Energize your future with cutting-edge battery pack solutions.

Raw material solutions for automotive high-voltage batteries.

covestro

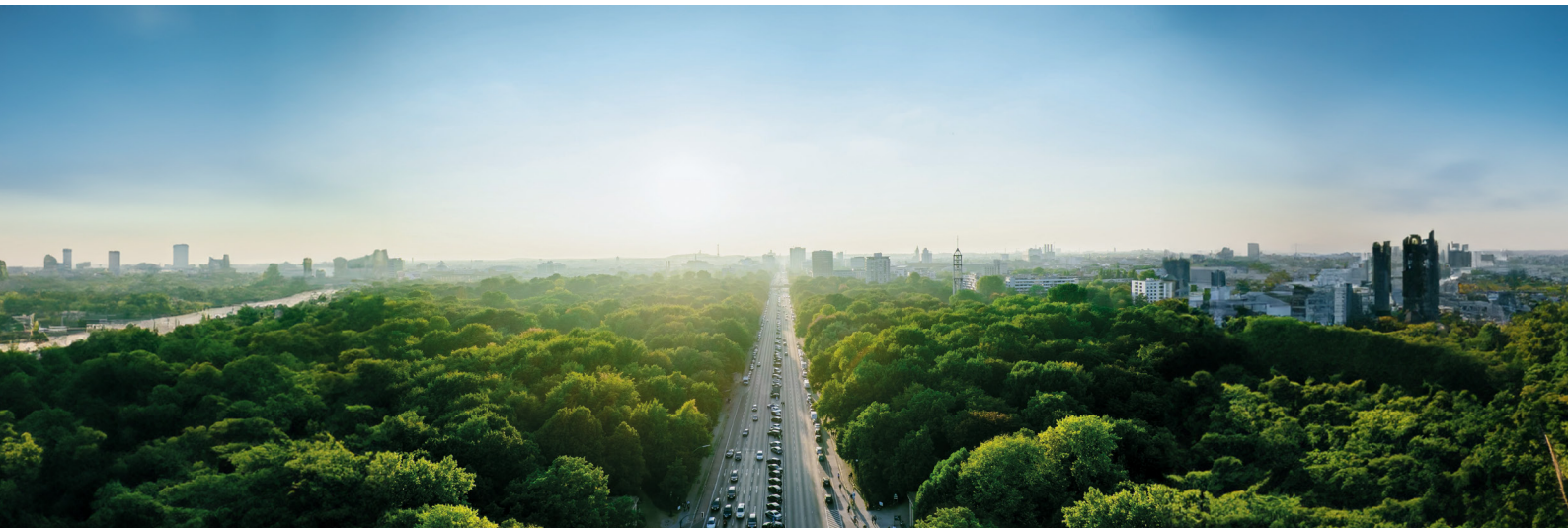
Who we are

Covestro has a longstanding history of providing cutting edge raw materials for use in the automotive industry. With a reputation for technical excellence, and a passion for innovation and cross-value chain collaboration, Covestro is committed to supporting the industry's transition to a more sustainable future!

- We are a collaborative partner to stakeholders across the global automotive value chain
- We are a high-tech raw material solutions provider with a global footprint and local mindset
- We provide materials solutions that include adhesives & sealants raw materials, specialty films, polyurethane elastomers, polyurethane foams, polycarbonates, composites, and thermosetting polyurethanes
- Our products are suited for use in a wide range of automotive applications including interior and exterior elements as well as EV battery pack assembly
- We are well positioned to help our customers succeed via a broad range of product and service offerings partnered with our expertise in application development and our R&D capabilities
- We are committed to speed and close collaboration in order to ensure success in a quickly evolving and dynamic market

Sustainability

- We are committed to providing raw material solutions that enable the transition to zero emissions transportation
- Our next-gen development work is heavily focused on bio-based, mass-balanced, and circular solutions that will enable downstream stakeholders to make continued progress toward their sustainability goals
- Covestro is committed to providing innovative and more sustainable solutions for the automotive sector, and we look forward to having car manufacturers and their suppliers join with us to drive positive change in the industry



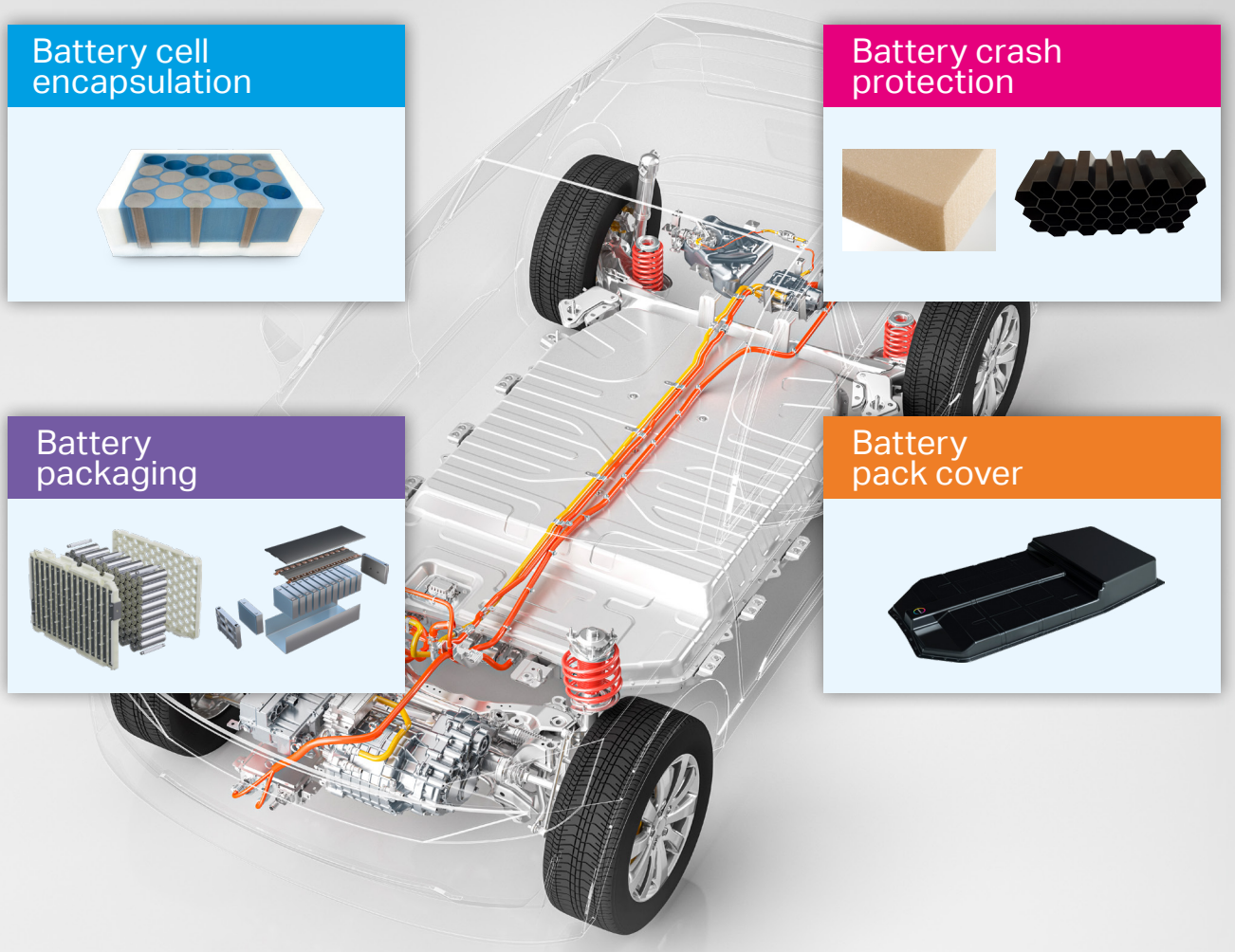
Our indispensable material solutions for battery packs

Polyurethane is a versatile thermoset plastic. As foam, it saves weight, insulates, and enhances NVH (Noise, Vibration, Harshness) performance. The cross-linking provides consistent mechanical properties across temperatures. It's customizable from soft to rigid, provides good adhesion, and is easy to process due to low viscosity.

On the other hand our polycarbonate solutions and blends are amorphous thermoplastics materials that are tailored to achieve differentiated properties. Their amorphous nature grants them high heat resistance, toughness, dimensional stability, electrical insulation while at the same time being inherently flame retardant.

We work with partners across the battery manufacturing value chain to provide raw material solutions for coatings, sealants, films and elastomers.

- **battery cell encapsulation**
- **battery packaging**
- **battery crash protection**
- **battery pack cover**



Battery cell encapsulation

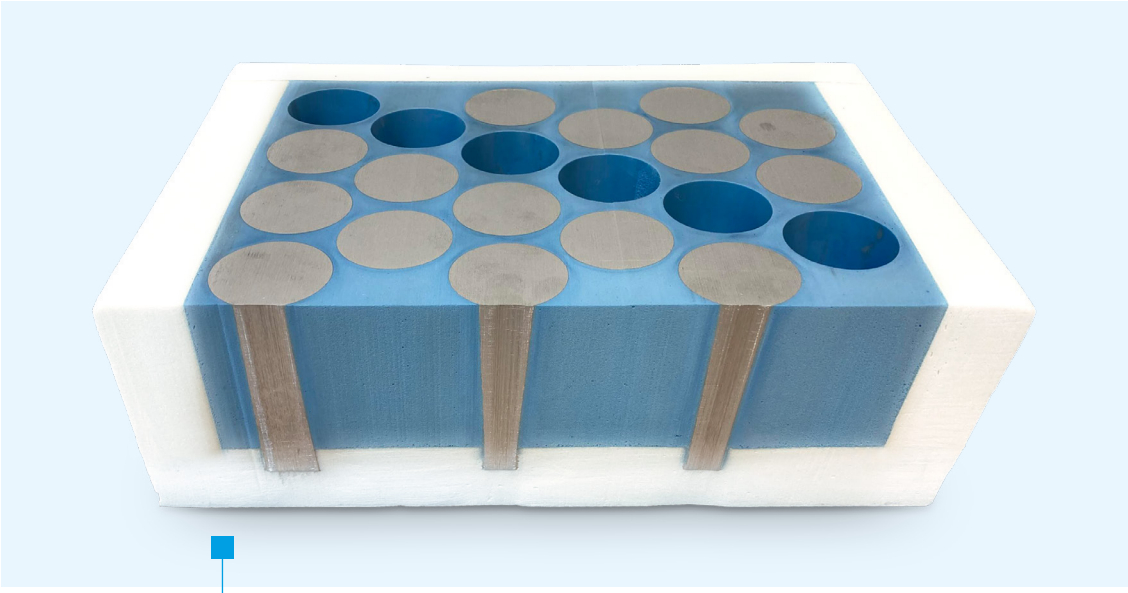
Baysafe® BEF is a product family of customized polyurethane potting systems that OEMs and battery manufacturers can use for foaming high-voltage battery packs in order to encapsulate the cells and protect them from external impacts.

Manufacturing advantages

- Low viscosity system and tailored foam reaction to enhance processing
- Enables filling of large packs and tight gaps between cells
- High degree of processing automation

Product advantages

- Lightweight foam solution
- Good adhesion to interface materials enhances the mechanical integrity of the pack
- Tailored mechanical foam properties to protect the cells against loads and vibration
- Thermal insulation and protection of cells in case of thermal runaway



Covestro battery demonstrator with **Baysafe®** BEF encapsulation foam (blue)

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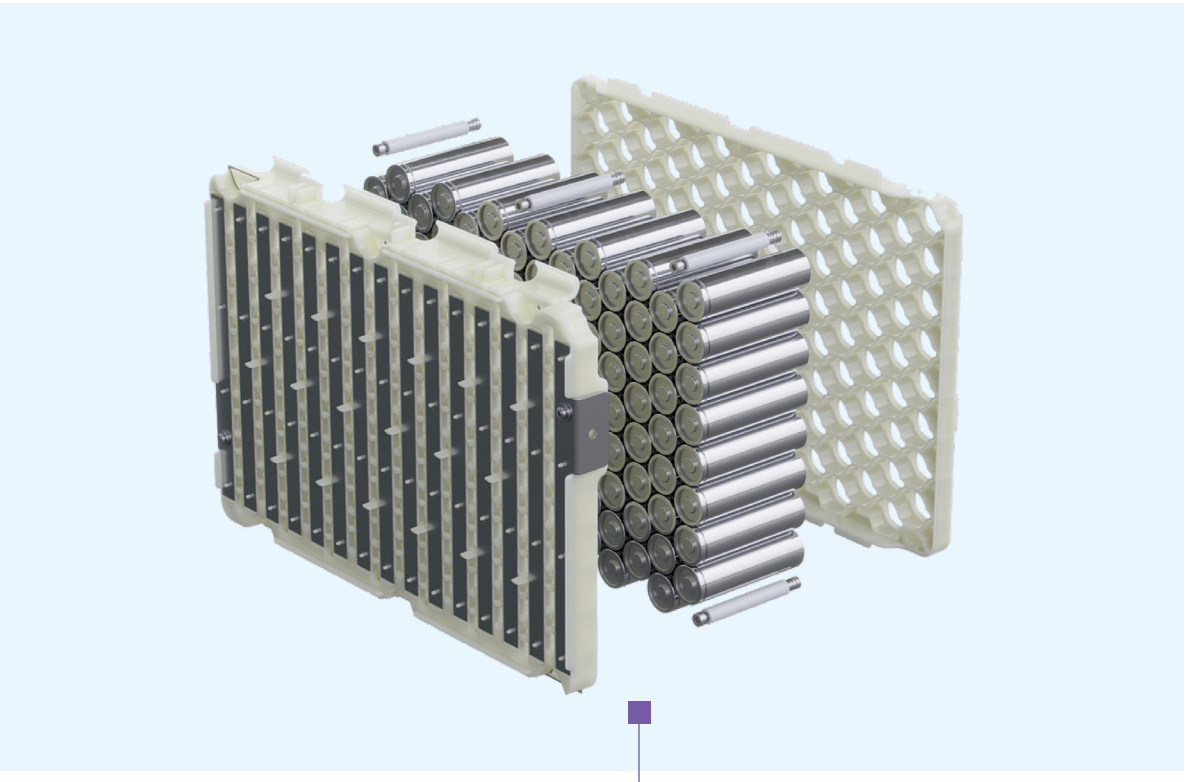
Makrolon® and Bayblend® are amorphous thermoplastics materials that grants them high heat resistance, toughness, dimensional stability, electrical insulation while at the same time being inherently flame retardant.

Battery packaging for Electric Vehicles

Bayblend® and **Makrolon®** materials exhibit remarkable retention of both electrical and mechanical properties across the operating temperatures of batteries, contributing significantly to the safety and dependability of battery packs. For example, when designing a cell holder for cylindrical, prismatic or pouch cells, it is of upmost importance to guarantee that cells are precisely located to avoid any hazard not only during assembly but also during battery service time. Our materials not only retain their dimensions during service but also have negligible water absorption thus preventing warpage.

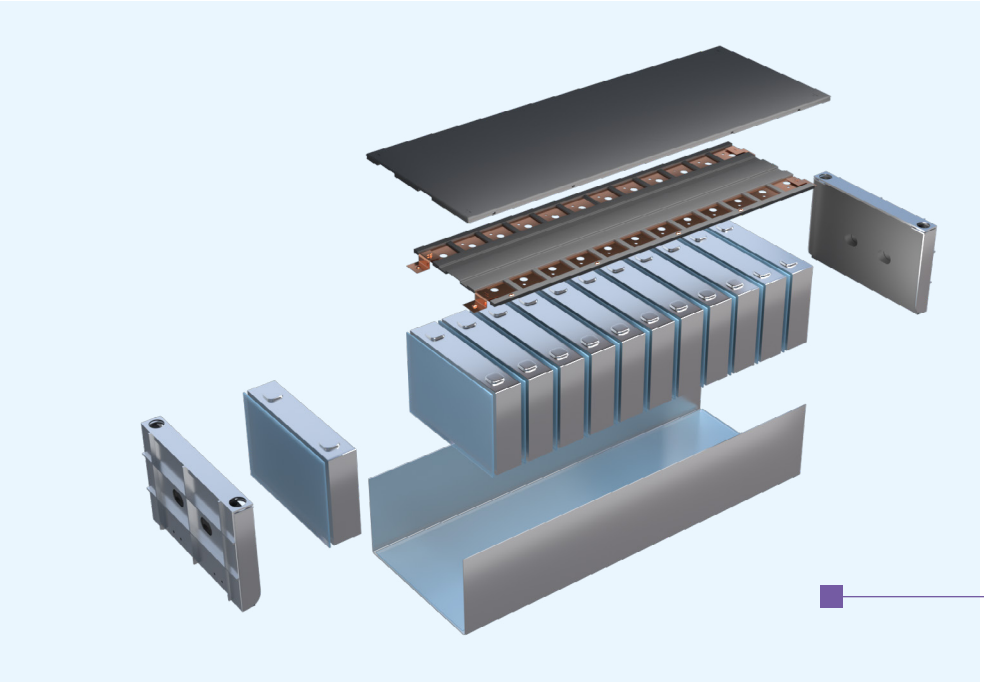
Furthermore, our materials are preferred choices for battery manufactures for different insulating and structural components in EV battery packs. Notable applications include busbar holders, cell contact systems, side plates, end plates, and module covers, among others. Our dedicated material portfolio offers high heat resistance, flame retardancy and electrical insulation that can be used for such intricated parts while achieving low wall thickness. For emerging trends, as cell-to-pack, our materials assure performance for structural components due to the inherent mechanical stability and ductility of **Bayblend®** and **Makrolon®.**

Moreover, for applications demanding higher voltage thresholds, newly developed materials provide effective safeguards against short circuits and tracking, even at voltages reaching up to 600 V. Our new grades **Bayblend®** FR3015 CTI and **Makrolon®** FR6019 CTI have flame retardant properties and high dimensional stability while being suitable for high-voltage environments.



Cylindrical cell holders and busbar holders made of our **Bayblend®** and **Makrolon®**

Battery packaging for Electric Vehicles



Cell contacts systems for prismatic cells made of **Bayblend®** and **Makrolon®**

Manufacturing advantages

- Tight tolerances for complex shapes enabling reliable part production
- Scrap rate reduction in production and part assembly due to low warpage
- Enable high efficiency when fixing cells with UV-curable adhesives
- Suitability for laser transmission welding for parts assembly
- Scalable and reliable production batch-to-batch consistency

Product advantages

- Excellent and inherent flame retardance: UL94-V0 classification down to 0.75mm
- High dimensional stability and low warpage for complex and larger designs enable in structural packs
- UV transparency for UV-curing of adehesives during cell fixation
- Compatibility with different coolant systems
- Excellent and stable electrical insulation over operating temperature range
- High heat resistance: relative temperature index between 80°C to 120°C
- CTI grades with CTI rating of 600V acc. to IEC60112 (50 drops, solution A)
- Higher thermal conductivity of Makrolon TC grades for thermal management

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Battery crash protection – Safety first

Battery cells require good safety measures to prevent any risks in terms of thermal runaway caused by a potential mechanical impact from the side or the bottom, e.g. in case of a crash. Covestro has developed versatile material solutions based on rigid polyurethane foam and Polycarbonate blends.

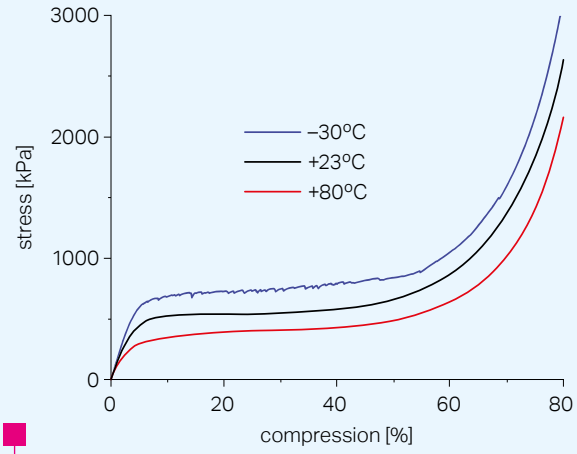
Baysafe® EA is a lightweight rigid polyurethane foam tailored for energy absorption by converting crash energy into foam cell deformation and heat.

Manufacturing advantages

- Foaming enables complex and large part geometries
- Good adhesion to other materials such as Baysafe® BEF encapsulation foam

Product advantages

- Lightweight foam solution (density 40 to 80 kg/m³)
- Thermal insulation of battery cells
- Tailored mechanical foam properties
- Lower temperature dependency of properties compared to thermoplastics
- Loadpath-independent energy absorption



Example of mechanical properties of **Baysafe® EA** at density of 80 kg/m³

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Battery crash protection – Safety first

Makroblend® PC-PBT

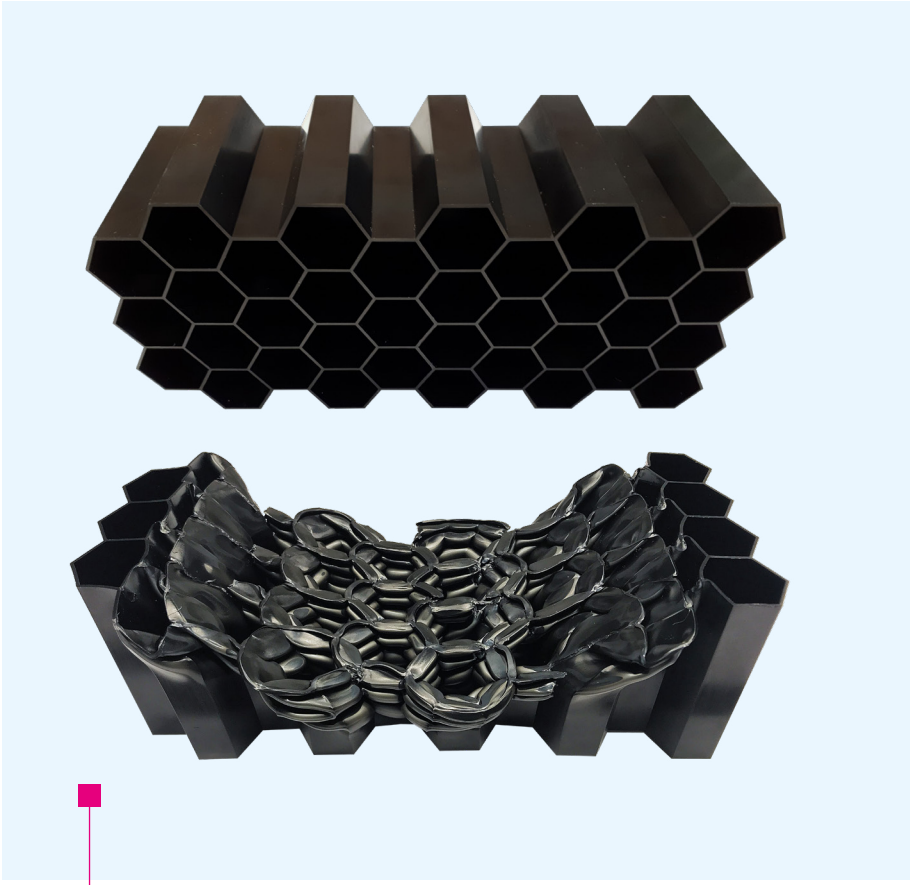
Honeycomb structure designed and studied by Covestro for crash energy absorption and battery side protection

Manufacturing advantages

- Integrate with electrophoretic painting process (e-coat)
- Design freedom to facilitate vehicle mounting
- Fit the design space, withstand the boundary conditions and maximize the energy absorption per weight according to the needs.

Product advantages

- Protect cells, pack and cabin against side-crash
- High level of impact strength and chemical resistance
- High level of ductility for side pole impact
- Tailored and customized force-displacement pattern
- Maximize energy absorption per weight



Makroblend® honeycomb structure before (top) and after side pole impact (bottom)

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Battery pack cover – Lightweight solutions

Battery packs contribute to a significantly higher weight of electric vehicles. Therefore, weight reduction measures are of high importance. Covestro has successfully developed two lightweight composite material solutions for 1) polyurethane based STM and 2) polycarbonate based LFT-D.

Baypreg®

Polyurethane is an ideal material to manufacture composite battery top covers using the Baypreg® Spray Transfer Molding (STM) process.

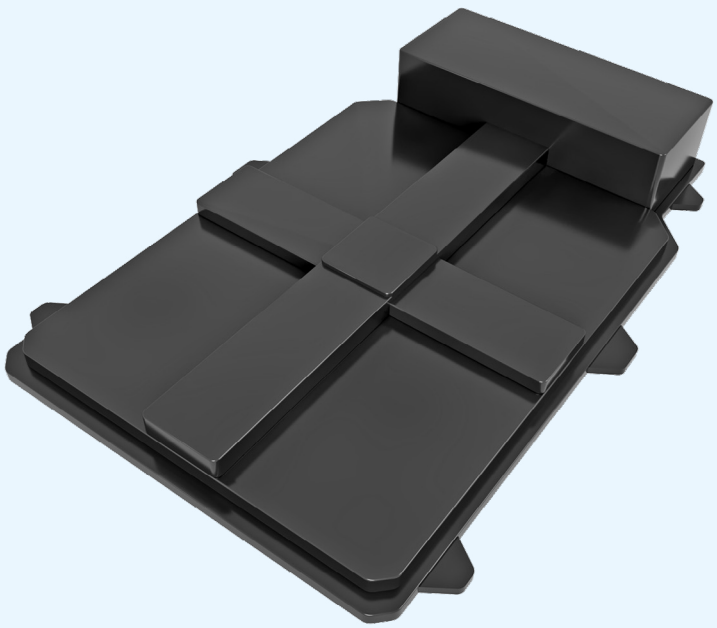
Manufacturing advantages

- Improved production efficiency and low cycle time
- Steel sheet can be integrated into the pressing process
- Integration of slim flange

Product advantages

- Lightweight solution | Density 1500-1850 kg/m³
- 1.5 mm part thickness of geometry (incl. steel sheet)
- High mechanical strength and stiffness across a wide range of temperature
- Electrical and thermal insulation

Baypreg® battery top cover



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Battery pack cover – Lightweight solutions

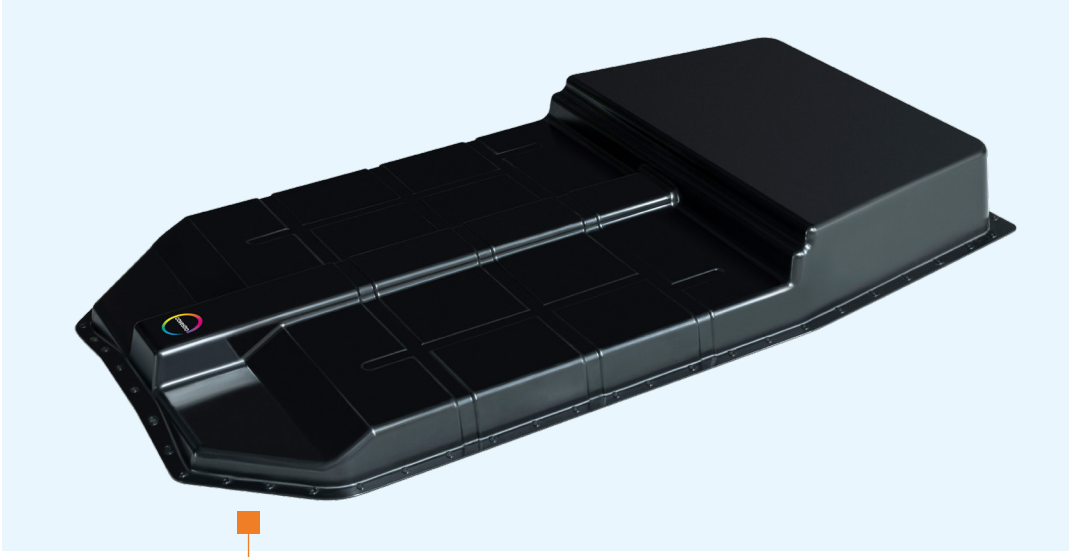
Makrolon® and **Bayblend®** can be processed using Long Fiber Thermoplastic Direct (LFT-D) to manufacture recyclable battery covers. Mass balanced ISCC PLUS certified bio-circular feedstock for large, lightweight parts available. Trusted partners along the value chain could support our customers in processing our materials into these parts.

Manufacturing advantages

- Lower cycle times than other methods such as sheet molding compound (SMC)
- Versatility for complex designs
- Parts can be easily shredded and recycled
- Lower carbon footprint emissions than metal counterpart

Product advantages

- Large-size part compression molding with in-line long glass fiber compounding (up to 40%)
- Flame retardant materials meeting UL94V-0 standard
- Lightweight solution: 20% lighter than SMC
- High modulus and stiffness with low warpage
- Final parts pass burning and abuse tests (GB/T 31467.3)
- Battery passport can be easily engraved thanks to PC matrix



EV top cover made of
Bayblend® FR3090LFT

Polyurethane versatile solutions make a difference

Baypreg®

- Battery top cover
- Spray Transfer Molding (STM)

Baysafe® BEF

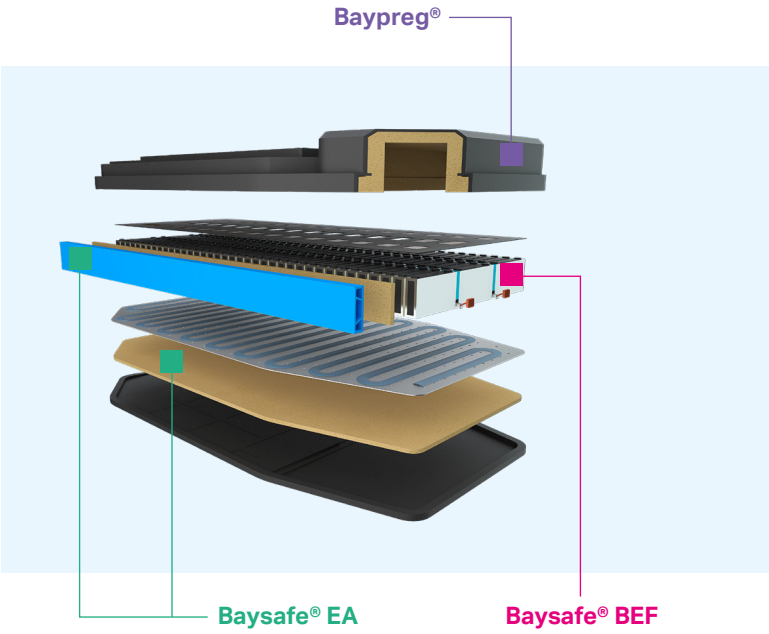
- Battery encapsulation foam
- Enhanced flowability
- Tailored foam kinetics
- Good adhesion to interface materials
- High elasticity & strength

Bayfit®

- NVH optimization
- Several applications to reduce noise in EVs

Baysafe® EA

- Crash protection for cells
- Against side & bottom impact
- Lightweight rigid foam
- Thermal insulation



Resins and hardeners for high-performance coating, adhesive and sealant interlayer solutions:

Formulating a wide of variety of thermal interface materials (TIMs) can be achieved by utilizing polyurethane adhesives raw materials with their unique properties and tailorable chemistry. Covestro currently offers high performing polyurethane raw materials to meet today's performance standards in thermally conductive structural adhesives, thermally conductive gap-fillers, and sealants used in EV battery pack assembly.

Advantages to partnering with Covestro

- As a longstanding and innovative partner to the adhesives industry, Covestro is committed to developing raw material solutions to help adhesive formulators and OEMs achieve ever-evolving performance needs in the dynamic EV market.
- While Covestro offers a high degree of technical support for current commercial products, next generation raw materials are at the forefront of our innovation and R&D strategy. Future pack designs, improved sustainability profiles, evolving safety standards and regulations, are all central to our new product development efforts.

Covestro fully embraces the Circular Economy:

Covestro is dedicated to achieving full circularity, showcased through our CQ portfolio of circular intelligent solutions. The RE series, an integral part of the CQ portfolio, offers renewable attributed products, ISCC PLUS certified, as drop-in solutions for fast implementation at no technical risk resulting in identical high quality and properties, that can reduce carbon footprint significantly by linking to biological waste and residues via mass-balance approach and renewable electricity where available. For example, some of our **Makrolon® RE** grades have very low product carbon footprint. Our **Bayblend® FR RE** series offers drop-in solutions with a significant carbon footprint reduction down to about one-third of the traditional version following the same approach. Our CQ portfolio also includes the R series, with mechanically recycled content in polycarbonate grades with up to 75% post-consumer recycled (PCR) materials like water bottles and headlamps. For polyurethane foams Covestro offers new **Desmodur® CQ** grades for its Isocyanates with an attributed product share of up to 60% bio or bio-circular feedstock via mass balance[2] (ISCC+ certified). Also, for its polyols Covestro can provide various CQ grades with bio-circular based feedstock attributed to the product via mass-balance (ISCC+ certified) and provide a substantial reduction of the carbon footprint while reducing the fossil content. Join us in embracing a more sustainable future with Covestro's innovative and environmentally conscious solutions.

1 Product carbon footprint to a verified life cycle assessment based on ISO standards 14040/14044 and demonstrated by assessing a partial product life cycle from resource extraction (cradle) to factory gate, also known as cradle-to-gate assessment The calculation takes into account biogenic carbon sequestration and no burden from the first life. It is based on preliminary data from the supply chain and replaces the electricity grid mix with renewable electricity used in the Covestro manufacturing process. No compensation measures were applied. The LCA methodology developed by Covestro AG is scientifically sound and corresponds to the state of the art. ID no. 0000083440: https://www.certipedia.com/quality_marks/0000083440?certificate_number=C01-2022- 04-21255061&locale=en" Covestro AG - Certipedia.

2 Scope cradle-to-Covestro-gate (without transport/packaging), as described in ISO 14040 environmental management – Life cycle assessment. In a methodology review, TÜV Rheinland has confirmed that the LCA methodology used by Covestro AG is in accordance with ISO 14040:2006 + A1:2020 and ISO 14044:2006 + A1:2018 + A2:2020, reflects the state-of-the-art and is scientifically based.

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