M Capital Group

Electric Vehicles

Technology Not Engineering

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M Capital Group

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

OUTLOOK

Electric vehicles (“EVs”) are revolutionizing the automotive industry, not only with advanced technology but also by playing a crucial role in the global shift towards clean energy. The transition marks a transformative step towards achieving zero-emission targets, such as those set for 2050.

Advancements in battery technology, growing environmental awareness, and supportive government policies are rapidly making EVs a viable and sustainable transportation option. The market, valued at US$256 billion in 2023, is projected to reach US$2,109 billion by 2033, with a compound annual growth rate (“CAGR”) of 23%. China, the United States, and Europe currently account for 95% of sales.

BYD, a China leading car manufacturer, has surged in popularity, with sales growth reaching 17% in 2023, nearly matching Tesla's 20% market share and positioning BYD as a serious competitor that could potentially surpass Tesla in EV sales as early as 2024. Declining battery costs are expected to drive further growth in EV sales, addressing a key customer concern and the ongoing challenge of charging stations availability. Major automakers are focusing on improved battery technology and international expansion.

While the drive for electric vehicles is pivotal for sustainability, the anticipated 40-fold increase in lithium mining and refinement by 2040 raises environmental concerns. Addressing these issues, positive trends in North America and Europe—such as active battery recycling programs—are making significant strides.

China leads the global electric vehicles market, accounting for 60% of global sales, with BYD as the only major automaker producing batteries in-house. The country also exerts significant control over the raw materials market, holding over 70% of key battery components, solidifying its role as a major supplier in the global EV supply chain. The rise of Chinese startups like Nio and XPeng, focusing on the mass market and forming international partnerships, has driven sales growth. However, recent tariffs from the US and EU, along with price wars and an oversupply by competitors, pose new challenges to the Chinese market.

The recent partnership between Volkswagen and Rivian, a US startup known for its software development and architecture, signifies a leap in technological advancement. Supported by the US government's Inflation Reduction Act (“IRA”) and the Investment and Jobs Act (“IIJA”), the US is accelerating its transition to a clean energy economy, creating sustainable jobs. Although policy inconsistencies across states can impact adoption rates, increased investment in charging stations presents an opportunity to create over 160,000 new jobs.

European’s strategic allocation of oil revenue for government incentives, combined with its 99% reliance on renewable energy, has facilitated creating charging stations. Further investments in charging infrastructure and the development of in-wheel motors by DeepDrive, a Munich-based high-tech company, boosting collaboration with BMW and Continental, potentially reducing costs and increasing the popularity of EVs. The EU's dependence on China for raw materials highlights the need to develop a domestic battery supply chain, contributing to a more sustainable future.

REPORT ROADMAP

This report examines the electric vehicles market, exploring key drivers, challenges, and market dynamics that shape innovation and propel growth. By analyzing current industry trends, the report offers future predictions for key growth regions including China, the US, and the EU.

As the market value is projected to reach over US$950 billion by 2030, this report analyzes how the electric vehicles industry is responding to factors such as increasing global sustainability awareness, supportive government policies, and rising customer demand in emerging markets.

ELECTRIC VEHICLES INDUSTRY OVERVIEW

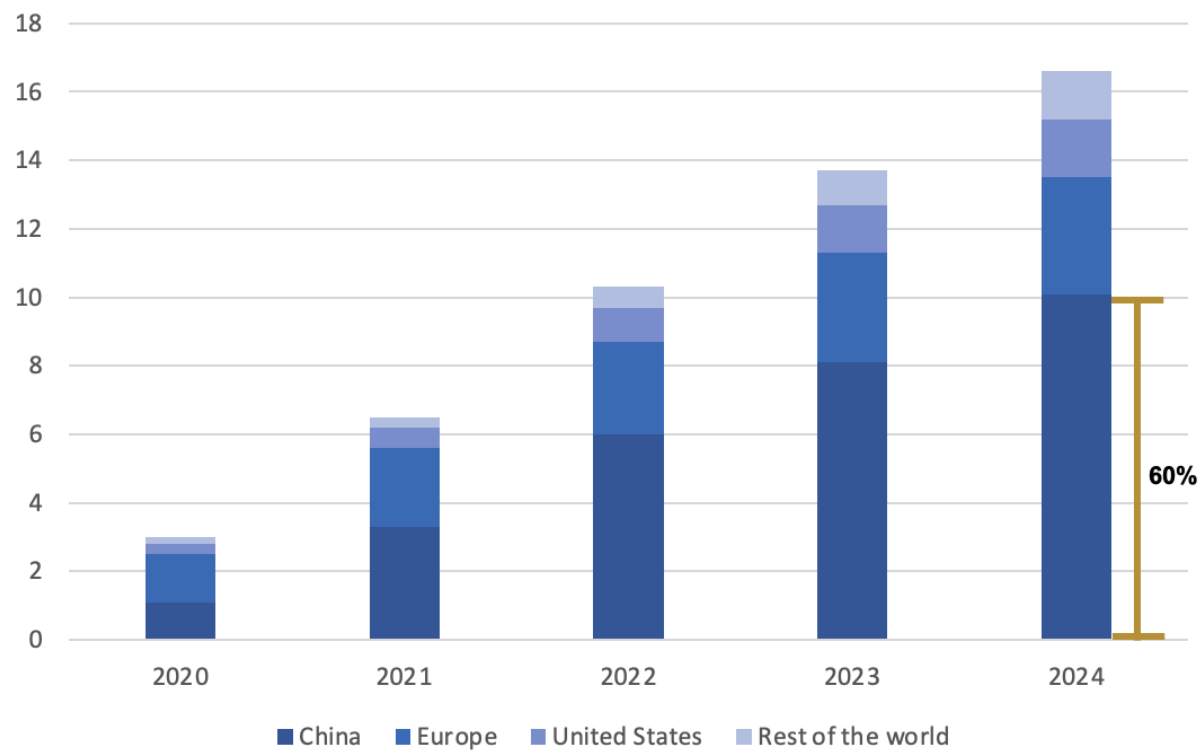
BACKGROUND

The early 21st century marks the beginning of a revolution in the EV industry. Sales experienced exponential growth, surging by 43% in 2023 compared to 2022. By 2024, EV sales surpassed 10 million units, accounting for 14% of all new car sales and representing a 60% increase from 2023.

Fueled by zero-emission targets for 2050 and the challenge of decarbonization, global electric car sales reached nearly 14 million units in 2023. Notably, 95% of these sales were concentrated in China, the United States, and Europe.

China holds the leading position as the largest EV market and a major player in the trade of batteries and components. China is expected to reach nearly 10 million EV units sold in 2024, capturing an estimated 60% of the global market share. With these trends, the future of electric mobility remains promising as the industry continues to gain market share.

Electric Vehicles Sales
2020 - 2024



Source: MCG, International Energy Agency, 2024

MARKET SEGMENTATION

The electric vehicles market can be segmented into distinct categories, based on technology and power sources.

TECHNOLOGY

EV technology encompasses three main segments: Battery Electric Vehicles (“BEVs”), Plug-in Hybrid Electric Vehicles (“PHEVs”), and Hybrid Electric Vehicles (“HEVs”).

BEVs

Operating solely on rechargeable batteries with typical ranges between 100-300 miles, BEVs have shown the highest sales growth among all vehicle types, reaching a record-breaking 17% market share. When combined with PHEVs, plug-in vehicles now account for 24% of the market.

PHEVs

Featuring both an engine and an electric motor, PHEVs offer a balance between electric and gasoline-powered driving by utilizing electricity stored in the battery until nearly depleted. With larger batteries and the ability to recharge from the grid, they can travel longer distances solely on electric power before switching to hybrid mode. During the first quarter of 2024, PHEV sales surged by 46% year-over-year, driven by their lower upfront cost compared to BEVs and the convenience of a gasoline engine, which eases range anxiety—a concern exacerbated by the high cost of BEVs and charging infrastructure.

HEVs

Often called "self-charging hybrids," HEVs combine a gas-powered engine with an electric motor, using regenerative braking to recharge the battery and improve fuel efficiency. Unlike PHEVs, HEVs cannot be plugged into an EV charger for recharging.

POWER

The power sources for electric cars consist of three primary components: stored electricity, onboard electric generators, and charging inlets. Each plays a crucial role in the vehicle's performance and charging capabilities.

Stored Electricity

Lithium-ion battery energy storage systems are commonly used for storing electricity, with capacities typically ranging from 5 to 100 kWh and voltage levels between 300 and 800 V. The battery's capacity directly influences the range, with about 1 kWh providing approximately 5 km of driving distance. Although these batteries generally last over a decade, frequent use of DC fast charging can reduce their capacity and longevity.

On-board Electric Generators

Electric generators facilitate charging by converting AC power from the charging inlet to fast-charging DC power, with a maximum capacity of 22 kW AC. During fast DC charging, the onboard charger is bypassed, allowing electricity to flow directly to the battery.

Charging Inlet

The connection point for recharging, known as the charging inlet, accommodates both AC and optional DC charging ports, with some models offering a unified port for both functionalities. By providing flexibility and efficiency in charging, this segmentation of EV power systems enhances consumers convenience and supports the widespread adoption of electric mobility.

OTHER SEGMENTS

The electric vehicles have also been segmented by Vehicle Type, Vehicle Class, and Vehicle Wheel Type.

Vehicle Type

Vehicles can be categorized by type into passenger and commercial categories. BEVs and PHEVs are primarily used for passenger vehicles, while HEVs are popular among taxi drivers.

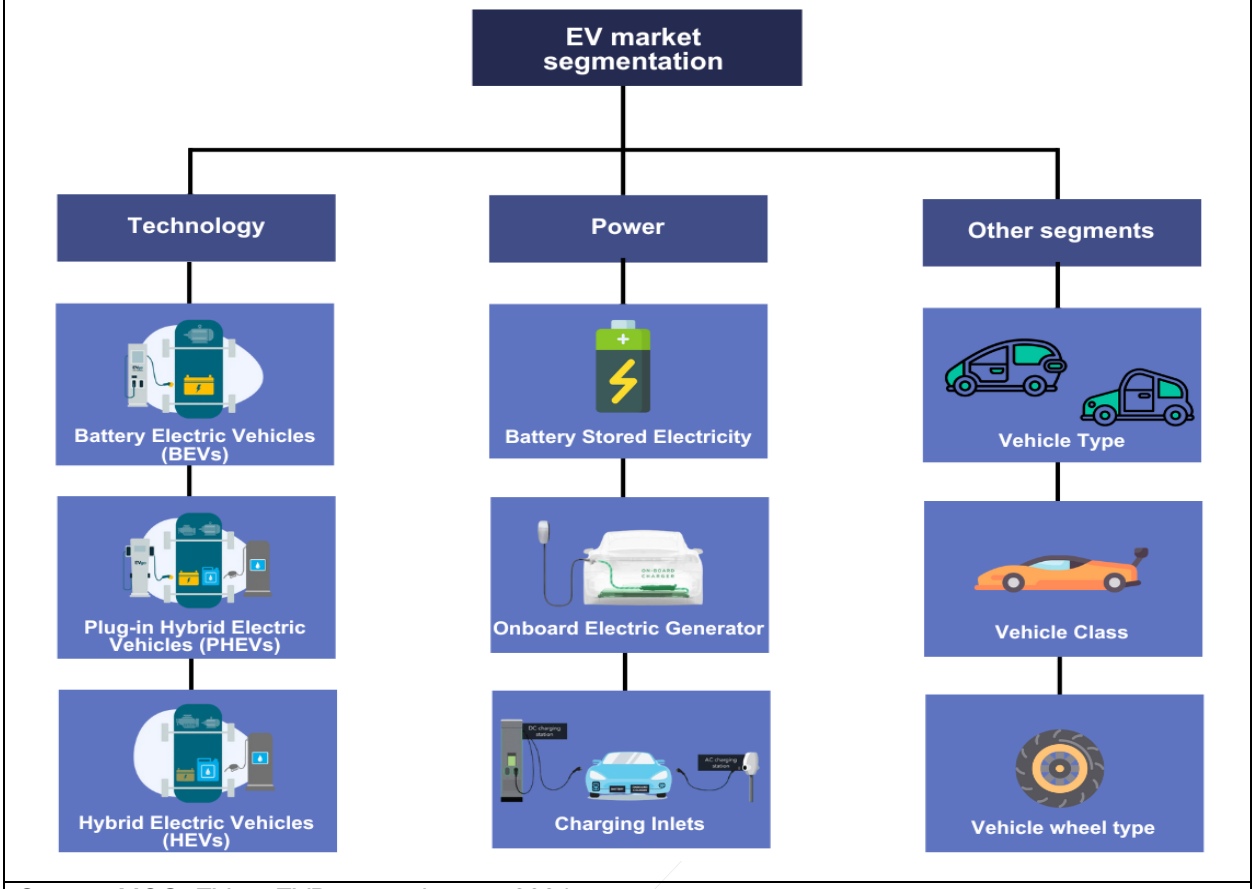
Vehicle Class

Classification including low-priced, mid-priced, and luxury, reflecting differences in driving range, battery capacity, technology, power, and building materials. Mid-priced vehicles, typically priced between US$ 30,000 and US$ 45,000, are expected to become the largest segment and experience the highest growth rate in the Asia Pacific region and Europe due to increasing demand for low-emission vehicles at affordable prices.

Vehicle Wheel Type

The market segments include front-wheel drive, rear-wheel drive, and all-wheel drive configurations. Front-wheel drive vehicles led in market share and growth rate due to their lower manufacturing costs.

Electric Vehicles Market Segmentation



Source: MCG, EVgo, EVBox, topcharger, 2024

MARKET SIZE

The electric vehicles market is expanding significantly, with the global market valued at US$256 billion in 2023 and projected to reach over US$2,109 billion by 2033, reflecting a CAGR of 23.42%.

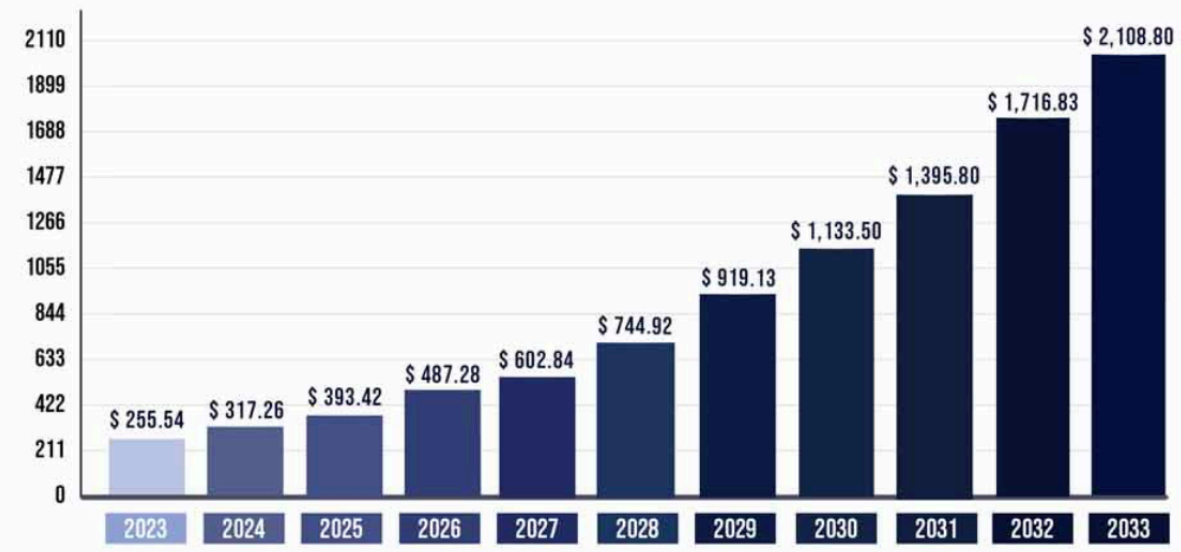
China holds the largest share of the global electric vehicles market, accounting for nearly 60% of worldwide sales, largely driven by domestic giant BYD. China's electric vehicles market is expected to experience significant growth, reaching an estimated US$674 billion by 2029, up from US$306 billion in 2024, with a strong CAGR of 17%.

Electric vehicles are also gaining market share in the United States. Statista predicts that the US electric vehicles market will generate US$83 billion in revenue by 2024, with a CAGR of 18% from 2024 to 2028. By 2028, sales of electric vehicles in the US are

expected to reach 3 million units, with California, Florida, Texas, and Washington leading the nation in adoption.

The European Union ("EU") exhibits steady growth in its electric vehicles market, driven by a strong emphasis on sustainability. In 2023, there were 14 million new deliveries of BEVs and PHEVs, marking a 35% increase from the previous year, though this growth is slower than the 55% rise observed in 2022.

Electric Vehicles Market Global Forecast
2023 – 2033 ("US$ Billion")



Source: MCG, Precedence Research, 2024

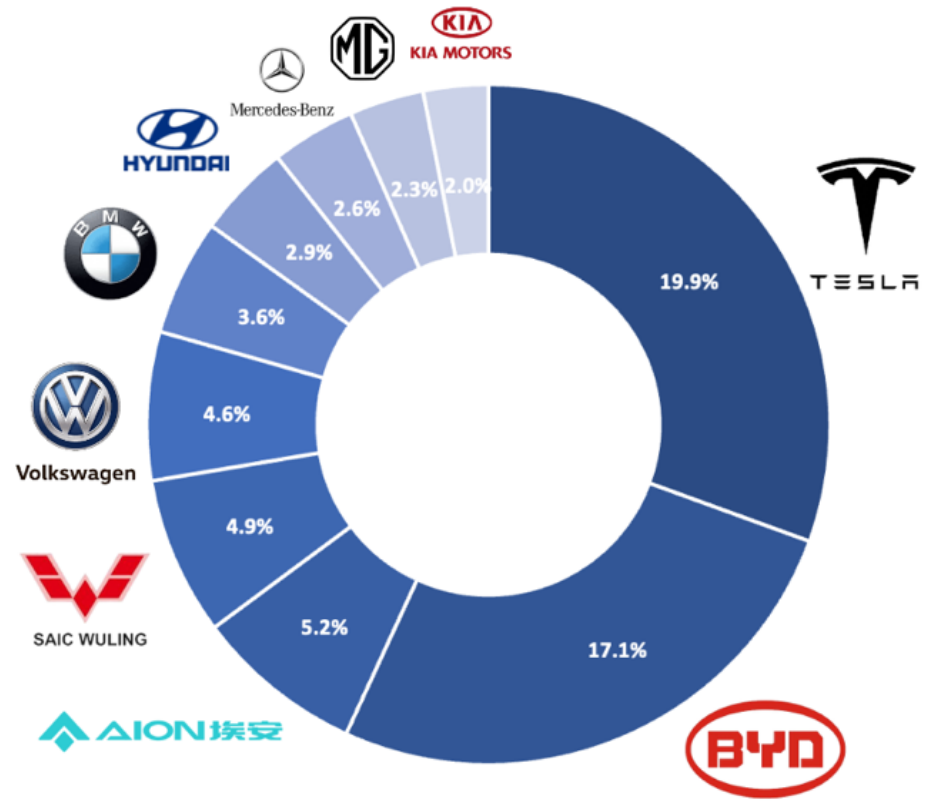
MARKET GROWTH

China, the US, and the EU remain the leading forces in the electric vehicles sales, with the top 10 companies in those markets controlling a staggering 95% market share.

BYD's popularity has surged, with a remarkable sales increase of 17% in 2023, nearly matching Tesla's 20% share. This rapid growth positions BYD as a serious threat, potentially surpassing Tesla in BEV sales as early as 2024.

Development in battery technology, coupled with growing environmental awareness and supportive government policies, are propelling EVs as a compelling and sustainable transportation solution, marking a transformative shift in the transportation landscape.

Top 10 Electric Vehicles Companies 2024



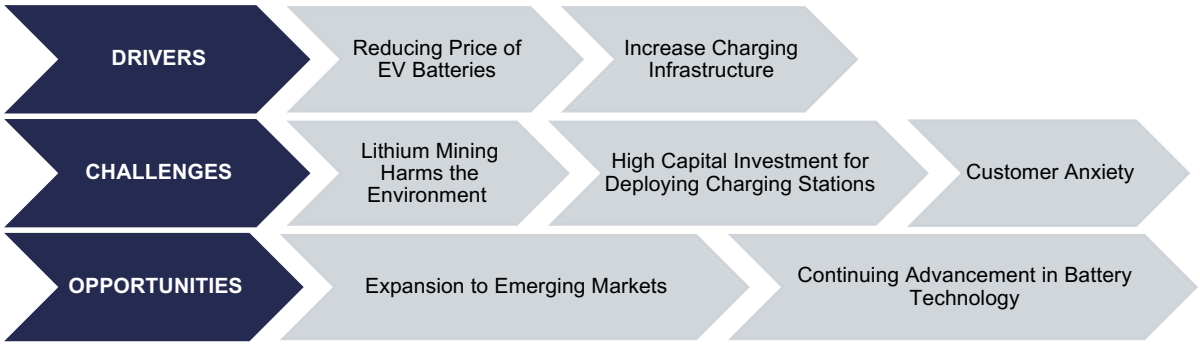
Source: MCG, visualcapitalist, 2024

CHANGING TRENDS: INDUSTRY EVOLUTION

OVERVIEW

Shifting industry dynamics and emerging opportunities are fueling the growth of the electric vehicles market. Key drivers include decreasing battery costs and expanding charging infrastructure, though concerns persist about the environmental impact of lithium mining and the high capital required for charging stations. Despite these challenges, expanding into markets such as the Middle East, Thailand, and Brazil offers significant growth potential. Advancements in EV battery technology continues to be crucial, influencing driving range, charging time, and overall costs.

Electric Vehicles Industry Analysis 2024



Source: MCG, 2024

DRIVERS

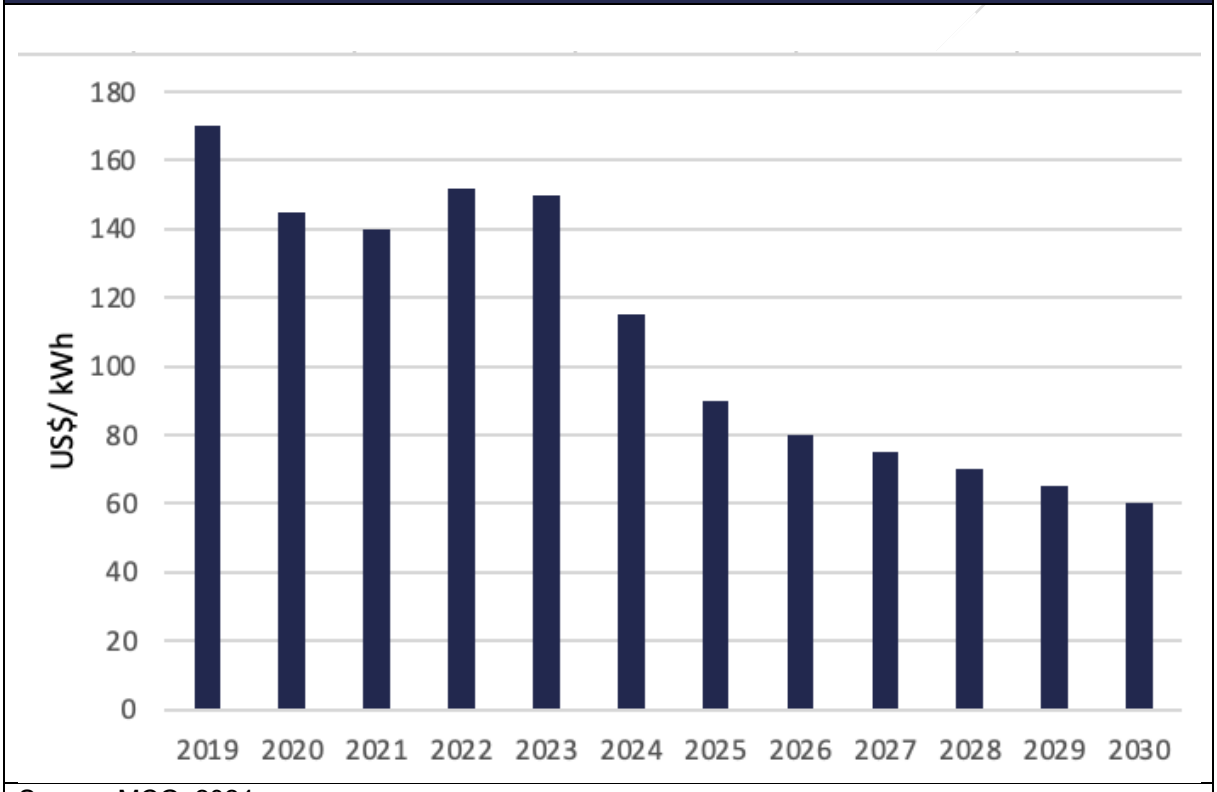
Fueled by growing consumer interest in sustainable transportation options, the electric vehicles market is rapidly expanding. Several key factors are propelling this growth, including reducing EV battery prices, technology advancements, competitive suppliers

pricing, and supportive government policies. Industry leaders such as automotive manufacturers, battery producers, and technology developers, are strategically shaping the industry to meet evolving consumer demands. Fluctuating prices, particularly in battery costs and manufacturing efficiencies, reflect the market's dynamic nature and evolving adoption rates.

Reducing Prices of EV Batteries

Over the past decade, EV battery costs have seen a significant drop. This decline is fueled by two key factors: a reduction in the cost of battery materials, particularly due to a recent bear market in metals, and continuous innovation from battery manufacturers. M capital Group forecasts a near-40% decrease in battery prices between 2023 and 2025. Based on these trends, the analysts predict a dramatic shift in EV sales composition in the coming years.

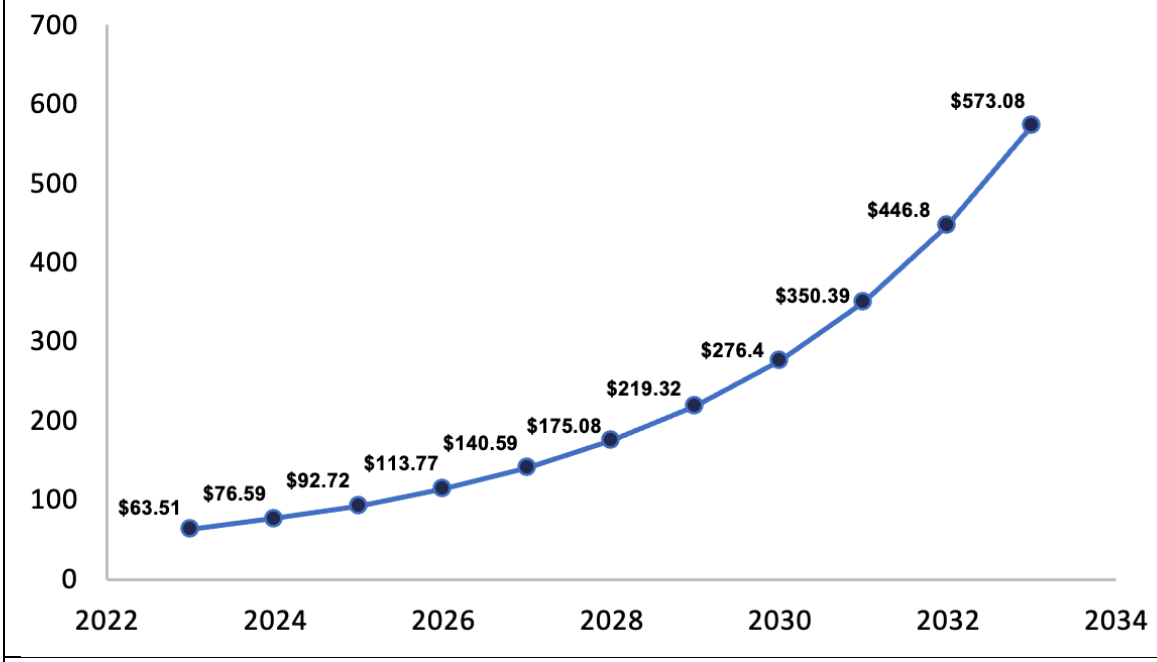
Electric Vehicles Battery Prices
2019 - 2030



Source: MCG, 2024

Due to the decline in EV battery prices, the global EV battery market reached a total value of US$63 billion in 2023. Precedence Research projects the battery market to reach US$573 billion by 2033, reflecting a CAGR of 25% from 2024 to 2033.

Electric Vehicles Battery Market Size
2023 - 2033



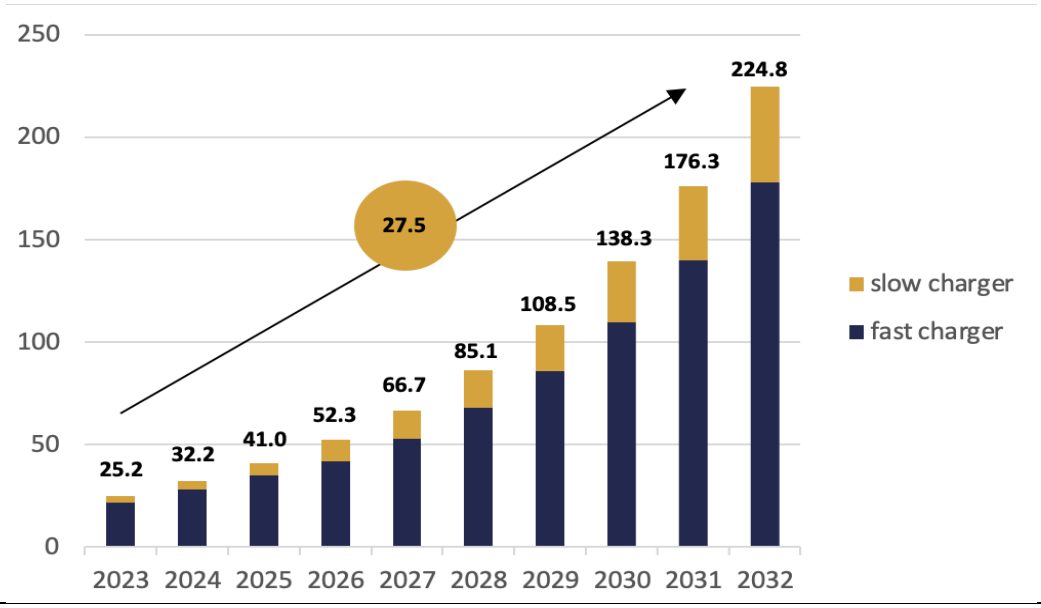
Source: MCG, 2024

Increase Charging Infrastructure

Rapidly expanding across the globe, the EV charging infrastructure market is poised for substantial growth. Projections indicate the market will reach a value of US$225 billion by 2032, reflecting a CAGR of 28% from 2023 to 2032. Currently, most EV charging occurs privately at home or in designated locations, but an increase in public charging stations, particularly in urban areas, is anticipated.

Government policies mandating the development of charging infrastructure are key drivers in expanding the EV charging network. For instance, the European Union's Alternative Fuels Infrastructure Regulation (“AFIR”) establishes minimum targets for member states, requiring publicly accessible charging stations to provide at least 1.3 kW of power per BEV and 0.8 kW per PHEV. Similarly, the US government is investing nearly US$50 million to subsidize projects aimed at expanding convenient charging access, aligning with its ambitious goal of establishing a nationwide network of 500,000 public EV charging ports by 2030.

Global Electric Vehicles Charging Infrastructure Market 2023 – 2032 ("US$ billion")



Source: MCG, Market.US, 2024

CHALLENGES

Although EV sales are experiencing a promising growth, the industry faces three main challenges that need to be addressed to achieve widespread adoption. The environmental impact of lithium mining and battery disposal raises concerns about the industry's overall sustainability.

Developing a charging infrastructure requires high upfront investment, posing a barrier to both private and public entities.

"Range anxiety" – the fear of running out of power before reaching a charging station – continues to be a significant barrier for many potential EV buyers. Addressing these challenges through innovations in battery technology, strategic charging infrastructure development, and educational campaigns aimed at overcoming range anxiety is crucial for ensuring the long-term success and environmental benefits of electric vehicles.

Lithium Mining Harms the Environment

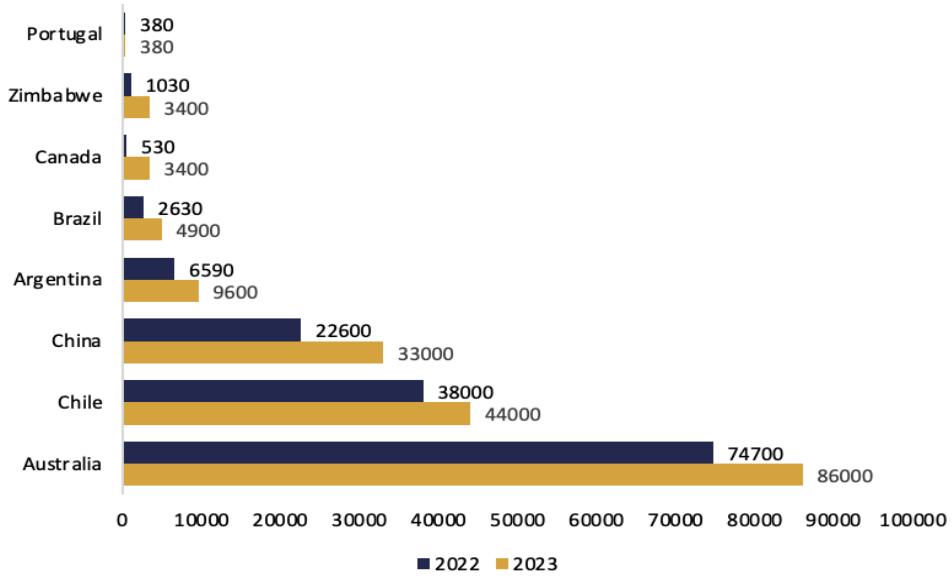
Lithium, often referred to as “white gold”, is an essential material for EV batteries, but its mining and refining processes raise significant environmental concerns. Demand for lithium is projected to rise over 40 times by 2040, potentially leading to social and environmental harms, as well as global supply chain bottlenecks.

Research from MIT's Climate Lab indicates a substantial carbon footprint associated with lithium mining, generating nearly 15 tons of CO2 per ton mined, exacerbated by emissions from fossil fuels-based manufacturing. A Howard Center investigation also reveals that the brining method consumes excessive water consumption, potentially depleting freshwater sources and harming nearby ecosystems.

Even with stricter regulations, environmental damage persists. While only 5% of lithium-ion batteries are currently recycled, a positive trend emerges. The U.S. Geological Survey reports a surge in lithium-battery recycling plant construction, with around 90 companies in North America and Europe actively recycling or planning to do so.

The global lithium supply chain is heavily concentrated in just a few countries, led by Australia, Chile, and China. Emerging players such as Thailand, India, and Argentina are developing their own operations, raising concerns about potential geopolitical risks that could disrupt trade.

World Lithium Mine Production
2022 - 2023 (“in metric tons”)



Source: MCG, APM Research Lab, 2024

High Capital Investment for Deploying Charging Stations

The high upfront costs associated with deploying charging stations pose a significant barrier to large-scale EV adoption globally, particularly in developing markets. For example, installing a single DC fast charger in India can exceed US$12,193, and adding more chargers to a station can further inflate the price to nearly US$48,772.

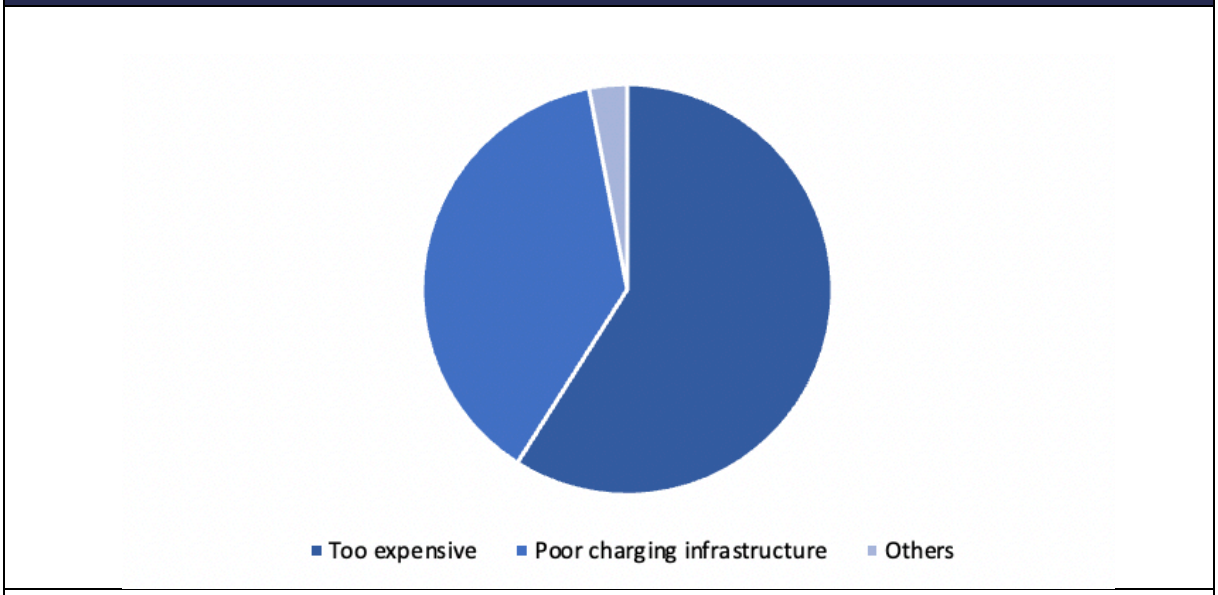
The Asia-Pacific region (“APAC”) faces additional ongoing costs for crucial supporting infrastructure, including management software, approximately US$9,145,000 technician and maintenance services, around US$4,267,000 and land lease expenses around US$7,316,000. These ongoing operational costs, reaching US$20,754,000 annually, create a significant hurdle for businesses and customers considering investment in EV infrastructure. This financial burden hinders the development of a charging network critical for widespread EV adoption.

Customer Anxiety

While the EV market offers environmental benefits, navigating it can be overwhelming for some consumers. Joachim Reinboth, Co-Head of Automotive and Mobility Services at BNP Paribas CIB, points out that knowledge gaps and a lack of practical solutions for everyday use are significant barriers hindering a broader shift towards EVs.

Cost remains a major hurdle, especially for price-conscious consumers in emerging markets. According to the Euromonitor International Mobility Survey 2023, where nearly 60% of respondents identified high EV prices as the primary reason for not considering an electric vehicle. Closely following this concern are limitations in charging infrastructure, leading to "range anxiety" – the fear of running out of power before reaching a charging station. The survey further reinforces this issue, with nearly 40% of participants expressing concern about the limited availability of charging stations, particularly for long trips or unfamiliar areas.

Reasons For Not Purchasing Electric Vehicles 2023



Source: MCG, Euromonitor International, 2024

OPPORTUNITIES

Opportunities for the electric vehicles market are highlighted by the adoption of EVs in emerging markets and ongoing advancements in battery technology. In particular, the rising adoption of electric vehicles in Asia and Latin America, along with the need for alternative energy sources in major oil-producing regions such as the Middle East, underscores significant growth potential. Advancements in EV batteries, including improved driving range, reduced charging time, and lower overall costs, are also driving the popularity of electric vehicles.

Expansion To Emerging Markets

Expansion into emerging markets such as the Middle East, Thailand, and Brazil presents promising opportunities for market growth.

The Gulf Cooperation Council ("GCC") EVs market size, estimated at US$ 4 billion in 2024, is expected to reach US$10 billion by 2029, growing at a CAGR of 19% during the forecast period of 2024-2029. Despite being a major oil producer, rising environmental concerns and technological advancements are driving the region to explore alternative energy sources and embrace electric vehicles.

Thailand is another emerging market witnessing a surge in EV adoption. According to TTB Analytics, total EV registrations in Thailand surged by 690% year-on-year in 2023, surpassing 75,000 vehicles. Government subsidies and investments from Chinese manufacturers have contributed to this remarkable growth.

Brazil's electric vehicles market saw a 178% year-on-year increase in passenger EV sales to 52,359 units in 2023 and is expected to rise another 84% in 2024. The "Brazil's Mover Program," launched in June 2024, offers incentives and financial credits to promote a reduction in carbon emissions, fueling this expected surge. Combined, these factors signal a promising future for the global electric vehicles market.

Continuing Advancements in Battery Technology

Advancements in automotive technology emphasize the EV battery as the key factor influencing driving range, charging time, and overall cost.

To advance the electric vehicles industry, increasing energy density aims to enable longer travel distances on a single charge. Rapid advancements in fast-charging technology strive to significantly reduce recharge times. Vehicle-to-grid ("V2G") integration, allowing EVs to interact with the power grid and potentially supply electricity during peak demand periods, gains traction. The trend towards localized battery production, with manufacturing facilities set up closer to EV production centers, also continues to grow.

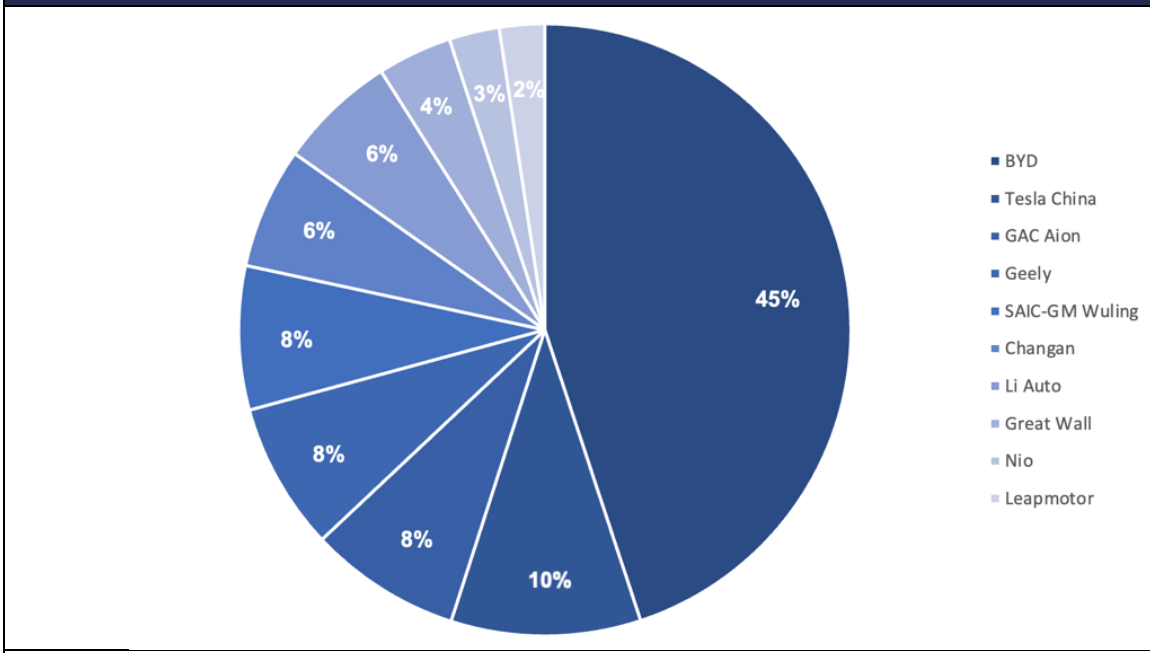
Advancements in battery management systems ("BMS") are crucial for optimizing battery performance, safety, and lifespan, holding immense promise for the future of electric mobility. These technological strides in EV battery development offer exciting potential for transforming the industry.

CHINA: INNOVATION DRIVEN

OVERVIEW

The Chinese EV market stands out for its strategic initiatives, government support, rapid innovation, and focus on global positioning, all of which establish China as a leader in both domestic growth and international competition within the evolving global electric vehicles market.

China's Key Players 2024



Source: MCG, CPCA, 2024

KEY TRENDS

Given China's vast market size, several key trends present growth opportunities, including dominance in raw materials, a substantial domestic market, the transition of startups to mass-market players, and the expansion of strategic global partnerships, all of which contribute to the growth of the EV market.

China's Key Trends 2024

Source: MCG, 2024

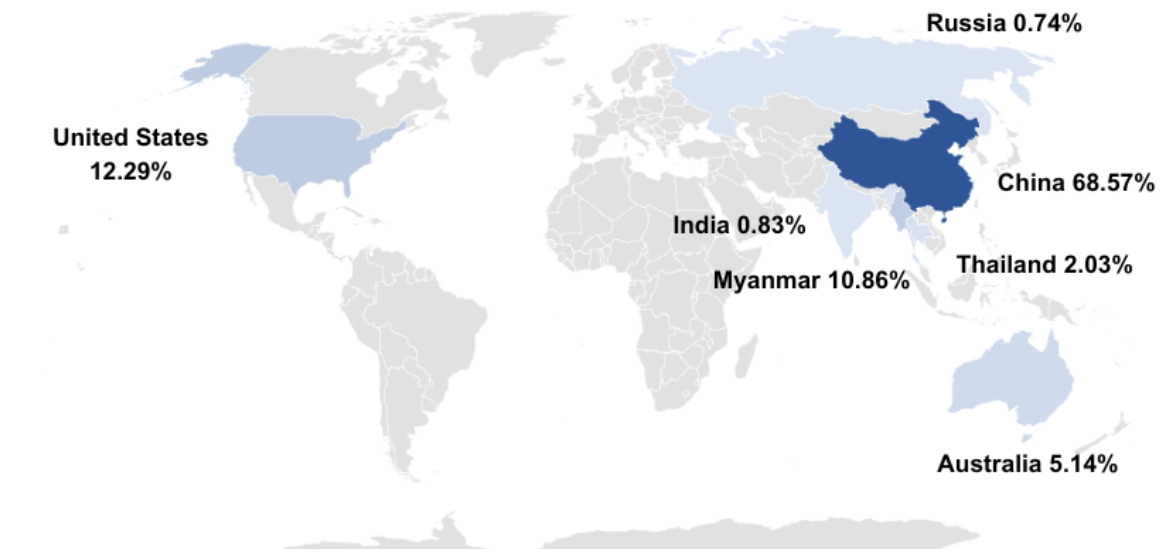
Domination of the Raw Materials

China's leadership in the production of critical minerals for EV batteries poses significant concerns for the global EV industry. Statista reports that China controls nearly 70% of global rare earth element production, a key component in many battery technologies.

Data from Reuters highlights China's extensive processing capabilities: nearly two-thirds of global lithium, 75% of cobalt, 95% of manganese, and a near-monopoly on graphite processing. Holding such a dominant position within the supply chain provides Chinese battery companies with crucial strategic advantages, including the ability to control

bottleneck resources, shape the development of new battery technologies, and exert greater negotiating power with suppliers.

Distribution of Rare Earths Production Worldwide 2024



Source: MCG, 2024

Large Domestic Market

Benefiting from China’s status as the world's largest automotive market, China's domestic electric vehicles sector is thriving. In 2023, China saw an impressive 82% surge in new EV sales, outpacing traditional automotive powerhouses like Germany and Japan, according to EV Volumes. These sales accounted for nearly 60% of global EV purchases that year, supported by domestic demand and increasing environmental awareness.

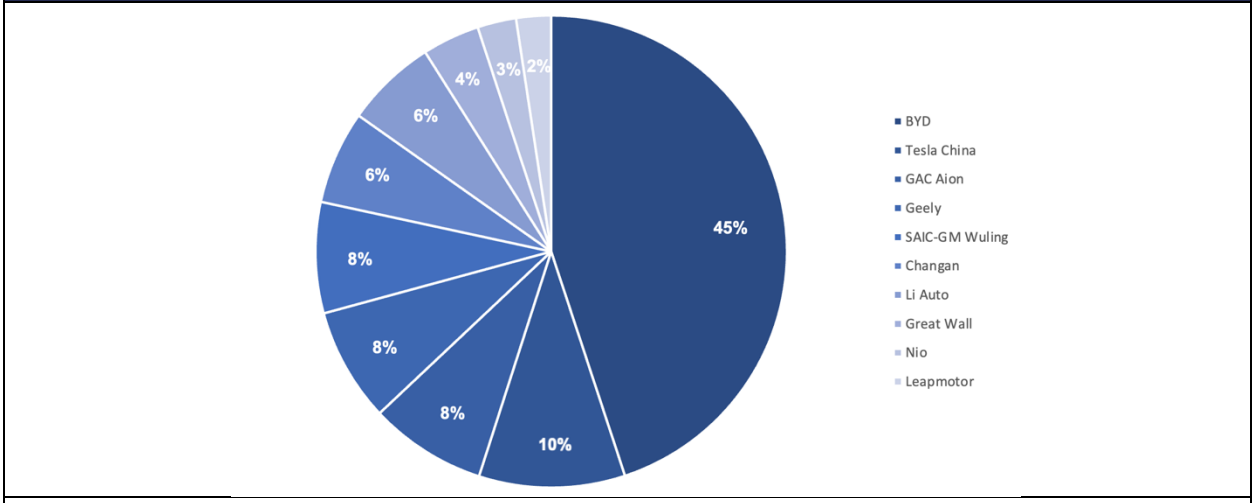
Start-up's Turn to Mass Market

The International Energy Agency reports that China has over half of the world's electric cars on its roads and responsible for 35% of global EV exports in 2022. Rapid growth prompted the China Passenger Car Association ("CPCA") to highlight the country's top 10 EV companies, including the rising startup, Nio.

Strategically targeting the lower-priced market segment, Nio plans to launch mass-market brands to compete directly with established players such as BYD and Volkswagen. Their first mass-market offering, an SUV, will be competitively priced against Tesla's Model Y, starting at US$35,197 in China, according to CNBC's Eunice Yoon. Achieving impressive sales, Nio delivered 87,426 vehicles in the first half of 2024 and plans additional releases this year.

Meanwhile, Xpeng, another leading Chinese EV manufacturer, aims to capture a larger market share. Offering a price range slightly lower than Nio's, Xpeng plans to launch a new sub-brand named Mona in the coming months. Vice Chairman and Co-President Brian Gu announced that these new vehicles will be priced under US$20,700, undercutting Nio's current target range. Following last summer's announcement of a more affordable brand, developed through a strategic partnership with Didi, Xpeng aims to differentiate itself by offering unique technological features to the mass market.

China's Top 10 Electric Vehicles Market 2023



Source: MCG, CPCA, 2023

Strategic Global Partnerships

The ambitious global expansion strategies of Chinese EV companies are driven by several clear objectives. With a saturated domestic market, these companies are seeking new customer bases to sustain growth, opening opportunities in international markets.

Chinese EV companies also seek to acquire cutting-edge technologies through strategic partnerships and acquisitions, gaining access to advanced innovations in software, services, and battery development. Establishing a strong international presence allows Chinese EV companies to transcend their domestic image and directly compete with established automotive giants. Collectively, these strategies—expanding into new markets, acquiring advanced technologies, and developing global brands—are designed to position Chinese EV companies as significant forces in the future of electric mobility.

CHALLENGES

Despite the rapid growth of the Chinese EV industry, several challenges threaten profitability and intensify competition including international tariffs, price wars, oversupply, and crowded markets.

International Tariffs

The US imposed increased tariffs on various sectors in May 2024, including steel, aluminum, microchips, batteries, and EVs, with the tariff on EVs quadrupled to 100%. A month later, Europe escalated the trade dispute by raising tariffs on Chinese EVs, implementing a 38% tariff targeting specific companies.

The escalation comes amidst a backdrop of Chinese EV market share in Europe, where Chinese electric vehicles accounted for around 25% of the market in 2023, reflecting a quadrupling of exports from China in the past five years. The rapid growth in Chinese EV presence in Europe appears to be a contributing factor to the recent tariff actions.

Price Wars

The ongoing price wars shape consumer preferences in China’s rapidly expanding EV market. Tesla’s declining market share highlights this trend, with Bloomberg reporting a decrease from 10% in the fourth quarter of the previous year to 7%, suggesting that Tesla faces challenges competing on price against Chinese EV companies now leading global sales. The introduction of new mass-market electric vehicles from Chinese startups, including battery-electric and hybrid models, further intensifies the competitive pressure, as these vehicles now account for over 40% of new passenger car sales in China.

Supplier Competition

The projected surge in demand for electric vehicles might not perfectly align with the expansion plans of key players, potentially exacerbated by intensifying competition within the industry. For instance, major smartphone companies like Xiaomi, Huawei, and Meizu have ventured into the EV market by partnering with automakers and launching their own models. An influx of new suppliers could create an oversupply situation, pressuring profit margins and potentially causing cash flow issues or financial crises of manufacturers.

To navigate these challenges, EV companies need to balance ambitious growth with market realities. Strategies to boost EV sales and drive market growth may include focusing on product differentiation, optimizing manufacturing processes, and implementing strategic marketing campaigns to secure a sustainable position in the evolving electric vehicles landscape.

OPPORTUNITIES

The ongoing rise in domestic EV adoption drives sales growth, while expanding into public transportation creates opportunities to achieve 100% electrification.

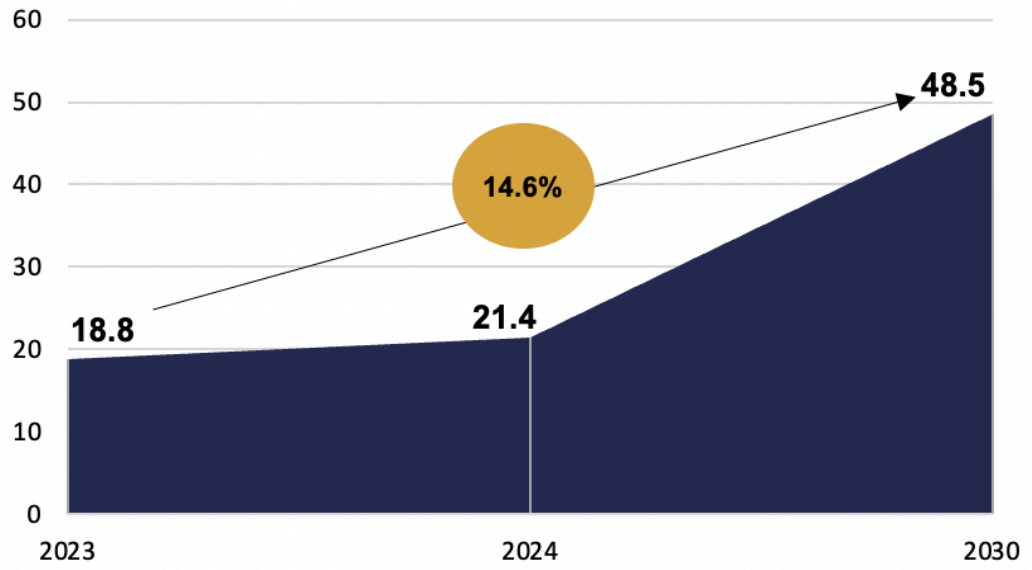
Electric Public Transport

A collaborative approach to electrifying public transportation characterizes Chinese EV producers. By partnering with taxi companies to strategically place charging stations along taxi routes, they ensure efficient operations and support infrastructure development. Such focus has been crucial in China's leading of the electric bus market, where the country held roughly 99% of the world's 385,000 electric buses in 2017. The fleet continues to grow rapidly, with an estimated 9,500 new zero-emission buses added every five weeks.

Efforts toward 100% electrification also extend to taxis, presenting a significant growth opportunity for the Chinese EV market. Prescient & Strategic Intelligence estimates the electric bus market's value to be between US$19 billion and US$49 billion in 2023, with projections reaching US$49 billion by 2030.

Positioned to enhance leadership in BEVs, Chinese EV companies are well-equipped for international expansion, leveraging their expertise to potentially lead the global EV production industry.

China's Electric Bus Market
2023 – 2030 ("in billions")

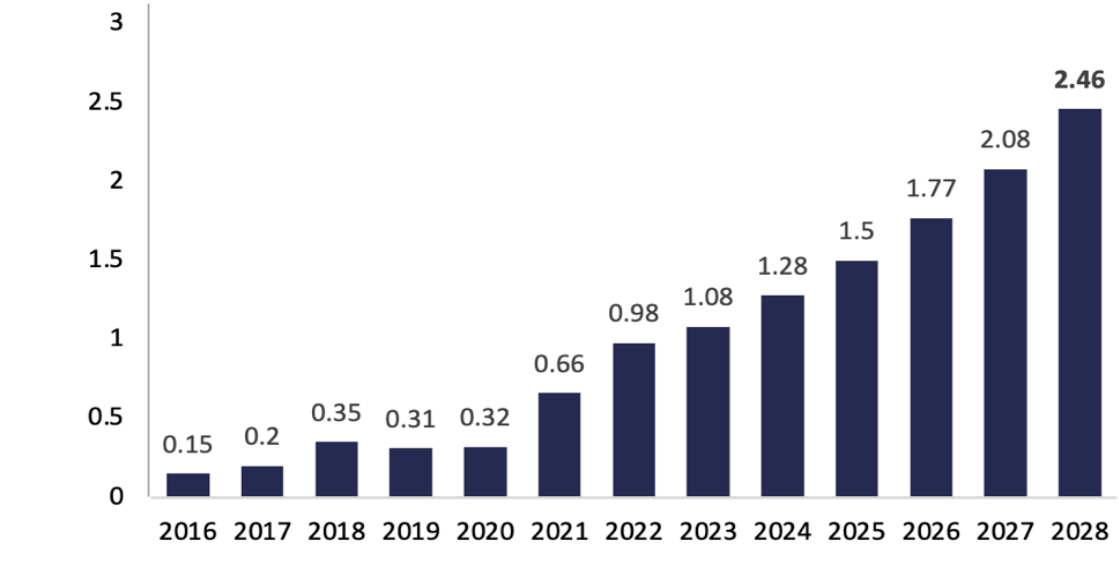


Source: MCG, Prescient & Strategic Intelligence, 2024

OVERVIEW

Remarkable growth characterizes the United States electric vehicles market, largely driven by key players like Tesla, holding a leading 60% market share. The surge has prompted numerous domestic and foreign automakers to shift their focus toward alternative fuel options, expanding beyond solely gasoline-powered vehicles.

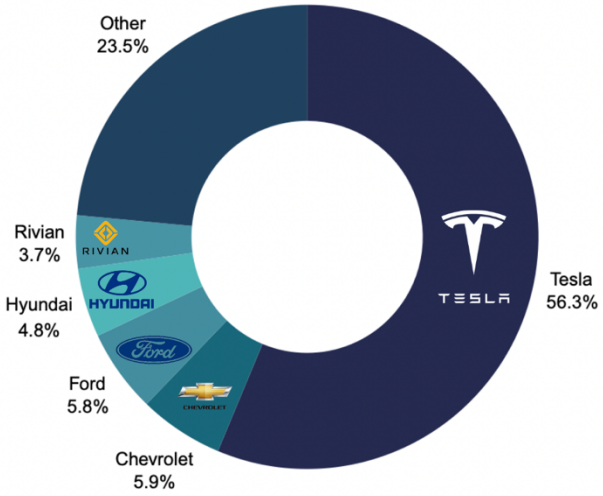
US's Electric Vehicles Unit Sales
2016 – 2028 ("in millions of vehicles")



Source: MCG, Statista, 2024

Among the top five companies in the U.S., Tesla stands out as the only one not originally established as a traditional automotive manufacturer.

US's Key Players 2023

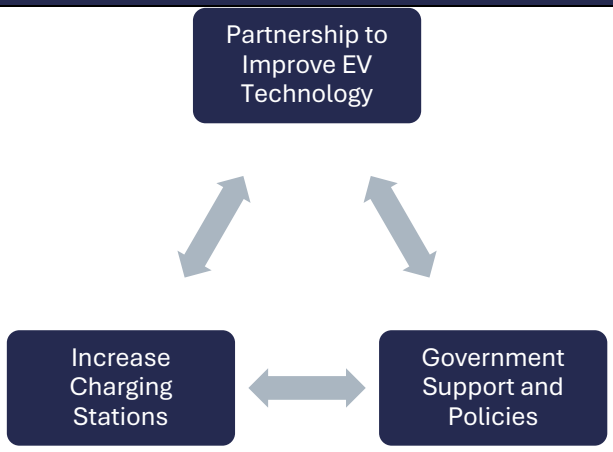


Source: MCG, Automotive News, 2023

KEY TRENDS

Several key factors drive the rapid expansion of electric vehicles in the U.S. Strategic partnerships among EV companies focus on advancing technology and expanding charging infrastructure, addressing customer concerns about range anxiety. Government policies and regulations further support the transition to EVs and sustainable energy, promoting wider adoption to meet future carbon emission targets.

Key Trends in the US EV Market 2024



Source: MCG, 2024

Partnership to Improve EV Technology

In a significant move, a German automaker, Volkswagen, has a deal to invest up to US$5 billion in Rivian, a promising US-based electric vehicle startup. The strategic partnership highlights Rivian's leadership in US in-vehicle software development and architecture. The deal is expected to enhance Rivian's brand awareness and market presence, while also providing essential support for overcoming technical and distribution challenges.

The influx of capital from Volkswagen will accelerate Rivian's factory expansion in Illinois and expedite the construction of its Atlanta plant. The faster timeline is expected to significantly boost production capacity sooner, allowing Rivian to deliver more electric vehicles to the market and potentially shorten its path to profitability.

Government Support and Policies

President Biden's ambitious climate initiative targets 50% of US vehicle sales being electric or plug-in hybrid by 2030. Major automotive manufacturers including Ford, GM, and Stellantis, have committed to reaching 40-50% EV sales by the same deadline. Government policies plays a crucial role in shaping market dynamics. IRA supports EV adoption through reinstated tax credits and other measures.

Challenges remain as evolving criteria for these incentives can impact the eligibility of certain EV models, requiring a delicate balancing act between encouraging innovation and ensuring affordability.

EV tax credits from the IRA have brought the cost of EVs closer to that of ICE cars. IIJA was also designed to ramp up charging infrastructure.

Increase Charging Stations

Expanding charging infrastructure is vital for electric vehicles adoption, as it impacts accessibility and convenience. As of Q3 2023, the US has seen substantial growth in EV charging infrastructure, with 152,000 charging ports spread across 58,000 stations. California taking the lead with 42,000 charging points. President Biden has allocated US$623 million towards expanding charging infrastructure that aims to alleviate concerns about range anxiety and encourage more people to consider switching to electric vehicles.

CHALLENGES

Despite the significant growth of the market, some obstacles can challenge the electric vehicles industry, particularly in the inconsistency of policies across states, overcoming initial cost barriers, and managing overproduction.

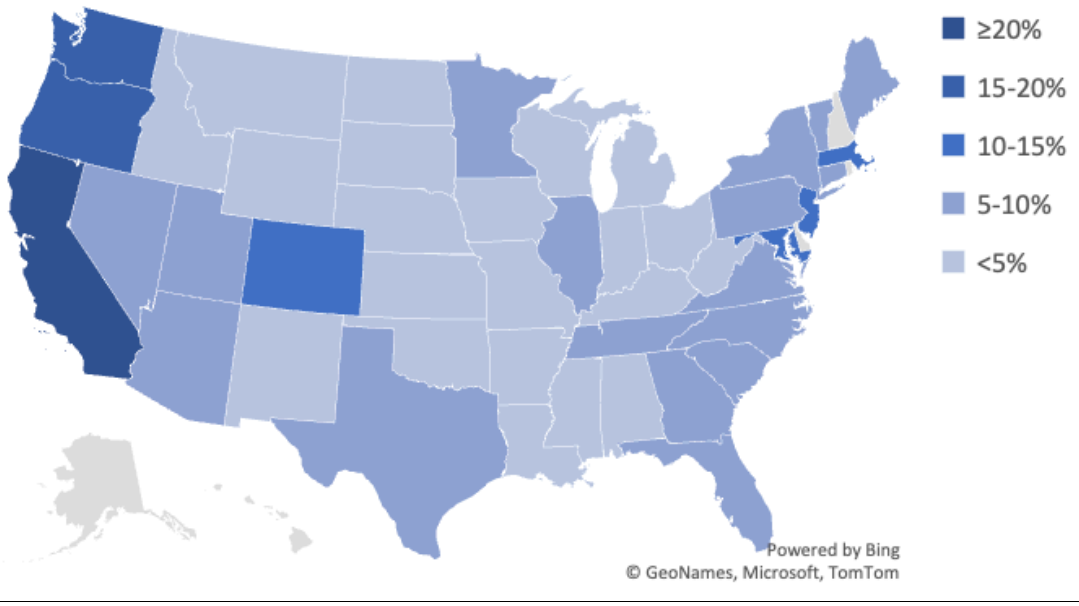
Inconsistency Across States

The varying approaches among states in the United States present a significant challenge to nationwide full adoption of EVs. EV policies significantly impact the pace and scale of adoption. States like California prioritize environmental conservation and have implemented comprehensive EV policies that offer financial incentives, establish EV-friendly infrastructure and zoning, and promote consumer adoption.

This commitment is evident in California's remarkable 19% of new car sales in 2022 being PEVs, significantly surpassing the national average of 6%. California's continued rise in PEV sales, reaching 23% in 2023, further demonstrates their success. In contrast, a growing number of states with less supportive policies might impose additional fees on EV owners or restrictions on EV sales. These contrasting policies contribute to the uneven landscape of EV adoption across the US, with Washington and Oregon also showing strong adoption due to their supportive policies making market shares exceeding 15%.

The accessibility of EV charging stations varies significantly by region. While the East Coast boasts a more established infrastructure, concerns exist regarding the quality and reliability of stations. Conversely, the West Coast, excluding California, faces a shortage of chargers to meet the growing demand. These regional disparities highlight the need for tailored approaches to address the diverse challenges faced by different geographical areas. Developing robust, reliable charging infrastructure across the country while considering localized needs in infrastructure development, regulatory frameworks, and consumer preferences is crucial for promoting widespread EV adoption.

Electric Vehicles Market Share of New Vehicles Sales 2024



Source: MCG, Bolt Earth, 2024

Pricing and Oversupply

Despite a noticeable decline in EV prices, they remain higher on average than gasoline-powered ICE vehicles, prompting many consumers choose ICE vehicles over EVs. Recent data from Cox Automotive reinforces this point, revealing that 52% of customers consider high prices a significant barrier to EV adoption.

Further complicating the issue is a current oversupply within the EV market, driven by a surge in production. With over 92,000 EV units in stock - nearly double the industry average and far exceeding demand - imbalance between supply and demand highlights the complex challenges facing the EV market. Manufacturers are grappling to align production with consumer preferences and affordability concerns. In the US, affordability emerged as the foremost concern for consumers contemplating EV adoption in 2023.

Alternative Lithium Sources

Despite possessing significant lithium reserves, the United States relies heavily on imports due to regulatory hurdles that hinder domestic mining.

To address this dependence and mitigate the risks associated with geopolitical tensions, the US is prioritizing sourcing lithium from allied countries. This strategy aims to diversify

its supply chain and lessen its reliance on nations that dominate the processing of lithium, such as China. A disruption in trade with these dominant players could have a crippling effect on critical supply chains.

Ultimately, the US aims to achieve self-sufficiency in sourcing critical metals and establish a more geographically balanced processing network alongside with its European allies. Enhancing logistical efficiency through this collaborative approach is especially important considering the rapid growth of the European electric vehicles market.

US Lithium Imports and Exports 2019-2023 ("in metric tons")

Source: MCG, APM Research Lab, 2024

OPPORTUNITIES

The growth of start-up companies has led to increased partnerships with major suppliers and a broader international presence. Expanding both public and private charging networks is essential for addressing consumer concerns and creating new opportunities for EV manufacturers, while also presenting significant job creation opportunities.

Suppliers and International Expansion

Stiff competition from Chinese EV manufacturers has intensified challenges for US startups like California-based Canoo, making it more difficult to secure funding. Canoo reported a wider-than-expected financial loss of US$111 million for the first quarter of 2024, exceeding analyst expectations of US$55 million according to LSEG data. Despite these headwinds, the company maintains a positive outlook for the year.

However, Canoo has built a promising sales pipeline exceeding US$3 billion, with confirmed orders from major players like Walmart, USPS, and the U.S. military. The strong demand highlights a growing market opportunity that is attracting investments from key suppliers.

Canoo's recent acquisition of a Foreign Trade Zone designation and the establishment of a new partnership with Saudi Arabia signal a strategic shift towards international markets. Industry analyst Legg emphasizes the significant potential in this move, citing data from Global Market Insights that estimates the global light-duty truck market to be valued at a staggering US$15 trillion.

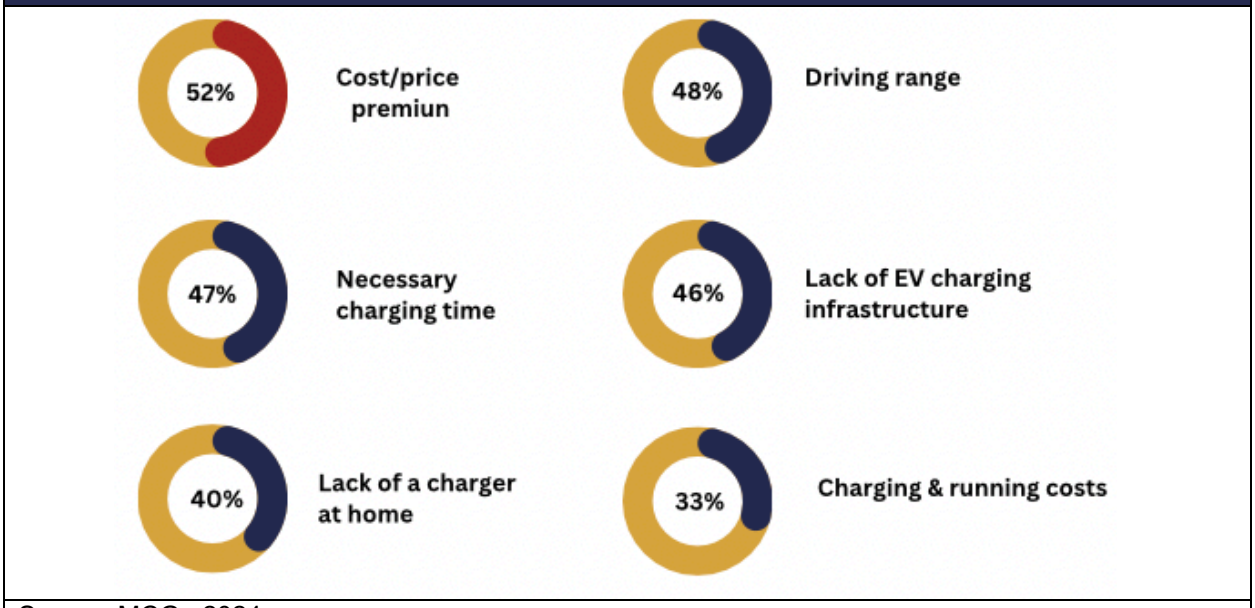
Increase Investment in Charging Stations

Expanding both public and private charging networks is essential to address consumer concerns and unlock new opportunities for EV manufacturers. Currently, insufficient charging infrastructure remains a major barrier to adoption, impacting 46% of US consumers. To address this challenge, S&P Global predicts a dramatic increase in charging infrastructure, requiring a fourfold expansion by 2025 and a more than eightfold increase by 2030.

The shift is further driven by EV companies like Tesla opening their supercharger networks to non-Tesla brands. Consequently, major US manufacturers, including Mazda, Stellantis, and Volkswagen, have announce the production of EVs with built-in connectors compatible with Tesla's North American Charging Standard starting in 2025. Such collaboration will contribute to a more diverse and accessible charging landscape.

The United States Postal Service (“USPS”) is also taking a significant step towards electrification. Their plan involves installing over 14,000 charging stations at delivery centers across the country, supporting their growing fleet of electric vehicles. This initiative further demonstrates the national commitment to expanding infrastructure and promoting EV adoption.

Top Concerns of US Consumers About Electric Vehicles 2023



Source: MCG, 2024

Jobs Opportunities

The expansion of EV charging infrastructure presents a significant job creation opportunity. According to the International Council on Clean Transportation ("ICCT"), this growth could generate over 160,000 new jobs by 2032 across various sectors. The electrical installation, maintenance, and repair fields are poised to be major beneficiaries, accounting for nearly half of the new positions – over 78,000 jobs. The focus will primarily be on light-duty vehicles infrastructure, with roughly 90% of these new jobs supporting this segment. The remaining 10% will address the growing need for electric medium- and heavy-duty vehicle infrastructures.

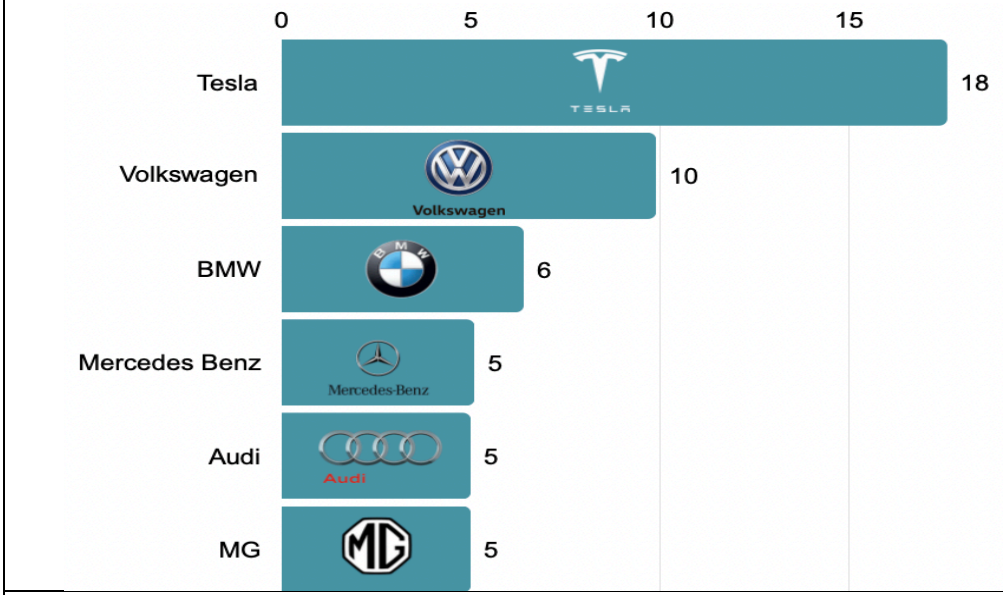
EU: FACE CHALLENGES

OVERVIEW

The European EV industry experienced a significant rebound, with sales surging by almost 14% to reach over 10 million new registrations - the highest level since before the pandemic. Tesla made a remarkable impact on the European electric vehicles market, capturing a market share of 17.6%, according to Clean Technica. Volkswagen and BMW followed closely behind with market shares of 10% and 6%, respectively.

Germany remained the top EV market in Europe, registering over 520,000 BEVs and 173,000 PHEVs in 2023. France and the United Kingdom followed closely behind, solidifying their positions as leading European EV markets.

EU's Key Players 2024



Source: MCG, Clean Technica, 2024

Industry Analysis of the EU EV Market 2024	
Key Trends	•Charging Infrastructure focused •In-wheel motor
Challenges	•China Traiffs •Material Shortage Risks
Opportunities	•Domestic Battery Supply Chain •Mass Market after Stagnation

Source: MCG, 2024

KEY TRENDS

Advancements in technology are key drivers of European EV trends, with many startups developing innovations in speed-charging infrastructure and in-wheel motors. These efforts aim to create scalable and cost-effective manufacturing solutions while fostering partnerships with established EV companies. Such collaborations enhance technological capabilities and accelerate adoption rates.

Charging Infrastructure Focused

Innovative startups are significantly shaping the charging infrastructure landscape. A notable example is the partnership between Cologne-based energy service provider RheinEnergie and The Mobility House, a Munich-headquartered startup specializing in smart charging solutions. Leveraging The Mobility House's expertise in utilizing electric vehicles for grid storage, a cutting-edge technology, this collaboration aims to optimize energy management. RheinEnergie seeks to expand its offerings, particularly in household energy supply and future electromobility solutions.

High-power DC fast-charging technology represents another area of innovation. Wallbox, a Barcelona-based startup specializing in EV charging solutions, has introduced the next generation of its Supernova DC fast charger. With the highest power-to-footprint ratio in the industry, this advanced design can fully charge a passenger EV for up to 100 miles in just eight minutes. The high power density also enables a compact design, contributing to a smaller environmental footprint.

In-wheel Motor

Offering substantial advantages for EVs, in-wheel motor technology enhances efficiency, compactness, scalability, and power density. These motors have the potential to increase an EV's range by 20% or reduce battery size. Munich-based high-tech company DeepDrive is at the forefront of this innovation, collaborating with eight of the world's top ten automakers, positioning itself for a significant impact on the EV market. The company plans to begin mass production of its in-wheel hub motor technology by 2025, capitalizing on the growing demand for EVs.

Recent developments are further supported by a collaboration between BMW and Continental, where these industry leaders are co-developing a next-generation electric vehicle components: an in-wheel motor with an integrated braking system. The partnership focuses on creating a scalable and cost-effective manufacturing process for the new motor, potentially accelerating its adoption. Industry forecasts suggest the integration of in-wheel motor technology into EV manufacturing could begin as early as 2026, further reducing costs and increasing the popularity of electric vehicles.

CHALLENGES

Recent tensions with China, including the imposition of tariffs on Chinese electric vehicles, could impact the risk of material shortages. Given China’s heavy reliance on critical raw materials, increasing global demand may pose challenges for EU EV manufacturing.

Tariff From China

In response to the EU's decision to impose tariffs on Chinese-made electric vehicles, China has threatened retaliatory measures targeting specific EU markets and products, including German automobiles, French luxury goods, and European aviation and agricultural products. The escalation in trade tensions occurs against the backdrop of a shifting automotive landscape in China.

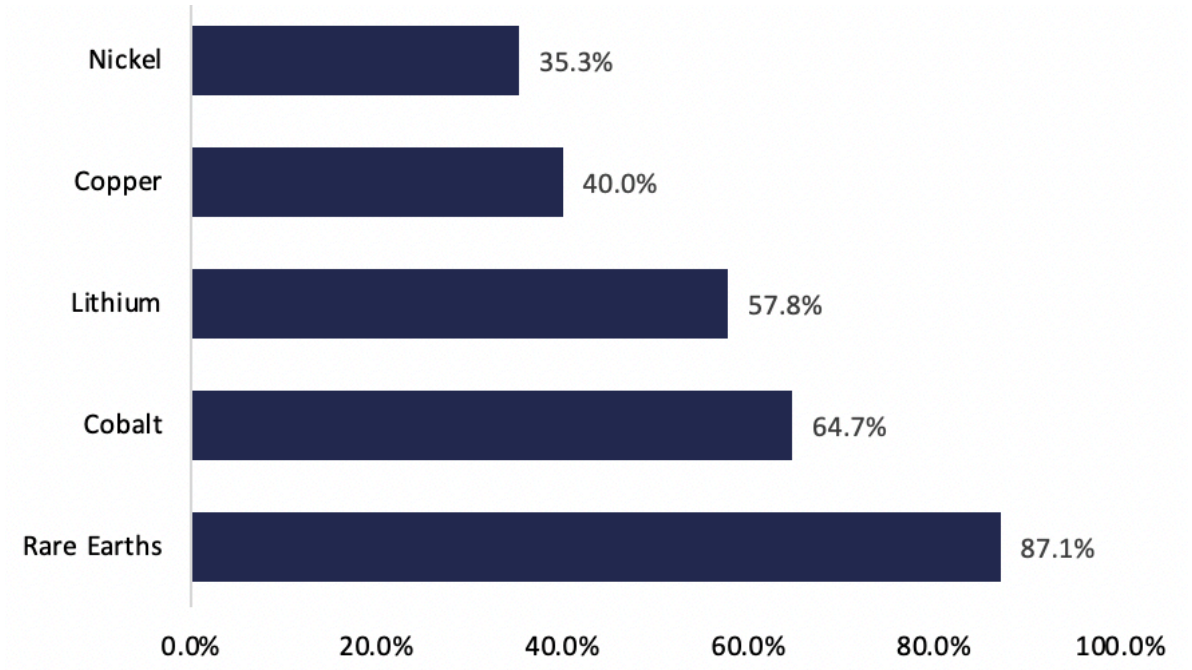
In 2023, BYD, a leading Chinese EV manufacturer, overtook Volkswagen to become the top-selling car brand in China. Concurrently, the market share of German luxury car brands priced above US$34,500 declined from 60% in 2020 to an estimated 45% in 2023, according to The Wall Street Journal. These developments highlight the potential impact of the trade dispute on the European automotive industry, particularly affecting German luxury car manufacturers in the critical Chinese market.

The Risk of Material Shortages

The European Union's reliance on critical raw materials such as lithium, cobalt, and nickel—primarily sourced from China—creates significant vulnerabilities. The rising global demand for these materials, combined with geographic and geopolitical uncertainties, poses a threat to supply stability. China's near-monopoly in processing these materials is particularly concerning, given its control over 90% of global rare earth processing and 60% of lithium processing. Such control heightens the risk of supply chain disruptions and price inflation for the EU, which depends heavily on imports.

In response to this vulnerability, the EU is pursuing a diversification strategy to reduce its dependency. Efforts are focused on securing alternative sources for permanent magnet rare earths, currently sourced 100% from China, and magnesium, with a 97% reliance on Chinese imports. The strategy aims to mitigate risks associated with overreliance on a single supplier.

China Raw Materials Share 2024



Source: MCG, Fastmarkets, 2024

OPPORTUNITIES

A heavy reliance on imports emphasizes the potential benefits of supporting a domestic battery supply chain, including environmental advantages and cost efficiency. As more EV companies work to produce more affordable electric vehicles in response to stricter CO2 emission regulations and to meet the needs of cost-conscious consumers, the anticipated growth in the mass market for EVs further highlights the importance of establishing a robust domestic supply chain.

Domestic Battery Supply Chain

Several European countries are launching initiatives to strengthen their domestic battery supply chains for electric vehicles, aligning with the European Union's goal of achieving self-sufficiency in battery cell production by 2025. Not only does this initiative address economic factors, but it also offers environmental benefits, as relocating battery cell and component manufacturing to Europe could reduce carbon emissions by 20-40% compared to imports from China.

Challenges extend beyond production, with global demand for essential battery components—lithium, graphite, and nickel—expected to surge dramatically by 2040. Projections show a 14-fold increase for lithium, a 19-fold increase for graphite, and a 20-fold increase for nickel compared to 2020 levels. Despite efforts to diversify the supply chain, China is likely to remain the dominant supplier for the EU well beyond 2030.

Promoting a circular economy within the battery value chain presents a viable solution. Estimates suggest that by 2040, battery recycling could meet up to 51% of the EU’s cobalt demand and 42% of its nickel demand. Such an approach highlights the potential of a circular economy to reduce reliance on external sources and create a more sustainable battery production system in Europe.

Mass Market after Stagnation

Recent stagnation in the European electric vehicles market has resulted from carmakers' focus on larger, premium models, leading to higher average EV prices that slowed sales. The average EV price increasing from under US$32,000 in 2021 to over US$44,000 by early 2024, while large EV sales grew by about 60%.

Anticipated changes include a renewed focus on producing more affordable, mass-market EVs in response to stricter CO2 emission targets coming into effect in 2025 and beyond. Plans are in place for new, cost-effective EV models for European production, reflecting this shift.

Failure to meet ambitious sales targets could significantly impact the industry, potentially leading to reduced investment and decreased competitiveness compared to global rivals. To address this risk, government support may be tied to carmakers' commitment to meeting reduced carbon emission targets, including the goal of 100% zero-emission car sales by 2035.

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