S&P Global

China ahead in delivering affordable electric mobility

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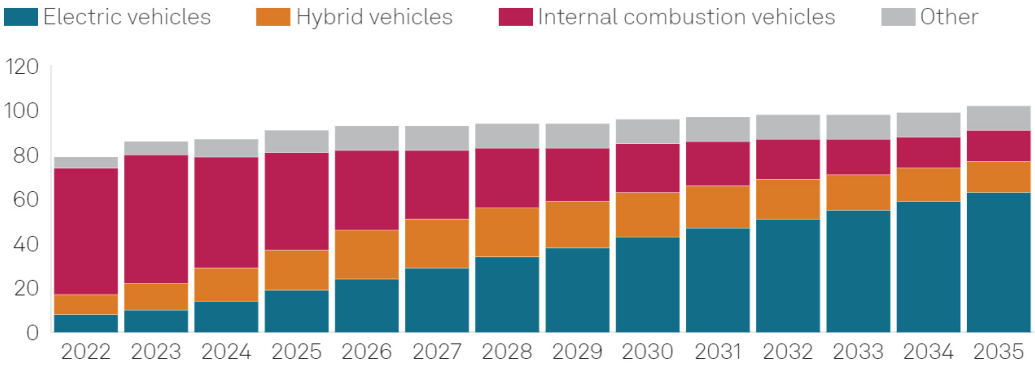
Key takeaways

- Momentum in the transition to electric vehicles is slowing. Battery-electric vehicle (BEV) penetration is now contracting in every major region. We have lowered our electrification outlook during the past 12 months, reducing our 2030 global BEV market penetration outlook by 2.3 percentage points during that time.
- China's BEVs are already close to price parity with internal combustion engine (ICE) vehicles. Supported by favorable affordability, China is leading the West in the adoption of EVs.
- Most legacy automakers are affected by diluted profitability from the sale of EVs, and a more protracted electrification process is an opportunity for them.
- Battery players are redefining the automotive supply chain, and automotive demand will dominate the battery market by the end of the decade. Western reshoring is countering China's established dominance in the battery supply chain.
- Battery prices are declining, but supply constraint risks loom post 2024. Furthermore, the debate about optimal battery chemistries remains unresolved.

Figure 1

Electric vehicle transition reflects a fundamental shift in the coming decade

Global vehicle sales volume (million units) by propulsion type



Data compiled May 14, 2024.
Hybrid cars include hybrid electric vehicles, plug-in hybrid electric vehicles and mild hybrid electric vehicles.
Other includes fuel-cell electric vehicles, range extenders and other propulsion types.
Source: S&P Global Mobility.

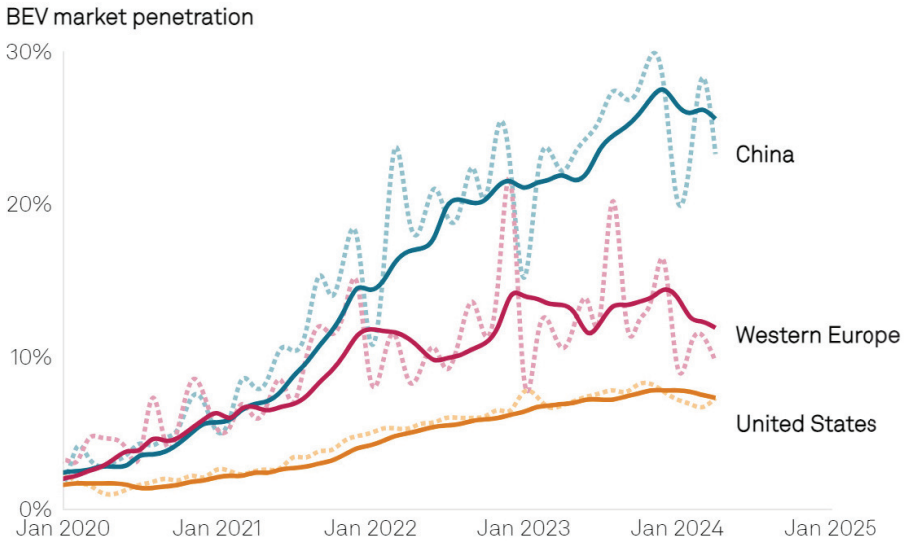
Momentum in the transition to EVs is slowing

Recent data points and shifting market sentiment suggest that the electrification of vehicles may take longer than once thought. In our base case scenario (Source: S&P Global Mobility), 40% of global light-vehicle sales will be battery-electric powered cars and light commercial vans by 2030. This represents a forward average growth rate of around 20% from 2023, with BEV sales levels at nearly 10 million units (11.7% of 85.5 million in global light-vehicle sales). We have steadily reduced our medium-term forecasts for BEV penetration (see the following chart) in recent months while keeping a more stable expectation for 2030. However, if consumer demand fails to accelerate, there is an increased risk that governments will soften regulatory stances on hybrid and ICE vehicles, further weakening the BEV outlook.

Figure 2

BEV penetration is now contracting in every major region

BEV sales as % of new light vehicle sales, monthly actual (dotted) and 6-month trailing average trend (thick line)

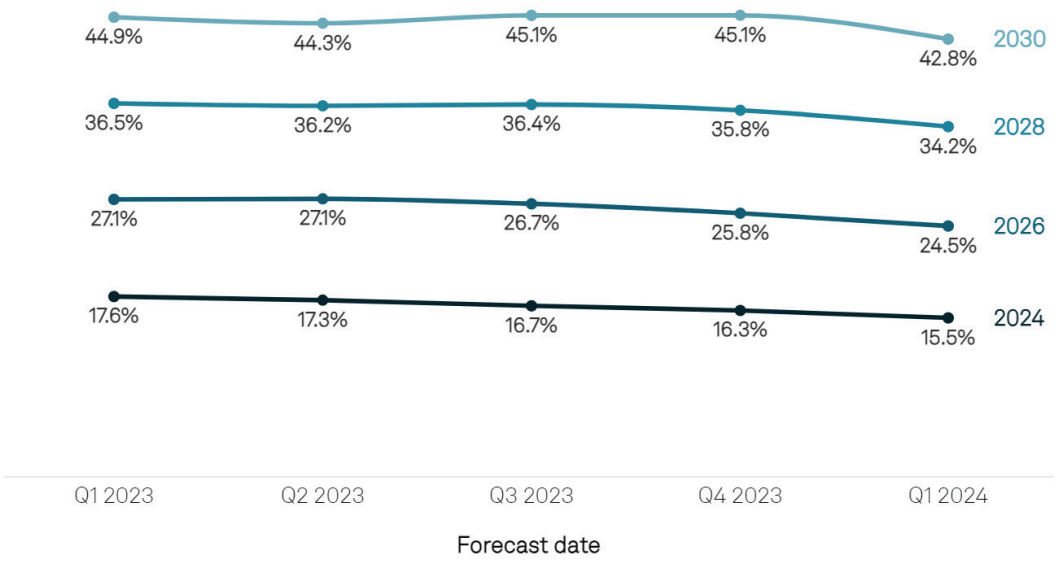


Data compiled May 14, 2024.
Western Europe refers to France, Germany, Italy, Spain and the United Kingdom.
Source: S&P Global Mobility.

Figure 3

We negatively revised our electrification outlook during the past 12 months

BEV sales as a percentage of light-vehicle sales, as forecast by S&P Global Mobility in the past five reports



Data compiled May 14, 2024.
Source: S&P Global Mobility.

China is leading the way in EV adoption

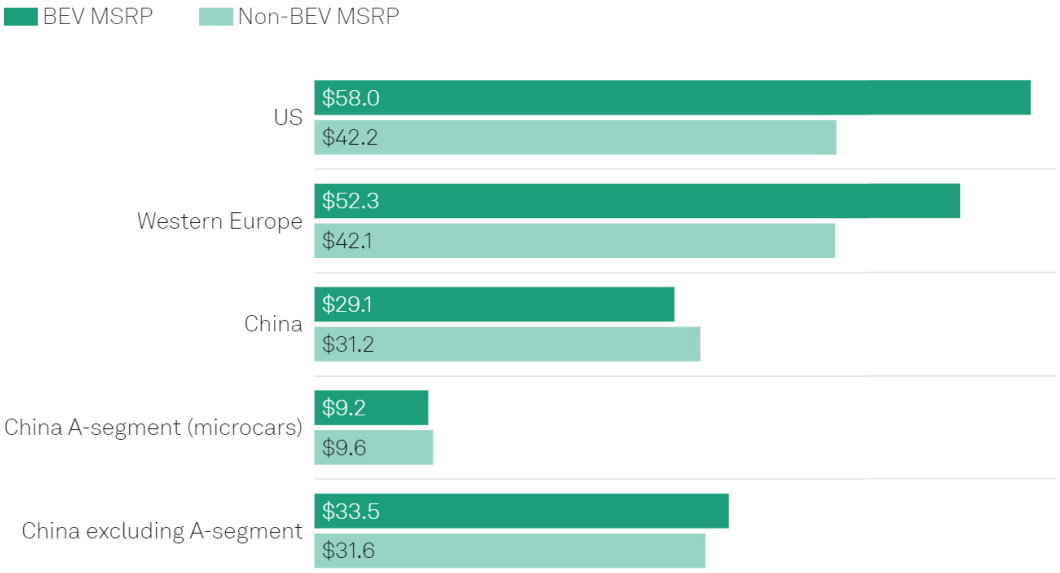
Consumers' reluctance to switch to EVs in the US and Europe is heavily dependent on the cost. As of now, the average manufacturer's suggested retail price (MSRP) premium between a BEV and a non-BEV vehicle is 24% in Western Europe and 37% in the US. Friction has increased further in markets where governments have reduced subsidies. Apart from the relative expense, customer hesitation to purchase BEVs in Europe and North America is compounded by concerns over range and charging infrastructure, as well as residual values and the risk of rapid technological obsolescence.

In China, by contrast, BEV penetration (25% in the first quarter of 2024) is expanding rapidly due to low manufacturing costs, substantial government support and an abundance of affordable products. The average MSRP for BEVs is 7% below that of non-BEV vehicles. Arguably, the electric "microcar" segment, which is specific to the Chinese market, somewhat suppresses this figure. Even ignoring microcars, the average price of a BEV in China is substantially aligned with a non-BEV. Although competitive conditions in China are intensive, and vehicle manufacturing is highly fragmented, financial distress in the sector has been limited so far as automakers have benefitted from the exceptional support of local governments.

Figure 4

China BEVs are close to price parity with ICE vehicles

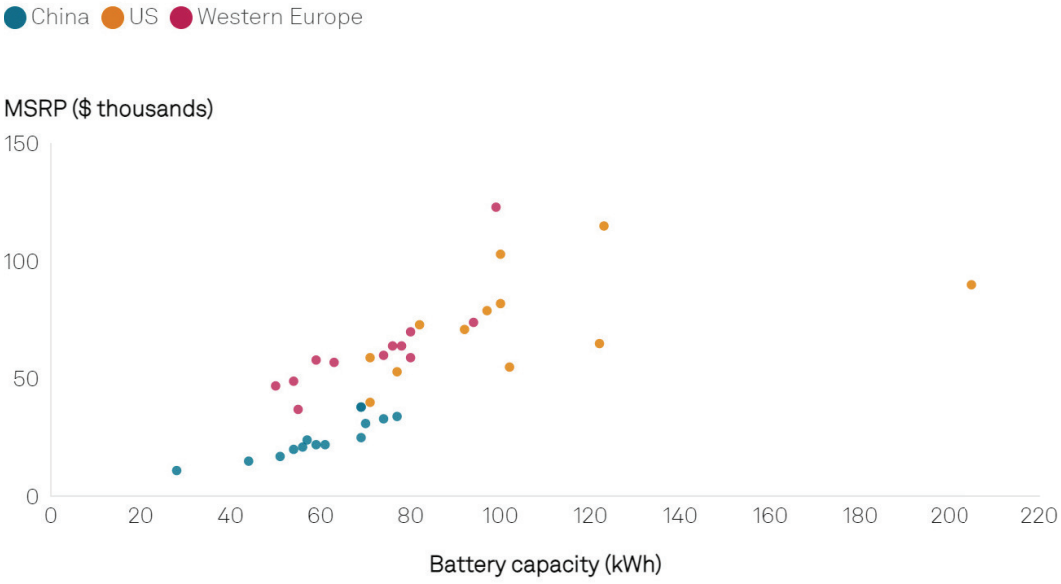
Weighted average MSRP comparison ($ thousands), BEV vs. non-BEV



Data compiled May 14, 2024.
Western Europe refers to France, Germany, Italy, Spain and the United Kingdom.
Source: S&P Global Mobility.

Figure 5

The attributes of best-selling BEVs vary around the world



Data compiled May 14, 2024.
Source: S&P Global Mobility.

Cheaper EVs in Western markets are arriving slowly

Western automakers are responding by developing cheaper cars. However, in Europe, we expect entry-price BEVs in the €20,000-€25,000 range (e.g., the VW ID2 and Renault Twingo) to arrive no earlier than 2025–2026 and only for a small subset of the portfolios. To make these vehicles truly affordable, product costs need to decrease materially — most notably, the cost of battery packs, which, on average, represent 40% of an electric vehicle's price. Automakers must accommodate mix deterioration in their electric product ranges owing to growth in the lower segments as less expensive electric cars are brought to market.

Legacy automakers experience diluted profitability from the sale of EVs

Consumer demand pressures combined with a proliferation of new electric product launches created an environment of fierce price discounting in EVs. Some legacy automakers have been forced to scale back their profit margin ambitions for electric models, abandoning hopes of profitability parity with ICE vehicles for now. We anticipate the gap will reduce in the second half of this decade in the EU and the US once automakers have adapted their cost structures to facilitate a less painful transition.

A prolonged transition benefits legacy automakers

An EV market slowdown could be incrementally positive for legacy automakers to the extent that it prolongs the life of existing platforms, thus maximizing the cash flow from legacy models. Simultaneously, it may buy original equipment manufacturers time to adjust their cost base and increase their ability to absorb the higher production cost of EVs partly. However, weaker net pricing and margins for BEVs, pressure on residual values for leased vehicles and lower remarketing values in the used car market (absorbed by the OEMs' captive finance or industrial operations, depending on the setup) will partially offset these benefits. Considering the current mix of sales (BEV sales at legacy automakers are generally lower than 20% on average), the net effect should remain positive.

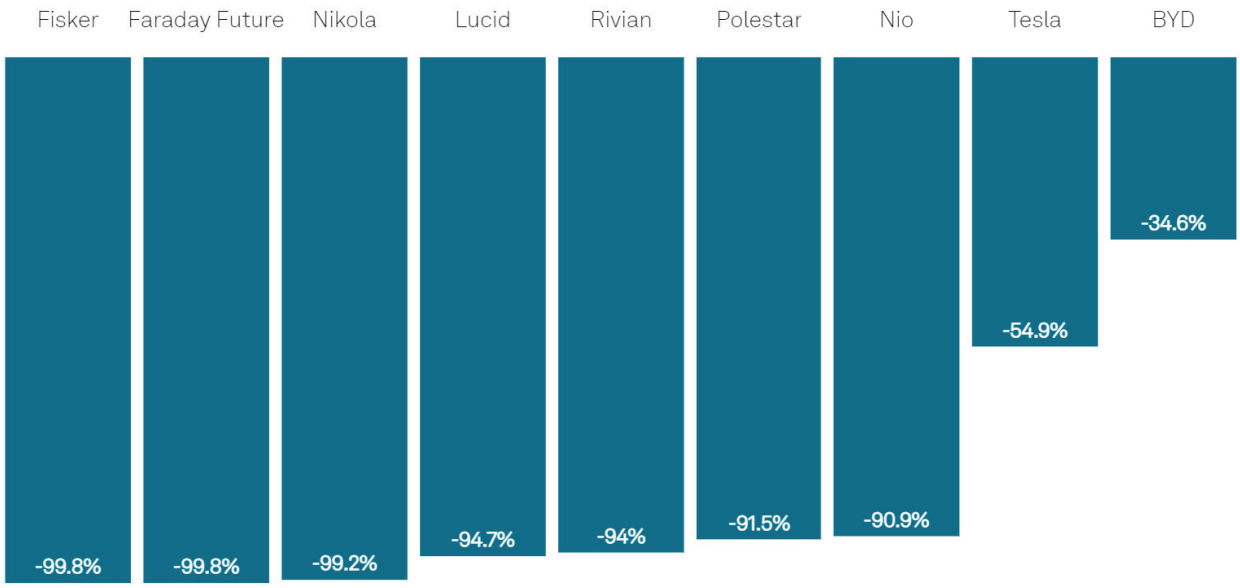
Investor sentiment around newer entrants has soured

Relative to their respective peaks, equity valuations for both new entrants into the BEV space and more mature companies that have focused on BEVs have fallen significantly.

Figure 6

Stock prices of major electric-only manufacturers have dropped by 30%-90% from peak levels

Percentage change of stock price relative to peak price for major electric-only manufacturers



Data compiled May 14, 2024.
Source: S&P Global.

While EV fatigue could help legacy automakers, it poses a challenge for pure BEV auto manufacturers, as they cannot compensate weaker BEV profits with other sales and suppliers with order books that are heavily dependent upon a quick ramp-up of electrification. In Europe, despite the temporary weaker market appeal of BEVs, there is no general concern about compliance with 2025 emission targets (apart from a few exceptions). Automakers head for emissions of average fleets trending toward 90-95g CO_2/km by 2025, a material reduction across the entire market. Missing the target implies penalties of €90 million per gram of CO_2. Still, the impact of regulatory costs can be watered down through pooling agreements with front-running BEV auto producers (as occurred in the past with FCA buying credits from Tesla, and not only in Europe). Also, we expect legacy OEMs to push hybrid vehicles as a tool to reduce the compliance gap. We foresee OEMs carefully optimizing the trade-off between lower-margin BEV sales versus the cost of credit purchases or penalties, as well as the share of hybrid vehicles in the mix. In the meantime, the US and UK have relaxed CO_2 targets set by the US Environmental Protection Agency (EPA) and the UK government, respectively. The UK is targeting a 22% zero-emission vehicle mix in 2024 and 28% in 2025 to facilitate a more gradual transition.

So, what is driving our long-term scenario of 40% BEV penetration globally?

1. Environmental regulations supporting zero-emission or low-emission vehicles globally are affecting market dynamics in regions even outside the traditional BEV market, as was increasingly evident in India, Thailand and Indonesia in 2023.
2. Gradual price parity between BEV and ICE propulsions within the same segment is the result of progressive declines in production costs. This is mainly due to dedicated platforms, lower battery costs, a reduced number of parts in the vehicle and increasing costs for ICE propulsion due to tightening emissions regulations, for example, in the EU.
3. The coverage of charging infrastructure in urban and suburban areas is improving.
4. In this decade, there is a lack of scalable technology alternatives that can compete effectively.

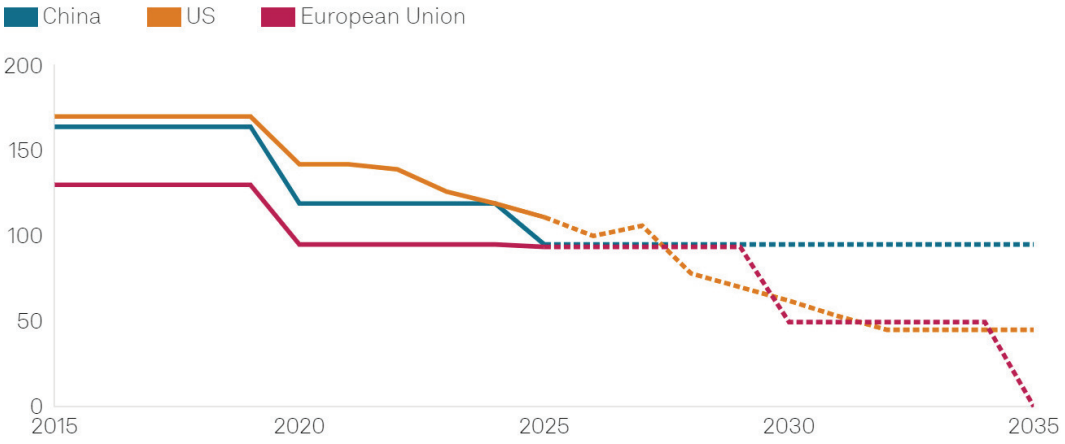
Regulatory changes guide the rate of decarbonization

Carbon emissions regulations are pivotal in determining the pace of the transition. The EU has set the most ambitious target of any bloc to reduce CO_2 emissions by 55% by 2030 compared with 2021 levels and to phase out the sale of new ICE-powered cars and vans by 2035. China aims to reach 50% "new-energy" vehicle sales (i.e., BEVs, plug-in hybrid electric vehicles [PHEVs] and fuel-cell electric vehicles) in regions subject to specific air pollution control measures and 40% across the country to support a national action plan for carbon peaking by 2030. Our base case projection is for these targets to be reached ahead of time. The US revised its EPA standards released in March 2024, which do not explicitly prescribe any battery-electric mix but do require accelerating year-on-year carbon reductions.

Figure 7

CO_2 regulations are a key driver of the pace of change

CO_2 emission targets (g/km) by region



Data compiled May 14, 2024.
Source: S&P Global Mobility; US EPA; European Commission; China MIIT.

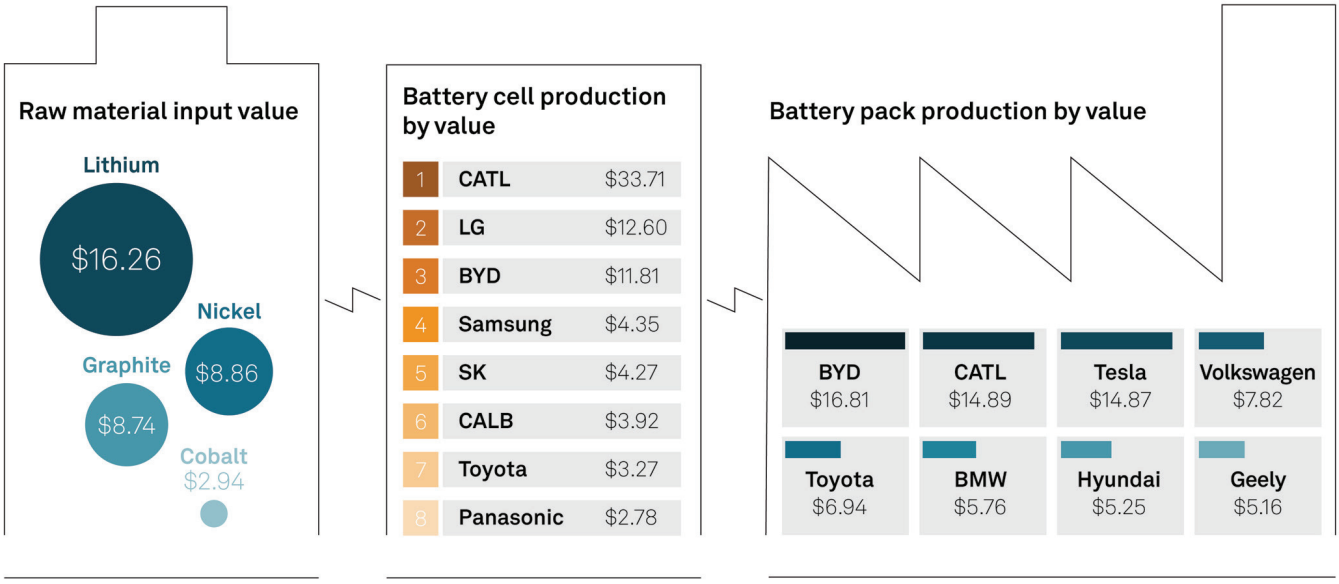
The politicization of electrification may add risk and cost

Electrification is expensive for automakers and suppliers. This takes the form of increased research and development expenses and capital costs such as new plants, supply chain reconfiguration or retooling. It is also seen in increased variable costs where vehicles require additional technological content. The industry demands long-term planning horizons and regulatory certainty to outline investments, which may run multiple product cycles into the future. In some jurisdictions, we see political factions forming differentiated viewpoints on vehicle emissions regulations, which connect emissions regulations to electoral outcomes and complicate planning. This divergence is notable in the US, where blue states (Democratic Party) have adopted EVs more readily than red ones (Republican Party). However, it is increasingly accurate that on a global scale, EVs may be markers of consumers' political identity.

Figure 8

Key raw material enablers of the transition

Sum of estimated revenue potential in 2024 ($ billion)



Data compiled May 14, 2024.
Source: S&P Global Mobility.

The automotive supply chain must be redefined

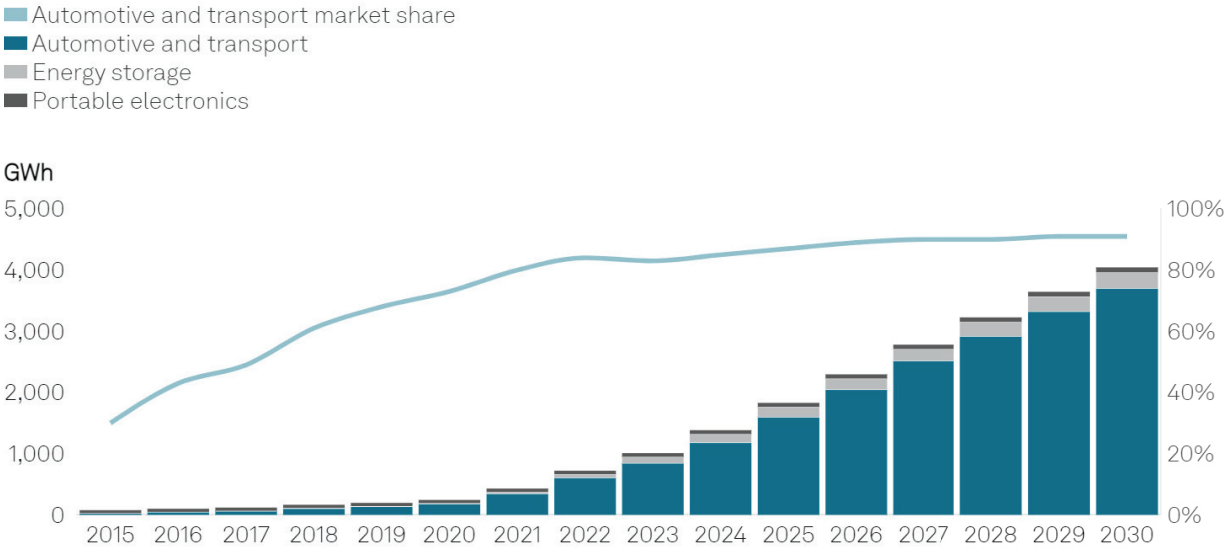
Despite intense news flow on the progress of developing battery technology aimed to replace potentially scarce critical minerals used in EVs, we have little visibility on the replaceability of lithium-based batteries within this decade. Contemporary Amperex Technology Co., Limited (CATL) is championing alternative batteries such as sodium-ion batteries. Sodium is an abundant mineral and performs better in colder temperatures than lithium-ion (Li-ion) batteries. The consensus is that sodium-ion batteries are unlikely to replace Li-ion batteries completely. The technology is not yet mature enough; it has not yet reached the commercialization stage and its energy density is still much lower than that of Li-ion batteries. S&P Global Mobility believes sodium-ion batteries will supplement Li-ion batteries in the future, especially for cheaper vehicles (which could explain the material decline in the price of lithium).

The dramatic decline of lithium prices since 2023 is reducing the economic incentive to scale up competing technologies. It may also reduce incentives for mining companies to invest in the exploration and development of new mines. This could have longer-term consequences, as the automotive industry is the primary driver of lithium-based battery demand.

Figure 9

Automotive demand already dominates the battery market

Total battery capacity produced by sector (GWh), automotive and transport battery market share (%)



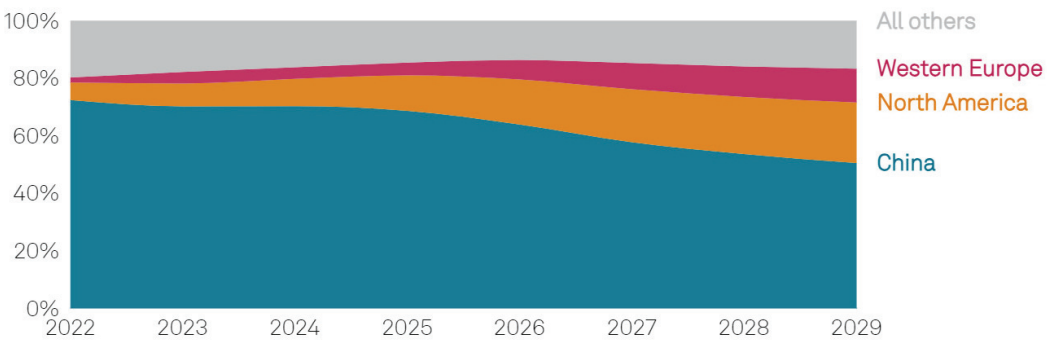
Data compiled May 14, 2024.
Source: Clean Energy Technology Analytics.

Asian cell producers will continue to dominate global EV battery supply, and the regionalization of supply chains provides them with an unprecedented opportunity to grow outside of China, as demonstrated by the investment spree of South Koreans in the US and CATL in Europe. It is unclear at this stage whether incentives offered in the context of the Inflation Reduction Act (IRA) in the US or Horizon Europe (the EU's essential funding program for research and innovation with a budget of €95.5 billion) could be accessible by partnership with established Asian battery producers.

Figure 10

Western reshoring expected to erode but not abate China's battery dominance

Share of global battery cell production value by location (%)



Data compiled May 14, 2024.
Source: S&P Global Mobility.

The most advanced localized non-Asian battery projects in Europe now are Automotive Cells Company (a joint venture established in 2020 between SAFT — a wholly owned subsidiary of TotalEnergies, Stellantis and Mercedes-Benz) and Swedish Northvolt. The Automotive Cells Company recently secured a €7 billion investment for the construction of three Gigafactories in France, Germany and Italy. Swedish Northvolt has raised over $6 billion to date to establish 150-GWh cell production capacity by 2030. Northvolt intends to use at least 50% recycled material in new cell production and achieve a cell production footprint of 10 kg CO_2 per kWh.

South Korean battery suppliers (LG Ensol, SK On and Samsung SDI) will dominate the North American battery market, attracted by tax incentives under the IRA, and eventually overtake Panasonic Holdings Corp., the leading supplier in the region up until 2022. The localization of production will make Korean players eligible for the Advanced Manufacturing Product Credit under the IRA. However, the multibillion-dollar investments in battery production capacity are exposed to the risk of the election outcome in the US.

Battery prices are declining, but risks of supply constraints loom post 2024

The price of batteries is continuing to decline. Pack costs averaged around $142/kWh in 2023 (volume-weighted average basis) and should average $128 this year. However, in the future, raw material prices will be in increased focus: Decreasing processing costs will result in raw materials comprising a more significant proportion of total battery production costs. We assume a relatively stable raw material price outlook from 2024 onward but also acknowledge that supply-side constraints — especially in medium-term lithium refining and nickel availability — pose risks for the cost assumptions in this base case.

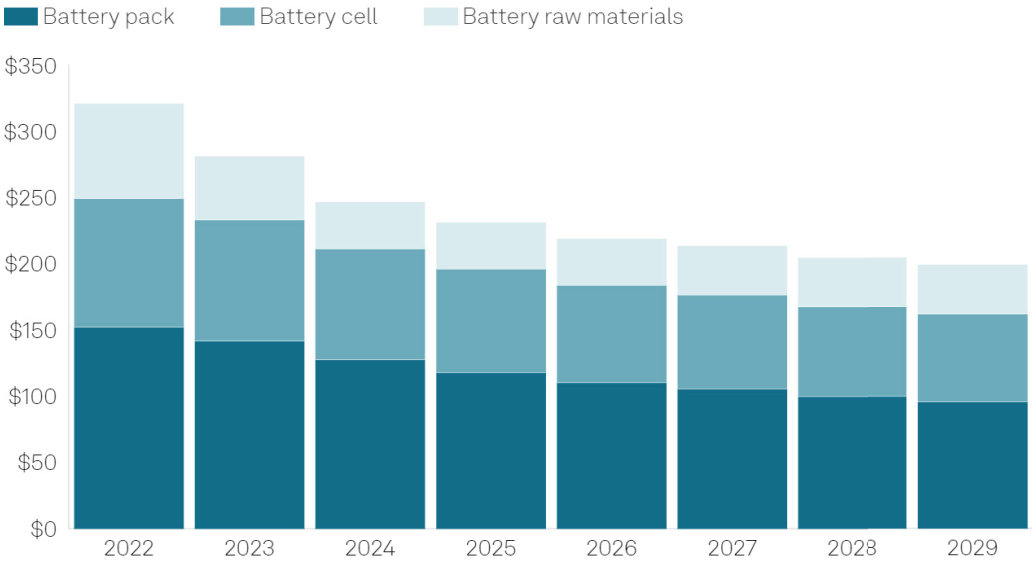
The debate around optimal battery chemistries remains unresolved

Today, most EV batteries are based on nickel manganese cobalt (NMC) chemistry, which is a relatively expensive but high-performing technology. The main chemistry alternative is lithium-ion phosphate (LFP), which is 25% cheaper and represents a smaller but faster-growing proportion of the battery market. LFP cells are favored in entry-level BEVs (especially in China) or PHEVs and other hybrids. For example, BYD's EVs overwhelmingly use LFP batteries.

Figure 11

The average price of batteries worldwide is still declining

Global average price of battery packs, cells and raw materials ($/kWh)



Data compiled May 14, 2024.
Average battery pack price is derived from the forecast potential revenue of battery packs divided by the forecast production volume.
Source: S&P Global Mobility.

Figure 12

Characteristics of NMC and LFP battery cells

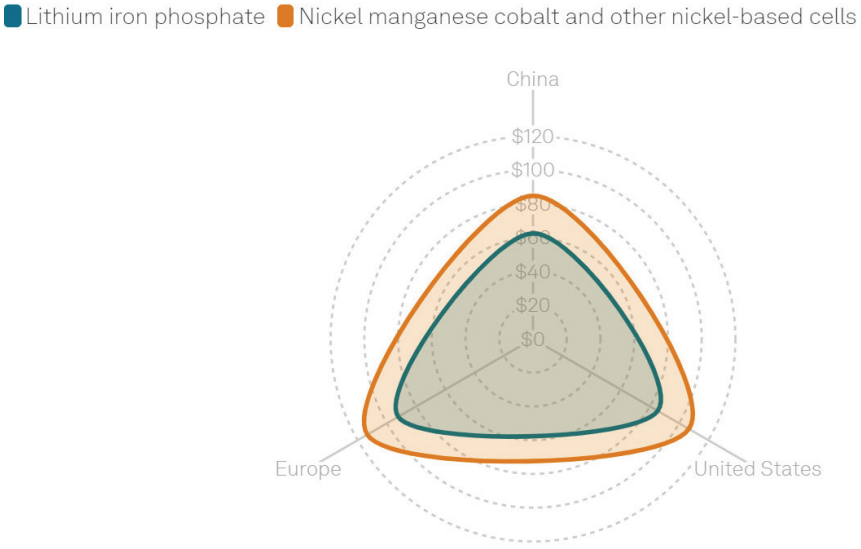
	NMC (nickel manganese cobalt)	LFP (lithium iron phosphate)
Share of the automotive market in 2023	63%	36%
Price per kWh	More expensive (approximately $104/kWh)	Cheaper (approximately $83/kWh)
Energy density	Higher	Lower
Advantages	– Allows compact and lightweight design – Longer driving range	– Lower cost – Longevity over many charging cycles
Disadvantages	– Risk of thermal runaway – Cobalt mining releases toxic materials to the environment	– Lower performance in freezing conditions

Source: S&P Global Mobility AutoTechInsight, 07/05/2024 and Commodity Insights Li-ion Battery Cost Report 2023 H2

Figure 13

Geography and chemistry play significant roles in battery costs

Li-ion battery cell production cost by technology ($/kwh)



Data compiled May 14, 2024.
Source: S&P Global Commodity Insights.

The differences in battery pack pricing between China, the US and Europe may persist owing to scale ramp-up, energy and labor costs. However, in the US, for example, the production tax credit available under the IRA ($45/kWh) could help to bridge the cost difference.

Charging infrastructure plays a pivotal role

The total vehicle stock amounted to 1.5 billion light vehicles in 2018 (including passenger cars and buses; Source: AftermarketInsight). Assuming an average annual 2% growth of the number of vehicles in use, total vehicles in operation should reach 1.7 billion by 2030. According to S&P Global Mobility, BEVs in operation by that time should hover at around 200 million units or approximately 12% of vehicles in operation.

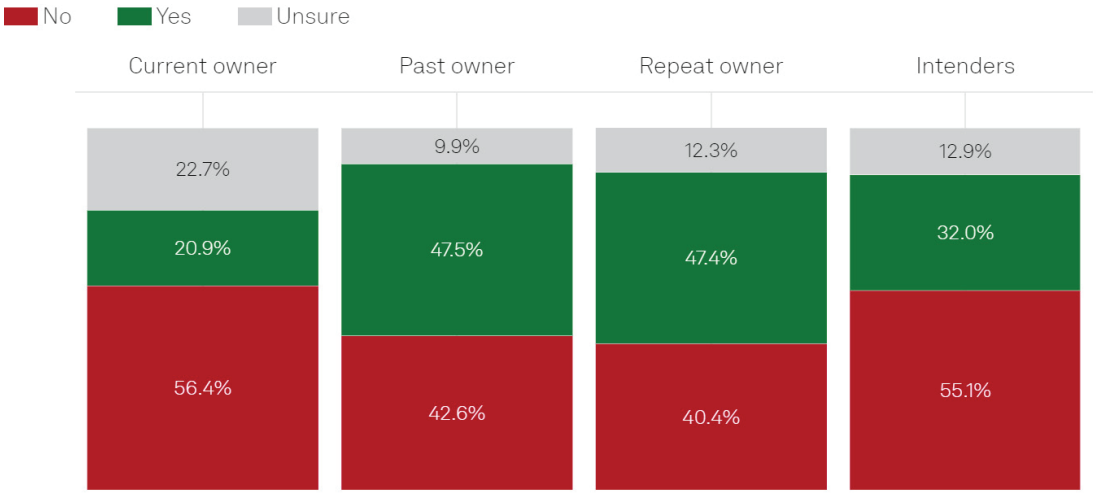
In the most significant European markets today (Germany, UK and France), the average is 10 public chargers per 100 BEVs in operation. Surprisingly, the public charging network is increasingly dense in countries where BEV penetration is lowest, namely in Spain and Italy, with 24 and 23 public charging stations (per 100 BEVs), respectively, ranking behind the Netherlands and Belgium with 35 and 32 public charging points, respectively. An analysis from McKinsey & Company, Inc. suggests that the European Union will need at least 3.4 million operational public charging points by 2030 to enable a successful transition from ICE vehicles to EVs. This compares with some 630,000 public charging points in the EU as of year-end 2023, with 13% being DC chargers and 87% AC chargers (Source: European Alternative Fuel Observatory). In comparison, China has access to 2.7 million public charging points installed (for battery-electric vehicles in operation amounting to 15.5 million). According to the US Department of Energy, the US has just over 61,000 public charging station locations for its EV population, hovering around 1% of vehicles in operation.

Charging concerns are second only to vehicle cost among reasons against buying an EV

The industry will need to address charging infrastructure challenges to take EV penetration to significantly higher levels. While early adopters may be more likely to charge at home, many car owners will depend on public charging to make the switch. Our S&P Global Mobility Global Consumer Insights survey found that 46% of respondents are concerned about the time required for charging, while 44% are concerned about the availability of charging stations.

Figure 14

Consumer survey: Charging infrastructure sufficiency for consumers



Data compiled May 14, 2024.
Source: S&P Mobility.

Although the electric transition may be entering a phase of lower growth, the changes unfolding will impact the competitive automotive landscape and global industrial supply chains for decades to come. For the world's largest manufacturing economies, the picture is evolving rapidly, and the stakes are high.

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