Renault’s restructuring – where is it heading?

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Renault’s restructuring—where is it heading?

The idea of Renault and Nissan merging into one company—the dream of the departed Carlos Ghosn—is now long gone, writes Ian Henry.
Luca di Meo, Renault’s Chief Executive since 2020, has taken his time but set out his plans for the company in November 2022 and more recently has redefined the scope of the alliance with Nissan; at the heart of the new Renault strategy is dividing the company into distinct standalone units, similar to the recent three-way division of Ford into distinct businesses for electric vehicles (EVs), light commercial vehicles (LCVs) and internal combustion engines (ICEs).

Renault’s EV and related software activity will be spun off into Ampere, with investment from Qualcomm underpinning this split; Ampere may have its own stock market listing later this year. Press reports in February suggested a potential market valuation for Ampere of €10bn (US$10.7bn), at around the same time as other reports suggested the Northvolt, a new battery company, would be listed with a value of €20bn. The ICE business, possibly called Horse, will operate as a joint venture with Geely of China, with Saudi oil company Aramco a possible minority investor; while Renault’s European business pivots to an all-electric future, Horse will focus on supplying ICE and hybrid powertrains from Latin America, India and South Korea.
In addition, Alpine, the sports car and racing brand, will be developed into an EV unit of its own. There will also be new mobility (Mobilize) and recycling (The Future is Neutral) business units.

**Ampere’s clear product plan**

Ampere will have at least six passenger EVs by 2030 in the core B and C segments, with the new Renault 4 and 5 at the heart of this new entity’s product line-up, along with the electric Megane and Scenic and two other unnamed models. By 2031, Ampere will produce 1 million EVs for the Renault brand. Production will be centred on the three EV factories in northern France, at Douai, Maubeuge and Ruitz. The van business, in which Renault is one of the market leaders in Europe, will also go fully electric; at the heart of the van strategy is a new skateboard chassis, FlexEVan, which will produce vehicles under a new brand name, Flexis.

Dacia, the low cost Romanian band, appears likely to operate outside the new Renault structure, with its prospects underpinned by its current margins of over 10%, with a target margin of 15% by 2030. At least three new Dacia models will be launched by 2030, which are expected to generate margins double that of existing Dacias.

**Redefined alliance with Nissan**

While Renault works on implementing its new structure and separating its once integrated...
operation into distinct businesses, it has also redefined its alliance with Nissan. In early February 2023, a new structure for the Renault-Nissan alliance was announced. This will see increased co-operation in EVs, Nissan will take a share in the new Ampere EV business and Renault will reduce its controlling stake in Nissan from 43% to a much reduced 15%, matching Nissan’s stake in Renault. The balancing 28% will be transferred to a non-voting trust although Renault will continue to receive dividends in line with the 43% shareholding; the 28% stake may be sold in future but there is no time commitment for this.

Renault will reduce its controlling stake in Nissan from 43% to a much reduced 15%, matching Nissan’s stake in Renault

Beyond the rebalancing of cross-shareholdings, the new alliance will have a three-pronged geographic approach: in Europe, Renault will rebrand two of its models for Mitsubishi (the Clio will be sold as the Mitsubishi Colt, while the Captur will be sold as the Mitsubishi ASX); Nissan will use the Renault FlexEVan electric van platform; and Renault and Nissan will develop compact and mid-sized EVs for Europe from 2026. In India,
there will be a Nissan version of the small Renault Triber EV; and in Latin America, Renault will source a half-tonne pick-up from Nissan Argentina, building on the production of 1 tonne pick-ups by Renault for both brands, while Nissan will produce a small car for Renault in Mexico, marking Renault’s return to North America.

Will this new plan work?

The initial reaction to this rebalancing has been positive, with analysts suggesting that the days of Renault and Nissan appearing to “fight each other” being over. That said, there are several questions to be addressed.

The idea of Renault and Nissan merging into one company—the dream of the departed Carlos Ghosn—is now long gone. However, the two companies still have significant and long-established interlinked activities. Unwinding these entirely would likely have resulted in significant write-offs and lost opportunities. The new alliance, and new Renault structure, appears much better suited to the times, with equal shareholdings, focused joint product development in EVs, sensible and practical joint manufacturing operations in Argentina, Mexico and India, and platform sharing in Europe, including a common 800-volt EV architecture. Much remains to be done to implement the new structure and quite where Dacia fits into this new structure remains to be seen, especially as the brand will remain focused on ICE and hybrid powertrains for the foreseeable future. A separate listing for some Dacia shares may well happen in due course.

Renault as a holding company?

Renault appears to be on the road to becoming a holding company with controlling or significant minority stakes in a number of distinct businesses, ie in EVs, ICE
powertrains, sports cars, mobility services and others. The days of a single automotive entity may well be over, with Luca di Meo clearly wanting each distinct business within the current Renault portfolio to stand alone. Certainly this approach is ambitious and full of challenges; for example, sharing dealerships across the Renault and Nissan brands in Europe will bring a new challenge as two very closely positioned brands will end up with very similar models being sold alongside each other. How that will work in practice will be interesting to observe.

**Nissan’s position in Europe uncertain**

Another interesting factor is Nissan’s position in Europe. Its Chief Operating Officer, Ashwani Gupta, has recently observed how the UK—where Nissan runs its only European factory—is becoming an uncompetitive place to manufacture vehicles; he has hinted that significant UK government support will be required in future for Nissan to remain in the UK in the long term, but whether the required support will be forthcoming is far from certain. If it is not forthcoming will we see more Nissans made by Renault in Europe, with the Sunderland factory, for long a shining light in Nissan’s global manufacturing network, under threat?

The new Renault structure looks as though it has the potential for a much more nimble and fleet-of-foot set of operations in Europe in particular; but for Nissan, at this stage at least, it could be actually become more dependent on Renault than it has been until now. Whether that is what Luca di Meo intends is another matter.
Ford—the last free-standing American in Europe?

Will Fords remain on European roads for much longer or will the automaker—like GM—become largely focussed on the American market? By Ian Henry

Once they were three, Chrysler, General Motors and Ford; true, Chrysler (now part of Stellantis) was never especially big in Europe, and there are still some Jeep models made in Italy and now Poland, while GM’s former European operations, Opel/Vauxhall, are also now part of Stellantis. For now, however, Ford carries on, but on an increasingly diminished scale; its product range has been cut back, and its Saarlouis factory is likely to close in the middle of the decade. Job cuts have been announced, engineering is being transferred back to the US and its market share is declining. So, will Fords remain on European roads for much longer or will the automaker—like GM—become largely focussed on the American market?
In the 1990s, Ford had a strong European model line-up and market share in cars of nearly 12%, based on the small Fiesta and compact Focus; this presence was sustained with MPVs in the S-Max and Galaxy, and latterly a compact SUV, Kuga, all of which seemed to catch the market’s mood; however, its share is now less than 5% and falling. In the commercial sector, the Transit has long held sway as the leading full size van, supplemented by the smaller Transit Courier and Connect. But while Transit retains market prominence, elsewhere Ford is at best in transition, and in some cases in serious decline.

The Fiesta, once the leading small car in Europe, will stop production in mid-2023 as the Cologne factory switches to producing electric vehicles (EVs) based on the Volkswagen MEB platform; its MPVs are now produced in very low numbers and should also come to an end by the middle of next year, if not before. The Mondeo is no more and the Focus has no direct replacement scheduled to be made in Europe. Of its current product line-up only the Kuga and the smaller Puma crossover will remain in the passenger segment; most of its future vans will be made in a production alliance with Volkswagen—the Transit will be made by Ford in Turkey, but the Transit Connect will be made in Poland, by Volkswagen.

Ford’s problems in Europe are reflected in its group financial results; it posted losses of US$2bn in 2022 (despite beating GM in terms of revenue); its poor results were partly due to losses on its investments in Rivian and Argo AI. These losses have accelerated the company’s retrenchment to the US and cutbacks in Europe. At least 3,800 European engineering and administration jobs will be cut, with many engineering tasks moving back to the US where the company’s EV development will be based; around 3,400 engineers will be retained in Europe to adapt US designs to the European market. The use of Volkswagen’s MEB platform now expected to be a short-term interim measure to tide Ford over in Europe while its North American arm finishes development of its next-generation global EV platform.

Ford’s new EVs will be developed and produced within its new Model E division, one of three new divisions around which the company will be organised; the other two divisions are Ford Pro (for commercial vehicles) which would appear to have a positive future; and Ford Blue (for combustion engine cars), although what the real long-term prospects for this division are remain to be seen.
Ford is also embarking on another round of cost-cutting to allow it to fund further EV development; it has made progress in EVs in the US, with F-series and Mach E Mustang EVs leading the way. Crucially, it claims to have battery materials supplies in place to allow it to make 2 million EVs a year by 2026, with batteries made mostly in a joint venture with SKI of Korea. It also claims its second generation US-designed EVs will be much lighter and cheaper to manufacture than its first generation EVs; but whether it can translate this apparent success to Europe remains to be seen.

Europe has always been different to the US in terms of the type and size of vehicles sold, with very different manufacturing cost structures as well; GM never found a way of managing its European operations to make a profit and now it seems that Ford is confronting the same issues which GM eventually resolved when it sold its Opel/Vauxhall operations to Stellantis. However, whether there is a company in Europe which would want the Ford of Europe operations is far from clear; sharing the same brand name as its North American parent means that selling Ford of
Europe with the Ford brand a difficult proposition—GM did not have that worry as Opel and Vauxhall were European only marques.

The jury is out on whether a profitable and viable Ford of Europe operation can emerge from this latest round of restructuring. Can the US operations design and develop vehicles suitable for Europe in the EV age? How many more factories will Ford close in Europe? Saarlouis may be sold, if someone can be found to take on the employment liabilities and re-tool the plant to make EVs, but that is a big if. The UK’s remaining Ford factory, the Dagenham diesel plant, will see declining output as the van market switches to EVs.

That said, several global markets are likely to allow diesel vans to be sold well into the 2030s, and maybe beyond, so Dagenham may have a longer life than might be expected. Valencia, once Ford’s largest plant outside Detroit, is now operating at half its capacity, and likely future model programmes do not suggest a major increase in production here is on the horizon. Turkey will remain the core Transit plant for global supply (apart from for the US), while Cologne and the Romanian plant at Craiova appear to have a positive future with EVs in the B and C segments, cars and crossovers. But having once made over 1.5 million vehicles a year in Europe, it will do well to retain half that volume in the medium term. Ford of Europe will be a much smaller operation than it once was. A fallen giant? Yes. The last (American) man standing in Europe? It seems like it, but for how long it remains standing is another question.
What could Tesla’s “recall” mean for the AV industry?

Tesla’s full-self driving system is facing 362,758 recalls, which could impact the uptake of AVs. By Elle Farrell-Kingsley

Tesla has been forced to “recall” all vehicles equipped with its Full Self-Driving (FSD) feature by order of the National Highway Traffic Safety Administration (NHTSA). On 16 February 2023, NHTSA announced that Tesla had agreed to recall all 362,758 vehicles equipped with FSD in the US due to a “serious risk that it may cause crashes.” The Tesla Autopilot investigation first opened in August 2021 due to a history of automated driving crashes.

The watchdog stated that Tesla’s software allows a vehicle to “exceed speed limits or travel through intersections in an unlawful or unpredictable manner,” increasing the risk of an incident. The recall covers 2016-2023 Model S and Model X, 2017-2023 Model 3, and 2020-2023 Model Y vehicles.

However, Tesla’s Chief Executive, Elon Musk, was prompt to comment that it was not a recall so much as an over-the-air (OTA) software update that will be provided free of charge. “That explanation misses two key points,” says John Uustal, Founding Partner of US law firm Kelley. “First, the vehicles are defective as manufactured. Second, while the update may improve the system, it’s still not an autopilot system. The technology isn’t yet there for a full analysis of the dangerous ways the system sometimes operates.”

Uustal has a history of taking on automotive, having won the longest trial in General Motors’ history, where a jury found GM guilty of negligently designing the fuel tank in a family station wagon that exploded after a low-speed crash.

The reality of FSD

Tesla’s recall comes just four months after a previous one in November 2022, where the same software may have meant some models hit the brakes too slowly while driving, impacting 40,000 vehicles. In total, Tesla issued 17
recall notices in 2022, covering 3.4 million vehicles. “When software companies put out an unfinished product, they know they can fix it with updates while they use customers to reveal the problems,” Uustal tells Automotive World. “This mindset is not appropriate for autonomous driving. These incidents have killed drivers, passengers and pedestrians.”

While Tesla’s FSD feature assists drivers with steering, accelerating and braking, the automaker says FSD is an “advanced system designed to provide more active guidance and assisted driving” under the active supervision of the driver. Despite its name, Tesla and NHTSA have outlined that FSD’s advanced driving features do not make the cars fully autonomous and that drivers must still pay attention to the road.

As to how Musk was able to market the system this way, Uustal says there isn’t a regulatory system to police corporate misconduct. “Who’s going to stop him? It’s unfortunately up to customers or lawsuits to do anything about it.”

Looking into whether the manufacturers of these models could also be liable for these
safety concerns, Uustal states, “It’s possible there was some kind of physical defect here, though it’s unlikely.” He also notes that some manufacturers will have outsourced the coding, ultimately leaving the liability with Tesla. But will the OTA update be enough? The attorney remains sceptical: “If it fixes the problem, then yes. But that remains to be seen.”

Public perception and safety

These incidents are drawing negative attention to the development of autonomous driving more widely. US Democrat senators Ed Markey and Richard Blumenthal said the recall was “long overdue”, adding, “Tesla must finally stop overstating the real capabilities of its vehicles.”

Despite autonomous vehicle (AV) developments gaining more public attention and investments in recent years, consumer confidence in AVs hasn’t matched the pace of innovation. According to US think tank Pew Research Center, 63% of Americans say they would not want to ride in a driverless passenger vehicle, while 44% believe AVs are a “bad idea for society.” Concerns include giving up control to a machine and whose safety should be prioritised in a potentially life-or-death situation. A further 75% of US adults said that if given a choice, they would still rather drive than rely on self-driving features, according to data from autoparts supplier CariD.

Musk’s previous 2022 comments on the safety of fully autonomous driving concluded that the pros outweigh the cons. “The people whose lives are saved don’t know their lives were saved. Let’s say you save 90% of people that otherwise would have died. The remaining 10% who did die, [their families] will still sue,” he said. When questioned if fatalities were an acceptable price to advance technology, he replied, “I’m a strong believer in doing the reality of good, over the perception of good. If we believe that the probability of injury is reduced, but we know we will be sued to do the right thing, we’ll do the right thing and get sued.”
However, the public negativity surrounding these crashes could put AV technology behind, even if only temporarily. “Tesla’s FSD has undermined consumer confidence in self-driving cars at a time when industry and government should be developing systems that build trust,” says Dan O’Dowd, Founder and Chief Executive of Green Hills Software, a safety and security software programming company. Indeed, Technology Industry Analyst Jeff Kagan notes that the impact will be felt across the sector, telling Automotive World: “This self-driving issue will impact both Tesla and the entire industry, but it will not derail it.”

“While Tesla is an exciting look into tomorrow’s self-driving technology, the truth is we are not there yet,” continues Kagan. According to the World Health Organisation, 1.3 million people die every year due to traffic collisions. Meanwhile, NHTSA found that human error accounts for between 94% to 96% of all auto incidents. As such, Uustal agrees with autonomous driving’s potential: “It could help save countless lives, and there is no doubt that many states have given preferential treatment to the technology and the companies as a result,” he says. “This technology is game-changing, but that’s not an excuse to endanger people before it’s ready.”

**Preventing future incidents**

As a result of these safety concerns, Uustal hopes it causes companies to “slow down on releasing these systems, even though all the current incentives push for speed.” Indeed, the first to market has a significant advantage as many developers race towards full AVs.

Although Tesla’s recall has only been in the US so far, other countries with the same models are yet to make any announcements. This, alongside the varying levels of autonomous driving developed according to different countries’ regulations, has raised questions about whether the technology could be determined safe in some countries but not others. “Technology that kills people cannot be defined as safe,” emphasises Uustal. “Perhaps some countries will find it ‘safe enough’ when others do not. Manufacturers would have to obey local laws, or at least suffer the consequence if they do not.”

But how can these safety concerns be prevented in the future? Regarding self-driving software, Uustal states that all systems have vulnerabilities. “Because of how these systems are fixed, improving one error doesn’t help other autonomous systems in operation.” Many solutions, such as Tesla’s OTA, remain hidden from other automakers—meaning that if they encounter the same issue, they may not create the same solution or at least not be able to do so quickly. “The solution is to prohibit these systems from putting people in danger until the technology is adequate.”

Ultimately, Kagan warns that it’s important for automakers, manufacturers, and customers to remember that “while Tesla is a key player, we are still in the very early stages of this new technology. The reality is that we tend to think we are much further ahead than we really are today.”
Xpeng hails ‘breakthrough’ in European EV push

Can this Chinese start-up make itself heard in Europe’s increasingly crowded electric market? By Megan Lampinen
Electric vehicle (EV) start-up Xpeng arrived on the crowded Chinese market in 2014 and quickly established a name for itself with a line-up of clean, highly automated vehicles. By 2020 it was ready to take on Europe, and dipped its toes in the Nordic’s EV-friendly waters. Norway made a logical choice for a European debut given its high percentage of EV sales (80% of the new market in 2022). Xpeng introduced its G3 SUV there in 2020, followed by the P7 sports sedan in 2021. Further stores opened in Sweden, Denmark and the Netherlands over the course of 2022, but now the automaker is stepping up its game.

The company recently unveiled two new potential heavy hitters for Europe in the form of the updated P7 and the all new G9 SUV, which will be offered in Norway, Sweden, Denmark and the Netherlands. Deliveries are scheduled to begin in June 2023 for the new P7 and September for the G9. *Automotive World* sat down with Elvis Cheng, Managing Director of Xpeng Sweden and the Netherlands, at the company’s design studio in Stockholm to hear more about the European launch strategy.

**Spotlight on Scandinavia**

Scandinavia in general, explained Cheng, is more open-minded than other European markets when it comes to new brands: “It offers a real opportunity for a brand like us from China. Also, EVs are rocketing here. That combination makes this a good region to test our business model and our technology.” Cheng and other members of the management team are very open about the need to gather feedback from these initial markets, which they will use to refine their offering and strategy before entering Europe’s larger markets like France and Germany.

Wherever it goes, Xpeng carries its Chinese heritage, but gone are the days where that entailed questions around quality. “The quality of cars from China is not what it was ten or even five years ago,” he states. “Aside from that, within the EV market it doesn’t matter where a brand comes from. The product speaks for itself. Our unique selling point is in the technology itself, supported by the quality, design and commitment to sustainability.”

**Model close-up**

The new P7 and G9 boast some of the most advanced EV technology in Europe. Management at the Swedish media launch event described the G9 as the world’s fastest charging SUV. The model’s powertrain system introduces China’s first 800V mass-production silicon carbide platform, which can charge the battery from 10% to 80% capacity in just 20 minutes. The SUV also promises a
range of up to 570km (WLTP) on a single charge. As this model is targeted at families and outdoor enthusiasts, it also offers towing capacity for loads up to 1,500kg.

The new P7 can charge at a maximum 175kW, which takes the 10-80% charging time to 29 minutes. Its range is slightly longer at up to 576km.

With touches like leather seats, the company’s own in-house operating system—Xsmart OS—and a huge range of advanced driver assistance systems including autonomous parking, Xpeng is positioning its models as premium but not luxury. “We want to make our product more accessible to customers,” Cheng explains. “That’s important for pricing and market competitiveness. We want to provide plenty of options to make our product more accessible to customers.” Prices for the new P7 range from €49,990 (US$53,430) to €69,990, and €57,990 to €71,990 for the G9.

Customer reach, customer satisfaction

That flexible approach does not extend to the sales model. While rival Nio is pushing hard on subscriptions, Xpeng plans to stick to traditional sales, at least for now. “We see other players using different models but we first need to make sure our basic operation is ready,” Cheng says. “As a new company, we do not have many resources and need to ensure they are focussed on the priority areas.”

For now, that means simply establishing a presence. Denmark and the Netherlands opened a location each in February, and these
will be followed by one in Stockholm in April, another in Gothenburg in June, one in Utrecht in July, and one in Malmö in October. Retail locations will consist of both smaller brand experience locations in high-traffic areas like shopping centres, as well as more traditional forecourts.

“These locations are not only about sales but also marketing,” he adds. The company is working with retail partners in many cases to support its expansion. In Sweden that means three more upcoming stores in collaboration with local partner Bilia, the largest car retail chain in Scandinavia, and in the Netherlands two future stores coming soon with Emil Frey. “It’s not like the usual dealership,” Cheng clarifies. “We own the cars and we are the ones who really manage the brand and marketing. This ensures the same standards and experience for customers.”

Cheng is keen to emphasise the focus on customer service, pointing to the care and attention given not only at the point of sale and delivery, where new owners are walked through the functions of their vehicle, but also the aftersales services. The Xpeng app allows owners to book service appointments and receive support, wherever they are located. “Customer satisfaction is our main priority in the beginning. We are not looking for a big volume right now. This year is all about the customer experience.”

And with EVs, that includes charging. Xpeng has worked with local companies including Plugsurfing and Shell Recharge to ensure that owners have access to more than 400,000 compatible public charging points across Europe. Talks are currently underway to expand that through more partnerships in additional regions. It has also teamed up with local partners to offer home charging units. “We want our customers to be worry free,” emphasises Cheng. “That is our task.”

**International development**

Brian Gu, Vice Chairman and President of Xpeng, hailed the new model launches as “a breakthrough in our international development, and a key indicator of commitment to expanding our presence in global markets.” This European push marks the company’s determination to make a real name for itself in the region, and management remain bullish on its reception among European drivers.

But Xpeng is not the only newcomer with big dreams. Europe is attracting growing attention from many hopeful EV makers. Xpeng’s compatriot Nio kicked off its own European expansion in Norway in September 2021 and is now advancing into Germany, Sweden, the Netherlands and Denmark. BYD is following a similar route. Meanwhile, General Motors is thinking about a return to Europe with an EV-only line-up.

“It will be a crowded space,” observes Christoph Domke, Global Director of Mobility Solutions at Guidehouse. “There’s a lot of demand and a lot of opportunity [within Europe’s EV market]. At some point this influx of new players will stop and then the question will be, who will dominate? I think you have to take the Chinese players very seriously.”
British and American motorists are ready to embrace the safety potential of automated driving (AD). This is one of the conclusions of a major new study published in November 2022 by British automotive risk intelligence company Thatcham Research. The Trust In Automation report polled 4,000 motorists in the US and UK to gauge attitudes towards, and knowledge of, automated driving systems on both sides of the Atlantic.

The findings suggest that there remain significant hurdles to overcome, and motorists require further convincing before they comfortably make the switch to automated driving. Yet the report paints a picture of a consumer marketplace that is broadly receptive to today’s assisted driving technology, and of fertile ground for the gradual move towards fully self-driving vehicles.

This is positive news for the automotive sector. Not only does it suggest the commercial viability of a market forecast to be worth around US$200bn globally by 2030 (according to Strategic Market Research), but it also suggests consumer trust in automation, and by association the current generation of assisted driving systems, remains high.

**Safety first**

Encouragingly, the major appeal of automated driving to consumers seems to be the perceived opportunity to improve road safety.
and reduce accident rates. The study revealed that 73% of UK and 81% of US respondents recognised the safety benefits of automation.

When asked what they consider the key benefits of the technology to be, the most popular answers included improving safety through removing human error (21% UK, and 21% US), improving mobility for the elderly and disabled (14% and 19%), and reducing pollution through fewer traffic jams and unnecessary acceleration/deceleration (8% and 7%). Thankfully, few drivers saw freeing up time to work (3% and 4%), entertain themselves (3% and 4%) or even sleep (2% and 3%) as advantages of automation.

The report did reveal notes of caution among consumers either side of the Atlantic. Most UK and US respondents said they would wait for the technology to mature before purchasing a self-driving car when available. It is therefore crucial the automotive sector maintains the all-important consumer trust, particularly during this delicate phase of assisted driving rollout in which the media and commentators will pounce on any accident related to AD system use and any potential confusion.

Reality check required

Not unsurprisingly, the report also reveals certain gaps in consumer knowledge. One focuses on a key challenge facing all stakeholders in automation in the move towards a self-driving future.
Some 52% of respondents—rising to 72% in the US—believe it is possible to purchase a self-driving car today. This view is more prevalent among younger age groups, where perhaps the influence of social media is more powerful. And the higher figure among US respondents is possibly due the fact that American motorists can already buy L2+ enabled vehicles, which permit an ‘eyes on the road, hands off the wheel’ driving experience.
But this perception of automation is not the current reality. Experts predict we are probably more like a generation away from achieving full automation, or at the very least several car generations. What we do have are a growing number of vehicles with AD systems that take control in certain scenarios, during which the driver must remain vigilant and be ready to take back control of the wheel.
This misconception is influenced by a handful of factors. Media hype is one of them. Consumers are constantly reading about ‘the arrival of self-driving cars’, or how the systems are ‘in testing’, which suggests the technology’s arrival is imminent.

The language used by carmakers is also in play. One of the reasons motorists believe self-driving vehicles are available to buy today is down to a misunderstanding around the capabilities of current assisted driving technology. Marketing hype, inconsistent technology naming conventions, and even the look and feel of a vehicle’s HMI may potentially give the false impression that a vehicle is capable of self-driving.

In fairness, it’s a tricky distinction to make clear—and even tougher to communicate accurately. The differences between L2, L2+ and L3 are significant, but they are also difficult for those outside auto tech labs to get their heads around and the average motorist is simply not going to engage with that level of technical detail. Yet in this nascent phase when the media will pounce on any negative stories involving AD, particularly those involving driver confusion around their responsibilities behind the wheel, it is vital today’s motorists are clear about the current technology’s capabilities.

This matters because consumer trust is key to the smooth—and safe—rollout of current technology, and the eventual uptake of self-driving cars when they arrive. Driver education and clear communication are the answer, and in this all stakeholders have a vested interest.

Happily, the interests of governments, consumers, carmakers, insurers, and automotive research centres such as Thatcham Research are aligned. Fewer misunderstandings around the capability of assisted technology means fewer accidents and related...
claims, fewer dents to consumer confidence, fewer negative press reports, and ultimately ensures a marketplace that is receptive to the potential of autonomous vehicles.

**Collaboration is key**

In this environment, collaboration between all stakeholders must be the way forward. An example of this collaborative approach can be seen in the SMMT’s guiding principles for marketing automated vehicles, published in 2021. The principles, developed and agreed by the UK government’s Centre for Connected and Autonomous Vehicles’ AV DRiVE Group—of which Thatcham Research is part—provide an outline for responsible advertising and communication relating to automated vehicles.

The CCAV is an expert policy unit that collaborates with the automotive industry and academia, and the guidelines aim to ensure motorists receive clear, consistent and accurate information about automated vehicles and the true extent of their capabilities on the road. Not only does this build a positive pathway towards full automation, it also ensures drivers are aware of their responsibilities while driving today’s crop of assisted or partially-automated vehicles. If consumer confusion threatens to stymie the rollout of automated technology, initiatives like the SMMT’s will be crucial in helping the industry realise the huge potential of automation in terms of safety, mobility and the environment.

It is also the case that not all automation systems are created equal, with significant differences in quality from vehicle-to-vehicle. Thatcham Research believes one of the ways the industry can maintain consumer confidence is through a consumer safety rating system for automated driving, allowing motorists to make the right safety choices with a certain degree of confidence.

Together, we can underpin the safe adoption of assisted driving technology today, and pave the way for the successful rollout of automation tomorrow. Trust is everything, and we must all push in the same direction to help build and maintain it.

*About the author: Matthew Avery is Chief Research Strategy Officer at Thatcham Research*
Speculation is rife about General Motors’ (GM) strategy after the company announced a wider return to Europe following a six-year hiatus. GM sold its Vauxhall and Opel brands to PSA Groupe, now a part of Stellantis, for US$2.2bn in 2017. GM’s return was confirmed in November 2022 with the appointment of Jaclyn McQuaid as President and Managing Director of GM Europe in Zurich, Switzerland.

A GM statement says McQuaid is tasked with implementing “a nimble, non-traditional mobility start-up, with an all-electric vehicle portfolio at its core.”

The European subsidiary of the company has already installed a European Design Centre in the UK and an IT hub in Ireland, which opened at the end of 2022 to support the rollout in 2023. At the time of writing, GM has not disclosed detailed plans for EV sales on the continent. However, the company’s Q4 letter to shareholders 2022, in which the Chevrolet Bolt EV and Bolt EUV are lauded as the best-selling mainstream EVs in the US for the second half of 2022, could provide an indication. The company states that production of these models will increase to “more than 70,000 this year for global markets.” Production is also increasing for other models in the US—the Cadillac Lyriq, GMC Hummer EV and BrightDrop

GM is returning to Europe with EVs but faces challenges with production costs and fierce competition from rivals. By Chris Eyte

Does GM stand a chance in Europe’s emerging EV market?
Zevo 600—raising the possibility that these vehicles will appear on the other side of the Atlantic.

The Cadillac brand maintained a very limited presence in parts of Europe after the sale to PSA Europe, but could play a starring role in GM’s return. “With the premium brand expected to be the first to go all-electric, it would make a good starting point for a broader entry for GM, along with Chevrolet,” suggests Sam Abuelsamid, Principal Analyst E-Mobility for Guidehouse Insights.

**More Europeans are buying EVs**

Even so, GM is returning to a changing automotive landscape, as EVs increasingly dominate. EV Data Center records a 15% increase year-on-year of battery-electric vehicles (BEVs) sold in Europe, equating to 62% of 2.68 million plug-in electric vehicles purchased in 2022. Predictions for 2023 show a further uplift of 25% year-on-year for EVs on the continent.

The results of an October 2022 poll by the Associated Press-NORC Center for Public Affairs Research might suggest that GM wants to market EVs in Europe as an alternative sales funnel to the US. It found that only one in ten American adults was...
“extremely or very likely’ to buy an EV in the next three years. The Biden-Harris Administration also faces political challenges about the switch to EVs from the Republican party, which may constrain EV investment.

McQuaid claims that more Europeans are buying EVs than anywhere else. “European customers are switching to EVs at a faster rate than anywhere in the world, and GM is investing US$35bn through 2025 in electric and autonomous vehicle technology to be a major driver of our industry’s transformation.”

A manufacturing conundrum

A key question for GM now is simply where will the new EVs for European customers be built? Currently, GM has no EV manufacturing plants in Europe—meaning it must install them or import models from the US. Both entail challenges. Energy costs have increased due to the war in Ukraine, with an estimated fourfold rise in per-unit production costs for passenger cars made in Europe.

Senior Lead Economist Robert A. De Santis raised similar concerns in the European Central Bank Bulletin (issue 7/2022). He points out that, despite the growth in popularity of EVs, the factors of war, energy costs and supply chain issues have “affected euro area automotive production more severely” than other markets.

On the other hand, importing cars from the US presents other challenges for GM. The Baltic Dry Index, a benchmark for moving major raw materials by sea, and showing the costs in US dollars via a point scale, is still volatile despite declining since December 2022. Throughout 2022, the index ranged between 1,368 and 3,300 on the point scale for dry bulk cargo, including vehicles, shipped on 20 standard ocean routes.

“The automaker will be forced to pass on these costs to maintain its cash flows,” says Arushi Kotecha, Automotive and Climate Change Analyst at The Economist Intelligence Unit (EIU). “It will also need to make further investments in the green transition, especially given Europe’s ever tightening regulatory regime around emissions and fuel economy.”

Plugging gaps in the European market

Pedro Pacheco, Vice President of Research in Gartner’s CIO Research Group, sees a correlation between GM’s return to Europe with the company’s corresponding return to

European customers are switching to EVs at a faster rate than anywhere in the world
Australia, following the sale of its GM-Holden subsidiary at the end of 2021. In his opinion, the increased demand for EVs, which is “clearly heating up” with the emerging presence of Tesla and Chinese automakers, means GM does not want to be left behind. “The available products on the market today don’t cater for the entire needs of EV customers,” says Pacheco. With room in the market for innovation, he states that GM “likely believes it can meet those needs.”

While GM has a good standing in EV technology and developing software, Pacheco believes that a major concern is the EV market taking off in Europe without the company onboard. “Strike while the iron is hot,” is his summary of the automaker’s intentions: “GM wants to take the opportunity to seize a part of the EV market before it’s too late.”

With its existing EV technology, the automaker could have an advantage in the European market. Pacheco says the number of vehicle companies with excellent EV tech is “only a handful”. He asserts it was more of a level playing field with internal combustion engine cars because the tech between companies was not too dissimilar. “There were not so many of the big gaps we see with pure EV powertrains, and this is the sort of scenario that GM is hoping to explore.” He predicts GM snatching market share away from “EV laggards” faltering to keep up with the electrification trend.

Despite these predictions, there remains an element of uncertainty to GM’s future in Europe. “We are quite limited in what we are saying currently,” a GM spokesman tells Automotive World. Pacheco concludes that regardless of how production is organised, GM will face fierce resistance from other brands already established on the continent. “GM either has an absolute killer product to amaze the European consumer or things are going to be a lot more difficult for it with this move.” These questions about GM’s long-term plans will only be answered when the automaker decides to publicly announce the next stages of its European EV rollout.
The battle for global battery electric vehicle (BEV) leadership will intensify in 2023. Battery prices remain critical to cost competitiveness, with automakers chasing the same commodities simultaneously.

Escalating EV battery costs and supply constraints could be the industry’s next bottleneck, according to a December 2022 Bloomberg Intelligence report. “This means there is only a two-horse race for BEV supremacy, with VW as the sole contender for Tesla’s crown,” says Michael Dean, Bloomberg Intelligence Senior Industry Analyst.

In the US, Tesla continues to dominate EV sales, accounting for 65.4% of the EV market, according to Experian’s Automotive Market Trend Report.
December 2022 report. However, that figure is on a steady downward trajectory, from 68.2% in 2021 and 79.4% in 2020. In Europe, it holds just 20%. However, this is still close to VW’s slight market lead of 21%. Meanwhile, their other automotive peers are lagging behind substantially.

Indeed, VW has had a taste of leadership since Q4 2020, when its brands—including Porsche and Audi—sold more EVs worldwide than Tesla, according to AlixPartners: 192,000 fully electric and plug-in hybrid vehicles Q4, compared to Tesla’s 181,000.

**Tech issues**

Although technology is widely considered Tesla’s advantage, its shares have fallen recently because of investor doubts concerning its lofty growth expectations and misleading autonomous driving capabilities. Nonetheless, Dean believes Tesla’s newly increased EU capacity through the opening of its Berlin Gigafactory should allow it to retain its BEV sales crown until 2024. “However, VW is hot on its heels and could overtake in 2025-26, assuming software delays are resolved.”

In 2021, a VW software glitch caused 56,000 cars to be recalled. Then, in 2022, in-house software Cariad caused further issues and delays. The Audi Q6 E-Tron and Porsche Macan releases, scheduled for 2023, have already been delayed to 2024. Delays and cost overruns were among the factors behind the VW supervisory board’s 2022 decision to oust Herbert Diess as Chief Executive and replace him with Porsche Chief Oliver Blume.

Delays were also due to supply chain constraints, particularly semiconductors. “Despite VW’s advantage in size and production, this proved problematic during the COVID-19 pandemic,” says Faustin Magnin, Automotive Equity Research Analyst at market research firm Woozle. It’s not surprising, then, that VW is investing €30bn (US$32.9bn) in its supply chains, including six new battery-cell plants in Europe by 2030. Sweden’s Northvolt is scheduled to begin production on premium cells for VW in 2023.
Price war

Another battlefront is consumer affordability, which Tesla is impacting through its decision to slash prices by as much as 20% in January 2023—a direct challenge to its rivals. It will likely attract buyers previously priced out of the market, as the reduction broadens the vehicles in Tesla’s line-up eligible for the US tax credit. The Tesla Model Y—one of the best-selling EVs worldwide—started at US$65,990 ahead of the price cuts. Tesla lowered it to US$52,990 on 13 January 2023 and later raised it slightly to US$53,490 the following day. It is also eligible for a US$7,500 federal Inflation Reduction Act (IRA) EV tax credit. Altogether, the model is US$20,000 cheaper than it was in 2022.

As such, this marks the beginning of a price war that Magnin highlights “could significantly hurt legacy manufacturers.” Although it may be too soon to determine the full magnitude, Ford’s 30 January announcement that it is making major price cuts to its Mustang Mach-E EV, comparable to Tesla’s Model Y, could prove broadly indicative. These cuts average about US$4,500, depending on the model’s features. The vehicle’s pricing now ranges from US$45,995 to US$63,995. Previously, its maximum was just below US$70,000.

Notably, VW announced on 31 January that it would not follow Tesla’s price cuts. VW sells the ID.4, a direct rival to the Model Y, at a starting price of around US$40,000, which already undercut the Model Y by US$26,000 before Tesla’s updated prices and remains US$13,500 cheaper even after the cuts. Furthermore, VW’s owners in the US are also eligible for the US EV tax credit, lowering the price tag by another US$7,500. “As the IRA went into effect, VW’s EV sales accelerated substantially,” says Ilana Shabtay, Vice President at market data firm, AutoLeadStar. VW saw a 126% increase in H2 2022 compared to the H2 2021—accounting for about 5% of US car purchases in 2022, according to AutoLeadStar.

However, VW’s overall EV sales are still substantially behind Tesla. The German automaker sold around 330,000 in 2022 (not counting EVs from its other brands) compared to Tesla’s 1.3 million, up 40% compared to its 2021 sales.
Markets

It’s possible that all of VW’s headwinds will be limited to Europe. Although the automaker enjoys a leading 21% BEV market share in the region, this dominance needs to be replicated in other markets, particularly China, where its BEV share from January to September 2022 only accounted for 4% of the market, says Dean. “China’s carrot-and-stick approach to stoking EV sales could push BEVs to account for 25% of all passenger vehicle purchases by 2025. Despite erratic component supply, sales in China have surged since the launch of the country’s new energy vehicle credit programme,” says Steve Man, Senior China Automotive Industry Analyst at Bloomberg Intelligence. VW sales in China may come at the expense of pricing and profitability, having ceded first-mover advantage to Tesla and local makers.

Volkswagen successfully continues e-offensive

Deliveries in 2022

GLOBAL DELIVERIES OF ELECTRIC CARS RISE CONSIDERABLY

330,000

+23.6%*

DELIVERIES OF ELECTRIC CARS MORE THAN DOUBLED IN CHINA

143,000

+102.9%*

GLOBAL DELIVERIES OF ALL CARS

4.56 M

*Percentage comparison with same period of previous year
“VW is much more established in Europe than in China. Its software problems make its car unattractive to Chinese consumers, especially young buyers looking for a smartphone on wheels,” says Magnin. Furthermore, the gap between Tesla and VW in terms of software is significant, especially for autonomous driving. “In North America, VW is still behind Ford, Chevrolet and several Asian brands,” he adds.

Infrastructure

Nevertheless, infrastructure could play a key role in determining the BEV leadership. “This is one area in which the US is lagging,” says Dean. Indeed, VW announced in January 2023 that it produced over 15,000 high-power charging (HPC) points for EVs connected to the charging network worldwide by the end of 2022. The automaker has teamed up with BP on building 8,000 charging points in Europe, which are being installed with help from Ionity and launched by VW, Audi, and Porsche.

By the end of 2023, the automaker intends to operate up to 25,000 HPCs worldwide, with plans for 10,000 in North America, 18,000 in Europe, and 17,000 in China by 2025. Despite these efforts, Tesla is still ahead on overall numbers. As of December 2022, Tesla operates 40,432 Superchargers in 4,470 stations worldwide, an average of over nine chargers per station,

The majority of Tesla Superchargers are limited to own-brand models only.
including 1,772 stations in North America and 1,801 in Asia-Pacific. However, it has a significantly smaller market share in Europe—only 897 stations—and it is here that VW is scheduled to overtake.

VW is pushing itself to the forefront of the EV race and its associated infrastructure worldwide. It is also the only automaker to create a broadly accessible network of HPC points for BEVs, regardless of brand. This is in contrast to Tesla’s HPCs—although a non-Tesla Supercharger pilot has been running since November 2021, most charge points can only be used by its own models.

“Using an open-source model for EV charging infrastructure is much healthier for the industry and more beneficial to consumers,” adds Peter Olmsted, FreeWire’s Director of Public Policy, suggesting that it could be a turning point for VW. FreeWire designs and manufactures battery-integrated ultrafast EV charging stations.

With Tesla’s market share in the US declining 14% since 2020, VW’s lead in Europe and accessible-to-all EVs HPCs could see both brands competing head-to-head very soon. Although Dean believes VW could surpass Tesla by 2025/26, predictions remain divided. Richard Reina, Technical Expert and former Volvo Cars engineer, is sceptical: “For the past decade, pundits have been predicting that the legacy automakers would eventually catch up with Tesla. It has not happened yet.” All eyes will be on VW to see if it can be the first to finally break Tesla’s streak and take the lead in automotive’s new electric era.
No app, no card: is this the future of EV charging?

BMW believes multi-contract Plug&Charge technology could prove a game-changer. By Megan Lampinen
The long-term success of electric vehicles (EVs) is inevitably tied to the charging experience. No matter how attractive the cars or how smoothly they drive, sales will stall if owners struggle to access or pay for the electricity they need to power them. Not everyone has the luxury of a home charging unit, so that means public charging infrastructure will need to up its game.

The European Automobile Manufacturers’ Association (ACEA) forecasts that around 6.8 million public charging points will be needed across Europe by 2030 as more drivers switch to EVs. Charging point numbers have been growing rapidly, soaring 180% over the last five years, but it’s still not enough. As it now stands, ACEA’s target would require a 22-fold increase in the number of chargers installed per year.

Then there is the payment aspect. Europe today lacks a widespread industry standard for payment acceptance at EV charging points. In many cases, consumers do not have a choice in how they pay and are forced into signing up to a specific app or provider programmes. Those that are not registered with the right service could find themselves unable to charge.

“Independently of car brand and country, charging is still perceived as one of the main obstacles when customers think about their next car,” says Andreas Aumann, Vice President of BMW Product Management. “Customers value effortless charging, in particular using their own wall box at home, but also on the go.”

Plug&Charge

BMW is investing billions to position for an electric future. By 2030, it expects at least half of its global deliveries to consist of EVs. To support that push, it has been working on the charging
experience for more than a decade and is one of the investors behind Europe’s fast-charging network, Ionity. The automaker’s latest step sees it introduce a new Plug&Charge function that allows drivers to use public charging points without a charging card or app. The promise is that this makes charging the battery “even easier than refuelling a conventionally powered vehicle.”

From mid-2023, certain BMW models will be able to automatically grant the authentication required for charging and billing. The driver simply connects the charging point to the vehicle charging port and the necessary data will transfer via the cable along with the electricity. While other setups require the user to activate the energy feed-in using an app or charging card, here the vehicle authenticates itself independently by transmitting the customer’s contract data. An added bonus is that the process does not need an online connection at the charging location, making it much more convenient for locations like underground garages.
Initially it will be offered in Europe and the US, with more markets to follow depending on the number of charge point operators (CPO) and mobility service providers supporting the Plug&Charge standard. The only requirement in Europe is that providers must be connected to Hubject’s Europe-wide eRoaming network. “Plug&Charge has not been offered by a substantial number of CPOs in the past, but this is changing now,” Aumann tells *Automotive World*. With BMW’s offering, multi-contract functionality allows customers to digitally store multiple charging contracts in the vehicle from at least five different providers. “We see multi-contract handling as a key enabler for an optimal Plug&Charge user experience,” he adds.

**Charging outlook**

For EV drivers, the flexibility of this feature will come as a welcome development, and it could sway buyers that are debating between various EV brands. However, there are still plenty of kinks in the wider charging experience. Numerous studies highlight that EV charger reliability remains a huge concern. For example, researchers with the University of California, Berkeley, recently found that about 23% of individual connectors examined from 181 public fast-charging stations in the San Francisco Bay were not functional.

BMW remains undaunted in its outlook, with Aumann insisting: “In the long run, Plug&Charge will become the dominant authorisation method at public charging points. CPOs and the automotive industry are working together based on robust standards—ISO 15118 in this case—to ensure interoperability. At the end of the day, customers will choose the charging station that provides the most reliable service.”

What good is Plug&Charge if the connector doesn’t work?

Multi-contract Plug&Charge technology represents a decided step forward in the charging experience, but advancements don’t stop there. Moving ahead, Aumann expects to see the gradual integration of EVs into the energy market through developments around cost-optimised managed charging or even bi-directional charging schemes. But how far can advances take the charging experience? “If there is a holy grail, then it is free energy for the electric car by making the car a part of the grid,” says Aumann. BMW is actively working on a number of projects to enable these technologies for EV drivers down the line.
New electric vehicle (EV) registrations in India reached over one million in December 2022, according to data from the Ministry of Road Transport and Highway. This represents approximately 300% year-on-year growth. Helped in no small part by the purchase incentives of the Faster Adoption and Manufacturing of (Hybrid and) Electric vehicles (FAME) scheme, the country is undergoing a significant shift to electrification. However, another economic trend is poised to accelerate the change even further: e-commerce.

As India experiences an e-commerce boom, small electric mobility options could capitalise on a more logistics-focused economy.

By Will Girling
Online market data platform Statista forecasts exponential growth in India’s e-commerce sector until the end of the decade—from US$74.8bn in 2022 to US$350bn in 2030 (+368%). Increased online shopping necessitates a concurrent rise in last-mile vehicle logistics. However, with Mumbai and Bengaluru ranked in TomTom’s top ten most congested cities in the world, this boom is unlikely to be served by cars and trucks.

“A new approach

Determined to promote electric mobility through reliable, high-performance, and competitively priced vehicles, Nae Mobility selected Azad Group—one of India’s oldest bus makers—as its manufacturing partner. Designs will be revealed when the vehicles are launched gradually throughout H1 and H2 of 2023.

Only small vehicles like two- and three-wheelers can navigate and load cargo in India’s streets with ease

“Only small vehicles like two- and three-wheelers can navigate and load cargo in India’s streets with ease,” asserts Ravi Kulkarni, Co-Founder and Chief Business Officer of Nae Mobility. Based in Bengaluru, the manufacturing start-up aims to produce a range of small EVs that are tailored specifically for the busy driving conditions of India.

Catering for both B2C and B2B use cases, Kulkarni tells Automotive World that Nae Mobility will initially focus on the electric three-wheeler (also called ‘auto rickshaw’) market, which he believes has been underserved: “These are very neglected products in terms of features and battery solutions.” This is corroborated by market researcher Mobility Foresights, which found that the
sector relied on one company (Bosch) for the majority of its e-powertrain innovation. Subsequently, technology has stagnated and investment up to Q1 2023 has been limited.

The difficulty with switching from internal combustion engine (ICE) three-wheelers to all-electric, continues Kulkarni, is that manufacturers must re-evaluate vehicle manufacturing from top to bottom. “Range and performance are affected by weight. OEMs need to explore alternatives, such as using composite materials instead steel sheets, in order to reduce weight without compromising quality, strength or cost.” The all-important battery must also deliver a high range relative to each charge, although he emphasises that this should be achieved by improved motor-controller efficiency rather than simply increasing pack size.

Reducing fleet downtime

Optimising motors and battery packs to provide better performance than ICE is a perennial challenge for any automaker operating in the EV space. Last-mile vehicles’ confined operating areas and greater access to charging or battery swapping make range theoretically less consequential than other vehicle types. Nonetheless, Nae Mobility considers this a valid basis for brand differentiation.

There is already stiff competition on this front: Omega Seiki Mobility released its OSM Vicktor three-wheeler in late 2022, with an industry-leading range of 250km from a single charge. Subsequently, Nae Mobility is working with an undisclosed partner to produce a range of battery solutions for its own vehicles. These will include a lithium-ion (Li) pack with a 150km (or more) range, but also a 110km rapid charging, liquid cooled Li-battery pack that can be fully charged in 15 minutes. “That’s about enough time for the driver to have a coffee,” notes Kulkarni. He expects this to reduce vehicle downtime and allow B2B fleets to maximise both e-commerce business opportunities and driver earnings. Notably, this innovation would also see Nae Mobility overtake industry competitor Altigreen’s neEV TEZ three-wheeler, which previously led the sector with an identical charge time but only 85-98km of range.

The company’s vehicles will be compatible with home chargers, public stations, and other rapid charger units. However, as of December 2022, the ratio of EVs to charging stations in India is approximately 360:1, according to Mint. By comparison, the EU’s stated ideal ratio is 10:1. Appropriately, Kulkarni states that Nae Mobility is also focusing on facilitating better vehicle operating experiences without adding more charging infrastructure. Specific innovations include batteries that can be swapped in under two minutes and an exclusive mobile app paired with over-the-air software updates. “GPS tracking will provide accurate data to analyse vehicle routing, performance, battery pack health, error management, etc. The app will also help customers find local charge points, access roadside assistance, and more,” he says. Nae Mobility aims to improve its products and services constantly to meet customer needs as they evolve—agility that will be needed in India’s rapidly evolving mobility market.
Small vehicles suit India

India’s electric three-wheeler market is expected to make incremental gains through to 2027—from US$754.5m in 2022 to US$1.9bn in 2027 (CAGR 16.25%), according to research and consulting firm Imarc Group. Among the reasons cited include customers’ concerns about vehicular pollution, congestion in cities, and rising fossil fuel costs. Indeed, the Ministry of Petroleum and Natural Gas recorded 78 price hikes and only seven reductions for gasoline between July 2021 and 2022.

Three-wheelers make the perfect vehicles for e-commerce operations

For e-commerce businesses seeking to increase profit margins, switching to a cheaper and more nimble form of electric transport could be an ideal mobility solution. “Three-wheelers make the perfect vehicles for e-commerce operations,” says Kulkarni. “Their loading capacities are generally 500-700kg, which is optimal for any logistic player’s day-to-day operations.” He adds that EVs’ running costs also make them considerably easier to run profitably over time—approximately Rs 0.7 (US$0.0089) per km, compared to Rs 9 per km for a gasoline ICE model.

With phase two of India’s FAME scheme expected to last until the end of March 2024, the government will support an estimated 500,000 electric three-wheeler purchases. Kulkarni states that Nae Mobility will also be “providing the necessary financing” to support customers in making the transition. “We are planning to increase EV awareness and promote their advantages and earning opportunities over ICE vehicles,” he concludes. As the Indian economy becomes increasingly focused on e-commerce, a new wave of small electric vehicles could capitalise on and maximise the change for businesses.
Global automotive sales were hit hard by the pandemic; the market lost confidence and buyers remained understandably cautious, even when COVID-19-related restrictions began to lift. Light vehicle (LV) sales eventually started to rally in 2021 and thankfully moved up a gear in 2022—for the past 12 months, global LV sales are expected to show a 3.5% year-on-year growth. Interestingly, electric vehicles (EVs) and hybrids are where the industry has seen the most movement.

According to the latest EY research, EV sales are expected to outpace the market, with growth of around 48% in 2022 set to reach 9.4 million units globally. More importantly, what does 2023 hold in store?

The good news is that projected sales for the upcoming 12-month period look set to return to pre-pandemic levels with a growth of around 9%. Once again, EVs and hybrids provide a highlight; the sector is expected to grow by 29% year-on-year in 2023, to reach an estimated 12.1 million units globally. However, the threat of an impending recession and ongoing supply chain issues could cast a shadow over the personal vehicle market.

Challenging conditions on the road to recovery

It’s clear that the automotive industry will need to find ways of navigating the supply chain disruptions caused by the pandemic, and new approaches...
The energy crisis has severely hit automakers' profit margins.

The energy crisis has severely hit automakers' profit margins. This is likely to continue well into 2023 and many automakers are expected to pass the costs on to customers. However, EY research suggests that the

will be required to tackle worsening bottlenecks, which have been exacerbated by the war in Ukraine. As a result, automakers are expected to shift from “just-in-time” to “inventory banking” strategies to increase supplies, despite the additional inventory costs. To protect themselves from further supply chain disruptions, automakers are increasingly likely to consider vertically integrated business models, particularly in the battery value chain, with localised battery manufacturing rather than importing cells from one or two large suppliers. We will see increasing examples of a blended strategy here.

Significantly, the energy crisis has severely hit automakers’ profit margins.
supply chain challenges will start to ease, enhancing capacity in vehicle production. Consumer demand remains strong and there’s good reason to be optimistic about EV sales in 2023. But certain regional variations are expected to emerge.

The US light vehicle market is projected to grow by around 10% to 12% in 2023, with total sales of more than 14.5 million vehicles. However, macroeconomic issues and geopolitical uncertainties present a significant risk to this anticipated growth number. EVs are forecast to have 61% growth, with around 1.5 million in sales; a market share of 10%, up from 7% in 2022. The European LV market is also expected to experience double-digit growth during 2023 with overall sales exceeding 13 million vehicles. EVs are projected to register more than 50% growth, delivering around 2.8 million in sales; a market share of 22%, up from 16% in 2022.

However, things don’t look as promising in China, where sales are expected to be flat for much of 2023. Nonetheless, anticipated sales will total more than 26 million vehicles with the EV segment seeing a 20% growth, with around 6.2 million in sales—a market share of 23%, up from 19% in 2022. Potential COVID-19 outbreaks and shutdown strategies are wildcards for China and could impact volumes significantly depending on the direction.
While the automotive industry faces several challenges, EVs are leading the charge with growing global interest. The EY Mobility Consumer Index revealed that 52% of the intended car buyers globally favor either a fully electric (EV), plug-in hybrid (PHEV) or hybrid vehicle. There is a three-fold growth in preference for fully electric cars, up from 7% in 2020 to 20% in 2022.

The move toward electrification is therefore expected to gain additional momentum in 2023, on the back of regulatory push along with stringent timelines and targets for bans on some types of internal combustion engine (ICE) vehicles. As a result, and if trends continue, 50% EV penetration, battery electric and plug-in hybrid (BEV+PHEV) is expected to be achieved in Europe by 2027 and in the US and China by 2032.

A major growth contributor is the waning range anxiety. The increasing availability of long-range EVs, continuous improvement in battery technology and evolving charging infrastructure are making consumers less anxious of range. Increasing experience with EVs in personal environments will further alleviate consumer concerns.

Modern EVs are increasingly becoming cutting-edge pieces of technology, loaded with smartphone-like connectivity and infotainment systems, with features that appeal to younger consumers. Consequently, automakers are accelerating their plans to deploy technologies, such as advanced driver assistance systems, in vehicles to attract young drivers. Plans for full autonomy have been delayed, partly because of growing technical and regulatory complexities.
Automakers are instead expected to focus more on providing customised in-vehicle experiences; digital cockpits, biometrics, voice-enabled services, while display screens are expected to shift from touch controls to haptic feedback and voice commands with artificial intelligence-based digital assistants. Chinese manufacturers are leading the charge when it comes to EV adoption, and the development of enhanced 5G is expected to unlock advanced connected car capabilities, which are expected to have strong growth in 2023. There’s also talk about using augmented reality (AR), virtual reality (VR) and the metaverse to enhance the customer experience.

To bring these features to realisation, automakers will need to balance in-house software development with established technology partners to leverage their software expertise to deliver best in class software-defined features to customers.

**Bridging the skills gap**

One of the biggest gaps the automotive industry currently faces is a scarcity of skills. With the advent of megatrends such as electrification, the demand for tech talent has increased, while several roles have become redundant, including traditional engine assembly and...
service technicians. There is therefore a real need to reskill the existing workforce, which will require a significant investment, as hiring new talent will not always be an option due to the industry’s inability to offer the types of remuneration packages available in the tech sector.

Equally, growing regulatory scrutiny for decarbonisation will continue to push automakers to take concrete actions toward long-term sustainability goals. But they will need to find a balance between their business objectives and meeting green demands.

The end of the ICE?

To move to green mobility, automakers will have to strike the right balance between optimising today’s business, while simultaneously investing in the vehicles of tomorrow. It’s already starting to happen—80% of the key auto markets are aiming to phase out ICE vehicles by 2035, a move that is being accelerated by the rapid expansion of clean air or low-emission zones. There are also growing concerns about battery recycling, with steps being taken in the EU to help ensure the proper infrastructure is in place to facilitate it.

Automakers are therefore expected to sharpen their focus on sustainable operations, including the end-of-life processing of vehicles, including EV batteries, sustainable sourcing of parts and increased use of recyclable materials in the overall design. What is abundantly clear is that 2023 is going to be a year of substantial change. Old “box on wheels” technologies will be supplanted by new smart vehicle technologies. The switch to EVs is rapidly reaching critical mass and the influence of environmental demands will further hasten the move to greener personal

Potential COVID-19 outbreaks and shutdown strategies are wildcards for China and could impact volumes significantly

transport. Bringing this all together against a backdrop of supply chain uncertainty and a burgeoning energy crisis will be hard work but the consumer demand is there so a route through will be found.

The ICE car park is still extensive and will remain very large even with the targets mentioned above. One of the key questions remains: What do we do with the existing ICE vehicles?

The views reflected in this article are the views of the author and do not necessarily reflect the views of the global EY organisation or its member firms.

About the author: Randy Miller is Global Advanced Manufacturing & Mobility Leader at EY
Hyundai and IonQ use quantum computing to propel EVs and AVs

Quantum computing’s near-infinite problem-solving capacity could propel automotive into the next stage of autonomy and electrification. By Elle Farrell-Kingsley
While the latest generation of connected cars have been upgrading their human-machine interface (HMI) systems to run via computers, supercomputers and gaming computers, the next development could very well be quantum computing. Quantum computing leverages quantum physics and engineering to perform advanced calculations and data simulations. According to market researcher Statista, the quantum computing market could reach US$93bn in the US alone by 2040. China, Japan and the EU are at the forefront of quantum patents, while China, the Netherlands and the UK are leading in quantum adoption.

In the US, IonQ is leading the revolution—opening the first quantum computing manufacturing facility in Washington. Subsequently, IonQ Co-founder and Chief Technology Officer Jungsang Kim states that his focus has been building on innovations in quantum mechanics and transforming them into a more practical technology. “We’re at a very exciting place of looking at the technology’s industry applications, starting companies, and pushing commercialisation,” he says. Automotive presents one such promising application: quantum hardware’s extensive problem-solving capacity makes it well suited for addressing prevailing issues in electric and autonomous mobility.

**Quantum vs classical**

The advantages of quantum systems over classical computers involve superposition and entanglement. For superposition, classical computers process and store units of data (bits) in a binary system of zeroes and ones. Comparatively, quantum computing contains quantum bits (qubits) that can represent a zero and one simultaneously. “If there’s one bit, it doesn’t make too much difference. But for sums with ten bits, two sets (the zeroes and ones) of ten bits means there are ten sets of 24 possibilities,” notes Kim. For classical computers to consider all these possibilities, they would need to process this a thousand times.

“By the time it reaches 300 bits—which is still not very much, as a typical smartphone has hundreds of gigabytes of memory—the number of possibilities that this can represent is larger than the number of atoms in the universe,” he says. To put this power into perspective, in 2019, Google’s quantum computer, Sycamore, calculated in four minutes what would have ordinarily taken AVs are still in their infancy, yet the quantum-derived algorithms we’re testing today have the potential to shape the commerciality, efficiency and safety of such systems.
over 10,000 years for the world’s most powerful computer at that time, IBM’s Summit.

Meanwhile, the second feature—entanglement—was the topic of the Nobel Prize in Physics in 2022. When two particles, such as a pair of photons or electrons, become entangled, they remain connected even when separated by vast distances. Entangled quantum states have the potential for new ways of storing, transferring and processing information, according to Prize winners Alain Aspect, John Clauser and Anton Zeilinger. “Using superposition and entanglement together, we can solve problems in automotive that would have taken classical computers ages to solve,” says Kim.

The development of AVs

Superposition and entanglement are key in taking quantum systems to the next level. “If you utilise them carefully, you can achieve highly functional computational powers that are otherwise unavailable,” says Kim.

Subsequently, Hyundai and IonQ are working together to make the latter’s quantum computer machine vision algorithms capable of conducting object detection on three-dimensional data captured by autonomous vehicles’ (AV) sensors. “AVs are still in their infancy, yet the quantum-derived algorithms we’re testing today have the potential to shape the commerciality, efficiency and safety of such systems,” says Kim.

AVs rely on AI to power cameras, sensors, and advanced drive assistance systems. Similarly, self-driving cars must react to dangerous scenarios, such as a person running out in front of the car and potentially causing a collision. “All of this is achieved by computing and algorithms today, and, as the complex situations come about, this is where a lot of computational power is being used,” he says.

Kim states that using quantum computing could fine-tune complex AI decisions and improve overall predictive capabilities: “We are shifting the paradigm by which we’re tackling this problem. As the technology evolves, we can do computations billions of times faster.” This will allow AVs to be deployed faster as the technology and its current problems are solved quicker. Kim notes that using quantum computers can also secure future commercial advantages, such as reduced costs and quicker processing times when developing AV software.

Increasing battery range

IonQ and Hyundai will also utilise IonQ’s industry-leading quantum computers to simulate electrochemical reactions of various metal catalysts. The new projects build upon previous work conducted between the two companies and further the role quantum computers have in developing the smart, environmentally friendly vehicles of the future. A positive outcome of this partnership, notes Kim, is that Hyundai has highlighted problems that quantum engineers had not previously considered: “It’s kind of where two imperfect parts meet: people who know the problem but don’t know any more advanced algorithms, and vice versa.”
Some of the problems experienced by automotive companies, he notes, are relatively easy to solve. For example, connecting iPhones to the screen on the car is a problem for which automakers already have the technology and solution. However, more complex issues, such as how automakers can triple or quadruple the range of a battery in an electric vehicle (EV), require a more complex approach.

In terms of extending battery range and fast charging, Kim explains that these are rooted in the underlying principles of battery chemistry and catalytic reactions, which must be understood to be resolved. However, he warns that “fundamentally, these chemical reactions are quantum mechanical, and therefore the complexity of these computations is exponentially more difficult.” The aim of IonQ’s research paper, titled *Orbital-optimised pair-correlated electron simulations on a trapped-ion quantum computer*, is to help automotive engineers better understand the electronic configuration of molecules—lithium in this case—and chemical reactions in batteries.

In December 2022, IonQ developed a new quantum algorithm to help make EV batteries cheaper and extend their charge. The algorithm can simulate the molecules involved in the lithium-air reactions that occur within lithium-ion batteries. It can then yield accurate predictions that help battery engineers understand the configuration of molecules, their energy profile and how they react. “If we can understand these battery chemistries and learn how to improve either the charging characteristics or the storage capacity, we can improve the efficiency of current technology and develop the next generation of batteries,” concludes Kim.
Munro plugs electrification gap for rugged off-road utes

There’s a gap in the market for an electric 4WD utilitarian workhorse, but not for long. Megan Lampinen hears more
Electrification is slowly but surely making its way into both luxury and affordable passenger cars, as well as light commercial vehicles and even heavy trucks. But for rugged off-road applications in harsh environments, there’s a decided dearth of options. Emergency rescue, mining, remote infrastructure maintenance, and recreation operators have little choice if they want to convert their fleet to zero emission. That’s where Scottish start-up Munro comes into play.

The Glasgow-based manufacturer appeared on the scene in 2019 and is preparing to launch its first model, the Munro MK_1, in 2023. “My Co-founder Ross Anderson and I realised we have to do something about the environmental challenge,” says Russ Peterson, who also serves as Chief Executive. “We’ve managed to come up with a project that has a large impact on industries that have proven difficult to decarbonise. This is not just another electric SUV.”

As rugged as the Scottish mountains

Munro Vehicles is named after the collection of Scottish mountains that measure more than 3,000 ft high, and that’s exactly the sort of rough terrain in which its MK_1 shines. It’s all about functionality, durability, longevity, reliability and ease of repair. “We were trying to make a work companion,” explains Peterson. “When you look at it across the parking lot you think, ‘I really want to drive this today.’”

As well as crew, the MK_1 can accommodate a 1,000kg payload and 3,500kg of towing capacity. Peak torque of 700Nm is available up to 50mph. The model is offered with the choice of a 220kW or 280kW electric motor, along with the option of a 61kWh or 82kWh battery pack. The electric powertrain offers zero tailpipe emissions, with a robust, simple-to-maintain mechanical driveline that promises uncompromised off-road ability. “We’ve kept the drivetrain quite mechanical, which is unusual for an electric vehicle (EV),” Peterson tells laptop on their legs and the laptop won’t touch the steering wheel,” he notes. “At the same time, I’m six foot four and I can sit in the back with climbing gear on and my knees still don’t touch the seat in front of me. We’ve designed the vehicle around the people that will be driving it rather than following trends or doing what looks pretty.”

The MK_1 will mark the first vehicle to be built at scale in Scotland since 1981
Automotive World. “Normally EVs have two or four motors, but that’s become a challenge in the wake of the supply chain shortages.”

Power in the MK_1 comes from a single motor, and Munro went with an axial flux unit as opposed to the radial flux motors usually deployed in mass market vehicles. In this case, its compact design means designers could slash 40kg of weight. The unit is located between the two front-seat occupants in front of the vehicle’s bulkhead. This results in a front/rear weight distribution of nearly 50:50. Peterson admits the mechanically-linked drivetrain is “a bit old school but so much easier to manufacture and source parts for.”

The design of the vehicle platform and the manufacturing of the shell were done in-house in Glasgow, but the batteries, motor and inverter are all proven technology brought in from as yet unnamed suppliers.
The company’s 2019 launch was made possible thanks to private funding from Peterson and Anderson, who also serves as Head of Powertrain. In late 2021, they secured a capital injection from London-based Elbow Beach Capital. An experienced automotive guidance board has been put in place to help steer corporate strategy, and includes Selwyn Mould, a former head of supply chain at Lotus Cars.

The first model, the Founders Edition, will be hand-built at its East Kilbride headquarters in 2023 for fleet trials and early adopters. “Most of our discussions are with large utility companies, construction firms and mining companies, mainly in the UK but also Canada and Australia, where mining is a big industry,” Peterson says. “We’re also targeting FTSE 250 companies that have an aggressive policy on decarbonisation but rely on diesel pick-ups.”

Some of these companies have been struggling to get their hands on the right sort of vehicles. “One of our partners needs to replace 700 vehicles and it’s an incredibly big challenge. Other OEMs are promising they can deliver in ten years or so, and we just don’t think that’s good enough. We need to do something a bit quicker.”

Three variants of the MK_1 will eventually be offered, starting at £49,995 (US$61,450) for the entry level trim Utility. Munro has already received deposits for several units that will be built this year, with orders coming from the UK, Switzerland, St Lucia, and Dubai. It has also signed a distribution agreement with Glasgow start-up Wire with an eye to selling in the US market.

The company expects to build 50 vehicles in 2023 before moving to a new purpose-built site near Glasgow in 2024. By 2027 it aims to deliver 2,500 vehicles a year. Notably, the MK_1 will mark the first vehicle to be built at scale in Scotland since 1981. “If we’re going to effect the change that we want to, we have to do some volume,” emphasises Peterson. “We can’t just build five or ten vehicles a year.” The segment may be underserved at the moment, but competition could heat up. “There are many companies dancing around this target market,” he adds.

Just how big is the potential addressable market? That’s not so straightforward. “At the end of the day it’s a niche segment,” concedes Peterson. “We are focussing on fleets that still have pick-ups but need off-road capability. If you operate mostly on the road, it’s probably not for you.”

All that’s left for long-term clean mobility success, he suggests, is a change in consumer mindset. The MK_1 offers a range of up 190 miles, which allows it to operate off-road for up to 16 hours on a single battery charge. But that doesn’t mean some fleets won’t still feel anxious about running out of power far from a charger. “The barrier is often in people’s minds. They have to change their comfort boundaries,” Peterson asserts. “People think that legislation or scientists or a new product will solve climate change. In fact, what is going to solve climate change is behavioural change and people adjusting their expectations.”
Range anxiety: realistic concern or modern myth?

Consumer concern regarding availability of EV charging infrastructure may not be necessary, argues Mathew Desmond

The concept of range anxiety—the fear of running out of power while driving an electric vehicle (EV) and being unable to find a charging station—has been cited by the automotive industry as one of the key barriers to widespread EV adoption. Concern around availability of charging infrastructure has made many consumers hesitant to transition to a fully electric model.

However, is range anxiety a realistic concern, or is it a modern myth? In recent years, the US government has provided a massive injection of funding into the development of new charging infrastructure throughout the country. Most recently, the US signed a bipartisan bill which included US$7.5bn to build a nationwide network of EV charging stations to increase charging accessibility and promote long-distance travel.

While this investment is promising, it will take some time before new charging infrastructure is widely available. With that in mind, the industry can pivot to three other key issues that are keeping customers reluctant to take the plunge into the world of EVs.
Learning to plan for EV travel

The concern over having enough battery life to travel from point A to point B can be daunting for drivers. However, those interested in purchasing an EV have a tremendous amount of information regarding charging options—and how to calculate range—at the tip of their fingers today.

Consumers can research whether they have charging options where they reside, or if they will need to source external options for fuelling up. For consumers that do not have access to charging at home, drivers can map out their daily route and the
infrastructure in the surrounding area—where they work, the grocery store, the gym, etc.—and compare that to the vehicle’s driving range at full charge. There are more options today than in the past, with EV charging apps connecting drivers to stations quickly and efficiently. By understanding their daily route and vehicle driving range, consumers can plan charging times in accordance with other weekly tasks, increasing the convenience of public charging away from home.

A caveat is that consumers planning a long trip should map out their route ahead of time to ensure that there are chargers available to accommodate the range requirements.

**Affordability concerns and managing price points**

While American consumers’ willingness to adopt EVs is growing, there remains hesitation around EV pricing, which can be higher than similar internal combustion engine vehicles. As it stands, the most affordable EV models have the lowest mile ranges, while vehicles in the mid-range and luxury categories offer more miles on a single charge, due to higher battery capacity. For this reason, the conversation has shifted away from range anxiety and towards a singular question: what is the price point a consumer can afford to get the maximum amount of charge?
The current economy has pushed EVs to the top of the list for purchase consideration due to the hike in gasoline prices. For prospective EV customers looking to save money, investing in an EV could be a smart choice to reduce variable costs that come from fluctuating fossil fuel prices. The public sector has also entered the conversation, with several EV automakers offering options for federal government tax rebates of as much as US$7,500 for a new EV purchase, which can help to reduce the purchase price.

The education gap between consumers and automakers

Key to the resistance to EV adoption is the lack of familiarity of consumers with all aspects of owning and driving an EV. Most drivers today have only experienced gas-powered vehicles and are not familiar with the basics of what it means to own an electric car. The average driver is typically unaware of how to find chargers, how to fuel an EV, what the real fuel cost savings are, and more.

One way to close this gap is for the public and private sectors to prioritise education. Informing consumers about available government incentives—such as federal and state rebates offered to EV owners—as well as educating them about the different types of charging options, states and highways with the most infrastructure to charge a vehicle, and the savings that are possible, can provide them with accurate information on a large scale. By providing this level of education, consumers’ knowledge will increase and more will be likely to approach an EV as a viable transportation option.

At this point in the EV journey, there’s enough information to help consumers focus on learning as much as possible about their local options for EV purchasing and charging, so range anxiety can indeed become a ‘myth’. With the proper research and planning—and a little education from those who know best—consumers will be fully capable of making an anxiety-free transition to the new wave of sustainable transportation.

About the author: Mathew Desmond is Industry Solutions Architect at Capgemini Americas
Could global AV adoption cause a data centre CO2 crisis?

Research suggests that, if AVs became commonplace, the cumulative emissions from processing masses of sensor data would be considerable. By Will Girling
The autonomous vehicle (AV) timeline has progressed to the point where SAE Level 4 capabilities are already being exhibited in key B2B sectors. While similar developments might take longer for B2C use cases, Mercedes-Benz’s January 2023 success in becoming the first OEM to secure US approval for Level 3 could indicate that progress isn’t far off. The Chinese government’s willingness to permit the testing of Level 4 robotaxi services in restricted city zones—such as Baidu’s in Chongqing and Wuhan—is already providing a glimpse into a future where urban spaces are served by networks of self-driving vehicles.

However, while the automotive industry grapples with complex technical and regulatory challenges, research from the Massachusetts Institute of Technology (MIT) raises important environmental questions about the reality of AVs. Indeed, the paper *Data Centers on Wheels: Emissions from Computing Onboard Autonomous Vehicles* suggests that the realisation of AVs on public roads could in fact be counter-productive to the carbon reduction efforts underpinning the electrification shift.

A hidden issue

Written by Soumya Sudhakar, graduate student in aeronautics and astronautics, in conjunction with associate professors Vivienne Sze and Sertac Karaman, the January 2023 paper paints a concerning picture. As of 2023, data centres contribute approximately 0.3% of global emissions. In a modelled scenario where one billion vehicles (95% of global total) were fully autonomous and drove one hour a day, they would consume 840W each. Cumulatively, the energy required to power vehicles’ onboard computers would effectively double data centres’ yearly emissions.

Unfortunately, Sudhakar tells *Automotive World* that automakers are broadly unaware that computer-related emissions in connection to vehicles are even an issue: “There has been a lot of attention paid to emissions from data centres but less to the emerging technology of the computers onboard AVs.” However, if AVs are to become a more substantial part of everyday life, the problem must be addressed sooner rather than later. “We hope our paper can be used by the automotive industry to quantify the operational carbon footprint of their autonomy stacks.”

Mitigating AV carbon

Any progression in self-driving capability will only serve to make the underlying problem worse. According to MIT, a Level 4 AV driving for one hour and computing ten deep neural network inferences on ten cameras would make 21.6 million inferences per day—21.6 quadrillion scaled across a global fleet of one billion, approximately 1,000 times more than Facebook’s global data centre network. Advancing to Level 5, which could theoretically require near-infinite data capturing capacity in order to operate safely under all circumstances, would increase this by orders of magnitude.

If automakers are to have any hope of mitigating the carbon intensity of AV
operations, they will need to be able to quantify their hardware’s emissions. Furthermore, Sudhakar states that the industry will need to gain access to internal proprietary numbers for levels of autonomy under development, including computer power, workload, and rate of growth. “These numbers can then be used within our framework to estimate emissions from computing onboard AVs based on new or internal data,” she says. The paper includes formulae so that companies can accurately perform the calculations themselves.

It is also important that OEMs recognise the ‘embodied’ versus ‘operational’ carbon of their AVs. With an operational lifespan of up to 20 years, MIT notes that AVs would likely outlive data centre servers themselves. This could influence how self-driving vehicle services on public roads are eventually deployed: a fleet of durable AVs would constitute a suitable shared mobility platform, and 100 million shared AVs driving ten hours per day would have the same operational emissions as one billion private AVs driving for one hour. Manufacturing fewer vehicles would also decrease embodied carbon simply by having to produce fewer components.

**A necessary change?**

It is clear that Sudhakar et al intend for their research to be the starting point for a larger conversation on the sustainability of AV fleets.

“There are several ways to reduce emissions from computing onboard AVs before the problem grows,” notes Sudhakar. These include using renewable electricity during production and operation and improving hardware energy efficiency. Ongoing research into the specific navigation and perception capabilities required for AVs, she adds, should mean that more specialised and therefore optimised hardware can be produced. Indeed, the paper found that doubling AV hardware efficiency every year until 2050 would freeze the sector’s total emissions at 2018 data centre levels.

In the section ‘Future Work: Reducing the Footprint’, the researchers also advocate that sector stakeholders explore algorithmic efficiency improvements, provided they do not compromise safety; improve the transparency of data regarding autonomy stack hardware
efficiency; and establish metrics to compare technology across the AV market. However, they also concede that the latter is difficult due to companies wishing to protect their intellectual property during the race to successfully scale AV services.

The challenge is large—but with the market making uneven progress in 2022, AV manufacturers and suppliers could find it beneficial to re-examine their approach. Sudhakar remains hopeful that devising new strategies and reconsidering operations at this early stage still has the potential to significantly mitigate the problem. In MIT’s official announcement of the research, Sze added: “We are hoping that people will think of emissions and carbon efficiency as important metrics to consider in their designs. The energy consumption of an AV is really critical, not just for extending the battery life, but also for sustainability.”
The metaverse, defined by Nvidia as the 3D internet, is making waves across all industries—particularly automotive. Metaverse applications are diverse: from developers training artificial intelligence (AI) systems in virtual worlds to enterprises building digital twin simulations of their industrial processes.

However, Nvidia is proposing the Omniverse as a space for industry operations. The Omniverse is a metaverse populated by industrial digital twins and virtual autonomous robots, allowing a company to create 3D models and simulations in the virtual space with all the constraints and details of the real world. Specifically, the Omniverse highlights the company’s approach to integrating industrial digital twins at scale using the universal scene description (USD) file format.

USD, originally invented by Pixar Animation Studios, is an open and extensible ecosystem for describing, composing, simulating, and collaborating within 3D worlds.

Thanks to its design and features, USD is poised to be the open standard that enables the 3D evolution of the automotive industry.
intertnet. “The Omniverse is a platform that we’ve created as a method for bringing people from all over the world together to work on a specific project,” says Danny Shapiro, Vice President of Automotive at Nvidia. “It allows people who use particular 3D software applications to keep using them within a larger, virtual space.”

This platform is facilitating the growth of autonomous vehicles (AVs) through its ability to produce lifelike simulations. However, doing so poses two challenges: generating a world with enough detail and realism to facilitate a realistic response from an AI driver, as well as creating simulations complex enough to cover all the scenarios in which the AI needs to be fully trained and tested.

Nvidia initially used game engines and software. However, due to a lack of detail and processing, it soon realised that these systems couldn’t function to the standards required for a critical safety system for AVs.

“That’s why we had to build Drive Sim and the Omniverse from the ground up,” notes Shapiro.

A library of 3D

Nvidia’s solution is to digitise the world—creating 3D digital assets based on real-world objects, including roads, lands, kerbs, trees, signs and lights. In addition to creating its own assets, Nvidia is able to speed up production of the world’s digital twin by incorporating assets and innovations from other companies. External companies can upload existing design workflows and pipelines using what Nvidia calls Omniverse Connectors, which enable designers to collaborate using multiple applications such as Autodesk Revit and 3ds Max, McNeel Rhino, and Unreal Engine 5. Another application for leveraging completed work includes publicly available and highly detailed maps, which can automatically generate 3D models based on existing data.
Furthermore, Nvidia is accessing drive videos, such as community uploaded dash cam footage, to accelerate the development of a hyper-realistic 3D world that can then be placed into the simulator. This is facilitated through the Neural Reconstruction Engine, a new toolset for the Drive Sim platform that uses multiple AI networks to turn recorded 2D video data into a dynamic, 3D digital twin environment.

Once the environment, assets, and scenario have been extracted, they are reassembled in Drive Sim to create a 3D simulation of the recorded scene or mixed with other assets to create an entirely new one.

Shapiro is careful to note that after virtual testing in the Omniverse, real-world testing will still be required to prove the simulation’s accuracy. “The two go together, but simulation allows automakers to accelerate their AV development timeline,” he emphasises.

**Powering Data**

Notably, the Omniverse is not just creating a simulated environment: it is also producing synthetic sensor data (information generated in simulations as an alternative to real-world data). Typically created using algorithms, synthetic sensor data can be deployed to train machine learning models. “We’re testing it in the cloud,” says Shapiro. “The synthetic data goes into the computer, runs the software, and then the computer tries to drive the simulated car.” This process is called hardware-in-the-loop.
All of this data requires a large amount of computing power, which Nvidia processes using a supercomputer, powered by the Nvidia Drive Orin system-on-a-chip. The Orin delivers 254 trillion operations per second and is the central computer for SAE Level 2 systems to Level 5 AVs. The next generation, the Nvidia Drive Thor, was unveiled in September 2022 and boasts up to 2,000 teraflops of performance, or 2,000 times a trillion operations per second. Available for automakers’ 2025 models, Nvidia states it will accelerate production roadmaps by bringing higher performance and advanced features to market in the same timeline.

However, as vehicles continue to advance and require more processing power, Shapiro reveals that Nvidia is investigating the use of quantum computing. “Looking forward, it’s clear that accelerated computing is needed,” he says. “We have many tools for the development of quantum, but we believe that’s still quite a way out.”

**Next gen of safe AVs**

“We want to ensure AVs are safe. It’s our number one priority,” he continues. “Safety is measured on how well the vehicles drive: how frequently or infrequently they have incidents.”

According to the World Health Organisation, 1.3 million people die every year due to traffic collisions. Meanwhile, the National Highway Traffic Safety Administration found that human error accounts for anywhere between 94% and 96% of all auto incidents. “We believe AVs can drastically reduce those numbers,” says Shapiro.

In addition to testing, the Omniverse will allow automakers to make progress in production. Mercedes, for example, announced at CES 2023 that it will be using the platform to design and plan its manufacturing and assembly facilities. By tapping into Omniverse technologies, the automaker can create feedback loops to reduce waste, decrease energy consumption and continuously enhance quality.

At a time when automotive companies are racing to produce the next generation of safe AVs, the development of virtual testing simulators could prove pivotal in increasing safety and efficiency. As the likes of Volvo, Mercedes and more incorporate Nvidia’s Omniverse, other key players such as Audi and Epic Games present their own metaverses—meaning that the race to develop the industry’s most realistic digital twin is on.