

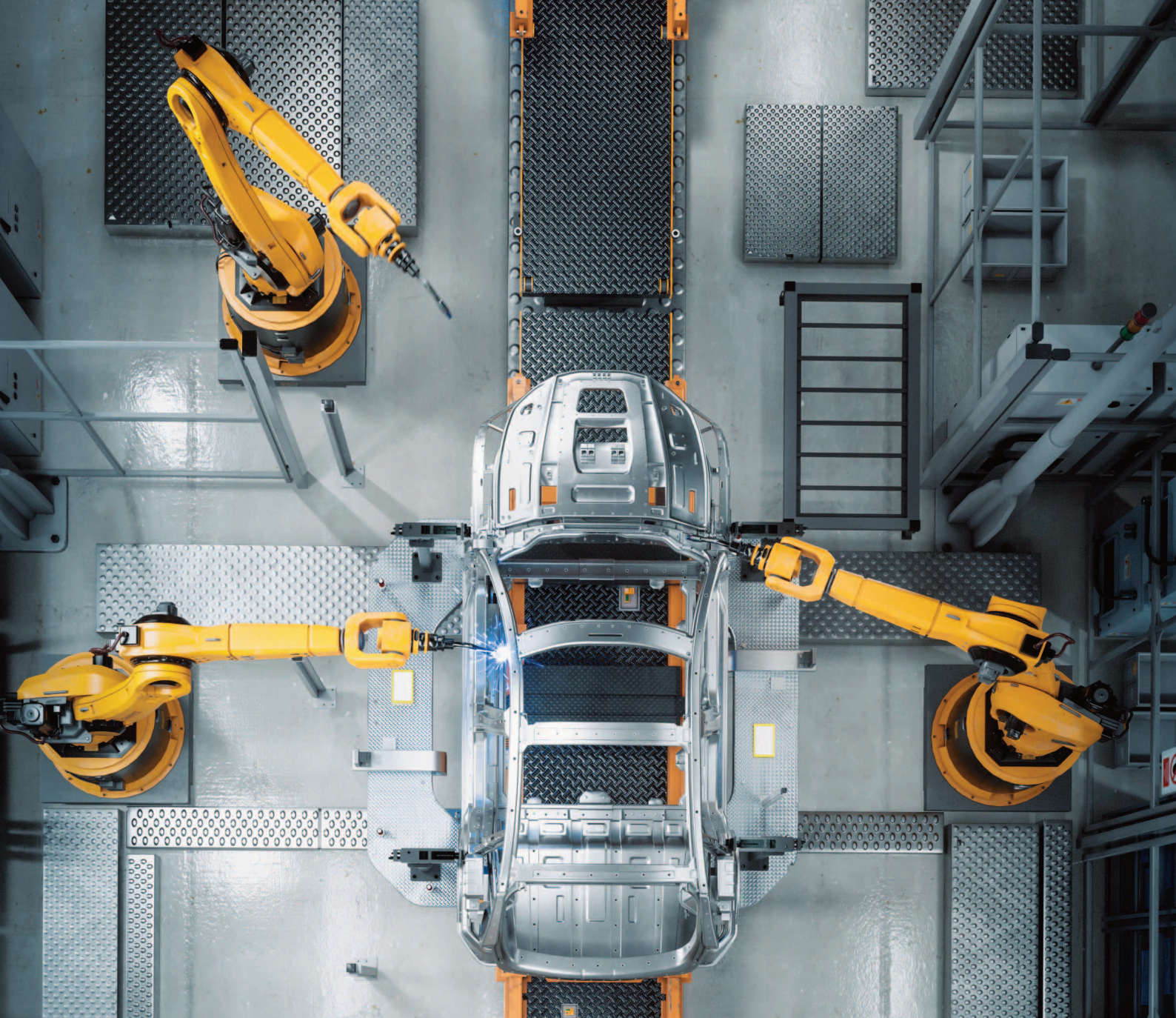
# Automotive World MAGAZINE

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**Are smaller EVs the key to  
sustainable e-mobility?**



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**Lamborghini** readies for an electric future | **Cupra** targets US launch |  
**Volvo** forges zero-emission path for buses



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# Are smaller EVs the key to sustainable e-mobility?

Research from T&E finds that reducing car and battery size is the most effective way to cut critical metal demand.

By Megan Lampinen

**E**lectric vehicles (EVs) have attracted considerable attention for their zero tailpipe emissions, but simultaneously raise concerns about the environmental impact of their supply chain. These models rely on critical metals such as copper, nickel and lithium, the extraction of which has been linked to various environmental and social concerns. Along with the problems around child labour and inhumane working conditions that have long plagued the mining sector, extraction processes can cause deforestation and damage to local biodiversity. One of the biggest concerns is around water pollution from toxic waste disposal or waste dams sliding and polluting the wider ecosystem.

But that's not to say that the supply chain cancels out the benefits of e-mobility. "It's important to stress that the lifecycle emissions of electric cars, including the entire supply chain, is already more than three times better than diesel or gasoline cars," says Julia Poliscanova, Manager, Clean Vehicles and E-mobility, at Transport & Environment (T&E). She concedes that EVs are not possible without these critical metals but points out that in the same way "combustion cars are not possible without copper or oil extraction." She emphasises that the wider extractive industry—be it for oil, gas or lithium—suffers from similar environmental and social concerns. These alone should not hold back EV adoption.

"Moving to electric has large climate benefits beyond doubt," she concludes. Just how substantial those benefits are could hinge on future demand for battery raw materials.



Lithium mining

## Future market scenarios

T&E has modelled three scenarios for Europe's demand of battery raw materials between 2023 and 2050. The outlook covers lithium, nickel, cobalt and manganese, and the scenarios range from 'Business as Usual' (BaU) to 'Accelerated Innovation and Few Car km' to 'Aggressive Innovation and Fewer Car Km'. All the scenarios assume full electrification of passenger transport by 2050 but take different approaches to battery chemistries as well as the size and number of private cars. Depending on the specific scenario, Europe's cumulative battery demand by 2050 is forecast to be 100 to 200 times higher than in 2022, requiring up to 20 Mt of battery metals. That compares to 170 Mtoe oil consumption in 2022.

“Today, in Europe, we are heading towards the BaU scenario, no doubt,” Poliscanova tells *Automotive World*. While each of the three scenarios assumes growing demand for battery metals, T&E predicts that it can be nearly halved with innovative technology and car use policy. “The point is that everyone does not need to drive an SUV. We can perfectly ensure the same level of mobility but at a lesser cost.” She points out that policies to address “the SUV-isation of the fleet” are lacking, and that many city policies to limit private car usage are being delayed or questioned. “However, with a very reasonable set of policy measures, we can easily go towards the Accelerated scenario, which we consider not just desirable but very feasible.”

“

Moving to electric has large climate benefits beyond doubt

While the BaU scenario assumes the currently expected industry trends on battery size and chemistry, along with the status quo private car activity, Accelerated assumes a substantial shift to smaller batteries,

A move away from SUVs could make a big difference in the EV supply chain





Mini Cooper electric

© BMW Group

a faster uptake of battery chemistries with less critical metals, and fewer km driven by private cars. But some of these targets are easier to achieve than others. “Both innovative chemistries and moving towards smaller cars and smaller batteries are low hanging fruit,” Poliscanova suggests. “Smaller batteries are the single factor that brings the largest reductions in the demand for battery raw materials,”

which T&E estimates at between one-fifth and one-quarter. This equates to avoiding more than 70 new lithium mines and more than 50 nickel ones.

T&E is also advocating government action on the tax front. “Using tax policies to steer sales towards smaller electric cars is a no brainer,” she asserts. “It makes electric cars affordable, reduces Europe’s resource consumption, and is key to the global competitiveness of our automotive industry, as many people in the world are in the market for affordable entry-level models.”

## How will the industry respond?

The T&E report concludes that electrification of passenger transport will be essential for climate goals but emphasises that it need not “break the planet”. The key is to ensure the metals required are responsibly sourced and recovered from old products where possible, in conjunction with new measures to downsize the car fleet and change the way people move. “If we are serious about not repeating the mistakes of insatiable oil dependency, then resource efficiency has to play a big role,” says Poliscanova. “In a supply constrained world, smaller electric cars are not just an environmental must but a sound economic and industrial policy.”

But a change in fleet mix towards smaller cars could take a bite out of automaker profits. Upcoming research from T&E may shed more light on this development. “Car prices in Europe have increased





Fiat 600e

© Stellantis

well above inflation, and carmakers' profits have increased substantially in the last few years as they shifted to selling larger premium models," she observes. "We will soon be releasing analysis to show that small electric cars can deliver sufficient profit markets in the mid-2020s. But the question is: what is a reasonable return on investment, and what is pure greed?"

As for the expected BaU scenario, Poliscanova suggests this need not be taken as any sort of industry failure: "BaU does not mean we undermine Europe's sustainability goals or that the electric car adoption will be unsustainable. It just means that we will have to extract more metals—the supply of which we do not have—than necessary. Whether or not this goes against our sustainability goals depends on the standards and

regulations we have in place to ensure mining is done responsibly." Here she points specifically to the Critical Raw Materials Act. Proposed by the European Commission in March 2023, the Act outlines actions to ensure the region's access to a secure, diversified, affordable, and sustainable supply of critical raw materials.

This particular T&E report looks specifically at Europe, but its broad conclusions also apply to other major markets today. "Shifting to smaller cars—which are also more affordable and can speed up the EV transition—and deploying resource-light chemistries such as sodium-ion, along with moving more people into public transit and shared mobility, are no brainers globally and offer a playbook for the world to reduce its reliance on mining," Poliscanova concludes.

# ‘Digital first’: the secret of Mercedes’ new production era

What can the automotive industry learn from Mercedes-Benz’s decision to place digital at the heart of its new manufacturing strategy?  
By Will Girling



Images © Mercedes-Benz

**A**s the shift from internal combustion engines (ICE) to electric vehicles (EVs) continues, automotive manufacturing is undergoing a transformation. As well as a new powertrain, automakers are integrating cars with software and exploring connected vehicles’ capacity to unlock additional revenue streams. At such a highly experimental time, the use of digital technology in factories has never been more essential.

But what will underpin the industry’s ongoing push to digitalise production networks as it prepares for a future shaped by electrification and software-defined vehicles? At a September 2023 virtual press event, Mercedes-Benz shared insight into its own vision for the next phase of automotive manufacturing.

## Digital first

Mercedes’ ‘digital first’ approach to production had led to experimentation with

and application of several cutting-edge technologies in its factories.

Artificial intelligence (AI) is emerging as a multi-faceted efficiency tool. In the paint shop of its Rastatt, Germany plant, the company uses AI to monitor sub-processes and achieve energy efficiency gains of more than 20% during the painting process. The automaker has also been trialling the use of generative AI platform ChatGPT since May 2023, with applications ranging from a digital contact point for



employees to automated analysis and simplification of complex production data.

MB.OS, the Mercedes operating system first exhibited in the Vision EQXX concept vehicle (January 2022), will also be introduced in its factories and become standard in its next-generation cars. This addition will allow vehicles fresh off the assembly line to be equipped with the latest versions of necessary software. Updates will be performed in a cyclically timed and comprehensive

package, rather than fragments, which the company claims is ten times faster than before.

## A world of digital twins

Despite the importance of AI and MB.OS, digital twin is arguably the most pivotal technology in Mercedes' new manufacturing paradigm. According to Chief Information Officer Jan Brecht, the company is striving to create a "world of digital twins".

To date, the automaker has deployed digital twins of varying complexity for its facilities in Rastatt; Kecskemét, Hungary; and Beijing, China. By inputting data on the geometric properties, surfaces, textures, software features, and kinematic features of a vehicle into a digital twin, the automaker has been able to conduct accurate testing that reduces the time and cost spent on real-world trials. Its new idea is to apply the same principle to production facilities themselves.



Mercedes uses granular data from its factories' manufacturing and production processes to create a "world" of digital twins

To achieve this, the automaker partnered with Nvidia to use its Omniverse platform—a collaborative, cloud-based digital space also gaining traction with [other major players](#) in the industry. “We can simulate all of the behaviours in our world—from fluid dynamics to rigid bodies and more,” said Rev Lebedian, Vice President of Omniverse and simulation technology at Nvidia. This opens up some exciting opportunities for Mercedes. Brecht suggested: “What if a manufacturing location could autonomously configure itself around the digital twin of a vehicle and then be tried and tested digitally before we broke ground for construction?”

## A software problem

Through the partnership, Mercedes is able to simulate light, matter, sensory perception, laws of physics, and even behavioural intelligence within its factories—a highly granular level of simulation. Nvidia is subsequently collecting data on vehicle components, manufacturing equipment, and buildings in order to enrich its digital twins. The company claims it is possible to simulate the precise opening physics of a car’s hood to determine where equipment should be positioned to avoid damage as the vehicle progresses down the assembly line. Using

Omniverse, the digital construction of a factory becomes, in Lebedian’s words, “a software problem”.

He informed *Automotive World* that every atom could be simulated if the data was available, although that level of fidelity would be unnecessary. Although the simulation is powerful, it is still only being used to test specific factors. Determining the ergonomics of how factory workers interact with the product line, for example, could require collision data and object kinematics but not the fluid dynamics of air.

A virtual tour of the assembly hall of Mercedes’ Kecskemét factory—the first to have its

entire facility represented in digital twin—demonstrated the extent of Omniverse’s capabilities. Shown within the simulation was an entire roof assembly robot station, dynamic vehicle models on an assembly line that could be manipulated by the user, and a team of virtual workers in the process of unmounting doors in real-time.

Crucially, this digital world will also be made available to the automaker’s partners and equipment suppliers, making physical visits to a planned site unnecessary. This means that alterations can not only be made faster, but simulation also mitigates the complex safety considerations that changes would require to be trialled in the real world. “That leads to much faster iterations and a shorter ramp-up time. Co-ordination efforts can be reduced by 50%,” claimed Brecht.

## A new production era

The importance of digital twin as the foundation of Mercedes’ new vision for manufacturing cannot be overstated. “It allows us to plan, retool, and ramp-up production of the Mercedes Modular Architecture (MMA) platform,” said Jorg Buzer, Member of the Board of Management at Mercedes-Benz AG Production, Quality and Supply Chain Management. Introduced in September 2023 at Munich



A Mercedes employee views the Omniverse—the automaker has partnered with Nvidia to drive a 'digital first' approach to facility planning

IAA, MMA has been developed to help scale up production for the automaker’s forthcoming battery electric vehicle (BEV) releases—including the CLA estate and new versions of the EQA and EQB—in accordance with market demands and customer requirements.

“MMA marks the next step in making not only the product but also the MO360 digital production ecosystem more intelligent,” he added. MO360 integrates data from manufacturing processes and IT systems across 30 of the company’s plants to deliver KPI-based production control for BEVs, hybrids, and ICE vehicles on one assembly line. The Rastatt plant is currently being used as a test case for the use of digital twin as a

means to configure existing infrastructure for a new assembly process.

The World Economic Forum estimates that a focus on digitalisation could unlock US\$670bn of extra value for the automotive industry by 2025. Mercedes’ decision to embrace new technologies throughout its manufacturing demonstrates how this figure could be achieved. The anticipated rewards of using digital twin, AI, and MB.OS in conjunction are enhanced process efficiency, the mitigation of production defects, and significant time savings. Buzer labelled this combination as nothing less than “a new era” for its production. Applied at an industry level, a similar approach could be no less transformative.

# Bus and coach future-proofing, Volvo style

The President of Volvo Group Canada,  
Prevost and Volvo Buses North America  
talks future mobility with Megan Lampinen



**F**rancois Tremblay has been with the Volvo Group for seven years, during which time he has successfully navigated the challenges of the COVID-19 pandemic and embarked on an ambitious sustainability push. Tremblay currently wears many hats, serving as President of Canadian luxury coach division Prevest, Volvo Buses North America, and Volvo Group Canada. It's a wide remit, covering coaches, buses, trucks, construction equipment and marine engines. It also means future-proofing for the diverse needs of different sectors. The key, he tells *Automotive World*, lies in establishing an empowered team and drawing on synergies wherever possible.

**These are all big, complex businesses. How do you manage to retain oversight across all the different areas?**

With some of these businesses, we are dealing with products

that have close to 10,000 parts, so there's a huge supply chain. Supply chain management has become a real challenge, especially over the last couple of years. It's important to make sure we have the right people around and empower them to do their job. That means acting as a coach, helping and challenging them. Above all I need to make sure I'm setting the vision and making sure everybody is aligned to it. It's also about creating synergies between the truck and bus businesses from a product and public affairs standpoint. We're stronger as a group than as individual businesses.

**How is the push towards zero-emissions impacting the segments in which you're involved?**

In terms of product, there will be more change in the next ten years than there has been in the past 40. We used to have



**Francois Tremblay,**  
President, Prevest, Volvo Group Canada  
and Volvo Buses North America

a single powertrain to think about—a diesel engine. Now we are thinking about hydrogen fuel cells, battery electric, and plug-in hybrids. Every time you incorporate a new powertrain within a product it's a major endeavour, requiring lots of engineering work and validation. Batteries are heavy and require considerable space. There are safety issues around electric and hydrogen options as well.

**What are you hearing from your customers about this transition?**

More and more customers are demanding it. We're working on a major coach contract with New York City, and for them, noise is an issue, especially early in the morning. Having something electric will definitely help when it comes to noise perception.



Prevest H3-45



Connected services will play an increasingly important role moving forward

We are also thinking about supporting our customers' sustainability journey. We are working with tech companies like Google, Facebook and Apple, and it's important for their image. Google alone uses more than 400 motor coaches to carry its employees from the San Francisco area back to Silicon Valley. These companies want to make sure that they're at the forefront of pushing sustainability. For them, using products that are green and electrified is important.

**There's been considerable excitement around autonomous driving. How do you see that playing out for your segments?**

The driver shortage has been a big challenge for both the motor coach and the truck segments. We will see autonomous driving arrive faster on the truck side, because these vehicles are carrying goods and generally running easier routes, point A to point B.

On the motor coach side, it will likely take longer because the drivers also act as customer service representatives, answering passenger questions and handling luggage. With coaches, though, we can help drivers be more secure with advanced driver assistance systems like advanced warning and automatic braking systems—things that help them better manage the product when they drive it.

**Automation and sustainability are also making themselves felt on the manufacturing side. What does that look like at Prevest and Volvo's North American operations?**

We are not only changing the product but also the way it's built and how we train our people. With manufacturing, the big focus is on more automation and robots. We just bought our first robots this year, which will be used for welding. The old trades are not as popular with the young generation.



Ten years ago, there would be maybe 90 welders coming out of the local trade school every year. Now it's less than 20. Robots are a great way to compensate for that.

### **So, are you just at the start of your smart factory journey?**

We will never be a fully automated Industry 4.0 factory because of the nature of the low-volume, high customisation product. That said, we're trying to automate as much as we can. We just bought some exoskeletons to help our ageing workforce manipulate heavier equipment and carry things like seats.

### **Alongside the many industry benefits of these megatrends, what are some of the challenges they pose?**

The three big ones are infrastructure, resources, and supply chain. We need to find people with the technical knowledge to support our product agenda. Globally, there's a scarcity of manpower, especially when it comes to skilled labour. Another big challenge is the supply chain, which is also suffering from a labour shortage. Supply problems started pre-pandemic but then really accelerated. With electrification, the demand for things like batteries has gone through the roof. It's quite a challenge to manage the supply chain with those new product technologies transitions.



The shift to zero emissions will take time. The latest coach model from Prevost, the H3-45, is powered by a Volvo D13 engine

Then there is the issue of charging and hydrogen fuelling infrastructure. It's easy to say we are going to do hydrogen trucks and buses, but these things need the infrastructure to support their operation. There are not that many heavy-duty charging stations in North America; it's much more focussed on cars. When you have 56 passengers sitting in a bus, you cannot stop for two hours to charge. Hydrogen stations are starting to crop up, but it will take decades before this market matures.

### **Can you flag any other hot topic technology areas for the future?**

Fleet management will be a big trend when it comes to digitalisation. The connected services within the vehicle represent a huge opportunity. We're becoming the product experts so we can help customers better manage their fleet and optimise their energy consumption. We see ourselves moving from a

manufacturer of heavy equipment to more of a transport solution provider. That could include financing support, advice on optimising fleet management or battery recycling. The idea is to move from a pure product solution towards a full transportation solution.

### **What sort of regulatory changes may be needed to support the move towards a cleaner, safer, more connected industry?**

Policymakers have a huge influence. I've been working with governmental bodies in both the US and Canada and organisations like the California Air Resources Board and get the feeling they really want to do good. But some of the things they're asking for are not realistically feasible in the short term. We have to educate them about the technologies available today and make sure that their agenda is in line with the feasibility of the technologies as they currently exist.



# **China's tech dominance drives new VC opportunity in the West**

**One venture capital fund sees great potential in the move by Western governments to rebalance technology dependencies. By Megan Lampinen**

**M**obility is evolving rapidly in the wake of digital disruption. While the systems that move people and goods are becoming safer, cleaner and more efficient, they remain far from optimised. That's the view of venture capital platform Assembly Ventures, which aims to usher in the new age of Mobility 4.0 by supporting impactful players across the wider ecosystem.

“We like to be active with the companies in our portfolio,” asserts Jessica Robinson, one of Assembly’s founders. “It starts with capital—cash is an important part of every start-up’s journey—but that’s only part of the relationship. We serve on the boards of all our portfolio companies in some capacity, and we support them on business development and strategic introductions that might be helpful to their growth plans.”

There are many venture capital platforms targeting mobility, but Assembly claims to be the first transatlantic one. Founded in 2020, it has locations in Detroit, Silicon Valley, and Berlin. “The link and opportunity between North America and Europe is baked into our investment thesis,” Robinson tells *Automotive World*. “Our strategic locations tie together the geographies that will be part of this next chapter for the industry.”

A big part of the investment potential in the US and Europe has been driven by a change in geopolitical strategy. Over the past few years, governments and industry players in the West have been taking action to rebalance technology dependencies. “We have to acknowledge shifting

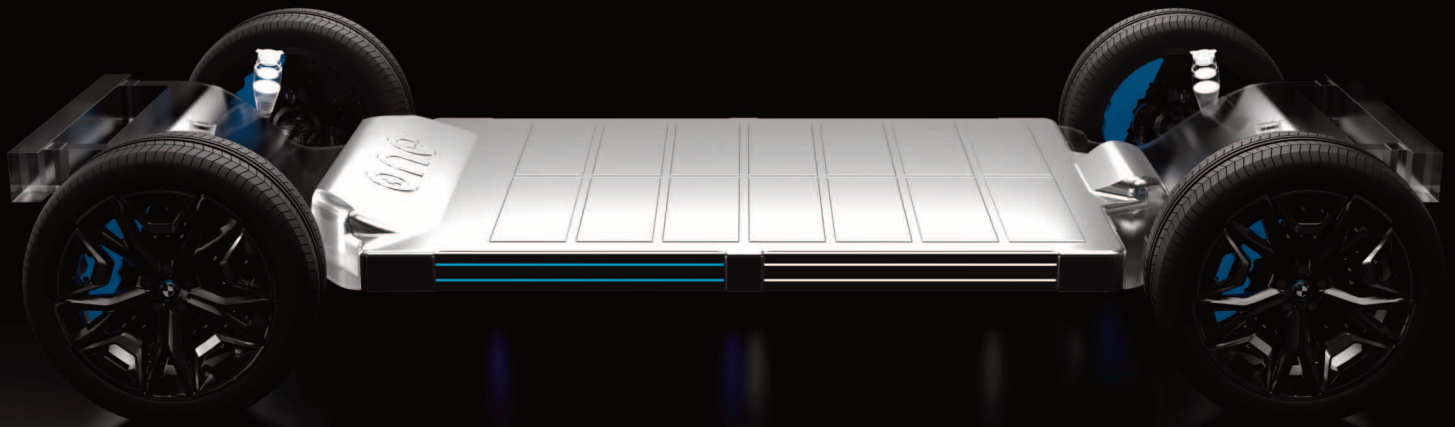
geopolitical considerations when it comes to materials, expertise, focus and resiliency, with a new region or relation that’s emerged. China is clearly dominant when it comes to certain technologies and materials in electrification,” Robinson explains. “We saw an opportunity to think about infrastructure, systems and applications (ISA) through that geographic lens.”

“

As the West continues to de-risk its reliance on Chinese technology, the coming decade could see a dramatic evolution of mobility supply chains

## Mobility 4.0

ISA is how Assembly refers to its three-layered approach for the future of mobility. Together, these three aspects contain all components required to build future-proof mobility systems. The company sees infrastructure—both physical and digital—as providing the foundation for new mobility. The system layer is where software meets hardware, coordinating and orchestrating information from infrastructure components with



Our Next Energy is working on energy storage for EVs and the grid

© Our Next Energy

outside data. The application layer is how users access a service; it represents the user interface and enables system monetisation.

“When we first started thinking about the technologies and the companies that would push the industry forward, the acronym CASE (connected, autonomous, shared and electric) was still quite prevalent, but we knew it was not the full story,” says Robinson. “It misses the subtleties of how the industry will move, either in step changes or in change that will seem like it happened overnight.”

## Spotlight technologies

As a result, the higher order framework that Assembly puts around any potential investment

will consider ISA. That breaks down further into a number of different investment themes around battery technology, clean energy solutions, climate tech, supply chain optimisation and automotive production. Its first investment came in 2021 and supported Michigan-based energy storage company Our Next Energy. The team there is working on batteries that could double the range of electric vehicles (EVs), as well as a grid storage solution.

Materials and circularity are additional hot topic areas for the fund. One of its portfolio companies, Sortera, ticks both boxes with its AI-powered industrial sensing platform that facilitates rapid sorting of different recycled materials. The company is starting with aluminium. “In

end-of-life vehicles today, aluminium just gets shredded and sent to a smelter and re-alloyed,” Robinson explains. “But if you can separate the different grades of aluminium and the original sources—whether it’s cast or part of the frame—you can just re-smelt that same quality of aluminium, and with just a little bit of alloying to correct it, you have near-perfect circularity.” Notably, recycled aluminium uses just 5% of the energy input of primary aluminium, which could prove a game-changer in terms of industrial emissions.

She flags supply chain resiliency as another promising investment area for the fund but takes a more cautious outlook around some other megatrends: “There is no doubt this is a critical moment in time for autonomous driving, and the promise is exciting, but we see the operational challenges in the headlines every day. There’s been a real sobering around the enthusiasm for that type of technology.”

The hope is that the evolution of technology and the lessons learnt collectively by the engineers in this space will still provide value that can be extracted in other areas, even if the enthusiasms haven’t played out as expected. For example, the industry is starting to show interest in applying complex sensor fusion to other applications, such as warehousing.

Robinson also suggests that enthusiasm around connected cities may be cooling. “The promise is there but it still has to be unlocked. In the US, we are seeing additional dollars now flowing into

communities for some of those technology deployments, but with a focus on vulnerable roadway users or neglected intersections. I remain hopeful on that one, because I think that’s where technology truly has the chance to change how we move on a personal level.”

Even electrification makes the caution list. “We have to walk our consumers down this path and get people comfortable with driving EVs,” she says. “Here again, some of the things that we’re learning from the automotive platform transfer into smaller form factors like mopeds, battery chemistries and charging infrastructure.”

## Automaker activity

Today, Assembly Ventures manages assets worth US\$94m, though that figure won’t stand still for long. It’s not just venture capital firms like Assembly that are investing in start-ups. Automakers are also active, and many have dedicated investment arms or are working with an accelerator or tech incubator to stay close to the action. BMW i Ventures, for example, invested in the Series A round of Our Next Energy. Stellantis Ventures is one of Assembly’s own investors.

As the West continues to de-risk its reliance on Chinese technology, the coming decade could see a dramatic evolution of mobility supply chains. For all investors, the key will be to identify the most pivotal, value-generating technologies driving the transformation to a cleaner and more sustainable mobility ecosystem.



# The American dream: Cupra targets US in global push

North America is pivotal to Cupra's vision of becoming a global brand. Megan Lampinen hears more

Cupra has come an incredibly long way over the years, but the journey is far from over. What started as a sub-brand for SEAT performance models was spun off as a standalone unit in 2018. Since then, it has been steadily carving out a niche for itself across Europe and more recently in Australia. In 2022, it brought in sales of 153,000 units and is gunning for a further 50% increase this year. Buoyed by such success, it now has its sights set on North America.

Chief Executive Wayne Griffiths has been talking about a potential North American launch for months, but an entry strategy is now starting to take shape, and Cupra has been “testing the brand” with potential customers in certain states, including California. The results, Griffiths told media at the IAA in September, are encouraging. “If we want to be considered as a truly global brand, we have to think big,” he emphasised.

North America already has its fair share of newcomers, including Rivian, Lucid, Fisker, Polestar and Vinfast, just to name a few. Cupra will face a decidedly uphill challenge not only against these players but also the well-established incumbents. The key, says Griffiths, will be a US-specific model—namely something large like an SUV, but definitely not a pick-up. The upcoming all-electric SUV

Tavascan or the plug-in hybrid Terramar SUV, both expected in 2024, could provide inspiration for the US model. Cupra's aim is to eventually go all-electric, which could tie in with the US Environmental Protection Agency's aim for two-thirds of new cars to be all electric by 2032 and President Biden's goal for half of all new vehicle sales to be electric by 2030.

"You don't go to the US with European products," emphasised Griffiths. "You need to look at a bigger SUV, and the platform that would allow us to do that is available in the VW Group. You then need a North American plant."

“

You don't go to the US with European products

The VW Group has plants in the US and Mexico, off of which Cupra could piggyback. Griffiths also flagged the importance of "a distribution strategy and system that allows you to be profitable" and confirmed that the brand was working on that.



Wayne Griffiths,  
Chief Executive, Cupra

## The scale of the challenge

While Griffiths stops short of confirming a launch date, it's clear that the brand is serious about its North American push, and it's now more a question of when than if. But what are Cupra's chances of finding success? "The odds are probably stacked against it," cautions Jonathan Storey of Automotive Reports. "The US is a very competitive market; one in which new entrants struggle to gain traction."

Griffiths is clearly counting on leveraging the infrastructure already established by VW Group, but that impact could be limited. "While Cupra has the heft of the wider VW Group behind it, you would have to say that has done few favours for the VW brand itself, US sales of which only just topped 300,000 units in 2022," Storey tells *Automotive World*.

That's not to say it can't be done. He points to Kia as a US success story: the brand sold a mere 12,300 units in the US in 1994. In 2022, its volumes topped 650,000 units. Tesla

achieved similar growth but in a quarter of the time. "The one thing that can be said with confidence is that Cupra stands a better chance than the SEAT brand would have," adds Storey.

Meanwhile, Griffiths insists the goal is a realistic, if challenging, one. "We don't underestimate how big a step this is," he conceded. But Cupra is no ordinary brand—it's a self-proclaimed rebel, and America was the original mecca for Europe's rebels seeking wider horizons. The American dream has always entailed an element of challenge.

"We never stop dreaming about what the next chapter holds for Cupra," he says. "In just five years we took a challenger brand and made it the fourth trendiest brand in Germany. We did that with a brand that stands out for its contemporary values of design and performance—not heritage. It has hit a nerve with young people and the next generation of car lovers...I am confident we have the right strategy in place to make Cupra an American success story."

# Lamborghini strives to capture the ICE experience in new EV

Unveiled five years ahead of its scheduled production year, Lamborghini's Lanzador demonstrates its vision for electric supercars. By Will Girling





In September 2023, an article in *The Times* quoted McLaren Chief Executive Michael Leiters as stating that it currently “doesn’t make sense” to produce electric supercars (e-supercars). His rationale was that the electric vehicle (EV) production process, more carbon intensive than internal combustion engine (ICE) models, is not offset over a model’s lifetime by the zero-emission powertrain. This is because, Leiters claims, supercar owners typically do not drive them more than 5,000 miles per year.

Nonetheless, battery electric models such as the Lotus Evija, Aspark Owl, and Nio EP9 demonstrate that sports car manufacturers are considering a future beyond ICE. Indeed, Ferrari is set to build its first EV by 2025, and Aston Martin has announced its intention to electrify its core range by 2030. By 2028, the global e-supercar market is expected to reach a value of US\$67bn, according to Infinity Business Insights.

But as consumers become increasingly conscious of sustainability issues, how can automakers accommodate these concerns while maintaining the excitement of a segment historically defined by large engines?

## A vision of the future

August 2023 saw Lamborghini provide the market with an insight into its vision of the future. At Monterey Car Week, the automaker unveiled its electric GT concept, Lanzador, five years ahead of the anticipated production year. It fulfils part of the company’s ‘Direzione Cor Tauri’ (‘Heart of the



The Lanzador combines design elements from previous Lamborghini models, including the Murcielago, Sesto Elemento, and the Miura

Bull’) strategy, which was announced in 2021. Its goal is to electrify the brand while also developing technologies and solutions that help Lamborghini retain its distinctive identity.



The Lanzador's interior has been designed by Lamborghini to evoke a "truly futuristic space"

"Direzione Cor Tauri is our roadmap through electrification," Stephan Winkelmann, Chairman and Chief Executive, tells *Automotive World*. "We started the first phase in 2023 with the launch of [plug-in hybrid] Revuelto." This will be followed in 2024 by the hybridisation of Lamborghini's entire product range. The 2028 production version of the Lanzador will be its first all-electric model.

Although Lamborghini did not disclose a precise performance spec for the concept car, Head of Design Mitja Borkert explains that development followed a tripartite strategy: beauty, futuristic elements, and

sustainability. Exemplifying the latter, the Lanzador's interior contains a number of recycled and environmentally friendly materials. These include seats made from leather "tanned with organic chemistry", merino wool, and 3D-printed foam created using recycled plastic.

The silhouette combines the window line of the Murcielago, bodywork of the Sesto Elemento, and the aerodynamics of the Miura. These design elements combine with the sustainable materials to create a Lamborghini product that Borkert states is both authentic to the company's past and in-line with its new vision.

## Attracting new customers

A July 2022 report from McKinsey & Co determined that the core aspects of a luxury brand—uniqueness, exclusivity, prestige, craftsmanship, artistry, and the extraordinary—are unlikely to change. However, as new ICE vehicles are phased out in global markets from the mid 2030s onwards, standing out from the crowd could increasingly depend on promoting a brand vision that addresses social concerns.

As such, Lamborghini's move to position itself as supercar manufacturer embracing both electrification and

environmentally friendly manufacturing practices could secure it a strong market position towards the end of the decade. Despite previously focussing around ICE, Federico Foschini, Chief Marketing and Sales Officer at Lamborghini, believes its core client base is “almost ready” for the brand to go electric. The intervening years between 2023 and 2028 will allow the company to fine-tune the Lanzador based on the needs of current customers. However, it is also considering how to attract new ones.

“The Lanzador is conceived for customers that are young and oriented towards innovation, technology, digitalisation, and connectivity,” says Foschini. The average premium EV buyer is in their early 40s, according to a 2022 joint survey by market researcher Savanta and OEM [Aehra](#). Notably, the same study found that millennials (26-49 years old) are the demographic most likely to purchase an EV overall, with baby boomers (65 and older) the least likely. A 2021 study by Pew Research found that millennials are also the most likely to believe climate change and sustainability should be society’s top priority. This could explain why Lamborghini envisions a more sustainability-focused future for its electrified brand.

## Replicating the experience

The Lanzador’s minimalist interior—described by the company as “a truly futuristic space” containing two large screens and a small central console—communicates Lamborghini’s desire to be perceived as a tech-forward

brand. The challenge will be to attract newer, younger buyers while also satisfying long-term customers, who might have preconceived ideas about its products.

Developing the Lanzador’s new “sportiveness concept”, says Chief Technical Officer Rouven Mohr, involved complex software and electronic integration. The car features steerable rear axle and air suspension, two motors on each axle, and a power delivery system that exceeds 1 MW—translating to approximately 1,340hp. The company claims this provides stability and efficiency under all driving conditions and styles. Subsequently, utilising a new iteration of Lamborghini’s driving dynamics control system (Lamborghini Dinamica Veicolo Integrata), customers will gain “the utmost freedom” to adjust and modify the car’s performance with controls on the steering wheel.

“The mission and priority for the electrification strategy is to ensure that we generate a typical Lamborghini driving feeling and experience in the fully electric world,” adds Mohr. The company’s emphasis on customisable performance could be an effective solution for harmonising the transition. Looking to the future, Winkelmann concludes that the feedback Lamborghini receives during this early phase of its electrification will be invaluable for laying the foundation of its next big step: the Lanzador’s market launch in 2028. With many of the automaker’s competitors on similar trajectories, the early 2030s could herald an exciting new supercar era underpinned by an emphasis on technology and sustainability.

# Inside Stellantis' multi-brand manufacturing strategy

Ian Henry explores the significance of recent production decisions and what it signifies for the company's wider strategy

Images © Stellantis

**S**tellantis is steadily making manufacturing sense out of its multiple brands, in Europe at least. With Peugeot, Citroen, DS, Opel/Vauxhall, Fiat, Alfa Romeo and Lancia, plus contract van manufacturing for Toyota, achieving manufacturing and platform economies of scale is a complex business. Throw in production of Jeeps and Maseratis in Italy and the challenges are evident. Having moved production of much of its line-up around Europe,

sometimes at a model change, sometimes in mid-cycle, Stellantis' plans are now becoming clear.

First, the number of single platform, multi-brand factories is rising; more on this later. Second, the number of single brand/model plants is declining, with Opel's Eisenach plant which makes the Grandland probably the last single model factory. The Rennes plant makes the Citroen C5 Aircross and some Peugeot 5008s, but

increasingly models for three or more brands are produced on a common platform, driving up the factory's efficiency and, in theory at least, giving suppliers higher volume deliveries.

The single platform, multi-brand policy has been evident for longest in vans: Hordain in France and Luton in the UK make mid-sized vans for Citroen, Peugeot, Opel/Vauxhall and Fiat. The French plant also makes vans for Toyota. Similarly the Vigo



plant in Spain, its associated over-spill plant the Mangualde factory in Portugal and now the Ellesmere Port plant in the UK do the same in the small van segment. In this case, the Spanish plant also makes models for Toyota. Doing this in vans is one thing; there is not a lot of difference in trim and specifications between vans across the different brands.

But doing this in passenger vehicles is a very different matter. The Stellantis brands

have differing styling features, or image cues, be it the lights, bonnet shapes, grilles and unique colours inside and out; dashboards look very different, steering wheel controls will vary, and seat fabrics and other trim also

differ widely. Wheel arches and corner modules, as well as roof lines all mean different metal parts, dedicated tooling and moulds and adjustments to the assembly process. Making similar models on a common platform in a single

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Making similar models on a common platform in a single plant is much more complex in passenger vehicles compared to vans



plant is much more complex in passenger vehicles compared to vans. When the latest small vans (Berlingo, Partner and Combo) were launched they came to market at the same time. Other than badges there was really very little difference, so manufacturing effectively the same model for different brands was something that Vigo and Ellesmere Port could take in their stride.

But in Tychy in Poland and soon at Melfi in Italy, it is a very different story. Tychy is moving from the Fiat 500 and Lancia Ypsilon to a three model line-up using the CMP platform originally developed by Stellantis' Chinese partner,

Dongfeng: an Alfa Romeo (possibly called Brennero) will appear in 2024 (this being a long awaited replacement for the MiTo); the Fiat 600 starts production in late 2023 (replacing the soon-to-end Italian-made 500X, although both models will be available alongside each for a few months); and the Jeep Avenger which appeared at the end of 2022 (ultimately replacing the Italian-made Renegade). Together these three models will give Tychy a very different line-up in the near future. These models have been launched with several months between them to allow the plant to cope with the specific

requirements of each model and their unique supply chains for key visually differentiating parts. Also, by phasing the vehicles' launch times the factory can avoid grouping peak production volumes, and similarly avoid common low points in their production cycles as well.

Having worked out how to do this with three brands, Stellantis is going further along this path at Melfi. The Jeep Compass, currently made in Melfi, will also end soon; its replacement will also be made in Melfi, this time alongside new models for Opel, Lancia and two for DS, which had started out as a premium Citroen marque.

The new five model line-up will use the STLA Medium platform, starting in 2024. The first will be a fastback model for DS, to be called DS8 or DS9. This will be followed by the next Jeep Compass in early 2025; in late 2025 there will be a second DS model, a replacement for the DS7 SUV which is currently made in France. Then in 2026, there will be a Lancia model similar to the new DS7, and finally, using the first DS model's fastback profile, there will be an Opel model, possibly called Manta. This is designed to be a more upmarket, aspirational model compared to the Insignia, which Opel stopped making a few years ago.



The new Jeep Compass will enter production in Melfi in 2025

Over the next two years therefore Melfi will switch from making three models (500X, Renegade and Compass) for two brands on two platforms, to making five models for four brands on a single platform. This is the new way forward for manufacturing at Stellantis; each plant will make vehicles on one platform, for three or four or more brands. Driving up scale economies, reducing the dependence of individual factories on a single model, providing better business for suppliers delivering common platform parts and allowing brands to enter new niches on the back of investment from other larger brands: these are all direct consequences of this plan. It has taken several years for Stellantis to begin to make sense of its multiple brands; finally it is doing this, and at pace.

In future the Zaragoza plant, for long purely an Opel factory, will make Lancias as well as Peugeots, meaning at least three brands will come out of that factory; Lancias will also be made in France, alongside Peugeots, while Opels have been made alongside DS models in France for more than three years. Two brands in a plant is commonplace, but it is not enough to maximise production efficiencies. Three brands will be the minimum going forward and in some cases four brands will be made in a single factory; and this will rise to five or even six at the van plants where production arrangements are simpler than at car factories. Welcome to Stellantis' new way of manufacturing and maximising brands synergies.

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# Asian nations pivotal to sustainable, electric future

Regional governments are introducing stimulus packages to support domestic EV markets and encourage battery R&D. By Benedikt Sobotka



Asia's electric vehicle (EV) market is poised for decades of historic growth. In the global race to decarbonise the industrial, transport and energy sectors, many Asian nations have bound from their starting blocks faster than their counterparts in Europe and North America. Asia is now a key battleground in the world's fight to decarbonise.

As a region, Asia has been heavily affected by droughts, floods and extreme weather in recent years, and climate-related disasters are only likely to worsen. According to

McKinsey, Asia is home to 93 of the 100 most polluted cities and six of the top ten countries most affected by climate risks. No wonder then, that many governments are introducing stimulus packages to engender growth in domestic EV markets and to support research and development of new battery technologies, as well as mining and recycling of key metals.

## China's market dominance

North Asian governments, in particular, are betting big on the green energy transition

and their commitment to electric transport is evident—more so perhaps, than the EU, which thus far has adopted a “targeted, temporary and proportionate” approach to financial aid for green industries and the development of EV industrial centres.

China has established itself as not only the region's but the world's preeminent EV market nation. The Chinese government is embracing supply-side policies to encourage greater domestic and export purchase volumes of EVs. In June, the





government announced a record-breaking US\$72.3bn package to boost EV sales, delivering tax exemptions for those purchased in 2024 and 2025 of up to US\$4,170 per vehicle.

The policy sends a strong signal to the international market. Following the news, Ford's Executive Chairman Bill Ford conceded that the US has some catching up to do on EV production. He was quoted by *The Telegraph* as saying: "They [Chinese EVs] developed very quickly, and they developed them in large scale. And now they're exporting them. They

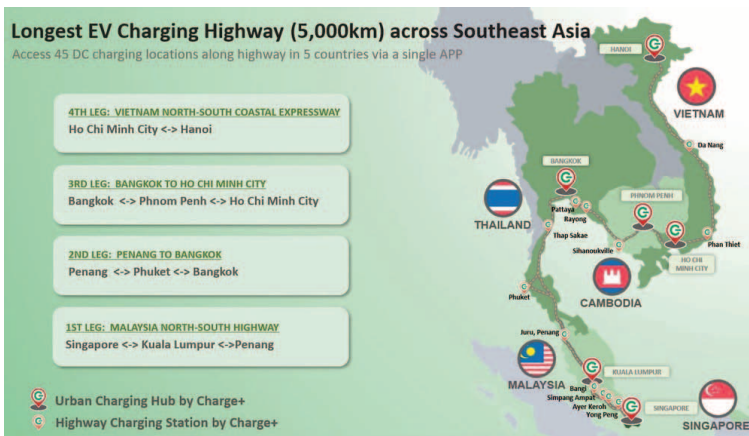
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It is incumbent on each and every EV producer nation to work in harmony with global markets and fellow producer nations, to ensure the supply of critical metals remains stable

will come here at some point, and we need to be ready.”

Beyond tax subsidies and onshoring incentive schemes, China is also exerting market dominance in the production and processing of EV battery

materials. Research firm Benchmark Mineral Intelligence estimates that this year alone, China will refine 62.5% of the world's lithium supplies and 76% of global cobalt supplies, and mine 65% of the world's natural graphite.



CHARGE+ plans to develop a 5,000km EV charging network across five countries in Southeast Asia

roadblocks to unlocking consumer uptake.

The total cost of ownership is, naturally, tied to the regulatory environment, and government support to make low-cost EV models available will be key. This extends not only to subsidies for buyers at the point of purchase, but also tax breaks and incentives to lower automakers' production costs. Affordability is a determining factor for consumers, and as the International Energy Agency notes, many of the EV options on sale in emerging Asian markets are currently heavily geared towards the higher end, such as SUVs, large and luxury models.

The lack of charging facilities and reliable electricity grid must also be addressed. This means not only improving the accessibility and interoperability of charging infrastructure, but ensuring that EV power sources are truly green, given electricity in ASEAN countries is still heavily reliant on fossil fuels. Fortunately, progress is being made in this regard. For example, Thailand's EV charging network is being financed by a green loan agreed by renewable energy company Energy Absolute and the Asian Development Bank, whilst Singapore's Charge+ plans to develop 45 high-speed charging stations connecting Singapore with Malaysia, Cambodia, Thailand and Vietnam.

## North Asian market support

Yet China is far from the only North Asian nation seeking to capitalise on the opportunities of the EV revolution. In Japan, the Kishida government has been working diligently to ensure major automotive manufacturers Honda, Suzuki, and Toyota are not left wanting for financial and operational support.

The Japanese government recently announced close to US\$2.2bn in tax subsidies to support battery production and development, including nearly US\$1bn in subsidies for Toyota and other manufacturers. The subsidy package follows on the heels of a trade agreement signed between the US and Japan in March, which will ensure greater supply chain security of key battery metals and cemented Japan's status as a major player in the global EV market.

## Challenger economies in South Asia

However, further afield in South Asia—particularly India and ASEAN—EV penetration rates are lagging. In 2021, EVs accounted for less than 1% of new vehicle sales in the region. Many countries have set ambitious targets for EV production and usage, such as Indonesia's goal of 2.5 million EV users by 2025, and some headway has been made in the past year. Electric car sales more than tripled in India and Indonesia in 2022, but this was, admittedly, from low base figures.

So what must be done for Asia's emerging market and developing economies to catch up with more advanced players? McKinsey identifies parity in total cost of ownership of EVs, OEM model availability, supply chain readiness, and charging infrastructure as the main

## Battery metals production

Another promising sign that Asia's challenger economies are taking on the status quo and ready to transform their energy and transport sectors is the increase in battery metal production and cell manufacturing. Indonesia has overtaken Australia to become the second largest producer of cobalt, a critical metal in electric batteries. Indonesia generated 9,500 tonnes of cobalt last year, totalling 5% of global supply, up from minimal volumes before 2021.

Multinationals like CATL, BASF, and LG Energy Solutions are investing heavily in Indonesia's domestic energy industries, including lithium-ion cell manufacturing, where the country hopes to achieve an 80GWh cell manufacturing capacity by 2030. Likewise, in the Philippines, President Ferdinand Marcos Jr recently signalled the country's plans to go beyond extracting minerals to "vertically integrate that entire activity all the way down to actual battery production."

## Protectionism and nationalism

It is clear that there is a growing sense of competition for EV market supremacy. Countries across the globe



Shell and BYD are developing EV charging networks in China

have introduced landmark policies to ensure they get a slice of the pie, as the world undertakes a monumental upheaval of its energy and power systems. The US Inflation Reduction Act, China's Made in China 2025 Plan and EU Critical Raw Materials Act are just a few such examples.

Countries' efforts to support their domestic industries in the race to net zero are to be welcomed. Regulatory action is surely needed to promote supply chain security and ensure EVs are a viable and affordable solution.

However, it should be remembered that the global energy transition cannot be realised by one nation alone. And whilst resource nationalism and supply-side protectionism can engender market growth in producer nations, it is important that this approach does not cut off

key metals supplies or battery technologies for other countries. To do so could endanger worldwide EV adoption rates and consequently, imperil the likelihood of realising net-zero across the globe.

To achieve sustainability across global energy value chains, cooperation must become the order of the day. It is incumbent on each and every EV producer nation to work in harmony with global markets and fellow producer nations, to ensure the supply of critical metals remains stable, and important developments in battery technologies and clean transport are not the preserve of one country but shared across global markets. In this regard, Asian nations have a vital role to play in ensuring EV production is sustainable for the long term. They also have a huge opportunity to benefit from the emissions reductions that EVs will bring.

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*About the author: Benedikt Sobotka is Chief Executive Officer of Eurasian Resources Group (ERG) and Co-Chair of the Global Battery Alliance (GBA)*

# Could patent licence agreements advance automotive 5G?

5G

Mercedes-Benz's decision to licence 5G technology through Avanci could indicate how 5G's mass adoption in automotive will play out. By Will Girling

5G

In April 2023, Viavi Solutions' seventh annual 'State of 5G' report found that 5G networks are now active in 67% of the world's largest economies by GDP. In total, 2,497 cities in 92 countries have commercial 5G networks—up from 1,947 in 72 countries the previous year—and 23 countries are trialling the technology. The US and China are currently leading uptake, with 503 and 356 5G connected cities respectively.

As adoption grows, the automotive industry will be able to leverage 5G's high capacity, low latency, and increased bandwidth to transform connected mobility. This change is expected to take place over the proceeding decade: valued at US\$2bn in 2023, Future Market Insights forecasts that 5G in automotive and smart transformation will be worth US\$42bn by 2030.

But what path will its development take, and how could technology licence agreements help facilitate continuous automaker innovation?

## A critical moment

"5G technology presents many opportunities," Michael Hafner, Vice President, MB.OS Base Layer & MBUX at Mercedes-Benz, tells *Automotive World*. These include fast data connections to enable over-the-air (OTA) updates, in-cabin video streaming and gaming, and [vehicle-to-everything](#) (V2X) communication that could prove crucial in the development of autonomous vehicles. Mercedes-Benz's 2023 E-Class saloon is its first model to feature 5G, with Hafner stating that "more carlines will follow shortly."

Although enthusiastic about its possibilities, Hafner believes that 5G network infrastructure remains a limiting factor in terms of scaling up the technology's applicability. Indeed, as of January 2023, there are only 45 standalone (SA) 5G networks globally—these are independent of and possess greater performance than non-standalone (NSA) 5G using 4G infrastructure. "Evolving from NSA to SA affects our hardware and therefore needs time to be implemented," he says.

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Patent owners and automakers both need more R&D time to develop 5G and improve vehicle connectivity

Laurie Fitzgerald, Senior Vice President at US patent platform Avanci, agrees that 5G is still relatively nascent compared to 4G but also emphasises that automotive industry interest in the technology is reaching a critical moment. "25 OEMs have confirmed

plans for in-vehicle 5G so far. Before the end of the decade, we could start to see new 5G vehicles outsell new 4G vehicles.” As more 5G SA networks become available, automakers will need the ability to pivot quickly.

It is for this reason that she believes a new technology licensing programme could play an important role in laying the foundation for automotive 5G. In August 2023, Mercedes-Benz became the first automaker to sign a 5G licensing deal with Avanci, which it will use in its vehicles in Germany. One month later, BMW became the second licensee.

## Simplifying 5G licensing

Because global cellular communication is underpinned by an ecosystem of technologies from a multitude of companies, standards are necessary to ensure products can work together harmoniously. These standards require innovations to be shared openly with the entire telecom industry, so it is through patents that individual companies can recoup R&D expenditure. Subsequently, for an automaker to access new 5G technology, it would need to strike individual agreements with scores of providers.

As an alternative, Avanci’s licensing programme consolidates 62 licensors—including Panasonic, Samsung, Sony, and Siemens—into one simplified agreement at a fixed cost per vehicle that enables automakers to use the standard-



essential patented technology necessary for 5G. The company’s concept, explains Fitzgerald, is to create a “one-stop-shop” that keeps OEMs fully up to date on 5G advances for the duration of the agreement—new patents and licensors are added automatically.

In addition to 5G, the licence also covers all standard-essential patents for 4G, 3G and 2G, including cellular vehicle-to-everything (C-V2X) technology. Fitzgerald believes this flexibility is important during the industry’s transition from 4G to 5G—adoption of the former may not slow appreciably for at least the next five years. “Even if some automakers don’t have solid plans for rolling out 5G yet, including it as part of a broad licence gives them the option to access relevant technology and then pivot when their strategy allows.”



Mercedes-Benz's E-Class model is its first to feature 5G, and "more carlines will follow shortly"

## Helping 5G flourish

"Of course, Avanci's solution is just an option for those that want to access 5G more easily," she adds. "If automakers prefer to set up their own agreements, they can still do so." However, more than 80 automotive brands currently use Avanci's 4G licence. Mercedes-Benz's early adoption could indicate that simplification will remain important in the 5G connected mobility space. Indeed, Hafner highlights that the licence grants the automaker a higher level of "freedom" in the scope of its continuing 5G innovation.

In addition to re-emphasising the "large potential" of 5G for enhanced in-vehicle entertainment and OTA, Hafner states that standalone 5G will allow Mercedes-Benz to explore network slicing and non-terrestrial-networks. The

former could be used to create custom virtual networks for specific traffic use cases, while the latter will "potentially be a big step" towards wider coverage and a more complete connection between user devices, vehicles, and satellites. He does not provide any details on specific future features or enhancements. However, 5G's significant potential in [improving road safety](#) could hint at for the industry's broader direction.

From Fitzgerald's perspective, the most important thing is that automakers aren't restricted in pursuing 5G innovation in vehicles by technology licensing issues. "Patent owners and automakers both need more R&D time to develop 5G and improve vehicle connectivity. By making the points where those industries intersect smoother, automotive 5G can flourish."

# How can generative AI remodel the automotive industry?

Richard Felton explores how generative AI is likely to shape the automotive industry, and how car manufacturers might be able to leverage the technology

**G**enerative AI applications continue to capture widespread attention and imagination. In the automotive industry specifically, generative AI has the potential to help transform the way vehicles are designed and developed.

For instance, AI can be applied to create new content and ideas, including exploring design options, based on criteria that has been stipulated by the developer.

Like all AI, generative AI is powered by machine learning models—very large models that are pre-trained on vast amounts of data and commonly referred to as foundation models (FMs). Today's FMs can perform a wide range of tasks that span multiple domains, like writing blog posts, generating images, solving math problems, engaging in dialogue, and answering questions based on a document. When applied to the automotive development process, generative AI could

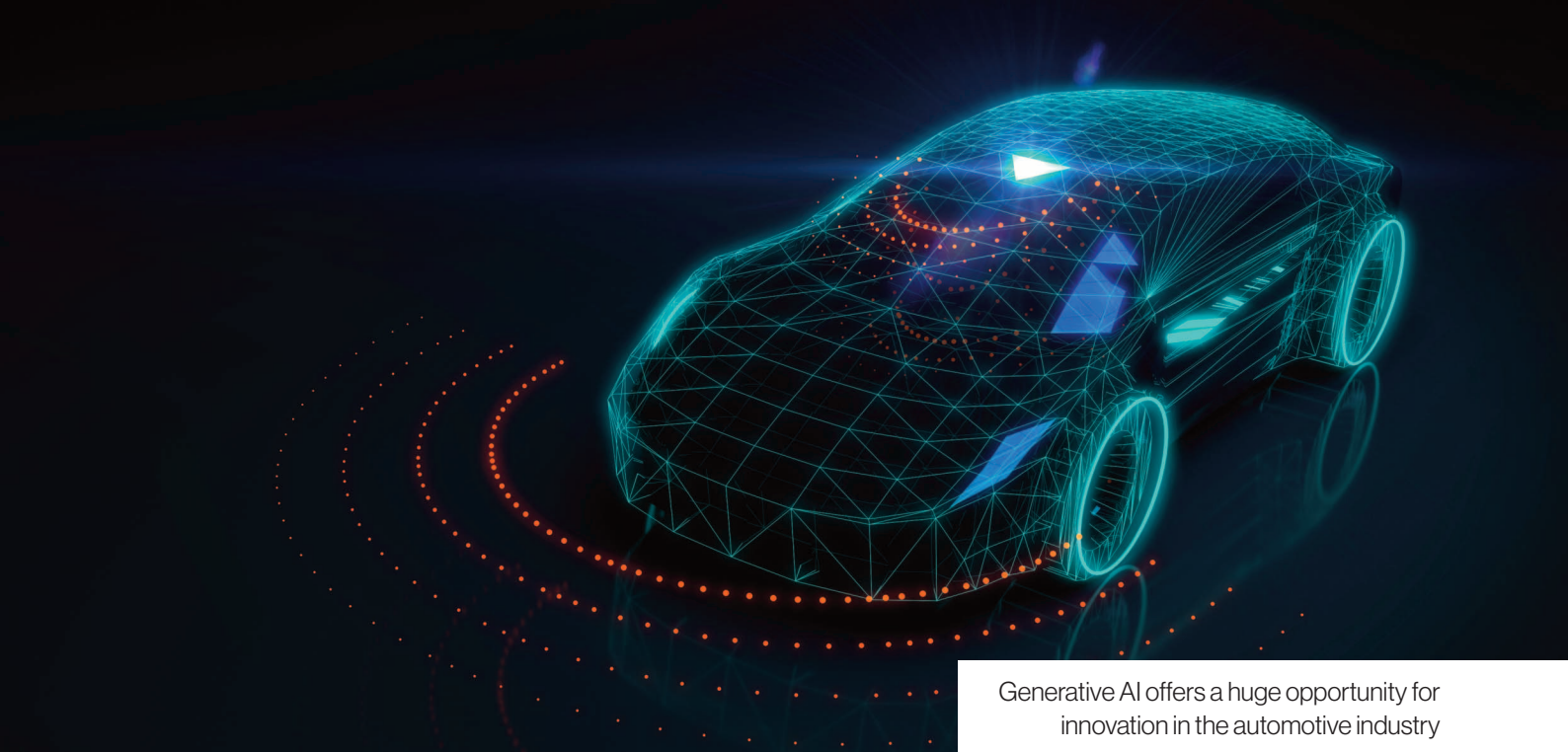
help automakers quickly identify the best design options for complex systems such as engines, lightweight structures, and vehicle features.

## The journey towards software defined vehicles

The automotive industry is increasingly adopting software defined vehicles (SDVs) with millions of lines of code, offering customers an agile and responsive experience. SDVs have the ability to update and upgrade vehicle features through over-the-air (OTA) updates, similar to how smartphones are updated with new features and become better products over time.

Generative AI can be used to create and optimise the software and control systems, as well as to help improve the performance of the vehicle's hardware. As a vehicle's code increases in complexity, it is important for software engineers to focus on developing new, innovative functionalities and not spend their time trying to keep up with a complex and ever-changing tool and technology landscape. Automotive customers can use AI coding companions that use generative AI to help improve developer productivity by generating code suggestions in real-time based on developers' comments in natural language and prior code in their Integrated Development





Generative AI offers a huge opportunity for innovation in the automotive industry

Environment (IDE). This can identify problematic code with high accuracy, and provides intelligent suggestions on how to remediate it.

## Testing autonomous driving using generative AI

Highly automated and autonomous mobility is a major focus of the automotive industry. Autonomous driving requires complex software and hardware systems that must be designed to work seamlessly together.

Generative AI can be an important tool in designing and testing these systems. For example, generative AI may be used by OEMs to create

simulations that test the vehicle's response to various driving scenarios. These scenarios and the accompanied simulated test data can be edge cases that statistically happen so rarely as to not be represented in typical circumstances, or so extreme as to be unsafe to test in real-world (e.g. near miss of a pedestrian crossing at night, in the rain, or in the dark). This is not just an efficiency improvement but will also allow automotive companies to create more test scenarios with the potential to improve the overall system capabilities.

## Cloud computing

Generative AI offers a huge opportunity for innovation in the automotive industry. But it does require a large amount of

computational resources and data, which can be costly and time-consuming to acquire and manage. Customers need performant, cost-effective infrastructure that is purpose-built for ML. This is where cloud computing comes in, helping optimise systems specifically for large scale generative AI applications with models containing hundreds of billions of parameters.

The opportunities afforded by AI and the cloud mean automotive manufacturers now have greater access to powerful computing resources needed to help scale their generative AI capabilities across a variety of applications including designing, training, and testing automated and autonomous driving systems.

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# China's heavy-duty FCEV leadership is a “long-term” play

**China may want to replicate its success with battery electric, but establishing dominance in heavy-duty FCEVs will not happen overnight.**

**By Stewart Burnett**

**C**hina is the largest market in the world for heavy duty trucks, peaking in 2020 with 1.6 million annual sales according to IHS Markit data. Since then, sales volumes have declined considerably due to COVID restrictions, with 2022 recording around 700,000 sales. In a March 2023 report (“China’s heavy-duty truck industry: The road ahead”), McKinsey & Co predicts a strong recovery in the coming decade due to the size and resilience of the national economy.

One of the trends set to define this recovery is a shift towards zero-emission vehicles. The country is already a leader with battery electric vehicles and could soon match that status with hydrogen fuel cells. A 2023 report by the World Platinum Investment Council states that China is

“well positioned to be one of the leading forces in the global fuel cell electric vehicle (FCEV) market, especially in the mass transport and heavy-duty sectors.”

## Fuel cell power

On 23 March 2022, the Chinese government released its plan for hydrogen energy development, which includes a target of putting 50,000 FCEVs on the road by 2025—primarily commercial vehicles (CVs). Juergen Rechberger, Business Field Leader, Hydrogen and Fuel Cell at mobility engineering firm AVL, believes this is the sensible choice. “While battery electric makes sense for passenger vehicles, hydrogen is in a very strong position for heavy duty,” he tells *Automotive World*. AVL is a pioneer in enabling hydrogen-based mobility with subsidiaries, software centres and offices situated throughout China.

One of the biggest benefits is fast refuelling times. Whereas a battery can take hours to charge, refuelling takes only a couple of minutes. Increased energy storage capacity and comparatively lower overall weight could also improve range. Whereas the combined weight of a hydrogen tank and fuel cell stack is around 143.5kg, a truck battery can weigh as much as 7,250kg.

Gregor Sebastian, Analyst at the Mercator Institute for China Studies, voices concerns over manufacturing EV trucks: “Scaling up the production is challenging because demand for batteries in passenger vehicles is already high.” Throughout 2023, monthly sales of passenger EVs have consistently

exceeded 600,000 in China. “In that sense, FCEVs help to deal with scarcity of resources,” he adds.

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While battery electric makes sense for passenger vehicles, hydrogen is in a very strong position for heavy duty

Business intelligence firm Fitch Solutions predicts that a lithium supply deficit could arrive as soon as 2025, driven largely by Chinese battery manufacturers.

## The larger strategy

Tu Le, Founder and Managing Director of Beijing consultancy Sino Auto Insights, believes a supply chain strategy may be unfolding. “The government doesn’t want to single-source the energy side of heavy-duty EVs,” he explains. For instance, a political dispute with Indonesia could see the country significantly short of nickel, a material used in most EV batteries.

Le emphasises that China does not want to be beholden to any country in the long term. By pivoting towards hydrogen, it can reduce its dependence on imports. As part of its hydrogen plan, the country has



invested Yuan 33bn (US\$4.5bn) to build out production capacity of green hydrogen, aiming to produce 100-200,000 metric tons annually by 2025.

As Rechberger observes, China wants to become the global leader in heavy-duty FCEVs. Indeed, the “Made in China 2025” strategic plan aims to transition the country from being a manufacturing dominated economy towards technology leadership. “It is the leader in EVs—and it wants to do the same for fuel cells too.”

According to Le, China’s ability to sustain its long-term commitments cannot easily be replicated in other regions. While the 2022 Inflation Reduction Act has enabled significant advancements for EVs in the US, it is facing political attacks. At a September

2023 rally, likely Republican presidential nominee Donald Trump suggested he would repeal it if elected, and called electrification a “forced transition.”

## A long game

While uncertainty hovers over other regions’ embrace of hydrogen, China has already begun exporting heavy-duty FCEVs—in August 2023, zero-emission CV company Wisdom Motor entered an agreement to export 147 of its trucks to Australia. Affordability will prove a likely driver of the country’s export success. “The cost advantages they have with batteries should carry over,” says Rechberger, pointing towards the country’s lower labour costs and strong domestic supply chains.



Wisdom Motor has entered an agreement to supply 147 heavy duty FCEVs to Australia, marking the largest order of this vehicle type to date

High-scale exports may take time to emerge, however, as other regions need to build out refuelling infrastructure. Major international players have

the company is waiting for China to build up scale before making a play.

Meanwhile, Chinese state oil and gas enterprise Sinopec has pledged to build 1,000 hydrogen stations nationwide by 2025. While Rechberger contests the likelihood of this coming to fruition, citing issues of demand and construction speed, Le remains confident. “The state-owned enterprises’ main goal is not profitability, but to hire people—and agility is their strength.”

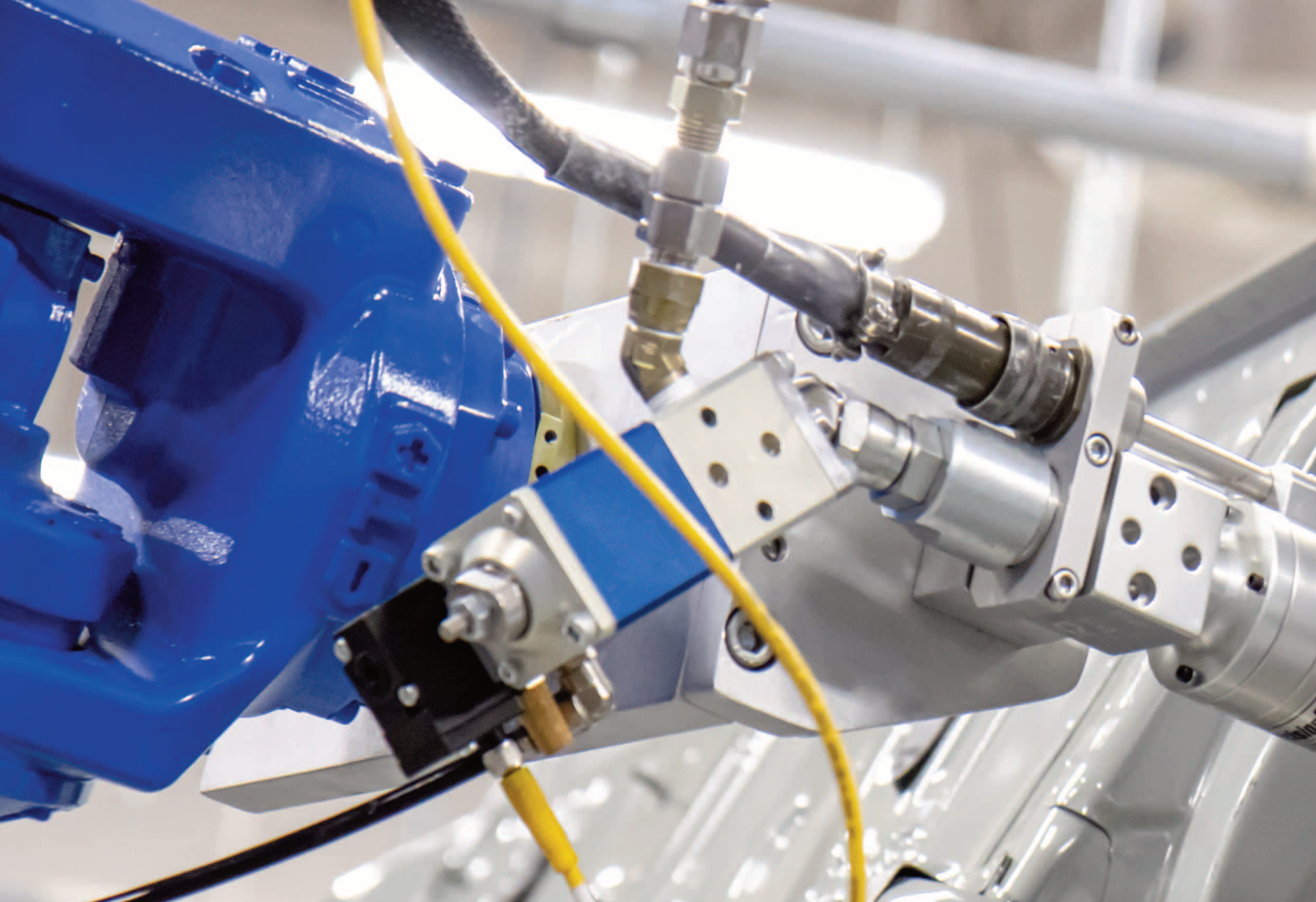
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The state-owned enterprises’ main goal is not profitability, but to hire people—and agility is their strength

Sebastian is mindful of China’s unique advantages in this regard. Ultimately, he believes that China’s leadership in hydrogen is likely but will take time to fully develop. For comparison, the country’s present leadership in EVs can be traced to 2001, when the technology was introduced as a priority research project as part of its Five Year Plan.

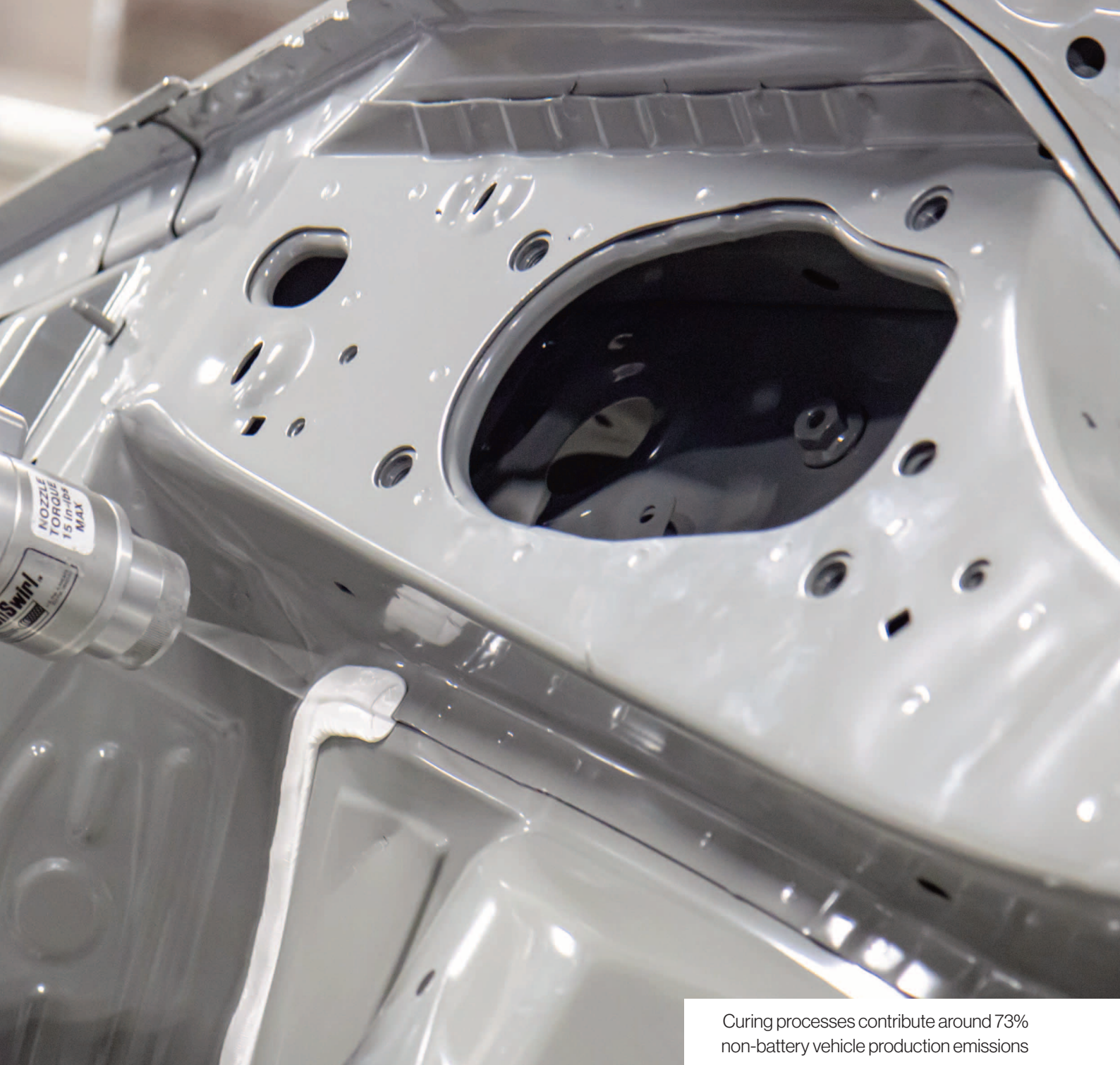
indicated hesitance—Shell confirmed in September 2023 that it has scrapped plans to build 48 hydrogen stations in California, despite receiving US\$40.6m in grants for this purpose. Le suggests

The consensus is that China’s focus will remain on battery electric while investments in heavy-duty FCEVs and hydrogen supply chain continue. “In ten years, I think China will still be at the beginning of this phase,” Sebastian concludes.



# Can sealants and adhesives help make Net Zero a reality?

With more and more OEMs setting Net Zero targets, Sunstar Engineering promises adhesives and sealants that halve curing emissions. By Stewart Burnett



Curing processes contribute around 73% non-battery vehicle production emissions

**A**s electrification gathers momentum in the automotive industry, numerous steps have been taken to ensure vehicles are as sustainable as possible throughout their entire lifecycle. In the EU, for instance, the 2021 'Fit for 55' package mandates greater

supply chain transparency and digital passports that provide comprehensive information on a battery's lifetime emissions. Battery production comprises a dominant proportion of electric vehicle production emissions—McKinsey estimates around 40-60% in research dated February 2023.

However, other avenues for emission reduction exist: curing processes account for 73% of all non-battery related emissions, according to research conducted on behalf of General Motors in 2013. Several attempts have been made to reduce these emissions in recent years, including by Sunstar

Engineering, a subdivision of Sunstar Group that, among other things, develops sealants and adhesives for use in automotive. The company believes it can drive reductions of up to 50% through its innovations in low-temperature and low-energy curing solutions.

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These products could lower OEMs' energy costs by around 50%

## Less time, lower temperatures

Stephen Howe, R&D Director for Sunstar Engineering Americas, strikes a note of urgency on sustainability. “OEMs need all the help they can get to stay ahead of their targets,” he tells *Automotive World*. Today's average vehicle, by his estimate, consumes 1,150-1,500kW of energy curing adhesives following the electrodeposition coating (ecoating—a method of painting that uses electrical currents for surface application), and a further 750-1,100kW curing adhesives and sealants in the paint shop. “Those two processes use most of the

energy in a manufacturing plant by far,” he remarks.

Weld bond adhesives are cured alongside the ecoat and can take up to 50 minutes, with ovens running as high as 200 degrees Celsius. To meet the needs of lower-temperature ecoat processes, the company developed a proprietary adhesive technology that can both lower curing temperature and time-in-oven. According to Howe, it can work as low as 130 degrees Celsius, saving up to 50% energy in the body shop.

Likewise, Sunstar's innovations in body sealants aim to reduce overall paint shop emissions by around half. Using one-component PVC sol/acryl sol materials means that multiple wet-on-wet coating applications can be applied quickly and baked simultaneously, saving multiple rounds of oven curing. Furthermore, while paint shop ovens normally run 130-150 degrees Celsius, Howe claims the company's latest body sealants can be cured as low as 80-100 degrees Celsius.

## Lighter is better

The lightweighting of sealer materials is also important for lowering lifecycle emissions. This is, in part, because lightweight materials can be easier and quicker to cure. However, some older generations of these materials have been problematic, particularly those using polymeric glass bubbles to capture and trap air. When sprayed on, the glass would often break, damaging application equipment and costing OEMs their sealant density targets. The weight savings are, effectively, cancelled out.



According to Nicholas Huff, Sunstar's Team Leader of New Technology Development, many OEMs came to avoid using lightweight adhesives and sealants. "It was far too much of a headache for them," he remarks. To tackle the issue head-on, Sunstar partnered with 3M (the inventor of the glass bubbles), which improved the crush strength of its glass from 5,500psi to 7,000psi. Once implemented into a new material, the company turned to equipment manufacturers Graco to identify process parameters that would nearly completely prevent glass breakage. "Optimising those parameters, we found, was more important than anything else."

Lightweight sealers, when properly implemented, help lower lifecycle vehicle emissions by increasing fuel efficiency and extending battery range. According to the Environmental Protection Agency, every 45kg of weight removed from a vehicle leads to 1-2% fuel savings. If adhesives and sealants can deliver reductions on this scale then, "you end up with billions of pounds less CO2 being emitted—just by shaving off that tiny amount of weight."

## **Sustainability and affordability**

In order to make eco-friendly solutions a viable option for OEMs, it is also important to prove they can offer optimal results at a lower cost. Howe emphasises that Sunstar's sealants and adhesives meet both of these criteria. While offering equal or superior results to their legacy counterparts, its products can also offer significant savings.

For Howe, the benefits are straightforward: less time and lower temperatures means a lower energy bill. "These products could lower OEMs' energy costs by around 50%," he claims. Although energy prices fluctuate from state to state in the US, this could bring per-vehicle

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Every 45kg of weight removed from a vehicle leads to 1-2% fuel savings

energy costs from US\$130-\$140 to around US\$70. When the volume of vehicles an automaker produces per year is factored in, "that's a whole lot of money."

Beyond sustainability and cost-effectiveness, the next most important concern for OEMs is customisability. As Howe explains, targets for temperature, weight and sealant density will vary from client to client. As such, a willingness to collaborate is key to Sunstar's sustainability mission—and to achieving Net Zero within auto manufacturing-at-large. "The future is coming fast. Really—it won't wait for us," he concludes.

# **A healthier car starts with automotive interior materials**

**Studies suggest that ‘new car smell’ is deleterious to car owners’ health, but a material additive could help eliminate the problem. By Will Girling**

**T**he automotive industry is gradually converging with health and wellbeing trends as new technology enables OEMs to incorporate next generation features.

This is especially true in the luxury segment. For example, in 2022, Bentley added seats with massage and posture correction functions to help reduce driver muscle fatigue in models such as the Bentayga and Azure. That same year, Chinese start-up automaker BeyonCa [announced](#) that its GT Opus 1 would include a ‘personal health guardian’ to monitor the driver’s status and provide professional medical advice if necessary.

But will this focus on health soon extend beyond the luxury market? Hugh Rathbone, Chief Commercial Officer at supramolecular chemistry company Aqdot, believes that it could soon become an important brand differentiator across the industry. However, instead of introducing advanced in-cabin tech, it will start with a new approach to manufacturing interior materials.

## Focusing on air quality

Improving air quality by removing pollutants and odours has been Aqdot’s focus since it launched in 2013. Originally spun-out from the University of Cambridge by researchers Chris Abell and Oren Scherman, the company closed its £11m (US\$14.37m) Series C funding round in November 2021.

Rathbone reports that OEMs are increasingly concerned with reducing the odour of interior trim,

and the COVID-19 pandemic has served to elevate its importance even further. “Awareness of air quality increased dramatically with COVID,” he states. “It started with viruses, now it’s about pollutants.” In 2021, a study by the University of California explored the effect of off-gassing (the release of trapped gases from materials) in vehicle interiors—commonly described as ‘new car smell’. It found that carcinogens such as formaldehyde and benzene reached levels unsafe for humans after just 20 minutes of driving.

Aqdot’s core powdered product, AqFresh, uses patented technology based on cucurbiturils. A mixture of these molecules can quickly bind to and eliminate a variety of volatile organic compounds (VOCs) and pollutants in the air. “The power of this technology has been known for 100 years, but the complex chemistry meant it was very difficult to make,” Rathbone tells *Automotive World*. “For five or six years, our founders learned how to manufacture it at multi-tonne scale.” This subsequently made it cheaper to produce and was the first step to introducing it to the automotive industry. Commercialisation began around the same time as the pandemic in early 2020.

## AqFresh

The versatility of the AqFresh additive enables it to be applied wet or dry, from paint to plastics, textiles, and air fresheners. This provides automakers with a broad range of incorporation points, including door panels, carpets, seats, and headliners.



Used as a direct coating for polyvinyl chloride (PVC), an industry standard VDA 270 odour test found that it could reduce odours and VOCs from 3.4 points in the control (clearly perceptible) to 2.1 points (barely perceptible). As a transfer coating, the result was a reduction from 3.7 points (disturbing) to 2.7 points (not disturbing). Similarly, a polypropylene (PP) dashboard containing AqFresh brought down malodour levels from 3.7 to 2.3 points. Rathbone concedes that the subject material affects the overall speed at which Aqdot can provide an efficacious formulation. For instance, the simplicity of PP is unchallenging, whereas the various additives of PVC can add greater complexity to the process. However, the true challenge could prove to be growing industry awareness of the issue being resolved.

According to an Aqdot customer survey, 70% of automotive customers in Europe are currently concerned about the air quality of vehicles, but this falls to 52% in the US. “Americans seem to actually love ‘new car smell’,” observes Rathbone. Although US consumers might take some educating, he believes that reports of the associated health risks are gaining greater exposure. Research published in April 2023 by the Beijing Institute of Technology (Haimei Wang, et al) on the potentially increased risk of cancer from car interior VOCs was covered that same month by Forbes and the New York Post. “The awareness among both consumers and automakers is certainly changing,” he asserts.

## A healthier car

While the importance of the issue is still nascent elsewhere, the Chinese industry is taking it far more seriously. China, states Rathbone, has been particularly conscious about indoor air pollutants because of deaths related to materials historically used in building construction over the previous decades. 84% of Chinese car owners are concerned about VOCs, according to Aqdot. This has filtered through to the nation's

smell', with almost the same number willing to pay extra to avoid it. Such a strong consensus is influencing business decisions. Although he cannot disclose specifics, Rathbone tells *Automotive World* that his company is currently working with "three OEMs, some of the largest car interior part Tier 1s, Tier 2s, and some rigid plastic Tier 3s." These partnerships include proof-of-concept work and joint development agreements concerning malodour elimination and air purification.

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The awareness among both consumers and automakers is certainly changing

automotive market, the size of which, Rathbone believes, could have the scale and influence necessary to tackle the issue globally. "China is setting the regulatory requirements and standards for European and US manufacturers, as well as domestic ones."

There is evidence to suggest that this could eventually translate to a vector for competitive advantage. The same Aqdot survey also found that 77% of Chinese customers would be more likely to buy a car without 'new car

For insight into how focusing on driver/passenger health and wellbeing could transform the global automotive industry, Rathbone concludes that European and US automakers should observe the Chinese market. "Almost every car in China has charcoal pouches to capture VOCs. These only have a marginal effect, but consumers are prepared to pay for them. If that demand can be met instead by creating augmented interior materials, we can provide better efficacy and a healthier car."



# **Renewable functional fillers boost vehicle lightweighting**

**To create lighter vehicles with a lower carbon footprint, OEMs need to re-examine the material composition of elastomers and plastics. By Will Girling**



**T**he impending ban of internal combustion engine vehicles in several markets and the subsequent investment in electric mobility are two of the major movements in an industry-scale push for more sustainable transport.

Industry engagement on larger issues is also becoming more nuanced as OEMs take their focus beyond tailpipe emissions. Many are actively exploring [circularity](#) as a means to both secure and decarbonise critical material supply chains. However, to create fundamental change, automakers and suppliers will need to simultaneously ‘think big’ and ‘think small’ on material sourcing and composition.

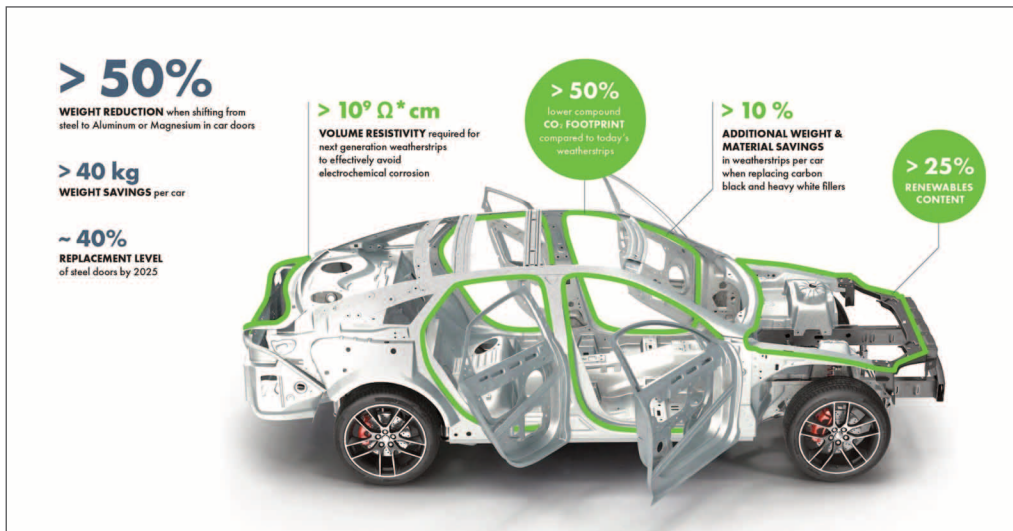
Martin Ledwon, Vice President of Sustainability at Tier 3 supplier UPM Biochemicals (UPM), tells *Automotive World* that the next step is to tackle essential but less obviously environmentally deleterious materials, particularly elastomers (hoses and seals) and thermoplastics. Doing so, he

argues, could yield benefits that go beyond general sustainability concerns and produce lighter, more efficient electric vehicles (EVs).

## De-fossilising functional fillers

Carbon black—a fine powder resulting from the partial combustion of hydrocarbons—is a versatile substance that has automotive industry applications ranging from EV batteries to polymers and metallurgy. However, because it is reliant on burning fossil fuels like crude oil, producing carbon black can contribute to environmental pollution. If using an oil furnace, the US Environmental Protection Agency notes that particulate matter, carbon monoxide, nitrogen oxides, and sulphur compounds are among the emissions released.

UPM calls common variants such as thermal black and furnace black “functional fillers”, which are used to bulk out products made from materials like plastic and rubber.



UPM suggests that using RFFs can unlock direct and indirect lightweighting opportunities throughout a vehicle

“A rubber hose, for example, could contain 30-40% rubber depending on the formulation. But what makes up the rest? The answer is functional fillers,” states Florian Diehl, Senior Manager of Sales & Marketing at UPM. The company’s solution was to develop a renewable functional filler (RFF)—UPM BioMotion—based on beech wood sourced from sustainable forests near its facilities in Leuna, Germany. UPM also uses the same basic material to produce [glycol for creating EV coolant](#).

“RFFs resonate with automotive industry sustainability megatrends. However, everyone is talking about decarbonisation, and that isn’t possible in the materials sector, which inherently deals with carbon as an irreplaceable element,” highlights Diehl. Therefore, UPM believes that the emphasis should instead be placed on de-fossilisation. By eliminating fossil fuels through the use of wood as a renewable feedstock for the material production process, it claims that BioMotion has at least a 90% smaller carbon footprint

compared to traditional carbon black options. From late 2024, its €750m (US\$835m) biorefinery is expected to produce 220,000 tonnes of renewable chemicals annually, including RFF, through carbon neutral operations.

## Lightweighting

The quantifiable product CO<sub>2</sub> reduction achieved using RFFs is likely to be welcomed by automakers increasingly focused on substantiating their eco credentials through [traceability](#). However, Diehl considers that the benefits for e-mobility go much further. “This is a new class of fillers; it has its own performance profile. The density is significantly lower than inorganic materials or traditional functional fillers like carbon black—between 25% and 50%—so manufactured final products are much lighter.” Importantly, UPM claims there is no performance trade-off when substituting for a traditional functional filler, which means automotive material supply chains can pivot quickly.



Although Ledwon concedes that part of UPM's near-term challenge will be to build industry enthusiasm for a relatively new product, he expects the market for fossil fuel-free elastomers and plastics to become highly competitive. Indeed, there are already several players exploring similar concepts. Novelis is using [bioplastics and additive manufacturing](#) to lightweight EVs, facilitating both cost savings and easier recycling. Meanwhile, Swiss cleantech Bcomp is working with BMW, Porsche, and Volvo Cars on [organic composites](#) for both interior and exterior applications.

UPM is working across the automotive value chain—from OEMs through to Tier 2s, depending on the application—to help raise awareness of the raw material's benefits. Although he cannot provide too many specifics at the time of writing, Ledwon discloses that some of the company's active partnerships include sealing systems specialists like Standard Profil and SFC Solutions. Stellantis, adds Diehl, is the first OEM ready to "release a global specification" for the use of BioMotion in some of the rubber products employed in its vehicles.

## Endless opportunity

Although RFFs are just one part of overall vehicle lightweighting, Diehl believes that incorporating them as a supplement to other efforts could significantly boost overall vehicle fuel/energy efficiency. For example, although switching steel in doors for lighter metals like aluminium or magnesium might be desirable, either would cause galvanic corrosion if in contact with other steel components. An OEM would

subsequently require non-conductive seals for the change to be made. Since traditional seals would add to a vehicle's weight and carbon footprint, they essentially dilute the positive effects of the change. On the other hand, seals made from RFFs

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These components are only the beginning—the opportunities are endless

like UPM BioMotion can be part of a virtuous cycle that enables lightweighting and a cleaner supply chain in the first instance while also creating further opportunities throughout the car.

The company gave an insight into the diversity of its product at Reuters' Automotive Europe 2023 conference in May. Weatherstrips, hoses, precision sealants, all interior and exterior plastics, and car bumpers were among the traditionally crude oil-based products that could be replaced with cleaner and lighter UPM BioMotion RFFs. "Our long-term vision is to be able to completely replace any synthetic material that's fossil based," concludes Ledwon. "These components are only the beginning—the opportunities are endless."

# EV players must collaborate on integrated battery cooling

Sunstar Engineering believes that the future of battery thermal management demands cutting-edge adhesives and an integrated approach.

By Stewart Burnett

**F**or the manufacturing world, electric vehicle (EV) batteries pose a variety of unique design considerations. Temperature regulation, for instance, is crucial in ensuring battery longevity and safety. A 2019 study by the American Automobile Association revealed that operating temperatures outside the optimal range of 20-40 degrees Celsius can reduce a battery's range by 10-12%—and even as much as 41% if HVAC is used to regulate heat. Poor temperature regulation can also lead to thermal runaway, with fires that burn up to 1,000 degrees Celsius.

Nicholas Huff, Team Leader of New Technology Group at Sunstar Engineering Americas, believes that effective thermal management “requires an integrated solution from all the players involved.”. This includes all players involved in the battery cell chemistry: the pack manufacturers, electronics companies, OEMs, and adhesives companies. Focusing on the latter, Sunstar Engineering aims to facilitate the next generation of batteries through new innovations in thermally conductive materials.

## All in the chemistry

One of the biggest challenges in supporting the thermal regulation of batteries is

finding the most suitable compound for the adhesive mix. “There are as many chemistries as there are applications,” says Huff. Most adhesives have poor thermal conductivity on their own, but there are numerous additives that can be used to enhance their efficacy.

Polyurethanes, for example, have strong thermal properties and can double as a flexible underfill to connect components. Metal particles such as aluminium, silver and copper are among the best thermal conductors—however, these are a risky solution for batteries as they also conduct electricity. This could lead to a battery being shorted or the formation of an electric arc—a discharge of electricity between gaps in a circuit.

Ceramics, Howe highlights, do not have this issue. Boron nitride is a ceramic nitride that can conduct heat well without risk of discharge, but it is expensive. Ceramic oxides like alumina are cost-effective but less thermally conductive. However, depending on the heat generated by a battery pack, and the manufacturer's budget for the adhesive, ceramics can still prove an effective solution.

Huff believes that some of the most promising research has explored materials enhanced with silicon and carbon nanoparticles. “In terms of the more experimental applications in battery

packs, these materials are of great interest.” Indeed, carbon nanotubes can increase the thermal conductivity of a synthetic oil substrate (used in liquid battery cooling) by 156%, according to a 2022 study featured in the journal *Biomass Conversion and Refinery*.

Ultimately, Huff remarks, there is no concrete answer as to which chemistry is most optimal for use in battery adhesives. As battery technology continues to develop, new compounds will need to be developed to meet their changing specifications and thermal requirements. Going forward, he emphasises that thermal conductivity will only be part of the equation.

## Facilitating second-life

The increasing demand for sustainability in batteries means that it is also important to ensure that the adhesives used facilitate second-life use and recycling. Being able to extract and repurpose materials such as lithium necessitates the use of a ‘debondable adhesive’, which, when exposed to certain conditions, will lose its bonding properties and allow a battery pack to be opened.

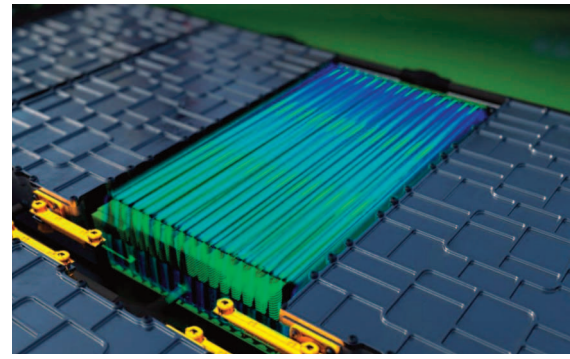
“The trick is making sure that those conditions don’t come up during the battery’s normal usage,” Huff states. Sunstar Engineering is currently working on a project

with an unspecified major OEM to deliver a suitable debondable adhesive. Sunstar Engineering is also investigating options with an unnamed university to make a bio-based version of this foaming material that sources its polymers from nature. “We hope to implement this technology for next generation battery designs,” he says.

## It’s a team effort

Adhesives cannot effectively cool a battery in isolation. Thermal management systems for EV batteries have been the subject of intensive research and testing in recent years. Huff believes some of the most promising developments have been in liquid cooling. Direct liquid cooling (where cold water is continuously fed through a battery-mounted plate) has been shown to offer more effective thermal transfer than indirect liquid cooling or air cooling. More advanced sensors are also being developed that can isolate potentially faulty cells and shut them down before thermal runaway occurs.

Adhesives companies can act as facilitators for such developments. “As battery pack designs change to enable better cooling strategies, adhesives must also change to incorporate better performance and handle the thermal and mechanical stresses inherent to new applications,” Huff explains.



Direct liquid cooling has been shown to offer more effective thermal transfer than indirect liquid or air cooling

In direct liquid cooling, for example, the cooling plate cannot make direct physical contact with the battery itself, as it will quickly lead to overheating. Instead, a compatible intermediary adhesive must fill the gap between the two parts to ensure that temperatures remain stable. The higher the thermal conductivity of the paste, the more efficient it will be in heat dissipation. Furthermore, the volume of material depends on the expected thermal load from the battery, the heat capacity of the plate, and the conductivity of the paste itself.

There is no one-size-fits-all solution for every use case. As EVs continue to evolve, Huff concludes that it will be essential for all industry players to collaborate on integrated thermal management systems that meet the changing requirements of batteries. “The EVs of today won’t be like the EVs of yesterday. The successful transition to electrification will be a community-wide effort.”