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EV PULSE NEVER STOPS, INDUSTRY POWERS UP

JULY 2023 **INDUSTRY BRIEF – CLEAN MOBILITY**

Executive summary

While official numbers for Q2 2023 have not been communicated yet, BEV (battery-electric vehicle) registrations have accelerated in recent months and should: (i) directly benefit both slow charger OEMs (original equipment manufacturers) and CPOs (charging point operators), (ii) indirectly fuel CPO investments and DC/HPC (direct current/higher power charging) charger growth going forward.

Lead times to obtain an EV are gradually improving (from up to nine months in 2022 to three/four months in Q1 2023), therefore boosting demand for wallboxes and increasing public charging demand based on a higher number of EVs on the roads.

Regarding regulations, the "drive to zero" campaign aims to bring governments and leading industry stakeholders together to collaboratively develop policies, programs and actions that can support the rapid manufacture and deployment of zero emission lightweight vehicles.

Innovation remains sustained with an overall shift towards more power capacity, illustrated by Alfen entering the DC market with a new 30 kW CP (charging point) being sold as of H2, and Alpitronic, ABB, Kempower, EV Box and Xcharge now offering 400 kW CP. Smart charging is also an important piece of the puzzle, enabling new functionalities and additional revenues both for OEMs and CPOs.

In terms of regions, Europe is still the main market for BEV and CP roll-out. However, we think that the North-American market could grow very rapidly. Given the similar market sizes of the two regions (380m inhabitants in North American markets vs 450m in Europe, close to 290m passenger vehicles, 9-12m registrations per year as well as similar inhabited surface areas in both regions), the number of EV chargers installed should be similar by 2035, however with a slight delay in the pace of the roll-out in NAM considering lower penetration rates of BEVs in the US compared to Europe in 2022-2025, and a gradual catch-up until 2035

01

CURRENT STATE OF THE EV MARKET IN EUROPE

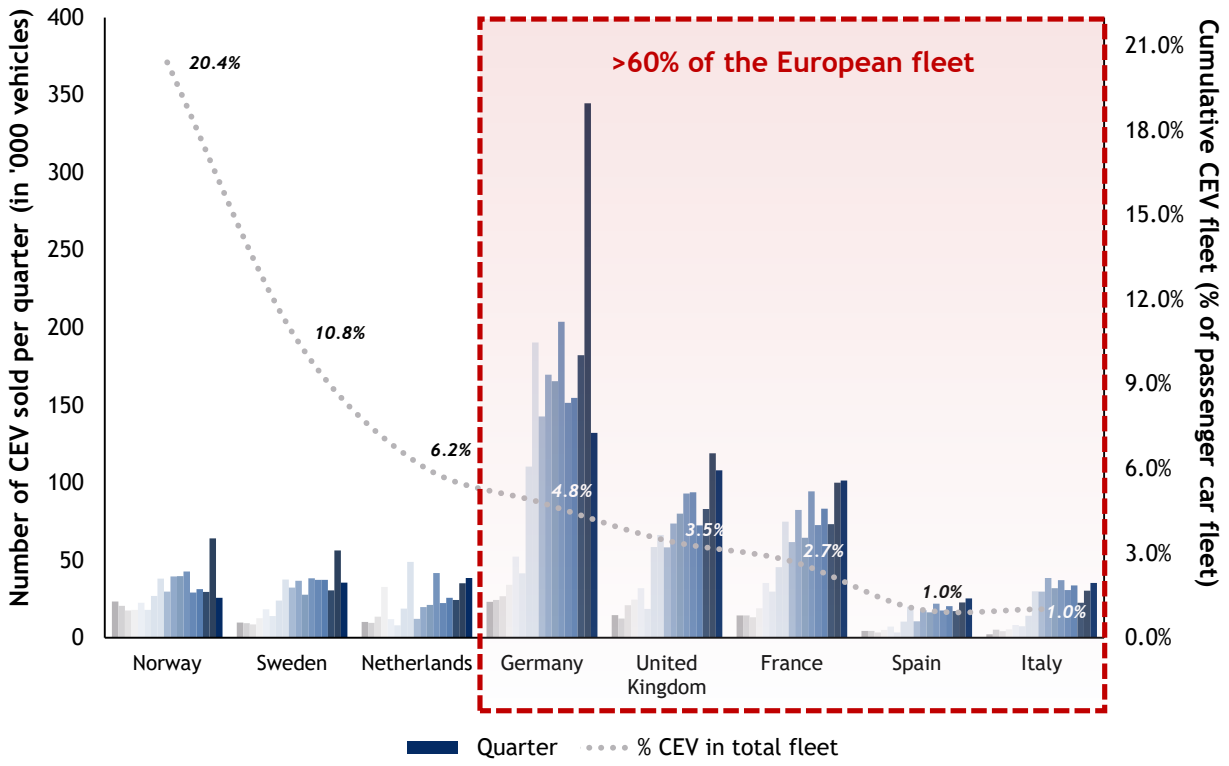
STEADY GROWTH AMIDST MARKET CHALLENGES AND REGULATORY SUPPORT

The European EV market has shown resilience and growth despite facing various challenges in 2022. EV registrations remained steady, benefiting from competition among OEMs and strategic pricing. BEVs now dominate CEV volumes, particularly in Nordic countries, and are gaining traction in larger markets. Regulatory frameworks and government initiatives, such as the European Green Deal and Fit for 55, are pivotal in supporting this growth by setting ambitious targets for zero-emission vehicles and expanding EV infrastructure. As EV registrations continue to rise, the demand for both slow and fast charging solutions is expected to surge, driving significant investments in public and private charging infrastructure across Europe.

Back in the race for EV registrations

Whereas last year was tough for automotive OEMs in Europe, EV registrations maintained a relatively steady pace. Touching down from sustained growth over 2019-2021, 2022 was an opportunity for EV markets to catch their breath in preparation for coming quarters. This should be further fueled by OEM competition in catching EV demand at reasonable prices (as communicated by Tesla in Q2 2023), while growth should outpace the margin focus as BEVs have historically tended to be more resilient to market downturns, maintaining stable registrations while also grabbing market share over ICEV.

Figure 1 - Quarterly CEV volumes and fleet dynamic in Europe between Q1 2019 and Q1 2023, most remains to be done

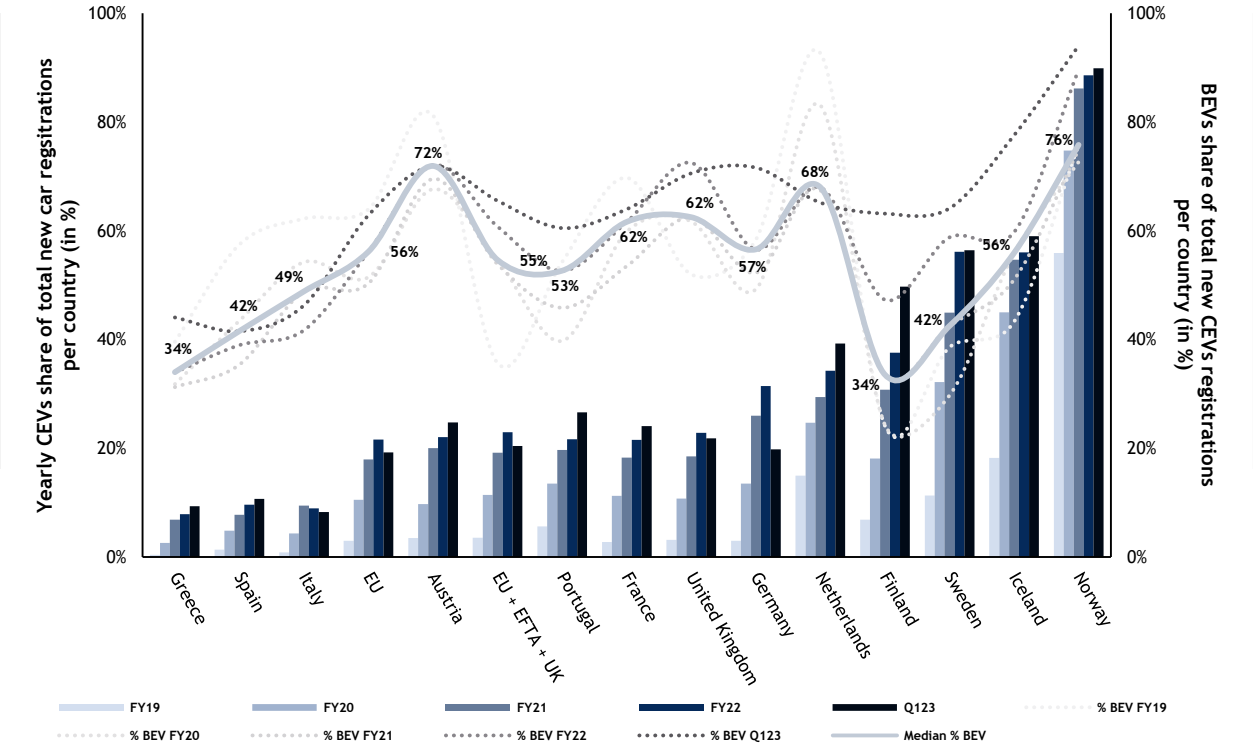


*Source: ACEA, Stifel**

The BEV trend is robust and continuing to increase in most European countries, grabbing more than 61% of additional chargeable electric vehicle (CEV) volumes coming onto roads in 2022 (vs 50% in 2021, Europe-wide) and representing 14% of overall vehicles sold in Europe in 2022 (from 2%, 6% and 10% in 2019, 2020 and 2021 respectively). Historically led by the Nordics (11-21% of their fleet already transitioned), BEVs are gradually gaining momentum in bigger countries paving the way for further growth in the medium-term. The trend is not restricted to Europe, with a hesitant yet deep and pragmatic US market, especially for higher power applications. As should be the case with southern European countries vs northern ones, the catch-up could be quick and allow for fast growth.

While BEV registrations might be slower than expected by some automotive OEMs (in light of Volkswagen announcing it has been forced to kerb EV production in Europe, with EV registrations down 30% compared to internal forecasts), this could highlight demand transfer from European to Chinese or NAM manufacturers, mainly based on lower prices or subsidy arbitrage strategies. Indeed, EV registrations are up 42% YoY based on January-May data in Europe and could be further boosted by ongoing destocking initiatives from Tesla and other OEM (highlighting European manufacturers could struggle and loose market share to competitors in the EV race).

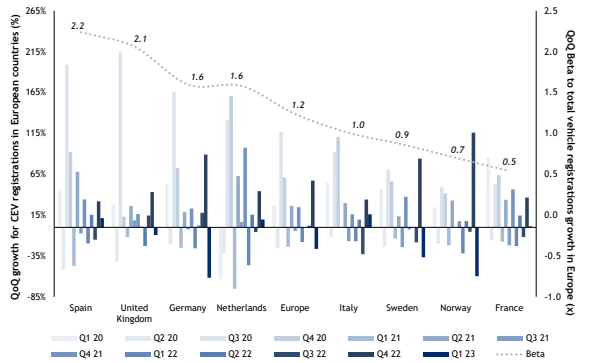
Figure 2 - BEV dynamics in CEV registrations in Europe from 2019 to Q1 2023



*Source: ACEA, Stifel**

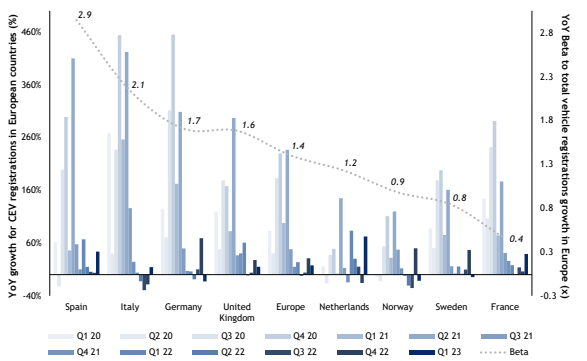
In the wake of supply-chain bottlenecking, soaring inflation and plummeting demand for new cars in 2022, EV deliveries were stable in Q2 and Q3 2022. This was a temporary slowdown however, as confirmed by renewed growth in Q4 2022 and a continued YoY acceleration since early 2023 (+14% YoY in January, +43% YoY in March, +66% in May), heading for at least 40-50% YoY growth in Q2 2023.

Figure 3 - QoQ CEV trends and sensitivity to European automotive markets



*Source: ACEA, Stifel**

Figure 4 - YoY CEV trends and sensitivity to European automotive markets



*Source: ACEA, Stifel**

While official numbers for Q2 2023 have yet to be communicated, growth in BEV registrations has accelerated in recent months and should be (i) directly beneficial for both slow charger OEMs and CPOs, and (ii) indirectly fuel CPO investments and DC/HPC charger growth going forward. Indeed, lead times to obtain an EV have gradually improved (from up to 9 months in 2022 to three/four months in Q1 2023), therefore boosting demand for wallboxes and increasing public charging demand based on a higher number of EVs on the roads.

Figure 5 - Quarterly revenue trends in Alfen's EV charging division vs CEV registrations

	Alfen, EV charging rev. (EURm)	QoQ growth (% diff.)	QoQ CEV reg. Europe (% diff.)	QoQ auto OEM reg. Europe (% diff.)
Q2 19	5.2	16%	-3%	3%
Q3 19	6.6	27%	7%	-14%
Q4 19	9.8	48%	38%	1%
Q1 20	13.2	35%	27%	-17%
Q2 20	11.5	-13%	-26%	-33%
Q3 20	11.3	-2%	117%	70%
Q4 20	17.5	55%	61%	-2%
Q1 21	19.3	10%	-24%	-9%
Q2 21	22.0	14%	26%	11%
Q3 21	25.2	15%	-4%	-21%
Q4 21	37.3	48%	25%	-3%
Q1 22	54.9	47%	-18%	5%
Q2 22	70.1	28%	0%	3%
Q3 22	70.6	1%	2%	-6%
Q4 22	56.2	-20%	57%	13%
Q1 23	47.0	-16%	-26%	7%

*Source: Alfen, ACEA, Stifel**

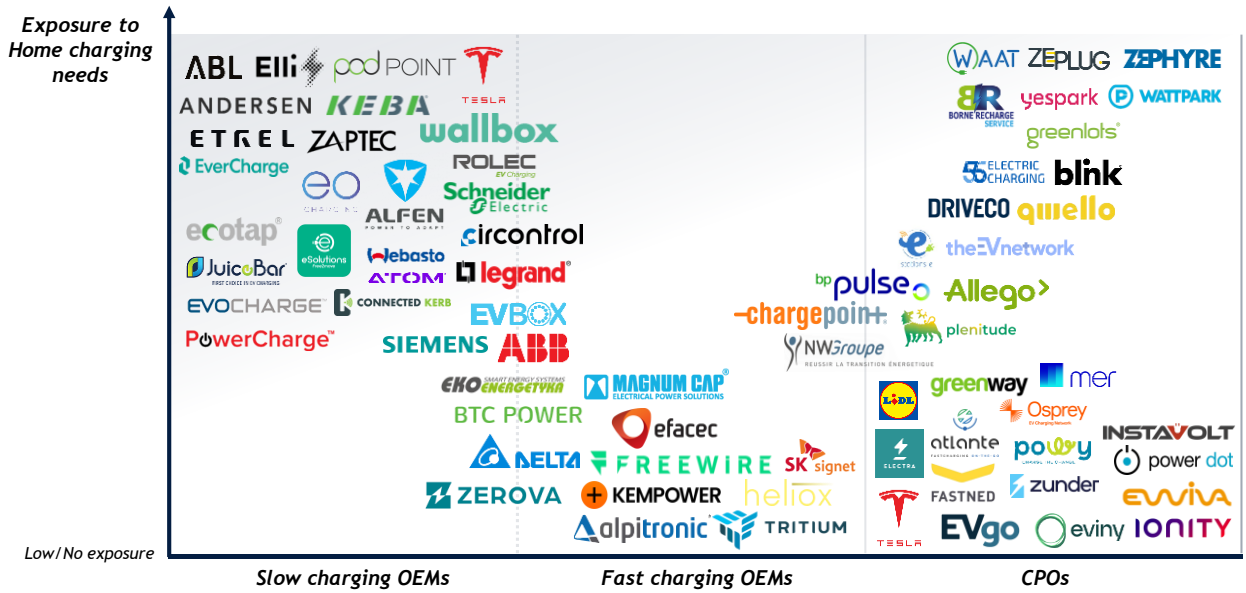
Figure 6 - Fastned's quarterly revenues dynamics vs CEV registrations

	Fastned rev. (EURm)	QoQ growth (% diff.)	QoQ CEV reg. Europe (% diff.)	QoQ auto OEM reg. Europe (% diff.)
Q2 19	0.9	11%	-3%	3%
Q3 19	1.0	12%	7%	-14%
Q4 19	1.7	63%	38%	1%
Q1 20	1.7	-3%	27%	-17%
Q2 20	1.0	-43%	-26%	-33%
Q3 20	1.6	63%	117%	70%
Q4 20	1.9	19%	61%	-2%
Q1 21	2.0	8%	-24%	-9%
Q2 21	2.4	20%	26%	11%
Q3 21	3.2	33%	-4%	-21%
Q4 21	4.9	53%	25%	-3%
Q1 22	5.7	16%	-18%	5%
Q2 22	6.9	21%	0%	3%
Q3 22	10.1	46%	2%	-6%
Q4 22	13.3	32%	57%	13%
Q1 23	13.3	0%	-26%	7%

*Source: Fastned, ACEA, Stifel**

This is clearly reflected in Alfen's revenues given their one-off nature while Fastned is exposed to recurring traffic and not to stocking/destocking trends. Therefore, the slower the portfolio of chargers the more a manufacturer is exposed to ups and downs in home charging trends, which could also explain diversification moves towards rapid and low DC chargers, dealing with CPOs rather than with retailers or automotive OEMs.

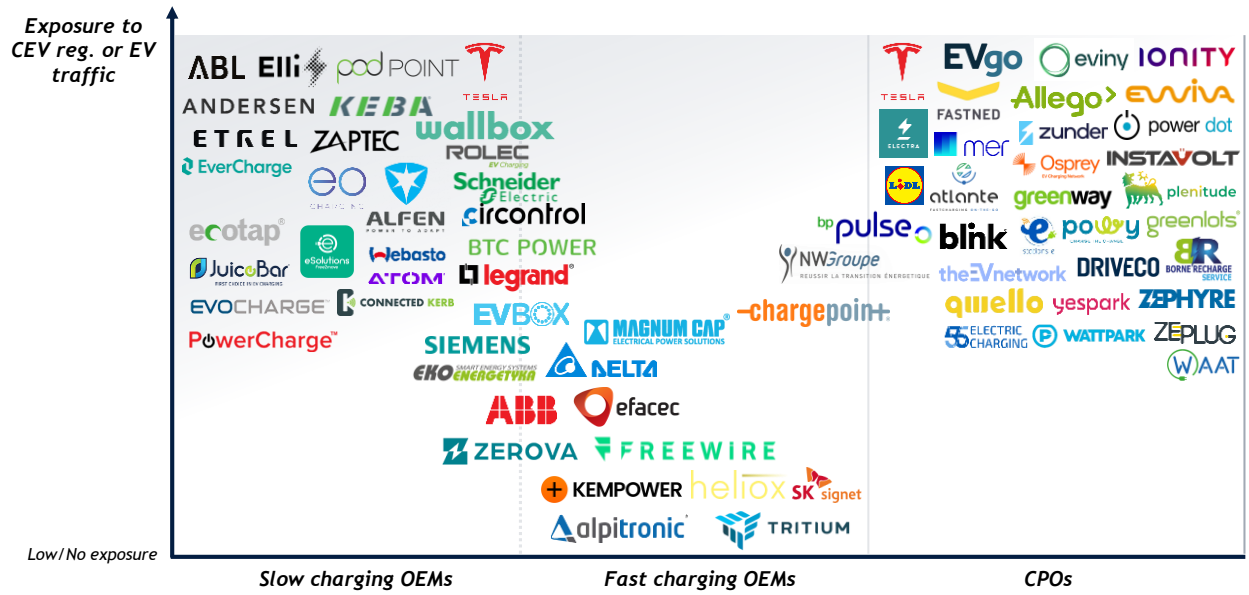
Figure 7 - Home/residential charging sensitivity matrix



*Source: Stifel**

Similarly, CPOs targeting condominiums, collective car parks or fleet services are the most exposed to CEV registrations by their end-customers, generally being subscription-based. Consequently, slow charging OEMs with BtoC and BtoBtoC revenue funnels tend to be the most exposed to CEV market volatility in our EV charging sample (Pod Point, Alfen, F2MeS), adding that hardware commoditization should be quicker than for DC and HPC chargers. As such, while it is true that DC/HPC OEMs could follow a similar path in the longer-term, strategic manufacturing piloting should allow for steady margins. Finally, regarding CPOs, with appealing long-term recurring yield profiles for correctly located ones, the greatest risks are set to lie in oligopolistic positions being reshuffled by regulators in the medium to long-term.

Figure 8 - CEV registrations and EV traffic sensitivity matrix



*Source: Stifel**

Still with a strong regulatory backbone

Reduced greenhouse gas (GHG) emissions by transport, as well as greater usage of public and alternative transport or initiatives to decarbonize the grid are key government and regulatory priorities. COP26 in November 2021, for example, made clear that e-Mobility had become one of the most promoted decarbonization initiatives.

With all new cars and van sales expected to be zero-emission in leading markets as of 2035 in Europe, EU governments have committed to ambitious and tangible EV roll-out targets.

The drive to zero campaign aims to bring governments and leading industry stakeholders together to collaboratively develop policies, programs and actions that can support the rapid manufacture and deployment of zero-emission light-weight vehicles. We have compiled the main programs/policies established over recent years in Europe:

- **AFID/AFIR:** Coordinate alternative fuel infrastructure development, EU countries to develop national policy frameworks (NPFs) for developing "an appropriate number" of refueling and recharging points by 2020 and 2025.
- **Fit for 55:** Scheme to reach the 55% GHG emission reduction target by 2030 vs 1990. Upward target revisions regarding energy taxation and AFID. New credit mechanism to boost renewable electricity use in transport with specific smart charging and V2G requirements for private stations, higher CO2 emission standards for new vehicles and a shorter timeline for adoption.
- **European green deal:** Governments have pledged to be the first continent to reach carbon neutrality with estimates pointing to one million public recharging stations required by 2025, serving 13 million LEV.
- **EV30@30:** Ambition of the Clean Energy Ministry's Electric Vehicles Initiative (EVI), setting a target to reach a 30% sales share for EV by 2030. The new AFIR framework (based on the European Green Deal) was agreed by European Institutions on 28th March 2023, and 2025 targets should now start to be implemented. The below table summarizes the differences between old (2022)and new (2023) AFIR, highlighting a strong push forward for battery e-mobility as opposed to hydrogen mobility. A general review of the AFIR framework will be conducted by 2026-end and every five years thereafter.

Figure 9 - BEV and Hydrogen infrastructure regulation calls (Fit for 55, AFIR), March 2023 Agreement vs March 2022 proposition

e-Mobility	Scope	Metric	EU Agreement (03/2023)	Last targets (03/2022)	Rapporteur's draft report (10/2022)
Battery HDVs	TEN-T core network	Power per recharging pool in each direction[1]	• 15% with 1.4MW by 2025 • 50% with 2.8MW by 2027 • 3.6MW by 2030	• 1.4MW by 2025 • 3.5MW by 2030	• 2.0MW by 2025 • 5.0MW by 2030
		Minimum speed of highest-power charging point per pool	• ≥2 stations of +350kW by 2027	• ≥1 station of +350kW by 2025 • ≥2 stations of +350kW by 2030	• ≥2 station of +800kW by 2025 • ≥4 stations of +800kW by 2030
	TEN-T comprehensive network	Power per recharging pool in each direction[2]	• 15% with 1.4MW by 2025 • 50% with 1.4MW by 2027 • 1.5MW by 2030	• 1.4MW by 2030 • 3.5MW by 2035	• 2.0MW by 2030 • 5.0MW by 2035
		Minimum speed of highest-power charging point per pool	• 350kW	• ≥1 station of +350kW by 2030 • ≥2 stations of +350kW by 2035	• ≥1 station of +800kW by 2030 • ≥2 stations of +800kW by 2035
	Urban nodes	Aggregated power output at each urban node	• 900kW by 2025 • 1.8MW by 2030	• 600kW by 2025 • 1.2MW by 2030	• 1.4MW by 2025 • 3.5MW by 2030
		Minimum speed of highest-power charging point per pool	• 150kW	• 150kW	• 350kW
	Safe and secure parking areas	Minimum speed of highest-power charging station per pool	• ≥2 stations of +100kW by 2027 • ≥4 stations of +100kW by 2030	• ≥1 station of +100kW by 2030	• ≥2 stations of +100kW by 2027* • ≥4 stations of +100kW by 2030* *allowing for smart and bi-directional charging
Battery LDVs	TEN-T core network	Power of recharging pool every 60km in each direction	• 400kW by 2025 • 600kW by 2027	• 300kW by 2025 • 600kW by 2030	• 600kW by 2025 • 900kW by 2030
		Minimum speed of highest-power charging point per pool	• ≥150kW by 2025 • at least 2x ≥150kW by 2027	• 150kW by 2025	• 300kW by 2025 • 350kW by 2030
	TEN-T comprehensive network	Power of recharging pool every 60km in each direction	• 50% with 300kW by 2027 • 300kW by 2030 • 600kW by 2035	• 300kW by 2030 • 600kW by 2035	• 600kW by 2025 • 900kW by 2030
		Minimum speed of highest-power charging point per pool	• 150kW by 2025 • at least 2x ≥150kW by 2035	• 150kW by 2025	• 300kW by 2025 • 350kW by 2030
H2 L/HDVs	Hydrogen refueling stations	Distance between every stations (≥1[3] ton/day) on TEN-T network	• 200 km by 2030, 700 bar	• 150 km by 2030, 700 bar • 450 km by 2030, liquid	• 100 km by 2027, 700 bar • 400 km by 2030, liquid
		424 urban nodes	• At least 1 HRS by 2030	• At least 1 HRS by 2030	• At least 1 HRS by 2027

(1) For the core TEN-T, EU agreed on 1 charging pool every 120km by 2025 and 2027 as well as 1 charging pool every 60km by 2030 while the 60km direction was set in AFIR 2022 targets
(2) For the comprehensive TEN-T, EU agreed on 1 charging pool every 120km by 2025 and 2027 as well as 1 charging pool every 100km by 2030 while the 60km direction was set in AFIR 2022 targets
(3) 2030 targets in the AFIR 2022 version had previously been set with 2tons/day hydrogen refueling stations

Source: IEA, Stifel, European Commission, ICCT*

The main anchors to this strategy consist of the construction and equipment of the TEN-T network, together with minimal targets for key cities throughout Europe. While the TEN-T core network should be finalized by 2030, the wider comprehensive network, should come online by 2050. This brand-new EU agreement highlights a clear focus on EV charging, with reinforced ambitions and a dedicated timeline for the ramp-up of EV charging infrastructure, while binding hydrogen refueling infrastructure requirements are both being lowered and delayed. This should demonstrate (i) the hegemony of battery mobility technologies, (ii) gradually complemented with hydrogen for haulage and intensive use-cases in the longer-term depending on technology maturity and availability.

Figure 10 - Framework behind the European TEN-T core network (~50tkm)

Source: European Commission

Figure 11 - Footprint of the TEN-T comprehensive network (~136tkm)

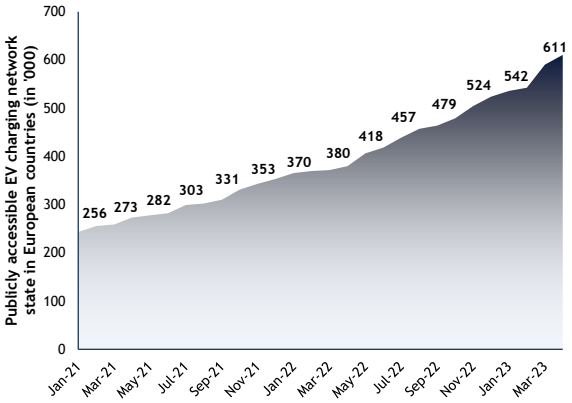
Source: European Commission

Sustained EV charging infrastructure efforts

As pointed out above, while the pace of EV registrations has direct and indirect implications for slow charger OEMs, the public and semi-public infrastructure roll-out is more exposed to regulations, tender and permitting facilitation and available infrastructure money to deploy.

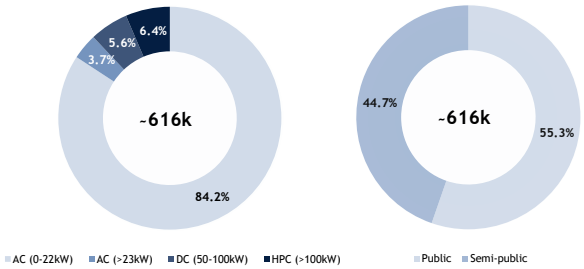
With multiple CPOs raising hundreds of millions last summer to execute their targets to deploy thousands of chargers by 2030 (EUR160m for Electra, EUR100m for Zunder, EUR75m for Fastned, EUR300m for NW Group, EUR240m for Zeplug, EUR150m for Powerdot), money is not the issue right now. As such, private operators whether in the slow residential/destination or the fast and ultrafast destination/en-route side accelerated their investments steadily throughout the year, the only limiting factor being the supply bottleneck for DC/HPC chargers and smart grid transformers.

Figure 12 - Total number of CPs between January 2021 and April 2023 in Europe



*Source: Eco-Movement, Stifel**

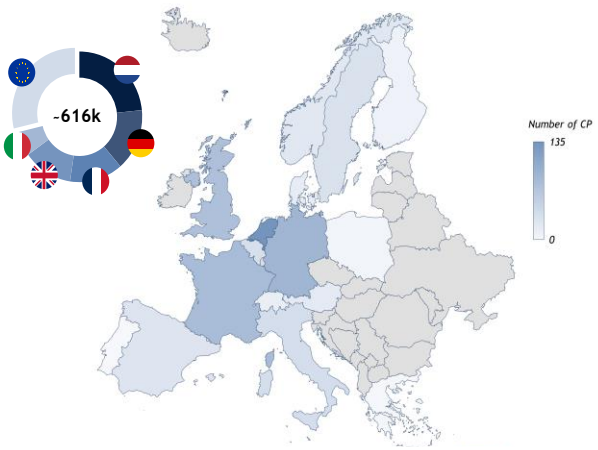
Figure 13 - European public EV charging network breakdown as of April 2023 (# CP excluding home and private workplace, % per type)



*Source: Eco-Movement, Stifel**

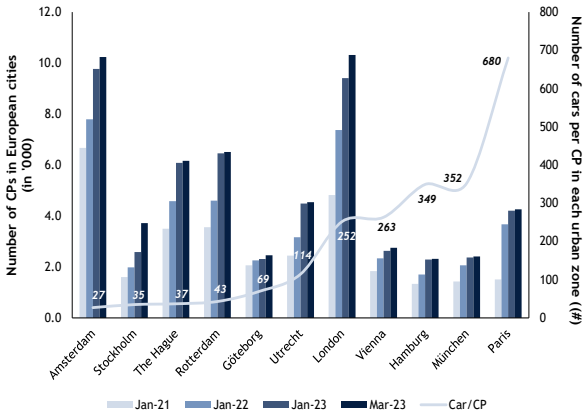
Now that everyone is competing for relevant charging sites and that grid operators are required to honor any charging site connection to the grid within six/nine months, relationships with EV charger manufacturers and site owners are key for CPOs to properly manage their ramp-up. Indeed, some might grow more than others only based on supplier preferred allotment, meaning pricing for HPC chargers should not be an issue.

Figure 14 - Public EV charging network state in Western Europe as of April 2023



*Source: Eco-Movement, Stifel**

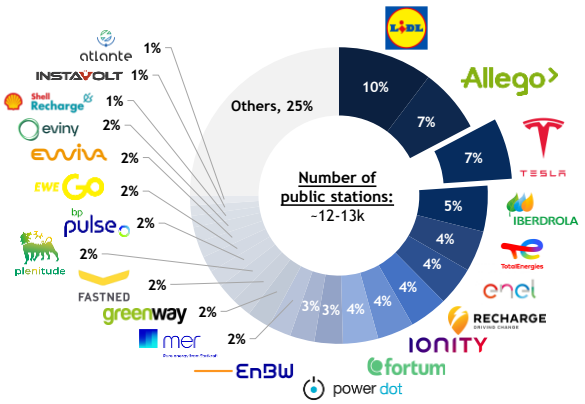
Figure 15 - State of Europe's 10 biggest EV charging cities as of April 2023



*Source: Eco-Movement, Stifel**

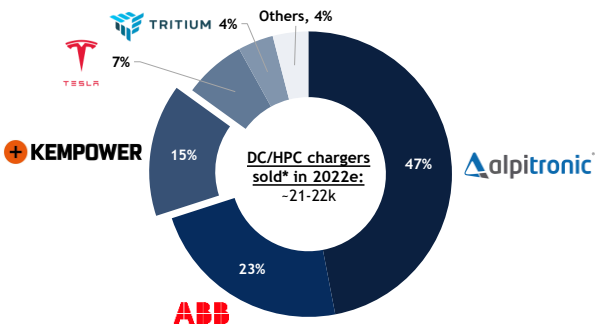
Nevertheless, given the size and strategic sponsors of some hybrid (Shell Recharge Solutions, BP Pulse) or pure HPC CPOs (Ewiwa, Ionity), order sizes for manufacturers can represent thousands of chargers, thereby drying significant manufacturing volumes from factories. With more than 600k chargers across Europe and above 35k HPC chargers, the shift towards e-mobility is underway, still led by Northern European countries but with an ongoing catch-up by Western European ones. As such, significant investments could stem from key cities, both forced by regulation milestones and the ramp-up in end-users to avoid range/plug access anxiety.

Figure 16 - DC/HPC CPO breakdown in number of stations in Europe as of April 2023



Source: Stifel, ChargeMap, ChargeFinder, companies' information*

Figure 17 - DC/HPC charging manufacturing in Europe as of end-2022

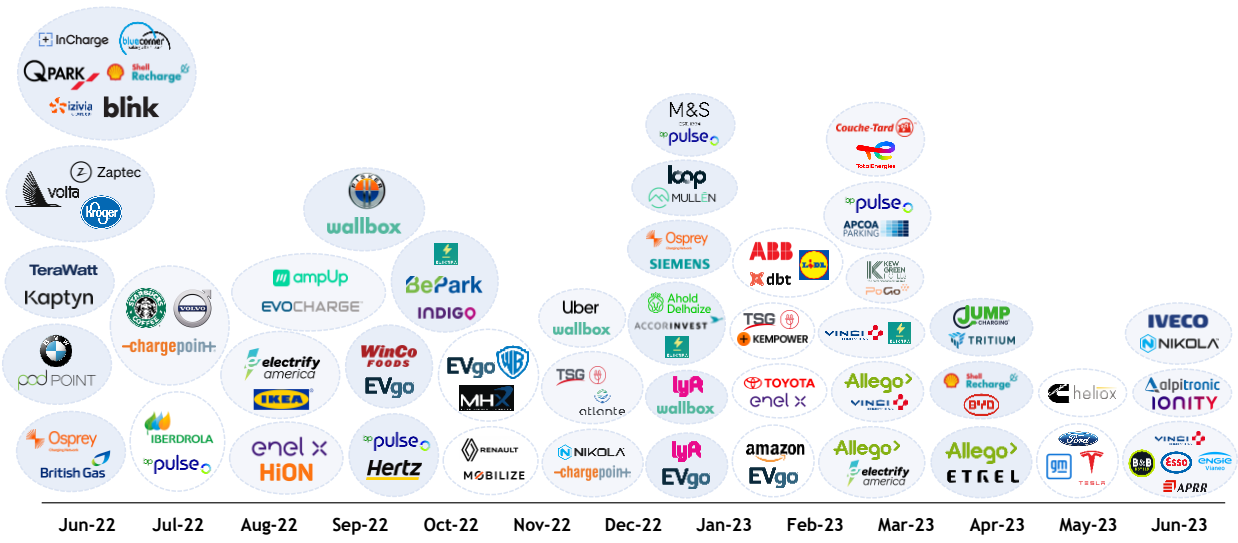


Source: Stifel, companies' information*

**or installed through intragroup activities (Tesla)*

The CPO market nevertheless remains quite fragmented with multiple players all rushing for valuable charging sites/EV chargers, and few relevant charger manufacturers answering both quality and availability needs of these infrastructure developers. As a result, lots of partnership and framework agreements have been developed by CPOs with destination place owners (grocery stores, retail/entertainment places such as Electra with Ahold Delhaize or AccorInvest in January 2023 or recently between Powerdot and Biedronka in July 2023), en-route placeholders (Vianeo/Electra with Vinci) but also with HPC OEMs (securing CRAs ; Ionity and Alpitronic) and automotive OEMs (Electra and Stellantis in last week).

Figure 18 - EV charging partnerships secured from June 2022 to July 2023



Source: Stifel, companies' announcements*

02

EV CHARGING TRENDS & DYNAMICS

ENHANCING POWER, SPEED, & EFFICIENCY

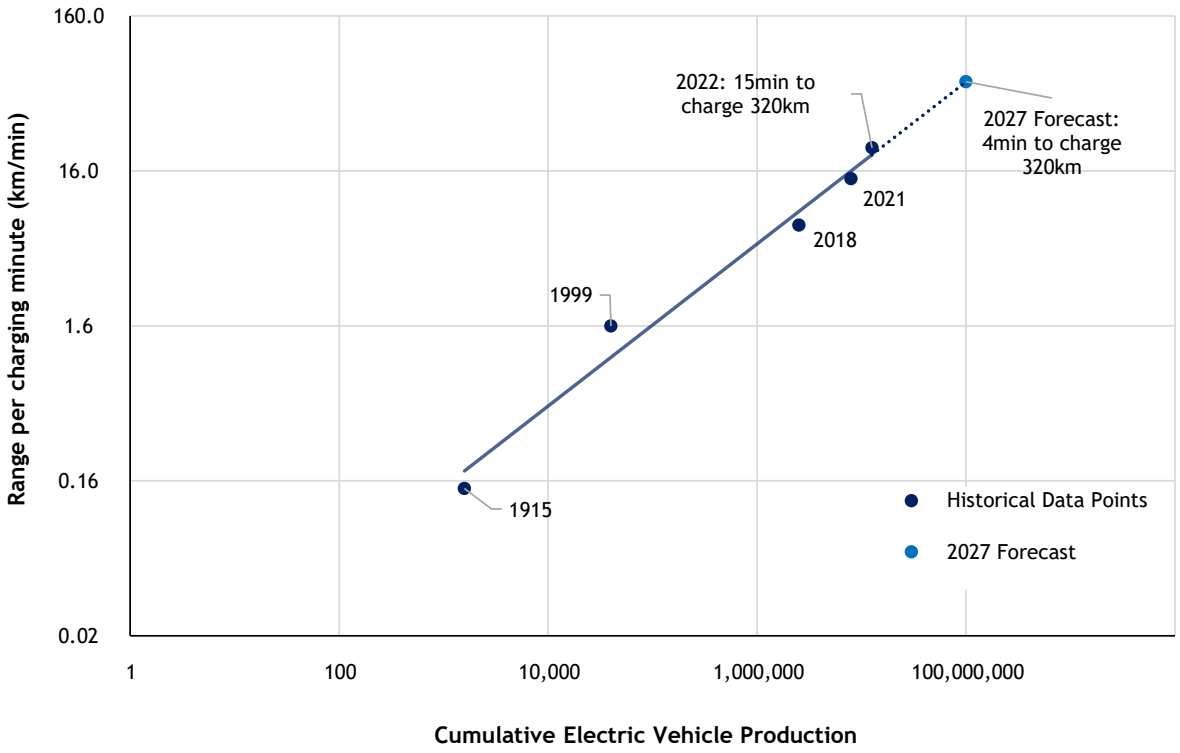
The EV charging sector is undergoing significant advancements aimed at reducing charging times and increasing efficiency. Innovations in battery technology and cooling systems are crucial for this evolution, allowing higher power levels while managing heat. The push for faster charging has created a competitive environment among both automotive and charger OEMs. This has resulted in significant investments in both high-power chargers and smart charging solutions. The dynamic nature of EV charging infrastructure development is bolstered by growing investor interest, highlighting the sector's potential for robust growth and consolidation.

Competition for more EV charging power …

Today, EV charging times are mostly limited because of the heat generated when current is supplied to batteries. The stronger the current, the more heat is generated. As such, there are two ways to deal with charging times: either through battery innovation to increase charging voltage (800V architecture first initiated by Porsche), improve cell design and introduce better BMS to directly manage charging curves according to the battery's own limitations, or through cooling devices/cooled conductors (first tested by NASA's FBCE). Both are needed going forward, as illustrated by Tesla with battery design/processing innovation (honeycomb, dry battery electrodes), the introduction of LFP (Ebusco) with lower gravimetric density but higher lifecycles or silicon polymers on the anode side. On the back of these R&D efforts, EV fast charging wait times should continue to follow their historical path, from 15km/min in 2021 to 80km/min by 2027-2030, coupled with lower internal resistances and higher energy densities, therefore accelerating the entire ecosystem scalability/adoption going forward.

Not only did this competition arise between automotive OEMs, rushing for energy density while allowing faster charging sessions, but this challenge also bounced back on EV charger OEMs. Indeed, given ever-growing needs for more power in mobility applications, eyeing on further facilitating light mobility and enabling battery-HDV, there is an overall shift towards more power. This can be seen with Alfen entering the 30kW segment for low DC CPOs (ie. on-street and destination parking lots) or Alpitronic/EVBox/Kempower releasing 400kW chargers and already eyeing 600kW-1MW chargers to support heavy-duty applications in the medium-term.

Figure 19 - EV charging wait times from 1915 to 2021 and 2027



*Source: IEA, Stifel**

Nevertheless, while this race first started with simple chargers (powerful but without modularity, i.e. 100% power on one plug for one vehicle), hardware providers have progressively been adapting their product to provide customers charging modularity. This is key to increase EV charging infrastructure efficiency, in terms of both the de-bottlenecking impact per EUR invested and investment yield.

Figure 20 - High but dynamic power is everything

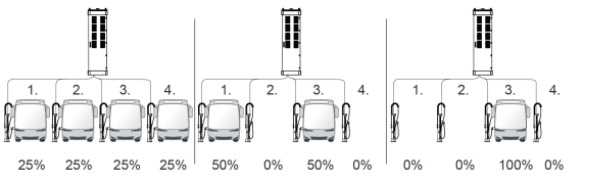
	alpitronic	ABB	KEMPOWER	EVBOX	DELTA	XCHARGE					
Model	HYC400	Terra HPC 360	Terra DC 184	C-Station	Troniq High Power	Troniq Modular	400kW	UFC 200	C7 Smart	C9LQ	C6EU
Modular	✓	✓	✓	✓	✓	✓	✗	✓	✓	✓	✗
Power module size	50W	90kW	90kW	50kW (25kW channels)	40kW	30kW	✗	40kW	?	?	✗
Max outputs per Power Unit	3 (2DC 1AC)	4	2	3 (2DC 1AC)	2	3 (2DC 1AC)	1	4 (2AC 2DC)	2	2-6	1
Max Power per output	400kW	360kW	180kW	400kW	400kW *(incoming)*	240kW	400kW	200kW	400-420kW	360kW	200kW
Dynamic load distribution	✓	✓	✗	✓	✓	✓	✗	✓	✓	?	✗
Illustration											

*Source: Companies' information, Stifel**

… rounded out by smart charging software

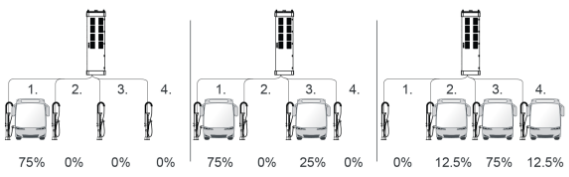
Both hardware and software innovations are required to bundle together powerful and intelligent EV chargers. Indeed, considering network operators green electricity and queueing constraints, hardware will rapidly need to be correctly designed to handle smart charging (i.e. with smaller power modules). As such, not only should EV chargers and/or power cabinets allow for controlled charging but power management solutions such as democratic/arrival priority or dynamic charging is required to increase the overall yield of EV charging installations.

Figure 21 - Democratic charging scheme



Source: Kempower

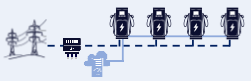
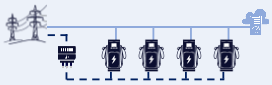
Figure 22 - Arrival priority charging scheme



Source: Kempower

In democratic systems, charging output is granted 25 or 50kW from the beginning of each charging session. The first vehicle receives maximum power until another vehicle starts a charging session. Depending on the number of cars in charge, the power modules, charging outputs and cable sizes, the remaining power is re-routed to other vehicles. In arrival priority, the first EV is granted maximum power from the beginning to the end of its session, freeing-up parking space for the next vehicles on a FIFO basis. However, with dynamic charging, the system adapts itself to EV specificities, identifying maximum charging power and closely monitoring the vehicle charging status to efficiently distribute/arbitrate between vehicles (according to 20-80% thresholds). As such, this solution would best fit infrastructure developers optimizing both capex and power delivered on a charging site according to traffic.

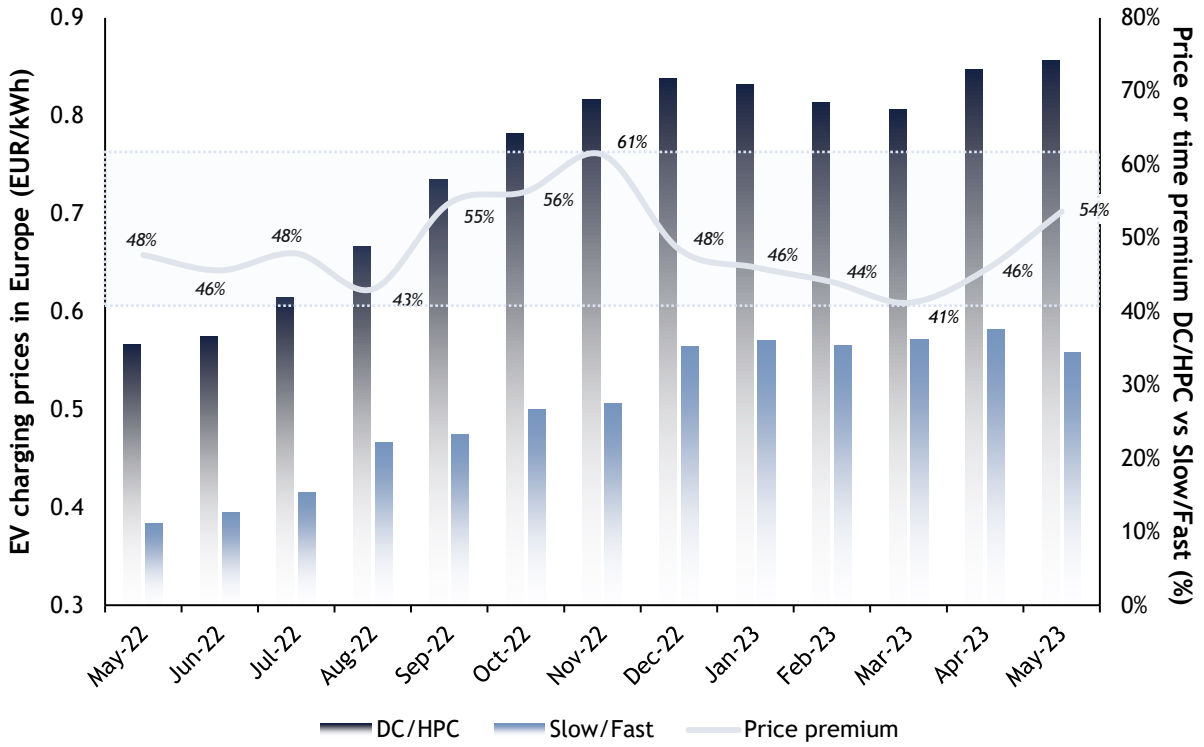
Figure 23 - EV charging software, the add-on bloc to clever designs

	Controlled charging technologies			
Name	Power Management	Intelligent Power Management	Local Load Management	Optimized Charging
Icon				
Description	Power limitation on each charging point not to exceed load limitations. Available load is manually managed according to the number of vehicles plugged but isn't optimized.	Dynamic distribution of the available load between charge points directly managed by an external controller running different algorithms, from first-2-come first-2-serve to privileged charging methods.	Microgrid power management between charging stations and other consumers on a local basis in order to balance power demand. As such, charging stations demand reduction can offset the ramp-up of production demand.	Using algorithms and data API, charging sessions can be optimized both on time, costs and self-consumption either from solar PV or home storage. Settings ensure charging takes place at low price but with high renewable share on the grid.
Hardware driven	✓	(✓)	✗	✗
Software driven	(✓)	(✓)	✓	✓
Local controller	✗	✓	✓	✓
Mass deployment				
Illustration				
Business Model	In controlled charging business, the model is built around existing infrastructure and often bundled with regular operations as an add-on. Charging-as-a-service and leasing solutions are increasing both on AC and DC/HPC charging. Main benefits are cost saving potentials from peak shaving.			

Source: Stifel, Improved*

This is not only important for CPOs to monitor their network (utilization rates, charging efficiencies, margins) but also for EV drivers to control their vehicle's electricity input. Indeed, while public charging helps reduce range anxiety, it comes at a higher price. From what we have observed, slow charging ranges with a 45-65% premium on home charging prices and fast charging tends to crystallize a 50% premium on slow charging. As such, it is key for EV drivers to be able to monitor EV charging prices at home, keeping TCOs as low as possible (~15-20kWh/100km for EVs vs 8-10l/100km for ICEVs).

Figure 24 - EV charging price index in Europe over the past 12 months



Source: Stifel, Zap-Map*

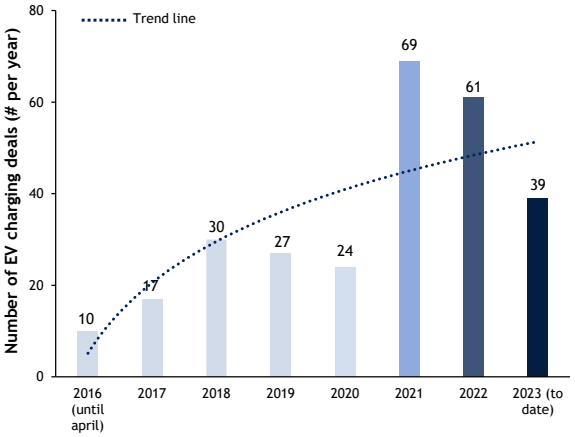
Indeed, EV charging prices can fluctuate widely according to energy costs and regulatory factors. However, it is crucial to note that not all operators face the same supply constraints, as some have secured long-term contracts with their suppliers. Operators decide whether or not to implement an aggressive pricing (response) policy based on the profitability threshold, although consumers generally, show limited sensitivity to it. Currently, location and overall station's reliability, including chargers and interfaces, remain the most significant factors to consider.

Investor awareness continues to increase

Investment activity in the EV charging ecosystem has multiplied globally by three to four times since 2016. A look at the number of transactions shows that activity skyrocketed in 2021, boosted by the macro environment and mounting interest in EVs, and also preserved from the automotive market downturn.

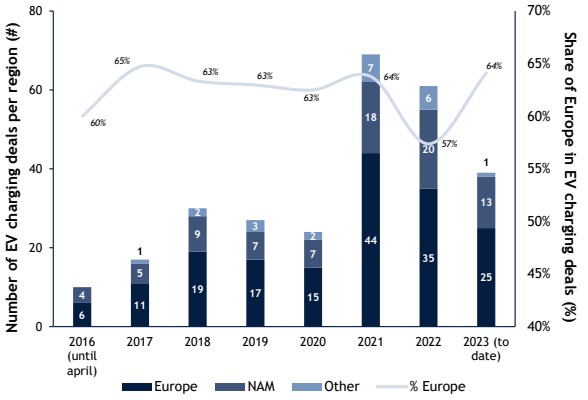
From a transaction value perspective, while OEM deals were generally larger in the past, the increasing pace in the EV charging infrastructure roll-out, whether in residential or destination charging with thousands of charging points being deployed and integrated into the grid, has placed pressure on CPO capex requirements and therefore led to significant fundraising operations over the last 12 months. As such, out of more than EUR2.4bn in communicated fundraising, about EUR1.6bn was related to EV infrastructure investments, directly shifting into the implementation of these targets. Consequently, while CPOs are growing quickly and remain quite fragmented, thereby leaving room for future consolidation, the OEM ecosystem has entered a temporary phase of clean-out while robust group's structure themselves to strategically address more growth going forward, and the weakest companies address growth or product misalignment challenges.

Figure 25 - Trends in EV charging deals between April 2016 and June 2023)



*Source: Pitchbook, MergerMarket, Stifel**

Figure 26 - Geographic breakdown of EV charging deals between April 2016 and June 2023



*Source: Pitchbook, MergerMarket, Stifel**

Software and e-MSP represent smaller amounts as they are more nascent in the ecosystem, but they are set to drive EV charging expansion and mass market adoption. From our discussions with OEMs and operators, we see a lot more room for consolidation on the charging point installers side.

Figure 27 - EV charging transactions from June 2022 to June 2023 (1/3)

Date	Target/Investee	Country	Description	Acquirer/Investor	Deal type	Financing Round / M&A rationale
Jun-23	OPCHARGE	NL	Operator of charging stations intended for public, business and private use	asn bank, AEGON Asset Management, RAMPHASTOS	M&A	PE Growth/Expansion
Jun-23	SERVICE4CHARGER	DE	Operator of an electronic charging platform intended for vehicles in public places	bp ventures, energie360°	M&A	Series A
Jun-23	efacec	PT	Developer of energy infrastructure facilities intended to design a smarter future	mutares	M&A	Acquisition
Jun-23	BORN	FR	Provider of charging equipment and services based in Lille, France	LESAFFRE, VERBAERE, AT2i	M&A	Joint Venture
Jun-23	CargaTuCoche	ES	Provider of automotive services specializing in the installation of EV charging points	René de Jong	PP	Seed
Jun-23	gyeve	GB	Developer of rapid EV charging system intended for fleet operators and car park owners	KERO	PP	Series B
May-23	Niveau	US	Manufacturer of fast-charging lithium batteries for increased power storage efficiency	sente ventures	PP	Series B
May-23	SPARKCHARGE	US	Manufacturer of EV charging units designed to eliminate the challenges of wired infrastructure	Undisclosed	PP	Series D
May-23	CHAEVI	KR	Manufacturer of EV charging platform to enhance the future of mobility	KB Asset Management	PP	Series C
May-23	powy	IT	Provider of EV charging services intended to contribute to the growth of sustainable mobility	SwissLife Asset Managers	M&A	Acquisition
May-23	Electrada	US	Provider of EV charging infrastructure to overcome accessibility and reliability hurdles	BlackRock	PP	Series B
May-23	HEVO	US	Developer of wireless charging units designed to charge EVs on the go	WEFUNDER	PP	Crowdfunding
Apr-23	COMPLEO	DE	Charging solutions providerfor EVs for various use cases, including public and semi-public charging	KOSTAL	M&A	Merger/Acquisition
Apr-23	INDUCTEV	US	Developer of a wireless power charging technology to meet the needs of EVs	Oshkosh, RCH Energy, Robert Jones, Ryan Leonard, Stephen Carras	PP	Series G
Apr-23	rabot.charge	DE	Provider of digital charging services for Evs	High-Tech Gründerfonds, vent.io	PP	Seed
Apr-23	VE	US	Manufacturer of energy storage and infrastructure systems for transportation	In-progress	PP	Series A
Apr-23	VELTIUM	ES	Operator of charging stations to offer simple charging devices	capital energy	PP	Series A
Apr-23	EARTH X ENERGY	US	Operator of an EV charger at multi-unit points for residential living and property owners	In-progress	PP	Seed
Apr-23	ALD Automotive, chargepoint	FR	Provider of EV charging network intended to enhance regional connectivity	ALD Automotive, chargepoint	M&A	JV
Apr-23	ALVERI	AT	Provider of e-mobility services intended for charging infrastructure and driving behavior	GreenTech Venture	M&A	Series B
Apr-23	CHARGEWELL	AT	Operator of an e-mobility platform to offer sustainable charging stations for different locations	BRM	PP	Series A
Mar-23	urban electric	GB	Developer of a retractable on-street charge point for drivers without a garage or drive	Balfour Beatty	M&A	Asset Financing
Mar-23	ELECTRIC CHARGING	FR	Manufacturer of installation systems intended to provide charging stations for EVs	YESSS RENEWABLES, CONQUEST	M&A	PE Growth/Expansion
Mar-23	VE	US	Manufacturer of energy storage and infrastructure systems for transportation	ITV Itochu Technology Ventures, ECLIPTIC CAPITAL	PP	Series A

*Source: Pitchbook, MergerMarket, Stifel**

Figure 28 - EV charging transactions from June 2022 to June 2023 (2/3)

Mar-23	EZ-CHARGE	GB	Developer and manufacturer of charging infrastructure to offer charging car parks across the UK	GREEN TOWER	M&A	Asset Financing
Mar-23	e-totem	FR	Manufacturer of charging systems and provider of installation services	CONQUEST, bpifrance	M&A	PE Growth/Expansion
Mar-23	BONNET	GB	Developer of an EV charging point platform in Europe	20VC, Blue Impact Ventures, Deliveroo, GV, Lightspeed Venture Partners, TIER, WISE BCI	PP	Series C
Mar-23	INDRA	GB	Developer of smart charging and energy storage systems	Gulf	PP	Series B
Mar-23	it's electric	US	Developer of curbside EV charging facility intended to cater to cities	Brooklyn Bridge Ventures, Clean Energy Venture Group, Climate Tech Circle, Graham & Walker, Keeler Investments Group, Pericles Group, The Helm, XFactor Ventures	PP	Seed
Mar-23	Inbalance	LT	Developer of EV charging system	Verslo Angelų Fondai II, CIVINITY, ORION, Urban Mobility	PP	Series C
Feb-23	CATALYZE	US	Integrate smart energy resources into new and existing infrastructure	EnCap Investments L.P., ACTIS	M&A	PE Growth/Expansion
Feb-23	eo CHARGING	GB	Designer and manufacturer of smart EV chargers based in the United Kingdom	zouk, vortex energy	M&A	PE Growth/Expansion
Feb-23	ANYOS	FR	Operator of a digital charging station for charging services for electronic automobiles	bpifrance, CIC, seed	PP	Series A
Feb-23	blink	US	Owner, operator, and provider of EV charging services	Public	SO	Secondary Offering
Feb-23	eSmart networks	GB	Provider of large-scale EV charging infrastructure intended to serve EV industry	FWCP Spark (UK) Holdco	M&A	Merger/Acquisition
Jan-23	ORANGE	US	Developer of charging infrastructure designed to offer electric-vehicle charging resolutions	Arash Keshmirian, Baukunst Collective Investments, Elevation Capital, Intelis Capital, Jonathan Crowder, Marc Geller, Marc Tarpenning, Martin Eberhard, Sven Thesen	PP	Seed
Jan-23	volta	US	Commerce-centric EV charging networks	Shell	M&A	Merger/Acquisition
Jan-23	3ti	GB	Operator of a solar car park company to turn car parks into renewable energy power stations	Silicon Angel Syndicate Climate Change Fund	PP	Series A
Dec-22	eshore	IT	Provider of electric mobility services	L2B CAPITAL	M&A	Merger/Acquisition
Dec-22	evviva	IT	Operator of an EV charging stations network based in Rome, Italy	Volkswagen, enelxway	M&A	JV
Dec-22	powerflex	US	Developer of EV charging network to transform any organization into a clean-energy facility	Manulife Investment Management	M&A	PE Growth/Expansion
Nov-22	rabot.charge	DE	Provider of charging services for EVs to become a sustainable and digital energy service provider	yabeo, ardian	PP	Seed
Nov-22	UNIFIED CHARGERS	FI	Manufacturer of EV charging stations to offer charging solutions with services	enersense	M&A	Merger/Acquisition
Nov-22	eleport	EE	Developer of charging stations designed to provide EV charging services	Gren	M&A	Series A
Nov-22	THE MOBILITY HOUSE	CH	Developer of energy storage and EV charging products	Alliance Ventures, Mercedes-Benz Group, Mercuria Energy Trading, Mitsui & Company, SP Group, Ventura Capital, Wermuth Asset Management	PP	Series C
Nov-22	AMP empowering mobility	US	Provider of automotive software and hardware services to drive e-mobility to the global mass market	EIF Ecosystem Integrity, HELLA Ventures, helios Climate Ventures, GRIMLEY CAPITAL	PP	Series A
Nov-22	WAAT	FR	Installator of charging stations	RAISE	PP	Series C

*Source: Pitchbook, MergerMarket, Stifel**

Figure 29 - EV charging transactions from June 2022 to June 2023 (3/3)

Oct-22	beev	GB	Operator of a network of EV charging stations based in Manchester, England	octopus energy	M&A	Asset Financing
Oct-22	Andersen	GB	Developer of customizable charge points designed to provide an alternative energy source for EVs	EVIOS	M&A	Merger/Acquisition
Oct-22	FASTNED	NL	Fast charging services provider for EVs	Schroders capital	SO	PIPE
Oct-22	zunder Charging Hero	ES	Developer of electric chargers to create a network of charging stations	White Summit Capital, mirova	PP	Series C
Oct-22	EDGE energy	US	Manufacturer of single-phase EV chargers to build reliable charging networks	CZVENTURES	PP	Series A
Oct-22	GOPOWEREV	US	Provider of EV charging services to solve today's transportation challenges	Good Growth Capital, Ecosphere Ventures	PP	Seed
Oct-22	loop ev charging network	US	Operator of a next-generation energy network	FIFTH WALL, AGILITY VENTURES, KEYSTONE NATIONAL GROUP	PP	Series A
Sep-22	Kopperfield	US	Operator of a home electrification platform for contractors and consumers	BIG Ventures, Cristina Cordova, General Catalyst, Giant Ventures, Gokul Rajaram, Kiran Bhatraju, Lachy Groom, MCJ Collective, Tobias Lutke	PP	Seed
Sep-22	FlexCharging	US	Operator of EVs charging platform designed to help prepare for the residential EV charging influx	accurant international	PP	Series B
Sep-22	DCS	SE	Retailer of EV chargers	sparc	M&A	Merger/Acquisition
Sep-22	bump	FR	Operator of an EV charging network to reduce carbon emission	DIF CAPITAL PARTNERS	M&A	Acquisition
Sep-22	BORNES SOLUTIONS	FR	Provider of charging stations for EVs in condominiums	ZEPLUG	M&A	Merger/Acquisition
Sep-22	ZEPLUG	US	Provider of EV charging services to offer private charging terminals	ICG ENTERPRISE TRUST	PP	Series C
Sep-22	EMPOWER SOLAR	US	Operator of a solar equipment company	SUNPOWER, MILKBOX PARTNERS	PP	Series A
Sep-22	CONNECTED KERB	GB	Provider of EV on-street residential charging technology	AVIVA INVESTORS	PP	PE Growth/Expansion
Sep-22	TROJAN ENERGY	GB	Developer of an EV charging system designed to make car charging available to everyone	The Scottish National Investment Bank	PP	Series D
Sep-22	MONTA	DK	Developer of an operating platform designed to power the EVs ecosystem	byFounders, Headline, BLUECO, AENU, CREANDUM, ENERGIZE	PP	Series A
Sep-22	VE WHEEL	US	Manufacturer of energy storage and infrastructure systems for transportation	ELEVATION VENTURES	PP	Series A
Aug-22	SPARKCHARGE	US	Manufacturer of EV charging units designed to eliminate the challenges of wired infrastructure	Automotive Ventures, BoxOne Ventures, Cleveland Avenue, Driven Capital Partners, E8, Mark Cuban, Pendulum Holdings, Pusha T, Revolution/ROTR, Summer Watson, SVB Financial Group, Tale Venture Partners	PP	Series A
Aug-22	HYPERVOLT	GB	Operator of electric charging networks to provide EVs to get charged anytime, anywhere	SHORE WIND CAPITAL, ARC GROUP, BIRCH HILL equity partners	PP	Series A
Aug-22	gogo	IN	Developer of EV charging solutions designed to build a robust network with charging stations	Olivier Guillaumond	PP	Series A
Aug-22	ATOM POWER	US	Developer of EV charging solutions designed to charge multiple vehicles at once	SK	PP	Series C
Aug-22	Clenergy EV	GB	Provider of EV charge point services to facilitate sustainable mobility	SMS	M&A	Asset Financing

*Source: Pitchbook, MergerMarket, Stifel**

03

NORTH AMERICA, THE NEXT BIG MARKET

EXPLORING THE OPPORTUNITIES AND CHALLLENGES IN THE RAPIDLY GROWING NORTH AMERICAN EV CHARGING LANDSCAPE

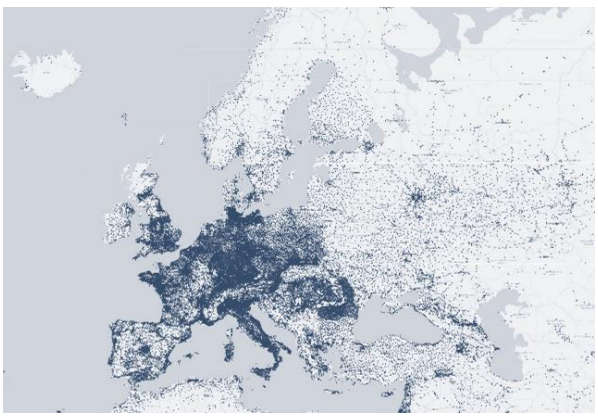
North America is poised to become a significant market for EV charging infrastructure, driven by substantial federal investment and policy initiatives like the Inflation Reduction Act (IRA). These policies aim to shift industrial focus from Europe to the US, encouraging investment in EV manufacturing and charging infrastructure. As a result, the North American market is expected to witness a rapid expansion in EV charging networks, accompanied by regulatory and competitive dynamics that will shape its growth. The adoption of Tesla's NACS standard and significant investment in DC/HPC chargers are key trends to watch.

Sizing North American markets

With the Inflation Reduction Act (IRA) considered as one of the most consequential bills in recent US history and the subject of fierce debate in the European Union, the rules of the industrial game are rapidly evolving and could make companies re-prioritize their investment plans from Europe towards the US. As a demand policy, EVs, chargers and battery manufacturing will be impacted, with subsidy schemes depending on protectionism measures and industrialization politics. Opportunities for new entrants should continue to arise, with a full supply chain reset on both sides of the Atlantic which could be accompanied by durable price inflation related to relocation. To ensure access to charging by 2030, the Biden administration has publicly committed to building a national network of at least 500,000 DC/HPC chargers by 2030:

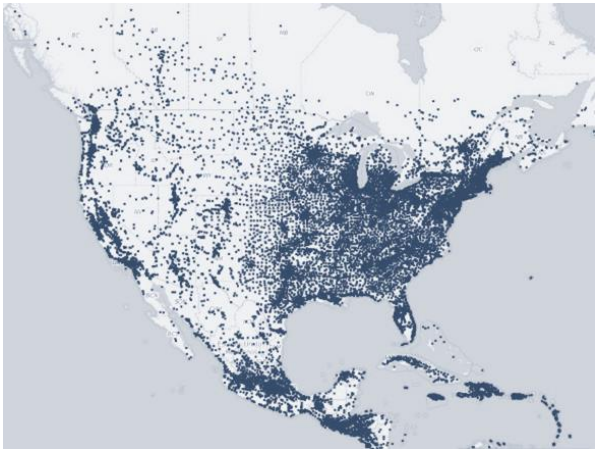
- Infrastructure Investments and Jobs Act, USD1,200bn (o/w USD550bn in 2021)
  - Buy American Act: already existing since 1933, the new "Build America Buy American" Act sets domestic content procurement and production preferences for infrastructure projects benefiting from Federal financial assistance. As such, subsidized EV chargers would need to be assembled in the US, with at least 55% of the BOM by 2024 from the US.
  - NEVI Program, Community & Corridor Charging grants: USD7.5bn state financing for the deployment of a base EV infrastructure (one station every 80km, only with HPC chargers) as is the case with the TEN-T network in Europe.
- Inflation Reduction Act (2022): USD394bn allocated for clean energy aiming at diversifying supply chains from China, increasing clean electricity production, on-shoring key component manufacturing, accelerating the electrification of transport, and deploying leading-edge green technologies. EV related initiatives within the IRA namely translate into at least USD25bn in subsidies, with USD7.5k per new BEV registration or USD4k for a used one and up to USD1k per home charger for individuals and either 30% of total installation costs or up to USD100k per HPC charger for corporates.

Figure 30 - Mapped European population density ('000 inhabitants per dot)



Source: Geonames, Harvard

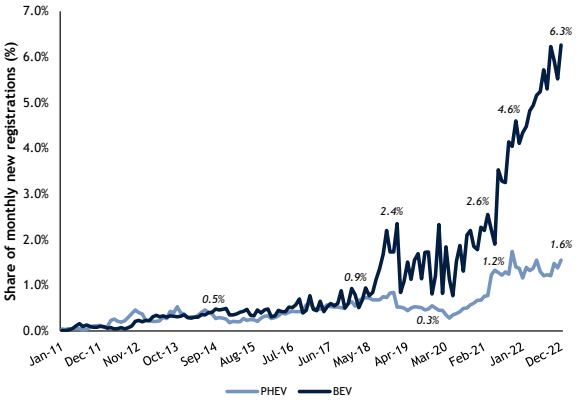
Figure 31 - Mapped NAM population density ('000 inhabitants per dot)



Source: Geonames, Harvard

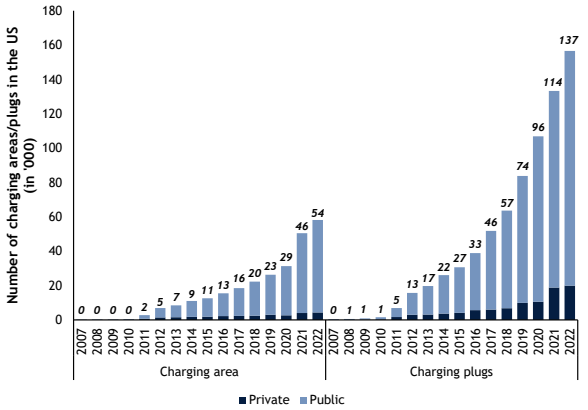
As previously highlighted, from a population, political ambition and regulatory viewpoint, the European and US markets are quite similar when it comes to EV charging infrastructure. While it is true that short- and long-haulage do not share the same structure in Europe and the US, and that personal cars tend to be bigger in the US than in Europe, EV charging infrastructure roll-out schemes in both countries are being established to tackle the chicken-and-egg dilemma, with a core network to bridge the transition.

Figure 32 - Monthly BEV and PHEV share of new registrations in the US since 2011



*Source: EERE, Stifel**

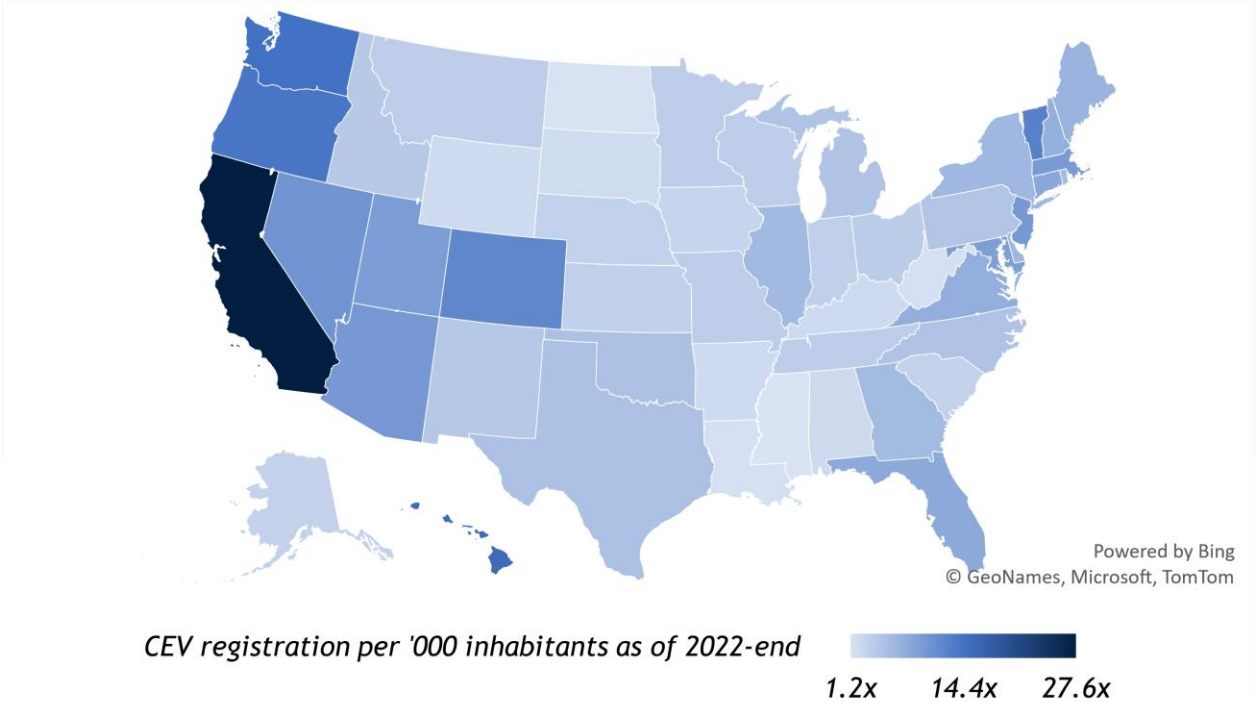
Figure 33 - Number of public/private EV charging sites and plugs in the US since 2007



Source: Stifel, AFDC*

With less than 1% of the vehicle fleet electrified in the US and about 808k CEVs registered in 2022 (~7-8% of total registrations), the EV journey clearly has a long way to go but as long as EV lines and EV charging infrastructure improve in the country, the region should gradually follow the European path.

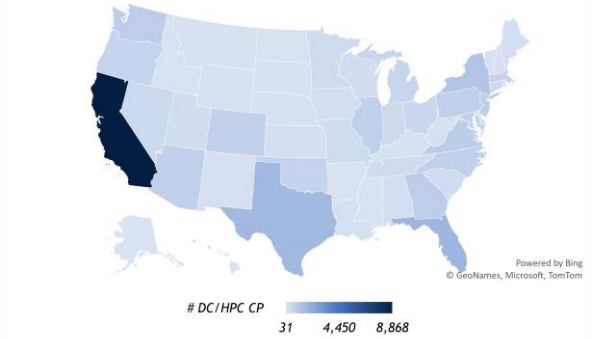
Figure 34 - CEV registrations per thousand people in the US as of 2022-end



*Source: US DOE, Stifel**

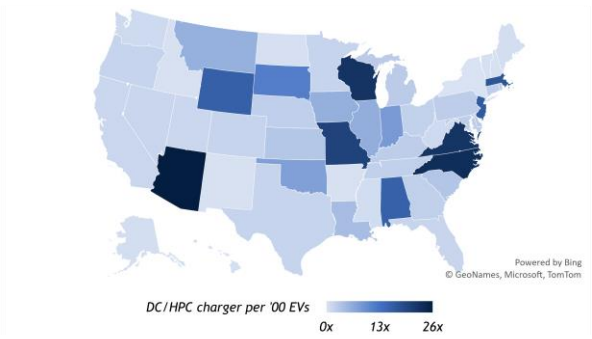
Like Europe with richer Northern countries vs Southern ones, there is a strong disparity in terms of BEV adoption between the US coastal and rural areas, which is also reflected in DC/HPC charging infrastructure.

Figure 35 - Number of DC/HPC chargers in the US, breakdown per State as of 2022-end



Source: Stifel, AFDC*

Figure 36 - DC/HPC charger per '00 EV in the US, breakdown per State as of end-2022



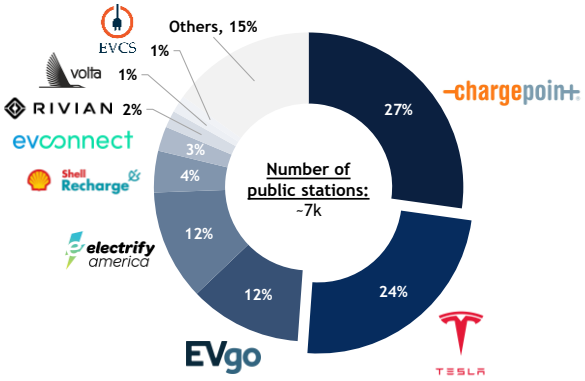
Source: Stifel, AFDC*

Our top-down analysis is based on our estimates for EV charger requirements in Europe (34m and 65m respectively by 2030 and 2035) and a corresponding share for DC/HPC chargers (5%). Considering similar market sizes between the two regions (380m inhabitants in NAM vs 450m in the EU, close to 290m passenger vehicles, 9-12m registrations per year as well as similar inhabited surfaces in both regions), the number of EV chargers installed should fall in similar ranges by 2035, however with a slight delay in the pace of the roll-out in NAM considering lower penetration rates of BEVs in the US compared to Europe in 2022-2025, and a gradual catch-up out to 2035.

Who's active in these markets?

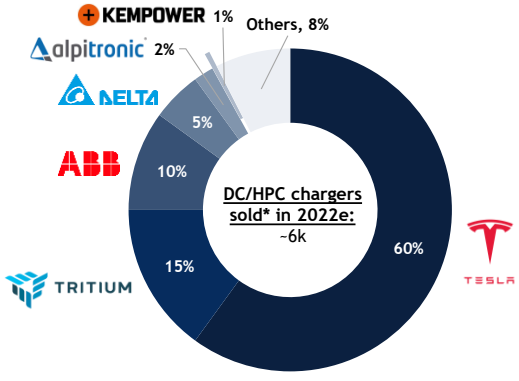
The EV charger market is attracting significant attention as governments and companies strive to capitalize on growing demand for EVs. However, the implementation of the BABA act mentioned above with a program of up to USD7.5bn in the US could challenge the established order between manufacturers in the industry (CPOs are quite agnostic, even if this could result in higher charger prices).

Figure 37 - DC/HPC CPO market breakdown in number of charging stations in the US as of April 2023



Source: Stifel, AFDC*

Figure 38 - DC/HPC charging manufacturing in the US as of end-2022



Source: Stifel, companies' information*

**or installed through intragroup activities*

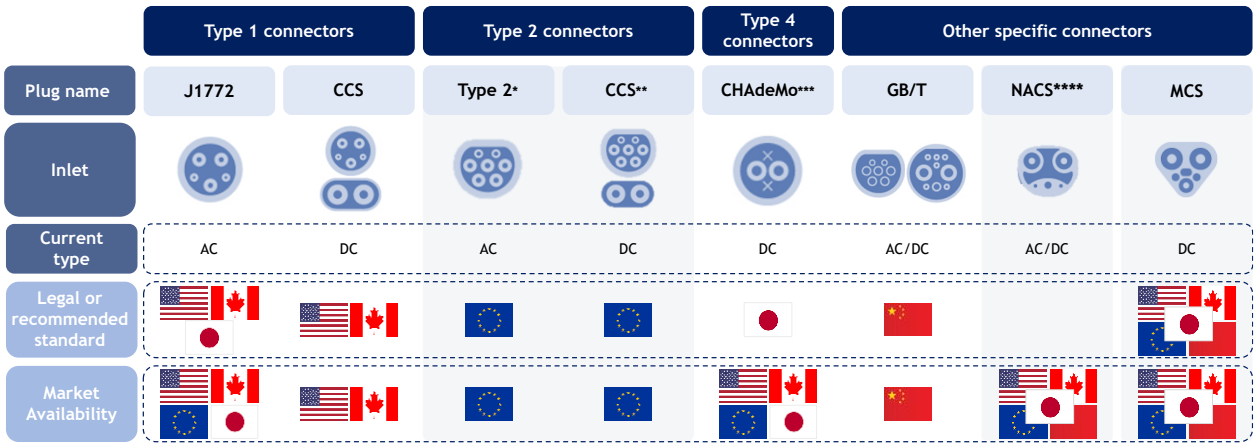
Indeed, to comply with BABA terms, companies are required to ensure that 55% of the BoM is sourced from US and FTA-related areas by 2024, creating an urgency among OEMs to relocate to the US. This is especially true for slow chargers as the DC/HPC market is quite nascent, reshuffling the cards among established and rising players in both markets.

Several prominent companies have entered the market and now have expansion plans in the region such as Kempower, Alpitronic, SK Signet, Siemens or ADS-TEC. While this is unlikely to offset established players such as Tesla, Tritium, ABB e-Mobility, Delta, XCharge or Zerova Technologies (Phihong), the Chinese players are nevertheless designated targets of such initiatives and competition should rapidly evolve in NAM given that moving production from one region to another typically takes 12-18 months.

Tesla: a top dog in Destination Charging?

Since open-sourcing in November 2022, there has been a lot of changes for NACS, Tesla's EV charging "standard". Even if CharIn stands by CCS (Combined Charging System) and MCS (Megawatt Charging System), the association also supports the standardization of NACS in the roll-out of EV charging infrastructure in NAM.

Figure 39 - EV charging plugs across geographies, CCS vs NACS?



** AFID Annex II requires AC charging stations to be equipped at least with socket outlets of Type 2 EV connectors for interoperability purposes.*

*** AFID Annex II requires high power DC charging stations to be equipped at least with "Combo 2" (CCS2). It is the charging standard on recent EV models such as BMW I3/iX3, Fiat 500e, Mercedes EQC, Jaguar I-Pace, Audi e-Tron, Volkswagen e-Golf/ID.3, Tesla Model 3 and Porsche Taycan.*

**** Used in Japan and in Europe (France requires all fast-charging points to include a CHAdeMo connector by the end of 2024. It is the charging standard on EV models such as Citroën Berlingo Electric/C-Zero, Kia Soul, Mitsubishi Outlander PHEV/iMiEV, Nissan eNV-200/Leaf and Peugeot iOn.*

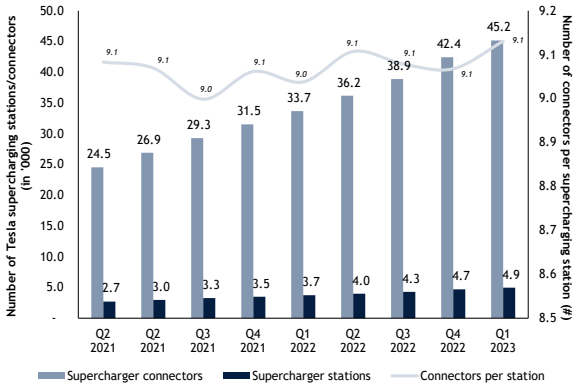
***** Tesla's own connector in NAM (under CCS protovol), open-sourced since November 2022.*

Source: Stifel, Electrek*

As such, CharIn will convene an open task force to submit NACS to the standardization process. This highlights how Tesla, after batteries, drives EV innovation and can create in-drafts in EV markets.

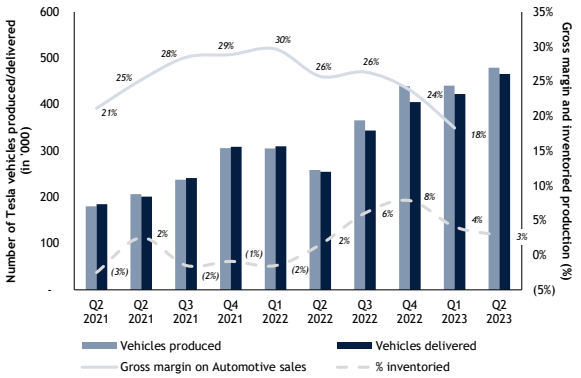
This is interesting because now that it has been adopted by GM and Ford (joining ABB e-Mobility and EverCharge) since June 2023 for their next-gen vehicles (by 2025) and rumors from Hyundai/Kia being interested, the standardization of NACS and its adoption by other manufacturers could mean that CCS1 will be phased out in NAM. Indeed, with more than a third of NAM vehicles going to market each year (Tesla, Ford, GM cumulated), and 50% of the public ultrafast charging network in the US, the trio supports a strong case for NACS standard, potentially boosting EV sales in the region by lowering range/plug access anxiety.

Figure 40 - Tesla Destination Charging network since 2021



Source: Stifel, Tesla*

Figure 41 - Tesla production/deliveries and gross margin dynamics since 2021



Source: Stifel, Tesla*

But what are the differences between CCS and NACS?

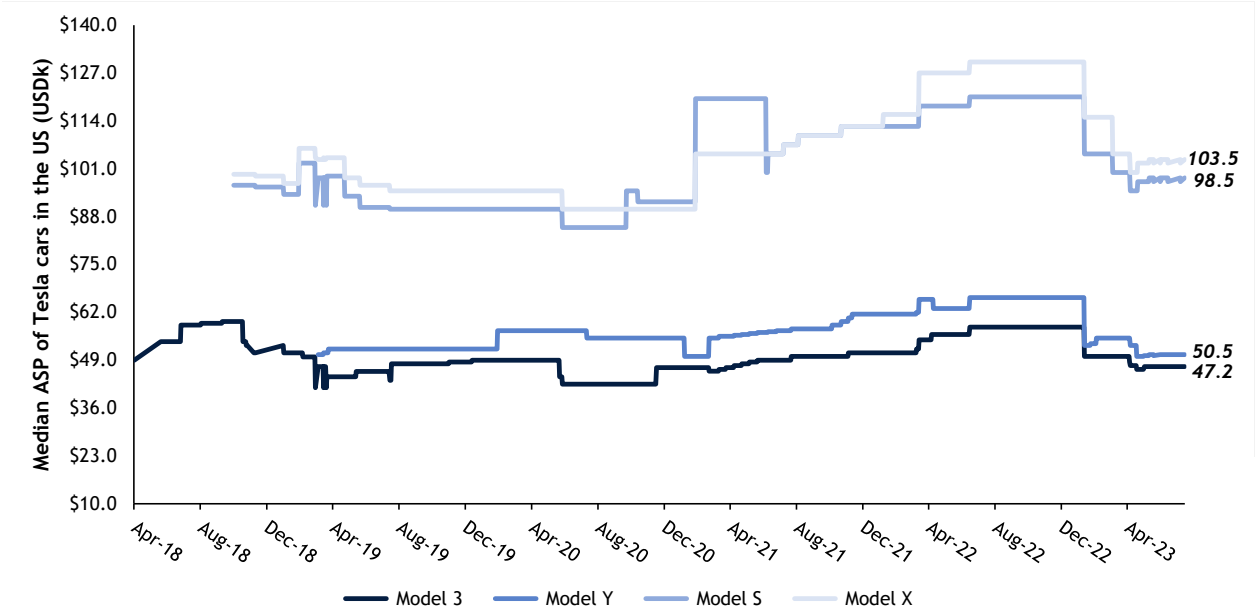
- NACS follows CCS protocols in itself but only uses a smaller and lighter connector. As such, Teslas can charge on otherwise existing CCS chargers using an adapter.
- Many more NACS HPC chargers than CCS1 in NAM given Tesla's extensive supercharger network (more than 15k HPC plugs in the US, ie. >54% of the entire HPC network), playing a crucial role in the transition to EVs.

While CCS1/CCS2 has been widely adopted in Europe and other regions, the adoption of NACS in North America presents significant advantages for consumers, manufacturers, and charging infrastructure providers, all incentivized in a rapid but smooth scale-up of EVs in the region (a customer-centric approach to incentivize the EV switch).

The most impacted by this switch if it materializes would be NAM CPOs (such as EVGo, Electrify America, ChargePoint …) as they could need to adapt to a new standard.

Nevertheless, Tesla should primarily continue to focus on being an automotive OEM rather than an EV charging infrastructure provider. Its CPO efforts first serves to address the chicken and egg dilemma and then fuels its brand effect, tilting margin upwards. Indeed, Tesla's extensive EV charging network in the US acts as a psychological barrier for customers when eyeing competition, because choosing a Tesla allows a customer to leverage access to 100% of the public EV charging network.

Figure 42 - Tesla's selling prices since 2018 (USDk w/o tax credit incentives)



Source: Stifel, Electrek*

Consequently, we see Tesla placing all hands-on automotive sales and manufacturing scale-up, arbitrating margins for growth as pointed out by CEO Elon Musk in April 2023, and potentially paving the way for further price decreases in the medium-term in order to reduce inventories.

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- Banking Services:
  - Bank and Trust with USD 31bn+ in assets(2)
  - Full suite of deposit and lending products and services

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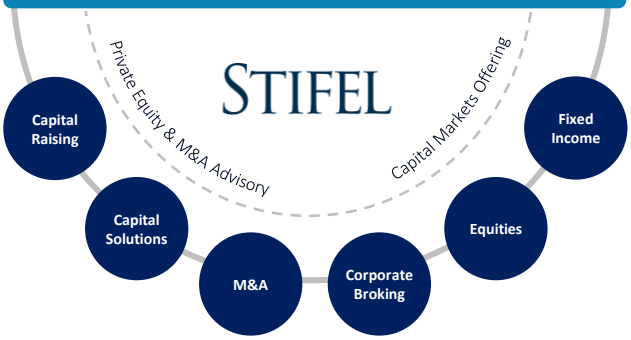

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FIG


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Technology

Note: (1) As at 02 February 2025; (2) as of 31 December 2024

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