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“Sika’s portfolio has been adapted to deliver full performance at lower bake ranges while also fully performing at standard high bake temperatures.”

– Jose Bautista, Global Product Manager Sika Automotive. Page 22.

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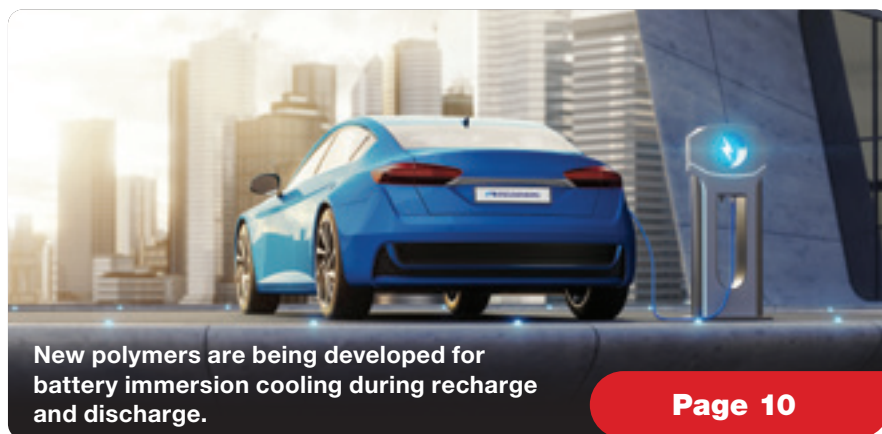
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**New polymers are being developed for
battery immersion cooling during recharge
and discharge.**

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When automotive execs become **mining** execs

Among their many other tasks and responsibilities, automotive execs now need to be able to master the mining of both scarce natural resources and data.

In today's information-driven world, the two are interrelated.

Data mining has gone mainstream with the rise of artificial intelligence systems, with ChatGPT and its clones now part of every writer's toolbox.

Manufacturing and logistics have been using AI in various forms for some time, with the latest developments giving it a turbo boost.

Strip away the hype and you will find that it is a very powerful management tool. It can mine and process huge motherlodes of data to uncover gems of very useful information.

The trick lies in learning how to use it, without an instruction manual.

To misquote Captain Kirk of Star Wars fame, we are going where no person has gone before.

Editor, Ed Richardson

He went boldly, but some managers need to be dragged kicking and screaming into the world of AI.

Others are hoping it will not be necessary to do anything about it before they retire. The bold will learn to mine information – at a scale never seen before (Kirk again).

AI has the power to do that, at warp speed.

But, it still takes a captain to interpret the data in order to steer the company or division in the right direction. That is what managers get paid for.

Techies are the geniuses who design powertrains, vehicle interiors and AI systems. Their designs only gain traction when guided by market intelligence, fueled by data mined through AI, supported (always) by talking to real live people.

It is not only marketing which benefits – logistics and manufacturing are also being transformed by AI, which is able to

provide unprecedented real-time views of the action (or inaction).

So, that's why managers from all departments must become miners and beneficiaries of data. Automotive Industries will keep you abreast of the latest developments.

That data becomes tangible when it is used to make the components that go into a vehicle.

This is where the industry needs miners of the essential raw materials used to power the next generation of electric and fuel cell-powered vehicles.

A supply chain vulnerability assessment for battery EVs by GlobalData found that countries with the biggest EV sales are also those with some of the biggest supply chain vulnerabilities, the exception being China.

Demand has spurred investment.

Lithium, rare earth elements, chromium, arsenic, cobalt, titanium, selenium and magnesium recorded the largest production volume expansions – ranging between 33% for magnesium and 208% for lithium – in the last decade, but this falls far short of the four- to six-fold increases in demand projected for the green transition, according to the Organization for Economic Development (OECD).

At the same time, global production of critical raw materials such as lead, natural graphite, zinc, precious metal ores and concentrates, including tin, has declined over the last decade.

The geographic concentration of vital minerals in countries which are not politically stable, or which do not comply with human rights and sustainable mining practices pose a particular risk.

Country leaders are leveraging this advantage. Export restrictions on critical raw materials have seen a five-fold increase since the OECD began collecting data in 2009, with 10% of global exports in critical raw materials now facing at least one export restriction measure.

But, the industry is not powerless and is always resourceful.

Recycling is the new mining. The circular economy is not only good for the environment, it can also help companies manage their supply-side risks – if they know where to dig for data. **AI**



AUTOMOTIVE INDUSTRIES and Rutgers, the State University of New Jersey, have put together a digital library of back issues of AI from the early 1900's (high res and low res) of approximately 230,000 images of the print publication. This archive, which documents the birth of the auto industry to the present, is available to AI subscribers. Go to AI's homepage www.ai.com and click on the "AI Library" link or visit www.ai-online.com/100YearLibrary

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“We are on a mission to ensure lighter weight, more sustainable vehicles are on the road and to do that, we must invest in joining technology that will enable aluminum to meet all of the automakers’ needs, including those for safety.”

Aluminum roll forming development line accelerates innovation

By: Jon Knox

Aluminum roll forming technology is poised to transform the pace at which the automotive industry changes to aluminum as the ideal material for producing lighter, greener automotive structures and parts.

Roll forming provides a simple, cost-effective solution for the automotive industry to produce lightweight, high-strength aluminum components faster and for less cost than today’s widely used methods. This is becoming increasingly important as the demand for lightweighting continues to increase, especially as the industry moves toward electrification.

Novelis has built a roll forming development line at its Customer Solution Center in Novi, Michigan (outside Detroit). Roll forming is not new, but the possibilities for roll forming aluminum sheet have not been fully developed.

Jamie Zinser, Vice President Global Automotive at Novelis.



Novelis is working collaboratively with its Tier 1 partners and automotive customers to ensure these possibilities are optimized to meet their lightweighting, performance and design goals.

Automotive Industries (AI) asked Jamie Zinser, Vice President Global Automotive at Novelis, what the purpose is of the roll forming development line.

Zinser: Novelis is the first aluminum company to invest in its own roll forming development line, which demonstrates our commitment to innovating and advancing a technology we see as critical to meeting the demands of the automotive marketplace. The shift to mass production of aluminum-intensive automotive parts is a natural next step as the industry prioritizes sustainability and lighter weight vehicles.

The primary purpose of the new aluminum roll forming development line is to help Novelis meet the automotive industry’s demand for a process that can produce large volumes of high-strength aluminum automotive parts.

Producing lighter, greener automotive parts on a mass scale requires consistent innovation, and when it comes to aluminum, less is more. This development line allows us to conduct full scope, continuous research and development.

We wanted to create an in-house environment that encourages our team to think differently, push past limitations, and apply new techniques that will result in unmatched innovation while also expediting the process of bringing solutions to market as the industry demands production of high-strength aluminum auto parts on a mass scale.

AI: Why is roll forming so important for the automotive industry?

Zinser: There has been demand from our OEM partners to improve the strength, cost, speed and quality of aluminum parts that are being produced with current methods.

In the roll forming process, strips of aluminum are continuously bent and formed to the desired shape. Roll forming allows for the elimination of secondary processes, which means a part is complete at the end of the roll forming line. That is because value-adding processes, such as passivation coatings, the punching of holes or features, and inserting fasteners can all be done in line.

AI: How does your aluminum roll forming development line help your customers reach their sustainability goals?

Zinser: First, let me stress that aluminum is infinitely recyclable and offers the lowest carbon footprint throughout a vehicle’s complete life cycle, which helps auto manufacturers reach their carbon reduction goals. An aluminum intensive EV requires fewer charges and less energy to operate than a steel-intensive EV.

Aluminum has one-third the density of steel, which results in a 45% lighter vehicle body. Less weight means that an EV can

A yellow circular arrow graphic with the text "Circular Economy" written along its top curve. The background of the entire advertisement features a close-up, blue-tinted image of a car wheel, showing the spokes and the tire's tread pattern.

**Lighter.
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**The Future of Mobility
is Aluminum**

We're All In

Novelis

achieve the same range with smaller batteries and less power. Aluminum lightweighting also results in secondary weight savings with less materials required for use in other vehicle systems.

Since more than 90% of a vehicle's aluminum can be reused, recycling an end-of-life aluminum vehicle means that it can literally be made into another car. This can help improve overall sustainability.

AI: How do you join components without compromising safety?

Zinser: Today's roll forming market offers a variety of advanced joining methods, such as laser welding, high frequency welding and adhesive bonding. The Novelis roll forming development line will facilitate expedited innovation around joining technologies, ensuring new methods and applications continue to evolve and safety is not compromised.

We are on a mission to ensure lighter weight, more sustainable vehicles are on the road and to do that, we must invest in joining technology that will enable aluminum to meet all of the automakers' needs, including those for safety.

It is also noteworthy that a lightweight aluminum vehicle is safer for passengers in comparison to a vehicle made of steel. Every aluminum intensive vehicle currently in use has a 5-star NCAP safety rating, which does not apply to all steel intensive vehicles. In addition,

lightweight, high strength, yet complex aluminum automotive components in a fraction of the time, which is necessary to produce the volumes the EV market will require.

AI: Are you working closely with OEMs on the development of the technology?

Zinser: Our team works with OEMs to determine how to maximize lightweight, high-strength aluminum to design the best solutions for specific applications at the right cost to better compete against steel and other materials. The facilities are led by industry-leading researchers, designers and engineers located near automakers' manufacturing sites in North America, Europe, and China.

We are working with automakers on technology that will result in more lightweight vehicles and more secondary savings. Smaller motors, batteries, brakes, and suspension parts will create lighter weight vehicles with lower emissions without sacrificing driving performance.

Our dedicated team of Novelis engineers, metallurgists, chemists, computer scientists and other experts are working together with automakers to determine how to maximize and shape the possibilities that aluminum has to offer as we look ahead two, five and 10 years. In fact, 40% of all Novelis Research and Development investment is dedicated to creating innovative solutions for automakers.



Novelis roll forming development Line 1 (left) and Line 2 in the Novelis Automotive Customer Solution Center in Novi, Michigan.

when a vehicle's weight is reduced, it decreases the impact of the vehicle load on the passengers in the car involved in an accident.

AI: How does aluminum roll forming benefit the electrification movement?

Zinser: It is important to note that lightweighting is critical to advance the electrification movement because EVs are heavier than traditional gas-powered vehicles due to their large battery packs. Battery packs add anywhere between 1,000 and 2,000 pounds.

Compared to other competing materials, aluminum has a clear advantage in strength-to-weight ratio. In fact, aluminum is the only metal that can achieve dramatic weight reduction while increasing vehicle range and providing equal or better quality, strength and durability. In addition, a lighter vehicle allows for better stability and quicker responsiveness.

Aluminum roll forming transforms the process of creating

To ensure our products work seamlessly in our customers' manufacturing environments, members of our team work in-house as resident experts to help our partners design next-generation aluminum products.

AI: What is next for Novelis?

Zinser: Looking forward, Novelis is optimistic about the potential of roll forming technology to optimize the benefits of aluminum, which can be used for every type of vehicle ranging from an electronic luxury car to a last mile delivery vehicle (LMDV). The company's global team is conducting extensive research as to how aluminum roll forming can be used for different vehicle parts and components.

The possibilities of roll forming to produce complex, high strength aluminum parts is still underdeveloped, and Novelis is committed to investing in this process and researching its potential. **AI**

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New generation of **battery sealing** materials are tried and tested

By: Nick Palmen

Thermal management of battery arrays in electric vehicles has sparked the development of a new generation of materials to provide insulation and cooling.

One of the technologies being explored at present is battery liquid immersion cooling. Heat is dissipated by a dielectric fluid which is in direct contact with the cells, busbars, and electrodes inside the battery enclosure.

Automotive Industries (AI) asked Boris Traber, Global Director Advanced Material Develop-

We started to benchmark our portfolio with the new fluids for battery immersion cooling three to four years ago. The outcome was surprising: While some of fluids showed a reasonable compatibility with our sealing materials, some of the materials exhibited very unusual behavior, for which we did not have an immediate answer.

Our focus was on sealing compatibility, but also interlayer membranes for compression elements immersed in battery cooling fluids became relevant.

AI: How did you determine how polymer materials used in seals and other components behave inside the cooling fluids?

Traber: Our standard approach to testing is to immerse samples of materials and then perform mechanical testing. After that, we measure volumes as well changes in mechanical values, which includes a compression test to establish the setting behavior of the seals.

Typically, this testing sequence would take over 336 hours of immersion. This gives us a pretty good indication of the performance of the material.

We started with a fluid manufacturer which contacted us to benchmark our standard sealing systems and test them against the fluids they provided. This worked well.

We have tested fluids for immersion cooling for eight other manufacturers. Our collaboration is protected by non-disclosure agreements, so we cannot divulge more details.

Boris Traber, Global Director Advanced Material Development at Freudenberg Sealing Technologies.



ment at Freudenberg Sealing Technologies, how new polymers are being developed for battery immersion cooling.

Traber: Elastomeric sealing materials are our core business. We constantly screen new markets and identify new requirements to place on the materials. As the next step we benchmark these new requirements with our current portfolio to evaluate if a new material development would be necessary.

The manufacturers send us their fluids, which we run through our liquid immersion program to establish compatibility. We then send the fluid back to let them do their own analysis.

AI: What was the goal when developing your new elastomer which is good at conducting heat and providing electrical isolation?

Traber: We were looking at heat transfer materials for e-mobility applications where the customer wants to connect a heat source with a heat sink, to take heat out of the system.

The major advantage of the material which we have developed is in the processing in conjunction with a good thermal conductivity. It can be formed through injection molding and can be bonded directly to several thermoplastic materials to which it is normally hard to adhere. We get adhesion between both systems in a mass production process.

The material can be formed into complex shapes which meet UL94. This means the material is flame retardant. This makes it very attractive for many applications because of the freedom of design, especially where it's bonded directly to a housing or other components.

AI: How do you evaluate the compatibility of rubber elastomers and thermal plastics in lithium-ion batteries?

Traber: Our evaluation of materials that are in contact with lithium-ion battery fluid starts with a prescreening procedure which determines whether we are on track. We start the benchmark by immersing only in solvents which are comparable with acetone.

For materials that look promising we have developed a test procedure in our laboratory in Plymouth, MI, United States. In this lab, we are able to test materials such as rubbers and thermoplastics at a high level to meet customer needs.

We standardize on one reference electrolyte to make the tests comparable.

The test identifies changes in mechanical properties and swelling or shrinking. In addition to Plymouth, at our lab in Weinheim, Germany, we test resistance to permeation by water and oxygen, which may affect the performance of the electrolyte.

So, it is not only important that the materials need to be resistant to the electrolyte and have low swelling, but they have to show low permeability.

In addition, in order to have a full picture of the performance of the materials, we have a cooperation partnership agreement with a German university. The materials are sent to the institute to extract absorbed material after immersion in a standard electrolyte.

The electrolyte is then used in a battery, which enables us to assess the decrease in performance over the lifetime of the battery.

During this test we can also determine whether any problems could arise with leaks or the lifetime of the products using these materials. Using this method we have identified a substantial number of materials suitable for contact with Li-ion electrolytes.

AI: How do you reduce the possibility of battery propagation?

Traber: Specially developed heat shields (cell spacer elements) for lithium-ion battery systems prevent the heat from "propagating" to neighboring cells when single cells are in abuse mode. Systems are needed which insulate the cells from each other while providing defined compression throughout the battery life.

Our approach is to separate the thermal insulation from the mechanical demands of the system. The thermal insulation is provided by an aerogel layer which is paired with a shaped silicone layer. The silicone sheet can compensate breathing

(charging) and swelling (aging) of the cell according to the customer requirements.

With our Freudenberg Sealing Technologies solution, we can achieve both functions very well.

The advantage of using these heat shield material combinations is that they can be quickly optimized to various customer demands. Even more, we are optimistic that they will hit the required lifetime, which is above 1,000 battery charging cycles.

AI: What are the key characteristics of this kind of shield?

Traber: For sure, the heat shield has to fulfill the already mentioned three key characteristics: it has to insulate against heat passing from one defect to a still working cell – measured with a heat flow meter and a hot plate tester.

Besides this, it must protect intact cells against direct fire attack – measured by a special torch test - and of course it has to provide the mechanical compensation due to swelling – measured with a cycle tester. All of these tests have been developed by Freudenberg Sealing Technologies and are good tools to develop the heat shield product at first glance.

AI: Does the new heat shield have a major impact on the required installation space?

Traber: The tendency in the market is to continually reduce the installation space. The smaller the inter cell layers, the more space for energy cells. We can provide solutions in the two-to-three-millimeter installation space, and we are looking at how to optimize the use of the material to go smaller. Here we consider also alternative solutions in further evolving our approach.

AI: What is next for Freudenberg Sealing Technologies?

Traber: Through the development of heat shields we have gained so much expertise and experience in their design and understanding the hysteresis of the materials that we will continue refining the compression elements, also for use in immersion cooling. We will also investigate the development of compression elements for solid state batteries.

In addition, we have successfully developed flame barrier materials as 2D mats, as well as 3D molded parts. Over the next few years we will roll out these products because we can clearly see the need for new materials to support the evolution of the electric vehicle. With our special grades of flame resistant thermoplasts we enter a new level of products. **AI**



The FST advanced battery testing laboratory in Plymouth, Michigan.

Simulation keeps Tenneco in the lead for the design of **shock absorbers**

By: Nick Palmen

Simulation has become an integral part of the vehicle development cycle, bridging the gap between computer modelling, laboratory testing, and real-world driving experiences.



Driving simulators are playing an increasingly important role in the research and development of vehicles, particularly in the areas of vehicle dynamics, human comfort factors and advanced driver assistance systems.

This is especially true for suspension systems which are notoriously difficult to develop and validate due to the complex interactions between the vehicle, the environment, and the driving conditions. To address this challenge, Tenneco, a leader in the development of suspension systems, has incorporated simulation tools into its development process, enabling it to test its shock absorbers much earlier and at lower cost than before.

Tenneco's use of simulation tools has proven to be effective in reducing costs, saving time and producing more accurate results. This makes simulation an essential component of Tenneco's development process for shock absorbers.

Simulation tools enable Tenneco research engineers to conduct experiments in a driving simulator that closely mimics real-world driving experiences. This leads to more accurate results that can be extrapolated to real driving situations. By integrating simulation into its working procedures, Tenneco has significantly reduced the cost and time required for physical prototype testing, bringing vehicles closer to production faster.

The driving simulator used in this research utilizes six linear actuators that join a base and a mobile platform through universal joints, allowing for simulation of a real vehicle's dynamics in three linear and three rotational degrees-of-freedom.

Simulation has proven to be highly effective for Tenneco in various use cases, as demonstrated by recent projects such as the European Commission's Connected and Shared X-in-the-loop Environment for Electric Vehicles Development project XIL for EV.

This project has developed a new experimental methodology for the development of complex systems for electric vehicles. It is based on the real-time connection of test benches of different subsystems located in different geographical locations that work as a single unit.

Additionally, simulation has been used to study vehicle handling, body motion, and primary and secondary ride, leading to the development of an experimental method for measuring human perception of seat vibration in the most problematic frequency range.

Looking towards the future, Tenneco plans to use simulation to optimize driving scenarios and minimize lap times on different tracks. To achieve this, the company aims to develop a realistic vehicle model, a flexible methodology for generating realistic driving scenarios and a robust optimization methodology.

Furthermore, simulation provides a safe working environment to analyse potential failure scenarios and evaluate the consequences of such conditions on vehicle dynamics and driver handling capabilities. This leads to the implementation of solutions applicable to real-world driving environments. **AI**



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Vehicle motion control through **advanced wheel torque** management

By: Nick Palmen

All-wheel drive electrification opens opportunities to improve driving dynamics, safety, efficiency, and convenience. The main levers are choosing the appropriate advanced drive architecture, and consequent functional integration through software.

Magna has been a pioneer in developing and optimizing four-wheel and all-wheel drives, driven by combustion engines. Currently, a shift towards electric all-wheel drives (eAWD) is taking place.

eAWD in BEVs (battery electric vehicles) has a number of advantages: It is easier to integrate, more power is required due to heavy batteries in some vehicle segments, and it enables improved wheel torque distribution. What is more, the drive functions are increasingly defined through software.

Magna improves efficiency, as well as drivability, through the "Magna Vehicle Motion Control approach".

The Vehicle Motion Control can be seen as the central part of a control loop consisting of five elements: real vehicle input; vehicle physics model; the vehicle motion control itself; the smart actuators it commands; and the resulting real vehicle behavior.

Real Vehicle Input refers to driver actions like steering or operating the accelerator and brake pedal. It utilizes all relevant data provided by onboard sensors like speed, acceleration, and yaw rate. In the future, this information will increasingly be enriched by off-board data.

The car will be able "to look ahead" and add the acquired information. For example, Magna's future vehicle physics model will contain a feature called "traction predictor". It will be based on sensor fusion that firstly adds information from cameras, Lidar and other technology, supported by data from the cloud.

The vehicle will watch the road surface ahead and include information from other vehicles which have recently been on the road and share the information gathered through the cloud. All this data will be combined in the vehicle physics model.

For the vehicle physics model, Magna uses all existing information that the vehicle and the drivetrain provide. With this data, the vehicle will be modeled as a "virtual twin". This enables the system to calculate how the vehicle moves, or how it will be positioned on the upcoming route.

Crucial aspects are what is known as side slip calculation and the related active sideslip angle limitation. The sideslip angle describes how much the axles slip sideward in relation to the intended trajectory, leading to over- or understeering. In current state-of-the-art vehicles, closed-loop control is mainly done by comparing the actual yaw rate to the requested yaw rate and the actual accelerations to the requested one.

Magna has worked on additional input, enabling it to realistically calculate the sideslip on both axles.

Step three in the loop is the vehicle motion control strategy.



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Magna is consistently refining its electric drives. With modular, scalable building blocks, vast diversity of cutting-edge mechanical modules & components and long-term system competence, Magna offers drivetrain configurations for any type of vehicle and propulsion system. From powerful HEV to connected PHEV to BEV with outstanding performance.

It's time to make a difference: intelligent, connected powertrain solutions, paired with Magna's electric and hybrid drives, are opening the next chapter of e-mobility.

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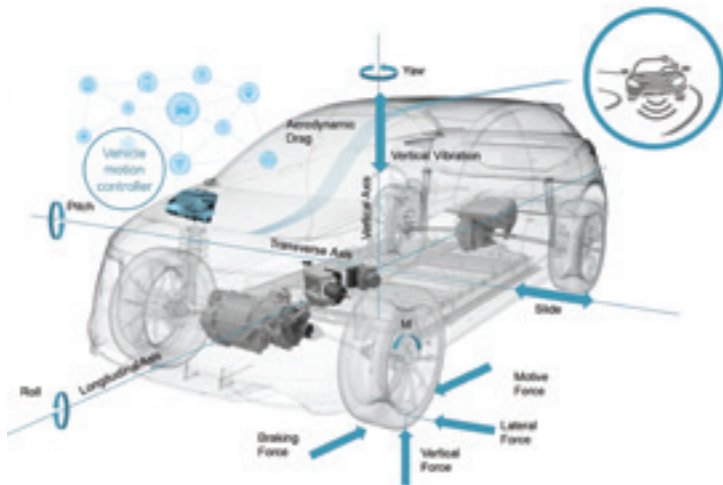


This is the onboard software that enables the vehicle to follow the targeted trajectory. It controls all relevant actuators like the e-drives, wheel brakes, possibly clutches, and active chassis components.

For example, it will split the torque between both axles to increase driving stability and provide a certain mode setting to individualize the vehicle behavior. These modes can range from a very stable standard setting to sporty modes with a certain amount of controlled drifting. In the near future, the motion control software will optionally be able to control active suspension components, active rear wheel steering, and include the management of steer-by-wire systems.

Smart Actuators are the next element in the control loop. Besides the wheel brakes, torque vectoring elements, brake hydraulics, brake booster, and decoupling devices. Magna also defines the e-motors as smart actuators. This is because the performance of e-motors in the system is a crucial element to manage the torque between the front and rear.

The motors can take over a large part of the wheel brake tasks in many driving situations. Magna is integrating the e-motors and brakes into one single domain. The fifth step, the real vehicle behavior, is described through an example below.



Functional elements of the motion control software

To place it in context, Magna has over the past few years developed several e-drive configurations that enable lateral torque vectoring in different ways. These include systems, where two e-motors are coaxially positioned on the axle. They include drives that utilize a superpositioning motor to shift the torque between left and right.

Another approach is using one motor with two clutches for lateral torque vectoring. Magna also offers a system that integrates the wheel brake function in such a system by merging both functional domains. This allows for advanced vectoring functionality without any physical lateral torque vectoring elements.

“Merging” practically means that two domains are integrated into a single new domain. The vehicle motion controller will command the torque and speed request for each wheel prioritized and include single wheel brakes when necessary. So, there is no longer a need for two vehicle physics models for the related controllers.

VEHICLE BEHAVIOR

In the following, an example is given of how different vehicle configurations will behave on the road. We compare an all-wheel drive vehicle without torque vectoring with an eAWD vehicle including integrated control of e-drive and brake. Both vehicles are driven on the same track by the same driver at the same speed. The image captured from a video shows a typical situation.



Improved safety margin through advanced wheel torque management

The tire slip indicator in the bottom right shows how each wheel behaves in a certain driving situation. The circle of the wheel slip indicator essentially represents the friction value that may not be exceeded to maintain driving stability. Each dot represents one of the four wheels.

The size of the circle represents the given friction value. In this example, the circle has a constant size during driving, because the friction value remains constant on the track. With a reduced friction value, the circle would be smaller. This illustrates, why the combination of the control loop steps described above, and the central role of the motion control software is crucial.

In the driving situation shown, the eAWD vehicle with the integrated control of e-drive and brake (black) is stable, while the standard eAWD vehicle (white) exceeds the traction limits with its front wheels. The control software manages to keep the “stress” of each wheel on an almost equal level. While the driver of the white vehicle needs to expend a lot of effort to keep the vehicle on the road, the black vehicle remains stable and has a considerable safety margin.

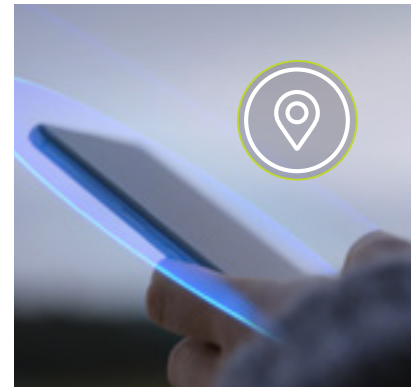
The improved controllability enables several advantages: The efficiency benefits, because of improved brake blending and a higher regeneration share through the e-motor allowing for reduced power consumption. This especially applies to real-world driving, due to generally higher longitudinal accelerations than in current homologation driving cycles.

As to safety, the trajectory for every driving situation is significantly improved. It is easier for the driver to handle the vehicle even in critical situations like avoidance maneuvers, low friction spots etc. This also applies to regeneration and braking, as the integrated software domain allows for better controllability.

The vehicle dynamics benefit from an increased achievable lateral acceleration and the related increase in cornering speed dynamics within the physical limits. Finally, the improved controllability such as reduced steering effort, as well as the predictive abilities allow for clearly improved comfort and convenience. **AI**



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Reducing temperatures in the body and paint shop

By: Ed Richardson

In their drive to continue reducing their total carbon footprint and utility costs, OEMs are analyzing all the cogs in the value chain, which include manufacturing processes in their plants.

Traditionally the high energy users in Automotive assembly processes are the body and paint shop. The drive to reduce costs while on the road to net zero emissions has led suppliers to the development of low-bake technology which reduces the total amount of energy used in the manufacturing process.

This trend has increased demands on all suppliers providing reactive components that respond to heat. In the case of a company like Sika, this would include coatings, adhesives, seals, baffles, reinforcements, and acoustic products, all of which are heat activated and cured.

Automotive Industries (AI) asked Jose Bautista, Global Product Manager Sika Automotive how

Jose Bautista, Global Product Manager Sika Automotive



the company has adapted its product mix to meet the demand for lower temperature curing in paint and body shops.

Bautista: At Sika we have followed the low bake trend for more than a decade after we identified it early. In response our chemists started developing technological building blocks. Today, Sika's portfolio includes well-proven low bake products which deliver the usual state-of-the-art performance as the standard bake products.

Due to the geopolitical situation that has been with us for more than a year, energy reduction has become a high priority. Therefore, we continue focusing our product development efforts hand-in-hand with our customers in order to meet their targets for the paint shop of the future.

AI: What solutions do you offer where acoustic products need to cure inside complex metal bodywork or around electric vehicle batteries, where it is difficult to provide heat?

Bautista: Even heat dispersion has always been a challenge, particularly in deep reaches of thick metal cavities. Car body construction evolution has been influenced by energy reduction initiatives and the introduction of new electric vehicle architectures.

New material mixes, as well as novel processing methods, are being implemented at the different OEMs. We have recognized that curing materials which develop full performance at lower temperatures and that provide additional water sealing properties are of high interest for our electric vehicle customers.

Many of the areas which need to be treated are metal reinforced for protection and exhibit challenges to reach standard temps during existing processes. Sika's portfolio has been adapted to deliver full performance at lower bake ranges while also fully performing at standard high bake temperatures.

AI: Is the change being led by the OEMs, by suppliers like Sika, or a combination?

Bautista: Ultimately, it is always the result of cooperation between OEMs and suppliers. At Sika we do not wait to have a firm request to develop a new product. Through our technology pipeline we strive to work one step ahead by creating the necessary chemical compounds ahead of demand.

The identification of trends and megatrends contributes to our innovation. At the same time, we maintain contact with our customers on a regular basis in order to identify their needs and opportunities. In the end, customers close the loop by "pulling" the product development through to market launch.



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AI: How low can temperatures go in paint shops?

Bautista: I can only talk from the perspective of our heat reactive products. With current technology we can efficiently perform down to 135-140°C. In the near future 120°C should be achievable. Going further down would require completely different technologies compared to the current ones. This holds true for the entire vehicle bake process - all heat activated materials must perform at lower temperatures, not just ours.

AI: Will we be seeing “cold” body shops?

Bautista: We have identified and already responded to this trend. Our Automotive News PACE award received for Sikaflex UHM serves as an excellent reference point, as does our “Cure-on-Demand” technology. Apart from current technical hurdles for substrate treatment, other factors like investment, process standardization and capacity restrictions play an important role in the switch to a fully “cold” body shop. The situation differs from customer to customer in their approach. Whatever the final demand, our product range is ready, with further development in the pipeline. In all cases, we continue supporting the market trends by working closely with our customers to ensure that we meet their needs.

AI: Innovative products can have a lengthy development cycle. How long has Sika been working on the solutions?

Bautista: Our development cycle starts with the creation of technology building blocks, which are combined to deliver the final finished products as they are launched into the market. A full development cycle from technology creation till serial production can take 5-7 years. The development time of products based on the same technology is, of course, much shorter. Our low bake products are the result of a trend identified more than 10 years ago.

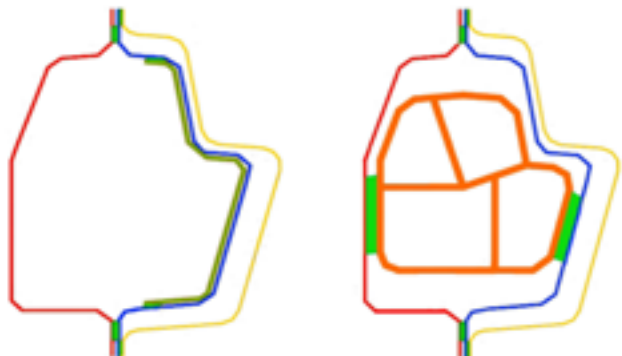
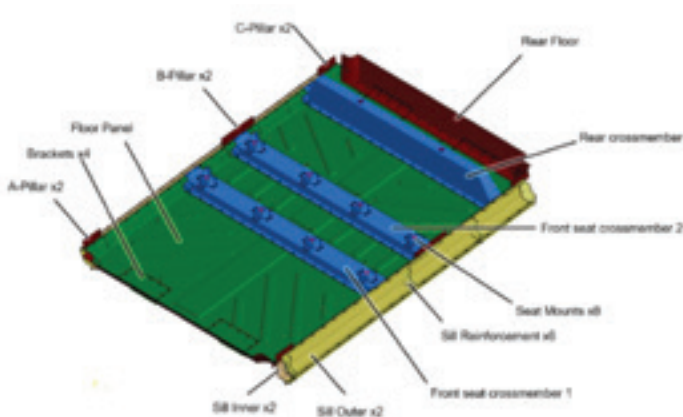
AI: What other market trends are you preparing for?

Bautista: One of Sika's corporate focuses is sustainability. We are concentrating our technology development efforts towards more performant and more sustainable products. Priority projects include bio-sources, re-usable and recyclable components.

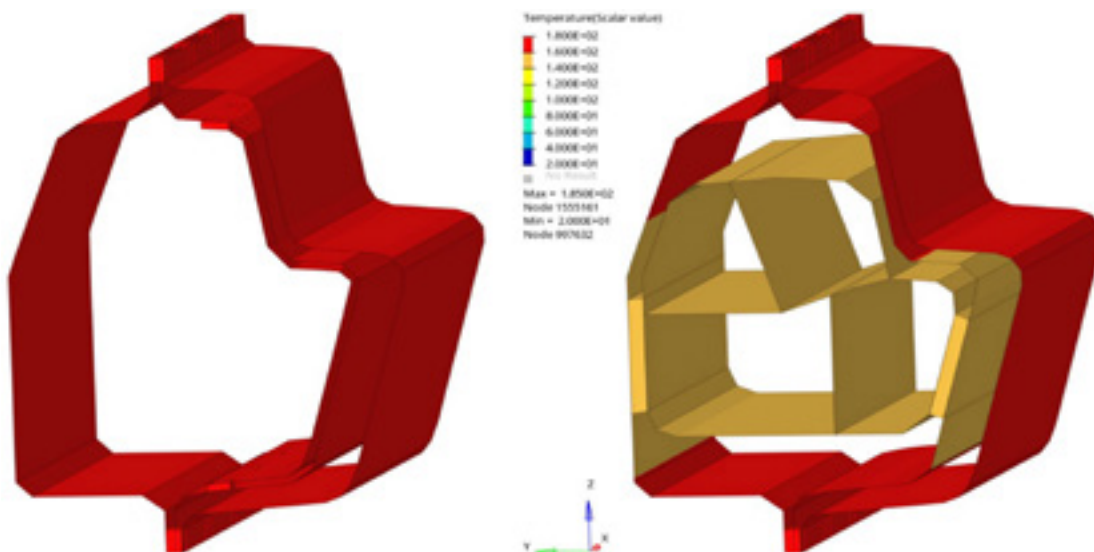
The sustainability trend will accelerate in the coming years and Sika is already investing in creating the right products to support the sustainability targets of the future. Like all trends we are already highly engaged with our customers on the subjects to enable not only our published goals, but to support them in their own. **AI**

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Amalgamating the **multiple systems** in a **software defined** vehicle

By: Nick Palmen

As the automotive industry comes to grips with the concept of software defined vehicles, there is growing awareness of the complexities involved.

Multiple layers of electronic components collect data, often in isolation. There is a wealth of information to be mined in the data as companies seek to differentiate their models through features rather than horsepower.

Automotive Industries (AI) asked Robert Moran, Product Management & Systems Engineering for Automotive Processors at NXP Semiconductors, how to understand the complexity of a software-defined vehicle.

Moran: Today's vehicle is a labyrinth of sensors, actuators, and motors that enable braking, propulsion, transmission, battery management, bi-directional

These systems control the comfort of the ride, how you interact with your car, the EV range you get, the reliability of your car, and so on.

AI: Will software replace sensors?

Moran: The vehicle generates enormous amounts of data that can create what we call "synthetic sensing," which is applicable to a range of new and existing use cases.

For example, you can train models to understand the behaviors and wear of mechanical brake sensors and their use in different environments. With an accurate model, the vehicle can predict when the brake pads need to be replaced.

The challenge is getting access to this data. It is difficult if you have disparate systems that lack the infrastructure to fuse this data for new applications.

At our software-defined vehicle engineering labs we focus simplifying the extraction of data for new user experiences that will benefit consumers, car-makers and the entire automotive supply chain.

AI: Is a tailored approach needed to get the most out of the data?

Moran: Absolutely, because every system is unique. You need to think about how to build platforms that can not only enable new data-driven services and features, but also provide migration paths for legacy software.

You also need to ensure you can meet the real-time safety and interface requirements of the legacy software.

AI: How will vehicle electronics evolve with the rollout of software-defined vehicles?

Moran: This is where it gets really exciting. We will see more centralization of software related to the vehicle features. We will need cloud-based development platforms that enable agile development. The same platform will be used to update the vehicle throughout its lifetime.

Robert Moran, Product Management & Systems Engineering for Automotive Processors at NXP Semiconductors.



charging and steering – and they must be built to seamlessly work together.

These systems are critical to the core vehicle functions and they rely on each other for safe operation. Each of the complex system of systems is unique and has different requirements. There is no one-size-fits-all chip.

AI: How will software change our motoring experience?

Moran: Software-driven features can bring a lot of value to this system of systems. Their impact on the user experience goes beyond what autonomous driving and infotainment can provide.

We will see more synthetic sensing, actuating and even motors in new, versatile software-driven use cases.

With the right software and the right platform, carmakers will be able to reduce the number of ECUs that enable discrete, isolated standalone features.

The electronics in these centralized platforms need to accommodate heterogeneous software environments. They must mix legacy and modern software technologies. At the same time, they need to provide automotive safety assurance and real-time behavior.

Easing the complexity for automakers is by no means an understated priority. They need to meet rigorous safety and security requirements, whether it is hardware or software-driven capability.

So, in this software-defined era, there's obviously more software that is running across the vehicle with dependencies from one system to the next – and it is complex.

The days of a single ECU running a single application are over. The new approach is to isolate software applications to keep user data private and vehicle operations safe.

Purpose-built compute and networking platforms that isolate software applications and the data they generate is crucial. It needs to work easily and adapt to changes in the software over time.

And ultimately, the system has to ensure vehicle safety features and user data are not compromised – even if the user plugs in an infected USB or connects their phone via Wi-Fi!

AI: How can OEMs best extract the value out of the data embedded within the vehicle?

Moran: Gaining access to the data is not the same as creating new data. A robust and configurable communications framework between the systems must be set up for the data to be captured and processed for new data-driven use cases.

Look at it this way: Today's tire pressure sensor tells you the tire pressure. It is fairly simple by today's standards. But if you could monitor and analyze the real-time data from the tire pressure, braking, accelerometer and temperature sensors, you could build a model of the real-world road conditions and how they affect tire and brake pad wear.

It could remove the need to have a mechanical sensor monitoring the brake wear or help you predict when the tires are going to wear. To do this, you would need to bridge different

communication protocols and legacy software to move data into a service-oriented framework.

Once data is made available, then processing at the edge – inside the vehicle – is the start for new insights. While there is not a single recipe to create new data-driven use cases or replace mechanical components, they typically include a combination of software, machine learning and processed data from one or many sources.

AI: Can a digital twin of the vehicle help manage health and updates throughout its lifetime?

Moran: Yes, and that is a focus for NXP. Software-defined vehicles give automakers the opportunity to decouple the software development cycle from the hardware development cycle. Keep in mind, the hardware cycle is on a much slower update cadence, so there are fewer changes in the hardware over time. With this decoupled framework, the software development and deployment can continue after the vehicle is with the consumer.

Before new software is deployed to a fleet of vehicles with consumers, automakers must be certain that they are not compromising safety. Here is where the digital twin comes in. It provides a virtual testbed to ensure any new software features will act in a reliable way across the system of systems.

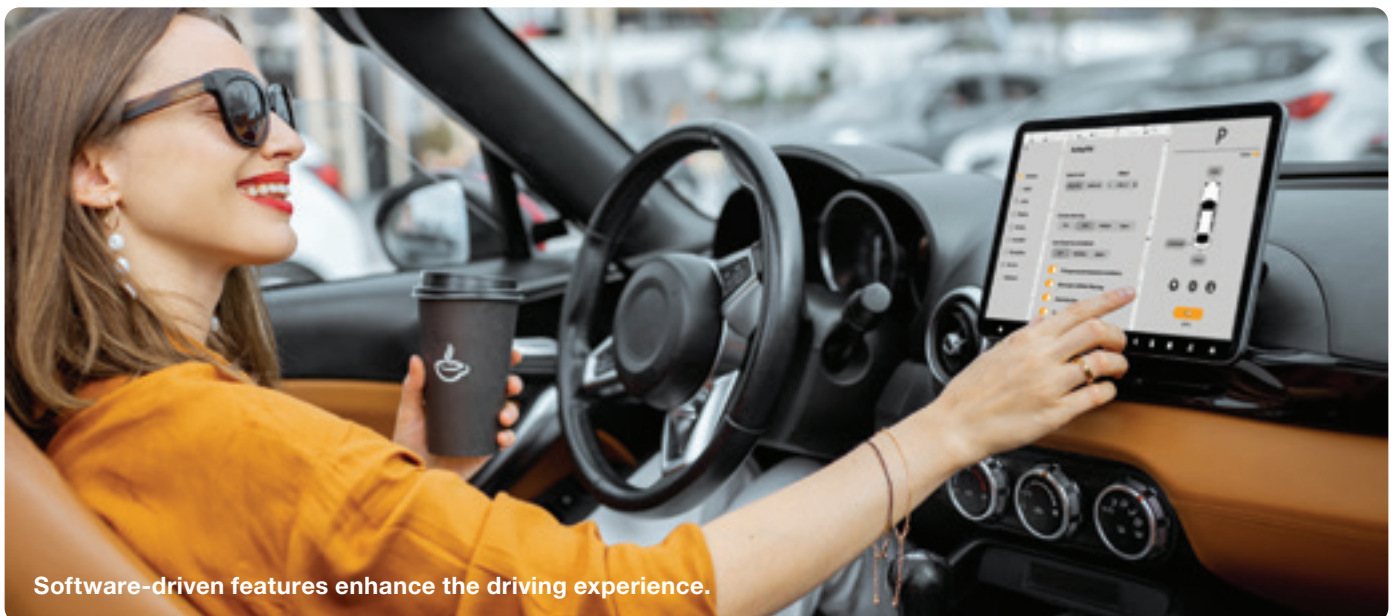
Beyond the safety aspect, the digital twin provides a testbed for new features. The data captured from the vehicle over time can be used for new hypothetical services that you can test in the cloud-enabled digital twin.

AI: What's next for NXP?

Moran: We work closely with automakers and Tier 1s. It is clear that no matter where they are in the process of the journey with software, there is tremendous complexity.

This has paved the way for us to focus on building a platform of system solutions that are designed for the “system of complex systems”.

So, what is next for us is to continue building on the industry-recognized platform that can address any kind of vehicle architecture configuration. We will continue to help automakers with the hardware platform designed for a software-defined system of systems that helps them unlock new data-driven use cases and vehicle features. **AI**



Software-driven features enhance the driving experience.

Driver monitoring essential complement to safety systems

By: Ed Richardson

Advanced driver assistance (ADAS) and other safety systems work best when combined with Driver Monitoring Systems (DMS) in an integrated safety suite.

This is one of the main findings of the analysis of over 16 million distraction events in commercial vehicles which had collectively travelled close to 13 billion kilometers by Seeing Machines.

When DMS is integrated with other safety systems, like Lane Keeping Assist (LKA), Forward Collision Warning (FCW), and Automatic Emergency Braking (AEB), the systems work collaboratively to improve safety and enhance the driving experience by ensuring that the driver is alert to the danger, according to the company.

Automotive Industries (AI) asked Paul McGlone, CEO of Seeing Machines, whether the rest of world would be following Europe by enforcing the fitting of both DMS and ADAS systems as standard equipment.

Paul McGlone, CEO,
Seeing Machines.



McGlone: Europe is certainly well ahead of the rest of the world in terms of requiring a range of technology to enhance safety. The European Commission has established regulations related to ADAS under the General Safety Regulation.

These regulations include the mandatory equipment of Driver Drowsiness and Attention Warning from 2024 for all new vehicle registrations and from 2026, will extend to Advanced Driver Distraction Warning systems. Further, the European New Car

Assessment Program (Euro NCAP) requires all cars to be fitted with DMS in order to achieve a five-star rating within similar timeframes.

Based on the global push for reduced road related trauma and death, we believe the world will follow suit. There are already signs of it happening.

In China, the Ministry of Industry and Information Technology (MIIT) has implemented regulations requiring certain vehicles to be equipped with DMS. There are specific technical requirements such as monitoring behavior, detecting distraction or drowsiness and issuing warnings.

In Japan, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has established guidelines for DMS under the Advanced Safety Vehicle regulations. And in the USA, the National Highway Traffic Safety Administration (NHTSA) has included the potential benefits of DMS in their research and guidelines related to advanced vehicle technologies and driver monitoring.

Recently, Ford announced that BlueCruise, its' assisted driving system, has been approved for hands-free use on certain UK roads. This system is underpinned by DMS where the driver is monitored to ensure that they are alerted to take control of the vehicle, if required. While the UK has determined that eyes must remain on the road if hands are off the wheel, having DMS underpins automated driving enhances safety and is likely to be a requisite for approval of hands-free driving in many global jurisdictions.

AI: What are the implications for automotive designers and manufacturers?

McGlone: Given there is legislation and regulation coming in many countries, most carmakers are planning to incorporate ADAS and DMS into their vehicle designs. In Europe, where auto designers and manufacturers have been watching the regulations closely, DMS and other ADAS technologies have

been in progress for years. We think it would be rare for a car which does not feature ADAS to be designed in Europe today

In the US, the rise in assisted (or semi-automated) driving technologies has underpinned the demand for ADAS, including DMS. Enabling humans to somewhat disengage with the task of driving requires the car to be aware of two key things, when it cannot manage the task of driving, and the ability of the human to regain control.

General Motors' SuperCruise system, underpinned by Seeing Machines' DMS, is pioneering assisted driving technology. This has been followed by Tesla's AutoPilot and now Ford's BlueCruise. These are not self-driving cars. Humans must have ultimate responsibility for the task of driving and therefore DMS makes perfect sense.

Carmakers will implement safety technology, but they will also maximize it by utilizing it for a range of convenience features. We will see more of these features as OEMs seek to differentiate their offerings using things like eye-tracking to enable functionality that might make life easier and more convenient for drivers, and eventually occupants.

AI: How does technology help to reduce the risk posed by driver distraction and fatigue?

McGlone: Understanding and reacting to human behavior in real-time is key to reducing risk. DMS does just that.

It is simple. If there is a risky situation, a robust DMS will be able to understand what the driver is doing, whether they are in a position to responsibly control the car and react accordingly. This will be optimized as ADAS features begin to work closely with DMS to understand the external environment and contextualize with what the human is doing at any point in time.

AI: Is artificial intelligence being used to improve vehicle safety?

McGlone: Road safety technology powered by AI aims to prevent accidents, reduce injuries, and save lives. By utilizing AI algorithms and computer vision systems, these technologies can detect and respond to potential dangers on the road, such as distracted driving, driver drowsiness, or unsafe driving behaviors. This proactive approach to safety aligns with the principles of responsible AI, prioritizing the well-being of individuals and society.

AI: How aware are drivers of the benefits of DMS?

McGlone: There is little broad awareness about the technology. We believe education is key in driving adoption in the safety technology and building trust in assisted driving.

When Ford launched BlueCruise in the UK, we commissioned a nationally representative poll of 2,147 UK consumers to gauge awareness of DMS and better understand consumer attitudes towards the technology with a specific focus on DMS, which is incorporated to enhance safety.

Some 70% of those surveyed said they believed technologies used to monitor and improve the performance of drivers had the

potential to help improve road safety and reduce road accidents, a sign that consumers' anxieties about DMS may be due to a lack of awareness around the technology.

The results also showed higher levels of support for DMS among younger adults, with 18 – 24-year-olds being the age group most likely to pay extra for a driver safety system to be installed. 14% said they would pay up to £250 for the technology, compared to on average only 9% among those over 45.

That said, only 5% of respondents across all age groups said that they thought that DMS should be a legal requirement for all UK vehicles, suggesting that potential legislative changes to make driver monitoring systems compulsory for all new vehicles may be out of step with popular sentiment.

The survey showed there is much work to be done by



Combining ADAS with DMS to detect distraction.

carmakers, suppliers and policy makers in educating the public as to the benefits of advanced driver monitoring systems and the regulatory changes which will make it a legal requirement in the decade ahead.

Even so, the results indicate that most UK drivers are receptive to these changes and are willing to try out technology offering clear driver safety benefits.

AI: What is next for Seeing Machines?

McGlone: Seeing Machines will continue to strive for its goal of getting everyone home safely through continued innovation of our technology and successful delivery for our customers. DMS is expanding into Occupant Monitoring System technology (OMS) where a wide field of view camera will be used to assist more than just the driver.

Our focus remains squarely on our three transport sectors – automotive, commercial transport and logistics, and aviation. **AI**

Reducing **carbon footprint** through PMMA innovation

By: Nick Palmen

In their quest to reduce the carbon footprint of vehicles throughout their lifecycle, OEMs are taking a critical look at all the materials that have traditionally been used in the assembly of motor vehicles.

This is leading to new applications for polymethyl methacrylate (PMMA), a synthetic resin produced from the polymerization of methyl methacrylate. It competes with glass in terms of weight and performance - PMMA grades allow 92% of light to pass through. It is also 40 to 50% lighter than glass.

Compounds suitable for use in exterior body parts and interior trim have also been developed, which helps to reduce the overall weight of the vehicle.

Automotive Industries (AI) asked Pavel Hlavacek, Market Development Manager at Trinseo, what challenges OEMs are facing with lighting and trim.

Hlavacek: They face the same challenges as

Pavel Hlavacek, Market Development Manager at Trinseo.



the design of all the other components that go into a vehicle. Changes are being driven by legislation, which is forcing OEMs to reduce their overall carbon footprint.

What we see is that lights have become more integrated into the surface of the vehicle like a dome part. Lighting has become merged into the surface, particularly in the front and rear. Over the past few years, we have seen customers acquire Tier 1s in order to integrate lighting into the component.

So, the Tier 1s now supply the front and rear ends with all the components already integrated. For us, the challenge is that designers are leaving smaller space for lights, but OEMs and the people who buy their cars expect the same performance and level of safety as the larger lights.

AI: How does PMMA meet those challenges and provide OEMs with more flexibility?

Hlavacek: PMMA is the right material because it provides a good combination of light performance and design. You have up to 92% light transmission. Design flexibility is important because many platforms are differentiated in part through their light signature. So, lighting is not just for safety, but for branding as well. PMMA is ideal for these applications. You need a certain level of heat resistance because the lights are getting smaller, and there is not much space for the heat to dissipate.

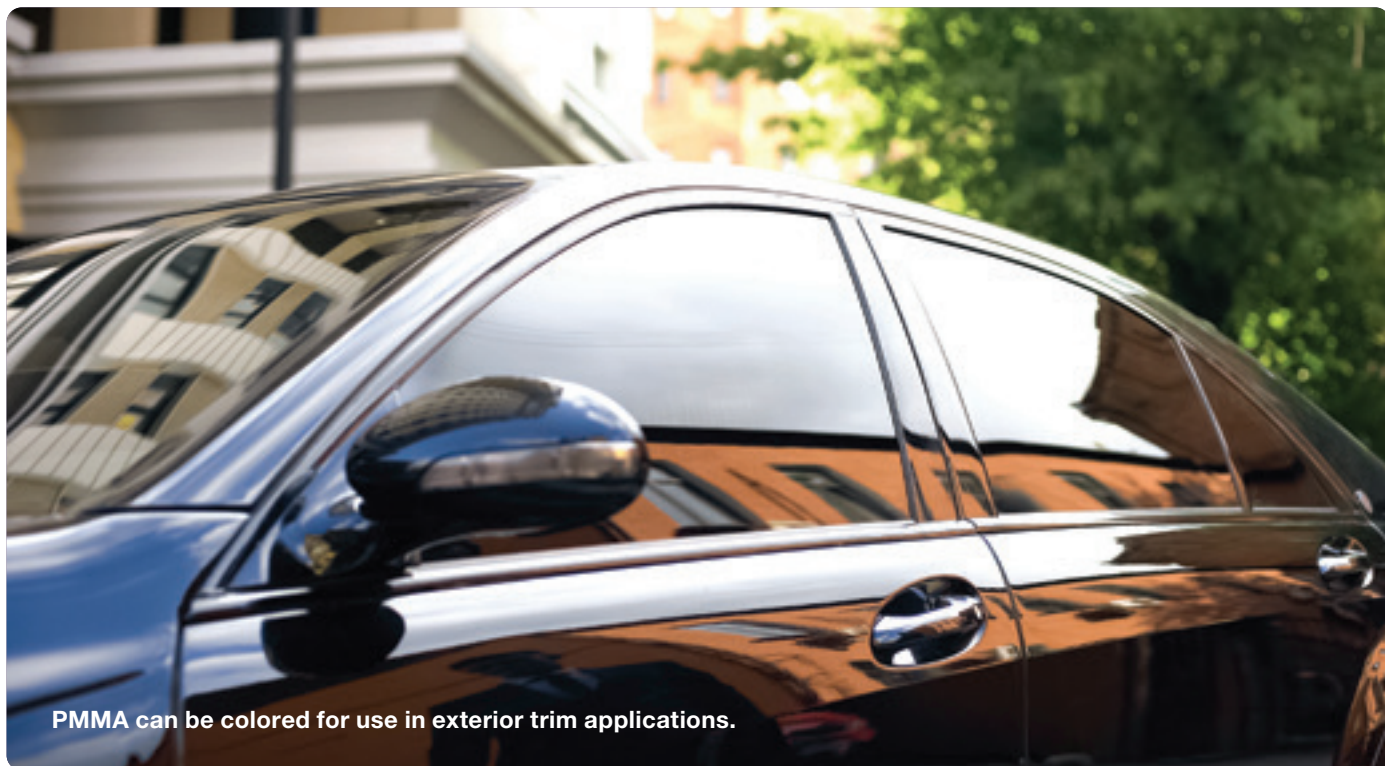
AI: Where do you see the applications for PMMA?

Hlavacek: We are targeting all lighting applications, both inside and on the exterior of the vehicle. Interior lighting is becoming more interactive. It can communicate with the driver to warn them that they are falling asleep or there is an obstacle in the road, for example.

Or it can change color and intensity according to your route or driving status. PMMA is also used in exterior trim applications. It can be colored, which replaces painting, and reduces the complexity and cost of the process.

AI: Given the increasing operating temperatures, how do you optimize your PMMA resins for use in the LED lighting applications?

Hlavacek: Our optimization cycle involves constant interaction with the OEMs and Tiers. There are also industry forums through which common challenges regarding the sourcing of raw materials are addressed. To stay ahead we innovate constantly by improving performance, introducing new colors and properties, like better chemical resistance, and greater diffusing power. There is a constant focus on heat resistance.



PMMA can be colored for use in exterior trim applications.

AI: How are you helping OEMs to meet their sustainability goals?

Hlavacek: Sustainability is a substantial part of the Trinseo DNA. This is reflected in the dialogue we have with the OEMs and Tiers. We also closely monitor the legislative environment and the sustainability strategies at government level.

We have also started developing sustainable PMMA compounds. One of the big advantages of PMMA is that it's fully recyclable. We have developed technologies to produce grades that are made with chemically or mechanically recycled feedstock as part of the ALTUGLAS R-Life family. In 2022 we introduced several grades that are now serving the cosmetics market, and we will soon broaden our portfolio to serve more markets, including automotive.

AI: What are the advantages of this for the customers and the environment?

Hlavacek: The objective is to help our customers to reduce their overall CO₂ footprint. We provide sustainable solutions through providing recyclable material which can be reused. In some cases, we are working with our customers to create a closed material loop through what is known as post-industrial recycling.

Also known as "pre-consumer material," post-industrial recycling comes from separating material from the waste stream during the manufacturing process, as defined by DIN EN ISO 14021:2016.

The automotive industry is not yet fully geared up for post-industrial recycling, but we are in close touch with some users of our materials in order to obtain high quality scrap which can be reused in various ways. For OEMs and Tiers this has the advantage of being able to manufacture components whose performance is in line with that of virgin PMMA.

It has the advantage of a reduced CO₂ footprint as less energy is used in its manufacture. The process also uses less water. We are working with our customers to fine-tune the technology and recycling systems.

AI: What's next for Trinseo?

Hlavacek: From a PMMA perspective, there is plenty of scope for development. We will be broadening our range to meet the changing needs of the auto makers. We would also like to expand geographically and follow our customers and partners from a global perspective.

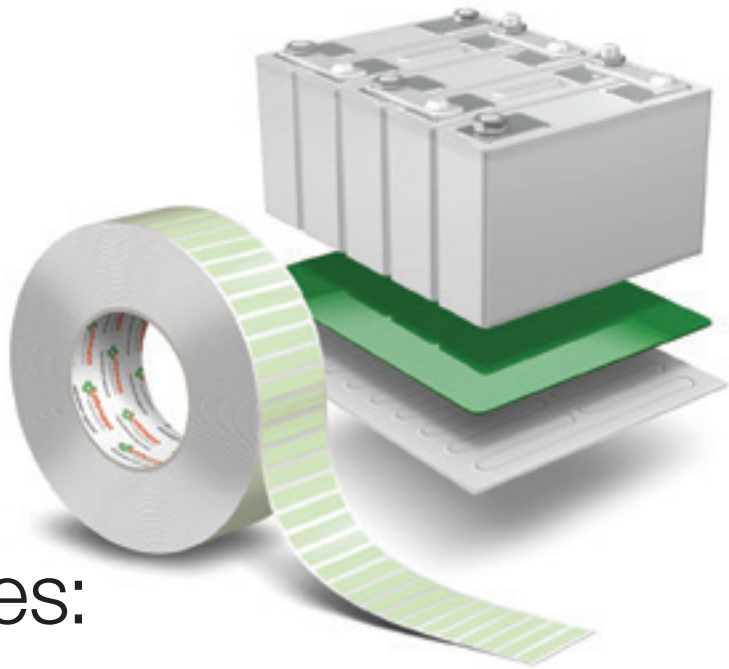
At present Trinseo has 24 manufacturing sites globally, with 11 R&D facilities. We are also looking at the localization of the feedstock because that helps reduce the carbon footprint of the logistics chain. Tools like Life Cycle Analysis (LCA) or Product Carbon Footprint (PCF) help us understand a material's impact through its complete life cycle, from manufacturing to disposal, in order to compare it to fossil-based or other benchmarking materials.

“Lighting has become merged into the surface, particularly in the front and rear.”

We will continue to focus on the LCA in order to ensure sustainability and reduce our carbon footprint and that of our customers. Digitization of the processes along the entire value chain is a priority. We are working with our suppliers and customers to be able to provide the LCA data automatically and in real time. This is another way in which we are assisting our customers to reduce their carbon footprint.

There are also some exciting new products in the pipeline, which we will be launching soon. They will be suitable for extrusion and co-extrusion, and for markets outside of automotive. **AI**

Thermal management in EV batteries is made easy with Lohmann's new adhesive tape range with a thermal conductivity of up to 2 W/mK.



Functional Tapes: Advancing **EV Batteries** and **eMobility**

By: Alan Tran

With the switch to electric powertrains having gained seemingly unstoppable momentum, the focus is on the batteries which store the energy for electric vehicles (EVs).

One of the technologies enhancing the performance, safety, and durability of EV batteries is functional tapes, which have emerged as a critical component. In this article, we explore the role of functional tapes in the context of EV batteries and eMobility, highlighting the advancements introduced by Lohmann Functional Tapes.

Enhancing Battery Performance

Functional tapes play a pivotal role in improving battery performance by addressing key challenges faced by EV manufacturers.

One such challenge is thermal management. EV batteries generate substantial heat during operation, which can affect performance and lifespan. By integrating thermally conductive tapes into battery modules, heat dissipation can be significantly enhanced, resulting in improved battery efficiency and prolonged lifespan.

Another critical factor in battery performance is electrical conductivity. Electrically conductive foams offer a smart solution for grounding without using springs or wires. The single-sided foam helps to enable safe grounding over lifetime by bridging gaps caused by part tolerances and thus offers reliable protection of sensitive battery components. At the same time the pressure-sensitive adhesive tape also fulfills a shielding function and helps to prevent malfunction or failure of the battery system.

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- Isotropic and anisotropic electrically conductive
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- Tapes available on rolls or as customized high-precision die-cuts
- Easy assembly thanks to reliable and seamless integration into highly automated production processes

Ensuring Safety and Reliability

Safety is paramount in the design and operation of EV batteries.

Functional tapes help enhance safety by providing mechanical stability and integrity to battery modules. Lohmann's adhesive solutions offer robust bonding properties, ensuring that battery cells and other components remain securely in place even under extreme conditions, such as vibrations and impacts. This prevents potential risks associated with loose connections or structural failures, thus ensuring the safety of the vehicle and its occupants.

Additionally, functional tapes aid in the prevention of thermal runaway, a critical concern in battery technology. Lohmann's flame-retardant tape laminations act as a barrier, reducing the risk of thermal propagation within the battery pack.

These tape laminations have been specifically engineered to meet stringent safety standards, providing an added layer of protection against thermal events.

Enhancing Battery Durability

The longevity and durability of EV batteries are key factors in their overall cost-effectiveness and sustainability. Functional tapes contribute to the durability of battery systems by providing protection against environmental factors, such as moisture, dust, and chemicals.

Lohmann's barrier tapes create a reliable seal around battery modules, preventing the ingress of harmful substances and safeguarding the battery's internal components.

This protection enhances the lifespan of the battery by reducing the risk of corrosion and degradation.

Furthermore, functional tapes aid in the prevention of internal short circuits within battery cells. Lohmann offers single- or double-sided PET films for high voltage insulation with high dielectric strength.

Additionally, Lohmann provides single-sided adhesive PET or PI films for the electrical insulation of the busbar.

Enabling Efficient Manufacturing

Efficient manufacturing processes are crucial for the mass production of EV batteries. Functional tapes simplify the assembly of battery modules by providing reliable adhesion and ease of application. Lohmann's tapes offer tailored adhesive properties, allowing for precise bonding of different materials commonly used in battery construction, such as metals, plastics, and composites. This flexibility streamlines the manufacturing process and reduces production time, leading to cost savings for EV manufacturers.

Additionally, functional tapes can enable the miniaturization of battery modules, facilitating the design of lightweight and compact battery packs. Lohmann's thin and flexible tapes contribute to space-saving solutions without compromising performance or safety, thus supporting the development of next-generation EVs.

Functional tapes have emerged as indispensable components in advancing EV batteries and eMobility. Lohmann Functional Tapes provide solutions that enhance battery performance,

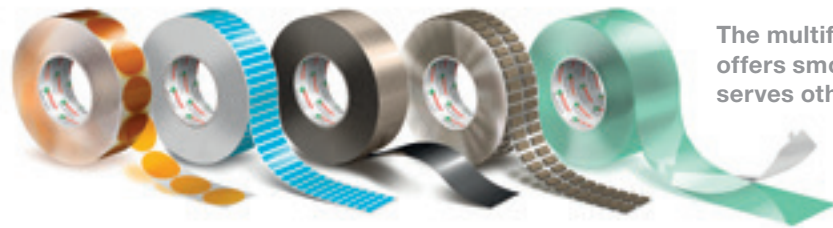
Lohmann's new DuploCOLL TC (Thermally Conductive) range of acrylic transfer tapes provide a thermal conductivity of up to 2 W/mK, tested according to ASTM D 5470. Connected to the cooling or heating element inside the EV battery, the TC tapes help keep the temperature of the lithium-ion cells between 20 and 35 °C by enabling a homogenous heat-transfer.

They also protect reliably against corrosion and abrasive dust, helping to maximize the lifetime of the cells.

The range fulfills the flame-retardant requirements according to UL 94 V-0. For short-term usage the portfolio provides heat resistance up to 180 °C, while enabling a high electrical insulation with a breakdown voltage of up to 26 kV/mm.

The new TC tapes are free of silicones, halogens and solvents and provide immediate adhesion even to irregular surfaces, realizing excellent surface wetting. These thermal interface materials (TIMs) can also compensate component tolerances and seal against dust or moisture.

In contrast to liquid TIMs, the assembly is clean and easy, no additional processing tools or special storage is needed and due to the customizable format of the tapes (die-cuts), there is a high freedom of design.



The multifunctional adhesive tape portfolio by Lohmann offers smooth thermal or electrical management and serves other functions.

ensure safety and reliability, extend battery durability, and enable efficient manufacturing processes.

With their innovative adhesive technologies, Lohmann contributes to the growth and sustainability of the electric vehicle industry. As the world accelerates its transition towards eMobility, functional tapes will continue to play a crucial role in shaping the future of sustainable transportation.

Customized bonding solutions

With the rapid advancements in the EV battery sector and digitalization as well as miniaturization on the rise, high-tech tape manufacturer Lohmann offers customized bonding solutions that do more than just bond.

Their multifunctional materials product range contains adhesive tape solutions that offer functions such as damping, sealing, electrical insulation or conductivity as well as reliable thermal management.

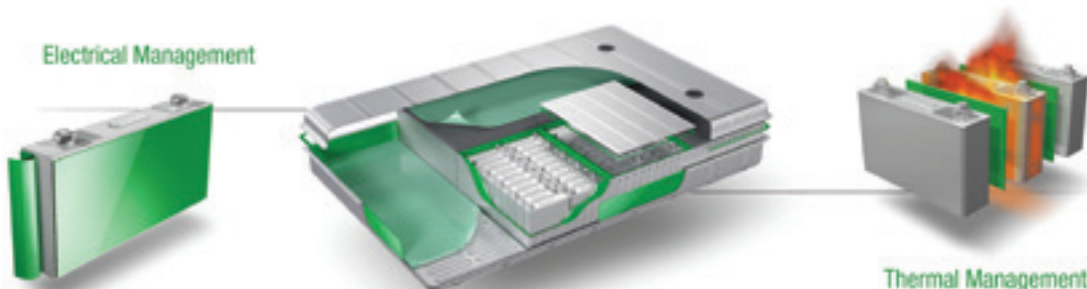
With more than half of electronic malfunctions being caused by thermal overstress, a safe and reliable heat transfer within the EV battery is key.

They also offer several advantages to silicone gap pads besides eliminating the danger of migrating silicone oil: The tapes are tacky at room temperature and therefore no additional fixation is needed during the assembly. As screws or clamps are not necessary, the adhesive tape solutions are a weight-saving alternative.

Lohmann's thermally conductive range is available as rolls or customized high-precision die-cuts in various thicknesses from 140 µm to 2 mm. Different colors are available for better detection by camera or optical sensor systems.

Lohmann's adhesive engineers are on hand to support their partners in the industry through the entire value chain, from the formulation of the adhesive to individual product modification, high-precision die-cutting and process integration.

With a 100 % green power production at the headquarters in Neuwied, Germany, Lohmann offers the advantage of a low-CO₂ European supply chain. **AI**



Multifunctional adhesive tape solutions and high-precision die-cuts for thermal and electrical management of Li-Ion batteries.

innovation



The High-Voltage Coolant Heater (HVCH) technology helps extend range by keeping the battery temperature at an optimal level.

BorgWarner

decision to plug into the EV surge is paying off

By: Ed Richardson

A strategic decision to rapidly grow its portfolio of components for electric and hybrid vehicles is paying off for US-based automotive supplier BorgWarner. The company believes it is on track to achieve approximately US\$4.3 billion of EV revenue by 2025.

BorgWarner reported in its results for the second quarter of 2023 that it expects its eProduct sales for the year to be between \$2.3 billion and \$2.4 billion.

Automotive Industries (AI) spoke to Dr. Paul Farrell, Chief Strategy Officer at BorgWarner and Harry Husted, Chief Technology Officer.

AI: What progress has been made in the eMobility transformation of BorgWarner since

The second element was mergers and acquisitions. Since the launch of the Charging Forward Strategy, we have made incremental acquisitions. Our target was an EV turnover of two billion, and we are at about 1.3. So, we have made good progress in the two years since Charging Forward was originally announced, with a little bit more work to do.

The third element was the disposition of combustion assets. The goal was three to four billion. With the spin-off of PHINIA in July 2023 and the sale of our Water Valley facility in January 2022, we realized three and a half billion. So, the first and the third elements are complete. And we are making good progress on the second element.

AI: Are you moving out of combustion entirely?

Farrell: No. We are not exiting combustion.

It is about balancing our exposure. Combustion, or Foundational products as we refer to them, is a big and important part of our business. For this year, we expect what we refer to as eProducts, which

are products for EVs or products for hybrids that could go into EVs, to account for around 17% of our revenue. Everything else would be Foundational.

AI: What are your updated company goals for Charging Forward 2027?

Farrell: Building on our success with Charging Forward, we recently extended it with Charging Forward 2027, which also has three elements. The first is growth in eProducts. We are

Dr. Paul Farrell, Chief Strategy Officer at BorgWarner.



the Charging Forward strategy was launched in March 2021?

Farrell: We have made a lot of progress. There were three main elements to the strategy. One was organic growth, which was the leveraging of organic development and the acquisitions made prior to the announcement of the Charging Forward Strategy.

Our target was to generate around two and a half billion dollars in organic EV revenue by 2025. At this point, we are at about three billion. So, we feel good about exceeding our original target.

targeting more than \$10 billion in eProduct sales by 2027. The second element pertains to eProduct profitability. We have made significant investments in electrification technology, and they need to generate a return. We are targeting breakeven on eProducts by the end of this year, with a goal of being at approximately 7% adjusted operating income by 2027.

Finally, the third element of Charging Forward 2027 is to maximize the value of our Foundational products by maintaining double-digit margins on these products through 2027.

AI: Which are the main products that will generate this revenue?

Farrell: We expect strong growth across our eProduct portfolio. A few key products driving that growth include inverters, electric motors, high-voltage coolant heaters and battery packs for commercial vehicles. We expect to sell more than 6M inverters in 2027, with estimated sales of approximately \$3.5 billion. Similarly, we expect to sell more than 3M electric motors in 2027, with estimated sales of approximately \$1.3 billion. And in 2027, we expect CV battery pack sales of approximately \$1.3 billion with an additional \$0.6 billion in estimated sales from coolant heaters, where we expect to sell roughly seven million units.

AI: Is there any crossover from your foundational product lines?

Husted: We have a lot of expertise in thermal management in general through our internal combustion portfolio. An example is fans. We have been providing big engine-driven fans for commercial vehicles. Now, the fans are electrically driven.

In the drive train space, we are leveraging traditional products like torque vectoring that plug and play into electric vehicles.

We are also big in transfer cases and have used that knowledge to develop our integrated drive module (iDM), which combines the power electronics, electric motor and mechanical components into a single drive unit.

AI: How are these investments benefiting your auto industry customers?

Farrell: Automotive OEMs have a lot on their plates, with the big transformation happening in their markets. We are here to help them with their transformation. We can deliver best-of-breed components, which include power electronics, electric motors, fully integrated drive modules, thermal management systems, battery packs, as well as other eProducts offerings.

Our broad portfolio means we are able to deliver a suite of solutions based on the needs of our OEM customers.

AI: What about hydrogen fuel cell technology?

Husted: A hydrogen fuel cell system has much of the same propulsion componentry that you find in an electric vehicle, such as inverters, batteries and electric drive units. We are well positioned to support companies developing hydrogen fuel cell power trains.

AI: What new products did you unveil at IAA Mobility?

Farrell: We are using our presence at IAA Mobility to showcase our eProduct portfolio. New product introductions include eCoolers, high voltage air heaters and a high voltage box.

Husted: What is important about the high voltage box is that it is a compact all-in-one power electronics unit that combines multiple power electronics components into the same package. It will help save space and cost across a range of electrified vehicles. This meets a need for smaller packaging through the combination of the on-board charger and DC/DC converter into a single unit.

The nice thing about the high voltage air heater is that it is quick to create heat in cold weather situations where you want to get heat to the windshield and passengers quickly. You are taking battery energy and turning it directly into heated air without going through a liquid loop, which adds time.

AI: How does it work?

Husted: It has small positive temperature coefficient stones that heat up when you run an electrical current through them. A heat exchanger touching those

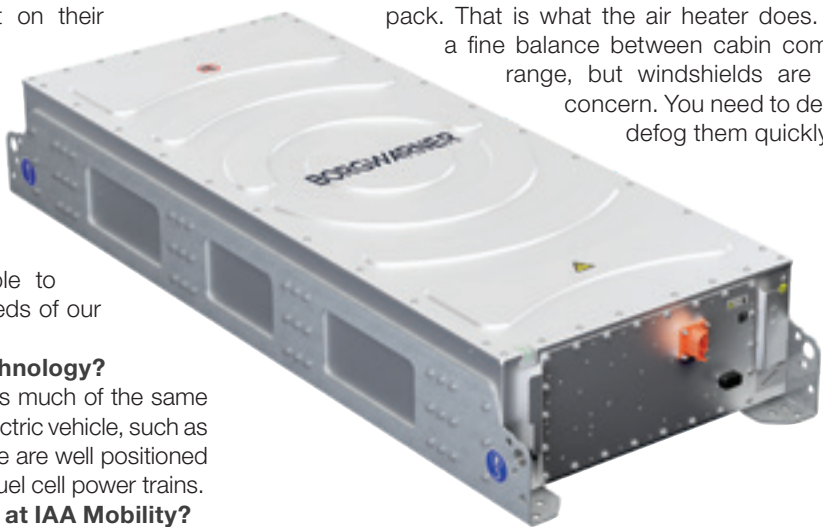


Harry Husted, Chief Technology Officer at BorgWarner.

elements warms up the air blowing through it, so you go from battery energy to heat very quickly and efficiently, which is important in a very cold environment where you need to heat the cabin and windshield as fast as possible. Another advantage is that you help warm up the battery when you start pulling current from it.

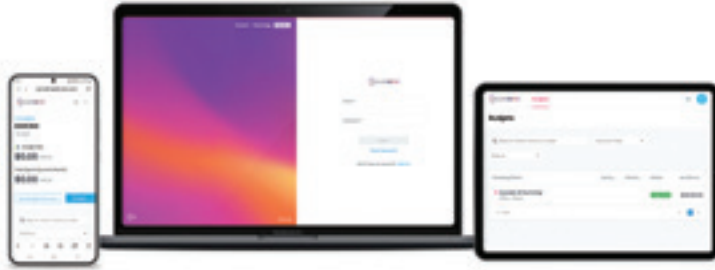
AI: What makes heat such an issue in EVs?

Husted: The internal combustion engine produces significant waste heat, which means that you have as much hot coolant as you want to warm the air. Because they are so efficient, EV drivetrains do not produce as much waste heat. For that, you need to pull some energy out of the battery pack. That is what the air heater does. There is a fine balance between cabin comfort and range, but windshields are a safety concern. You need to defrost and defog them quickly. **AI**



The ultra-high BorgWarner energy battery system AKM CYC uses the new cylindrical cell battery modules with very high energy density.

innovation



All-in-one dealer marketing software packages can be used on any device.

Dealer marketing powered by AI

By: Ed Richardson

Artificial intelligence (AI) is using digital marketing channels and activities to boost the traditional dealer marketing mix.

Founded in 2007, when online and social media promotion were still in their infancy, automotive specialist marketing agency DOM360 has years of experience in using AI to fine tune a combination of traditional advertising with digital merchandising, social media and digital marketing.

This expertise is being made available more widely through a dealer-focused suite of software called Dealerverse™.

Automotive Industries (AI) asked Robert Donovan, Dealerverse™ founder, what have been the biggest changes in dealer marketing over the past 15 years.

Donovan: The composition of the advertising budget was focused on radio, TV and print. In the United States, the recession of 2008 changed all that. We went from having around 70-80% of the budget being traditional to 70-80% being spent on digital.

Robert Donovan,
Dealerverse™ founder



One of the reasons was we were trying to calculate return on investment. Digital marketing companies were able to provide data, such as the number of clicks on a website. Technology enabled us to measure the number of leads the clicks generated.

AI: What sparked the introduction of Dealerverse™?

Donovan: We created Dealerverse™ based on our internal agency experience of nearly two decades where DOM360 delivered significant results. We are excited to share Dealerverse™ with OEMs, internal dealer marketing departments, franchisees, and other digital marketing agencies in order to meet the ever-growing needs of our clients for greater speed and quality.

AI: Where do marketing and sales meet?

Donovan: One of the dramatic changes is the involvement of marketing in the dealer's internal processes, such as customer relationship management. We can help the dealer institute an appropriate work plan and make decisions based on data. On

the service side, we have access to information such as when a car needs an oil change or service.

AI: How are you using artificial intelligence to boost sales?

Donovan: We have taken our dealer data, anonymized it and captured it in our databases for the past 10 years. This huge store of data is the cornerstone of artificial intelligence.

AI will help you analyze the impact of different ads and which platforms are best for a particular message or approach. The data helps the client to manage their business better. We can tell them how much has been spent on marketing a particular car, and whether spending more on advertising is going to move it.

Advertising spend is also more tightly controlled. We used to budget pretty rigidly for each platform. We are having better success by taking the digital budget and focusing on the medium that is working at that particular time. This changes as the wind blows.

AI: What should dealers be doing to get the best return on advertising?

Donovan: Creative marketing is not two dimensional anymore. Select vendor partners for their strengths. A digital marketing company is not necessary a great website provider and vice-versa.

AI: How do you measure the impact?

Donovan: The essence of digital marketing is being able to build a better mousetrap than the guy down the street. It starts with unique visitors. Then we go to leads, unique form submissions and phone calls. At the dealer CRM level, it gets into appointments where the customer shows.

It goes all the way into the metrics such as whether the customer had a test drive, were they introduced to the manager, did the dealer have the right vehicle, and then the sale. If you manage those key performance indicators, then you can dissect and find out which part of the process is not working at any given time. Dealers can also measure themselves against industry standards.

AI: Do you help dealers work more closely with OEM principles?

Donovan: Most dealers underutilize the fantastic amount of demographic and registration data that OEMs subscribe to. This information allows dealers to go down to individual zip codes and determine what is selling and how their models are doing compared to the opposition. **AI**

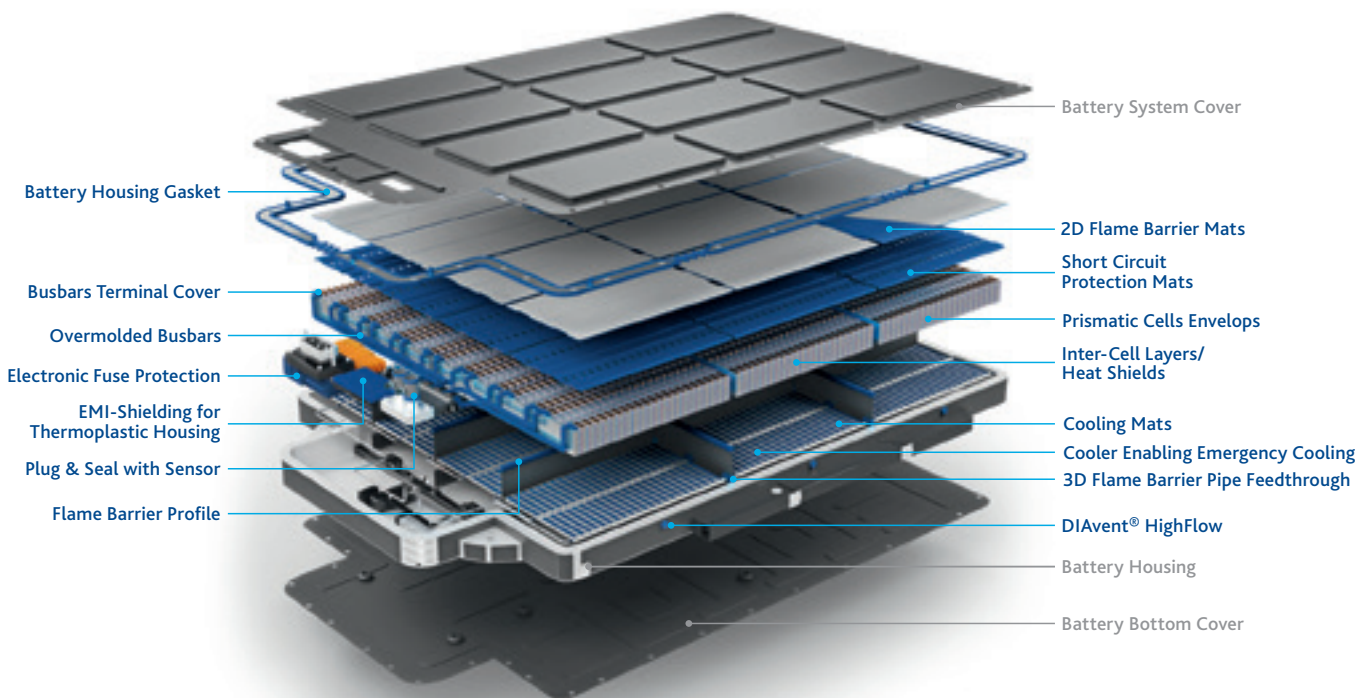


FUTURE OF BATTERY SAFETY

Discover a New Generation of Battery Sealing Materials

Freudenberg Sealing Technologies engineers have developed a pioneering new generation of materials and products to provide safety functionality like thermal insulation or venting gas resistance to protect battery systems in case of malfunction. Our revolutionary products include customized flame barrier mats, flame barrier profiles, three-dimensional flame barrier form parts and busbars with customized protective layers. Our inter-cell layers integrate thermal propagation protection as well as defined cell compression over product lifetime. Finally, the DIAvent® HighFlow is our combined product for pressure regulation and overpressure release.

Explore more



Automechanika Shanghai to be staged at end of year

By: Clinton Wright

The motor industry will be able to take stock of developments and trends during 2023 and projections for the future at Automechanika Shanghai 2023.

Staged from 29 November to 2 December, it will focus on Innovation4Mobility to highlight rapidly evolving areas of the supply chain.

Automotive Industries (AI) asked Fiona Chiew, the General Manager of the organizers Messe Frankfurt, to mention some of the highlights of Automechanika Shanghai 2023.

Chiew: With so much change unravelling across the industry, it is very important that players from around the world have a platform to evaluate performance in 2023 and talk about future plans.

This year we are delighted to host an expected 4,800 exhibitors, with the floor space reserved by companies from 34 countries and regions like Australia, Brazil, Belgium, Canada, China, France, Germany, Hong Kong, Italy, Japan, Malaysia,

across the spaces aim to help foster meaningful business exchanges between exhibitors and prospective buyers.

AI: Where do you see opportunities in the Chinese market for Tier 1 suppliers?

Chiew: From China's hyper-sized consumer pool, the demand for car ownership remains strong, with a forecast of 27.6 million new vehicle sales in 2023, up 3% from the previous year.

The Government is placing a lot of emphasis on incentivizing car purchases, especially new energy vehicles. Of the total sales calculation, new energy vehicles should exceed the nine million mark, a growth of 35%.

In addition, exports in the sector are expected to increase by approximately 17% to 800,000 units.

Therefore, the general demand, advancements in technology, and introduction of new energy vehicles have led to a new set of deliverables that carmakers and OEMs look for, particularly when it comes to innovation in products and processes. This, in turn, creates both challenges and opportunities for Tier 1 suppliers.

AI: What advice do you have for exhibitors and attendees from outside China to ensure a fruitful visit?

Chiew: Planning your trade fair experience is critical for gaining the best results.

We have several channels available for exhibitors to increase their overall presence at the show.

I suggest participating in our Innovation4Mobility Showcase and fringe events.

The conferences and seminars are bilingual, so it is an excellent opportunity to become a speaker or sponsor and share information about trends and market solutions, extending brand visibility beyond the booth.

Companies can also utilize the show's online and digital resources and connections with our trusted trade and mass media partners to engage with a broader audience.

We also make your networking at Automechanika Shanghai easy and efficient! I highly encourage both buyers and suppliers to sign up for Match Up (business matching program).

In addition, we recommend that buyers join our dedicated Buyers Group Program, Premium Buyers Club or Auto Tech Club for exclusive onsite benefits.

We are arranging a number of factory visits to car manufacturers and industrial automotive parks in the lead-up to the show.

Participants can better understand the advantages each manufacturing hub in China brings to the supply chain.

During these activities, manufacturers will share insights on new energy vehicle development and solutions for autonomous driving, creating more opportunities to share knowledge about trends that heavily influence automotive transformation. **AI**

Fiona Chiew, the General Manager of the organizers Messe Frankfurt



Singapore, South Africa, South Korea, Taiwan, Türkiye, the UK, and the US.

I am looking forward to seeing leading brands like AUTOBACS, Bilstein, BorgWarner, Bosch, Brembo, Corgi, Doublestar, EAE, FAWER, Haige, Jekun Auto, Launch, Lecho, Liqui Moly, Mahle, MAXIMA, QUANXING, SATA, Sogreat, SPARKTRONIC, Tech, TMD Friction, Tuopu, VIE, Wanxiang, YAKIMA, ZF, ZTE, and Zynp Group at the fairground.

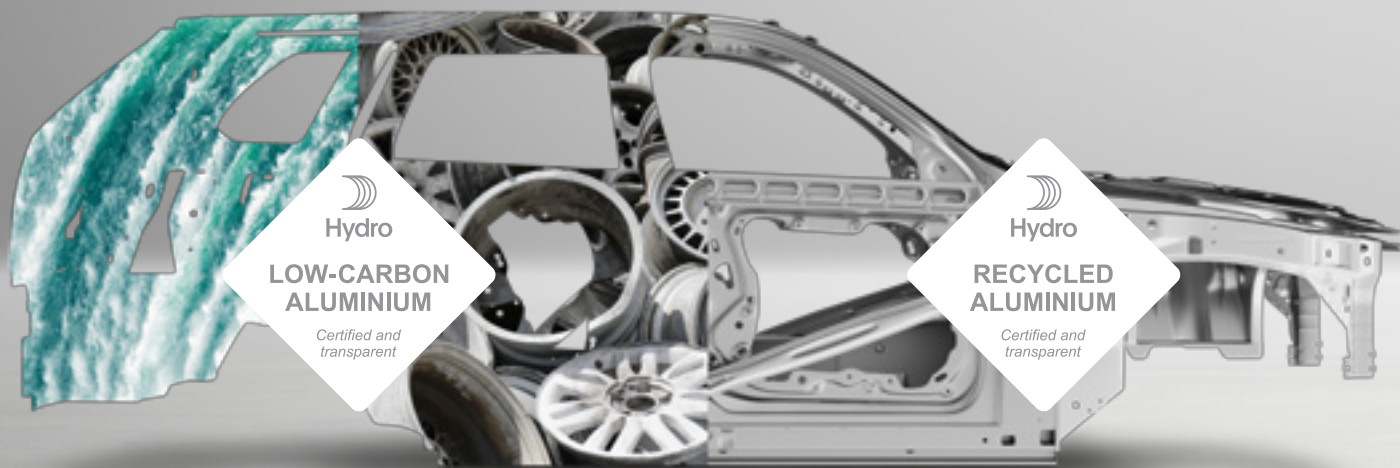
AI: Please tell us a bit more about Innovation4Mobility.

Chiew: The concept Innovation4Mobility originates from the Automechanika brand's flagship show in Frankfurt. We are repackaging it in a way that speaks to the Chinese market.

For instance, through our Innovation4Mobility Showcase, the Future Mobility Area will give prominence to rising business opportunities developing from new energy vehicles and connectivity.

The Customizing x Tech Area will spotlight trends in the customizing market with a collection of customized cars, car wrapping, accessories, infotainment, lighting, and products for driving activities like car camping.

The revamped Innovation4Mobility Mainstage and Green Repair Area returns to complete the Showcase. Integrated facilities for product displays, start-ups, forums and networking



Every step matters on the path to zero



Light, durable and crash-resistant, aluminium has long been a material of choice in the automotive industry. With increasingly strict emissions regulations and consumers demanding more sustainable options, the choice of materials must be based on more than just function, but on embedded emissions throughout the entire lifecycle.

With our low-carbon aluminium, we use renewable energy and recycled scrap to lower build phase emissions. Couple that with aluminium's infinite recyclability and lightweight for lower use phase

emissions, greener aluminium can help you remain competitive in a market governed by global climate concern.

Our greener aluminium products all come with a verified certificate detailing the environmental footprint – a transparent and easy way of reporting.

Visit hydro.com/path-to-zero to see how greener aluminium can help you reach your sustainability goals without compromising on safety and design.



Industries that matter

innovation

SPECFLEX C creates a more sustainable ride, while maintaining the same quality performance.

Material science innovation to meet changing needs of auto industry

By: Nick Palmen

With the growing shift to electrification in the mobility and transportation industry, automotive OEMs are faced with the challenge of developing new solutions for greater reliability, safety, and performance.

Vehicles need to be sustainable, safer, more connected, autonomous, electric, and profitable.

New materials are needed to meet performance requirements and increasingly stringent global sustainability regulations, as well as consumer expectations.

Buyers expect their vehicles to be more comfortable, more satisfying, and safer.

To meet the need for new engineered materials, Dow created MobilityScience™ in 2020.

Jon Penrice, President of Dow Mobility



Automotive Industries (AI) asked Jon Penrice, President of Dow Mobility, what the objective was of the establishment of MobilityScience™.

Penrice: I think the first point to make is Dow has been in the automotive industry for a long time. We understood that the industry was going through the kind of change that happens once in a generation, or once in 100 years. In 2020 it created an enormous opportunity, where the whole industry was talking about material science and solutions with an openness that we hadn't seen for a very long time.

What we identified was that Dow, with our huge variety of technologies with chemistry sets ranging from silicones to polyurethanes, to plastics to acrylics, was sub optimizing the offering to our customers by going to market as product silos.

Customers were looking for solutions, not products. We brought our technology together on the MobilityScience™ platform to create a one-stop-shop for the automotive industry.

The focus is on application rather than products.

AI: What about complexity in vehicle design?

Penrice: What is interesting about the transition to electric mobility is that there's been a complete redesign of materials thinking.

There has been a redesign of multiple functions. An example would be the challenge of managing heat moves from the engine to the battery. That has implications for fire safety.

Or, if you want to extend the range of a car, you increase the size of the battery. But then you're carrying around dead weight, so lightweighting has become an opportunity to replace metal components with plastic using our ENGAGE™ polyolefin elastomer range.

Another example is that an electric car does not have the white noise of the engine, and therefore the demand for acoustic materials has shot up. So, we see a huge growth in our BETAFOAM™ acoustic technologies.

Energy efficiency has become one of the biggest material science needs. There is demand for improved heat management to encapsulate electronics with thermally conductive materials.

The materials must be sustainable because the overall objective of the switch to electric vehicles is low carbon mobility.

So, we are providing a new set of tools and the materials the industry is looking for.

AI: How are you plugging into the circular economy?

Penrice: Circularity is one of the biggest challenges. It is being driven by regulation.

The EU end-of-life directive that's going through the processes now in Brussels will impose strict regulations and drive demand for circularity.

Typically, if you're going to go circular, you will recycle. But the auto industry requires very high-quality standards from high performance materials.

So, we are developing what we call advanced recycling, where we give the molecule a second life without compromising on the performance. This means starting back at the building block stage.

AI: Dow has been the official Jaguar TCS Racing material science partner since 2021. How well is the track working as a real-world test bed?

Penrice: The value is speed. We have what we call a race to road strategy. Developing innovation in a very high-pressure environment like a racing car enables you to do multiple iterations with a partner who really wants to get that fraction of a second advantage.

So, they're very open to new technology. We are collaborating extremely closely to find those small points of difference. The technologies that make a small difference to a racing car can be translated into a much wider road application.

AI: In what areas can you make the biggest difference for sustainability?

Penrice: It starts with the carbon footprint of a car. OEMs focus on carbon emissions during manufacture and use. As a material science leader, Dow can help enable not just electric vehicle production but also reduce the embedded carbon used to make those materials.

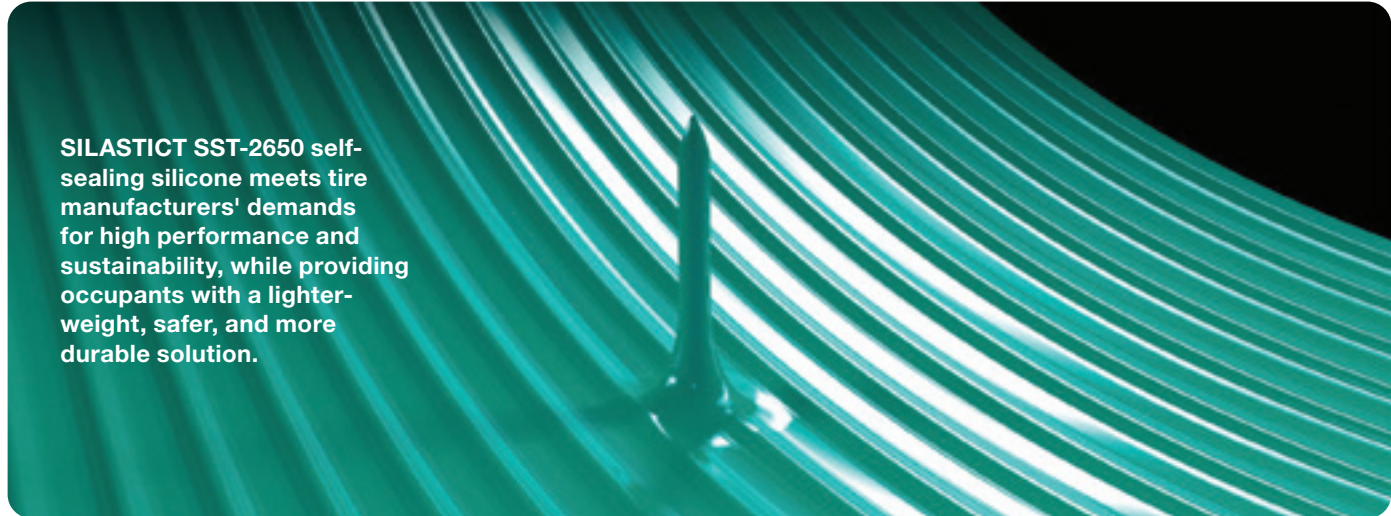
An example is the first net carbon zero ethylene cracker, which will be built at Fort Saskatchewan, Canada. It will decarbonize approximately 20% of Dow's global ethylene capacity, while growing our global polyethylene supply by about 15%. We will be able to pass this carbon advantage on to our customers.

AI: Do you work with partners to create automotive circular material solutions?

Penrice: A good example is our self-sealing technology called SILASTIC™. We have partnered with Bridgestone tires to develop a material that at the end of end of life can be peeled away from the inside of the tire and recycled. We have another partnership in the seating industry where waste is converted into first grade car seating materials. Thanks to this partnership, we created circular polyurethane solutions produced using a mass balance approach.

AI: What is next for Dow?

Penrice: We have set ourselves the goal to become net carbon zero by 2050. To achieve that goal, we have multiple investments and multiple technologies. This includes new lower carbon production technologies as well as lower carbon energy sources including renewable energy and a partnership to develop



SILASTIC SST-2650 self-sealing silicone meets tire manufacturers' demands for high performance and sustainability, while providing occupants with a lighter-weight, safer, and more durable solution.

If you make an inverter more efficient through better thermal management, that translates into speed for a racing car, but to you and me, it would be extended range.

Plus, the brand association with Formula E is very powerful. As a sport, it has been net carbon zero from day one. And that fits very well with Dow's ambition to become net carbon zero.

AI: Is there a crossover with other Dow technologies?

Penrice: It is very clear to us that to enable a circular economy you need multiple solutions, particularly in the area of disassembly. So, we're looking to transfer our technologies from other markets, such the mattress industry where Dow's RENUVA technology takes end-of-life mattresses and converts them into polyurethane materials that can be made into new mattresses. If you can do it for mattresses, why can't you do it for car seats?

small modular nuclear reactors.

We are also just at the beginning of the circularity journey. Very little of what the automotive industry uses consists of circular materials. We see that growing to meet regulatory targets, which I think is going to be 25%.

Today, I would say it is probably less than 1% for the industry. So, we want to be a leader in bringing circular solutions to the industry.

Internally, it's important to find new ways to engage your employees and make them feel proud to work for your company. Fortunately for us, everybody wants to be part of our MobilityScience™ team because it's a visible way for our people to work on something that aligns with their personal values.

It is tremendously exciting for our employees to go home and tell their families that they're working on something that people can relate to and that makes a difference. **AI**

Top to bottom – Webasto integrating battery and glazing design

By: Nick Palmen.

Sunroofs have evolved from simple glass panels to innovative surfaces offering different driving experiences using adjustable glazing and will, in future, house modules such as LiDAR and cameras.

Automotive Industries (AI) found out more about these advances at IAA 2023 where we spoke to Webasto Chief Technology Officer Marcel Bartling and Jan Henning Mehlfeldt, who is responsible for the global roof business.

AI: What are the applications for high-tech glass?

Mehlfeldt: What we see is that the design language of cars is changing – clean lines and large glass surfaces characterize the exterior of vehicles more and more. This creates a great opportunity for us as roof specialists to offer

But our latest innovations, which we presented at the IAA, create a cool new driving experience which is visible for everyone.

AI: How do you integrate technology directly into the glass panels to create that experience?

Mehlfeldt: Our goal is to provide a combination of functionalities, for example, protection from the sun's radiation

Webasto Chief Technology Officer Marcel Bartling (left) and Jan Henning Mehlfeldt, who is responsible for the global roof business.



ambient light, switchable glazing, and solar cells integrated in the roof.

These features are what we term “high-tech glass”.

Some innovations are still in the development phase at our glass competence center in Luxembourg and at our headquarters in Stockdorf.

Up to now the consumer may not have been aware of our roof innovations - lighter and thinner glass is not visible to everyone at first sight.

and amazing light features.

When it comes to autonomous driving, the interior will be even more important.

Occupants will want the option of being able to dim the interior to watch a movie, or to sit back and enjoy the ambience. We see ourselves as the integrator of this option into the car.

AI: What sunroof innovations and visual solutions did you showcase at IAA Mobility 2023?

Mehlfeldt: We showcased the latest glazing technology which is moving from high-end premium cars to serial production.

Also on display was our biggest openable roof panel with integrated solar cells.

There are other solar systems on the market, but they work on a closed roof. We add the enjoyment of fresh air to the driving experience.

AI: What roof solutions do you offer for autonomous driving?

Mehlfeldt: The first challenge for car makers is the integration of hardware into a car using their software. Sensor suppliers mainly focus on the component.

We are bridging the gap by incorporating the full range of sensors – radar, LiDAR and cameras in a very good looking exterior. If the design is not appealing, people won't buy the vehicle.

We believe the roof is the best place for sensor integration because it is protected from collision damage and road dirt and offers a 360-degree view.

To this we are adding the functionality sensor availability like heating, cooling, de-icing and thermal management.

AI: How does the new prototype roof sensor module work in an openable panoramic roof?

Mehlfeldt: If you look at the prototype cars currently driving on the road, you see that there is often a big tower of sensors which does not look nice and is not what people want to drive around with permanently.

Our innovation and our competency is to integrate the sensors in an elegant way for autonomous levels two plus, three and even four, which includes robo taxis and passenger cars.

We can combine all this technology into a sunroof.

AI: Are you becoming an electronics company?

Bartling: We are saying our future is in roof and electrification, which makes thermal solutions and batteries our second core business. That is why we are at IAA. The design of the roof is strongly influenced by the way the battery pack is integrated into the vehicle architecture.

We are one of the only companies with the competencies to provide the right solutions for the car architecture at the very early design stage. As with batteries, the glazing must ensure the safety of the occupants while being more energy efficient and enhancing the driving experience.

AI: Can roofs provide differentiation between models?

Mehlfeldt: We can already provide individualized solutions to meet different customer requirements in terms of light dynamics. Indian taste is different from the Chinese taste or the American taste.

Beyond sunroofs, we provide lightweight roof panels for convertibles, which can be individualized through their configuration.

So, individualization is provided in terms of both technology and features. For consumers, technology always appeals.

AI: What battery solutions do you provide for passenger cars and commercial vehicles?

Bartling: Our battery business, which we entered in 2017, rests on two main pillars. One is individualized solutions for our automotive customers, where at a very early stage we are given the requirements of the OEM. This segment of our business is growing.

The second pillar is a modular approach using what we call our standard battery. They can be easily integrated into commercial vehicles. It is a "plug and play" solution.

AI: How important is it that car manufacturers use a single supplier for the full sequence from design to manufacturing?

Bartling: It is very important, given the relationship between the design of the battery and the roof and their integration into the vehicle architecture.

Mehlfeldt: The solutions which we are developing, be they high tech glass or a battery system, are much more than just a component.

Their integration into the vehicle design is the key challenge.

When it was just a piece of glass, it was easy to glue it into a car as a windshield.

But now we are adding elements such as sensors and switchable glazing. If you combine all these features and add the complexity of a sunroof, then the OEM will need a single supplier with the competency to provide the solution.

In the future we may therefore become system suppliers. We understand the technology and we are able to produce just in time or just in sequence.

This is important for the new entrants into the automotive industry which may not have the deep knowledge required to integrate and build the complex battery and roof systems.

Tier 1 suppliers like Webasto can enable them to be successful.

Bartling: We believe our customers value this logic of a one stop shop because we can interact at a very early design stage.

As a global company we can provide local support in Germany, Korea, China, the United States and Mexico.

This is a big advantage when it comes to handling big battery packs and when it comes to meeting the new requirements around CO₂-neutral logistics and nearshoring.



Webasto sunroof in closed position.

AI: What is next for Webasto?

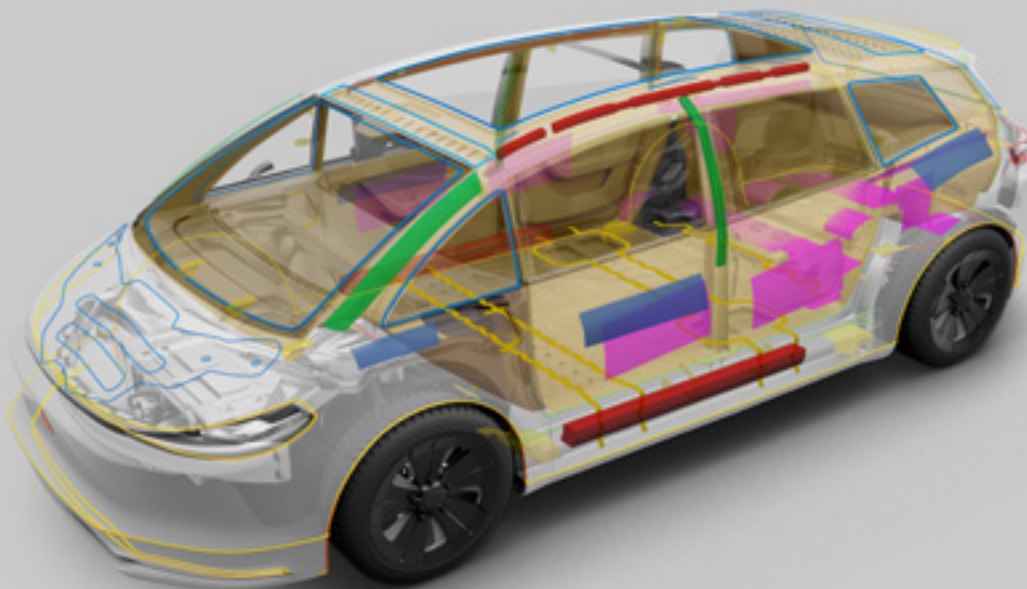
Mehlfeldt: The whole company is focused on innovation to produce sustainable products. Sustainability is something which we are now translating into our product roadmap.

Therefore, we are developing low-emission products, such as the solar roof.

There will be similar innovations in our battery systems and all our other products. They will be made using sustainable resources.

Bartling: At IAA Mobility, we showed a "greener battery". An exhibit made of wood and recycled materials. Of course, this is not intended for actual use in vehicles in this form.

But it highlights Webasto's objective of responsibly using sustainable raw materials in our products to facilitate recycling, among other things. **AI**



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