

## HIGHLIGHTS IN THIS ISSUE

BY SAM FIORANI

Another year in the books and it was historic. The automotive industry transitions from its petroleum-fueled past to an electrically charged future and it will culminate in the most revolutionary change in the past century.

This new landscape could shake up the players at the top of the market more than anything that has come before. Inside these pages is the AFS view of what is on the immediate horizon and how the industry will look over the next few years.

**Happy new year!**



The Biden administration's IRA aims to plug US buyers into EVs built in North America but has raised hackles

## NEWS



BY SAM FIORANI

### EV incentives raise ire around the world

In an attempt to spur demand for electric vehicles in the US, the Biden administration pushed the Inflation Recovery Act (IRA) in the fall of 2022. While the IRA covers a number of industries, the automotive industry has stirred some of the greatest interest. Incentives for buyers of EVs have been available in the US for years. However, they expired shortly after a manufacturer sold 200,000 plug-in models, which has excluded Tesla and General Motors.

Under section 30D, the new IRA resets the US\$7,500 incentives for light vehicles based on a number of milestones, but the 200,000 limit has been removed. In its place, to qualify for the whole incentive, vehicles and batteries must be produced in North America and material sources for those batteries must come from "friendly" countries.

These limits have allies of the US angry and the EU and South Korea have complained loudly. The US-Korea Free Trade Agreement, signed in 2017, has been at the center of South Korea's argument, which may lead to a softening of the IRA when it comes to that country. Similarly, the Transatlantic Trade and Investment Partnership (TTIP) has led to discussions across the other ocean. Final decisions have yet to be reached and the complete package may not be ready until the spring of 2023. Among the changes are portions addressing commercial vehicles. An apparent loophole in the legislation allows companies to ship commercial vehicles into the US and

gain access to incentives without meeting the vehicle and battery content criteria provided for passenger cars and light trucks.

US Senator Joe Manchin has been leading the charge to close this particular loophole, in section 45W of the IRA, which could potentially be “used on vehicles that will be leased, rented or used for ridesharing purpose”. Manchin pleaded with Secretary of the Treasury Janet Yellen to “follow congressional intent” by making sure this does not happen to ensure automakers will not “focus their attention away from trying to invest in North America to meet the needs of 30D... putting our transportation sector further at risk”.

## Renault and Nissan restructuring

Much has happened at Renault and Nissan since Carlos Ghosn left his post as CEO of the alliance. Nissan balked at the idea of merging with Fiat-Chrysler, leaving room for Groupe PSA to step in to create new global automaker Stellantis. Renault split its operation into legacy (Horse) and electric (Ampere) groups, finding partners for the traditional ICE group. Meanwhile, Nissan has been struggling in the North American market, with plants

operating well below optimal levels. The larger two partners in the Renault-Nissan-Mitsubishi alliance are discussing a restructuring of its cooperative operations.

## Attrition in China

At one time, China was the market every automaker and nearly every brand wanted to pierce. When this started, it was believed that the French, German, American, Japanese and South Korean brands were positioned to take advantage of the market with higher-quality products, but that time seems to be passing.

In recent months, domestic brands and models have climbed the sales charts. Wuling has the best-selling model with the Hongguang Mini EV and BYD has moved into second place among brands, just behind Volkswagen, and is responsible for four of the top 10 best-selling models, with a fifth model in 12th place.

This intense domestic competition has foreign brands rethinking their strategy. Last month, it was reported that Jeep would stop producing locally and now Skoda is considering the same future. Volkswagen’s Czech marque is just inside the top 50 brands sold in China and this could be a harbinger of other brands retreating from the country, including Citroën, Peugeot and Mitsubishi.



## Borgward closes, again

As China-based vehicle manufacturers set their sights on exports, many of these companies searched for global nameplates, either active or dormant. State-owned Beiqi Foton worked with members of the Carl Borgward family to relaunch the Borgward brand in 2016, but it gained very little momentum. It had been dormant in Germany since the 1960s, with a few other operations continuing through the end of the decade, and memories of the brand have all but faded from the market.

Production of the revival began in June 2016 with the BX7 model and plans to build and market vehicles in Europe were announced. Production peaked in 2019, with four models totaling nearly 53,000 units. However, the company quickly unraveled. The official closure of the automaker was announced in December.

Korean company started releasing workers as there are no plans to resume assembly of the Hyundai Solaris, Hyundai ix25/Creta and Kia Pride in the immediate future. St. Petersburg supplied a significant portion of Hyundai/Kia’s global output, with Russia maintaining about 7% of the automaker’s global sales.

## New Tesla plant in Mexico

Elon Musk has long discussed the goal of Tesla being the world’s largest producer of motor vehicles before this decade is out. With the company’s largest plant operating around one million units annually, Tesla will need seven or eight more plants like it just to have the capacity to compete with Toyota and Volkswagen. Currently, the company is ramping up production at plants in Texas and Germany,



CEO Luca de Meo has split up Renault’s operations

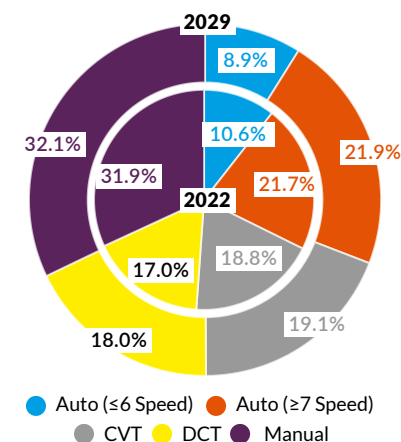
## ‘NISSAN HAS BEEN STRUGGLING IN NORTH AMERICA’

## Hyundai reduces workforce in Russia

In recent years, Hyundai’s plant in St. Petersburg has produced more than 200,000 vehicles annually. Following Russia’s invasion of Ukraine, production at the plant stopped. However, the automaker has not sold its holding in the factory. By the end of 2022, the South

### TRANSMISSION CONSUMPTION BY TYPE

Excludes BEVs



Source: AutoForecast Solutions



and discussions have begun for another assembly plant in Mexico. Authorities in Nuevo Leon seem to be laying the groundwork for a local Tesla factory.

Nuevo Leon is already home to a plant in Monterrey that makes vehicles for Kia and opened nearly a decade ago. In early December, the regional airline launched a new route from the state to California, where Tesla's first plant is located. Tesla is expected to invest up to US\$1 billion in the new factory.

## Volkswagen investment to update the ID.3

The first of Volkswagen's electric ID lineup will be updated in 2023 to spur sales. The Golf-sized ID.3 was envisioned as a battery-electric supplement to the popular hatchback. After investing another €460 million (US\$485 million), the updated ID.3 will begin rolling off the assembly lines at the Wolfsburg plant, joining prior production at the Mosel, Dresden and Shanghai plants.

The new ID.3 will be joined on the same assembly lines in 2025 by an electric crossover based on an enhanced version of the MEB platform. Volkswagen expects the new crossover to be capable of 435 miles on a charge.



Wolfsburg is one of four plants set for revised ID.3

## GLOBAL ELECTRIC VEHICLE INITIATIVES **AFS**

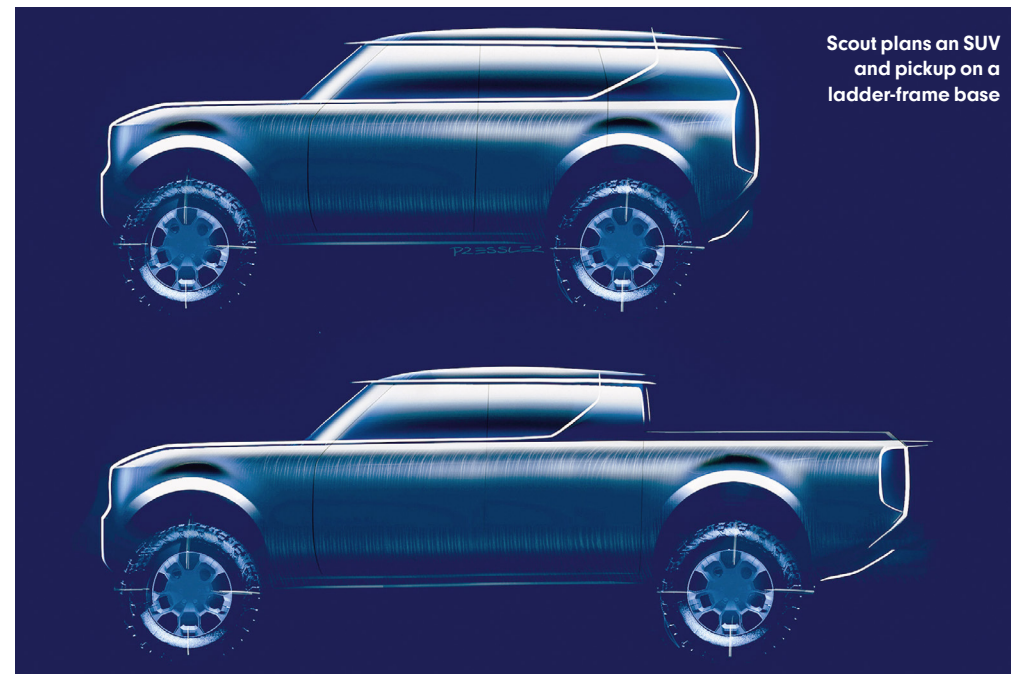
BY CONRAD LAYSON

### Who will build Volkswagen's all-electric Scout?

Announced this past May, Scott Keogh would leave his position as CEO of Volkswagen of America to become CEO of a car company inside the Volkswagen Group that didn't yet exist. It fell to Keogh to revitalize Volkswagen's presence and market share in North America by reviving the iconic Scout brand, which the Volkswagen Group inherited when it took over the remaining portion of truck maker Navistar.

Scout was the model from International Harvester that founded what became the sport utility vehicle category beginning in 1962. By 1966, Ford brought out the Bronco SUV, with rival Chevrolet launching the Blazer in 1969, cementing the category into the American market through competition. Keogh maintained that Scout would be designed and built in North America with an SUV and pickup body on a ladder frame. So, with six people in total, Keogh and company began to look at how Scout could begin producing all-electric vehicles by 2026.

Much has happened since Scout was outlined in the May 2022 issue of the AutoForecast Monthly Report. Former Volkswagen Group CEO Herbert Diess, under whom Scout was reconstituted, planned for Scout building a dedicated, stand-alone EV factory in North America. Traveling about the country this past summer, Keogh held talks with city leaders in Bloomington, Indiana, where International Harvester built the majority of Scout SUVs. Coincidentally, Audi was also looking to



Scout plans an SUV and pickup on a ladder-frame base

establish additional production capacity in North America and sought to co-locate EV production lines with Scout's new factory, wherever it would be. While site surveys continued in Bloomington and other locations, Audi's plan to co-locate with Scout were laid to rest. Diess and the board decided that Scout was to be a solo operation.

That began to change when Diess was ousted by the Volkswagen supervisory board in early August and replaced by Porsche head Oliver Blume on September 2. Along with most of the Volkswagen Group's initiatives, Scout was reviewed in depth at Wolfsburg and reimagined as an asset-light entity, newly responsible for returning six-digit production and sales figures per year. Taken to its logical conclusion, asset light means that Scout won't have a dedicated factory. Wishing to maintain the cachet of

**'SCOUT WAS THE MODEL THAT FOUNDED THE SPORT UTILITY VEHICLE CLASS'**

having Scout designed and built in North America, Volkswagen decided first on having Scout built on contract.

For Keogh and the nascent team at Scout, choosing between North American contract manufacturers Magna and Hon Hai Precision, known colloquially as Foxconn, seemed to go smoothly. Both contract manufacturers

have vehicle design and development teams in-house so are capable of designing and assembling the all-electric architecture Scout requires. Foxconn's Lordstown plant is ready to build Volkswagen's newest vehicles at 100,000-plus volumes, which was attractive. Talks with Magna that began in October were also productive. The company's record producing various BMW, Mercedes-Benz and the all-electric Jaguar I-Pace and Fisker Ocean models in Graz, Austria cemented the company's capabilities with the Volkswagen team. Magna indicated it would use the Volkswagen contract to build the North American assembly facility the company has wanted. In contrast, Foxconn had only started to build Lordstown Motors' pickup at its facility in Lordstown, Ohio, at the beginning of September.

Volkswagen's Scout team also considered the bid build prices between the two. Unsurprisingly, Foxconn offered the lowest production costs per vehicle, which were orders of magnitude below Volkswagen's own vehicle build costs in either Europe or its Chattanooga plant. Volkswagen managers recognized this as Foxconn being willing to do almost anything to get its first, high-volume order from what promises to be a high-profile brand.

Magna's build cost was higher but still represented a value compared with Volkswagen's.

With competitive bids, costs and recommendations in favor of Foxconn in hand, Keogh and company passed the decision to Volkswagen's supervisory board in Wolfsburg at the end of October. And that's when the wheels began to come off of the wagon.

The first signs of dissent about

## 'DISSENT ABOUT THE ASSEMBLY PLAN CAME FROM A SURPRISING CORNER'

the Scout assembly plan with Foxconn came from a surprising corner. The board members representing the works councils, the actual line employees at Volkswagen, and IG Metall, the largest labor union in Germany, each questioned Foxconn's ability to build a quality vehicle with so little vehicle assembly experience under its belt. Foxconn's business model is to add vehicle assembly to its electronics and consumer goods assembly portfolios, not to substitute or replace any of the existing business lines. In contrast, Magna's entire business model focuses exclusively on the automotive industry. This appealed to the two board members and was a key part of their argument for working with Magna.

Additional questions surrounding Foxconn's low unit production price persisted. Could it really be that low? Would Foxconn's inexperienced vehicle assembly team cause expensive delays and even long-term quality issues with finished products? The two board members were more comfortable with Magna's expertise and experience to avoid these issues.

Other questions about Foxconn

emerged as the supervisory board's discussions continued. Uppermost was Foxconn's recent behavior during the stringent corona virus lockdowns at its iPhone factory in Zhengzhou, the capital of Henan Province, China. Workers first fled the factory for fear of being locked in with inadequate food and supplies. Later, the remaining workers rioted when those very conditions came to pass. Would an inexperienced Foxconn management team have enough cultural awareness to exercise the proper discretion with US workers? How would an incident at Foxconn's Lordstown Plant reflect on Volkswagen?

More pointedly, the board members began

asking themselves how the government of the People's Republic of China might respond to Volkswagen doing business with Taiwan's Foxconn, in light of Volkswagen's increased reliance on China to maintain the company's financial health.

Most concerning, Foxconn's Hon Hai Tech Day on October 18 introduced the Model B crossover, the Model C SUV and Model V pickup truck as prototypes available to any and all interested OEMs and startups. Foxconn intended the three prototypes to showcase the company's vertical integration with its own MIH (Made In Harmony) design consortium bringing the entire Contract Design and Manufacturing

Service (CDMS) into being. But what alarmed the Volkswagen board was the fact that all three vehicles were completed and reasonably functioning prototypes with distinct bodies, styling and Foxconn logos. In contrast, Magna's electric skateboard, developed with Israel's REE Automotive, made its debut in 2021 without a top hat and is currently being supplied to Fisker Inc. as part of Magna's contract production of the Fisker-designed Ocean SUV in Graz, Austria. The relationship between Magna and Fisker illustrated the supplier-OEM relationship Volkswagen was seeking. Foxconn's branded and

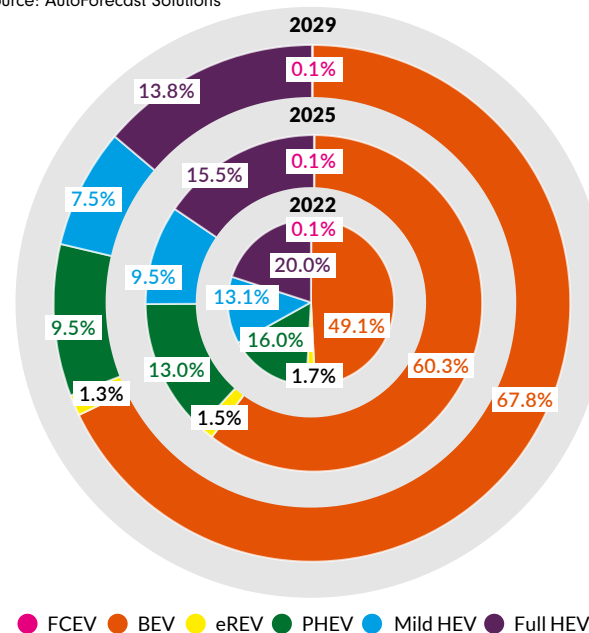


**Ex-Volkswagen of America CEO Scott Keogh heads up Scout**

## GLOBAL LIGHT VEHICLE ELECTRIFICATION

Percentages based on electrified vehicle market only

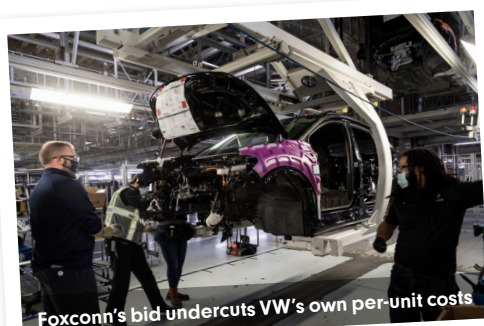
Source: AutoForecast Solutions



mostly complete EV prototypes indicated to some members of the supervisory board that Foxconn was threatening to become a manufacturer of vehicles in its own right. Was it in Volkswagen's interest to let a potential future competitor gain experience with volume manufacturing by allowing Foxconn to build Scout? The board meeting broke up, with no decisions made and more follow-up work to be performed. Magna International was extended the opportunity to resubmit its proposal to co-design and produce the Scout SUV and pickup.

All of which gives Audi another opportunity to benefit from Scout's platform development as well as an incremental increase in volume production in North America.

Audi has long underperformed in North America in comparison with rivals BMW and Mercedes-Benz. A rough and ready SUV or even an Audi pickup truck would do much to expand the brand's product line into areas not occupied by Audi's rivals. If Audi were to produce a ladder-framed, all-electric SUV on contract in the US, it could introduce a direct competitor to Mercedes-Benz's Geländewagen, a vehicle able to compete in the most rugged terrain there is. Moreover, the Audi EV would be launched as an all-electric, all-terrain vehicle, beating the all-electric version of the G-Class to market.



Foxconn's bid undercuts VW's own per-unit costs

Most of all, Audi is already tasked with supporting Magna in the development of Scout's battery technology and electronic architecture. Under Audi's guidance, Volkswagen Group modules and sub-assemblies are to be integrated into the new Scout products during the design and build phases of the project. It was not lost on the board that Magna already builds the Geländewagen for Mercedes-Benz in Graz, Austria.

Including an Audi product run of a speculative 50,000 units on top of the 100,000 units of volume expected for Scout would theoretically reduce the per-unit build cost for each of the brands. Having an Audi SUV built in the same facility as Scout would complicate the Volkswagen Group's relationship with its dealers. As previously reported, Volkswagen dealers' desire for a pickup truck to sell has been thwarted by the manufacturer's insistence that Scout is a separate brand.

Adding an Audi SUV to Scout's production run would undercut that argument. Even so, adding an Audi product to Scout's production contract is an idea gaining traction in Wolfsburg, and under serious consideration by the board. Audi supports the idea, provided Magna gets the contract. A Foxconn award would be likely to mean Scout would go it alone and provide proof that Foxconn can meet the proper build quality standards.

As things stand, much of the board is predisposed to awarding Magna the contract to build Scout in the US – and, by extension, a new Audi model. But time grows short if Keogh's promise of a 2026 debut for an all-new, all-electric Scout is to be kept. That would require a decision to be made in January. Can the Volkswagen supervisory board come together that quickly? Audi, along with the rest of us, should soon find out.

## GLOBAL LIGHT VEHICLE PRODUCTION OUTLOOK

BY SAM FIORANI

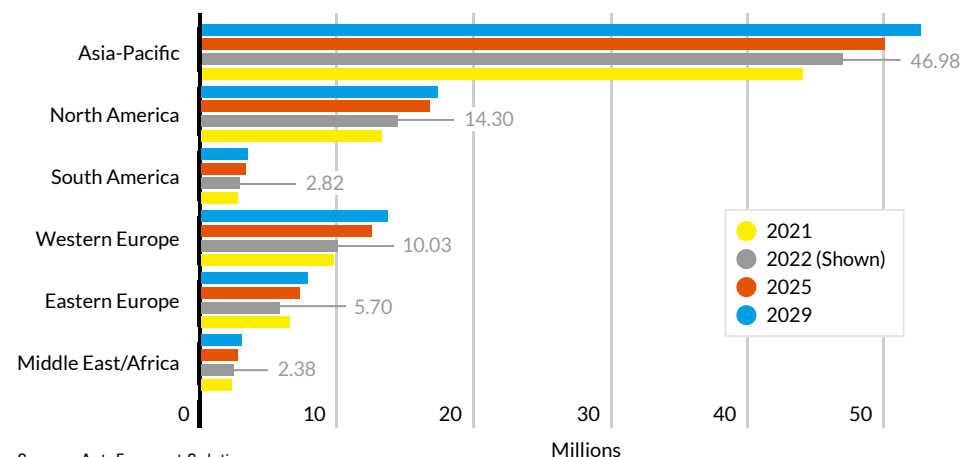


Semiconductor issues will hamper output well into 2023 and probably into 2024. Global production losses in 2021 topped 10 million units, improving to about 3.5 million units in 2022. The competing forces of supply chain issues and lowered expectations will find chip-based losses falling below two million units – a sizable improvement, but not the 60% improvement last year. Recent announcements from Toyota and Volkswagen, among others, show the issue has yet to be resolved fully.

Inventory levels in North America are rising. In the last four months of 2022, the stock of pre-sold vehicles grew 40% as steadier supplies of parts and the growing fear of a recession took hold. Stock of new vehicles has not been this high in the past 18 months, but it remains well below pre-chip shortage levels.

Production in 2023 will grow by 4.9% – still below pre-pandemic levels and way below the trend that peaked in 2017 at over 95.6 million units of global light vehicle production. As the global industry recovers, returning to those levels will not happen before 2028 as the market slowly heads toward the glass ceiling of 100 million units, which will be broken in 2033. Asia-Pacific powers the global market, with 55.8% of the world's vehicle output in 2023. A recovery in China is necessary to propel this region forward because it makes up by far the largest share. Japan, India and South Korea are also struggling to grow. With China getting back to record levels over the next few years, growth will level off while the country will make its transition from supplying the domestic market to becoming an export hub.

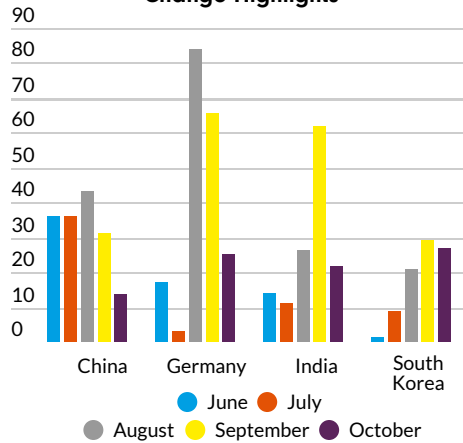
### GLOBAL LIGHT VEHICLE PRODUCTION OUTLOOK



Source: AutoForecast Solutions

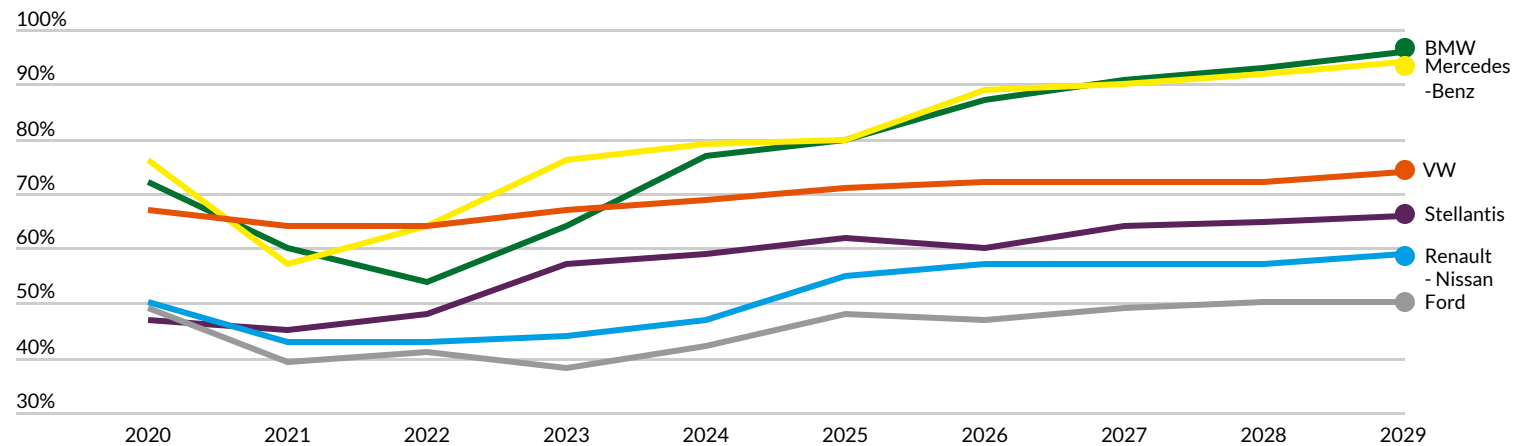


**Year-Over-Year Production Change Highlights**



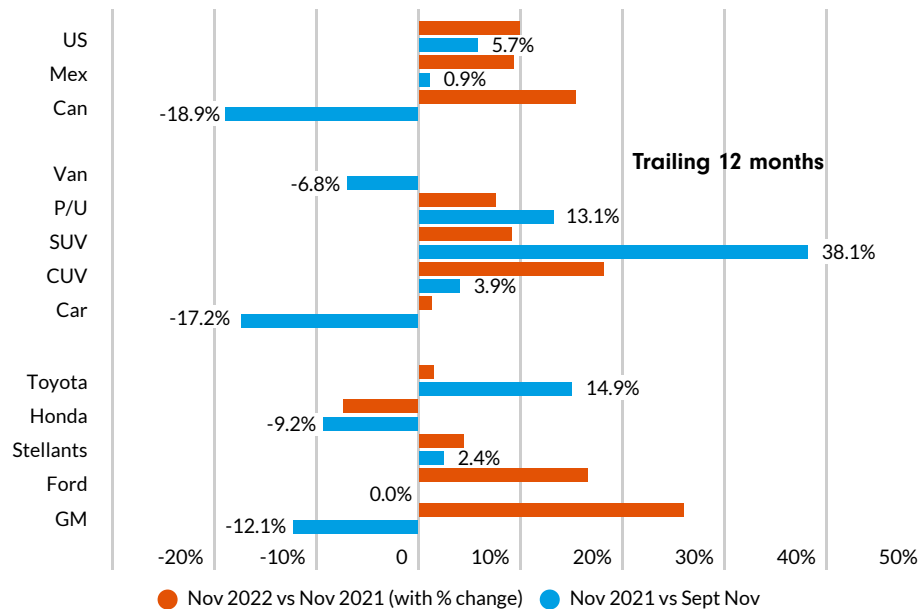
The AFS Forecast covers 60 countries.  
Chart shows changes 2022 over 2021.

**UNITED KINGDOM CAPACITY UTILIZATION BY VEHICLE MANUFACTURER**

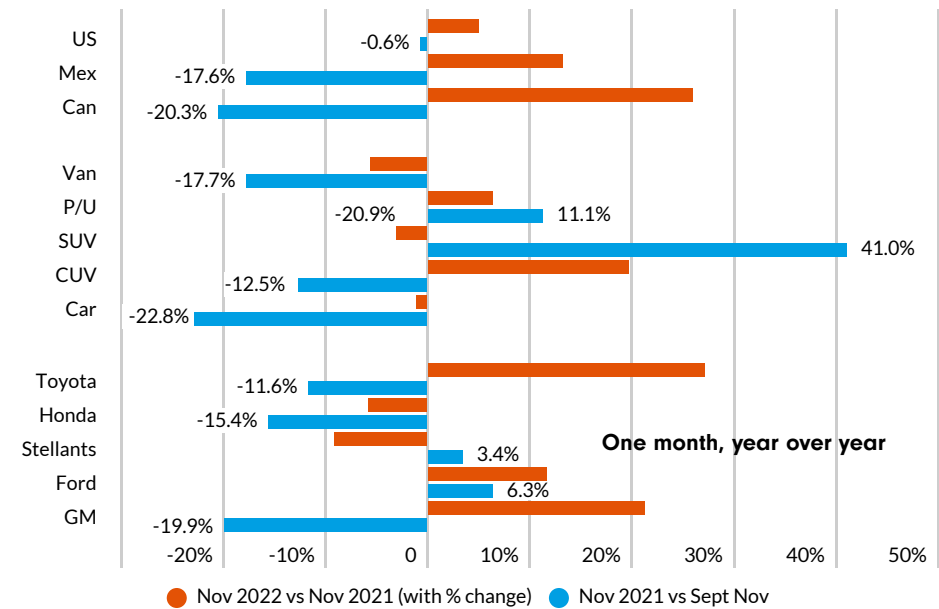


**NORTH AMERICAN PRODUCTION CHANGES**

Source: AutoForecast Solutions



Trailing 12 months represents 12-month period vs the year-prior period



One month represents single month over prior single-month change

# GLOBAL LIGHT VEHICLE SALES OUTLOOK



BY SAM FIORANI

Even as the fear of a global recession rears its head, consumers keep buying cars and trucks. The market still hasn't returned to growth, but the losses are declining, which is the first sign that gains are around the corner.

North American sales reflect this trend. At the end of the year, the year-on-year monthly losses in Canada have fallen from nearly 21,000 units in July to just over 2,000 units in November, which will still result in lower sales for 2022, but a 6.2% gain in 2023.

A small increase in Mexico of 1.6% in 2022 was powered by growth over the last five months of the year and that will propel the country to a 6.4% gain in 2023. Hitting a trough

in 2022 with losses of 8.1% despite a five-month trend of year-over-year improvements, the US will bounce back by 5.6% in 2023.

Despite strong growth at the end of the year, the EU ends 2022 nearly half a million units behind 2021.

Five months of improvements to close 2022 looks good compared with the year prior but historically the numbers lag significantly behind those of earlier years. Continued growth will push through the new year, but sales will still not top 10 million units in 2023, a level that won't be reached again before 2024.

Larger markets pulled the region down in 2022 but some smaller countries, led by

Portugal and Romania, actually improved, turning the corner for the region.

China is also struggling to get back on the growth path. Slower sales in the world's largest vehicle market continued through 2022, with November reporting 7.6% fewer vehicles sold this year compared with 2021.

This trend will result in 2.7% lower sales in

2022 compared with last year, marking the slowest year-on-year drop since the market began contracting in 2018.

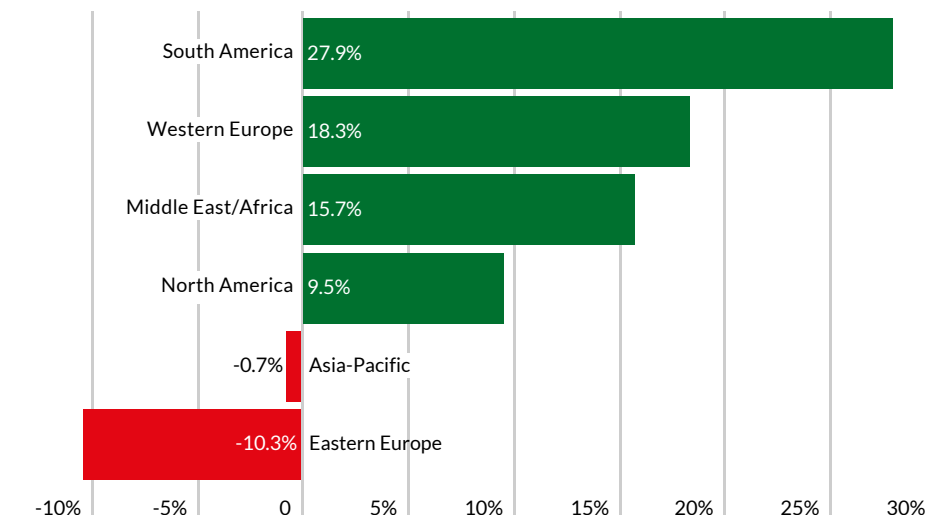
Next year will reverse this five-year streak with a 9.5% gain, putting the market ahead of every year since 2020, but about five million units below the growth trend that peaked in 2017 at 27.35 million units.



Sun is setting on the sales decline in North America

**'HITTING A TROUGH IN 2022, THE US WILL BOUNCE BACK BY 5.6% IN 2023'**

## DECEMBER 2022 YOY LIGHT VEHICLE SALES CHANGE

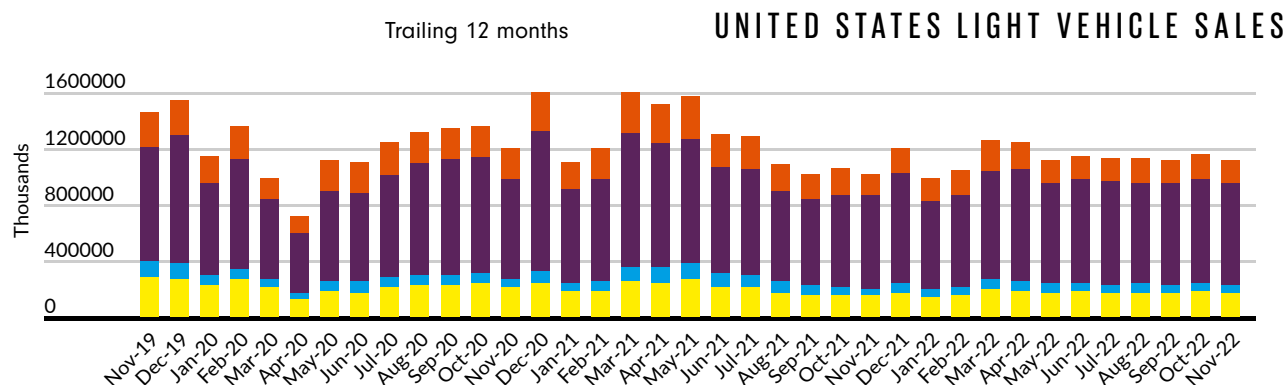
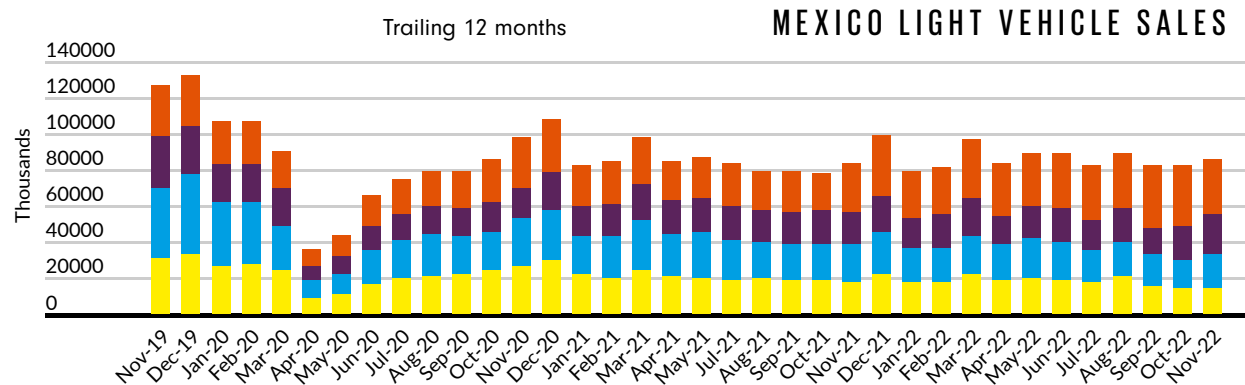
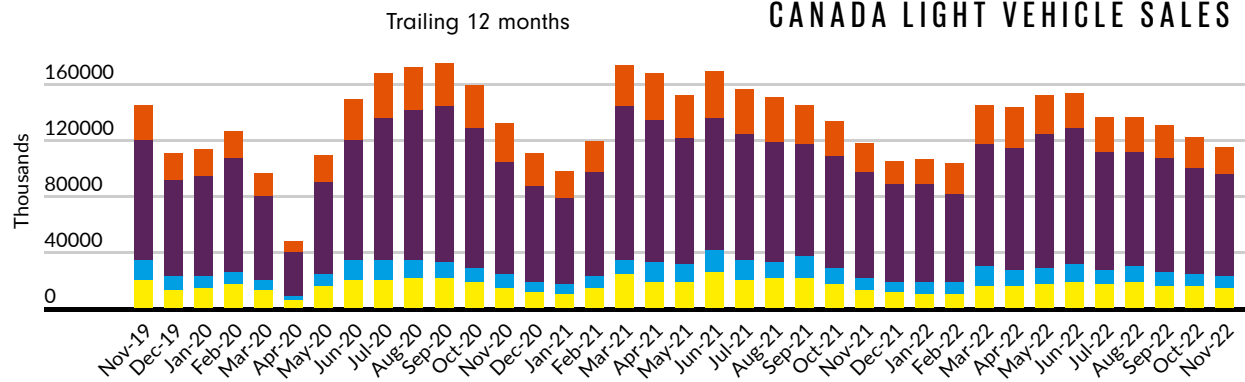


Source: AutoForecast Solutions

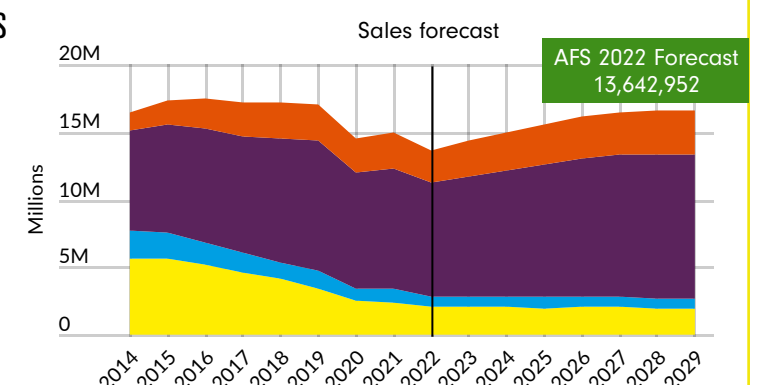
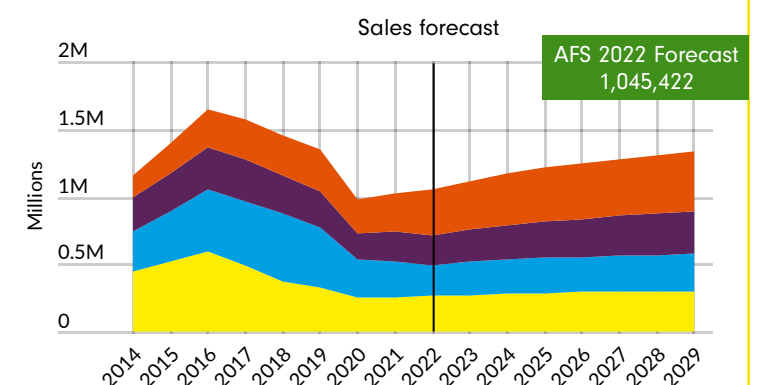
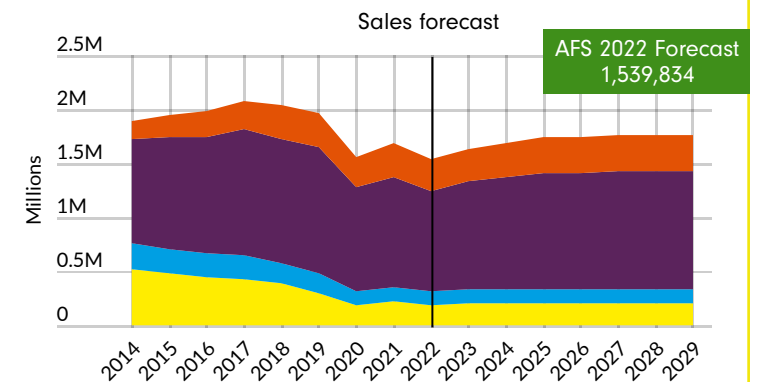


Light vehicle sales in China will end a five-year streak of market contraction with an increase of 9.5% in 2023

Source: AutoForecast Solutions



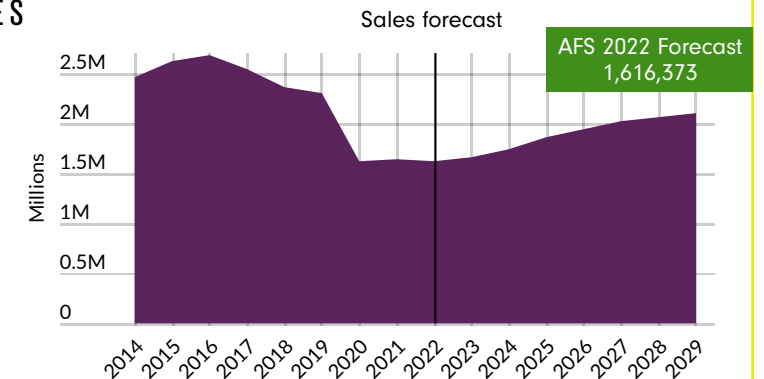
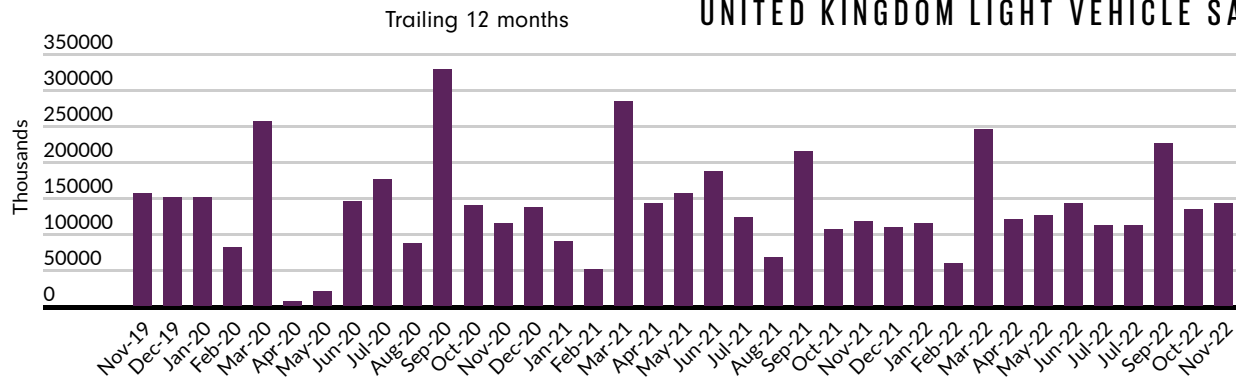
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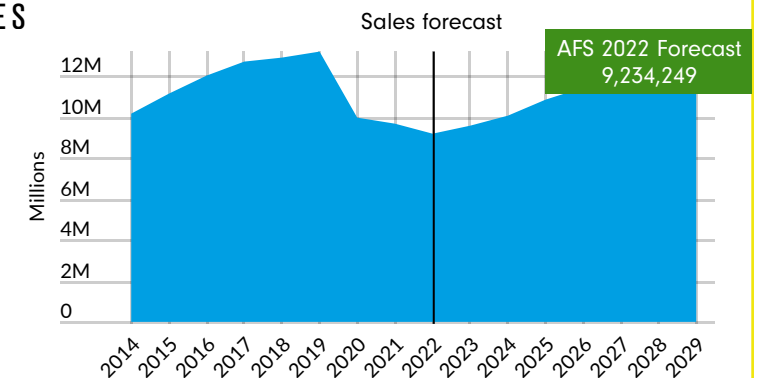
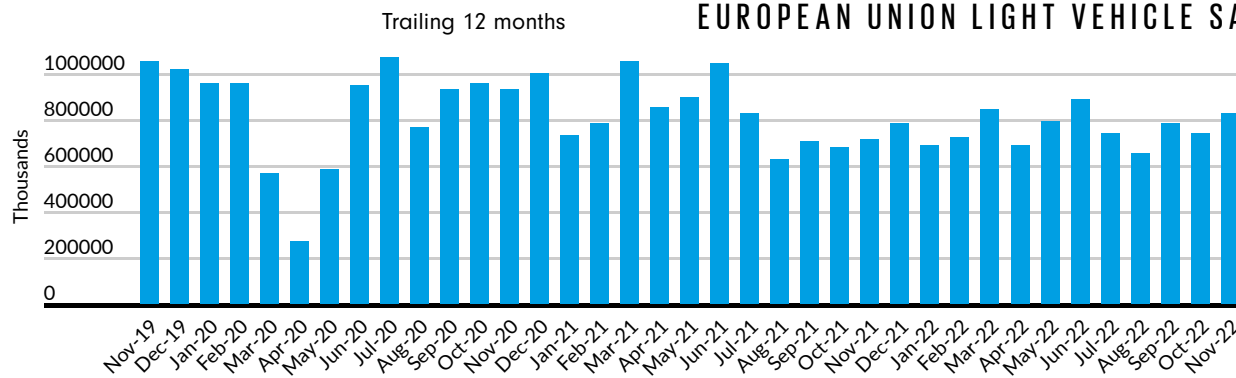


Source AutoForecast Solutions

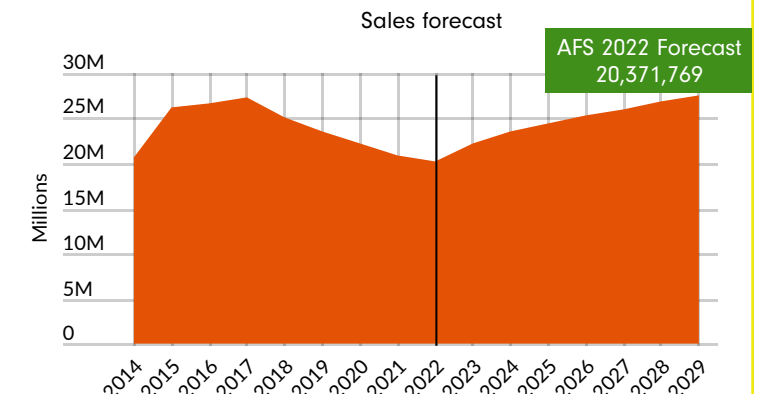
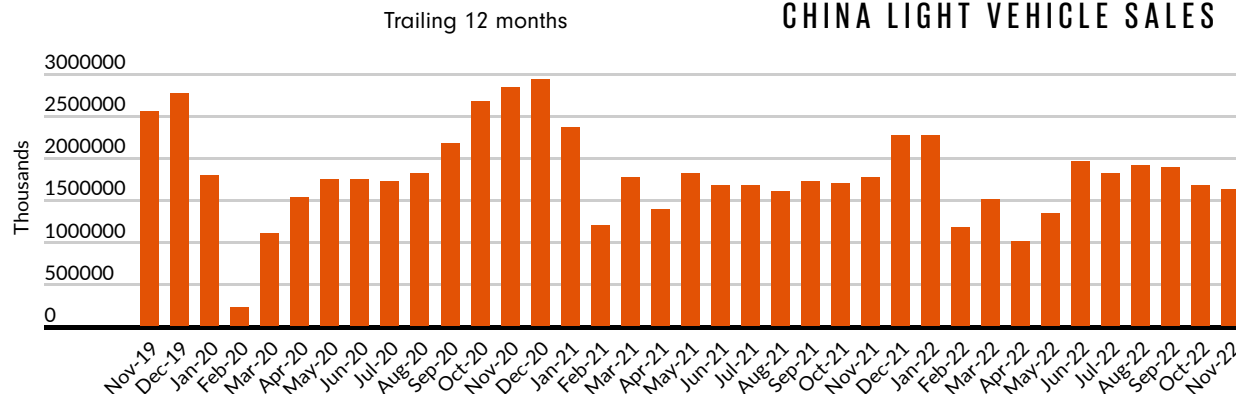
## UNITED KINGDOM LIGHT VEHICLE SALES



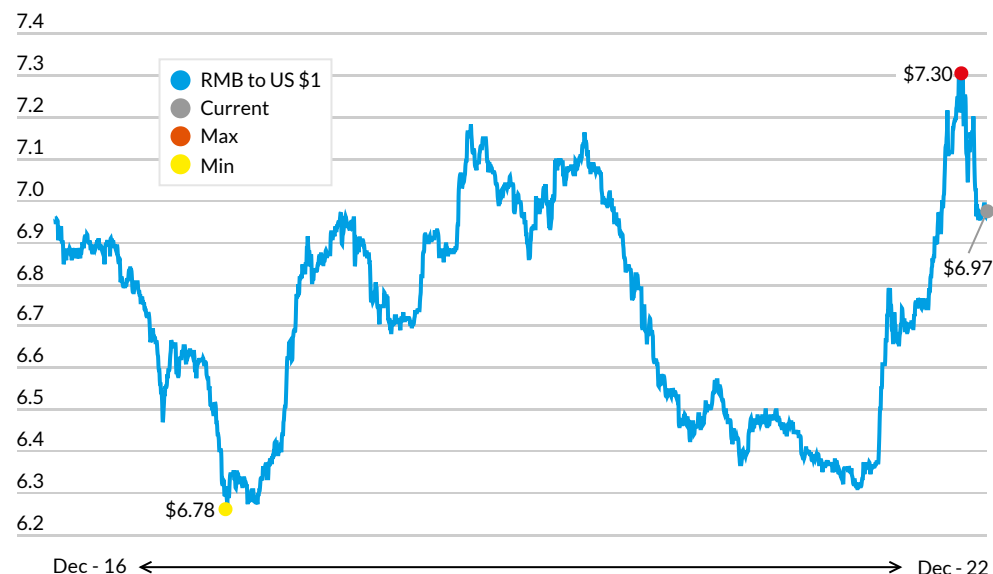
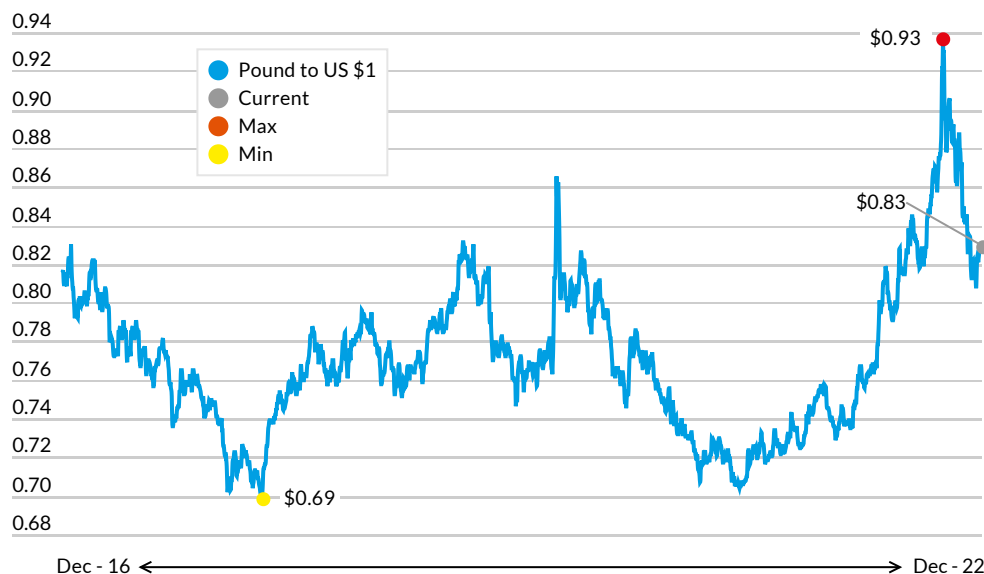
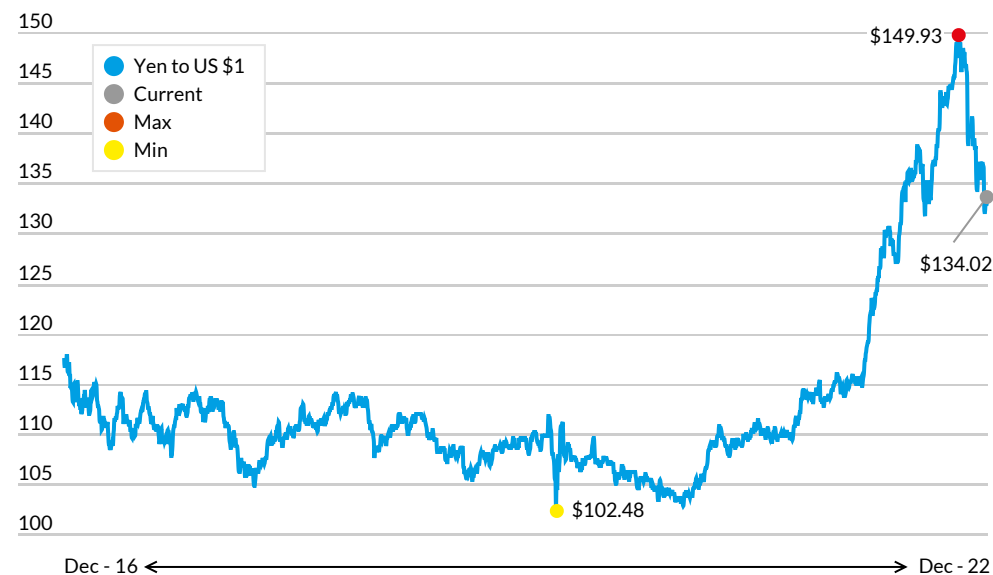
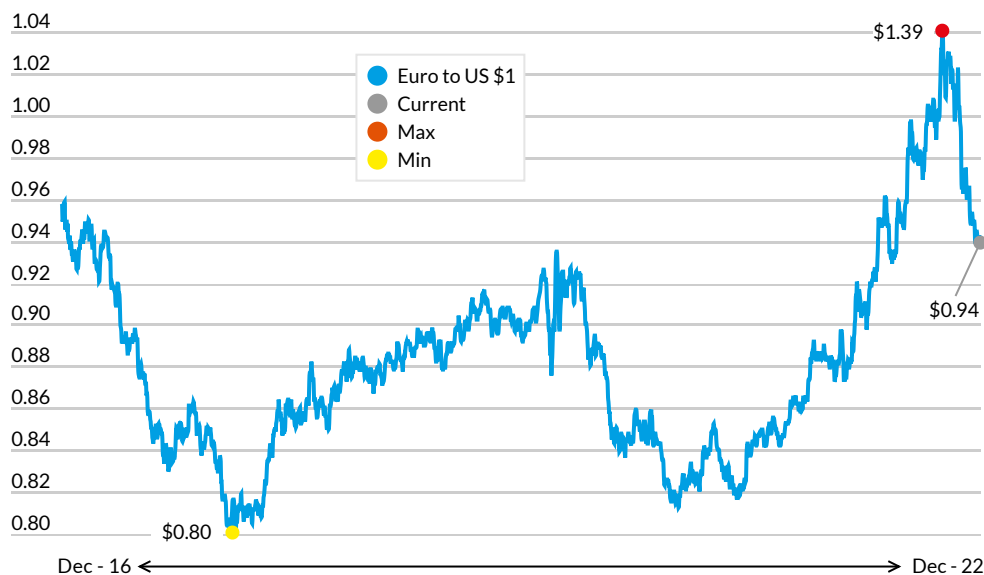
## EUROPEAN UNION LIGHT VEHICLE SALES



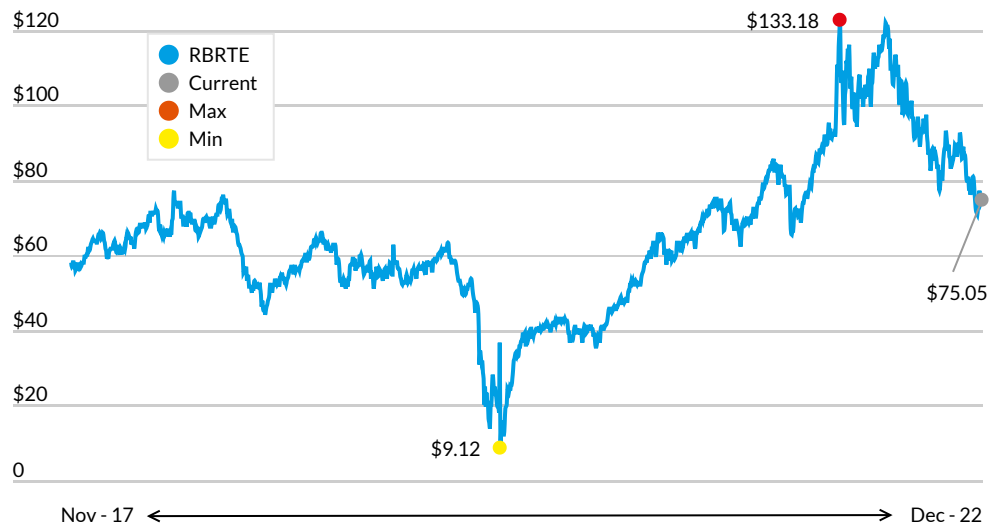
## CHINA LIGHT VEHICLE SALES



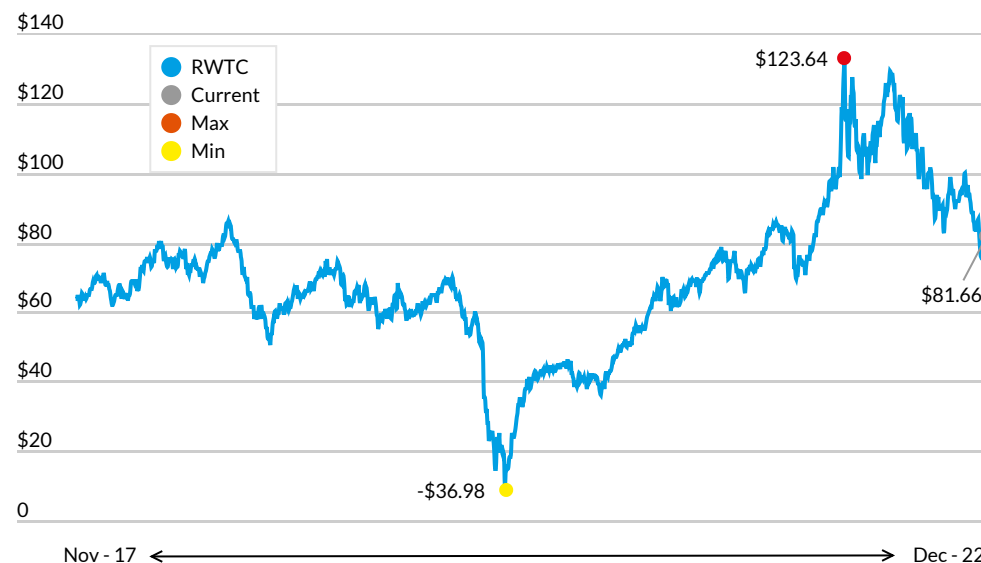
## EXCHANGE RATES VS US DOLLAR



**Europe Brent Crude**



**OIL PRICES**

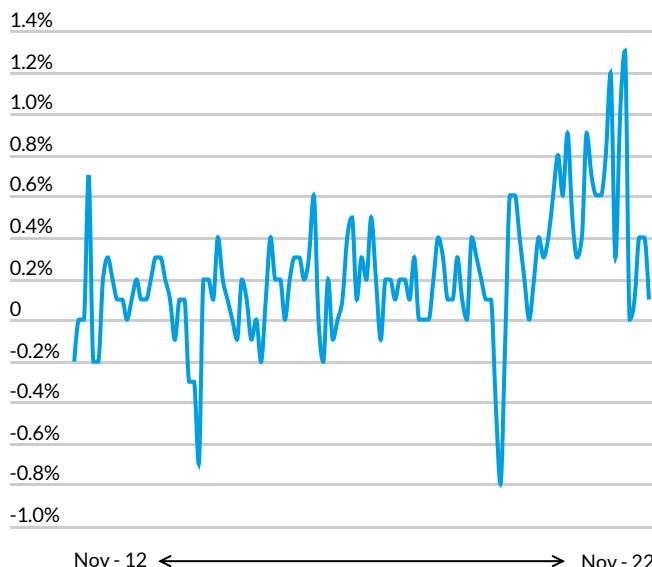


**Change in Personal Consumption Expenditures**



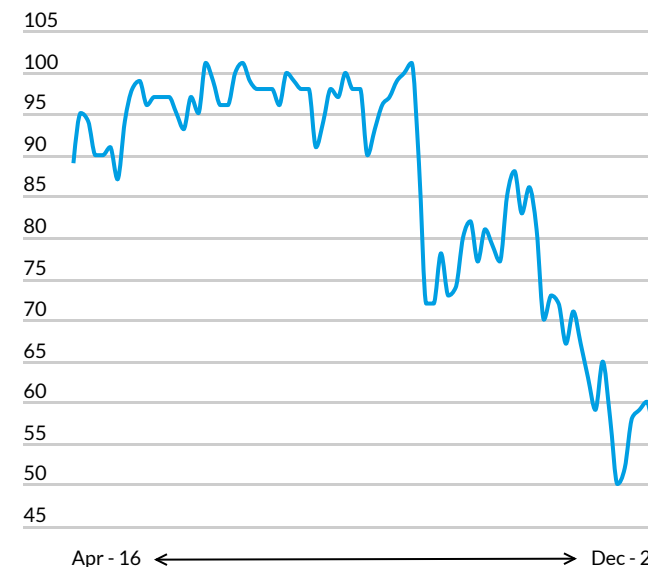
Federal Reserve Bank of St. Louis

**United States Consumer Price Index**



US Bureau of Labor Statistics

**Consumer Confidence**



University of Michigan



## SPECIAL REPORT



CONRAD LAYSON, JOSH SESTAL, BRIAN MAXIM  
AND SAM FIORANI

# Outlook for 2023 and beyond

As the industry recovers from pandemic shutdowns, every stakeholder is looking for their place going forward. We have learned so much and believe this new knowledge will alter the landscape. Many things will change, but some will not evolve in the ways that conventional thinking would have us believe.

In the history of the automotive industry, notable landmarks denote waves of changes. Packard's H-pattern shifter, Cadillac's self-starter, Ford's moving assembly line, Oldsmobile's Hydramatic transmission and DAF's CVT all changed the industry for the better, leaving hundreds of other dead ends in their wake. The industry is in the early stages of another revolution that will accompany many industry-changing technologies and strategies alongside ambitious attempts that will not gain traction – and it will take years before the difference becomes obvious.

Near-term industrial shifts toward electric vehicles are changing the passenger car and light truck right now. Further down the road – a bit further than the industry believed just a few months ago – will be full autonomy. And even further out will be the shift to fuel cells or something even better. Being prepared for the certainties of change and the risks of what that change will be will separate the winners and losers, avoiding becoming a Tucker or a DeLorean as a footnote in history.



Globalizing the supply chain helped to boost profits for automakers but that approach is now causing issues

### ● ECONOMY

Global forces are building to generate questions about near-term economic conditions. Just as inflation around the world grew following the pandemic shutdowns, Russia's invasion of Ukraine disrupted trade. Automakers building vehicles in Russia were immediately affected and that was compounded by sanctions against the country and any company doing business inside its borders. All of the major global automakers and suppliers inside Russia have backed away, reducing their income and dramatically affecting their assets as plants were sold or abandoned.

Ukraine played a key role in the global supply chain before the invasion. It provided wiring harnesses to automakers around the world, primarily in Eastern Europe, and the interruption of those supplies had companies

scrambling for alternative sources of these important components. In the end, the disruption was temporary, but the resourcing of parts will make rebuilding Ukraine after the war tougher as automakers and suppliers will be even more leery of the region if Russia continues to covet the former Soviet republic.

In order to combat inflation, global central

banks raised interest rates, stifling industrial growth. Money for investment had been virtually free for so long that markets had begun to take it for granted. In the past year, rates have soared, with the US Federal Funds Rate starting 2022 at 0.00-0.25% and ending the year at 4.25-4.50%, making borrowing far more expensive. These rates are expected to grow above 5% in 2023 as the Fed looks to get inflation under control.

While vehicle sales should not be directly hit by these rising rates, buyers will find other parts of their life more expensive, leaving less to spend on new vehicles. Automakers with captive finance arms have always been able to set their own interest rates as part of their incentive packages. Even in times of high interest rates, automakers have offered buyers loans with interest as low as 0%. Boosting sales through low interest rates goes only so far when buyers need to seek more money for homes and have to spend more on food and utilities.

Unstable economic conditions provide little encouragement for buyers to look at purchasing new, or even used, vehicles, and that will slow demand over the next year or so. Although currently calling for an improvement in the 2023 North America production outlook, the threat of a deeper recession and continued rate hikes are creating an AFS forecast scenario in which recovery may be pushed out an additional 12 months.

### ● SUPPLY CHAIN

Interrupting the flow of wiring harnesses from Ukraine was just part of the recent supply chain troubles. Following the semiconductor shortages in the automotive industry and beyond has been a guilty pleasure among market watchers for two years, but the struggles don't end there either. Globalizing the automotive supply

**'ECONOMIC  
CONDITIONS WILL  
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OVER THE NEXT  
YEAR OR SO'**

chain over the past few decades boosted the profits of manufacturers and suppliers. Finding the lowest-cost sources of labor and raw materials allowed prices to be stable on aging technologies while high-tech navigation, infotainment and vehicle control systems have flourished, boosting profitability of vehicles. That was until outside forces disturbed the flow of these components.

A political swing toward localization threw up walls between trading partners and previous free trade agreements were placed in question. Trade between the US and China had increased significantly since the 1970s, but growth of the Chinese economy and treatment of workers prompted Western countries to re-evaluate trade with the country, leading to trade barriers from the US, among others.

These moves dovetailed into the rise of the COVID-19 pandemic. After a year of shutdowns and finding ways to coexist with the virus, China focused on its plan of "zero COVID", where any outbreaks would be immediately quarantined, shutting down factories, neighborhoods or entire cities. Shutdowns inside China have persisted long after the rest of the world was vaccinated and living with lesser effects of the virus.

China's decision to close off affected areas interrupted the supplies of components needed for the manufacture of many global products. For the automotive market, many manufacturers rely on parts sourced from China due to the lower labor costs and expansive industrial support network built over the past two decades. Among other regions, production of vehicles in Japan have been halted numerous

times due to the lack of Chinese-sourced parts.

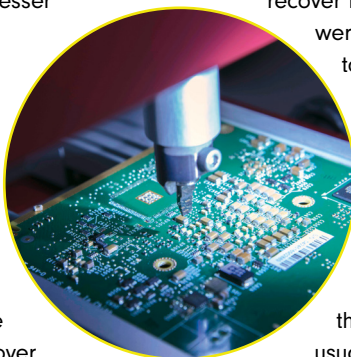
The China example is just one of many fragile areas of the global supply chain. With stockholders becoming more and more important in the direction of companies, stabilizing the flow of parts is vital to improving the value of automakers and suppliers. China will continue to be a key source of parts, but many components are being analyzed for a better balance of cost of labor, cost of raw materials and stability of the relations with the source country.

### ● SEMICONDUCTORS

Although other supply chain issues still exist, nothing currently hampers vehicle production as much as the flow of semiconductors. At the start of the pandemic, many different components became scarce and raw materials or labor issues occurred, due to COVID-19. As time went on, vehicle assemblers and parts suppliers found ways to overcome these issues, along with the pandemic subsiding significantly. The tight supply of semiconductors shifted to other industries as the automotive industry stepped out of line, believing that it would not quickly recover from the shutdowns. They

were wrong and they were sent to the back of the line. Unused to playing second fiddle to anyone, the auto industry looked for more chips but that required more capacity.

Building a facility to make semiconductors involves tens of billions of dollars. Spending that much money on a new fab usually means making products with the latest technology. Chips used in the vehicles affected by the original shortage are of older designs and



**Limited chip supply has prompted automakers to prioritise profits**

## 'THE SHORTAGE OF OLDER-DESIGN, LOWER-PROFIT CHIPS IS HERE TO STAY'

these lower-profit chips don't take priority when new plants are built. So the shortage of those chips is here to stay, forcing the industry to look at newer chip designs. Automakers know this.

When the shortage began, automakers had a chance to engineer out this issue but largely they have not. Some new BEVs use newer chips, but the traditional, older vehicles haven't made the migration yet. That has given vehicle assemblers the ability to limit less profitable vehicle production in favor of higher-value models. This shrinking production reduces the required workforce in preparation for future BEV production needing fewer workers. The reason for this direction is blamed on an issue that has no real villain, which provides a "get out of jail" card for workforce reduction.

Focusing on profits now provides more funding in the transition to BEVs. With the first wave of electric vehicles lacking profits, this temporary windfall helps as tighter emission mandates continue to push for the electrification of light vehicles, leading toward eventual cost reductions and profits.

### ● ELECTRIFICATION

A future propelled by electric vehicles is virtually certain. The need to reduce the pollutants emitted from motor vehicles has added so many emission control devices that today's petroleum-



fueled vehicles produce a tiny fraction of the pollutants that their predecessors did just half a century ago, but motor vehicles still generate a substantial amount of the world's greenhouse gases. Shifting to battery-electric vehicles is the next step to reduce this output.

However, the transition to zero emissions is not without some peril inherent with adopting new methods of producing electric vehicles. The typical supplier-OEM relationship isn't sufficient to keep up with evolving market demands motivated by changes in electric vehicle technology and evolving consumer tastes. Tesla's in-house component design and production capabilities demonstrated the benefits of being agile when reacting to market demands. Tighter control over component specifications, especially those unique to the brand, shorten both production and validation time compared with the traditional model. This was never more evident than during the depths of the chip shortage, when Tesla engineers shifted away from the standard and scarce 7nm automotive component chip to the more modern 5nm chip and barely missed a beat. Agility in overcoming supply chain disruptions is a key component of future success.

Battery cell production is vital to the production of future electric vehicles. Joint ventures between battery cell makers and



OEMs are the business arrangement du jour, spreading the financial risk between the partners. Platforms with their electric motors attached, otherwise known as skateboards, are designed with standardized form factors, although the cell's chemistries have characteristics unique to the particular OEM being supplied. Battery-side partners work closely with OEM engineers to optimize cell cathode chemistry and behaviors when connected inside the pack. Supplier issues with future battery systems are unlikely to be tolerated by customers, as evidenced by LG Chem's defective cells in Chevrolet Bolts. The Bolt's production volumes are returning, but slowly as customers come back to the market and reappraise the Bolt's value proposition.

Battery cell development is currently centered on lithium ion batteries. The minerals contained in those cells are scarce due to limitations on extraction and refining. Added to that are political constraints such as the Inflation Reduction Act (IRA) in the US. AFS expects battery-electric vehicles (excluding hybrids) to comprise 5.9 million units, or 34%, of North American production volumes by the 2029 calendar year (CY). That would call for battery cell production capacity to achieve over 500GWh per year. Counting existing and near-future battery cell factories announced for North America but not yet operational, approximately 320GWh of supply will be online by 2026CY.

Even with continued onshoring of battery cell production, lithium ion cell supply will be a close call. The sources of lithium carbonate and spodumene needed from which to refine battery-grade lithium and battery minerals will form their own bottleneck before 2030. While estimates of current and future supplies vary greatly, most mineral forecasters agree that there will be a shortage of refined lithium,

conforming to the IRA's requirements, beginning by 2026. It takes five years to permit and bring to operation a brine pool evaporation project to produce lithium carbonate for refinement. It takes eight years to bring a hard-rock spodumene mine into operation from the permitting date.

### ● BATTERY PRICE PARITY

Most proponents of electric vehicles talk about price parity, which is the point in time when a vehicle with an internal combustion engine and a comparable battery-electric vehicle will cost the same. The idea is that increased battery production and the associated economies of scale will force battery costs down and bring the two vehicle types closer in price. Not only has this not happened yet, but the target date for price parity keeps being delayed.

Price parity was initially supposed to have occurred in 2020CY, then in 2022CY, and now it is being pushed back to around 2025CY. This is happening because battery costs have not been easing as the proponents expected. Economies of scale have been realized but that factor isn't as strong as it was expected to be. Continued improvements will bring these costs lower but the reductions will not be significant.

Battery costs are actually starting to rise because of the scarcity of raw materials. As the demand for lithium-based batteries has soared, the availability of some of the raw materials has not and that is causing shortages. It takes several years to increase mining capacity for these materials. With supply creeping up slowly over the next couple of years and demand roaring, battery prices are expected to rise significantly during 2023CY and 2024CY.

New raw material capacity is expected to come online in 2025CY and through 2026CY. After that happens, battery prices should drop significantly to the levels of early 2022CY. The result of this will have some impact on electrified vehicles, on a global scale. Prices for BEVs will increase through 2024CY, slowing demand and production. We may not see an actual plateau, but a bit of a dip in the growth curve should be expected. As we move into the post-2024 era, BEV prices should become more digestible. The growth curve at that point should become much steeper, settling down around 2027.

While all of this is occurring, the average cost of new vehicles will continue to increase. The industry focus on higher-profit models due to production limitations has pushed the prices of ICE vehicles up, which actually moves the price parity point closer while BEV component prices, and the necessary rise in BEV prices, are working against this market shift. Finding a way to make BEVs profitable will be important to long-term industry success.

### ● SOFTWARE

Software is another OEM key to success, now and in the future. The Volkswagen Group's CARIAD SE was formed to create the group's software and solve the problems caused by existing vehicle operating systems, which have become a conflicted web-work of patches. The agile production methods introduced by the new hires from the software industry failed to take hold in the larger organization. The results were a revolt within the organization, a change in CEO, and a step backward with the Volkswagen ID.3 and ID.4 models already in customer hands. The bugs in existing vehicles are slowly being worked out, although Volkswagen still cannot update vehicle software

**'PRICES FOR  
BEVS WILL  
INCREASE  
THROUGH  
2024'**



Volkswagen Group recognized the need to create software in-house but it is still fixing bugs in its ID models



over the air, as can some rivals. Properly addressing the software issue will break the winners from the pack going forward.

Future issues on the horizon are largely continuations of the existing headwinds. OEMs need to come to terms with how they approach the role of software in their organizations. Farming out operating system development to third parties cannot continue if a legacy OEM expects to transition into making software-defined vehicles (SDV).

The unwary OEM could be tempted to trade away control of screens and access to vehicle/occupant data to Google or Apple in order to cut costs. Taking that bait could lock an OEM into a downward development spiral where an outside firm controls the experience with the vehicle. The time required to build competency in software development goes well beyond merely hiring more software engineers and requires a shift in attitude and perception of the entire organization. A realization that derailed Volkswagen's path to developing SDVs and other legacy OEMs has yet to be recognized.

## ● AUTONOMY

Technology and electrification are obviously joining forces to bring about autonomous vehicles. Raising the levels of autonomous control is improving the safety of passenger vehicles, with crash avoidance, parking assist and lane keeping, but creating fully autonomous vehicles is far more difficult than early entrepreneurs first thought. This gap between technology and reality has pushed Argo.AI out of the field and delayed the launch of Apple's planned autonomous vehicle.



**The path to fully autonomous vehicles remains long and tough**

TuSimple and Waymo are among the other companies focused on autonomy who have downsized or moved their attention elsewhere recently.

Once the technology has caught up with the dream, regulators will need to update the laws to allow such vehicles to exist on public roads. Full Level 5 autonomy, where vehicles control everything without any driver input, will not arrive before the next decade.

## ● MORE COMPETITION

In an interview with Automotive Industries about two decades ago, industry legend Bob Lutz explained how the industry would progress and allow for more competition. General thinking before this held that building motor vehicles, by their nature, was expensive enough to keep out new players. As the 20th century approached its end, the industry was driving toward a small handful of global players dominating the market, with a few niche players picking up the scraps. But Lutz was right for two reasons: one he foresaw and one he overlooked.

At the time of his interview, Lutz was working to revive the Cunningham sports car marque. In its asset-light approach, Cunningham designed an all-new vehicle but looked to someone else to assemble it. Pre-dating Lutz's involvement, Cunningham was being developed as a "virtual car company" where it would own the product but outsource almost everything else.

Companies like Magna Steyr and Valmet provide a way to produce vehicles when a manufacturer doesn't have the factory space or can't find a way to make low-volume production profitable. Outsourcing vehicle assembly helped

get the European Chrysler Voyager, Peugeot RCZ and Saab 900 Convertible into production. While major manufacturers use this method to make niche models, the same process is helping get models from startups on the road.

New players like Foxconn jumped into the market, providing assembly space for emerging electric vehicle companies. Leveraging Foxconn's plant in Lordstown, Ohio, production of the Lordstown Endurance pickup, the INDIEV One and Fisker PEAR has been fast-tracked. Other startups will take the same path on their way to vehicle production.

While these new players may see such outsourcing as an asset-light approach to production, that path does not bypass the need for adequate funding. Legacy automakers with strong balance sheets and seasoned executives have experience with higher interest rates



**'GEELY, GREAT WALL AND BYD ARE WORKING ON GLOBAL MARKETING'**

and should weather the situation well. Many EV startups, however, rely on easy access to capital. Even Rivian, among the best-funded startups, recently laid off workers, rationalized its product roadmap and delayed the launch of its R2 vehicle in an effort to preserve capital. When interest rates were hovering around zero, finding venture capital was relatively easy, but this becomes much tougher as the market rates rise and only the strongest will survive.

The reason for industry growth that Lutz missed was China. In the late 1990s, the idea of China rising as a global player was being discussed, but it was largely focused on supplying vehicles for its home market. GDP in China in 1998 was \$3,356 per person, so few people could afford a car. Today, that figure has grown more than sixfold while inflation has not quite doubled the cost of goods.

The rudimentary passenger car market of the 1990s has blossomed into a full industry with a dozen globally competitive automakers alongside more than 100 smaller vehicle manufacturers. State-owned companies like BAIC, Changan and SAIC have attempted to export their products, with limited success, and the lack of competition in Russia is an opening for these companies. Sales of SAIC's MG brand have shown some strength with its electric vehicles, but the focus will be on the private companies. Established manufacturers Geely, Great Wall and BYD are working on global marketing plans. Geely expanded by absorbing other automakers for their brand names and manufacturing footprint. Great Wall, long believed to be a potential export powerhouse, is crafting a new design philosophy and new brand names in order to target European and American buyers. But it's BYD that has recently taken the lead with its successful electric vehicles and footholds in Western markets.

EV startups such as NIO and Xpeng should not be overlooked in the rise of Chinese automobile manufacturing as they expect to be global players as well.

## ● THE SALES MODEL

When supply chain disruption slowed production, sales outlets were unable to fully stock their inventories. Lower inventories turned the traditional negotiation process further in the salesperson's favor, increasing profitability for automakers and dealerships. Immediately, lessons were learned and it was announced that this was a paradigm shift. However, vehicle sales in much of the world rely on a broader system that can't be controlled so simply.

In the short term, franchise dealers, primarily in North America, will carry fewer products. Reducing the stock will cost dealers less in financing and "floor planning". Rising interest rates make large inventories of unsold products even more expensive, which pushes dealers to cut these costs where they can and encourages a smaller variety of demonstration vehicles. With less to wade through, buyers have less room to negotiate and have a higher propensity to order exactly what they want. It's a win-win for people selling cars and trucks at a cost to the buyer. This, so goes the belief, is the future.

Capitalism, being what it is, will not allow this to happen unabashed. If there's a void in the marketplace, such as customers looking for lower prices and/or a wider selection of products, someone will fill the void. The dealership network in the US has been built to ensure stores will be within a short drive of most Americans, and the older networks are so large that they compete with one another. This competition further lowers the transaction prices of vehicles, especially when a buyer can go a few miles down the road to the next retailer



Cars from startups Rivian (inset) and Lucid (main image) are being sold by bypassing the dealership model

selling the same product. American franchise laws protect these stores from manufacturer-driven competition but also keep franchises competing with each other.

In the Automotive Industries interview mentioned earlier, Lutz ruminated on the nature of dealerships for his then-new automotive venture. Relaying a discussion with a friend about bypassing dealers, he said: "I told him that won't happen, because he'd find it very difficult to add value – you can't make the dealer go away. You'd need to find a factory that sells you cars directly." Without knowing it, he was predicting the rise of Tesla.

"You've got this nationwide dealer-protection legislation in every state," he explained. As Tesla is blazing a new retailing trail, the EV maker is finding that many states' legislation prevents automakers from competing with

## 'IN THE SHORT TERM, FRANCHISE DEALERS WILL CARRY FEWER PRODUCTS'

its own dealers, but a question arises if a manufacturer has no dealers. Does the legislation mean a manufacturer can't sell its own products in this case?

More and more American states are leaning toward startups and this could be a sign of a larger movement. Factory stores and factory-direct sales are not new but they are becoming

the norm as Tesla expands its reach and new players such as Lucid and Rivian enter the market. Growth of these companies uncovers the flaw in the factory-direct model: service.

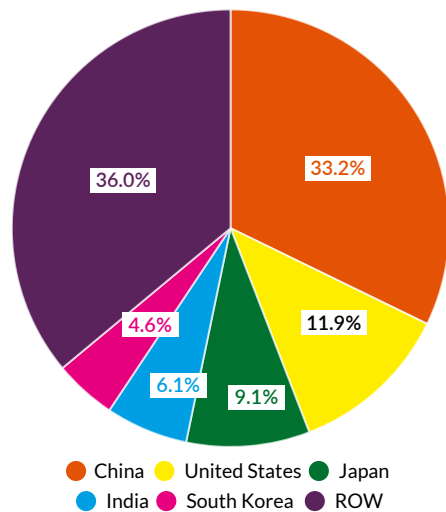
A network of dealerships provides factory-trained technicians to quickly and properly repair problems. When thousands or hundreds of thousands of owners need their vehicles checked for a quality issue, a local dealer can arrange the proper evaluation and fix with minimal trouble on the owner's part. Over-the-air updates help with software issues, but when a component has a problem, someone needs to physically make the repair and this is where dealers shine. Finding alternatives for the startups is important to the long-term survival of these dealer-free companies.

As the dealer network evolves, an increasing number of transactions will work through the manufacturer. New agreements designed to retail electric models limit the inventory necessary for dealers and could transition stores into the paperwork processor. Franchise laws continue to slow this shift, but regulations will develop for dealers to remain competitive in the industry being outlined by startups.

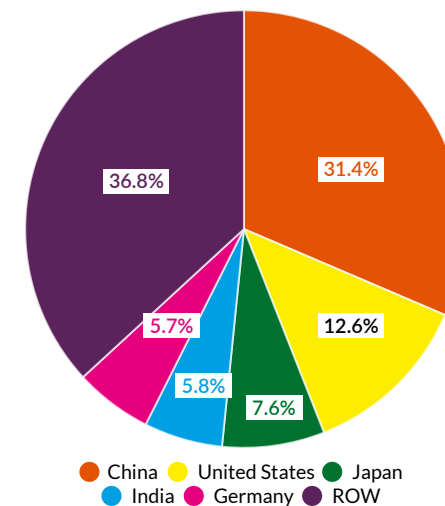
## ● AN INDUSTRY IN TRANSITION

A year ago, the semiconductor shortage, the shift to EVs and the disruption of new players were the near-term issues facing the automotive industry and they remain very important today. Items that couldn't be accurately predicted – such as Elon Musk's foray into social media ownership and the associated fall in Tesla market value, Volkswagen's move to revive the long-dormant Scout SUV and Russia's invasion of Ukraine – showcase the need to keep a constant eye on this industry. Expect more of the unexpected in 2023 but be prepared for the changes obviously coming.

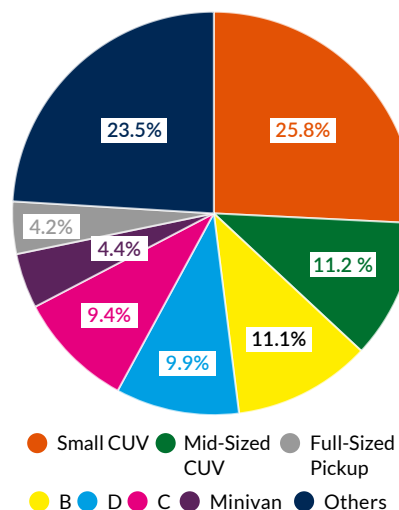
## 2022 TOP 5 GLOBAL COUNTRIES



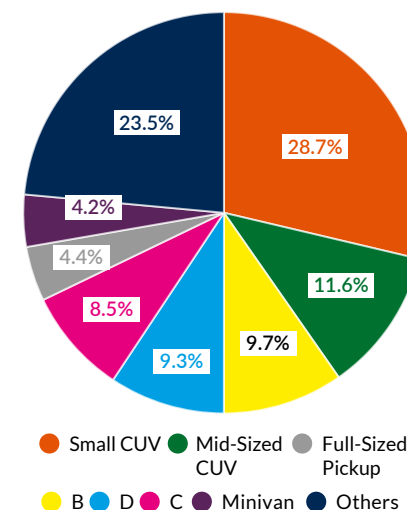
## 2029 TOP 5 GLOBAL COUNTRIES



## 2022 TOP GLOBAL SEGMENTS



## 2029 TOP GLOBAL SEGMENTS



## TOP 5 BRAND OWNERS

Brand Owner	2022 Production	Brand Owner	2029 Production
Toyota Motor	10,210,125	Toyota Motor	10,833,414
Volkswagen	7,989,677	Volkswagen	9,248,136
Hyundai Motor	6,891,321	Stellantis	8,501,712
Renault-Nissan-Mitsubishi	6,743,781	Hyundai Motor	8,050,815
Stellantis	6,575,195	Renault-Nissan-Mitsubishi	7,447,635

## TOP 5 GLOBAL PLATFORMS

NGA-C	2,486,477	CMF-B HS	3,239,179
CMF-B HS	2,443,433	Gen III	2,458,463
MQB A1	2,095,923	KP2	2,350,267
NGA-K-SUV	1,854,925	NGA-C	2,156,169
N	1,825,443	NGA-K-SUV	2,147,518

Renault-Nissan-Mitsubishi (CMF-B HS), Toyota Motor (NGA-C, NGA-K-SUV, NGA-C), Tesla (Gen III), Volkswagen (MQB A1), Hyundai Motor (KP2, N)

## TOP 5 GLOBAL ASSEMBLY PLANTS

Chongqing Engine 1	1,067,482	Manesar 1	1,123,019
Manesar 1	1,067,306	Chongqing Engine 1	1,069,321
Liuzhou 2	792,719	Liuzhou 2	766,495
Gigafactory 3	698,015	Gigafactory 3	676,464
Xi'an 2	656,929	Beijing 1	662,655

Maruti Suzuki (Manesar 1) Changan Auto (Chongqing Engine 1) SAIC-GM-Wuling (Liuzhou 2) BYD (Xi'an 2) Beijing Benz (Beijing 1) Tesla (Gigafactory 3)



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