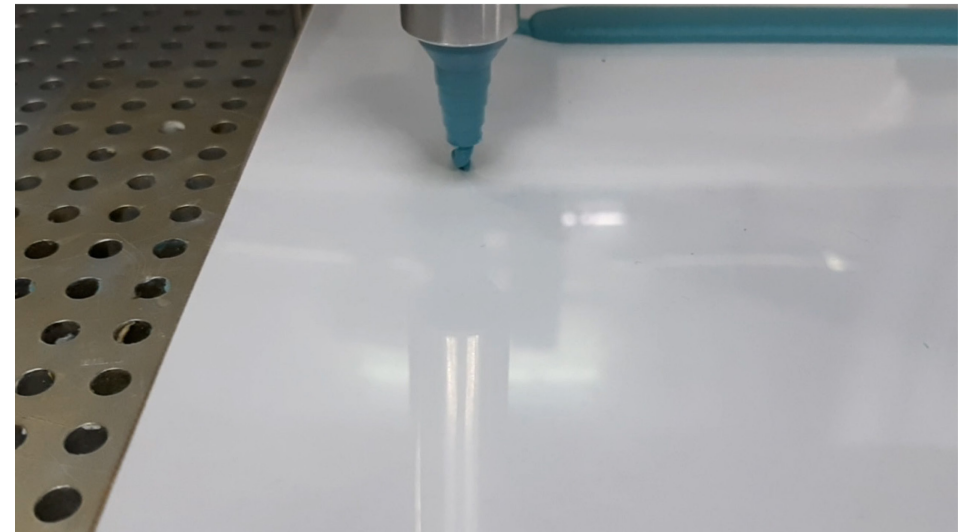
## Thermally conductive 2K-polyurethane\* adhesives for batteries

### Solution:

- Combination of the versatility of polyurethane with best fit of thermally conductive additives



Thermally conductive 2K PU\* adhesives: simulation supported formulation development



### Innovative formulation fulfills high demands for:

- Flowability and required pressing force
- Thermal conductivity and thermal stability
- Adhesion

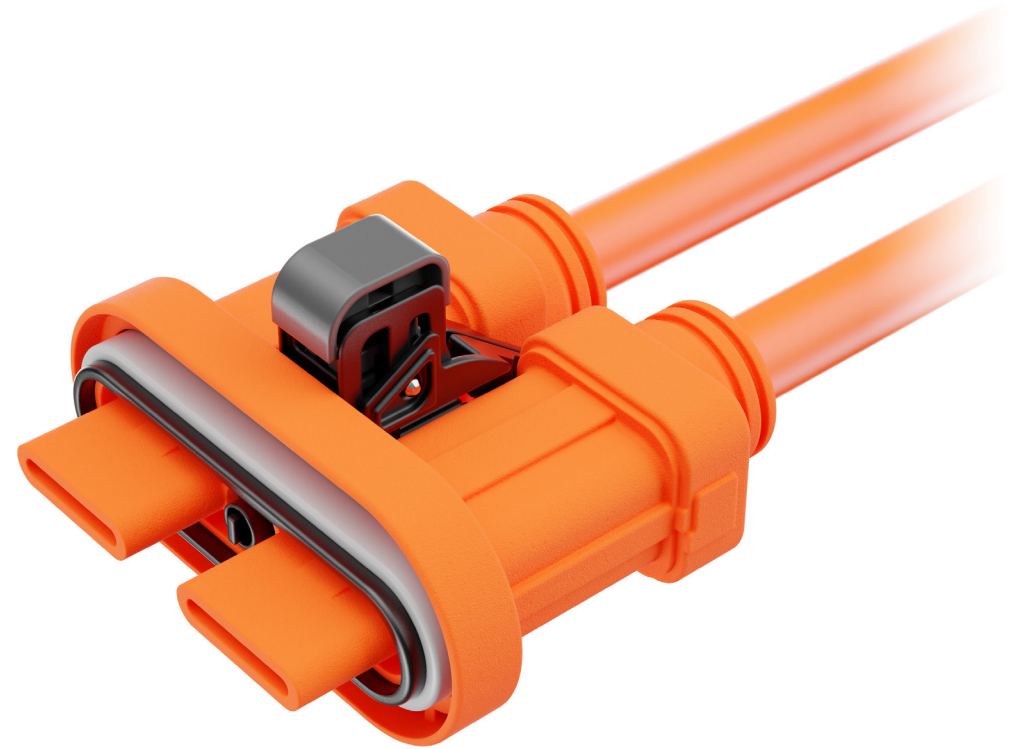
High flowability and processability at 75 vol% filler loading  
Thermal conductivity of 3 W/mk

\* 2 component polyurethane

# Enabling safe handling of high-voltage cables

## Challenges and requirements:

- The orange color RAL 2003 is the standard signal color for high-voltage connection e-mobility applications in electric vehicles
- Color stability requirement: 1,000h at 140°C
- Polyamides tend to severe discoloration during heat ageing



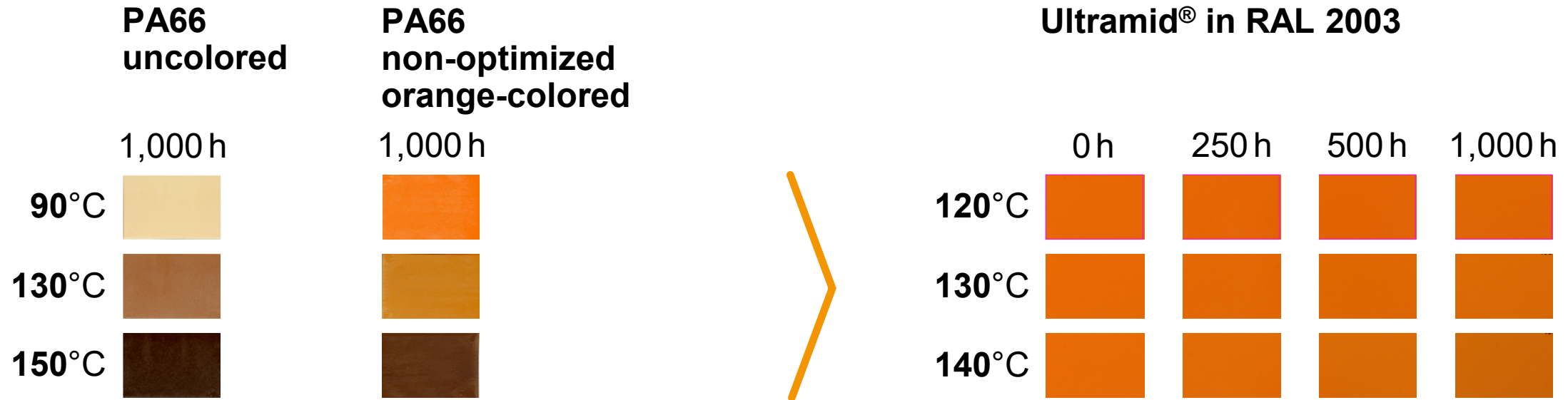
Long-term color-stable orange needed



# Enabling safe handling of high-voltage cables

## Solution:

Durable orange-colored applications through novel polyamide (PA) formulation and designed pigment formulation

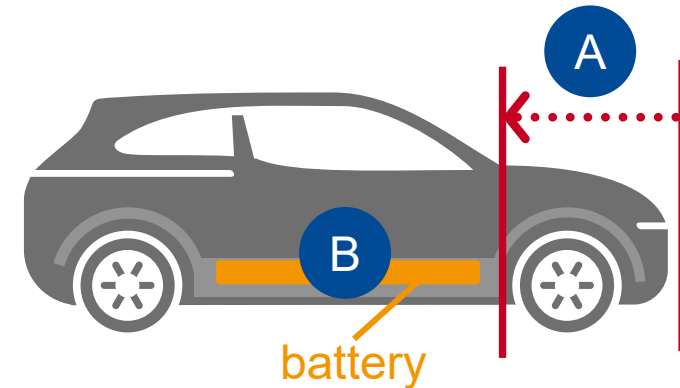


Portfolio of long-term color-stable orange Ultramid®

# Enabling passenger safety

Challenges and requirements:

- Trend toward shortened frontend **A**
- Need for crash protection of the battery **B**
- Higher overall vehicle weight



New vehicle architecture requires new safety concepts

# Enabling passenger safety

## Solutions:



High-energy-absorbing **plastic front end** realized in co-creation with a global OEM

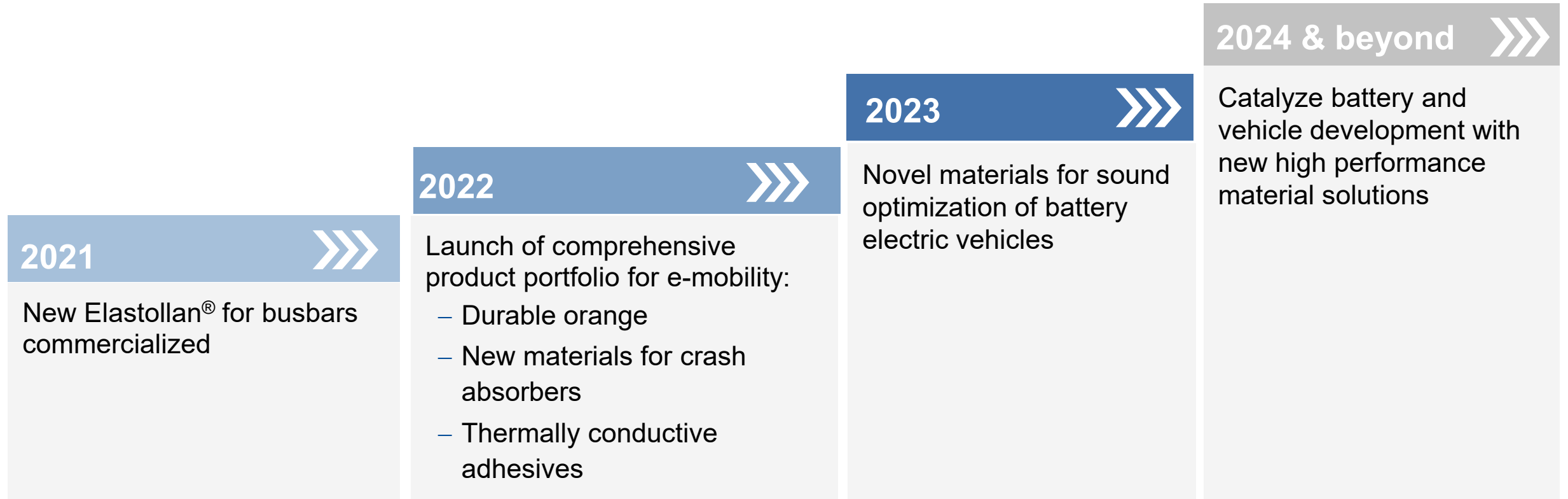
3D formed **crash absorbers** from **polyamide particle foam** with high energy absorption (structural parts in car bodies)

High stiffness and energy absorbing **pultruded polyurethane** and **thermoplastic profiles**

## New material classes for next-level crash safety

# Facing the sustainability challenge in e-mobility – next steps

## Our contribution to sustainable mobility



Decarbonization of mobility requires a broad portfolio of material solutions –  
BASF is the partner of choice for the automotive industry



We create chemistry