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SEAT and Cupra CEO tackles new mobility headwinds

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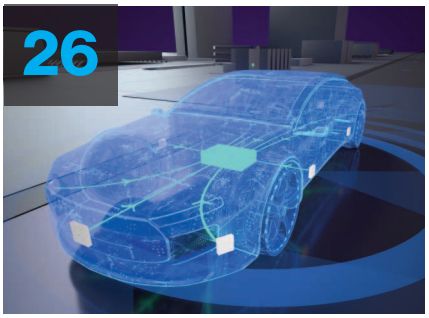


SEAT and Cupra CEO tackles new mobility headwinds

Wayne Griffiths shares his strategy around electrification, subscription services, shared mobility and the metaverse. By Megan Lampinen

Long-time Volkswagen Group executive Wayne Griffiths has been tasked with steering the Volkswagen Group brands SEAT and Cupra into the era of new mobility. It's a big ask for these particular brands: the latter dares not risk alienating its racing and performance fanbase and the former is at times painfully constricted by affordability concerns. While Cupra originated as SEAT's badge for sportier variants of mainstream models, it officially became a separate entity five years ago and began pursuing its own DNA. Today, the two brands benefit from Volkswagen Group synergies and shared Spanish heritage but are pursuing different demographics.

Wayne Griffiths,
CEO, SEAT and Cupra

Like everyone else, they face significant headwinds in their evolution. From supply chain challenges and a global economic downturn to a looming electric vehicle (EV) price war and a potential water crisis, Griffiths has his work cut out for him.

Semiconductor shortage

Cupra is a newcomer at just five years old but growing quickly. Since launch, it has sold more than 300,000 cars and 2022 figures give it a 1.4% share of the EU27, just short of Tesla's 1.6% but on par with Mini and ahead of Jeep's 1.1%. Momentum is strong and it claims to be the fastest growing brand in Europe. In 2022, Cupra recorded a whopping 92.7% increase in sales, compared to a 38% rise at Tesla, 9% at Toyota, and 7% at Kia. "Cupra is really driving profitability," says Griffiths. The SEAT brand, however, has taken a hit with 2022 sales contracting 40.5% to 232,700 units. According to Griffiths, this is no reflection of market demand but rather a sacrifice that was made in the wake of component shortages.

"The semiconductor situation is still volatile," he explains. With not enough semiconductors to go around, higher-margin models from Cupra had to be prioritised. "If you

Cupra Tavascan

look at the order bank, demand is as high or higher [for SEAT] than it's ever been," he emphasises. "We had to prioritise Cupra for margin reasons and reduce SEAT volumes. We have to stay profitable. We also have to protect Cupra; you can't launch a new brand and not deliver."

Electrification

Keen to quash any misconception that Cupra could damage SEAT, he emphasises the important role this brand will play: "Cupra will help SEAT. It allows us to electrify SEAT as a company much earlier than I would have dreamed." Cupra's first all-electric model, the Born, is based on the Volkswagen Group MEB platform and built at the same plant in Zwickau, Germany as the VW ID.3. More than 31,400 units were sold in 2022, its first full year on the market. The brand's second EV, the Tavascan, will follow in 2024. The SEAT brand only offered one EV, the Mii, but later discontinued it and is focussing on more affordable hybrids and clean combustion engine models moving forward.

Getting the pricing right will be pivotal for Cupra's success in the EV segment. The Born starts at about €37,000 (US$41,000). The Tavascan's price has not yet been decided, with Griffiths saying only that it will fall somewhere between the mass and premium segments. "There is a lot of pricing volatility around EVs, which makes it hard to fix a price at the moment," he explains. "That's down to material costs, inflation and the exchange rate. At the end of the day, we must be competitive or we won't achieve volume. The synergies we use in the VW Group in China allow us to do that."

Manufacturing challenges

Tavascan production has been allocated to the VW Group Anhui factory in China, which VW is positioning as a state-of-the-art innovation hub for e-mobility. "We are not doing this project on our own," Griffiths emphasises. "By working in conjunction with VW Group we can become highly efficient, and that should help us pass those efficiencies on in competitive pricing."

In Europe, the Group's manufacturing operations could face a separate headwind in the form of a water shortage. The global automotive industry consumes a vast amount of water for a number of different manufacturing processes. The US Geological Survey estimates that more than 39,000 gallons of water go into producing the average vehicle. Griffiths notes that recent talks with government officials from Spain's Catalonia region, where SEAT and Cupra are based, flagged a looming crisis. "It's been very dry in

The Born marked Cupra's first all-electric model

Cupra Born production at Zwickau plant

southern Europe. We need some rain," he says. "There is a crisis happening at the moment and it could impact us."

Product vs service

Then there is the wider market evolution from product to service, a trend that no automaker can afford to ignore. SEAT has been exploring forms of shared mobility and micromobility. The SEAT:Code software centre developed the brand's first multimodal mobility platform as a service. Speaking at the platform's launch, SEAT Vice President for Finance and IT, Carsten Isensee, emphasised that it "shows that we are no longer just a vehicle manufacturer, but also a mobility services provider." SEAT Mo is the first operator to use the platform for its e-scooter sharing service that launched in Barcelona in 2020, but it's also open to other operators of sharing services and works with any type of mobility.

Cupra, meanwhile, is dabbling in subscription services. It's been offering the Born model for three-month periods, with the fee covering use of the vehicle, insurance, roadside assistance, 24/7 Driverline support and any maintenance that may be required. "We need to offer people the opportunity to try an EV without having to buy it, and I don't mean a test drive," Griffiths tells *Automotive World*. "Subscription will be particularly important in the early days of electrification. For many

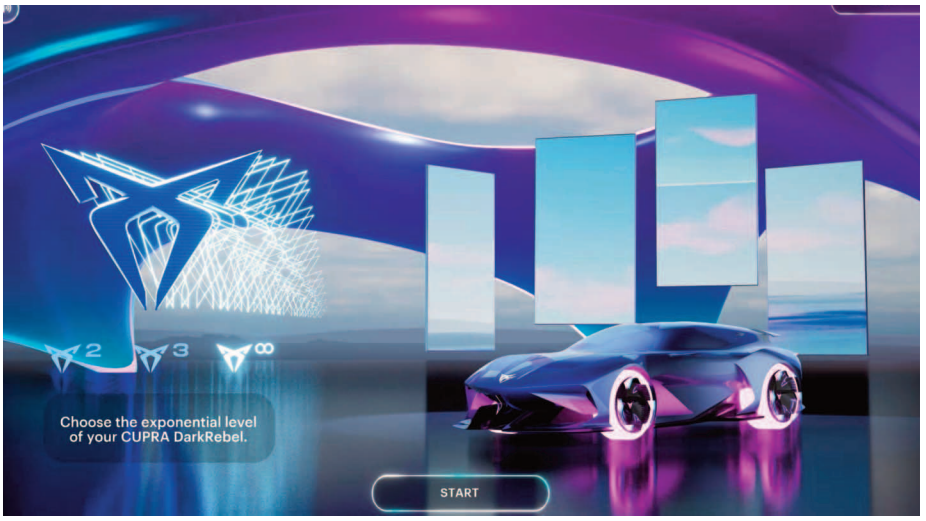
people, once they get in an EV they don't want to go back [to gasoline or diesel]. They quickly see it's feasible for work and travel, but you have to get over that first hurdle."

However, such service-based offerings are not big profit drivers, at least not yet. "New businesses like sharing and subscription models are difficult to make viable," Griffiths cautions. "Hardly any of them make any money." That said, he concedes that "SEAT definitely needs to look at subscription offerings and provide solutions for affordable, sustainable urban mobility for the next generation. The brand is testing different types of products that offer such a solution."

Virtual technology

Under Griffiths' leadership, Cupra is also jumping on the metaverse bandwagon with the introduction of Metahype, a virtual space where members of the 'Cupra tribe' can socialise, play racing games, explore the Cupra model range, browse brand lifestyle products and suggest designs for the upcoming concept model, the DarkRebel. While Cupra recently showed a virtual image of the DarkRebel electric concept alongside the Tavascan launch in Berlin, the design is far from formalised. The brand hopes to gather input from fans on Metahype in the coming months.

SEAT Mo offers a range of urban mobility options



Cupra fans can Influence the future design of the DarkRebel by creating their own version

"We want to involve the Cupra tribe and see what people think in terms of style and design," says Griffiths. "There are many things Cupra lovers can influence. The idea of co-creation is evolving, and people will be excited about the prospect of influencing the final design."

Details are scarce, but the language around this new model is bold. Griffiths says it will serve as "the ultimate interpretation of Cupra's design for the future" and frequently references the importance of "dreaming big." True to its self-proclaimed status as a black sheep brand rebelling from the status quo, designers are promising some striking moves with this one. "We need some to love the car but not everyone to like it," he adds. How much of this concept eventually plays out in a production vehicle remains to be seen, but Griffiths teases: "We don't dream for dreaming's sake. If you are going to tease it, one day you may need to deliver."

Images © SEAT

General Motors drops Chevrolet Bolt for premium EVs

The Bolt has been abandoned, and the evolving EV market may be the key. By Lee Monks

General Motors (GM) has ceased production of its trailblazing Chevrolet Bolt. This is despite strong numbers, relative affordability–the basic-model Bolt is GM's cheapest electric vehicle (EV) option at US$26,500–and popularity: the Chevy Bolt EV and Bolt EUV are its best performers in the electric market, and the former was its very first mass-market EV. Furthermore, as recently as October 2022, GM announced a rise in Bolt production to meet demand. So, why ditch the model now?

The official line suggests that the decision was simply part of the brand's ongoing evolution. "We have progressed so far that it's now time to end the Chevrolet Bolt EV and EUV production, which will happen at the very end of the year," GM Chief Executive Mary Barra says. However, some commentators have pinpointed a wide range of problems.

Jato Dynamics' Automotive Analyst Juan Felipe Munoz-Vieira considers the Bolt no more than a transition vehicle. "The Bolt was conceived to accelerate GM's arrival to the EV market, as it was easier to do so than electrify its big trucks and SUVs. The EV industry is evolving so fast that the Bolt is no longer competitive." Ivan Drury, Director of Insights at Edmunds, offers a similar verdict: "The design, size and slow charging speeds never quite caught on with consumers, and a series of recalls due to fire hazards likely also made an impact."

The Bolt has now been dropped

Bolt's plethora of problems

The first recall in late 2021 involved every Chevrolet Bolt EV ever made due to a risk of battery fire. Just over a year later, 140,000 Bolts were taken off roads. Once again fire risk was the issue, this time due to a seat belt fault.

Michelle Krebs, Director of Automotive Relations at AutoTrader Group and an Executive Analyst for Cox Automotive, reinforces Drury's take on the Bolt's impending obsolescence. Krebs cites the model's outdated battery setup and the car being "hampered" by its size. On a different note, she also sees General Motors moving away from lower-end products. "It strikes me that GM is moving away from affordable EVs, at least initially. Chevrolet promises an electric SUV Blazer starting at around US$30,000, a price likely to rise quickly with add-ons."

Krebs believes the Bolt is being indirectly replaced by "a much pricier vehicle"–the electric Silverado pick-up. "Chevrolet tried to dress up the Bolt EUV as a sort of SUV, the category much preferred by consumers." Munoz-Vieira agrees: "Consumers in the US don't like small cars. If you want to play hard in the American EV game, you must compete with electric trucks and SUVs." The Bolt production plant in Michigan is already being retooled to the tune of US$4bn for its GMC Sierra and Chevrolet Silverado truck lines.

> "Consumers in the US don't like small cars

A rapidly changing landscape

If these analyst observations are correct, GM has shifted its focus up-market. In the short term, it's hard to see this premium shift improving GM margins: it sold 5.9 million vehicles in 2022 (as Bolt sales increased 72% in the same year), compared to 6.21 million the previous year. Nonetheless, attention has now swiftly refocused to the Equinox EV, its basic model starting at US$30,000. The Equinox did well in 2022 with sales of 212,071

units (+28% year-on-year), making it the fourth best-selling US crossover, according to GM figures. However, it will have to do even better in 2023 to justify GM's expectations.

"EVs will be the mainstream choice for the next generation of customers and Equinox EV will lead this charge for us," said Barra. "With the flexibility of GM's Ultium Platform [GM's scalable battery tech], we are bringing to market vehicles at nearly every price point and for every purpose." Scott Bell, Vice President of Chevrolet, adds to the sense that entry-level fare is being jettisoned: "We know truck and SUV customers better than anyone and we've channelled that insight and experience into our new EVs."

"If EVs are going to go mainstream, affordable ones are absolutely necessary," Krebs adds. "At the moment, EVs average around US$10,000 more than gas-powered vehicles. Our surveys consistently show price is the main obstacle to EV adoption." GM's decision could ultimately be banking on an expectation that electric SUV affordability will increase over time. According to a recent Bloomberg New Energy Finance study, both passenger car and SUV EVs will match internal combustion engine vehicle prices by 2027. If so, and with SUVs and crossovers currently making up 45% of all new vehicle purchases worldwide, GM will be well placed.

Ireland punching above its weight in new mobility innovation

The local mobility ecosystem is blossoming. Megan Lampinen reports back from the Emerald Isle

The Republic of Ireland is determined to establish itself as a leading hub for future mobility development. This small country, about the size of the US state of South Carolina and home to just five million residents, is better known for Guinness and shamrocks than it is for automotive production and engineering. However, the usual stereotypes could soon be turned on their head.

With little automotive manufacturing history—DeLorean is one of the more notable exceptions—the move towards electrification and the software-defined car offer an opportunity to lead in new priority areas. Over the past few years, the country has been pouring investment into electric vehicle (EV) batteries, sensor technology, engineering talent and software development. Organisations like Industrial Development Agency Ireland and Enterprise Ireland are actively supporting and facilitating investment opportunities for a wide range of companies in this field. Valeo and Jaguar Land Rover (JLR) are just two of the global big names to operate local R&D centres spearheading company-wide developments across pivotal areas like artificial intelligence (AI), sensors, and software.

“Why did JLR come to the west of Ireland? We are here because of the people, the talent and the skills,” said

John Cormican, General Manager of JLR engineering locations in both Ireland and the US. Speaking at the Software Engineering Centre in Shannon, Cormican told *Automotive World*, "There are tons of software and tech companies in our area. We get the big names: the Microsofts, the Intels, the Qualcomms. For a small country, we are punching well above our weight."

Along with attracting global heavy hitters, it's equally important to nurture new talent, and that's exactly what technology hubs like PorterShed and mentoring schemes like New Frontiers are doing. Designed to help start-ups get off the ground, they can provide office space and facilitate networking, peer support and financial assistance opportunities. "These places help you find the right people so you can start having the sort of conversations you need to have," shared Liam Lynch, Chief Executive of telematics data specialist FleetOps. The start-up has a base at the PorterShed tech hub in Galway, where Lynch noted how a casual chat over a coffee can lead to useful funding or hiring opportunities for the companies based there.

Then there's the research and academia angle. Lero, Ireland's research centre for software, is spearheading work into areas such as autonomous driving, AI, cyber security, smart cities and vehicle-to-everything (V2X) connectivity. Among other endeavours, it's

currently leading a €4.2m (US$4.66m) research collaboration on driverless vehicles, bringing together Irish academia with global automotive and Irish firms to address some of the key challenges facing developers in this space. “Most automotive companies have had challenges in the software space,” noted Lero’s General Manager Joe Gibbs. “Our core research focus on software has a significant importance for the automotive industry at this time, and there are numerous opportunities for us to contribute to OEMs and Tier 1s that are struggling.”

Lero is headquartered at the University of Limerick (UL) campus along with the Bernal Institute, where scientists and engineers are exploring a wide range of topics, from EV battery chemistries and new composite materials to the societal impact of e-bikes. At the National University of Galway (NUIG), work is underway on autonomous and automated driving and connected cities. “This is a fantastic area for the research community, because there are questions everywhere you look,” observed Professor Martin Glavine, Electronic & Computer Engineering at NUIG. He’s been working on connected vehicle technology in collaboration with Valeo as well as automated driving applications for agricultural vehicles on the road, among other projects. Highlighting the strong connections between industry and research, Glavine adds, “It’s no accident Ireland is a real player in this space.”

The Software Engineering Centre in Shannon is developing new technologies to support electrification and self-driving features on future Jaguar and Land Rover vehicles

Software

Ireland is home to 200+ software companies employing 34,000 people. The world's top 7 software companies are in Ireland as are 9 of the top 10 US technology companies.

Global Business Services

Ireland is one of Europe's leading locations for Business Services due to the availability of high quality IT, superb infrastructure and human resource skills. Companies in the sector serve major European and global markets.

FinTech

Home to many of the world's global payment companies across all sectors of the payments ecosystem with 430 Financial Services Companies employing over 44,000 in Ireland.

Engineering & Industrial Technology

Ireland is the European location of choice for a growing number of multinational industrial engineering and technology with over 250 companies in the sector employing more than 23,000 people.

Cyber Security

Ireland has over 80 companies with cyber security operations. More than 20 of these are leading multinational security software companies. 5 of the world's top 10 cybersecurity companies in Ireland.

AI (Artificial Intelligence)

Over 40 leading companies have operations in Ireland either utilising AI as a core function within their business or developing next generation commercial AI platforms.

No future mobility ecosystem would be complete without a testing ground, and that's where Future Mobility Campus Ireland (FMCI) comes in. Located on next to Shannon Airport on the same Shannon Industrial Estate as JLR's Software Engineering Centre, and led by former JLR Engineering Manager Russell Vickers, the testbed is open to any party that wants to trial solutions "in a laboratory with real-life conditions."

Use cases could include autonomous driving, micromobility, smart cities, V2X communications, eVTOLs and unmanned drones. FMCI has also been brought in to coordinate a project for Ireland's first passenger and cargo vertiport, which is expected to support the country's first air taxi service. Bringing the testbed to life has been a labour of love for Chief Executive Vickers, who jokes, "I wasn't grey when this project started. Seriously."

Vickers' passion and hard work are not unusual in this landscape, where amidst the rolling green hills between Limerick and Shannon are numerous R&D centres, and hidden down the stone-clad pubs and cafes of cities like Galway are technology hubs like PorterShed. As Ireland jockeys for a foothold in future mobility, its success will hinge not on the 'luck of the Irish', but on their investment, innovation and drive.

The quantum leap is needed for automotive sustainability

Johannes Oberreuter explores how quantum computing can help the automotive industry transform itself for a more sustainable, more autonomous future

The automotive industry is undergoing a period of profound transformation, compelling its players to reinvent themselves and redefine the purpose of their business. This transformation is being driven by two key factors. Firstly, there are urgent climate goals that call for alternative propulsion technologies. This includes the need for solutions that move in the direction of a de-carbonised and circular economy. Secondly are the changing expectations of consumers who are shifting their preferences towards sustainable and technological choices, one of which is autonomous driving.

The challenge for manufacturers is to implement major alterations on multiple company levels to find efficient solutions for vehicle development and production that are as cost-effective as possible. To achieve this, car makers are increasingly looking to incorporate quantum computing into their solutions which is capable of generating benefits perfectly in line with the needs of the industry. The following are just a few examples of how quantum computing can help the automotive industry transform itself for the challenges of a more sustainable, more autonomous future.

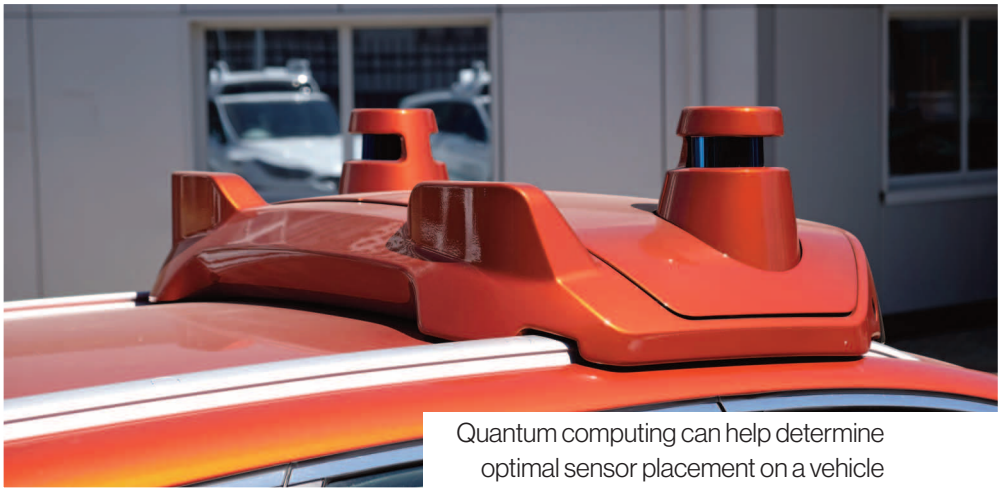
Optimising sensor set-up

Modern vehicles are equipped with numerous sensors to interact with their surroundings but positioning them is an extremely complex task. An error could lead to a needless excess of sensors, very high costs, or reduced vehicle safety. Quantum computing can optimise the process as it can analyse a multitude of combinations to ensure the sensing devices are positioned most efficiently.

In addition, quantum calculations make it possible to better understand which types of sensors are needed and how they should be oriented. The areas covered by the sensors are also crucial. The optimal configuration must ensure that all areas are adequately covered and that the most critical ones are observed simultaneously by several sensors of different types. This too is a task quickly solved by quantum computing.

Boosting testing efficiency

Testing new vehicles is essential to ensure their safety and quality, however, it is a very costly phase for car manufacturers. Here, they are faced with a two-level combinatorial problem. Optimal vehicle configurations must be determined to test all its components, but the tests must take place in such a sequence as to ensure the maximum possible number of tests for each product. Quantum computing is particularly useful because it promotes flexibility, efficiency, and scalability by identifying the lowest number of test vehicles and allowing the highest number of tests at the same time.



Quantum computing can help determine optimal sensor placement on a vehicle

Improving quality control

Currently, manufacturers use machine learning to create images during the production process that enable them to quickly visualise and identify defective parts, resulting in significant time and costs savings. However, quantum circuits now allow new representations of the data and can be trained much faster. Through a hybrid architecture, large amounts of data can be processed efficiently, using the potential of qubits to train new data encoding. Hybridisation is a very flexible approach and can easily be applied to other machine learning use cases, where data also comes from other sources.

Integrating quantum computing into business processes means taking the quantum leap—a leap which automotive companies must be willing to explore. They must revolutionise themselves to remain competitive on the market, especially against digital native players. Quantum has already proven to be the perfect ally for anyone who wants to focus on the efficiency of their company. The next and critical step remains to move on to its integration.

The opinions expressed here are those of the author and do not necessarily reflect the positions of Automotive World Ltd.

Johannes Oberreuter, Manager at Reply, Quantum Computing Practice

The Automotive World Comment column is open to automotive industry decision makers and influencers. If you would like to contribute a Comment article, please contact editorial@automotiveworld.com

Volvo's Roger Alm: decarbonised transport is more than trucks

Volvo Trucks President Roger Alm speaks to Megan Lampinen about the many changes a move towards electric and fuel cell trucks will bring to the business model

Images © Volvo Trucks

Battery and fuel cell electrification offer a route to zero tailpipe emissions in the transport sector, but some vehicle segments offer more challenges than others. The average passenger car weights about two tons, travels 15,000-20,0000 km a year and sits idle for more than 90% of the time. A truck, on the other hand, weighs in at 40-60 tons, can easily cover 150,000 km a year, and runs as much as possible within the confines of regulated driver breaks.

Electrifying the truck segment is a daunting task, but one that could have a huge environmental impact. Roughly 7% of global CO2 emissions come from heavy road transport. Volvo Group began building its first battery electric trucks in 2019 and is jockeying for a leadership position in this nascent segment. Today, it has six different electric truck models in production, including heavy-duty models. It's also in the midst of developing a fuel cell electric truck and operates the fuel cell joint venture cellcentric with Daimler. By 2030, Volvo expects 50% of its global sales to come from the electrified range. By 2040, every single model in its line-up will be fossil-fuel free.

Overseeing this zero-emission push is Volvo President Roger Alm, who proudly describes the company as "first mover" in what will prove the most significant industry transformation since the move from horse and carriage. "But we are only at the beginning of this transformation," he tells *Automotive World*.

What does this shift to electrification mean for you personally?

A lot of it involves talking to our customers and helping them make the transition away from diesel. You can see their happiness when they sign the deal. I was part of the agreement that saw one of our biggest customers [DFDS] order 125 electric trucks, and that was a great, very emotional moment.

Just to counter that, what are some of the biggest challenges in this transition?

There are definitely uncertainties when customers move into a new technology. In this case, that's centred on range and charging. When I speak to our customers, it is clear they want peace of mind and have many questions around route planning, battery optimisation and finance. To support them we are creating many new services. With electromobility, our business will move from only selling trucks to selling complete services.

The e-mobility transition also needs charging infrastructure and incentives. How important are other players in realising this vision?

All of us need to contribute and make an impact. We simply cannot continue treating the world as we have done. The commitments under the Paris Agreement seem very challenging at the moment, and everyone is wondering how we will achieve that. It is clear that the demand for transport will increase as the population grows. One of the

solutions to stop global warming is to decarbonise transport. I am a firm, positive believer that this is the right way forward and I'm proud how we are contributing to a better society.

Volvo's not just contributing; it claims to be leading. How do you see your market position playing out moving forward?

We started electrification with the medium-duty range in 2019. We knew that this was not complete, but we thought it was a starting point from which we could learn. When entering a new segment, you need to learn, then adapt, and then change. We were very clear that this is the right direction. Of course, competition will come but we welcome that.

Geographically, which regions of the world will emerge as leaders in electrified heavy-duty transport?

Northern Europe is leading the race together with North America. Southern Europe is starting to gain momentum, and a handful of other countries and regions are coming as well. We at Volvo sell electric trucks in about 40 countries today, and are expanding that offering to markets in Asia, Africa and Latin America.

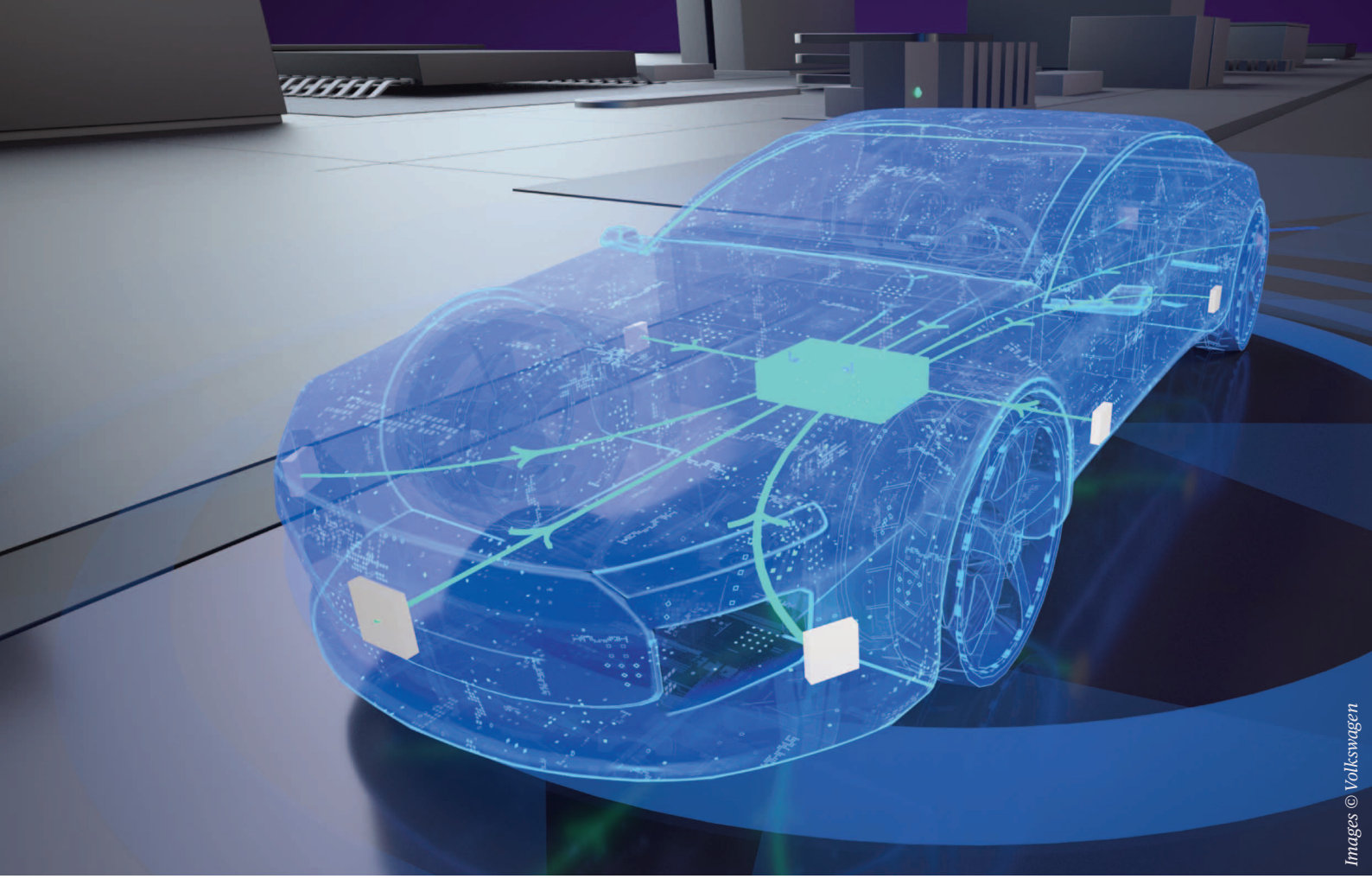
What would constitute a successful year for you?

Selling a lot of trucks and seeing happy customers. For that you need to have happy employees and a good product offering that supports the sustainability push.

Roger Alm,
Executive Vice President Volvo Group and President Volvo Trucks

What's the most rewarding aspect of leading Volvo Trucks through this transition?

We expect a massive shift to zero emission in the future, and many companies have set ambitious environmental targets. To reach them, they have to decarbonise their transport. We will support them on that journey. I love my job. When I end the week on Friday I look forward to some days of rest, but I am extremely happy to get back to work on Monday.



Images © Volkswagen

Volkswagen's Cariad woes—is there a clear way forward?

Volkswagen's EV push has been stymied by problems at Cariad, the in-house unit charged with developing the software underpinning these new models. By Ian Henry

VW is going all out on electrification

The move to electric vehicles (EVs) requires a fundamental shift in the way in which cars are designed, developed and produced. Some vehicle companies, such as Stellantis have found a way of making EVs on the same platform as their internal combustion engine (ICE) powered ancestors, albeit as an interim measure. Others have chosen all-new pure electric platforms. BMW and Volkswagen are prominent amongst the latter, but while BMW–which had trialled EVs with the i3 and i8–has been able to launch the iX3, iX and i4 without many issues, and has many more EVs on the way, Volkswagen's EV push has been stymied by problems at Cariad, the in-house software unit charged with developing software underpinning its new EVs.

Cariad became a distinct unit within the VW group in 2020 in order to coordinate strategy across the company's many brands and platforms. But this has been without much tangible success to date. In fact, delays and losses have grown and recently a reshuffle of senior management took place; Peter Bosch, who had been running Bentley since 2017, has moved to Cariad, with its hitherto Chief Executive, Dirk Hilgenberg, leaving, along with Chief Technology Officer Lynn Longo, and the unit's Chief Financial Officer, Thomas Sedran. All three are said to be looking for new posts within the group, a euphemism for their probable departure to pastures new.

Cariad was created with 1,500 software engineers brought together from across the group's brands; and since 2020, it has added 4,000 more engineers, many in the US and China. Given the challenges of developing a single unified software platform for EVs–encompassing the potential for Level 4 autonomous technology too–covering vehicles from the successor to the Up! to vehicles the size of Bentley was always going to be a challenge. So perhaps Volkswagen's problems in this area should not come as a surprise; whether the company should have embarked on such an ambitious programme may be a valid question.

Key new electric models, notably the Porsche Macan and Audi Q6 e-tron, are running late; these were deemed critical models to take the EV fight to Tesla. But this contest has clearly been delayed, despite commitments earlier in the year that the Cariad software would be ready for the Macan's launch in 2024.

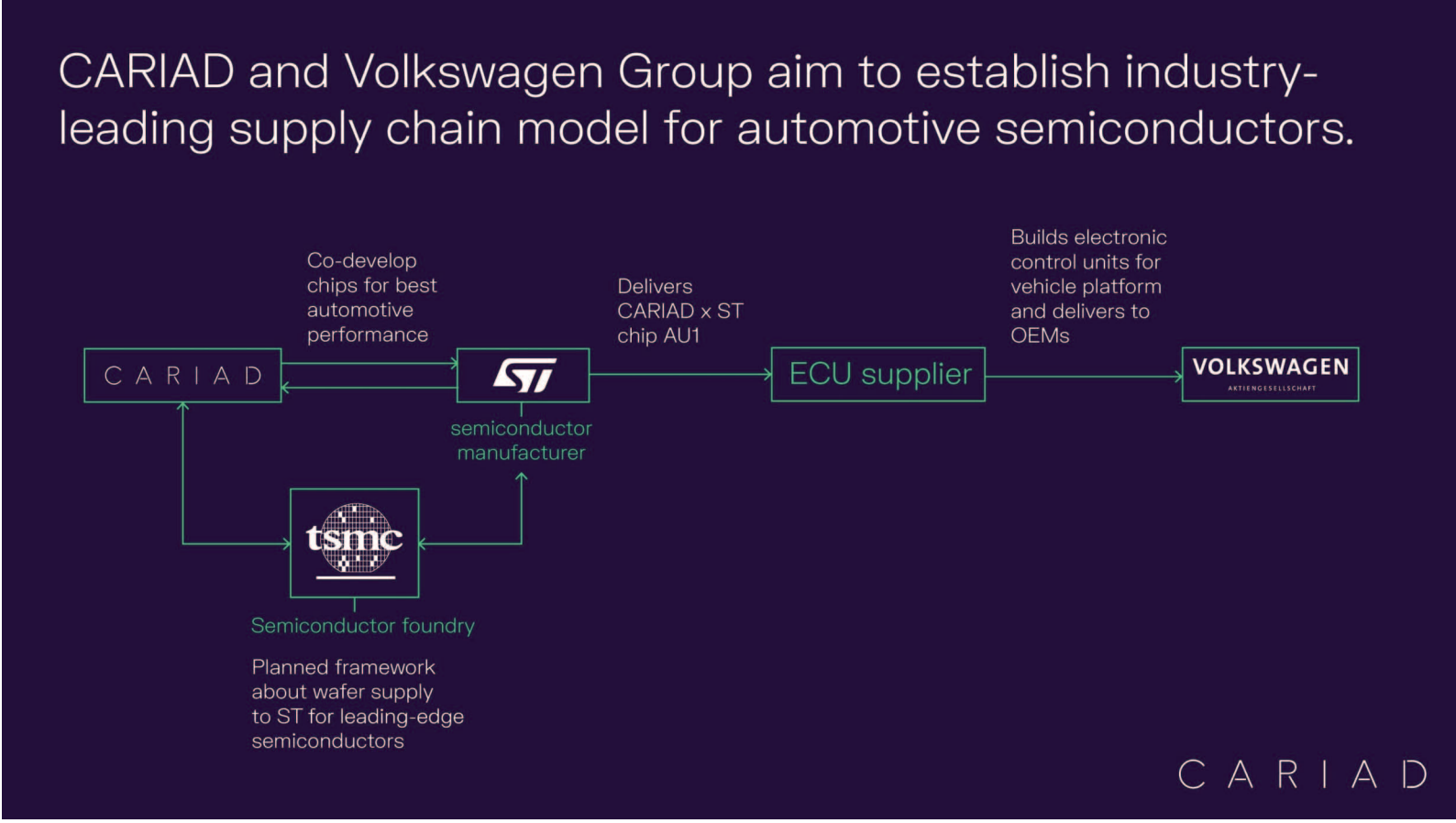
Peter Bosch–who officially takes charge on 1 June 1–will restructure Cariad, although quite what this will involve is not known yet–and explore new partnerships with tech companies, suggesting that Volkswagen will not try to do everything alone. Rather it will co-operate more with external specialists or experts. At least two new software specialists will join the

Cariad board (Bosch himself is a long time VW fixer rather than a software specialist) and Cariad will also likely draw more on VW's existing relationship with Intel Mobileye in autonomous driving technology. This follows on from VW having ended its co-operation with Ford in the Argo AI joint venture.

Prior to the change in senior management being announced, Cariad had announced a joint venture with ThunderSoft of China in the area of vehicle connectivity and infotainment systems; initially it seems that this will focus on VW's Chinese models, suggesting that applying radically new technology on a global basis is too much of an operational challenge. Interestingly, Cariad will be a minority shareholder here, with a 49% stake, in contrast to its autonomous driving chip JV with Horizon Robotics, in which Cariad is an equal partner, with a 50% stake. Cariad also relies on Qualcomm chips in Europe and North America; whether the ultimate goal of a single unified software and electronics architecture for all VW group vehicles is a realistic goal, and an achievable aim when reliant on two different chip companies is an open question.

Certainly, VW had to move away from legacy systems which reportedly used as many as 120 different micro-computers controlling different functions; the Qualcomm system on a chip technology was designed to get around this disparate approach. To date this has not worked.

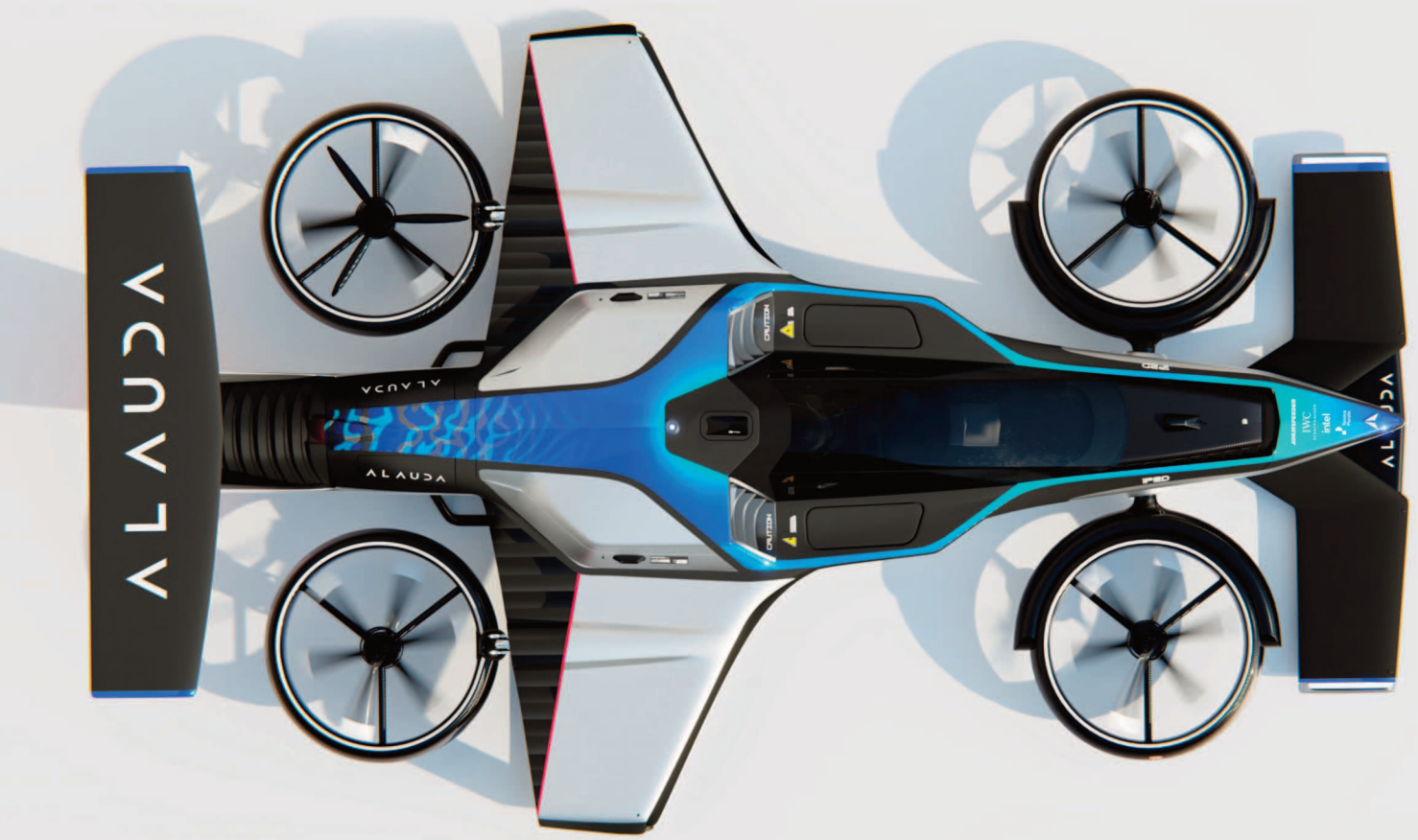
All of the above comes in the light of the VW committing a further €180m (US$) investment in EVs over a five-year period from March 2023, on top similar sums already spent in this area. In line with the above-mentioned software JVs in China, VW has chosen to continue to deepen its general involvement in China, despite the geopolitical issues which the country presents. VW's Chief Executive Oliver Blume had said that the company had to listen to its Chinese customers "more strongly." It



also comes in the light of the March 2023 announcement that Cariad had lost €2.1bn in 2022, on revenue—from other VW group companies—of just €800m (US$195m).

Transforming car companies from traditional manufacturing and technology approaches into 21st century organisations focused on software, electric powertrains and ultimately autonomous driving is the overarching challenge facing the industry. New mobility solutions are required for sure but can 'super-large' legacy companies—with their traditional structures and organisations—deliver this change? Volkswagen remains a global operator, unlike GM and Ford, which have largely retrenched into their domestic heartlands; Toyota has yet to commit to a complete EV switch, and is starting this process in Japan, with relatively small steps elsewhere. Stellantis has chosen a step-by-step approach, as have Renault and Nissan, retaining hybrid systems alongside their EVs. But Volkswagen has gone all-out to challenge Tesla and other new entrants head on; moving into EVs wholesale with complex legacy systems in the background and trying to impose a unified software architecture across a wide range of vehicles is very ambitious to say the least. Maybe the new management will succeed, but the challenge is large, and possibly too much, even for Volkswagen.

> "VW had to move away from legacy systems which reportedly used as many as 120 different micro-computers controlling different functions



Airspeeder makes flying race cars a reality

More than just a show of speed and skill, this new racing series could prove a testing-ground for personal eVTOLs. By Megan Lampinen

Images © Airspeeder

Motorsport serves as a pivotal testbed for innovative technology that may eventually find its way into the mass market. Many of today's leading passenger vehicle brands can trace their roots to the racetrack. Henry Ford started out by building race cars: in 1901 he famously beat renowned driver Alexander Winton in a ten-mile race at Grosse Pointe, Michigan to secure investors for his fledgling car company. Seven years later, he launched the Model T and by 1920 the US had 7.5 million cars on the road.

Renault co-founder Marcel Renault and Rolls-Royce co-founder Charles Rolls were also both racing drivers. The first Fiats were racing cars, as were the first Mercedes models. Could racing now play a similar role for the nascent electric vertical take-off and landing (eVTOL) industry?

Airspeeder

Airspeeder is an electric flying vehicle racing series using eVTOL models from Alauda Aeronautics. Both companies were founded and are overseen today by entrepreneur and visionary Matt Pearson. At the moment, all the eVTOLs in the racing series come from Alauda Aeronautics and are remotely piloted. In 2022, Airspeeder staged two demonstration races, both un-crewed, with five-metre-long drones in close proximity. Very soon they will be manned.

"Like Enzo Ferrari said, we started by competing against ourselves and we ended by beating all of our rivals," Pearson tells *Automotive World*. "We're doing it all: building the vehicles, setting up the race infrastructure, and writing the rules." Other teams are expected to come aboard soon, though no details can be confirmed at the time of writing. "It's exciting to see some of the biggest mobility companies in the world thinking about this," he teases.

The focus is on racing today, but in the future it will also include personal air mobility

The first manned races will begin in 2024 and the debut crewed eVTOL model will be the Mk4. Alauda claims it will be the world's fastest eVTOL with a top speed of 360kph (225mph) achieved in just 30 seconds from a standing start. It has an estimated range of 300km and promises near-zero emissions with its 1,000kW (1,340hp) turbogenerator, which can run on green hydrogen and feeds power to the batteries and motors.

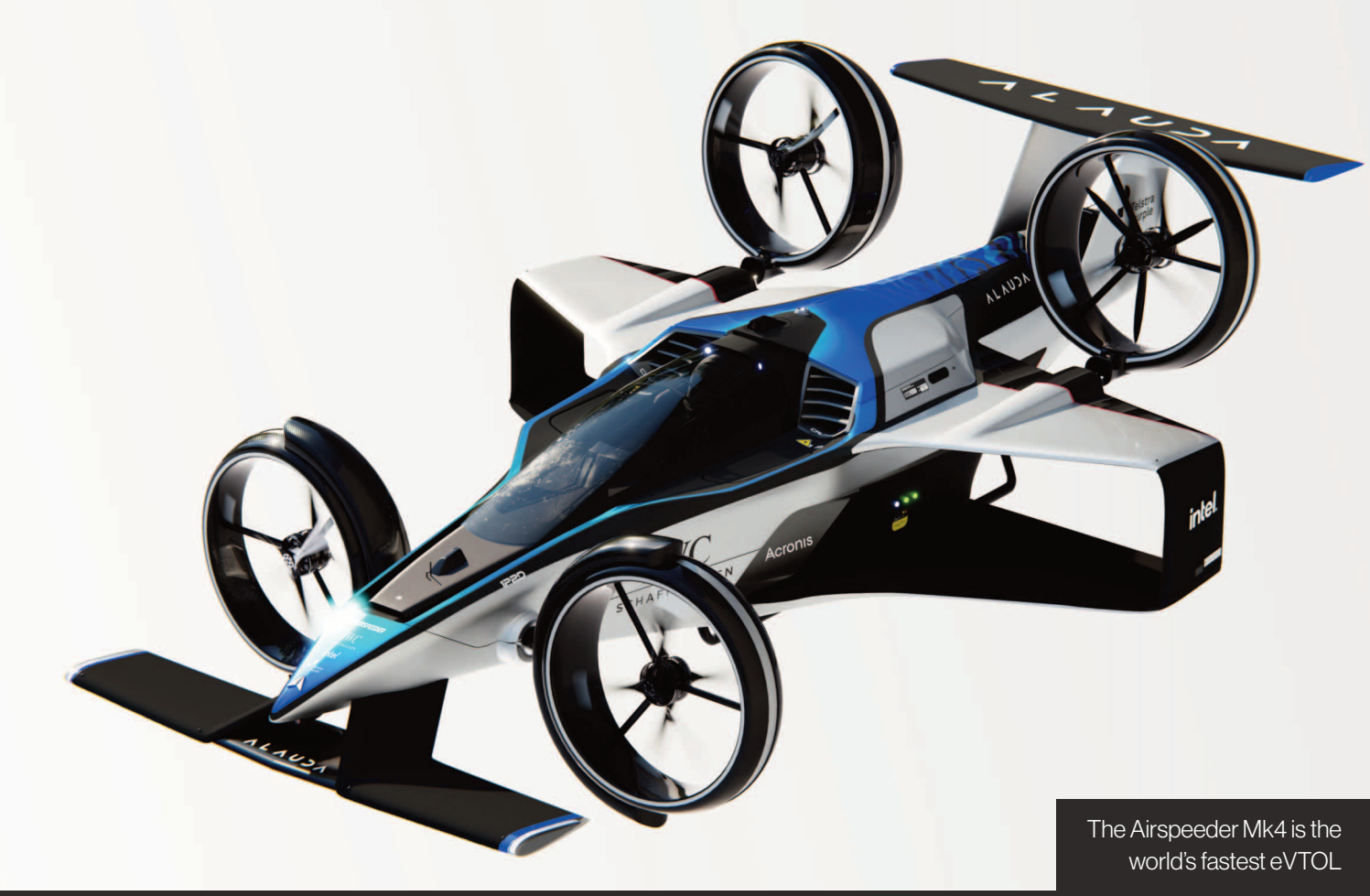
Alauda regards hydrogen as an ideal fuel for personal urban air travel, as it has a high energy density and can be stored in a lightweight, compact form suitable for small aircraft. However, burning hydrogen in a turbine can produce toxic nitrous oxides (NOx) when it burns too hot. To tackle that, the demonstrator 'Thunderstrike' engine incorporates a unique combustor made using 3D printing techniques and designed to keep the hydrogen flame temperature relatively low, significantly reducing NOx emissions.

Racing eVTOLs are just half of the equation: they also need a track. But how do you build one in the sky? "With great difficulty," jokes Pearson. The solution involves using augmented reality with a touch of physical infrastructure. "The pilots see the view in front of them, over which we lay a digital track. People get by pretty well with a few stripes of paint on a road today. We can do the same thing for our racetrack, along with some flags, big plinths and gates. This is generally how we imagine people will get around the cities of the future."

Racing is just the start

While Pearson's focus today is on preparing for the launch of the manned Airspeeder Racing Championship in 2024, the long-term vision is to bring private flying cars to market as a means of urban transport. "Racing gives us a microcosm of the city of the future," says Pearson. "On the track we can safely demonstrate the technology, build awareness and get people excited about these things."

In the future, Alauda Aeronautics plans to offer performance eVTOL models for private ownership, not the shared mobility market that many other hopefuls are targeting. "The highest-end model of a privately-owned vehicle is a race car," he points out. The eVTOL technology honed on the track today will likely find its way in a modified form to private owners of the future. "We think that transportation simply has to go three-dimensional," he asserts.



The Airspeeder Mk4 is the world's fastest eVTOL

Urban populations continue to grow and cities around the world are struggling with traffic congestion and air quality issues. While some players are going underground in the manner of the Tesla Loop, others are looking upwards. "There are only so many tunnels you can build, so ultimately we will have to take to the sky," Pearson predicts. "We hope that people will be able to do their own commuting in the air. It will transform our cities. And maybe, if we work really hard on reducing the cost of components like the engine, we might have a Model T moment where this becomes a mass production mobility option."

The roadmap

The timeline on that is uncertain. While Pearson believes the technology is "almost there," he concedes that long-term success also hinges on regulation and customer acceptance. "Now it's down to getting people excited about having flying cars in our lives. Not everyone is as crazy as we are, so we need to convince the world that these are safe, exciting and wonderful things to own."

He believes the eVTOL market will grow in stages, starting very likely as a recreational vehicle allowed in designated areas. The next step would be to open it up to coastal commuting, with flying allowed over the sea, followed by routes over specified aviation corridors such as along a green belt. "Eventually, when we're all comfortable with the safety and perceptions change, we could see that 'Blade Runner' kind of future where it's commonplace over cities. That's probably not until the second half of this century, but we have to

Lexus: efficiency represents the next chapter of electrified

Lexus' design priorities for its RZ 450e could indicate that automaker differentiation in the electric era is shifting.
By Will Girling

Images © Lexus

The global push to lower CO2 has shaped the initial conversation regarding electric vehicles (EVs). As zero tailpipe emission machines, they fulfil consumers' desire to be more environmentally friendly in their choice of mobility. A 2022 survey by eBay Motors Group found that this motivated 75% of EV purchases, with only 10% expressing no interest in this aspect.

That same year, EY's Mobility Consumer Index recorded that 52% of those surveyed (13,000 across 18 countries) intended to purchase some form of EV. This was the first year a majority consensus in favour of EV ownership had been reached. Again, the consultancy found that early adopters were driven by environmental concerns.

However, as EVs move beyond early adoption and fully into the mainstream, what will customers prioritise when environmental benefits become table stakes? According to Tatsuya Ishigaki, Assistant Chief Engineer at Lexus, the next chapter of e-mobility will focus on performance.

Designing for the electric era

In early March 2023, Lexus unveiled its all-electric RZ 450e, the luxury automaker's first globally available battery electric SUV–it also has seven plug-in hybrid models. "The goal for the RZ was to take the Lexus design language and move it towards battery EV (BEV) functionality," Ishigaki tells *Automotive World*. "In particular, this meant understanding the heightened importance of reduced drag in the frontal area as well as overall aerodynamics as they affect efficiency." The front grille features a shutter that opens to facilitate air cooling and closes to reduce air resistance.

The Lexus RZ 450e's front grille features a shutter that opens to facilitate air cooling and closes to reduce air resistance

The RZ uses the electric Toyota New Global Architecture (e-TNGA) platform to achieve high body rigidity, augmented by the use of steel and aluminium throughout for weight reduction. A 71.4kWh battery is added to this lightweight platform to achieve a range of 196 to 220 miles depending on the trim (Premium or Luxury). The latter figure matches the 2023 industry average, according to the Electric Vehicle Database.

Inside, the RZ prioritises a minimalist approach that is quickly gaining favour with electric SUV manufacturers. "The BEV concept itself is a simple one, with fewer moving parts and a much simpler drivetrain," notes Ishigaki. As such, a stripped back cabin both reflects this

to the customer aesthetically while also allowing engineers to further redistribute mass and boost vehicle efficiency.

Electrification: phase three

McLaren Applied, which uses motorsport insights as a resource for commercial light passenger vehicle R&D, previously told *Automotive World* that performance differentiation between brands will become increasingly important for e-mobility. In the third phase of electrification (the industry is currently in the second phase), Head of Electrification Stephen Lambert suggests that OEMs focusing on efficiency will form a virtuous cycle that results in lighter vehicles, increased range, and lower prices across the industry. Furthermore, in the fourth phase, he predicts that refining the enjoyment of the driving experience itself will become a primary consideration.

Similarly, Lexus' priorities with the RZ indicate that the fundamentals of EV differentiation could be gradually returning to the level playing ground of the gasoline-powered era. Indeed, Ishigaki implies that the RZ is aiming to establish a foundational identity it will build on in the proceeding years. Combined with a continued focus on reliable and durable engineering, he believes the RZ's design and spec will define Lexus' signature performance for its future BEV models. "The enjoyable driving experience coupled with sufficient range and SUV utility makes the RZ an ideal first BEV for many luxury buyers and Lexus customers in particular."

"The single biggest challenge has been to increase efficiency while maintaining driving enjoyment," adds Ishigaki. "This means considering so many aspects of the vehicle: battery mass, tyre size, suspension tuning, acceleration and output, and all while delivering a Lexus-like experience." Central to the OEM's new electric identity is its Direct4 concept, an all-wheel drive system that uses

The Lexus RZ 450e's minimalist cabin emphasises space—an increasingly popular choice for electric SUVs

two symmetrically arrayed electric axle units–150kW at the front and 90kW at the rear–to balance torque. The system serves to optimise and proportionally distribute force, traction, pitch and drive across all four wheels according to driving conditions.

The next chapter of electrified

In addition to Direct4, the RZ introduces another innovative technology that Ishigaki states will evolve significantly in Lexus' future models: steer-by-wire (SBW).

First explored by Lexus with its RX, and also featured in concept cars like Peugeot's Inception (unveiled at CES 2023), SBW is gaining popularity as a next-gen vehicle control technology. Using electrical signals instead of mechanical linkages, this system adjusts the steering ratio proportionally to a vehicle's speed. This boosts agility and stability at both low and high speeds, minimises steering turns and maximises comfort. "Used together with additional electric motors–one per wheel–such a system could theoretically be capable of dynamic posture control and wheel-specific electric motor torque to control body roll," states Ishigaki. Currently subject to different regulations by region, Lexus intends to introduce the SBW to the US market when able but has not specified a timeline.

At a time when developments in self-driving tech aim to remove control from the driver, Ishigaki emphasises that Lexus' EVs will continue to prioritise crafting an enjoyable, directly controllable experience. With the e-mobility timeline gradually shifting from 'will customers buy an EV?' to 'which EV will customers buy?', McLaren Applied's vision of a future marked by technological efficiency could be imminent. Ishigaki concludes that this can only be a positive thing for EV development, and Lexus' incorporation of Drive4 and SBW demonstrate that it is prepared for a new paradigm: "Such a future could help create vehicles with a higher dynamic handling ceiling than what is possible with today's technologies."

Is this the cutting edge of cyber exploits?

Events like Pwn2Own seek to raise the bar on connected car security. By Megan Lampinen

Bring together a group of hackers to find and exploit vulnerabilities before the bad guys can, and reward the best ones with cash or prizes: that's the idea behind Pwn2Own. The competition is now in its 17th year and has recently expanded its cyber security focus from consumer products like laptops and mobile phones to include connected vehicles. Since 2019, Tesla has been offering its models as a target for cyber security exploits.

"Before the competition we worked with Tesla to figure out how best to address car security from a Pwn2Own perspective," says Dustin Childs, Head of Threat Awareness, Zero Day Initiative at cyber security company Trend Micro, the host of Pwn2Own. "How do we write the rules to make it fair and safe? How do we make it relevant? We don't want to do stunt hacking, something that just looks cool but doesn't have any practical purpose. It took quite a while to get everything straightened out."

While COVID interrupted the competition for a couple of years, it was back in force in 2022. At the Vancouver event that year there were two hacking attempts on the Tesla, one of which successfully exploited the infotainment system remotely. From there the team could then open the frunk, flash the lights and move the windshield wipers. It was an impressive demonstration but the following year took things up a gear.

The easiest task for 2023 was to exploit the car's Bluetooth/Wi-Fi systems. The most difficult was to take over Autopilot. A team from French cyber security firm Synacktiv was able to exploit a vulnerability in the Model 3's Gateway energy management system and another in the infotainment centre. The opening offered just enough access to the control systems to make driving unsafe. "It meant they couldn't touch the brakes or steering but they could touch other components while the car is in motion that would really make you have a bad day," Childs tells *Automotive World*. "Last year they could only do this when the car was in park, essentially. This year they could do it even while it was in motion." Imagine driving down the road while the frunk or the side doors unexpectedly open. The exploit was enough to win the team US$350,000 and a new Tesla.

Notably, it was not carried out on the car itself due to safety implications. "We didn't want to accidentally touch the Autopilot system and drive the car into the building or a crowd or

> A car's not just a car anymore; it's a system of systems, and each of those systems is a potential attack surface

anything like that," Childs explains. Instead, key components were extracted from the vehicle and laid out on a table.

State of the art for exploitation

Tesla is keen to learn from events like this and uses the findings to address flaws and initiate patches. Vulnerabilities can arise almost anywhere, but Childs is particularly concerned about problems with patches. Industry-wide, he sees plenty of room for improvement. Trend Micro buys bugs throughout the year, and between 10% and 20% of them are the direct result of a failed patch. "A lot of the security patches that are going out from a lot of vendors are not adequate; they're not actually solving the problem. In some cases, they're introducing new problems," he says.

This is just one area around which he hopes to raise awareness with events like Pwn2Own. With Statista predicting more than 400 million connected cars on the road by 2025, the industry needs to move quickly. "A car's not just a car anymore; it's a system of systems, and each of those systems is a potential attack surface. Not many people are trying to connect the dots of all the various systems," he notes.

The company is holdings its first automotive-specific hacking event, Pwn2Own Automotive, in Japan in January 2024. As the name suggests, this is focussed on vulnerabilities within the automotive sector. Numerous automotive brands will be putting up targets, not just Tesla.

"We want to uncover those major findings, those 'ah-ha' moments that are key to ensuring security," says Childs. "We don't have all the answers yet but we want to find them and we're putting a lot of money towards it."

Financial incentives have proven effective at motivating research. Offering US$150,000 for a target will attract some notice and spur serious efforts. "We want to connect skilled, independent researchers around the world with vendors who might not think like an attacker," he adds. Notably, it takes a full exploit, not just a simple demonstration or proof of concept, to win Pwn2Own. The aim, emphasises Childs, is to showcase "the state of the art for exploitation."

Lithium-air promises cheaper and more powerful batteries

Research indicates a novel lithium-air chemistry could outperform current gen batteries in both cost and performance. By Will Girling

The full potential of lithium-ion batteries (LiBs) has arguably still not been reached, yet many automotive stakeholders believe solid-state batteries (SSBs) will be a key enabler of the second electric decade. Indeed, this next-gen tech already promises to be safer and more durable and powerful than its liquid electrolyte predecessors.

While bringing a mass producible SSB for the automotive industry has proved difficult, recent developments suggest the first examples could arrive by the decade's end. Consequently, the global SSB market's value is projected to reach US$14.5bn by 2032–a 2,337% increase on 2022's figure–according to Global Market Insights.

However, far from being a homogenous solution, SSBs cover a wide range of material compositions. As supply chains and regulations continue to affect the global industry's trajectory, there is ample room for new battery chemistries to resolve the challenges posed by electrification.

Lithium-air

In February 2023, Mohammad Asadi, Assistant Professor at the Illinois Institute of Technology (IIT), published a paper outlining his design for a lithium-air chemistry SSB. Lithium-air batteries, which theoretically deliver an energy density equivalent to gasoline, have been the subject of research for more than 12 years. Asadi and a team of researchers discovered an SSB based on lithium oxide, which has a very high energy density, and, more importantly, outperforms the battery solutions already available.

"We use a composite polymer-ceramic electrolyte that shows high ionic conductivity and stability and a four-electron reaction," Asadi tells *Automotive World*. The result is a lithium oxide formation and decomposition at room temperature, generating 1kWh per kilogramme–an energy density that is up to four-times higher than current generation lithium-ion. This is by no means the limit: "Our initial work has focused mainly on the science of the composition; the battery cell is just lab scale." By optimising the design, he believes even greater capacity could be unlocked.

"Prior to this research, the feasibility of lithium-oxygen cells was developing slowly," adds Larry Curtiss, Senior Chemist at the Argonne National Laboratory, who also participated in the research. This was because developers were using liquid electrolytes and pure oxygen, which subsequently made the volumetric density impractical for incorporation into a vehicle. Switching to a solid electrolyte avoids this significantly, making it suitable for automotive use cases. "I think this opens up a whole new area for batteries," he states.

Solving pain points

Charging time and overall durability are among the core considerations for new electric vehicle (EV) battery technology. A reduction in the former

© Illinois Institute of Technology (IIT)

Mohammad Asadi (centre) published his paper on a lithium-air SSB design following 12 years of research

could encourage adoption by increasing customer convenience, while boosting the latter will help answer lingering questions concerning the sustainability and affordability of battery replacement.

At this nascent stage of development, both Curtiss and Asadi state that lithium-air's ability to solve these industry pain points has yet to be proven. Although the lab cell can operate safely at high rates, it is currently only rechargeable for 1,000 cycles. For comparison, a best-in-class LiB has three-times the durability. Furthermore, both are well below the projected 10,000 cycle lifetime of Adden Energy's sulphide based SSB. "However, one advantage of lithium-air batteries is that they have a relatively simple design," says Asadi. "They use oxygen in a manner comparable to an internal combustion engine." As such, he proposes that OEMs will be able to quickly understand and easily incorporate them.

Lithium-air could also prove popular with vehicle manufacturers from a purely economic perspective. Asadi states that the cathode materials required are inexpensive–they are similarly priced to LFP (lithium-iron-phosphate), which is approximately 30% cheaper than the widely popular NMC (nickel-manganese-cobalt) LiB chemistry. "The difference is that lithium-air offers four-times the energy density of a LiB. That means the overall battery can be smaller, regardless of whether it is powering a light or heavy vehicle." This in turn will allow automakers to dedicate less design space to batteries, reduce vehicle weight, increase range, and lower production costs.

Transitioning production

The next step for lithium-air batteries will be to transition from a lab cell to a mass producible platform. Asadi projects this could take up to three

years. In the run-up, IIT and the other research participants will seek to secure partnerships with automotive stakeholders and equipment fabricators to help bring the technology to market. At the time of writing, these collaborations are still at the discussion stage.

that while sourcing lithium will remain a consideration at present, "even that could eventually give way to sodium-air battery chemistries."

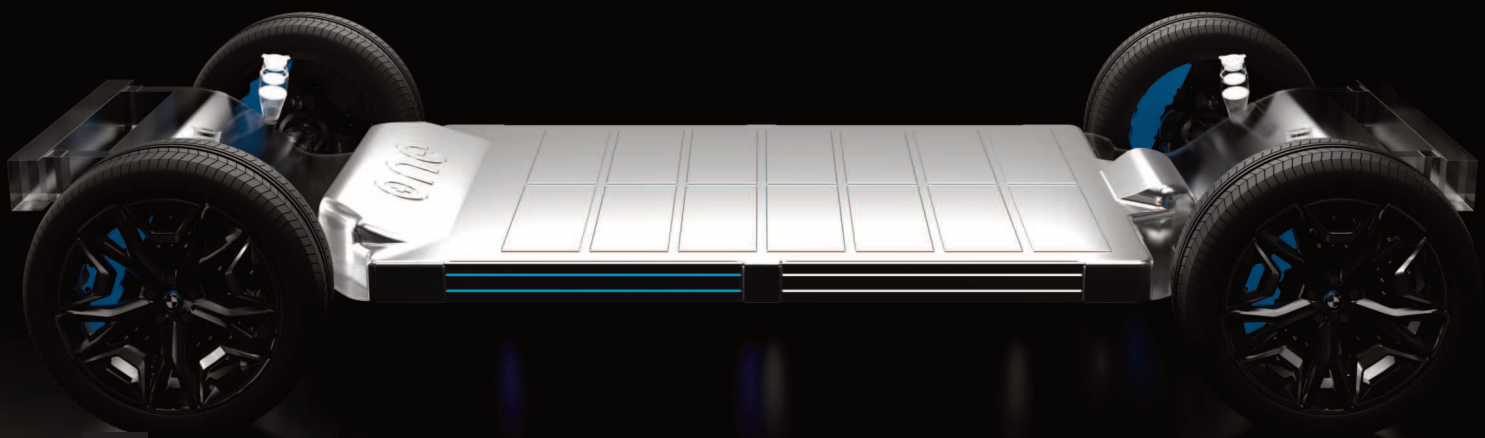
Due to the novelty of lithium-air, neither Asadi nor Curtiss can state with certainty what role it will play

It is by reducing cost without sacrificing energy density that lithium-air could prove highly influential in shaping the future of electrification

Aside from its performance and cost advantages, Curtiss emphasises that lithium-air will also shorten supply chains by eliminating certain materials. Cobalt, for example, is an essential component in NMC LiBs, but its supply is overwhelmingly controlled by China (the Financial Times estimates it will secure 50% by 2025). This is problematic for other markets, such as Europe, which could have divergent ESG standards for mined materials. Furthermore, a Q1 2023 price dip makes it difficult for countries like the US to initiate domestic cobalt projects, despite there being clear incentives in the Inflation Reduction Act. A cobalt-free chemistry like lithium-air mitigates the issue entirely. Curtiss also suggests in automotive's future. However, both are convinced that the safety and performance of SSBs will make them an inevitably game-changing technology for electric transport. Cost will likely prove the largest hurdle if the battery industry begins transitioning away from liquid electrolyte designs, and it is in this regard that most solid electrolyte compositions continue to struggle. By 2026, ResearchandMarkets calculates that SSBs could be 200-500% more expensive than a LiB's 2022 price. Therefore, it is by reducing cost without sacrificing energy density that lithium-air could prove highly influential in shaping the future of electrification.

Dual chemistry batteries unlock 600+ mile range capability

ONE's work on iron-phosphate and dual chemistry batteries promises to address ongoing challenges for the electric automotive industry. By Will Girling



Images © ONE

Innovative automakers like Tesla have helped launch electric vehicles (EVs) into the mainstream and establish them as viable mobility options. This push for credibility characterised the first phase of electrification–defined by McLaren Applied as from the early 2000s to late 2010s–and has now given way to the second phase, where practically every OEM is either selling or developing an EV.

However, despite making large gains, the e-mobility sector faces ongoing challenges relating to battery technology. From socio-economic factors disrupting raw material sourcing and pushing up prices to performance deficits and safety concerns about overheating, current gen battery chemistries are far from optimal.

Mujeeb Ijaz,
Chief Executive, Our Next Energy (ONE)

Prioritising LFP

In early 2020, Mujeeb Ijaz, previously Manager of Electric and Fuel Cell Engineering at Ford and Senior Director of Energy Storage at Apple, considered three ongoing challenges facing battery technology: range, chemistry, and supply chains. Not long after, Ijaz founded Our Next Energy (ONE) in Michigan and became its Chief Executive in order to resolve these crucial issues.

"EV batteries today are still highly susceptible to their driving environment–cold weather can halve the EPA-rated range of a car," Ijaz tells *Automotive World*. "Redefining the real-world range of an EV was the first big opportunity I identified." In his view, 600 miles should be the goal–double the industry standard. However, the only liquid electrolyte battery chemistries offering close to this performance are nickel/cobalt compositions. "With these you have risks of thermal runaway, high costs, and ethical sourcing issues," he adds. Subsequently, ONE opted to develop EV batteries without these metals and focused on utilising domestic North American supply chains.

Instead, the company's Aries range of batteries for heavy (Aries I) and light (Aries II) vehicles use a lithium-iron-phosphate (LFP) composition. This chemistry's low rate of self-heating and the abundance of iron in the US resolves many of the safety, cost, and supply issues of nickel and cobalt. However, there is a trade-off: Ijaz notes that LFP generally matches only 60-70% of a standard lithium nickel-manganese-cobalt cell's range performance. To compensate, the company increased the cell-to-pack volume to more than 70%–by comparison, the Tesla Model 3's LFP battery is around only 32%, while Volkswagen's and GM's are at 45%.

This results in a single-charge range of more than 150 miles for the Aries I and 350 miles for the Aries II.

Dual chemistry

While ONE's LFP batteries enabled it to tackle two of Ijaz's identified challenges, the 600-mile target range remained elusive. "To achieve that, we latched onto a second idea: divide the battery into two parts," he explains. In this scenario, one cell would still be used for most driving use cases. However, a specialised DC-DC converter allows energy from a second cell to be seamlessly transferred to the first when a range boost is required.

ONE's eventual product—Gemini—is a dual chemistry battery that combines a 441-watt hour per litre (Wh/L) LFP cell with a 1,007Wh/L manganese anode-free cell. The former provides a 150-mile range that Ijaz calls adequate for "99% of EV usage," while the latter delivers an extra 450 miles for longer distance driving. Real-world testing has pushed this performance even further. In June 2022, ONE signed a demo agreement to integrate a Gemini battery into the BMW iX SUV, resulting in a confirmed range of 752 miles on a single charge.

Dual chemistry batteries like Gemini, Ijaz states, solve the energy density to durability trade-offs with which most existing EV batteries must contend. "Even though chemistries will inevitably change in the 2030s, the dual architecture could remain relevant for decades afterwards," he asserts. One drawback is cost: Ijaz concedes that the DC-DC converter alone costs US$2,000 per unit. "However, we also integrated functions like voltage and temperature monitoring, cell balancing, and charging software in one device." As such, he claims that this consolidated battery management system keeps the dollars per kilowatt-hour ratio close to standard lithium-ion. Furthermore, by using no cobalt, 75%

less nickel, and 20% less lithium, the Gemini's total supply chain is also cheaper and easier to access.

A multitude of chemistries

Ijaz emphasises that cultivating industry interest and engagement for different battery chemistries remains a priority. In February 2023, ONE secured US$300m in a Series B round that drew investment from BMW iVentures among others. The company's North American material supply chains also mean that it can capitalise on key Inflation Reduction Act incentives. However, with its dual battery technology not yet ready for mass production, the company is opting for a three-tier roadmap starting with truck and bus, progressing to grid energy storage, and finally the broader automotive industry. In addition to BMW, ONE has relationships with three other automakers–the details of which are not yet public.

"We're pretty far ahead of schedule in that journey," says Ijaz. "Our battery isn't waiting for a new chemistry breakthrough; it's more about system integration. In 2023, I expect to have multiple demonstrations of 600-mile EV options using Gemini." With range anxiety still a common customer blocker to EV adoption, he is confident that the substantial range boost of dual chemistry batteries can convince automakers to take on the added complexity. "If the market can provide a variety of range options, the industry can note which batteries customers gravitate towards. Then, instead of 'should I buy an EV', customers will be asking themselves 'which EV should I buy?'"

Therefore, the battery market in 2030 and beyond could be characterised by variety instead of consolidation. If dual chemistry batteries prevail, Ijaz anticipates that LFP will become the most widely used primary cell, due to its cheap manufacturing costs, safety, and high durability. However, the second cell will provide the industry an opportunity to experiment with alternatives. "We could see new iterations up to every three years," he suggests. "Dual batteries provide the best of both worlds: stability and room for innovation." More importantly, ONE's example demonstrates that nickel and cobalt chemistries prevalent today do not represent a developmental dead-end. By reconsidering the fundamentals of design, application, and material sourcing, new batteries can effectively address the needs of customers and the broader automotive industry.

> "Dual batteries provide the best of both worlds: stability and room for innovation

Ford's Model e forecasts US$3bn in 2023 losses—now what?

In the wake of heavy losses for its EV division, Ford may need to manage expectations about a mid-term recovery. By Stewart Burnett

As the transition towards electrification picks up pace, investors are beginning to get a taste of the downside. With Ford's recent projection of losses in the region of US$3bn (before tax and interest) for its electric vehicle (EV)-focused Model e division in 2023, the company is working to reassure investors that the future remains bright for its EV products. Further complicating matters is its announcement of a restructuring into three distinct divisions, hosting an investor "teach-in" on 23 March 2023 to explain the changes and articulate its roadmap for the future. The automaker has also forecast a return to single-digit profits for Model e by 2026. However, in the short- to medium-term, the pressure is on.

Growing pains

While the losses of the Model e division may seem daunting to investors, they are not unusual for the industry. John Lawler, Ford's Chief Financial Officer, has characterised them as typical for any "EV start-up", remarking: "As everyone knows, EV start-ups lose money while they invest in capability, develop knowledge, build volume and gain share." By treating its Model e division in this way, the OEM believes it can pair agility and innovative capacity with its

Images © Ford

> The route to profitability is seldom as short as projected

substantial industry knowledge and resources. In this sense, Model e has a hefty advantage over actual start-ups competing in the EV space.

Jonathan Storey of Automotive Reports believes that Lawler's analogy is reasonable: "Start-ups are nearly always optimistic and the route to profitability is seldom as short as projected." Lucid, for instance, reported losses of US$2.6bn in 2022, and Rivian almost US$6.8bn. What gives Ford's Model e division its core advantage over a typical start-up, however, is the stabilising offset provided by its other two divisions–Ford Blue and Ford Pro–which each reported profits of around US$7bn in 2023. Their strong performance will ensure that the automaker's profits remain healthy while it works towards scaling up production.

Lowering costs

While rising demand will serve as the primary driver of Model e's anticipated 2026 return to profitability, lowering manufacturing costs is also crucial. To this end, Ford is set to announce a new US$3.5bn battery plant in Michigan in collaboration with Chinese partner Amperex Technology, which specialises in affordable, high-quality EV battery production.

Having a domestic plant will help the company ramp up its EV production without

experiencing supply chain issues like bottlenecks or political instability, both of which have proven highly disruptive in recent years. Being able to source parts domestically also provides Ford autonomy to take increased efficiency and affordability as seriously as it deems necessary.

Lawler has said that the division is "obsessing over energy-efficient designs because they will allow us to significantly reduce the battery size and cost." However, Storey is not convinced this will have a significant impact: "Energy efficient design is not a new ambition; broadly speaking, there are no low-hanging fruit left for the engineers to pick." He also adds the caveat that "lighter will tend to mean more expensive"–if the company intends to lower costs significantly, it may entail further investment in R&D, with no guarantee of results by the mid-term.

Managing expectations

Over the past few years, Ford has established a significant presence in the US EV market. It is currently vying with Hyundai to become the second-largest player in the space, occupying 7.56% market share compared to the latter's 7.81% as of 2022. While Tesla remains dominant with 50.6%, Ford may be able to capture new customers as the global EV market expands, with Vantage Market Research anticipating a more--than--threefold leap in value to US$693.7bn by 2030.

Ford plans to take advantage of tax breaks in the Inflation Reduction Act to construct its Michigan plant

> “Even for established car-making operations, medium-term forecasts often turn out to be more optimistic than realistic

For now, aggressively targeting growth and market presence could come at the cost of financial pain. Ford remains steadfast in its target of 8% operating margin by 2026, although Storey believes this kind of optimism is typical of the industry: “even for established car-making operations, medium-term forecasts often turn out to be more optimistic than realistic.” While there is a lot of pressure on the automaker to prove that the heavy losses are a necessary burden, a more grounded forecast may help to keep investors on board.

Even if the company can increase its margins, there is still the potential for disruption on the horizon. Storey predicts that “increasing price competition will also be a significant factor.” With Chinese brands like BYD beginning to penetrate Western and Japanese markets at more affordable price-points, this may have already begun. A March 2022 study published in *Nature Communications* by Anqi Zeng et al has also forecast a shortage of cobalt (essential for the manufacture of batteries currently used by the company) between 2028 and 2033, placing pressure on the company to speed up the timeline on its domestic production of lithium-based batteries. A combination of these factors could serve to prolong the Model e division’s financial problems beyond what Ford currently anticipates.

Mining vs recycling: is one superior for battery sourcing?

Announcements from BMW and Mercedes-Benz suggest approaches to battery material sourcing could create an automotive industry dichotomy.
By Will Girling

Images © Mercedes-Benz

The availability of battery materials has become a pressing issue for the automotive industry. Driven by a combination of accelerated demand for electric vehicles (EVs) and complex socio-economic circumstances, the global supply and price of certain key metals—such as lithium, cobalt and nickel—have been highly volatile.

In an effort to 'close the loop', battery recycling facilities have emerged as a solution to the inefficiencies of mining projects. Some automakers have grown increasingly committed to this approach, viewing it as capable of simultaneously reinforcing supply chains, boosting regional production, and creating a more sustainable industry.

In late March 2023, BMW announced that its future investments would specifically target more efficient battery design and recycling initiatives instead of mining. That same month, Mercedes-Benz Chief Executive Ola Kaellenius stated the company was "able and willing" to invest capital in mining. In addition, Stellantis, Ford, GM, and Tesla have all reportedly channelled funds into mining projects to secure resources. Notably, Mercedes-Benz is simultaneously developing a battery recycling facility in Kuppenheim, Germany.

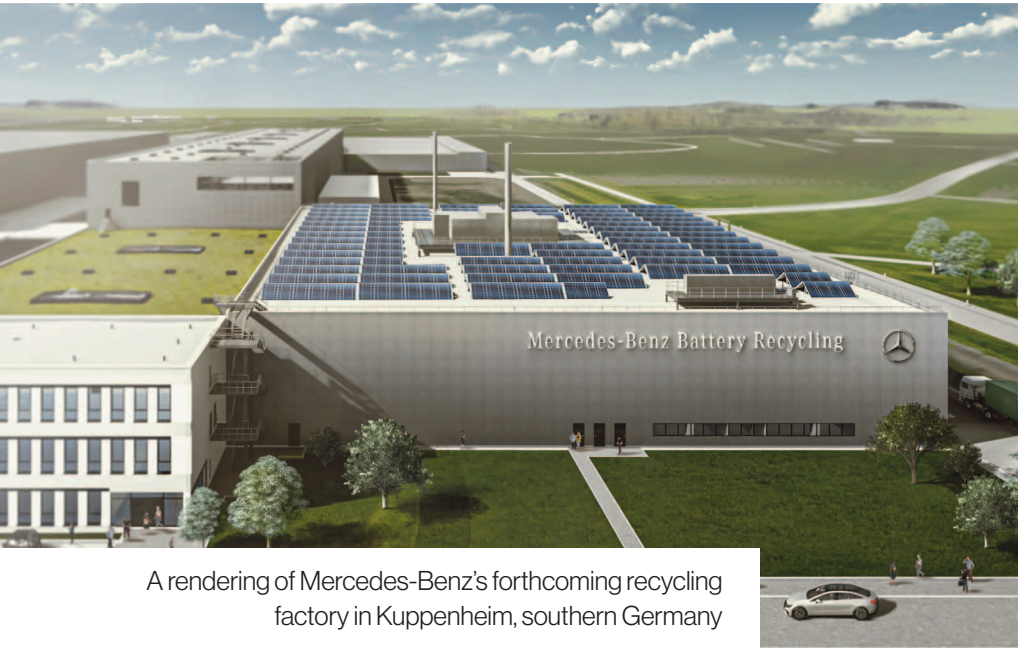
The battery is linked to 30-40% of a new EV's total cost, meaning that manufacturers have a strong incentive to explore new supply chain solutions. With BMW and Mercedes-Benz taking different lines on the issue of mining, although both acknowledge the importance of recycling, what could the future of battery material sourcing look like?

A culture change

Dave OudeNijeweme, Senior Director at energy and consultancy firm Worley, and Greg Pitt, Vice President of Battery Materials at Worley, equate the present situation to the ongoing shortage of semiconductors. "That supply crisis clearly highlights the impact of not being in control of your supply chain," they tell *Automotive World*, referring to lost earnings through inhibited production capacity. Mines and refining facilities are capital intensive, yet the progress of EV adoption globally—one in seven cars sold in 2023 is now electric, according to the World Economic Forum—make them a pragmatic investment decision for OEMs.

> "Investing in a mine is something we haven't seen for 100 years within automotive

Newer brands like BYD and Tesla, state OudeNijeweme and Pitt, have demonstrated greater alacrity for vertically integrating business-critical aspects of the value chain than older players. However, the shortage of battery materials could precipitate a



A rendering of Mercedes-Benz's forthcoming recycling factory in Kuppenheim, southern Germany

cultural change within the industry. "OEMs are risk averse by nature because their brand is on the line," adds Alex Holmes, Chief Operating Officer at cathode production company Nano One. "Investing in a mine is something we haven't seen for 100 years within automotive. Then again, they haven't had to rebuild their supply chains for a century either."

There are also strong political and economic motivations for investing in mines. China, notes Jordan Roberts, Battery Raw Materials Analyst at price reporting agency Fastmarkets, controls approximately 70% of refining capacity for battery raw materials. Independence from this hegemony would benefit the US and European industries as they seek to gain a stronger foothold in e-mobility. Furthermore, as regulations like the US' Inflation Reduction Act stipulate domestic material origin requirements to qualify for incentives, manufacturers are likely to continue pushing for increasingly localised production hubs.

No guarantees

Despite these advantages, Dom Tribe, Partner and Automotive Specialist at management consultancy Vendigital, informs *Automotive World* that investing in mining can't intrinsically solve supply issues. "Investment won't necessarily guarantee them a share of the mined materials," he notes. This is because deals are generally used just to secure agreed prices over a long period of time. "The high degree of market competition means that no matter how much money an automaker throws down the supply chain, the race for resources is such that it could still be beaten."

Holmes, OudeNijeweme and Pitt are all also sceptical that mining projects alone could supply enough raw material to satisfy demand. The mismatch in timeline between the start of a new project and a mine actually going online–Holmes estimates up to 15 years–suggests that they are not a practical near-term solution. Subsequently, recycling and production efficiency initiatives will need to fill the gaps. "Scrap from gigafactory start-ups is considerable: yields are typically less than 50% once online and take years to get to 90%," says Holmes.

The proliferation of regulations like the German Supply Chain Due Diligence Act on a more global scale, which specify the quantity of recycled material per battery unit, could ultimately direct industry attentions away from mining. Julia Harty, Energy Transition Analyst at Fastmarkets, notes that these minimum levels are currently low in Europe but are exhibiting growth in South Korea. "If this is a sign of what's to come in terms of global regulations, then OEMs will feel more pressure to increase their usage of recycled battery metals over the next five to ten years," she projects.

BMW's and Mercedes-Benz's relatively early investments in circular economics reflect the need to start building this capacity meaningfully, which Holmes believes could take more than a decade. OudeNijeweme and Pitt also suggest that automakers' efforts to develop recycling could prove more immediately fruitful–it is "easier to understand" as they are already responsible for it. "Securing upstream supply is largely unfamiliar to OEMs, and some have traditionally put the responsibility of this supply on their Tier 1 and 2 suppliers."

A multi-faceted approach

Despite the statement from BMW, neither Holmes nor Roberts believes that an industry-wide division of mining vs recycling is likely to manifest. “Recycling will be key to ensuring stable long-term supply, closing the loop and reducing raw material extraction,” says Roberts. “But OEMs with plans for an aggressive rollout of EVs also understand that recycling isn’t currently at the stage to service its needs.” Fastmarkets estimates that recycled batteries will supply just 6% of the annual EV demand globally by 2030.

“Mining is a challenging thing for OEMs to associate with their brand,” adds Holmes, referring to the well-known ESG concerns of some projects. While poor practices undoubtedly persist in the industry, he highlights that most mines cannot be permitted, financed or operated in 2023 without strong social and environmental best practices. Therefore, Holmes believes automakers must not form intractable ideological opposition to mining: “Based on the realities of today, and the next decade at least, it is not realistic to be solely focused on recycled materials.”

After all, any attempt by a regional industry to close the loop and become self-sufficient in a rapidly growing e-mobility industry will entail an initial surge in raw material extraction. “Considering the full picture, mined material is needed now to provide investors with confidence that product will make it to market on time,” state OudeNijeweme and Pitt. However, on a longer timescale, automakers will need to invest in the technologies and techniques required to gather, sort, and recycle end-of-life batteries back into feedstocks and balance material demand with production efficiency. Failure to do so, they believe, will result in either a lack of market competitiveness for some brands or even an inability to continue production in the electric era.

> “Mined material is needed now to provide investors with confidence that product will make it to market on time

Considering the immediate future, Tribe concludes that OEMs opting for one investment direction over another will be taking on an element of risk regardless of whichever they choose. In a ‘chicken or the egg’ situation, mining and recycling invariably require the other to form an effective and reliable long-term supply chain solution. Ultimately, a multi-faceted approach to sourcing–utilising mining, recycling, more efficient design, and even research into alternative chemistries that don’t require expensive or hard-to-acquire metals–is likely to prove the most effective strategy.

High-performance additives maximise renewable diesel potential

Renewable diesel fuels represent a convenient and effective means to reduce carbon intensity in the heavy-duty diesel trucking market. Kevin Griffith outlines how to make the most of them

Emissions reduction efforts continue apace in industries around the world. The heavy-duty diesel trucking and transportation market is one of those industries, and because full-scale electrification is still far from capable of universally replacing traditional heavy-duty diesel engines, other approaches to reduce carbon intensity are necessary.

Enter hydrogenation-derived renewable diesel (HDRD), or simply renewable diesel, an alternative that is seeing growing popularity throughout the heavy-duty market. And for good reason—renewable diesel is chemically the same as traditional diesel fuel and may be used in its pure form as a 100% drop-in fuel for today's diesel vehicles. No modifications are required, making it a convenient and nearly hurdle-free means of reducing carbon intensity on a broad scale throughout the heavy-duty market.

The US, Canada and Europe are today incentivising the use of renewable diesel to spur its growth. For example, qualified renewable diesel has been incentivised through Renewable Fuel Standard obligations and fuel tax reductions in the US and by the European Renewable Energy Directive (RED) II, in an effort to partially compensate for higher costs versus traditional diesel. Production capacity is also growing worldwide, making renewable diesel fuels increasingly available for fleets.

Maximising the potential for renewable diesels is critical—and doing so will require formulating these fuels with high-performance additives.

Renewable diesel defined

As defined by the US Energy Information Agency (EIA), "renewable diesel and other

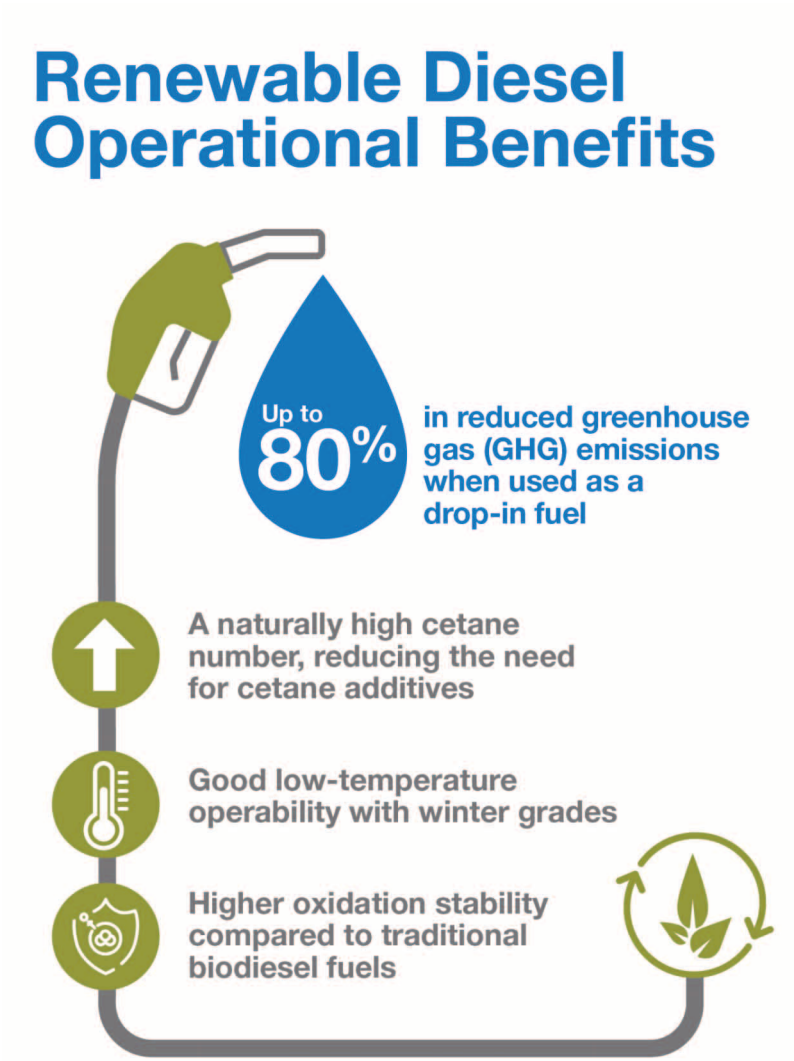
(non-fuel ethanol) biofuels and biointermediates can be produced from nearly any biomass feedstock, including those used for biodiesel production, through a variety of processes such as hydrotreating, gasification, pyrolysis, and other biochemical and thermochemical technologies." The fuels meet the ASTM D975 standard for traditional diesel, allowing them to be used interchangeably in any common diesel engine.

Because they are derived from renewable feedstocks, renewable diesels currently offer reductions in greenhouse gas (GHG) emissions upward of 80% depending on the feedstocks used—a sizeable figure. Production from waste cooking oil offers the greatest carbon dioxide reductions, according to the EU Renewable Energy Directive (RED) II, which from January 2021 specifies a minimum 70% reduction in greenhouse gas emissions versus fossil fuels.

In addition to these reductions in carbon intensity, renewables bring a number of operational benefits to the table, including a naturally high cetane number, reducing the need for cetane additives; good low-temperature operability with winter grades, making them well suited for colder climates; and higher oxidation stability compared to traditional biodiesel fuels.

Maximising renewable diesel's potential

Despite their inherent cleanliness and other benefits, renewable diesels still stand to significantly benefit from high-performance fuel additives. While renewable diesels are very clean fuels, carbonaceous deposits from combustion will still build up over the long term. It's true that deposit formation could be delayed



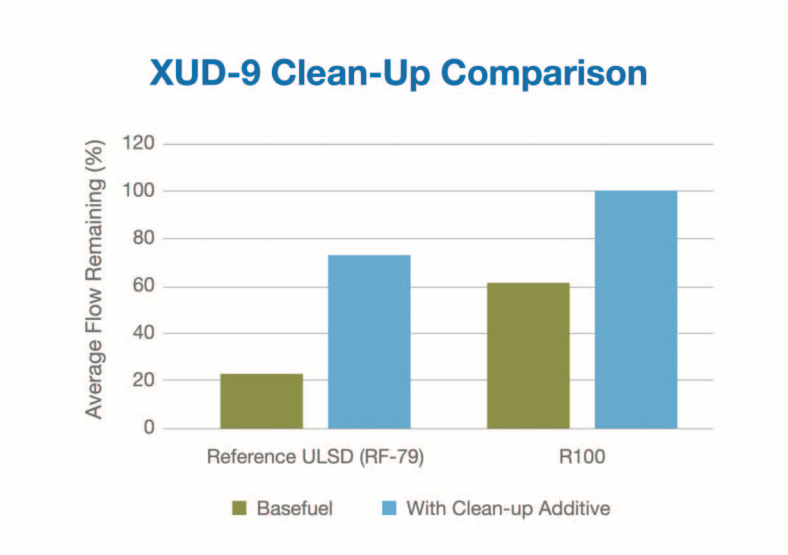
through the use of untreated renewable diesel, but the application of deposit control additives remains necessary for controlling and removing performance-degrading deposits.

What is at stake when it comes to excessive deposit buildup? Over time, deposits accumulate on the injector spray nozzles and the interior moving parts of the injectors, potentially causing fuel economy losses as these deposits interfere with fuel spray patterns and even the amount of fuel delivered.

Additionally, excessive deposits inevitably interfere with a diesel drivetrain's aftertreatment devices (diesel particulate filters (DPFs), for example). These devices are required on most diesel trucks on the road today–but suboptimal combustion caused by deposits leads to an increase in particulate formation that plugs up DPFs, requiring a truck to burn them off through a process known as regeneration (regen), which uses significant amounts of extra fuel. Regens can be performed while a truck is still operational or while a truck is idle, requiring downtime. Though regens may not be eliminated through the use of cleaner fuels, those treated with the right deposit control additives can substantially reduce the frequency of regens or other forms of time-consuming maintenance.

The benefits of deposit control additives are borne out in a conventional fouling and cleaning procedure to measure deposit formation (called XUD-9 engine testing). Lubrizol has performed this testing and has demonstrated that untreated R100 renewable diesel fuels provide reduced injector flow loss compared with untreated ULSD. The addition of cleanup additives is required to eliminate flow loss and maintain optimal performance.

Another area where untreated renewable diesel lags behind traditional diesel is in lubricity, or the fuel's capacity to help prevent metal-on-metal wear throughout the engine's fuel delivery system. Today's high-pressure diesel pumps



and injectors are designed to extremely tight tolerances and benefit from a fuel that delivers some lubricating properties. Enhanced wear protection from the fuel can help mitigate premature breakdowns and costly downtime.

The benefits of high-performance additives

Additive treatment for renewable diesel fuel formulations will be critical for such formulations to maximise their carbon reduction potential–but the truth is that high-performance additives can benefit all varieties of diesel fuel, and will become increasingly important as carbon reduction initiatives increase. For fleet operators, it is worth opening a conversation about the expected performance levels of diesel fuels, be they traditional or renewable. As described earlier, the right deposit control additives and lubricity improvers can lead to higher levels of engine efficiency and reliability.

For fuel formulators and marketers, working with the right additives supplier opens opportunity to differentiate from the competition. This can be especially beneficial for fuel suppliers interested in adding renewable diesels to their portfolios.

Expect renewable diesels to grow in availability and usage in the coming years. As this happens, multifunctional fuel additives that restore and maintain optimum performance of diesel vehicles will grow more important. Fleets should educate themselves on expected diesel performance and seek out high-performance formulations, while fuel marketers can work with collaborative additive suppliers to differentiate their formulators from the competition. Maximising the potential of renewable fuel formulations depends on it.

About the author: Kevin Griffith is Fuel Additives Product Manager at Lubrizol

EVs and the grid—it's all about give and take

Rob Stocker explores the role EVs will play on grid infrastructure

There is no disputing that we need more flexibility within the grid in the UK, and across countries globally, if we're to accommodate an influx of new energy resources. Large volumes of renewables are and will continue to feed in, while increased demand from the electrification of transport and heat continue to cause strain during peak times. In the UK, although there is flexibility within the grid, the nation's energy regulator Ofgem (Office of Gas and Electricity Markets) has recently proposed to create an energy marketplace that aims to address the challenge of how we unlock value from assets that are connected to our distribution networks.

Using electric vehicles (EVs) as an example, there is a huge long-term potential for both give and take on the grid. Advancements in smart charging will transform the way that EV users charge their vehicles, opting to take from the grid at times that suit the grid's capacity–offering the potential to avoid peak times and essentially manage the 'surplus' energy that exists within our systems at other times of the day–and vehicle-to-grid (V2G) is offering drivers a way to feed power back into the grid in times of a supply deficit by discharging back into the grid to plug supply shortfalls.

Whilst the Ofgem marketplace will provide further flexibility within the UK market, similar models are possible in other global markets. For example, the Netherlands or Norway, which already have a relatively progressive level of EV penetration, could make contributions to their national energy system in the more immediate term through a more orchestrated approach to charging EVs in aggregate.

However, both in the UK and in countries with a high number of renewable assets, there has been a lot of news recently around turning off renewable power generation because the grid simply doesn't need the load–or can't cope with it. Where EVs are concerned, given there could be millions feeding in to the grid via V2G, it would be much easier to

manage compared to a wind turbine or a solar panel. That is because like any battery storage system, the power can be stored and doesn't have to be fed in if the grid can't cope with it, whereas with renewable power, it must be turned off or wasted. So, from that perspective a marketplace approach could benefit the grid through the EV's aggregated capacity, and EV users via capacity payments or rewards.

Beyond passenger EVs, flexibility needs to be extended to other transport modes; for example, in the US, where it has one of the largest fleets of school busses globally. These school buses are used in a very predictable fashion where they drive the same routes each day and therefore serve as a huge opportunity to participate in grid balancing services during their hours of non-utilisation, which is, in effect, most of the day. In states like Texas, that recently faced blackouts during times of grid imbalances, this type of marketplace or system, where EVs are feeding in and out of the grid, could offer a salvation that they've simply not had to date, especially as they transition further renewable power into the grid.

All of this will have to be considered with regulation in mind though. If you're pooling sources of power into a central depository, so to speak, there will be challenges associated with how each of these sources of power are regulated and it may be a consideration that they're brought under the same regulation, which, on its own, will bring its own challenges.

The opinions expressed here are those of the author and do not necessarily reflect the positions of Automotive World Ltd.
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