

**strategy&**

*Part of the PwC network*

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# EV charging market outlook

A continued quest for profitable growth in the fast-growing, yet highly competitive, EV charging market

April 2024



# Focus of this year's EV charging outlook



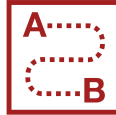
## Clear long-term shift to electrification for light and heavy transport

- There is ever clearer regulatory certainty for light-, medium- and heavy-duty vehicle electrification in Europe and China towards '35
- Share of new BEV sales of <6t is expected to reach 96% in Europe and 78% in China; translating to 36% and 49% of total stock
- For >6t the share of new BEV sales is expected to reach 62% and 41%, and stock to reach 22% and 26%, in Europe and China, respectively



## Delivering profitable growth is high on the agenda across the ecosystem

- Highly competitive EV charging market with players playing across 7 ways to play from HW, SW specialists to integrated solutions, owners & operators
- Volatile BEV sales/ country-specific HW and roll-out incentives influence growth rates
- Only a handful players reaching profitability in HW and CPO businesses



## Shift to mass adoption of BEVs in Europe requires focus

- In '23 BEVs accounted for 16% of total new sales; the EU Commission's aim is 95%+ in '35
- We look at four key aspects to address to overcome short-term variations:
  - i) Affordable and sufficient BEV models
  - ii) Residual BEV value and battery wear
  - iii) Charging accessibility
  - iv) Charging user-experience incl. price



## Adjusted valuations, fewer deals, but financing still achievable for strong cases

- Valuation adjustments of publicly listed players
- M&A volumes reduced in 2023, deals driven by:
  - i) Consolidation of overextended HW companies
  - ii) Financing innovative solutions
  - iii) Debt financing for public charging operators
  - iv) Infrastructure investors expanding asset-heavy CPO investment into frontier markets
- To hedge the growth risk, JVs grow in popularity



## Clear charging energy demand, with preference for wired tech

- 400+ TWh and 780+ TWh charging demand in Europe and China respectively by 2035
- Clear use cases for private and public charging; shift in demand from 75%+ private to more public fast charging, as already the case in China
- Wired charging as the main technology, with a push for battery swapping mainly in China<sup>1</sup>
- Over 150m chargers and ~54k swapping stations needed for Europe and China by '35



## Integrating EV charging in the wider energy ecosystem unlocks potential

- EV charger increasingly combined with on-site battery storage & power generation and optimized across a wider network to speed up roll-out, deal with peak demand, and tap into the evolving energy flexibility markets
- Profitable business cases are highly site-, region- and country-specific
- Evolving partnerships to convert CPO businesses into energy businesses



# 1

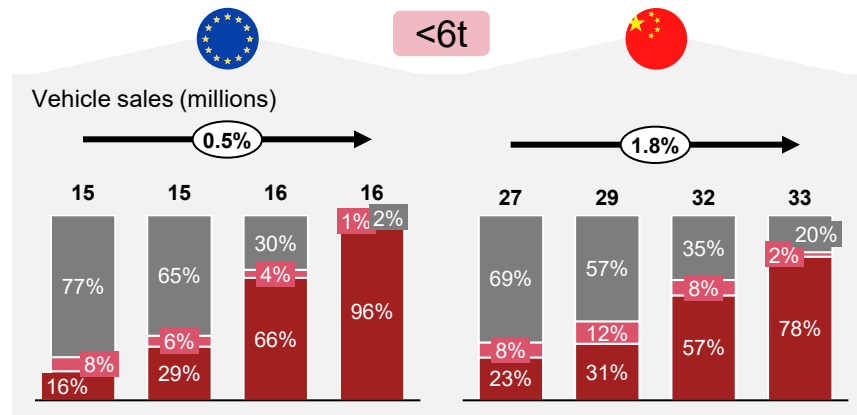
## Electrification of LDV/HDV

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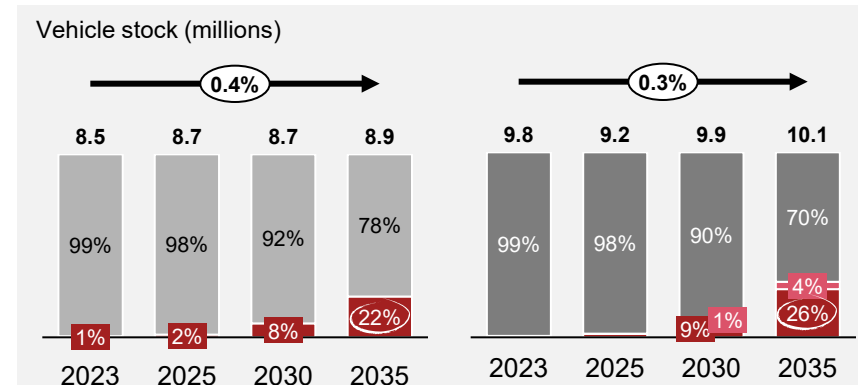
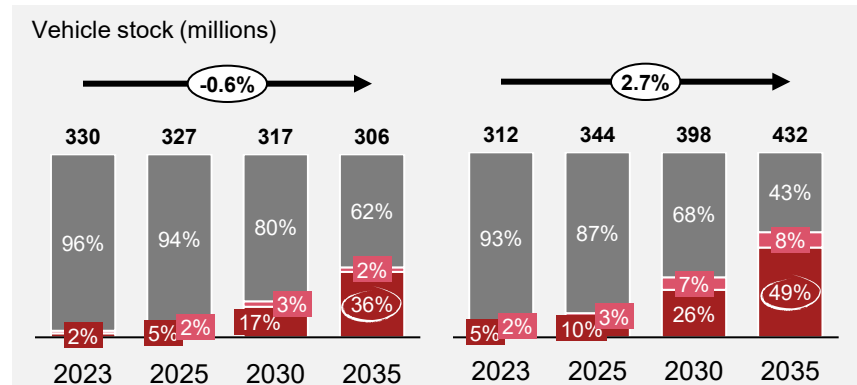
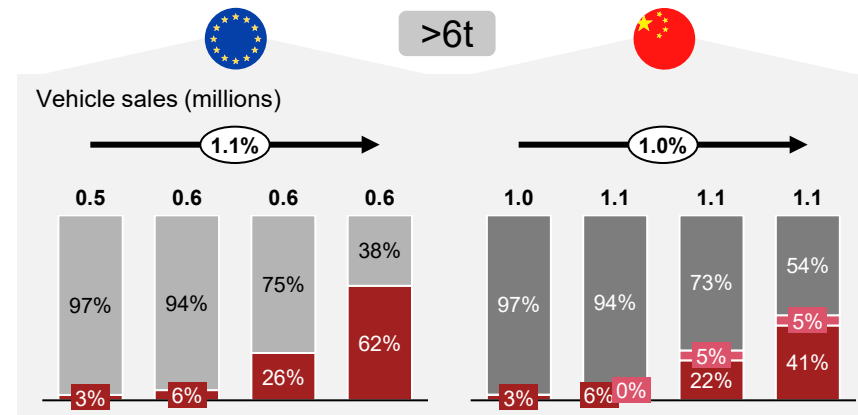
# Clear long-term shift to electrification for light and heavy transport, with 36-49% of >6t and 22-26% of >6t vehicle stock being fully electric by '35

## Diffusion of light-duty and heavy-duty vehicle sales in Europe<sup>1</sup> per type

### Passenger and light commercial vehicles <6t



### Medium- and heavy-duty vehicles >6t



### Key takeaways

- **Europe:** adoption rate of BEV and BET new sales will continue to grow and reach 96% and 62% respectively by 2035
- **China:** BEV and BET sales are expected to reach 78% and 41% by 2035, driven by China's commitment to carbon-neutral
- PHEVs with clearer use-cases in China than in Europe across weight classes. Typically, PHEVs in China have larger batteries, translating to a clearer charging demand contribution than in Europe



# 2

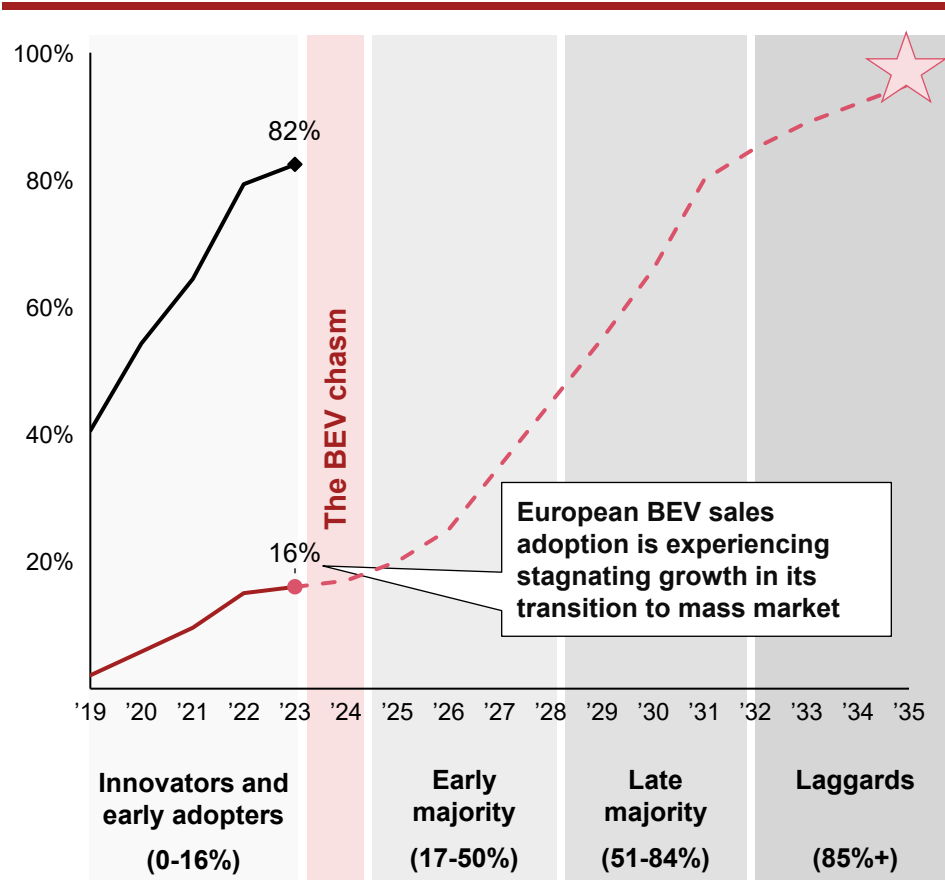
## Road to mass adoption in Europe



# To overcome the short-term headwinds to BEV adoption in Europe, the industry needs to address four key aspects

## Path to mass adoption in BEV sales in Europe

BEV sales development in Europe (% of sales)



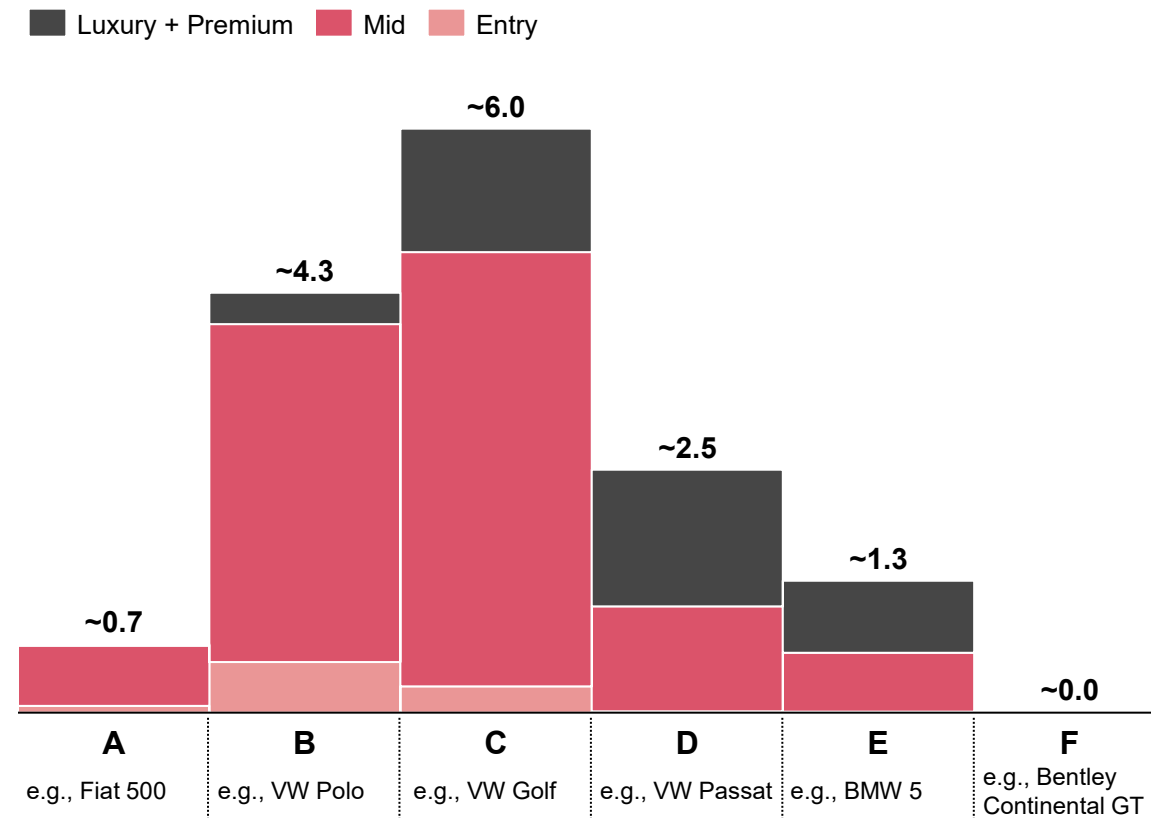
How to ensure mass adoption of electric vehicles in Europe by 2035

Affordable and sufficient BEV models	Residual BEV value and battery wear	Charging accessibility	Charging user-experience
<ul style="list-style-type: none"> <li>• <b>Macro-economic environment</b> (high interest rate, inflation) is <b>not conducive</b> to car purchase in general</li> <li>• <b>Inconsistent BEV incentives</b></li> <li>• Insufficient supply of <b>affordable</b> and <b>attractive</b> BEVs models in volume segments A, B and C</li> </ul>	<ul style="list-style-type: none"> <li>• Skepticism over low residual values, given recent new BEV price cuts, along with an <b>under-developed used EV market</b></li> <li>• Deterrence due to <b>concerns over battery longevity</b></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Grid limits</b> and building <b>regulations</b> imposing limitations on charging <b>deployment at scale</b> for private and public charging</li> <li>• <b>Scarcity of public charging stations</b> in a widespread network to address <b>range anxiety</b> continues to deter some BEV buyers</li> </ul>	<ul style="list-style-type: none"> <li>• Price level, lack of <b>transparency</b>, and poor customer journey</li> <li>• <b>Prevailing single-app ecosystems</b> impede access to charging</li> <li>• <b>Variable</b> service level (availability and charging speed per charger)</li> <li>• <b>Lack of auxiliary services</b> to improve the charging experience</li> </ul>
<b>Accelerate the development and roll-out of cheaper BEV models</b>	<b>Combat skepticism around low residual values in BEV secondary market</b>	<b>Accelerate network expansion, especially within the fast-charging public segment</b>	<b>Improve UX through price transparency, charger reliability, and cost efficiency</b>

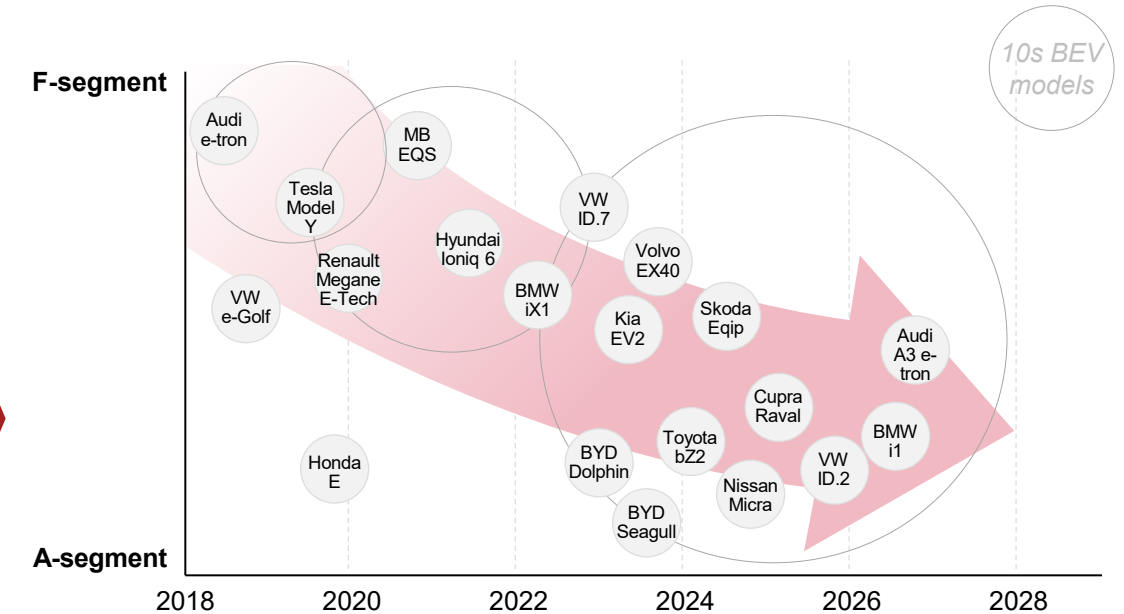
# OEMs actively address the lack of affordable BEV passenger vehicles by targeting the mid-priced B- and C-segment in the European market

## Passenger vehicle sales distribution in Europe

'23 new vehicle sales<sup>1</sup> segment/price distribution, Europe (million units)



Future BEV model launches<sup>2</sup>

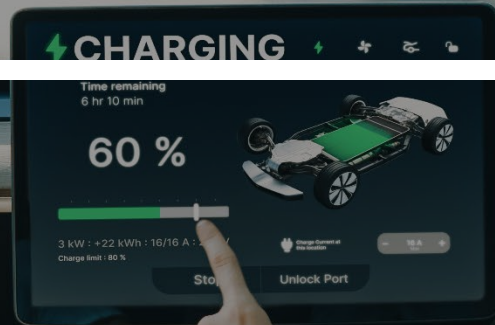


A majority of current battery electric vehicle (BEV) sales are concentrated in the higher-priced D and E segments, partly due to constraints from limited model options as seen in past model launches. Going forward, we see **increasing model launches in the more affordable B and C segments**, reflecting broader mass-market adoption



# 3




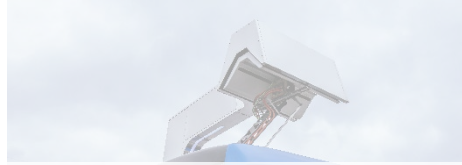
## Energy and infrastructure demand





# Cable charging as main BEV tech; battery swapping pushed in China, induction still in pilot stage, and overhead only in niche applications

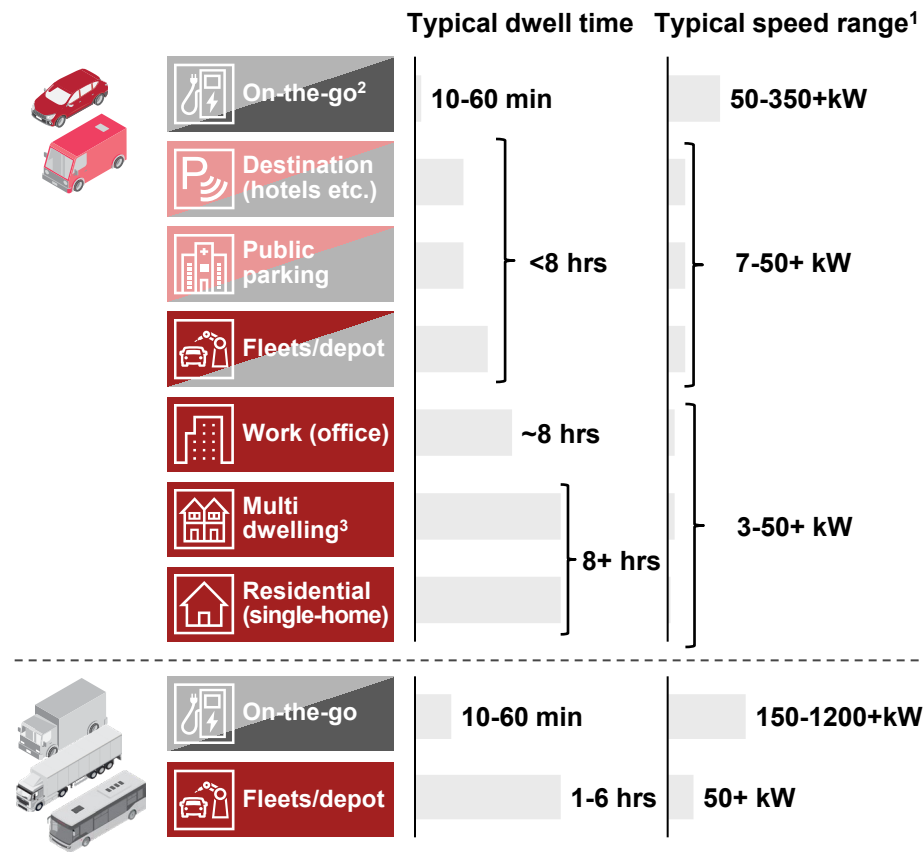
## Charging technology overview

	 Cable charging	 Battery swapping	 Induction	 Overhead
	Focus of this study	Deep dive on deployment China vs. Europe	On watchlist for OEM adoption	Niche only
<b>Vehicle suitability</b>	Light <6t	✓	✓	✗
	Med/Heavy >6t	✓	✓	✓
<b>Charging speed</b>	AC <22kW	✓	✓	✗
	DC >50kW	✓	Competes with recharging sessions <10mins typically DC	(✓)
	DC >150kW	✓	✓	✓
	DC >500kW	✓	✓	✓
<b>Standardization</b>	CCS/Tesla (USA)	OEM-specific	Not established so far	Not established so far
<b>Deployment</b>	●	◐	Pilots, OEM deployment prob. >2026	Niche applications only
<b>Pros (+) / cons (-) relative to cable charging</b>		+ Reliance on (high) power supply + Charging time - Battery efficiency - Physical space	+ Reduced physical environment needs + Time to initiate charging process - Charging speed (currently)	+ High charging speed - High infrastructure costs
<b>Key trends to watch</b>	<ul style="list-style-type: none"> <li>Battery buffering</li> <li>Integration into HEMS</li> <li>Energy efficiency for high-speed charging</li> </ul>	<ul style="list-style-type: none"> <li>Roll-out of network/ financing</li> <li>OEM adoption</li> <li>Common standard across OEMs</li> </ul>	<ul style="list-style-type: none"> <li>Energy efficiency</li> <li>OEM adoption to avoid retrofit</li> <li>Cost curve development</li> </ul>	<ul style="list-style-type: none"> <li>OEM/industry adoption</li> </ul>

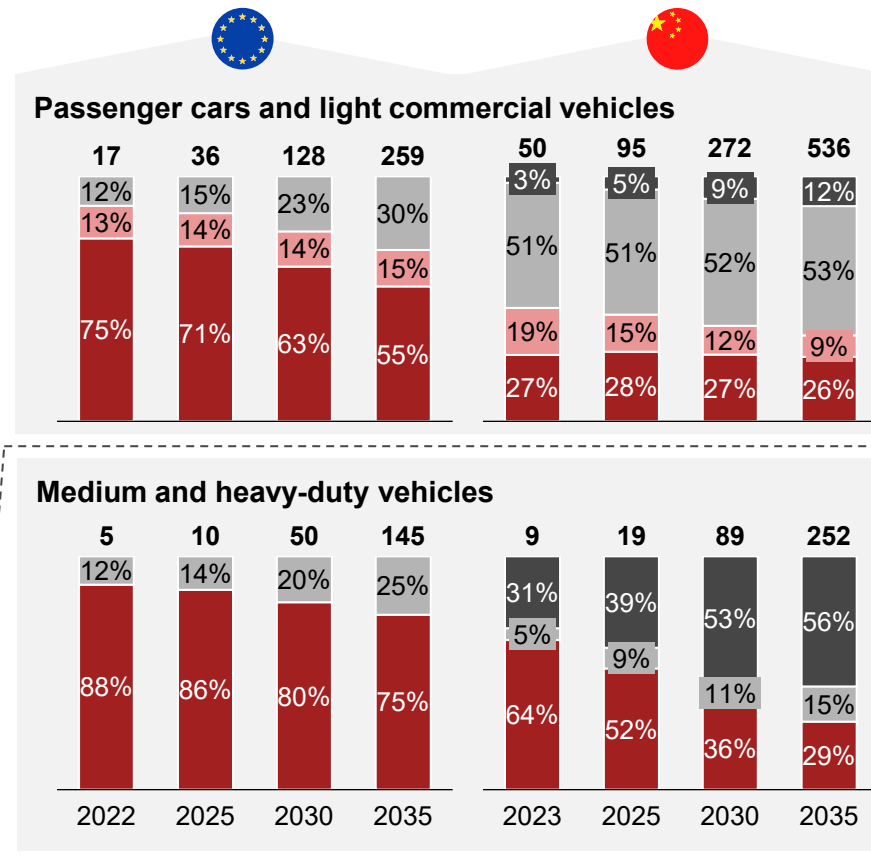
# 400+ TWh and 780+ TWh charging demand in Europe and China respectively by 2035

## Charging use cases and electricity demand

### Charging locations and use cases



### Electricity demand by use case, TWh



### Comments

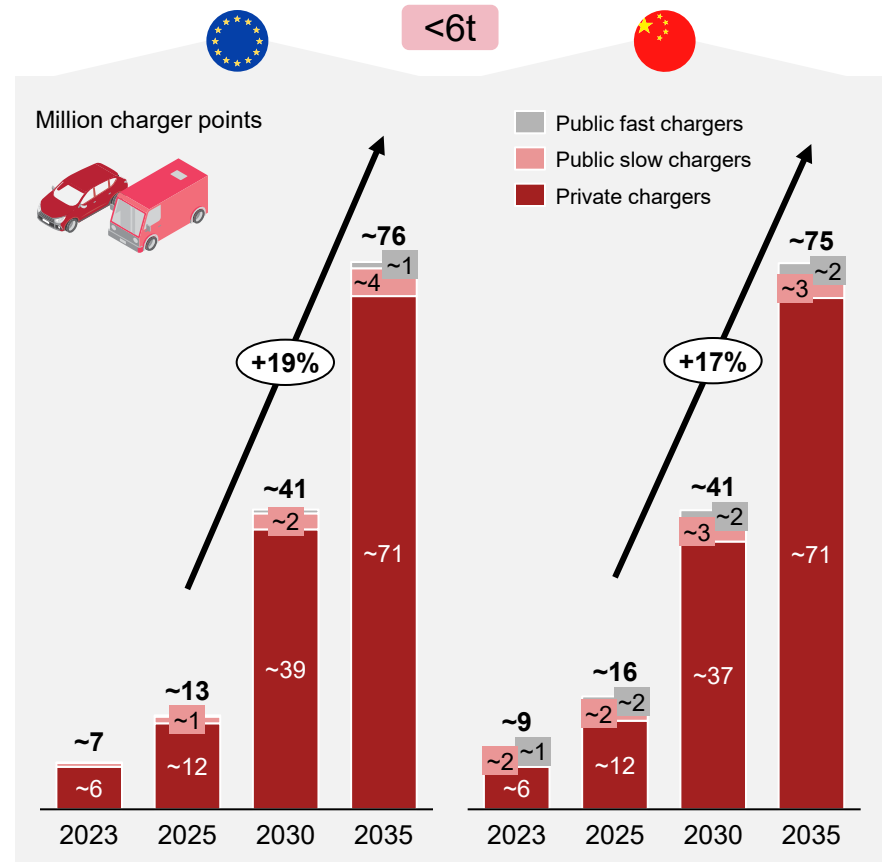
- Beyond battery capacity and speed, charging station locations are determined by dwell time and accessibility
- LDVs:** public fast charging is set to increase its share of electricity as technology advances and reduces users' "range anxiety", with on-the-go and destination charging representing the best use cases in Europe & China. There is a greater popularity of public charging in China which is expected to continue
- HDVs:** by '35, the electricity demand is ~145 TWh in Europe and ~252 TWh in China, with a difference due to BET adoption and driving distances. In Europe, 75% of truck charging demand will be met by depot charging, while depot charging and swapping will lead in China, covering 29% and 56% of demand respectively by 2035



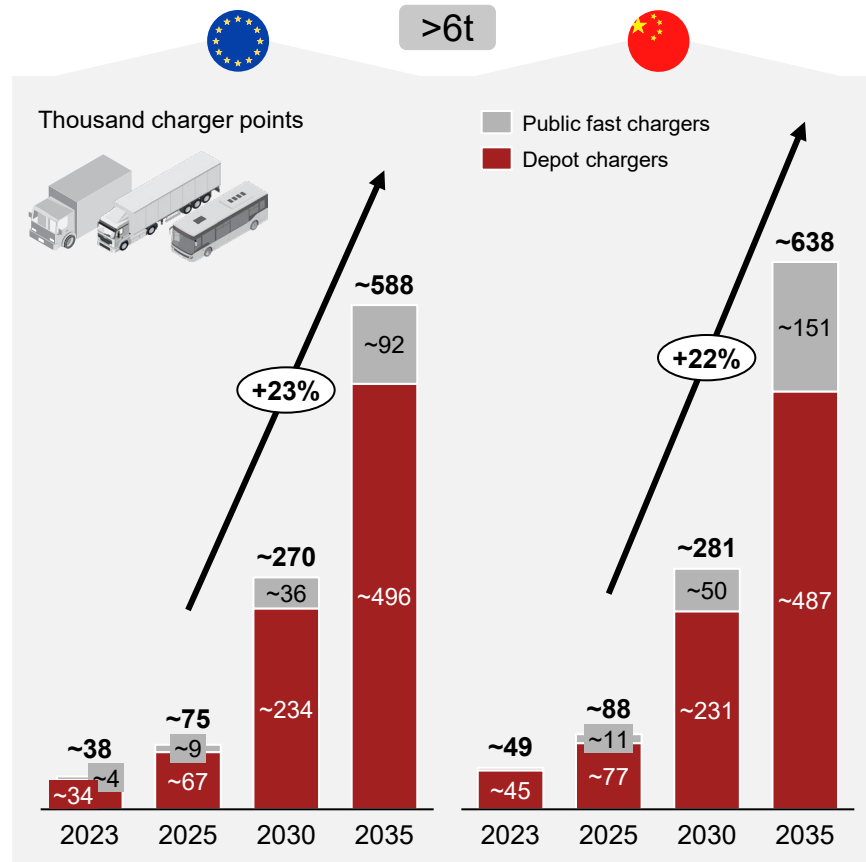
# Leading to ~151m charging infrastructure needed for LDVs and ~1.2m for HDVs; charging availability determines the mix of chargers

## Charging infrastructure

### Installed charge points for passenger and LDVs



### Installed charge points for MDVs and HDVs



### Comments

- Growing adoption of BEVs drives the need for charging infrastructure in Europe and China
- **LDVs:** installed base of charge points is ~76m in Europe and ~75m in China in 2035. Private (slow) chargers will account for the majority of the installed base, as consumers prefer charging at home or work.
- **HDVs:** by '35, the installed base of charge points is ~588k in Europe and ~638k in China. HDVs operating on short-haul routes are projected to be electrified first, with charging mainly occurring overnight at the depot, eliminating dependency on the public charging infrastructure. As the entire HDV fleet transitions to electricity, the demand for public charging increases, leading to an increasing share in the charging mix

# Battery swapping expected to remain a niche in Europe due to high total cost of ownership, but higher prospects in China due to local power grid

## Battery swapping use cases and costs

### Use cases for battery swapping



#### Operational predictability

Battery swapping can work well in use cases of strictly defined charging patterns (e.g. logistical operations)



#### High energy peak costs

In market environments with higher energy peak costs, swappable batteries can be charged at off-peak times or from BESS<sup>1</sup>



#### High energy requirements

Battery swapping can be more beneficial in cases of high energy and power requirements



#### Vehicle utilization

Battery swapping facilitates high vehicle utilization, as well as potential weight load advantages

### TCO<sup>2</sup> for swapping vs. charging



#### Capital costs

Battery swapping requires higher infrastructure investments compared to cable charging



#### Scaling opportunity

Cable charging offers easier infrastructure unit scaling opportunities versus swapping



#### Cost of energy

In an optimal charging and flexibility ecosystem (BESS<sup>1</sup>), cable charging can bring cost of energy down to similar levels as battery swapping

**Battery swapping yields a higher TCO<sup>2</sup> compared to cable charging**

### Key insights



#### Battery swapping is expected to remain a niche in Europe

Structural stability and the development of “long-range” batteries has led to limited range anxiety in Europe, inhibiting battery swapping as a competitive alternative



#### Swapping pushed in China due to infrastructure constraints

The less stable Chinese power infrastructure limits peak power

Battery swapping, as an alternative charging method, has been applied for fleet passenger vehicles (taxis) in China, and also with an increasing potential for heavy-duty transport






















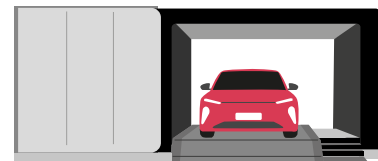


# Battery swapping, as an alternative charging method, has been applied for passenger vehicles in China, and has potential for heavy-duty

## Battery swapping in China

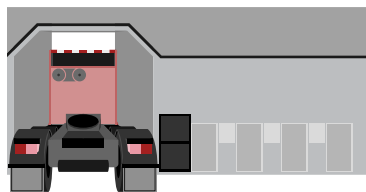
### Use cases in passenger vehicles and heavy-duty vehicles

	 Cost	 Efficiency	 Experience	 Location
 Private car				
 Taxi/Hailing car				
 Heavy vans/Trucks				



*"By 2035, ... and realizing the large-scale application of shared battery swapping modes for urban taxis and ride hailing services"*

From "China Energy Conservation and New Energy Vehicle Technology Roadmap 2.0", 2020/10



### Four major categories of battery swapping players

<b>1 OEMs</b>	NIO Power, SANY, etc.
<b>2 Technology suppliers</b>	Aulton, etc.
<b>3 Energy companies</b>	State Power Investment Corporation, etc.
<b>4 Battery manufacturers</b>	CATL EVOGO, etc.

**Example ventures**

- **NIO Power**, a leading passenger vehicle battery swapping player
- **Target group** from initial NIO cars to other cars potentially from Chinese OEM alliance such as Geely, Chang'An and Chery etc.
- **Number of stations in China:**
  - by 2023: **2,350**
  - by 2025: **4,000** (ambition)

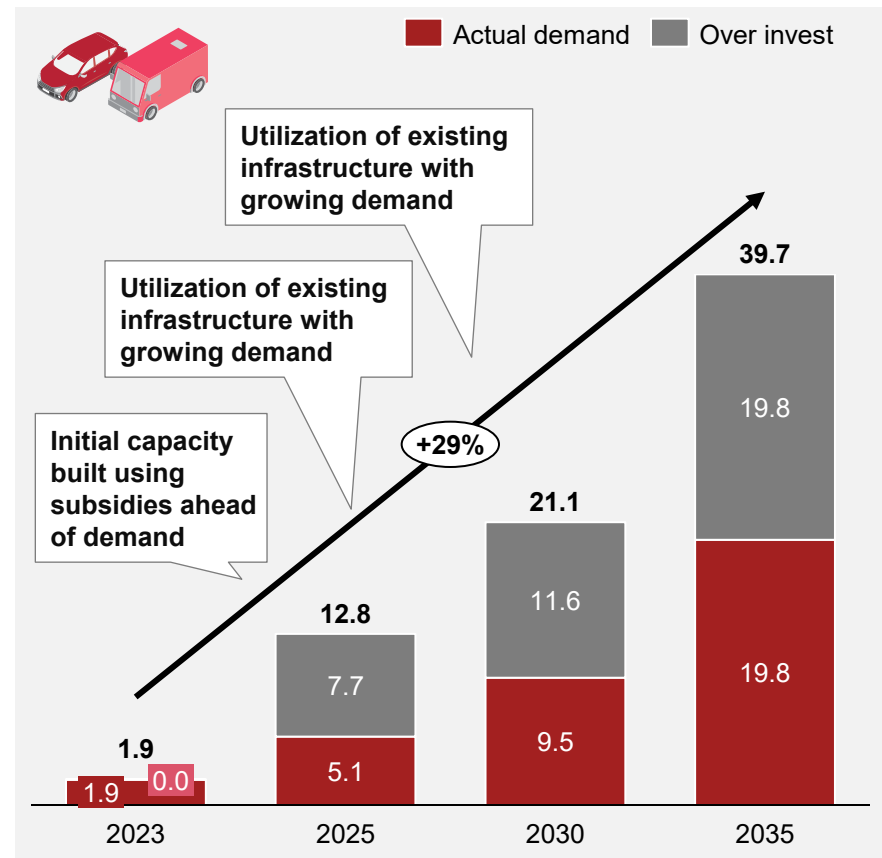
- **EVOGO**, a CATL company with "Choco-SEB" modular battery and energy storage technologies
- **Target group** are cars from multiple OEM brands in PV and CV equipped with CATL batteries
- **Number of stations in China:**
  - by 2023: **~30**
  - by 2025: **5,000** (ambition)



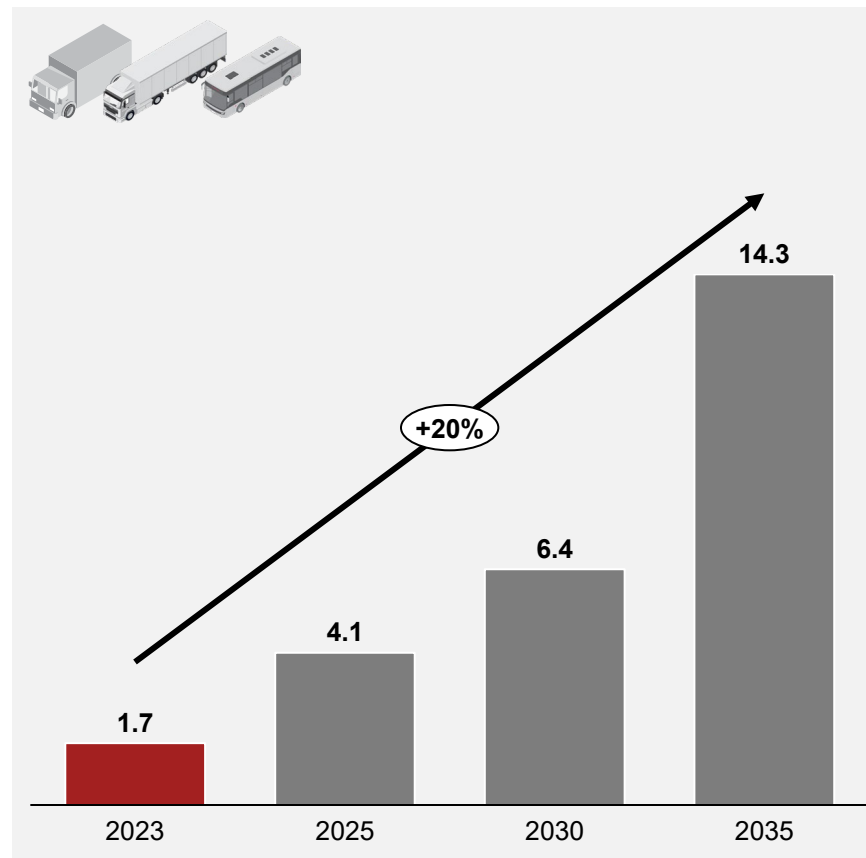
# Leading to ~40k battery swapping infrastructure needed for LDVs and ~14k for HDVs; utilization rate determining the number of stations

## Swapping infrastructure in China, thousand stations

### Installed stations for passenger and LDVs



### Installed stations for MDVs and HDVs



### Comments

- In order to satisfy the rapid development needs of China's NEV market, driven by national incentivization and technological iteration, the number of battery swapping stations will continue to increase
- For LDVs, the penetration rate of the LDV swapping model is expected to rise gradually to ~30% by 2035, and swapping stations will increase to ~40 thousand by 2035
- For HDVs, the penetration rate of the HDV swapping model is expected to rise gradually to ~56% by 2035, and swapping stations will increase to ~14 thousand by 2035



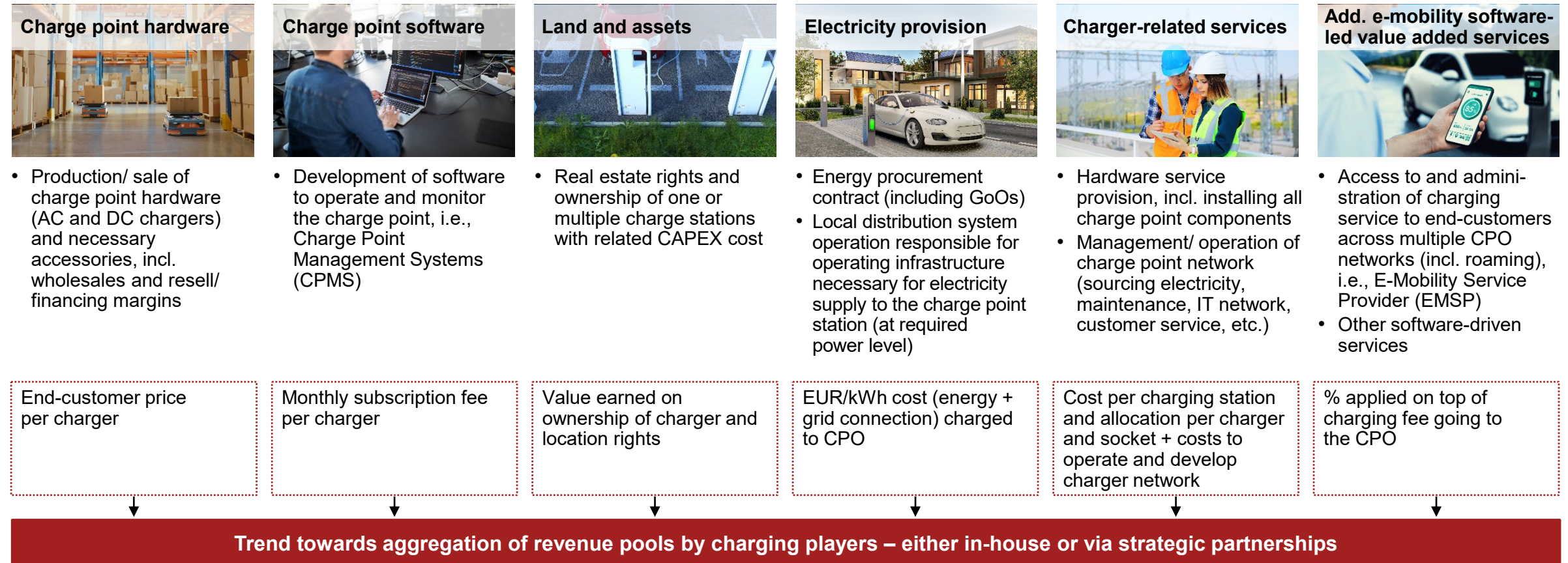
# 4

## Ways to play, financial performance, and M&A

# The EV charging value chain has six main revenue pools, ranging from charge point hardware to additional VAS<sup>1</sup>

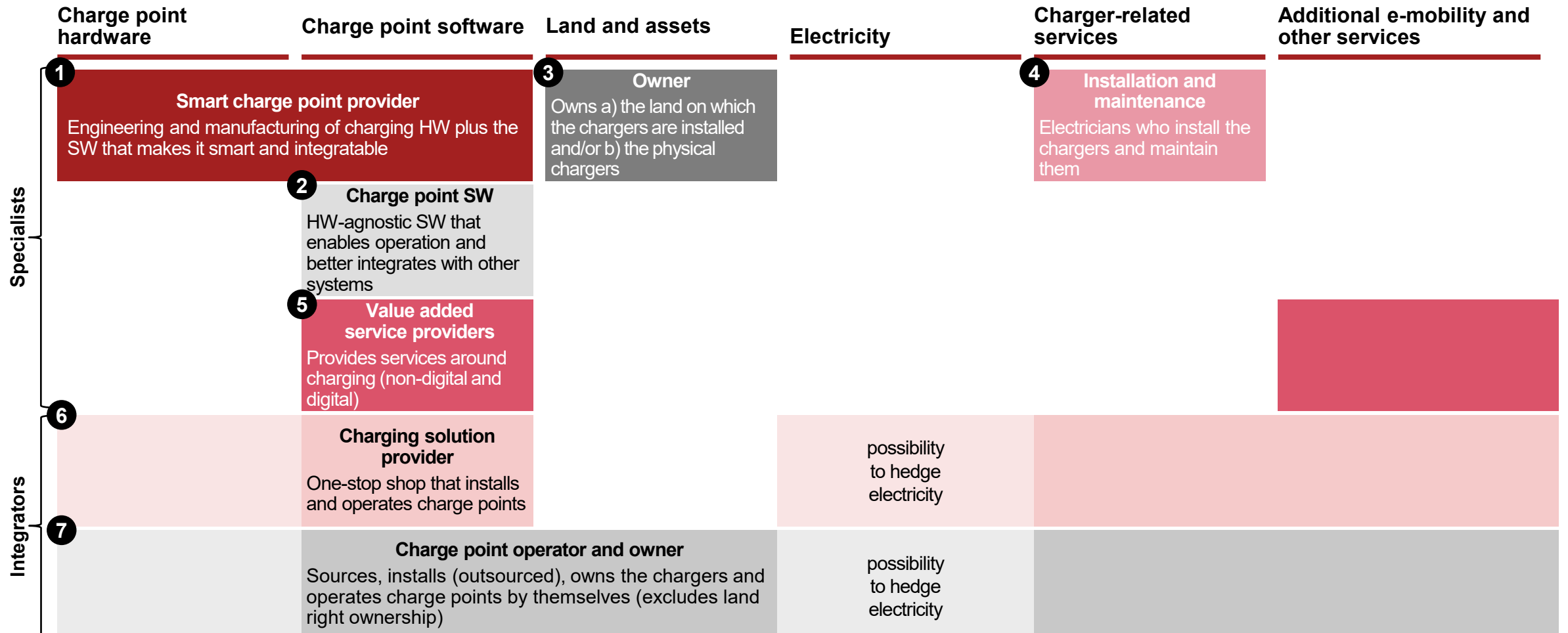
## Main revenue pools and model parameters

### Charging market components for private and public charging segments



# Existing competition can be grouped into a broad set of 7 ways to play – tapping into one or more of the revenue pools

## Ways to play across the revenue pools





# Key drivers for successful business growth and operations vary along the seven 7 ways to play

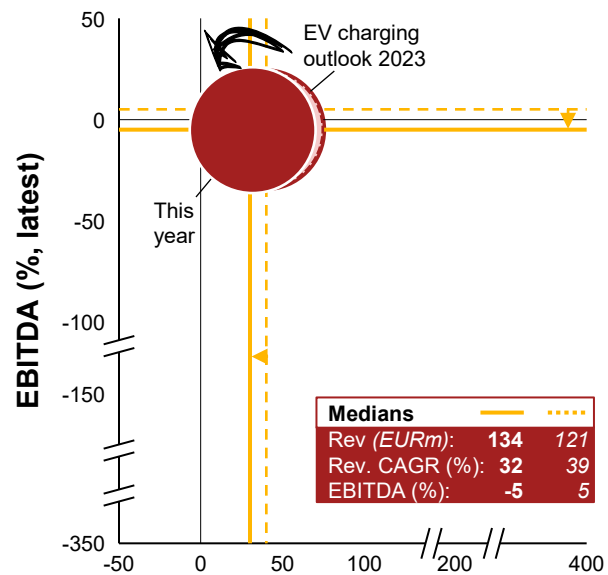
## Key elements of business model per Way to Play

- 1 Smart charge point provider** | Sell as many chargers as efficiently possible via scalable channels, with smart features to monetize installed base through asset lifetime
- 2 Charge point Software** | Increase adoption of latest software in the installed base with the growing EV charging hardware roll-out, and focus on usage and integration pricing
- 3 Land and asset owner** | Earn income from rental of premises to CPOs, dwell time spend at destination and potential to co-own chargers with usage-linked returns
- 4 Installation and maintenance** | Install as many chargers as possible and become point of contact for customer support and hardware maintenance
- 5 Value added service providers** | Capture sustainable share of revenue from existing players/ end-users as the market matures, enabled by software integrations
- 6 Charging solution provider** | Grow installed base and help monetize land for owners through a delivery of complete charging solution delivery
- 7 Charge point operator and owner** | Secure as many sites as possible and maximize electricity throughput while maintaining electricity mark-up and cost to serve across the charging network

# Strongest momentum observed for charge point operators, while solution providers keep facing difficulties in becoming profitable

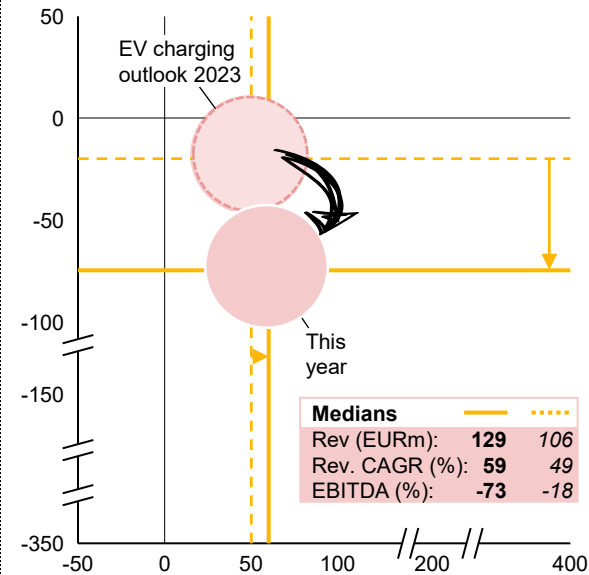
## Median financial performances along selected ways to play Comparison of this year's study to "EV charging market outlook 2023"

### 1 Smart charge point providers (SCCP)



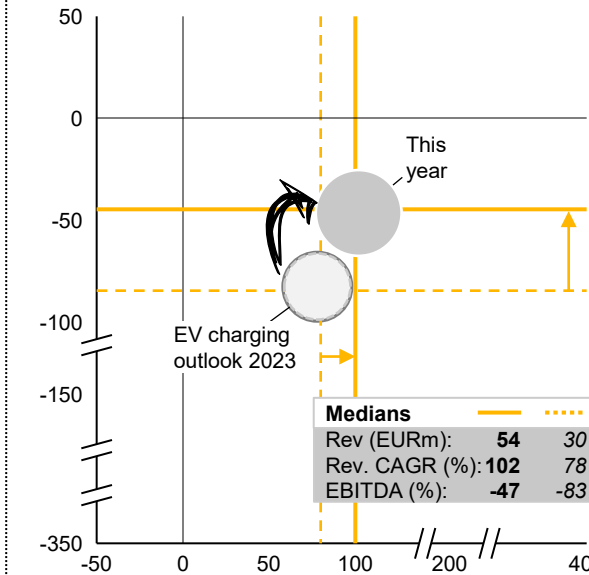
Already **well-established market movement with modest but stable growth** and several players demonstrating positive EBITDAs

### 6 Charging solution providers



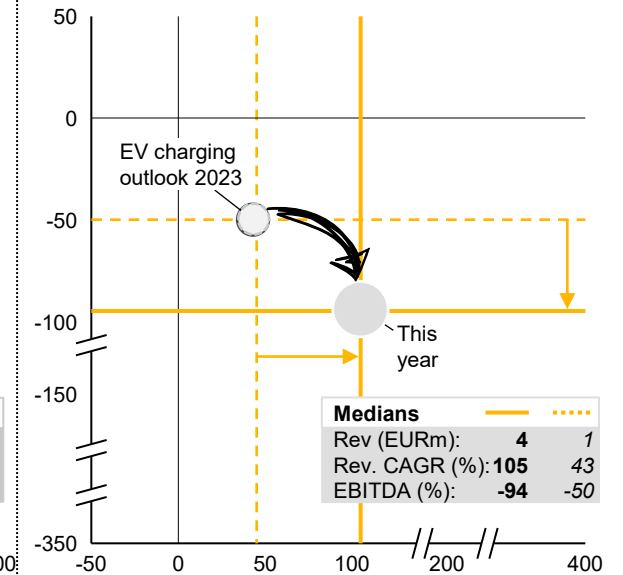
Charging solution providers **struggle with profitability turning even lower**, but overall market growth remaining high at close to 60%

### 7 Charge point operators and owners



**Strong overall market momentum with almost doubled median revenues** and trends towards profitability along increasing number of BEVs and utilisation

### 2 Charge point management software

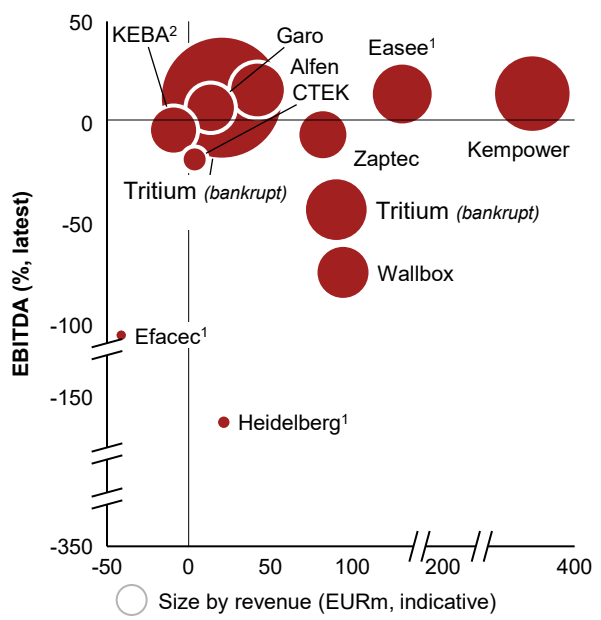


As there is **only a few CPMS**, no clear indications can be made, with more players expected to be seen going forward (e.g., Monta)

# Charging players continue to grow at a fast pace with '20-'23 CAGRs of 40-80% – only a few HW & CPO providers EBITDA-positive so far

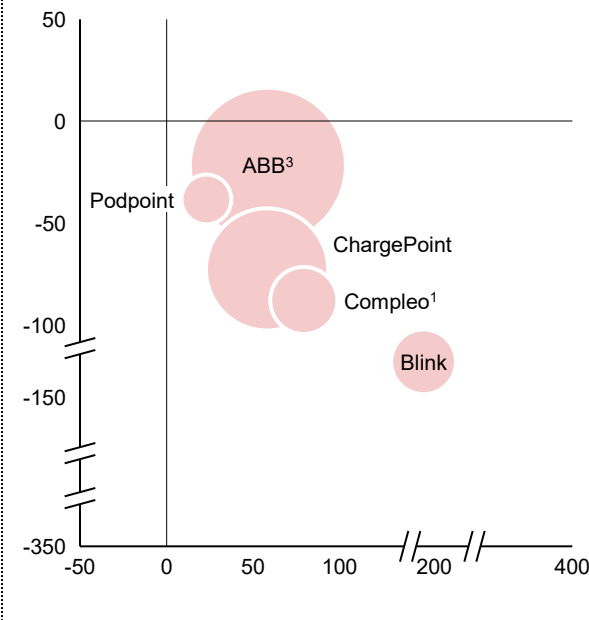
## Financial performance of selected players per way to play '23<sup>1,2,3</sup> EBITDA margin (%) vs. '20-'23<sup>1,2,3</sup> revenue CAGR (%)

### 1 Smart charge point providers (SCCP)



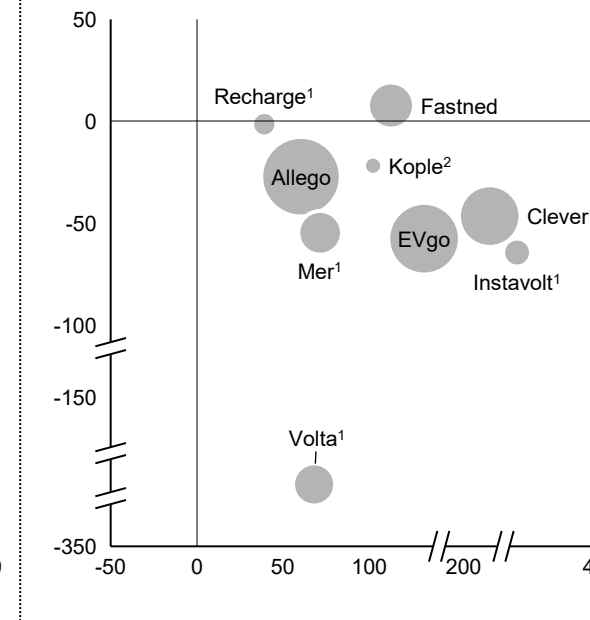
Several players already showing revenues above EUR 100+m with remaining growth, profitability varies across sample but larger players positive

### 6 Charging solution providers



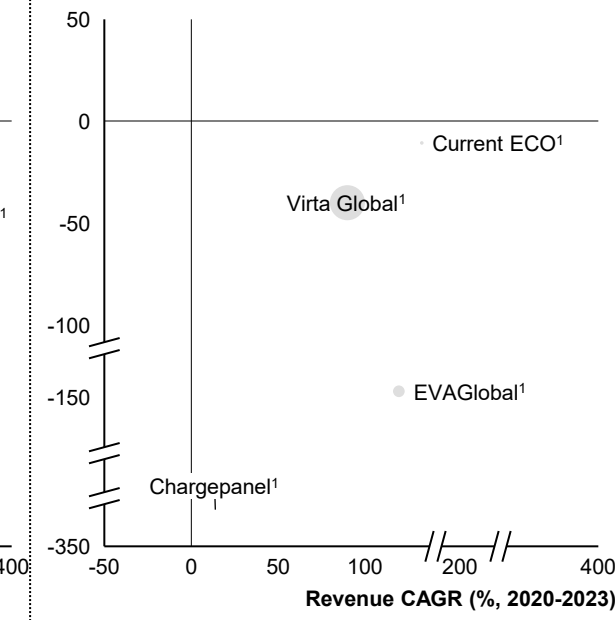
The selected players are showing strong growth, but EBITDA still negative, with fewer large players already reaching revenues above EUR 100+m

### 7 Charge point operators and owners



Network expansion and low utilization driving negative EBITDA, whereas rising numbers in BEV sales and fleet elevate revenue growth

### 2 Charge point management software



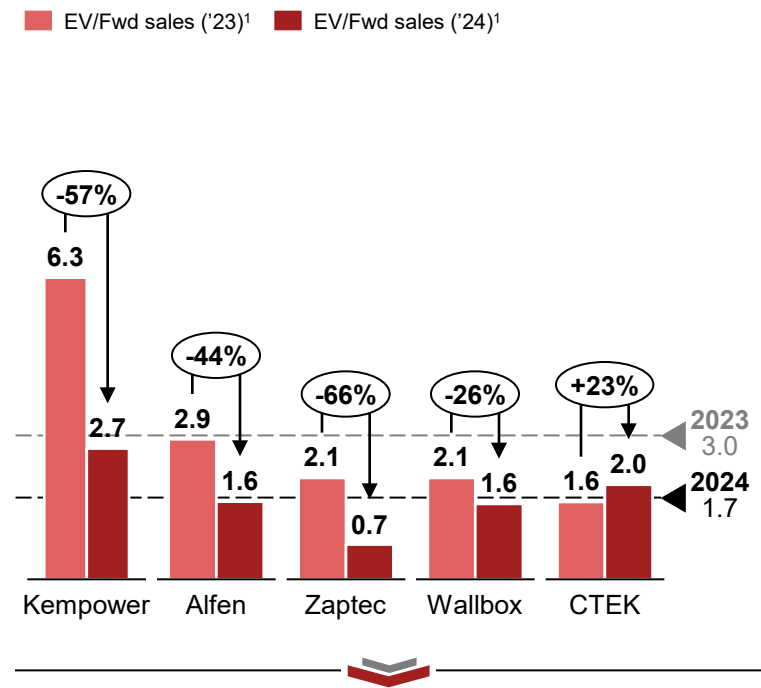
Early adoption and growth phase driving negative EBITDA, with new players entering the market and highest overall top-line growth



# EV charging forward sales multiples down 30-70% L12M – solution providers struggling, Kempower and Fastned stand out among peers

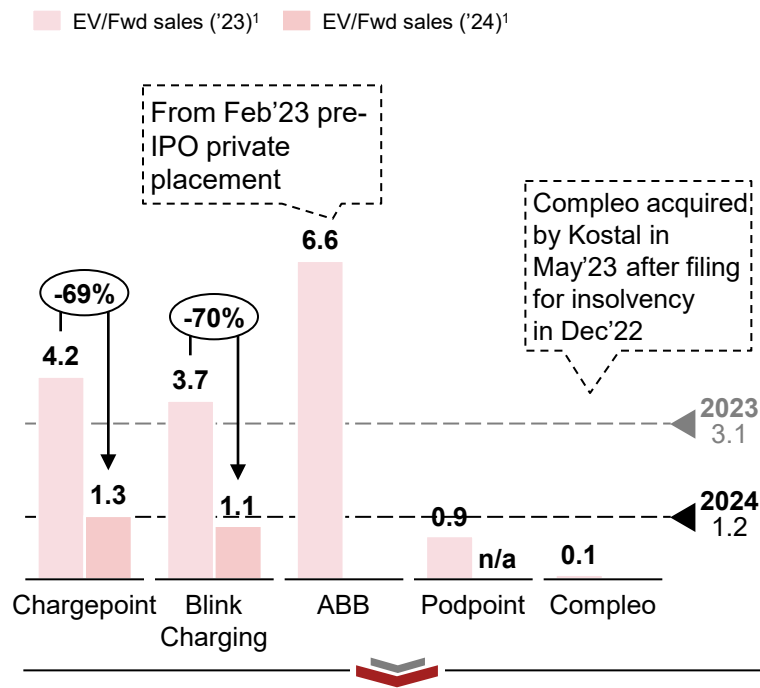
**Enterprise value/sales ('23E) and ('24E) multiples<sup>1</sup> per way to play for publicly listed players**

## Smart charge point provider



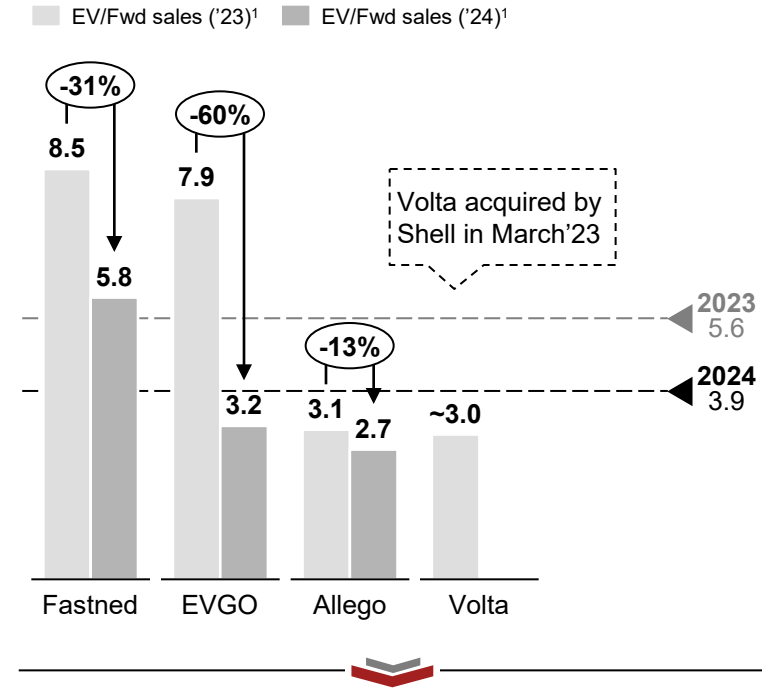
Forward multiples down towards 2x following poor trading in last 12 months; however, growth estimates have also been readjusted following slower growth than anticipated – Kempower (DC exposure) outperforms

## Charging solution provider



Sharp valuation correction for charging solution providers, as they continue to lack a clear avenue towards profitability – Compleo taken private following bankruptcy

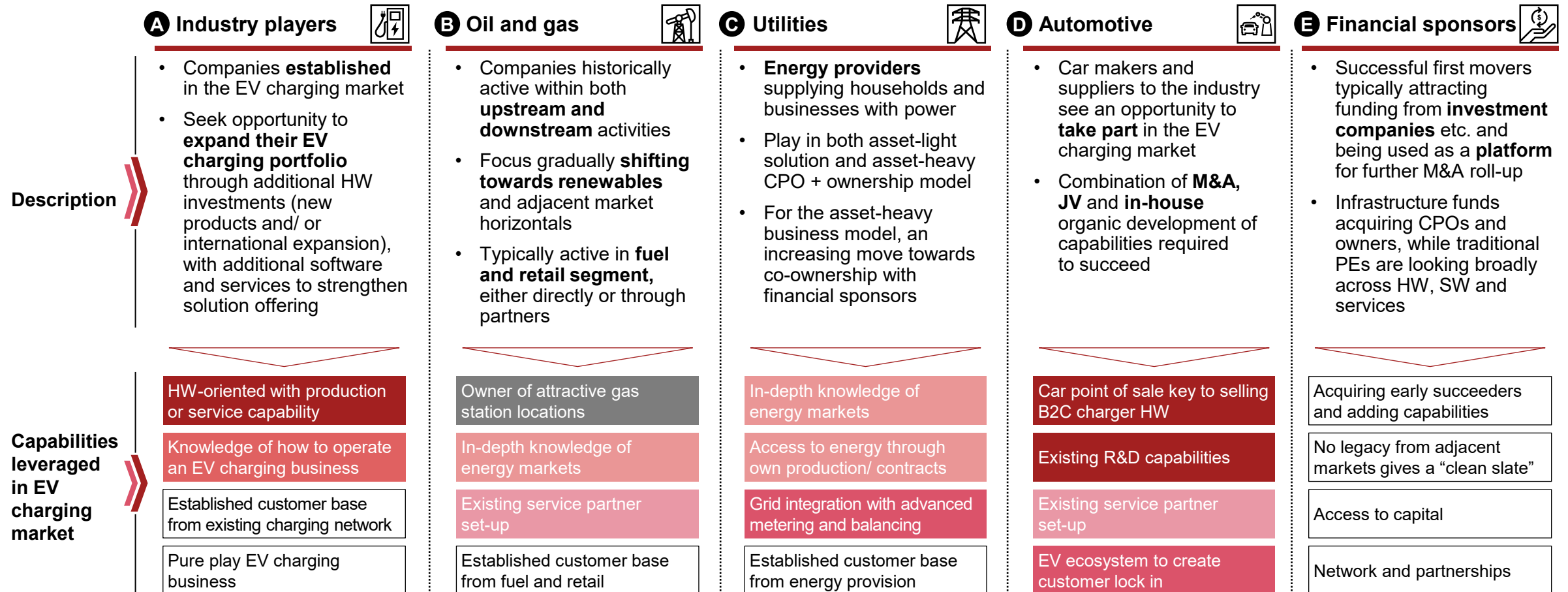
## Charge point operator and owner



Remaining high valuations among CPOs, with US players showing largest decline – Fastned with premium valuation, reaching EBITDA break-even in 2023 despite continuous network expansion

# Different industry players are actively carving out material positions across the EV value chain through organic growth and M&A

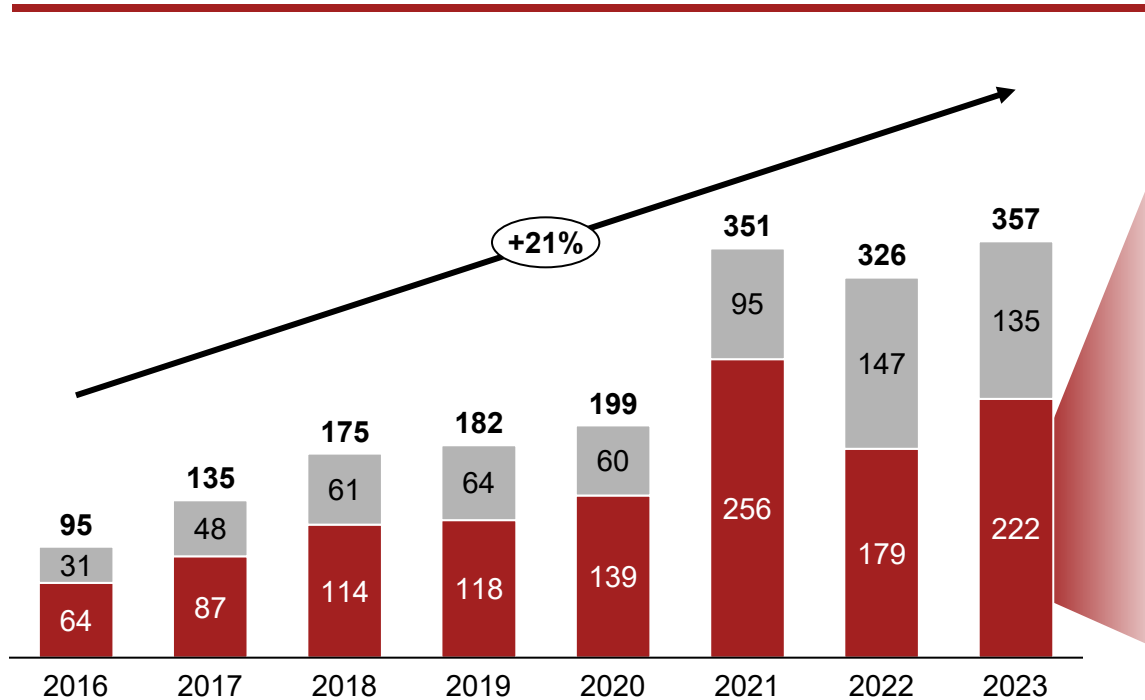
## EV charging market consolidator archetypes



# While the number of tracked transactions in 2023 remained in the '21-'23 range, the disclosed value has more than halved relative to 2021

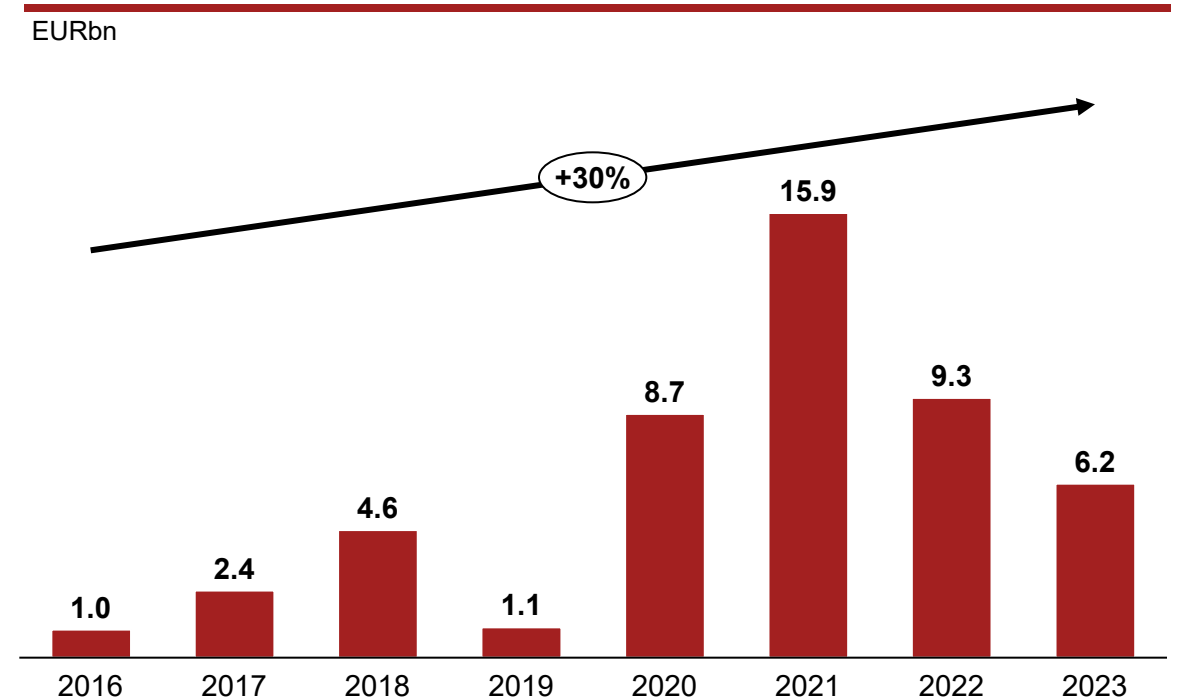
## Number of deals and transaction value of disclosed deals

### Number of deals



### Transaction value (disclosed transactions)

EURbn



■ Non-disclosed  
■ Disclosed

**Deal Date:** From: 01-Jan-2012;  
**Deal Option:** Search on a full transaction; Deal Status: Completed; Announced/In Progress;  
**Deal Types:** All Buyout Types; Other Private Equity Types; All VC Stages; All Round Numbers; All Series; M&A/Control Transactions; Non-Control Transactions; Other M&A Transactions; Public Investments > IPO; All General Debt;

**Locations:** United States; Europe; Asia > East Asia > China; Middle East > Israel; Search HQ Only;  
**Emerging Spaces:** Energy > Electric Vehicle Charging Infrastructure; Keywords: electric vehicle charging; EV charging; public charging infrastructure; vehicle charging; charging software; charging solutions; charging infrastructure; Search Emerging Spaces OR Keywords;



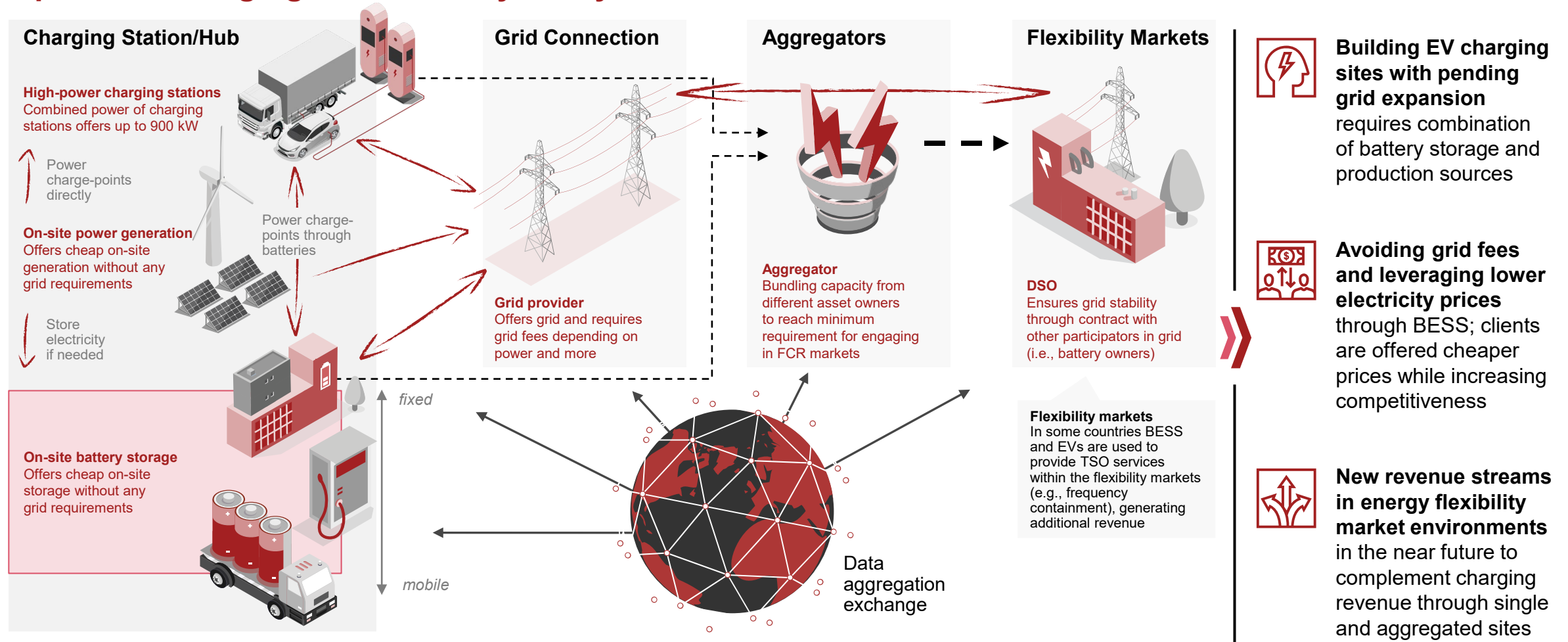
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## EV charging in wider ecosystem

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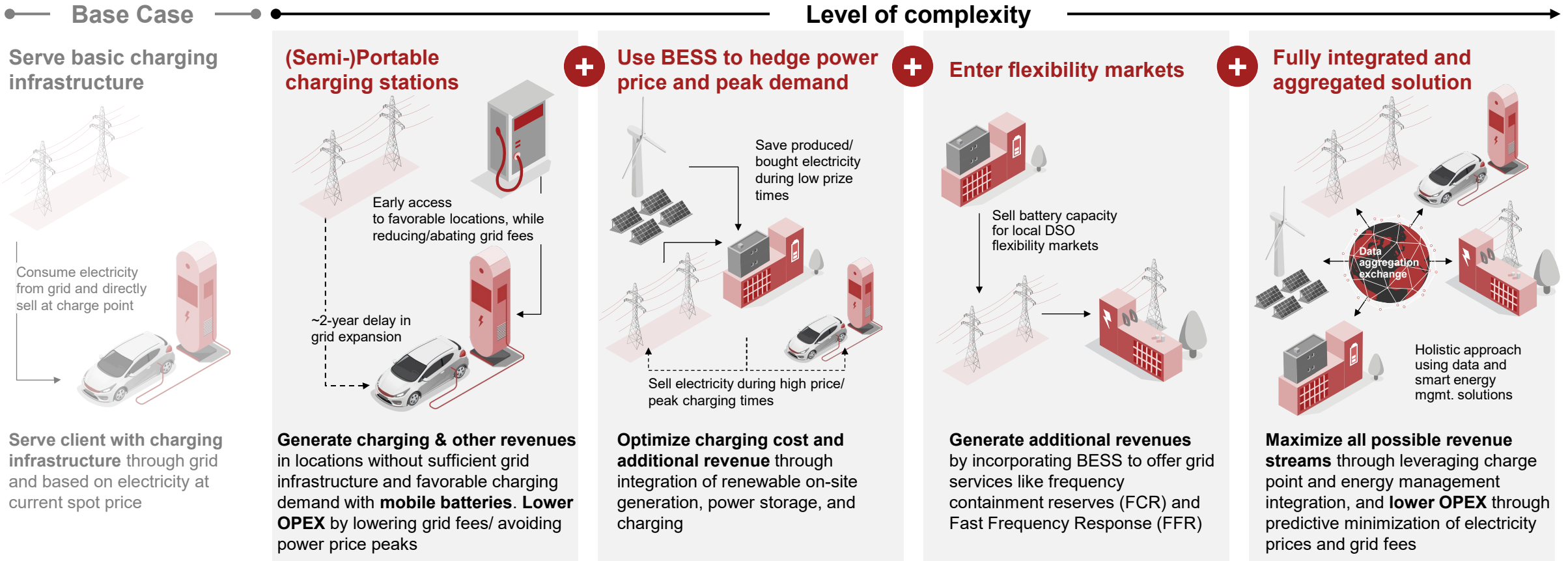
# CPOs, site owners, and other players can unlock further value from charging by integrating it into the evolving energy ecosystem

## Optimized charging and flexibility ecosystem



# Potential additional revenue/ lower costs should be weighed against the CAPEX and OPEX complexity required

## Business Cases considerations



**To derive an attractive business case, each player needs to take all use cases into account and weigh them against the CAPEX needed and the ability to internalize operational complexity**



# Considerations for profitable growth going forward per way to play

1

## Smart charge point provider

- Design HW with **lifetime value** (SW and services enabled recurring revenue) and **wider energy/ mobility ecosystem integration** in mind
- Strong focus on **sales channels and partner network** development, including **end-user and installer activation**
- Scale with **global production** (in-house/ contract manufacturing) and **quality control** (including country level compliance)

2

## Charge point management software

- Clear customer value proposition with key functionality to **operate charge points efficiently**
- Focus on **Cloud-based solutions** with self-service sales and marketing to **enable scaling of cost-base**
- Develop **modern User Interface**, intensive collaboration to capture data and generate insights/ increase uptime and create “**market-places**” for wider adoption/ scale

3

## Land and asset owners

- Consider **ownership options** (land only vs. land + charging infrastructure)
- Offer **attractive adjacent offerings** to consumers and attract other businesses to locations
- Evaluate **business cases for on-site generation/ storage and additional revenues** in power ecosystem

4

## Installers and maintenance

- Become a **go-to resale partner** for hardware providers (including bundling with solar and storage)
- Maintain **local footprint and proximity to clients**
- Develop strong **after-sales offering**

5

## Value-added service providers

- Enable **seamless EV charging user experience** (incl. pricing transparency)
- **Integrate with the wider charging and energy ecosystem**
- **Leverage data captured** to deliver increased value through insights and analytics
- **Volume-based pricing** to increase recurring revenue share

6

## Charging solution provider

- Software-driven with hardware provisioning through contract manufacturers
- Customer centricity and integration in customer journey including **product bundling** across segment (public + private) and financing, services and energy
- Maintain cost-base control and **strong access to capital while scaling** to profitability

7

## Charge point operator and owner

- Create a clear **location strategy** (public/ fleet), **securing key sites early with right contract durations**, and optimize against grid availability
- Focus on **customer centric** integrations (car/ routing, payment, dwell time attractiveness)
- Manage **cost base** (HW, el. prices), **operational excellence** and create **competitive end-user pricing**
- Optimize **own/ third party<sup>1</sup> financing**



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