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Electric Vehicle Outlook 2024

BloombergNEF

Executive summary

Electric vehicle markets around the world are not all traveling in the same direction or at the same speed in 2024. Sales of EVs continue to rise globally, but some markets are experiencing a significant slowdown and many automakers have pushed back their EV targets. Progress varies by segment, with electric commercial vehicles set for another blistering year and segments like buses and two- and three-wheelers already reaching very high levels of electrification.

Electric vehicles are no longer only a wealthy country phenomenon. Developing economies like Thailand, India, Turkey, Brazil and others are all experiencing record sales as more low-cost electric models are targeted at local buyers. Chinese automakers are expanding quickly abroad as they look for new markets for their EVs.

The transition to a clean transport system is also affected by growing geopolitical tension. Through strong, long-term planning and support, China has built up a formidable lead in batteries and the EV supply chain. Europe, the US, India and others are now pushing back against China's dominance with efforts to onshore manufacturing jobs and support domestic companies. Tariffs and further protectionist measures could slow down global EV adoption in the near term.

Policy support for EVs also looks less certain than it did a year ago. Several European governments slashed subsidies earlier than expected. The resulting slowdown has spurred calls to relax both the near-term vehicle CO2 targets, and the longer-term plan to phase out internal-combustion vehicle sales. Progress in the US will depend on the results of the presidential election later this year, leaving China as the only large auto market that has reached the point of consumer-led takeoff for EV sales.

Policymakers should not lose sight of long-term goals. While oil demand from transport is set to peak later this decade, only a couple of Nordic countries, and California, are currently on track for having a completely zero-emission passenger vehicle fleet by 2050. The rest of the globe is still lagging behind. The window for achieving net-zero emissions in road transport is closing quickly and there is no room left for complacency. EVs are still the most cost-effective and commercially viable route to fully decarbonizing transport.

The underlying technology for electrification continues to improve. Several next-generation battery technologies are reaching commercialization in the next few years and prices have fallen by 90% over the past decade. This trend looks set to continue, with early indications that prices are dropping sharply in 2024 due to lower raw-material prices, manufacturing advances, and overcapacity. This is good news for automakers and EV buyers but marks a challenging time ahead for new entrants to the battery industry.

Electrification is not the only vector of change in road transport. Shared mobility, vehicle connectivity and, eventually, autonomous vehicles are also set to reshape automotive and freight markets around the world in the decades ahead.

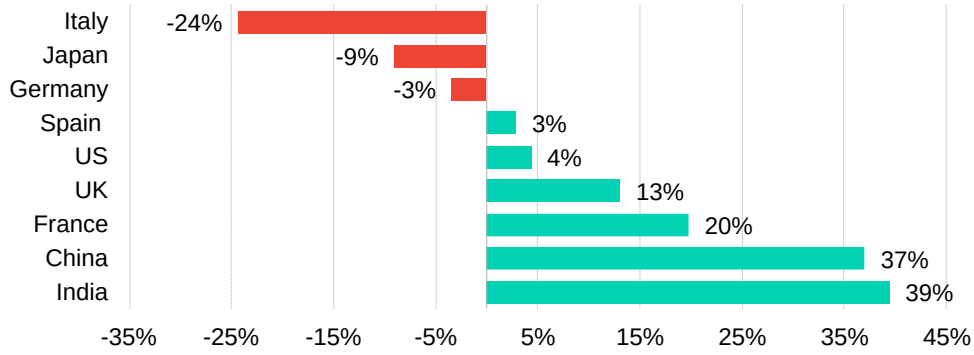
Against this increasingly complex backdrop, we are proud to present our 2024 Electric Vehicle Outlook, which examines each of the trends outlined above, and provides two updated scenarios for the future of road transport, drawing on BNEF's team of sectoral and regional experts around the world. Our Economic Transition Scenario describes how current techno-economic trends are expected to drive the EV transition, while the Net Zero Scenario examines what a path to a zero-emission global road fleet by 2050 could look like.

This report includes analysis on EV adoption in passenger vehicles, commercial vans and trucks, two- and three-wheeled vehicles and buses globally. It also looks at other drivetrains, including hybrids, natural gas and fuel cells, and then explores the resulting impacts of all of these on electricity markets, oil demand, battery materials, charging infrastructure and CO2 emissions.

The key findings are as follows:

- **The EV sales growth slowdown is real, but it is not the same everywhere in the world.** Countries like China, India and France are still showing healthy growth, but the latest data for Germany, Italy and the US is more concerning. In Japan, lack of EV commitment from the major domestic car makers, as well as no new models in the mini-car segment (kei-car) are holding the market back. Still, some slow-down was expected and the global growth rate in 2024 is broadly in line with BNEF forecasts from previous years.

Figure 1: Passenger EV sales year-on-year change in select countries, 1Q 2024



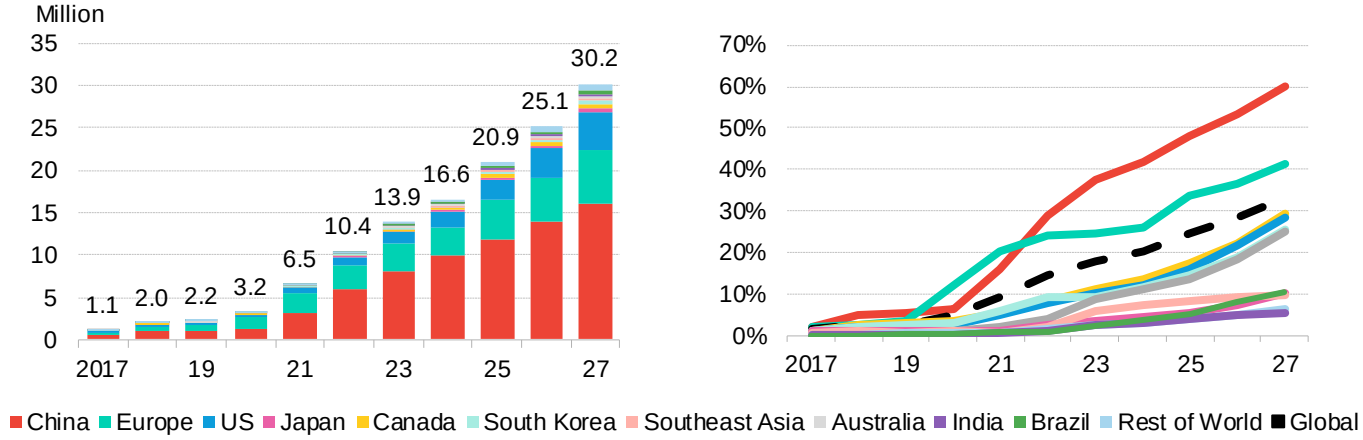
Source: BloombergNEF, MarkLines, Jato Dynamics. Note: Includes battery electric vehicles and plug-in hybrids.

- **More automakers are softening previous electrification targets.** Since 2023, several automakers – including Tesla, Mercedes-Benz, General Motors and Ford – have made cuts to their near-term goals for electric vehicles, often quoting their inability to manufacture EVs at as low a cost as internal-combustion cars. Yet, some automakers are holding their ground and achieving results. Kia, for example, targets all-electric vehicle sales of 1.6 million by 2030, or around 37% of the automaker's total sales. Against the slow-down rhetoric, the company is set to launch an affordable, all-electric SUV – the EV3 – later this year. At Volvo, global sales of electrified models (BEV and PHEVs) in April 2024 increased 53% compared with the same period last year, making up nearly half of all sales that month, according to a company statement. The newly released all electric compact SUV – the Volvo EX30 – was the driving force behind the year-on-year increase of 75% in the automaker's EV sales in Europe in April. Chinese automakers also continue to do well with their EV sales. A big gap is emerging between the automakers that are successful on EVs, and those that are not.
- **Global passenger EV sales continue to grow in the next few years, but the growth rate is visibly slower than before.** EV sales are set to rise from 13.9 million in 2023 to over 30 million in 2027 in our Economic Transition Scenario. In the next four years, electric car sales grow at an average of 21% per year, compared to the average of 61% between 2020 and 2023. The EV share of global new passenger vehicle sales jumps to 33% in 2027, from 17.8% in 2023. Only China (60%) and Europe (41%) are above that global average by then, but some European car markets move even faster, with the Nordics at 90% and Germany, the UK, and France all well above 40%. In the US, EV market jitters inflamed by the

upcoming presidential elections helped slow down adoption this year, and by 2027 only 29% of cars sold in the country are electric. Japan significantly lags other wealthy countries.

Still, the underlying technology for EVs continues to get better and cheaper, with many new, lower-cost EV models set for launch in the next few years. Some of the fastest growth rates are in emerging economies, with EV sales set to quintuple in Brazil by 2027 and triple in India. The fleet of electric cars grows fast, rising to over 132 million by 2027, from 41 million passenger EVs on the road at the end of 2023.

Figure 2: Global near-term passenger EV sales and share of new passenger vehicle sales by market



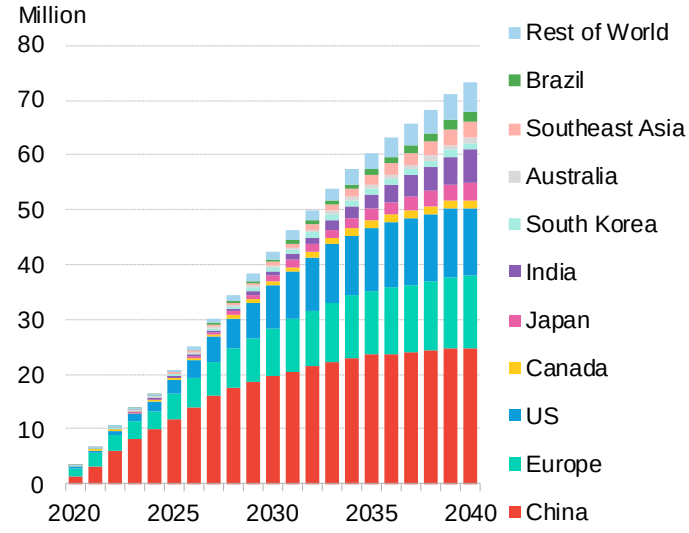
Source: BloombergNEF. Note: Europe includes the EU, the UK and EFTA countries. EV includes BEVs and PHEVs.

- **Sales of internal combustion vehicles have peaked and the fleet peaks soon.** Sales of internal combustion vehicles peaked in 2017. By 2027, sales of internal combustion vehicles are set to be 29% below their 2017 peak. The internal combustion vehicle fleet peaks in 2025. Hybrids experienced growing sales in 2023 in specific locations and segments of the passenger-vehicle market. Our economic analysis indicates that electric vehicles will be the primary method of decarbonizing road transport, however, hybrids can play a meaningful role. In Europe, the US, China, Japan and South Korea, we expect full hybrid sales to surpass 15 million units annually by 2030. Adoption rates can range between 20% and close to 50% in different markets. The main support for further hybrid penetration comes from the increasingly stringent fuel-efficiency rules. In the absence of those, we would expect relatively low passenger hybrid-vehicle sales, close to current levels in most markets.
- **Our long-term outlook for EVs remains bright, despite near-term challenges.** Improving economics of electric vehicles underpin the continued long-term growth in EV adoption. EVs reach 45% of global passenger-vehicle sales by 2030 and 73% by 2040 in BNEF's Economic Transition Scenario. Despite great progress and a steep growth trajectory, Southeast Asia, India and Brazil are still below the global average adoption by then. A stronger regulatory push is needed in these markets to help bridge the gap with the more developed EV markets. Still, by 2040 the three regions represent 15% of the global EV market, up from just 2% in 2023 and 4% in 2030.

  While EV sales exhibit a traditional 'S-curve' for adoption, each country and region starts on this trajectory at different times. The varied start time and slowdown points between countries mean that the global average appears more linear than any individual country.

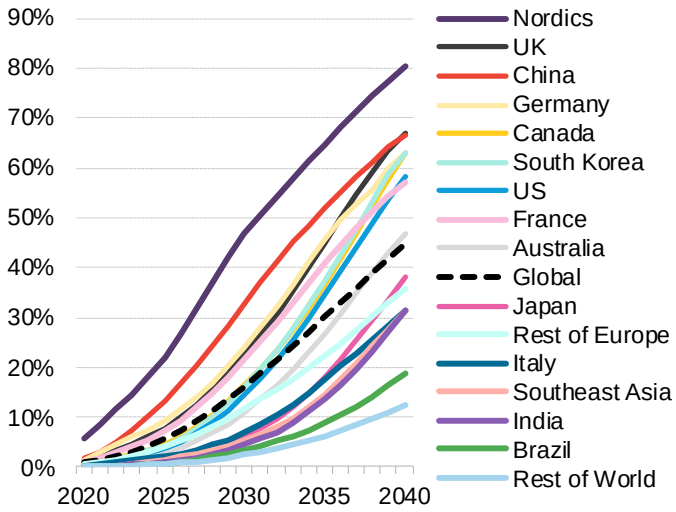
  Despite rapid EV adoption, less than 50% of the global passenger-vehicle fleet is set to be electric by 2040.

Figure 3: Global long-term passenger EV sales by market – Economic Transition Scenario



Source: BloombergNEF

Figure 4: Global long-term EV share of passenger vehicle fleet by market – Economic Transition Scenario



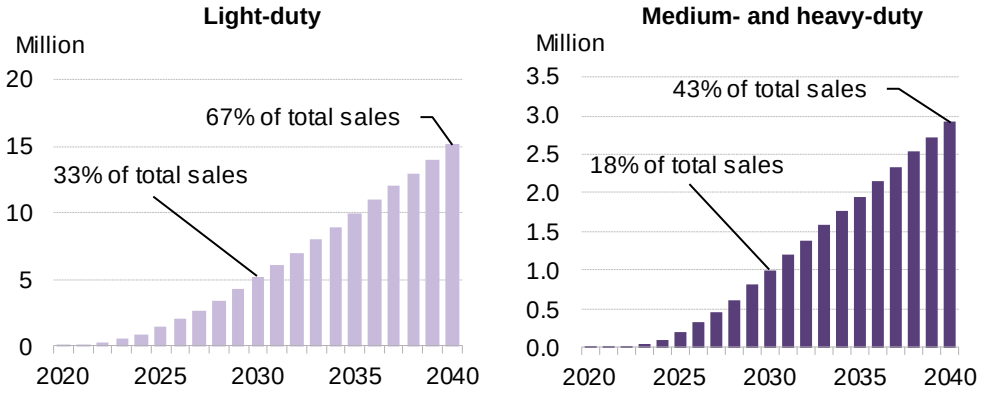
Source: BloombergNEF

- **The decarbonization of the commercial vehicle sector – including vans, trucks and buses – has already started and is set to accelerate.** The pace of zero-emission vehicle adoption differs across countries and segments: sales of electric light-duty delivery vans and trucks are spreading fast in China, South Korea, and several European countries, while sales in the US are weak for now. Still, on the back of good economics, the global e-van market approaches one third of sales by 2030 and two-thirds by 2040 (Figure 5).
- **Electric heavy trucks become economically viable for most use cases by 2030.** In heavier segments, battery electric trucks are mostly used in urban duty cycles initially. But their economics improve even for long-haul routes and around 2030 approach those of diesel powertrains. Fuel cell trucks remain a viable option for some duty cycles and in some countries, but their outlook is far less certain. Zero-emission technologies account for 18% of global truck sales by 2030, reaching 43% by 2040 (Figure 5).
- **New environmental policies are set to alter technology choices among truck makers.** Zero-emission powertrains are currently only slowly adopted within medium- and heavy-duty trucks. Still, newly enacted greenhouse gas rules in Europe and the US will push manufacturers to develop and sell large volumes of electric and fuel-cell trucks. The EU's CO2 emissions targets imply high rates of electrification even by 2030. Municipal buses continue to electrify at a rapid pace and exceed 60% of sales already by 2030, reaching 83% by 2040.
- **Global road transport is still not on a net-zero trajectory, and protectionist policies risk knocking it further off course.** For the world to achieve a completely zero-emission vehicle fleet by 2050, sales of combustion vehicles need to stop around 2038 in our Net Zero Scenario, with leading markets phasing out combustion in the early 2030s. In the Economic Transition Scenario, only the Nordic countries reach a full phase-out of combustion vehicles before 2038.

  As more countries implement industrial strategies to capture value from the transition, there is a risk of some of these slowing adoption and climate goals falling further out of reach. Governments will need to carefully weigh up competing priorities and avoid policies that

reduce competition or access to affordable EVs. The gap between BNEF's Economic Transition Scenario and the Net Zero Scenario is still significant and the need for a stronger regulatory push has not waned since the previous outlook.

Figure 5: Electric and fuel cell commercial van, truck, and bus sales near-term sales outlook – Economic Transition Scenario



Source: BloombergNEF, government agencies, China Automotive Technology and Research Center, EV-Volumes, Japan Automobile Dealers Association (JADA). Note: Electric vehicles include battery-electric and plug-in hybrid vehicles.

- **Only the three-wheeled vehicle segment is on track to achieve a zero-emission fleet by 2050 without additional policy intervention**. Two- and three-wheeled vehicle sales continue to rise in emerging economies and electric sales are set to exceed 90% globally by 2040. Over 40% of two-wheelers and over 80% of the three-wheelers sold in 2023 were electric, leaving the latter as the only vehicle segment currently on track to achieve a net-zero fleet by 2050.

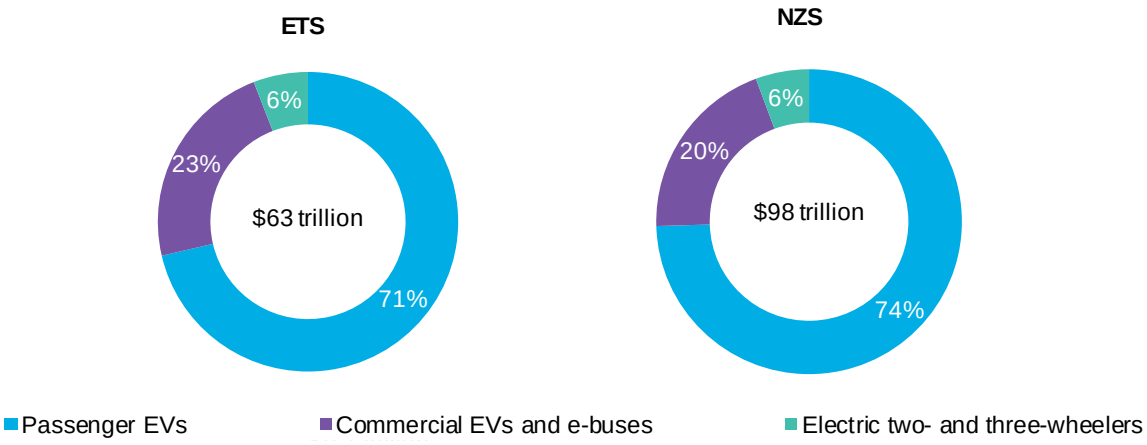
Table 1: Road transport segment progress toward net zero

Segment	Current share of road transport CO2 emissions	Current estimated global fleet size	Zero-emission vehicle (ZEV) fleet share in 2050 – Economic Transition Scenario	Level of policy intervention needed to hit Net Zero Scenario (100% ZEV share) by 2050
Three-wheeled vehicles	<1%	120 million	95%	On track
Two-wheeled vehicles	5%	1.1 billion	80%	Almost on track: minor additional measures needed
Municipal buses	1%	3.4 million	86%	Almost on track: minor additional measures needed
Light commercial vehicles	11%	170 million	77%	Positive trajectory: moderate additional measures needed
Passenger vehicles	53%	1.3 billion	69%	Positive trajectory: moderate additional measures needed
Medium + heavy commercial vehicles	30%	83 million	28%	Not on track: strong additional measures needed urgently

Source: BloombergNEF, various government sources. Note: Fleet size represents vehicles of all drivetrain types and are estimates based on various sources and BNEF data. Some values rounded. Current emissions and fleet size data are for 2023.

- **Massive spending is required in both scenarios.** The cumulative value of EV sales across all segments hits $9 trillion by 2030 and $63 trillion by 2050 in the Economic Transition Scenario. This jumps to over $98 trillion by 2050 in the Net Zero Scenario. There is already fierce competition among governments to ensure the development of local supply chains. EVs and batteries will remain a central part of many countries' industrial policy over the coming decades.

Figure 6: Estimated global EV market opportunity by 2050 – Economic Transition Scenario vs. Net Zero Scenario

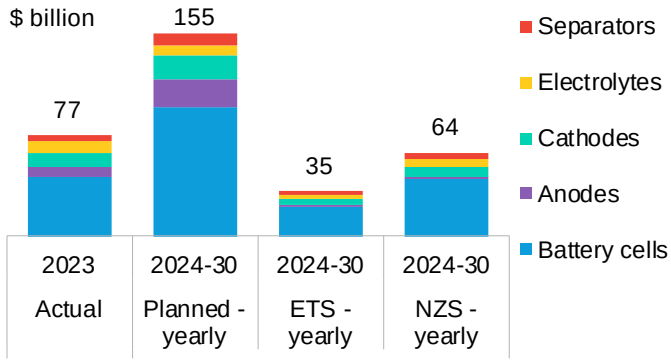


Source: BloombergNEF. Note: Includes battery electric and plug-in hybrid electric passenger and commercial vehicles, battery electric buses and electric two- and three-wheelers. Estimates are cumulative, spending starts in 2024. Dollars are in real 2023. 'ETS' is Economic Transition Scenario, and 'NZS' is Net Zero Scenario.

- **Large investments are needed in all areas of the battery supply chain, though planned investment would be more than enough should it materialize.** Annual lithium-battery demand grows rapidly in our Economic Transition Scenario, approaching 5.9 terawatt-hours annually by 2035. Meeting this demand requires large but achievable increases in materials, components, and cell production. At least $35 billion needs to be invested in battery-cell and component plants by the end of the decade, which is easily exceeded by the $155 billion already planned by companies (Figure 7). Over-investment is most apparent in battery-cell manufacturing, where planned lithium-ion cell manufacturing capacity by the end of 2025 is over five times the 1.5TWh global battery demand expected that year. Overcapacity is a big issue for battery makers, especially as many have ambitious plans to expand.

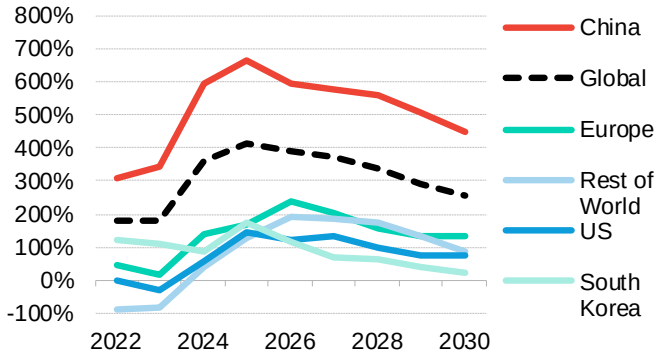
  Under BNEF's Net Zero Scenario, new demand for lithium-ion batteries from transport is 1.7 times that of our Economic Transition Scenario and reaches 218TWh cumulatively by 2050. New technologies that lower the footprint of resource extraction will become important, so will recycling. In lithium, for example, direct lithium extraction technologies could significantly lower the water and land-use in the extraction process, while improving metal recovery.

Figure 7: Annual battery factory investment by scenario



Source: BloombergNEF. Note: 'ETS' is Economic Transition Scenario. 'NZS' is Net Zero Scenario. Battery factory requirements include investment needed to meet EV and stationary energy storage demand. Planned investment based on company factory announcements benchmarked by respective regional capex. ETS and NZS based on China capex estimates.

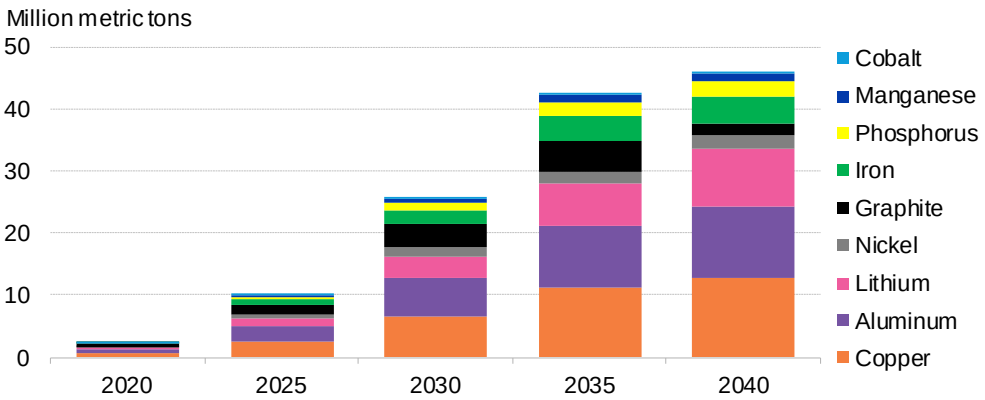
Figure 8: Lithium-ion battery cell manufacturing overcapacity ratio from 2022 to 2030, based on current announcements



Source: BloombergNEF. Note: Overcapacity ratio based on the manufacturing capacity over the same year's demand. Demand is based on BNEF's EVO 2024. Nameplate manufacturing capacity as of May 9, 2024, not de-risked.

- **Lithium-iron-phosphate batteries are taking over the EV market, reducing the expected need for metals like nickel and manganese.** Fiercely competitive pricing strategies continue to put pressure on battery technology improvement. Improvements in lithium-iron-phosphate (LFP) technology, including super-fast-charging capabilities, cold temperature performance and higher energy densities, are increasing its market share, particularly in China, where many of the companies making LFP cells are based. LFP reaches over 50% of the global passenger EV market within the next two years. Nickel and manganese are among the biggest losers from the advancements in LFP batteries. Nickel consumption in lithium-ion batteries reaches 517,000 metric tons in 2025, while manganese reaches 131,000 metric tons. These are 25% and 38% lower than our previous estimates in EVO 2023 for nickel and manganese, respectively, due to the shift toward lower-cost chemistries.

Figure 9: Annual metals demand from lithium-ion batteries under the Net Zero Scenario

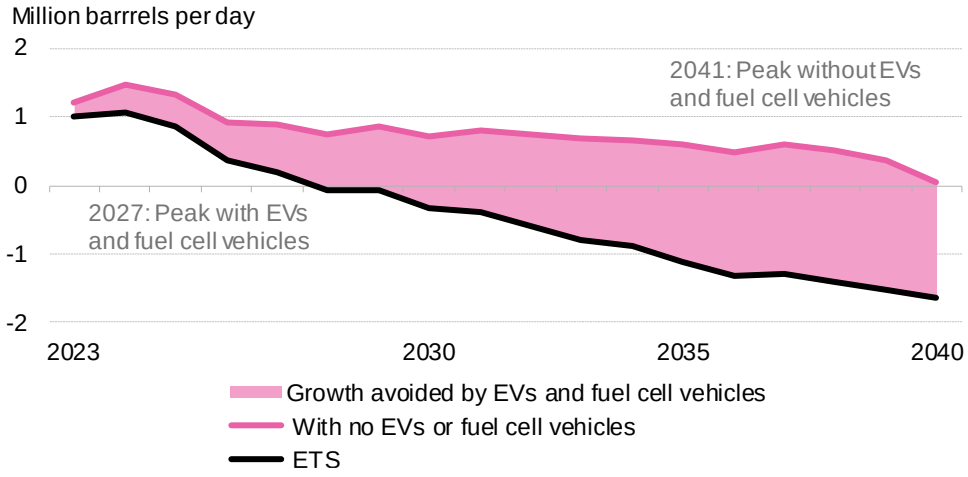


Source: BloombergNEF. Note: Lithium is expressed in million metric tons lithium carbonate equivalent (LCE). Note: Demand occurs at the mine mouth, one year before battery demand.

- **With 83 million electric cars, trucks, and buses on the road next year, and over 340 million electric two- and three-wheelers, oil demand displacement from EVs starts to ramp up.** In the next three years oil demand displaced by electric and fuel-cell vehicles of all types more than doubles from today, to almost 4 million barrels per day by 2027. This is slightly more than the volume Japan consumed in 2022.

  Rapid uptake of electric and fuel-cell vehicles across all segments drives the arrival of peak road fuel demand by 2027. Without EVs and fuel-cell vehicles, road fuel consumption would continue to grow until 2041 (Figure 10).

Figure 10: Year-on-year road fuel demand growth avoided by electric and fuel cell vehicles

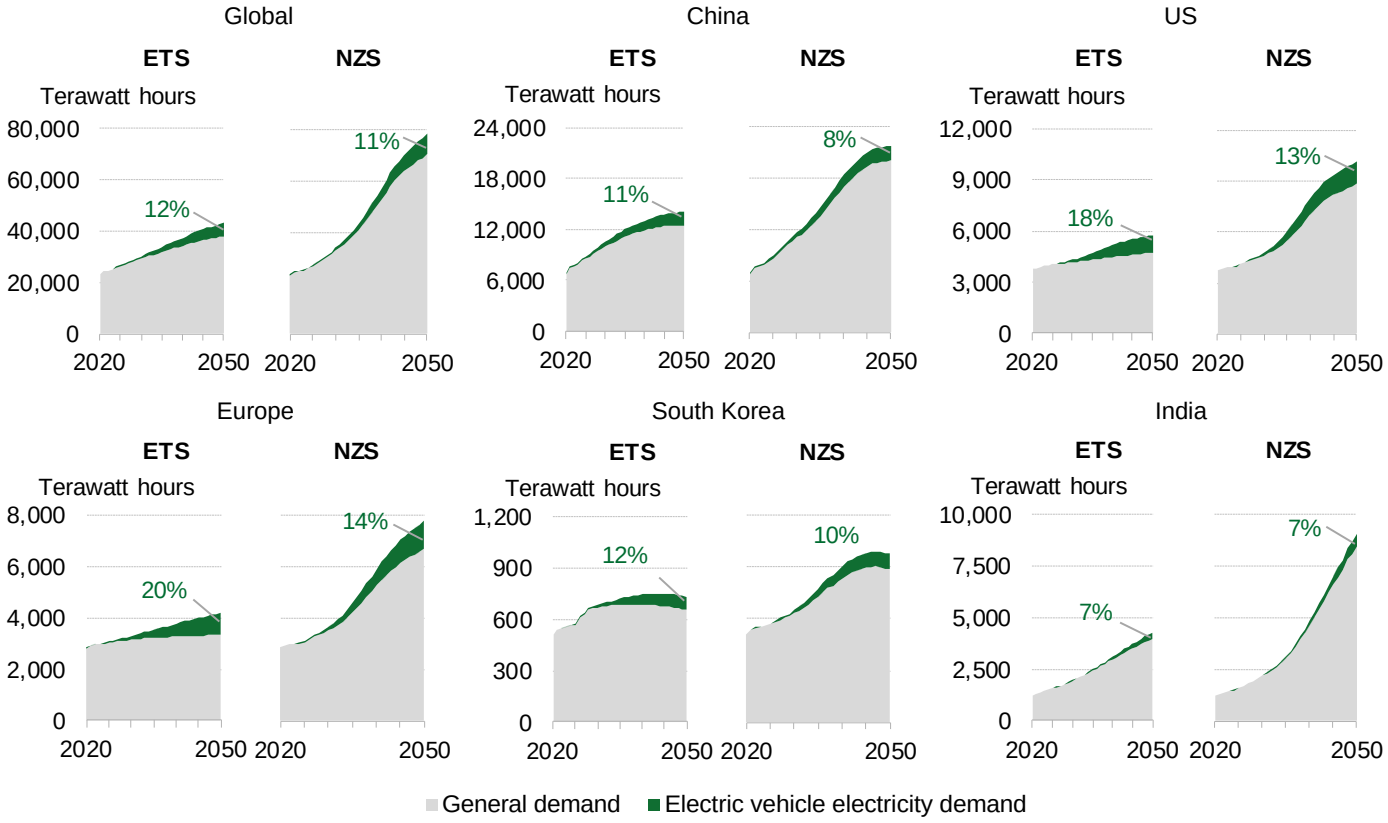


Source: BloombergNEF. Note: Includes biofuels. Alternative drivetrains include electric, fuel cell and natural gas vehicles. ETS is BNEF's Economic Transition Scenario.

- **A fully electric global fleet could consume twice the amount of electricity as the US did in 2023.** By 2050, in the Net Zero Scenario, some 8,313TWh of electricity is needed to power an all-electric vehicle fleet, double the amount of electricity consumed in the US in 2023. This drops to 5,290TWh in the ETS, and the demand accounts for between 11% and 12% of the global total in 2050, depending on the scenario. Despite the large growth in electricity demand, electric vehicles can aid the electrification of the energy system through smart charging, as grid operators apply variable pricing and other mechanisms to incentivize flexibility. The cost to upgrade the grid for EVs peaks at around 16% of annual grid expenditure in the mid-2030s in the ETS, before dropping soon after. The expenditure is equivalent to just $100 per battery electric vehicle in 2040.

  To supply all that electricity demand, the charging industry will need to mature rapidly over the next decade, creating opportunities for charging operators, manufacturers and developers. Between $1.6 trillion and $2.5 trillion in cumulative investment is required in charging infrastructure, installation, and maintenance by 2050, depending on the scenario. The size and distribution of power within the charging network is highly dependent on the assumed consumer charging preferences, business models and the prevalence of faster charging technology.

Figure 11: Electricity demand outlook for selected regions by scenario



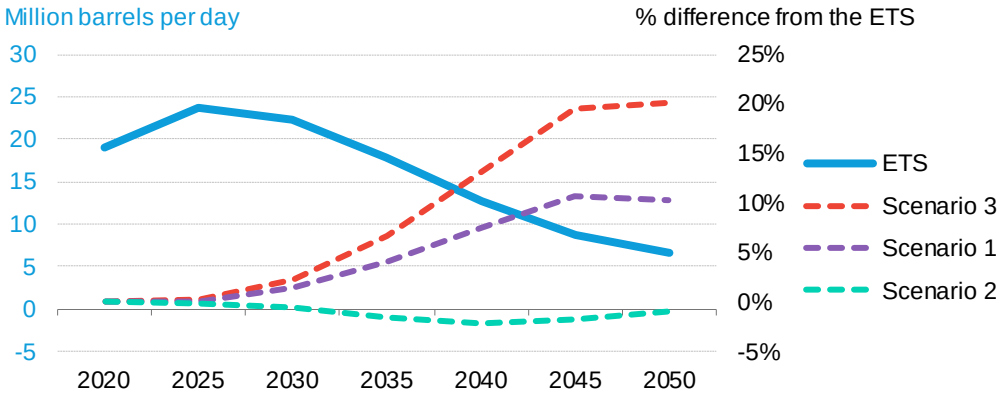
Source: BloombergNEF. Note: Uses general electricity demand projections from BNEF's New Energy Outlook 2024. This is the final energy consumption and excludes any losses in transmission. EV electricity demand includes demand from passenger EVs, commercial EVs, e-buses and electric two- and three-wheelers. Percentages refer to percentage of EV electricity demand of total in 2050.

- This year's EV Outlook includes three new Thematic Highlights, each of which explores a different part of the transition in vehicle markets around the world. The topics are:
  - The return of plug-in hybrids
  - EV driving distances are higher than expected
  - China's low-cost battery push
- **Plug-in hybrids are making a comeback, but it is still unclear whether it is a temporary trend,** or if PHEVs will remain an integral part of the transition for longer. The faster uptake of PHEVs is largely driven by China, which overtook Europe as the largest PHEV market in 2022 amid an influx of affordable models from automakers like BYD and Li Auto.

  The average electric range of PHEVs is rising and hit 80km in 2023, with some in China pushing well above 100km. PHEV battery pack sizes in China are almost twice the size of those deployed in the US and Europe, many of which were designed primarily to comply with fuel economy regulations.

  Although considered a bridge technology toward a zero-emission future, putting too much faith in plug-in hybrids comes with risks attached. Our meta-analysis of studies on the share of kilometers driven in electric mode by PHEVs shows a range of 11% to 54% depending on the country and owner type. If PHEVs are displacing BEV sales and are not utilizing their full electric driving potential, they add to oil demand in our analysis.

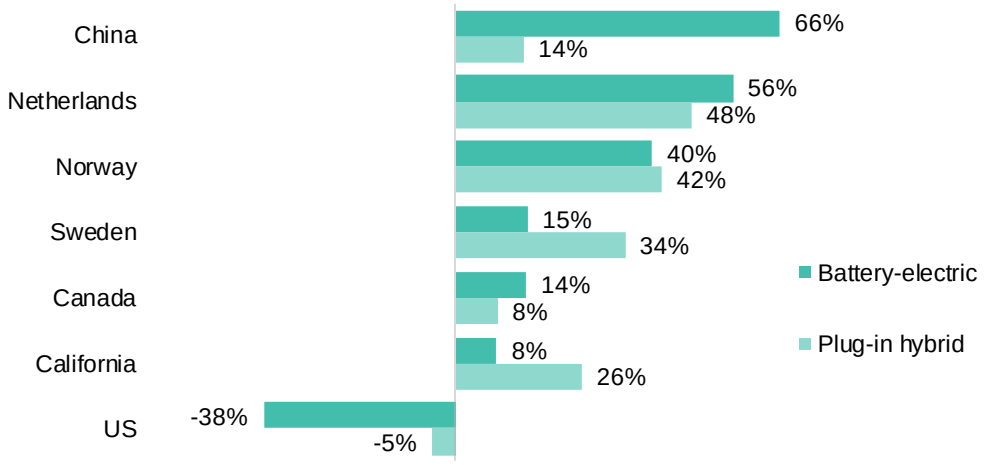
Figure 12: Global oil demand in the ETS and how it changes depending on the various PHEV adoption and electric-mode utilization scenarios



Source: BloombergNEF. Note: "Scenario 1" corresponds to high PHEV adoption, "Scenario 2" corresponds to high PHEV utilization and "Scenario 3" corresponds to high PHEV adoption and low PHEV utilization scenario.

- **Electric vehicle usage is on the rise.** In markets where EVs are developing an early foothold there is a growing body of evidence that they are winning over the most active drivers and are racking up more kilometers on an annual basis than ICE vehicles. In China and the Netherlands, the trend is particularly strong, with BEVs traveling 66% and 56% more than ICE vehicles, respectively. There is significant variation between geography and drivetrain. In the US, BEVs are driven about 40% less than ICE cars, and the mileage of PHEVs is 5% less. However, the standout EV adoption state in the US – California – has EV usage numbers that are closer to what can be observed in markets like Sweden.

Figure 13: Difference in annual vehicle kilometers traveled compared to internal combustion engine vehicles by drivetrain and market



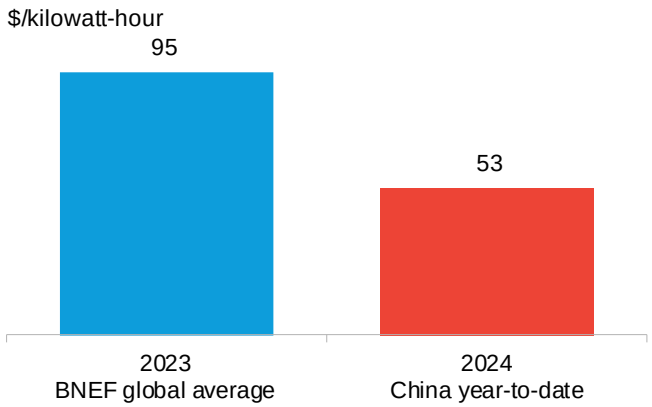
Source: BloombergNEF, National Big Data Alliance of New Energy Vehicles of China, Statistics Norway, Statistics Sweden, Statistics Netherlands, George Washington University, UC Davis, news reports. Note: Latest data available. California data is from a UC Davis study published in 2020. US data is from a study by George Washington University published in 2023. US data includes all states.

Automakers have an opportunity to shape their product portfolio to appeal to high-mileage drivers. High usage of EVs among working drivers is a strong signal that these vehicles are in demand. In some instances, automakers may need to tailor their vehicles to specific use cases. For example, Roewe vehicles, which are popular with ride-hailing drivers in China, have a lower range than many other EVs, but are offered at upfront price points that are attractive to ride-hailing drivers.

- **China's batteries are incredibly cheap**. While battery-cell manufacturing overcapacity is a phenomenon globally, it is most acute in China and is a major factor driving prices lower. In the domestic market, EV lithium-iron-phosphate (LFP) cell prices have averaged $53/kWh between January and April 2024, a 44% year-on-year drop (Figure 14). Planned battery production capacity in China is almost seven times demand by 2026. Sustained low prices could lead to an additional 23.9 million EVs being sold in China between 2024 and 2035, according to our scenario analysis. This averages 2 million additional BEVs and PHEVs per year over the next decade (Figure 15). That uptick, however, is not enough on its own to solve China's overcapacity. Actual excess supply will be lower due to varying utilization rates, commissioning delays and abandonments, but fierce competition is a trend that is likely to remain in the next couple of years, if raw material prices remain low.

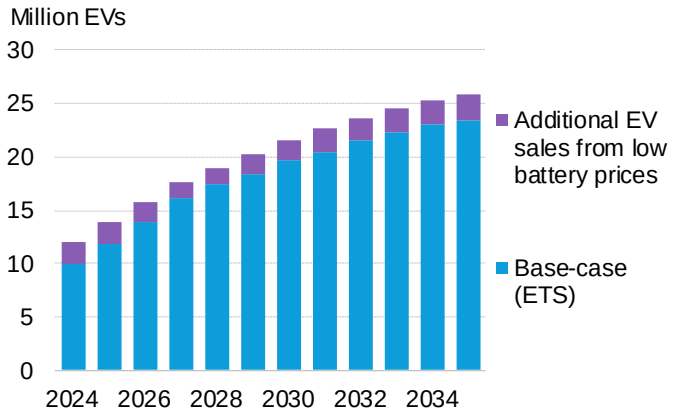
  Although low battery prices are a boon for demand, they put a strain on governments and automakers outside China that are seeking to localize their respective supply chains.

Figure 14: Lithium iron phosphate (LFP) battery cell prices



Source: BloombergNEF, ICC Battery. Note: 2023 price from BNEF's Lithium-ion Battery Price Survey. 2024 price from Jan-Apr from ICC Battery.

Figure 15: China EV sales by battery price scenario



Source: BloombergNEF. Note: The base-case uses BloombergNEF's Economic Transition Scenario (ETS) with battery prices from the BNEF's 2023 Lithium-Ion Battery Price Survey, the low-price scenario uses the same proprietary modeling with battery price data from ICC Battery averaged over January to April 2024 for the 2024 price and then the same year-on-year decreases expected in the price survey's long-term outlook.

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