

EV Charging Index Edition 5 | 2024

Recalibrating

EV growth slows as attention turns to charging infrastructure



Introduction

After a period of rapid expansion, 2023 saw a slowdown in EV sales growth. The sector currently faces numerous headwinds, including high electricity costs, inflation, and reduced subsidies as governments shift their funding focus from vehicles to charging facilities, as reflected in the latest edition of the Roland Berger EV Charging Index. Nevertheless, it should only be a matter of time before EV growth rates recover.

This fifth edition of the EV Charging Index covers 32 markets in Europe, the Americas, the Middle East, and Asia and 31 indicators. It is based on industry interviews, primary research, and a survey of 16,000 participants conducted in Q2 2024. In this report, we present the overall findings regarding EV penetration, policy, infrastructure, and market dynamics. The EV Charging Index score assesses a country's charging facility readiness, measuring network sufficiency and customer satisfaction under the ongoing EV trends.

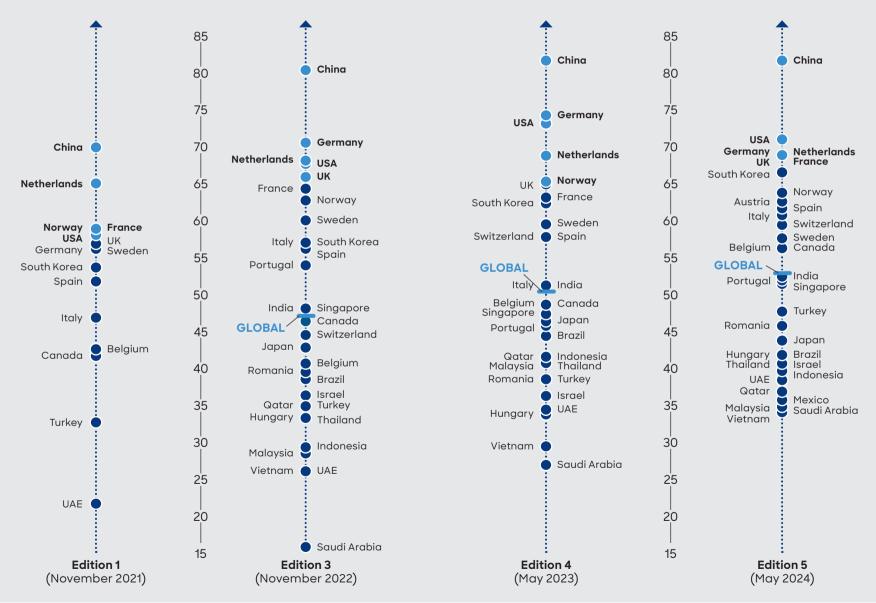
In 2023, the overall vehicle-to-charger ratio and vehicleto-public-charger ratio edged back in the right direction thanks to rapid growth in certain regions. More than 80 % of respondents think public charging has become easier in the last six months and all markets are moving towards faster charging.

Across the globe, OEMs are increasing their involvement in charging, either through their own branded networks or collaborating with others in consortiums. Meanwhile, the market is vibrant, with a variety of new companies entering the fray in both mature and developing regions.

Scores and rankings: Global growth continues, but the pace has slowed

China's overall score may not have increased in 2023, but its lead at the top of the rankings has not suffered. Its closest competitors – Germany, the United States, and the Netherlands – have all seen their scores either stall or decrease, a trend seen across most established markets in 2023.

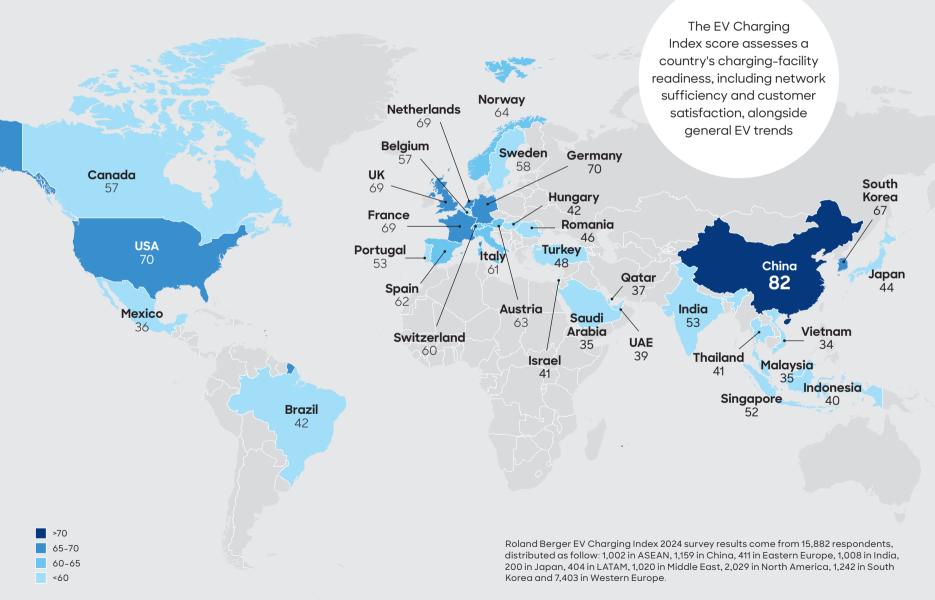
Bunching together: China leads the way again, while developing markets show rapid growth



Source: Roland Berger EV Charging Index 2024 survey

Although the development of the US public charging network is still well behind other leading nations, the very high percentage of EV owners with at-home charging reduces dependency on the public network. Meanwhile, developing markets in the Middle East and Southeast Asia are showing rapid growth in EV sales, and closing the gap to the leading nations.

Slow growth: Scores have improved in many countries, but some nations have stagnated



Source: Roland Berger EV Charging Index 2024 survey

EV sales penetration

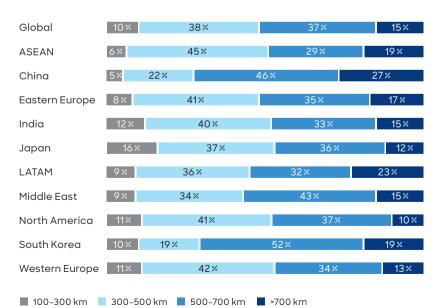
Global EV sales penetration rates (the share of EVs sold as a percentage of total vehicles sold) continued to rise in 2023. However, penetration rates varied considerably across countries, influenced by factors in policy, supply, and demand. Asia (excluding China) and the Middle East saw the biggest rises, with penetration rates doubling in both regions compared to 2022. Europe, China, and the Americas all saw more gradual increases. Some major auto markets recorded a decline in EV sales penetration: South Korea's rate fell from 11% to 9%, while Germany's fell from 37% to 26%.

China: Strong EV growth continues

China continues to lead the way for EV growth, with a 36% sales penetration rate in 2023. Plug-in hybrid electric vehicles (PHEVs) were the biggest contributor, up 85% compared to 2022. Meanwhile, battery electric vehicles (BEVs) maintained solid momentum (up 25% vs 2022) and now comprise just over two thirds of the overall EV parc (the registered number of vehicles within a region). Pricing is becoming increasingly competitive as a growing number of local OEMs launch new models.

High demands: Most drivers in China expect to travel at least 500 km on a full charge

What is your expected range for an EV from a full charge?



Source: Roland Berger EV Charging Index 2024 survey

A combination of high-performing vehicles and raised demands means drivers in China have the highest expectations when it comes to range: more than 70% of respondents expect to travel at least 500 kilometers on a full charge. Almost 30% expect 700 kilometers or more.

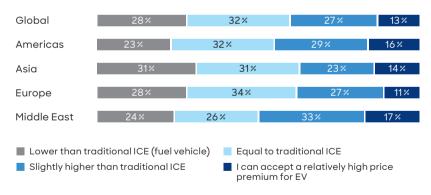
United States: Range anxiety fuels PHEV sales

Drivers in the US purchased almost 1.5 million EVs in 2023 – a 10% sales penetration rate, up from 8% in the prior period. These figures were buoyed by the increasing popularity of PHEVs, which made up nearly 20% of US EV sales in 2023. This supports the notion that many Americans still have range anxiety and lack trust in the availability and reliability of public charging infrastructure.

Price competition is heating up after the release of numerous new models and subsequent price reductions from incumbent EV players. The Index shows drivers in the US have an above-average willingness to pay a premium for their EV ($46 \times vs. 40 \times global average$), potentially reflecting the fact that EVs are not yet in the mainstream.

Quality counts: US drivers are most willing to pay a premium for their EV

What is the acceptable (bottom-line) price for an EV (excl. maintenance costs)?



Source: Roland Berger EV Charging Index 2024 survey

Western Europe: Mixed picture in mature and developing markets

Growth in EV sales and parc penetration continued in 2023 but showed signs of slowing in the second half of the year after policy changes in mature markets such as Germany and the UK. Norway continues to lead the way, with a sales penetration rate of 91%, while the Netherlands hit 44%. The UK, Germany, and France, where EVs comprise 4-5% of the passenger car parc, all saw sales penetration rates of around 25%. In some less mature markets, where EVs make up closer to 1% of the passenger car parc, EV sales penetration showed considerable growth: in Turkey, for instance, the EV sales penetration rate rose to 7% in 2023, up from 1% in 2022.

There are numerous drivers behind these trends. Cost of ownership remains high, particularly in Europe due to the continued conflict in Ukraine. Large, mature markets have seen subsidies and incentives for EVs lowered or removed, whereas the likes of Spain and Italy have maintained theirs, and countries such as Croatia and Cyprus introduced subsisides in 2022. There is also continued skepticism from some consumer segments: half of respondents in Western Europe say public charging infrastructure is insufficient and charging takes too long.

China: Attention turns to charging infrastucture

After phasing out its subsidies for EV purchases in January 2023, the Chinese government has increased its focus on charging infrastructure. It issued new guiding principles, indicating an emphasis on system quality and optimized coverage in addition to quantity.

Major provinces and cities such as Hainan, Shenzhen, Guangzhou, and Chongqing plan to build extensive supercharging facilities, while other provinces have also announced policies to encourage the development of charging systems.

United States: Dual focus on vehicles and charging

Incentives in the Inflation Reduction Act (IRA) cover both vehicle purchases and charging infrastructure development. Many EV purchases qualify for rebates and there is a renewed investment tax credit of 30% of total capital costs available for most charging infrastructure.

The Bipartisan Infrastructure Deal's National Electric Vehicle Infrastructure (NEVI) program struggled to disseminate funding and build new charging infrastructure in a timely manner. Lessons have been learned, and the NEVI funding process is now expected to run more quickly as states have experience with the application, award and funding processes. State and utility programs remain in place to support EV charging infrastructure development through upstream investments and local rebates, although these are limited to certain geographical areas.

Charging infrastructure

Infrastructure growth

There is considerable divergence in infrastructure growth. China has long led the way here, but other nations are now also investing heavily to expand charging networks.

China: Rapid charge point expansion continues

The number of charge points grew 65% in 2023, reaching 8.6 million units. The growth rate for private charge points was the main driver, rising 72%, although public charge point growth was also strong (52%). Local regulations supporting the construction of private charge points in residential areas, as well as the promotion of private charging in rural areas, have been particularly beneficial for private charging infrastructure expansion.

Community parking lots are the most preferred location for public charging in China, just ahead of parking lots at retail centers and workplace parking. The latter two are more popular in the United States and Western Europe, however. EV drivers in China have a slightly stronger-than-average preference for charging at hotels and resorts, but rank municipal street charging lower than all other regions.

Public charging priorities: Community parking lot charging is important for Chinese EV drivers

In which three locations do you think public charging facilities are most necessary (besides home charging)?

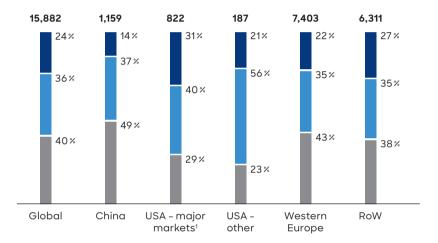
	Global	China	USA	Western Europe	RoW
Workplace (e.g., parking lot near/under office buildings)	56%	43%	60%	55%	59%
Parking lots at shopping/ retail centers	57%	44%	61%	58%	57%
Destinations of hotels/ resorts/Disneyland	35%	39%	39%	34%	36%
Community parking lots	33%	47%	34%	32%	32%
Highway-area charging stations	45%	42%	46%	46%	44%
Municipal street-side charging areas	19 %	12%	15%	22%	18%
Others	1%	0%	0%	1%	1%

Source: Roland Berger EV Charging Index 2024 survey

Almost half of respondents in China believe EVs cost less to drive per kilometer than internal combustion engine (ICE) vehicles – a higher percentage than all other regions, particularly the US. This is reflected in the high number of respondents (two thirds) that find charging costs in China (including power and service fees) to be moderate and acceptable.

Electric pays off: Chinese drivers are happy with EV charging costs

How does the cost of driving a kilometer in an EV compare with the cost of driving a kilometer in an ICE vehicle?



Cost of driving an EV is higher than an ICE vehicle

Cost of driving an EV is equivalent to an ICE vehicle

Cost of driving an EV is lower than an ICE vehicle

1 USA - major markets are states with the most mature EV markets: California, Florida, New York, and Texas

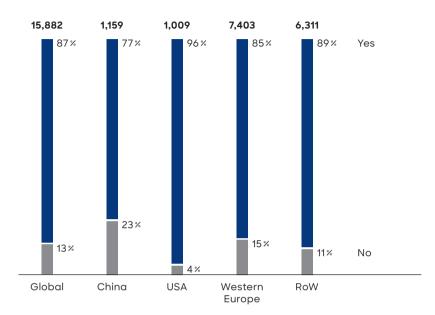
Source: Roland Berger EV Charging Index 2024 survey

United States: Public charge point growth stalls

The number of US public charge points reached 165,000 at the end of 2023, up 5 % since the last Index. The growth rate has slowed, though, falling from 9% in the previous period.

The vast majority of US EV drivers charge their vehicles at home: 96% of respondents own and use a home charger, compared to a global average of 86%. Apartment living is more common in other regions, and living environment is the main reason cited for not owning a home charger (62%), ahead of the cost of purchase and installation (41%).

Home comforts: US EV drivers have a strong affinity for home charging



Do you own and actually use a home charger?

Source: Roland Berger EV Charging Index 2024 survey

Western Europe: Infrastructure expansion outstrips EV growth

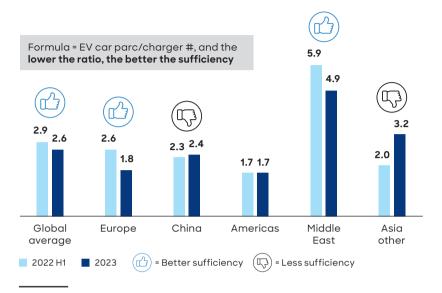
The number of public DC charge points in Western Europe grew by around 80 % in 2023, far outpacing the growth in EV sales, with France and Germany the main catalysts. There are now approximately 635,000 charge points across Western Europe, including more than 90,000 rapid DC chargers. In some less mature markets, such as Spain, there is a notable emphasis on expanding the overall capacity of both AC and DC chargers. Where EV penetration – and therefore utilization – is low, this indicates a focus on prioritizing more cost-effective solutions that can yield returns.

Infrastructure sufficiency

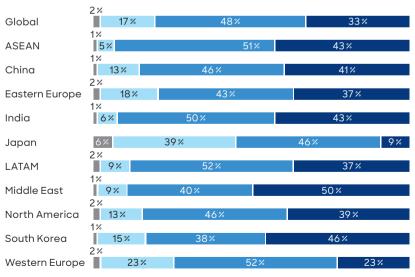
In 2023, most regions saw a decline in their overall vehicle-to-charger ratios. The exceptions were Europe (when excluding Turkey), and the Middle East, which improved significantly thanks to favorable policies, major investment, and rising ambition. Saudi Arabia led the way, improving its ratio from 10.4 to 1.0, while the UAE jumped from 7.6 to 4.3. It's a similar story for the ratio of vehicles to public chargers, with Europe and the Middle East the only regions to record an improvement.

Uneven growth: Vehicle-to-charger ratios have declined in most regions

Charging infrastructure sufficiency - vehicle-related ratios



Upward trend: The majority of consumers in all markets say EV charging is getting easier



Do you think public charging has become easier over the past six months?

More difficult No different

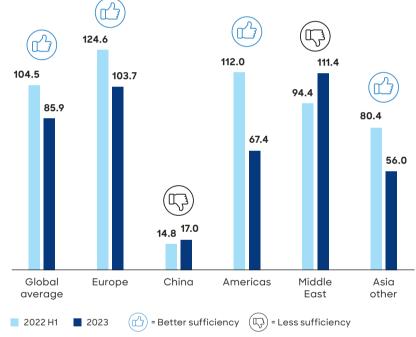
Gradually a bit more convenient Much more convenient

Source: Roland Berger EV Charging Index 2024 survey

On a global scale, the ratio of fast DC chargers to electric vehicles improved significantly in 2023. This was fueled by improvements in Europe, the Middle East, and Asia (except China). The Americas and China saw slight declines in their ratios. Meanwhile, the share of DC chargers in public charging infrastructure grew across all regions, reflecting the growing demand for high-speed public charging.

Need for speed: All regions have seen growth in DC charging infrastructure, although this has not matched EV parc growth in some areas

DC charger sufficiency

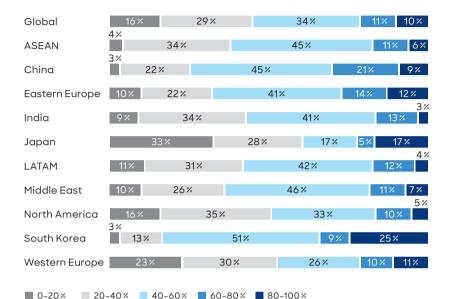


Source: Roland Berger EV Charging Index 2024 survey

China: Public charging remains popular

With EV growth still high, China's overall vehicle-to-charger ratio was unchanged (2.4), while its vehicle-to-public-charger ratio rose slightly from 7.1 to 7.5. Public charging is more popular in China than in most other regions – around three quarters of respondents say they use public charging facilities to cover at least 40% of their annual mileage, much higher than the global average (55.6% of respondents). A key factor is the low penetration of home chargers, mostly due to the environment in which people live. **Going public:** EV drivers in China are more reliant on public charge points than in most other regions

How much of your annual mileage is covered by using public charging facilities?



Source: Roland Berger EV Charging Index 2024 survey

South Korean EV drivers are most reliant on public charging

Respondents in South Korea are most reliant on public charging facilities, with 86% using public chargers for 40% or more of their annual mileage. The country has a reasonable public charging infrastructure, largely thanks to the efforts of its leading OEMs, but a low number of private charging points as many citizens live in apartment blocks.

Nearly all Chinese EV drivers report having used public charging, with 60 % using it more than three times a week, which is the highest of all regions. China also has the highest satisfaction rate for the sufficiency of its public chargers and supporting facilities. A large majority of respondents in China (86.5%) say public charging has become easier in the last six months.

When it comes to obtaining information on public charging facilities, Chinese EV drivers rely much more heavily on apps from independent charge map providers than drivers in other regions. **Plugged in:** EV drivers in China rely on apps from independent providers for public charging information

Where do you get information on available public charging facilities?

	Global	China	USA	Western Europe	RoW
App from third-party charging operator (e.g., ChargePoint, EVGo)	55%	55%	58%	52%	58%
App from vehicle OEM or car dashboard display	55%	58%	59%	51%	57%
App from independent charge map provider (e.g. Chargemap, Zap-Map)	30%	53%	34%	25%	31%
Walk around to seek when in need of charging	14%	9%	11%	15%	14%

Source: Roland Berger EV Charging Index 2024 survey

United States: Improvements needed in public charging infrastructure

In the US, EV adoption has recently grown more quickly than the country's charging infrastructure, causing the vehicle-to-public-charger ratio to leap from 17.1 to 24.5. Meanwhile, charger density remains low, with only 2.4 chargers per 100 kilometers of highway, up slightly from 2.3 in the last Index.

Overall, significant numbers of respondents in the US report that public charging infrastructure is insufficient (49%), charging time is too slow (46%), and charge points are broken or unavailable (34%).

Western Europe: Public charging on the up

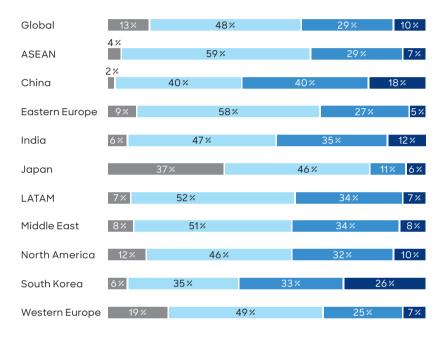
While some countries and regions still lack charge points in the right locations, the sufficiency of the overall charging infrastructure is now much healthier than it was two or three years ago. Indeed, 75% of European respondents think public charging is becoming easier, although around half see room for improvement in charging speed.

The vehicle-to-public-charge-point ratio improved from 17 in H2 2022 to 15.8 in 2023. This is important as demand is strong: more than 80 % of Western European respondents use public chargers at least once a week, with just under a third doing so three or more times each week.

This is despite 85% of Western European respondents owning and using a home charger.

Public interest: Public charging is important for Western European drivers, but their reliance is not as high as in most other regions

On average, how many times a week do you charge your EV using a public charging network?



Never or quite rarely

- 1-2 times per week
- 3-4 times per week
- Over 5 times per week

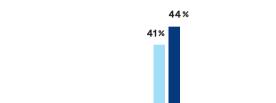
Source: Roland Berger EV Charging Index 2024 survey

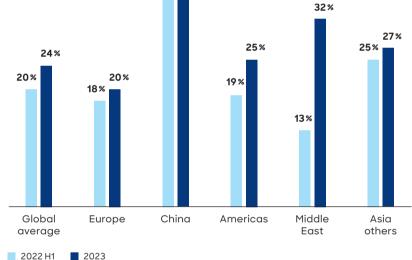
Charge point technology

DC % of public chargers

A combination of technological advancement and increased demand for faster charging is boosting growth in rapid DC charging infrastructure across all regions. According to the global average in our survey, almost a quarter of all public chargers are now DC.

Boosted: The share of DC chargers is rising across all regions



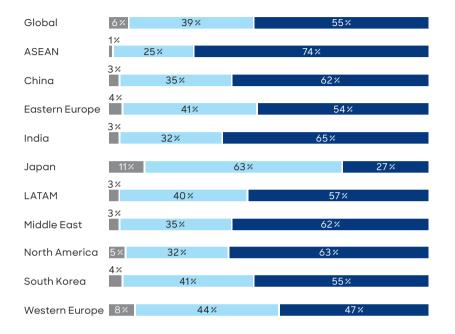


Source: Roland Berger EV Charging Index 2024 survey

China: Impressive DC charging infrastructure mostly meeting expectations

Almost one in two public chargers in China is now DC (44%), making it one of the world leaders in fast-charging infrastructure. This is reflected in driver satisfaction with the speed of public charging facilities: almost two thirds of respondents (62%) feel they are generally fast enough, comfortably above the global average of 55% and similar to North America, the Middle East, and India. Western Europe is the laggard here, with only 47% of respondents satisfied with the speed of current public charging options. **Fast enough:** In most regions, the majority of respondents are satisfied with charging speeds

Based on your experience, are you satisfied with the charging speed of current public charging facilities?



I don't have an opinion
No, there's major room for improvement
Yes, it's generally fast enough

Source: Roland Berger EV Charging Index 2024 survey

Japan: Charging speeds remain too slow

Japan has by far the lowest ranking in terms of customer satisfaction with public charging speeds. This is a longstanding issue for the country and one of the biggest barriers to EV adoption, with EV sales penetration just 3.6%. In 2023, the Japanese government announced plans to relax the restrictions on installing fast chargers, lowering installation and operation costs, which may boost EV adoption. Construction of superfast charging points (350 kW) acclerated in 2023 as the technology matured and more vehicles became compatible. There has even been some construction work on liquid-cooled, ultrafast charging facilities with a maximum output power of 600 kW.

China remains the only country to establish a mature battery swapping business model. Local OEM NIO is the pioneer in this field: the company now has more than 2,200 battery swapping stations, accounting for two thirds of such stations in China.

United States: DC improves slightly, while utilities continue to test V2G through pilot programs

The ratio of DC to AC chargers in the US improved slightly in 2023, with fast chargers now comprising 24% of public charging stations, up from 23% in 2022. This equals the global average, but there is still plenty of room for improvement.

Where the US does lead the way is in vehicle-to-grid (V2G) pilots, with several projects rolled out in 2023. Leading utility companies and OEMs launched these pilots to help drivers reduce their utility costs by transmitting electricity back to the grid during certain hours. While the US may lead in this area, there is no scaled commercialized V2G yet in the US as markets are not yet sufficiently developed to compensate EV owners.

Western Europe: DC on the rise but AC still relevant

There has been rapid growth in DC public charging facilities, especially on highways, but AC charging will remain an important part of Europe's charging mix, especially as around half of survey respondents think charging is too expensive. AC charging will be particularly important in urban areas and workplace settings. It will also play a part in some innovative new energy solutions such as smart charging, V2X (vehicleto-everything) charging, renewables integration, and battery buffering, which have been undergoing experimentation across different parts of Europe, led by charge point operators (CPOs), utilities and energy retailers, and OEMs and integrators.

EV charging market dynamics

Electric vehicle charging station value chain/ CPO business models

China: International expansion for charging companies

After establishing extensive partnerships with overseas operators in 2022, leading Chinese charging companies are now accelerating their international expansion, especially in Europe. These companies have advantages in technology and cost efficiency as well as business model flexibility – by also operating as manufacturing subcontractors, for instance. This enables them to rapidly expand their business volume and geographic footprint.

United States: Searching for profitable business models

The continued underperformance of public companies and insolvency of some private ones highlights the ongoing difficulties in finding a profitable model for public charging and CPOs. Fleet charging and other niche models appear to be receiving the majority of funding, while services businesses, such as installation or maintenance, may offer profitability at scale.

Meanwhile, new participants are joining the game to add more public charge points - Walmart, for instance, plans to leverage its widespread presence and large number of store parking lots. The retailer was working with public charging providers but now plans to own and operate its own fast charging facilities across the US at its stores.

Western Europe: Subdued investor sentiment

Investor sentiment became more subdued over the course of 2023, with deal volumes down compared to 2022. The glut of new chargers in some segments of the market, coupled with new CPOs and players from adjacent value chains such as utilities and supermarkets, led to a slowdown in utilization growth and hesitancy from some investors worried about overbuild and an increasingly complex competitive landscape.

Auto OEM involvement

Though not the main players in most markets, OEMs are increasing their participation in numerous forms across the globe. This is especially true in less mature markets, where they can drive EV sales by expanding infrastructure.

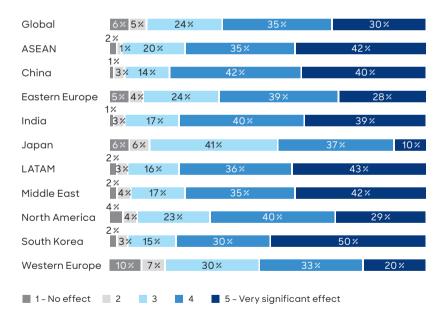
China: Variety of approaches to branded charging

OEMs increased their charging presence across China in 2023, demonstrating a variety of approaches to branded charging. With OEMs now actively establishing and promoting their own branded charging points, most Chinese customers see it as a key factor when buying an EV.

Premium names such as Porsche, Land Rover, and BBA only offer their chargers to brand owners, aiming to provide differentiated experiences. New EV OEMs such as NIO, Tesla, and Xpeng, on the other hand, have opened up their charging stations for use by other brands, which has increased utilization and economic benefits. Meanwhile, many other brands are planning to build or partner with existing CPOs to launch their own branded charging points.

Well connected: Branded charging networks are an important factor when purchasing an EV

If an auto OEM has its own branded charging network, how much does it impact your decision-making when purchasing an EV?



Source: Roland Berger EV Charging Index 2024 survey

United States: Lack of clarity around recent developments

An automotive consortium between GM, BMW, Honda, Hyundai, Kia, Mercedes, and Stellantis was created in July 2023 to install 30,000 DC fast chargers throughout the US. Since then, the group has announced a new name, Ionna, and a CEO, but there has been limited public activity since. Prior to publication, the most recent press release said the first chargers would be rolled out in 2024. Rivian has expanded its charging network exclusively for brand users. This may reflect the dissatisfaction with existing options, especially for higher-end vehicles, with many 'fast' chargers unable to charge at their maximum capacities.

Tesla's decision in 2023 to open its own network to other brand users as well as the widespread adoption of the company's NACS charging standard were game changers in the industry. However, Tesla's most recent announcement, in May 2024, has shaken the sector, with the company laying off the 500-plus person team developing new Supercharger networks. Currently, the rationale behind the move and its impact on the industry remain unclear.

Western Europe: Limited OEM involvement

Beyond Tesla's Supercharger network, OEM involvement in public charging is limited in Europe. There is some semi-public charger provision – at dealerships, for instance.

India: OEMs expand their charging footprint

More than three quarters of respondents in India said their EV purchasing decision would be impacted by an OEM's branded charging network. Pioneering collaborations are developing fast in the country: Audi and Chargezone's co-development of India's first 450 kW ultra-fast charging 'e-tron hub', for instance, highlights the innovative strides being made in fast-charging technology. MG Motor India has collaborated with Zeon Electric to bolster its existing EV charging infrastructure, focusing on key locations such as highways, cities, and MG dealerships across various states.

Market concentration

A small number of first movers still have large capital investment in most regions, resulting in high market concentration levels (CR3 ranges from 40-80 %). However, market activity began to increase in 2023, particularly in Europe and Southeast Asia, where more companies, including start-ups, started to capture market share.

China: Little change in market concentration

The top three players in China remained stable, with the CR3 increasing slightly from 52% to 55%. The total number of charge points almost doubled, from 850,000 to 1.5 million. Leading CPOs strengthened their

business, covering charging facility manufacturing, charge station construction, and operation. As total solution suppliers, they further extended both their product and services to cater for more network scenarios.

United States: Increasingly concentrated market

Market concentration in the US rose from a CR3 rating of 64% to 77% in 2023. This figure has always been high, reflecting the dominance of early movers, particularly Tesla and Chargepoint.

Western Europe: Scale-ups and new entrants

Market concentration remained relatively high, with a CR3 rating of 30-50% in many countries. There were scale-ups at both national and regional levels as well as a range of new CPO participants.

Investment sentiment

Charging-related investment has become increasingly popular across all regions, although capital market performance by listed CPOs did not live up to expectations in 2023.

China: Hotbed of activity

Investment continues to heat up in China, with 23 deals totaling RMB 2.6 billion (USD 360 million) closed in 2023. Charging station maker Star Charge is aiming for an IPO in 2024 after four rounds of financing over the last six years. The company has already achieved profitability, indicating the potential sustainability of the charging operation business.

United States: Declining market caps for public CPOs

There were five public deals and USD 500 million worth of investment closed in 2023. These include the acquisition of distressed assets, with Shell picking up Volta for USD 169 million as the largest publicly announced deal of the year. Publicly traded CPOs continued to see declining market caps, with share prices falling at Chargepoint, EVGo, and Blink, representing a fraction of their peak valuations.

Western Europe: Investment on the rise

Charging-related investment events have become increasingly popular with the active expansion of industry parties and the participation of start-ups, leading to 10 more disclosed funding activities in 2023 than in 2022. In Italy, competition was boosted by increased private investment. 2023 saw a total transaction value of EUR 710 million across seven major transactions in Italy – six more than 2022. These were mainly represented by investments in smaller players such as Powy and Atlante.

Recalibrating

Five key takeaways from the EV Charging Index 5

Varied picture for EV sales

While EV sales continue to enjoy strong growth in many regions, some major markets saw progress stall or even decline in 2023. Amid political uncertainty, wavering policies and regulations are a key driver, for example in the US and UK. Mature markets are reducing or removing incentives for EVs, but less mature markets in southern Europe are now pushing infrastructure expansion and EV sales. Mixed OEM strategies also play a part - some auto manufacturers are recommitting to new BEV platforms, while others shift (back) to PHEV. Slow progress towards cost parity between ICE vehicles and BEVs is a further factor.

Continued customer skepticism

The perceived reliability and availability of chargers in some regions has limited EV growth, despite a significant increase in (high-power) charge points and improvements in accessibility.

Fluctuations in fast-charging sufficiency

Many markets are aiming to improve user experience by adding quality as well as density to their charging networks. This means growth in DC charger networks is outpacing EV sales growth in some markets – much of Western Europe, for instance. However, this is not yet the case across the board – in the United States, EV sales are growing much faster than the DC charging network.

Subdued investor sentiment

Investor caution has led to lower valuations and financial challenges for some companies in the EV arena.

The evolution continues

Participants continue to test new business models and technologies, with a wide range of solutions likely to be appropriate for different use cases.

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