ADVANCING THE FUTURE OF ELECTRIC VEHICLES

Trends Report

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Introduction

In recent years, the landscape for electric vehicles has changed dramatically. New automotive experiences are making their way onto the streets, enabled by swift technological advances in areas like virtualization and autonomous driving. Meanwhile, regulatory trends are bringing forward the timeline on electrification for many manufacturers, even as consumer demands shift towards greater sustainability. The number of electric cars on the road still lags behind ICE (internal combustion engine), but it is growing rapidly: electric car sales broke all records in 2022, making up 10% of new vehicle acquisitions worldwide.[1] With the agreement for all new cars sold in the EU to be zero-emission by 2035, countries are setting ambitious goals to accelerate sustainable mobility.

What are the stakes for electric vehicle development, and how can we expect technologies to shape the market for EV innovators in the next few years? This report looks at some of the key trends and what they mean for startups, R&D and OEMs in the EV market.
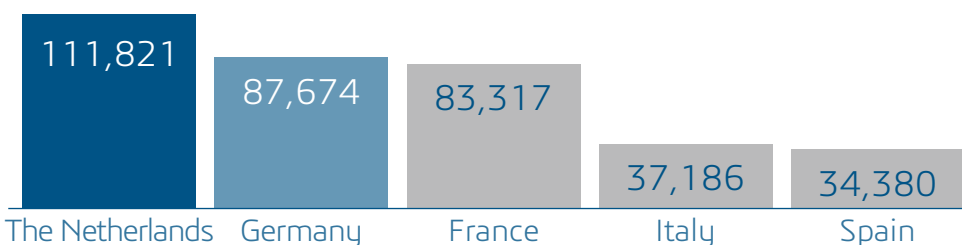
Charging stations charge forward

Across the automotive market, there's a shift to greater investment in PEV (plug-in electric vehicle) development, driven by new climate change targets worldwide. In the EU, WLTP (Worldwide Harmonized Light Vehicle Test Procedure) requirements, national and local laws will effectively ban the sale of new ICE (internal combustion engine) vehicles by 2035. In Asia, both Japan and South Korea have set significant targets for reductions in greenhouse gas emissions that affect automotive manufacturers, committing to achieve carbon neutrality by 2050. China, meanwhile, announced in December 2020 that it would reduce over 65% of its CO_2 emissions per unit of GDP by 2030 from its 2005 level and achieve carbon neutrality by 2060.[1]

A key challenge is the development of charging infrastructure. Many new charging stations[2] are needed, particularly rapid charging stations, which still lag significantly behind. Regional and federal governments worldwide have come up with new infrastructure plans that include charging stations. In the United States, infrastructure plans include a $7.5 billion investment in EV charging infrastructure with a target to build a national network of 500,000 EV chargers by 2030.[3]

These changes mean more incentives for startups and OEMs to join the race to develop innovative PEV technology — for the vehicles themselves as well as the batteries, components, charging stations and urban infrastructure that go with them.

Key figures

In 2022, almost **75%** of all EV charging points in the EU were concentrated in five countries in Western Europe: [4]

The Netherlands	Germany	France	Italy	Spain
111,821	87,674	83,317	37,186	34,380

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1   https://www.reuters.com/world/china/chinas-xi-targets-steeper-cut-carbon-intensity-by-2030-2020-12-12/ https://www.iea.org/news/china-s-clean-energy-strengths-can-help-it-reach-a-peak-in-emissions-by-the-mid-2020s
2   A charging station can include several charging points which have several individual chargers. https://alternative-fuels-observatory.ec.europa.eu/general-information/recharging-systems
3   https://www.whitehouse.gov/briefing-room/statements-releases/2023/02/15/fact-sheet-biden-harris-administration-announces-new-standards-and-major-progress-for-a-made-in-america-national-network-of-electric-vehicle-chargers/
4   Recharging points (EVSE), Total number of AC and DC recharging points in 2022, according to the AFIR categorization, retrieved February 16th, 2023. https://alternative-fuels-observatory.ec.europa.eu/transport-mode/road/european-union-eu27/country-comparison

In 2022, it was estimated that at least **6.8 million** public charging points will be needed by 2030 in the EU.[1]

China is the world's largest electric car market, with about **7.8 million** electric cars in use as of 2021.[2]

Over **65%** of the world's PEV charging stations (1.1 million) were in China as of June 2022.[3]

The United States intends to build a national network of **500,000** EV chargers by 2030.[4]

In 2023, the US Federal Highway Administration announced **$2.5 billion** funding over five years to install charging and alternative fueling infrastructure in publicly accessible communities.[5]

The US Department of Transportation created a **$5 billion** initiative in 2023 to create a coast-to-coast EV charger network on major highways to support long-distance trips.[5]

1   https://www.acea.auto/files/ACEA_progress_report-2022.pdf#page=18
2   https://www.statista.com/statistics/244292/number-of-electric-vehicles-by-country/
3   https://www.statista.com/statistics/571564/publicly-available-electric-vehicle-chargers-by-country-type/
4   https://www.reuters.com/technology/potential-winners-losers-new-us-ev-charging-standards-2023-02-15/
5   https://www.whitehouse.gov/briefing-room/statements-releases/2023/02/15/fact-sheet-biden-harris-administration-announces-new-standards-and-major-progress-for-a-made-in-america-national-network-of-electric-vehicle-chargers

The power of choice

Alongside regulatory changes, consumer expectations and desires are changing. There is increasing normalization of EVs, with a shift in consumer mindsets about pricing: in 2022, 57% of consumers believed that the total cost of owning an EV was lower than that of an ICE vehicle. However, the main obstacles for consumers to switch to EVs remained the same as in 2020: concerns about range and low availability of charging infrastructure.[1]

Key figures

Global sales of
electric cars increased by
75%
in the first quarter of 2022 compared to the same period in 2021.[2]

In 2022,
electric vehicles made up
80%
of new car registrations in Norway.[3]

50%
of available electric car models were SUVs in 2021.[4]

The global electric three-wheeler market is set to reach **$1.5 billion** in 2031.[5]

1   https://www.castrol.com/en_in/india/home/about-castrol/newsroom/press-releases/2022/castrol-study-highlights-key-insights-on-ev-readiness.html
https://www.caranddriver.com/news/a33765591/electric-vehicle-buyers-survey-castrol/
2   https://www.iea.org/reports/global-ev-outlook-2022/executive-summary
3   https://www.cbsnews.com/news/electric-vehicle-europe-norway-tesla-sales/
4   https://www.iea.org/reports/global-ev-outlook-2022/trends-in-electric-light-duty-vehicles
5   https://www.bloomberg.com/press-releases/2023-01-12/electric-three-wheeler-market-size-to-grow-usd-1-5-billion-by-2031-growing-at-a-cagr-of-7-valuates-reports

Consumers value design, performance, and technology, but they also place a premium on sustainability. In a 2022 global study, 52% of car buyers said they would prefer to buy an EV for their next car purchase.[6] In the US, the administration supports electric transportation, with the goal of EVs making up 50% of vehicle sales by 2030.[7] According to a survey by Consumer Reports, 71% of US drivers said they would consider buying an electric vehicle at some point in the future, with nearly a third indicating interest for their next vehicle purchase.[8]

Boosting growing acceptance of EVs is the greater diversity of choices. In 2021, there were 450 available EV models on the market – a 15% increase compared to 2020 – and it is expected that the number will continue to rise with consumer demand. Between battery EVs, hybrid EVs, plug-in hybrid EVs, extended range EVs and more recently fuel cell EVs running on hydrogen, buyers have more and more options to choose from. All types of vehicles are concerned by electrification, from two/three-wheelers, to small and large cars, crossovers, and SUVs, which made up the majority of EV sales in the US in 2021.[9]

Startups and OEMs looking to fill this niche benefit from an agile digital design environment that allows them to test design concepts as well as materials. Ultimately, this will result in vehicles that continue to dynamically push the limits of performance, with a smaller environmental footprint.

❝ There is a short window of time for entry into electromobility. You have to be quick with a reliable, fully developed product on the market.″[10]

Martin Šoltés, Co-Founder and Managing Director, EVUM Motors

6   https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/automotive-and-transportation/
automotive-transportation-pdfs/ey-mobility-consumer-index-2022-study.pdf#page=4
7   https://www2.deloitte.com/content/dam/Deloitte/sk/Documents/consumer-business/gx-global-
transportation-trends-2022.pdf#page=8
8   https://www.consumerreports.org/media-room/press-releases/2022/07/more-americans-would-
definitely-get-electric-vehicles--consumer-/
9   https://www.iea.org/reports/global-ev-outlook-2022/trends-in-electric-light-duty-vehicles
10   https://www.3ds.com/insights/customer-stories/evum-motors-electric-vehicle

Solutions to range anxiety

Range anxiety has been a consumer concern since the advent of PEVs. However, manufacturers are now finding new solutions to tackle worries about range — with the construction of new charging stations, as well as with innovations in technology and business.

EV manufacturer NIO, for instance, is working on building more charging stations and mobile battery charging vehicles, according to vice-president of power management Shen Fei. All of its current models are offered with a "battery-as-a-service" plan where customers can opt to purchase and own the car while leasing the battery, allowing them to keep batteries up-to-date as the technology improves. The company opened more than 900 battery swapping stations in China, where drivers can rapidly replace their depleted battery with a fully charged one.[1] NIO has also brought battery-as-a-service to Europe where ten stations are in operation, and plans to have 120 stations across the continent by the end of 2023.[2]

Other manufacturers such as Indian startup Simple Energy have developed their own battery management system to achieve optimal efficiency. Their 236 km range e-scooters have removable lithium-ion battery packs that offer normal and fast charging modes. The company is also widening its scope not only to develop electric scooters, but also other vehicles, as well as charging infrastructure to make ownership of their vehicles more convenient for their users.[3]

❝ Our vision is to accelerate the adoption of electric vehicles that can travel longer distances. Until now, there has been a gap between what consumers want and what they receive in terms of electric scooter performance. No electric two-wheeler on the Indian market has met their requirements for long range, fast charging and value for money. So that's where we've focused our research and development efforts."

Suhas Rajkumar, Founder and CEO, Simple Energy

1   https://www.wired.com/story/china-ev-infrastructure-charging/
2   https://www.electrive.com/2023/01/03/nio-counts-10-battery-swapping-stations-in-europe/
3   https://www.3ds.com/insights/customer-stories/simple-energy

The rapid progress of two/three-wheelers

According to the International Energy Agency, electric two/three-wheelers are perfect candidates to encourage electrification among drivers thanks to their light weight, small batteries, and simpler charging infrastructure.[1] In Asia, market shares for electric two/three-wheelers are growing fast, with 9.5 million sales in China in 2021, out of 10 million sales worldwide.[2] In India, where the electric two-wheeler market progressed by more than 300% in 2022 compared to the previous year,[3] it is expected that electric two-wheeler sales will reach 22 million by 2030.[4]

Indian startup Simple Energy develops lightweight e-scooters with the goal of accelerating the adoption of EVs by improving range, speed, charging time and affordability compared to the two-wheelers available on the local market. To reach their 236 km range, they had to reduce their scooters' weight and rethink every aspect of their design. They decided to fully develop their e-scooter in-house, including the electric motor and battery pack.

66 There were a lot of existing components available in the market, including the motor, that didn't meet our requirements. We wanted a very compact system that still delivered high performance and we realized that we needed to take control and build our own to get the best results. We've manufactured many components locally to ensure that we're not too expensive for our target market and can retain our competitive edge."[5]

Kiran Poojary, CTO, Simple Energy

1   https://iea.blob.core.windows.net/assets/ad8fb04c-4f75-42fc-973a-6e54c8a4449a/GlobalElectricVehicleOutlook2022.pdf#page=102
2   https://iea.blob.core.windows.net/assets/ad8fb04c-4f75-42fc-973a-6e54c8a4449a/GlobalElectricVehicleOutlook2022.pdf#page=30
3   https://www.autocarindia.com/bike-news/electric-two-wheeler-sales-up-305-percent-in-2022-426801
4   https://www.businessinsider.in/business/news/electric-two-wheeler-sales-volume-in-india-expected-to-reach-22-million-by-2030-says-redseer-report/articleshow/97570866.cms
5   https://www.3ds.com/insights/customer-stories/simple-energy

In Europe, where 5 million electric bicycles were sold in 2021,[1] cities are investing in cycling infrastructure to decongest cities and encourage drivers to adopt greener mobility alternatives. However, lack of safety on the roads is a concern for many drivers who are hesitant to switch to electric bikes. Italian manufacturer I-FEVS decided to develop new EV concepts including solar-powered e-bikes with road safety as their first priority. Their modular e-bike has three wheels for better stability, a novel suspension system and a high-strength nanostructured steel square-tube frame. The e-bike can be used for commuting, goods delivery and even short-distance family travel. To keep improving its product as well as its battery pack, the company is using virtual twin technology to monitor its e-bikes on the road.

> ❝ We are automotive people. We want to produce the way automotive companies do and that means we want to introduce virtual twins to actively manage the e-bike at all stages. The continuous exchange of data between the physical vehicle and a live, virtual model has many implications on design, maintenance, product improvement and management throughout its life.❞[2]

Pietro Perlo, Co-Founder and President, I-FEVS

1   https://cyclingindustry.news/european-electric-bike-sales-pass-5-million-all-bikes-22-million/
2   https://www.3ds.com/insights/customer-stories/i-fevs

Greener urban mobility

With growing difficulties to drive in congested cities, the expansion of delivery platforms and increasing pollution, drivers and companies in urban areas need lighter vehicles that can move around easily all while limiting their impact on the environment.

Korean startup Equal designs lightweight compact electric trucks and lorries that can be used for freight transportation in factories as well as urban areas for workers in the gig economy, with the goal of meeting sustainability needs in the logistics sector. They quickly created the LOFI III, a modular electric three-wheel truck that puts customer needs at the heart of its design by offering a high level of customization: future customers can choose if the truck is long, short, open, closed, or even refrigerated.

" Our electric truck will not only be sustainable, but also affordable to rent. It's designed to solve many user pain points as well, such as being able to run on steep slopes and narrow alleys without any problems. It's these features that set us apart from the competition."[1]

Noh Youngjo, CEO, Equal

1   https://www.3ds.com/insights/customer-stories/equal-electric-vehicle

Another option to limit pollution in cities is to convert pre-existing internal combustion engine vehicles. In the Philippines, Spanish EV developer QEV Technologies is working with local manufacturers to convert thousands of minibuses, called jeepneys, into e-buses using its Astrokit, which includes the motor, inverter, gearbox, cooling, charging, battery pack and all electronics needed to transform a combustion-engine vehicle into a fully-electric vehicle.

" There are a lot of smaller manufacturers out there producing the external shell of a bus, but they don't always have the ability to move to electric. It's hard for them to develop this technology from scratch. So we sell them the platform or work with them to build a full e-bus. [...] We want to apply this technology to change the world. We want to have clean cities. For us, it's not just about developing the fastest, most expensive cars; we need to focus on lowering costs and bringing greater efficiencies to the wider mobility industry, and we can use our expertise to do that."[1]

Joan Orús, COO, QEV Technologies

1   https://www.3ds.com/insights/customer-stories/qev-technologies

MaaS and FaaS transit for people and goods

Mobility-as-a-Service offers flexible, multimodal transport and mobility options that are set to shape the smart city of tomorrow. Much of the growth in MaaS is likely to come not just from passenger vehicles, but also from innovations like "robo-taxis" and modular electric vehicles for goods delivery — as the increasing popularity of mobile and online shopping increases demand for cheap, efficient delivery options.

Similarly to MaaS, Fleet-as-a-Service (FaaS) offers are emerging in the heavy-duty EV sector, facilitating fleet owners' transition to electric mobility. Heavy-duty vehicles such as electric trucks still represent a minority of EV sales worldwide. China accounted for 90% of electric truck sales in 2021, but e-trucks are gaining ground in the United States and Europe thanks to support policies, increasing model availability and their economic advantage in certain sectors.[1] Seeing as the transportation industry contributes to 27% of greenhouse gas emissions in the US, the electrification of trucks would make a considerable impact. More particularly, last-mile deliveries represent between 20% and 30% of European cities' carbon dioxide emissions according to the Hellenic Institute of Transport in Greece.

Los Angeles-based manufacturer and fleet services provider Xos is working to reduce carbon emissions in commercial transportation by manufacturing 100% battery-electric Class 5 to 8 medium- and heavy-duty trucks that travel on last mile, back-to-base routes up to 270 miles per day. According to Dakota Semler, CEO of Xos, the way commercial trucks operate makes them ideal for electrification: most of them only drive under 200 miles and operate by day, meaning they can access dedicated charging infrastructure at night. "We don't need to wait for the technology to mature to be able to solve these kinds of routes," he adds.
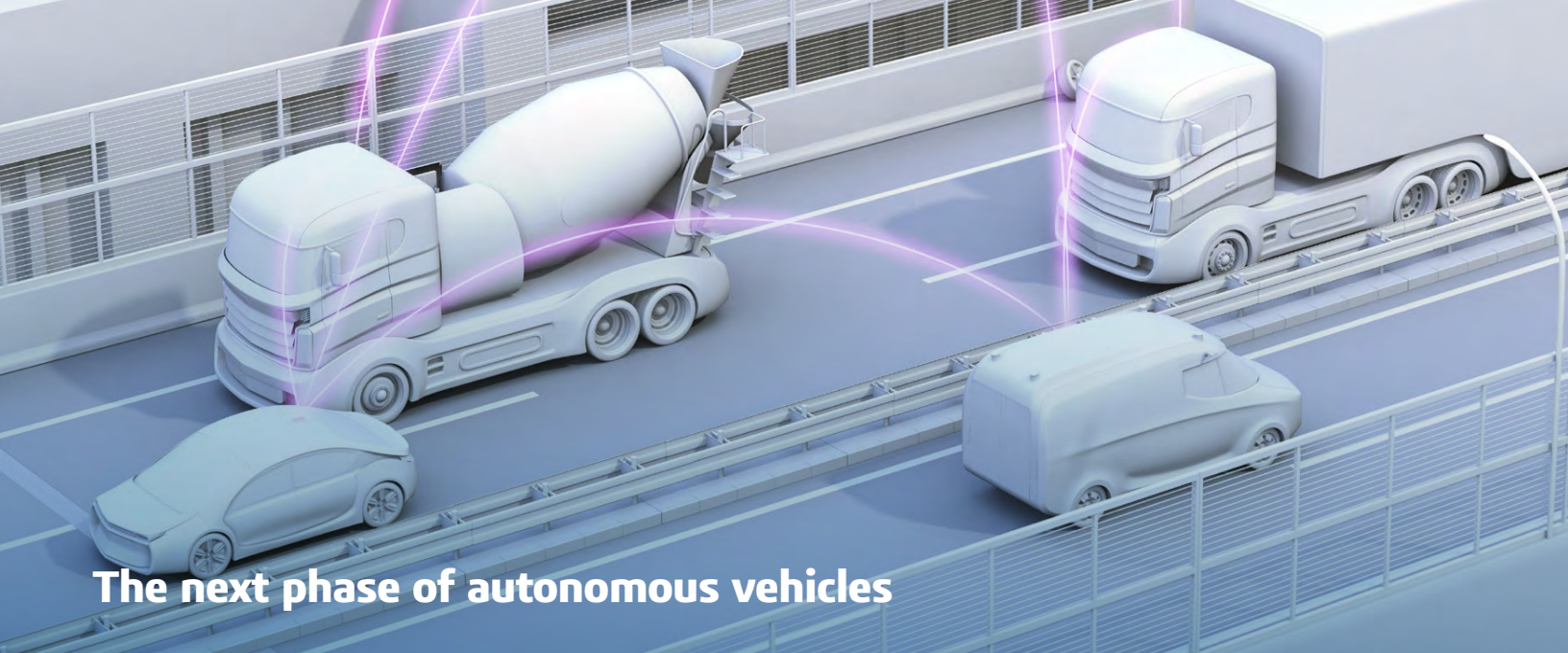
Xos' trucks operate to deliver households and businesses across the US. Xos manufacture their own battery system and modular chassis, purpose-built for medium- and heavy-duty commercial vehicles to meet customers' specific safety, security, reliability and sustainability requirements. They also develop their own software to control the vehicle, power electronics and onboard safety systems.

Their fleet-as-a-service offering, Xosphere™, provides customers with a comprehensive suite of products and services such as charging infrastructure and vehicle maintenance, as well as leasing and financing options, all available on one user platform, to make the transition to electric mobility much easier for their customers.

"We have an internal saying that technology sells our first truck to a customer, but maintenance, service and support is what sells the next trucks after that. Maintenance is an incredibly important aspect, particularly for commercial vehicles operating on the road so long every single day. It really becomes one of the core cost centers for fleets to manage and, ultimately, try to reduce," says Dakota Semler, CEO of Xos.[2]

1   https://www.iea.org/reports/global-ev-outlook-2022/trends-in-electric-heavy-duty-vehicles
2   https://www.3ds.com/insights/customer-stories/xos

The next phase of autonomous vehicles

Autonomous vehicles are on the cusp of becoming a wide-scale reality. Though they are not yet widespread, there are hints on the horizon of how self-driving cars might change the urban landscape — making trips more relaxing and efficient, perhaps encouraging drivers to prefer their own vehicles over rideshares, or be willing to live further from their place of work.

Spotlight on Advanced Driver Assistance Systems (ADAS)

Advanced Driver Assistance Systems (ADAS) are a critical innovation in the development of next-generation automated driving technologies. They offer an extra layer of safety and convenience while driving and they are an important step towards fully autonomous vehicles. Radar, light detection and ranging (LiDAR), vehicle-to-vehicle communication, internet connectivity, smart road infrastructure and satellite navigation all help ADAS to be aware of their surroundings, and all these systems rely on antennas and sensors.

Modern vehicles contain countless antennas and sensors that are crucial to the overall performance and safety of autonomous and assisted driving systems. All these components need not only function correctly in isolation, but also in close proximity to one another. System integrators cannot rely on combining all these systems in the prototype phase, as late stage failure would be prohibitively expensive to rectify. Thus, their development relies on ever-more-sophisticated simulation capabilities. In recent years, simulation platforms have even become so accurate that simulations now certify as real vehicle test miles, allowing carmakers to bring vehicles to market faster.
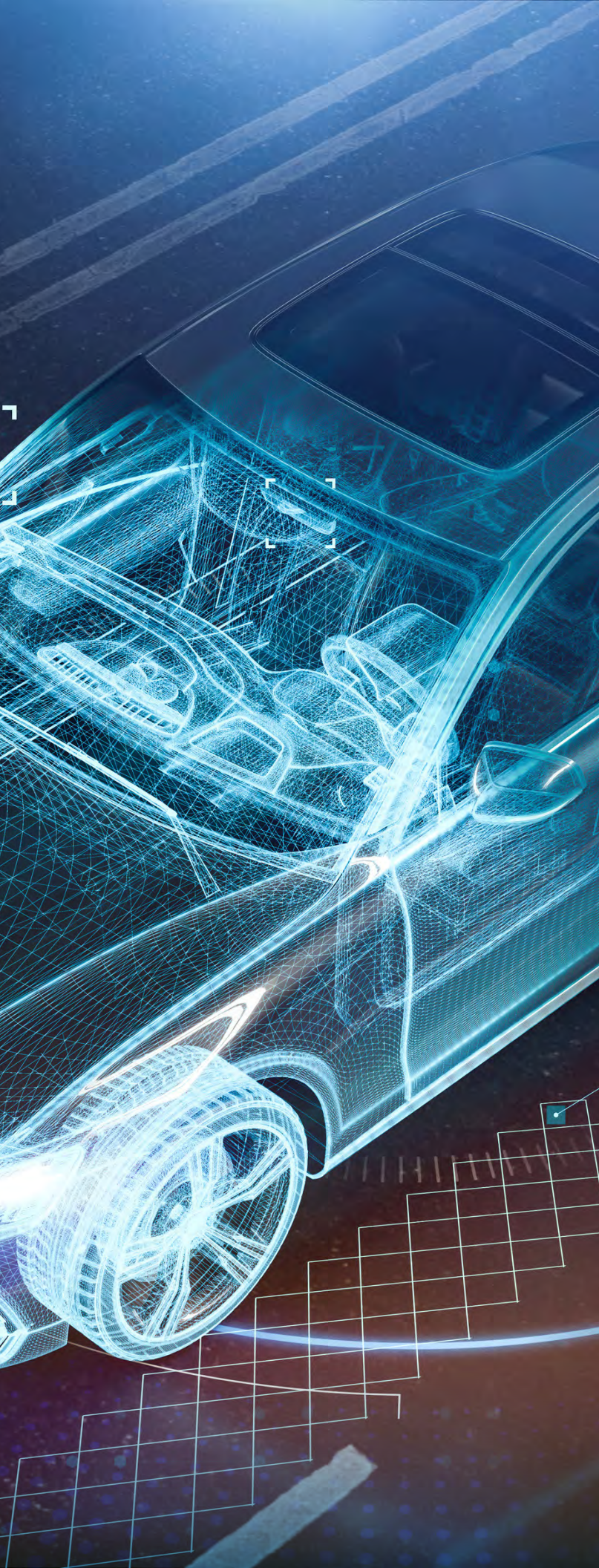
Key figures

Simulation and virtualization are permitting significant cost reductions in autonomous vehicle development.

Estimated total savings:[1]

USD $429 Bn
in autonomous vehicle development
costs via simulation

227 Mt CO2
emissions in autonomous
vehicle development

2 Mt CO2
emissions reduction from physical
prototypes and test vehicles

1 https://www.3ds.com/progress-is-human/water-and-consumption/virtual-twins-and-sustainable-consumption

Savings and sustainability through virtualization

Virtualization strategies have been a critical driver of automotive innovation. They entail significant savings in product development as well as greater sustainability, slashing the amount of materials consumed in prototyping. OEMs are using virtual twins to test multiple designs and features, "eliminating many aspects of prototype testing at part and vehicle level," according to a 2021 Accenture report in partnership with Dassault Systèmes. A virtual twin can be leveraged to accelerate the development of the whole vehicle concept in the design stages to reduce physical testing and to simplify change management.

Across the industry, virtualization strategies have saved an estimated $261 billion in product development costs. Accenture research suggests that top EV manufacturers have an edge over EV startups in their use of virtual twin solutions. Startups who adopt virtual twin solutions now could be looking at more savings and faster product development.

Virtual twin solutions are used by...[1]

100%
of the world's top EV manufacturers

30-40%
of EV startups

60-70%
of best-in-class OEMs
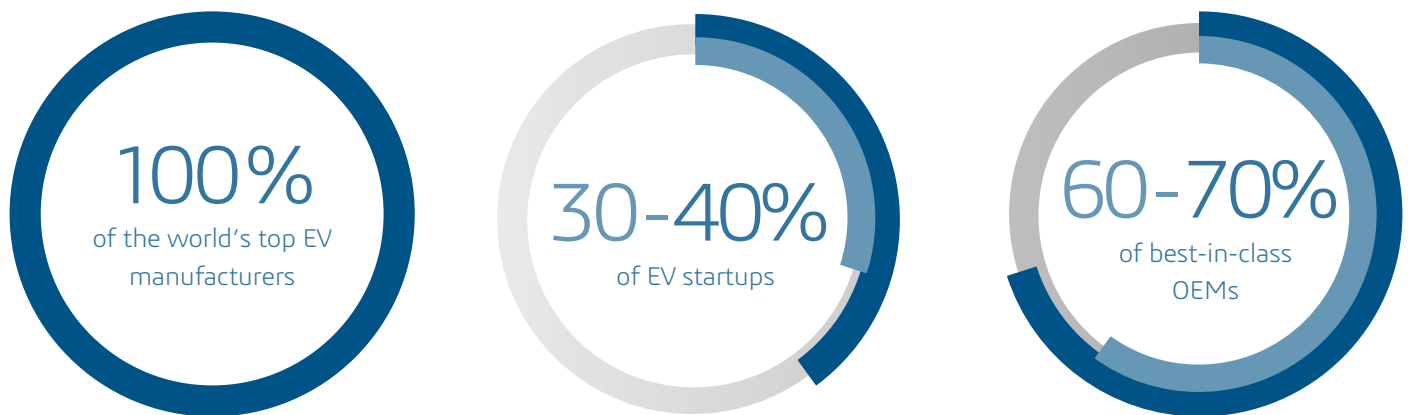
Virtualization is also making its way into design experiences. Some CAD software now offers capabilities like virtual reality review, with further possibilities like virtual showcasing, showing how a vehicle will perform on a smart device, in augmented reality.[2]

> **❝** The virtual twin will help us to identify when to change parts and update firmware, how to effectively manage predictive maintenance, how to best manage the battery pack and deliver future product refinements. We are pursuing a strong collaboration not only with our industry partners but also with our customers. We want them to be actively involved in our vision for a new world and the virtual twin will help to nurture that relationship."[3]
>
> *Marco Biasiotto, head of the mechanical department of I-FEVS*

1   https://www.accenture.com/us-en/blogs/industry-digitization/accelerating-sustainability-with-virtual-twins
2   https://www.youtube.com/watch?v=6ZqWUuaWM-g
3   https://www.3ds.com/insights/customer-stories/i-fevs

Stay up-to-date with the 3DEXPERIENCE Platform on the Cloud

Cloud solutions are a critical driver of innovation, enabling virtualization and seamless collaboration across the value chain. Virtual twin technology, simulation and secure data management tools are helping EV manufacturers to get their projects off the ground and gain market share. Sign up to learn more about how the **3D**EXPERIENCE platform on the cloud could help accelerate electric vehicle innovation for your business.
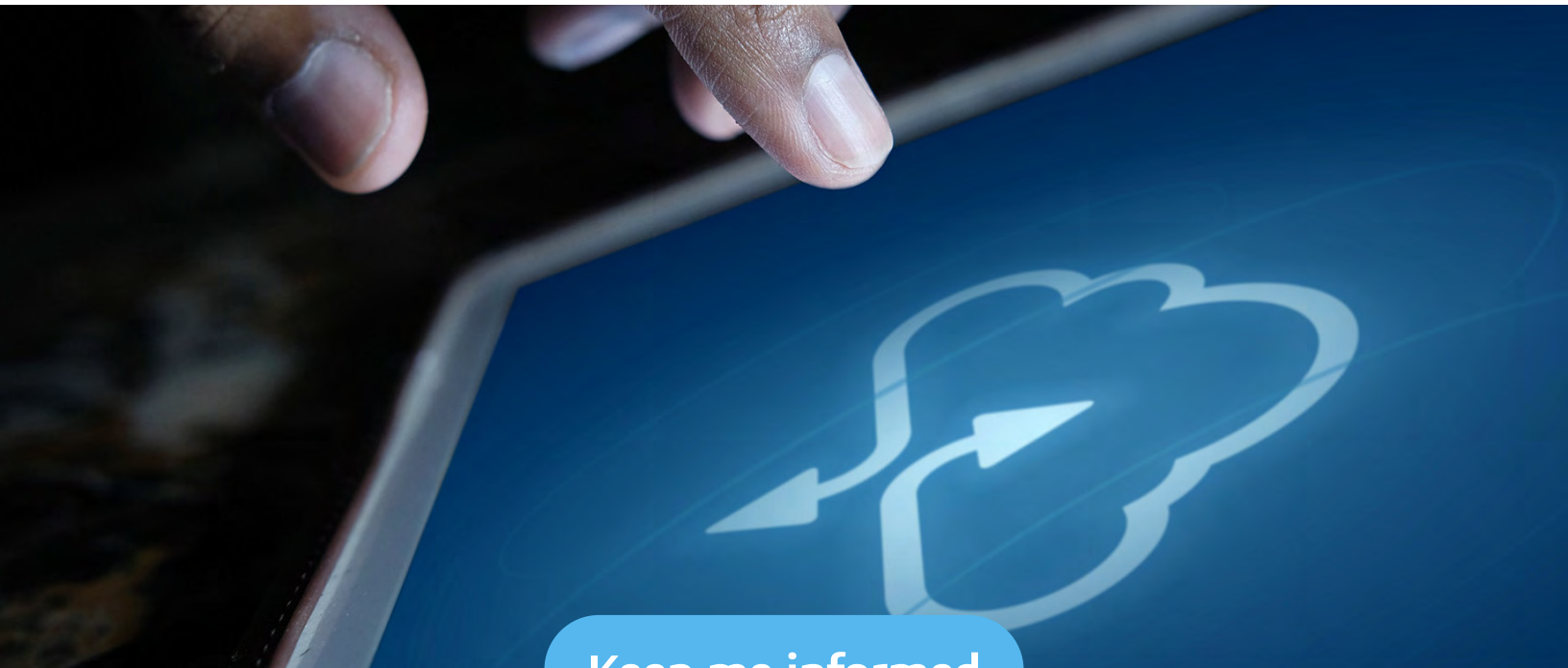
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17