

Transforming transportation

Policies to electrify European roads



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- European transportation is the only sector where carbon emissions have actually risen over the past three decades¹. Electrifying road transportation has therefore become an urgent priority
- Relative to other parts of the world, Europe has established itself as an important hub of electric vehicle (EV) production and expanding charging point infrastructure, but this progress is in jeopardy
- Securing safe and diversified commodity supply chains is required. The growth in European EV production will necessitate an estimated 18 times more lithium and five times more cobalt by 2030². Europe also needs to build its lithium-ion battery productive capacity
- The installation rate of EV charging point infrastructure needs to increase nine-fold by 2030. Failing to invest will put at risk the target of increasing EV passenger car numbers over tenfold to 42.8 million by the end of the decade³
- To support the growing numbers of EV requires investment in renewable energy production capacity and power grids
- The European EV market has become an attractive destination for new entrants particularly from Asia who are taking market share from EU auto makers. U.S. players are making strong in-roads into rolling out EV charging point infrastructure
- The lack of venture capital may also be a factor stifling innovation in the sector. Where home grown technologies are being developed, the lack of local funding risks these technologies being exported to more dominant market players in Asia or the U.S.
- Initiatives to crowd-in private sector capital are therefore urgently required. While capital flows into charging infrastructure have begun to ramp up, they are not nearly large or widespread enough to meet required roll-out levels
- Infrastructure investors are likely frontrunners to finance the charging infrastructure network, but most investment opportunities do not provide suitable risk/return profiles for the asset class. Subsidy support should not only address installation, but also operation, given the EV market has yet to fully develop

¹ WEF (September 2022). The European Union has cut greenhouse gas emissions in every sector – except this one

² European Parliament (April 2022). New EU regulatory framework for batteries: Setting sustainability requirements

³ ACEA (March 2022). European EV charging infrastructure masterplan

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1 / Introduction

Following our December 2022 report⁴, a framework for European transformation, this paper is the first in a series of reports exploring the transformational journey required across the European transport, energy and building sectors and the actions required to mobilise the necessary capital to finance this transition.

As outlined at the end of last year, a transformation of the European economy is urgently required given a more hostile geopolitical environment, in recognition that past growth drivers are now moving in reverse and to meet the continent's ambitious climate and environmental goals.

In this paper, we begin with an examination of the European transportation sector where decarbonisation has largely been absent to date⁵. Section two assesses the European transportation sector and the growth in electric vehicles (EV) and charging point infrastructure across the continent. The third section examines the risks and opportunities facing the sector, which include the need to build safe and diversified supply chains and supporting the domestic industrial base to build the necessary infrastructure where possible and desirable.

Policymakers will also need to keep a watchful eye on foreign entrants who are moving aggressively into the sector and, ideally, coordinate appropriate responses with geopolitical allies, notably the United States to mitigate longer-term economic and security risks. We conclude by proposing certain financing models that might help to crowd-in private sector investment.

We will show that there is no room for complacency. This is not so much because Europe necessarily urgently needs to hold on to its status as the world's second largest producer of passenger cars. In itself, surrendering this edge to foreign competitors most notably in the United States or friendly Asian allies would not necessarily be detrimental to European prosperity. Rather, our argument, is that Europe already has plenty of strength to build on and appropriate policy actions could accelerate the electrification of transport infrastructure globally, if Europe serves as an example. Urgent action is also required to meet the European Union emission reduction targets which includes cutting new passenger vehicle emissions by 55% by 2030 and for all new cars sold to be emissions free by 2035⁶.

⁴ DWS Research Institute (December 2022). A framework for European transformation <https://www.dws.com/en-gb/insights/global-research-institute/a-framework-for-european-transformation/>

⁵ WEF (September 2022). The European Union has cut greenhouse gas emissions in every sector – except this one

⁶ European Commission (28 October 2022). Zero emission vehicles: first "Fit for 55" deal will end the sale of new CO2 emitting cars in Europe by 2035

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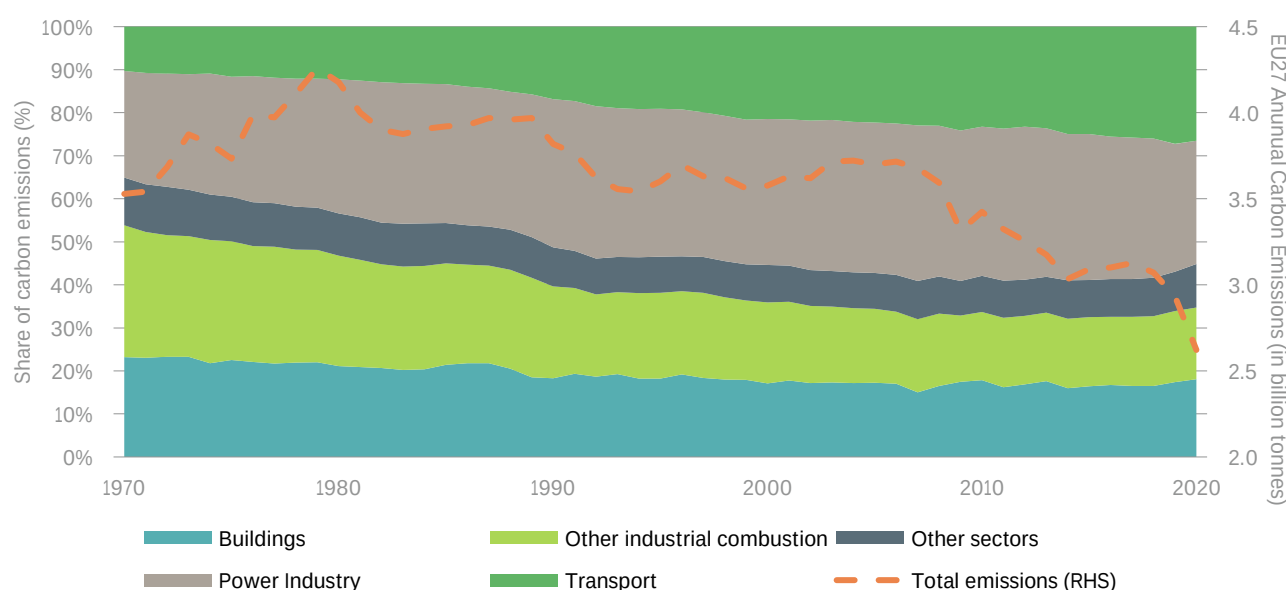
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2 / Market Landscape

2.1 Decarbonising road transport

The European transport sector accounts for 26% of the continent's CO₂ emissions compared to 10% at the beginning of the 1970s⁷, [Figure 1](#). It is also a major source of pollution such that 96% of Europe's urban population are exposed to fine particulate matter above the guidelines set by the World Health Organization⁸. While the major sectors of the European economy have seen emissions decline over the past 30 years, transportation stands out as an outlier, with emissions up 7% compared to 1990 levels⁹. To address this, one of the goals of the European Commission's Green Deal¹⁰ is to achieve a 55% reduction in transport-related greenhouse gas emissions by 2030, and a 90% decline by 2050 (compared to 1990 levels). Within the transportation sector, road transport represents 77% of the sector's overall emissions¹¹ in 2020 and it is this segment of the transportation sector that is the primary focus on this research paper.

Figure 1: Evolution of carbon emissions in the European Union by key sectors



Source: European Environment Agency (May 2022). Annual European Union greenhouse gas inventory 1990-2020 and inventory report 2022, Eurostat

The transport and specifically the automotive sector is economically important for the EU, representing 7% of EU GDP and employing 13.8 million people through direct and indirect jobs¹². The emissions-related goals for the transportation sector will be achieved, in large part, by the adoption of battery electric vehicle (BEV) passenger cars and trucks.

Europe plays a leading role in the e-mobility sector accounting for a third of the global EV car fleet and home to a fifth of the charging stations globally, [Figure 2](#). In the third quarter of 2022, European BEV car sales represented 11.9% of total EU car sales¹³, compared to just 2.4% three years ago¹⁴. Industry estimates¹⁵ suggest this share will rise to 29.9% by 2025, reach 70.7% by 2030 and achieve the EU's ultimate goal of all new cars sales being zero emission by 2035.

⁷ <https://www.eea.europa.eu/publications/annual-european-union-greenhouse-gas-1>

⁸ European Environment Agency (November 2022). Air quality in Europe 2022

⁹ <https://www.eea.europa.eu/ims/greenhouse-gas-emissions-from-transport>

¹⁰ European Commission SWD (December 2020). Sustainable and smart mobility strategy

¹¹ European Environment Agency (26 October 2022). Greenhouse gas emissions from transport in Europe

¹² [Automotive industry \(europa.eu\)](https://www.eea.europa.eu/ims/greenhouse-gas-emissions-from-transport)

¹³ ACEA (November 2022). Fuel types of new cars

¹⁴ Combined battery electric vehicles (BEVs), plug in hybrid electric vehicles (PHEV) and hybrid EVs cars combined made up 42.9% of all new passenger cars sales in 2022Q3

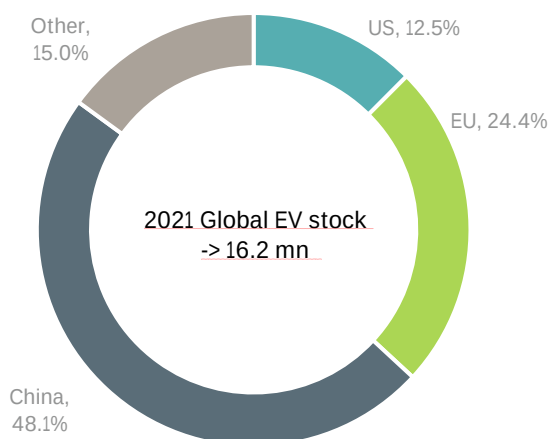
¹⁵ ACEA (November 2022). Electrification trends worldwide

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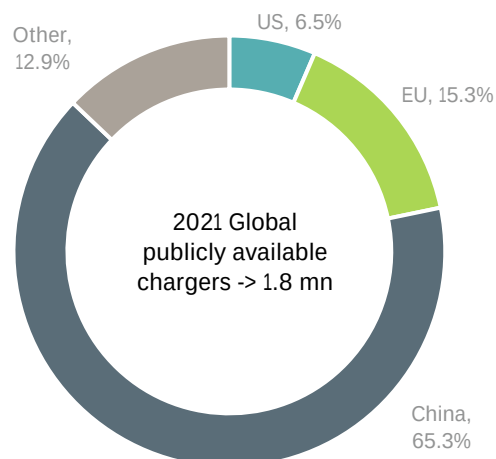
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Figure 2: Footprint of EVs and charging infrastructure by region (2021)

Regional breakdown of the number of global EV stock



Regional breakdown of publicly available chargers (slow & fast)



Source: IEA, DWS Research Institute.

However, this expansion in the European EV car fleet masks a significant divergence of EV car sales and EV charging point infrastructure across the continent. Broadly speaking, EV car sales are more prevalent in higher income western and northern European markets compared to eastern Europe, while the continent's south presents quite a mixed picture. To understand the EV market landscape and potential adoption trajectories across Europe, we have grouped the region, including Iceland and Norway, into four distinct regions, [Figure 3](#). This analysis reveals:

- **Wealth has a role to play** -> Half of Europe's population live in the Nordics and western Europe and the other half in eastern and southern Europe. These regions are split between EV leaders and laggards respectively. One driver of this disparity between EV ownership is attributable to GDP per capita.
- **The power of taxes** -> EV leader countries also have in common higher levels of excise duties on transportation fuels (petrol/diesel) compared to their southern and eastern counterparts. Tax incentives in favour of EVs are also playing a role in richer western and Nordic markets.
- **Younger is cleaner** -> New vehicles in the Nordics and western European are roughly one quarter less carbon intensive compared to cars running in southern and eastern European. This can be attributed to the higher share of EVs in the total car fleet. This is also captured in the average age of these fleets, which are as much as six years younger in the Nordics and western Europe.

Figure 3: European transportation markets compared

	Nordics	W. Europe	S. Europe	E. Europe
Population (% of total)	6%	43%	31%	20%
GDP per capita (€ current prices, 2021)	57,520	45,370	20,850	19,055
Motorway and e-road KMs (% of total)	8%	47%	32%	13%
Electric PVs % of stock in the region	23%	10%	2%	2%
Average age of car fleet (number of years)	10	9	13	15
Excise Duty on Unleaded Petrol (€/1k ltr)	641	637	515	456
Excise Duty on Diesel (€/1k ltr)	437	528	408	372
Carbon emissions from new PV (g CO ₂ /km)	88	114	125	136

Source: Eurostat, European Commission, TEDB – "Taxes in Europe" database.

Private charging, at home or in the workplace, is currently the main source of EV charging in many countries. The estimated global number of private Light Duty Vehicles or LDV chargers (residential and workplace) in 2021 is 15 million. In comparison, the number of public charging stations globally stand at 1.76 million. While it may be true that most EV charging today takes place at residences and workplaces, the increasing number of EVs will require even greater numbers of public EV charging points.

In Figure 4, we compare the stock of existing EVs and related infrastructure across major EU and non-EU countries. We find that:

- **Too many EVs are on the road per charging station** – Within the EU, most countries have a high number of EVs per publicly available charging stations. The 2014 Alternative Fuel Infrastructure Directive (AFID) regulates the deployment of public electric vehicle supply equipment which recommended that EU member states reach 10 electric LDVs per public charger by 2020¹⁶. With the exception of Netherlands, Italy and Greece, all major EU countries still fall short of this metric.
- **If you build it, they will come** – The Netherlands is an exception amongst EU countries when it comes EV infrastructure deployment. Despite accounting for less than a tenth of the total EV stock within the EU, it accounts for almost a third of the charging point infrastructure¹⁷. This approach is more forward looking since charging point infrastructure is being built with an eye to future (not current) demand. This strategy is one pursued by China, where the EV infrastructure is significantly higher than required for the current EV stock, resulting in one of the lowest ratios of EVs to charging stations anywhere in the world.
- **The benefits of fast charging points** – Despite being relatively small markets, Spain and Portugal have managed to push their average KW per EV materially higher than the EU average, not by greater deployment of EV charging stations, but by ensuring a higher mix of fast charging stations¹⁸. The charger power (kilowatts [kW]) per EV is an important metric, given fast chargers can serve a higher number of EVs compared to slow chargers. Poland also scores well on this metric.

¹⁶ European Commission (October 2014). The deployment on alternative fuels infrastructure <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094>

¹⁷ ACEA (June 2022). Electric cars: half of all chargers in EU concentrated in just two countries

¹⁸ Official Journal of the European Union (October 2014). Directive on the deployment of alternative fuels infrastructure

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Figure 4: Electric passenger vehicles and publicly available charging infrastructure – Inside and outside the EU

	EV stock % of EU	Charging station % of EU	EV per charging station	Fast chargers* share	Average kW per EV
EU countries					
Germany	33.4%	19.1%	26	18.0%	0.70
France	18.2%	20.3%	13	8.3%	1.05
Netherlands	9.9%	31.9%	5	3.0%	2.60
Sweden	7.6%	5.1%	22	11.8%	0.70
Italy	5.8%	8.3%	10	9.9%	1.50
Belgium	4.3%	4.8%	13	6.2%	1.05
Spain	3.9%	3.1%	19	31.7%	1.20
Denmark	3.7%	1.6%	35	16.3%	0.50
Finland	2.5%	2.4%	15	11.7%	1.05
Portugal	2.0%	1.6%	19	33.3%	1.40
Poland	1.0%	1.4%	10	37.8%	2.45
Greece	0.3%	0.4%	9	6.7%	1.80
European Union	100.0%	100.0%	14	10.4%	1.10
Non-EU countries					
United Kingdom	19.0%	13.7%	20	21.0%	0.90
Norway	15.9%	7.3%	32	34.0%	0.70
USA	51.1%	42.4%	18	19.3%	1.10
China	1.9x	4.3x	7	40.9%	3.80
World (incl. EU)	4.1x	6.5x	10	31.8%	2.40

Source: IEA, DWS Research Institute, data as of 2021. * Fast chargers are more than 22 kW and can serve LDVs with power ratings of up to 350 kW. Slow chargers are less than or equal to 22 kW

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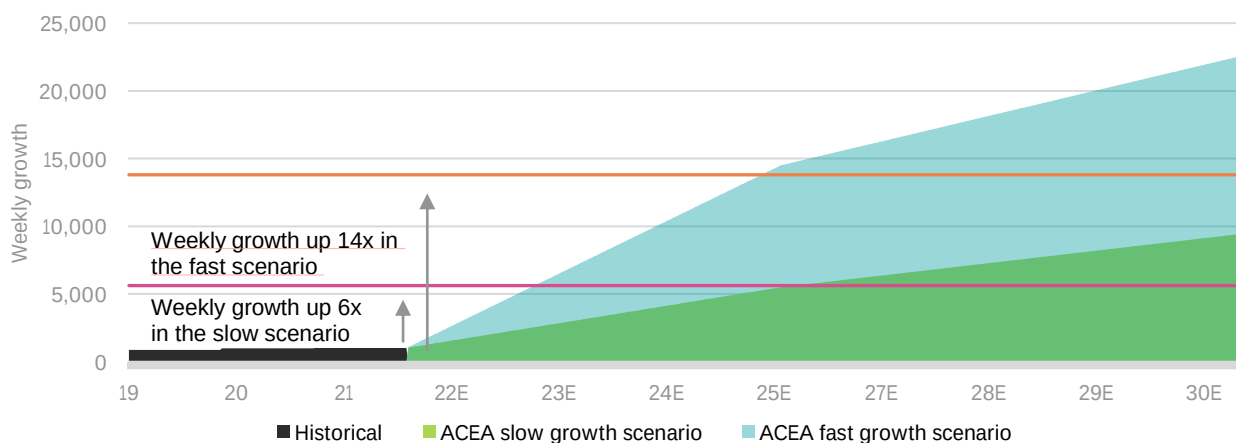
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Country case study: Netherlands

Even though it is just one-tenth the size of Germany, the Netherlands is home to almost a third of EU's charging stations for electric vehicles¹⁹ with Germany in second place. The Netherlands therefore has the most charging points per 100km of road at 64.3 of any EU country. The Dutch Climate Agreement targets all new passenger cars to be zero emissions by 2030. At which point, an estimated 1.9 million electric passenger cars will be on Dutch roads compared to 467,635 currently²⁰. EV demand has been supported by government subsidy schemes which can be in the region of €4,000 per vehicle²¹. To ensure the EV charging infrastructure is fit for the future, the Dutch National Charging Infrastructure Agenda was established to coordinate action at a national, regional and local level working with government and grid operators to build a charging network

To have any chance of meeting the greenhouse gas emission reduction targets for the EU transportation sector by the end of this decade, it will mean firstly that an estimated 42.8 million EVs need to be on the road across the EU by 2030²². And second, that the weekly installation rate of public EV charging points across the EU needs to rise from around 1,000 in 2021 to over 20,000 charging points per week by 2030. This would imply an average installation, ranging between 5,600 to 14,000 charging points per week between 2021 and 2030, [Figure 5](#). As things stand currently, the weekly installation rate of charging points is about one sixth slower than even the conservative ACEA scenario of charging points by 2030. In addition, imaginative ways need to be considered when it comes to urban planning and the contributions that can be made from relying more on public transportation. For example, within suburban settings allowing a larger share of the EU working age population to live without a personal vehicle.

Figure 5: Current vs high and low weekly electric vehicle charging stations growth scenarios



Source: ACEA March 2022 (European EV charging infrastructure masterplan), IEA, DWS Research Institute. As per the parlance used by ACEA, the slow growth scenario refers to as "Utilization-oriented pathway" and fast growth scenario refers to "Demand-driving scenario".

¹⁹ ACEA (June 2022). Electric cars@ Half of all charges in EU concentrated in just two countries

²⁰ Dutch National Charging Infrastructure Agenda (2022) <https://nederlandelektrisch.nl/u/files/nal-brochure-engels-online-2-0.pdf>

²¹ Ministry of Infrastructure and Water. Dutch Government (June 2020). Electric driving subsidy scheme <https://www.nieuwsienw.nl/1679483.aspx?t=Subsidieregeling-elektrisch-rijden-definitief-aanvragen-vanaf-1-juli>

²² ACEA (March 2022). European EV charging infrastructure masterplan

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3 / Threats and opportunities

The development of the e-mobility sector presents Europe with significant opportunities when it comes to growth, employment and trade. However, the sector is confronted with a number of threats which need to be addressed. These include:

- (i) Regional competitiveness and the rules governing state aid
- (ii) High dependency on non-EU based raw material imports critical for the e-mobility sector
- (iii) New foreign entrants to the European EV car market
- (iv) Securing a dominant role for European EV infrastructure providers

(i) Regional competitiveness and the rules governing state aid

The U.S. Inflation reduction act (IRA) and its US\$370 billion worth of clean-technology subsidies are now changing the rules of the industrial game²³. Under the IRA, electric car buyers are eligible for a tax credit of up to US\$7,500 as long as the vehicle runs on a battery built in North America with minerals mined or recycled on the continent²⁴. The concern with the IRA is not the EV tax credits, but rather the bankable production tax credits given to batteries and their critical metals supply chain until 2032. As the capital requirements to ramp up cleantech at the speed and scale required are significant, Europe needs to examine various policy alternatives to make domestic car and battery production attractive. Ideally, that would entail finding common ground with the U.S. and other geopolitical allies on subsidies to speed up the renewables transition throughout the “Global West”. Handled well, it could serve as an example of how like-minded liberal democracies can still work together. Fortunately, key decision-makers in both Brussels and Washington appear to be moving towards constructive solutions.

In February 2023, the European Commission unveiled its Green Deal Industrial Plan²⁵, intended to defend Europe's industrial base notably from Chinese competitors. The plan aims to speed up the expansion of renewable energy and green technologies—including an easing of state aid rules to enable higher subsidies—in a bid to “level the playing field”, if necessary with the U.S. too. In such a scenario, great care will be necessary to avoid industrial policies degenerating into a wasteful tit-for-tat of subsidies and other distortive measures, that would likely see both sides lose. For now, we remain cautiously optimistic that this can still be avoided.

The European Commission's plan builds on previous initiatives, complementing ongoing efforts under the European Green Deal and REPowerEU. The Commission intends to upgrade the bloc's regulatory framework for quick deployment, ensuring simplified and fast-track green project permitting, promoting European strategic projects and developing standards to support the scale-up of technologies across the EU. The European Commission has also proposed setting up a new ‘European sovereignty fund’ to give incentives to produce in Europe or safeguard already established industries. In a first step, it is suggested to re-channel some €250bn of existing money into the fund as a “bridging solution” until other instruments are found.

(ii) High dependency on non-EU based raw material imports critical for the e-mobility sector

Europe's dependency on certain raw materials from key commodity producing countries necessitates a strategy to secure safe and diversified supply chains. Strategic dependencies include a reliance on a particular commodity from one or two key suppliers and/or a dependency on a specific technology. To assist in this regard, in 2020 the European Commission²⁶ published its updated list of critical raw materials and last year the Commission proposed its European Critical Raw Materials Act²⁷.

For the automotive sector, there are a wide range of raw materials required across the industrial process including for platinum group metals, rare earth metals and cobalt. When it comes to the electrification of the European transportation

²³ The White House (August 2022). Inflation Reduction Act guidebook [Inflation Reduction Act Guidebook - Clean Energy - The White House](#)

²⁴ WoodMac (January 2023). Transforming the U.S. EV battery supply chain

²⁵ European Commission (February 2023). The Green Deal Industrial Plan: putting Europe's net-zero industry in the lead

²⁶ European Commission (2020) [Critical raw materials \(europa.eu\)](#)

²⁷ European Commission (September 2022). https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_22_5523

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sector, attention is closely focused on battery production since it is estimated that to meet the increased requirements for electric vehicle batteries and energy storage the EU will need up to 18 times more lithium and 5 times more cobalt by 2030, and nearly 60 times more lithium and 15 times more cobalt by 2050, compared with the current supply²⁸.

What is required are steps to strengthen partnerships along supply chains and build strategic reserves. Initiatives such as the European Battery Alliance²⁹ is one example which has the ultimate aim of building battery cell manufacturing within the EU. Last year, the lithium supply agreement³⁰ between the Canadian government and two German automakers to expand battery production in Europe is likely to be template for other strategic partnerships. The aim is to increase Germany's share of global lithium-ion battery capacity from 1.6% in 2021 to 11.3% by 2025³¹.

(iii) New foreign entrants to the European EV market

EU legislation announced last October means that all sales of new internal combustion engine cars will be banned from 2035. While Europe is currently the world's second largest producer of passenger cars, this leadership position is being challenged. This reflects the transformation of the global auto industry with new business models, entrants, and competitors as the sector shifts to electric vehicles. For example, Asian OEMs are entering the market at high speed, with more than ten new entrants building their European sales capacities over the last few years³². And while current sales figures among this group remain low (a few thousand per brand per year), the ambitions of these players are high.

Overall non-European companies share of new electric vehicles (battery and plug-in hybrids) has increased from 24% in 2020 to 29% in the first nine months of last year, [Figure 6](#)³³. According to Transport & Environment 2022 report, Chinese-made EVs accounted for 5% of fully electric car sales in the EU in the first half of last year and this share could reach as much as 18% share of the market by 2025³⁴.

Figure 6: EU vs non-EU sales of BEV & PHEV car sales in Europe since 2020

	2020	2021	2022*
Market share trend			
EU OEMs	76%	75%	71%
Non-EU OEMs	24%	25%	29%

* Data from January to September 2022
 OEM: Original equipment manufacturers; BEV: Battery electric vehicle; PHEV: Plug-in hybrid electric vehicle
 Source: ICCT (October 2022). Market monitor: European passenger car and light commercial vehicle registrations

The rising market share of non-EU car registrations marks a worrying trend for European based auto manufacturers. Of particular concern is that consumer loyalty to premium European brands appears fragile when changing ownership from internal combustion engine to electric cars. According to one survey, two-thirds of European customers are interested in buying an entirely new brand when moving to an electric vehicle with Asian disrupter brands appearing the most popular³⁵.

(iv) Securing EU companies leadership in EV charging point infrastructure

In Europe, more than 70% of EV recharging is undertaken at home or at work³⁶. However, the EU will need at least 3.4 million operational public charging points by 2030 to cater for the growing number of EV passenger cars on the road. This

²⁸ European Parliament (April 2022). New EU regulatory framework for batteries: Setting sustainability requirements

²⁹ European Commission https://single-market-economy.ec.europa.eu/industry/strategy/industrial-alliances/european-battery-alliance_en

³⁰ Mining Technology (August 2022). Canada partners with German automakers for battery materials

³¹ Statista (January 2023). Share of global lithium-ion battery manufacturing capacity

³² McKinsey (December 2022). New EV entrants disrupt Europe's automotive market

³³ ICCT (October 2022). Market monitor: European passenger car and light commercial vehicle registrations (January – September 2022)

³⁴ Transport & Environment (October 2022). From boom to brake: is the e-mobility transition stalling?

³⁵ McKinsey (December 2022). New EV entrants disrupt Europe's automotive market

³⁶ European Alternative Fuels Observatory [Electric vehicle recharging prices | European Alternative Fuels Observatory \(europa.eu\)](#)

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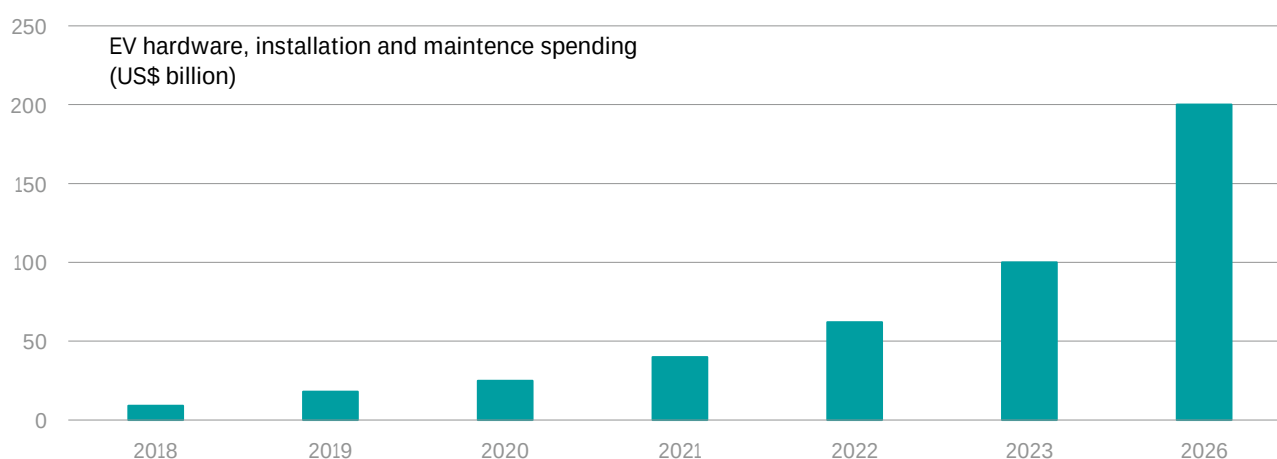
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infrastructure is essential since according to a 2019 McKinsey survey, more than half of consumers' concerns relating to EVs involved batteries, charging, and driving range³⁷.

Currently, foreign companies are stealing a march on Europe's charging point infrastructure. For example, Tesla has a strong presence in the electric cars segment in Europe, with its Model Y becoming the continent's best-selling vehicle in November 2022 among all cars, including ICE vehicles³⁸. One of the prominent advantages of Tesla is that it operates a network of superchargers stations across the continent, enabling fast charging and long-distance driving. In comparison, IONITY, a joint venture founded in 2017 of the car manufacturers BMW Group, Ford Motor Company, Hyundai Motor Group, Mercedes Benz AG and Volkswagen Group with Audi and Porsche, are lagging behind when it comes to building a network of fast chargers across Europe. In 2022, they operated 430 stations with 1,900 charging points in 24 European countries. By 2025, IONITY expects more than 1,000 stations with 7,000 charging points³⁹. This compares with Tesla's 875 stations with 10,000 stalls in 2022⁴⁰.

Car manufactures are also partnering with oil and gas companies to develop charging networks. In 2021, Volkswagen announced an €400 million investment to expand its global fast-charging network in partnerships with BP, Iberdrola and Enel⁴¹. The company intends to operate about 18,000 public fast-charging points in Europe by 2025, a five-fold expansion compared to 2021 and about one third of the total demand predicted on the continent for 2025. The same year, Mercedes-Benz announced a partnership with Shell to offer EV customers access to the Shell Recharge network that will operate 30,000 plug-in points in Europe, North America, and China by 2025 – including 10,000 high-powered units. Both companies want to develop plug-and-charge technology and provide chargers in work and home environments⁴². However, significant investments will be required to meet these goals, which we explore in the next section of this report.

Figure 7: Cumulative spending on EV charging globally



Source: Bloomberg NEF (2022, 2023 and 2026 estimates)

³⁷ McKinsey (November 2022). Europe's EV opportunity—and the charging infrastructure needed to meet it

³⁸ Autonews (December 2022).

³⁹ IONITY (November 2022). Five years of IONITY: How the charging network is boosting e-mobility

⁴⁰ Inside EVs (October 2022). Tesla celebrates 10,000 superchargers in Europe

⁴¹ Volkswagen (March 2021). <https://www.volkswagenag.com/en/news/2021/03/power-day--volkswagen-presents-technology-roadmap-for-batteries-.html>

⁴² Daimler North America (July 2021). <https://www.prnewswire.com/news-releases/mercedes-benz-prepares-to-go-all-electric-301339345.html>

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4 / Financing needs and models

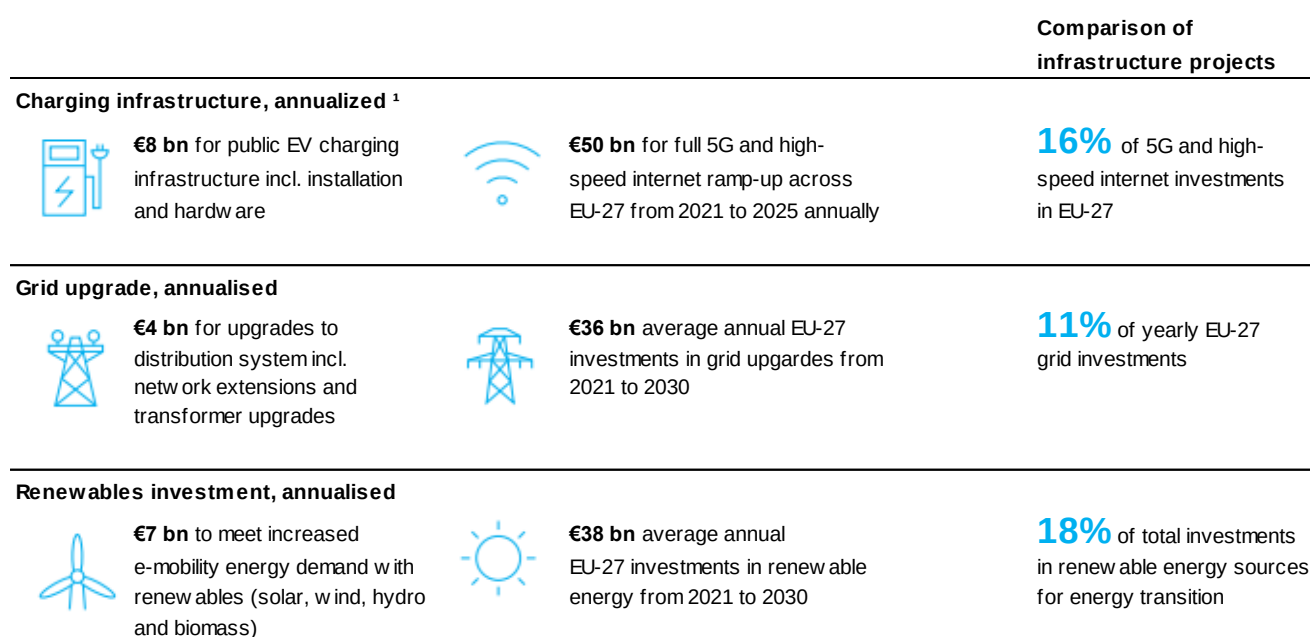
Investment requirements

The infrastructure investments required to meet these goals will be spread across three areas:

- (i) charging infrastructure
- (ii) upgrades to power distribution systems and transformers for e-mobility purposes
- (iii) increased renewable power generating capacity.

While investment models have matured and government support has been forthcoming for the latter two areas for some time as the energy transition has taken off, funding for charging infrastructure itself has failed to keep pace. ACEA estimates⁴³ that combined investments across these three areas will need to amount to €280 billion by 2030. And when examined relative to other comparable infrastructure projects, it reveals that annual investment for EV charging infrastructure amounts to 16% of the required investment for 5G and glass fiber infrastructure in the EU or around 11% of the annual investment in grid updates, **Figure 8**.

Figure 8: Required investment in charging infrastructure, grids and renewables compared



¹ For annualized numbers, the total investment sum was divided by the number of years the investment program runs (2021-2030).

Source: ACEA (March 2022). A European EV Charging Infrastructure Masterplan <https://www.acea.auto/files/Research-Whitepaper-A-European-EV-Charging-Infrastructure-Masterplan.pdf>

Given the compelling demand outlook for EV charging infrastructure, it is hoped that the private sector will become the vanguard of the roll out of charging points across Europe to address the existing shortfall. Growth in EV infrastructure transaction activity in recent years could suggest that some of the US\$1 trillion of private assets under management (AUM) globally is now targeting infrastructure, as well as the growing number of liquid infrastructure funds, are primed to help with the sector's growth. Indeed, 2022 saw a significant ramp-up of infrastructure deal activity in the EV infrastructure sector, with US\$8 billion transacting over 46 deals, according to data from Infralogic⁴⁴. This represents a near ten-fold increase in transaction value since 2019.

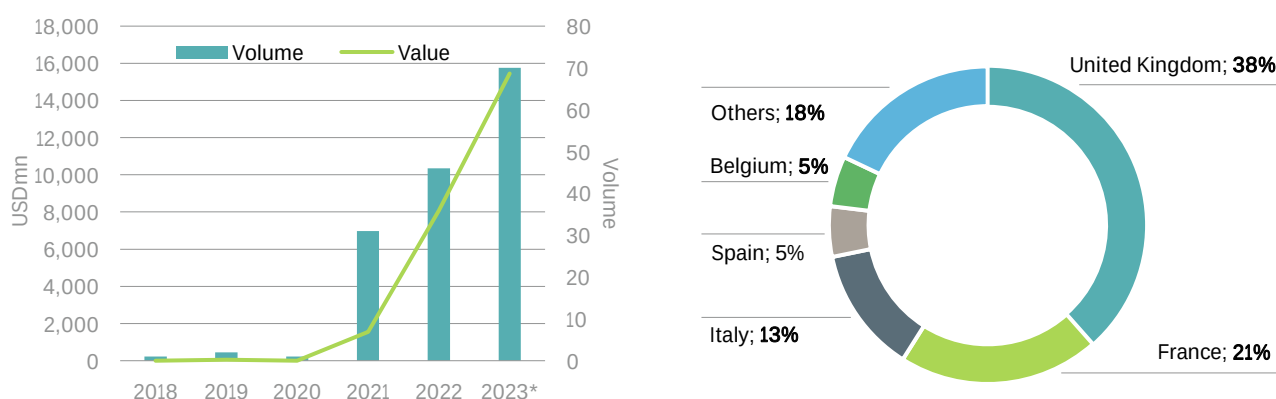
⁴³ ACEA (March 2022). A European EV Charging Infrastructure Masterplan

⁴⁴ Infralogic (February 2023).

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Figure 9: EV Infrastructure closed transactions, value & volume (LHC) and EV infrastructure live transaction pipeline, by European geography, % total Pipeline



Source: Infralogic, February 2023. *2023 includes live transactions. Others in the pie chart includes Ireland (5%), Netherlands (5%), Estonia (3%), Finland (3%) and Sweden (3%)

However, such levels of private activity currently fall significantly short of the substantial charging point requirements detailed earlier in this report. There are two key drivers of the shortfall in private capital:

- (i) A lack of government support to guide investors, with the industry somewhat of a 'wild west' with players of all shapes, sizes and jurisdictions pursuing different strategies
- (ii) And secondly, there are few EV charging businesses developing charging points that exhibit the infrastructure characteristics that investors deem attractive from an infrastructure portfolio allocation perspective namely securing long-term, low volatility, defensive returns.

There is, therefore, a requirement to address these mismatches in expectations between the necessary investments and investor appetite.

Incentives target EVs, not infrastructure

One of the key issues is a lack of incentive to roll out EV charging infrastructure in locations without existing, proven demand. Government subsidies and carbon emission reduction targets have been forthcoming with regards to transitioning the European vehicle fleet, but there have been fewer examples of consistent and comprehensive support for the operation of charging infrastructure. Investors need further guarantees in the form of operating subsidies for their investors given the amount of risk they take on with a 'build it and they shall come' strategy.

Typically, local governments have incentivised urban charging infrastructure roll out with methods such as VAT relief on construction costs or reduced-cost permitting processes. While this has encouraged deployment, it has largely been in areas with adequate existing demand as there has been little regulatory support for the operation of the assets once installed. This has resulted in the significant neglect of areas which have not yet seen high EV penetration.

In December 2022, the approval of the German government's so-called 'Deutschlandnetz' charging scheme, which importantly covers both upfront costs on ongoing operating costs, will be an important accelerator of charging infrastructure deployment. Other European governments should look to achieve similar incentives for operators⁴⁵. Such incentives could replicate the more traditional infrastructure availability payment-style models, where investors are not taking on demand risk.

⁴⁵ State aid: Commission approves €1.8 billion German scheme to roll out high power charging infrastructure for electric vehicles - EU Commission - December 14, 2022

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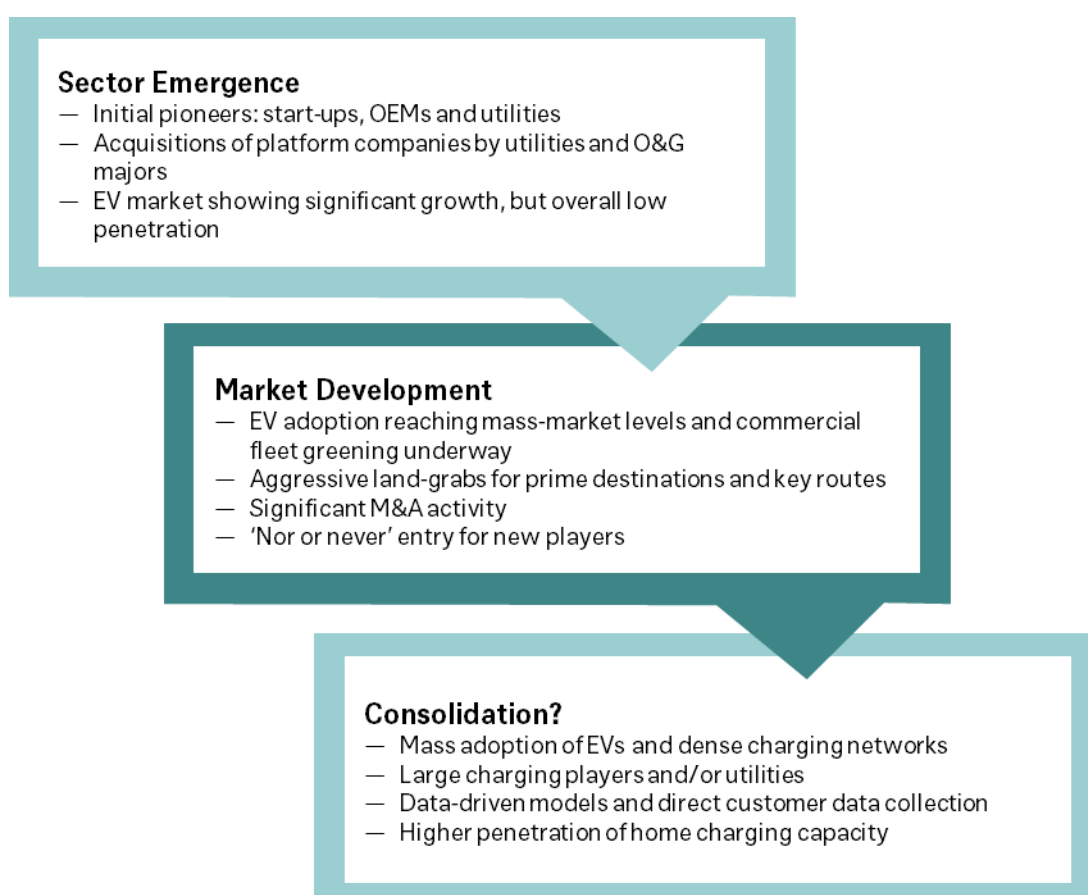
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Infrastructure investor needs

With comparatively long hold periods and illiquid assets, investors in infrastructure would be exposed to significant risk without having sought specific asset characteristics in investments that can protect from inflation, secure market position, provide long-term stable cashflows and deliver essential services.

As new sector requirements for investment such as EV infrastructure emerge, the fact that they are fixed assets providing public services brings infrastructure investors to the top of the list of expected providers of capital. However, as often immature businesses without the full spectrum of infrastructure characteristics, many infrastructure investors are unwilling or even unable to invest in such assets given their fiduciary responsibilities and the likely mismatch between returns profile and investor expectations. This is particularly the case when considering the emerging technologies and business models of the EV charging sector now and how they will potentially mature over the coming decade. **Figure 10** provides an indicative timeline of how the EV charging infrastructure market may evolve.

Figure 10: Indicative EV charging infrastructure timeline



Source: DWS Infrastructure Research, February 2023. Note: EV Charging Infrastructure market currently in Development phase.

The EV charging market has significant scope for market entry and expansion in its current phase of development. As outlined before, many markets are still heavily underserved by charging points and this is true at the national, sub-national and municipal levels. However, as this need is steadily addressed, infrastructure investors will need to have ensured that the businesses they are developing are well positioned to weather the market's likely volatility as it moves towards a more stable, long-term structure dominated by large incumbents such as utilities.

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Infrastructure investors will be providing capital to EV charging businesses which can best exhibit strong infrastructure characteristics, sufficiently addressing the below areas of risk:

- **Revenue risk:** Once operational, profitability will depend on enduring, robust demand and managing costs. From a cost perspective, the ability to increase prices charged in line with electricity prices will be crucial in most cases; hedging electricity prices will require the clear demand patterns of EV-driver charging behaviour which will only truly begin to emerge as the sector consolidates and large players can leverage their significant user bases. For demand, reducing risk will involve capturing as much market share as possible (see Barriers To Entry below). This only works well when alternative options for charging are not readily available (e.g. home charging, other public charging infrastructure). While the pace of the EV fleet's growth will necessitate investment in public charging regardless, this will become an increasingly important factor as home-charging becomes more prevalent and EV range-anxiety decreases.
- **Barriers to entry:** A key characteristic of infrastructure assets is that they are not subject to levels of competition seen in other sectors due to high capital costs and limited physical assets in operation. To replicate this protection for investors in the EV infrastructure space, destination strategies, such as servicing charging needs at shopping centres, sports grounds, public transit stations etc., will be important. Signing exclusivity deals with prime real estate owners and retailers with large footprints will allow businesses to capture the market at high-volume destinations, as opposed to other charging locations that have less regular traffic flows and are more likely to have a variety of charging options available.
- **Technology risk:** As with the roll-out of most new technologies, the pace of change in the EV charging sector is significant and this presents an inherent risk to long-term asset holders. More rapid charging technology and better user-interface platforms are likely to follow. As such, to limit technology risk, business models which account for charge point renewal and flexibility from a software perspective should be sought. Numerous businesses with sound technology have failed to reach scale due to the market moving slower or in an alternate direction to what was expected. Selecting technologies that can help to mitigate existing business risks can provide an advantage. For example, technologies that couple charging points with on-site batteries and generation not only help to smooth electricity costs, but also limit the strain on local grids which are increasingly at risk from growing electrification, making it an appealing option for local authorities.
- **Greenfield risk:** Installation costs for charging points, particularly without a guaranteed demand stream once operational, are a large liability for investors to take on. While subsidies are available to a certain extent in many European markets which can cushion this cost, working with experienced E&C partners with a track record of utility-style build-outs will be crucial. This also extends to the pre-build phase, where detailed location scouting and local connections can be crucial. Timeframes for approval for charging points can extend beyond a year given the connectivity requirements, thus further delays during the build-out phase could be costly.
- **Counterparty risk:** As with any long-term investment, working with experienced and financially sound counterparties will shield EV charging operators from assets not performing as expected. Local governments with a high-number of constituents driving EVs are more likely to work constructively to deliver charging infrastructure. Likewise credit-worthy corporates looking to provide charging services at their destinations will want quality, long-term arrangements to compliment their offering and want to benefit from economies of scale by servicing multiple destinations with the same provider. Smaller, localised partners or even singular destinations are less likely provide sufficient diversification or credit-worthiness.

Businesses which can build up the characteristics to manage the above risks will not only perform well in the current period of market growth by delivering capital appreciation as charging service demand grows significantly, but also will be positioned with the best assets when we move into the final phase of the market's development with the largest players look to take market share.

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