

Automotive World MAGAZINE

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Traton pins long-term success to sustainability



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Traton pins success to sustainability | **Autoliv** restructuring signals supplier shakeup |
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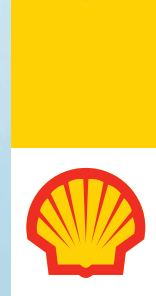
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Traton pins long-term success to sustainability

The automaker's Chief Sustainability Officer outlines his roadmap for a profitable approach to sustainable development. By Megan Lampinen



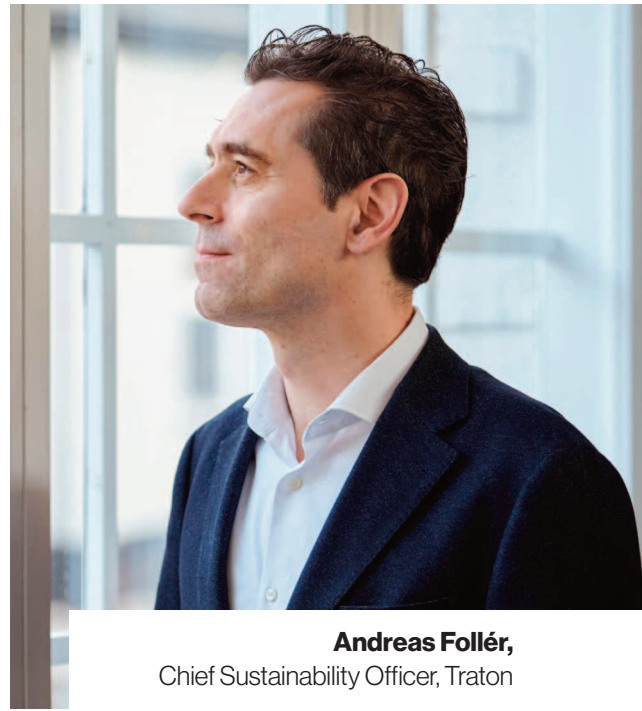
Commercial vehicles (CV) will play a vital role in realising the EU's 2050 carbon neutrality target.

Today, heavy-duty trucks and buses are responsible for more than 25% of the region's greenhouse gas (GHG) emissions from road transport and more than 6% of total GHG emissions. For CV manufacturers, the pressure is on to transform both their product offerings and their production operations.

Success built on sustainability

At Traton, much of that responsibility falls to Andreas Follér, Chief Sustainability Officer. "Climate impact is the most significant challenge for an OEM," he tells *Automotive World*. "My approach to sustainability starts with a thorough analysis on our impacts and risks, and what science says must be done to align our operations and products with the aspirations of sustainable development. The challenge is to do that and still be a successful company. Sometimes that could provide goal conflicts, but I'm an optimist by heart."

Traton's own press material makes it very clear where the priority lies: "We are convinced that our company's success must be built on responsible and sustainable conduct." And that covers the entire Traton Group: Scania, MAN, Navistar, and Volkswagen Truck & Bus. But the unified group under the Traton name has only existed since 2018, and the brands are still in the process of integrating their operations.



Andreas Follér,
Chief Sustainability Officer, Traton

Today, only Scania and MAN have science-based carbon-reduction targets in place, though Follér says progress is "well underway" with Navistar and VW Truck & Bus. "Aligning our strategies, plans and roadmaps with an aggressive carbon reduction timeline is the milestone for which we are aiming, and that will happen late this year or early 2024," he asserts.

Electric vehicles

Scania is leading the sustainability charge within the Group and will set the template in most areas for the other brands to follow. While sustainability encompasses many levers, one of the biggest is the emissions from the vehicles once they hit the road. More than 90% of the carbon emissions from the Scania business is generated when products are in use, so replacing diesel with battery electric could have a huge impact.



© Traton

Scania’s electric solutions currently include hybrid and battery-electric trucks and buses. By 2025 it expects electric solutions to make up 10% of

hopefully less,” emphasises Follér. “It’s crazy. This is the greatest and fastest technological change ever in our industry—maybe any industry.”

“

Climate impact is the most significant challenge for an OEM

The batteries that power these vehicles also offer a real opportunity to address sustainability. Since 2017, Scania has been working with Northvolt to develop a high-performance, long-lasting battery cell. In April 2023, the partners unveiled the fruit of that project: a lithium-ion cell with the capacity to power trucks for 1.5 million kilometres, roughly the truck’s useful lifetime. Produced with fossil-free electricity at Northvolt’s Ett gigafactory in northern Sweden, the cell’s carbon footprint is approximately one-third that of a comparative industry reference. “This is great news for sustainability, because the environmental impact of battery cell production is enormous,” notes Follér. Scania is also exploring recycling options and second-life applications for its EV batteries.

total vehicles sales volume, rising to 50% by 2030. “We are moving from 100% internal combustion engines running on diesel to 100% electric vehicles (EVs) running on green electricity in just two decades,

Traton, meanwhile, is playing an active role on the charging front in a bid to promote uptake of EVs. It joined forces with rivals Daimler and Volvo to establish a high-speed public charging network. The partners are investing a combined €500m (US\$554m) in the joint venture, which



© Navistar

Electric vehicles are a big part of Traton's sustainability roadmap

aims to install at least 1,700 green energy charge points across Europe. “Just offering EVs is not enough; we need to be able to operate them on a large scale,” Follér says. “This joint venture will only provide a fraction of the chargers that will be needed, but we’re putting our money where our mouth is.”

Operational emissions

Production processes, logistics, global workshop facilities, and even corporate offices all contribute to an automaker’s environmental footprint as well. At the Scania brand, operational CO2 emissions have fallen by 44% compared to 2015 levels. The aim is to boost that to 50% by 2025. A big part of that will come from using

electric trucks in the company fleet and renewable fuels and fossil free electricity in global operations.

Between 2015 and 2025, Scania wants to cut its energy use per vehicle produced by 25%. Cab production in Oskarshamn is one example of how such savings might be realised. “It is 100% carbon neutral now,” he confirms. The Oskarshamn facility has reduced the amount of water used per cab to 0.8 cu m, mainly through the recycling of process water. The biggest energy savings are found in the press shop, where a heat pump recycles excess heat from the presses, and in the paint shop that recycles air. Together, these two activities have cut the plant’s yearly energy consumption by around 7,000 MWh.



Scania has made notable advances towards more circular production at its cab factory in Oskarshamn, Sweden

Follér also suggests that circularity and remanufacturing represent an important part of the wider sustainability picture. Here, it's Navistar in the US that is the pioneer. "Navistar is a leader in harvesting components from fleets, remanufacturing them, and selling them back to the service networks. It's big business, and we have much to learn."

Traton is also encouraging its suppliers to adopt sustainable practices. In June 2023, Scania took the landmark step of placing its first order for green steel, which will be used in truck production. The

company uses around four tons of steel to manufacture a truck, meaning the impact could be significant. The initial contract with H2 Green Steel calls for deliveries of the sustainable material to begin in 2027. By 2030, Scania wants to use green steel exclusively in its European production, along with 100% green batteries, 100% green aluminium, and 100% green cast iron in its production.

"We are really working toward becoming a leader in the green transition, but it also entails setting requirements on your suppliers and your business partners to be a part of this," says Follér.

The cost

While Scania in particular is making promising strides towards a more sustainable future, plenty of work remains to be done at the Group level. Joint purchasing could help, but today the bulk of purchasing is still done by the individual brands.

“Sometimes one brand will lead in a specific area. My job is to use that to inspire the other brands to be more ambitious,” he concedes. “We are very young as a Group and still in the transition phase.”

While the long-term vision is one of a more sustainable Traton Group, that will come at a certain cost. Product development alone with the shift from diesel to battery electric is “probably the biggest investment” for any of the brands, says Follér, accompanied by additional expenses around a switch to fossil-free energy in production, more sustainable supply chain requirements, etc.

But it’s not as if the company has a choice. “This is a huge cost. But can we say that we chose not to do this? Can we instead bet on the old technology? No. We must be able to take these costs now, because it’s the future of our industry. The cost of inaction will be significantly higher. The OEMs that lead this transition to zero-emission vehicles will be winners, and the ones who resist it will no longer be around in ten years.”

For Follér, sustainability is a journey that could potentially never reach an end. “I would be happy if all our operations and all our products worldwide run with clean, renewable energy, but that would not be the end of Traton’s sustainability journey,” he says. New questions then arise.



© Scania

Where does the sustainability journey end?

For instance, how is that clean renewable energy generated? What metals and minerals are used to build the turbines that create the green electricity? “You just look to the next horizon,” he adds. “But my hope is that we can find solutions to address the most severe challenges right now, on our shift. We’re a part of the problem, and we need to be a part of the solution.”



Volkswagen's new China strategy signals power shift

Why have Volkswagen and Audi decided to partner with existing Chinese companies to improve their position in this market? By Ian Henry

In the last couple of years, the development of electric vehicles (EVs) across the Volkswagen Group has been hit by problems at its software division, Cariad. This has led to delays in the adoption of the SSP (Scalable Systems Platform) architecture across a series of new models planned for Audi initially, but also the Volkswagen brand itself. Also, various Audi concept cars, such as Grandsphere and Artemis, appear to have stalled in their development phase, while the much-vaunted new Trinity factory, which was originally due to be built near to the group's home plant at Wolfsburg, has been cancelled due to financial constraints. Instead, Volkswagen will now build a new factory within the existing footprint of its Wolfsburg site rather than at an entirely new site. Models based on the SSP have been delayed until 2029-30 and so the recently announced Chinese partnerships taken on an even more urgent dimension.

In Europe this delay has led to the extension of the use of the MEB platform which underpins existing ID models at Volkswagen and derivatives at SEAT and Skoda. At Audi, some development of EVs using Porsche's PPE EV architecture has continued but the delay to the group's new EV platform is causing problems in China, which is by far VW's biggest market. Chinese EV makers, including many start-ups, are perceived as having stolen quite a march on the legacy car companies and in this light, and fearing falling farther behind, both Volkswagen and Audi have decided to partner with Chinese companies to accelerate their EV plans, at least in China. Little has been said on whether these new partnerships could extend

beyond China, but it would not be surprising were this to happen in due course.

Interestingly the two brands, Audi and Volkswagen, have chosen different partners for their latest moves in China. Volkswagen will partner with a relatively new company Xpeng, in which it will take a 4.99% stake and hold an observer's seat on the board. Meanwhile, Audi will license the use of an EV platform from its long-established partner, SAIC.

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The problems at Cariad, and the delays these have meant for EV development at VW and Audi mean that these partnerships are both logical and necessary

Volkswagen is spending US\$700m on its investment in Xpeng which will see Volkswagen models made in China use an existing Xpeng platform, Edward, which is used on the current P7 and G9 models. Intriguingly, it will not use Xpeng's newest EV platform; the official line is that the Xpeng technology—and especially its specialisation in autonomous technology—will be integrated into the existing MEB platform and the future SSP architecture too. Two mid-sized Volkswagen branded models will be

launched by 2026, with production due to take place at Volkswagen's EV factory at Hefei in Anhui province.

“

It would also not be surprising to see Chinese platforms used for manufacturing Volkswagen or Audi models in Europe; and when this happens, the centre of power in the industry will finally be seen to have shifted

These two models will reportedly supplement the existing MEB-based models made in China but may well

ultimately supplant them.

Volkswagen has moreover established a new company, Volkswagen Group China Technology Company (VCTC), through which all development work with Xpeng will be channelled. VCTC will look at adopting Xpeng's smart cabin technology in particular to boost the new vehicles' appeal to young Chinese consumers.

Audi's arrangement with SAIC appears to be a more conventional technology licensing arrangement, expanding the two companies' long-standing partnership. The new Audi EVs—which are likely to be local versions of the Q6 e-tron and A6 e-tron—are described as part of Audi's “in China for China” strategy.

So why have Volkswagen and Audi decided to partner with existing Chinese companies to improve their position in this market? This strategy is, moreover, a complete turnaround from when the brands first went into China in the early 1980s. At that time, China had no contemporaneous modern automotive technology and was desperate for Western automotive companies' technology; the VW Group was the first to take advantage of the potential of the

An exterior view of the Xpeng G9





Audi has already been working with SAIC but does not yet offer EVs in China

Chinese market and has been the largest developed world car company in China ever since. However, like many of its European, American and indeed Japanese competitors, it has found itself caught out by the speed of development in EVs by the Chinese companies, both new entrants such as Xpeng and established players like SAIC. In addition, China has become the biggest automotive market overall, and Volkswagen's own biggest market (accounting for 40% of its sales and over half its profits), so it cannot afford to be left behind in this rapidly developing region. The problems at Cariad, and the delays these have meant for EV development at VW and Audi mean that these partnerships are both logical and necessary.

Officially, and initially at least, these partnerships are for vehicles for the Chinese market; however, as several of Volkswagen's competitors (and indeed the SEAT brand) are already using China as an export base, it would not be surprising at all to see Volkswagen and Audi export vehicles made using Chinese platforms; it would simply seem to be a matter of time before this happens. Equally, it would also not be surprising to see Chinese platforms used for manufacturing Volkswagen or Audi models in Europe; and when this happens, the centre of power in the industry will finally be seen to have shifted, while in many ways it already has shifted, even if not many have recognised this yet.

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Ian Henry is Director at industry consultancy AutoAnalysis

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Is the EV gold rush coming to an end?

With some established OEMs facing challenges shifting EV inventory, the market could be reaching a ‘survival of the fittest’ situation. By Stewart Burnett

For the past few years, automakers have observed an exponential rise in electric vehicle (EV) adoption rates. In the UK alone, uptake levels increased by 60% between April 2022 and April 2023, according to data from non-profit organisation New Automotive. Many countries have facilitated the transition by implementing subsidies for prospective owners. In the US, for instance, the Inflation Reduction Act offers tax credits for the purchase of new and used EVs, making them cheaper to purchase.

In recent months, however, it has become apparent that some OEMs' EV ambitions are outpacing their ability to sell products. Data analytics firm

Cloud Theory has reported a potential inventory problem for Ford in the US—while the company's dealers sold 86.4% of their Mach-E inventory within 30 days over Q2 2022, this figure has fallen to 27.7% for the same quarter in 2023. Meanwhile, Volkswagen has ordered a temporary closure of its Emden factory, with the facility's works council head citing “strong customer reluctance” towards EVs as the reason for the shutdown.

Saturated with options

There are signs that an EV sales plateau is beginning to emerge. A June 2023 study by iSeeCars reveals that US states with high adoption levels (such as California and Washington) are





© Ford

experiencing a slowdown of sales. It concludes that as EVs approach a 10% share of the total vehicle market in these areas, it becomes difficult for growth to continue.

Pedro Pacheco, Vice President of Research in Gartner's Chief Information Officer Research Group, is less convinced. He tells *Automotive World* that it is "too early" to determine why some OEMs are having trouble moving their inventory. "The EV market is changing, but not in the way some predict," he remarks.

What has changed might not be demand but a proliferation of available EV products. Pacheco observes that there was a significant

lack of EV models to choose from between 2020 and 2022, particularly in terms of vehicle type. Providing customers with a wider variety of options (such as Volkswagen's ID. Buzz minivan and Ford's F-150 Lightning pick-up in 2022) made it easy for OEMs to achieve quick growth within the space. This was a one-off, he opines, and its effects may be difficult to sustain under new market conditions.

Behind the curve

Now that customers have a range of brands and models from which to choose, they are becoming more discerning as to which brands and models they trust. As Kevin Mak,

Principal Analyst for Automotive Market at TechInsights, points out, the “strong customer reluctance” reported at Volkswagen may not be towards EVs in general but towards the company’s offerings specifically. He believes legacy automakers are increasingly being overlooked in favour of cemented EV brands like Tesla.

Mak tells *Automotive World* that “Volkswagen has to try harder to maintain the appeal of its products—including EVs.” Delays in its new EV platforms (most of which are expected in 2026) and supporting software are hampering the company’s efforts to capture market share, leaving the company vulnerable to its competition. With further delays on the horizon—its flagship Trinity EV project may not arrive until the end of the decade—

the company’s challenges may persist for some time.

Ford, meanwhile, has delayed its anticipated annual production of 600,000 EVs from the end of 2023 to the following year. The company states that customer demand has been “a little slower than expected” and increased the forecasted 2023 losses of its EV division, ‘Model e’, from US\$3bn to US\$4.5bn. Such delays and losses, Mak suggests, only help to solidify Tesla’s reputation as the de-facto EV brand, ensuring that the company retains its dominance over the market.

Survival of the fittest

While several OEMs have reported struggles in shifting their EV product, Tesla has been able to

Ford dealers were able to shift 86.4% of Mustang Mach-E inventory within 30 days in Q2 2022, but only 27.7% in Q2 2023





© Tesla

forge ahead with strong continuous year-on-year growth. In Q1 2022, the company reported 310,050 total EV sales, and 422,880 in the same quarter in 2023—a 36.3% increase.

According to Pacheco, the automaker has been able to provide its prospective customers with a strong value proposition. “Tesla’s rebates have made it more difficult for customers to choose an alternative,” he remarks. In Connecticut, for instance, Tesla vehicles costing US\$50,000 or less are eligible for a US\$2,250 rebate, with an additional US\$2,000 available

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Tesla’s rebates have made it more difficult for customers to choose an alternative

for customers participating in means-tested programmes.

Coupled with the company’s recently relaunched referral programme, which offers owners US\$1,000 for referrals leading to the purchase of new cars, this creates an impression of value around the Tesla brand. Indeed, the company’s website comprehensively lists financial incentives for its customers on a per-region basis, ranging from

discounts on home charge points to tax credits.

This, in effect, leaves OEMs like Ford and Volkswagen in a situation where they must prove the value of their own offerings in order to gain a lasting foothold in the new market. “The EV market is progressively changing from a ‘gold rush’ to ‘survival of the fittest’ as time wears on,” concludes Pacheco.

Daimler's Fuso backs battery swap for heavy trucks

Mitsubishi Fuso and Ample will begin battery swap trials with the eCanter this winter, writes Megan Lampinen



One of the biggest complaints about electric vehicles (EVs) centres on the relatively long charging periods.

Battery swapping side-steps the problem by automatically replacing the vehicle's depleted battery with a fully charged one, slashing the wait time down to a few minutes. The concept is nothing new: in 1912 General Electric Company introduced battery swapping as a monthly subscription service in the US state of Connecticut, and the following decade saw the offering expand to other states. However, by the mid-1920s, the business had fizzled out due to a lack of widespread standards and poor EV uptake in general.

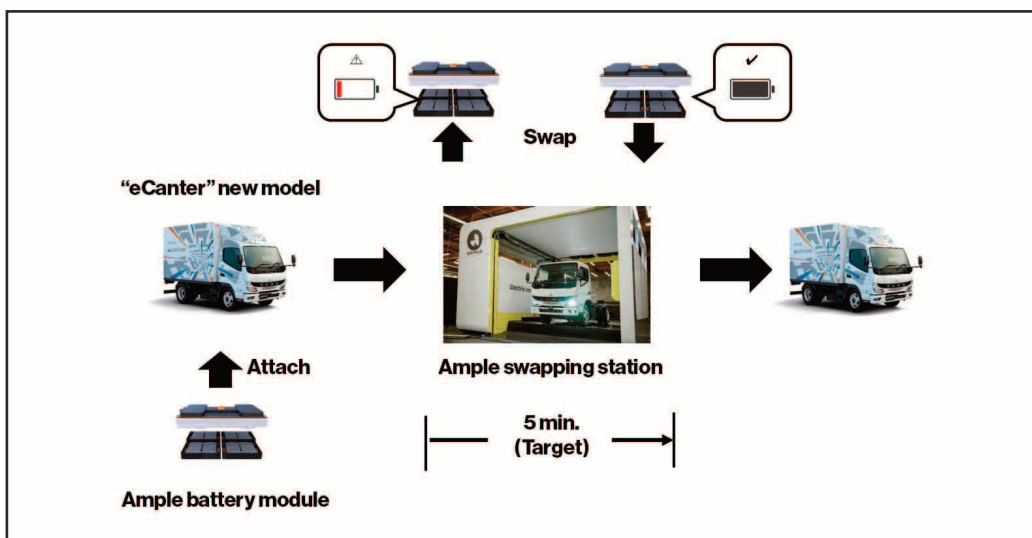
This century saw Better Place pick up the baton, but its service also failed to take off as expected and the company later filed for bankruptcy. Tesla also dabbled in the technology before walking away, claiming it was "riddled with problems." Interest has been slowly reviving, particularly in China. Nio, one of the most vocal proponents, already operates about 1,400 swap stations in its home market and plans to add 1,000 more in 2023 alone. It's

also taking the network overseas, with long-term plans for 1,000 such stations in Europe.

Much of the attention to date has been focussed on passenger cars, but the technology is also gaining momentum in the commercial vehicle (CV) segment. With fleets, uptime is king, and anything that keeps the vehicle off the road eats into profitability. If a truck is parked and charging for several hours, it's not earning money.

Fuso and Ample

"Although trucks with electric drivetrains are now among the most promising means of achieving carbon neutrality on the road, many challenges remain, including reduced uptime due to charging needs," comments Simon Schmid, Head of Zero Emission Ecosystem at Daimler Truck Asia. In Japan, home to Daimler's Mitsubishi Fuso Truck and Bus Corporation (MFTBC) brand, an electric light-duty truck typically requires around ten hours with AC charging and a few hours with DC charging.



Ample battery swap technology



Daimler Trucks is pushing hard on the electrification front and set up [the E-Mobility Group](#) business unit back in 2018 to oversee these efforts across all its brands. Even before then, MFTBC established itself as a domestic leader in electric trucking. The first-generation eCanter debuted in 2017 and represented Japan's first series-produced light-duty electric truck. The latest model launched in March 2023, offering a range from 99km to 324km. Operations are primarily targeted at inner city applications, like delivery and refuse collection. But new use cases could soon become feasible: MFTBC has

partnered with California battery swap expert Ample to conduct a pilot in Japan.

Under the new project, MFTBC will adapt an eCanter with modular batteries that can be automatically exchanged at an Ample station. While the trial does require some adaptation to the existing truck, Schmid expects that in the long term, "battery swapping will only have a limited impact on vehicle design and production line."

With an Ample swap taking just five minutes, MFTBC is optimistic that this approach could enable electric trucks to take on longer routes. Notably, Ample's swap solution can be adapted for any vehicle make, design or model, which Schmid points out will help generate synergies. "That said, swapping for trucks gets more difficult with weight and size as the swapping station needs to accommodate the truck," he adds.

When it came to selecting the right battery swap partner, Schmid says MFTBC was impressed with the maturity of Ample's technology. The company was founded in 2014 and was named one of *Time's* 100 Most Influential Companies of 2023. It boasts that its swapping stations are cheaper to build and install than a fast-charging station and three to ten times less expensive to use. "We are confident Ample's technology will result in a good overall customer experience," he emphasises. And that's where the new pilot could provide pivotal feedback.



The eCanter at an Ample battery swap station

Abig push

MFTBC aims to provide a completely carbon neutral product portfolio in Japan by 2039, which ties in with the Japanese government's target of achieving carbon neutrality by 2050 and its specific goals around decarbonising commercial vehicles under the Green Growth Strategy. The good news for MFTBC is that fleet operators in general are also onboard with the green roadmap.

“As more customers start to use electric trucks, we face demand for shorter charging times,” says Schmidt. “For trucking, that relates directly to downtime. This is where exchangeable batteries come in, supporting vehicle uptime by delivering a full charge within minutes. By extension, that also encourages the transport industry's EV shift.”

For now, it's not yet clear if customers will face a choice of battery swap or plug-in charging, or

if both will be offered with every truck. In the car segment, Nio offers both with every vehicle. “It is too early to tell how battery swapping will be added into our portfolio,” elaborates Schmidt. “Most probably all kinds of charging options will exist at the same time, as transport customers have different specific use cases. Our eConsulting team supports customer choice when it comes to the best fit for their operations.”

Road trials kick off this winter in Japan and MFTBC hopes they will shed light on not only customer reaction but also scalability and commercialisation potential. “Topics around the business model of this service will also be included in the project,” Schmid reveals, though he steers clear of any specifics. “As a major driver of e-mobility innovation, Fuso is looking into all options to offer the right solutions for individual customer use cases.”

Does Autoliv restructuring signal wider sectoral changes?

Production volumes and profits may be rising but automakers and suppliers are still scaling back their operations, writes Ian Henry

Autoliv's products—seat belts and airbags—are safety critical and universal fitted components; they are also almost always single sourced, guaranteeing suppliers long-term business once they have been nominated for a given contract. Announcing its Q2 2023 results recently, the company reported rising revenue, profits and margins. Significantly it also said it had managed to agree price increases with customers to compensate it for rising inflation and raw material prices.

Interestingly, however, these positive results were preceded by an announcement in June that it was planning a major round of cost cutting; specifically this will centre on cutting 11% or 8,000 of its worldwide labour force, in turn meaning the closure of several factories and downsizing at others. 6,000 jobs will go at production sites, and 2,000 in technical centres and admin functions. From the closures recently announced—the end of a German technical centre and the expected closure of a UK weaving plant—the company will reportedly save

US\$25m in 2024 and US\$55m in 2025. These are useful sums to save no doubt, but only just over one-quarter of its US\$212m profit reported in Q2 2023 alone. More closures will follow it is certain, especially in Europe, although the closure programme will take until at least 2025 to be completed.

Improved logistics and an optimised geographic footprint are the intended aims, along with a reduced cost base; Chief Executive Mikael Bratt said that Autoliv will simplify and consolidate how it operates across the business. A technical centre in northern Germany will be consolidated with a centre in the south country by early 2025, with 500 positions cut. The UK weaving factory, in Congleton near Manchester, will mean 250 jobs going and the work transferred overseas by the end of 2025, but to where is not yet known, nor whether to another Autoliv site or an independent weaver. A sales office in Italy will close, probably reflecting Stellantis having centralised airbag and seat belt purchasing decisions in France, reducing the supplier's need for a direct sales interface team with Fiat in Italy

The closure of these facilities will account for about 10% of the planned cuts, so this is only the start. But with production volumes now actually rising, it is worth asking how Autoliv will manage to meet rising demand with fewer plants and a smaller workforce? A new round of automation, production line efficiency

measures and outsourcing to Tier 2 and 3 suppliers seems likely, although the company has released no real detail on this aspect of its plans.

The Autoliv announcement followed Volvo's announcement of 1,300 job cuts, and sister company Polestar is also cutting 10% of its workforce, even in the context of rising production volumes. As the industry emerges from the buffeting experienced at the hands of COVID and the chip crisis and faces up to the challenges of embedded inflation and continually rising raw material



Seat belts are one of Autoliv's main product areas, along with airbags

but it is not immune to the broader economic pressures facing suppliers.

Suppliers of components in legacy areas—especially into the engine and transmission plants, as well as suppliers of exhausts,

new areas. So job cuts at such suppliers over the next few years will be expected and entirely unsurprising. But the job cuts at Autoliv are different. They are coming in a technology area which will remain in the new EV world, and which will—in the case of airbags—still have growth opportunities in emerging markets where airbag fitment is not as widespread as on vehicles made in the developed world locations.

So even Autoliv, a company with a standard fit product or two, with rising profits and increasing volumes, must cut costs in this world of rising and embedded inflation and a constant upturn in raw material prices. Autoliv management is looking to a new streamlined organisation and manufacturing footprint and is taking the opportunity of a strong set of financial results to fund a new round of restructuring. The question which follows therefore is which other major suppliers will follow Autoliv's lead?

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With production volumes now actually rising, it is worth asking how Autoliv will manage to meet rising demand with fewer plants and a smaller workforce?

prices, it has to address its cost structures and the implications of the switch to EVs. Autoliv may not be a supplier impacted by the switch to EVs directly,

clutches and engine cooling systems which will not be required in EVs—will gradually lose most or all of their business, unless they move into

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Emotion shapes SEAT and Cupra future mobility design

SEAT Design Director Jorge Diez puts heritage at the heart of both mainstream and rebel brand success.

By Megan Lampinen

Designing the vehicle of the future has become as exciting as it is challenging in the wake of digital advances, electrification and shared mobility. For SEAT Design Director Jorge Diez, it's also a juggling act. Diez oversees car design at not only the SEAT and Cupra brands but also the urban mobility brand Mo's range of scooters. While all three proudly reflect their Barcelona roots, they each have their own target demographic and budgetary constraints. For Diez and his team, it's an opportunity to explore widely different design languages.



Jorge Diez,
SEAT Design Director

SEAT, Cupra, Mo

For the mobility service side, the design is focussed on solving urban transport challenges. "Here we are looking at cities and how to offer mobility that is convenient and easy to use," Diez explains. The Mo line-up currently consists of five electric scooter options.

SEAT and Cupra are all about cars. "When we design for SEAT, we always have a touch of sportiness, but the vehicles need to be liked by many people," he notes. "When you have a mainstream car, you need to compromise."

Cupra, on the other hand, proudly describes itself as a rebel brand with a disruptive attitude and an unconventional mindset. It is well aware that its models will not appeal to everyone, and they are not designed to. It started life as SEAT's badge for sportier variants of mainstream models but was turned into a fully-fledged brand five years ago. Since then, it has cultivated a unique DNA. "Maybe some people

love it, maybe some hate it—that is fine," says Diez. "When you try to please everybody, you lose the brand essence. With Cupra, we can risk much more in the design."

The brand's DarkRebel concept vehicle serves as a platform to explore such risky design elements. He specifically flags the use of metal around the headlights as well as the centre spine, which is reminiscent of the spine of a boat. A virtual image of the DarkRebel concept was shown in April 2023 but the design is far from formalised. At the moment, the team is gathering feedback from the fanbase, known as its Tribe, via the virtual Metahype platform.

Some of the features suggested and explored may be difficult to realise in production, but that's no deterrent for Diez: "Sometimes we like to put in difficult things. The concept we build is a dream for our designers. With a show car, you push the limits to the maximum. Then our board members say, 'Now you need to do it in production,' so you need to take a step back."



SEAT Mo is all about urban mobility options

Future mobility shaped by heritage

Cupra's next production model will be the Tavascan, the brand's first all-electric SUV coupe and its second electric vehicle (EV). "Electric cars bring a different architecture, and this always conditions the design," Diez tells *Automotive World*. "With EVs, you can feel that the wheels are getting bigger. On the bottom you have the battery, and somehow all electric cars look heavier."

Both Cupra and SEAT emphasise the love of driving and put considerable focus on the driver, but the industry as a whole is moving towards a paradigm where the driver plays a less active role. That's not what these brands are all about. "When many companies enter electrification and introduce advanced technology, they end up creating numerous screens in the vehicle," he observes. "With that you lose the feeling of the love of driving. We don't want to make cars that go from A to B. For us, this would be boring. We prefer to emphasise the emotion of driving."

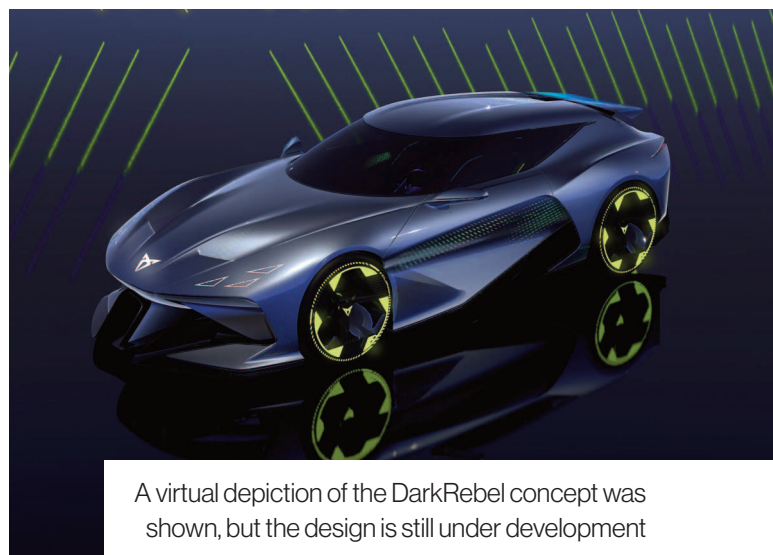
To achieve this, the brands are exploring ways to evoke all the human senses in the way occupants engage with the vehicle. "Imagine that you have a movie without sound; you lose

a lot of functionality. We are exploring everything—even smell—that is attached to emotion," says Diaz.

And this ties in closely with their Spanish heritage. "We come from Spain. It's an emotional country," he notes. Compared to Germans, for instance, Diaz suggests, "We are a bit louder, more expressive, and the cars are loud and expressive as well. Cupra is bringing out the culture of the country."

This also plays out in the model naming strategy for both SEAT and Cupra, where many models are named after Spanish places: SEAT Ibiza, SEAT Leon, etc., and Cupra's range of Born, Formentor and Tavascan. "The Born is named after a neighbourhood in Barcelona, and the Cap de Formentor is a rocky place close to the sea—very brave, and this fits perfectly with the name."

While there are many different industry strategies around nomenclature, Diez suggests there will be no move towards anything like the numerical precision of VW's ID range or similar approaches adopted by BMW and Mercedes-Benz: "For us it's a



A virtual depiction of the DarkRebel concept was shown, but the design is still under development



Cupra Tavascan will be the brand's second EV

bit more personal. You would not call your family members one, two and three. You'd call them by their names. When you have a strong identity, you have your own name as well."

Wherexnext?

While SEAT's budgetary constraints entail a slower journey towards electrification, Cupra is leading the charge with the Born and the Tavascan. But battery propulsion is just part of the brand's sustainability push. It is also moving towards greater use of recycled materials with lower carbon footprints. Diaz specifically highlights seat belts made from recycled bottles. These new materials offer designers an opportunity to create distinct, new user experiences. "We are doing a lot of work with materials," he tells *Automotive World*. "What is the feeling they create when you are sitting inside, or when you touch it? For us this is really important."

Moving forward, vehicle interiors are expected to become increasingly pivotal in brand differentiation. "In the past, the automotive industry was focussed more on the engines and the machine as an object. We need to focus on different things now: it's all

about the customer, what people want," he states. "For us, both interior and exterior are important. When people see the car on the street, they need to love it. When they go inside, it confirms that feeling. The two work together."

“

We don't want to make cars that go from A to B. For us, this would be boring

As he positions SEAT, Cupra and Mo designs for the future of mobility, Diaz can draw on more than 20 years of experience at a number of big-name players, such as Audi, Volkswagen, and Mitsubishi. The end goal is always great design: "Great design shows the feeling of the car and is honest. Honesty means that when you see something, you also feel it when you drive. This is our mission primarily, and at the moment the portfolio is really wide open."

Luxury must become affordable to grow EV market, says AXL

New retail strategies from Canada's first domestic EV brand, AXL, aim to increase the mass appeal of electric mobility. By Will Girling

Canada's automotive industry produced 1.2 million vehicles in 2022, making it the fourteenth largest overall. The nation's substantial mineral wealth, including deposits of lithium and nickel, are expected to [give it an advantage](#) as a manufacturing hub in the global shift to electric vehicles (EVs).

Despite being an important production location for automakers like Stellantis, GM, Ford, and Toyota for many years, Canada lacked its own homegrown EV maker. That changed when Ontario-based AXL Electric Vehicles announced its Sharx-5 model in June 2023. "We started with a cause: to create a car with mass appeal, as many features as possible, and a design that will convince people to make the transition to EVs," states Ali Eslami, Founder and Chief Executive.

According to the International Energy Agency's (IEA) Global EV Outlook 2023, EVs accounted for 14% of all new vehicles sold globally the previous year. While these figures are a cause for optimism—the IEA expects momentum to continue throughout 2023—AXL's plan seeks to supercharge the transition.



The Sharx-5's interior has the features commonly associated with luxury EV models, yet is delivered at a cheaper-than-average price point

Affordable luxury

Ali is aware that high EV entry costs impede adoption but doesn't believe that lowering this barrier should entail a reduction in quality or experience. Whereas other OEMs are [shrinking vehicles](#) or [pruning inessentials](#) to produce cheaper EVs, AXL strives instead to reconcile two concepts commonly held in contrast: affordability and luxury. The company's name, he informs *Automotive World*, is an acronym for 'Affordability meets (X) Luxury'.

A mid-size, all-electric SUV with space for five occupants and named after its shark-like design, the Sharx-5 has a 67kWh lithium-iron-phosphate battery capable of delivering 500km (311 miles) of range, 209hp, and acceleration of 0-100 kph in 7.4 seconds. The cabin features temperature controlled seats, 4G

internet, a three-screen display, integrated Apple CarPlay and Android Auto, over-the-air updates, and more. "We put a lot of effort into creating exterior and interior designs that are modern and practical," says Ali. This is all available to customers at a reserve price of US\$39,800.

Although only 10.5% cheaper than the average EV price (US\$44,000), AXL's intention with the Sharx-5 is to provide customers with more value for their money. The US\$39,800 is a flat cost that comes with everything as standard, including common premium features like 20-inch wheels and a high-fidelity sound system. "These kinds of luxury features are generally priced out of reach for most customers. However, to bring EVs to a wider audience, we knew we had to create an offering that included them to make it as attractive to as many people as possible."



Ali Eslami,
Founder and Chief Executive, AXL

Simplifying price

Striking the luxurious-yet-affordable result didn't come easy: "It was the biggest challenge we faced." Overcoming it meant carefully controlling entire supply chains and reaping the benefits of recent advancements in EV manufacturing. "Overall, producing an EV just isn't as expensive as it used to be. Concerns about supply shortages are fading, and I think it's time to start enjoying the positive impact this can have on pricing," he states.

Despite offering a high spec EV at a lower-than-average price point, a basic overall retail experience conveys AXL's more restrained ethos: there are no trim options beyond colour selection. This simplified approach to retail is reminiscent of Tesla's similarly limited purchase options, and certainly contrasts with the overwhelming [emphasis on customisation](#) offered by luxury brands like Bentley. "We believe most customers prefer a simple

ordering process instead of getting immediately lost in all the options a showroom might have to offer them," says Ali. Approachability, he adds, is an important component of the company's strategy.

Ali also claims that the company is cutting profit margins as part of a long-term plan to boost the brand's accessibility and overall market share. "This is how we're proving that AXL is different and truly represents the next generation of EVs." It also validates [McLaren Applied's prediction](#) that competition in the third phase of electrification will be waged according to innovative retail pricing strategies, something inaugurated by Tesla's aggressive price drops in early 2023.

Targeting the global market

According to AutoTrader.ca, the average price for a new EV in Canada is CA\$58,895 (US\$44,339). AXL's offering is likely to appeal to its domestic market, but the automaker's ambitions aren't confined within its home country's borders: "We are a global brand," Ali emphasises. As such, Canadian customers will need to wait.

Deliveries are expected to commence from spring 2024 and will initially target Gulf Cooperation Council countries. Production will then expand to select European and Asian markets later that same year,

and finally to North America in 2025. Ali did not provide *Automotive World* with details on why this schedule was chosen. However, the undulance of Canada's EV market share—falling from an all-time-high of 8.4% in Q4 2022 to 6.9% in Q1 2023, according to S&P Global Mobility—could offer an explanation. Indeed, reports from Mordor Intelligence estimate that Canada's 2023 US\$0.28bn EV market will only be worth US\$1.54bn by 2028. In contrast, it predicts that the Middle Eastern market will grow from US\$2.70bn to US\$7.65bn across the same period. Factors cited include state-sponsored clean energy and transport investments and economic diversification plans.

Nonetheless, Ali states that AXL's Canadian origins enable it to claim recognition as the country's first domestic EV brand, benefit from its rich mineral resources, and leverage the expertise of its large automotive industry talent pool. With internal combustion engine bans set for implementation in the first half of the 2030s in North America,

Europe, China, and parts of Latin America and Southeast Asia, he considers now to be the perfect time

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AXL has created a unique product that can help with the global electrification process

to bring the Sharx-5 to market, adding: “AXL has created a unique product that can help with the global electrification process.”



AXL Sharx-5

Images © AXL

What are the health risks of EV battery manufacturing?

The automotive industry is trying to bring more EV battery capacity online, but worker health risks could present a long-term challenge. By Will Girling

The global rise of the gigafactory is an important phase in the electrification of the automotive industry. Building electric vehicle (EV) battery capacity is proving to be a costly and difficult process in some territories, but automakers are pushing ahead with plans to realise a full transition away from internal combustion engines. For example, in May 2023, Mercedes-Benz Chief Executive Ola Källenius told *Reuters* that his company would need at least 200 GWh of capacity (roughly eight gigafactories worldwide) to do so.

However, as the industry works to resolve one issue, another presents itself. Michigan-based industrial air

filtration company RoboVent highlights that the release of nano-scale particulates during lithium-ion (Li-ion) battery production pose a significant health risk to factory workers. These materials include carbon nanotubes, lithium salts, and polymers.

“Nanoparticles can go so deep into lung tissue that they enter the bloodstream,” says Frank Cea, Vice President of Growth and Engagement at RoboVent. “This can cause a wide range of negative health effects. As manufacturing applications expand worldwide, we’re probably going to learn more about the long-term effects of nanoparticles in automotive.”



Filtering health risks

With the large-scale EV industry still relatively young, it is too early to know the exact health risks associated with nanoparticles released during battery manufacturing. Mike Meyer, Executive Vice President of RoboVent, notes that many of the materials used in the EV battery production process have severe health effects for workers. Nickel is a known human carcinogen, and cobalt is listed as possibly carcinogenic. It is still unclear what long-term effects these materials, as well as others (lithium, carbon, and graphite), could have on workers' health in nanoscale particle size.

However, there are significant health risks associated with ingesting heavy metals commonly found in Li-ion batteries (nickel, cobalt, and lithium)—they include respiratory issues, neurological impairment, kidney damage, and increased risk of cancer. It should also be noted that the uncontrolled spread of nanoparticles can have a deleterious impact on battery production itself. RoboVent claims that contamination can reduce efficiency, shorten a cell's lifespan, and cause inconsistent performance in products. In order to solve both sets of problems, it is currently working with “known companies in automotive” on air ventilation and filtration systems and solutions concerning EV battery production. Its



Three of RoboVent's Senturion Modular Dust Collector units

methods typically combine aspects of containment, ventilation, and filtration, although each use case will invariably use a bespoke mixture.

The company broadly advocates using multi-phase cartridge-style particle collectors ducted with hoods and positioned as closely as possible to dust-producing processes and equipment during crucial stages of battery production. Meyer notes that nanoparticles can become a health risk at several points, including raw material processing, electrode production, cell assembly and finishing, and even recycling. “Because of their size, nanoparticles act like a gas. They could then inadvertently leak throughout a workspace.” RoboVent aims to reduce airborne nanoparticles 90-95%, which Meyer claims it can quantify with specialised measuring instruments.

Regulations

The recent uptick in EV battery manufacturing facilities means that while risks may still not be fully understood, the surface area for danger is growing. This is also compounded by increasing research into [alternative battery compositions](#) that resolve the inefficiencies of Li-ion. “OEMs and their suppliers are mindful of indoor air quality,” says Cea. “But, as new materials are used and products are built to scale, long-term health impact studies concerning the effects on workers need to be carried out simultaneously.” He notes that this is not information that manufacturers are generally open to sharing. Therefore, it is vital for regulators to ensure workers’ health is protected through new legislation.



As [US electrification](#) continues to gain momentum, it will be important for regulators and manufacturers to reach consensus on the issue as soon as possible. The first step may be for the American Conference of Governmental Industrial Hygienists (ACGIH) to set best-practice guidelines, which the Occupational Safety and Health Administration (OSHA) could use to create a “realistic” or actionable regulatory framework. Subsequently, with the time period also given for public comment, Cea tells *Automotive World* that change is likely to be gradual.

The COVID-19 pandemic has already been partially responsible for a reassessment of [in-cabin air quality and material safety](#). Similarly, Cea believes it could serve to heighten awareness of air quality and the importance of filtration in automotive manufacturing. This is not just limited to Li-ion production—dust and fumes from several industry processes are at risk of causing fires and explosions, which the US Bureau of Labor Statistics estimates accounts for 3% of workplace fatalities.

According to ABB’s 2023 Global Automotive Manufacturing Outlook Survey, general labour shortages in the US industry were cited as a major concern for 56% of respondents.

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After all, who wants to work for an unsafe company?”

Recruiting and retaining staff, concludes Cea, are still substantial challenges. Rather than see nanoparticle filtration as yet more red tape in an already uncertain EV market, he urges battery makers to seize the opportunity to make the increased safety of their facilities a selling point for staff. “After all, who wants to work for an unsafe company?”

Electric tuk-tuks tackle emerging market challenges

Tuk-tuks proliferate in many regions but can emit more than a full-size passenger car. By Megan Lampinen

There's no one-size-fits-all approach to urban mobility, as cities around the world vary widely. What works in Phoenix won't necessarily be a good fit for Paris or Bangalore. What is universal is the need to address urban congestion, vehicle emissions, and equitable access to transportation.

Developing markets

While vehicles in developed markets like Europe and North America have grown steadily cleaner over the past couple of decades, the same progress has not trickled down to the emerging markets. Half of the world's most polluted cities are

in India. The fleets in such markets are generally older and more polluting. Even the two-wheeler segments—huge in many Asian cities—are big polluters, as the models tend to have fewer gears and cylinders. The International Council on Clean Transportation has noted: “The rapid growth of two- and three-wheelers, especially cheap and easy to maintain two-stroke models, has contributed to severe deterioration of the urban environment. Motorcycle populations in Asian cities, and increasingly in cities in Africa and Latin America, are significant and growing.”

Replacing the fleet with zero-emission alternatives could have a tremendous impact. A

World Bank study of 20 developing countries across Africa, Asia, the Caribbean, Oceania, Europe and South America concluded that more than half would benefit economically by adopting electric mobility. Start-up company eTukTuk agrees but suggests that not just any form of mobility will do. It aims to decarbonise the developing world with its coming line-up of electric three-wheeled tuk-tuks, supported by a charging network and blockchain technology.

“The vehicles are designed not just for efficiency and zero emissions; they also bring many other benefits to drivers, the local population and the wider economy,” says Chief Information Officer Seth Ward. That's a pretty bold claim, but then eTukTuk sees itself as more than just a vehicle manufacturer.

“We are an ecosystem,” Ward tells *Automotive World*. “Vehicles and charging stations go hand in hand. Many of the places we are launching don't have the charging infrastructure for anyone to even consider buying an electric vehicle. So, wherever we launch, we will also establish infrastructure, and it will be open to all vehicles, not just our own.”

Sri Lanka up first

At the moment, eTukTuk has two working prototypes, but it hopes to launch production

later in 2023 in Sri Lanka. Local production is at the heart of the platform, with about 85% of the parts intended to be sourced and manufactured locally, which will keep the costs down. The only imported parts are the electronics and battery.

Sri Lanka is also the first market for sales and charging. “In countries like Sri Lanka, the percentage of total journeys that are completed in internal combustion engine (ICE) tuk-tuks is really high, and they are in almost constantly use and generally favoured over public transport,” Ward notes. The impact of switching to battery-power could be immense. “In this case you need to factor in that they would be replacing tuk-tuks that have roughly double the carbon output of a typical car,” he emphasises. “You will struggle to find another way forward that could offer such a reduction in pollution on the busy streets as switching tuk-tuks to zero-emission.”

As for charging, the company will be starting from a blank canvas. Sri Lanka currently has almost no public EV charging infrastructure, but the government recently received a US\$2.9bn loan from the IMF to support its energy transition. eTukTuk has selected about 300 locations throughout the greater Colombo area for its charging stations, with locations featuring between one and four chargers with a few ‘super stations’ offering up to 12. An 80% charge takes 20 minutes.

Blockchain is the backbone of the network. It allows for a digital identity, meaning individuals who may not have traditional bank accounts or credit cards can access services and resources such as charging infrastructure. This is particularly important for Sri Lanka, where society is cash-heavy and payment systems generally restrictive. “With blockchain, anyone can start taking digital payments and create an account in seconds. It is much more efficient and transparent,” he says. “It also allows us to put in place driver incentives and rewards.”

Economic impact

The vehicles will retail for about US\$3,750, though that figure is subject to change, which the company regards as competitively priced with gasoline and diesel models. Notably, Sri Lanka has banned the import of any more ICE tuk-tuks, which should further boost interest in electric options. For operators, they promise up to a 68% reduction in operating costs thanks to lower electricity costs compared to gasoline and less maintenance. The company also projects up to a 400% increase in take-home pay over a five-year period.



The models feature a patented roll cage design and are intended for local manufacturing for maximum sustainability

With that sort of promise, drivers are understandably interested. “Every driver I spoke to in Colombo was receptive to the idea of clean vehicles but concerned they might be too expensive to buy and thought they would be more expensive to run than a traditional tuk-tuk,” says Ward. “Once they understood how much better off they would be financially, they wanted in.”

This offering could also go down well with certain governments as they move towards greater energy independence. “In Sri Lanka, the economy ground to a halt as a result of its dependence on fossil fuels during COVID-19 and the energy crisis,” he observes. “There were massive queues at fuelling stations. The government has recognised how vital it is that we get our eTukTuks on the market, addressing air pollution and making the nation more resilient in terms of moving passengers and cargo.”

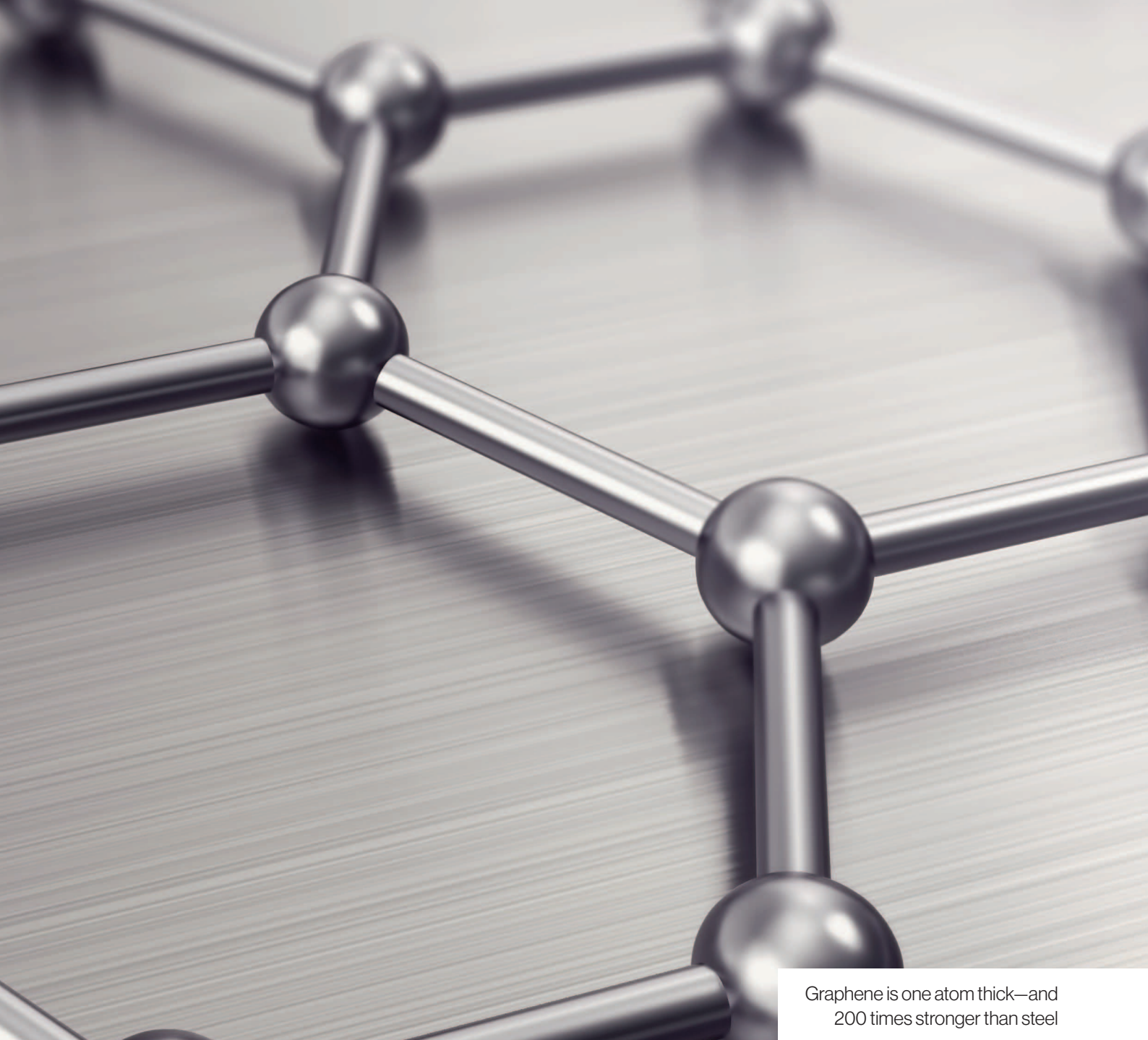
Will graphene make cars cheaper, lighter, and stronger?

Lightweight strength, recyclability, and affordability mean graphene could be a key additive component for future vehicles. By Lee Monks

Graphene, 200 times stronger than steel, is a single layer of carbon atoms, tightly bound in a hexagonal honeycomb lattice. Its discovery in 2004 by Andre Geim and Konstantin Novoselov won the pair the Nobel Prize for Physics. Since that find was made at the University of Manchester, it's apt that the city should be host to a national graphene research and development hub with global links. With numerous carmaker projects already

completed or in development, graphene's multifarious future automotive applications could be guaranteed.

The Graphene Engineering and Innovation Centre (GEIC), which opened in December 2018, complements cutting edge research and development at the neighbouring National Graphene Institute (NGI). The GEIC's main function is the development of graphene prototypes for commercial



Graphene is one atom thick—and 200 times stronger than steel

products. During *Automotive World's* visit to the GEIC, its Engineering Director John Whittaker was clear about what initially drove graphene's commercial growth.

New technology

“The industry needed a new applied technology. Automotive manufacturing is already highly optimised regarding elements such as turbo chargers, oils, lubricants,

gasoline, and light-weighting.” Graphene can offer key incremental gains. “It's technology that can push things a little further,” he adds. Despite this, there was uncertainty surrounding the material in its early years. “Graphene's application was misunderstood. It's not a magical ingredient that can do everything. It's an additive that's highly complementary to existing processes, and the industry is getting smart about this now.”



© BAC

Graphene is a useful component in automotive for numerous reasons. It possesses exceptionally high tensile strength, is extremely light, offers high electrical conductivity, and is so thin (one million times thinner than a human hair) that it can be considered two-dimensional. The global market for graphene was valued at US\$9m in 2012 and skyrocketed to US\$865m by 2022, according to Statista. Global management consultant MarketsandMarkets claims that the graphene market will reach US\$1.48bn by 2025, with automotive and transportation as the largest application industries.

GEIC partner Briggs Automotive Company (BAC) showcased graphene's automotive capabilities in 2011 with its Mono, the world's first production car to fully incorporate graphene-enhanced carbon fibre in every body panel. "The Mono is an expensive track car, but it was representative of what can be done," says Whittaker. "By adapting graphene-enhanced carbon fibre, BAC achieved significant weight reduction." The Mono also utilised

graphene to improve exhaust system breathability, which provided brake horsepower advantages. "There are many incremental graphene applications that can lead to a system improvement," he adds.

The GEIC

The GEIC follows up NGI work so initial laboratory tests can be further realised and scaled as required. Those requirements involve the incorporation of graphene into specific products and applications. "The GEIC is industry-led and engages with companies and the supply chain to accelerate the application of graphene technology," Whittaker says.

Work conducted at the GEIC production facilities includes energy storage. The pouch battery development currently underway, Whittaker suggests, is scalable to electric vehicle (EV) battery application due to graphene's surface area magnitude and electrical conductivity. The process

is complex and involves graphene slurry coating a substrate that's then cured to produce functioning electrodes. The electrodes are squashed to optimise conductivity before the device is set into the required shape and electrolytes are added. The final stage is a test to ensure cell performance.

Whittaker also emphasised graphene's attribute as a recyclable additive. "At the GEIC, a recycled virgin polymer will lose performance, but augmented with a small amount of graphene, the polymer can be replenished to full strength. Graphene has a key function in the material lifecycle." There are numerous means of extracting carbon from other materials. For example, he highlighted the flash Joule heating method—the rapid vacuum heating of materials to exceptionally high temperatures within milliseconds—which can convert plastic into graphene. "It's also possible to extract graphene from spent charcoal."

The GEIC has already established numerous relationships with OEMs, including Bentley and Ford. "Ford needed a thermally managed polymer on an electrical distribution system. The GEIC produced something lighter, cheaper, and more durable than what it had used previously." Ford then implemented the graphene-augmented polymer into 5.2 million US vehicles. As an added benefit, the material reduced the acoustics in the cabin by 17 decibels. "Simply put, if a small quantity of polymer is augmented with graphene, rather than using polymer alone, production costs are reduced, and performance improves."

Future growth

Whittaker sees specific areas of growth in the future and cites numerous areas in which graphene can contribute: "Graphene can make a huge difference to energy conservation in supercapacitors, the performance of modern batteries in EVs, the slower degradation of tyres, and thermal management and component longevity." This is by no means the limit of the material's potential uses. Other GEIC projects involve advancements in graphene-enhanced braking systems, increasing the conductivity of battery anodes and cathodes, improving sodium-ion battery performance, and enhancing touch-screen haptic interfaces.

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It's technology that can push things a little further

With so many potential innovations and applications, graphene could prove to be an important material for the automotive industry. Whittaker concludes that the economic and technological arguments for its integration in vehicle manufacturing are clear. "Graphene is now commercially viable: it's much cheaper than it was, and a carmaker doesn't need much." While its full impact has yet to be seen, graphene's implications for the future of electric mobility could be profound.

Has Minus Zero created the ‘brain’ for India’s AV industry?

AV software start-up Minus Zero believes it has developed a new algorithm and AI stack capable of operating safely on Indian roads. By Will Girling

Images © Minus Zero

To date, India’s uneven and notoriously congested roads have made the development of autonomous vehicles

(AVs) outside of [niche use cases](#) arguably more difficult than other territories. Subsequently, domestic industry efforts have generally focused instead on less ambitious advanced driver-assistance systems (ADAS), the market for which is expected to be worth US\$4.2bn in 2027—up from US\$1.5bn in 2021, according to Mordor Intelligence.

However, India could prove to be a particularly valuable testbed for pioneering artificial intelligence (AI) based safety tech. The Ministry of Road Transport and Highways estimates that 18 people die on the country’s roads every hour. It also



Minus Zero's zPod

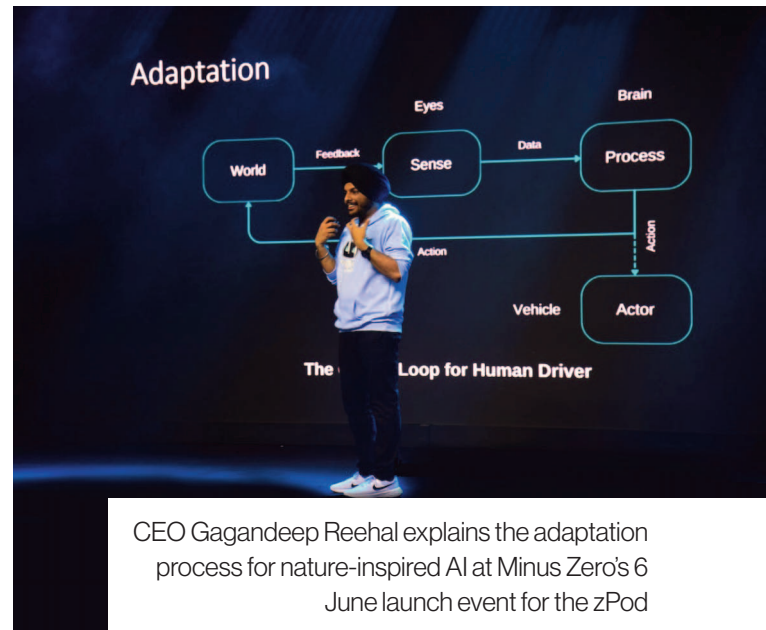
contains four of Asia's most congested cities—Bengaluru, Pune, New Delhi, and Mumbai. A 2019 report from Boston Consulting Group estimated that traffic jams cost the national economy US\$22bn annually in lost productivity. But is ADAS enough to resolve these issues?

Gagandeep Rehal, Chief Executive and Co-founder of Bengaluru-based AV start-up Minus Zero, believes full AVs are essential for improving road safety. Committed to overcoming the deficiencies that make conventional vehicle AI inappropriate for India's roads, his company made history in June 2023 when it demoed the nation's first AV concept vehicle, the zPod.

Nature-inspired AI

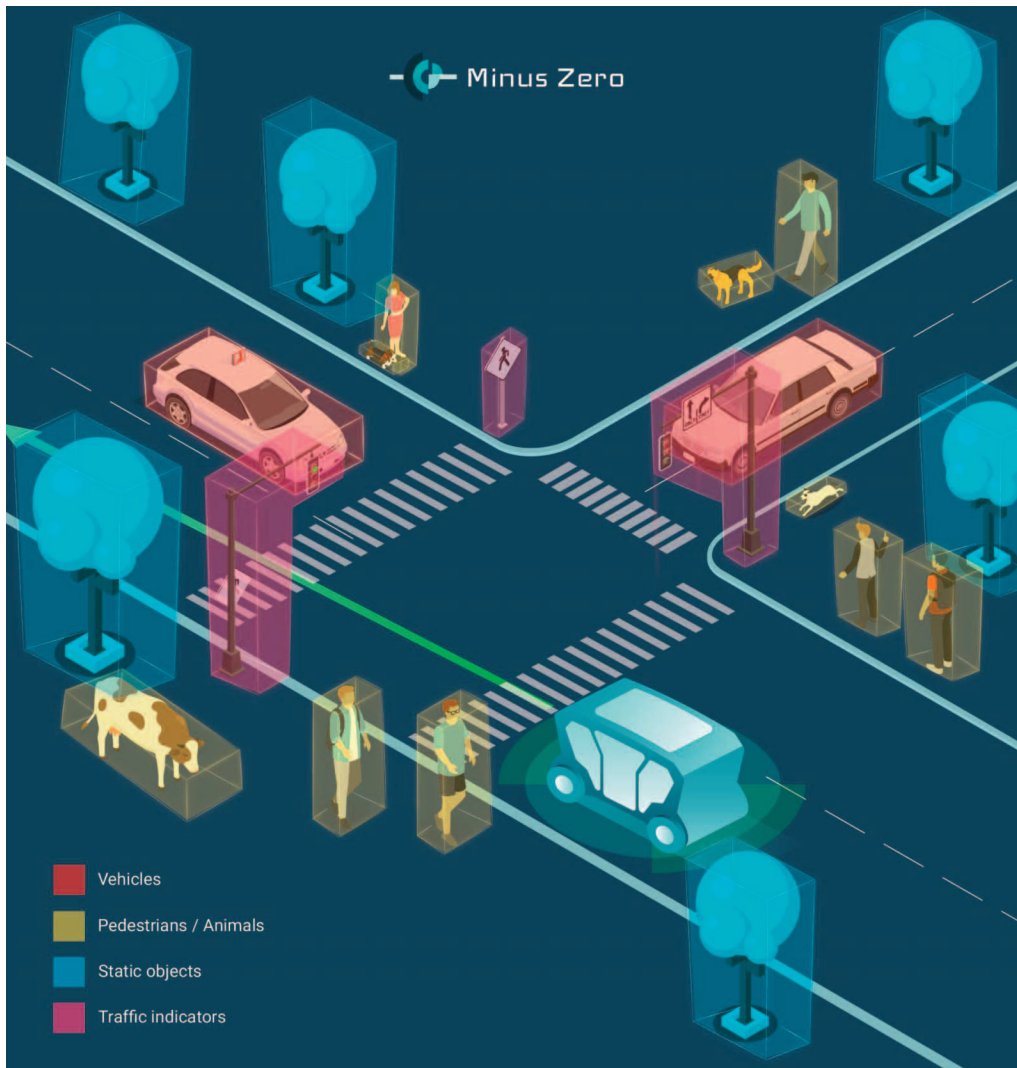
Not intended for mass production, the zPod is instead a composite of Minus Zero's technologies and software philosophy. At the centre is Rehal's concept of "nature-inspired AI" as an alternative to common AV navigation processes.

Although no global industry standard has yet emerged for AVs, he notes that most developers opt to combine neural networks of training image data with HD maps to produce a stack capable of 'understanding' its environment. Sensor hardware is also added to provide real-time feedback. Rehal criticises this approach as slow and ultimately unsafe on real roads: data from the world is received by sensors, processed by software, translated into action, and then relayed back to the sensors for feedback. However,



this relies on the full operability of hardware, which can be compromised by everything from wear and tear to sensor orientation on different vehicle types. "The world is very chaotic, and algorithms using this approach cannot possibly take into account every situational variation," he says. "While it might be okay 90% of the time, that remaining 10% is where accidents will happen."

On the other hand, when a human drives, he notes that data, action, and feedback are constantly interacting in the brain so that it can adapt to the world itself. "With nature-inspired AI, what we're doing is making AVs operate more like the human mind," Rehal tells *Automotive World*. In practice, Minus Zero's published whitepaper describes this as creating an algorithm capable of learning generalised but coherent representations of the world that can be used for predictive decision-making within the established rules



and context of driving. It claims the algorithm would, therefore, not need vast streams of training data for every specific eventuality—an approach used by some [training simulators](#)—before it was ready for real world driving.

An untouched industry

In Reehal’s view, the Indian AV market is in a comparable position to the US in 2004—when the first DARPA Grand Challenge on vehicle automation was held. “It’s relatively untouched, and that’s because the road conditions are much more challenging as a test ground. Some

experts even conclude that AVs could be 50 years away.” Minus Zero’s nature-inspired AI stack—True Vision Autonomy (TVA)—aims to shorten that timeline considerably.

TVA is a suite of hardware and software engineered for low-power computing at the edge. The company claims that it is scalable to SAE Level 5, as well as vehicle, geography, and use-case agnostic. “Adaptation is crucial,” Reehal emphasises. “If you learned to drive in San Francisco and then moved to New York, did you need to learn everything all over again? No—because you can adapt, and that’s what an AV stack must do, too.”

Notably, the company also dispenses with common sensors like LiDAR and radar, opting instead for a Tesla-like configuration of six cameras around the vehicle to provide visual input. It claims to be the only AV company in India taking this approach.

[Controversy](#) surrounding Tesla's camera-based vision system has led some AV segment players to favour LiDAR and explore ways to [improve it](#). However, Reehal contends that "images are the richest source of information we can have" and that alternatives either provide too little data (LiDAR) or have low resolution (radar). "The problem with cameras so far has been that the neural networks are too limited." He equates the difference between previous efforts and TVA to the evolution of chatbots from five years ago into ChatGPT. "Faster generalisation is the key. Over the coming year, we're going to showcase autonomous driving at night and in poor weather to prove our system's adaptability to all environmental conditions."

India's AV timeline


Minus Zero is an AV software company and not an automaker, so its immediate preoccupation is to capture the attention of OEMs and suppliers in the automotive value chain. "That's what our 4 June 2023 launch of zPod was all about," says Reehal. The four-seater, all-electric zPod's demonstration on public roads was meant to serve as an inspiration to the Indian industry about the possibilities of autonomous mobility. The response, he adds, has been positive so far.



The zPod driving on public roads during its June 2023 trial

However, the introduction of AVs to India's roads will not happen overnight. "Right now, what comes to the general consumer's mind are reports of crashes associated with AVs. That's one of the biggest obstacles," Reehal states. Indeed, markets such as the US and Europe, where AV development is more advanced, still struggle with [public mistrust](#) due to high-profile incidents involving driving assistance technology—even though most do not actually feature vehicles with Level 4+ capabilities. To build familiarity with AVs, Minus Zero will initially target geofenced use cases away from public roads, such as university campuses, airports, and theme parks. This will then progress to logistics applications.

In this way, the company envisages India's AV timeline developing in [almost exactly the same way](#) as other markets. "You have to slowly remove the constraints around the technology so that its societal benefits can materialise," says Reehal. "This is not a problem that can be solved by one company. It's an ecosystem problem, and Minus Zero is providing the brain."



Synthetic fuel can only occupy a “niche” in automotive

Despite a consistent presence in the clean energy transition conversation, there may be no feasible path for e-fuel in automotive.

By Lee Monks.

The predominant narrative is that electric vehicles (EVs) running on lithium-ion batteries will replace internal combustion engine (ICE) vehicles. According to energy research company Wood Mackenzie, EV sales could reach 62 million units per year by 2050, consolidating a total global EV stock of 700 million.

Despite this broadly accepted eventuality, synthetic fuels are sometimes touted as feasible alternatives to gasoline, diesel, and electric. Big Oil is consistently linked to the development of hydrogen, kerosene, methanol, and biomass derivatives. But what about carmakers?

Hyundai's Nexa and Honda's Clarity, both powered by fuel cells, are on the roads, albeit in small numbers. Renault's R&D team, while still developing EVs, is also working on hydrogen options. Toyota touts its Mirai as a bona fide hydrogen flagship car that represents "just the start for hydrogen" and harnesses "a viable alternative to fossil fuels".

However, for every article extolling the credentials of synthetic fuels, there's another with a contrary take. Lucien Mathieu, Cars Director at clean transport campaign group Transport & Environment, shares his thoughts on the validity of synthetic fuels as a Big Oil transitional option and the role of fossil fuels as the industry strives for zero emissions.

What's your take on Big Oil's transition to cleaner energy? Are synthetic fuels an option?

It's clear to us that Big Oil intends to slow down electrification, potentially derail it, and build up additional



fossil fuel demand in the meantime. EVs are a mortal threat to Big Oil. Once cars go electric, which will happen, oil demand in the sector will evaporate. So, the strategy is to promote so-called clean fuels as alternatives to EVs. This is very clear if you look at the eFuel Alliance, which was created by the oil majors and some regressive companies from the ICE value chain. They've united to attack the EU's climate laws and promote e-fuels.

Can you provide an example?

In March, after initial broad agreement around EU emissions targets for 2035 and beyond, German liberals insisted on an exemption for e-fuels. Ultimately, the goal was to throw ICE a very weak lifeline that could potentially rely on subsequent legal action to fully succeed. Big Oil's fingerprints were all over these manoeuvres. The laws and agreements that the eFuel Alliance has aggressively attacked and undermined are crucial to the clean energy transition.



Lucien Mathieu suggests aggressive “fake” campaigns undermine the clean energy transition

What has the eFuel Alliance done to promote e-fuels?

Following this last-minute exemption, the eFuel Alliance has emerged stronger and emboldened. The German oil industry federation, Unity, incidentally also a member of the eFuel Alliance, created a fake

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E-fuels are not the solution for road transport

grassroots campaign with a PR company and organised some pro e-fuels demonstrations. This kind of behaviour is to create the illusion that

Big Oil heavily supports e-fuels. The reality is that it’s not true, and e-fuels are not the solution for road transport.

Why don’t you think they are a feasible option?

E-fuels are incredibly expensive and inefficient: you need about five times as much energy to run an e-fuel car compared to EVs. The role of e-fuels will be limited and only really makes sense for airplanes through kerosene derivatives.

Do you see the e-fuel exemption as a temporary compromise that will ultimately lead to a bigger future role for ICE?

The regulations are about cars, not fuels. Fuels are regulated separately. The automotive industry is partly attempting to extend the tag ‘carbon neutral’ to include numerous fake green solutions, such as e-fuels and biofuels, both completely unfeasible. By doing this they ensure that cars don’t have to be fully electric. It’s easy to anticipate what could happen. For example, a crediting

system could be employed to falsely label some cars as 100% e-fuel, 100% clean. This kind of certification could become a problem. The Big Oil expectation is that in future, as opposed to cars running solely on e-fuels, there'll be a blend, and gasoline and diesel can still play a part. Under such a scenario, ICE vehicles will still be sold after 2035 and fossil fuels can continue beyond that point.

ExxonMobil is in exploratory conversations to develop its own native lithium supply. Is this significant?

With the transition, there'll be a massive need for extra raw materials such as lithium, nickel, and cobalt. We see investment all along the raw materials value chain, including refinement and producing the active materials for battery cells. The big challenge regarding EVs is the scale of the transition, which needs to rapidly accelerate. Opening a mine can take between five and ten years. We need investment now, urgently. There are some industrial policies, such as the Critical Raw Material Act in Europe, that provide a framework to ensure sufficient flow of investment into infrastructure. Whether it's ExxonMobil or another company, massive investment is needed to enable the transition, and there are many financial incentives in place to encourage this.

Does the industry need more leadership from Big Oil?

Big Oil needs to funnel more of its enormous profits towards the green transition if it has clean energy intent. Realistically, there needs to be more regulatory action to ensure it does so. There's no point in Big Oil putting a

few EV chargers out there. Oil companies spend far more on pursuing fossil fuel extraction.

Is Big Oil stifling the transition?

The transition is happening. Of course, it could be faster, and Big Oil could help. But some of the bottlenecks are things like the price of EVs, which are currently higher than ICE. Purchase price parity is inevitable within five years—EVs are cheaper from a total cost of ownership perspective. What's needed are subsidies to accelerate the rollout, and perhaps more focus on smaller EVs to quicken parity. There are other challenges like charger availability.

Do you see Big Oil playing a significant role in the future of automotive?

It needs to reckon with significantly less fossil fuel demand. It possesses huge financial resources built up over a condensed period. It's up to Big Oil what it does with those. It could certainly play a big role.

But you don't see hydrogen having feasible automotive potential?

Although it was once seen as a viable possibility by carmakers, there are no longer any significant plans by any of them to fully get behind hydrogen, whatever you might read. It's too expensive, there is no infrastructure plan compared to EVs, and EVs are much cheaper. Hydrogen-fuelled cars will exist, but they'll be niche and of no wide relevance. Green hydrogen is needed for aviation, shipping, and industry. However, it will play no part in the wider road transition, and synthetic fuels generally have no serious future in automotive.



Can solid-state batteries help EVs shed weight?

Eliminating the last traces of range anxiety will require a new kind of battery that is far more powerful and lightweight than current units, writes Siyu Huang

Electric vehicles (EVs) are gaining traction worldwide, and for good reasons. They produce less pollution, are cheaper to maintain, offer great speed and power, and now come in all sizes, from the pint-sized Nissan Leaf to the F-150 pick-up and three-row SUVs. Even the most common concern of range anxiety has abated, as EVs today have a range of between 300 and 500 miles.

The next challenge for EVs is to extend their range so that they can go as far on a single charge as gasoline vehicles can on a tank of gas. While the advantages of current EV batteries have helped significantly expand ownership of climate-friendly cars, eliminating the last traces of range anxiety will require a new kind of car battery that is far more powerful and lightweight than current EV batteries.

Battery weight matters

Lithium-ion batteries, the most common in EVs, are much heavier than comparable gas tanks. For instance, while a 15 gallon tank of gasoline weighs about 90lbs and provides about 300 miles of range for a mid-size sedan, a traditional Lithium-ion (Li-ion) battery pack has to weigh well over 1,000lbs to provide a similar range. As the vehicles become bigger, the batteries become even larger and heavier. For example, some off-road SUVs weigh 9,000lbs, with the battery accounting for 2,900lbs. This is because a gas tank can store about 17 times more usable energy per kilogram than a current-generation lithium-ion car battery. As a result, a popular gasoline pick-up gets 3.3



miles per pound of gas, while its corresponding electric version only gets 0.12 miles per pound of battery. The gas version has twice the range (460 miles) than its electric version does (230 miles) on a 150-pound gas storage system, while the EV battery is over ten times as heavy.

This challenge limits Li-ion batteries' ability to provide long ranges because of diminishing returns: the heavier the battery, the heavier the car is, and the heavier the framing needed to support the battery, so even more battery is needed to power this heavier load. Using lithium-ion batteries to push EV ranges beyond their current limits would create a counterproductive cycle where much of the battery exists simply to carry the battery, reducing the EV's efficiency.

It's also important to keep vehicles as light as possible while extending their range to avoid the increased risk of damage that additional vehicle weight presents to other vehicles, bicyclists, pedestrians, and aging highway infrastructure. The key to developing more powerful and efficient long-range EVs is a battery that can hold

Electric vehicles on the market today are much heavier than their gas-powered counterparts due to the battery pack. Next generation batteries are being developed to be much lighter and sustainable.

	Current Generation Electric Vehicles	Gas Powered Vehicles
Ford F-150	Lightning longer range (32 mile) BEV pickup 6590 lbs	F-150 4,000 5,000 lbs
GM Chevrolet	Silverado 8,000 lbs	Crew Cab Interma; Combustion 5,700 - 4,900 lbs
Volkswagen	ID.4 4,700 lbs	Tiguan Compact SUV 3,700 lbs

Sources:
<https://electrek.co/2022/05/11/ford-f-150-lightning-big/>
<https://tfltruck.com/2022/01/news-2022-ford-f-150-lightning-weighs-less-than-you-may-think/>
<https://www.caranddriver.com/volkswagen/id4/specs>



significantly more energy in a smaller, lighter package than lithium-ion, powering cars for vast ranges without burdening them.

The long-range solution

Battery innovations, specifically solid-state batteries (SSBs), could be the key to helping EVs tackle the weight issue. Next-generation SSBs use advanced, more efficient lithium anodes that allow the batteries to pack much more energy into smaller, lighter frames. Moving the anode to lithium, the lightest metal on earth with superior electrochemical

potential, increases EV batteries' energy density. Furthermore, due to their lower weight and more compact volume, they have a smaller footprint than the heavier and bulkier batteries on the market today.

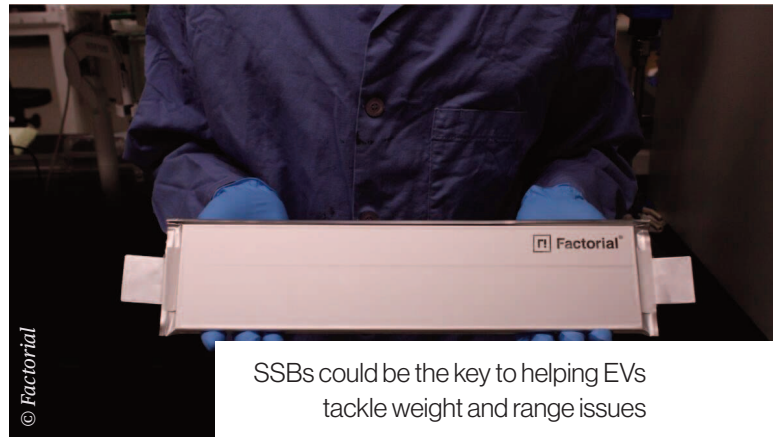
For example, while most traditional Li-ion batteries have an energy density of 200-325 Wh/kg, companies that are developing solid-state batteries have reported they can carry up to 30-50% higher energy density than lithium-ion batteries. This means that the cells for a 90kWh battery would weigh, on average, 363kg (800lbs) with traditional li-ion chemistry but 262kg (580lbs) for a solid-state chemistry.

The extra energy stored in this lightweight battery powers vehicles for longer than similarly sized traditional Li-ion batteries currently used in EVs, without weighing them down. For example, a current generation SUV with a 300-mile range could be using 25% of its battery just to move the battery because of how heavy it is. With a lighter-weight battery, such as SSB, that percentage goes down significantly.

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A gas tank can store about 17 times more usable energy per kilogram than a current-generation lithium-ion car battery

Automakers can use those significant weight savings either to reduce the footprint of the battery to get the same range in a lighter vehicle or to provide more range at the same weight. And there's added perks: SSBs are even safer than Li-ion batteries, and they have fast charging capabilities without degrading the battery as quickly and with less



SSBs could be the key to helping EVs tackle weight and range issues

concern about thermal runaway. SSBs can help relieve supply chain pressure by reducing the amount of critical battery minerals, such as graphite and cobalt, that is needed.

The future of EVs is bright, light, and powerful

It's amazing how far the EV industry has come in a short time; EV ranges have more than doubled since 2010. However, the weight of current generation EVs poses problems for EV owners and policy makers, including resource inefficiency, safety risk and infrastructure decay. Even with lighter weight materials and some savings in the motor/gearing, current generation EVs are significantly heavier than similar size (and often longer range) gas-powered vehicles.

Lighter-weight batteries can bring EVs closer to the safety, efficiency, and range standards that consumers expect from gasoline vehicles. As the industry approaches the limits of Li-ion batteries, lightweight SSBs could provide a path to make EV ownership and driving as accessible and fuel-efficient as gasoline vehicles are today.

About the author: Siyu Huang is Chief Executive Officer of Factorial Energy



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What's the template for autonomous MaaS management?

**A consistent form of service governance and management is key to autonomous mobility success.
Megan Lampinen hears more**

Many companies are hard at work developing autonomous driving systems for passenger cars, shuttles and trucks. Their primary focus has been on automating tasks around perception, path planning and vehicle control to enable a driverless future. But this vision of autonomous mobility will also require service management and oversight, and that's where players like Beep come in.

Oversight

“I’m not going to downplay the intelligence of these vehicles, but we also need a level of monitoring and oversight so that we can ensure the vehicles are doing exactly what they think they’re doing and what we have told them to do—two totally different things,” says Racquel Asa, Chief Marketing Officer at Beep. The Florida-based technology company specialises in managing autonomous, electric shuttle services for first- and last-mile applications. It has onboard shuttle attendants to monitor the

vehicles, supported by a software and command centre.

“Our command centre is solely dedicated to knowing where our

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If you put it in the right use cases, it’s a recipe for success

vehicle is and what it is doing,” she adds. “We can ensure that it runs safely time and time again, wherever it is operating.” The long-term vision is to remove the onboard attendant and introduce some level of tele-assist, but not teleoperation. Asa emphasises that there is a big distinction between the two: “Teleoperation entails someone

An autonomous shuttle helps move visitors around Yellowstone National Park





What's the ideal seating design for autonomous shuttle services?

sitting in the Beep command centre remotely driving the vehicle. We don't have any intention of a one-to-one scenario like that. Instead, the market needs a level of tele-assist that allows the vehicle to bubble up."

By this, she means a safety case that needs to be validated and assisted by engineers sitting in the Beep command centre. The engineers would be alerted to a situation that requires their attention and can then validate if/when the vehicle is safe to proceed. "At no point is the engineer or agent taking over the vehicle and driving. What they are doing is validating the vehicle is safe to proceed," she clarifies.

A good fit

Over the past three years, Beep has accumulated more than 100,000 road hours and currently operates the largest and longest-tenured autonomous shuttle network in the US, located in Lake Nona, Florida,

where eight shuttles run along seven routes. As well as the Florida application, it has also conducted a number of mobility projects around the US, including within Arizona's Yellowstone National Park, the Atlanta suburb of Peachtree Corners in Georgia, and more recently in a Wake County municipal park in North Carolina. The company is also in talks with two transport authorities on the West Coast. European companies ZF and Bentler are also working with Beep to launch their new shuttles in the US.

All shuttle journeys are fairly short, lasting no more than 20 minutes in one direction. "We are really targeting those journeys that are too far to walk but where it is probably not worth taking a private car," Asa tells *Automotive World*.

To bring these emerging technologies and solutions to communities, Beep partners with corporate campuses, public transit agencies, master planned communities, cities, and

municipalities. Together they identify appropriate routes and environments for these low-speed vehicles—none operate above 25mph. The key is to make sure there is a good fit between the operational design domain and the mobility problem that needs to be solved. “You can implement technology all day, but if it’s not meeting a need, no one will use it,” she emphasises.

Pinellas Suncoast Transit Authority, one of Beep’s public partners, tested in multiple cities including St Petersburg, Florida. Here, the vehicle operated along a one-mile stretch of road where there was limited private parking. Pivotal, the northernmost stop on the line was where the Cross Bay Ferry dropped off people coming across the bay from a different city. The autonomous shuttle was perfectly positioned to pick them up when they arrived in St Petersburg and take them to the redeveloped waterfront.

“We had tremendous ridership during that time, roughly 9,000-10,000 passengers with just a short-term pilot,” Asa shares. Pilots like this one are incredibly helpful in validating the role that autonomous shared services can play in the wider mobility scene. “Findings from our pilots and rider surveys confirm that people indeed want this,” she adds. “You see headlines that say people are not comfortable with autonomous vehicles. We have data that shows the exact opposite. If you put it in the right use cases, it’s a recipe for success.”

Pilots also help inform the business model as Beep prepares to scale its offering. Insights are drawn from all aspects: user experience, how the vehicles are operated, the sort of

vehicles that are selected, etc. For instance, the current generation of shuttles can seat eight people, but the next-generation vehicle platforms, which will be available by about 2025, will have capacity to seat between ten and 22 people, depending on the form factor. “We’re getting bigger because that’s what we heard the market wanted,” Asa says. “But we wouldn’t have known what the market wanted had we not tested and put the current vehicles on the road.”

Benefits

All the vehicles run by Beep are electric, which will help tackle tailpipe emissions, but that’s not the only benefit. “For some of our private sector clients, this becomes an amenity that is offered by them and nowhere else,” she points out. That applies to the Florida retirement community Tradition, developed by Mattamy Homes.

Autonomous shuttles are a particularly good fit for environments like this, where there is a large pool of individuals with clear mobility needs. Beep recently expanded its autonomous shuttle route with a stop right in front of Tradition that runs to the city centre and shopping facilities. “For some residents, the mobility opportunity this opens up to them is life changing,” Asa emphasises.

The impact of this emerging mobility segment will become more pronounced as more applications hit the road. Custom Market Insights forecasts the global autonomous shuttle market will have a CAGR of 5.2% between 2023 and 2032, by which time it could reach a value of US\$371.65m.

Could a rift be forming between Big Oil and OEMs?

After many decades of partnership, Big Oil may not be entirely supportive of automakers' attempts to transition away from fossil fuel reliance.

By Stewart Burnett

For many decades, the automotive industry has moved in tandem with Big Oil. In the 1950s, the two industries allied to build out US road infrastructure and foster a culture of dependency on private vehicles. The two industries were in mutual agreement about electric

vehicles (EVs) for some time, too—they were expensive, disruptive, and a threat to profits. However, much has changed in the last five years. EV sales continue to surge, with the International Energy Agency (IEA)'s Global EV Outlook 2023 report forecasting a 35% increase in unit sales from 2022.

Most OEMs are preparing for an all-electric future. Volkswagen projects that, by 2030, 80% of its European sales will be EVs, as well as 55% of its US sales. This shift has been met with mixed responses from the industry's long-time ally. Indeed, while Big Oil has offered some support for electrification, it has also fought against it in numerous instances. Could a potential rift be forming between the two industries?

Fighting transition

Some industry watchers have speculated that Big Oil is looking to turn back the dial towards internal combustion engine (ICE) vehicles. Julian Skidmore, Senior Firmware Engineer at EV consultancy Versinetic, tells *Automotive World* that “at a basic level, Big Oil's primary product is almost entirely incompatible with the industry's rapid switch to zero-emission motorised transport.” As a result, he suggests, its historic recalcitrance over sustainable energy will increasingly bleed into the automotive sector.

This is evidenced by several pending Californian lawsuits. One example, *Western States Petroleum Association v. California Air Resources Board et al.*, takes aim at the state's Advanced Clean Cars II regulations, which aim to facilitate road transport's transition to zero emissions. California has been leading the charge for electrification in the US, making it a prime target for such litigation.



As of January 2023, Shell operates over 90,000 chargers worldwide, including homes, businesses and public charge points

Tensions can also be observed in July 2023 marketing material from ExxonMobil's subsidiary Mobil Oil. These commercials emphasise the perceived inconvenience of charging and the clutter of cables associated with EVs, attempting to connect gasoline with notions of "freedom". One culminates in a shot of an ICE car driving with a trail of severed cables trailing behind it, as the slogan "Disconnecting feels a lot like breaking free. Mobil 1: the world's leading synthetic motor oil" flashes onscreen.

This is not the first commercial in this vein. Indeed, the auto industry arguably fired the first shot—a 2011 marketing campaign for the Nissan Leaf asked its audience, "What if everything ran on gas? Then again, what if everything didn't?"

Possible malintent

It should be noted that some Big Oil companies have also made moves to invest in charging infrastructure. For example, BP acquired UK charging firm Chargemaster in 2018, taking control of the company's 6,500 public charge points across the UK and rebranding it BP Pulse. Shell also has a noteworthy presence within the charging market—as of January 2023, it operates more than 90,000 charging points worldwide, including homes, businesses, and public charge points.

Kevin Mak, Principal Analyst for Automotive Market at TechInsights, tells Automotive World that while these developments are promising, things are "not progressing at

the pace OEMs would like". This may, in part, explain why OEMs have taken direct action to build out charging infrastructure themselves—something they were never inclined to do with gasoline stations.

Such efforts from OEMs may also be intended to serve as a bulwark against malintent. Skidmore claims that, based on current behaviour, it may even be "likely" that Big Oil will use its charging resources to make EVs less appealing. "Rather than offer help, they could buy EV charging infrastructure to shut it down or make it disproportionately expensive."

This speculation may be warranted: since the Chargemaster acquisition, BP has raised its charging tariffs by

315%, but only raised gasoline by 120%. While it is the case that electricity prices have spiked in the UK—triggered in part by the war in Ukraine—the current charging tariffs are disproportionately high at a time when electricity prices are returning to around 130% of their cost in 2018. Furthermore, BP announced in February 2023 that it had lowered its fossil fuel reduction target from 40% to around 25%, which could indicate the company has little intention of letting go of its core product easily.

by Geely and Renault that focuses on synthetic fuels and hydrogen technologies. However, Aramco’s participation is not guaranteed, and its stake would be comparatively small—20% at most.

There has also been some movement to invest in battery raw materials. In May 2023, ExxonMobil acquired upstream exploration company Galvanic Energy’s lease to extract lithium (a mineral crucial for the production of 60% of all EV batteries, according to 2022 IEA

temptation of the cash cow is the easiest in the short-term, but deadly in the long-term,” he states. By 2025, strategic research firm BloombergNEF projects that EV adoption could displace as many as 2.5 million barrels of oil per day—around 2.4% of the 94 million total. By 2050, this figure could rise to around 31 million (33%).

Alternatively, Big Oil could divert the focus of the business towards electrification—something Pacheco and Skidmore both acknowledge will be difficult. “The fossil fuel industry has enjoyed 250 years of unrivalled supremacy, making this a monumental practical and cultural challenge,” Skidmore remarks. Its extensive resources and tentative, though contingent, steps towards electrification could certainly enable it to endure a short-term financial loss and reinvent itself.

Ultimately, perpetuating tensions over EVs does not serve the long-term interests of either major oil companies or automakers and will ultimately hamper efforts to realise a zero-emission future for automotive. Furthermore, returning to a growth strategy focused on gasoline-powered vehicles may not even be feasible—Stanford University’s Millenium Alliance for Humanity and the Biosphere predicts that global oil reserves could run out by 2052 at current usage rates. As such, Skidmore concludes, a more thorough and unwavering commitment to electrification is Big Oil’s most secure option.

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Succumbing to the temptation of the cash cow is the easiest in the short-term, but deadly in the long-term

More commitment required

Even if they were to be taken on good faith, Big Oil’s moves to support electrification could be perceived as limited. For instance, in March 2023, Aramco signed a letter of intent to become a minority stakeholder in a new joint venture founded

data) at a 120,000-acre site in southern Arkansas for around US\$100m. However, this is a comparatively small investment against the company’s US\$56bn in profits from 2022—almost all of which came from oil.

Pedro Pacheco, Vice President of Research in Gartner’s CIO Research Group, sees a choice looming on the horizon for Big Oil. “Succumbing to the