Automotive World

Electric mobility MAGAZINE

Issue 4 | March / April 2025

Ampere accentuates EV drive experience in Renault 5 E-Tech

SimScale decentralises engineer simulation tools | **Mercedes-Benz** recharges EVs using solar paint | **NXP** highlights the importance of IC consolidation | **Factorial** brings **Stellantis** closer to solid-state batteries | **Electreon** expands dynamic wireless charging | **Rept Battero** enables CV affordability with modular system

SIMSCALE

Optimize EV Designs Faster with **AI-Powered Cloud Simulation.**

The limits of automotive innovation aren't physics—they're your CAE tools.

Cloud-Native
True SaaS with instant access from anywhere, at any time.

Any Scale
No limits to simulation size. From one-off runs to design space exploration.

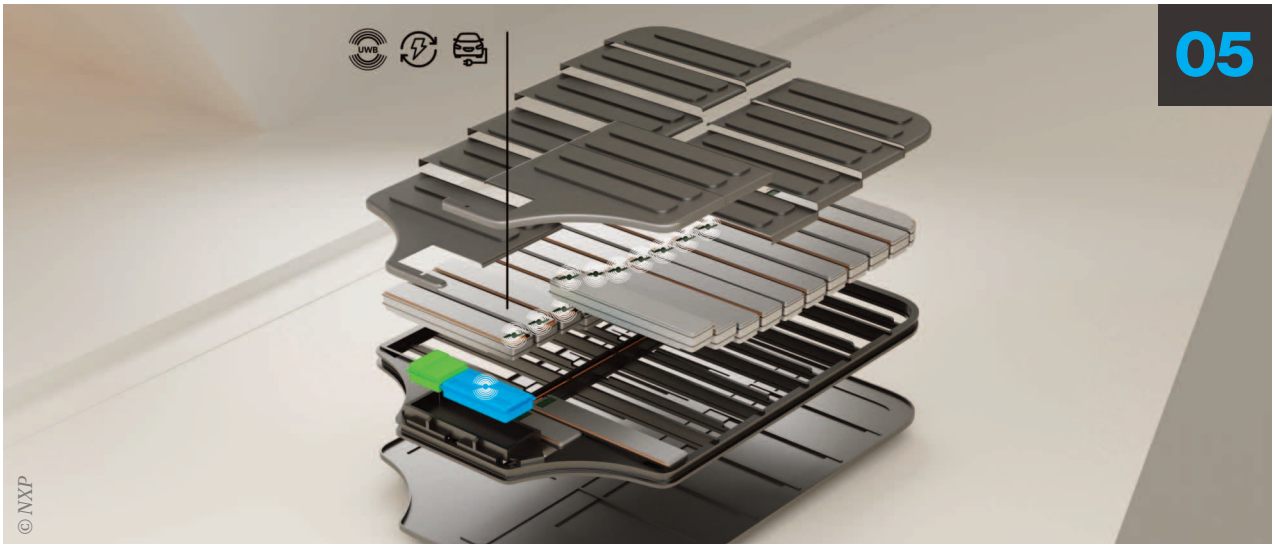
AI-Powered
All data on SimScale ready for AI training and inference.

One Platform, Broad Physics
A single platform for both early and late-stage simulations.

Real-Time Collaboration
In-app support and sharing simulations with colleagues.

Explore SimScale's Automotive Solutions

IN THIS ISSUE



Automotive World

Automotive World
1-3 Washington Buildings
Stanwell Road, Penarth,
CF64 2AD, UK

www.automotiveworld.com
support@automotiveworld.com

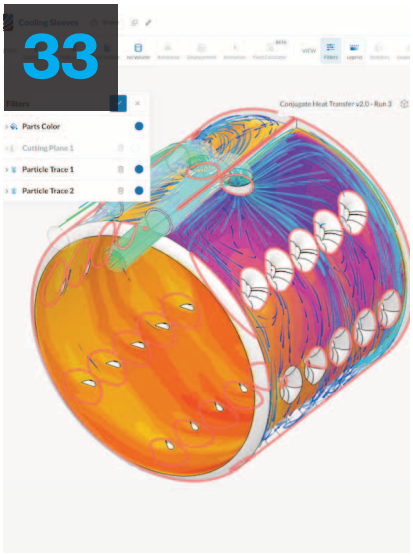
Registered number:
04242884
VAT number: GB 815 220 173

CEO & Managing Director:
Gareth Davies

Contributors:
Will Girling
Stewart Burnett
Megan Lampinen

Production:
Anmol Mothy

Cover image courtesy of Renault



IC-level consolidation expands the field of EV innovation

Integrated circuit players like NXP believe system consolidation efforts can save OEMs costs, boost time-to-market, and help EV adoption. By Will Girling

The importance of integrated circuits (ICs) in modern vehicles has been clear ever since the production disruption caused by shortages in 2021/22. Today, an electric vehicle (EV) could contain up to 3,000 semiconductors—between three- and ten-times more than an equivalent internal combustion engine model. The global automotive IC market, valued at US$54.6bn in 2024, is expected to reach US$120.6bn (+121%) by 2031, according to Verified Market Research.

As EV architectures become increasingly complex, more semiconductors will likely be required. However, some chip companies experienced setbacks in 2024, as new trade policies and dips in consumer EV uptake caused automotive demand for ICs to decelerate.

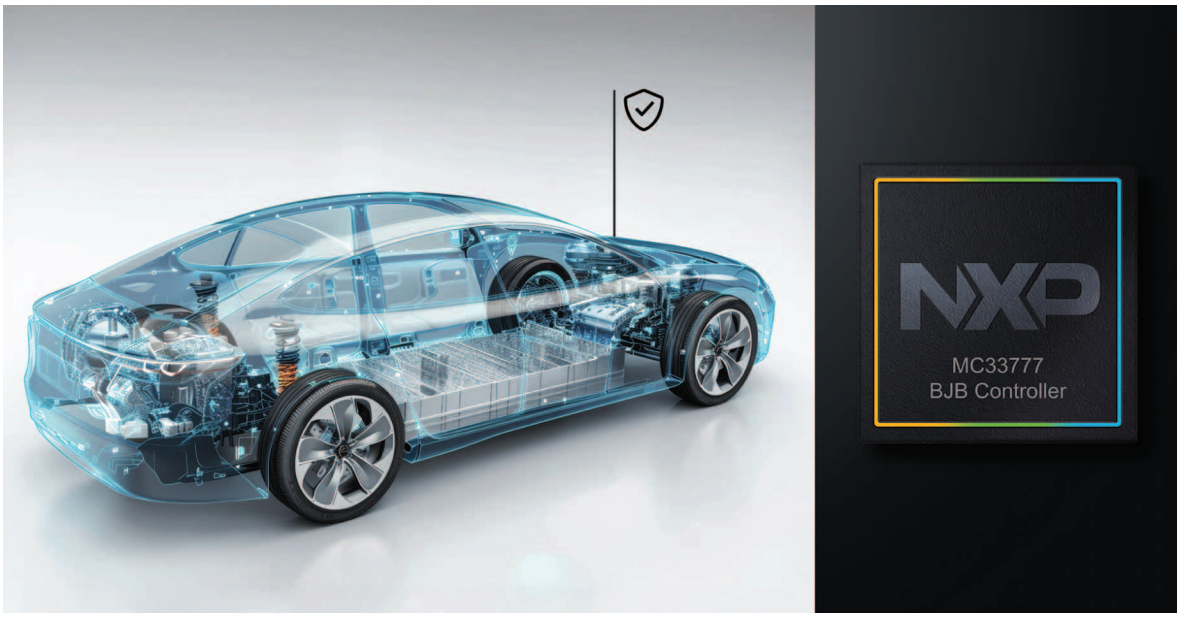
To regain the market, manufacturers have a three-fold task: prove their offerings can save automakers money, improve EV functionality, and build more attractive products.

Focus on efficiency

The majority of industry stakeholders consulted by *Automotive World* concluded that batteries are the single key technology that could take EVs into the mainstream. As such, optimising this vital component is a logical focus point for IC developers.

A battery management system (BMS) monitors the cells and modules that make up an EV battery. It plays a vital but challenging role: ensuring the safety, reliability, and overall health of the powertrain. A BMS does this by actively optimising performance, estimating a battery's operational state, and relaying important information to other devices within the vehicle. As battery technology evolves, BMS advancement is needed in tandem.

Naomi Smit, Vice President and General Manager of BMS at NXP, notes that these systems are becoming increasingly complex, yet legacy automakers must balance this with the desire for faster time-to-market and stringent safety requirements. Meanwhile, competition is heating up: "New players in the space are accelerating the development model while still keeping BMS costs low and maintaining vehicle margins." Therefore, established manufacturers must seek new solutions to keep up with the market.



NXP states that its MC33777 is the first battery junction box IC to combine several important monitoring and action capabilities on one device

Instead of a siloed issue, she encourages automakers to consider BMS enhancement from a holistic perspective. The drive for greater efficiency is becoming a call to arms among many EV component suppliers—one that could ultimately help remedy prevalent issues concerning range, production cost, and system reliability. In this wider context, redefining BMS technology through IC innovation could be transformational in terms of EV performance, safety, and desirability.

The value of IC-level integration

In September 2024, NXP introduced the MC33777, which it claims as the first battery junction box IC to combine "sense, think, and act" capabilities on a single device. These enable continuous battery monitoring cycles every eight microseconds, allowing the chip to detect and react to overcurrent scenarios up to ten times faster than previous generations of ICs. Across the life of an EV, NXP's product can help prevent incidents of melting fuses, which present a danger to drivers on the road and are often highly costly for automakers and Tier 1s.

"The MC33777 represents a shift from passive to active reaction speeds," says Smit. "The decision to activate a pyro-fuse during a high-voltage event is made instantly." Pyro-fuses facilitate the shutdown of electrical currents in safety-critical situations, and NXP designed the chip in collaboration with partners who wanted to incorporate them. Prior to creating its own, NXP could not find a pyro-fuse driver on the market. Rather than create a singularly dedicated IC for this purpose, which would be cost inefficient and add system complexity, the company decided to combine it with temperature and voltage sensor functions.

By adopting this approach, the MC33777 combines several monitoring and remediation functions in one, reducing the number of BMS components overall by 80%. Although she cannot quantify cost or time-to-market improvements, as these

> **ICs help expand the field of innovation, but it's going to take the entire ecosystem working together to take EVs into the mainstream in every market**

will inevitably vary according to each automaker's existing technology, Smit does state they could be significant. "Fewer components means fewer things to consider at the design, test, and validation stages."

A consolidated chip also means more available space on the printed circuit board. Since many modern EV batteries are "highly congested", Smit suggests this could increase design flexibility. Furthermore, by running BMS software functions on the MC33777 instead of alongside it, automakers can save R&D costs in a discipline that many are struggling to integrate with their legacy organisational structure.

The future of consolidation

IC-level consolidation is becoming a common theme across the automotive industry—there are parallel discussions also occurring in the software-defined vehicle (SDV) space. At the same time, Smit states that these efforts must still be considered carefully. "There are clear benefits, but it depends on specific functionalities. Significant investment is required from IC players, and product flexibility can be limited in some ways. If something is integrated, customers have less choice when purchasing."

However, she emphasises that battery safety and communication capabilities will almost certainly benefit from consolidation. Standardising the "logic" of how these operate on an industry level will save costs by mitigating complexity and streamlining vehicle platforms. Notably, these are also areas where EV and SDV development currently intersect: how EV systems are streamlined is part of the ongoing transition from domain to zonal architectures, as automakers must reconcile new features with a limited power supply.

While Smit stops short of calling IC-driven consolidation the silver bullet for growing EV adoption, she notes that the impact potential is compelling. "The main barriers to growing the EV market are range, the availability of charging infrastructure, and cost. IC players are tackling two of those: extracting as much performance from the battery as possible and enabling system cost reductions that also accelerate time-to-market. However, we can't do it alone. ICs help expand the field of innovation, but it's going to take the entire ecosystem working together to take EVs into the mainstream in every market."

Can modular battery systems spur CV electrification?

Rept Battero's Big Bank modular battery system enables affordability through modularity, without compromising on range or charge times. By Stewart Burnett

The electrification of commercial vehicles has been slower than other vehicle market segments. A range of factors, from limited charging infrastructure and slow recharging times to high upfront costs and limited range, have discouraged the majority of carriers from taking the plunge. The heavy-duty segment lags furthest behind, with electric vehicles (EVs) accounting for just 1% of all new truck sales.

Amid rising competition from other alternatives to diesel, including hydrogen and liquefied natural gas, battery makers must work to ensure their solutions provide the best value of all low-carbon options. In September 2024, Chinese battery maker Rept Battero introduced its new Big Bank battery system, intended to facilitate electrification of the commercial vehicle segment. Targeting the European market, Big Bank offers flexible combinations of individual packs to accommodate the electrification of all vehicle types affordably. But what makes this solution particularly well suited to addressing the challenges of decarbonising commercial road transport?

Density and range

"We are very confident in the electrification of commercial vehicles," remarks Kang Du, Commercial Vehicle Business Director at Rept Battero. "But we recognise that Europe is not progressing as quickly as China. We developed the Big Bank to help accelerate that transition."

In terms of raw power, the Big Bank system sits at the higher end of lithium-ion battery technology: with an energy density of 210

Wh/kg, each individual pack provides 50 kWh of power. An individual pack is boxy and rectangular in shape, with a large heat sink occupying the mid-section. These packs can be combined or 'stacked' together to create a battery system that maxes out at 500 kWh, enabling a range of 600km in a heavy-duty truck.

Rept Battero has directed particular attention to maximising the utilisation of space inside its packs to ensure maximum energy storage. In 2022, the company introduced the Wending battery, which uses a proprietary approach to increase space utilisation by more than 7%. This technology has been carried forward into the Big Bank system and is ready to meet larger scale demand. "We've heavily invested in automation and precision on our production lines," Du tells *Automotive World*.

At the same time, the company has worked to ensure that its battery system can be charged quickly and efficiently, regardless of configuration. It has enabled 2C fast charging, allowing the flagship 500 kWh configuration to recharge from 10% to 80% in approximately 18 minutes. A useful life of more than 5,000 charge cycles and an estimated service life exceeding ten years could help assure fleet operators as they weigh the merits of purchasing an e-truck.

Modularity and affordability

While other battery makers may be able to compete with the Big Bank system on range and charging speed, its main point of differentiation is flexibility. The modular approach to battery pack assembly allows for larger battery systems to be assembled quickly and efficiently from smaller individual packs. This helps drive value that can be passed onto Rept Battero's customers through cost savings at no compromise to performance.

© *Rept Battero*

"Ultimately, the Big Bank is just a collection of single packs. It's what you can accomplish by combining them that makes it compelling," says Du. "Depending on the configuration, you can meet the different energy requirements of a range of commercial transport needs." In this sense, the system is compatible with trucks of all sizes, as well as smaller commercial transport vehicles like vans. The ability to purchase different configurations at scale will, in turn, also make it easier for truck makers to lower their sticker prices.

Du acknowledges that pure battery electric may not be the only path forward for commercialising the road transport sector. "It's clear that multiple technology pathways exist. However, we remain committed to the electric fleet." Meanwhile, Rept Battero offers an alternative 'sister' solution to the Big Bank system for plug-in hybrid trucks: the Green Bank.

> **To be frank, we own the mining resources—our competition has to buy them**

Substantially smaller and flatter than its pure-electric counterpart, the Green Bank system allows a 10-55 kWh power range, depending on configuration.

While the carbon saved won't be as substantial as pure battery electric, Rept Battero still claims Green Bank can reduce fuel consumption by more than 35%. This could make it a compelling solution for those interested in electrification but wary of limited charging infrastructure and e-trucks' higher sticker price. Both the Green Bank and Big Bank systems are capable of cold starting in temperatures as low as minus 35 degrees Celsius.

Leveraging the trade environment

Both Big Bank and Green Bank benefit from strong vertical integration through Rept Battero's parent company, Tsingshan Group. This offers a significant advantage over other battery manufacturers: "To be frank, we own the mining resources—our competition has to buy them." In addition to investments in lithium mines in Zimbabwe, the company controls nickel and cobalt. This helps make Big Bank more affordable than alternative solutions while still commanding strong margins.

Looking ahead, Rept Battero faces potential challenges due to the ongoing trade war between the EU and China. Currently, the EU imposes duties of 10% on all EV batteries imported into the bloc. While this is lower than the US (25%), trade tensions between the two regions concerning EV imports could eventually reach batteries. Some groups in the EU are advocating for tariffs: Transport & Environment recommends a tariff hike on Chinese battery to 20% by 2027 to incentivise onshoring. At the time of writing, most Western automakers rely on China for batteries.

Du acknowledges the challenging nature of establishing international business amid regulatory headwinds, and Rept Battero maintains an open mind about onshoring in Europe. In his view, a bigger obstacle to commercial fleet electrification is the removal of subsidies on e-truck purchases in Germany and Sweden, which he believes has slowed the EV transition. "This means growth will be more steady, but there is still a huge market waiting. This will still provide great growth opportunities for companies like ours."

Rept Battero's strategy could already be bearing fruit, as its modular approach that focuses on range and affordability is garnering attention from major truck makers. "They're very interested in the Big Bank system. We're still sharing data and information, but we think there is a bright future here for this technology," concludes Du.

Onshoring LFP raw materials could unlock affordable EVs

A partnership between GKN Hoegenaes and First Phosphate aims to deliver a world-first North American supply for LFP batteries. By Stewart Burnett

Establishing a domestic electric vehicle (EV) supply chain has been a key strategic goal for the US in recent years. While the return of President Donald Trump could potentially slow down EV adoption, he shares his predecessor Joe Biden's affinity for strengthening US manufacturing and local supply. China may have a strong lead in numerous aspects of EV production, but the US aims to become a significant competitor.

Lithium-ion battery supply chains are particularly important for US electrification efforts, and many automakers currently opt for nickel-manganese-cobalt due to its high range and energy density. However, lithium-iron-phosphate (LFP) batteries are gaining popularity for the comparative affordability of their constituent raw materials, as well as high cycle life and low risk of thermal runaway.

Much of the raw materials supply for LFP is concentrated in Asia and controlled primarily by China. As US-based OEMs push to bring cheaper EVs to market, outsourcing materials is only expected to become more challenging because of Trump's protectionist trade policies. Therefore, a sustainable and local LFP supply chain could prove essential.

Critical compounds

Iron phosphate comprises more than 80% of the cathode in an LFP battery, making onshoring its supply a strategic priority. In November 2024, powder metals supplier GKN Hoeganaes, a division of GKN Powder Metallurgy, and mineral development company First Phosphate partnered to develop a North American supply chain for LFP active cathode materials. Matthias Voss, President of GKN Hoeganaes, tells *Automotive World* that, to his company's knowledge, there is "no capacity in North America right now, and it is much the same in Europe. The supply chain for this compound really needs to be built from scratch."

Currently the bulk of iron phosphate production is located in China. Voss notes this places urgency on the US government to act. Additionally, China may not necessarily be able to meet international demand. Given the country's exponential domestic sales growth—from 8.4 million in 2023 to 12.86 million in 2024—it may soon hit capacity and need to turn to other regions to secure iron phosphate for its own production.

Both GKN and First Phosphate are established players in their respective sides of the supply chain—the former in iron powder and the latter in phosphoric rock. First Phosphate is also working to develop battery-grade phosphoric acid, another important chemical in the LFP cathode. The two companies' partnership was preceded by GKN's successful integration of First Phosphate's magnetite into its melting process, which led to the development of a high-purity iron powder that could be used in EV batteries. Subsequently, they set their sights on the wider EV supply chain for LFP. "This is going to be a huge global market, but a local supply chain is what everybody's looking for," Voss emphasises. "We're definitely seeing a trend towards LFP among Western OEMs."

Proprietary processes

The ongoing collaboration has unlocked a series of innovations that could help scale affordable local iron phosphate supply and produce better performing and cheaper materials compared to their overseas competitors. "We developed a means of using the magnetite that helps First Phosphate avoid large amounts of waste material in its own process," Voss states. He adds that while other global players can generate iron powder, the "devil is in the details." The biggest challenge is purity, which can have a tangible impact on battery performance.

To this end, GKN has developed a proprietary melting process, wherein molten steel is atomised into irregular and homogeneous particles that are subsequently annealed—a slow cooling process that removes internal stresses and improves malleability—to produce exceptionally high-grade steel powder. This 'Ancorsteel' process is already used for a range of purposes in the automotive industry. However, by integrating First Phosphate's magnetite, it could provide a level of purity previously unseen and of superlative importance for the LFP chemistry.

> **From day one, our biggest driver was to build out a circular economy for these materials**

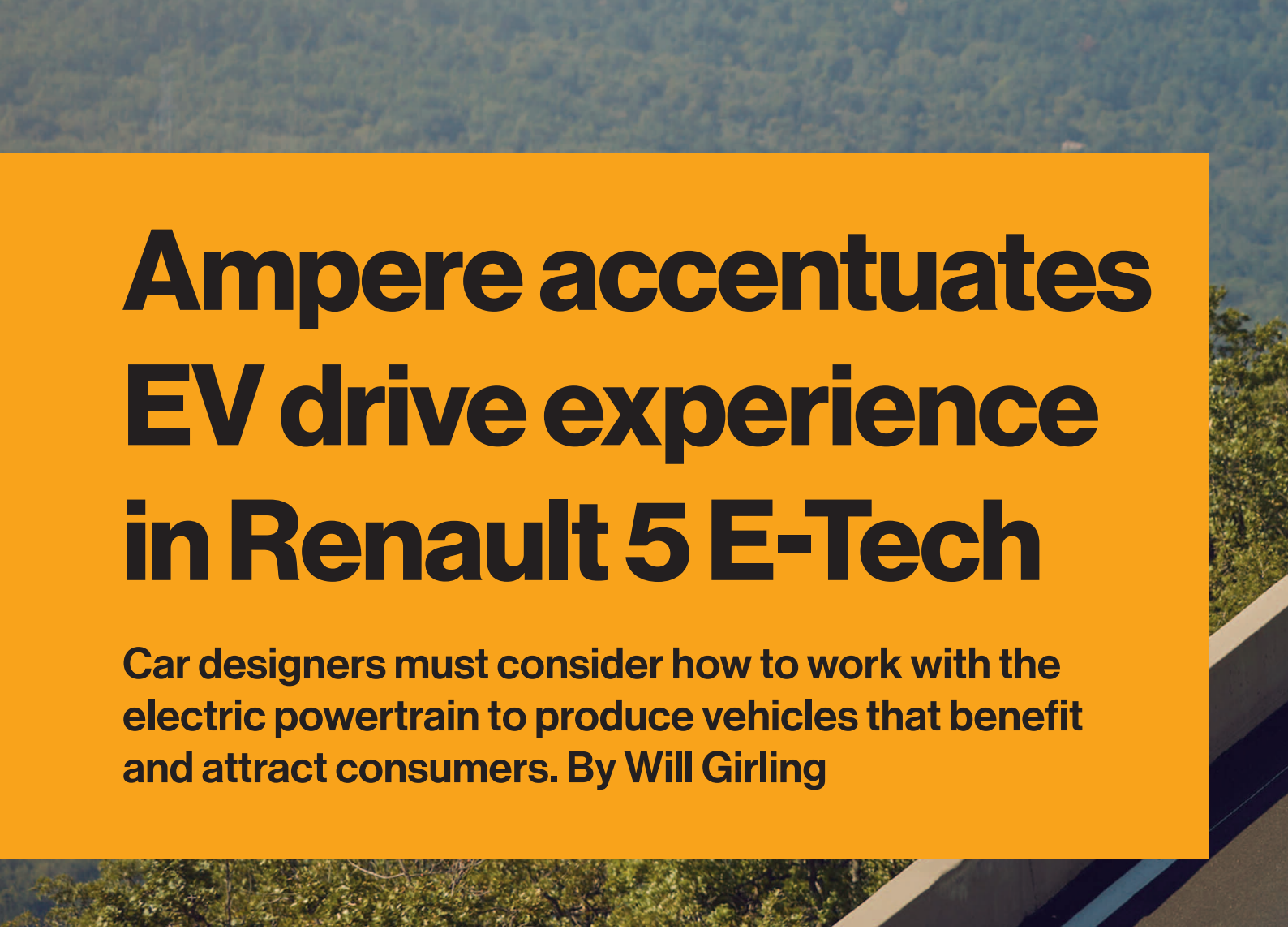
The final piece of the puzzle is developing battery-grade phosphoric acid, which typically requires a purity between 85% and 95%. Currently, First Phosphate is working towards achieving this grade, and the phosphoric acid will be outsourced in the meantime. While continuing to build this production capacity, First Phosphate will begin producing both iron phosphate and LFP in H1 2026.

Circularity

While innovative processes can help give North American suppliers an advantage on quality and cost, consistent availability could prove equally important. For GKN and First Phosphate, this means building out the circular economy. At the time of writing, all of GKN's iron is sourced and refined from recycled industry scrap. "From day one, our biggest driver was to build out a circular economy for these materials," remarks Voss.

GKN is also interested in recovering used iron from batteries at the end of their useful life, which Voss characterises as "the second stage of the journey". Once the required processes are in place, recovery might eventually solve most challenges around procurement. However, it should be noted that while most of the iron can be recovered from a battery, extraction is currently expensive and inefficient compared to mining. "From a chemical or processing standpoint, it is possible," he notes. "But in terms of the cost, automatic separation and disassembly remain a major challenge." Accomplishing these in a low-cost manner will prove critical for adoption.

Circularity still commands a premium price tag, which conflicts with the broader ambition for lower EV sticker prices. But time is on the companies' sides in this regard, as most of the batteries produced so far remain in their first-life applications. EVs may be the future, Voss concludes, but this may only be realised if the battery supply chain can be brought closer to home. By onshoring the LFP chemistry and refining the processes involved in its production, affordability and supply stability become possible. "The industry shouldn't be dependent on a single region for its precursor materials," he emphasises. "Unfortunately, we're already in that situation, so we need to work on getting out of it."



Ampere accentuates EV drive experience in Renault 5 E-Tech

Car designers must consider how to work with the electric powertrain to produce vehicles that benefit and attract consumers. By Will Girling

As electrification progresses around the world, it can be easy to forget the scale of the transformation underway. Automakers must consider how they relate to the electric vehicle (EV) market and new infrastructure, and consumers must acclimatise to products that often differ significantly from what came before. Vittorio d'Arienzo, Platform Global Leader at Renault subsidiary Ampere, believes the transformation is no less significant than the transition from horses to cars in the early 20th Century. "EVs completely change the vehicle architecture, so we can really consider it a quantum leap," he tells *Automotive World*. "Of course, every OEM will employ a different strategy, some progressive and some conservative."

Building on the 'Renaulution' vision of Renault Chief Executive Luca de Meo, Ampere is going "all in" on EV technology that provides tangible user benefits beyond carbon reduction. "We can't expect to charge customers more just for that," states d'Arienzo. For an EV to succeed, it must have the DNA of a desirable car, with the electric powertrain merely a detail in the broader concept. He puts forward the Renault 5 E-Tech, which began production in 2024, as an example of this design philosophy in action.

Freedom of design

In d'Arienzo's opinion, EVs, free from the constraints of emission regulations like Euro 6 and 7, provide an opportunity to reintroduce a sense of excitement back into driving performance. "You can start from a blank piece of paper," he says. De Meo was reportedly captivated by the original Renault 5 and wanted to bring its design ethos into the electric era. "I think it's one of the few vehicles where a platform had to fit the design, not the other way

Renault R5: "I think it's one of the few vehicles where a platform had to fit the design, not the other way around," states d'Arienzo

around," states d'Arienzo. Ampere's objective with the R5 E-Tech was to deliver a "responsive, smooth, and pleasurable" driving experience.

The model is built on the AmpR Small platform for electric B-segment cars. Its 42kWh or 50kWh battery–depending on spec–is situated low and central relative to the wheels for a low centre of mass and gravity. A compact multi-link rear axle created additional battery space, while the flexibility of an electric powertrain on the front axle allowed designers to make the bonnet shorter and more aerodynamic. This new generation design formula, explains d'Arienzo, produced a wide body with short overhangs and a large (254cm) wheelbase, enabling stable handling and interiors more spacious than a typical small hatchback. In total, the R5 E-Tech is 9cm shorter and 6cm higher than a modern Renault Clio.

"You couldn't do all this in an internal combustion engine (ICE) car: the engine and gearbox are so wide that they restrict wheel turn radius." Recognising, unlocking, and marketing these inherent benefits of an electric powertrain will be important for expanding EV adoption. "This is design freedom without compromising on the basics: comfort, driveability, and storage." It is important to get these right, d'Arienzo emphasises, because the EV driving experience can be very different for customers accustomed to gasoline-powered, manual gearbox models. By comparison, the R5 E-Tech offers what he calls "neutral" on-street behaviour.

Delivering the EV experience

It is significant that the automaker resurrected the Renault 5 name for its new electric model. The original was produced from 1972 to 1985 and became one of the best-selling cars in France's history–approximately 5.5 million units. At a time when affordability is top of consumers' minds, particularly in Europe, the automaker is now attempting to recapture this mass market success in the electric era. In France, there are currently three versions of the R5 E-Tech available with different specs, starting at around €27,900 (US$28,743), or €25,990 after factoring in the country's EV incentive deductions. A €25,000 base model will be released later in 2025, placing it among the cheapest non-Chinese EVs in the world.

The R5 E-Tech is envisioned as the frontrunner of a "family" of EVs built on the AmpR Small platform. "On the one hand, it's expensive to start with a dedicated platform. But in the long term, customers need to

> **I think we need to transform the compact/city car segment so European customers can move away from 2.5 tonne SUVs with 100kWh batteries**

feel the real advantages of EV ownership," says d'Arienzo. He summarises these as better and quieter performance than ICE and a lower total cost of ownership. "If manufacturers don't focus on those, they're simply providing an electric powertrain without actually delivering a different experience."

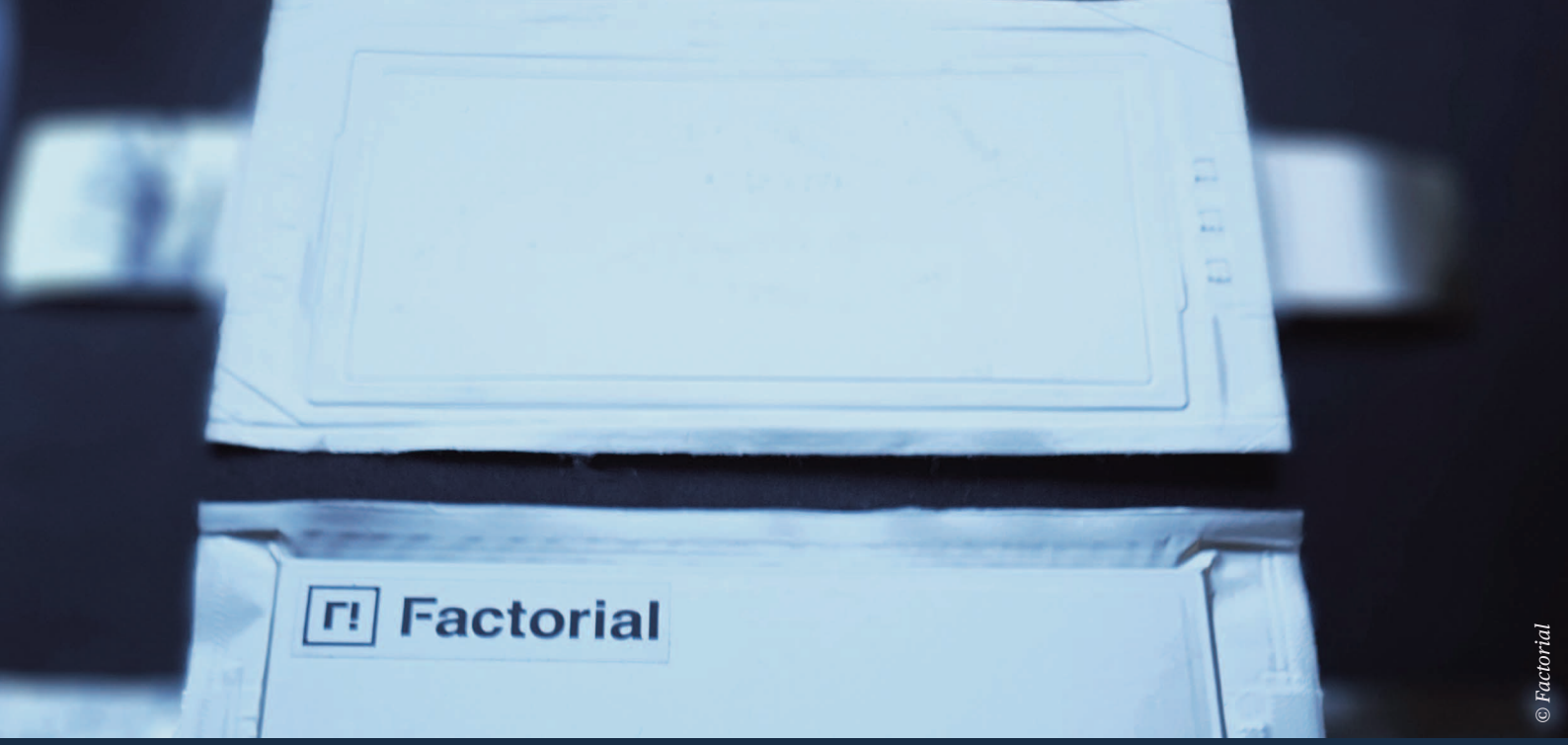
Determining how design makes use of components like batteries and motors, he continues, needs to be an intrinsic part of the early EV development process. "Customers should love EVs because they drive well, look cool and offer everything necessary, not just because they're electric." Indeed, there is evidence to suggest that consumers around the world have shifted away from environmental considerations to prioritising the daily practicalities of EV ownership. Several legacy automakers are now discovering that EV desirability is the key to maintaining their share in highly competitive markets.

Democratising EVs

Following a year of decline in the European EV segment, the region's automakers now face a significant pricing challenge. Government-sponsored purchase incentive schemes have largely been abandoned or scaled back, leaving many products unaffordable and inaccessible to the mass-market consumers necessary for sustaining growth.

If the objective of electrification is to have a positive impact on the environment, d'Arienzo believes selling polarising, niche, and unsustainably produced EVs must come to an end. "In particular, I think we need to transform the compact/city car segment so European customers can move away from 2.5 tonne SUVs with 100kWh batteries." This will be more difficult in some markets than others, although he reports anecdotally that it is happening. It is notable that in November 2024, the R5 E-Tech's first full month of sales, it managed to outsell the Tesla Model Y in France.

By popularising smaller models with affordable prices and EV-centric design, d'Arienzo posits that e-mobility can be "democratised", and the industry can deliver on its ecological mission. "That all starts by considering the weight, footprint, and efficiency of the vehicle." The next model built on the AmpR Small platform–the Twingo E-Tech, scheduled for release in 2026 and priced at less than €20,000–will continue Renault's push in this direction. "Models like these will make our cities a better place to live, and customers will find they've paid one-third of the average price for an EV that's still easy to drive and own," he concludes.



© Factorial

Stellantis shifts Factorial solid-state closer to scale

Public trials of the Dodge Charger Daytona with solid-state batteries kick off in 2026. By Megan Lampinen

Solid-state battery technology could prove a game-changer for electric vehicles (EVs), improving safety and performance while reducing costs. But the market remains nascent and developers have yet to reach any sort of scale.

US-based Factorial believes that is about to change.

The company has been making steady progress with its proprietary solid-state platforms FEST (Factorial Electrolyte System Technology), and facilities in the US and Korea are ramping up capacity. It has secured joint development agreements with such big-name players as Mercedes-Benz, Stellantis, Hyundai and Kia, and the first models powered by its cells are set to hit the roads in public trials in 2026. “It’s not easy for

any next-generation cell maker to reach this stage," says Factorial Chief Executive Siyu Huang. "We are probably the furthest along among all the other players."

Solid-state hits the streets

The Stellantis partnership with Factorial serves as a clear example of solid-state batteries' growing significance in the EV landscape. The automaker invested US$75m in Factorial back in 2021, and the two have been working closely ever since.

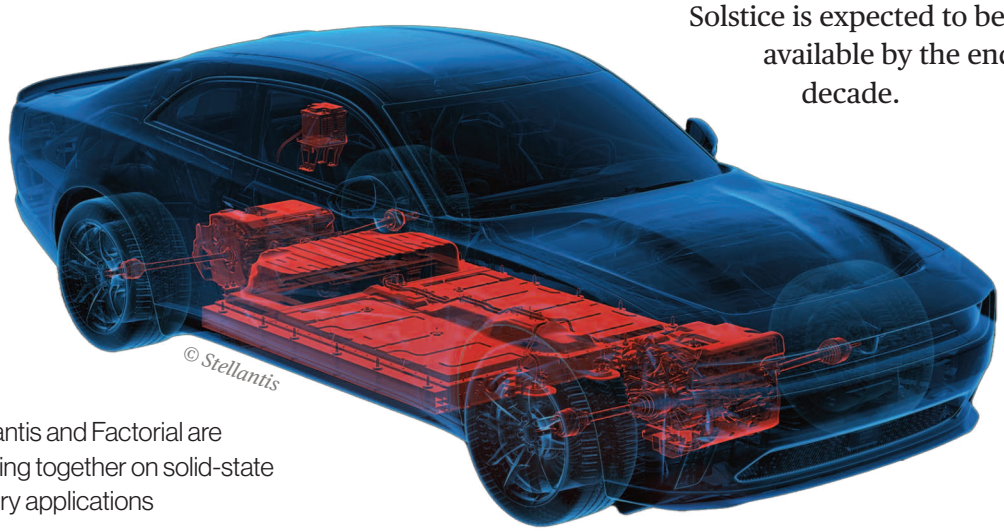
The latest development will see Stellantis launch a demonstration fleet of new Dodge Charger Daytona models incorporating Factorial's solid-state batteries in 2026. The new Charger Daytona is based on the STLA Large platform, which is intended to underpin two million vehicles across the Dodge, Jeep, Chrysler, Alfa Romeo and Maserati brands, opening the door for future solid-state deployments.

"By integrating Factorial's innovative battery solution into the STLA Large platform we are validating its potential to enhance our EV line-up, ensuring customers benefit from improved performance, longer driving ranges, and faster charging times in the coming years," commented Ned Curic, Stellantis' Chief Engineering and Technology Officer, speaking at the initial announcement in October 2024.

The milestone has been some time in the making. "It's been a year of discussion followed by two years of testing," Huang tells *Automotive World*. The fleet is intended to run in real-world conditions, driven by non-professional drivers. The choice of the Dodge Charger Daytona is notable, as this is a performance-branded model. "For this segment, it's important to have a battery with not only high energy density but also high-power," she observes.

The batteries to be used in the Charger Daytona offer a specific energy density of more than 390Wh/kg. In comparison, most of today's state of the art lithium-ion batteries offer 260-280Wh/kg. "For us, 390Wh/kg is not so much the ceiling as the floor," she says. "It's where we started with our B-sample. There's a lot of potential even moving beyond 450Wh/kg, which is a different part of the S-curve in terms of the technology ramp-up."

Factorial is also working on just such a 450Wh/kg battery with Mercedes-Benz. Dubbed Solstice, the new battery should be able to extend EV range about 80% beyond today's average. With potential applications in both EVs and consumer electronics, Solstice is expected to become available by the end of the decade.



Stellantis and Factorial are working together on solid-state battery applications

Dodge Charger Daytona

Generally speaking, energy density improvements allow for both extended range and vehicle weight reduction. “We can design around the customer needs, but the most acute problem for the EV market right now is weight,” Huang says. She estimates that EVs are on average between 1,000 and 3,000 pounds heavier than their combustion engine counterparts and carry considerable cost premiums. “Anecdotally, OEMs say that every pound of weight saved equates to a US$5 saving in vehicle costs. If we can reduce 1,000 pounds, that’s potentially a US$5,000 saving per vehicle– quite substantial.”

Focus on US and Europe

The demo fleet will begin operation in 2026, but neither partner has indicated how long it will run before it gets the final green light. “That depends on how the demo goes,” Huang concedes. “We need to secure data on just how much energy efficiency the batteries can achieve in the real world, and the impact on weight, performance and power. Conservatively, it could take three to four years after the 2026 initial launch before we can ramp up to mass production. That said, there could be opportunity to go even earlier than that.”

Stellantis is the first automaker to publicly announce deployment of a demo fleet, but Factorial is in talks with other players about demonstration potential. Without going into details, Huang only states: “Historically, we have considerable support from our shareholders Mercedes and Stellantis. There is also a tremendous amount of interest from other automotive OEMs.”

While interest in solid-state grows, so too will the competition. CATL, BYD, QuantumScape, and ProLogium are just a handful of the other solid-state hopefuls jockeying for a slice of the market. But Huang is confident that Factorial has a key role to play. “We’re a US player, very focused in the US and European markets, with a healthy shareholder base,” she emphasises. “Most of the other solid-state players are heavily backed by Asian shareholders, which puts them in a different place considering today’s geopolitical environment.”

Given the change in administration, the US market faces considerable uncertainty in its near-term EV roadmap. But while the Trump government is widely expected to roll back government support for EVs, it could also increase trade barriers, particularly against China. In that sense, domestic capacity and an American and European investor base are indeed valuable assets.

Photo by Zaptec on Unsplash

Charger power modules can help secure the power grid

Solum's power modules prioritise grid stability while also unlocking a range of incentives for charging firms and drivers. By Stewart Burnett

The growing uptake of electric vehicles (EVs) poses an enormous infrastructural challenge that governments and players across the automotive value chain must solve.

A widespread and reliable network of public charging stations is needed for widespread adoption. While a great deal of these will be situated in urban hubs and along key transportation corridors, they must also be situated in rural and underserved areas to prevent 'charging deserts'. However, power grids will face added strain from intensified demand. The UK Department for Business, Energy and Industrial Strategy, for example, has estimated that a 100% electrification scenario would increase total domestic energy consumption by around a quarter.

Upgrading grid infrastructure to handle this increased load will involve substantial investments and take years to achieve. Brian Dongkyun Ryu, Executive Vice President for Automotive and Power at EV charging solutions firm Solum, tells *Automotive World* that players in the space have an important role to play by reinforcing grid stability and building consumer trust in electrification.

Waste not, want not

"As EV adoption expands, power grids around the world will confront unprecedented challenges," explains Ryu. "The biggest challenges will come during rush hours, weekends and holidays, when many vehicles attempt to charge simultaneously at public charging stations." This can cause severe strain on the power grid and potentially lead to stability issues like blackouts. The uneven quality of grid infrastructure in rural and underserved areas could put them most at risk. A 2024 study in the journal *Energy Research & Social Science* found a strong correlation in the US between blackout frequency, income, race, and zip code.

To minimise the possibility of such incidents, Ryu emphasises that charging operators must make efficient power use a key priority: "High-efficiency design minimises energy loss during the charging process." The Allgemeiner Deutscher Automobil-Club (ADAC), Europe's largest automobile association, estimated in 2023 that 10-25% of energy used in the EV charging process is lost on its way to the battery. Reducing inefficiency would reduce grid strain by making charging sessions shorter.

Achieving better energy efficiency comes down to the type of power module contained in the charging unit. This applies across both home charging and public charging solutions. To this end, Solum offers 30kW and 50kW power modules designed to accommodate charging across all vehicle types and use cases. The company's modules boast an energy conversion rate of more than 95%—notably higher than ADAC's average. This is not because of any particularly unique or disruptive technology, he adds, but rather due to many years of expertise and refinement in the design process. Prior to entering the EV charging segment, Solum provided power modules for industrial and home storage applications.

One key technology that differentiates the company's charging power modules, however, is liquid cooling. Also commonly used in EV thermal management, this ensures maximum performance without throttling due to excessively high temperatures. Most companies still use cooling fans as solutions. "In effect, you're doing more than just lowering energy use—you're extending charger stability and lifespan and directly reducing charging station operating costs," notes Ryu. This way, charging operators have business incentives to adopt above and beyond facilitating grid stability. He also highlights the modules' integrated self-diagnostic and self-monitoring capabilities, which enable preventative maintenance.

Energy management platforms

While minimising energy waste during the conversion process can prove helpful, this alone cannot solve the problem of grid stability. Ryu posits that EV batteries can also function as nodes in the larger power grid: "Bi-directional power conversion technology effectively transforms EVs from transportation devices into energy management platforms when they're at home."

Solum unveiled its 50kW series power modules at CES 2025

Bi-directional charging, or vehicle-to-grid (V2G) technology, allows energy stored within the battery to be returned to the grid when certain criteria are met. By receiving real-time information about grid demand, electricity prices and the EV owner's preferences through an external communication network, V2G allows EV owners to directly participate in ensuring the grid stability of their local communities. However, there is also some hesitance around the technology, due in part to a lack of customer familiarity. While players in the EV segment are encouraging the idea of cars as energy management platforms, Ryu acknowledges that many customers have yet to accept EV charging itself as an acceptable alternative to refuelling with gasoline.

However, demonstrating the advantages of bi-directional charging might go a long way to build not only trust but also appeal. By returning energy to the grid during peak times, drivers can turn their EVs into a source of recurring revenue, while also taking advantage of charging during times when charging is cheaper. "This is another example of how you can build grid stability by offering solutions alongside a range of customer incentives."

Solum's bi-directional charging capabilities can do more than restore power to the grid. "I think blackouts reveal our power modules' most practical application," notes Ryu. "If such an event happens, you can turn the EV into an emergency home power supply." The average EV battery is typically capable of running essential home appliances and lighting for several hours.

Ultimately, Ryu emphasises that developing EV charging networks and building grid infrastructure and resilience are comparable challenges. No single company or government will be able to handle them alone, especially ahead of some countries' internal combustion engine phase-out deadlines. By minimising energy waste and enabling bi-directional charging, alongside a range of incentives and quality-of-life features, Solum's power modules indicate that meaningful steps towards grid security do not necessarily require customers to compromise when buying an EV.

Mercedes: solar paint turns EVs into mobile power stations

An innovative coating containing solar power modules could transform the electric vehicle value proposition and ownership experience. By Will Girling

The convenience of electric vehicle (EV) charging–from wait times to availability and cost–remains one of automotive's perennial challenges. EY Mobility's 2024 Global Mobility Consumer Index found that 27% of those surveyed ranked lack of charging infrastructure as their biggest concern regarding EV ownership, more than any other single factor. The global EV charging market is growing quickly to address these concerns: valued at US$22.45bn in 2024, it could be worth US$257bn by 2032, according to Fortune Business Insights.

Mercedes-Benz recognises the importance and opportunity of solving the charging issue with novel technologies and production techniques. Jochen Schmid, Senior Manager of Future Electric Drive, tells *Automotive World* that his department generally focuses on the efficiency of e-motors, inverters, and batteries: "Charging is usually something that happens outside the vehicle." However, his team is turning this idea on its head by focusing on how the car itself can be part of the equation.

On 22 November 2024, the automaker announced that it was collaborating with an unnamed partner to develop 'solar paint' that might eventually generate enough power to fuel the majority of drivers' annual mileage for free.

Enlarging charging surface area

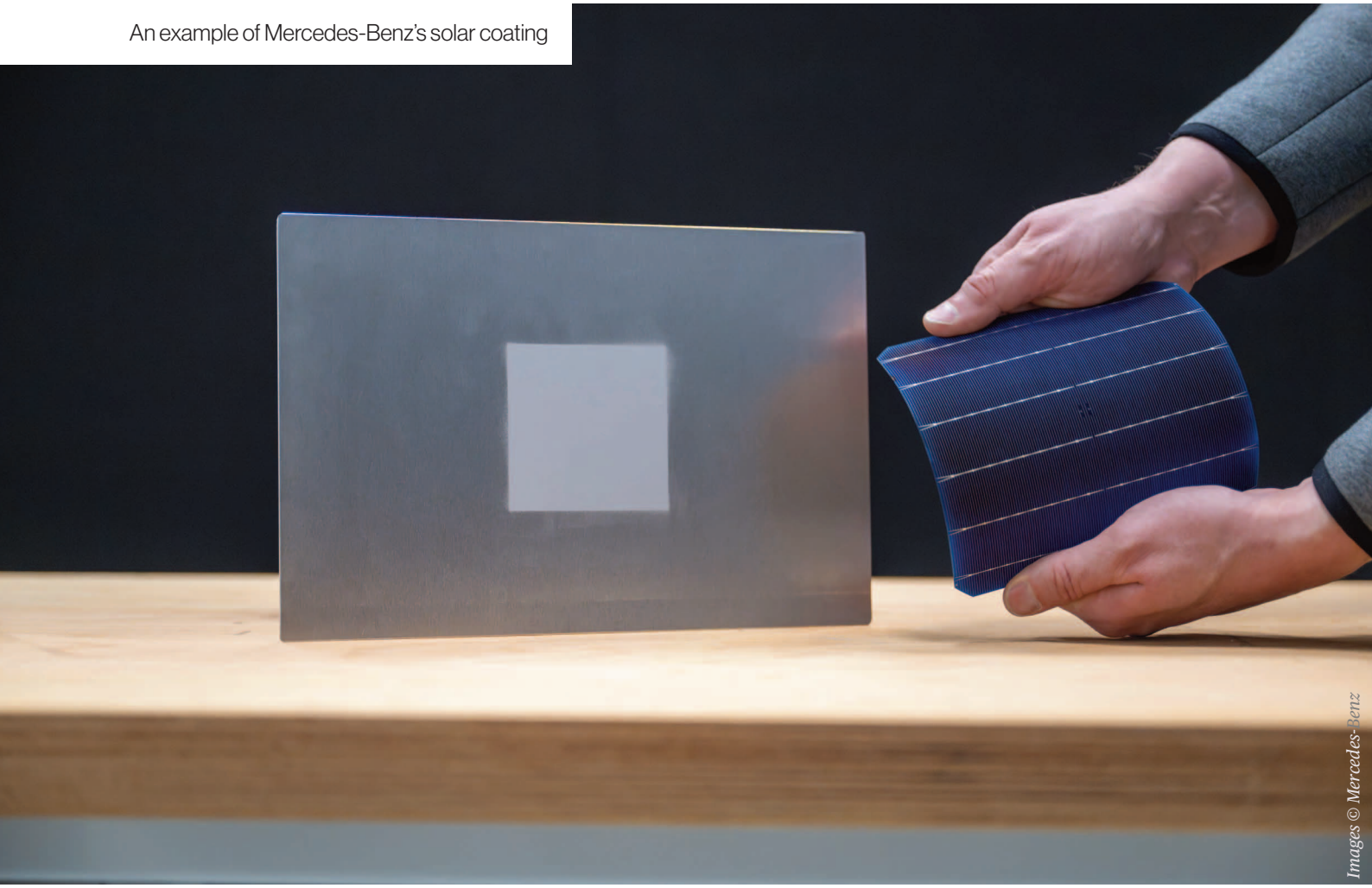
The concept of a solar-powered EV is not new, and dedicated start-up OEMs are making progress bringing their products to market. It should be noted, however, that examples like the Aptera use photovoltaic

(PV) cells similar to the solar energy industry. “Standard solar cells are effective but have some limitations: the manufacturing processes are complex, the glass is bendable but brittle, and coverage is restricted,” Schmid states. Therefore, Mercedes-Benz is taking a different approach.

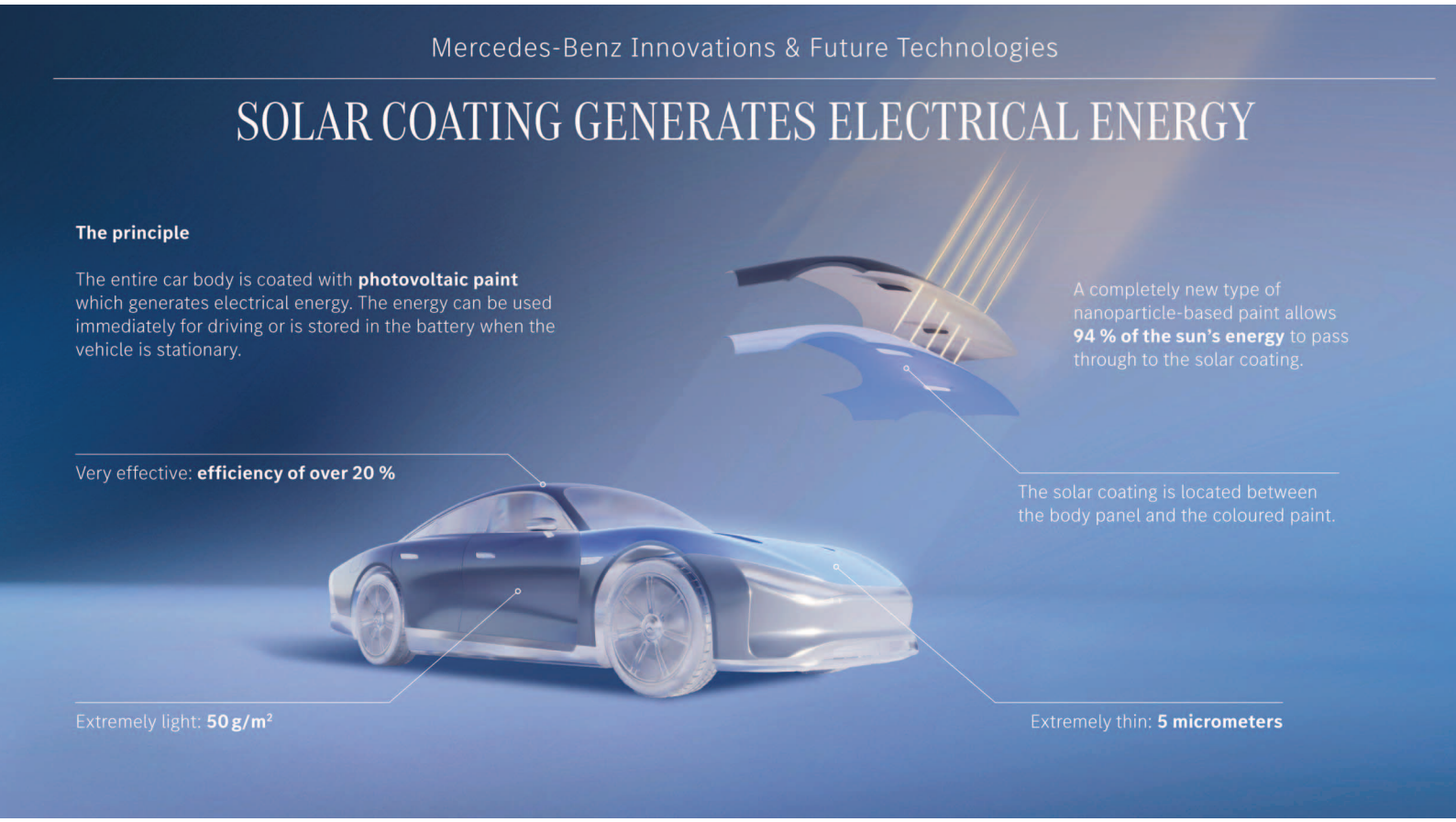
It started with a new kind of solar module, five micrometres thick and weighing 50g per square metre. As these cells were developed further, their efficiency gradually increased from 7% to 20%–roughly the same as standard PV and efficacious enough for automotive applications. By packing them into a wafer-thin layer of paste and spreading it at room temperature, Mercedes-Benz can utilise any area of the vehicle exterior that would traditionally be painted. “This enlarges the surface availability for solar charging far beyond just putting some PV cells in the roof,” says Schmid.

Although the new solution could broadly be described as paint, he explains that it has some important distinctions. “It’s not comparable to spray coating currently on production lines, and ovens aren’t used at any point.” There are also implications for EV construction: “All hang-on parts–doors, hoods, fenders, roof, etc.–need to be either thin sheet metal or moulded plastic. Until a very late stage, the car would look like a skeleton, and then all the outer parts with the solar paint applied would be clipped on.” At this point, the electric connection between panels and car is finally “realised”.

An example of Mercedes-Benz’s solar coating



Images © Mercedes-Benz



Harvesting sunlight

Mercedes-Benz claims that its solar paint is cheap to produce, easy to recycle, and contains no rare-earth elements or silicon. But despite creating an innovative method for increasing the surface area available for charging, the company still had a problem to solve. A string of six solar cells wired in series is 3V (0.5V each)—too low to be useful for an EV's high-voltage (400V or 800V) battery. Using standard equipment to step up the voltage would require several phases, meaning added complexity and cost and reduced space in the vehicle to accommodate equipment.

The breakthrough came with a new power converter—a unit consisting of several micro-converters integrated directly with battery cells. Schmid describes it as "a ground-breaking technology that can boost low voltage to high voltage in one step."

Combined with the solar paint, the power converter enables each hang-on part to feed directly and efficiently into an EV's high-voltage system.

In the real world, all sides of a vehicle will not be equally exposed to the sun, and light levels will naturally vary according to geography, season, and climate. Nevertheless, Schmid points out that most cars are parked outside for the majority of the day, presenting a regular opportunity to "harvest" enough light to make a tangible difference in the economics of EV ownership.

Assuming the vehicle in question was a popular mid-size SUV model—approximately ten to 13 metres of paintable surface area—he estimates that Mercedes-Benz's solar paint could generate enough energy to drive around 12,000km (7,456 miles) per year in central

> **Having the paint is just the start; we need to develop an easy and affordable process for its application during series production**

European countries like Germany. This is only slightly less than the region's average annual distance travelled per person: 12,540km, according to the European Automobile Manufacturer's Association (ACEA). In sunnier locations, such as California, drivers could find more than 100% of their energy needs met, opening the opportunity for grid arbitrage through vehicle-to-grid (V2G) capabilities. Mercedes-Benz and other automakers are already exploring this idea.

The long road ahead

Using solar paint could have some practical implications for an EV's colour, which might absorb or reflect more light depending on the shade. However, Schmid states that colour would not be achieved through ordinary paint pigment. "We use a coating containing nano particles that filters light wavelengths reaching the vehicle's surface. To an observer, the car will appear whatever colour was chosen– anything from the colour spectrum, including black." Importantly, this coating achieves 94% translucency, ensuring that the solar modules can still operate highly efficiently.

Although solar paint could prove revolutionary in terms of daily cost savings to customers and electric grid optimisation, he emphasises that incorporating all this innovative technology remains at the research phase. "Having the paint is just the start; we need to develop an easy and affordable process for its application during series production." Throughout 2025, Mercedes-Benz will trial several potential approaches to determine the fastest and most economical. This will likely involve a lot of experimentation, as the solar modules must be tuned according to the geometry of the hang-on component to which they're applied, as well as the power converter's interaction with the battery.

The road ahead could be long, but Schmid is confident that solar paint will prove its worth. "I think it's an understatement to say this might influence an EV purchase decision. With V2G capabilities, customers could choose to buy a car for their house's solar power needs instead of putting PV panels on the roof." In effect, buyers would own a "mobile power station" that also generated a large portion of their annual mileage for free, and business fleets would gain a lucrative source of extra income. "That could be the beginning of entirely new customer purchase behaviour and accelerate EV penetration tangibly," he concludes.

Dynamic wireless charging advances from proofs to permits

From Motor City to the LA Olympics, Electreon is powering ahead with wireless charging deployments. By Megan Lampinen

Wireless charging for electric vehicles (EVs) offers significant benefits for commercial fleets in terms of convenience and operational efficiency while dramatically improving grid resiliency. Whether it's static charging during a delivery stop or dynamic charging along a popular stretch of road, freedom from the plug tackles range anxiety, reduces road clutter, and opens the door to lower battery capacity requirements. But just how far away is this reality?

Spotlight on Electreon

Headquartered in Israel, Electreon's in-road wireless charging solution was recognised as one of the world's top 100 inventions for 2021 by *Time* magazine. Based on inductive coupling between copper coils installed below the road surface and receivers installed on EVs, the system sends electricity wirelessly through a magnetic field. This electricity is then transferred as energy to the vehicle's battery either when parked or driving. The coils in the road are activated only when a vehicle with an approved receiver passes over them. While deployments today remain limited, Electreon believes that one day this technology could become an industry standard.

Over the years, the company has been taking its wireless in-road charging solutions around the world with projects in China, France, Germany, Israel, Italy, Sweden, Norway, and more recently the US.

Motor City

In Detroit, Electreon technology is powering the first wireless charging road in the US. As part of the Michigan Central Station mobility hub, 14th Street has been equipped with inductive-charging coils along a one-quarter mile stretch between Marantette and Dalzelle streets. Electreon plans to extend the charged section by

Ford is one of the project partners in Michigan

three-quarters of a mile in the future. Dynamic charging is supported by several stationary wireless charge points as well.

An E-Transit model from Ford, one of the project partners, has been demonstrating the technology's capabilities in a shuttle operation. "We have been conducting VIP visits and gathering test data," says Stefan Tongur, Electreon's Vice President of Business Development. "All the charging is done wirelessly. Now that we've proven the technology works, we can go through the permitting process and liaise with stakeholders to bring this into the public domain."

In November 2024, Electreon extended the Detroit pilot to include a last-mile delivery operation in partnership with UPS and electric truck manufacturer Xos. Electreon's wireless charging technology has been integrated into a Xos Stepvan, which is charging dynamically en route, at static locations, and overnight at its depot. "This additional use case shows that charging can be done anytime, anywhere," Tongur tells *Automotive World*. "For this particular use case, the en route static charging will be particularly effective. UPS drivers stop for an extended period and can now charge during that time. This charging infrastructure need not be limited to UPS—we can open it up for other logistics companies as well."

Los Angeles

Over in California, Electreon is preparing to launch the state's first in-road EV charging system to support yet another use case: buses. Project partner UCLA is converting its entire campus transit bus fleet, BruinBus, to fully electric ahead of the 2028 Olympic Games in Los Angeles. "Regulation dictates the speed of the electric transition in California," notes Tongur. "There, it's not a question of whether a fleet wants to go electric; it's mandated." As a result, many operators are scrambling to secure the necessary grid capacity at their depot. An electric road that wirelessly charges vehicles as they drive could prove a game-changer, and that's exactly what Electreon and UCLA are setting out to prove.

The demonstration will start with a quarter of a mile stretch of electric road along Charles E Young Drive between the Westwood Plaza intersection and Murphy Hall, later extending to three-quarters of a mile. This will be supported by stationary wireless charging spots at passenger pick-up

and drop-off locations, transit depots, and a new transit hub between the UCLA bus depot and the upcoming UCLA/Westwood station. Several other transit agencies will be able to access this transit hub and hence the wireless charging technology, opening up the potential user pool.

"This location has become high profile ahead of the Olympics and offers considerable opportunities for scaling," says Tongur. "We are also considering further expansion down the road to UCLA Research Park. It's a bigger endeavour, but we are keen to explore how this technology can be scaled and support more fleets, vehicles, and use cases."

Adaptable to different environments

The examples above are just a portion of Electreon's US activities and join existing projects in Europe and other parts of the world—all involving different fleet types. Broadly speaking, the company regards wireless charging as a good fit for predictable, pre-determined traffic routes. "Wireless charging is an enabler that can be adapted to different environments," says Tongur.

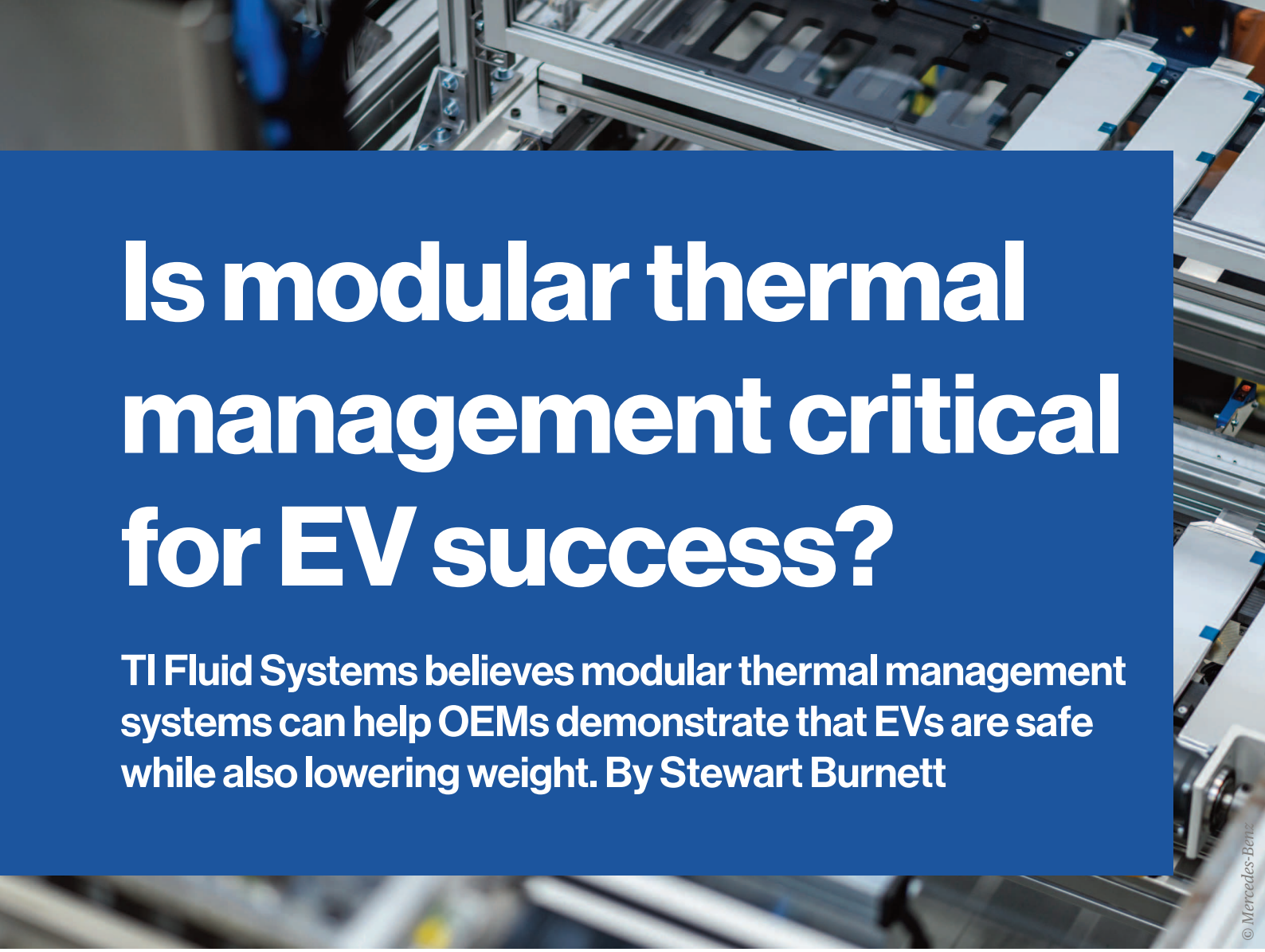
While he suggests the holy grail of wireless charging is long-haul transport, the obstacles for this use case are significant: "Wireless charging for long-haul could change our entire view of transportation, but the path there is very challenging in terms of business models, regulation, and vehicle availability. For now, we are looking at corridors or cities with predefined areas within which vehicles operate. The main metric is high utilisation of charging infrastructure."

Along with buses, shuttles and last-mile delivery, he also sees huge potential for wireless charging in car-sharing. "One of the biggest problems with electric car-sharing is that customers often don't plug in the vehicles after use, so there's no juice in the car when the next customer arrives." Having wireless charging coils under designated parking spots could eradicate that issue. He also flags taxis as a good fit, with charging located under official taxi queues outside hotels or airports, as well as drayage trucks operating in a port environment and toll roads.

Importantly, the infrastructure is open to multiple users. "Electric roads can serve as a shared charging infrastructure and support millions of vehicles—cars, buses, trucks," Tongur emphasises. During peak travel times, such as holiday weekends, traditional plug-in charging stations could become overwhelmed as EV numbers increase. In this scenario, wireless dynamic charging dramatically rewrites the rulebook. "It will accelerate EV adoption," he asserts.

But how quickly? In 2022, Electreon Co-Founder and Chief Executive Oren Ezer told *Automotive World* that wireless could become the dominant form of charging by 2027. While Tongur is optimistic, he cautions that this will hinge not just on Electreon's expansion but buy-in from automakers and suppliers willing to install the technology in their vehicles. "The bottleneck is with the OEMs," he says. "The turning point is when wireless charging comes on a vehicle as standard or an option at purchase."

In 2023 Electreon, formed an agreement with Toyota and Denso to jointly develop an aftermarket wireless kit for current EVs to use wireless charging technology, as well as integration of the wireless technology into new cars. Collaborations like this are the start of what's needed to realise a wireless future. "With these partnerships we are on a good pathway [towards becoming the dominant form]," concludes Tongur. "As we see with mobile phones, once you've gone wireless, why would you go back to the cord?"



Is modular thermal management critical for EV success?

TI Fluid Systems believes modular thermal management systems can help OEMs demonstrate that EVs are safe while also lowering weight. By Stewart Burnett

© Mercedes-Benz

Electric vehicles (EVs) may be transforming the automotive landscape, but with them comes a unique set of challenges. Of these, one of the most pressing is battery thermal management. Managing the thermal performance of batteries is crucial to their longevity, safety, and overall performance. Lithium-ion batteries are quite sensitive to temperature and must generally be kept within 15-35 degrees Celsius.

Become too hot and the battery can degrade, lose efficiency, or even go into thermal runaway and cause a fire. Conversely, cold temperatures affect performance and range. Striking the right balance is a complex task that involves continuously monitoring and controlling the battery's temperature in real time. A single error could reinforce consumer doubts around EVs, which are generally concentrated around the battery.

An effective thermal management system must meet this challenge head-on but also be compact and suit the vehicle architecture. Johannes Helmich, Chief Technical Officer at TI Fluid Systems (TIFS), believes the best approach comes in the form of modular solutions. Modular thermal management systems offer flexibility, scalability, and improved performance while also allowing components to be easily replaced or upgraded. "At the same time, it is important to have a supplier that can provide everything you need for that modularity," he tells *Automotive World*. "And that can promise its solutions will also reduce vehicle weight and come in at a decent price point."

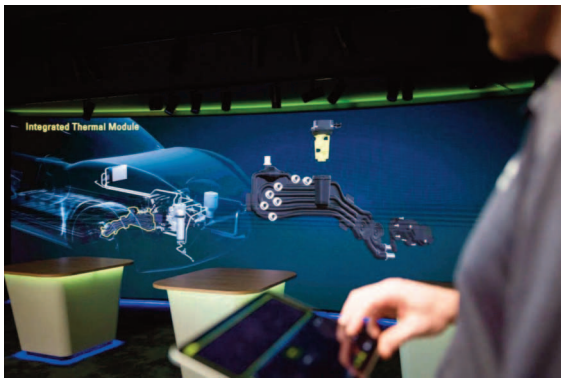
Safety comes first

The first and most important area to tackle, explains Helmich, is efficacy: “With the switch from internal combustion engines (ICEs) to EVs, the urgency to get thermal management right is so much higher. You can’t leave square one without ensuring that it is effective.” This means making sure that temperatures are kept within the optimal range regardless of the vehicle’s state, be it on the road or charging.

However, there is no one perfect solution that will suit all manufacturers and vehicle types. Some OEMs may opt for dual-circuit cooling architectures that possess separate cooling circuits for the battery during charging and driving. Others may prefer smart temperature control algorithms that dynamically adjust the cooling system based on real-time data or use external power sources to condition the coolant during charging cycles to save power.

Helmich notes TIFS’ e-mobility innovation centres empower the company to develop modular products that match the specific needs of each automaker. “Instead of looking at our product and matching it to the need, we’re looking at specifically what is requested,” he explains. “We look at the physical architecture as-is and what efficient ways might exist using our toolkit to come up with a tailor-made solution.”

By offering a wide range of modular technologies, solutions and parts that are mutually compatible, TIFS believes it is possible to meet the thermal management challenges of virtually any EV battery system. “We’re a supplier that can provide the entire portfolio of thermal management parts,” states Helmich. The company is continuously broadening its ‘toolkit’ of applicable parts, from connectors, seals and valves to pumps, electronic control units, and entire modules.



© TI Fluid Systems

TI Fluid Systems offers ‘tailor-made’ solutions to automakers’ battery cooling challenges

Flexibility on the automaker’s preferred materials is a key aspect of TIFS’ approach to modularity. For example, in addition to silicone rubber cooling hoses—the tubes that direct the coolant where it needs to go—it also offers plastic rubber ones. Either solution can be preferable depending on the specifications around weight, range of movement, and cost. TIFS also works actively to develop new modular solutions in response to automaker feedback and meet the thermal challenges of future battery technologies like solid-state. “We are certainly looking ahead. Thermal management will always play a key role, no matter what technologies are used in the future.”

Automation and lightweighting

Regardless of the modular thermal management system, it must integrate with autonomous software that continuously monitors and adjusts battery temperature. All monitoring software collects data in real time from various sensors situated throughout the battery pack and generates a thermal map based on these inputs. More advanced iterations of the technology can also use predictive analytics to predict future trends around the battery’s behaviour and potential thermal runaway risks. This can be integrated with the

> **You can bring the weight down by up to 60% using thermoplastic refrigerants**

battery management system directly to coordinate control of battery health and temperature. TIFS works to ensure its modular systems are fully compatible with its monitoring tools.

"You need to have active interaction between the environment and your desired thermal performance," explains Helmich. "If you're driving up a mountain, you will inevitably need to put more demand on the cooling. The vehicle should be able to quickly identify this and take appropriate action." By ensuring that its software is compatible with the full range of potential thermal management configurations, TIFS believes it can remove a barrier to adoption around the modular approach.

At the same time, a modular system cannot compromise other design priorities. Instead, it should help enable them if possible. As an example, Helmich highlights lightweighting through the minimisation and substitution of unnecessary materials and parts. EVs typically weigh substantially more than their ICE equivalents—a Peugeot e-208 weighs 1,910 kg, almost double the 1,090 kg of its 1.2-litre gasoline-powered equivalent, the Peugeot 208. Much of the weight difference comes down to the battery, and offsetting this can boost vehicle range and lower wear and tear on components like the brakes and tyres.

While tailor-made solutions can lower weight by providing only what is required to suit the customer's vehicle architecture and thermal goals, further weight reductions are possible through material substitution. Helmich highlights that there are a number of solutions available that offer comparable thermal performance, including thermoplastic refrigerant lines and using aluminium instead of steel in certain components.

"You can bring the weight down by up to 60% using thermoplastic refrigerants," Helmich notes. At the same time, he adds, it is crucial that these solutions remain competitive on price, otherwise automakers will look elsewhere. Meeting the criteria of thermal performance, cost-effectiveness, and lightweighting is core to TIFS' modular approach. He further emphasises that these concerns remain secondary to effective cooling, but modular solutions make it easier to tackle several at once.

Ultimately, thermal management is as critical to electrification's success as any other metric, like range or charging speed. They help ensure a battery's long-term health and safety, and their success passively allows consumers to overcome their concerns. Adopting modular thermal management solutions could ultimately help automakers build that trust, while also meeting wider goals around vehicle weight and production costs.

SimScale: decentralised simulation accelerates EV innovation

Breaking down the barriers to AI-driven simulation and validation could help engineers unlock EV innovation in the timescales required. By Will Girling

The use of simulation tools in an engineering and design context is nothing new. Valued at around US$13bn in 2023, the global simulation software market could be worth more than US$34bn by 2032, according to Fortune Business Insights. For teams designing the next generation of electric vehicle (EVs), the ability to replicate real-world physics like structural mechanics, thermodynamics, and electromagnetics is invaluable.

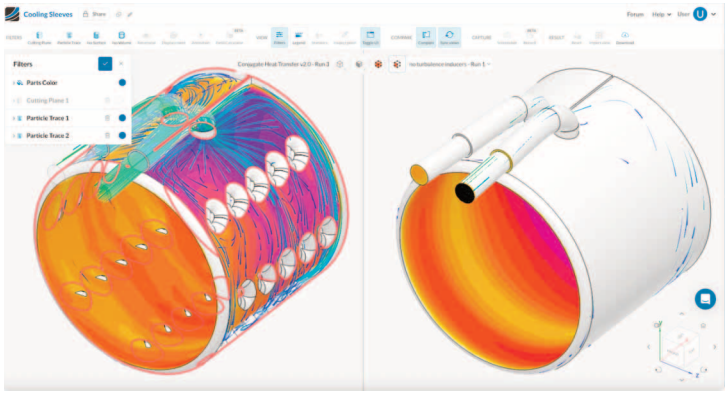
Cloud-native engineering simulation software provider SimScale estimates that one in 25 engineers might already have access to such tools. Chief Executive David Heiny acknowledges that there are many offerings on the market, yet progress is still necessary: "Making simulations faster, better, and more accurate is an endless task." However, focusing on performance alone is not necessarily the most disruptive angle to help EV engineers.

"We believe in changing how simulation is used in the overall product development process," he explains to *Automotive World*. "The complex and compute-intensive nature of modern simulation methods typically silo its use in small, specialised teams." Needing to interface with these separate teams on design verification can extend overall project lead times and constrain EV innovation. As such, SimScale aims to make simulation tools a fully automated and accessible part of every engineer's IT stack.

The need for speed

Today, an automaker's simulation tools are often a heterogenous stack of off-the-shelf components arranged in a desktop application. The result can be both expensive and

convoluted to use, with each validation step carried out manually. As an alternative, SimScale claims to have produced the first vertically integrated cloud-native software-as-a-service simulation application that can be deployed broadly, early and aggressively, while experts still maintain central governance.



© SimScale

Example of an e-motor and associated physics simulated using SimScale

"Teams get access to user, data and process management, as well as high performance computing and our AI model," says Heiny. "We take over that complexity so engineers can focus on their actual engineering work." SimScale's decentralised simulation tools enable EV development teams to act faster by providing easier access to simulation insights. To push the pace of development even further, its platform uses machine learning models to provide almost instantaneous predictions for new design variants based on historical data. This enables it to predict the performance of simulated critical systems and components, including batteries, e-motors and inverters.

Heiny notes that SimScale was not exclusively conceived for automotive, though its benefits and utility for the industry became clear during the shift to electrification. As engineers help automakers make their often complex transition from internal combustion engines to EVs, time is not on their side.

"The powertrain architecture is changing on a global scale, but OEMs and suppliers need to support legacy product lines in addition to designing new ones," he says. "All the people we spoke to said they had a need for speed."

Overcoming bottlenecks

Between 2020 and 2023, global EV sales accelerated from around 3.2 million units to 13.4 million (+319%). Although this growth rate flattened in 2024, some analysts expect it to start picking up again from 2025, as several entry-level models enter the market. Heiny states that the pace of vehicle R&D has become intense for suppliers and automakers alike: "Delivering a request for proposal (RFP) response used to take around three months, but EV programmes are so much faster—that same RFP deadline could now be three weeks."

SimScale's tools offer engineers a way to move faster without sacrificing quality. Heiny explains that simulation lead times—the interval between selecting and validating a design decision—can be reduced from days or weeks using standard practices to seconds through AI. "That's significant because these lead times are the bottlenecks to product iteration, quality, and delivery. The faster a vendor can iterate, the greater their RFP's chance of winning an automaker's business." Through its cloud-based API, SimScale facilitates the real-time collaboration necessary for a team to work collectively and validate its own design decisions while still giving simulation experts full oversight for quality control purposes.

It is equally valuable for automakers' in-house R&D. In one prominent use case, Rimac Automobili's engineers needed to evaluate new thermal management solutions to produce optimal EV battery performance across a unit's operational

> **Innovation will [determine success], and decentralised simulation tools can help [OEMs] achieve it at a faster pace**

lifespan while also ensuring user safety. The complete validation process inevitably required testing multiple variables (such as liquid- and air-cooled systems) and key parameters (maximum cell temperature, thermal gradient).

Satisfactory results through physical tests conducted serially could have taken up to 300 hours. SimScale notes that physical product geometry can both limit observation and restrict the variable range of parameters under investigation, which are not issues in virtual testing. However, the SimScale platform's AI and high-performance computing capabilities enabled it to perform 30 simulations in parallel. The company states that it was ultimately able to complete testing in just 13.5 hours, representing a 96% time saving for Rimac.

Leader or laggard?

Former Stellantis Chief Executive Carlos Tavares once characterised the emerging EV era as "Darwinian", where only the most dedicated and capable brands would survive. In 2025, even the segment's pioneers are struggling to offer differentiated or advanced products, and existing EV technology is still far from attracting the mass market appeal necessary for sustaining growth. In this highly competitive environment, Heiny positions simulation tools as invaluable for resolving some of the most prominent EV engineering challenges.

"There are a handful of pure EV players out there, but the vast majority find themselves in the middle. If they want to survive the EV powertrain shift, suppliers and OEMs will need to perform a ton of innovation in a highly compressed amount of time." He envisions a future in which 99% of all product validation is performed digitally, with only the very last step requiring a physical test. It is by shortening lead times that automakers will ultimately be able to produce EVs in the timescales demanded by regulations and the market.

The stakes are high, and the approach an engineering team takes can mean the difference between success or irrelevance. "Change isn't optional anymore; the global powertrain shift is going to happen, no matter what," Heiny concludes. "Engineering teams need to decide if they want to be leaders or laggards; innovation will be the determining factor, and decentralised simulation tools can help them achieve it at a faster pace."