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MARKET RESEARCH

Amping Up Sustainability: A Deep Dive into EV Charging Stations

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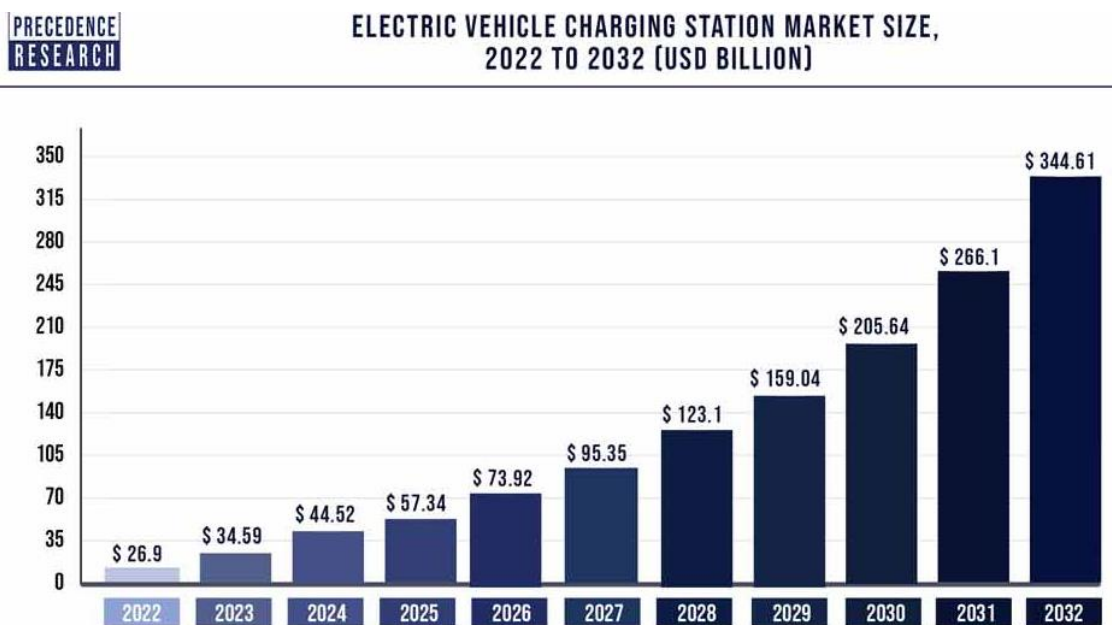
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MARKET OVERVIEW

The Booming Electric Vehicle Charging Station Market

The electric vehicle (EV) charging station market has witnessed a remarkable surge in recent years, driven by the global transition towards cleaner and more sustainable transportation options. In 2022, the market was estimated to be worth approximately USD 26.9 billion, and it is projected to experience substantial growth, reaching around USD 344.61 billion by 2032, with an impressive Compound Annual Growth Rate (CAGR) of 29.1% from 2023 to 2032. This growth trajectory highlights the tremendous opportunities and attractiveness of the EV charging station market.



Factors Driving the Growth:

- EV Adoption Rate:** The growth of EV charging stations is intricately linked to the adoption rate of electric vehicles worldwide. As per statistics, Norway leads the world in the percentage of EVs sold annually out of the total vehicle sales, with 49.1%. Iceland follows with 19.1%, Sweden with 8%, the Netherlands with 6.7%, Finland with 4.7%, and China with 4.4%. This robust adoption rate is a key driver for the demand for charging infrastructure.
- Government Initiatives:** Governments across the globe have recognized the importance of reducing carbon emissions from vehicles. They are actively promoting the adoption of EVs and associated charging infrastructure through various incentives, subsidies, and regulations. These initiatives have played a pivotal role in boosting the market.

3. **Commercial Charging Stations:** Commercial spaces have witnessed a higher penetration of electric vehicle charging equipment compared to residential areas. With the increasing use of electric vehicles, the number of commercial charging stations is expected to rise further. This is essential for enabling long-distance travel and addressing the range anxiety of EV users.
4. **Rise in Carbon Emissions:** Growing concerns about carbon emissions and hazardous pollutants from conventional transportation have accelerated the need for electric vehicles. This, in turn, has led to a surge in demand for EV charging infrastructure in both residential and business settings.
5. **Cooperation Among Manufacturers:** Automobile manufacturers are collaborating to improve charging infrastructure. This collaboration, coupled with the development of subscription models, is contributing to market expansion.
6. **Mobility as a Service (MaaS):** The increasing popularity of Mobility as a Service is expected to fuel market growth. MaaS integrates various forms of transportation services into a single, seamless solution, making EV charging more accessible and convenient for users.
7. **Subscription-Based Models:** Subscription-based charging services have gained traction. Utilities like Vattenfall AB, Duke Energy Corporation, and New York Power Authority have partnered with OEMs to offer subscription-based services to their customers, promoting the use of EVs.

While the market shows immense potential, it faces challenges, primarily associated with costs. Maintenance, installation, and operational costs of EV charging infrastructure can be significant, impacting the market's growth.

Impact of COVID-19:

The COVID-19 pandemic initially disrupted various industries worldwide, including the EV charging station market. Lockdowns and restrictions affected labor availability and project timelines. However, as countries lifted restrictions, the market resumed its growth trajectory, with ongoing projects expected to flourish in the post-pandemic era.

MARKET DYNAMICS OF ELECTRIC VEHICLE CHARGING STATIONS

The electric vehicle (EV) charging station market is experiencing remarkable growth, underpinned by several key drivers, opportunities, but also restrained by challenges.

Drivers:

1. **Growing Adoption of Vehicle-to-Grid (V2G) Technology:** V2G technology is transforming the EV landscape, allowing for bidirectional energy exchange between EVs and the grid. With V2G, EVs can store and discharge unused energy, improving electrical component performance and enhancing the overall value of electric vehicles.
2. **Increasing Emphasis on Sustainability:** Sustainability is a driving force behind the adoption of EV charging stations. Installing these stations not only demonstrates a commitment to sustainability but also aligns with environmental goals. Providing smart EV charging infrastructure with dashboards for energy optimization is a significant component of sustainability efforts.
3. **Development in EV Infrastructure:** Manufacturers are making strides in enhancing EV infrastructure. Cloud-based app connectivity allows users to easily locate nearby charging stations, benefiting both EV users and charging station operators. This development promotes the growth of EV charging infrastructure, making it more profitable and accessible.

Restrains:

1. **Stringent Government Regulations:** Government regulations play a crucial role in the deployment of charging stations. Service providers must navigate a complex web of guidelines and permissions, especially when dealing with private property, local government mandates, and utility company approvals.
2. **Lack of Vehicle-Grid Interoperability:** The effective deployment of EV charging infrastructure requires coordination among stakeholders, including the grid, utilities, and charging manufacturers. The lack of consensus and transparency among these parties has hindered the development of an affordable, reliable, and secure EV charging network, affecting project timelines and profitability.

Opportunities:

1. **Surge in Electric Vehicle Sales:** The global increase in electric vehicle sales is a significant catalyst for the EV charging station market. Leading

electric vehicle markets are investing heavily in charging infrastructure and research and development to meet the growing demand for electric vehicles.

2. **Increasing Demand for Clean Transportation:** Electric vehicles are at the forefront of the clean transportation revolution. As mobility evolves to include autonomous, connected, and shared vehicles, emissions, traffic congestion, and accidents are expected to decrease significantly. This transformation opens doors for various clean transportation options, including electric mopeds, scooters, cycles, and smart EV charging stations.

Challenges:

1. **High Cost of Chargers:** Level 3 fast chargers and ultra-fast chargers come with a substantial initial cost. While fast charging is desired for its shorter charging times, level 1 and level 2 chargers offer slower but more affordable charging. The high cost of rapid chargers remains a challenge for widespread adoption, particularly for businesses and public charging networks.¹

Level of Charging Insights:

Chargers at Level 3 are intended for industrial use. An EV can be charged 16–32 times faster at a level 3 charging station than at a level 2 one. Level 3 charging station capacity is being increased by researchers. In the future, fueling a conventional vehicle will take longer than charging an EV at a level 3 charging station. The third level of charging has the maximum output of all the levels and charges significantly more quickly than the first two. This level, which also offers DC Fast Charging, needs a special cable to handle higher electrical loads. Additionally, they are typically managed by outside businesses, according to NeoCharge.

For instance, Level 3 charging stations are effectively Tesla Superchargers. Like other third-party stations, they provide direct current quick charging. The primary distinction is that these stations only work with automobiles bearing the Tesla brand. Other EVs currently cannot use Superchargers.

Charging Station Type Insights:

DC charging station led the global electric vehicle charging station market with largest revenue share in the year 2022. This is mainly attributed to fast charging capacity and attractive pricing of DC charging stations. The DC charging station directly charges the battery by converting the power before it enters the car's converter. The DC charging station charges the battery directly as it converts

¹ (Electric Vehicle Charging Station Market Size, Industry Report 2023-2032 , kein Datum)

the electricity prior to entering in the cars converter. Additionally, rapid increase in the adoption of technologies, such as Near-field Communication (NFC) and Radio Frequency Identification (RFID), in charging stations installed on highways also flourishes the DC charging market growth.

Many top companies are investing in the development of wireless charging systems for electric vehicles because wireless charging has the potential to grow significantly for the players in the market for electric vehicle charging stations. For instance, the Korean automaker Hyundai introduced the first wirelessly charging EVs with the Genesis GV60. This was swiftly followed by the Chinese automaker FAW, which teamed up with real estate giant Wanda Group to develop 60 autonomous parking garages with, among other features, car charging stations for 60 different types of vehicles. China was the first country to implement wireless charging, and it is anticipated that this trend will spread. Additionally, wireless charging allows autonomous charging and offers electric vehicle drivers a whole new experience. For those who supply vehicle-to-grid (V2G) services, wireless charging opens up new economic opportunities.

Vehicle Type Insights:

Governments all around the globe are encouraging the production of automobiles in response to increasing concerns about the environmental impact of conventional cars. zero-emission cars, or electric vehicles, are becoming more well-liked as a more eco-friendly mode of public transit across the globe. To encourage the use of EVs, numerous national authorities provide financial incentives, such as refunds and tax exemptions, lower parking/toll charges for EVs, free charging, and subsidies. Thus, the battery-electric vehicle industry is rapidly growing. Electric cars require much less maintenance than internal combustion engines since they have fewer moving parts.

Electric cars require less upkeep than regular gasoline or diesel vehicles. As a result, the annual cost of operating an electric car is relatively low. Road tax and registration for electric vehicles are less expensive than those for gasoline or diesel vehicles. These elements are fueling battery-electric vehicle growth on a global scale.

Connector Type Insights:

The AC charging specification created by renowned connection maker Mennekes was highly received by EV users and is widely utilized in Taiwan, Europe, Australia, Southeast Asia, and Australia. The lack of a pin on the object distinguishes Type 2 from other types. Customers can choose SINBON's 20A, 32A, and so on.

Due to the increasing demand for electric vehicles, there is a greater need for charging stations. As a result, new products are being created, and there is a wider variety of EV charger specifications available.

AC charging chargers need to arrive faster. An electric vehicle may be fully charged in roughly 3 minutes at its 22 kW maximum rating. The majority of European electric vehicles use the Type 2 connector, which is what the chargers often have.

Application Insights:

Public type charging stations held major revenue share in the year 2022 as they are more cost-effective to the manufacturers. In addition, they have sufficient parking space and are accessible to all public.

On the other hand, private type charging stations are basically workplace based or residential based station that are only accessible to the owners or limited public. As a result OEMs and different utilities are also focused towards building public charging station. Thus significant benefits offered by public type over private type fuels the market growth.

The future of the EV industry is mainly in public EV charging, which must be reliable and easily available for the EV sector to experience sustainable growth. Public EV charging is any station that enables members of the public to refuel their cars, whether it is used at specialized charging stations (like those found at current gas stations) or at establishments that provide public access, such as stores and apartment buildings. No limits apply to which drivers can use the public charging station.

The advantages of public EV charging are numerous. Tax subsidies and other financial incentives at the federal, state, and local levels support a large portion of the public charging infrastructure. Widespread use also entails public charging. While station utilization increases income, it is net-positive for sustainability. As a result of the higher utilization and revenue, owners may have more opportunities.

Mounting Type Insights:

A dedicated circuit that can handle a heavier load than a typical home circuit connects the wall-mounted box to the electrical grid. A Mobilize power solution is accessible to everyone who wants to charge their car at home or to business owners who want to add electric vehicles to their fleet. Additionally, each owner of an electric vehicle residing in a shared apartment building has the right to have a charging station installed in their parking space in an increasing number of nations, including Spain, France, India, and Japan.

By using this cutting-edge technology, one may, for instance, charge an electric vehicle at night when there is less demand for electricity and then use that electricity to power their homes during the day (V2H) or help balance local or even national energy supply and demand (V2G). A more balanced power supply translates to cheaper costs and more dependable electricity for everyone.

By End User:

A dependable and sophisticated commercial EV charging station is essential for your company or local government because many companies aim to convert their fleets to electric vehicles while also offering EV charging options for clients and tourists. Consider the software and service provider EV Connect for electric vehicle charging. The platform provides possibilities for charging electric vehicles at public, private, academic, and hospitality facilities. The platform develops and maintains the industry's most dependable and flexible cloud-based platform for controlling charging stations and the drivers who utilize them. The service provides charge station agnostic command and manages enterprise, driver communications and support, demand-response capability across several charging networks, energy systems integration via an open API, and more.

Regional Insights:

Asia Pacific dominated the global electric vehicle charging station market in 2022 and is expected to be the most lucrative region during the forecast period. This is majorly attributed to the increasing investments by the government of China, South Korea, Japan, and other Asian countries for installation of charging infrastructures. For instance, in April 2020, China announced its plan to invest USD 1.43 billion in 2020 to maintain its leadership in EV adoption race. Similarly, Singapore, India, Korea, and Japan are also investing in the electric vehicle charging infrastructure to promote its adoption in their region.

Europe and North America witness moderate growth in the global electric vehicle charging station market. This is mainly due to the government's ambition in Europe & North America to curb the carbon emission and increase the adoption rate of electric vehicles. Nearly, 76% of total charging stations in Europe are just concentrated in four countries that are Germany, France, UK, and the Netherlands. In June 2019, Volkswagen Group announced its plan to install 36,000 electric vehicle charging points in various parts of Europe by 2025. Similarly in June 2018, three major states of U.S. that include New York,

New Jersey, and California announced to spend USD 1.3 billion in the deployment of EV charging infrastructure to boost their EV adoption.

The U.S. is dominating the electric vehicle charging station market in the North America region. Electric vehicle use is fast expanding throughout North America. The U.S. is the third-largest market for electric vehicles, according to the International Council on Clean Transportation, with around 320,000 new electric vehicle sales in 2019. According to the International Energy Agency, about 1.8 million electric automobiles were recorded in the U.S. as of 2020, which is more than three times the number registered in 2016. The total number of electric vehicles registered in the U.S. increased from under 300,000 in 2016 to over 1.1 million in 2020. California began establishing charging station networks to help with the broad adoption of electric vehicles. As of 2021, there are more than 42,000 publicly accessible charging stations in the U.S.

For instance, electric car owners in the UK can take advantage of the EVHS (Electric Vehicle Homecharge Scheme) OLEV (Office for Low Emission Vehicles) subsidy, which, starting on April 1, 2020, pays up to USD 384.9 off the price of buying and inaugurating a residence charging point. Government incentives are also available to companies in the UK. The WCS (Workplace Charging Scheme), a voucher-based program created to assist with the up-front costs of purchasing and installing wall chargers, allows you to declare up to USD 10,999.5 for 40 chargers.

Additionally, according to bp pulse, the first charging station for medium- and heavy-duty electric trucks would open in Europe. There are now six public charging stations with ultra-fast 300kw charge ports over a 600km section of the Rhine-Alpine route in Germany. The freight roads, one of the busy roads in Europe, the corridor links the Mediterranean port of Genoa in Italy with the Netherlands and the North Sea ports in Belgium via a 1,300 km long network of motorways.

Additionally, the assistance in France takes the form of a tax credit: up to a deduction of 300 euros, equal to 75% of the cost incurred and detailed on the invoice, including installation charges. This assistance is a component of the ADVENIR project, which aims to install EV charging stations across France.

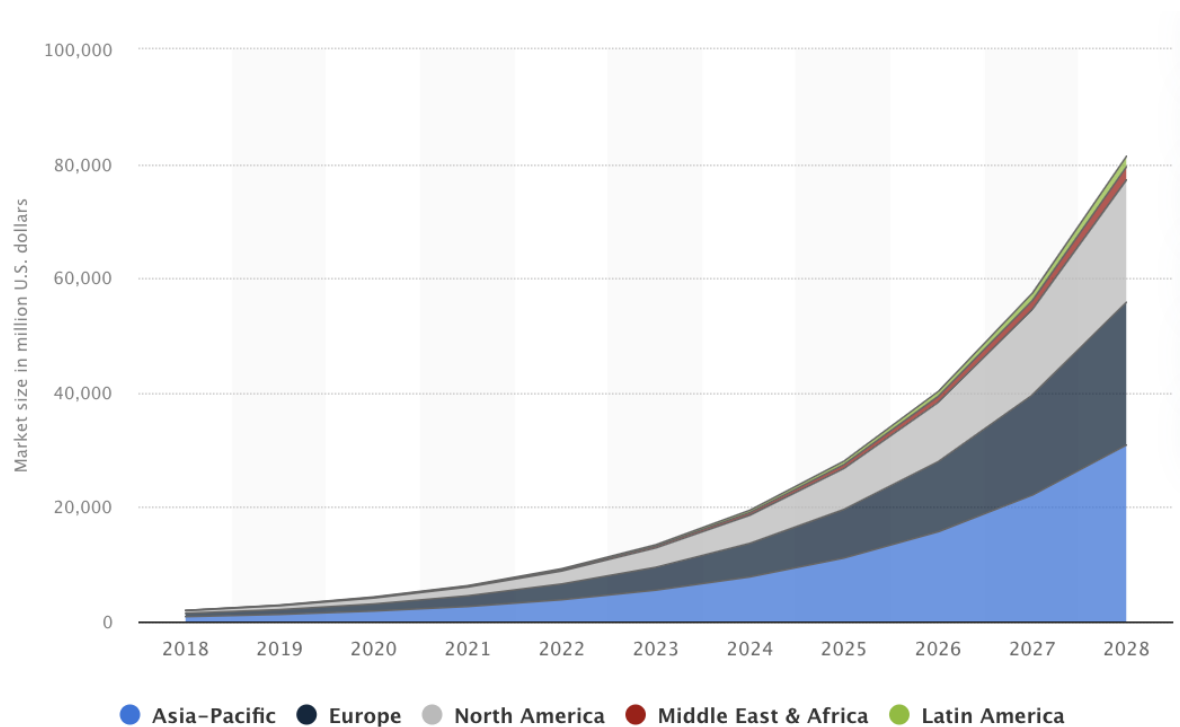
The global EV charging station market is evolving rapidly, driven by technological innovations and government support. Asia Pacific leads the way,

while Europe and North America are catching up. With the growing adoption of electric vehicles and the continuous development of charging infrastructure, the future of sustainable transportation looks promising.²

² (Electric Vehicle Charging Station Market Size, Industry Report 2023-2032 , kein Datum)

MARKET TRENDS

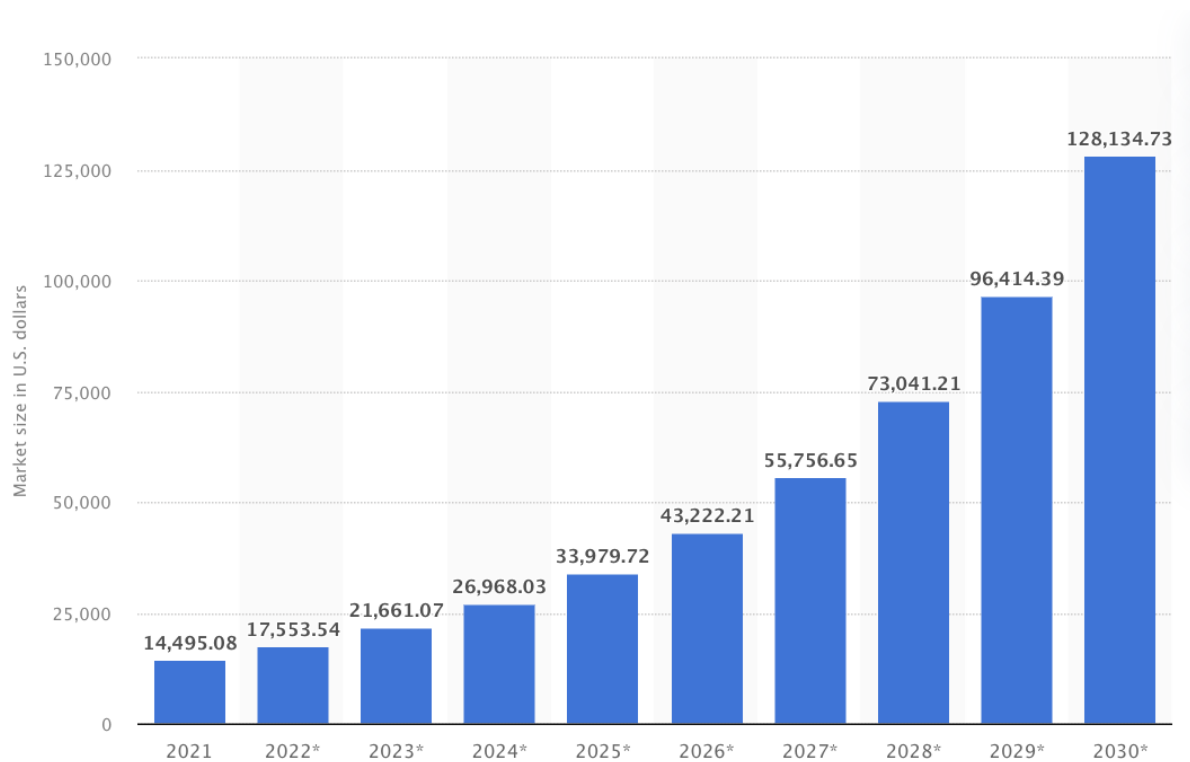
PROJECTED GLOBAL ELECTRIC VEHICLE CHARGING SYSTEM REGIONAL MARKET SIZE 2018-2028



The Asia-Pacific region is the largest market worldwide for electric vehicle charging systems. By 2028, it is projected that the market in this region will reach over 30.8 billion U.S. dollars, growing at a compound annual growth rate of about 42 percent from 2.6 billion U.S. dollars in 2021. The Asia-Pacific market is projected to represent about 38 percent of the global market for charging systems in 2028.³

³ (Projected global electric vehicle charging system regional market size 2018-2028 , kein Datum)

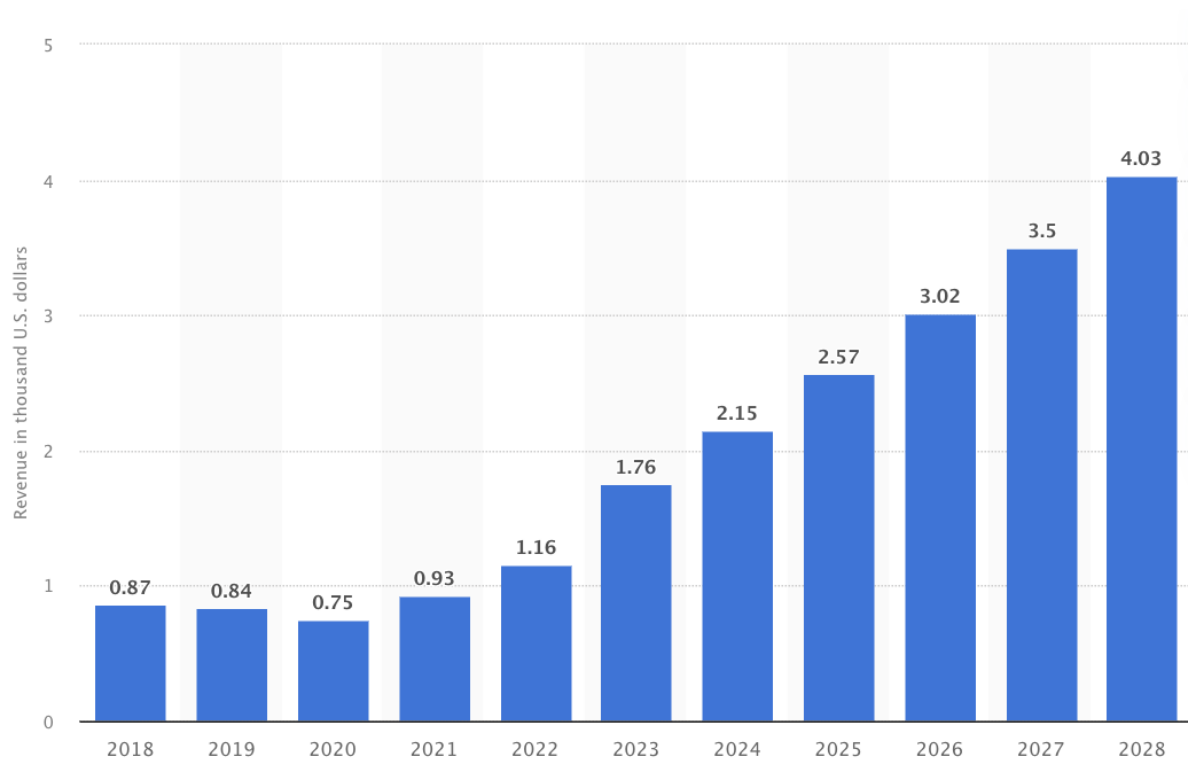
PROJECTED VALUE OF THE ELECTRIC VEHICLE CHARGING MARKET WORLDWIDE 2021-2030



An electric vehicle charging market forecast by Next Move Strategy Consulting projected the market to reach around 128.13 billion U.S. dollars in 2030. EV charging was worth around 14.5 billion U.S. dollars in 2021 and is expected to have a compound annual growth rate of 28.21 percent between 2022 and 2030.⁴

⁴ (Projected value of the electric vehicle charging market worldwide 2021-2030 , kein Datum)

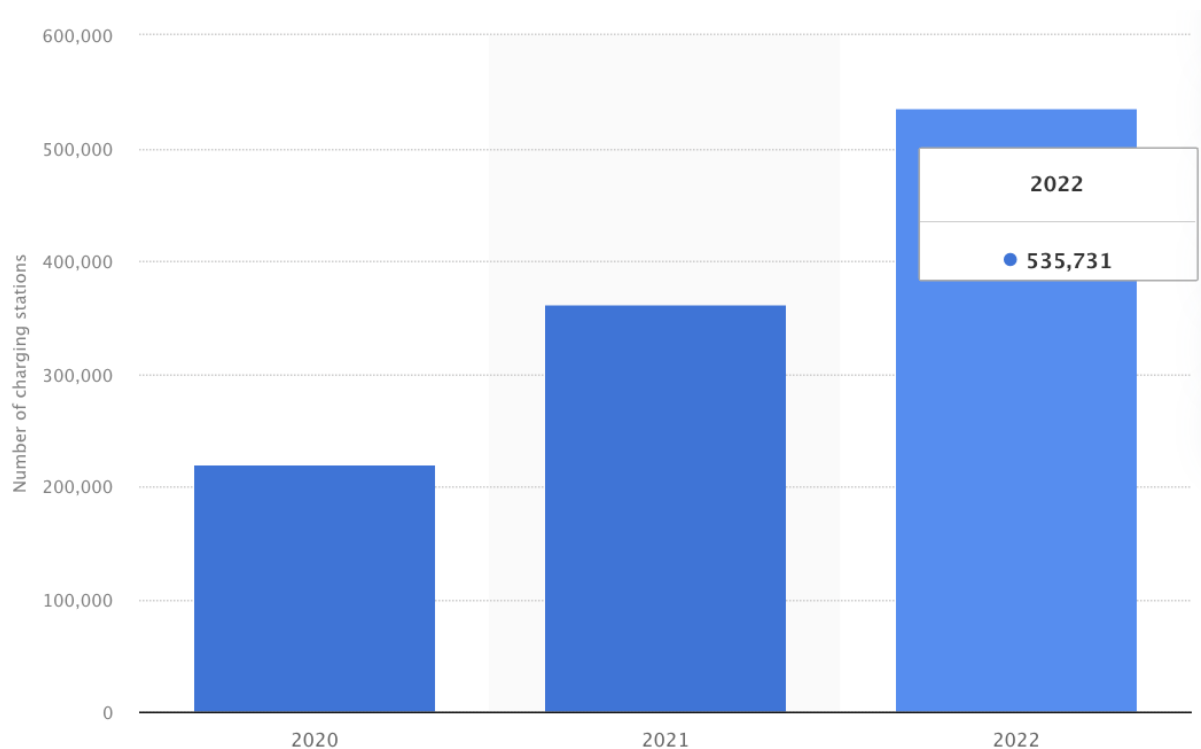
AVERAGE REVENUE PER ELECTRIC VEHICLE CHARGING STATION WORLDWIDE 2018-2028



The global revenue per electrical vehicles charging station was forecast to continuously increase between 2023 and 2028 by in total 2.3 thousand U.S. dollars (+130.68 percent). After the eighth consecutive increasing year, the indicator is estimated to reach 4.03 thousand U.S. dollars and therefore a new peak in 2028.⁵

⁵ (Average revenue per electric vehicle charging station worldwide 2018-2028 , kein Datum)

NUMBER OF ELECTRIC VEHICLE CHARGING STATIONS IN EUROPE 2020-2022



In 2022, there were roughly 535,700 public charging stations for electric vehicles in Europe (including Turkey). This figure includes both alternating current and direct current chargers. Figures grew consecutively between 2020 and 2022.

EV market share

Battery-electric vehicles have a market share of around 13.95 percent across the European Union, while plug-in hybrid electric vehicles hold a somewhat equal share of 8.9 percent. Electric mobility in Europe is expected to continue its growth in the future, with charging stations set to become a staple on European roads.

Charging stations across Europe

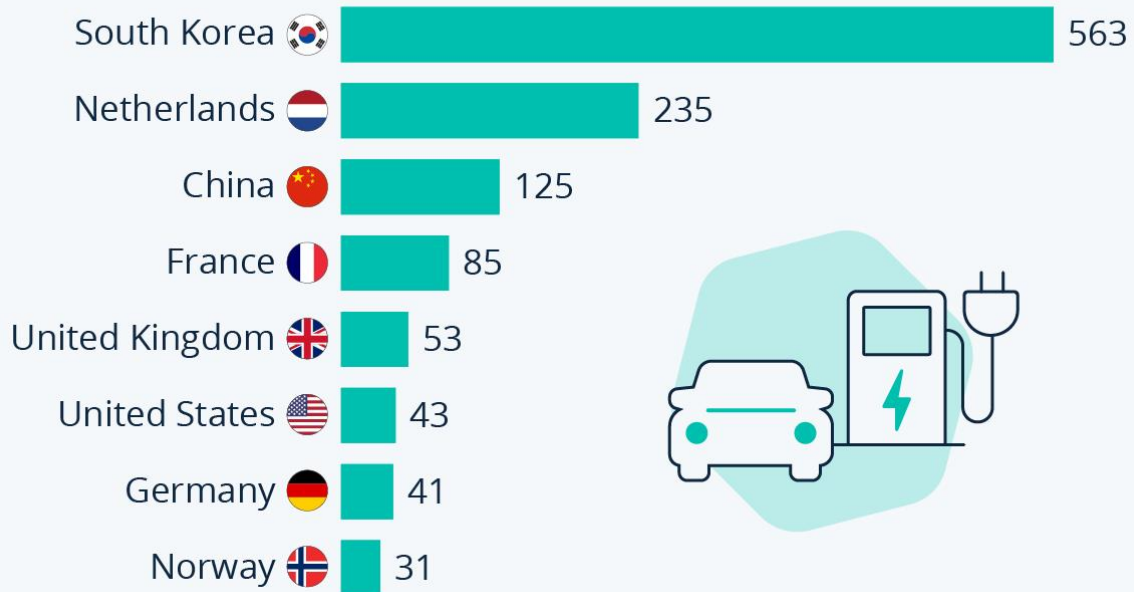
In 2021, Germany was home to over 59,400 public charging stations for electric vehicles. The number of charging stations was highest in Norway. The country is known to have the greatest share of new electric vehicle registrations relative to overall new registrations.⁶

⁶ (Number of electric vehicle charging stations in Europe 2020-2022 , kein Datum)

EV INFRASTRUCTURE: SOUTH KOREA LEADS THE CHARGE

EV Infrastructure: South Korea Leads the Charge

Number of public charging stations per 1,000 plug-in electric passenger cars in 2022*



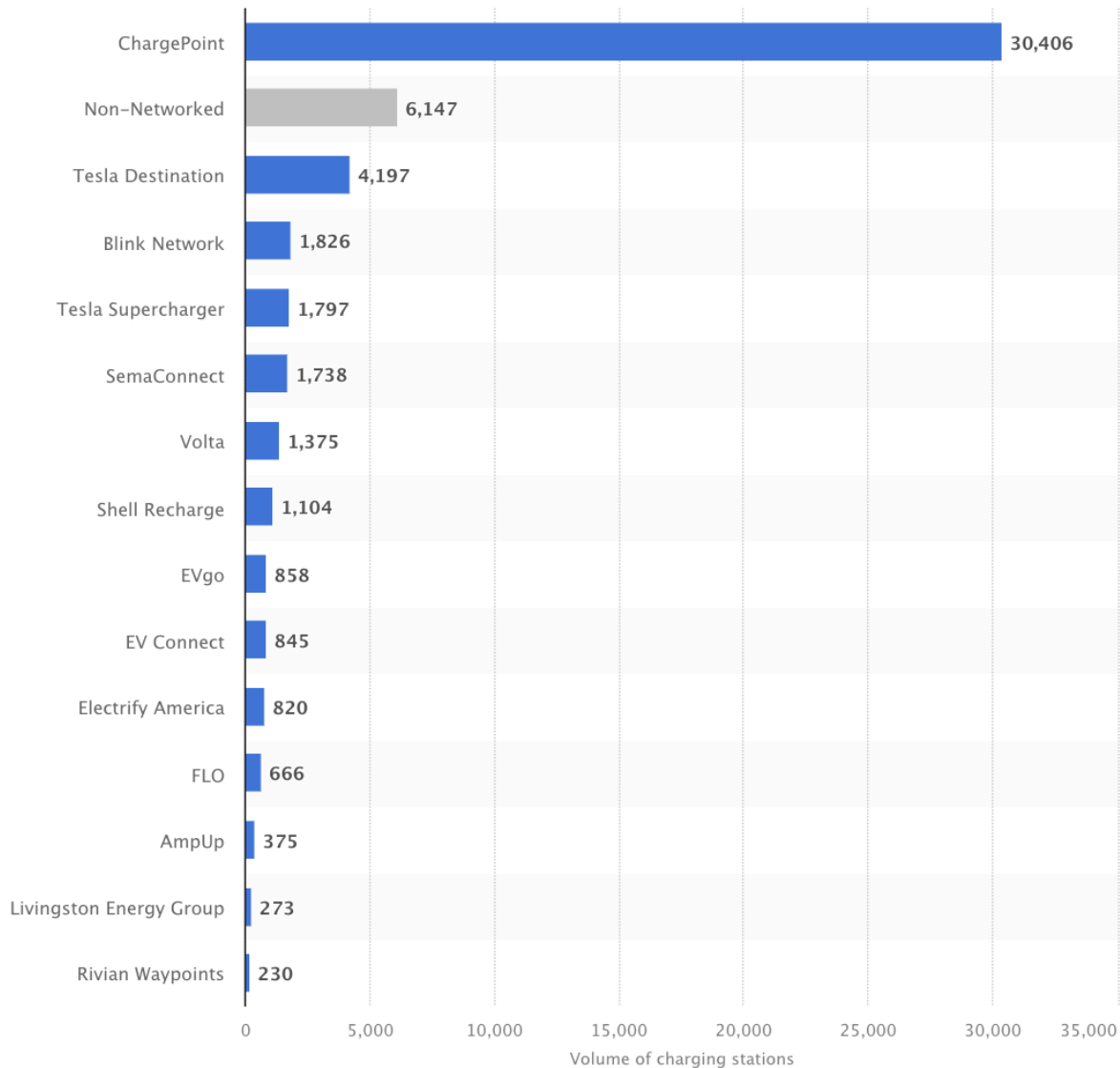
According to the IEA, there were 2.7 million public charging points worldwide at the end of last, more than 900,000 of which were built in 2022. And while most charging needs are still met by home charging, public charging infrastructure is still a key driver of EV adoption, especially in densely populated urban areas, where home charging is much less prevalent.

Having built more than a million additional public charging stations since 2019, China has invested in EV infrastructure like no other country in the past few years. As our chart shows, it's South Korea that leads the charge in terms of public charging stations per 1,000 plug-in electric vehicles. According to the IEA data, South Korea had 201,000 public chargers for 357,000 plug-in electric passenger cars at the end of 2022, amounting to 563 charging stations per electric car – by far the highest density in any of the world's largest EV markets.

With 1.76 million charging points, China accounts for almost two thirds of the world's public charging infrastructure, but, due to its huge electric vehicle fleet, the country only ranks third in terms of chargers per EV on the road. The Netherlands ranks second in that respect, with 235 public chargers per 1,000 electric cars.⁷

⁷ (EV Infrastructure: South Korea Leads the Charge , kein Datum)

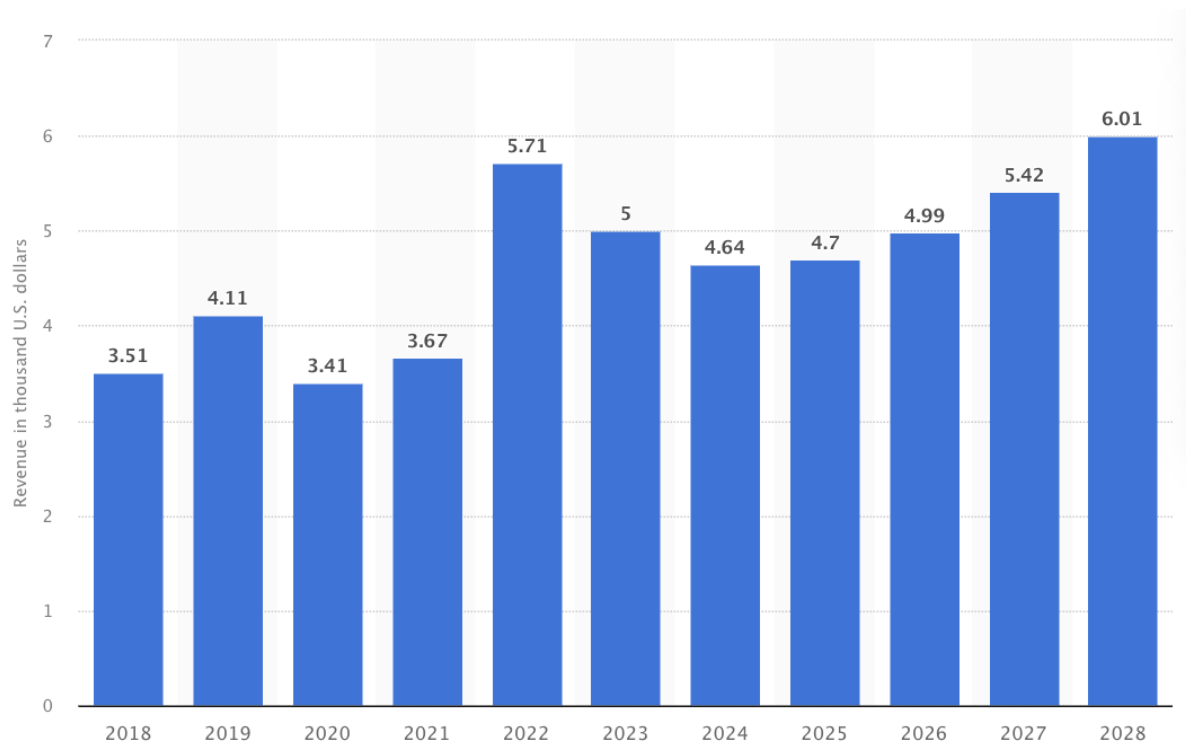
PUBLIC ELECTRIC CHARGING STATIONS BY NETWORK IN THE U.S. 2023



As of June 21, 2023, ChargePoint was the largest provider of public electric charging stations across the United States, recording some 30,400 stations. The provider dwarfed all other networks, with non-networked charging stations coming in second in the ranking, at some 6,200 stations in the country. The U.S. counted some 28,000 publicly available fast electric vehicle chargers in 2020.⁸

⁸ (Public electric charging stations by network in the U.S. 2023 , kein Datum)

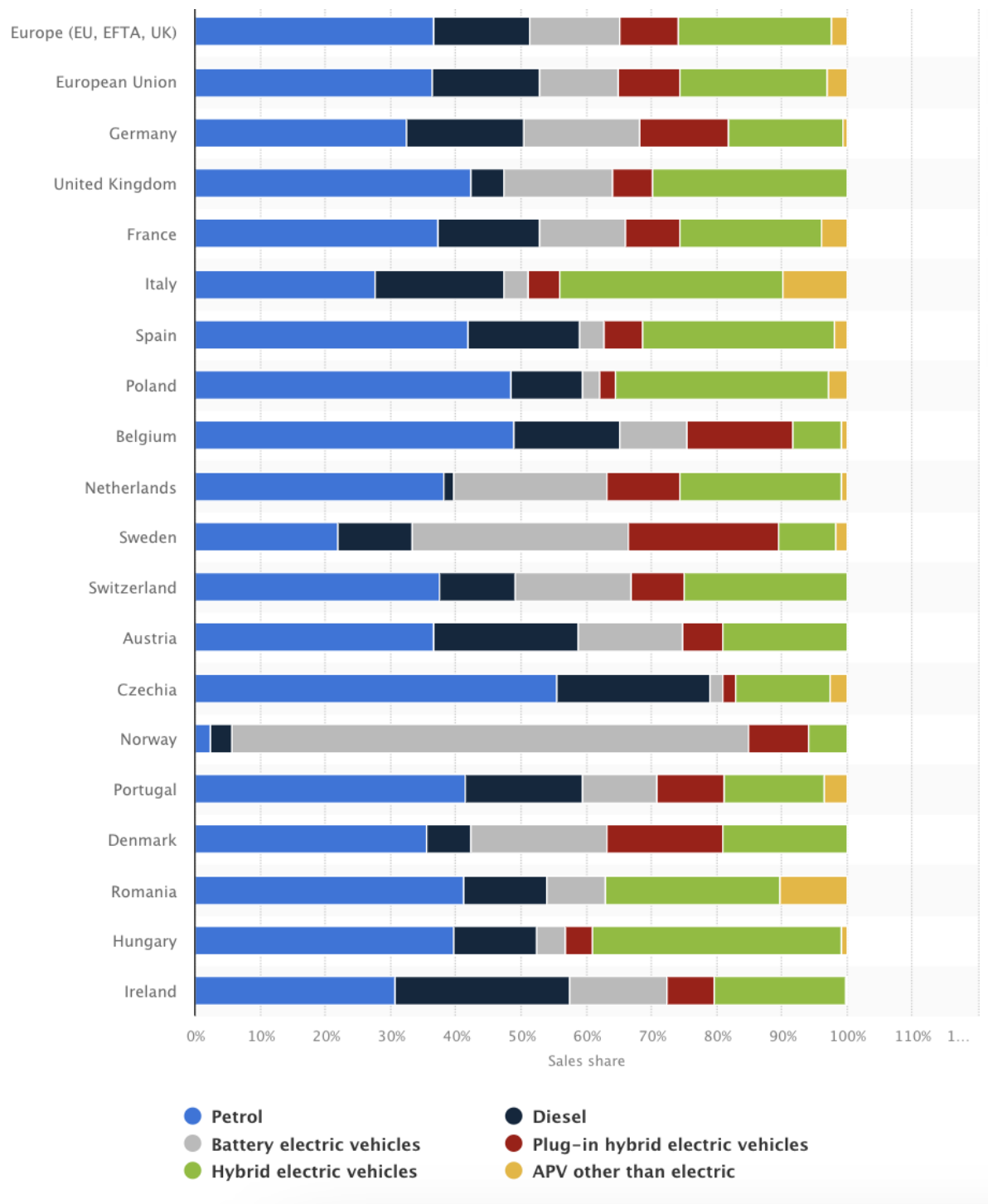
AVERAGE REVENUE PER ELECTRIC VEHICLE CHARGING STATION IN THE U.S. 2018-2028



The revenue per electrical vehicles charging station in the United States was forecast to continuously increase between 2023 and 2028 by in total one thousand U.S. dollars (+20 percent). After the fourth consecutive increasing year, the indicator is estimated to reach 6.01 thousand U.S. dollars and therefore a new peak in 2028.⁹

⁹ (Average revenue per electric vehicle charging station in the U.S. 2018-2028 , kein Datum)

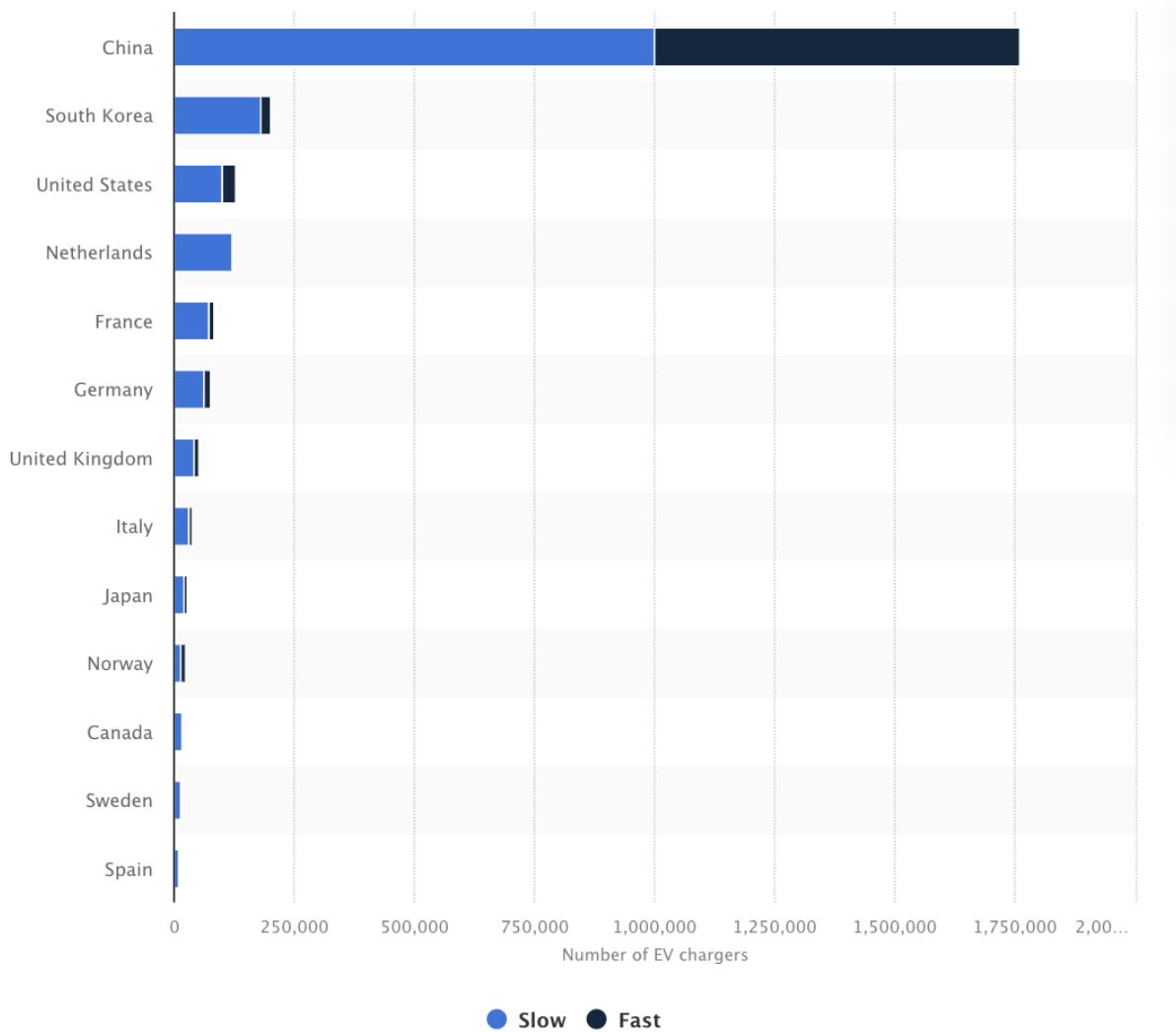
SHARE OF FUEL TYPES OF NEW PASSENGER CARS IN EUROPE BY COUNTRY 2022



Between January and December 2022, Norway had the highest share of battery-electric cars in Europe, with just over 79.3 percent. The country with the largest proportion of diesel-propelled vehicles was Ireland, with over 26.7 percent of sales in the country that year being diesel vehicles.¹⁰

¹⁰ (Share of fuel types of new passenger cars in Europe by country 2022 , kein Datum)

PUBLIC EVSE CHARGERS BY COUNTRY AND TYPE 2022



China had nearly 1.8 million publicly accessible electric vehicle chargers in 2022, accounting the largest public charging infrastructure in the world. The United States ranked third: 100,000 slow chargers, and around 28,000 fast chargers were installed across the nation.

An estimated 14.1 million electric cars were in use across China in 2022, with the country ranking first on the e-mobility index a year earlier. Therefore, it is no surprise to learn that the availability of electric vehicle supply equipment (EVSE) is far greater there than anywhere else worldwide. The country has focused investment on charging infrastructure, particularly fast-charging facilities, which has led to China having the highest number of publicly available fast chargers worldwide. China is also among the countries with the largest land surface area worldwide.

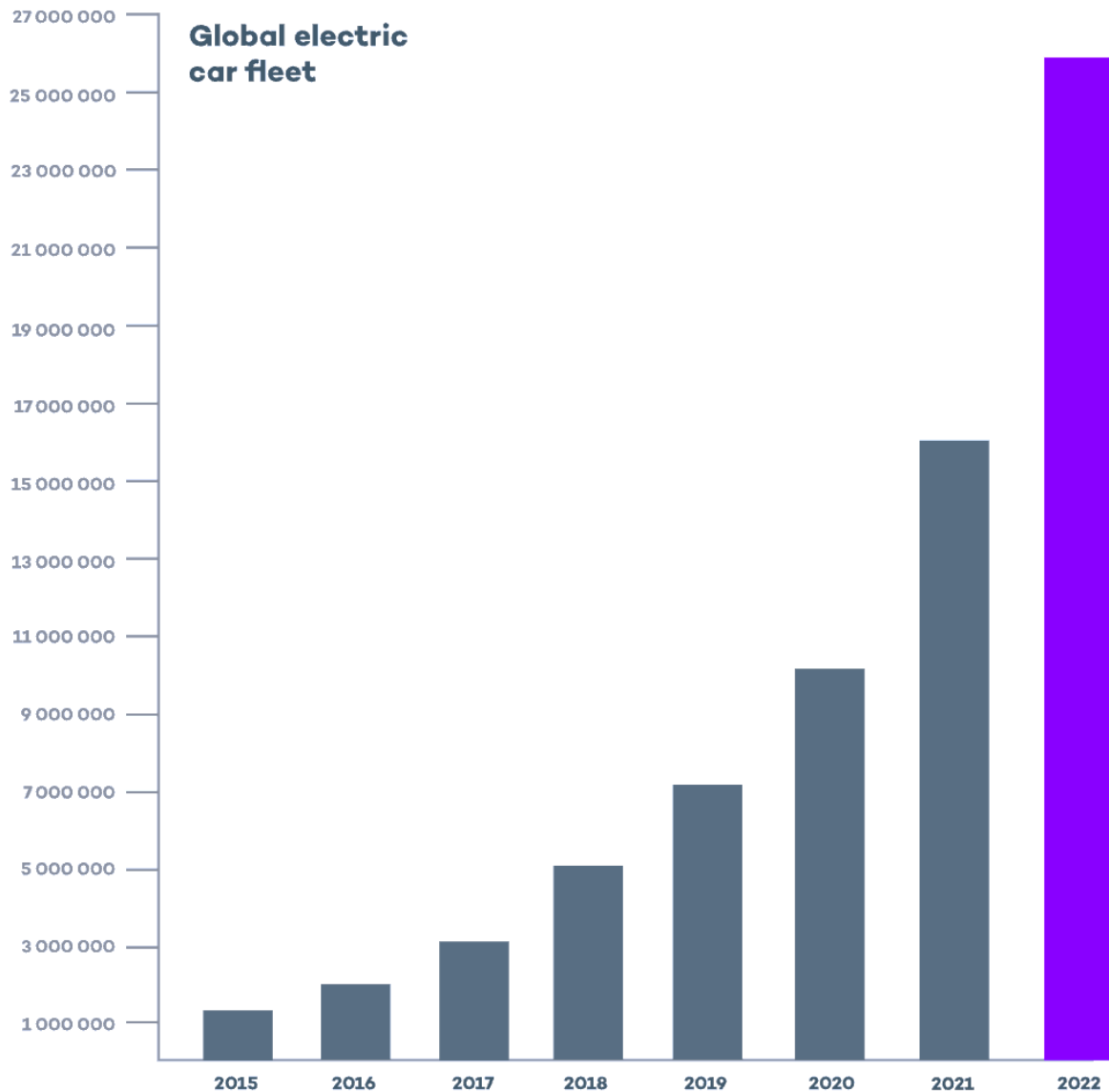
There are three main types of electric vehicle charging: level 1, level 2, and fast charging. Slow chargers come under the level 2 category, providing between four and 22 kilowatts of power; fast charging offers power that is higher than 22 kilowatts. The higher the charger's power, the quicker it takes to charge the battery of an electric vehicle.¹¹

¹¹ (Public EVSE chargers by country and type 2022 , kein Datum)

CUSTOMER ANALYSIS

The Global Electric Car Market: A Revolution in Motion

Electric vehicles (EVs) are at the forefront of the global automotive industry's ambitious objective to achieve zero-emission targets by 2050. The years 2022 and 2023 witnessed remarkable milestones in the EV market, solidifying their significance in the future of transportation.



Global Electric Car Market in 2022:

In 2022, the electric car market showed extraordinary resilience and growth, breaking records that underscore the industry's potential. With over 10 million EVs sold worldwide, the market crossed a significant threshold. What is even more remarkable is that 14% of all new cars sold in 2022 were electric. This marks a substantial leap from the 9% market share in 2021 and less than 5% in

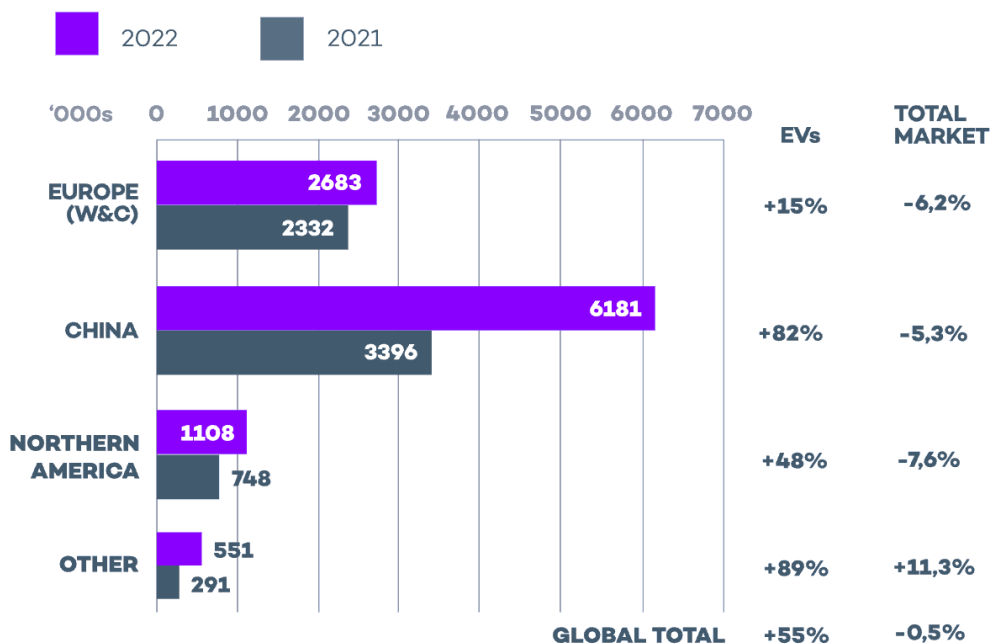
2020. Consequently, the global EV fleet surged to more than 26 million vehicles, representing an impressive 60% increase from the previous year. This surge can be attributed to several factors, including increased awareness of environmental concerns, supportive government policies, and technological advancements that have made EVs more appealing and practical for consumers.

Global Electric Car Market in 2023:

The momentum of the electric car market continued into 2023. In just the first quarter of the year, a staggering 2.3 million EVs were sold globally. This figure marked a 25% increase compared to the same period in 2022, indicating that the growth trajectory remains robust.

Projections suggest that by the end of 2023, global EV sales could reach a remarkable 14 million units, with electric cars potentially capturing 18% of the total global car sales market. This growth is being fueled by a growing awareness of climate change, stricter emission regulations, and a wider variety of EV models available to consumers.

BEV+PHEV Sales and % Growth

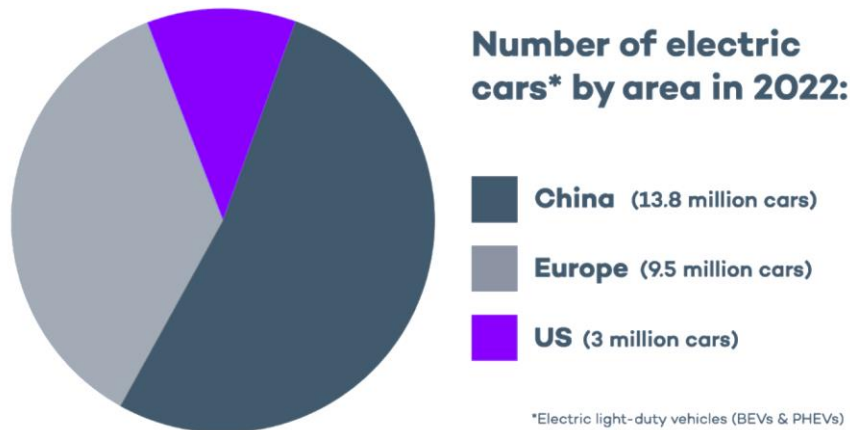


The European Perspective:

Europe, while experiencing a slight downturn in EV sales in 2022 compared to the exceptional growth seen in 2020 and 2021, continued to be a pivotal player in the global electric car market. Despite the dip, electric car sales in Europe

surpassed 2.7 million units in 2022, marking a more than 15% increase compared to the previous year.

Several factors contribute to the steady growth of EV sales in Europe. The continent has implemented stricter rules regarding CO2 emission standards, including a mandate for a 100% reduction in CO2 emissions for new cars and vans by 2035. Furthermore, many European governments have introduced stimulus measures, tax benefits, and subsidies in major markets to incentivize EV adoption.



Notably, countries like Norway, Sweden, the Netherlands, and Germany have maintained their positions as the largest European markets for electric vehicles. According to the 2023 Global EV Outlook by the International Energy Agency (IEA), these nations have demonstrated a strong commitment to reducing emissions and transitioning to electric mobility.

The State of Other Electric Vehicles

While passenger cars often steal the spotlight in the electric vehicle (EV) revolution, it is important to recognize that various forms of transportation are also transitioning towards greener alternatives. From light commercial vehicles (LCVs) to heavy-duty trucks, buses, and two-wheelers, the entire transportation industry is making strides towards electrification.

Light Commercial Vehicles (LCVs):

In 2022, a significant milestone was achieved as the sales share of electric LCVs surpassed that of passenger EVs for the first time. Electric LCVs experienced remarkable growth, with sales increasing by over 90% even as the overall LCV market declined. Globally, there were approximately 310,000 electric LCVs on the roads in 2022.

The electric LCV market is expected to accelerate further in the coming years as more models become available, and commercial customers recognize the cost benefits of electric LCVs.

Heavy-Duty Trucks:

In 2022, the sales of medium- and heavy-duty trucks reached almost 60,000 units worldwide. Many truck manufacturers are actively working towards an all-electric future, leading to an expansion in the number of commercially available zero-emission truck models. The market now boasts over 840 models from more than 100 OEMs.

The electrification of heavy-duty trucks is critical for achieving a zero-emission future, as these vehicles, while constituting only 10% of all internal combustion engine (ICE) vehicles, are responsible for a substantial 70% of ICE CO₂ emissions. Recognizing this, several governments have pledged to achieve 100% zero-emission truck sales by 2040, and both the US and the EU proposed higher emission standards for heavy-duty vehicles in 2022.

Buses:

Electric buses have gained popularity since 2020, and in 2022, nearly 66,000 electric buses were sold globally. China played a dominant role in this market, accounting for over 80% of global electric bus sales. China's expertise in manufacturing electric buses has made it a major exporter to Latin American, North American, and European countries.

In the European Union, the Clean Vehicles Directive has set targets for the public procurement of electric buses, driving increased adoption in countries like France, Germany, and Spain. In 2022, Finland boasted the highest sales share of electric buses in Europe, with electric buses accounting for more than 65% of total bus sales.

Two and Three-Wheelers:

Historically, China has been a dominant force in the electric two-wheeler market, a trend that continued in 2022 despite a drop in sales from over 10 million in 2021 to less than 7.7 million in 2022. This decrease can be attributed to supply chain challenges resulting from the COVID-19 pandemic.

In terms of electric three-wheelers, India led the race with 425,000 units sold in 2022, while China closely followed with almost 350,000 three-wheelers sold in the same year. These two countries collectively accounted for nearly 99% of global sales in this category.

The State of EV Charging

As electric vehicles become more commonplace on the roads, the development of EV charging infrastructure becomes increasingly vital to support the widespread adoption of EVs.

Global EV Charging Points:

In 2022, there were a total of 2.7 million public charging points for electric vehicles worldwide. This marked a substantial growth of 55% compared to 2021, with 900,000 new charging points installed during the year.

China was a leader in both slow AC charging and fast DC charging, with the installation of 360,000 slow and nearly 297,000 fast charging points in 2022.

EV Charging in Europe:

In Europe, there were over 450,000 publicly available EV chargers in 2022. Projections estimate that by 2025, there will be approximately 1.3 million publicly accessible charging stations, with the number expected to grow to 2.9 million by 2030.

Countries such as the Netherlands, France, and Germany have been leaders in deploying EV charging infrastructure, with Spain's public charging infrastructure witnessing remarkable growth in 2022, increasing by 223% compared to the previous year.

EV Charging Trends:

- Fast chargers are gaining prominence as they make longer journeys more convenient and help alleviate range anxiety. In Europe, the number of fast chargers increased by more than 55% in 2022, reaching almost 70,000 units.
- The Alternative Fuels Infrastructure Regulation (AFIR), revised in 2023, sets requirements for EV charging coverage across Europe. It aims to ensure a fast-charging station is available every 60 kilometers along the main European routes by 2025.
- Smart charging of electric vehicles, which involves cloud-connected charging devices, is on the rise. This technology offers greater convenience and control over electricity consumption for both businesses and consumers.
- Vehicle-to-grid (V2G) technology is also gaining traction, allowing electricity stored in EV batteries to be transferred back to the grid. The V2G market is expected to grow significantly, reaching over €4.5 billion by 2024.

The electrification of various forms of transportation beyond passenger cars reflects the broader transformation of the transportation industry towards sustainability. Electric LCVs, trucks, buses, two-wheelers, and three-wheelers are all contributing to a cleaner and greener future. Additionally, the expansion of EV charging infrastructure, both globally and in Europe, is a crucial enabler for the continued growth of electric mobility. As technology evolves and regulations become more stringent, the electric vehicle market is poised for further expansion and innovation in the years to come.¹²

POLICY DEVELOPMENTS

Global Trends

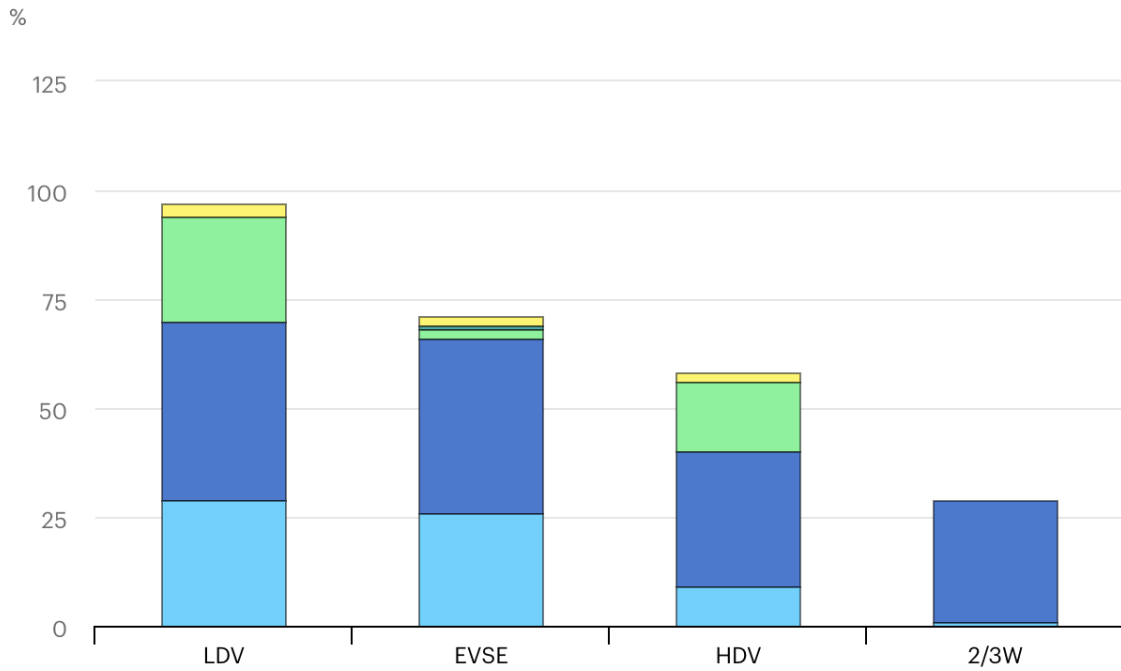
Governments worldwide are actively implementing policies to support the deployment of electric vehicle (EV) charging stations, recognizing the importance of this infrastructure for the broader adoption of EVs.

Globally, over 20 countries have announced plans to phase out the sale of internal combustion engine (ICE) vehicles within the next 10 to 30 years. This includes emerging economies such as Cabo Verde, Costa Rica, and Sri Lanka. Furthermore, more than 120 countries have committed to economy-wide net-zero emissions pledges. These pledges are important as they drive the policy focus towards electrifying not just passenger cars but also commercial vehicles like trucks and buses, which contribute significantly to CO2 emissions. California, for instance, has proposed a Zero Emission Vehicle (ZEV) sales requirement for heavy-duty trucks starting from 2024, while the Netherlands and other countries are advancing in zero-emission commercial vehicle zones.

¹² (THE GLOBAL ELECTRIC VEHICLE MARKET OVERVIEW IN 2023: STATISTICS & FORECASTS , kein Datum)

Share of global market with policy coverage, 2022

Open 



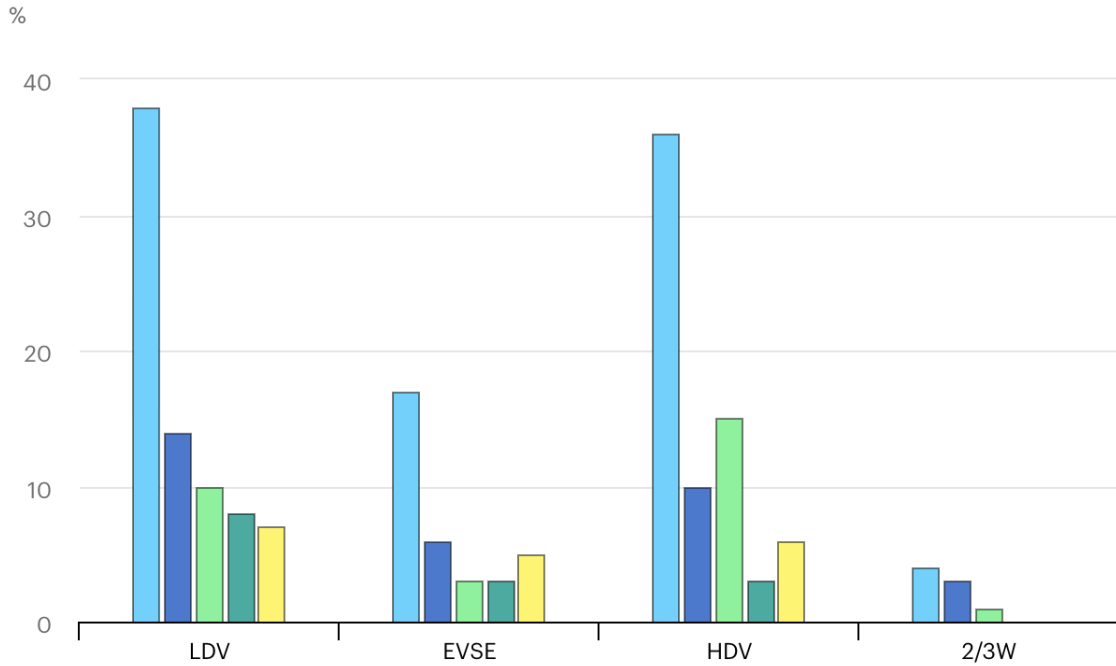
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● Europe ● Asia ● Americas ● Africa ● RoW

In terms of specific policies, zero-emission vehicle targets are key for transport decarbonization. About half of annual global sales of light-duty vehicles (LDVs) are covered by targets for 2035 or earlier. China, the European Union, and the United States are major contributors to these targets, with other markets also showing increasing ambition.

Share of global electric car markets by selected carmakers, 2022

Open 

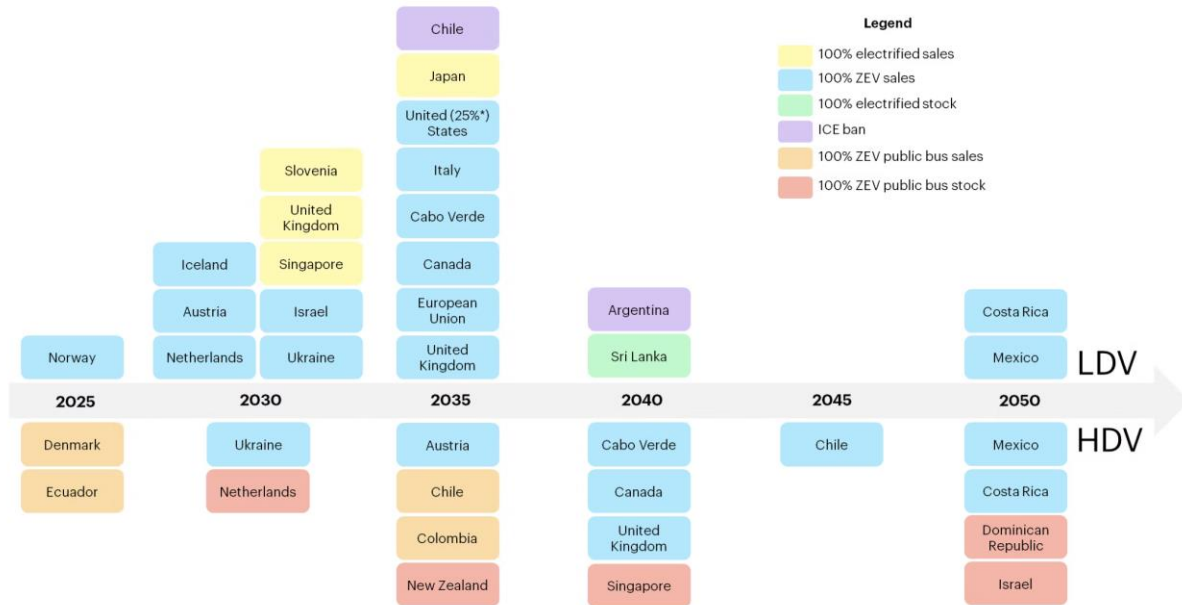


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● Europe ● Asia ● Americas ● Africa ● RoW

The deployment of public charging infrastructure is essential for wider EV uptake. Countries like Norway, which has a high ratio of battery electric vehicles (BEVs) per public charging point, demonstrate the importance of developing sufficient charging infrastructure to support EV adoption. The ratio of EVs per charger varies by country, influenced by factors like the availability of home charging and the type of EVs (battery electric or plug-in hybrid electric vehicles). The European Union, for example, is focusing on increasing total public charging power capacity in line with the growth of its EV fleet.

In Europe, the widespread adoption of EVs is seen as a key element in achieving decarbonization goals. However, ensuring that the electricity used to charge these vehicles comes from renewable sources is critical to prevent an increase in carbon emissions. Equitable access to charging infrastructure is also a significant concern, especially for those without access to private charging points.



The EV Energy project has identified several barriers to EV adoption, including the range and cost of EVs, public perception, and discrepancies in charging infrastructure across Europe. Recommendations for improving charging infrastructure include increasing public charging stations, developing smart charging systems like Vehicle2Grid (V2G), and integrating e-mobility into urban planning.

In the United States, both federal and local governments support EV charging through financial incentives and policies. The federal government offers tax credits for EVs and has set a target for half of all new car sales to be EVs, plug-in hybrids, or hydrogen-fuel cell vehicles by 2030. State and local governments also play vital roles in developing charging infrastructure, offering incentives such as rebates, tax credits, and grants.

Canada is aiming to ban the sale of new fossil-fuel vehicles by 2035 and offers incentives for purchasing EVs and charging equipment. The Zero Emission Vehicle Infrastructure Program is a significant initiative to increase the availability of charging and hydrogen refueling stations.

These examples illustrate the varied and complex landscape of EV charging infrastructure policies and initiatives worldwide, reflecting the growing global commitment to sustainable transportation and the reduction of carbon emissions.

Regional Highlights

European Union

- The EU is driving ambitious targets, with a goal of one million public EV charging points by 2024 and three million by 2029. This is in line with its overall ambition to become climate-neutral by 2050 and to have at least 30 million EVs on roads by the end of the decade. Germany plans to install one million public charging stations by 2030, significantly up from the current number.

United States

- The U.S. aims for half of all cars and light-duty trucks sold to be EVs, plug-in hybrids, or hydrogen-fuel cell vehicles by 2030. The Build Back Better Act proposes a \$12,500 tax credit for EV owners, enhancing incentives from the current legislation.

Canada

- Canada has committed to banning the sale of new fossil-fuel burning vehicles by 2035. It also offers incentives for purchasing EVs and EV equipment and has a 5-year, \$280 million Zero Emission Vehicle Infrastructure Program to increase the availability of charging and refueling stations.

United Kingdom

- The UK has set a target to end the sale of new fossil fuel cars by 2030, the first G7 country to do so. It has also pledged £1.8 billion to encourage EV sales and develop more EV charging stations, along with offering grants for EV purchases.

Mexico

- Mexico's electrification policies are still developing, with aims to cut emissions in half by 2050 from 2000 levels and to have 35% renewable energy by 2024.

Strategy and Challenges

- An efficient rollout of public charging infrastructure is crucial for EV adoption. Countries like Norway and the Netherlands have managed to keep fewer than ten EVs per charger. The European Union is also focusing on the total public charging power capacity per EV to support the growing EV market.
- Governments are encouraged to create national master plans for EV charging infrastructure, considering aspects like network size, optimal locations, affordability, accessibility, and construction timing. Germany has implemented a centralized toolkit for coordinating charging requirements down to the individual street level.

There's a clear global trend towards supporting EV charging infrastructure, with various countries adopting unique approaches tailored to their specific needs and goals. These policies are not only aimed at increasing the number of charging stations but also at ensuring their effective distribution and accessibility.¹³¹⁴¹⁵

EV CHARGING STATION MANUFACTURERS

CHARGEPOINT

ChargePoint, a leading provider of solutions for charging electric vehicles (EVs), has been actively working on enhancing its charging station infrastructure and services.

- 1. Uptime Improvement Efforts:** ChargePoint is striving to achieve nearly 100% uptime for its EV chargers. This initiative involves the application of technology from networking and information security fields, including predictive analytics, 24/7 proactive monitoring, and machine learning models. This will enable ChargePoint to rapidly detect and respond to station downtime, improving charger uptime and ensuring faster incident response. Currently, ChargePoint reports an uptime of 96% across its public network in North America and Europe, and over 98% for ChargePoint Assure customers.
- 2. Training and Certification Programs:** ChargePoint is developing a comprehensive training and certification program for electrical contractors who work with EV charging infrastructure. This program aims to reduce reliability issues by ensuring proper installation of charging stations from the outset and effective repairs when necessary. ChargePoint's training and certification programs are expected to be the most comprehensive in the EV charging industry and are slated to go live in early 2024.
- 3. Integration of NACS Connector Options:** ChargePoint has announced the availability of North American Charging Standard (NACS) connector options for new orders and for currently installed CP6000, Express 250, and Express Plus customers. This addition enables customers to serve the charging needs of any EV in any parking space. ChargePoint's DC line

¹³ (Policy developments , kein Datum)

¹⁴ (EV Policy: Laws and Incentives Around the World , kein Datum)

¹⁵ (Trends in charging infrastructure , kein Datum)

of products, along with its home-based AC line of products, will be sold or reconfigured with NACS connector options. The ChargePoint mobile app includes filters for NACS, J1772, CCS, and CHAdeMO connectors, helping EV drivers easily locate and access the appropriate charging solution for their vehicle.

4. **Continued Investment in R&D:** ChargePoint's new reliability initiatives build on the company's significant investments in research and development. In its fiscal year 2023, ChargePoint invested over \$194 million in R&D, underscoring its commitment to innovation in the EV charging sector.

These efforts by ChargePoint are part of its broader mission to create a new fueling network to move people and goods on electricity, simplifying the transition to electric mobility for businesses and drivers alike. ChargePoint's network is one of the largest EV charging networks, and it offers a comprehensive portfolio of charging solutions designed for various scenarios, from home and multifamily to workplace, parking, hospitality, retail, and transport fleets of all types.

ChargePoint's focus on improving the charging experience, enhancing reliability, and offering flexible solutions reflects its commitment to supporting the growing demand for EV infrastructure and the shift towards sustainable transportation solutions.

SIEMENS

Siemens, a global technology leader, has been actively involved in the expansion and improvement of EV charging infrastructure. Here are some key aspects of their initiatives and plans:

1. **Fast Charging and Network Expansion:** Siemens charging stations offer fast charging capabilities, significantly reducing the time required to charge an EV compared to a standard household outlet. To further enhance accessibility, Siemens has partnered with ChargePoint to create a network of charging stations that are accessible with a single account. This collaboration simplifies the process of locating and using charging stations.
2. **Mobile Accessibility and Flexibility:** The charging stations developed by Siemens can be operated through a mobile app, allowing users to find and pay for charging on the go. These stations provide the flexibility to

be used both at home and in public spaces, offering convenience to EV owners.

- 3. Sustainability and Smart Technology:** Siemens charging stations are designed with sustainability in mind, using clean energy from renewable sources like wind and solar power. Moreover, these stations are equipped with smart technology, enabling remote monitoring and management, thus ensuring efficient operation.
- 4. International Expansion:** Siemens has expanded its presence in the EV charging market internationally. For instance, in Mexico, Siemens has partnered with the clean technology company VEMO to install 160kW charging stations along central highways. Their goal is to reach 500 charging points by the end of 2024. This expansion is in response to the growing EV market and aims to alleviate 'range anxiety' among EV drivers.
- 5. Manufacturing Expansion in the U.S.:** Siemens opened a new assembly plant in Carrollton, Texas, to produce EV chargers, marking it as their second EV charger manufacturing hub in the U.S. This facility aims to produce 1 million EV chargers for the U.S. market, supporting the creation of 100 new jobs. The chargers manufactured here, named VersiCharge Blue, range from 48 to 80 amps and are designed for various installations, including commercial and public spaces.

These initiatives by Siemens demonstrate their commitment to supporting the transition to electric vehicles through reliable, accessible, and sustainable charging solutions. They are playing a significant role in shaping the future of electric transportation by providing the necessary infrastructure and technology.

EVGO

EVgo, one of the nation's largest public fast charging networks for electric vehicles (EVs), is implementing several innovative strategies to enhance its charging station infrastructure and services:

- 1. Prefabricated Charging Infrastructure Deployment:** EVgo is adopting a prefabrication approach to new station installations, which is anticipated to cut the average station installation time in half. This method includes assembling all charging equipment, like dispensers and power cabinets, on a single base frame before being shipped to the charging site. This

approach aims to ensure consistent, high-quality assembly in a controlled environment, which can further accelerate deployment timelines. Prefabricated skids are also future-proofed to accommodate features like lighting, security cameras, and canopies.

2. **Customer Experience Enhancements:** Along with time and cost efficiency in installation, EVgo is focusing on elevating the EV driver customer experience. Features such as Wi-Fi infrastructure for improved cellular connectivity and synthetic turf covering on skid frames to cushion and protect connectors are being implemented. These additions aim to enhance the resiliency and user experience at the charging stations.
3. **Partnership for a Nationwide Network:** In collaboration with General Motors and Pilot Travel Centers, EVgo is working on a nationwide EV fast charging network. The network aims to include at least 25 locations with 100 charging stalls by the end of 2023, expanding to around 200 locations by the end of 2024. These stations feature high-power 350kW chargers and offer amenities like restrooms, food, and free Wi-Fi, aiming to boost range confidence for EV travelers.
4. **Focus on Accessibility and Reliability:** EVgo's commitment to delivering a convenient, reliable, and customer-centric charging experience is evident in these initiatives. The partnership with GM and Pilot Company is strategically designed to connect urban and rural communities and focus on highly traveled corridors, making EV charging more accessible and reliable.

EVgo's initiatives reflect its dedication to accelerating the transition to electric mobility by building a robust and efficient charging infrastructure. These efforts are pivotal in supporting the growing demand for EV charging and enhancing the overall charging experience for EV drivers.

THANK YOU!

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