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Emission testing crisis shifts from diesels to plug-in hybrids

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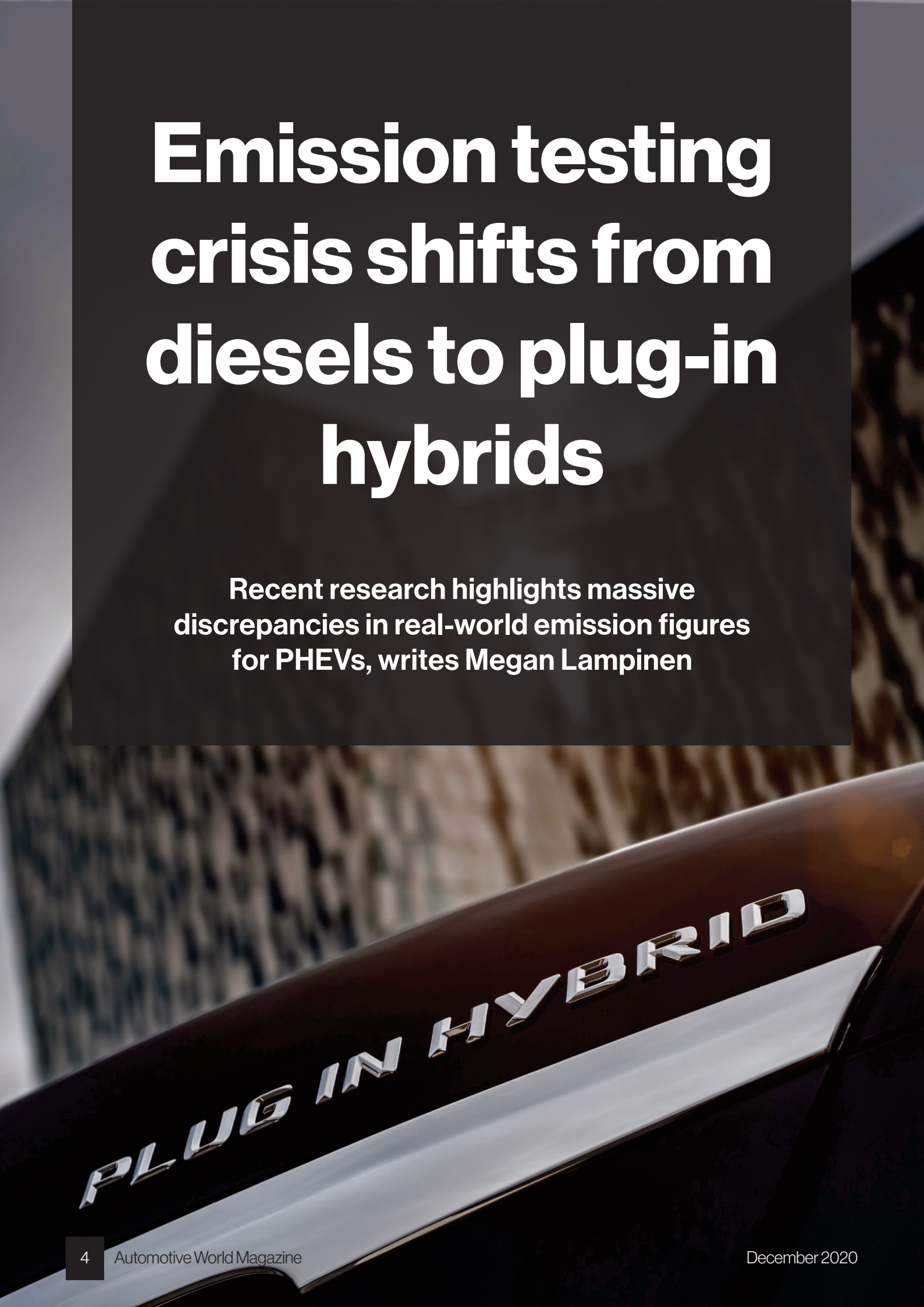
Emission testing crisis shifts from diesels to plug-in hybrids

Recent research highlights massive discrepancies in real-world emission figures for PHEVs, writes Megan Lampinen



Powertrain electrification has been hailed as a likely solution to the transport industry's environmental challenges, but plug-in hybrid electric vehicles (PHEVs) are now facing scrutiny. Recent research casts doubt on the environmental benefits of these models, which combine an electric and a conventional combustion engine drivetrain. PHEVs can potentially tackle global greenhouse gas (GHG) emissions and local air pollution, provided they operate primarily on electricity. But there's limited evidence into just how much driving they do in this mode. So what does that mean for their overall emissions?

New findings

In September 2020, the International Council on Clean Transportation (ICCT) released analysis of its study into the fuel use by PHEVs in real-world operation, drawing on data from 100,000 PHEVs in China, Europe, and North America. It found that fuel consumption and tailpipe CO2 emissions in real-world driving, on average, were about two to four times higher than type-approval values. That's a huge deviation from New European Drive Cycle (NEDC) type-approval values, and researchers noted that it spans much larger ranges than for conventional vehicles. It also found that the real-world share of electric driving for PHEVs, on average, is about half the share considered in the type-approval values.

But were the automakers themselves aware that such huge differences in performance might surface? "I don't think our findings came as a surprise to automakers," says Peter Mock, Managing Director, ICCT Europe. "All manufacturers keep a close eye on the real-world performance of their vehicles, even though they typically do not disclose any of that data to the outside world."

Notably, the ICCT is the company that first uncovered the major discrepancies in diesel passenger cars back in 2013, which eventually turned into the global, multi-player Dieselgate scandal. However, Mock emphasises that this is not necessarily another Dieselgate: "In the case of NOx emission levels that we observed, at least in some cases there was fraud, i.e. deliberately reporting wrong data to regulators and consumers. In the case of CO2 for PHEVs, the issue is that the testing requirements defined were overly optimistic and now allow manufacturers to advertise PHEVs with a low electric mileage as climate-friendly, while in reality those vehicles may perform worse than a conventional internal combustion engine (ICE) vehicle."

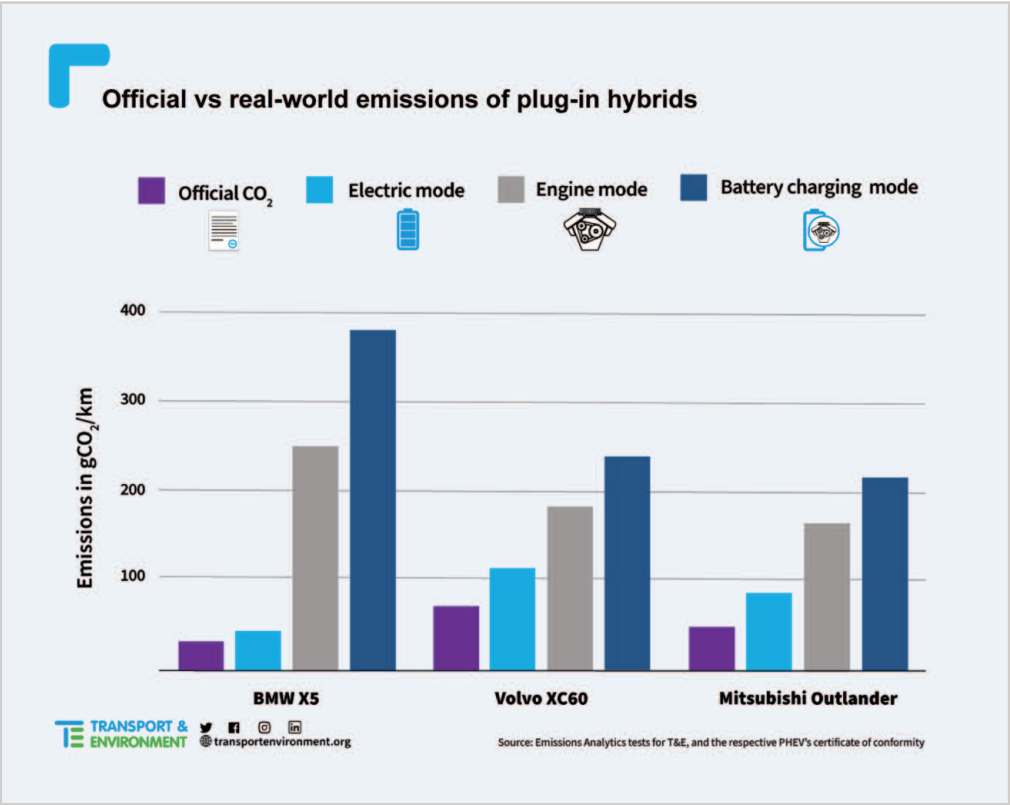
Two months on from the ICCT study and now Transport & Environment (T&E) has come forward with similar analysis into the real-world emissions of PHEVs. T&E commissioned Emissions Analytics to test three of the most popular PHEVs sold in 2019: a Volvo XC60, a Mitsubishi Outlander and a BMW X5. When tested on a fully charged battery in optimal conditions, the Emissions Analytics evaluation showed that these three models emitted 28-89% more CO2 than advertised. On an empty battery, emissions were three to eight times above official values. When driven in battery-charging mode, the PHEVs emitted three to 12 times more.

> The real-world share of electric driving for PHEVs, on average, is about half the share considered in the type-approval values

T&E's Anna Krajinska, Emission Engineer and author of the report and the testing programme, isn't claiming fraud in this case either, but she has concerns about what's going on. "Manufacturers know what they are doing when they fit weak electric motors and small batteries to PHEVs," she tells Automotive World. "Rather than optimising their PHEVs to deliver actual CO2 savings on the road, manufacturer's are optimising them to exploit the weaknesses of the NEDC and WLTP regulation to claim unrealistically low CO2 values and tax benefits, while delivering CO2 savings on paper only, with limited benefit in the real world."

Her colleague Julia Poliscanova, Senior Director for Clean Vehicles at T&E, is more blunt in her criticism: "Plug-in hybrids are fake electric cars, built for lab tests and tax breaks, not real driving... Carmakers blame drivers for PHEVs' high emissions. But the truth is that most PHEVs are just not well made. They have weak electric motors, big, polluting engines, and usually can't fast charge."

From the start, PHEVs have been advertised as low emission cars, with most officially emitting less than 50g/km of CO2. "When real world usage of the three tested vehicles was taken into account, the CO2 emissions increased by 50-230%," notes Krajinska. "Additionally, it is not made clear to consumers at the point of sale how these vehicles need to be driven to achieve such low CO2 values in practice. Often there is also a very limited amount of information available on the limitations of the PHEV, such as under what conditions the car can't drive in zero-emission mode."



The automaker perspective

So what do the automakers have to say in response to these findings? Mitsubishi expressed scepticism over the validity of the results, with a company spokesperson stating: "Our published mpg and CO2 figures are the numbers that are produced as a result of a standardised WLTP test that was specifically designed for PHEVs. Independent tests can produce unreliable or variable figures depending on conditions and a variety of other factors and we naturally contest any findings where we have no oversight of the testing or methodology. Disregarding a PHEV's electrical powertrain during testing, for example, is like testing a gasoline or diesel car and only using three of its gears."

Others point out that real world results vary depending on driving conditions. "The WLTP test is designed by the international regulators as a standardised method of comparing vehicle efficiency to allow direct comparison between different cars and different technologies," says BMW. "These tests show clearly that PHEV technology, when charged regularly as intended, can save significant fuel consumption and emissions over the equivalent gasoline or diesel models." It points out that while the tests are conducted in a laboratory environment, that's to ensure that all vehicles are tested in the same way for accurate comparisons. "While we cannot comment on the test method used in this report, it is no surprise that different emissions figures are reached, as on-the-road driving conditions are infinitely variable," it adds.

Volvo essentially has the same response: "The existing emissions testing regime provides a useful

> The testing requirements defined were overly optimistic and now allow manufacturers to advertise PHEVs with a low electric mileage as climate-friendly, while in reality those vehicles may perform worse than a conventional internal combustion engine vehicle

industry standard that allows customers to make comparisons between cars, but real-world variations will apply." It believes that PHEVs represent "a crucial step in our path to full electrification" and "an important transitional technology on the journey towards zero emission mobility," pointing out that customer data shows Volvo PHEVs are driven in pure electric mode an average of 40% of the time. Mitsubishi claims that its EV owners drive in electric mode during 72.2% of their commute, 84.3% of the time they are running errands or doing school runs, and 32.8% on longer journeys. "PHEVs have played and continue to play an important role as a transitional technology," says Mitsubishi. "They ease people into electrification, helping them to realise they actually could live with an EV day-to-day, while they also produce lower emissions overall than traditional ICE vehicles."

The UK's Society of Motor Manufacturers and Traders (SMMT) is also backing its members on this issue. SMMT Chief Executive Mike Hawes comments: "PHEVs provide flexibility, with the ability to drive in

zero emission mode for typically 25-40 miles–more than ample given that 94% of UK car journeys are less than 25 miles. This makes PHEVs perfect for urban commutes while avoiding range anxiety over longer journeys, reducing emissions and improving air quality. We can't comment on unverified, unregulated tests by commercial entities, but even these have found that overall, PHEVs emit at least 25%-45% less CO2 than their pure ICE counterparts, and of course, they emit 100% less when driven in battery mode."

Government support

Notably, the UK government has excluded PHEVs from the 2030 end of sale date for gasoline and diesel cars and vans. At the same time, governments across Europe offer incentives on their purchase. This is precisely what has the ICCT and T&E concerned. The ICCT wants national incentives to favour only those PHEVs with a high all-electric range and a high ratio of electric motor power to combustion engine power. Where possible, it recommends that incentives be linked to demonstrating "the proper real-world performance of the vehicles, for example by using UF data collected from on-board fuel consumption meters or during regular technical inspections." T&E takes a more aggressive stance, seeking an end to government purchase subsidies and tax breaks. "Unless you drive them softly, carbon emissions can go off the charts," adds Poliscanova.

There are also calls for a change in Europe's credit system, specifically that the threshold for providing zero- and low emission vehicle (ZLEV) credits be adapted to real-world data and the current multiplier of 0.7 be removed to avoid any incentive for PHEVs with a low electric range. T&E objects that selling PHEVs makes it easier for automakers to meet EU CO2 standards, as PHEVs receive additional credits. It wants this to end with the next review for the 2025 and 2030 targets. "The only way plug-ins are going to have a future is if we completely overhaul how we reward them in EU car CO2 tests and regulations," warns Poliscanova. "Otherwise PHEVs will soon join diesel in the dustbin of history."

When wheels meet legs: Hyundai aims for unprecedented mobility

The New Horizons Studio is reimagining how vehicles will traverse not just roads, but the whole world.
By Megan Lampinen

© Hyundai

One of the toughest challenges for automakers is to prepare for the future of mobility, today. That means anticipating transport needs, and securing the necessary technological and manufacturing know-how to meet them. And it all starts with a vision of how people and vehicles will need to move.

At Hyundai, the ultimate aim is unprecedented mobility. The automaker recently set up a new unit, the New Horizons Studio, focused on the development of Ultimate Mobility Vehicles (UMVs). These vehicles are designed for travel in unconventional and off-road terrain, in some cases where vehicles have never operated before, and for this, wheels alone won't cut it. "We began by asking, 'What if you could bring in robotics and make the car transform from a four-wheel drive to a four-legged walking machine?'" explains John Suh, Founding Director of the New Horizons Studio. Suh has a strong background in robotics and previously served as Founding Director of the Hyundai CRADLE (Center for Robotic-Augmented Design in Living Experiences).

From that initial question came a series of other questions, and the team quickly concluded that there were severe limitations with the typical car suspension design. Even designs specifically modified for off-road use faced limitations, frequently becoming stuck in mud or snow or rolling over. This was particularly challenging for applications such as search and rescue, defence, land management, and exploration. If only the vehicle could somehow lift its wheels out of the mud or snow, or turn itself over again.

From four-wheel drive to four-legged

The answer is a combination of wheeled motion and articulating legs, and Hyundai believes it promises a new paradigm in mobility. "A four-wheel drive vehicle is very capable and can do many things, but there are times when it just cannot go over certain obstacles," Suh tells *Automotive World*.

© Hyundai

The Elevate Concept could help individuals with limited mobility in urban or suburban settings

In 2019 the automaker debuted the Elevate walking car concept at CES. The model could drive at highway speeds and then actuate a set of legs to climb over a wall or walk over rough terrain. Based on a modular EV platform, it could switch out different bodies for specific situations. The robotic leg architecture featured five degrees of freedom plus wheel hub propulsion motors and was enabled by electric actuator technology. The New Horizons Studio team was set up to further develop this idea of a transformer class of vehicles and eventually develop products for various markets.

The Elevate concept was presented as the future of the first responder industry, with the idea being that a rescue vehicle could climb over flood debris or broken concrete in the aftermath of a tsunami or earthquake. But the potential goes far beyond that. “There are still many wild places on earth where there are no roads,” Suh points out. “In these environments, the usual standby for transport is a mule. Now imagine a mechanical ‘mule’ that could be loaded with equipment but wouldn’t need to be feed; it could run on electricity instead.”

There is even potential for city and suburban applications. Instead of calling a taxi or an Uber, people with disabilities that do not have access to a ramp could order a UMV that walks right up to their front door, even if there is a flight of steps leading up to it. The vehicle could then level itself and allow the person to walk right in. "This is the future of the home, where technology adjusts around you to fit your needs," says Suh.

All applications with UMVs are ground-based, but they need not all be based on Earth. Suh envisions use of UMVs on the moon or other planets for exploration purposes. "There is renewed interest in this sort of exploration, and those places have no roads," he points out.

Autonomous potential

Like various other forms of transport, these UMVs have the potential to operate without a human driver at the wheel. Ernestine Fu, who serves as the New Horizons' Director of Product Management, brings a wealth of experience on this front. She previously led research on human operator and autonomous vehicle interactions at Stanford University's Volkswagen Automotive Innovation Lab.

"Autonomous vehicle technology could be incorporated into this vehicle but it's not a prerequisite," Suh clarifies. He suggests that urban applications like ride-hailing for the elderly or those with disabilities could make a good match for self-driving. Another option is for the UMV to become a companion of sorts: "The person using it could be walking on their own, but have this machine next to them helping out, like a buddy."

> "What if you could bring in robotics and make the car transform from a four-wheel drive to a four-legged walking machine?

These UMVs could also be powered by a zero-emission propulsion system, such as a battery electric setup, but like automation, this is this not the real focus of the development team. "Battery electric technology could also be incorporated, but the key feature is the ability to transform," emphasises Suh.

The Elevate in Drive mode

The development process

In developing these potentially revolutionary vehicles, the New Horizons Studio will be drawing heavily on digital design, simulation and virtual environments. These in themselves are nothing new to the automotive industry, but Suh hopes to step it up a gear: “I’m inspired by what movie studios do today. They have moved into digital production, and it’s far beyond postproduction visual effects. They are putting together the digital effects in real time.”

This approach, combined with traditional simulation techniques, should accelerate the design phase and open up new possibilities. “With this technology we could explore a wider set of solutions than was possible before,” he adds. “Since it’s all done digitally, you do not have to purchase the material or machine it. If you free your mind from having to stick with one solution–make it broad and expansive–then we can keep our eyes open to possible solutions that we may not have otherwise looked at.”

This is part of why Suh wanted the word ‘Studio’ included in the new business unit’s name: “It’s not just a

design studio. We are creating a whole experience, like a movie studio would, in addition to using the modern-day techniques that they are." From a practical perspective, use of the virtual environment has proven very helpful with remote working in the wake of the COVID-19 pandemic.

Diversification

A digital approach at the New Horizons Studio is expected to accelerate developments, but tangible results may take time. The team still has some significant technology obstacles to overcome, primarily in the leg wheel locomotion system itself. "This represents a different way of moving. And for a good reason, because it is difficult," he concedes. "I'm hoping to solve that problem or at least understand the capabilities of the technology by the end of 2021. That would then open up more confidence and planning for a whole vehicle programme." Suh goes on to suggest that a couple years after this would make a reasonable target to have a full vehicle ready.

It remains to be seen if some of the technology deployed on these UMVs trickles down into mainstream models, but in theory at least some of it should. "When you design for the extreme, or those with disabilities, everybody actually benefits," says Suh. As an example he points to the policy of using sloping curbs on US pavements, designed to allow wheelchair access. They also turned out to be very welcome for people with pushchairs and for robots.

"Where we are going is not exactly known," he points out. "We will end up someplace, but we don't know exactly where that place is. And in the process, we will be uncovering new capabilities and new insights into vehicle technology."

The focus on UMVs is just the latest step in Hyundai's efforts to diversify its traditional passenger car and commercial truck expertise. One of the biggest moves on this front came with the establishment of the Urban Air Mobility division, but the New Horizons Studio furthers that push. "This signals our interest in thinking differently and doing differently," says Suh. "That's how you create the future: by inventing it."

> "Where we are going is not exactly known. We will end up someplace, but we don't know exactly where that place is

Battery swap revisited

Better Place went bust and Tesla walked away but there's growing interest in this alternative to plug-in electric vehicle charging. By Megan Lampinen

Momentum in the electric vehicle (EV) segment has remained solid over the course of an otherwise turbulent year for the automotive industry. More players than ever are scrambling to gain a foothold in this promising sector, which promises not only air quality and environmental benefits but also lucrative revenue streams for those that read the market right. Backing the wrong technology will prove an expensive and time-consuming waste that could prove fatal in such a demanding environment.

partner in the form of Renault, the company ended up going bankrupt. About six years ago Tesla grabbed headlines with the news that it would be rolling out battery swap technology for its drivers, but ended up walking away before the project ever got up and running.

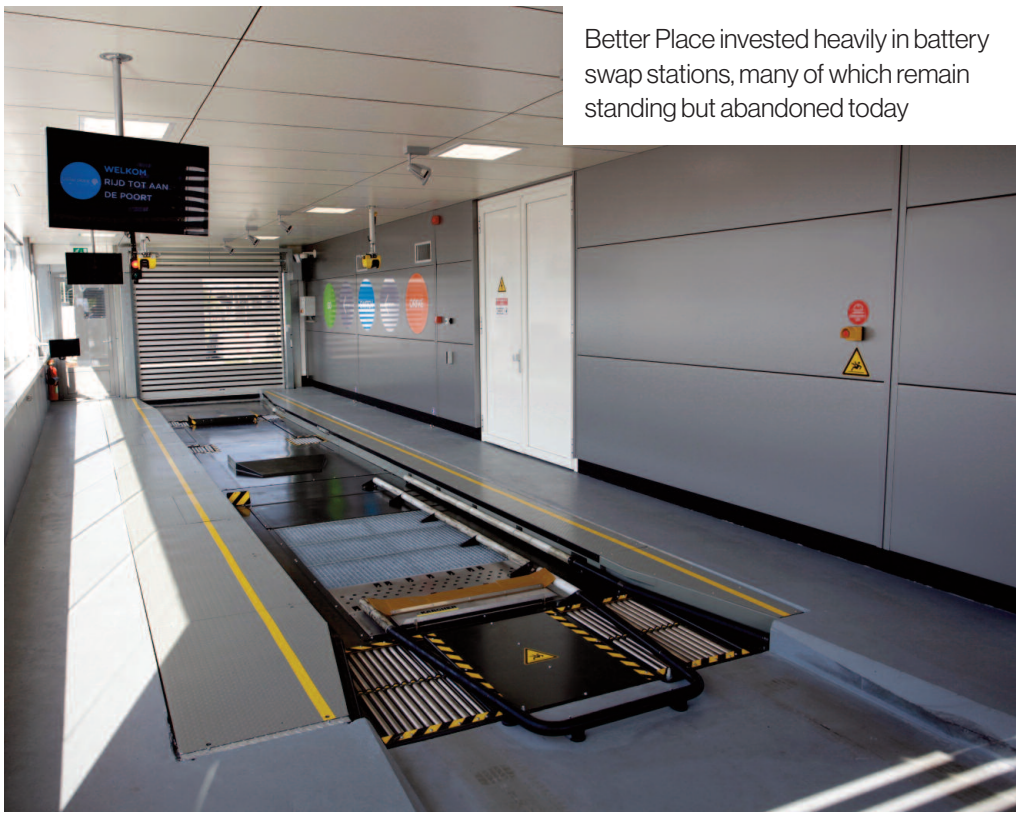
Now there's Nio, the Chinese EV start-up that is using battery-swapping functionality as a key differentiator in an increasingly crowded segment. In October 2020, the Nio Power battery swap service in China marked the 1 millionth swap. The network has been

> "There are virtually no cases where a battery swap would be more interesting than a fast charge or a general charge

Plug-in chargers vs battery swap

Battery swapping is emerging as one of the more controversial technology areas within the EV segment. In theory, it cuts out the hassle of waiting for a charge, which can take anywhere from less than 30 minutes to more than 12 hours. Israel's Better Place emerged as an early pioneer of this approach, which was at the very heart of its business model. Despite nearly US$1bn in infrastructure investment and an enthusiastic

expanding and now offers 155 stations in Nio's home market. China as a whole is making hefty investments in battery swap. Earlier this year, a group of 20 Chinese organisations–including Nio–signed a declaration to collaborate on building an "Eco-circle for the Body-to-Battery Separation Model of New Energy Vehicles." The government is behind it as well. China's Ministry of Industry and Information Technology issued a statement to *Bloomberg* in January, confirming it would "actively promote the demonstration application of battery-swap mode and improve the system and standardisation."



Better Place invested heavily in battery swap stations, many of which remain standing but abandoned today

Is it easier?

But not everyone is as bullish on the technology's prospects. "Battery swap is only useful if you believe that it's an easier way for you to refuel your vehicle," says Chris Burghardt, Managing Director–Europe at ChargePoint. "What we see is that most cars are charging at home or at employee car parks. They're not on the move. The extreme cases, where a family is going on vacation, are more about battery range. There are virtually no cases where a battery swap would be more interesting than a fast charge or a general charge." Notably, ChargePoint has a vested interest in the charging network: it is the only EV charging company that designs, develops and builds its own charging hardware and software systems.

But other charging ecosystem players are slightly more open to swapping's potential. "You might see this work with robotaxi and shared ownership fleets," says Doron Myersdorf, Chief Executive of StoreDot. The Israeli start-up is developing ultra-fast charging technology for EVs, potentially slashing charging times to just five minutes. Despite what he says about fleet potential, Mysersdorf is not a backer of swapping. "People want to own the battery. It is an important part of an EV," he told *Automotive World*. "It also accounts for about one-third of the cost. People don't want to share this or have others fiddle around with it on a regular basis."

The mechanics of a swap

Some players have flagged the practical obstacles inherent in the mechanics of battery swap. "Every time you take out a battery, there's moisture that ingresses," said Burghardt. "There is generally a lot of

© Nio

The Nio Power battery swap service in China recently marked the 1 millionth swap

wear and tear on the system that you don't have with charging. And even before that, you must have a very complex system that ensures the right batteries are available for the right vehicles at the right time."

This last issue is a big one. How easy is it for a single battery swap system to work with several different vehicle makes and models? "The problem is the form factor for vehicles," said ChargePoint Chief Executive Pasquale Romano. "There's no 'one size fits all'." Industry watchers have suggested that part of Better Place's downfall was due to the fact that its system only worked with the Renault Fluence ZE model. "Cars must be specially designed to work with battery swap, as is the case with Nio, or heavily modified," warned Jon Salkeld, Technology Director of BP's Advanced Mobility Unit. "It's quite tricky to see how an average consumer passenger car would be suitable for this. The potential use cases would be with large fleets of taxis, which allow operators to economically have all the cars modified."

Myersdorf raised similar concerns, and added: "The sort of technical compliance required is not easy unless you are working with something like a taxi fleet where all the taxis are the same." China, the leading market for battery swap, is tackling the problem head on. At the moment, the country's top four EV suppliers with battery swap services are limited to brand-

specific swap stations, i.e. a Nio won't work in a Beijing Electric Vehicle Marketing Co location or vice versa. The Chinese government is reportedly developing standards for battery-swapping services to address this. How this plays out in the long run, though, depends on various factors. Economic analysis by MIT a couple years ago suggested that the expense of a battery swap taxi fleet was slightly lower than conventional charging, if you assume the cost of the taxi driver as well. "If swapping happens it will happen in this area but as charging rates increase, even that segment could see itself eradicated," added Salkeld.

> "While battery swap is theoretically the quickest way to add energy back to the car, the downside is you need roughly one and half batteries per car to make that work

After all, the cost of a swap station is significant and reports from China suggest some of these must complete hundreds of swaps a day to break even. "While battery swap is theoretically the quickest way to add energy back to the car, the downside is you need roughly one and half batteries per car to make that work," noted Salkeld. Given the cost of batteries and how much they contribute to the overall EV price, that's a potential waste of one-third the value of an EV.

Commercial delivery and scooters

Then there is the commercial delivery segment, which some observers see as a potential match for swapping. "Where I have interesting conversations in this space is with heavy-goods vehicles," said Graeme Cooper, Project Director, Transport Decarbonisation at the National Grid. Uptime is a top priority for fleets and these vehicles tend to have high utilisation rates. Long-haul trucks face strict regulations on their drivers' hours of service and have to stop regularly. Cooper suggests that perhaps transport hubs that service drivers' needs could also swap out batteries.

Meanwhile, last-mile urban delivery applications could take advantage of a 'return to base' model. "Picture a last-mile delivery depot where the delivery van comes in briefly to change the driver, swap the battery and head back out," he suggested. But last-mile delivery isn't restricted to vans and trucks. Electric scooters, for example, are growing increasingly popular for applications like home grocery deliveries from supermarkets.

The Gogoro Network Battery Swapping Platform promises a swap in as little as six seconds

© Gogoro

Tapping into this segment is Taiwanese two-wheeler manufacturer KYMCO, whose Ionex Commercial range of e-scooters offers fleets the option of standard charging, fast charging and battery swap. The idea is to have fleets conduct the bulk of charging at their own in-house stations or swap out batteries on the go as required. Each scooter can carry a couple of extra batteries for easy exchange.

Fellow Taiwanese rival Gogoro is also pursuing the battery swap route for its range of electric scooters and boasts an extensive network of nearly 2,000 GoStations across Taiwan. Last year it unveiled a new design for these swap stations, which offers up to 50% more batteries than the previous version while at the same time reducing the size of the station. The station can even harness the energy of the batteries it houses in an emergency; this would allow it to continue operating or to direct power to microgrids in the city to help maintain critical systems.

"There's growing interest in grid balancing and using batteries for more than just moving around," observed Roger Atkins, Founder of Electric Vehicles Outlook. "That's where many people believe there is a future for battery swap. Combined with growth in fleet vehicles and applications there, as well as micromobility, there is a real sense that this is being revisited at the moment."

INTERVIEW:

Gorazd Lampic, Chief Executive, Elaphe Propulsion Technologies

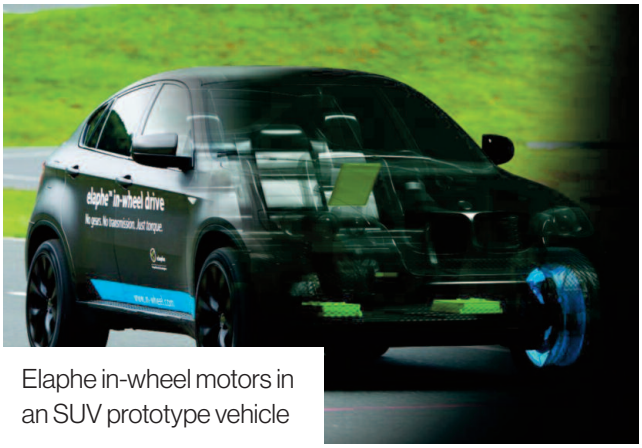
A €4m funding round indicates growing support for a revolutionary approach to battery electric vehicle propulsion. By Freddie Holmes

The battery electric vehicle (BEV) has improved significantly over the last decade, with the operating range and driving performance of new models eclipsing that of early examples. Despite these advances, the BEV remains an ongoing experiment, and design approaches vary between manufacturers. Some opt for large batteries and electrified front and rear axles, while others have gone for smaller, lighter systems with a single 'e-axle'.

However, there is one common trend: power is still transferred through a series of systems and components before eventually reaching the wheels. Some within the industry believe this can be done more efficiently by placing the motor closer to where power is needed: directly in the wheel hubs.

Elaphe Propulsion Technologies is a Slovenia-based company that has been working on high-torque electric motors since the late 1980s. It believes that such motors can be integrated within individual wheels to great effect, and a recent funding round would indicate that investors think so too. In September, the company received €4.2m (US$4.7m) from EIT InnoEnergy, an organisation that invests in sustainable energy projects and is supported by the European Institute of Innovation and Technology.

Speaking to *Automotive World*, Elaphe's Chief Executive, Gorazd Lampic, explained how the cash injection will accelerate the company's deployment of in-wheel motor technology for next-generation BEVs, and how it is a 'sustainable energy unicorn' in the making.



Elaphe in-wheel motors in an SUV prototype vehicle

© Elaphe

Are in-wheel motors the next big thing in the electric vehicle space?

© Elaphe

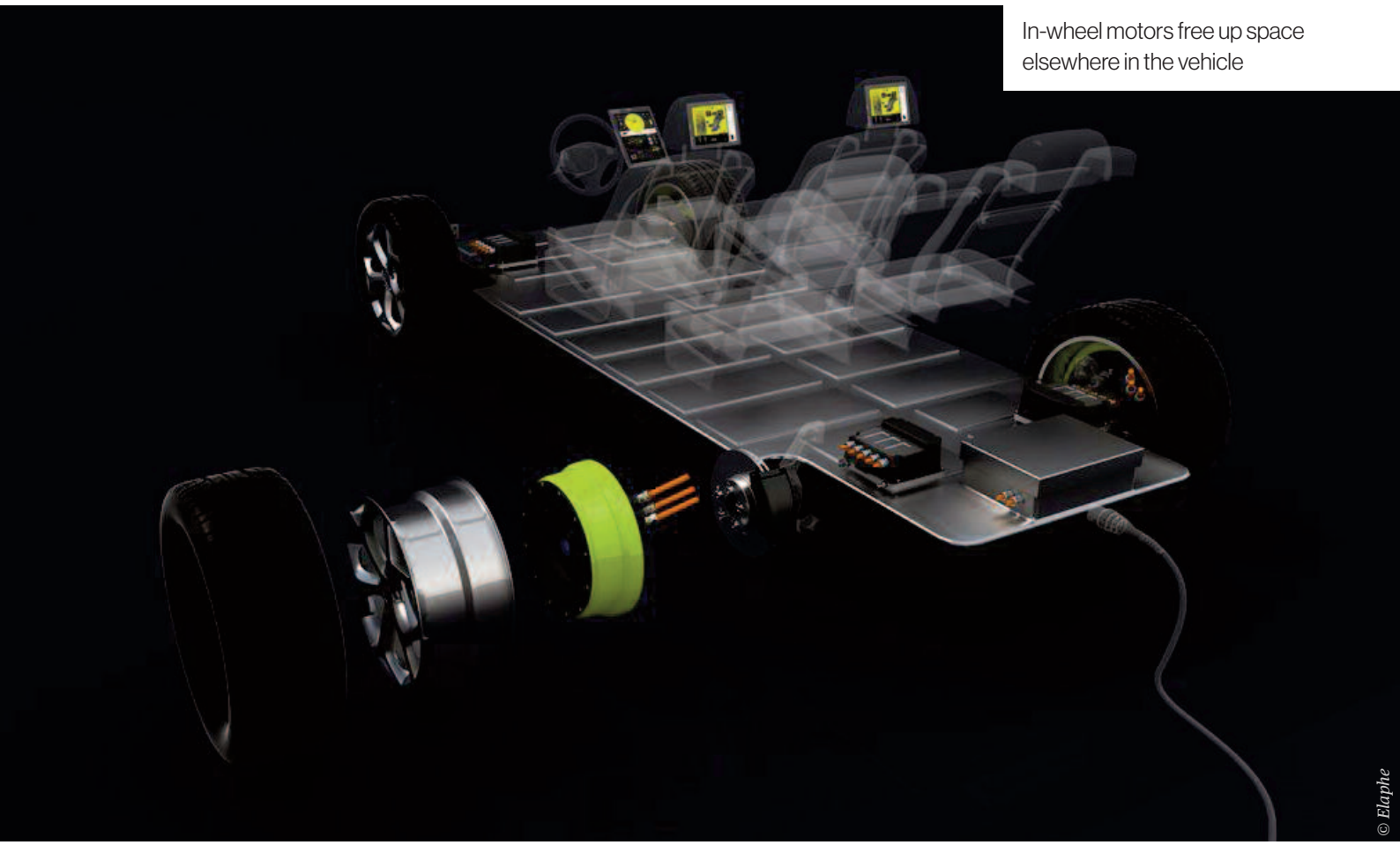
Where does Elaphe's total funding stand after the latest investment round?

All together it totals around US$17.5m if we do not count our own invested revenue over the past 15 years. We've invested probably more than US$25m so far to bring our technology to a point where we can commercialise and scale. I am personally very proud of what we have achieved with very moderate funding in an otherwise extremely capital-intensive undertaking. This helped to push us to work on the whole system, finding cost efficiencies where possible and providing us with core knowledge of everything from vehicle motion control software to full in-house powertrain design, manufacturing, and validation.

How does Elaphe stand to benefit from EIT InnoEnergy's support?

InnoEnergy is a vessel for both private and public money in Europe and strategically supports high-growth-potential companies that develop future technology. At a broad level, the investment shows the European Union's (EU) ambition to lead global sustainability efforts, and there are several favourable dimensions of being under the umbrella of InnoEnergy.

Firstly, the investment is a recognition from the traditionally conservative EU venture capital environment and shows that it is prepared to encompass innovative solutions. InnoEnergy is also widely known to support European sustainable energy unicorns in the making, and we take this investment as a firm milestone on our road to becoming one.



In-wheel motors free up space elsewhere in the vehicle

© Elaphe

Besides InnoEnergy's collective business and technical knowledge, an important benefit is access to its network of major market players across industries, and more specifically, the European automakers. InnoEnergy brings additional reinforcement to commercial discussions with automaker customers, which thus see Elaphe as a trustworthy supplier that is ready to grow stably and reliably, with a heightened ability to perform cutting-edge research while meeting the toughest industry standards.

In addition, Elaphe is now a member of a broader ecosystem involving developers and manufacturers of components, electric vehicles, and other solutions in the field of sustainable technologies. It gives us a strategic opportunity to increase cooperation among members of this ecosystem.

Are in-wheel motors a long-term replacement for traditional EV powertrain layouts, or are they just another solution that might suit certain applications?

The technology is scalable and highly customisable so it can cover quite a large share of the market. Today, it can power a pick-up truck, a light commercial vehicle or a supercar, for example. It will bring market advantages to those using it, and this positions the technology as the go-to long-term solution.

However, the world is not black and white and there will be applications where a different architecture can make more sense. We simply want to cover the segments where we can add real value. The architecture will be part of the next evolutionary step in the development of electric powertrains

and it is a transformative technology that challenges how vehicles are built and controlled.

Just as internal combustion engines (ICE) replaced steam engines, hybrids are replacing ICEs, and full EVs are replacing hybrids, we expect that distributed powertrains will replace the traditional powertrain with in-wheel being a large part of the mix. Central electric motors have already been replaced by e-axles and e-axles are already two-, three-, or four-traction motor solutions.

The trend of moving the motor closer to the wheel is already seen throughout the industry, illustrating the direction of automotive needs. The transition to in-wheel technology will happen segment by segment, provided that it demonstrates the necessary benefits it brings to a particular segment.

There will be certain segments where central motors will remain superior. High-speed front-wheel-drive vehicles, which have oversized friction brake dimensions—and perhaps very low-cost segments where benefits will not bring a substantial impact—will be the last among those implementing in-wheel technology. This may also be true for applications which are more sensitive to unsprung-mass.

Elaphe has said that 'the timing is right' for in-wheel powertrain technology. What has changed to make that the case?

In-wheel technology has matured significantly over the last decade. The technology was first introduced 120 years ago by Porsche, but had limited applications due to technology and power-supply limitations. As electric powertrain solutions developed during the 20th century, we have seen occasional examples of in-wheel motors in modern vehicles. We must not forget that in-wheel motors are already produced massively—tens of millions of units per year—in applications like two-wheelers.

> “Many visionaries have built vehicles around the idea of in-wheel motors over the last 30 years, but the technology—and the world—simply was not ready to deal with EVs until very recently

Many visionaries have built vehicles around the idea of in-wheel motors over the last 30 years, but the technology—and the world—simply was not ready to deal with EVs until very recently. Today, manufacturers are finally taking a wider, holistic view on vehicle design and application value, after decades of focus on component-level value. And with the shift to EVs being so transformative, manufacturers are being forced to redefine their unique selling points, their competitive advantages, and their user base.

By achieving challenging technical developments such as high specific torques and wheel power above 200kW, we have reached a point where the automotive industry can now adopt in-wheel motor technology.

Could you provide an update on Elaphe's manufacturing footprint and prospects for expansion?

We cannot share all details since they are confidential, but we have manufacturing facilities at our headquarters in the EU, a manufacturing joint venture in China and a licensing agreement in the US with a specific automaker. We always make sure to create partners and not competitors, as a transition to new technology demands a holistic approach.

It is important to note that our current manufacturing sites are used for the assembly of motors to cover the current volume needs of the market, but also for demonstrating the processes and production techniques needed for scale. In the EU we are manufacturing several types of Elaphe motor families as well as some custom solutions on agile lines, but in China, the line is developed for particular motor families. We will shortly be investing in growing capacities in multiple ways.

Is Elaphe considering an IPO in the future?

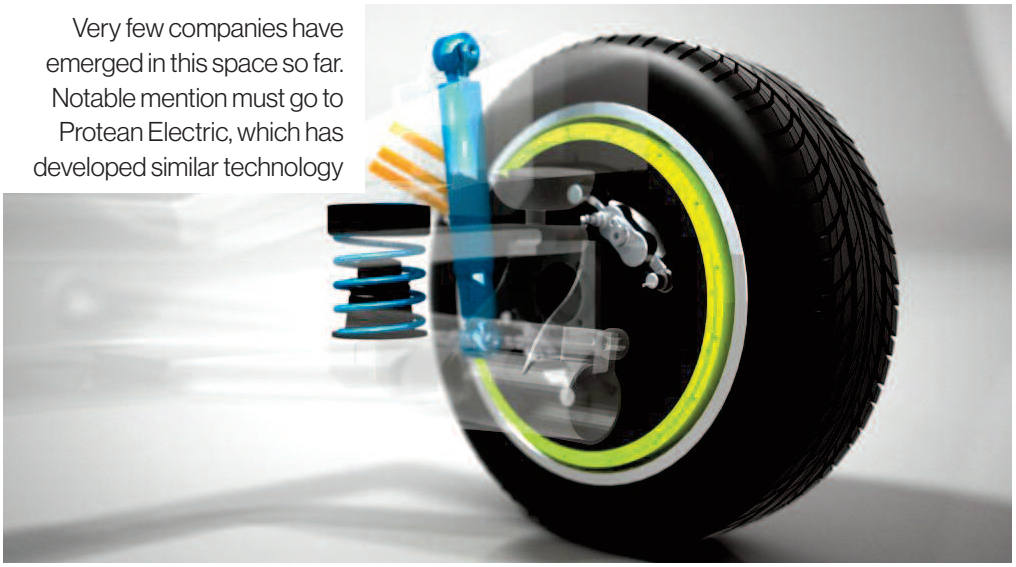
Yes, that is one of the main scenarios in our strategic plan, provided that it helps us in realising our vision. But there are a few other steps we need to take to get there. Luckily, we have the widest possible support from the industry and our strategic partners that will help to achieve that target.

> "We always make sure to create partners and not competitors, as a transition to new technology demands a holistic approach

Most Tier 1 suppliers in this space have made significant investments in electrified powertrains over the years, but few have directed investment toward in-wheel propulsion systems. Why is Elaphe in a race with seemingly few direct competitors?

Many are dealing with this technology, but their main business purpose is to follow their automaker customers' needs and timelines. There are several reasons why no one is all-in, which are both technical and business-oriented.

Very few companies have emerged in this space so far. Notable mention must go to Protean Electric, which has developed similar technology



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In-wheel motors can only be developed effectively through close collaboration of teams with multiple skill sets, including several disciplines in mechanical engineering–such as design, computer-aided engineering, quality and testing–as well as the various facets of electrical and software engineering. One of the main challenges that larger companies face is their strict structural system, as well as the availability of resources that can be dedicated to such projects. Conversely, small companies typically lack this expertise, while universities and research institutes lack motivation or perseverance.

At Elaphe, we are very fortunate that our founders and CTO have a background in physics, which means we have been able to cover most of these challenging fields to a level that was good enough to get close to a globally optimal solution. This has been further improved over the years with dedicated experts from numerous fields, who brought much deeper domain knowledge. This has meant we can support commercial and research projects and invest everything we make back into the game.

How would you describe the outlook for the in-wheel motor market, and Elaphe's position within it?

In general, we see the in-wheel market as a healthy ecosystem with the right number of players that can share the effort of educating vehicle developers on one side and motivating suppliers on the other. There are very few automotive-grade hub-motor companies in the world, and that is partly due to the years of hands-on experience needed to create technology that is automotive-grade, cost-effective, and able to be manufactured in high volumes. It will take a significant leap in new materials or other technologies to overcome the advancements and know-how that we have gathered over the years, and particularly in the past decade.

We have had positive feedback from automakers that recognise the value of working with Elaphe on in-wheel projects, because we help accelerate the development time whilst simultaneously reducing their cost and risk. We want to make a mark on the world, so we can help accelerate towards more reasonable use of the planet's resources.

Behind the hype, fuel cell trucks remain a viable technology, say experts

Nikola's fall from grace prompts questions of fuel cell trucking's viability. Continued big name developments should ease concerns. By Xavier Boucherat

© Nikola

Even when limited to the scope of automotive industry, 2020 has been a banner year for dramatic headlines: the uncertainty, disruption and human cost of the COVID-19 pandemic, for example, has cost manufacturers dearly. In this sense, it is all the more impressive that Hindenburg Research—a 'financial research' firm which works to "shed light" on "man-made disasters floating around in the market"—caused the stink it did. Its research on Nikola Motors, and the would-be truckmaker's supposed shortcomings, found plentiful coverage on mainstream media, none of which would have pleased the since departed Chief Executive Trevor Milton.

The intense scrutiny that Nikola has come under highlights the interest and excitement that once surrounded the company, an apparent frontrunner in hydrogen-fuelled heavy-duty trucking. Hindenburg—which held a short position on Nikola at the time of the report's publication, and undoubtedly profited on the collapse of its share price—did not hold back in its criticism. The report questioned everything from Milton's claims that its Phoenix HQ was solar-powered, to the suitability of its Head of Infrastructure Development, Dale Prows: according to LinkedIn, before his move to Nikola, Mr Prows was the Chief Executive and General Manager of a golf club and spa.

Nikola's ex-Chief Executive Trevor Milton had a loud and sometimes abrasive Twitter presence. Following his departure, the dust appears to be settling for the company

The hype train

The report's harshest criticisms were reserved for Nikola's technology. A video released by the company in 2018 appeared to show a Nikola One driving itself along a desert road. Hindenburg asserted that the truck was a pusher–meaning it did not have a functioning powertrain–and that it had been towed to the top of a long, low grade hill and allowed to roll. In a response, Nikola essentially confirmed this, saying it "never stated its truck was driving under its own propulsion" in a statement. The Hindenburg report followed a June 2020 article from *Bloomberg*, which appeared to show the Nikola One unveiled in 2016 was not complete. This was despite Milton's repeated claims that the vehicle was fully functional.

Other damaging material on Nikola's technology included comments from Powercell AB, a fuel cell stack supplier originally slated to work with the company before pulling out of the deal in 2019 due to "totally unacceptable" business terms. According to a Powercell spokesperson, Nikola responded to Powercell's withdrawal with plans to build its own fuel cells: "It was a lot of hot air coming from them," said the spokesperson. There have been no announcements from Nikola on any sort of proprietary fuel cell system since.

Nikola World 2019 appeared to prove the truckmaker did have functioning models, with a hydrogen-powered Nikola Two propelling itself in front of an audience. Now helmed by former GM man Mark Russell, the company says it plans to begin testing of production-engineered prototypes of fuel cell trucks by the end of 2021, and beta prototypes in 2022. In a press release, the company said it is currently evaluating additional strategic partners and supply chain arrangements. Partnerships with Bosch and CNH Industrial appear to remain intact. Nikola maintains that many of Hindenburg's accusations are false, and driven by profit given its short position in the company's stock.

Speaking previously to *Automotive World*, Sam Abuelsamid, Principal Analyst, E-mobility at Guidehouse Insights, suggested that Nikola is guilty of nothing not seen elsewhere in the industry. "The original Nikola video was smoke and mirrors in much the same way that all concept vehicles are," he said. "I am reasonably confident that before Bosch, Iveco and others signed on to work with Nikola, they would have all taken a much closer look at what the company was doing. By the time they went public this year, they were much further along in the process." The company's video, he argued, is no more fraudulent than Tesla's decision to acquire SolarCity in 2016, despite allegedly knowing the company was insolvent.

Big player interest proves there's gold in hydrogen

However, it is clear that in the past, Nikola has been guilty of some deception. Combine this with the continued wait for model launches and the failure of its 'game-changing battery cell' to materialise, and it prompts questions of confidence not just in Nikola's future, but also the very idea of fuel cell trucking. Prior to revelations, Nikola was a standard bearer for the technology, promising world-beating performance that could threaten the internal combustion engine, and securing a high profile pre-order with Anheuser Busch. It is understandable that following the Hindenburg report, industry watchers will be questioning the viability of the fuel cell trucking agenda.

> "Ricardo can say that this technology works. Of course it is bad that there is now a debate around whether it works or not, but this is simply down to bad press

> Daimler is a well-established company, and it would not make announcements around fuel cell truck demonstrators lightly. Toyota too has developments in the public domain, some of which go back a number of years

Cedric Rouaud is Global Technical Expert in Thermal Systems and Project Director, R&D Fuel Cell Lead, Technology and Digital at Ricardo. "From what we have seen and what we have developed here at Ricardo, we can say that this technology works," he says, drawing attention to Ricardo's work in the Toyota Portal Project, which has put fuel cell trucks to work in the Port of Los Angeles: "Of course it is bad that there is now a debate around whether it works or not, but this is simply down to bad press."

Those seeking reassurance, he suggests, should look to developments among the big players. Just this month, Daimler Trucks and Volvo Group unveiled more details on their heavy-duty fuel cell truck joint venture. The world's largest truckmakers hope to begin customer tests in three years, and launch series production in the second half of the decade. In addition, Daimler and Rolls-Royce have signed an agreement to cooperate on stationary fuel cell generators.

Another recent announcement came from Toyota: the company will put hydrogen-fuelled trucks on the road for verification by 2022. A reported range of 372 miles is much lower than the Nikola One's top-end range of 750 miles, but unlike the latter, Toyota has actually put fuel cell electric vehicles on the road in the passenger car market.

"Daimler is a well-established company, and it would not make announcements around fuel cell truck demonstrators lightly," says Rouaud. "Toyota too has developments in the public domain, some of which go back a number of years. It is true that several challenges remain and these will take time. The industry must strive to enter a virtuous circle."

Jean-Dominique Bonnet, Principal Consultant, Commercial Vehicles, Frost & Sullivan, points out that Nikola has been a shot in the arm for the fuel cell vehicle segment, particularly in North America. "The company has already made an impact on the future of trucking as it has awakened an interest for hydrogen trucks in the US," he says. He adds it is possible the company can be misunderstood: "Nikola does not have any real technology by themselves. Their concept is the integration of a hydrogen truck and its supply of hydrogen, in a one-year lease. In addition, they promise that hydrogen will be priced competitively versus diesel."

However, he considers it unlikely that fuel cell trucks will be able to compete on an economic basis until 2030, when cheaper hydrogen can finally be expected. This gives bigger truckmakers the advantage. "At this point, a long-established OEM may be able to introduce small amounts of fuel cell and battery electric vehicles into its mix, alongside lots of diesel models," he says. "An OEM offering fuel cells only will struggle, even if they add battery electric like Nikola is planning. It is my opinion that Nikola has absolutely no edge over Volvo, Daimler, Hino or Hyundai." Fuel cells, he concludes, are not likely to play a significant role in trucking for many years, but their development will continue apace, driven in part by political forces including big oil interests, with companies such as Shell already invested in infrastructure.

Meanwhile, Nikola continues. At the time of writing, talks between the company and GM continue, in a deal which would see the Detroit incumbent develop and manufacture the Badger electric pickup. Milton's departure—and that of his loud Twitter presence—means the dust appears to be settling. For any chance of survival, the company will need to convince investors its offerings are real, and make explicit what is possible, and what is fantasy, particularly with regards to its hydrogen network. A spokesperson for Nikola Trucks declined to answer questions from *Automotive World*, instead directing the publication to the company's Q3 earnings call, scheduled to take place after this article's publication.

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COMMENT:

Will brand Tesla ever run out of charge?

Alyssa Altman considers the long-term prospects of brand domination within the electric vehicle segment

Ranked as one of the best brands in the world, Tela sits comfortably alongside the tech giants Amazon, Netflix, Apple, Microsoft, etc and is undoubtably having its moment in the spotlight. Lofty global net-zero emissions goals and a growing consideration of sustainability and electric vehicles (EVs), spurred further by the pandemic, means Tesla has never been more powerful or relevant.

With a recent valuation of US$300bn+, making it the most valuable automaker in the world, it's hard to imagine that this titan is still a mere teenager. Once just a small sportscar manufacturer with big dreams, it's Elon Musk, the rebellious yet charismatic Chief Executive, who supercharged it to the global electric car and clean energy powerhouse that it is today. A company where a single tweet can affect the stock

market; a marketing machine so mighty that the Tesla brand is quite literally transforming the car industry before our very eyes, shifting EV perception from ugly and undesirable to attractive and aspirational. Tesla is no longer the scrappy little challenger in the auto space. It's not even a competitor; it's a pioneer. A true leader. But with traditional carmakers hot on its tails with EV investment and offerings, the heat is on for Tesla, and whether it can maintain its market-leading position is yet to be determined.

> "With a recent valuation of US$300bn+, making it the most valuable automaker in the world, it's hard to imagine that this titan is still a mere teenager

Tesla's recent Q3 results were unsurprising for a company that likes to "wow" at every opportunity. It recorded a profit for the fifth quarter in a row–not bad for an auto company in the midst of a global pandemic. Additions which were announced during the earnings call–Smart Summon and 'autonomous mode relaunch'–consistently show its fans and investors that it is committed to continually improving its products and offerings. The company also reported a record-breaking quarter for vehicle deliveries, making it on track to be up 30% to 40% from last year–only a slight adjustment to the previously promised (pre-pandemic) 500,000+.

So, if Covid can't squash Tesla's spirit, what can?

To date, Tesla's product success is down to its focus on premium EVs, a once empty gap in the market that is now closing at speed. Car companies including GM, BMW, Jaguar Land Rover, Mercedes-Benz and Volvo are all entering the luxury EV and hybrid market. And with multiple new models due to drop over the next 12 months as manufacturers work hard to meet robust emissions roles, 2021 could be an interesting year for Tesla. The premium EV market looks set to go from one dominant player to a multitude of choice, testament to what is an extremely fast-growing market. In coming months, we'll see Tesla do battle with Porsche, Audi and Mercedes, and this is without even considering the likes of GM, Ford, Honda and Toyota who will be continuing to drive forward their own EV strategies at a more competitive price point.

However, Musk likely relishes the competition. For it means his brand's mission to "accelerate the world's transition to sustainable energy" is being realised. Sales of EVs have accelerated to a record high this year. And for years, automakers have kept a close eye on Tesla as it absorbed all the risk in this new and unknown segment. But with all the risk comes all of the reward. Tesla has not only created a viable market for EVs, it's owned it.

As the EV market expands, Tesla knows better than to restrict itself to the premium sector. Its latest price drop is less about a lull in demand (figures show that not to be true) but more about attracting an ever-wider range of brand fans who can spread the word about the innovation in Tesla products, pushing up those all-important delivery numbers. Tesla is also not focusing purely on EVs. Amplifying its Autopilot semi-autonomous tech, Tesla moves further into the self-driving car space–the "next big thing" in automotive.

So, whilst competitors may dig deep and splurge on evocative advertising campaigns, one thing they don't have is Musk at the helm and the sheer brand power that brings. Tesla knows how to keep the world talking. By adding more recruits to the "Tesla Army" with each sale, tweet and outlandish PR stunt, it subsequently instills a sense of optimism in investors that will continue to drive the brand forward on its evolutionary journey to innovate, diversify, and change the auto and energy sectors for the better. You have to admire Musk's starry-eyed vision. And who doesn't love a hero/antihero on a quest to save the world?

However, Tesla's lofty valuation isn't based solely on figures. It's a prediction that Tesla, with an abundance of innovation and determination, will be able to expand its monopoly on the EV market as interest and demand for clean energy continues to grow. Not only that, but Tesla has shown strides to diversify with a current portfolio that boasts not only EVs, but also battery energy storage and solar products.

It's Musk's Silicon Valley roots, maverick-like vision and his problem-solving entrepreneurship that make the Tesla brand that it is. Shunning traditional advertising spend, he curates highly speculated product unveilings that rival the likes of Apple and dominate the Twittersphere.


© Tesla

Whilst nobody has quite the brand power that Tesla has, it can't be denied that competition is catching-up. But can it actually catch up? As other car manufacturers drive forward their own EV strategies, Tesla's ambitious plans—Cybertruck, its own battery production, new European factories—will need to not only become more ambitious but be realised, and in record time. However, in the heady space of innovation Tesla must not forget its core. Using the full force of its brand, it must double down on performance, design, and affordability of EVs to make them accessible to the masses and unrivalled in terms of experience.

Transparency and approachability coupled with the charming swagger of a celebrity CEO will keep Tesla investors and fans interested. The brand will continue to tease and titillate from reveal to release, building excitement, momentum and making us feel as if we're part of Tesla's journey to change the world, regardless of whether we actually own a Tesla. And that's why, regardless of the competition, Tesla will continue to play a pivotal role in driving EVs forward, whilst improving the quality, reliability and accessibility of the vehicles it produces.

> "Tesla has not only created a viable market for EVs, it's owned it

Today, Tesla finds itself one mile ahead of the rest, thanks to its incomparable brand presence, and its resilience and ingenuity in the face of adversity. Long-term, who owns the EV market will all come down to product and price and the ability to play a key role in architecting and implementing EV infrastructure, but for now Tesla rules the road.

The opinions expressed here are those of the author and do not necessarily reflect the positions of Automotive World Ltd.
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The Automotive World Comment column is open to automotive industry decision makers and influencers. If you would like to contribute a Comment article, please contact editorial@automotiveworld.com

From CASE to COVID: VW Group CEO shares headwind strategy

How does the world's largest automaker tackle the industry's biggest challenges? By Megan Lampinen

Herbert Diess has been steering the world's largest automaker through a period of unprecedented challenges. The pressure to adapt to a connected, autonomous, shared and electric (CASE) future was hard enough, and then COVID-19 hit. Add in some political and trade uncertainty in a couple major markets and you end up with pretty strong headwinds. But the Volkswagen Group Chief Executive didn't get where he is today by shying away from a challenge. Speaking in an exclusive virtual event hosted by *Bloomberg*, Diess shares his views on some of the most pressing concerns of the moment and his strategic approach to navigating what could prove the biggest transition in automotive history.

Trade

The US is a key focus area for Volkswagen Group. At the moment this is its weakest region in terms of market share but VW has been working hard to address that through local production investments and more recently through a partnership with Ford. Over the past four years US President Donald Trump has put considerable pressure on manufacturers to build locally, but what happens if there's a change in trade policy under a new administration? The 2020 election results remain unclear at the time of writing, but Democratic candidate Joe Biden stands a good chance of winning.

"Under a Biden administration, trade friction will be reduced, but some policies including a more aggressive stand against China are not likely to change much," forecasts Cox Automotive's Chief Economist Jonathan Smoke. As for VW in particular, Diess is following developments closely but believes that trade talks would carry on with key regions in the usual way. "You will always have trade balances, which are a concern for some nations," he explains. "We are used to that. It's important they are solved in a way that's not disruptive, which we might face with Brexit in the next couple of months."

The UK is another hot spot for potential trade disruption as the transition period for Brexit ends this year. While new rules take effect on 1 January 2021, no new trade deal has been agreed as of yet and concerns are growing. The EU is the biggest export market for manufacturers in the UK, a group that includes VW Group's Bentley brand as well as numerous others. "It's a scary scenario," concedes Diess. "The two regions are very much intertwined when it comes to car manufacturing, and accounting for day-to-day tariffs will be very disruptive. Having the borders blocked is not helpful for either side."

Pandemic

This year also brought a very unexpected headwind in the form of COVID-19, which halted production and closed dealerships across much of the world. Volkswagen, like many others, quickly applied the lessons learned from China when it came to safely managing personnel. On the whole, Diess is proud of the company's response. "We are learning to live with it but it's tough for us," he says. The threat of a second wave now looms in Europe. While VW is better prepared than before with set policies

The pandemic forced VW to temporarily halt production and later restart it in a safe manner

in place and worker testing available, Diess admits everyone remains "tense and concerned."

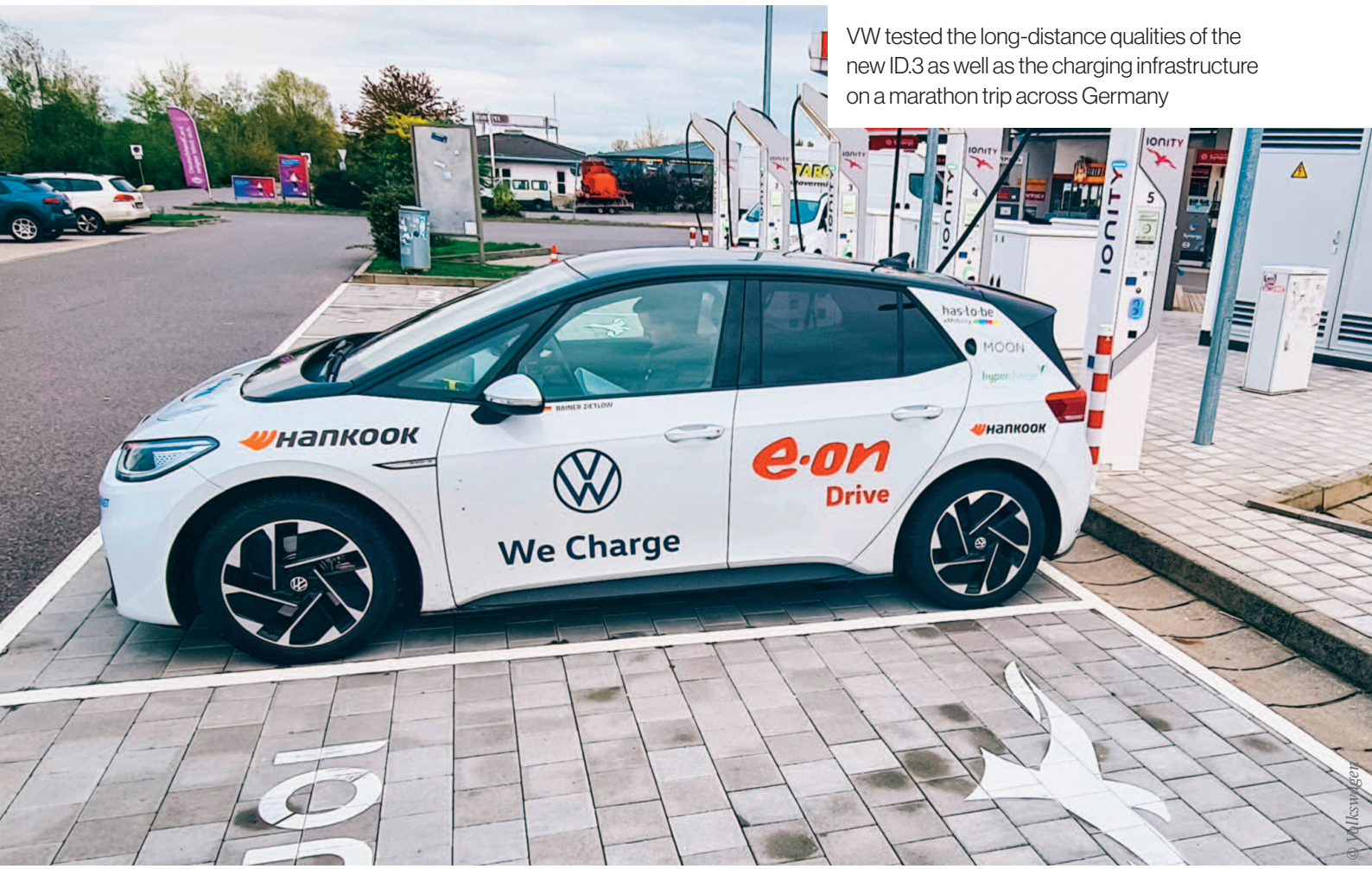
On the plus side, vehicle sales levels could be worse. VW's volumes last quarter were almost on level with last year. The company has a healthy order book and new products in the pipeline. "We are relatively confident that we can keep production high for the next few weeks," he notes. "If we don't face a real shutdown of our dealers and disruption to the supply chains, if people remain disciplined and virus cases are driven down, then I am optimistic we can manage the crisis and get through it."

Transformative trends

Against this backdrop of trade tensions and a pandemic, the group is pushing ahead with its transformation towards electrification and automated driving. "If you look to the future, the car has to become electric and it has to become an internet device," he says.

Electrification is rapidly gaining pace and VW expects to double its electric vehicle (EV) sales in Europe next year. It is hopeful for a similar performance in China, which Diess sees as the ideal location for EVs given the shorter driving distances and lower average speeds. "We are the best prepared company for the EV age," he asserts. That's a bold claim at a time when most global players are investing in electrification, but VW is nothing if not ambitious on this front. It plans to invest €33bn (US$39bn) on its electrification push and has been building up battery capacity through investments in start-ups. "Battery capacity is the major constraint in the electrification of our drivetrains," he says. "If the Green Deal comes through in Europe, we will have to build up even more capacity than we already decided." That entails adding another Gigafactory, he confirmed.

At the same time, the company is scrambling to bolster its software expertise. "The car is becoming more of a software device; this is the biggest transition that the auto sector will face," Diess cautions. Vehicles suddenly need to process huge amounts of data related to road conditions, the habits of the driver, safety technology, etc. This will only increase as automated features take over more and more of the driving responsibility–a development that Diess anticipates in the next five to ten years. And that means decision time.



VW tested the long-distance qualities of the new ID.3 as well as the charging infrastructure on a marathon trip across Germany

© Volkswagen

"Autonomous driving is not too far away and this will be a much more dramatic change for our industry," he predicts. "There's a decision we have to take. Are we to become providers of a shell, a body style, that is then equipped by a computer from a third party, or are we able to convert this [ourselves]? Are we prepared to run hundreds of millions of cars at the same time, talking directly to drivers in the cars?"

VW is going for the latter option, which Diess admits represents "a huge step change." Like EVs, it requires the acquisition of new competencies, which he says the company has steadily been building up. Over the past few months VW has acquired several software companies, including most recently the front camera software business area of software specialist HELLA Aglaia Mobile Vision GmbH. In the long run, the Group plans to develop its own operating system: "We need our own operational system to be able to manage the car, keep it safe and connect it to the cloud. We want to have the ownership of this process, as this will be the brain of the car."

Under the long-term vision, VW will license this technology to other parties as an additional revenue stream—quite a jump from its historical manufacturing expertise. "We think we can do it," Diess insists. "We have software skills and are ramping up fast. This is the most important race and decisive point for our industry in the next five to ten years."

Do tech tie-ups mean truckmakers risk becoming white goods manufacturers?

Smart gambit or a risky concession? The recent Waymo Daimler tie-up poses interesting questions around identity for truckmakers moving forward.
By Xavier Boucherat

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DAIMLER
Daimler Trucks

WAYMO

Daimler's recent announcement that it will partner with Waymo on an SAE Level 4 truck strongly hints at what some had suspected: the Alphabet-owned subsidiary leads the way on self-driving technology development, and automakers attempting to go it alone are at risk of being left behind. The announcement came despite Daimler Trucks having previously announced it would develop its own system, following the 2019 acquisition of Torc Robotics.

It is not the only truckmaker to forge a partnership with the tech sector. Waymo itself has worked with Paccar-owned Peterbilt, whilst Traton Group announced in September 2020 that it would partner with TuSimple to develop Level 4 Scania models. Meanwhile, in 2019, Volvo Trucks announced it would develop an advanced artificial intelligence (AI) platform for autonomous trucks with Nvidia.

It raises a question commonly asked of the passenger car segment, particularly in the context of FCA's close relationship with Waymo: if autonomy and connectivity define the value of tomorrow's trucks, will truckmakers take on a role more akin to contract manufacturing? And is this an intrinsically good or bad thing?

The big brands are going nowhere

Axel Schmidt, Senior Managing Director, Sector Lead Automotive at Accenture, does not see things this way. "I can't see how traditional truck makers are becoming 'white goods manufacturers'," he told *Automotive World*. "Their core skills are manufacturing and engineering,

and these abilities have been built over more than 120 years. That is hard to match."

In that sense, the big tech players remain solidly reliant on the traditional manufacturer's much-honed prowess. The limited success of new manufacturers, many of which are yet to put vehicles on the road, speaks to the enduring power of the incumbents. In addition, the power of truckmaker brands remains considerable: having built close relationships with customers throughout the years, the big names inspire confidence, and are entirely unlikely to be replaced anytime soon.

Without truckmaker expertise, Schmidt stressed, there will be no self-driving. "We've seen this plenty of times, when software-driven companies try to enter a certain market," he said. "At some stage, they recognise that software capabilities are far from sufficient for success, and so it's no surprise when they team up with established truckmakers

"We've seen this plenty of times, when software-driven companies try to enter a certain market. At some stage, they recognise that software capabilities are far from sufficient for success, and so it's no surprise when they team up with established truckmakers

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truckmakers. That way, they hold the two key levers to be successful in autonomous driving." With the legislative framework for autonomous trucking already established in markets such as Germany, he adds, a route to reaping the benefits of autonomy has become increasingly pressing.

Sam Abuelsamid, Principle Analyst, Guidehouse Insights, suggests that the nature of the commercial vehicle industry, which caters to a huge range of applications, means that major truckmakers already inhabit something of a contract manufacturing role. "To a degree, truckmakers are already white goods manufacturers," he suggests. "Most offer a range of customisation options for their customers which, in some cases, will feature engines from different suppliers."

Abuelsamid agrees that engineering knowhow remains firmly with the likes of Daimler, adding that a continued role for truckmakers is further enshrined by a well-established product support and service network. Moving forward, he said, the industry should not necessarily resist change: "To some extent, truckmakers are becoming Tier 1 suppliers to AV companies, but this is not necessarily a bad thing. After all, Levi Strauss got rich selling jeans to prospectors in the California gold rush. Those that sell picks and shovels have usually done better than those working at the mines."

Pedro Pacheco, Senior Director Research at Gartner, agreed: "At one point, Henry Ford believed it was crucial for an automaker to produce its own steel. There is not one OEM that does that today. Similarly, there are

many other aspects that are essential in creating the best truck. Autonomous driving is just one of them."

Truckmakers, which have developed expertise in systems integration, must therefore stay focused on delivering the best total package to customers in order to succeed. Trucking customers will still expect the kinds of efficiency and robustness that only expert manufacturing can deliver.

What's more, autonomy is not the only megatrend of import. Indeed, electrification and the deployment of low- to zero-emission commercial vehicles is likely to come into play far sooner than high-level autonomous applications. Furthermore, responsibility for ensuring all these megatrends work in tandem rests with the truckmaker. Jean-Dominique Bonnet, Principal Consultant, Commercial Vehicles at Frost & Sullivan, believes electrification hints at what might follow in years to come.

"I don't think it's a case of Daimler simply buying something from Waymo," he said. "If we consider electrification: in the beginning, electric engines were very simple. But now if we consider the major automakers, these things are incredibly complicated. Electric motors have gone from a commodity to something proprietary."

Automakers have adapted and optimised systems around vehicles, he explained, and whilst it might be that truckmakers won't radically altar autonomous driving stacks in the same way electric powertrains have been adopted, truck-specific expertise will still be required for successful integration. In short, truckmakers and their century of expertise are going to matter for a long time to come.

COMMENT:

How to pivot autonomous drive strategies in the post-pandemic period

Automotive players face an urgent need to turn autonomous drive initiatives into profit makers, writes Pedro Pacheco

The disruption of COVID-19 has had a major impact on many automotive companies. Autonomous drive projects have been particularly hard hit and heavy budget cuts are set to delay Level 4 timelines even further. The common approach is to prioritise initiatives with a shorter payback period, such as electric vehicle (EV) technology and connected services, as well as to assess how COVID-19 has potentially slowed other plans and commercial deployments.

Now nearly seven months since the World Health Organisation declared a world pandemic, some Chief Information Officers have had to assess their digital strategy. For those in the automotive sector this means prioritising plans to allow the company to pivot its autonomous vehicle strategy to one built for the post-pandemic period.

Level up for shorter payback

The UN has defined legislation on Level 3 autonomous drive to be adopted by 60 countries–a milestone for autonomous driving with regions such as the EU and Japan enforcing this legislation in 2021 and a clear and immediate commercial opportunity for automakers. Companies should utilise technologies already developed for Level 4 such as high-

definition maps, artificial intelligence and sensors in use cases with a quicker return. This could include deploying 'sellable' Level 3 systems into a broad number of countries, starting with passenger cars.

Substantial returns could also be found from deploying other commercial use cases in Level 2.5 or Level 3. Technologies such as automatic parking, vehicle summoning from car parks or EV energy-optimised driving as well as adapting appropriate use cases to heavy-duty vehicles could provide large returns.

> Partnerships can be beneficial but equally hindering if they are not complementary to your business or well executed

Data-first strategy

One of the main benefits of advanced Level 2 and Level 3 technology is data collection. We know that the main obstacle to widespread and safe Level 4 autonomous driving in a broad range of geographies is the lack of data which, when processed, is needed to train the autonomous vehicle's perception algorithms.

With vehicles on the road featuring Level 2 and 3 technology, automotive companies will be able to gather data and produce a digital twin model of a region for essentially no cost bar possible cellular fees. This means companies can progress towards Level 4 faster and cheaper than other strategies which may involve buying such data or collecting it via a dedicated fleet of vehicles.

Diversify your use cases

Most of the pivoting actions Chief Information Officers in the automotive sector will need to make will involve turning autonomous drive initiatives into profit makers to sustain growth for the long-term. Another way of doing this is to adapt the same self-driving systems to suit other use cases. With minimal work and training of the algorithm's neural networks, solutions can be marketed either directly to end users or to the manufacturers of robots, drones, ships and many other different products.

Find strong technology partnerships

Autonomous drive projects require a lot of heavy lifting in many cases. Finding a partner that excels in the technical areas where your company may have shortcomings can accelerate time to market. It can also significantly reduce cost at a time where savings must be made. In turn, a quicker go-to-market and adoption will also help achieving a quicker ROI. However, careful considerations must be made– partnerships can be beneficial but equally hindering if they are not complementary to your business or well executed.

The opinions expressed here are those of the author and do not necessarily reflect the positions of Automotive World Ltd.
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The Automotive World Comment column is open to automotive industry decision makers and influencers. If you would like to contribute a Comment article, please contact editorial@automotiveworld.com

Risky business: the hidden costs of EV battery raw materials

The electric vehicle supply chain must address underlying issues that relate to the sourcing and processing of crucial raw materials. By Nathan Picarsic

Over the next 20 years it is projected that there will be somewhere between 300 and 500 million electric vehicles (EVs) on the road. That total would constitute a staggering leap from the roughly five million new models sold in 2018. For passenger car powertrains, the long-promised future of clean transportation is now.

However, close scrutiny of the EV power unit supply chain, and particularly the raw materials used to build EV batteries, reveals unappreciated costs. These are costs that suggest this future might be neither as clean nor as reliable as has been suggested, and that it might even come with unprecedented human rights infringements. Issues also manifest in supply chain security risks—a layer of concern that is not being discussed, let alone addressed, in the EV context.

The hidden risks with these power sources begin at their upstream origins. The hundreds of millions of new EVs to hit public roads will be powered by batteries, which rely, at least in the immediate future, on lithium-ion variants. Lithium-ion batteries operate by virtue of an anode made of graphite and a cathode made of varying combinations of cobalt, nickel, manganese, and several other alternatives. Nickel-manganese-cobalt batteries dominate the market at present; Tesla uses a lithium-nickel-cobalt-aluminium chemistry and is working on a set of cobalt-free or -reduced batteries drawing on lithium-iron phosphate technology and chemistries that rely more heavily on nickel.

Where do these minerals come from? Lithium is concentrated in Argentina, Bolivia, and Chile. The Democratic

With ICE bans in force, demand for EVs will soar. What does this mean for the supply chain?

Republic of the Congo (DRC) is the world's dominant source of cobalt. Mineral extraction in these locales is rife with environmental degradation and human rights abuses. DRC cobalt extraction and processing paints a stark picture: by some estimates there are more than 40,000 children put to work in the DRC's artisanal cobalt mines with little concern for occupational safety, let alone the illegality of child labour. In Chile, lithium mining, a water-intensive business, has crowded out the agricultural sector and contributed to increased soil contamination.

But environmental and human rights concerns are just the first order of risks in the underlying EV battery recipe. The necessary raw materials are disproportionately concentrated in a small set of markets, most of them emerging. And the extraction and processing of these minerals is overwhelmingly controlled by one single actor: China. Thanks to industrial policy, Chinese companies dominate, at home and abroad, the

Demand for cobalt has led to illegal mining practices

harvesting and processing of the critical raw materials necessary for EV production. They do so propped up by state subsidies, responding to Beijing's ambitions to control the EV supply chain and wider industry. Concentrated supply and concentrated upstream consumption introduce significant EV supply chain security risks.

The DRC's role in the cobalt supply chain neatly demonstrates the threat. It is the largest global producer of cobalt, accounting for approximately 60% of world totals. DRC cobalt resources are disproportionately invested in and mined by Chinese firms backed by the Chinese Communist Party (CCP). In 2018, China accounted for more than 85% of the DRC's cobalt ore and concentrate exports, by value. Chinese companies own or invest in entities that own at least 12 of the DRC's mines with cobalt reserves. All but one of those Chinese companies is state-owned. Chinese companies also invest in the processing of the DRC's cobalt and in integrated supply chains around it.

Some are controlled by a single company; state-owned China Nonferrous Metal Mining Group Co. has established a broad network of leach plants and smelters, as well as a mineral research and development centre, in the DRC. Other supply chains leverage strategic alliances and offtake agreements among different Chinese players: Chinese-domiciled Jinchuan Group sells the cobalt hydroxide produced at its Ruashi mine in the DRC to its own operations and its affiliates: the oxide ore produced at its Musonoi copper-cobalt mine goes to a smelter built and operated by Chinese-domiciled Chengtun Mining.

Such vertical integration does not stop at the raw materials. China's battery makers enjoy preferential treatment in the growing Chinese domestic automotive market. They are increasingly the preferred vendor for US, Japanese, and European automakers as well. For example, China's Contemporary Amperex Technology Co. (CATL) supplies BMW, Volkswagen, Toyota, and Honda.

China also uses investments and strategic partnerships to extend its integration to foreign players. Chinese state and corporate actors have established control over, influence on, and access to many of the most promising EV start-ups. Lucid Motors, for example, counts Chinese state-owned Beijing Automotive Group (BAIC) and the state-backed funds of

Production of the electric Polestar 2 began in China in March

Tsing Capital among its earliest financial backers. Rimac, one of Porsche's bets in the EV space, has also received investment from China's Camel Group.

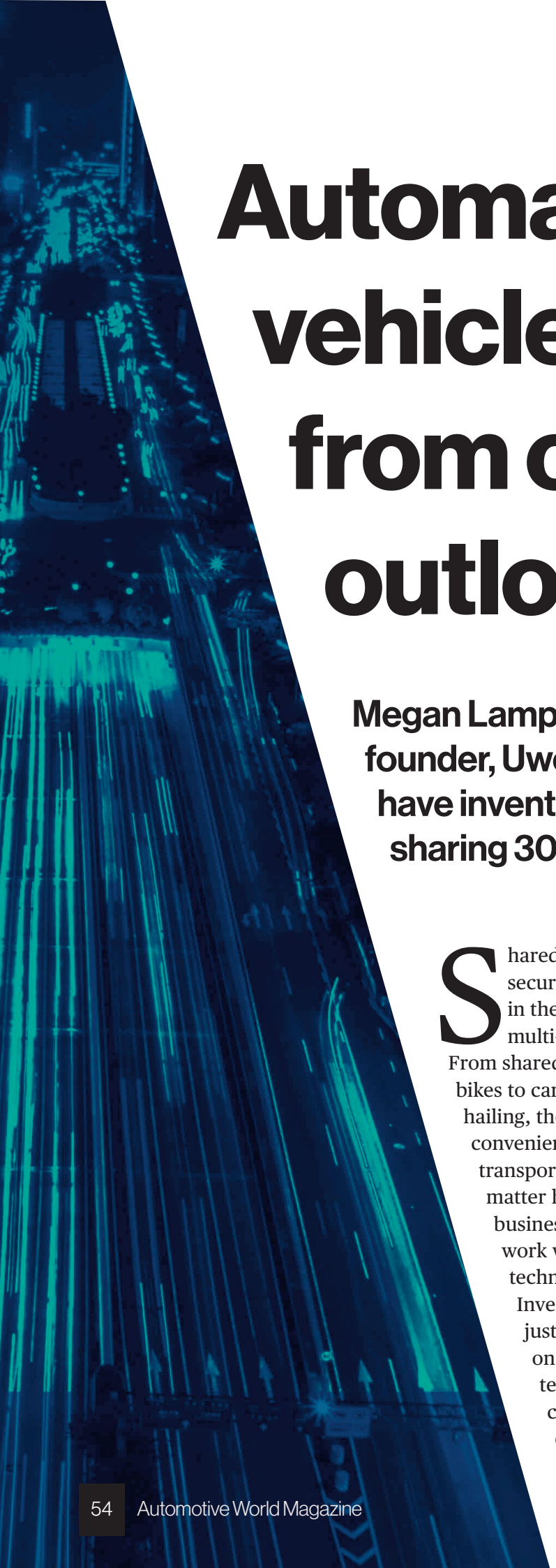
Why does this concentrated supply control and influence matter? First, it introduces a single point of failure at which supply chain disruptions could be magnified and generate ripple effects with little forewarning. The COVID-19 era has demonstrated the risks of unilateral dependence and a lack of resiliency in globalised supply chains. And China has been known to use supply chain dominance for coercive ends. And in a global game, concentration affords a single actor—in this case China—informational advantages that may support non-market and anti-competitive behaviours. For example, could Ford expect to negotiate in good faith, in competition with Nio, for access to critical raw materials controlled by Chinese concerns that enjoy the same CCP state-backing as Nio?

Indeed, corresponding environmental and human rights concerns have motivated broad efforts to reduce the role of tainted materials in EV batteries. Technological advances may shift the materials landscape. For example, silicon inputs could replace graphite as the anode source on lithium-ion batteries. Cathode innovation, such as Tesla's efforts to reduce cobalt in its batteries, offers another path toward improved environmental marks.

But those shifts are unlikely to change China's control. Beijing also dominates related industrial sectors, like polysilicon, the upstream input used in the solar panel supply chain. It therefore may be premature to expect technological breakthroughs to solve supply chain risks. Moreover, China's omnipresence in the technological landscape may allow it the influence necessary to preserve control: CATL, China's largest EV battery maker, is a key technology partner in Tesla's latest plans, including specifically in the lithium-ion phosphate approach.

The internal combustion engine and its gasoline burning profile may be on the out, but the future being ushered in should be made clear. Those calling the shots in Detroit and Stuttgart, and determining regulations in Washington and Brussels, should broaden their aperture before offering rosy promises.

Nathan Picarsic is Founder and Chief Executive of US-based strategy consultancy Horizon Advisory



Automated vehicle sharing: from origins to outlook

Megan Lampinen speaks to Invers' founder, Uwe Latsch, who claims to have invented automated vehicle sharing 30 years ago

Shared mobility is securing a starring role in the wider vision of multi-modal transport. From shared mopeds and bikes to carpooling and ride-hailing, these services offer convenient, affordable transport options. But no matter how great the business model, it won't work without a strong technology base, and Invers aims to provide just that. "We focus on solving the technological challenges that come with shared mobility, such as telematics, API, and connectivity," says Uwe Latsch, founder and Chief Technology Officer of Invers.

But more than that, Invers prides itself as being a pioneer in the shared mobility sector, with claims of having invented automated vehicle sharing back in the early 1990s in a small German town not far from Cologne. Speaking to *Automotive World*, Latsch shares the back story on his company's origins and the core idea that is now helping to shape the global mobility roadmap.

> Technology is the foundation for a successful mobility service for any type of vehicle
>
> *Uwe Latsch*
> *Invers*

Uwe Latsch with the first onboard unit

How did you come up with the idea for a car-sharing scheme?

Back in the late 1980s and early 1990s there was a strong ecological movement in Germany. Among other things, owning a car was considered uncool, especially among students such as myself. However, there were occasions when you needed a car, such as visiting your girlfriend's parents who lived in the countryside. I began discussing this gap with some of my friends, and thought it would make sense to buy a car together and share it. But as busy students, we did not have time to organise a physical handover of keys or keep track of who wanted the car when. With an engineering background, I figured that an IT-based system would make this process of sharing cars much simpler. With a telematics unit installed in the car, keyless access became possible.

What were the earliest use cases and who were the initial users?

When I started venturing into building car-sharing technology, smartphones didn't exist. WiFi didn't exist. GPS technology in the consumer market

was in its infancy. As a result, station-based car-sharing was the first version of car-sharing that was implemented. This means the vehicles could be found in the same spot, with no need for location-based technology. As a result, car-sharing users were a niche group of people within a community who valued the flexibility of vehicle access but did not want to own a car, like myself. University settings and neighbourhood associations were ideal for the early days of car-sharing.

> “Once cell phones became smartphones, the opportunities for car-sharing and new forms of mobility became limitless

How would you characterise Invers' early customers?

They are forward thinkers. When we started this business in 1993, shared mobility was not on top of people's minds. But they saw the value of a shared car versus a private car. Our first customers are now our oldest customers. In 1995, Greenwheels in the Netherlands started with only ten cars, and now it is the biggest Dutch car-sharing operator. CarClub Singapore started with us in 1997 with 100 cars, as part of a new mobility strategy developed by the city officials. In Germany, our main rail provider, Deutsche Bahn, started car-sharing with us in 2001 to extend their public transportation reach to a larger scale, with cars at their stations.

What factors have fostered the growth of shared schemes?

Shared mobility may have started as a grassroots movement for eco-conscious individuals, but studies have shown that people do not choose to share vehicles solely because of the environmental benefits. Convenience is a high priority that influences how people choose to get around the city. Technology has fostered the growth trajectory of shared mobility and has enabled people to easily sign up for the service, book a car, and start driving.

Invers technology powers hundreds of shared mobility schemes, including Greenwheels

You mention technology—is this primarily linked to connected and mobile developments?

Once cell phones became smartphones, the opportunities for car-sharing and new forms of mobility became limitless. The functions that we now take for granted, such as connecting to the internet and sharing messages instantly, came decades after the first notion of car-sharing started. In the past decade, we've seen the car-sharing experience become more seamless, convenient, and easy—all factors that are critical for mass adoption. As an engineer, the advancements in technology open up continuous opportunities to take what we know and expect in shared mobility to the next level.

How close is this segment to becoming mainstream?

We are still not on a level of mass adoption. Most trips are still made by a private vehicle. Owning a car is in many places still too cheap for people to consider alternatives. This is something that needs to be addressed on a policy level in cities and governments. But while that happens, we will continue making shared mobility even more convenient and attractive on the technology side.

In your view, what are some of the most and least successful schemes? What was the key to their success or failure?

Mobility is a tough industry to grow in profitability—there's a reason why public transit, and even car ownership, is subsidised. Right now, there is plenty of venture capital money in new mobility services spread across different schemes, whether it be car-sharing, scooter-sharing, or MaaS. It will be a mix of these different schemes that will make shared mobility grow overall.

There are underlying factors that contribute to the success of an operation. Strong relationships with cities are key to ensure the mobility service fits the needs and goals of people and its environment. It is more effective to spend time building up a service that can be beneficial to the

city, instead of spending time figuring out how to not break the law. In addition, having reliable technology is key. Since convenience is a high priority for people, shared mobility operators need to provide a consistent, reliable service. If vehicles are disconnected or the booking app doesn't work, then shared mobility is no longer convenient. Technology is the foundation for a successful mobility service for any type of vehicle. Consumers need to trust that the service will work and be there when they need it, hence the need for reliable technology.

How has COVID impacted the segment? Will this prove a short- or long-term impact?

The global lockdowns inevitably impacted people's ability to move throughout the city, resulting in decreased usage of shared mobility services. As lockdowns were lifted, people began opting for mobility options that were less crowded, namely avoiding public transit. While public transit has proven to be a source of COVID-19 transmissions, people are starting to drive and even bike more. Because not everyone needs to have access to their own personal vehicles, this is where shared mobility comes in.

Shared mobility gives people the option of choosing the mode that suits the trip purpose best. For example, a trip to the grocery store will be better with car-sharing than scooter- sharing.

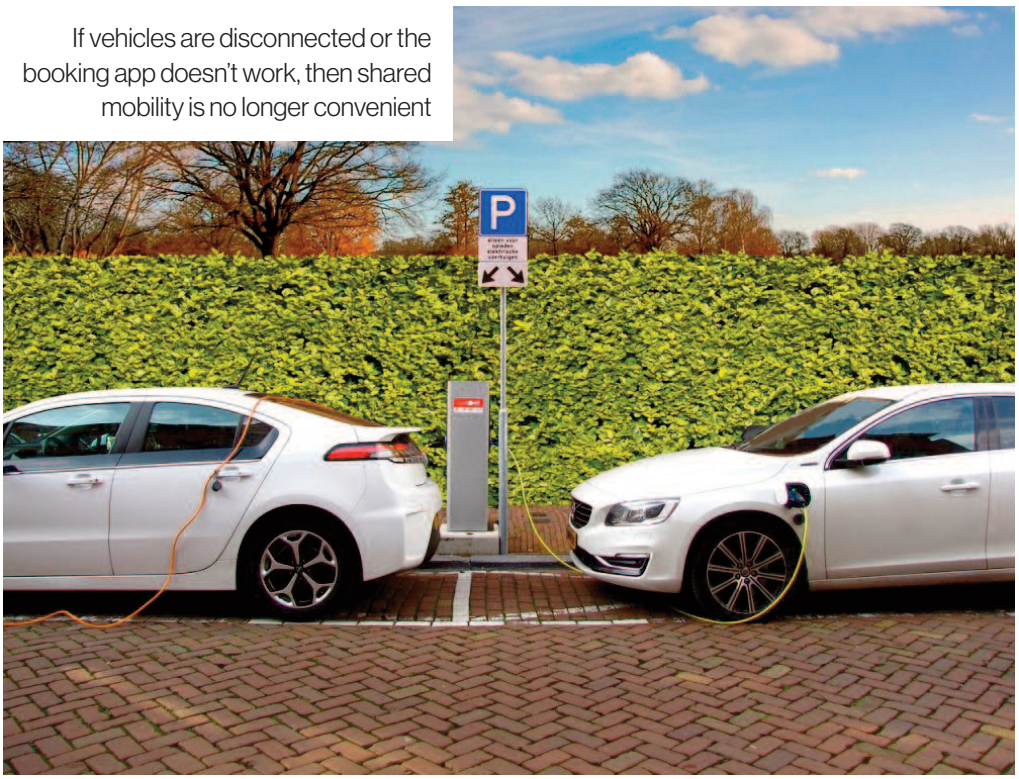
> Mobility is a tough industry to grow in profitability–there's a reason why public transit, and even car ownership, is subsidised

COVID-19 has made people more aware of these options, which would be a long-term benefit for shared mobility. In the short-term, operators will be refocusing on how to better serve the changing needs of the consumers. It may be a challenge in the short-term, but these efforts will hopefully pay off in the long-term.

How do you see automated driving impacting shared mobility?

In a shared mobility setting, autonomous vehicles (AVs) will provide people with the added benefit

If vehicles are disconnected or the booking app doesn't work, then shared mobility is no longer convenient



of not having to drive the vehicle themselves. However, the goal of AVs should be about helping to further reduce the number of cars on the road. To avoid empty cars driving around aimlessly, the same AVs should be used for different purposes, whether that be for a shared mobility service or cargo deliveries. AVs by themselves are not a solution to the mobility challenges facing cities, namely congestion. They need to be paired with other innovative approaches that will ultimately reduce people's reliance on personal vehicles.

What next for the segment?

Shared mobility is a dynamic space, which is one reason why I believe it will be resilient through the pandemic. Existing operators will be equipped with the experience to adapt quickly to rapidly changing needs. We already have seen and will continue to see new business models, such as subscription or peer-to-peer vehicle sharing, and partnerships like cooperations with food deliveries or health organisations as operators cope with ever changing market developments. Also, start-ups will have observed new gaps and priorities in the current mobility ecosystem that they can fill. There will be more growth and more innovation–it is a positive outlook for shared mobility.

And for Invers?

We are doubling down on our efforts to build an even stronger API centric infrastructure for shared mobility operators and especially for their developers. Our aim is to enable operators to grow and scale based on what their consumer needs and wants are. We will do this by focussing on the developers' needs, by developing deeper relationships with automakers and booking software providers and by expanding the reach of our telematics.

How will biometric sensing influence automotive HMI?

Future vehicles will automatically adapt based on who their occupants are, where they are and what they are doing, rather than the other way around. By Sam Abuelsamid

From the stones used by our hunter-gatherer forebears to the ploughs of the agricultural era to the laptop I'm writing this article on, humans have used tools to get a range of jobs done. One consistent feature of those tools is that while we actively interacted with them, the tools were largely inanimate objects. That's all starting to change as modern electronics are giving machines the ability to sense and respond to the users. Biometric sensing is the next big frontier in automotive human-machine interfaces (HMI).

To some degree, crude biometrics have been with us for some time now. Electronic stability controls (ESC) first appeared in the late-1990s and featured a range of sensors designed to detect the driver's steering and speed inputs, the actual response of the vehicle and then execute corrective actions through a variety of actuators to help make the two match. Sensing the amplitude and rate of the driver's steering wheel input is quite straightforward. It's a system that works well enough when the driver is expected to be fully in command of the vehicle. But what happens when the driver starts to become partially disengaged as we add some levels of automation to the driving task?

We now need much more sophisticated and nuanced sensing systems that can tell us more about the human occupant of the vehicle when they may not be fully involved in driving. True hands-free automation arrived in 2017 with the debut of the General Motors' Super Cruise system. Despite allowing the driver to take their hands off the steering wheel during highway driving, as a Level 2 partially automated system, it still required the driver to watch the road and be ready to take control immediately.

Biometric sensing is the next big frontier in automotive HMI

A system like the steering wheel torque sensor used by Tesla to detect hands-on for its AutoPilot system wouldn't work if the hands aren't expected to be on the wheel. GM utilises an infrared emitter and camera system developed by Seeing Machines that illuminates the driver's face to determine head position and gaze. If the driver looks away from the road for more than a few seconds at highway speeds, the system alerts the driver to take back control of the vehicle. If the driver fails to respond promptly, Super Cruise will bring the vehicles to a safe stop.

The same type of system can be utilised even in manually driven vehicles to help detect drowsiness or impairment. These are leading causes of crashes and fatalities. Since modern vehicles use a range of by-wire actuation systems, a biometric system that can detect inattention for any reason and automatically bring the vehicle to a safe stop could be a huge safety benefit.

Even these more capable biometric sensors are just the beginning. The infrared sensors being used now are relatively low-resolution devices meant to detect head and eye position. However, hundreds of millions of people around the world already carry a device in their pocket with a much higher resolution version of the same technology that can authenticate a user's identity.

Apple introduced the iPhone X in 2017 with an infrared sensing system to unlock the device when the registered owner looked at it. Since the version used by Apple is intended for secure authentication, it has significantly higher resolution than the sensors being used for gaze detection. Adoption of higher resolution units for vehicles could allow for keyless authentication and add an extra layer of security to prevent theft. A number of major automotive suppliers have also demonstrated systems using either infrared or standard visual light RGB cameras to detect the driver and automatically enable stored preferences or even download them from the cloud for shared vehicles.

> "We now need much more sophisticated and nuanced sensing systems that can tell us more about the human occupant of the vehicle when they may not be fully involved in driving

In an era of a global pandemic, new types of biometric sensing can also provide much more information about the well being of vehicle occupants. In 2012, Ford demonstrated a system it dubbed driver workload monitoring. Using a range of sensors in the steering wheel and seat belt, the system was designed to detect stress levels in the driver. A piezoelectric sensor in the seat belt picked up respiration while infrared sensors on the wheel measured both the ambient and driver's temperatures and conductive sensors measured heart rate.

If the driver's stress level increased in combination with data from the vehicle's sensors indicating enhanced workload such as traffic or other conditions, the system could automatically enable do not disturb mode in the infotainment and reduce audio volume.

In a future where robotaxis become common, similar sensors could have a variety of applications. Thermal imaging sensors can be used to detect passengers with a fever and automatically trigger a sanitising cycle with a UV-C lamp after the passenger gets out of the vehicle. The passenger could also be notified that an elevated temperature was detected that they may not be aware of and suggest they get a medical exam.

Passengers in automated vehicles may also face increased probability of motion sickness; temperature sensors may detect a change in the passenger state associated with motion sickness and automatically adjust the vehicle's driving behaviour and climate control to mitigate any effects to the passengers. If a passenger does become ill or smokes in one of these shared mobility vehicles, camera sensors will detect this and send the vehicle back to the depot for cleaning. If something is left behind when a passenger gets out, the vehicle can stay in place and automatically send a notification to the passenger to come back for their item.

For the foreseeable future, automated vehicles will still be coexisting with human-driven vehicles and will likely be involved in crashes even if the software doesn't cause them. Thus shared mobility vehicles will have to offer occupant protection systems such as seat belts and airbags. However, since many of these vehicles are likely to have non-traditional configurations such as carriage-style, rotating or reclining sleeper seats, offering proper protection regardless of the direction of impact will be important. Biometric sensors can detect where passengers are sitting and in what posture to automatically adjust the deployment of passive safety devices for optimal protection.

> The future is full of vehicles that sense the users and automatically adapt behaviour based on who those occupants are, where they are and what they are doing rather than the other way around

The future is full of vehicles that sense the users and automatically adapt behaviour based on who those occupants are, where they are and what they are doing rather than the other way around.

Sam Abuelsamid is Principal Research Analyst, Guidehouse Insights. He leads the group's E-Mobility Research Service, with a focus on transportation electrification, automated driving and mobility services.

COMMENT:

US election results to colour future mobility agenda

A victory for blue or red could spell dramatically different futures, investment demands and priority areas, writes Megan Lampinen

The 2020 US presidential election attracted a record number of voters and promises a potentially record long wait for confirmation of a victor. COVID-19 has meant extraordinary levels of mail-in ballots, the counting of which could take several days to complete. Even after all the votes are tallied there could be further delays: President Donald Trump has warned that he intends to contest a Democratic victory in the courts.

Meanwhile, the White House has erected a non-scalable fence around the property in anticipation of violence, and police in major cities are bracing for civil unrest. Amidst this uncertainty, the automotive industry keenly awaits the results. A victory for blue or red could spell dramatically different futures, investment demands and priority areas.

Essentially, the US will either discard any pretence of an environmental agenda, or scrap Trump's plans and try to sign back up to various commitments. Trump's Administration made it clear from the start that it would be dialling back on environmental targets. Scott Pruitt, the Trump appointee who took over from Gina McCarthy as EPA Administrator, pushed back the corporate average fuel economy (CAFE) and CO2 emissions standards for model years (MY) 2021-2026, previously agreed under the Obama Administration. What's been put forward in its place, the finalised Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule, consists of watered down targets and, most worrying of all, a potential negative US$22bn societal net benefit. That's compared to a positive US$98bn net societal benefit under the original 2012 standards.

"During my 18 years as Director of the Office of Transport and Air Quality, the EPA never put forward a regulatory requirement that would hurt the public more than it would help it," Margo Oge, who led the EPA team that authored the previous 2017-2025 standards under Obama, told *Automotive World*. "It's unheard of."

The past four years, though, have been full of steps previously unheard of in US government and policymaking. In 2017 Trump announced plans to withdraw the country from the Paris climate agreement. Today, after a three-year delay, the US has officially become the first country ever to leave this global coalition designed to tackle climate change.

On the other hand, Joe Biden, the Democratic presidential nominee, promises greater government support for clean energy technology and vehicle electrification, including

purchase incentives, charging infrastructure and R&D. Specifically, the 'Clean Cars for America' proposal envisions the creation of 500,000 charging stations and an electrification of the government fleet. Biden is also expected to put forward tighter automotive greenhouse gas emissions standards.

California. This is a positive for common rules and objectives across the US and globe, but it will not be good for affordability as regulation will lead to costlier automobiles, which are already historically expensive."

But it's not just about the green agenda. Trade policy and hence

> "Economic and environmental specifics aside, Biden promises a more rational, rule-governed, well-mannered and science-driven approach to policy

Writing on the potential of a Biden victory, Cox Automotive Chief Economist Jonathan Smoke comments: "Expect a quick return to the fuel economy and emissions standards set by the Obama administration and an immediate end of the clash with

manufacturing footprint could also go in different directions. Another Trump presidency would very likely see trade policies that continue to favour re-shoring and local content. Political pressure, primarily in the form of tweets from Trump,

has been linked to a number of production commitments over the years from such players as Ford and FCA. As a result, it would make sense that US manufacturing remains a key marketing strategy for brands. Under Biden, there's general agreement that trade friction would be eased but overall change would be minor. "Perhaps the biggest benefit for auto will simply be no new surprises and namely removal of the threat to the EU and Japan," suggests Smoke. "We will likely see far less Section 232 drama with trading partners like Canada."

And therein lies the essence of this crossroads: drama and surprises. The US has had too much of both in the last four years and now risks losing its credibility on the global stage. Economic and environmental specifics aside, Biden promises a more rational, rule-governed, well-mannered and science-driven approach to policy. That alone should create the stability and clarity that all businesses need to thrive.

The opinions expressed here are those of the author and do not necessarily reflect the positions of Automotive World Ltd.
Megan Lampinen is Editor at Large at Automotive World
The Automotive World Comment column is open to automotive industry decision makers and influencers. If you would like to contribute a Comment article, please contact editorial@automotiveworld.com

How test tracks are accelerating autonomous vehicle research

Freddie Holmes finds out how the ACM is helping automakers, start-ups and many others in the mobility space to safely bring new solutions to market

© ACM

New vehicles have been tested in the safety of private tracks for decades, allowing automakers to reach reliable levels of performance before taking to public roads. Various facilities have opened up in recent years with a particular focus on automated driving functions and systems that rely on vehicle connectivity.

Since opening in 2017, the American Center for Mobility (ACM) has become a favoured proving ground for a range of new vehicle technologies. Based in Southeast Michigan, the ACM offers around 500 acres of road networks, tunnels and motorways. It is situated at Willow Run, a brownfield site that once produced bombers during the Second World War, and counts Ford and GM as previous owners.

Reuben Sarkar took the role of President and Chief Executive at the ACM in May 2020. Speaking to *Automotive World,* he explained how the facility is now helping to hone the next generation of smart vehicles, and why the role presented a homecoming of sorts.

> “You need a physical track to run controlled experiments in a safe way

The ACM is more than just a repurposed airfield. Do you get a sense of the historical significance being based at Willow Run?

Everyone here acknowledges the history of the site, and for me there is a personal significance: I used to work in transmissions engineering at Willow Run 20 years ago when it was owned by GM. That particular plant has since been deconstructed, but the history is still there.

How would you describe the scale of the operations?

The ACM makes use of 500 acres in total, with around 300 acres dedicated to our test environments. It’s not really a facility that you can just walk around–the test track is quite sizeable. We also have a tech park that is being developed, which itself will be quite significant. It is certainly not just a repaved runway. It has real roads, and environments that have been designed to represent what you will see in the real world. Michigan has some of the most challenging roads, which are full of cracks, faded lines and potholes, so we have replicated that in certain areas. We also have user-defined environments that are very flexible, and the site provides far more than an old track that has simply been repaved.

How would you describe the ACM’s role in the push for AVs?

The first stage in the AV testing process is usually to gather naturalistic data from normal driving

The ACM boasts environments that have been designed to represent the real world

on real roads. This is needed to understand the scenarios and edge cases that test whether these autonomous systems work. From there, scenarios can be set up, tested, and repeated in a safe and controlled manner on the track, using data that is representative of the real world.

There is the argument that if you can test for free on public roads, why should you pay to use a track? Firstly, nothing is free. To validate an AV for public roads, you need to pay for drivers to accumulate enough mileage to say that it is statistically safe. It is widely considered that eight to ten billion miles of real miles on public roads will be required to do so. This is extremely difficult to achieve, and even the most advanced fleets are still far short of the threshold to properly validate these systems. You need a physical track to run controlled experiments in a safe way, and if you know what kind of conditions to run, you get more out of a track test than you do on a public road.

Is the ACM in competition not only with other test tracks in this regard, but also virtual environments?

Simulation dovetails nicely with track tests, and we do not view it as a competing element. We believe simulation will help companies to

The ACM's sprawling 500-acre site features a freeway loop to test higher speed systems

© ACM

more rapidly figure out what they want to do on the track. Real-world driving data can be used to train algorithms before running real tests on the track. At the ACM, we plan to participate in road testing, simulation and track testing. We have partnerships in the virtual space to bring in simulation capabilities, and a growing toolchain kit that we are actively developing. At least for the foreseeable future, you will not see track testing displaced by on-road testing or the virtual environment: they will all be working in concert with one another.

> We are thinking about how to be more than just a proving ground

Is the element of privacy an attraction for AV developers looking to hone their systems away from the public eye?

Customers use our track for a wide variety of scenarios. A large percentage of the time, we do not know what these companies are trying to do, and that is certainly an element that attracts developers to the ACM. Customers in this space are typically very protective of their information, and they can run their own tests on the track without us monitoring it. Companies can rent a private garage here, and even I am not allowed to enter. Automakers tend to

want to do their own tests, with their own engineers and drivers. However, there are other models where customers could drop their cars off to us, ask us to develop a test plan. We can run it on their behalf and report back results.

Is this particularly true for start-ups that may be looking to secure private investment?

A start-up might look to utilise this kind of 'drop off' service because the results of our tests can serve as a respected third-party validation for their product. Start-ups are often looking to generate data, create whitepapers and produce information that can be used to promote their product. We want to continue to push for more start-up companies to use the facility, and the state of Michigan has even made grant funding available where small companies can apply to have their fees paid for to use our test facility. This is important because many companies may not have the initial funding for this kind of development.

Venture capitalists have even been embedded in our facility with a desk and an office, with the goal of simply being present in the ecosystem and staying abreast of which companies are coming through. It is an effective way of making connections.

Might the ACM eventually serve as a benchmarking facility for different automated vehicle systems?

We are investigating whether benchmarking would be something of interest. Eventually, I believe people will desire benchmarking and interoperability data: how do the sensors and systems in the vehicle from automaker A perform against those used by automaker B? The industry is not there yet, as developers are working on their own technologies first. But eventually, you could envision the ACM and others performing large interoperability studies between all these technologies.

Are there any plans to expand the ACM as AV testing heats up?

Before I joined the ACM there was a heavy emphasis on building out the infrastructure, which is largely complete. My focus is now on business development: increasing the utilisation of the facility and ensuring the products and services we offer meet the needs of our customers and the industry. We are also thinking about how to be more than just a proving ground. We want to find new ways in which we can provide value. Many of our customers have voiced an interest in using our facility for other reasons aside from AV testing, such as improving fuel economy or optimising electric vehicle systems. We have a 90-megawatt sub-station that was already on site, which we can use for electrification purposes such as extreme fast charging.

The ACM will continue to expand its definition of 'mobility' to align with our customers' needs. You'll see more electrification work, more environments that are suited to testing Class 8 heavy-duty vehicles and perhaps even drone development in future.