CURRENT PERSPECTIVES FOR CHARGE POINT OPERATORS AND HARDWARE MANUFACTURERS

Challenges faced and the drivers of profitability and innovation

EFESO
MANAGEMENT CONSULTANTS

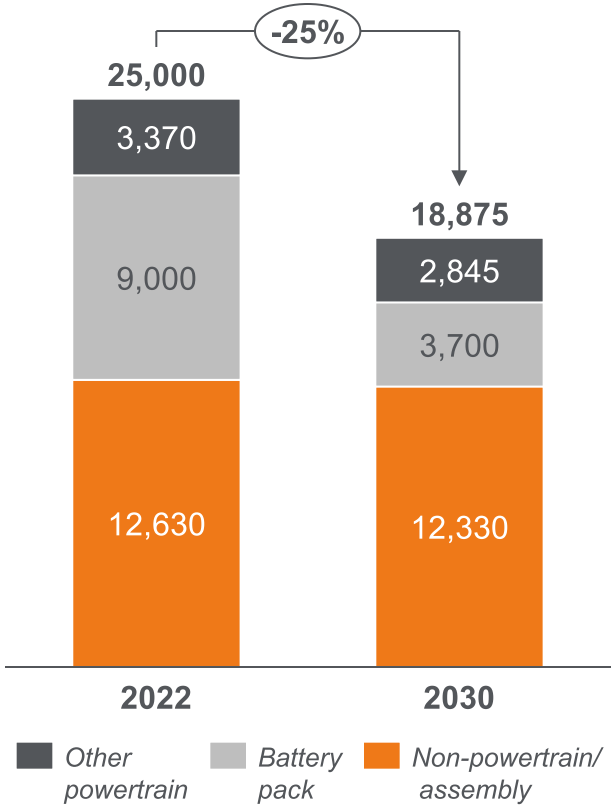
COST & VALUE ENGINEERING

INSIGHT

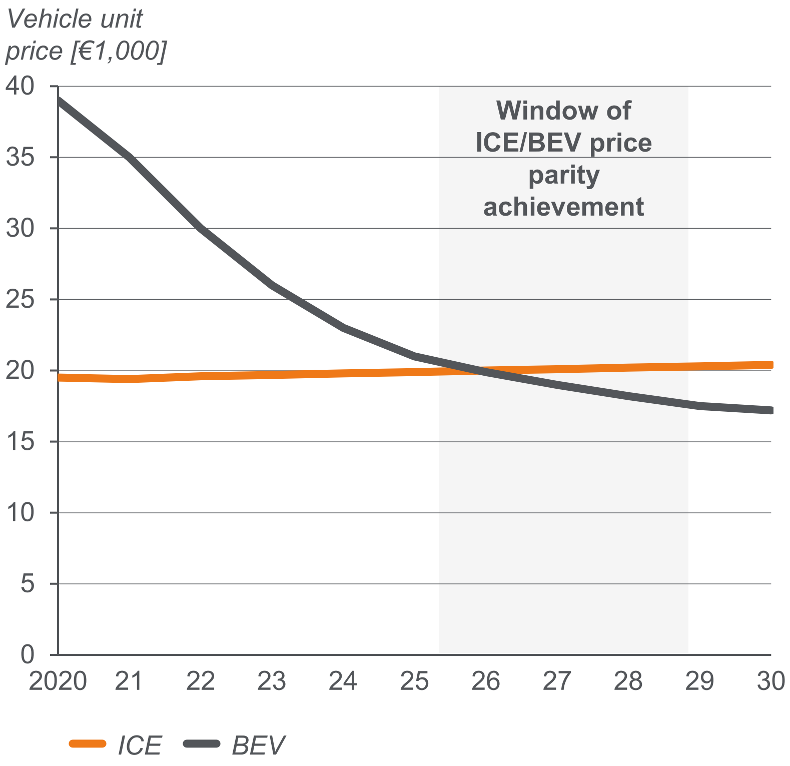
Passenger BEVs will become cheaper than ICE vehicles in the second half of this decade, driven by a 60% decrease of battery prices by 2030 vs 2022

Battery cost decreases will lead to BEV/ICE price parity from 2026 onwards

Direct manufacturing costs for a 250-mile range BEV in US$[1)]



Estimated pre-tax retail prices for SUV-C segment vehicles[2)]



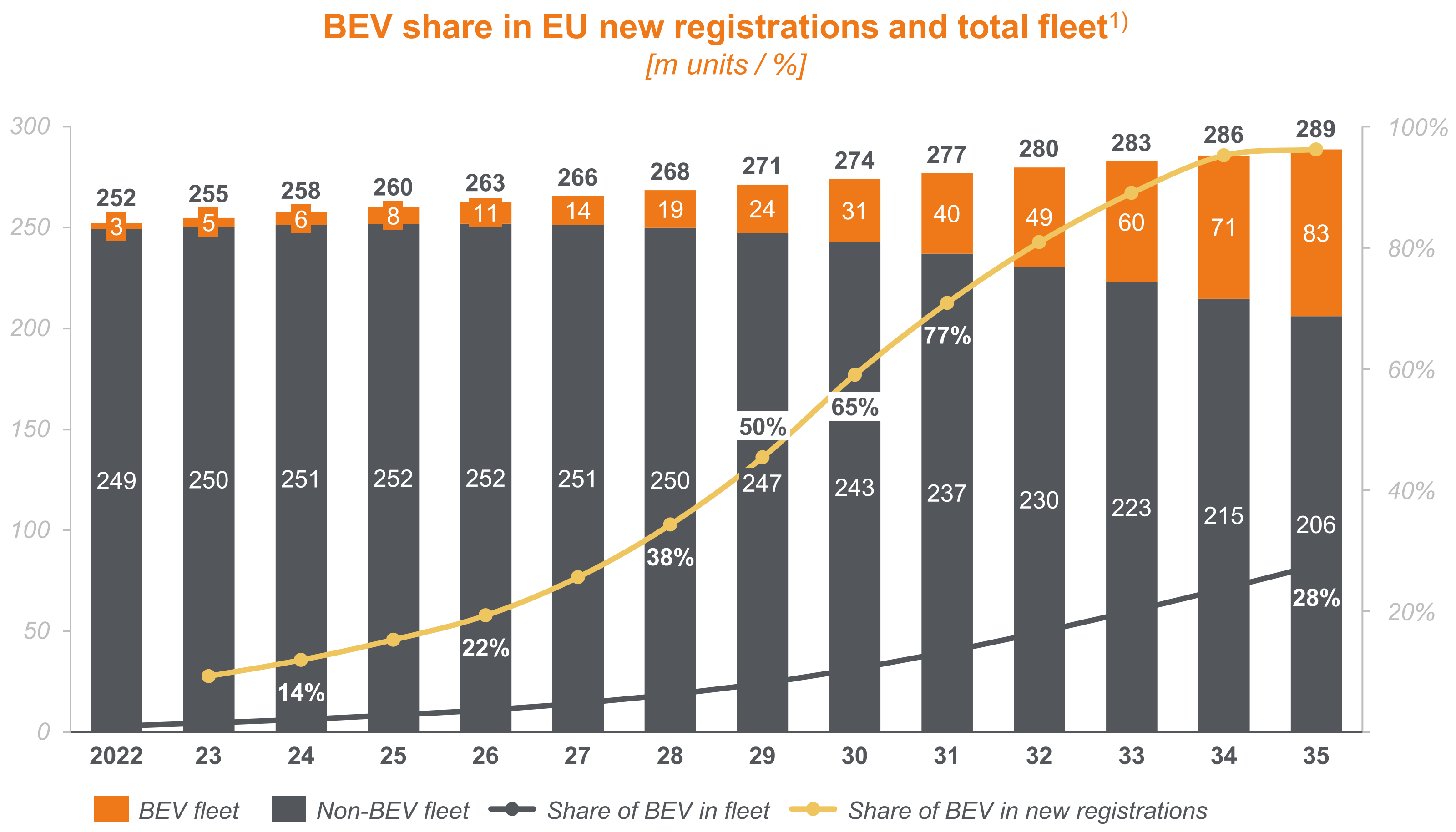
Insight

- Battery pack costs will **decrease 60% by 2030 vs 2022,** reducing **total direct manufacturing costs** by as much as **-25%**
- Battery cost reduction factors will include **higher electric drive efficiency** (leads to higher range and/or smaller batteries needed); **higher usable fraction** of battery pack; **higher pack-to-cell efficiency**
- Driven by **cost reduction dynamic** and the **pressure to retain high utilization**, **price parity** between ICE and BEV passenger cars is expected between **2026 to 2028** across passenger car segments, starting with the Large/SUV classes

1) ICCT, Assessment of light-duty electric vehicle costs and consumer benefits in the US in the 2022-2035 timeframe; P. Slowik, A. Isenstadt, L. Pierce, S. Searle 2022; 2) Source: BloombergNEF, Hitting the EV Inflection Point (2021) and Electric Vehicle Outlook (2023)

The price advantage of BEV will lead to inflection point in European BEV sales shares

EU BEV share to exceed 50% of new registrations in 2029



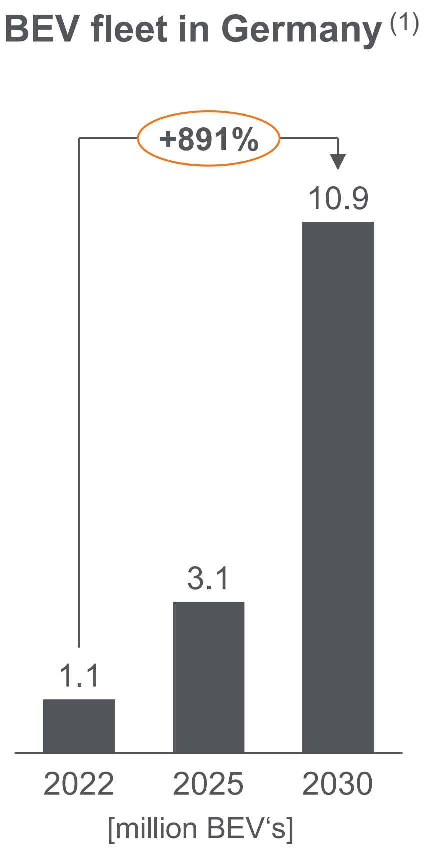
Insight

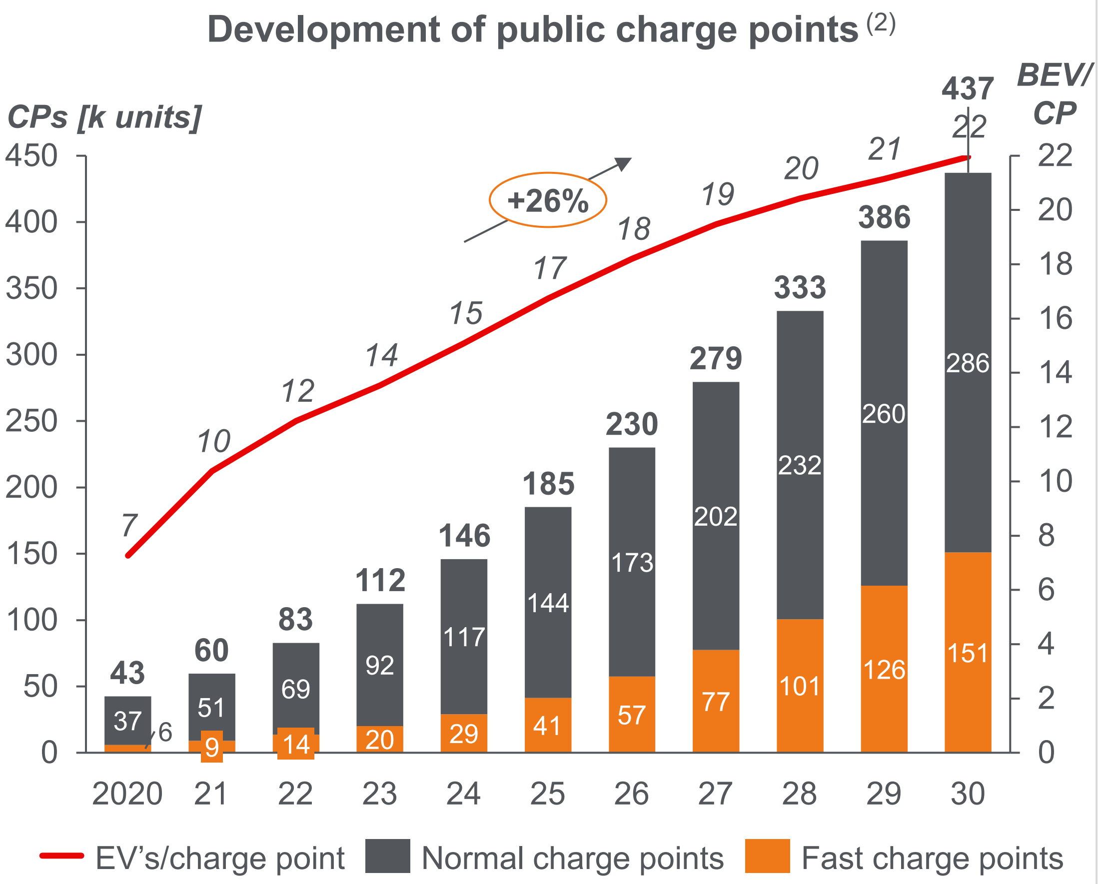
- With BEV prices lower than ICEVs and stricter EU CO_2 legislation in 2025+[2)], BEV sales share will reach an inflection point in **2029, with 50% of new registrations**
- When ICE car sales end in 2035, the BEV fleet will have reached **83m vehicles**, or a **28% share** of the total passenger car fleet
- For Germany, this trajectory means that the target of 15m BEVs will most likely be achieved by the end of 2032 instead of 2030

1) ACEA, Eurostat, EFESO BEV model calculation; non-BEV fleet includes PHEV and other drives; 2) Regulation (EU) 2019/631 sets EU-wide CO2 fleet target to 15% reduction by 2025 for cars and vans relative to 2021 baseline

In 2030, there will be one public charge point per 22 BEVs – under-served or under-critical to be profitable?

Germany: BEV penetration vs public charge point rollout





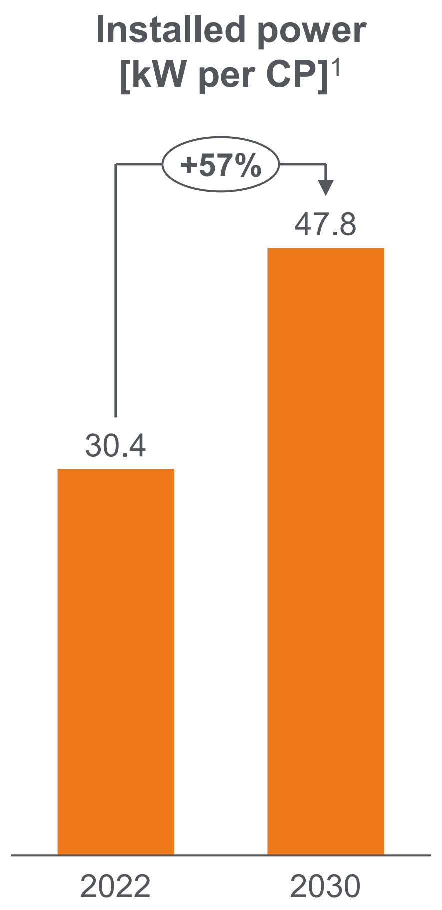
Forecast & Implications

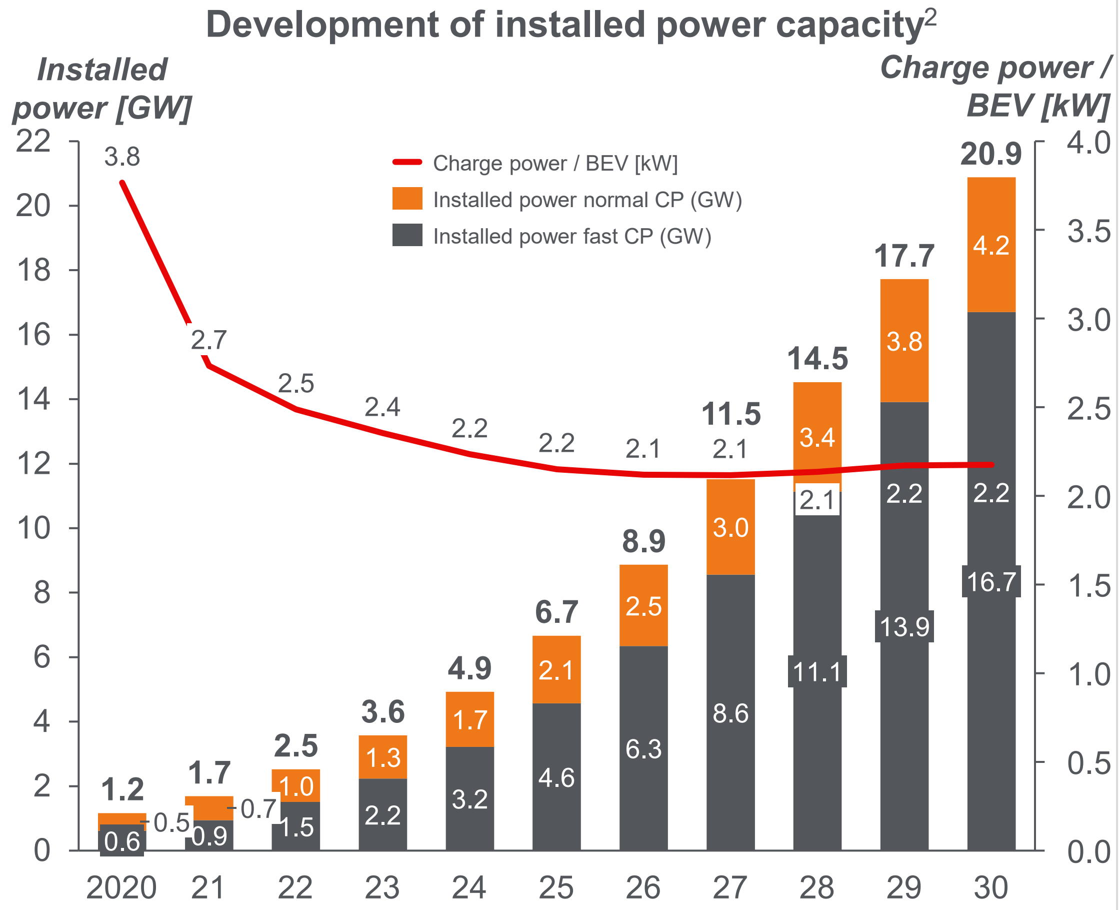
- While the BEV (Battery Electric Vehicles) fleet is expected to grow with a 41% CAGR, public charge points will only grow with a 26% CAGR, raising the **ratio** of **BEVs** to **charge points** from **12:1** in 2022 to **22:1** in **2030** in Germany
- This trajectory is significantly lower than the 1 million CP target set by the German government. It could help sustain an overall utilization level beyond 20%, so generating abundant profitability for a healthy number of players
- But CP utilization will vary greatly. On the , one hand there are likely to be very overcrowded stations in peak hours, beside highways and in densely populated urban areas. On the other hand, there will also be poorly frequented CPs, struggling to **regain invested capital and, perhaps, even their ongoing operating costs**

1) EFESO model calculations; 2) EFESO calculations based on scenario „HPC charging' published by Nationale Leitstelle Ladeinfrastruktur/ Bundesnetzagentur and extrapolation of current trends; Note: Fast charge points: up to 22 kW; fast charge points: more than 22 kW power

The typical installed power of charge points will increase by +57%, so establishing a stable ratio of 2.2kW per BEV

Germany: Charge point efficiency and total installed power capacity





Forecast & Implications

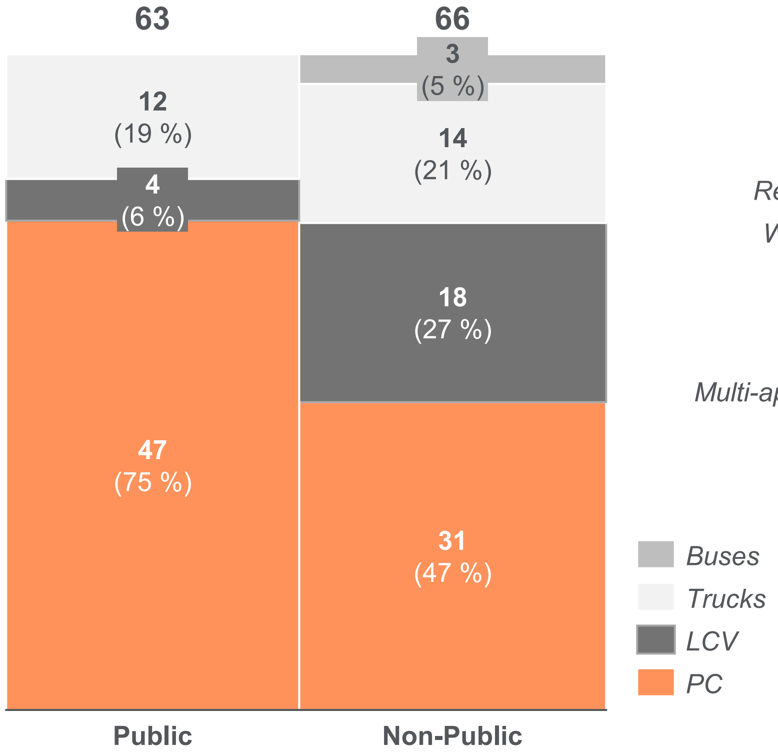
- The relative **growth of fast charge points is twice as high as normal** charge points (62% vs 31%)
- Average power of currently built-out charge points is 62kW, lifting the **average power per charge point from 30kW (2022) to 48kW (2030)**
- Fast charging will account for **35% of charge points**, but **80% of installed power capacity** in 2030
- Despite an increased BEV/CP ratio to 22:1, the ratio of **installed power will stabilize at 2.2kW/BEV**

1) Bundesnetzagentur, BMVI; EFESO model calculations based on current trend extrapolation
2) Statista; Bundesnetzagentur; EFESO model calculations based on BMVI scenario 'HPC charging'

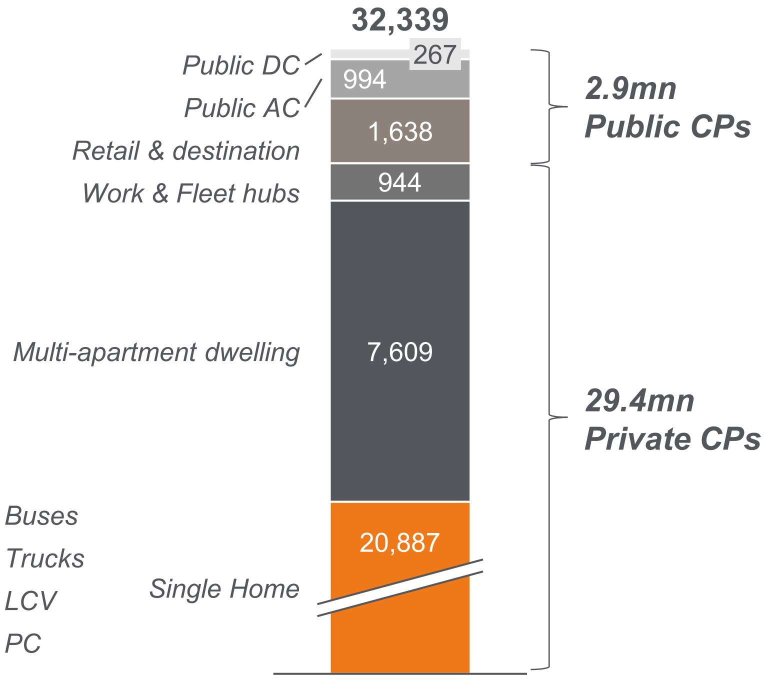
By 2030, EU charging infrastructure will serve 130 TWh of energy via ~3m public and 30mn private charge points

EU charging infrastructure outlook 2030[1]

EV Energy demand distribution 2030
(TWh)



Public & private charge point infrastructure 2030
(1,000 units)



Comment

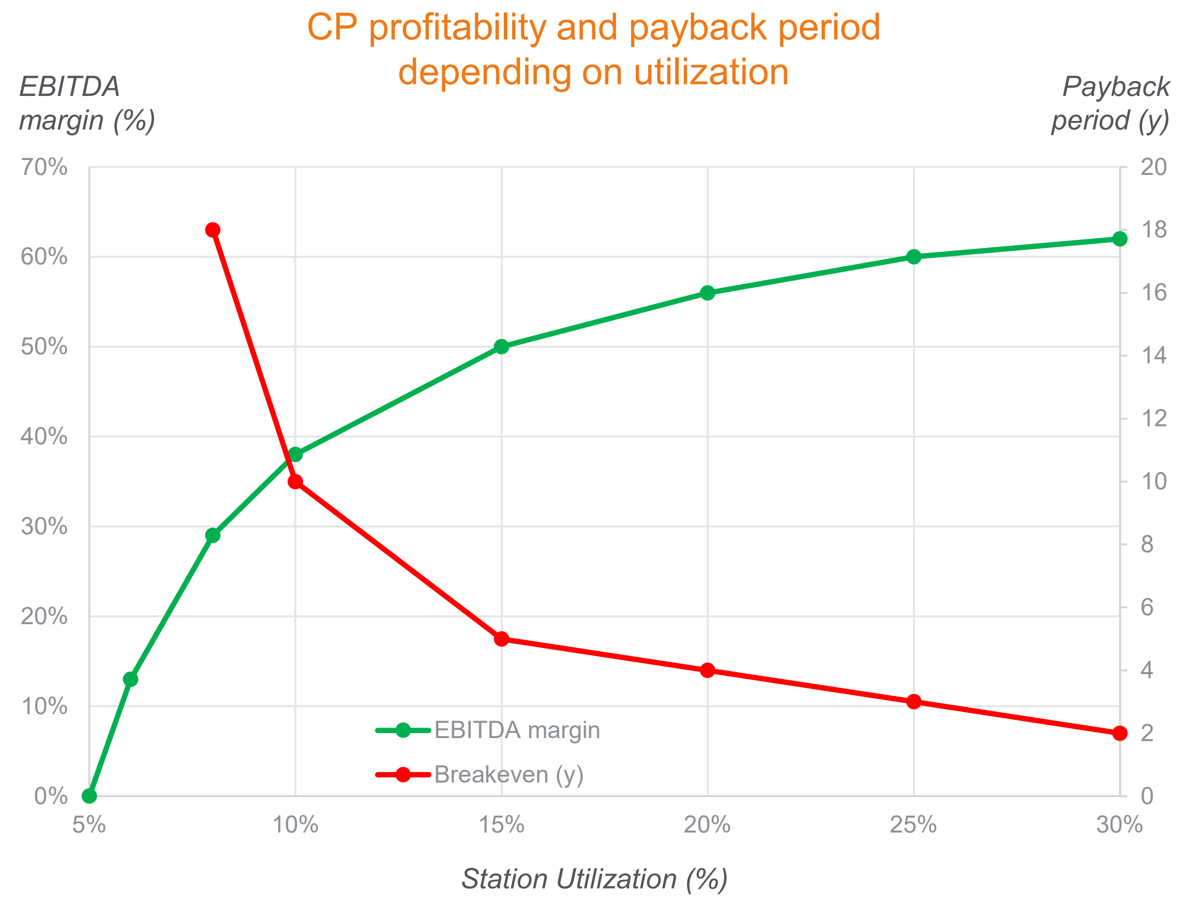
- **130 TWh of energy will be** needed for the total number of passenger and commercial vehicles in 2030, accounting for **5% of total electricity demand**
- Total amount of energy provided will be **almost evenly split** between public and non-public charging infra, with **public CPs representing only 9%** of total infra, due to **higher capacity and utilization leverage**

The big challenge for public CPOs?: will the network be well enough sized ***for sufficient utilization and profitable operation?***

1) ACEA, EU EV Charging Masterplan, March 2022 ('Utilization-oriented scenario': balance of utilization and EV consumer adoption); PC: Passenger Cars; LCV: Light Commercial Vehicles; PC energy demand adjusted to EFESO BEV penetration model; Retail & destination charging incl. public garages

A CPO's profitability is strongly dependent on utilization, with 10% to be considered as a bare minimum and 30% as a benchmark on charge station level

Cost & profitability structures of charging stations[1]



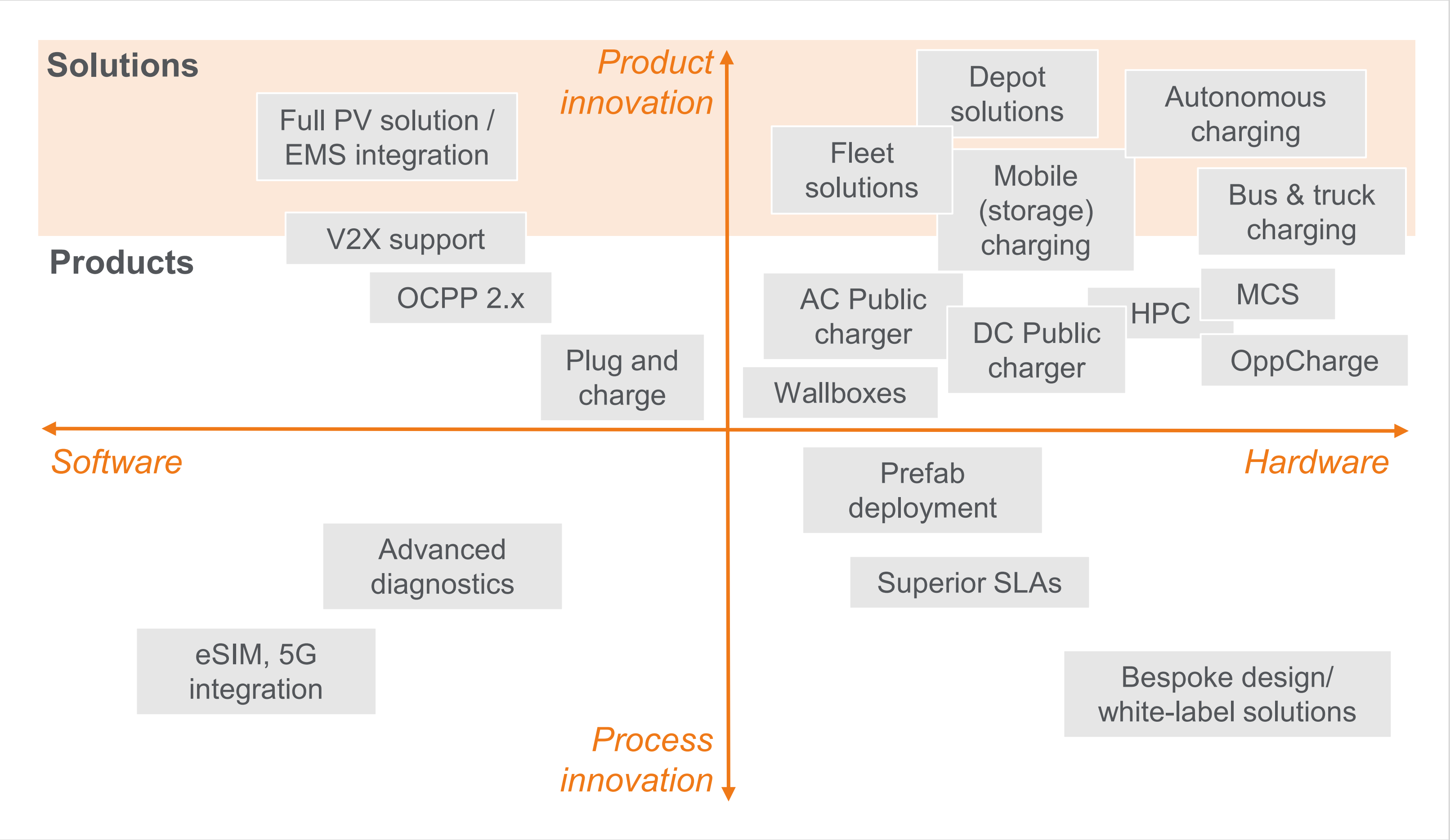
Implications

- **CP utilization** is the dominant KPI to watch for in CPO **profitability:**
  - › **10% utilization: minimum expectation** for non-subsidized CPs, payback **~10 years**
  - › **20% utilization**: payback **~4 years**
  - › **25-30% utilization**: **highly profitable**, but customer experience starts deteriorating due to overcrowding in peak times
- **Uptime** of **close to 100%** is key enabler of high utilization:
  - › **Hardware defaults and power outages require high maintenance SLA's with hardware, utility and connectivity providers; modular hardware architecture** will be key
  - › Software-triggered downtimes can be minimized by regular **firmware updates**, executing **remote / automated diagnostics/ debugging**, using **AI tools**, focusing on **preventing and overcoming interoperability issues** etc.

1) Model calculation based on average station metrics published by various CPOs; own estimates

Hardware manufacturers need to innovate at pace, trading between enhancement and extension of portfolio offering in HW, SW and integrated solutions

Business model innovation framework for charging infrastructure



Risk & opportunities

- Competitiveness of **manufacturing and purchasing cost constantly at risk** (e.g., **Tesla disrupting market** by supplying own supercharger infrastructure to competitors)

Opportunities:

- Key enabler for **CPO's operational efficiencies: help reducing CP downtime** / increase utilization, revenue generation and customer satisfaction
- **Excel in I&C (reduce lead times** with pre-configured, pre-installed components)
- **New revenue streams with service and maintenance business models,** e.g., flexible load management, data analytics & realtime / predictive maintenance

EFESO offers supports in all the key areas that define your innovation and operational excellence, ensuring your long-term success and profitability

Hardware manufacturing	Network roll-out	Network operations
Strategy, portfolio & business model	*Roll-out excellence*	*Operations excellence*
Supply chain management	*Cost optimization*	*'Best in class' customer experience*
Production & quality	*CO_2 / Sustainability*	*Digital ecosystem embedding*

We have optimized a comprehensive range of ancillary relevant trades and technologies, allowing savings of up to 30% to be achieved

Optimization of global operating cost and efficiency for a global automotive organization

Scope: *R&D, SCM, Operations structure and footprint*

Optimization of construction projects for complete factories, warehouses and office buildings

Scope: *Cost structure analysis for buildings, infrastructure and equipment. Project management, development and other costs*

PCO, programs & CSA for a variety of E/E components from different industries

Scope: *Cost structure analysis for HV-Chargers, instrument panels, electrical cabinets, charging units, controller semiconductors…*

We manage holistic optimization programs

- *Costing*
- *Design-to-cost*
- *Implementation*

PCO and design-to-cost program for **steel canopy frames**

Scope: *Cost structure analysis and development of technical cost saving measures*

PCO and design-to-cost program for HV batteries (incl. battery management systems & inverters)

Scope: *Cost structure analysis, design-to-cost and costing scenarios for critical materials*

PCO program solar panels and solar panel integration

Scope: *Cost structure analysis and process optimization for PV-panels and mounting on carrier material*

PCO: Product cost optimization; CSA: Cost structure analysis; BPG: Best practice greenfield

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