CREATING TOMORROW'S SOLUTIONS

International Press Workshop 2023
Silicones – the Key to E-mobility

Julia Henn, WACKER SILICONES, March 14 & 15, 2023

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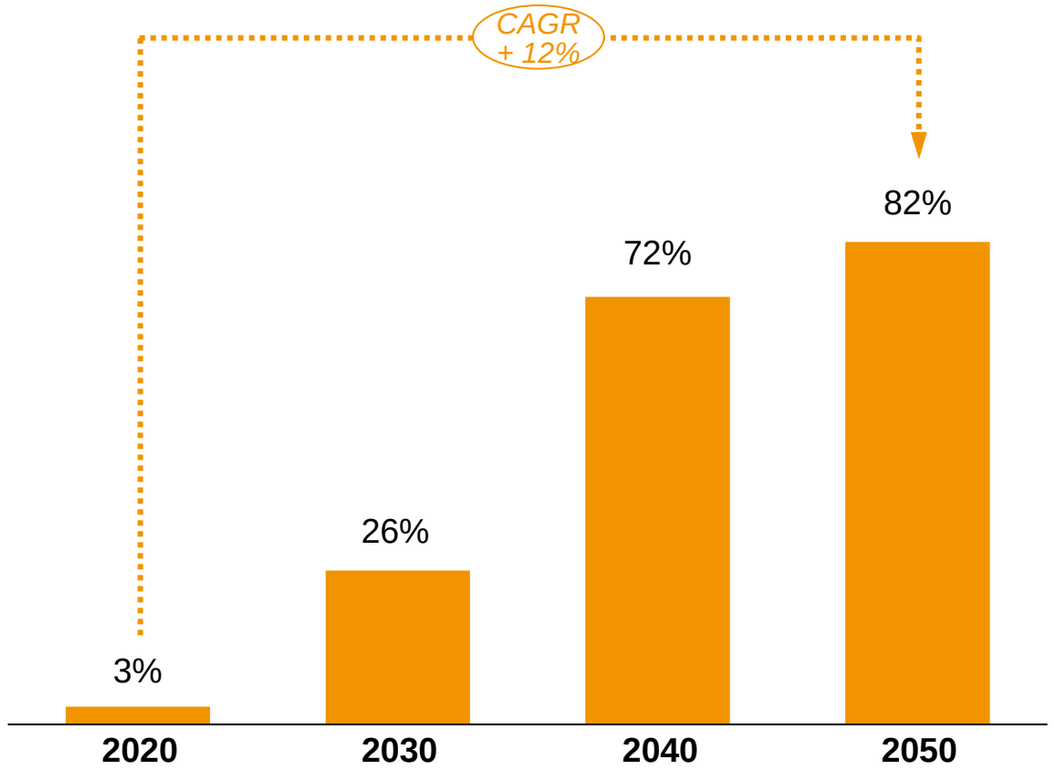
Global Car Market Saturated, EV Share will Increase Significantly from 2030 onwards

Electric vehicle (EV) share of global car sales*



Trend towards Electric Mobility

Regulation

Governments and the automotive industry have a clear strategy towards e-mobility.

Consumer behaviour

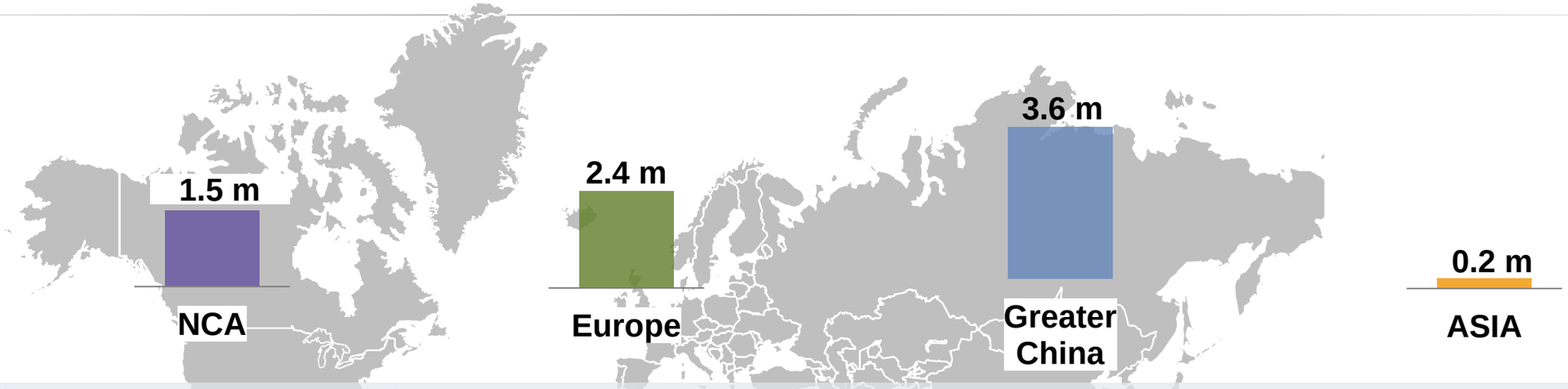
Consumer behaviour and awareness are changing as more people accept alternative and sustainable mobility modes.

Technology

Industry players are developing new concepts of electric, connected, autonomous, and shared mobility.

***Sources:** STATISTA (2023) **/** Morgan Stanley; ID 1202364, https://www.statista.com/statistics/1202364/ev-global-market-share/

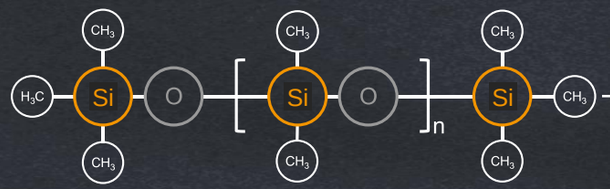
Regulation Boosts Local E-car Markets



	NCA	Europe	Greater China	ASIA
Favorite models	**e.g. Ford F-150 lightning**	**e.g. Tesla Model Y**	**Wuling Hongguang mini EV**	**Hyundai Kona**
Regulation	• Inflation Reduction Act impact on US EV manufacturing	• Ambitious environmental targets • Low regulation in Germany	• Strict regulation, subsidies partly expiring • Chinese supply preferred	• India FAME** Scheme 100% EV in 2030
Auto industry	• Tesla as pioneer	• VW with “New Auto” strategy • Requesting low CO_2 footprint • Volvo 100% electric in 2030	• New force of car makers with fast developments • Cost-efficient battery platforms	• Development strategy focuses on foreign markets • Main battery source for global e-mobility market (> 50%)

* Statista (2022), here: battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEVs)
** FAME (India): Faster Adoption and Manufacturing of Hybrid and Electric Vehicles

WACKER Automotive Silicones – Core Advantages



- Highly flexible polymer chains
- Strong bonding energy Si-O
- Low intermolecular interactions

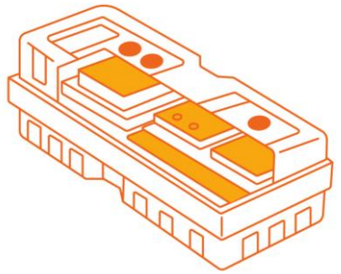
Properties

- Chemically inert
- Water-resistant
- Oxidation-resistant
- Temperature-resistant

Application Benefits

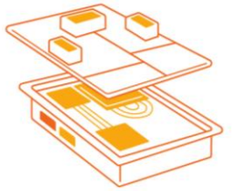
- Thermal requirements – thermal stability
- Thermal management performance
- Assist functional safety / thermal event isolation
- Customizable
- Approved material to protect automotive electronics for decades
- Easy to process

Silicones Enable Sustainable and Safe Performance of Key Components in EVs

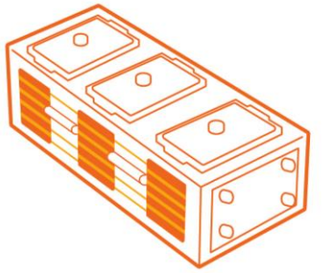


Power conversion
Encapsulation of electronics
Thermal management

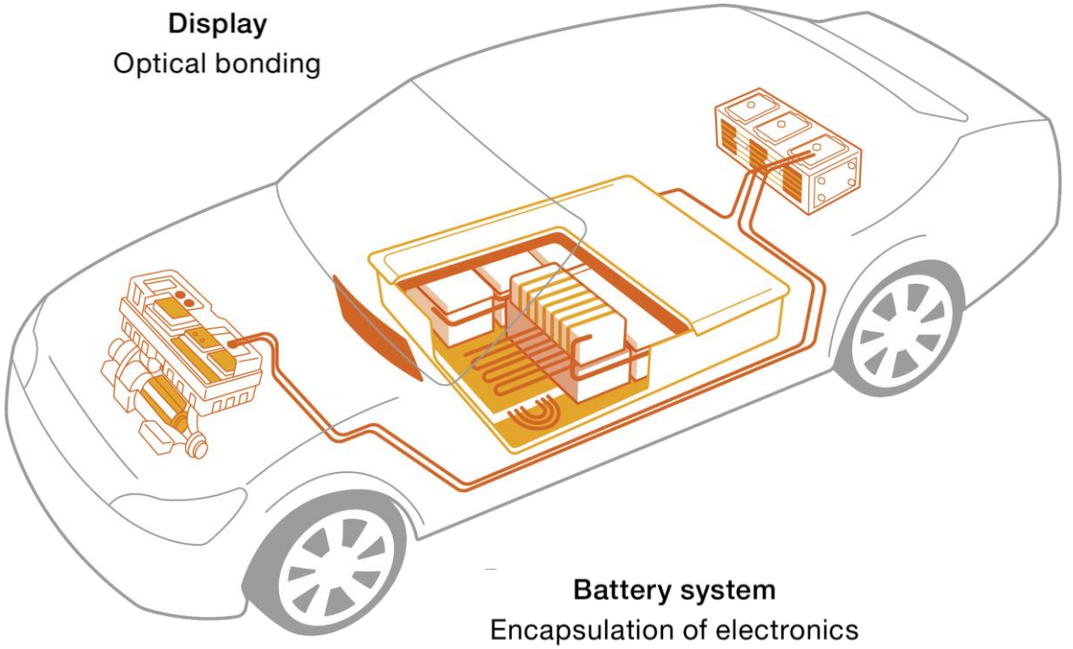
Display
Optical bonding



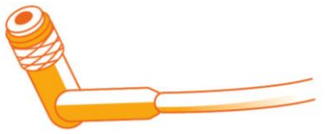
Sensor/ECU
Encapsulation of electronics



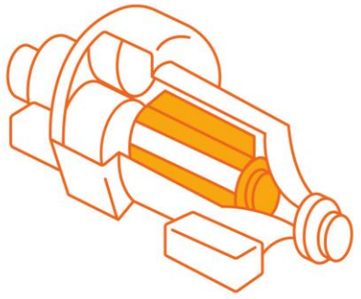
Fuel cell
Sealing bipolar plates



Battery system
Encapsulation of electronics
Thermal management



High-voltage cables
Electrical insulation

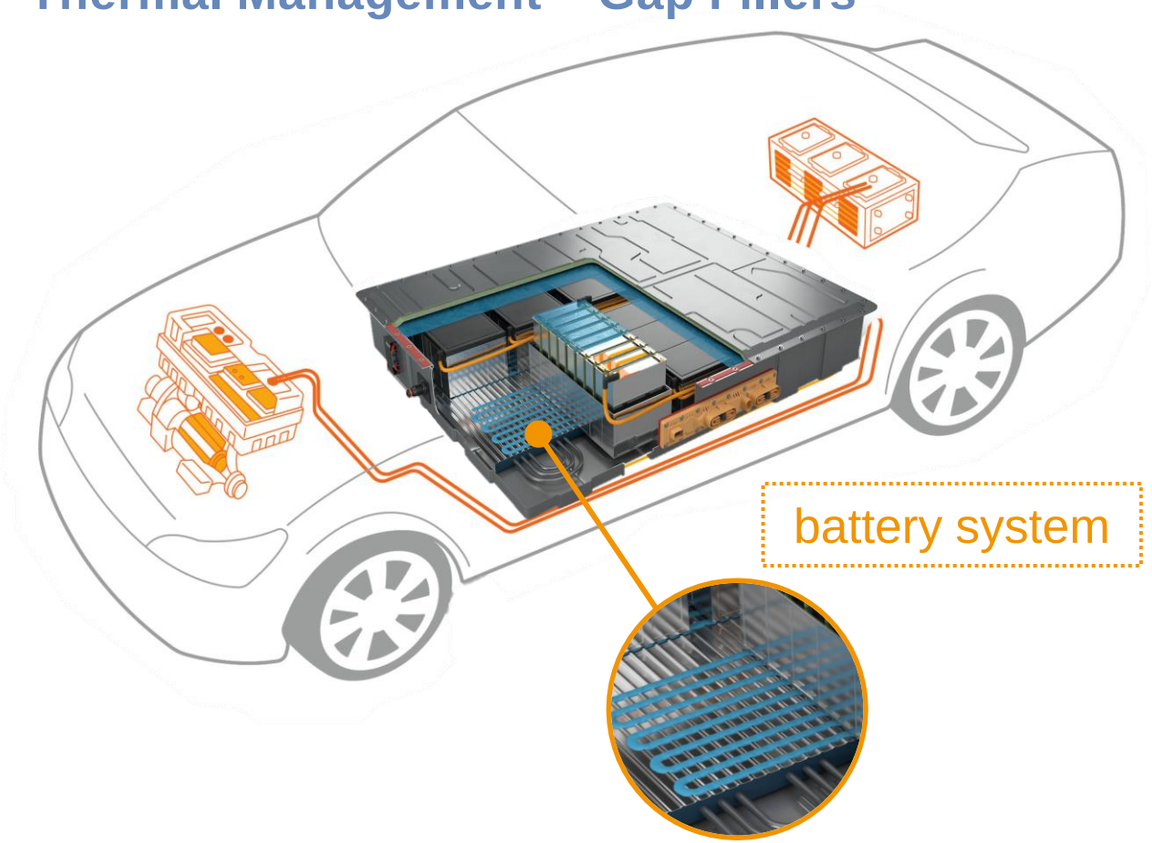


Electric motor
Coil impregnation
Active cooling

High-voltage connectors
Electrical insulation

Essential Cooling Solution to Ensure Proper Temperature Conditioning

Thermal Management – Gap Fillers



The Challenges:

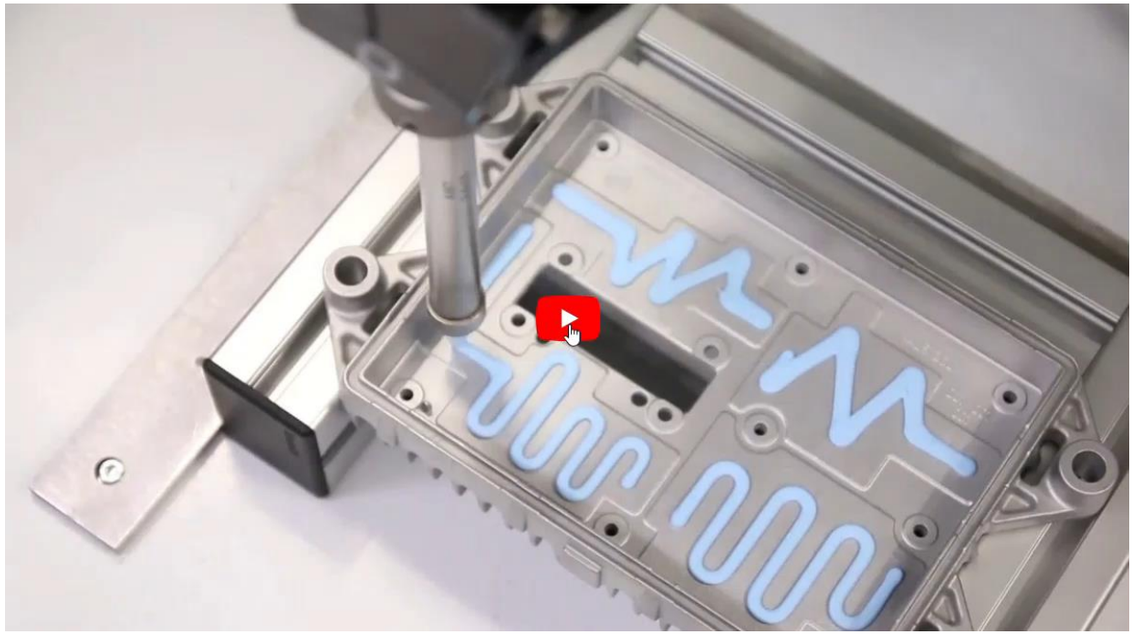
- Soft, flexible gap filling between uneven surfaces
- Dissipate heat effectively from the battery to the cooling plate for an optimum temperature range of 20 to 40°C

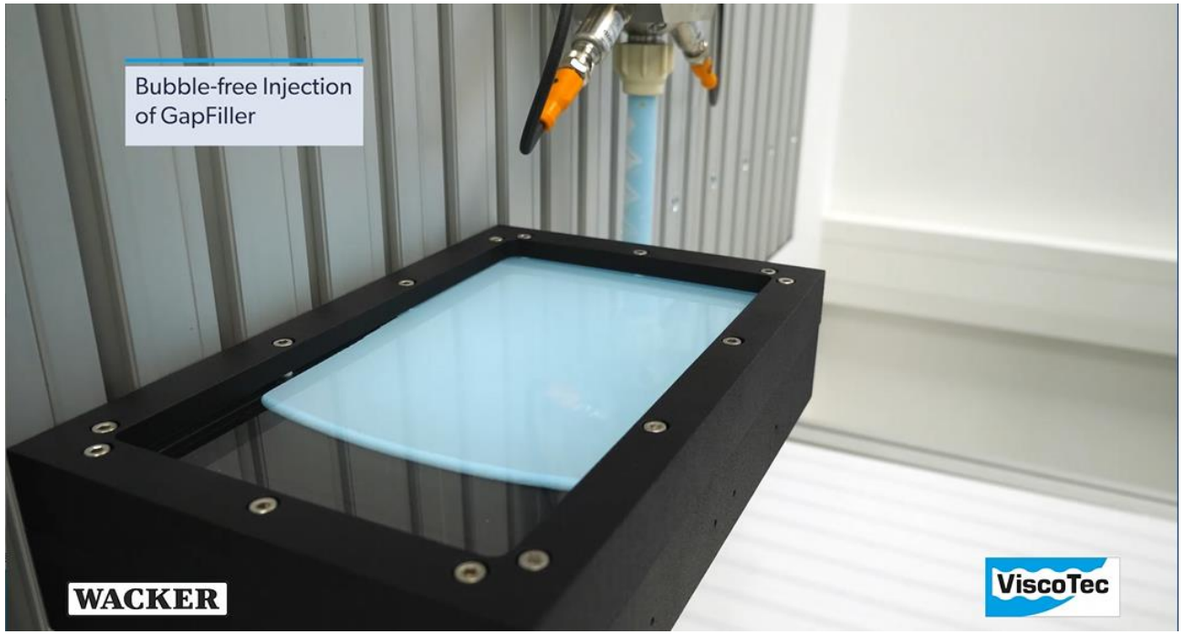
Our Solution:

- Thermal conductivity between 2 and 5 W/mK
- 2-part addition curing at room temperature or with heat
- Low density gap filler available
- Remaining soft and tacky between –50 °C to +180 °C
- Low volatiles, D4-D8 < 350 ppm, UL94-V0*

* UL94-V0: Plastics flammability standard released by Underwriters Laboratories

WACKER’s Silicone Gap Filler Series for the Automotive Business



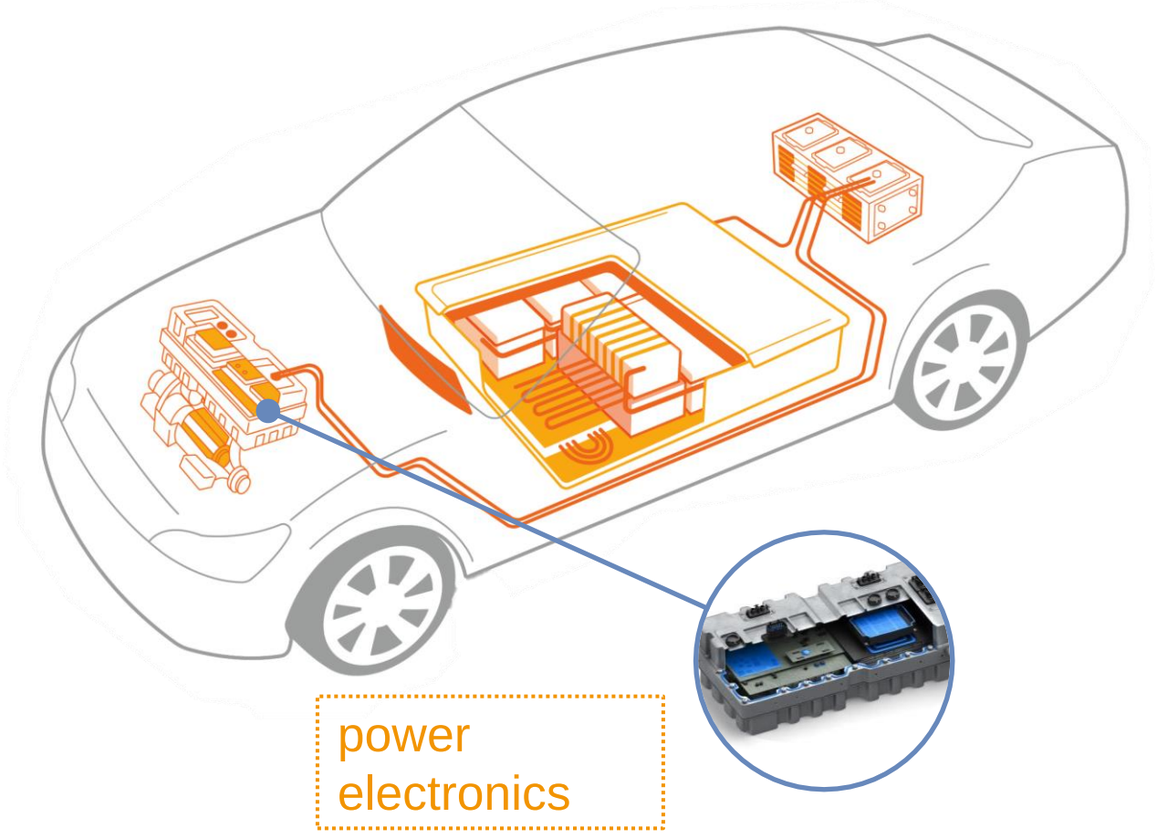


WACKER SILICONE Gap Filler Series for Battery Systems

SEMICOSIL® 961-X TC	2.7 – 3.0 W/mK*	2.5 – 3.0 g/cm³	Best in application
SEMICOSIL® 966-X TC	2.5 – 3.0 W/mK*	2.5 – 3.0 g/cm³	Lowest in viscosity
SEMICOSIL® 967-X TC	2.5 – 3.2 W/mK*	2.0 – 2.3 g/cm³	Highest in efficiency

Thermal Management Encapsulation Cools Down Charging and Inverter Applications

Thermal Management – Potting



The Challenges:

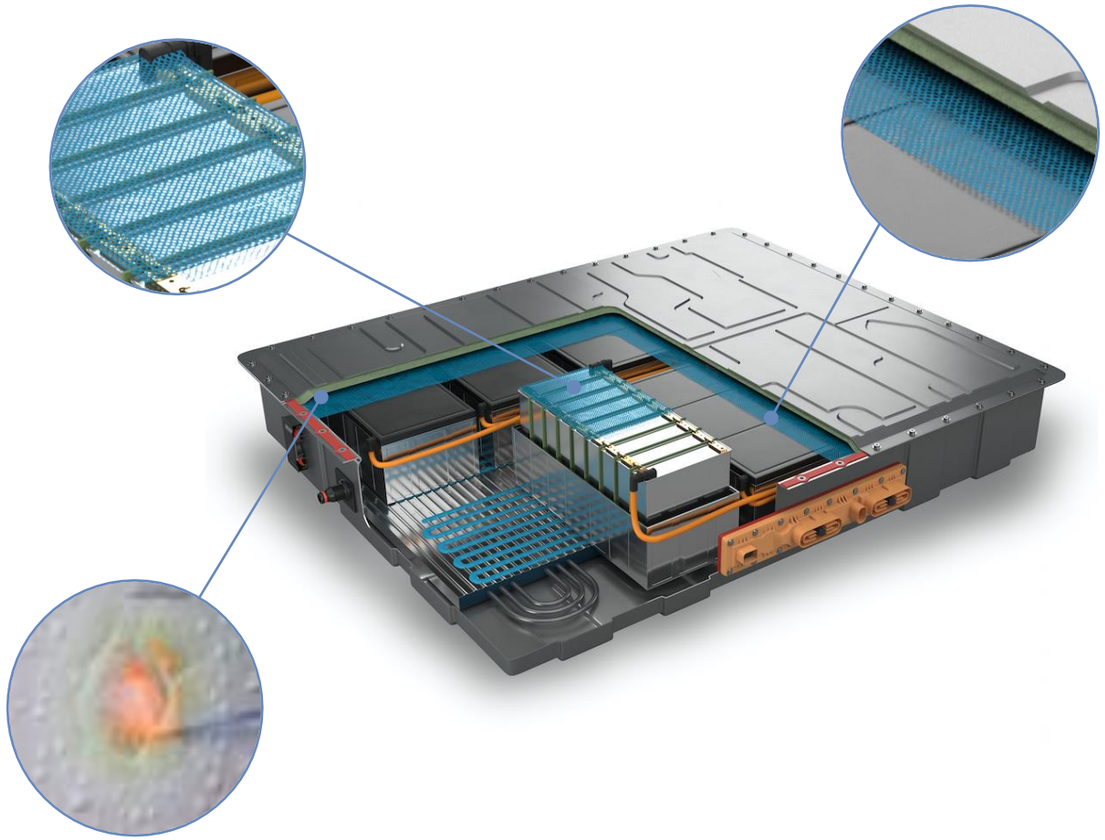
- Dissipate heat effectively from the electronic device
- Low viscous, flowable encapsulants – optimum balance between viscosity and sedimentation
- Easy to process for automotive serial production

Our Solutions:

- Thermal conductivity 0.8 – 4.0 W/mK
- Density 1.4 g/mL – 3.0 g/mL
- Low sedimentation grades
- Low temperature-cure grades available

Various Highly Innovative Silicone Solutions Increase Battery Safety

Battery Safety / Film, Sheets & Coatings



The Challenges:

- Provide > 5 min passenger safety in the event of a thermal runaway (legislation)
- Automotive serial production / short cycle time
- Easy processing

Our Solutions:

- HCR compound SILMIX®
- RESIN composite – SILRES® MK
- RESIN composite as heat shield for battery cells
- Ceramifying coating / FILM – ELASTOSIL® CM

Over 100 Years of Success Demonstrate WACKER's Dedication to Automotive and Electronics

Center of Electronics Excellence in Seoul (Korea)

WACKER SILICONES

- **Globally present** with 12 production sites (3 fully integrated) and 15 local tech centers
- **Large-scale production capacities** for silicone elastomers available in Germany, USA, Korea, China and Japan
- **R&D centers + application chemists** working on automotive silicones around the globe and cooperating with leading equipment manufacturers
  - **Burghausen**: Global Competence Center for E-mobility and automotive electronics
  - **Shanghai:** Global TIM* Competence Center
  - **Seoul**: Center of Electronics Excellence
  - **Ann Arbor:** Competence Center E-mobility

* TIM = thermal interface materials

WACKER has a Global Operations Setup to Meet Customer Growth in Each Region

Batch processes

Continuous processes

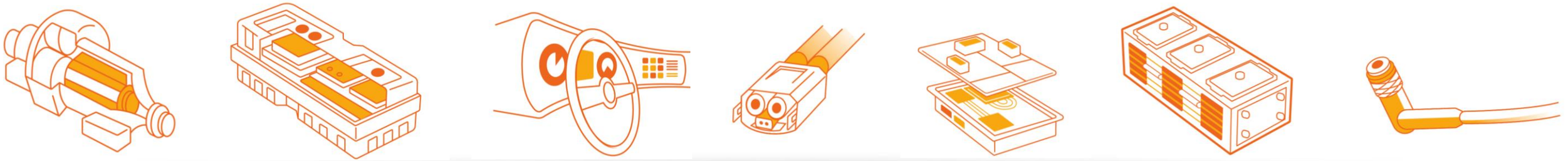
- Production of TIM* and selected specialty silicone rubber grades in Burghausen and Zhangjiagang certified acc. to IATF 16949**

* TIM: thermal interface material, **IATF: International Automotive Task Force

Automotive Silicones – WACKER is Poised to Grow its E-Mobility Business

Summary

- EV share of car sales will increase significantly from 2030 onwards.
- With regulations and several government incentives in place, the electric vehicle supply chain is realigning and will focus on more localized production.
- Specialty silicones from WACKER offer unique properties that make electric vehicles more reliable, longer-lasting and more efficient. EVs contain up to 4x more silicones than ICEs.
- WACKER is working on a variety of approaches to improve the future safety of high-performance batteries.
- With parts of its silicone production in Burghausen and in Zhangjiagang certified according to the IATF standard 16949, WACKER is able to supply many of its silicone products directly to automakers and their system suppliers.



Thank you for your attention!