

Automotive World MAGAZINE

Issue 28 | April 2022

A map of Ukraine with major cities and regions labeled. The Dniipro river is highlighted in blue. Several cities are marked with red circles containing an airplane icon, indicating airports. The word 'UKRAINE' is written in large, bold, black letters across the center of the map. Other labels include 'Kyiv', 'Vinnytsya', 'Dnipropetrovsk', 'Kryvyi Rih (Krivoy Rog)', 'Zaporizhzhya', 'Odesa', and 'Horlivka'.

**Automotive impact:
Russia-Ukraine conflict
heralds shortages,
price hikes and uncertainty**

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Published in April 2022 by:

Automotive World est. 1992

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Automotive impact: Russia-Ukraine conflict heralds shortages, price hikes and uncertainty

Megan Lampinen takes a closer look at potential supply chain disruptions, production plans, sales forecasts and investment strategies





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Russia's invasion of Ukraine has sent shock waves across the globe, introducing an element of military aggression and political instability in Europe not seen in decades. With the threat of nuclear war looming and the lives of millions of civilians in immediate danger, the top priority is not necessarily on the automotive sector. However, there is a recognition that the economic impact from

this situation could be severe and preparations must be made to mitigate the coming hit.

Decimated sales

The situation remains fluid and the forecast could change dramatically depending on the direction the conflict takes. In general, the market outlook is not promising and the conflict will inevitably disrupt supply

chains, production output and new vehicle volumes. J.D. Power and LMC Automotive lowered their 2022 global new car sales forecast by 400,000 vehicles in the wake of the conflict.

Explaining the move, Jeff Schuster, President, Americas operations and global vehicle forecasts, LMC Automotive, says the invasion adds "another layer of substantial risk to the [market] recovery in 2022." As he



Renault's Russian production has been hit by a parts shortage

foreign minister Sergei Lavrov. Sanctions are also targeting the Russian central bank and will remove some Russian lenders from the Swift global payments system. "As it will take a while for such sanctions to be implemented, the most benign scenario would see the conflict effectively ended before sanctions begin to have a significant effect," notes Storey. "There will be a more indirect effect on demand in other markets, as cost of living increases due to the rise in oil and gas prices dampen vehicle demand. If the conflict is prolonged then such effects can only intensify."

elaborates: "An already tight supply of vehicles and high prices across the globe will be under added pressure based on the severity and duration of the conflict in Ukraine. Rising oil and aluminium prices will likely affect consumers' willingness and ability to purchase vehicles, even if inventory improves."

Looking at Ukraine alone, new vehicle demand was already weak at just 103,200 units in 2021 compared with a peak of 623,000 in 2008. Jonathan Storey of Automotive Reports expects new vehicle sales in Ukraine "will be decimated for at least the duration of the conflict."

In Russia, the largest impact on demand could come from economic sanctions on the economy generally. The US, Canada, the UK, the European Union, Japan, Australia and South Korea are all imposing sanctions, with a focus on freezing President Vladimir Putin's assets as well as those of

Production halts

Global automakers are already starting to take precautionary steps both with their production and export strategies. According to Russian newspaper *Vedomosti*, the likes of Audi, General Motors, Volkswagen, Skoda, Porsche and Tata have either halted or plan to halt shipments to their Russian dealers. Ford has suspended its joint venture manufacturing operations with local partner Sollers, stating how it "is deeply concerned about the invasion of Ukraine and the resultant threats to peace and stability. The situation has compelled us to reassess our operations in Russia."

Even those that want to carry on operations may find it hard. Factories located within Russia could struggle to get the components they need to continue turning out products while parts suppliers in the region will



Hyundai and Kia are heavily exposed to the Russia/Ukraine crisis

struggle to send out shipments to vehicle factories overseas. “We currently expect that supply chain disruption will impact auto production in Russia,” says Matthias Heck, Senior Credit Officer at Moody’s. “Global automotive production could also be impacted, but to a much lesser extent.”

Volkswagen is suspending output for a few days at its Dresden and Zwickau plants in Germany due to a delay in parts shipments from Ukraine. VW Group Chief Executive Herbert Diess announced the creation of a special task force to assess potential consequences from the Ukraine situation. The VW Group also sources components from Russia, where it runs a plant in Kaluga, but it cannot ship to or from there with the sanctions in place. “The short-term impacts on

production should be fairly light, but if the conflict is prolonged then western sanctions will have an impact on Russian vehicle production,” cautions Storey.

GM has said its supply chain exposure is ‘limited’ but the automaker is actively working with suppliers to minimise potential disruptions to its component supplies. “We continue to monitor developments and take action to implement mitigation strategies as appropriate,” reads a company statement.

Hyundai Group has particularly high exposure to Russia. It turns out more than 230,000 Hyundai and Kia brand vehicles from Russian facilities every year. Both brands have a sizeable foothold on the local market, with market shares of more than 10% and 12% for Hyundai and Kia,

respectively. Kia also builds its Rio models at the ZAZ factory in Zaporozhye, Ukraine.

However, the impact on most automakers' overall volumes should be limited. Some industry watchers expect the drop in Russian and Ukrainian sales could be compensated for by upping volumes to other markets in Europe. But at the same time, they could find themselves with an even more pronounced shortage of semiconductors and electric vehicle (EV) battery cells.

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Rising oil and aluminium prices will likely affect consumers' willingness and ability to purchase vehicles, even if inventory improves

Semiconductor shortages

The microchip shortage is already causing production delays but could grow worse in the weeks ahead. Russia and Ukraine are key suppliers of neon gas and palladium, which are used in semiconductor chips. Palladium is also used in catalytic converters. In mid-February, the White House's National Security

Council reached out to the chip industry, urging it to find alternative raw material sources in the event that Russia retaliates against threatened US export curbs. In addition, Ukraine is the third-largest producer of nickel and aluminium, both of which are used in EV batteries.

“Automakers have fared well in the semiconductor crisis as they focussed on selling higher margin cars,” Heck tells *Automotive World*. “Therefore we would not see a significantly negative effect provided there is still some supply coming along from the semiconductor companies. Russia is a major—but not the only—global producer of palladium, and we understand that current automaker inventories are sufficient to mitigate short-term supply disruption. In case of an extended supply disruption, there could be some negative impact, but we also expect that in such a scenario other regions would look into options to increase their supplies.”

Fuel prices and Big Oil

Should Russia cut off supplies of these materials then prices could rise. The same could happen with diesel and gasoline. Russia is one of the largest oil producers, and a disruption in supplies from the region could send oil prices skyrocketing. That directly impacts fuel station pump prices for motorists. Brent crude oil prices have risen dramatically, recently reaching US\$106.61 a barrel, the highest seen in nearly eight years. They are expected to remain elevated with considerable volatility. In the UK, data from the RAC puts the average cost of a litre of gasoline at £1.51 (US\$2.01) and diesel at £1.54. One year ago, they stood at £1.225 and



£1.2599, respectively. An RAC spokesperson warned that further rises could very well result in “untold financial difficulties for many people.”

Some environmental groups have expressed the hope that rapidly rising fuel costs will accelerate the shift to EVs, but not everyone is convinced. “We currently see increasing fuel prices as well as spiking electricity prices,” notes Heck. “On balance, we do not expect that these will give another push to the already existing trend towards electrified vehicles.”

However, the industry move towards electrification will decidedly lessen its dependence on oil moving forward. In fact, it could be suggested that this

offers a way out for Big Oil. Notably, both Shell and BP are pulling out of their Russian projects and investments, turning up the pressure for others to follow suit.

Uncertainty

The outlook for Russia’s automotive sector will invariably hinge on how the current conflict plays out, making any forecast difficult. Not surprisingly, the Russian Ministry of Industry and Trade is expressing every confidence that its domestic manufacturing industry can thrive regardless of conflict-related developments like sanctions or supply chain disruptions. Its confidence stems from hefty local investment

efforts. Reportedly, the state programme ‘Development of the Automotive Industry’ has effectively increased local content in some cars to as much as 75% .

That’s not enough to ensure a thriving automotive ecosystem, let alone position itself as a leader in future mobility. For global players, whatever attraction Russia might have held will have disappeared for the near term. A political hot potato does not make for a lucrative investment prospect, particularly at a time of already considerable uncertainty. While nobody is willing to commit to a long-term outlook, even in the “short-term there are no good scenarios,” cautions Storey.

Mobility location data evolving towards spatial intelligence

HERE Technologies' CEO shares his view on where the location data segment is headed and how it could revolutionise mobility. By Megan Lampinen



Developments in connected and automated mobility are driving an evolution in location data, as vehicles, transport operators and local authorities demand ever-greater knowledge about the road environment. HERE Technologies has been positioning itself as a leader in this ecosystem, where data serves an increasingly pivotal role in a growing number of applications. Two years ago, company Chief Executive Edzard Overbeek claimed HERE data was powering 48 use cases across multiple industries. While he now concedes that specific number may no longer be relevant, the wider data play certainly is.

“Many of the use cases are, and have been, materialising, but there are also others that we decided may not be

needed now or that could be revisited later,” Overbeek tells *Automotive World*. “I don’t know the exact number but we are certainly powering in the tens of use cases, independent of all the work that many of our customers are doing on our location data platform.”

An onslaught of projects

Judging by the flood of recent announcements, HERE has been busy over the past few months as it works with a range of industry players for location data applications. On the autonomous driving front, Mercedes-Benz is leveraging HERE’s High-Definition Live Map (HDLM) as part of the new Drive Pilot—the first commercially available SAE Level 3



© Mercedes-Benz

(L3) automated driving system. The cloud-based HD Live Map provides the system with detailed data about the three-dimensional (3D) road network. In combination with the input from the vehicle sensors, the map data is used by Drive Pilot to manoeuvre the vehicle on the road. “This is the first car that is truly L3 and has been authorised to drive that way, making this a major milestone,” Overbeek emphasises. “Almost nobody else is at that level.”

On a completely different angle, HERE is harnessing location data to provide an Intelligent Speed Assistance (ISA) map, which provides speed limit information on any given road at any time. This is particularly important in situations that are challenging for onboard camera-only ISA solutions,

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The relationship between location data points will become increasingly important... That will mark the next wave for location data in general

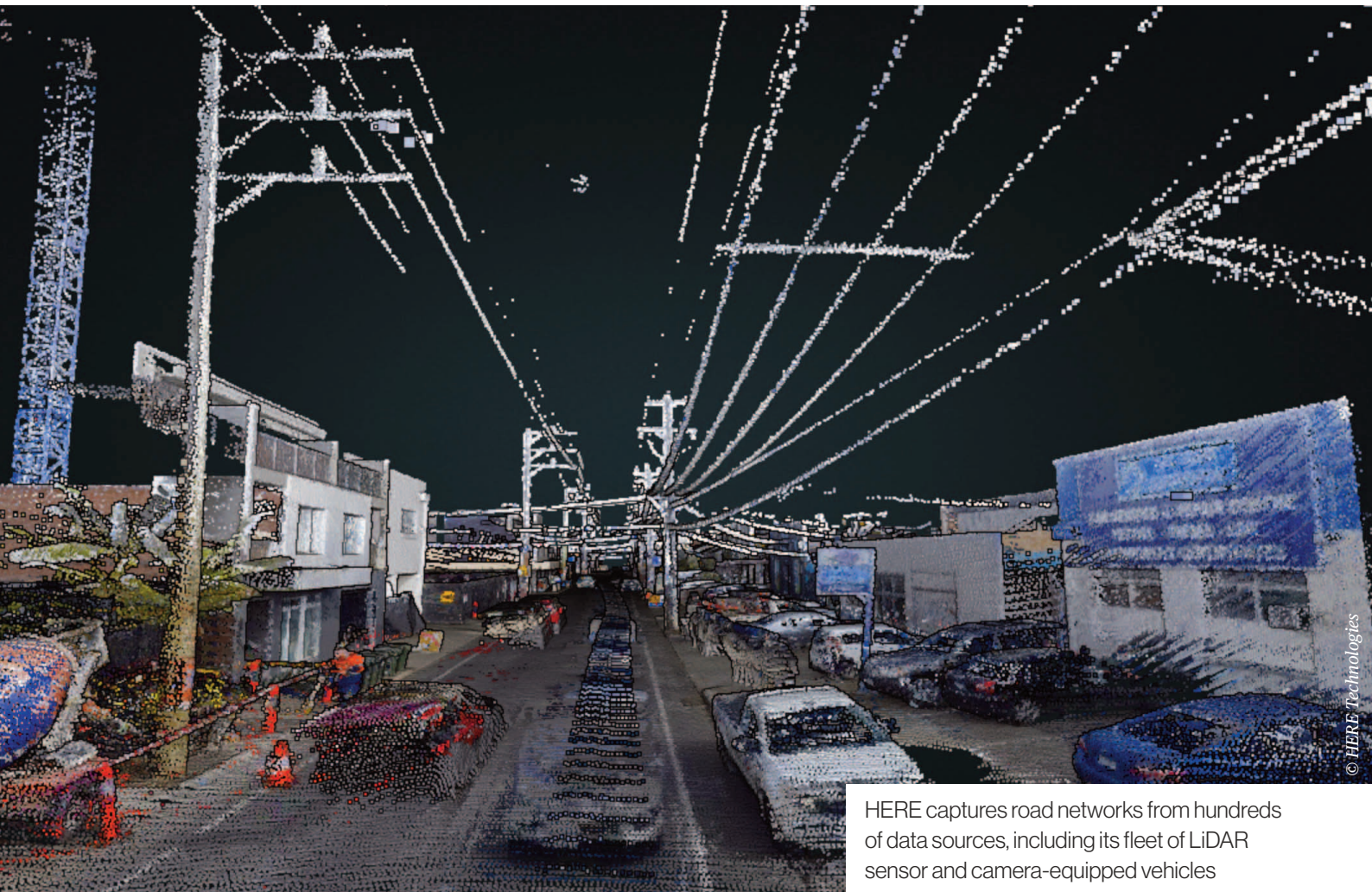
such as where no speed limit signs are posted, where there may be conditional speed limits based on the time of day or weather conditions, concealed speed limits due to foliage

growth or lack of infrastructure maintenance, as well as implicit sign-posted speed limits, which indicate a change in speed limit based on default rules like the start of built-up areas or the beginning of motorways.

Overbeek flags both the Mercedes and the ISA projects as “significant” indicators of where mobility data is heading, along with a third endeavour around LiDAR data. In January 2022 HERE began offering its global library of 3D LiDAR data on the HERE Platform. This LiDAR data captures millions of kilometres of roadways and surroundings in high-fidelity across more than 50 countries and territories. Importantly, it offers 3D modelling capabilities that enable

‘digital twin’ representations of reality; HERE claims identification, classification and localisation of objects within +/- 2 centimetres of relative accuracy within the LiDAR point clouds.

This data can be used by transport agencies for virtual infrastructure asset management, road network planning, traffic congestion analysis and federal reporting requirements. Engineering, architecture and design firms may use these datasets to perform site selection analysis and design impact simulations, while energy utilities and telecommunications companies may harness the data to conduct pole or wire inventory management and



HERE captures road networks from hundreds of data sources, including its fleet of LiDAR sensor and camera-equipped vehicles

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What we see now is the correlation and the semantic interrelation between the different location points. This is what we call spatial intelligence

Edzard Overbeek
HERE Technologies



© HERE Technologies

assessment. HERE suggests its LiDAR data could even prove helpful in optimising 5G network planning and design.

Overbeek notes that the positioning of this as a ‘data as a service’ model is particularly significant of a wider industry evolution, pointing out: “It is far more economic for customers to use that. With the growth in augmented and virtual reality, the need for LiDAR data and building digital twins is significant and something that will assist with the development of better products and services.”

Spatial intelligence

These are just a tiny sampling of some of the activities through which HERE has been expanding its reach, and they point not only to the evolution underway within the mobility sector but also the company’s own operations. In the past Overbeek has commented how HERE has transitioned from a traditional mapping provider to a true technology company. He has also described it as

the NASDAQ for location data. All of these descriptions remain relevant today, but his current emphasis is on spatial intelligence.

“Location data can be used in applications to go from A to B, to improve estimated time of arrival projections, to reduce CO2 footprint—a whole bunch of use cases,” he says. “But what we see now is the correlation and the semantic interrelation between the different location points. This is what we really call spatial intelligence. Our platform capability is truly becoming a digital representation of the physical reality, meaning those datasets can now do many other things and developers can build systems on top of that.”

He sees HERE solidly establishing itself as the industry’s preferred neutral platform for location data, but simultaneously bringing additional visualisation and analytics into play to power new applications around the spatial correlation between different location datasets. This next stage in its evolution, Overbeek estimates, should take three to five years to realise. “Today we are at the very forefront of



It is not always clear what the speed limit is on a given road

many of the technology revolutions, whether it's Big Data around location and artificial intelligence, machine learning, training models or neural map models. We have moved on from a traditional mapping company into a technology company around location data, which was the original vision."

The next wave

HERE has been playing in the location data segment for some time but new rivals are now appearing on the scene. Overbeek sees this as a testament to the market's growth potential. While the likes of Wejo and Otonomo are making a name for themselves, Overbeek is confident HERE will retain its edge. For four consecutive years, industry analysts at Counterpoint Research have ranked it as the world's number one location platform from among 25 location data vendors. Competing against such giants as Google and TomTom, HERE led the latest rankings in all seven categories and across more than 40 of the criteria, including HD Map and Advanced Driving Assistance Systems (ADAS), Real-Time Traffic, Routing, Navigation, Electric Vehicle (EV) Services, Tracking & Positioning, and Security & Privacy.

"Companies are coming to the conclusion that for the more precise use cases around autonomous driving and HD mapping, you need curated datasets," he says. "You can't just do it on open-source map data; it's not good enough."



Moving forward, Overbeek expects many more businesses to realise the importance of location data. “Two or three years ago when I was on stage talking about location data, the audience would be scratching their heads a little bit, asking what is this location data? That’s understandable—it’s not something tangible. But now they are starting to see it, and see what they can do with it.”

This momentum comes in part from regulations, which are pushing transparency. “A good side-effect of GDPR is that people know what we are doing with the data, that they opt into it and they receive a better service as a result of that,” he adds. At the same time, the boom in e-commerce and last-mile delivery

has brought location data front and centre for many operators. Nobody can afford to get a delivery location wrong, or even to miss a delivery window due to a lost driver.

“We see much more openness with regards to location data in general, and that spurs interest in our platform,” Overbeek says. “Over the next couple of months and years, the relationship between location data points will become increasingly important. It will create more analytics and visualisation opportunities for companies, which can incorporate that in the way they orchestrate and operate their businesses. That will mark the next wave for location data in general.”



A FUTURE MADE IN
AMERICA

Where does Motor City fit in future mobility?

**Detroit could either prove a cautionary tale
or the poster child for future-proofing.
By Megan Lampinen**

Detroit has long served as the heart of America's automotive industry. By the 1920s, Chrysler, Ford and General Motors had all set up a base in the area and by 1950 nearly 300,000 people worked in automotive manufacturing. Around this time the nickname Motor City made its way into common parlance. The industry that emerged in the city and its surroundings became the template for mass production, which quickly spread beyond cars to numerous other sectors, and the region's reputation was made.

But the world has come a long way since then. The financial crisis hit automakers hard, with bankruptcies at both Chrysler and GM, and the shift to new mobility has players now focusing on software and services more than chrome and steel. But Detroit and the state of Michigan as a whole are determined to not only remain relevant but to lead the movement towards future mobility.

"Mobility is not just a big part of our economy; it's part of our way of living," asserts Trevor Pawl, Chief Mobility Officer for the State of Michigan. One out of every five jobs in Michigan today is related to mobility; losing that edge would have a serious economic impact. But it's not about to. "The Motor City is poised to maintain and gain relevance as we foster and implement CASE (connected, autonomous, shared and electric) mobility," Pawl tells *Automotive World*.

Michigan is pursuing a 'system-level' approach that takes in numerous forms of transport. From drones and scooters to self-driving shuttles and robotaxis, the way that people and goods move is not restricted to one mode. At the same time, the CASE

megatrends are systematically linked, and Michigan wants to establish competency in all the core elements. "Simply being the best at autonomous vehicles (AVs) is too narrow of a win to claim global leadership over all of mobility," he notes. "A state that intentionally and consistently integrates all these elements into its systems of movement for people and goods will have more economic and community development wins."

Pawl emphasises how "this includes growing our industry and smart infrastructure, as we ensure our regulatory environment remains a national model for promoting innovation and responsible technology deployment." Michigan was one of the first US states to pass laws allowing AVs to operate on standard roadways.

The Michigan Central Innovation District

One of the more recent developments in its future mobility push is the creation of the Michigan Central Innovation District in the historic Corktown neighbourhood. In 2018, Ford Executive Chairman Bill Ford announced plans to restore abandoned Michigan Central Station as the centrepiece of a mobility innovation hub. The automaker unveiled a site plan in late 2020 for what will become a 30-acre walkable community, including housing, cafes, shops, parking, biking trails, green space, etc—all within a 20-minute walk. "It will prioritise the needs of residents and businesses, as well as the 5,000 employees who work there, connect with the surrounding neighbourhoods and city, and preserve the history of the area with a mix of old and new," Ford explained.



1. The Train Station
2. The Book Depository
3. West Building
4. The Factory
5. Bagley Parking Hub
6. West Parking Hub
7. The Mobility Platform
8. The Triangle
9. Book Depository Plaza
10. Station Plaza
11. Vernor Plaza
12. Ford Resources and Engagement Center

0 50 100 © PAU



Ford and its partners will transform the area around the abandoned train station into a mobility innovation hub

Importantly, this community will function as an open platform for innovators, start-ups and entrepreneurs to develop and pilot new transport solutions. The district will include a mixed-use makerspace with flexible workspaces, hands-on labs and innovation studios to spur collaboration. There will be micromobility exchanges with the promise of state-of-the-art transit and electric vehicle (EV) charging options. “Michigan has been at the centre of mobility ever since it put the world on wheels, and this announcement is the next piece of the puzzle,” says Pawl.

The knowledge economy

In February 2022 Google joined as a founding member. Speaking at the time of the announcement, Google Chief Financial Officer Ruth Porat commented: “By offering digital skills training, mentoring to high schoolers learning to code, and Google Cloud technology for Michigan Central projects and research on the future of mobility, we look forward to contributing to Michigan Central’s mission and all it will accomplish.”

Pawl recognises the importance of growing the local knowledge economy, adding: “We need to win on the high-tech talent front, investing in the education and retention of software developers, and technology start-ups that could be the next billion-dollar, job creating unicorn. The Michigan Central Innovation District and the Ford-Google partnership check this box in a bold way.”

The State has said it will “align more than US\$126m in new and existing

investments, programming, and resources to support the project.” That pledge involves the cross-departmental collaboration between the Michigan Office of Future Mobility and Electrification (OFME), the Michigan Economic Development Corporation (MEDC), Michigan Department of Labor and Economic Opportunity (LEO), Michigan State Housing Development Authority (MSHDA), Michigan Department of Transportation (MDOT), and the Michigan Department of Environment, Great Lakes, and Energy (EGLE).

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If done right, there would be nothing else like it in North America

Of that total, US\$107m is a result of existing investments focused on housing and Michigan Avenue reconstruction that will be aligned under the goals of the MOU. “The remaining amount will focus on new services and programmes to activate the district, while hitting on key economic, workforce, and community goals,” says Pawl. It’s a hefty financial contribution, but the impact could be substantial. “If done right, there would be nothing else like it in North America,” he adds.

GM's Commitment to EV Jobs & Investments in Michigan

GM in Michigan

50,631 employees	\$18.6B+ invested since 2011	31 facilities
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EV and Battery Manufacturing and Engineering in Michigan

Orion Assembly, Lake Orion, MI

- January 2022 – \$4 billion to convert the facility to produce electric trucks, creating more than 2,350 new jobs and retaining 1,000 current jobs.
- March 2019 – \$300 million to produce the Chevrolet Bolt EUV.
- Vehicles include Chevrolet Silverado EV, electric GMC Sierra, Chevrolet Bolt EV, Chevrolet Bolt EUV and Cruise AVs.

Factory ZERO, Detroit and Hamtramck, MI

- January 2020 – \$2.2 billion to retool Factory ZERO, the Detroit Hamtramck Assembly Center, into a fully dedicated EV assembly plant, creating more than 2,200 jobs.
- Vehicles include GMC HUMMER EV Pickup, GMC HUMMER EV SUV, Chevrolet Silverado EV, Cruise Origin, and GMC Sierra EV.

Pontiac Stamping, Pontiac, MI

- May 2021 – \$40 million to renovate the existing facility, and install new, highly flexible fabrication machinery and presses to support future electric vehicle production and various product applications.

Ultium Cells Battery Cell Plant, Lansing, MI

- January 2022 – \$2.6 billion investment by GM and LG Energy Solution, via their Ultium Cells LLC joint venture, to build a battery cell manufacturing plant, creating 1,700 new Ultium Cells jobs.
- Lansing Ultium Cells will supply battery cells to Orion Assembly and other GM assembly plants.

Brownstown Battery, Brownstown Charter Township, MI

- Brownstown Battery Assembly Plant opened in summer 2009 after a \$43 million investment to manufacture lithium-ion battery packs.
- March 2018 – \$115 million investment to upgrade Brownstown and Orion Assembly to support Cruise AV production.

Wallace Battery Cell Innovation Center, Warren, MI

- October 2021 – All-new facility on the campus of GM's Global Technical Center to accelerate new technologies like lithium-metal, silicon and solid-state batteries along with production methods that can quickly be deployed at battery cell manufacturing plants.

Estes Battery Systems Lab, Warren, MI

- This location is responsible for evaluating battery packs, modules and cells prior to production.
- Expanded in 2013, the Estes Lab is the largest battery systems lab in North America, enabling GM to perform major battery durability tests in-house.

© General Motors

Multifaceted

A recurring theme in Pawl's observations is the importance of tackling mobility from numerous angles and competencies. "We are living through a transformational moment and there are multiple fronts on which the state must compete," he notes. One front is ensuring that there are new manufacturing jobs available as automakers shift from internal combustion engine to EV technology. In three years, the Governor has worked with Michigan's automakers and suppliers to create over 20,000 auto jobs.

Many of these represent a straight transfer for the current workforce, but not all. "The mobility industry is a fast-moving, global juggernaut," he asserts. "In order to compete, we have to take a multifaceted approach that both addresses the need for new



In January 2022, GM announced an investment of more than US\$7bn in four Michigan manufacturing sites, significantly increasing battery cell and electric truck manufacturing capacity

© General Motors



© Ford

talent and includes our already-existing workforce.” Aside from the specific Michigan Central Innovation District investment the state also has several talent-related programmes in place, some designed to attract talent and some designed to help the current workforce acquire new skills. For example, through the Michigan Revolution for Electrification of Vehicles (MiREV) it offers an EV job centre where workers with traditional auto workforce experience can become skilled in electric and autonomous vehicles. “This approach is critical. We can’t just leave our workforce behind and risk losing their talents to another region,” says Pal. “Simultaneously, we recognise the need to bring in new talent to help get some of these projects off the ground.”

The path to future mobility

For Pawl and his team, mobility refers to technologies and services that enable people and goods to move around more freely. Notably, there is no specific mention of automotive in that definition. “Automotive is one industry converging on the space,” he

explains. “In a place like Michigan, a nucleus for the global automotive industry, it’s easy to forget that CASE technologies are foundational platforms that stretch across industry sectors, far beyond automotive.” Due to a heavy reliance on the same foundational CASE technologies, he believes partnerships like the Ford-Google one will only become more common. “Michigan can leverage its automotive advantage, and the Michigan Central Innovation District, to drive forward more of these partnerships and other transportation modes like shipping and last-mile delivery,” he says.

Pawl is the first Chief Mobility Officer in any US state but he won’t be the last. Moving forward, he wants to see dedicated teams focused on mobility investment and the technologies that will unlock new mobility solutions that go beyond the car to encompass areas like trucking and aerial mobility. Regulations that support the launch of new products are also pivotal. “My vision is that we provide a holistic ecosystem of mobility solutions and that they benefit not only our economy but also our communities,” he says. “Safe, sustainable mobility for all is possible by 2030.”

Daimler-Volvo JV targets global fuel cell domination

Freddie Holmes speaks with Matthias Jurytko, CEO of cellcentric, about the company's push for affordable, efficient and mass-produced fuel cell systems



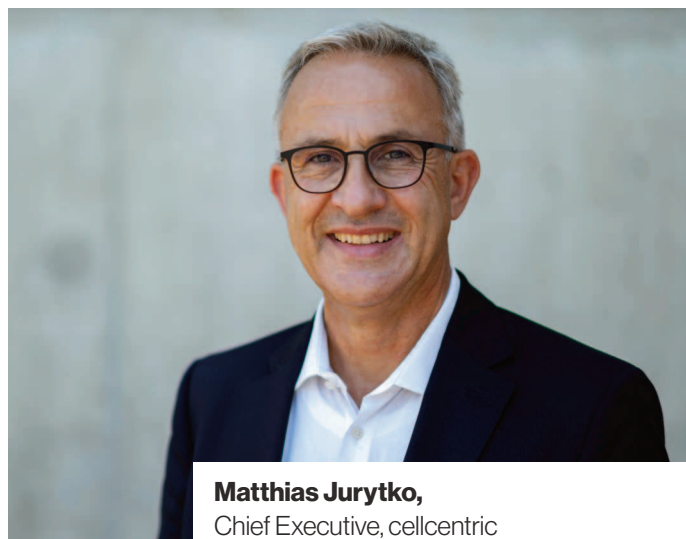
Nothing has brought manufacturers closer than the move toward zero emissions powertrains. Hydrogen has proven particularly troublesome, but a blockbuster new partnership between two of the sector's biggest names aims to kick things up a gear. The joint venture (JV) between Daimler and Volvo, cellcentric, aims to create a powerhouse supplier of fuel cell systems.

The new company says that it aims to become a global leader in the production of fuel cell systems. Joint research and development efforts—and a veritable war chest of funding—promise to boost production capacity and drive costs lower. And while there are other factors behind a commercialised fuel cell truck—no less production and distribution of hydrogen fuel itself—the JV promises to catalyse developments not only for Daimler and Volvo, but also for the rest of the industry.

Matthias Jurytko is Chief Executive of cellcentric and joins the company from his prior role as Head of the Mercedes-Benz Truck plant in Würth. Speaking to *Automotive World*, Jurytko explained how cellcentric plans to shake things up and why there is space for fuel cell powertrains alongside battery electric.

cellcentric sits in an interesting position: a powertrain supplier that is owned by two OEMs. How would you describe cellcentric's position in the value chain?

cellcentric develops, produces, and commercialises fuel-cell systems for use in heavy-duty trucks as the primary focus, as well as other applications, without external support. This makes cellcentric a



Matthias Jurytko,
Chief Executive, cellcentric

classic Tier 1 supplier. Our market strategy is to supply our two shareholders first and foremost. This is both an obligation and a certain security when we already have regular customers. However, cooperation with third-party customers is also an integral part of our strategy.

And this dynamic is illustrated by the fact that you not only supply Daimler and Volvo, but also manufacturers like Rolls-Royce?

That is correct. As well as mobile applications, we also supply components for stationary use. Last November, we sealed a strategic cooperation with the Rolls-Royce Power Systems business unit. Based on the cellcentric systems, CO₂-free and climate-neutral complete systems for emergency power supply for data centres are built up by our partners at Rolls-Royce Power Systems.

What are the obvious benefits of being backed by two of the CV industry's biggest names?

We can draw on expertise and experience like hardly any other young company. Our backbone is our



© Daimler Trucks

Hydrogen and battery electric trucks will share the road, with different uses for different fleets

experience of over 30 years in fuel cell technology, which cellcentric gained in its former organisational structures within Mercedes-Benz and Daimler Truck AG. Furthermore, it is a great advantage to be able to draw on the expertise of Daimler Truck AG and the

shareholders to develop our fuel cell system to meet the requirements for use in heavy CVs.

With Daimler Truck AG and the Volvo Group, we already have two major truck OEMs as customers, which demand a high number of our aggregates built to very high standards, which allows us to scale high volumes.

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With Daimler and Volvo, we already have two major truck OEMs as customers

The joint venture marked its first anniversary in March 2021. What has changed at the company—and in the FCEV space—since then?

Over the last two years, I would say that the most interesting phase of the fuel cell development and commercialisation happened: we paved the way to bring two strong competitors together as partners. We were very active in further developing, testing and enhancing our product along the five core dimensions we labelled “CEDReC”: Cost-effective,

Volvo Group as leading companies in the CV industry. Our research and development departments work in bilateral exchange with both

Efficient, Durable, Reliable and with Customer benefits for long haul applications.

Next to our product, we focused our efforts on creating a sustainable environment for its production and currently we're ramping up our pre-series production facility in Esslingen, close to Stuttgart. Furthermore, we are in the process of selecting a location for our series production. We are also active in Canada, where our colleagues are currently moving the facility to a new location in Burnaby.

There are discussions around what the long-term replacement to diesel will be. With parent companies that are invested in both BEV and FCEV, what is cellcentric's view?

In the CV segment, there are various use cases that require appropriate alternatives to proven technologies. In general, the rule of thumb is that the lighter the load and the shorter the distance, the more likely it is for a battery electric truck to be used. The heavier the load and the longer the distance, the more suitable the fuel cell. In the latter case, the low weight of the fuel cell and the short refuelling time to recover driving range are convincing, both of which are comparable with conventional diesel drive.

What is cellcentric's strategy to bring fuel cell systems to mass market maturity? Is there a master plan?

Probably the most important next milestone is the establishment of a series production facility. To this end, we are setting up higher-volume pre-series production at our site in Esslingen. There, we are preparing for

large-scale production by fine-tuning the processes and production facilities required for this to ensure the high quality standards required by our customers.

Are there any obvious challenges to achieving a hydrogen fuel cell powertrain that is cost competitive with today's ICE technology?

Competitiveness in the commercial sector is driven by various factors, and the so-called total cost of ownership (TCO) is the decisive factor. By scaling into automotive mass-market volumes we will significantly decrease the production cost of fuel cell systems. However, the production cost of the powertrain and vehicle itself will remain higher for quite a while compared to conventional vehicles—the total TCO of fuel cell vehicles is expected to achieve parity in the middle of the decade. Therefore, it is crucial to join forces across industries and politics to set the right frameworks and further accelerate into a hydrogen-based society.

Despite the need to go zero emissions, electrification is clearly a burden in terms of new investments. Do you anticipate growing collaboration in this space?

We perceive that the fuel cell market is very active in terms of collaborations. We evaluate this as valuable for the development of the market and the technology, and thus for achieving the climate targets. We see many examples for partnerships; cellcentric is a good example of a JV that was established to combine competencies and create synergies. We need to work together to make this necessary change as fast as possible and build a sustainable future.

C-V2X is primed to reshape road safety

Connectivity and 5G will provide a new layer of safety as the industry looks to support drivers today and autonomous vehicles tomorrow. By Freddie Holmes



Once just a broad vision to improve situational awareness for drivers, cellular vehicle-to-everything (C-V2X) is now nearing commercialisation. This was one key takeaway from Mobile World Congress (MWC), a conference that focuses on how new connections can be made using technology. At MWC 2022, attentions turned toward technology that can connect vehicles with the outside world.

Based in L'Hospitalet de Llobregat, a built-up area on the outskirts of Barcelona, MWC is in an ideal location to showcase how technology can make roads safer not only for other drivers, but also vulnerable road users. Pavements here are populated by pedestrians, bicycles and e-

scooters, often zipping across intersections and through red lights. During peak hours, traffic is hectic at best, with car horns, sharp braking and last-minute lane changes all part of an accepted road culture.

In 2018, the neighbouring municipality of Esplugues de Llobregat even made headlines when a woman died after being hit by an e-scooter. This raises separate questions around micromobility regulation, but also highlights how nonchalant riders are at risk in busy traffic. Similar trends can be seen in other densely populated cities, not only in Europe but also in the US and China in particular.

In the long term, C-V2X promises to tackle these issues,

equipping cars, bikes, scooters and even pedestrians with receivers that can provide real-time alerts. Drivers can be warned of a nearby cyclist or pedestrian about to cross the road, for example, something that even the smartest of navigation systems cannot facilitate today.

[Real-world trials](#) have shown how even in their early stages, C-V2X functions can handle this to great effect. L'Hospitalet de Llobregat itself is no stranger to C-V2X, having served as a testbed for various applications over the last few years. SEAT has worked with Telefonica, for example, to make pedestrian crossings safer, and to warn vehicles entering a roundabout of nearby bicycles.



C-V2X has been on the cards for some time already, but efforts are now being catalysed by the rollout of new 5G networks. The idea is that, with rapid and reliable data exchange possible over 5G networks, C-V2X can warn drivers of possible collisions—in a matter of milliseconds—and alert drivers to changes in the local road environment in real time. Until now, drivers have had to work from what they can see or hear—information that is either provided too late or in not enough detail.

The push for C-V2X is simply an extension of a trend that has been seen for decades; drivers have always searched for ways to become better informed behind the wheel. Mirrors provide better visibility around the

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This is significant not only for drivers today but also for autonomous vehicles tomorrow

vehicle, radios offer traffic and weather updates, while parking sensors help to avoid any expensive accidents. But what if the car could warn of nearby cyclists about to dart out into the road? What if the car knew about sudden road closures up ahead, or could predict the ideal time to arrive at a set of traffic lights?

Technologies such as these are moving swiftly from concept to commercialisation, and promise to take road safety to the next level. This is significant not only for drivers today but also for autonomous vehicles tomorrow, which will effectively be able to see around corners, over hills and predict potential accidents.



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Western OEMs to boost Chinese presence

New manufacturing rules could see foreign automakers flock to China in greater numbers than ever, writes Freddie Holmes

A relaxation of factory ownership rules is set to bring a wave of investment into China. It will see existing brands expand their presence—and undoubtedly attract new players—in the world’s leading new car market.

Western brands are not guaranteed success in what is already a diverse and highly competitive space, but even a small slice of the action is enticing enough. From January 2022, a new regulatory framework has allowed for additional foreign investment to be made through existing joint ventures (JVs) in China. With automakers made

aware of this in advance, plans were set in motion some time ago to capitalise on the change. Announcements have come thick and fast.

Automakers react

In January 2022, Stellantis announced it would be upping its stake in the GAC-Stellantis JV from 50% to 75%. As part of its long-term plan, revealed in March 2022, the company revealed it is targeting revenues of €20bn (US\$21.78bn) in China by 2030. Significantly, the news seemed to come as a surprise to its JV partner. In a statement, GAC said that it only

New Peugeot models at the Guangzhou Auto Show 2021





© BMW Group

BMW is one of several western automakers taking control of its Chinese operations

learned of the move after spotting a press release on the Stellantis website. “GAC Group deeply regrets that this release has not been agreed by us,” it said. “GAC Group will strictly abide by the national laws, regulations and policies, and adhere to the principle of mutual trust and win-win.” How this dispute will unfold remains to be seen.

In February, BMW said it had bought a majority stake in BMW Brilliance, its JV with Brilliance China Automotive Holdings. BMW now holds a 75% stake, up from 50% previous. The automaker expects to see a “positive one-time effect” on its finances of €7bn to €8bn. The increased stake was agreed back in October 2018, but a spokesperson for BMW explained that the amended legal framework in January 2022 was “the prerequisite for the new contract to come into force.” With 846,237 BMW Group vehicles

delivered to Chinese customers in 2021, China is currently the automaker’s largest single market globally, based on sales volume.

Audi said in February that it would be building a brand-new factory to make electric vehicles (EVs) in Changchun, a city in the northeast of the country. The site will be owned by a new recently formed entity—Audi FAW NEV Company—but will produce only Audi models. Annual capacity is expected to exceed 150,000 units when fully operational, and Audi plans have more than ten EV models in its portfolio in China by 2026. A spokesperson told *Automotive World* that with a 60% share (55% Audi, 5% Volkswagen Group China) the new entity is “the first cooperation company with a majority stake of Audi in China.” They added that the new production site will allow Audi “to strengthen our position in the market.”

More to come?

Could these new factory ownership requirements encourage more western automakers to create a presence in China moving forward? Industry analysts certainly think so. Nishita Aggarwal, Industry Analyst at the Economist Intelligence Unit (EIU), says that lifting the ownership requirements “will make the Chinese passenger car market more attractive to western automakers” and that it is ultimately good news for automakers looking to tap the world’s largest new car market. “Full ownership of foreign automakers would ensure better access to the thriving Chinese automotive market and an

opportunity to compete with home-grown automakers,” Aggarwal emphasised.

Karl Brauer, a seasoned industry observer and Executive Analyst at ISeeCars.com, is of a similar opinion. The fact is that more than 26 million cars are sold in China each year, and any effort that could increase an automaker’s piece of that pie will be strongly considered. “The size and growth trajectory for China will have every Western automaker focused on that market over the next 20 years. By removing the ownership restriction, China will get the full support of the global automotive industry,” Brauer told *Automotive World*. “Global

AUDI AG – 02/2022

First pure Audi e-car plant in China

- » Audi FAW NEV Company builds plant in Changchun on an area of approximately 150 hectares
- » Production will start by the end of 2024
- » Models will be based on the PPE (Premium Platform Electric)
- » CO₂ neutral and fully connected production of 150,000 electric cars annually





Baojun E100

© General Motors

automakers always prefer more control over operations, and more ownership means more control. I fully expect every foreign automaker with a Chinese presence to increase its stake in the current JVs. Expect an ongoing investment in Chinese operations starting this year.”

The importance of local expertise

While some automakers clearly remain committed to their Chinese partners, it is reasonable to expect existing JVs to become less about shared ownership. Armed with new

freedom to operate independently, automakers will look to buy back control and design and sell vehicles on Chinese soil on their terms. Whether JVs are bought out entirely or simply shifted in favour of the foreign entity will depend on the automaker’s long-term strategy for China. Partners with existing knowledge of the Chinese market have been useful for years if not decades in many cases, and splitting up those relationships may be unwise.

Audi, for example, has a JV with SAIC. An Audi spokesperson explained that this relationship gives the German automaker “a deep insight into the Chinese market.” Local partners like these, they added, bring expertise and knowledge of customer requirements at an early stage of the vehicle development process: “This has proven to be very helpful, especially for models specially designed for the Chinese market.”

It was also reported in February that Tesla is considering a second factory in China, doubling its annual manufacturing capacity to around two million units in the process. Tesla had already managed to build and run its first factory independent of a Chinese JV thanks to a free-trade zone in Shanghai. This was the first deal of its kind and may have catalysed discussions around greater freedom for foreign automakers in China. In

March, General Motors revealed it would create a brand new “premium import business” in China that would be wholly-owned by GM. It already operates a 50-50 JV with SAIC that produces Buick, Cadillac and Chevrolet models, as well as Baojun and Wuling models.

BMW has also indicated that there does not appear to be a broader plan to buy out its partner completely. In the same month that it bought a majority share in the JV, it also extended the contract for that deal through to 2040. A BMW spokesperson advised that the extended joint venture contract will “lay the foundation for sustainable business success, creating growth and prosperity in China.”

The EIU’s Aggarwal expects that foreign automakers may still ultimately look to take greater control of their operations in China, but warns that negotiations could become heated in some cases. The emerging GAC-Stellantis dispute would seem an early example. “We will see restructuring in the car manufacturing segment as foreign automakers look to gain more control of their joint ventures in China,” she explained. “Volvo Cars [is planning to take full control](#) of its Chinese JVs from its parent company, Geely Group, by 2023. Other foreign carmakers may follow suit and increase stakes in their JVs, although there could be some resistance from their Chinese counterparts.”

The road ahead

Significant change could be afoot in China moving forward. Already flush with start-ups and established automakers, more could be on

the way—perhaps catalysed further by manufacturers uprooting from Russia in protest against the invasion of Ukraine.

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The size and growth trajectory for China will have every Western automaker focused on that market over the next 20 years

“Whether it’s a young automaker like Rivian or Lucid, or an established brand like BMW or Toyota, removing these restrictions will encourage Chinese investment, which will lead to increased competition, better products and lower costs,” concludes Brauer. “All of those trends favour the consumer while generating increased sales. China is already the largest car market on the planet. Expect it to pull further away from the second largest market—the US.”

Does the Supertruck II present a viable future for the freight industry?

Electrified alternatives leave DTNA's Supertruck II struggling to find its place in the commercial vehicle industry. By Christopher Dyer



The Supertruck II is one of 2022's highly anticipated releases from Daimler Trucks North America (DTNA). Aiming to consolidate the knowledge it gained on Supertruck I, the company hopes its new prototype will demonstrate the effect emerging industry trends, such as departures from fossil fuel and integrated hybrid systems, are having on the form factor of its trucks.

During a Q&A with Derek Villeneuve, Advanced Vehicle Systems Manager and Principal Investigator for the Supertruck II project at DTNA, and Jeff Cotner, Chief Designer for the Supertruck II, Villeneuve told Automotive World that the prototype could influence the wider manufacturing group, while also providing an architecture that DTNA sub brands will use in their own models. However, with a diverging market and some increasingly competitive options from other manufacturers, where does the new Supertruck sit in an industry under increasing pressure to electrify?

New demands and current concepts

With new demands for hybrid powertrains and alternative fuel increasingly important for fleet owners, Villeneuve described the necessity to adopt a “clean sheet approach” for DTNA's new Supertruck prototype. When the first iteration of the truck was released in 2012, the



Supertruck II is one of 2022's highly anticipated releases from Daimler Trucks North America

project addressed concerns around fuel consumption and brake thermal efficiency. However, demands in the commercial truck segment have rapidly evolved, with sustainability and carbon emissions reduction now the primary concern for manufacturers.

efficiency. He describes it as a “mild” hybrid system, feeding back residual energy from normal operations back into the vehicle's electric motor.

The Supertruck also utilises the same technology employed on Formula 1 racing cars for aerodynamics, using a spoiler to

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Hybrid powertrains like those on the Supertruck II are likely to remain a stop-gap solution during the transition from fossil fuels

Supertruck II looks to resolve this through its hybrid-powertrain system. Villeneuve comments that “the hybrid and electrical architecture used on the Supertruck II enables other fuel saving technologies such as engine drag reduction and EcoRoll” to enhance the new prototype's fuel

reduce air drag on the truck and its load, reducing fuel consumption as a result. A new drivetrain system, EcoRoll complements this by disengaging the truck's gearbox when rolling downhill. These relatively basic resolutions have reduced the Supertruck II's fuel consumption on its predecessor by 22%.



© Daimler Truck

Villeneuve described the necessity to adopt a “clean sheet approach” for DTNA’s new Supertruck prototype

Cotner, which led the design of DTNA’s Supertruck II project, suggests this formed part of a new disruptive approach for the vehicle’s styling. “The team was very inspired by streamlined sports equipment that mixes different materials to form a seamless aerodynamic form, such as bike helmets and golf clubs,” he said. “This inspiration drove us to make details like the headlights, front grille and side intake as flush with the main body surface as possible. Often in trucks, these details are added to the main surface and have the potential to create drag. With the Supertruck II, we integrated these details to optimise the aero performance of the shape and help reinforce the impression of ultimate efficiency.” Villeneuve suggests these strategies mean the project is “on track to exceed the Supertruck I’s results in these key areas and in overall vehicle freight efficiency.”

Current competition

Unlike a fully electrified truck, the Supertruck II uses a hybrid system that cannot be used as a stand-alone electric option. Both Cotner and Villeneuve maintain that “mild hybridisation remains the most efficient mode of maximising the truck’s fuel efficiency,” but the truck could already become more dated. Accelerating market development, focused on moving away from diesel and reducing the industry’s carbon emissions has divided the long-haul truck segment.

Hyundai, for example, has already begun shipping its hydrogen Xcient fuel cell trucks to Europe. DTNA has also begun producing electric trucks under its Freightliner brand with electric conversions of its Cascadia Class-8 and M2 medium-duty trucks. Brett Smith, Technology Director at the US-based

Center for Automotive Research, comments that the freight industry is mirroring shifts in the passenger vehicle segment, and while “fleets aren’t going to shift over 100% to electric or battery cell vehicles immediately, that shift could be pretty quick and pretty effective when it happens.”

DTNA has announced increased funding for research into battery technology, something it confirms will ultimately form part of the Supertruck III project. While hybrids look to be a part of the industry for the short term, manufacturers are shifting towards full electrification or hydrogen fuel cells. Hybrid powertrains like those on the Supertruck II are likely to remain a stop-gap solution during the transition from fossil fuels.

Problems and predictions for the future

Despite its shortcomings, DTNA’s Supertruck II prototype remains at the forefront of technical innovation through its use of different materials and driver aids. While the prototype uses most of its existing frame and load bed from other Freightliner vehicles, Villeneuve was keen to point out that “some of the structural elements were changed to aluminium, as a way of saving weight.” This has the added benefit of reducing the vehicle’s fuel consumption, something that the truck also achieves through its recycled carbon fibre body panels.

However, fuel efficiency and lightweight sports styling aren’t the only concerns for the project. The US is seeing an ageing demographic of truckers, many of which are prioritising comfort and

advanced driver assistance systems over style. Villeneuve comments that the new technologies on the Supertruck II “will require very little extra effort on the part of the driver to make them function.” He added that many of the systems are likely to “continuously remain active and could deploy or engage automatically when driving at highway speeds.” The new truck also has DTNA’s predictive and adaptive cruise control that “works in harmony with these new systems,” when paired together.

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Mild hybridisation remains the most efficient mode of maximising the truck’s fuel efficiency

While the Supertruck II was a ground-up approach by DTNA to find the ideal freight vehicle, it remains hampered by the constantly evolving nature of the commercial vehicle segment. However, the truck’s relevant and radical ideas, such as recycled carbon fibre body panels and a Formula 1-style spoiler, ensure that it looks as futuristic as its makers hoped it to be. While its impact remains to be seen, Villeneuve was keen to confirm that progress between both iterations of the Supertruck continues to “influence the future development of our products.” He concluded by saying that “several future engine technologies found on the Supertruck II may be integrated into future engines as well.”



Intelligent energy management to rewrite EV expectations

Exro's 'brain for electric motors' enhances the performance of electric vehicles while offering significant cost savings. By Megan Lampinen

Could smarter motor control technology accelerate the electric vehicle (EV) revolution? Exro certainly thinks so as it gears up to launch the Coil Driver on the market.

Described as a better brain for electric motors, Coil Driver uses coil switching to optimise the performance of an electric motor, in real time, essentially creating an intelligent electronic gearbox inside the motor. This ability to seamlessly change configurations allows for torque demand and efficiency optimisation. For EVs, that translates into less power electronics overall and better acceleration, gradeability, and high-speed torque. Company Chief Executive Sue Ozdemir believes it is a true industry game-changer.

“Essentially, one motor can behave as multiple motors,” explains Ozdemir. In most vehicles today, an inverter sends messages to multiple motors, deciding which motor needs to be used and whether it should be fast or strong, etc. “We, however, tell one single motor, ‘go fast, go strong, go fast, go strong’. It is seamless and dynamic, as many times as needed while the vehicle is driving,” she adds.

The technology has been in development for about seven years now and was formed into what is now the Coil Driver in early 2019. A big part of the

development push was to find a more cost-effective, less complex and higher performing propulsion system for EVs—a big ask, but one the industry was clamouring for. “As electrification became more popular and more types of vehicles went electric, OEMs and Tier 1s began searching for new solutions to address performance and system cost,” says Ozdemir. “We really wanted to have something that changed the way people thought about energy, and that’s what sparked our Coil Driver.”

Years of trial and error

The performance figures shared by Exro tell a compelling story. It retrofitted an 800-volt Coil Driver into an electric Humvee, giving it 4,300Nm peak torque from one motor. That compares to Tesla’s Semi Class 8 truck, which achieved just 1,000Nm with two motors, and GM’s Hummer EV which produced 1,285Nm from three motors.

Notably, the tech is scalable from 100-volt systems to 800-volt ones, from e-bikes to Class 8 tractors, and interest is coming in across the mobility spectrum. Exro has already secured supply agreements with Canadian shuttle manufacturer Vicinity Bus and SEA Electric for use in e-trucks, among others. It expects to have two- and three-wheel applications going out in the first quarter this year. The company is also working with Canadian supply giant Linamar to develop an eAxle using Coil Driver.

Plenty of other companies today are developing coil switching through the electronics, specifically electric motors. However, this can substantially increase the electronic component cost. Exro claims that its patented technology keeps component cost reasonable, and allows it to control some traditional issues like torque ripple. “It wasn’t easy,” Ozdemir tells *Automotive World*. “This took years and years of trial and error, and years and years before we achieved what we have today.”

While the benefits are clear, it may not be the perfect solution for every application. “If you use the Coil Driver just as a drive, it essentially would have a higher cost because there’s more components in it,” she concedes. “But then you also wouldn’t be getting the benefit of it. The real benefit is that you can reduce the complexity of the system, eliminate a two-speed gearbox and remove additional motors. Once you do that and you optimise your system, the saving is upwards of 20%.”

The ultimate EV experience

Numerous companies are searching out different angles to improve EV performance, but the focus has primarily been around new motors or batteries. One of the key benefits of this approach is that it works within the existing powertrain. The technology was recently named a finalist for the 2022 Edison Best New Product Awards in the

automotive technology category. Winners will be announced later this year.

“I would describe Coil Driver as a game changer,” says Ozdemir. “It will change the way that automakers and consumers look at electrification. We are passionate about making sure that we have the ultimate driving experience; we want vehicles to have the performance to which we are accustomed with classic cars and big trucks. The trouble is, that comes at a cost. Not every family can afford to purchase two or three US\$100,000 EVs; that’s just a fact.” With the cost saving potential, they won’t need to.

In December 2021 Exro officially opened its production facility, located in Calgary, Alberta in its home market of Canada. The 37,000sq-foot facility will have capacity for 100,000 Coil Driver units a year and features automotive-grade production lines, product showrooms, and collaborative office spaces for the team of more than 50 Calgary-based employees. As output ramps up, Ozdemir is hopeful the industry will embrace new technology like this, and new ways of addressing challenges. “We have to encourage the world to not fall victim to just following the status quo. Remember, electrification is still very much in its infancy. There will be great technology, ours included, that challenge the traditional way of doing things, and we’re going to have to embrace that to realise a really truly electric future.”

Will the car serve as a payment portal for subscription services?

Automakers aim to realise a ‘digital dividend’ from the connected car, but it is unclear how in-vehicle UX may drive that monetisation. By Freddie Holmes

Connected cars will create additional revenue streams throughout their lifetime. The initial sale of the vehicle will provide a lump sum up front, but long-term income is expected to come from services sold as add-ons.

This dynamic mirrors what has been seen in the consumer electronics space, where the sale of a smartphone, tablet or even television is eclipsed by recurring subscription fees that generate revenue for years to come. How this will work in practice is still being fleshed out. Will there be a card reader mounted in the vehicle, or will digital payments be accepted via infotainment screens in the cabin? Perhaps payments could

be made via the car’s digital assistant, or will a smartphone app be enough?

Regardless, it seems logical that the user experience (UX) will have a part to play. Convincing passengers and drivers to spend their money should be convenient and intuitive.

Efforts to monetise

It remains very early days for connected subscription services in the automotive industry, but most major automakers now have online shops where features can be added or enabled.

BMW, for instance, offers add-ons through its Connected Drive store, available as one-off

‘lifetime’ purchases or as a rolling monthly subscription. These include Drive Recorder, which creates a short cinematic film from a period of driving; IconicSounds Sport, which amplifies engine noise into the cockpit; and an Online Entertainment Voucher, which acts as BMW’s own music streaming service. A spokesperson for BMW told *Automotive World* that the automaker is adapting to evolving customer expectations around “modern mobility”, with the aim of integrating relevant services into the vehicle. They added that “the digital lifestyle they are accustomed to should continue—seamlessly and without any restrictions—no matter whether they are in their car or away from it.”



© Tesla

Stellantis has also detailed a range of add-on services that should haul in additional revenue, made available through over-the-air (OTA) downloads in most cases. Jeep, for example, will offer an off-road subscription to give drivers access to over 6,000 pre-loaded off-road trail maps, peer-to-peer charging and Jeep-to-drone pairing, allowing drivers to film their drive from the sky. In addition, the Group Ride service will allow for Jeep drivers to locate and communicate with other members of the Jeep community. Dodge is developing performance upgrades that will deliver immediate horsepower gains, while Alfa Romeo will use OTA downloads to enhance the instrument cluster. At its Software Day in December 2021, [Stellantis said it expects to generate around](#)

[US\\$22bn annually](#) from subscription services across its light vehicle brands.

“Some OEMs are already experimenting with subscription services, offering things like connectivity packages and companion apps through monthly or annual payments,” observes Asa Forsell, Senior Product Manager, Automotive, The Qt Company. “In the future, OEMs might want to add features like autonomous driving modes and advanced navigation systems to their subscription offering. Electric vehicles might also bring with them interesting opportunities for charging network subscriptions.”

Tesla offers a Premium Connectivity package via a

monthly or annual fee, which bundles features revolving around entertainment. These include the usual suspects such as Netflix and Spotify, but also more niche things like Karaoke, which turns the cockpit into a Karaoke bar. Tesla initially offered all its connectivity services for free, but since 2018 has launched different trim packages to create additional revenue from each vehicle sold. A US\$9.99 monthly fee may not sound like much, but Tesla delivered 936,172 cars in 2021. If every vehicle had Premium Connectivity enabled, that would equate to roughly US\$1.12bn in revenue for the year. The service is enabled through the Tesla Account web portal, meaning that, from a monetisation perspective, the vehicle’s UX remains untouched.



Automakers expect that subscription services will boost revenue in ways never before experienced

And soon, Audi could offer what has been described as a ‘theme park on wheels’ through a partnership with holodeck, which produces XR (extended reality) goggles. XR essentially considers all forms of virtual and augmented reality experiences, and the plan is to synchronise these virtual environments with the car’s movements. The start-up says it will create a “new level of immersion in entertainment, educational, gaming and well-being content.”

The technology will be integrated in Audi models from June 2022 that are based on the latest MIB 3 platform, including the A4, Q5 and e-tron range. Audi says it can reduce motion sickness suffered by passengers and is a view toward what might become standard in autonomous vehicles of the future. It is unclear exactly how this will be paid for—users will have to buy a VR headset at least—but it is easy to see how ongoing revenue could be generated from different

entertainment and wellness services moving forward.

XR might be the most blatant change to the UX when it comes to monetisation. Services like these might also be most likely to have consumers reaching for their wallets. In-vehicle XR experiences, for instance, cannot be replicated on a smartphone. That’s according to Juergen Reers, Managing Director Mobility and Mobility X.O Lead at Accenture. “The value of an offer might be driven by the uniqueness of a certain service,” he told *Automotive World*. “If a particular service is available in every device, it might be tough to charge a premium for it in the car.”

Although the industry is understandably hesitant to explore opportunities around advertising revenue, some observers suggest that vehicle screens could eventually suffer a similar fate to services like YouTube, which were once ad-free. Aakash Arora, a Managing

Director and Partner at Boston Consulting Group, says that in-vehicle advertising could find its way into shared or autonomous vehicles in particular. This might be supplemented by AR. For example, a retailer might be able to combine a driver’s online shopping preferences with the real-time location of his or her vehicle. If the vehicle passes near a relevant store, a discount code could be shared to the vehicle to encourage impulse purchases.

That being said, Arora points out that in-vehicle advertising “is not a huge market—we haven’t seen billion-dollar companies coming out with advertising platforms for taxis.”

App-based, for now

Regardless of how the UX is designed, the fact remains that features must ultimately bring value—saving time or money, providing entertainment or improving productivity.

“It’s important to ensure any subscription model is also built with a long-term approach in mind, which presents a very different UX need than a one-off sale,” explains Forsell. “If subscription services are going to work, continuous updates offering new apps and features are key. Subscribers must feel as though they are getting good value for money to continue paying the monthly fees.”

A challenge may also come in deciding what is offered as standard and what is provided as an optional extra. Consumers are used to having apps and services pre-installed, and most will already have existing subscriptions to music and video streaming services that are unlikely to see much traction as an in-vehicle purchase. BMW, for instance, had to reverse a decision to charge users for access to Apple CarPlay in the UK. CarPlay was originally planned to be offered free for 12 months, before incurring a rolling charge for continued access. After facing backlash from local press, the decision was overturned.

Perhaps the creation of a ‘credit card on wheels’ is the way to go, eliminating the need for users to get out their phone or open up a laptop. Instead, services could be enabled directly from the car itself. ZF’s Car eWallet subsidiary, for example, envisions new cars becoming “business entities to autonomously pay for services like fuelling, parking or charging on their own.” However, this is arguably less

about monetising the vehicle, and more about turning the car into a rolling payment device. Allowing vehicles to make their own payments may not even be necessary, with features and subscriptions already easily enabled via a smartphone—already convenient enough to use in off-the-cuff situations.

“The unknowns are more around the types of services and purchases that will prove popular, so we need a user interface that can be updated over-the-air as ideas and services develop, ensuring existing vehicles always have the latest UX,” he continues. “Success will ultimately be driven by the

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If a particular service is available in every device, it might be tough to charge a premium for it in the car

And maybe the automotive industry can learn a thing or two from the video game sector, which has been steering users towards new features and in-game purchases for years. “Online games are incredibly complex but generally don’t come with instructions,” says Heiko Wenczel, Epic Games’ Director of Automotive and HMI for Unreal Engine. “We already have decades of experience in making complex ideas easily accessible so that subscription services are intuitive and attractive to end users.” Wenczel says that the challenge is not only around developing a subscription service, but shaping the user journey around it.

innovation and quality of these services and how they are offered and priced, so I can see plenty of approaches being tried, tweaking of strategies and a lot of learning before we have an answer.”

Monetising the connected car will be a careful balancing act, offering genuine value but without polarising customers. UX design could have a significant impact on whether this balance is achieved. However, it seems as though external apps and web portals will handle the bulk of the work—if not all of it—for the time being. “In the case of the automotive industry, user testing is vital so OEMs can learn what services the end user is willing to pay extra for,” concludes Forsell.



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BrightDrop: the 'real value' is not so much the EVs but the ecosystem

GM's BrightDrop has had a busy first year and shows no signs of slowing down, writes Megan Lampinen

General Motors' BrightDrop burst onto the scene in January 2021 at CES. More than simply a product or a service provider, GM describes it as an ecosystem that will facilitate the shift to a future of all-electric goods movement. Its range of commercial solutions promise to help fleets reduce costs and promote sustainability efforts while maximising productivity, worker safety and freight security. It's a tall ask but progress in the first year has been impressive.

Since its public debut BrightDrop has managed to launch its first electric light commercial vehicle, the EV600, with its first customer, FedEx Express. This project raced from concept to commercialisation in just 20 months, marking the fastest development in GM's history. During the past year the company also revealed its logistics software, expanded testing of its electric delivery carts, and secured several Fortune 500 companies as customers, including Walmart, FedEx Express and Verizon. "The momentum from our first year shows that we are delivering to our customers as promised—and in record time," says Steve Hornyak, Chief Revenue Officer of BrightDrop. The key, he suggests, is BrightDrop's ability to leverage GM's many decades of manufacturing expertise and yet work with traditional "start-up velocity."

It kicked off 2022 by announcing at CES that it had secured Walmart as its latest customer; the retail giant reserved 5,000 delivery vans to support its growing last-mile delivery network. At the same time the company expanded its collaboration with FedEx, with the latter adding on another 2,000 EV production reservations, with plans to add up to an additional 20,000 in the years to follow, pending a definitive



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purchase agreement. "Both announcements further demonstrate our ability to help the world's largest companies reach their sustainability goals and fight climate change head on," suggests Hornyak.

Beyond EVs

While much of the headline focus has been on its delivery vans, management consistently emphasises that BrightDrop is more than just an EV company. "We are a technology provider with a holistic set of solutions designed to help fleets lower costs, maximise productivity, and improve safety—all while reducing harmful emissions and street congestion," he tells *Automotive World*..

Software constitutes a significant part of this ecosystem, and an integrated, cloud-based software platform provides customers with visibility and access to their BrightDrop products through both web and mobile interfaces. It is also pursuing products like the propulsion-assisted,

connected, electric cart developed to transport goods over short distances, such as from the delivery vehicle to the customer's front door. "The electric cart works in tandem with our electric delivery vans to completely redefine the delivery environment," Hornyak explains. "We're improving the way consumers receive their goods for a more sustainable future."

BrightDrop is all about reimagining how goods are moved, facilitating the shift to sustainable delivery solutions that tackle both carbon emission and urban congestion problems. "We don't believe there is a one-size-fits-all solution to solving these challenges, and we also don't believe it's just about adding more vehicles to the road," he clarifies. "That's why we're approaching this very differently by offering an ecosystem of products, software, and solutions for nearly every aspect of the delivery journey, making the transition to an all-electric future as seamless as possible for our customers."

When it comes to the cost of delivering a package today, just 15% is related to the vehicle, according to data cited by Hornyak. "The other 85% is the opportunity we are targeting with the broader ecosystem. With our backing of GM, the EVs are the easy part to understand, and we view them as the platform for which we're building everything else around. The real value unlock for our company is in everything else—and that's where BrightDrop's holistic ecosystem approach differentiates itself."

Near and long term

A big focus at the moment for the team is on its electric cart, the EPI. "If you think about the last mile of delivery in major urban centres today, you often see delivery trucks double parked, idling and blocking bike lanes. At the same time, it's common for couriers to be carrying heavy loads while making multiple trips to and

FedEx was the first customer to receive the EV600 units



Walmart signed an agreement to reserve 5,000 of BrightDrop's EV600 and smaller EV410 electric delivery vans

from the vehicle to deliver a package to its destination,” he notes.

The EPI is equipped with propulsion-assistance, which allows couriers to move heavier loads. It is designed to both reduce the number of trips made and also reduce package touch points, operational costs, and physical strain. FedEx put it to work in a pilot project last year, with impressive results. The couriers found they could handle 25% more packages per day with less physical strain. A separate pilot in New York City found that the EPI allowed FedEx to increase package deliveries by 15% per hour, remove one on-road vehicle from the delivery route and cut delivery vehicle curbside dwell time in half, when used on routes in a high-density, vertical urban environment such as highrise buildings. “That is game-changing,” emphasises Hornyak. The courier giant plans to expand testing of the EPI to ten markets starting this year.

Looking ahead, Hornyak anticipates an expansion of the BrightDrop team and offering as it pushes ahead with its vision of decarbonising last-mile delivery. FedEx Express, its first customer, currently has BrightDrop vehicles on the road today and Hornyak is confident additional customer deliveries will follow. “The soaring demand of e-commerce, and the growing expectation that consumers must receive their packages quickly, has proven we need solutions that reimagine delivery in order to offset carbon emissions and help alleviate street congestion,” he adds. “BrightDrop is the company providing those solutions today, and because of our holistic product offering, we believe there will always be room for us in the marketplace.”





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Qualcomm's MWC announcements underline automotive intent

Already starting from a strong footing, Qualcomm is eager to further accelerate its automotive portfolio. By Jack Hunsley

The core focus of Mobile World Congress (MWC) is geared largely to innovation in sectors such as telecommunications or smartphone development. However, the fact that automotive not only received a mention but dedicated focus during Qualcomm's MWC 2022 press conference underlines the increasing overlap between telecoms and mobility.

Indeed, following a litany of smartphone and 5G announcements, Qualcomm's Chief Executive, Cristiano Amon, turned to the future of mobility and, in particular, his company's growing enthusiasm and focus on enabling the 'digital chassis'.

Qualcomm's MWC-specific automotive news centres on its latest Snapdragon-enabled connected car technology services. That includes a new car-to-cloud 'Connectivity-as-a-Service' feature which enables "global connectivity, integrated analytics and on-device and cloud-enhanced apps and services; a new Snapdragon Telematics Applications Framework which allows automotive developers to enact telematics functionality across all platforms within the Snapdragon Digital Chassis; and a new Wi-Fi and Bluetooth combination chip that allows automakers to enact faster Wi-Fi speeds and increased bandwidth.

Auto influx

Even just a few years ago, an automotive-related announcement on such a scale would be unthinkable for a company like Qualcomm at MWC. However, the latest news only serves to underline the extent the tech giant is pushing to expand its portfolio. "What is very exciting about automotive is that it is a massive

industry that hasn't transformed in a long time, but suddenly, there are many different vectors of transformation," Nakul Duggal, Senior Vice President and General Manager, Automotive at Qualcomm, told *Automotive World*. "Entire transportation networks now must be realigned to a very different type of infrastructure that essentially changes our cities and consumption patterns."

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This opportunity is much bigger than selling chips

For Qualcomm, the scale of this disruption offers huge potential, with the company forecasting that there is US\$13bn of potential value already in its development pipeline. The chipmaker is also already working with practically every major automaker: in just the last six months, partnerships and deals with BMW, Renault, Ferrari, General Motors, Peugeot and Opel have been announced. Duggal assured *Automotive World* that there are more to come too.

"Automakers are changing their business model from selling hardware to selling a product with which they want to maintain a long-term relationship," he explained. "In this day and age that has to be done with software, and it is not a core competency for any of the traditional automakers."



© Qualcomm

This realisation has significantly influenced Qualcomm's automotive strategy. Its MWC press briefings are littered with phrases such as 'simplicity', 'customisation' and 'differentiation'. In short, the company is eager to stress that it can offer automakers an easily understandable, open and scalable platform from which to build as they wish. This approach has allowed Qualcomm to design an automotive portfolio that can be applied throughout the automaker spectrum.

For instance, its most recent announcement is that of a partnership with Ferrari's Formula One outfit. However, the same Qualcomm-originating building blocks are also being used in mass-market models from players such as Renault and General Motors. "Different automakers have different needs," said Duggal. "We are not going to decide for the automaker what they need to build. They need to tell us what they need and we'll support them as they want to be supported."

Collaboration

Though there's huge theoretical potential, Qualcomm is well aware of the challenges ahead. A key hurdle is simply the maturity of this automotive segment, a fact which has pushed Qualcomm towards both acquisitions—as seen with Veoneer, for instance—and partnerships with the likes of Google and others. "The space is so new that even very large players do not quite know what needs to be done," said Duggal. "There's plenty of combined learning that needs happens through these experiences."

Another challenge is understanding how best to deploy its smartphone experience and expertise. For instance, Duggal points to the differences in how the automotive and smartphone industries scale. "We know how to build at scale, but automotive adds yet another level of complexity because the level of standardisation is much lower," he explained. "You also have a different

time horizon and different automakers operating to various points in time while also having to deal with environments and platforms over a much longer period.

Automotive will not see a scenario where you work on a project for 18-months and then leave that in the past. You must support what you develop for the long-term and whatever you're doing has a much longer gestation cycle."

Qualcomm aims to counter this issue by developing horizontally. Duggal explained that Qualcomm always has a lead customer in mind when it comes to product development, restraining from working "in the abstract." This ensures the company can build a clear timeline to work and that it has a specific set of customer requirements to help guide the process. "Once we land on that then we can look at the landscape in terms of how broad the addressable market is," he added.

Then there is growing want of OEMs to keep their new software-defined vehicles up to date. This challenge has clear similarities with over-the-air (OTA) updates already deployed in the smartphone sector. However, enacting such functionality in automotive will require a significant change under the hood. Specifically, as Duggal detailed, this involves factoring in extra compute power into Qualcomm's chip to help futureproof for upcoming upgrades as well as designing a hardware architecture that can be physically upgraded. This, he said, will prevent a scenario where automakers are "wedded" to ageing technology but can instead keep up with the latest technological developments.

Only the beginning

Qualcomm MWC-announced products will start trickling out into the market in late 2022 and early 2023, but Duggal stresses that this is only the tip

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Automakers are changing their business model from selling hardware to selling a product with which they want to maintain a long-term relationship. In this day and age that has to be done with software

of the iceberg for the semiconductor expert. Touching on the company's future roadmap, he underlines that "this opportunity is much bigger than selling chips." Other development focus areas include writing algorithms and software stacks for areas such as assisted driving, map development, as well as building a service that will allow Qualcomm to "manage the entire platform."

BMW reiterates CASE goals amid volatile waters

Russia's invasion of Ukraine, COVID, and ongoing supply issues have not dampened BMW's enthusiasm for CASE mobility. By Jack Hunsley



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The automotive industry has witnessed unprecedented challenges and transformation within the last two years, with all players expected to continue innovating despite huge hurdles. In 2022, this is still the case. With electric vehicle (EV) deployment, connectivity development and autonomy all advancing, the industry's top players are eager to reassert their spot within the hierarchy.

BMW is no exception and during its 2022 annual press conference, held virtually, the automaker outlined both its 2021 performance and its planned releases and development strategies for the future.

Strong performance

A walk-through of BMW's 2021 performance reflects the automaker's ability to perform amid troubled waters. Though conceding that it was a "weak year" in comparison to 2020

due to the pandemic, Nicolas Peters, Board Member for Finance, noted that the Group's 2021 EBIT margin of 14% was well above its minimum annual

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We expect that in 2025 one in four of our customers will order their vehicle online

long-term target of 10%. In addition, though the semiconductor shortage intensified throughout the year, BMW still closed 2021 with 2.5 million vehicle sales, of which 100,000 were all-electric cars.



BMW Group Annual Conference at BMW Welt in Munich on 16th March 2022. The Board of Management of BMW AG, l-r: Dr Milan Nedeljković, Production; Dr Joachim Post, Purchasing and Supplier Network; Oliver Zipse, Chairman; Frank Weber, Development; Dr. Nicolas Peter, Finance; Ilka Horstmeier, Human Resources; and Pieter Nota, Customer, Brands, Sales



BMW's i7 Series will be fully unveiled in April 2022

© BMW Group

The automaker intends to build on this success in 2022 and beyond, with Oliver Zipse, BMW Chairman, outlining numerous short and long term product, platform and strategic targets. One example is the upcoming new 7 Series which will be fully unveiled in April 2022, bringing with it Level 3 autonomous driving. Zipse described the model as “tech magic at its best,” adding that its release will represent the first time BMW is “fully using [its] tech stack” for assisted driving functions. The 7 Series’ Level 3 features will be demonstrated before the end of 2022.

BMW’s work on alternative powertrain technologies was also mentioned. The automaker projects that by the end of

2025 it will have delivered two million all-electric vehicles to customers. By 2030, half of its annual deliveries should be BEVs, which could equate to 1.5 million vehicles, though Zipse added that this will depend on how the development and deployment of charging infrastructure and how battery raw material supply evolves. He also reaffirmed its confidence in its solid-state battery provider Solid Power, describing it as the “strongest partner” in the field.

Hydrogen also remains a relevant technology for BMW. “We see hydrogen electric drivetrains as an ideal complement to electric drivetrains,” said Zipse. “This is the only way our fleet can have the maximum impact in protecting the climate.” BMW’s continued commitment to hydrogen does leave it in the minority, however. For instance, Zipse noted that BMW is the only automaker to commit to producing a hydrogen vehicle within the framework of the European Commission’s Important Projects of European Interest (IPCEI) programme. IPCEI provides funding across numerous projects including those focusing on future technologies. BMW’s hydrogen iX5 is now in the final stages of its development with small series production scheduled to begin in the autumn.

“We firmly believe we should continue to offer a second zero-emission option in the long term for some of our customers worldwide

and for a section of our vehicle portfolio,” a BMW spokesperson told *Automotive World*. “Production of fuel cell and tank systems is key to industrialisation of hydrogen fuel cell drive trains, and we are preparing for this in a targeted manner.” Zipse added that BMW is also already preparing for next-generation hydrogen powertrains.

Digitalisation

BMW is also embarking on a vast digital transformation, with two key avenues detailed during the conference. The first is its new iFactory template, which will see concepts and techniques such as digital twins, artificial intelligence and metaverse-like collaborative spaces eventually roll out across all its manufacturing facilities. “With our BMW iFactory we are defining the future of car manufacturing,” said Milan Nedeljković, Board

Member for Production. “Merging the real and virtual worlds opens up a whole new dimension.”

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The automaker projects that by the end of 2025 it will have delivered two million all-electric vehicles to customers

Nedeljković said that the iFactory concept will allow for “lean and highly flexible” manufacturing, both vital factors considering the powertrain diversity automakers now



must deal with. “The ability to integrate different drivetrains and architectures is our strength in the transformation towards e-mobility,” he said, adding that iFactory’s adoption will also “lay the foundations” for Phase 3 of BMW’s electrification strategy, the Neue Klasse vehicle platform, expected in 2025. Green energy will also be used at every BMW manufacturing location, which will allow the automaker to lower its CO2 emissions per vehicle by 80% by 2030.

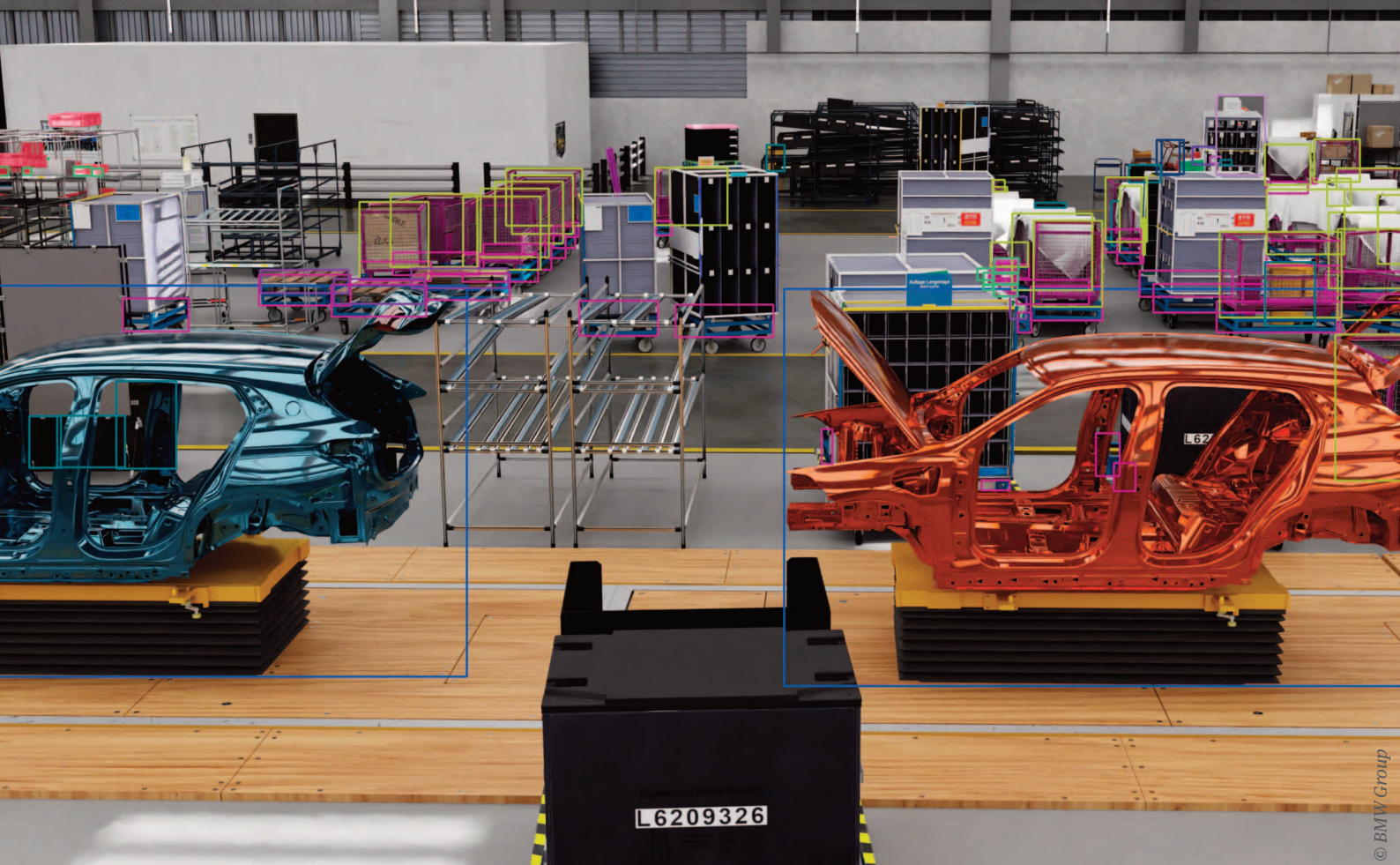
BMW’s customer digital strategy is also getting a revamp. Pieter Nota, Board Member for Customer, Brands and Sales, said that BMW’s current accompanying vehicle app has already been well received by its six million

users, but that the OEM aspires to offer the “best customer experience in the industry.” Nota hopes this will be enabled again by leveraging the metaverse to streamline vehicle sales and create a seamless customer journey.

“We expect that in 2025 one in four of our customers will order their vehicle online,” said Nota. “This demands new solutions. It is about building direct customer access and enabling a seamless customer experience for all our customers via all sales channels.” Though largely a digital initiative, Nota did stress that this transition will be implemented in conjunction with BMW’s existing dealer partners, adding that “they remain our backbone.”



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Hurdles aplenty

Despite spending the majority of the conference detailing its future ambitions, BMW's speakers also touched on the now many short term headwinds.

The conference opened with a message for the people of Ukraine and with specific references made to BMW's employees and those of its associated suppliers in the country. Maximilian Schoeberl, Director Corporate Affairs, added that BMW is assessing "what it can do in Ukraine's neighbouring countries to improve the humanitarian situation" and that it expects to experience "production interruptions and supply disruptions for important components" due to the invasion. BMW does, however, expect most of its affected plants to resume normal production this week, excluding Mini's plant in Oxford, UK.

Peters also noted that BMW's optimism for 2022 and beyond comes with caveats, namely the chip shortage, ongoing concerns on battery raw material supply and the pandemic. On the former, the OEM does not expect the shortage to ease in 2022, with Joachim Post, Board Member for Purchasing and Supplier Network, also adding that BMW is investing heavily to prepare for any future supply issues.

"To secure sufficient battery cells we have almost doubled the purchasing volume... from almost €12bn (US\$13.2bn) to €20bn," he said, adding that for "strategically relevant parts" BMW is now also working directly with chip manufacturers and software experts. "In this way, we ensure the necessary know-how, the best functionality and supply." Even amid challenging times, it appears BMW has no intention to scale back its megatrend ambitions.

Nio's Power Swap Stations are an evolutionary step for mass-market EVs

With an increasing share in the battery swapping market, Nio is capitalising on the demands of the Chinese market.
By Christopher Dyer

As demand for efficient and convenient access to electric vehicle (EV) infrastructure continues to rise in in China's major cities, battery swapping represents a useful alternative to conventional charge stations. This approach enables owners to charge their vehicles without the plug-in infrastructure that other competitors require. Nio is one proponent of battery swap, offering the swappable battery pack as a subscription service separate from the rest of the vehicle. That means a lower average purchase costs for Chinese consumers, and it has proven popular.

With the Shanghai-based automaker now building a new European base in Norway, Automotive World spoke to Hui Zhang, Vice President of Nio Europe, on what's contributed to battery swapping's success and where the technology's future lies outside Chinese markets.

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The popularity and size of the EV market in China is a key driver for battery swapping

- Hui Zang
Vice President, Nio Europe



Why has battery swapping become so popular in the Chinese market?

In China, the sales of plug-in hybrids and EVs grew 158% from 2020 to 2021, increasing to 3.52 million vehicles and accounting for 13.4% of all car sales. The popularity and size of the EV market in China is a key driver for battery swapping. Taking less than five minutes, it is also the fastest way to provide a power solution that is more convenient than refuelling at gas stations.

For Power Swap Stations (PSS), Nio shows battery availability and service status in real-time, giving visibility to users so they can plan accordingly. For the many people living in tower blocks who cannot always access on-street chargers, battery swapping provides a quick and easily accessible solution. The reliability and popularity of battery swapping has also been tested at scale. A network of over 800 stations in China has performed more than six million swaps to date.

Has battery swapping democratised EV ownership in China?

Battery cost accounts for a significant proportion of any EV. Our strategy is always to make ownership an easy and joyful experience for Nio users. Battery as a Service (BaaS) is a breakthrough innovation, both from a technology and business model perspective, addressing several user concerns. Nio BaaS users can purchase a car without the battery, lowering the price point and making EVs more accessible. BaaS users then subscribe to battery packs of various capacities according to their needs and pay monthly. For example, opt for a bigger battery capacity for the summer holidays when travelling, and then return to regular size to keep prices lower.

Battery swapping also overcomes challenges such as battery degradation, battery upgradability, and lower residual value. This creates a better balance between the purchase cost and ongoing user cost, with both



Battery swapping also overcomes challenges such as battery degradation, battery upgradability, and lower residual value

© Nio

fees lower than those of ICE cars in the same segment. This makes the purchase decision easier. Users in China who choose to purchase Nio cars with BaaS receive Yuan 70,000 (US\$11,084) off the vehicle price and can subscribe to a 70-kilowatt-hour

How is Nio's battery swapping infrastructure maintained?

The facility itself is weatherproof and has 202 sensors, 37 cameras and 21 terra operations per second of computing power. It can detect and monitor metrics and situations like temperature, humidity, flooding, surge, short circuit, leakage, grounding, general security, fire safety and smoke. Routine maintenance is carried out by a Nio service agent.

All Nio swapping and charging facilities are connected and monitored by Nio Power Cloud, a cloud-based service allowing the PSS to perform several checks on the batteries each time they come back to the station. If the performance of a particular battery is no longer up to the standard, the battery will be held in the station for a Nio service agent to fix.

Nio was bailed out by the Hefei government last year. Has the pandemic and recent financial insecurity affected its perspective on battery swapping?

The numbers speak for themselves. On 9 July 2021, there were 301 Nio PSS. In January 2022, that figure surpassed 800, and as of 24 February

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Battery swapping provides a powerful solution that is more convenient than refuelling at gas stations and provides the flexibility to upgrade battery technology and battery size

battery pack for only Yuan 980 per month. Additionally, BaaS also represents a systematic solution to the long-existing challenges for EV penetration, including battery degradation and upgradability.



2022, we have almost reached 840. In 2022, our power network deployment will continue. We will be building 1,300 PSS, 6,000 Power Chargers and 10,000 destination chargers. By 2025, the total number of Nio PSS will exceed 4,000 worldwide.

So the industry can expect to see Nio Swap Stations in western markets?

Nio's PSS technology has already arrived in Europe. On 19 January 2022, Nio opened its first PSS outside of China, located in Oslo, Norway. The target for 2022 is to open 20 PSS in Norway.

At a wider scale, Nio plans to build 1,000 PSS outside of China by 2025 to implement BaaS. It will continue to increase the number of stations and by the end of 2025, the total number of Nio PSS will exceed 4,000 worldwide. Strategic cooperation with Shell, announced on 25 November 2021, will help support this. Nio and Shell will jointly construct and operate battery charging and swapping facilities, with plans to install 100 Shell-sponsored battery swapping stations in China by 2025 and start to construct and operate

pilot stations in Europe from 2022. Shell's charging network in Europe will also become available to Nio users.

In light of increasing investment and development around solid-state and silicon-based battery technologies, do you still think battery swapping has a viable future?

Battery swapping provides a powerful solution that is more convenient than refuelling at gas stations and provides the flexibility to upgrade battery technology and battery size—users do not need to worry about battery technology becoming obsolete during the vehicle's lifespan. BaaS can support short and long-term upgrades so that all users can share the dividends of battery technology progress.

But battery swapping is just one piece of the jigsaw. Nio also has a range of solutions as part of Nio Power: PSS, home charging, the Nio Power Charger network, and mobile power. For users, the primary concern when buying an electric car is its range, so providing diverse solutions to relieve the anxiety holding people back from purchasing an EV is a priority.

Fuel cell trucks move from concept to customer trials

Data and feedback from early-stage pilots are shaping the next generation of hydrogen trucks. By Jack Hunsley

Many automotive industry stakeholders continue to hold high hopes for hydrogen mobility, banking on the tech following a similar trajectory to now widely

normalised battery electric vehicles. Though the debate is growing on whether hydrogen is diesel's default replacement, the consensus is that if any mobility segment can make hydrogen powertrains work, heavy-duty

long-haul trucking can. However, with battery tech maturing across the automotive spectrum, the time is quickly coming when hydrogen trucking's proponents must move beyond theory and bring their products into reality.



There is perhaps no other player in the hydrogen ecosystem as eager to make this leap as Nikola. Scarred by its embroilment in the Hindenburg scandal, the start-up has quietly gone about its business across the last two years, developing the Tre model that it first unveiled in 2019.

As Jason Roycht, Nikola's Global Head of Fuel Cell Electric Vehicles, told *Automotive World*, the start-up sees the last two years as the Tre's 'alpha' development phase, defined by small scale production—seven trucks have been manufactured to date—with these vehicles now being delivered to initial customers for validation and testing. “The crescendo of that was the two trucks that we drove out from Arizona to Los Angeles,” he added. Nikola claimed in a January 2022 tweet that these trucks had made the trip on a single tank with fuel to spare. “That work represents tremendous progress for us in terms of integrating, engineering, and getting the core systems to where we believe they need to be for the eventual reliability and performance of the truck,” said Roycht.

Next steps

Nikola already has one eye on the 'beta' phase. Though details are understandably scarce as to what exactly this stage will entail, Roycht was able to give a few pointers.

In terms of gearing up to take this next step, he noted that the start-up has endured a “pretty long process” that necessitated an “engineering design freeze.” Roycht, however, assured *Automotive World* that Nikola is already over these initial hurdles and is moving quickly towards manufacturing. “We will be starting the beta unit builds in the next months



Nikola has spent the last two years developing its Nikola Tre

and those builds will continue through Q2 and Q3,” he said. “The beginning of Q4 is when the world will get to see those beta units.”

As for the technical changes, Roycht says these can be split into physical- and software-focused alterations. On the former, the most obvious change will be to the truck's exterior appearance with Nikola incorporating an improved aerodynamic design. There are also physical changes under the hood, however. In particular, Roycht pointed to opportunities to “improve the layout of the truck” with specific reference given to the vehicle's thermal management capabilities and the packaging of the fuel cell. In all instances, the goal has been to improve performance while attempting to lower weight and costs.

On the software, the focus has been calibration. “This is where the alpha trucks are important for us,” said Roycht. “The more data we can get of actual real-world use cases the more we can fine-tune our software, our calibration and the operational pattern to ensure we can get the best fuel efficiency, the highest level of durability and ageing on the battery and fuel cell.” Though he added that the beta will

“probably see more physical changes than software changes” he also stressed that the latter is where the “IP of Nikola is going to be,” adding that “there is a tonne of learning, efforts and improvements that are going on underneath the bonnet.”

One key example here can be seen in the ‘hybrid-like’ nature of Nikola’s fuel cell powertrain. With both battery packs and fuel cells onboard, Roycht underlined that it is vital that Nikola’s software can intelligently and efficiently understand where, how and when power should be distributed from the powertrain. “The decisions we make in the software about how to run on either the fuel cells, the battery or both at any given time is going to be the differentiator in the fuel efficiency and durability of those vehicles,” he said.

Other candidates

Though Nikola’s technology appears to have progressed nicely over the previous two years, the elephant in

the room is the company’s ongoing association with its former Chief Executive, Trevor Milton. At the time of Hindenburg, the company had grown to be the darling of not just the hydrogen mobility sector, but arguably one of the most attractive names in the automotive industry. Since 2019, however, the start-up has found itself on the backfoot, a situation that has allowed both new and old manufacturers a chance to advertise themselves as the leading hydrogen trucking proponent.

Many of the alternative candidates find themselves at a very similar juncture to Nikola in that they are just now putting concept vehicles into small scale production for customer trials. Hyzon Motors, for instance, confirmed in January 2022 that it had successfully delivered 87 fuel cell heavy-duty trucks across 2021. Hyundai announced an upgrade to its fuel cell truck in May 2021. Using feedback from previous customers trials, it made changes to improve the fuel cell system’s durability and fuel





Nikola Tre BEV

© Nikola

efficiency to “better stay in tune with the demands” of commercial fleets. The truckmaker says that 1,600 Xcient trucks will be operating in its chosen testbed of Switzerland by 2025 while it also plans to expand elsewhere in Europe and further into North America and China.

Meanwhile, Daimler Trucks began testing its 1,000km range GenH2 in May 2021. The OEM is aiming for the GenH2 to meet the durability requirements of the Mercedes-Benz Actros, a target that equates to 1.2 million driving kilometres over a ten-year period and a total of 25,000 hours of operation. However, unlike Nikola’s, Hyzon’s and Hyundai’s models, the GenH2 will not be put into customer hands until 2023. Under the hood, Daimler Truck believes in the long run it will use liquid rather than gaseous hydrogen given the former’s “far higher energy density,” however, this has required the truckmaker’s

engineers to develop a new prototype tank system to accommodate the fuel.

build, which you can look at as an adjustment of what we’ve been doing with the battery

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The more data we can get of actual real-world use cases the more we can fine-tune our software, our calibration and the operational pattern to ensure we can get the best fuel efficiency, the highest level of durability and ageing on the battery and fuel cell

As for Nikola, in terms of its technical development, Roycht is eager to accelerate. “The task at hand over the next half of the year is to go from the alpha

electric Tre, to the beta build, which will see a full integration into the chassis with the structure, thermal dynamics and everything else.”