Charge France

Allego atlante DRIVECO ELECTRA ENGIE Vianeo FASTNED IONITY powerdot alpitronic EDF T&E

Why BEVs outperform PHEVs and Range-Extended EVs for light transport decarbonization by 2035 in Europe

September 2025

Contents

Acknowledgements

ChargeFrance thanks the BCG team for their analytical support on the total cost of ownership and lifecycle emissions. Their expertise in market analysis was key to writing this study.

Preface

Road transport generates nearly 12% of global greenhouse-gas emissions and up to 18% [1] of EU emissions. Accelerating the transition to electric mobility is urgent and one of the most consequential industrial transformations Europe must undertake. To fulfill its climate commitments, preserve its competitiveness and reinforce its strategic autonomy, Europe must hold steadfast to its commitment to phase out internal combustion engine (ICE) vehicle sales by 2035 and avoid any slowdown (14% of Battery Electric Vehicle (BEV) sales in Europe in 2024).

Thanks to advances in technology, the four main barriers to switching to a BEV (charging time, range, resale value, costs) are quickly fading in the majority of use cases. Public charging stations target 5-20 minutes recharge; new models launched in 2024 average over 500 km of nameplate autonomy vs. 640 km for ICE; and resale value gaps between BEV and ICE are projected to narrow to 4% by 2035. Total cost of ownership (TCO) are also lower for a BEV than alternatives as of 2025 in 75% of cases in Europe[2], and BEVs retain a cost advantage even if fuel prices were to fall to €1.0/L, a price not observed in Europe for two decades.[3] Purchasing costs are now also lower for small/city cars (B-segments) than ICE cars, and cheaper than plug-in hybrids (PHEVs) for larger cars.

BEVs achieve superior cost and emissions advantage compared to PHEVs and range-extended EVs (REEVs). Real-world data shows that PHEVs run on electric mode only 45-50% of the time for private users and only 10-15% for company cars, far from the 80% initially forecasted. BEVs also tend to cost less to own and drive (640 – 1,600 €/year less than a PHEV for an average driver[4]). REEVs, strongly picking up in China, share the same structural weakness. Early real-world data in China shows they run 35% of the time using the generator. REEVs, often large cars, rely on smaller batteries and use a simple, low-cost generator that would not anchor powertrain jobs in Europe.

European OEMs are catching up with imported brands on BEV sales in Europe, launching affordable BEV models[5], and now accounting for 65% of BEV sales in H1 2025. Targeted investments—from charging value chain to battery manufacturing & recycling—should create about 170,000 direct jobs by 2030. In parallel, charging infrastructure is being rolled out steadily.

This working paper presents a fact-based assessment of the future of passenger car powertrains, demonstrating that battery electric vehicles (BEVs) outperform PHEVs, REEVs and ICE for Europe's light transportation emission targets. Our objective is to reduce ambiguity and sharpen focus for all European actors, so that we act collectively and join forces to reach a resilient, sustainable and competitive European mobility system. Charge France stands firm on maintaining the 2035 target to ban ICE vehicle sales, advocates to accelerate large-scale reskilling of the European workforce, and avoid channeling, incentives and investments toward bridge technologies.

[1] Source: ETC CM report 2024/06

[2] Based on 5 years Total Cost of Ownership analysis

[3] Example for family cars (D-Segment) in France, assuming blended public & private charging costs in 2025

[4] Considering a D-segment car, utility factor ranging from 15% (corporate fleet) to 50% (private user), as per ICCT 2022 real world usage data, for an average driver in Germany, France, Spain, Italy

[5] Below €25,000

The report in 6 figures:

75%

of Battery Electric Vehicles (BEV) currently sold in Europe are cheaper to own and drive than currently available alternatives (PHEV, REEV, diesel, etc., based on 5 years of ownership)[6]

59%

of customers own or would be ready to buy a BEV as their next vehicle, conditional to 4 barriers that are quickly fading in most use cases (charging time, range, resale value, costs)

1,600 €/year

Additional savings when driving a large BEV (D-segment) vs. an equivalent PHEV. Savings range from 640€ to 1600€\year for corporate and private cars across Europe[7].

3.2X

Lifecycle CO_2 emissions of a large family ICE car (D-segment) vs. similar BEV (~55 tCO_2 vs. ~17 tCO_2), up to 9x in France for small-city cars[8]

10-65%

Utility factor, i.e. distance driven on electric when driving a Range-Extended EV, hence unclear contribution to net zero emissions target

-15%

Reduction of total oil imports in Europe by 2035 vs. 2025 (i.e. €40-45bn, out of €125 bn), if electrification reaches 2035 objective of 100% BEV sales[9]

[6] 5-year costs as of 2025, assuming 13,194 km driven annually, €1.99/L and 5.9L/100 km for ICE, vs. €0.38/kWh for BEV. When accounting for current resale value discount, 49% of cars sold have a positive 5-year TCO (instead of 75%). Electricity price based on mix of charging (e.g. home, work, public stations)

[7] Considering a utility factor of ranging from 15% to 50%, average driver in Germany (13920km/year), France (13200km/year), Spain (13100km/year) & Italy (8,100km/year).

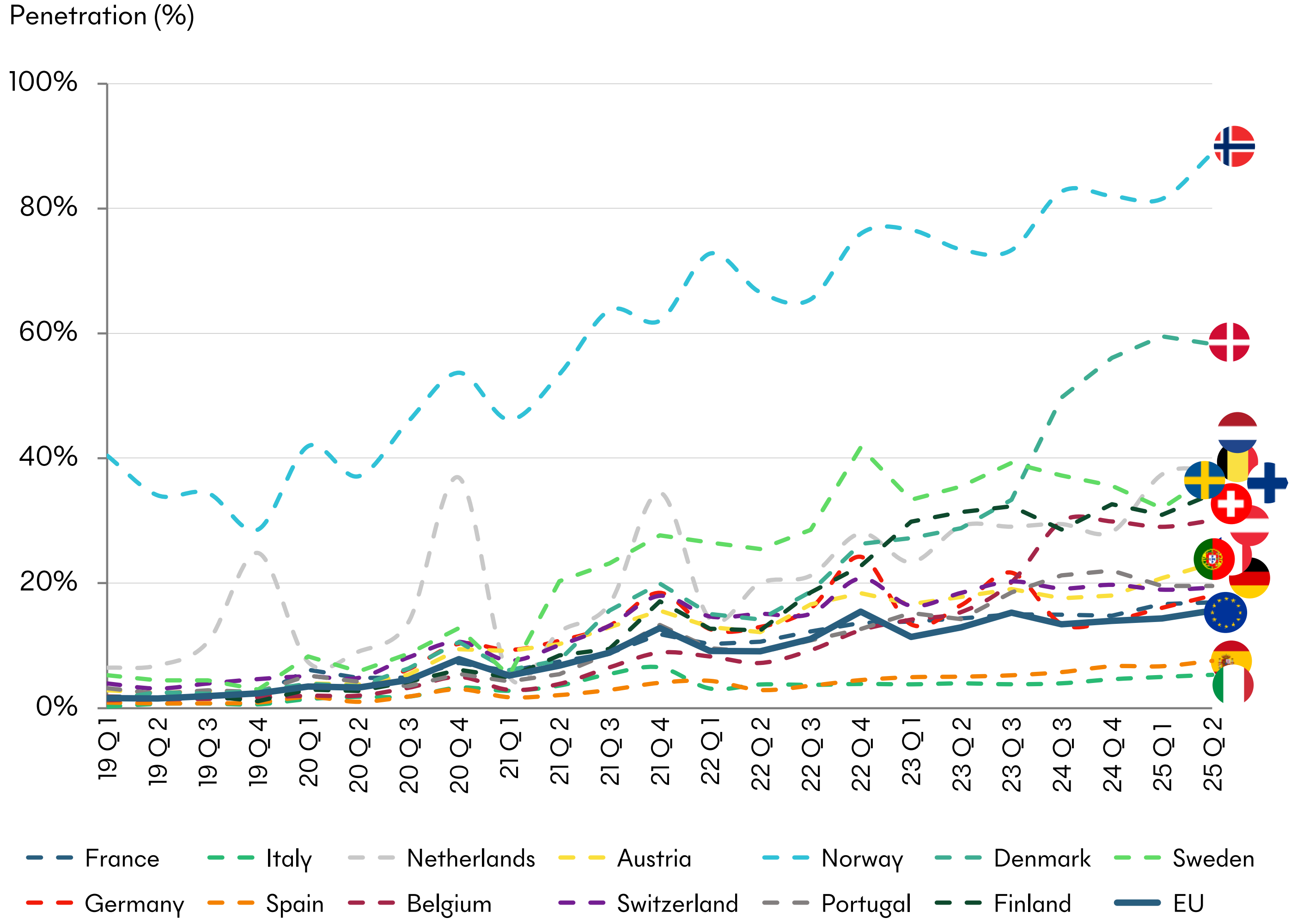
[8] Using France example of 50 gCO2/kWh energy grid and with 225,000 km driven

[9] I.e. c.30% BEV on the road

The report in 5 graphs

GRAPH #1: THE EV TRANSITION IS IN MOTION ACROSS EUROPE: BEVs 14% OF 2024 SALES AND 15.6% OF H1 2025 SALES IN EU

EV penetration in new car sales volumes in selected European countries, 2019-Q2 2025



Note: 2024 Q4 Data are estimates
Source: S&P Global ; BCG analysis

GRAPH #2: BARRIERS TO BEV ADOPTION ARE QUICKLY FADING IN MOST USE CASES AND SHOULD UNLOCK MASS ADOPTION (59% OF EUROPEAN CUSTOMERS OWN OR WOULD BE READY TO BUY A BEV AS NEXT VEHICLE, IF EXPECTATIONS ARE MET)

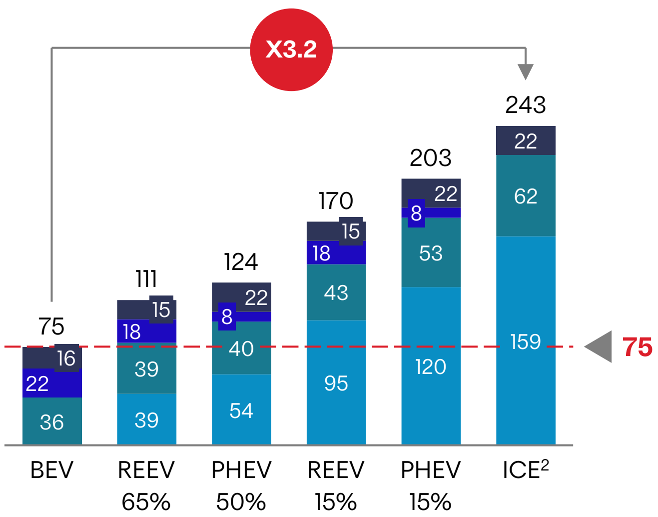
2024 expectations of next wave BEV buyers		Conditions in 2025 or short-term outlook
Faster charging time	30mins	**Down to 15-30 minutes** on HPC and possibly down to 10min with 800V+ EV batteries and ultra fast chargers[1]
Longer vehicle range	460km	**544 km average range** of new models released in 2024
Higher resale value	~ICE	**Narrowing** – 8% car value discount after 5 years today, (ICE is worth 45% of purchasing value, BEV 37%), down to 3% by 2035 (45% vs.42%)
Lower maximum price to buy an EV	€50K	**BEV is cheaper to own & drive** in 75% of cases today in Europe, 91% by 2028

1. On cars with the adequate power system and in locations with grid connections capable of support it
Note: Mean figures; Next wave's sample: n = 2038; BEV owners' sample: n = 587
Source: BCG BEV Adoption Survey Europe (n = 5,121), May 2024

GRAPH #3: BATTERY ELECTRIC VEHICLES (BEVS) ALLOW TO MEET NET ZERO EMISSIONS, EVEN FOR LARGE FAMILY CARS, AND THE SPREAD IN LIFETIME EMISSIONS IS GROWING AS EUROPE'S ENERGY MIX IS DECARBONIZING

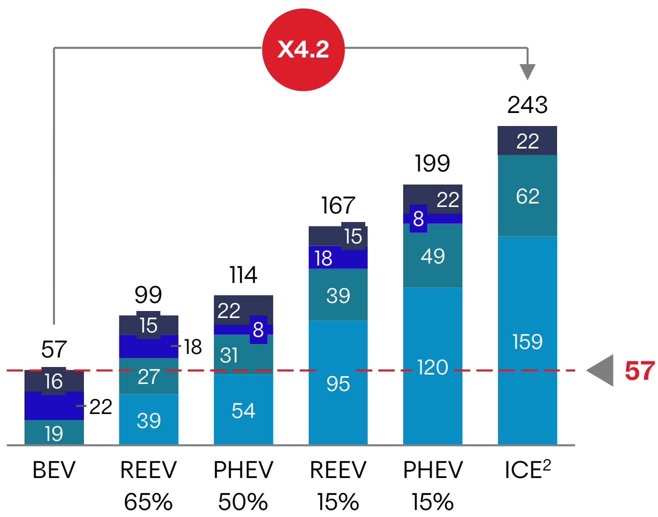
Lifecycle BEVs emissions are 3.2x lower than ICEs with Europe's average carbon intensity

D-segment lifecycle emissions in gCO_2-eq/km
Europe 2024 (210gCO_2/kWh)



BEVs' CO2 edge over ICEs will grow as Europe's electricity decarbonates

D-segment lifecycle emissions gCO_2-eq/km
Europe 2030 (110gCO_2/kWh)



Car production | Battery production | Energy production | Energy consumption

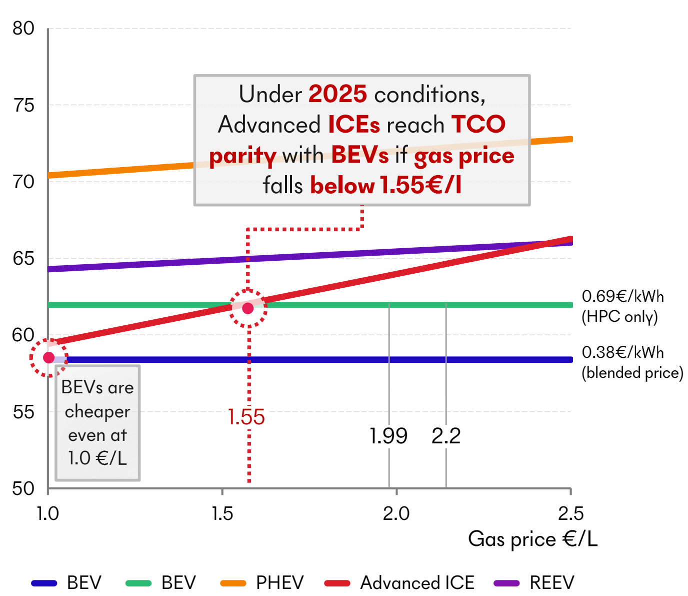
1. Assumes 300km of battery autonomy for BEV 2. Assumes traditional fuels
Note : ~225000km driven ; BEV consumption: 17.4kWh/100km; Fuel consumption: 7.1l/100km for ICE & 4.8l/100km for PHEV 50% utility factor (6.3l/100km for 15%). REEV consumption 5.0l/100km & 17.4kWh/100km
Source: IEA EV life cycle assessment calculator ; European Environment Agency (2023) ; BCG analysis

GRAPH #4: IN EUROPE, IT IS CHEAPER TO OWN AND DRIVE A BEV CAR THAN A PHEV, REEV OR ICE, EVEN A LARGE FAMILY CAR WHEN FUEL PRICES ARE LOW, AND IT SHOULD BECOME EVEN CHEAPER BY 2030

In 2025, owning & driving a BEV is cheaper at 1.0 €/L for blended electricity price & 1.55 €/L when charging on HPC

5-year TCO

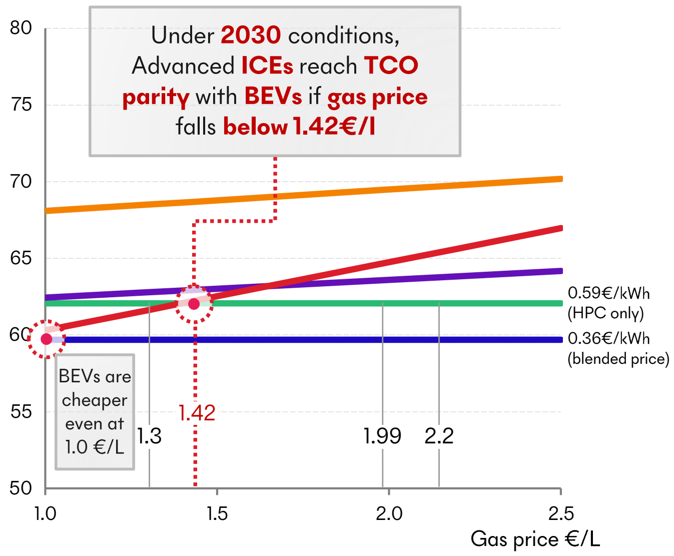
D segment, 2025 (in k€), 0.69€/kWh, ~12,000km/year



In 2030, owning & driving a BEV becomes even more favorable, with parity of HPC vs. fuel at 1.42€/l

5-year TCO

D segment, 2030 (in k€), 0.59€/kWh, ~12,000km/year



Note : BCG model assumptions – Energy efficiency gains PHEV/BEV/REEV in 2030 : 12% – PHEV utility factor: 53%; REEV utility factor: 65%;
TCO analysis does not include current resale value discount. D-segment used as an example of the highest cost savings. . Assuming an average distance of 11879km/year
Maintenance and insurance costs difference between ICE and BEV not considered here
Source: BCG Powertrain model ; BCG analysis

GRAPH #5: WHEN BUYING A FAMILY CAR A BEV IS CHEAPER TO DRIVE AND EMITS 2 to 5 TIMES LESS CO2 THAN A PHEV OR A REEV

		BEV	REEV EV-Optimized[2]	REEV ICE-heavy[2]	PHEV - private car[2]	PHEV - company car[2]	ICE
Utility factor (% electric drive)			65%	15%	50%	15%	
Share of 2024 sales per type *(excl. 16% HEV)*		15%	0% (24% of total sales in China in 2024)		7%		62%
Average purchasing cost for a family car (€)		€51,700[3] (incl 2600€ subsidies)	€54,300		€56,200		€50,400
Monthly cost over 5 years for an average driver (€)	*Monthly cost[4]*	€110	€150	€160	€200	€270	€230
	Additional monthly cost vs. BEV		+€40	+€50	+€90	+€160	+€120
Lifecycle CO2 emissions (gCO2eq/km) over 225,000 km	*Car production (of which battery)*	38 (22)	32 (18)	32 (18)	30 (8)	30 (8)	22
	Car usage	9	60	135	86	170	220
	Recycling upside[1]	- 5.5 to - 11	-4.5 to - 9		- 2 to - 4		-
	Total emissions gap vs. BEV		X2	X4	X3	X5	X6.5

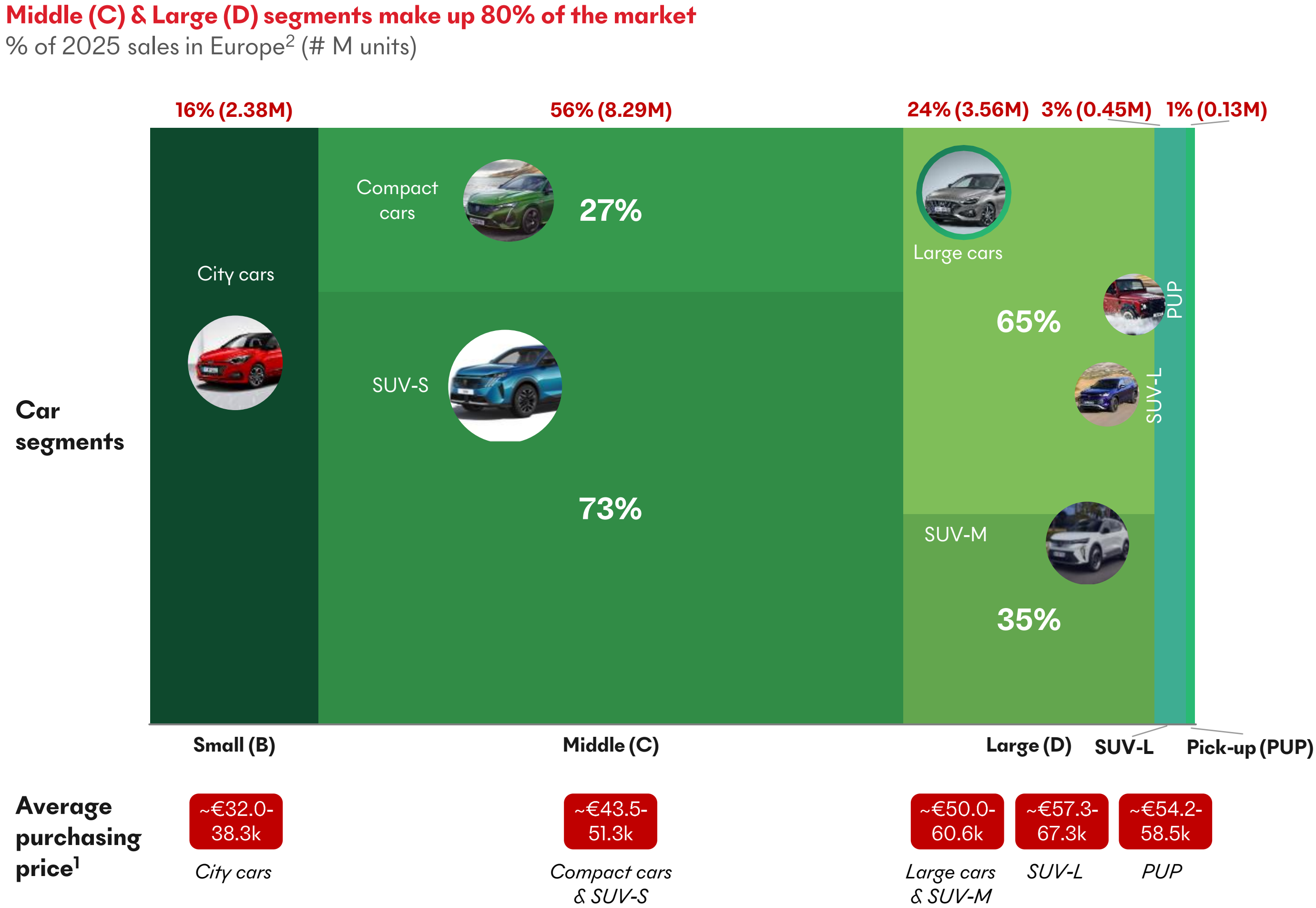
13,194 km driven annually

xxtCO2 Production CO2 · xxtCO2 Usage CO2 · €xx Upfront costs · €xx Operating costs · +x Difference vs. BEV

1. LFP batteries emissions can be reduced by 25% through recycling vs. 50% for NMC 2. Utility factors : PHEVs company car 15%, PHEV private car 50%, REEV ICE-advanced 15% and REEV EV-Optimized 65% 3. In France subsidies apply only below €46,000 4. Driving & maintenance costs
Note : ICE gas consumption 7.1l/100km, PHEV 9.5L/100km & 24.6kWh/100km, REEV 6.5L/100km & 17.4kWh/100km, BEVs 17.4kWh/100km
Source: BCG analysis

Key concepts & definitions

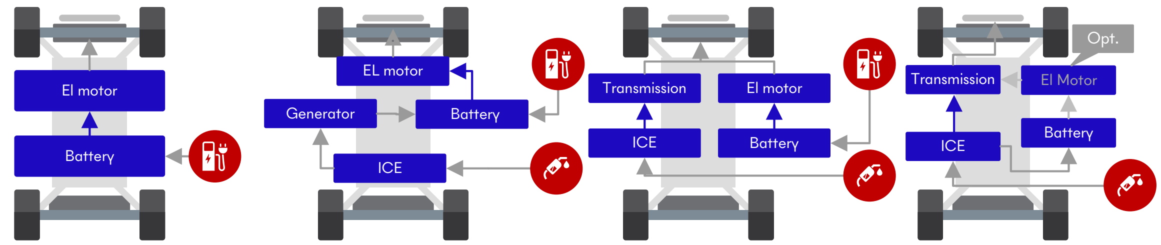
FIGURE 1: SALES PER CAR SEGMENT IN EUROPE (EU27 + UK)



1. 2025 BEVs average prices ranges between France, Germany, UK, Italy, Spain, the Nordics & Rest of Europe 2. EU27 + UK + EFTA
Source: S&P 2025 Market data ; BCG Analysis

Powertrain categories / Vehicle types: While Battery Electric Vehicles (BEV), run exclusively on an electric engine and "Advanced ICE" cars (i.e. latest diesel/petrol, "start & stop" cars) on internal combustion engine, PHEV (Plug-in Hybrid Electric Vehicle) have a double motor system. Range-Extended EVs (REEVs), lately picking up in China for large cars, run on an electric engine but have a petrol reservoir and a generator that can recharge the battery.

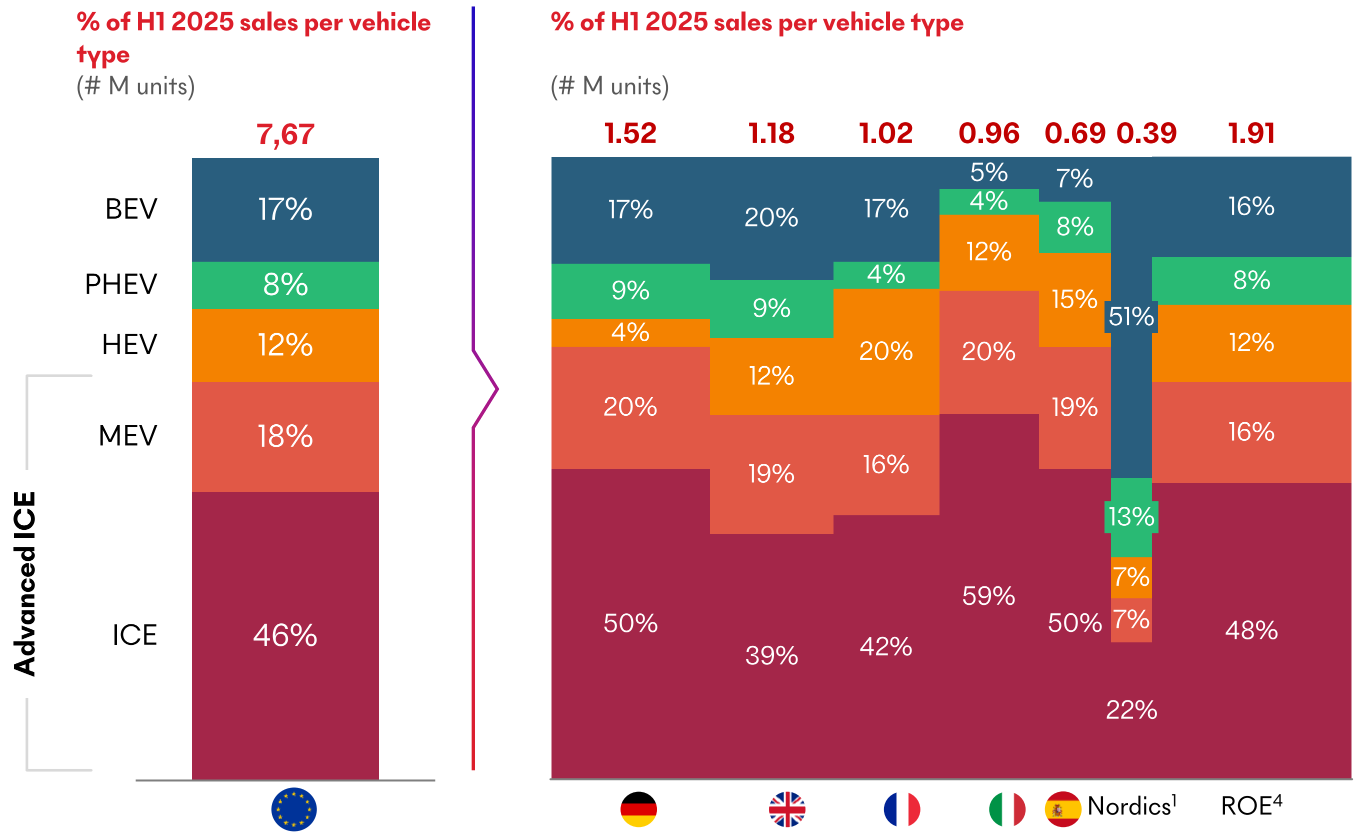
FIGURE 2: POWERTRAIN CATEGORIES



	BEV	REEV	PHEV	Advanced ICE
Propulsion	**Electric motor**	**El. Motor + ICE[2] not linked to wheels**	**Internal combustion engine + El. motor**	**Internal combustion engine + El. Motor not linked to wheels**
Drive system	• External charging • Driven by stored battery	• Fuel must convert to electric energy for drive • External charging & refueling	• External charging & refueling • Fuel can directly drive	• Refueling • Fuel can directly drive
Example model	ID.3	Li Auto L7	Honda CR Z	Toyota Prius

1. The structure may vary depending on the OEM. The diagram shown here is a representative and simplified version 2. Internal combustion engine
Source: Literature research; BCG analysis

FIGURE 3: 17% of H1 2025 SALES IN EUROPE WERE BATTERY EV (BEV), WITH HETEROGENEOUS PENETRATION ACROSS COUNTRIES



1. Denmark, Finland, Norway, Sweden 2. Engine with electric assist; no electric-only drive 3. Engine + motor; limited electric-only drive 4. Rest of Europe
Note : Europe considered as EU27 + UK + EFTA
Source: S&P 2025 Market data ; BCG Analysis

Public & Private Charging Points: Public charging points are networked electric-vehicle chargers installed in locations open to all drivers—such as highway rest areas, supermarkets or municipal car parks—while private charging points are units installed at homes or workplaces for the exclusive use of residents, employees or fleet vehicles. Europe already operates more than one million public chargers alongside an estimated 7-8 million private units, reflecting complementary roles in the charging ecosystem.

CPO (Charging Point Operator): a company that typically finances, builds, operates and maintains charging stations for Electric Vehicles.

TCO (Total Cost of Ownership): the sum of all costs a driver incurs over a vehicle's holding period to compare powertrains on a like-for-like basis. It includes purchase price, maintenance, driving costs (energy or fuel). For simplification purposes, insurance, taxes, financing & depreciation are considered neutral between powertrain types in this working paper, and hence not reflected in the amounts provided.

Upfront costs: the one-time expenditures required to put a vehicle on the road—principally the purchase or lease price and any registration fees—incurred before the first kilometer is driven, and netted from subsidies.

Driving costs: variable day-to-day expenses of using a vehicle—mainly electricity or fuel, routine servicing and consumables—incurred over the kilometers travelled.

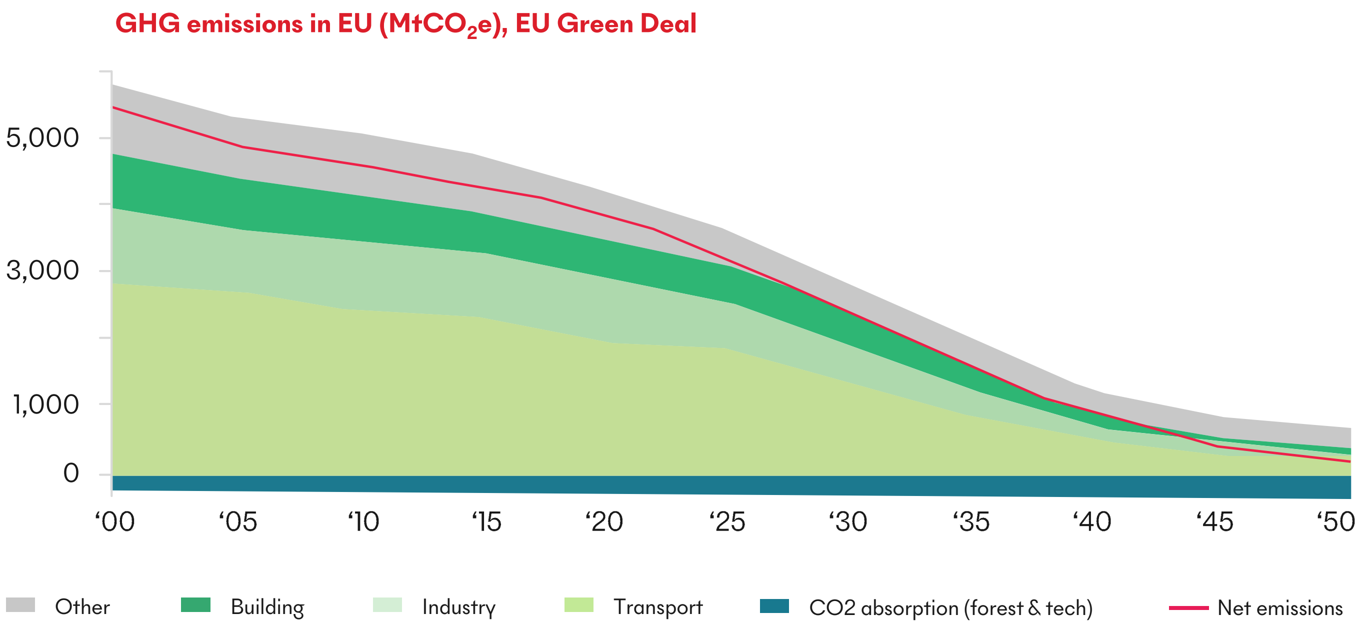
Lifecycle C02 emissions: every ton of carbon dioxide-equivalent associated with a vehicle from raw-material extraction and manufacturing through decades of driving and final disposal, offering a full-chain measure of climate impact.

1. The EV transition, initiated by regulation and essential to decarbonization, is now in motion across Europe

a. TRANSPORT SECTOR NEEDS TO BE AT 0% EMISSIONS BY 2050 TO ENABLE EUROPE TO REACH DECARBONIZATION OBJECTIVES

The Paris Agreement adopted in 2015 emphasized the urgent need to limit global warming to 1.5°C above pre-industrial levels to significantly reduce the risks and impacts of climate change, with stricter regulations and rising renewable targets to accelerate the transition. In response, the European Union has translated this ambition into binding legislation through the "Fit for 55" package voted in 2023, which sets the target of reducing net greenhouse gas emissions (GHG) by at least 55% by 2030 and 90% in 2040 compared to 1990 levels—on the path to full climate neutrality by 2050 (see figure 4).

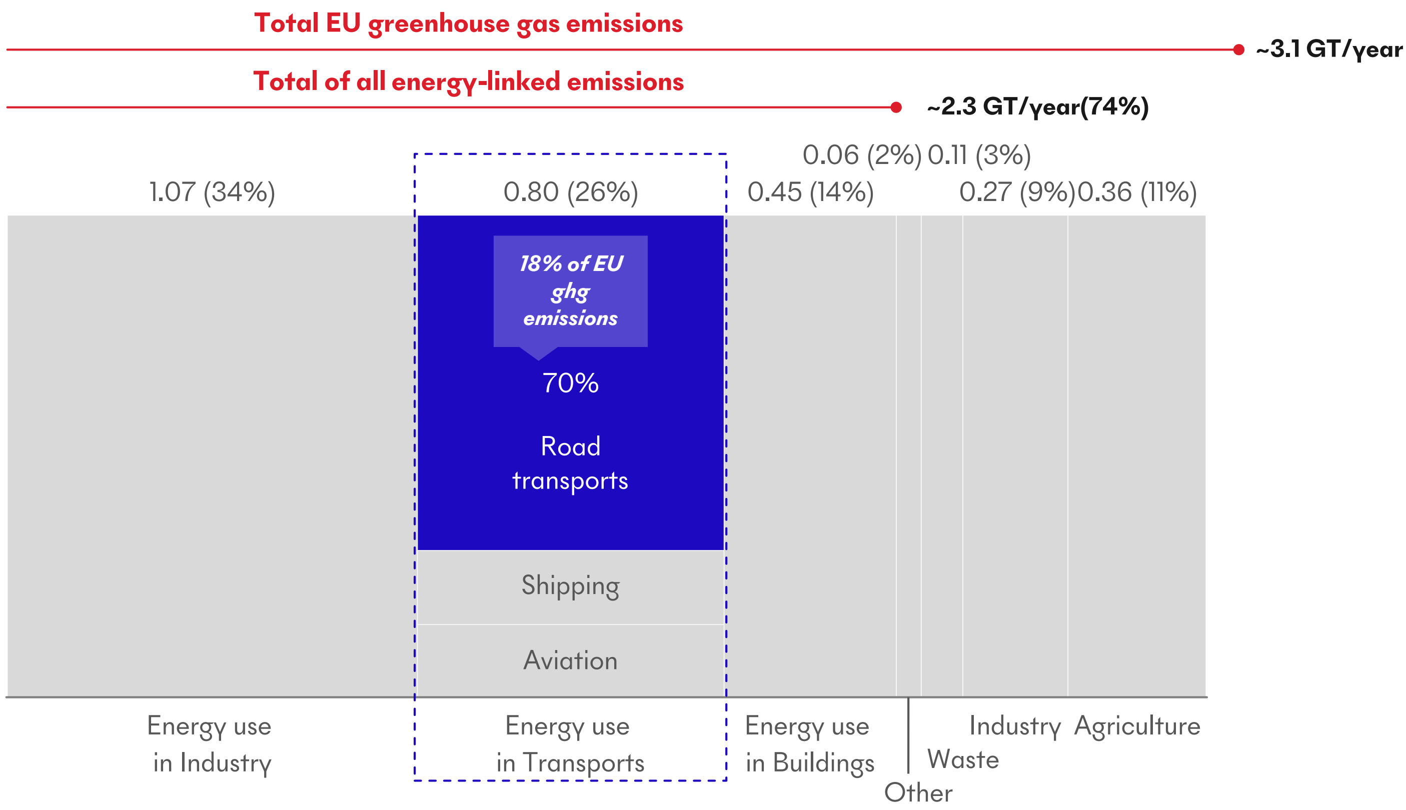
FIGURE 4: EU EMISSIONS' TRAJECTORY IN A 1.5°C SCENARIO IN MT CO2E



Source: European Commission 2050 strategic vision, ADEME, BCG analysis

Because heavy industry and agriculture will decarbonize more slowly, cutting road transport emissions has become a cornerstone of Europe's climate strategy. Road transport contributes to nearly 18% of global European GHG emissions. In 2023, EU greenhouse-gas emissions totaled 3.1 gigatons, with the transport sector contributing to 0.8 Gt (about 10% of that global transport-linked GHG emissions globally); 70% of which on road transport emissions. This underscores that road traffic electrification coupled with a firm stance on phasing out tailpipe emissions is central to any credible decarbonization strategy (see figure 5).

FIGURE 5: EUROPEAN UNION GHG EMISSIONS BY SECTOR IN GT CO_2E, 2023



Source: European Environmental Agency (ETC CM report 2024/06); BCG analysis

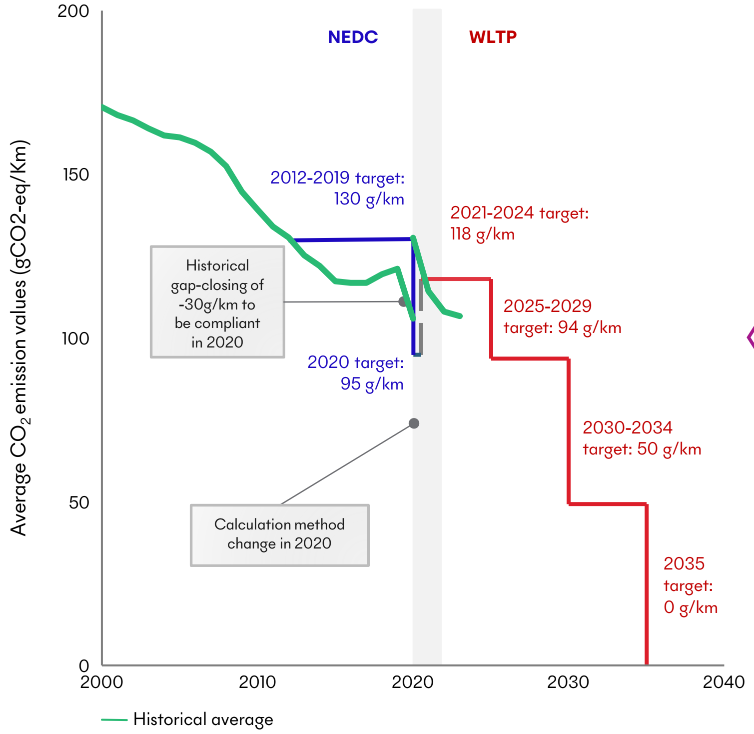
The EU requests decreasing maximum CO2 fleet emissions for entire OEM fleets in 2020, 2025, 2030 and 2035. So far, OEMs were able to meet every target change – be it on their own or through OEM pools. The industry thus closed a double-digit gap in 2019 and still met the 2020 emissions standard.

Latest regulatory developments allow manufacturers to pool with others to reach their 2025 targets, calculated as a 3-year average over 2025-2027. Fleet emissions already dropped to 106.7 g/km in 2023[10] from 130.7 in 2020, on track for the next threshold of 94 g/km until 2029.

[10] T&E report

FIGURE 6: HISTORICAL AVERAGE CO2 EMISSION AND EU TARGETS

Historical average CO_2 emission values and European targets for new passenger cars



takeaways

Average CO_2 emission value is decreasing at a rate compatible with 2025 target

Future 2030 and 2035 targets will need acceleration of penetration due to more ambitious target

Historical outperformance (121 to 95gCO2-eq/km in 1 year) in 2019-2020 could show that **OEMs want to be compliant and take this regulation seriously** – see deep-dive next page

Regulatory Update – March 2025

The emissions gap can now be closed over a three-year average period, **giving OEMs increased flexibility in meeting their targets**

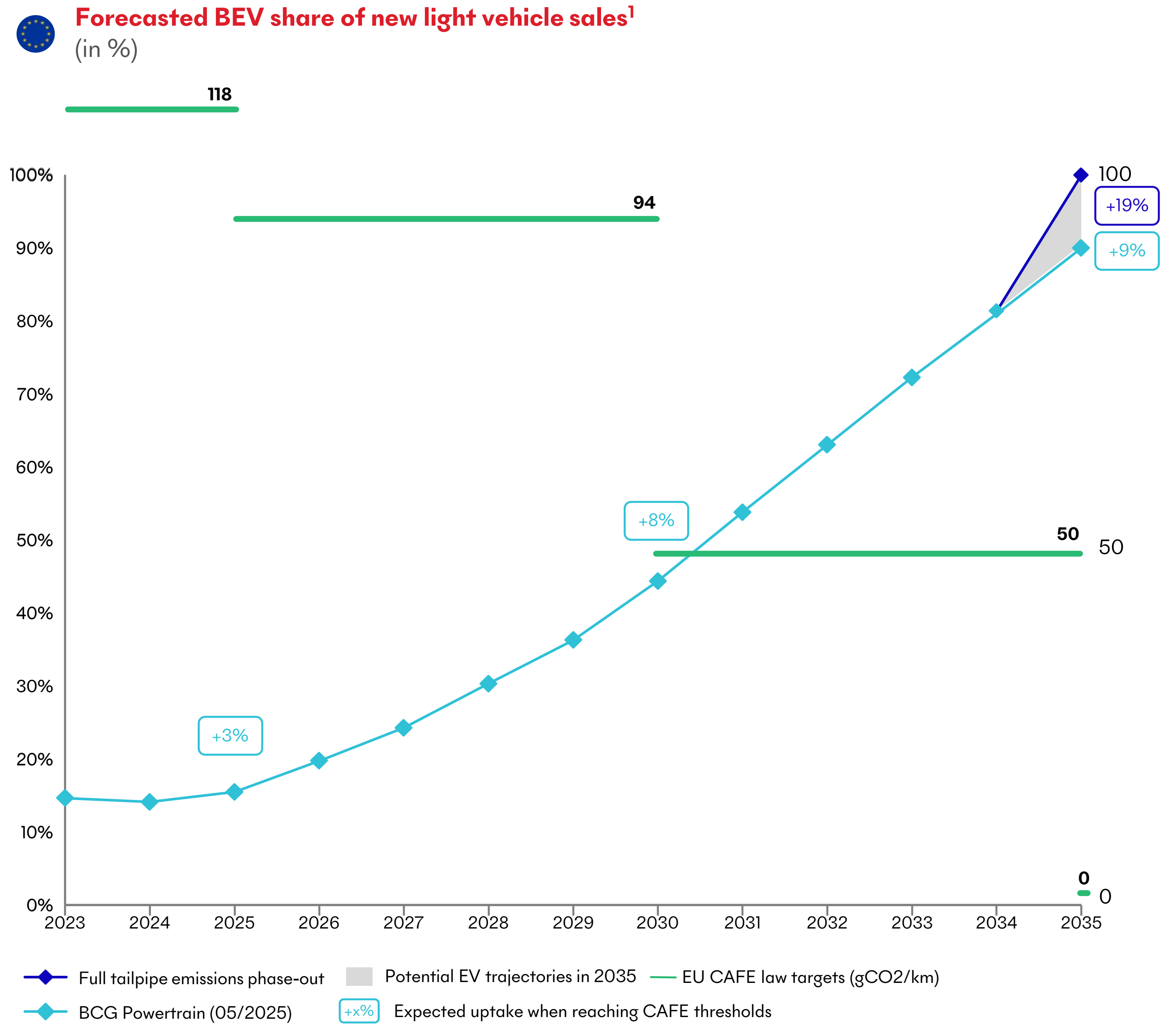
1. NEDC : New European Driving Cycle 2. WLTP : Worldwide Harmonized Light Vehicles Test Procedure
Source: T&E 2024 report; BCG analysis

b. BEVS REPRESENT THE MOST FEASIBLE PATH TO MEET 2035 TAILPIPE EMISSIONS PHASE-OUT

Electric cars are shifting from early adopters to mass adoption in Europe. Forecasts put BEVs at 40-45% of Europe's new car market sales by 2030. By 2035, complete compliance with the EU's zero-emissions mandate is the only route compatible with the net zero ambition (see figure 7). Even in slower change scenarios (e.g., because of sporadic subsidies or lower incremental battery gains than anticipated), BEVs are still expected to represent about 90% of new registrations a decade from now.

Four main criteria influence the pace of adoption: government policy, price parity, OEM dynamics and infrastructure readiness. Policy must stay firm: consistent incentives, avoiding stop-and-goes, and strict reinforcement of the 2035 tailpipe emission phase-out to keep momentum, while a "penalty-and-sell" loophole or signals of postponing targets would stall it. Price parity is next: demand has been growing in Europe in 2025 thanks to new affordable models launched and will drive fleet electrifications as well as private car adoption. In 2025, 75% of BEVs sold in Europe have a lower 5-year total cost of ownership (TCO) than ICEs when not considering resale value. Third comes industry execution: the performance of European automakers vs. global competitors is also critical, as production shift, labor challenges or supply-chain disruptions could erode profitability, lead to job losses and weaken competitiveness, delaying the transition to electric. Finally, a robust charging network—offering everything from slow chargers to high-voltage fast chargers, especially as vehicles adopt higher-voltage batteries—is essential to deliver a reliable customer experience. Any gaps or unreliability in infrastructure will undermine consumer confidence and impede EV uptake.

FIGURE 7: FORECASTED BEV SHARE OF NEW LIGHT VEHICLES SALES PER YEAR



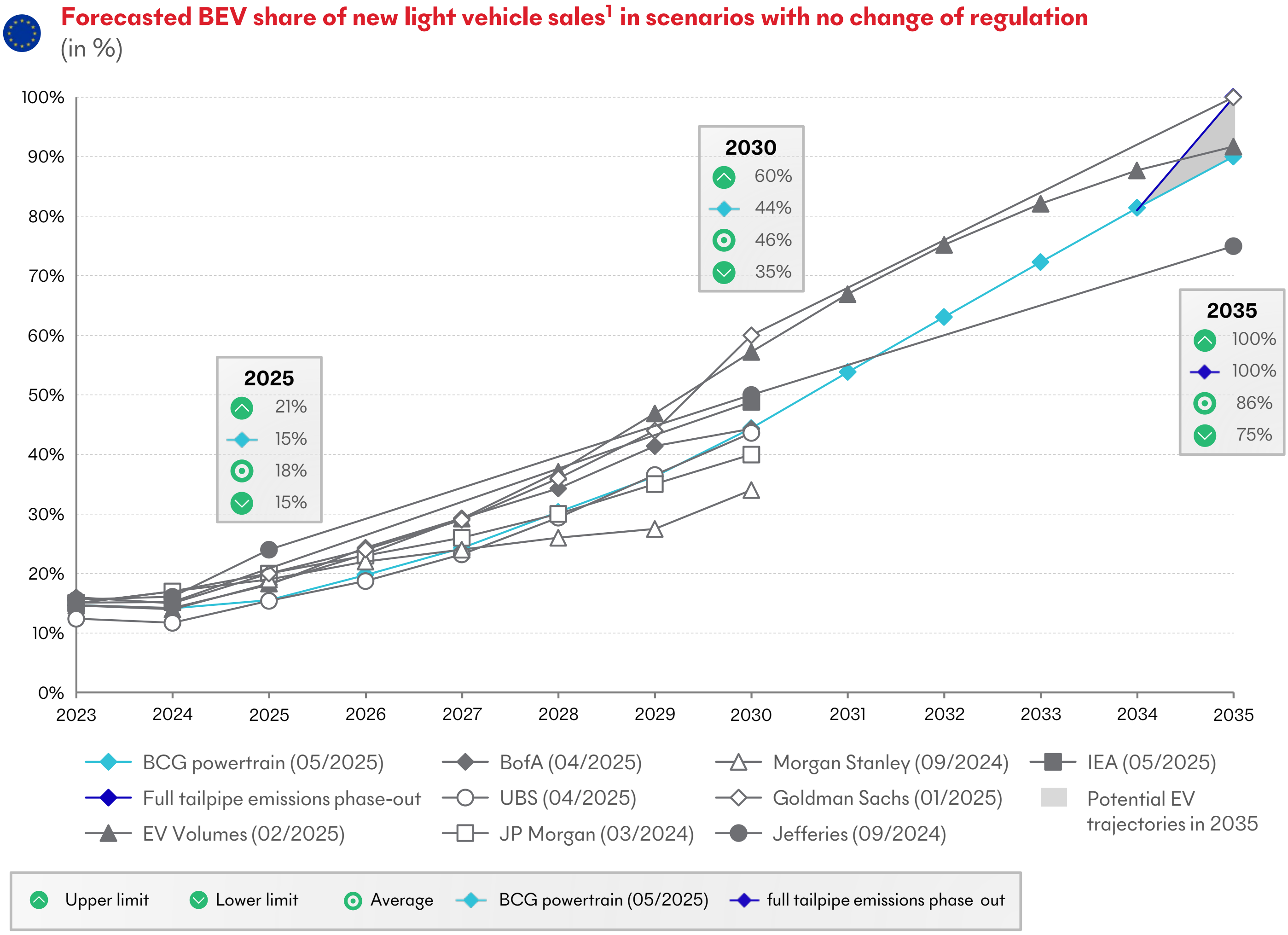
1. Considered only West & Central Europe
Sources: BCG Powertrain model (05/2025), BCG analysis

This trajectory is consistent with most forecasts, with limited impact from latest sales figures and industry news. The trajectory aligns with other leading analyst projections, as independent sources forecast BEV market share between 75% and 97% by 2035, confirming a consensus around mass adoption by mid-decade (see figure 8), assuming no change in regulatory framework occurs in the coming years. In Europe, BEV sales held steady at 2.2 million units in 2024, matching 2023 levels despite a tapering of policy support across major auto markets[11]. REEV models in Europe would not change BEV penetration dramatically, with only 1% decrease forecasted by 2030, but marginal impact by 2035 (see section c).

[11] Source: IEA Global EV Outlook 2025

FIGURE 8: COMPARISON OF BCG BEV SCENARIOS WITH OTHER ANALYST REPORTS

Forecasted BEV share of new light vehicle sales[1] in scenarios with no change of regulation (in %)



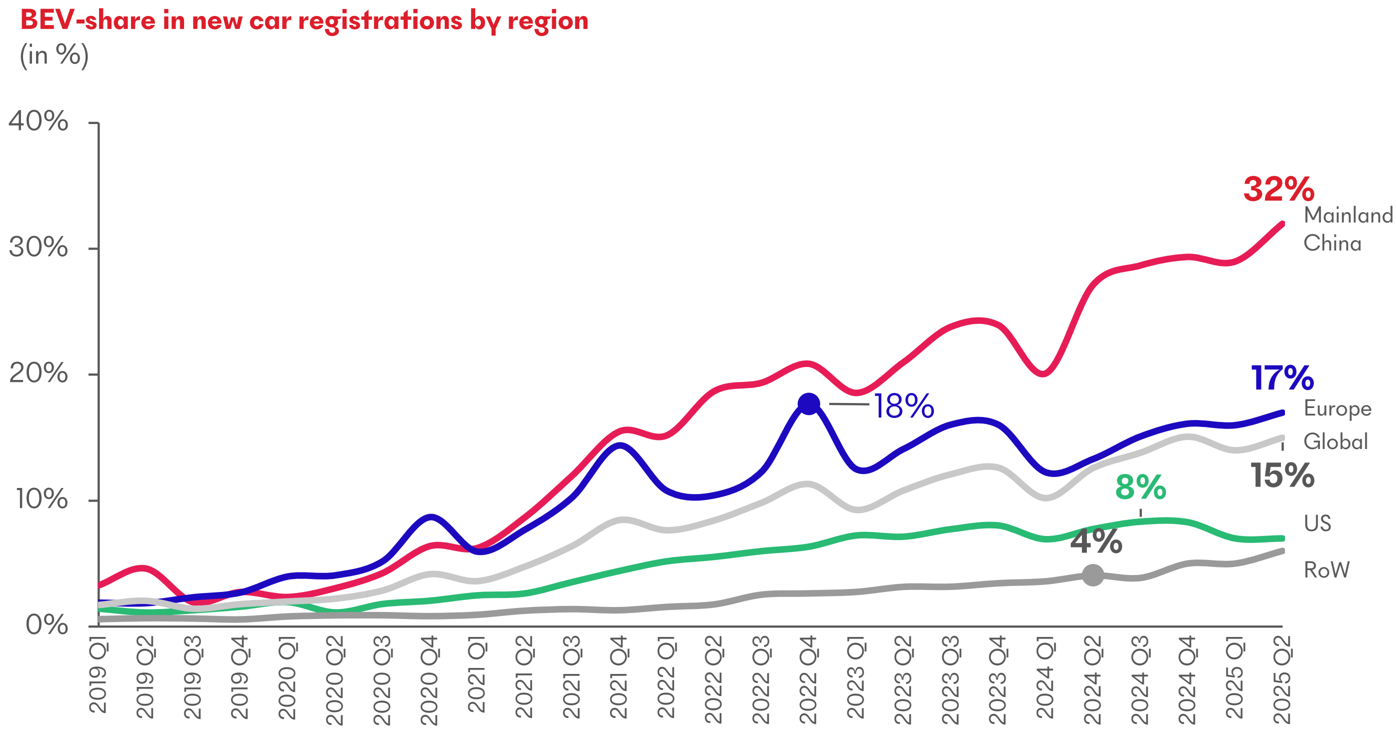
1. Considered only West & Central Europe 2. No change in regulatory targets in 2026 or 2027
Note: Assumed curves if only point estimates available (e.g., 2025 and 2030)
Source: Analyst reports and publications; BCG Powertrain model (05/2025)

Electrification could accelerate beyond these forecasts, subject to European citizens confidence. Actual market developments often outperform early projections due to the underestimated pace of consumer technology adoption. This "solar effect"- where clean technologies follow an S-curve and outpace legacy forecasts-has already been observed in photovoltaics, for which consumer demand was higher than initially anticipated and/or supply was more available than initially forecasted.

c. THE EV TRANSITION IS IN MOTION, WITH NORDIC COUNTRIES LEADING THE WAY

The EV transition is in motion globally. In Q4 2024, BEVs accounted for 15 % of new car registrations worldwide, with China setting the pace at 29 % (see figure 9).

FIGURE 9: BEV SHARE IN NEW CAR REGISTRATIONS BY REGION, 2019- Q2 2025



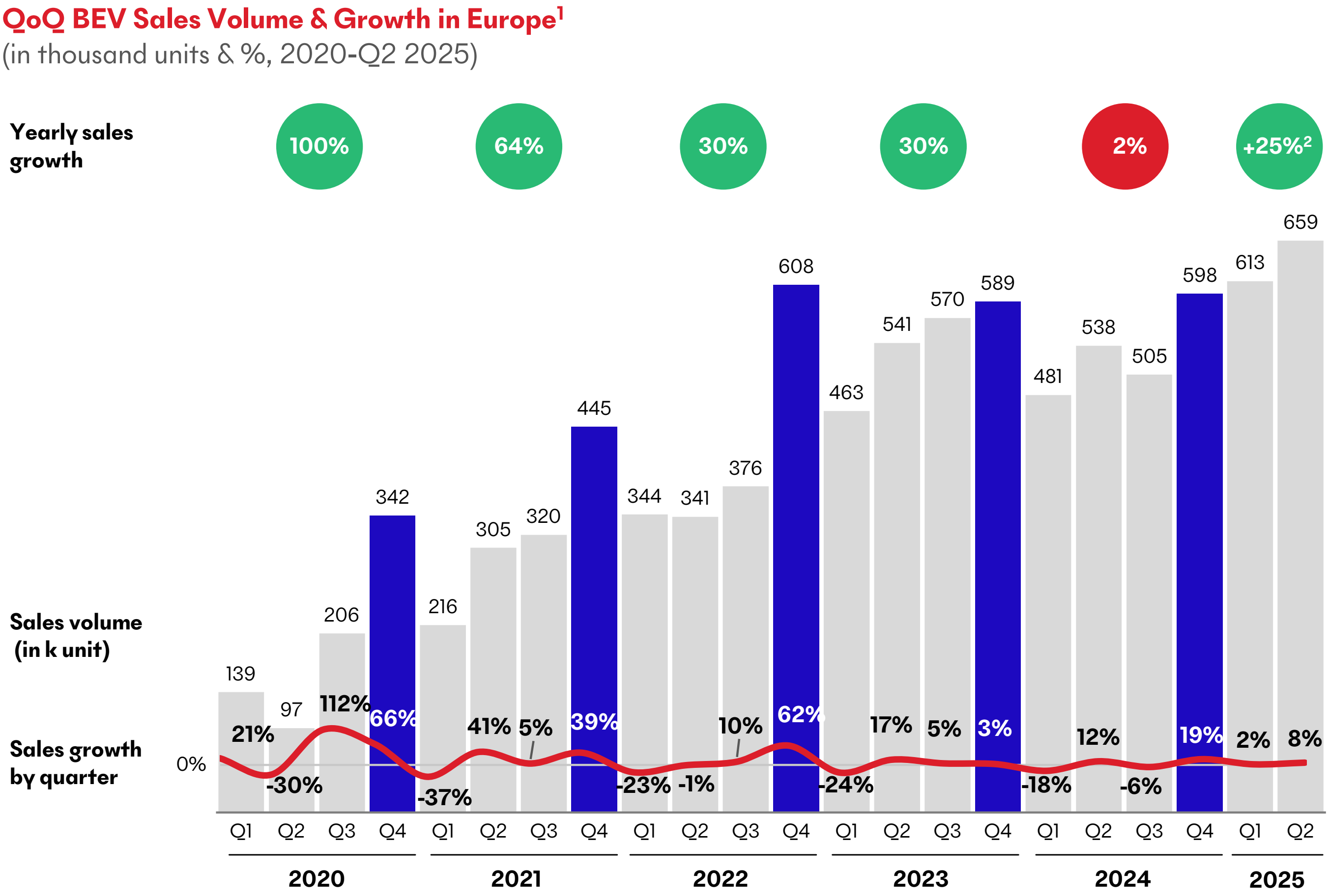
Note: Includes all light vehicles, except heavy vans; Europe includes EU27 + EFTA + UK, China Mainland; BEV = battery electric
Source: S&P Global Mobility ("IHS Automotive") Auto Demand Tracker (02/2025); BCG analysis

The EV transition is in motion across Europe, with Nordic countries leading the way. BEV sales have picked up across all European countries since 2019, with 2% of BEV sales in 2019 & 14% in 2024. Penetration is heterogeneous across European countries, with Norway leading the way (82% of BEV sales in Q1 2025, and more than 85% forecasted for Q2 and Q3 2025[12]). Eastern & southern European countries are lagging (7% for Italy in 2024, 11% for Spain in 2024), but showing signs of catch-up (e.g +73% BEV sales between H1 2025 and 2024 in Spain)[13].

While European countries differ in adoption speed, the path to BEV penetration, however, is robust: cumulative EU registrations keep rising with a 24% increase of BEV sales in Europe in H1 2025 vs. H1 2024, confirming the positive impact of new affordable models available.

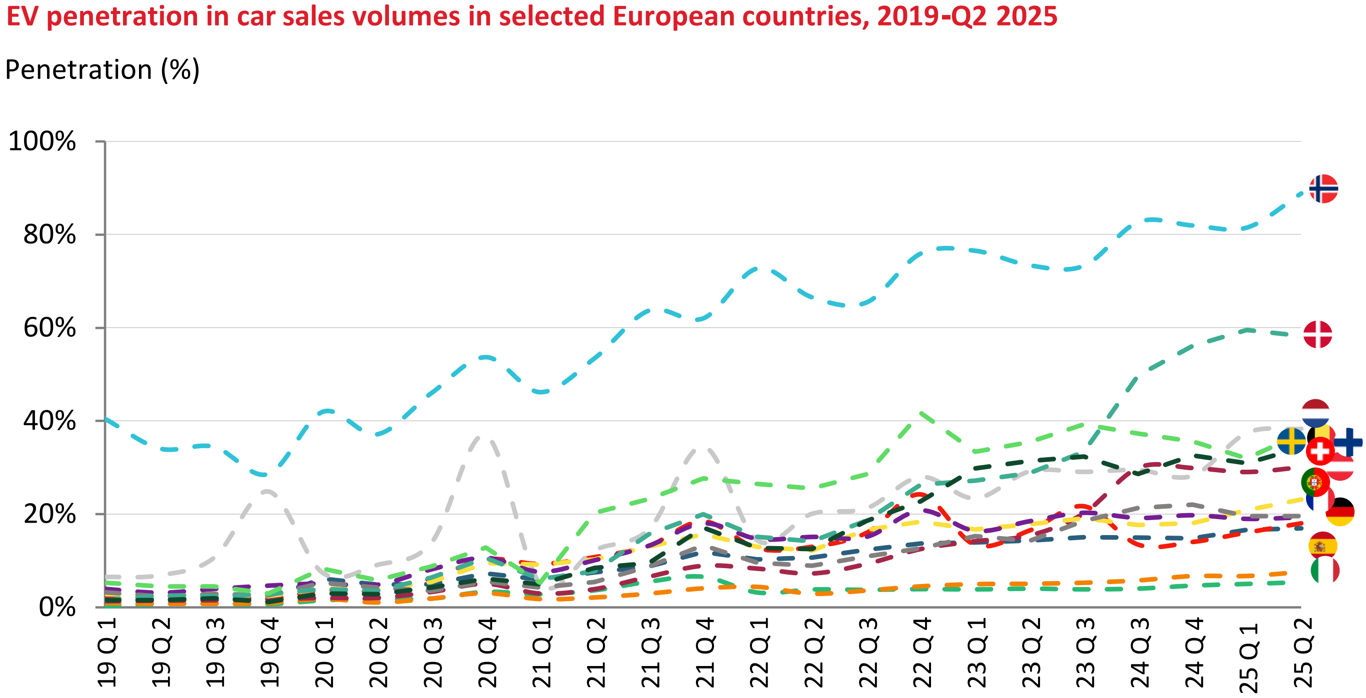
[12] S&P Global
[13] S&P Global

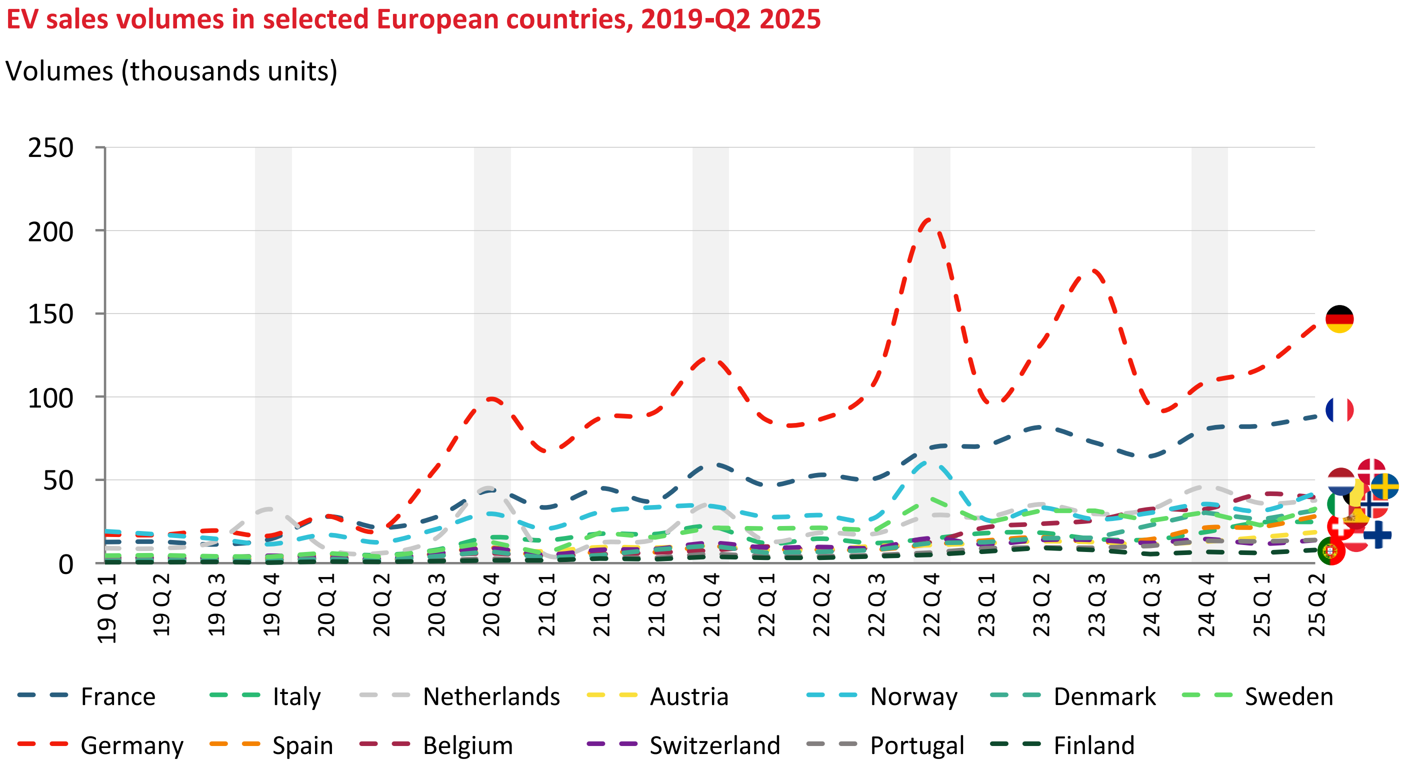
FIGURE 10: BEV QUARTERLY & YEARLY SALES GROWTH 2020-Q2 2025



1. Europe includes EU27 + EFTA + UK 2. YoY H1 comparison
Source: S&P Global Mobility Market Data ; BCG analysis

FIGURE 11: EV SALES PENETRATION IN CAR SALES VOLUMES IN SELECTED EUROPEAN COUNTRIES, 2019-Q2 2025, IN % AND VOLUME





Note: 2025 Q2Data are estimates
Source: S&P Global ; BCG analysis

2. Barriers to BEV adoption are quickly fading in most use cases

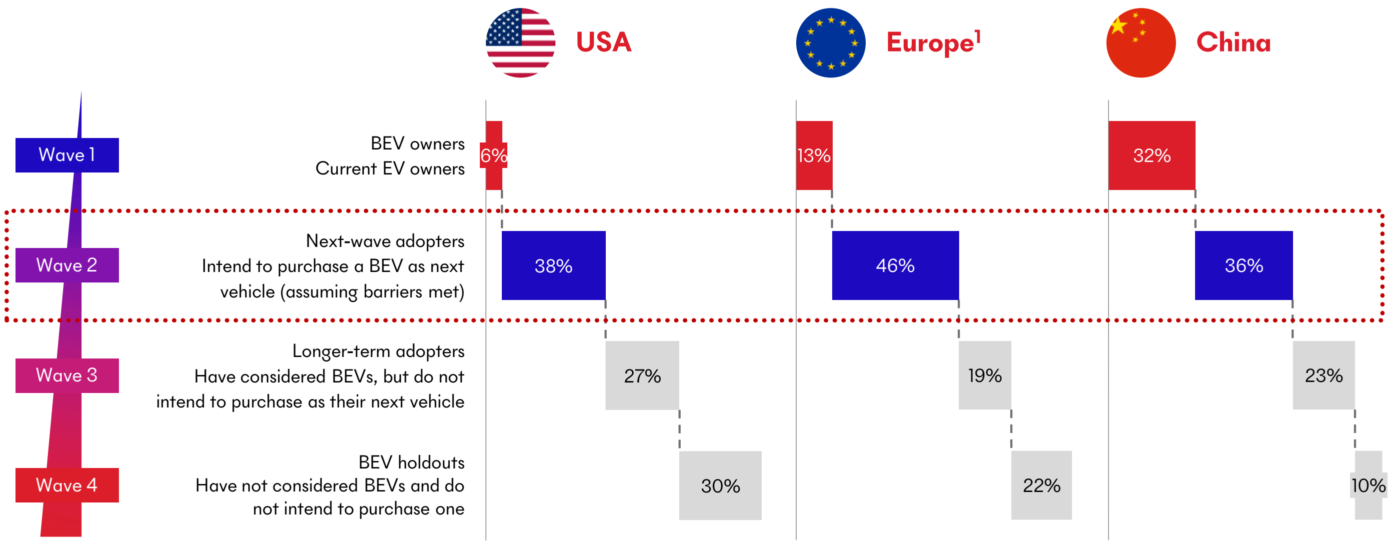
a. 59% OF EUROPEAN CUSTOMERS OWN OR INTEND TO SWITCH TO A BEV, CONDITIONAL TO 4 FACTORS: CHARGING TIME, RANGE, RESALE VALUE, RUNNING COSTS

There is a growing enthusiasm for BEV adoption across all major European markets [14]. Recent consumer surveys show that Europeans are leading the EV transition, not only just "open" to buying an electric vehicle. According to a study conducted across Europe, China and the USA, **46% of European respondents declare they intend to purchase one as their next vehicle[15]** (see figure 12) if prerequisites are met -which is the case in most situations as of 2025 in Europe- (see figure 13), adding to the 13% who already own a BEV. This signals a strong underlying demand for electrified mobility and validates the strategic direction set by regulators and manufacturers.

[14] BCG BEV adoption surveys: US=~3000 respondents, EU=~5000 respondents, CH = ~2500 respondents; 2024

[15] Actual BEV sales penetration remains <15% across most markets, and that intention-action gaps persist due to perceived concerns over charging, cost, and reliability

FIGURE 12: CONSUMER ADOPTION SURVEY RAN ON 10 000 + SELECTED RESPONDENTS



1. Weighted average of 5 European countries: Germany, United Kingdom, France, Italy and Spain
Source: BCG BEV adoption surveys: US=~3000 respondents, EU=~5000 respondents, CH = ~2500 respondents; Jan-May 2024

Consumer willingness to switch to BEVs is conditional to four main roadblocks that are quickly fading in the vast majority of use cases: charging time and experience, driving range, car and battery lifetime and price.

FIGURE 13: BEV ADOPTION SURVEY RAN ON 5000+ RESPONDENTS

Expectations of next wave BEV buyers

Faster charging time	**30mins**
Longer vehicle range	**460km**
Higher resale value	**~ICE**
Lower maximum price to buy an EV	**€50K**

Perceived roadblocks for adoption

- Perceived lack of HPCs, need for detouring, long waiting time, costs for private charger installations
- Range anxiety, lack of predictability of battery range and range in cold weather conditions
- Lower resale value compared to ICE vehicle, 2nd/3rd owner vehicle attractiveness
- Perception of high operating costs & energy price variation

Source: BCG BEV Adoption Survey Europe (n = 5,121), May 2024

i. CHARGING TIME & EXPERIENCE: CHARGING WILL SOON LAST 10-20 MINUTES AND BE EASIER AND MORE COMFORTABLE THAN FUELING

Electric vehicle (EV) charging is rapidly evolving to surpass fueling experience in ease and comfort. Ultra-fast public chargers have already cut charging times from one to three hours down to 15–30 minutes (see figure 14), and operators are targeting a consistent 10–20 minutes window to get above 80% battery. For many drivers, range anxiety and long recharge times have been the most cited barriers to EV adoption, shaped by decades of expectations built around quick gasoline refueling. But as infrastructure scales and technology improves, those perceptions are changing.

Charging Point Operators (CPOs) are investing heavily to turn charging into a seamless, frictionless experience. Europe now boasts over 1 million public charging points with 137,000 gas stations and as of 2023, 58% of the population lives within one kilometer of a charger[16]. Unlike traditional fueling, EV charging also offers the added flexibility of overnight charging at or near home. And when drivers do stop at public stations, the experience increasingly prioritizes comfort in addition to speed.

CPOs are redesigning the charging experience into something far more intuitive and user-friendly: retail partnerships place chargers near supermarket entrances, while premium stations may grant access to lounges with Wi-Fi, restrooms, coffee bars, and quiet workspaces. Digital services have also advanced. Plug & Charge technology allows EVs to initiate charging automatically, without swiping a card or opening an app. Some networks even unlock the charger via license-plate recognition and link the driver's phone to Wi-Fi instantly upon arrival—enabling live charge monitoring, software updates, or in-car streaming.

FIGURE 14: COMPARISON OF PERFORMANCE AND USE CASE ACROSS DIFFERENT TYPES OF CHARGERS

Types of charging speed	Slow charger	Medium - Fast charger	HPC & Ultra Fast (High Power Charging)	Ultra fast combined with 800V+ EV batteries
Power output range	**4 - 22 kW AC** *(and 24 kW DC)*	**25 - 150 kW DC** *DC systematic above 50 kW*	**≥ 150 kW DC**	**> 1,000 kW DC**
Example of use cases	Places where a driver will stop for long periods of time: • Streets • Homes	Places where a driver will stop for 1-2h: • Retail stores • Supermarkets	Places where drivers will do quick stops: • Urban stops & parking • Highways • Restaurants / supermarkets	Places where drivers will do quick stops: • Highways
Charge times	**3 – 12h**	**1 – 3h**	**15 – 30[1] min**	**~10[1] min**

1. Charging time to get above 80% battery for a car sold in 2025; the last percentages to get to 100% typically take more time;
Source: Expert interviews; BCG analysis

[16] IEA, 2024

Combining the latest 800V+ technology with on-site battery storage could cut recharging times to about 10 minutes. The BEV landscape is rapidly evolving with some OEMs introducing ultra-high-voltage architectures (800V+) to unlock fast charging capacities. In February 2025, Alpitronic – one of Europe's leading manufacturers of high-power charging solutions – launched its first megawatt charging system to meet the demands of next-generation heavy-duty and passenger vehicles, with up to 1000 kW of output[17]. In March, BYD presented a new battery system, showing that handling 1 MW charging power is now within reach[18]. Together, these developments show significant dynamics towards charging times of just a few minutes. However, delivering such high charging power is difficult to achieve solely through the electrical grid, which poses a challenge to electrical grids that operators are on their way to solve. Pairing charging stations with battery storage systems should help overcome these limitations, enabling ultra-fast charging without overloading local infrastructure. This, of course, requires additional infrastructure investment going forward, along with both chargers and a car fleet capable of handling the high power.

ii. DRIVING RANGE: A LONGER DRIVING RANGE WITH A UNIQUE DRIVING EXPERIENCE (PRE-CONDITIONING OPTIONS, QUIET CABIN, MORE DESIGN FREEDOM)

BEVs are rapidly closing the gap with ICEs in terms of driving range. Advances in battery density, energy efficiency, and vehicle design have pushed the average range of newly launched BEVs beyond 500 km in 2024—improving at a rate of 6% per year since 2021. While still below the average 640 km range of ICE vehicles, this progress, combined with the fact that 92% of trips are under 50 km[19], is reducing range anxiety and boosting user confidence. Upcoming improvements on battery density and energy efficiency will not only impact driving range, but a trade-off between range & cost/weight made by OEMs on new models. Improvements in fast-charging infrastructure further reinforce this shift, making range concerns increasingly secondary.

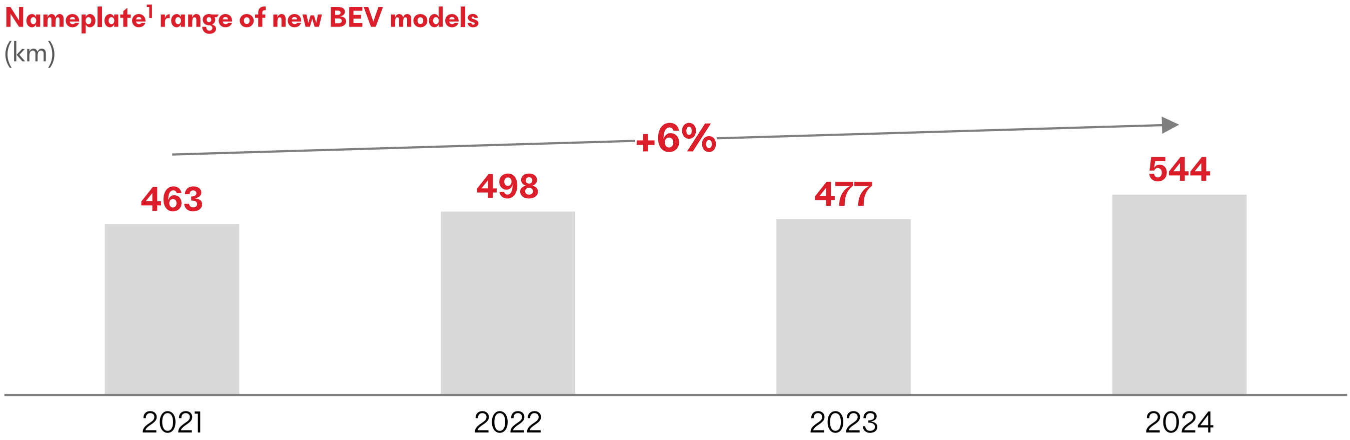
BEVs also allow redefining what it means to drive, through pre-conditioning features, higher design flexibility, better acceleration and quieter cabins than ICE. Features like remote pre-conditioning for cabin comfort via app or schedule allowing the vehicles' immediate readiness in all weather conditions, near-silent driving, and new design possibilities (such as flat floors and panoramic user interfaces) make BEVs more than just a cleaner alternative—they are a leap forward in mobility. Their superior torque enables sharper acceleration, and the absence of a combustion engine can reduce interior noise by up to 10 dB—creating a cabin environment perceived as half as loud, and far more refined, than that of an ICE vehicle.

[17] https://insideevs.it/news/763970/colonnina-ricarica-5-minuti-italia-mercedes/

[18] Source: byd company website

[19] DG move EU-wide Passenger-Mobility Survey, 2022

FIGURE 15: NAMEPLATE RANGE OF NEW BEV MODELS, PER LAUNCH YEAR, IN KM[20]



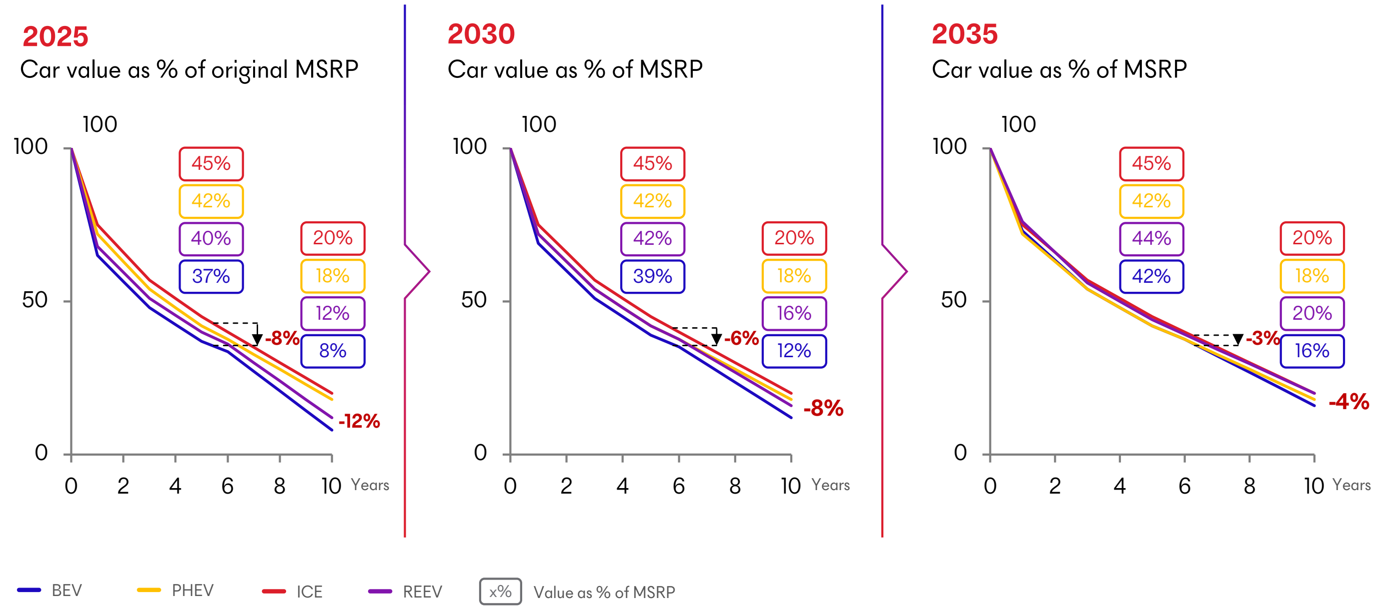
1. Theoretical range announced by care manufacturers for their BEVs
Note: Based on mass market US/ EU/ Korean OEMs' BEV new model launch schedule plans.
Source: OEM websites, Nomura report 04/2025

iii. RESALE VALUE: BEV DEPRECIATION IS CURRENTLY AT ITS LOWEST AND THE GAP WILL NARROW FROM 8 PP TO 3 PP BY 2030 AFTER 5 YEARS

The resale value of BEVs has been an early concern of dealers & leasing companies due to battery longevity. Nevertheless, the lower resale value of a BEV, currently at its lowest vs. alternatives, does not impact cost advantage of BEVs. In 2025, a 37% terminal value for purchase price after 5 years vs. 45% for an advanced ICE does not invert cost advantage of BEVs. This resale value gap will narrow down to 3pp by 2035. Even if assuming a resale after 5 years in the TCO calculation, 100% of BEVs sold in France would remain less expensive than other powertrains, 91% in Spain and 41% in Germany.

[20] Nomura analyst report based on OEM launch announcements, does not include China OEMs

FIGURE 16: TERMINAL VALUE AS % OF MSRP[21] ACROSS POWERTRAINS IN 2025, 2030, 2035



Source: Expert interviews ; BCG analysis

iv. OPERATING COSTS & ENERGY PRICES: BEVs ARE CHEAPER TO DRIVE, EVEN FOR LARGE CARS IN CASE OF LOW FUEL PRICES

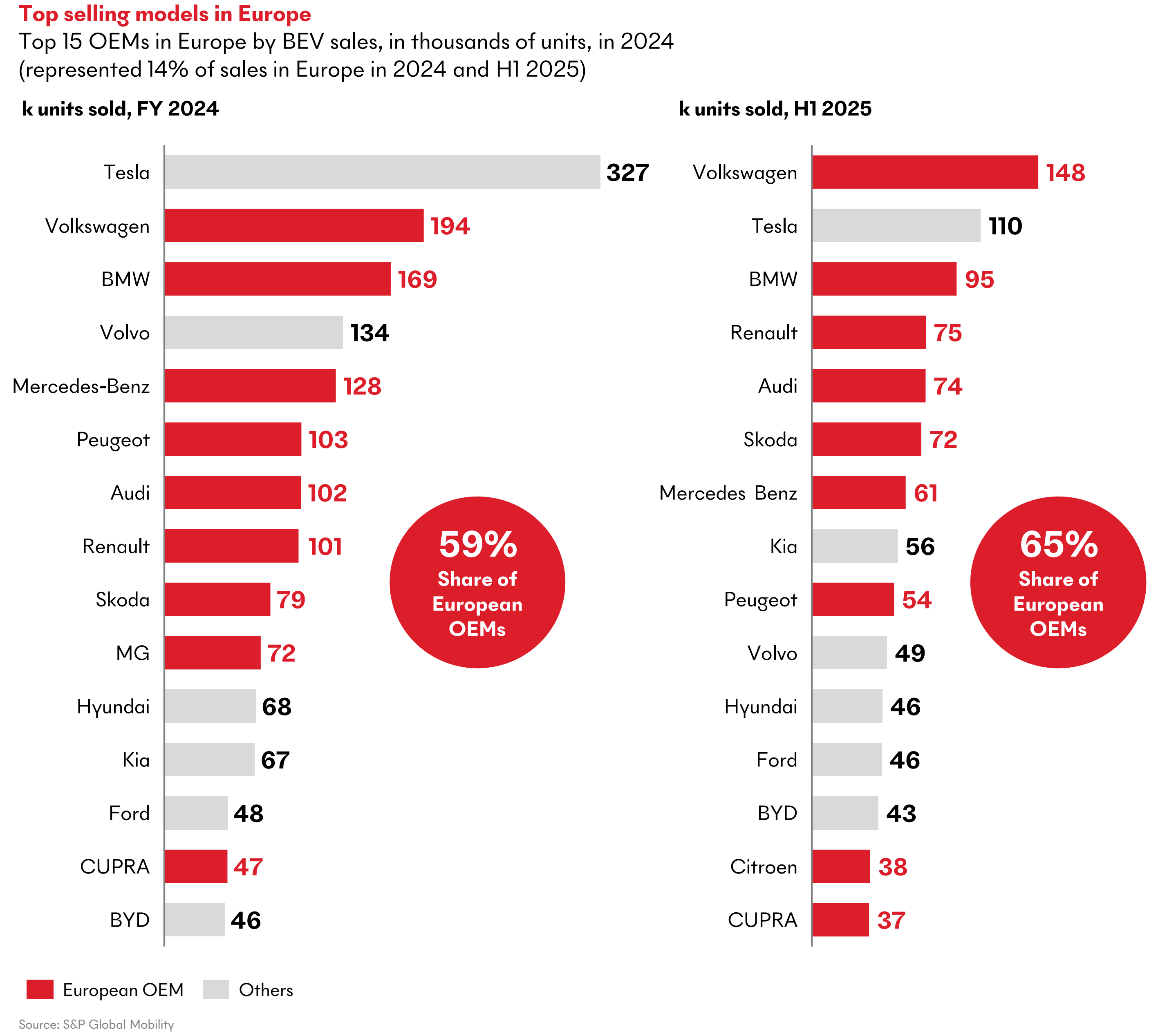
Operating costs & energy costs raise concerns for potential EV adopters, due to lack of return on experience and sometimes lack of factual data. As demonstrated in section 3.a., operating costs of a BEV are structurally cheaper both for driving & maintenance for any type of segment. While the BEV upfront (i.e. purchasing) cost is cheaper for a B-segment across Europe, thanks to new model launched in 2024 and 2025 and purchasing subsidies, the upfront cost typically remains higher for D-segment cars. Nevertheless, cost parity is reached within two years, and BEVs' competitive advantage is robust to both fuel price fluctuation and price of energy.

[21] MSRP: Manufacturer's Suggested Retail Price

b. LATEST 2025 SALES SHOW A COMEBACK FROM EUROPEAN OEMS

H1 2025 sales show a strong "catch-up" from European OEMs, with 65% of total BEV sales in Europe, compared to 59% in 2024. Nine of the top 15 BEV sellers in 2024 were European OEMs, and they have built on this momentum in H1 2025, further strengthening their positioning in BEV sales (see figure 17).

FIGURE 17: TOP 15 OEMS BY BEV SALES IN EUROPE, IN THOUSANDS OF UNITS SOLD, FY 2024 & H1 2025[22]



[22] Sources: S&P Global Mobility for 2024 sales; JATO for Q1 2025 sales

FIGURE 18: CONSUMER EXPECTATIONS FOR BEVS & SHORT-TERM OUTLOOK

2024 expectations of next wave BEV buyers		Conditions in 2025 or short-term outlook
Faster charging time	**30mins**	**Down to 15-30 minutes** on HPC and possibly down to 10min with 800V+ EV batteries and ultra fast chargers[1]
Longer vehicle range	**460km**	**544 km average range** of new models released in 2024
Higher resale value	**~ICE**	**Narrowing** – 8% car value discount after 5 years today, (ICE is worth 45% of purchasing value, BEV 37%), down to 3% by 2035 (45% vs.42%)
Lower maximum price to buy an EV	**€50K**	**BEV is cheaper to own & drive** in 75% of cases today in Europe, 91% by 2028

1. On cars with the adequate power system and in locations with grid connections capable of support it
Note: Mean figures; Next wave's sample: n = 2038; BEV owners' sample: n = 587
Source: BCG BEV Adoption Survey Europe (n = 5,121), May 2024

3. BEVs provide a stronger value proposition[23] for car drivers & owners, European welfare & strategic autonomy

a. IT IS CHEAPER TO OWN & DRIVE A BEV FOR 75% OF CARS CURRENTLY SOLD IN EUROPE, AND 91% BY 2028

As of 2025, it is cheaper to own and drive a BEV for about 75% of car types sold in Europe (based on 5-year[24] TCO parity[25]), and should be the case for 91% of light vehicles by 2028. Total Cost of Ownership (TCO) & upfront costs (purchasing) are critical for mass electric-vehicle adoption. Despite differences across countries, TCO parity has been reached in most EU countries and for most segments when including subsidies, i.e. for all car segments in France (figure 19, representing 14% of EU light vehicle sales[26]), in the UK, the Nordics and most of Central & Eastern Europe. Germany & Italy, respectively accounting for 21% and 11% of EU sales, have higher driving costs for BEV on SUV & large car-segments[27], due to relatively high electricity price compared to fuel (see figure 20), but TCO parity is expected to be reached by 2028 for BEV. TCO parity has been reached in 44% of segments in Germany and 30% in Italy and is expected across almost all remaining segments by 2028.

[23] Than PHEVs, REEVs and ICEs

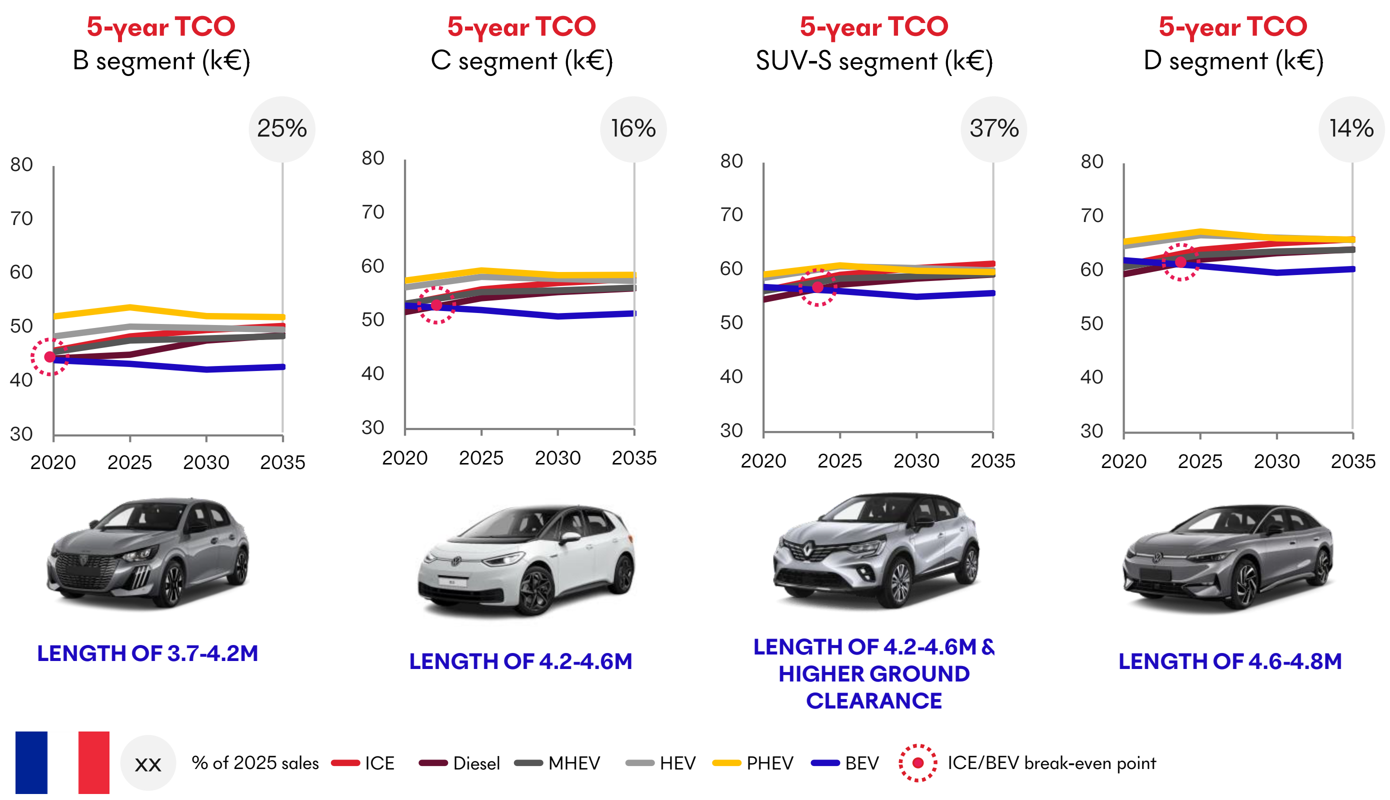
[24] 5-year TCO is used in this report as it enables a more comprehensive comparison of vehicles, especially for different powertrains (e.g., ICE vs. EV), where some cost advantages may emerge only in years 4–5, while it is long enough to reflect true ownership costs, yet short enough to remain relevant to both corporate and private buyer decision cycles. When accounting for current resale value discount, 49% of BEV cars sold have a positive 5-year TCO (instead of 75%)

[25] TCO is calculated over a 5-year period based on 2025 average sales price per car-segment & European country. Operating costs based on average driving distance per European country (EU average of 13,194 km/year), include maintenance costs and range from €344 to 706/year for a B-segment car to €452 to 926/year for a D-segment car. Car terminal value is assumed to be 100% depreciated after 10 years. Without subsidies 47% of BEV cars sold in 2025 have a positive 5-year TCO. 2028 figure includes subsidies.

[26] S&P Global Mobility

[27] €0.41/kWh & €1.96/l in DE, €0.48/kWh vs. €1.97/L in Italy

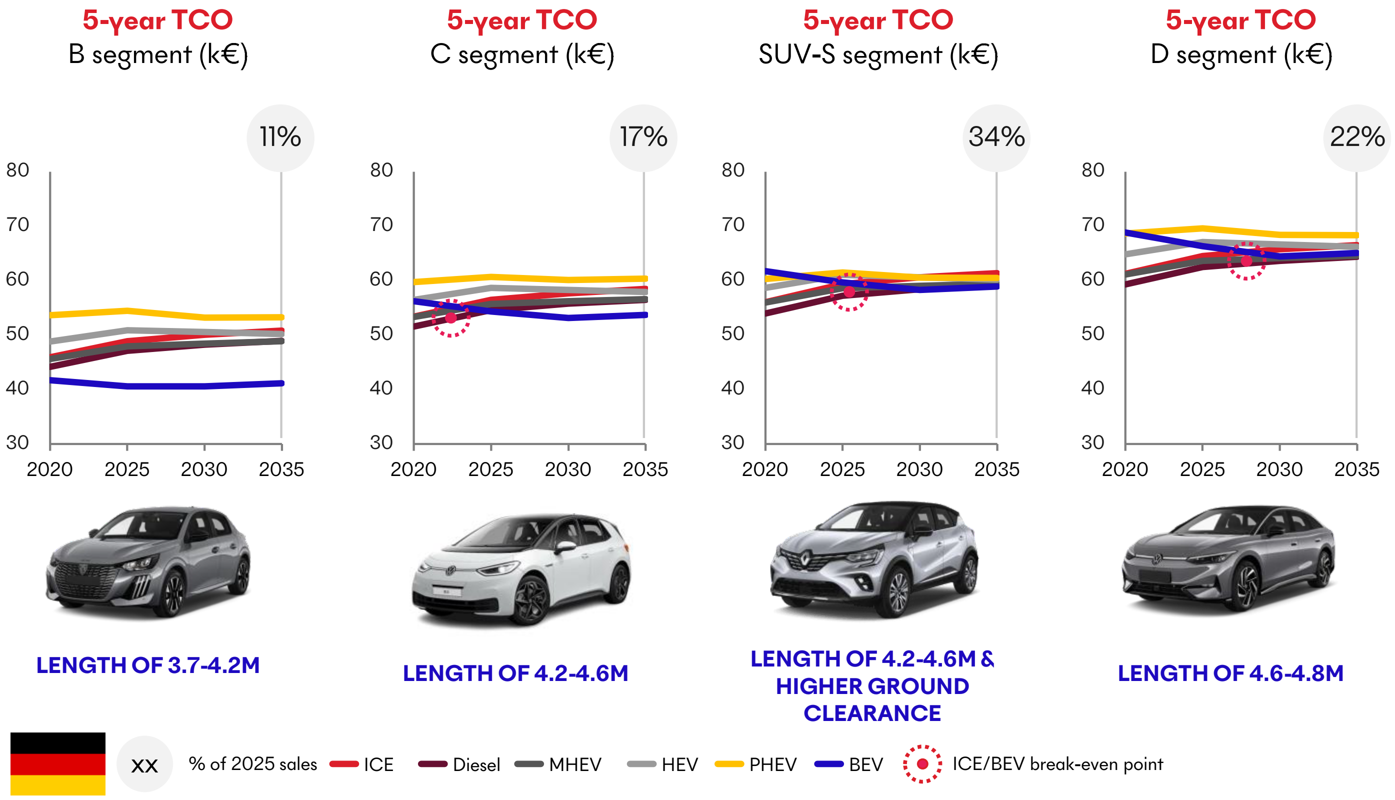
FIGURE 19: 5-YEAR TCO SENSITIVITY ANALYSIS IN FRANCE ACROSS 4 CAR SEGMENTS[28]



Note: TCO calculated without subsidies; B segment are small cars, C segment are mid-size cars, D-segment are larger mid-size cars;
Source: S&P market data; BCG Powertrain model ; BCG analysis

[28] ICE: Internal Combustion Engine; MHEV: Mild Hybrid Electric Vehicle; HEV: Hybrid Vehicle; PHEV: Plug-in Hybrid Vehicle; BEV: Battery Electric Vehicle

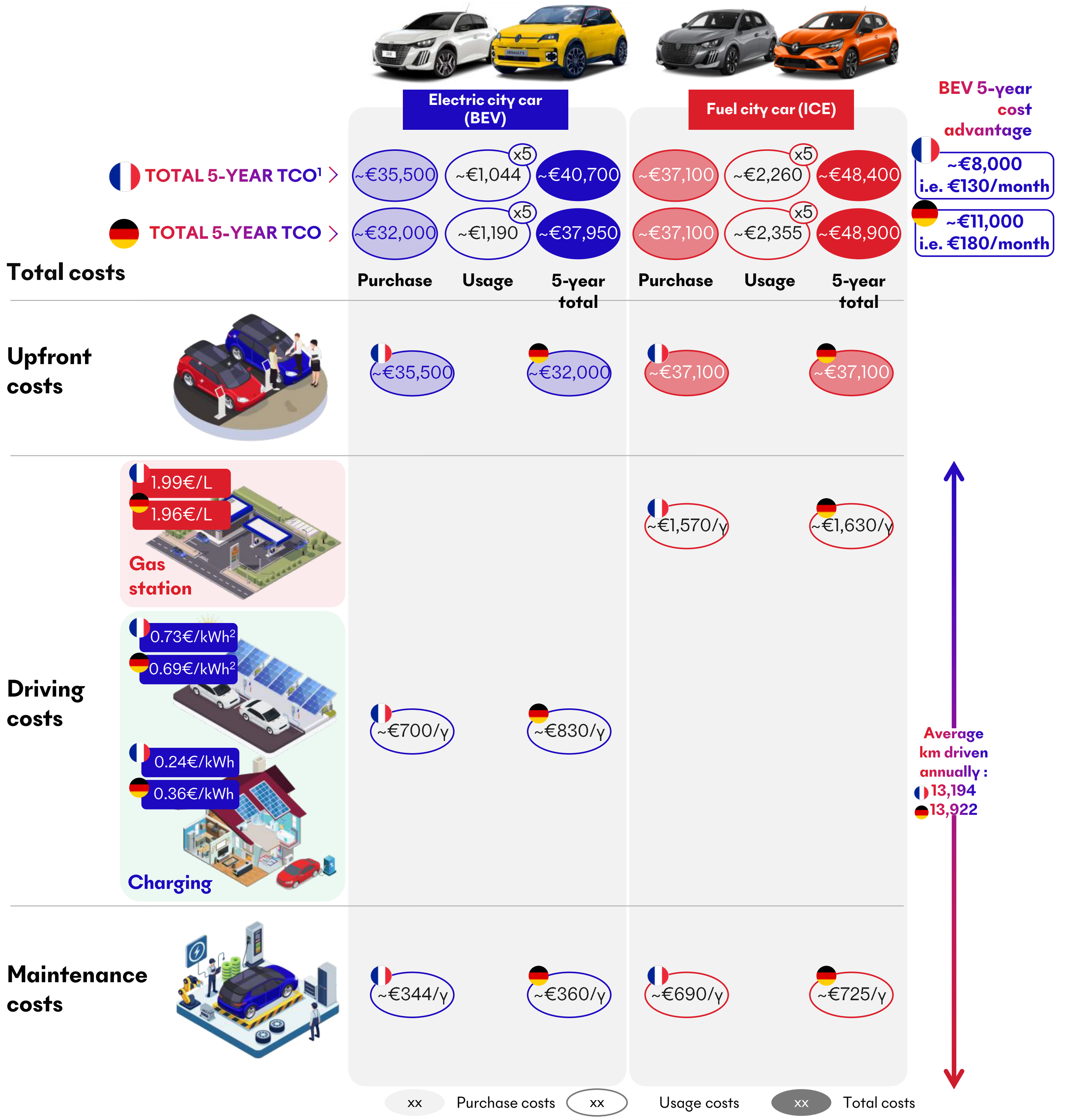
FIGURE 20: 5-YEAR TCO SENSITIVITY ANALYSIS IN GERMANY ACROSS 4 CAR SEGMENTS



Note: TCO calculated without subsidies; B segment are small cars, C segment are mid-size cars, D-segment are larger mid-size cars;
Source: S&P market data; BCG Powertrain model ; BCG analysis

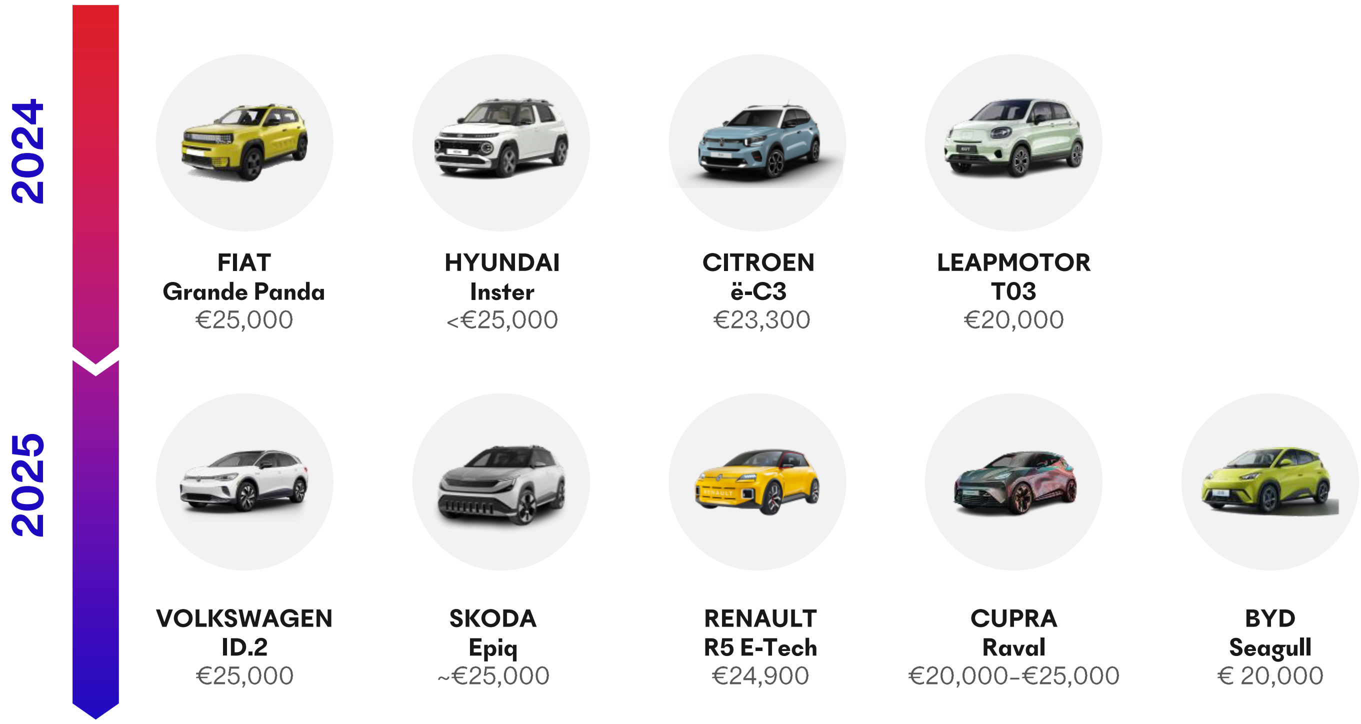
New & affordable (below €25k) EV models being sold in Europe released in 2024 & 2025 (e.g. Fiat Grande Panda, VW ID.2, Renault 5, BYD Seagull) **and latest innovation on EV vs. ICE vehicles create a well-positioned supply for EV.** OEMs have announced the roll-out of additional affordable EV models from 2025 to 2027 (see figure 22), thus enabling further adoption by heavily reducing the acquisition cost of EVs. This trend is expected to continue further, supported by decreasing battery prices.

FIGURE 21: IN FRANCE €8,000 EXTRA PURCHASING POWER AND €11,000 IN GERMANY IN 5 YEARS WHEN BUYING & DRIVING A CITY CAR (B-SEGMENT) BEV VS. ICE



1. French price includes 2.6k€ subsidies; TCOs calculated without current resale value discount 2. High Power Charging
Source: BCG analysis

FIGURE 22: 2024-2025 ROLL-OUT OF NEW EV MODELS PRICED BELOW €25K



Source: OEMs websites, BCG analysis

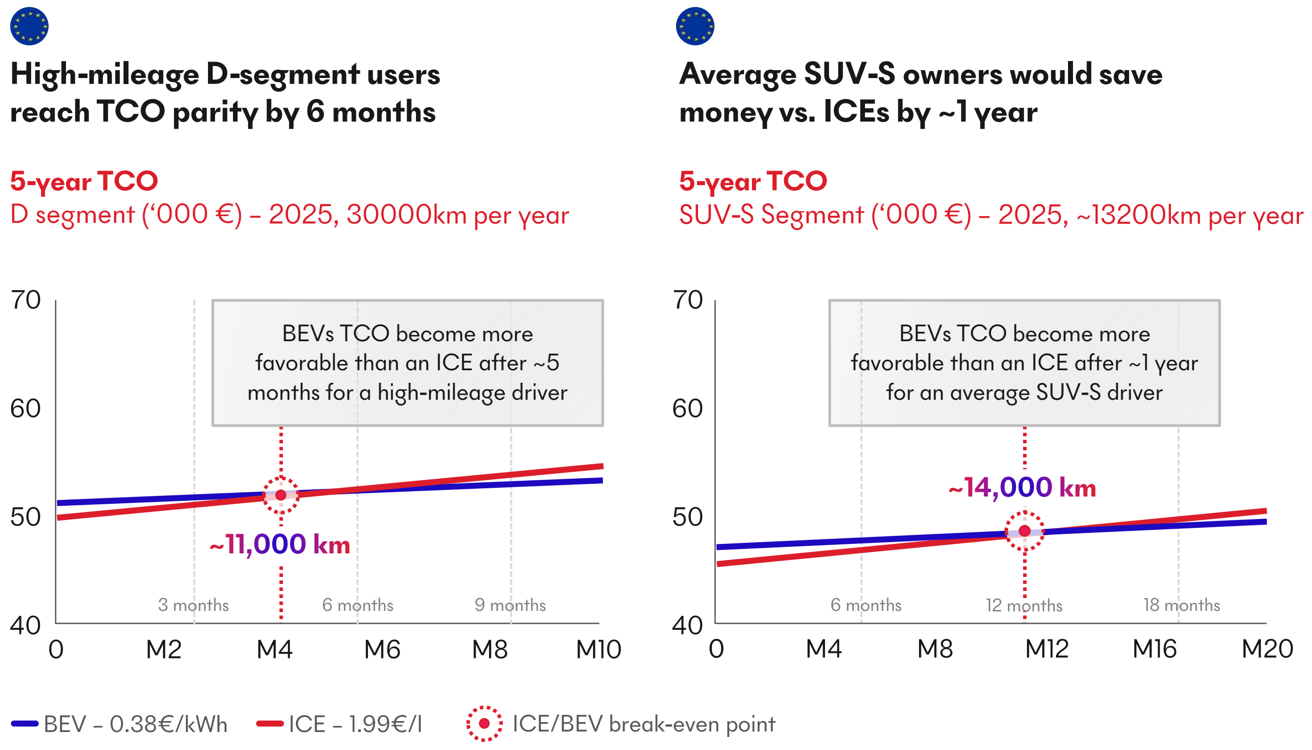
BEV cost advantage is robust to sensitivities to: 1) car size, 2) charging mode, 3) fuel price, 4) distance driven, 5) utility factor and 6) energy efficiency gains.

1) **<u>Sensitivity to car size:</u> even for large cars & SUVs, BEVs become cheaper than ICEs within 6 to 13 driving months**

While for small cars (i.e. B-segments, such as Renault R5, VW ID.3 and Peugeot e-208)**, it is cheaper to buy** -when netting from subsidies- **and use a BEV than an ICE (see figure 20), a BEV becomes cheaper within 6 to 13 months for larger cars & SUVs,** assuming a fuel price of €1.99/L and an average electricity price of €0.38/kWh[29]. This comparison is based on two representative use cases: i) A high-mileage D-segment driver (e.g. a sales representative) covering 30,000 km/year and ii) An average small SUV (SUV-S) user, such as a typical family, driving approximately 13,200 km/year.

[29] Blended electricity price for EV charging, combining public (slow, medium, fast, and HPC), workplace, and home charging. Price levels range from €0.31/kWh in the Nordics to €0.48/kWh in Italy

FIGURE 23: TCO Advantage of BEVs emerges within a year across D and SUV-S segments



Note: TCO calculated with subsidies and without current resale value discount, 0.38€/kWh and 1.99 €/l gas price
Source: BCG Powertrain model ; BCG analysis

2) Sensitivity to charging mode: BEVs remain cheaper whether charging takes place at private stations (e.g., at home), in fast-charging public stations (e.g., HPC), or a mix of both

The advantage of BEVs over REEVs and PHEVs holds true across charging modes: BEVs are projected to have the lowest 5-year TCO in any cases[30]. In the base charging case[31], D-segment BEVs in Europe have a 5-year TCO of €58.3k, €9.7k less than PHEVs and €4.8k less than REEVs. In the private charging case[32], BEVs have a 5-year TCO of €56.9k, €9.3k less than PHEVs and €5.2k less than REEVs. In the public charging case[33], D-segment BEVs have also a more favorable 5-year TCO at €61.9k, €10.1k below PHEVs and €3.5k less than REEVs (see figure 25).

3) Sensitivity to fuel price: BEVs remain cheaper even with fuel prices below €1/L (5-year TCO)

Even in case of lower fuel prices (e.g. €1.7/L), BEVs start being less expensive than ICE within 6 – 12 months, and within 18 months to 3 years in case of both low fuel prices and only charging in public fast chargers, as illustrated in Figure 24. Over a 5-year period, BEVs are less expensive than ICE even with fuel prices below €1/L (see Figure 25).

[30] TCO analysis do not include current resale value discount

[31] Corresponding to a mix of charging places (home, work, and slow, medium and fast public charging) and assuming electricity price of €0.38/kWh

[32] Corresponding to a charging done at home exclusively and assuming electricity price of €0.25/kWh

[33] Corresponding to charging done on public fast charger exclusively (HPC) and assuming electricity price of €0.69/kWh

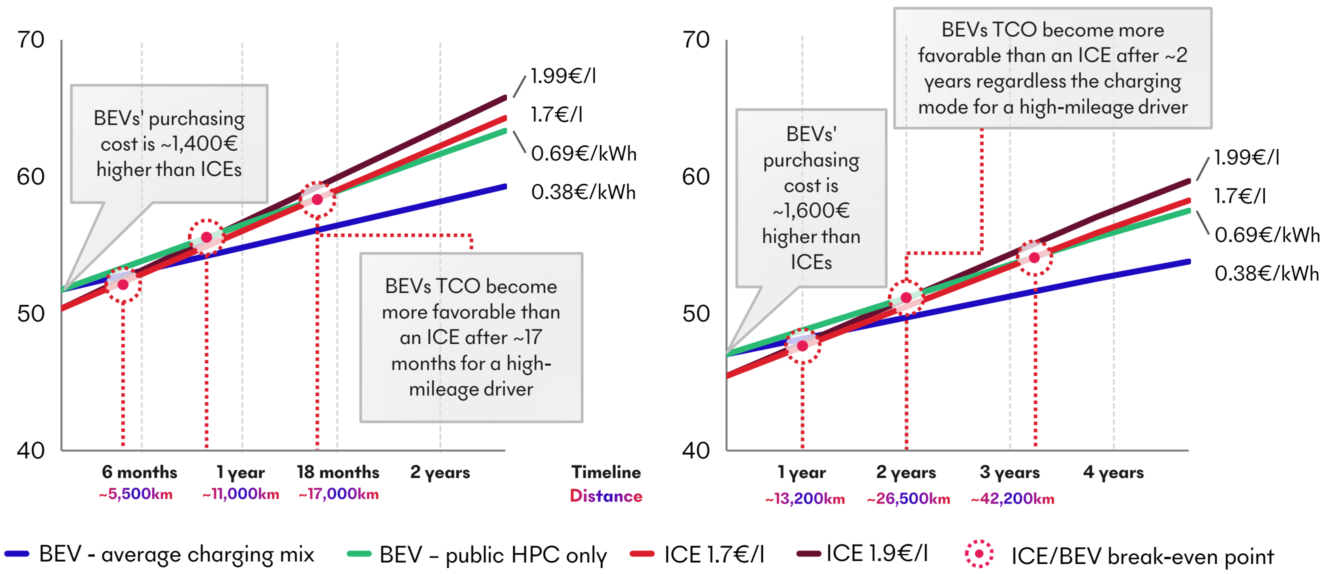
FIGURE 24: TCO | EVEN WITH LOWER FUEL PRICES, BEVS REACH TCO PARITY IN ~6 MONTHS FOR D-SEGMENT AND ~18 MONTHS FOR SUV-S, THANKS TO LOWER OPERATING COSTS

High-mileage D-segment users will save money by 18 months, regardless the use case

5-year TCO BEVs vs ICEs
D segment ('000 €) – 2025, 30000km per year

Even charging on HPC, SUV-S owners would save money vs. ICEs within ~2 years

5-year TCO
SUV-S segment ('000 €) – 2025, ~13200km per year



1. For 10 000 km driven per year, 0.69€/kWh and 1.7€/l gas price
Note : TCO calculated with subsidies and without current resale value discount
Source: BCG Powertrain model ; BCG analysis

Moreover, fluctuations in fuel vs. electricity price ratios influence TCO but do not eliminate the economic edge of BEVs, if fuel prices remain above €1.55/l in 2025 and €1.42/l in 2030 (figure 25), which is increasingly more probable with the Emissions Trading System 2 coming into place from 2027 onwards.

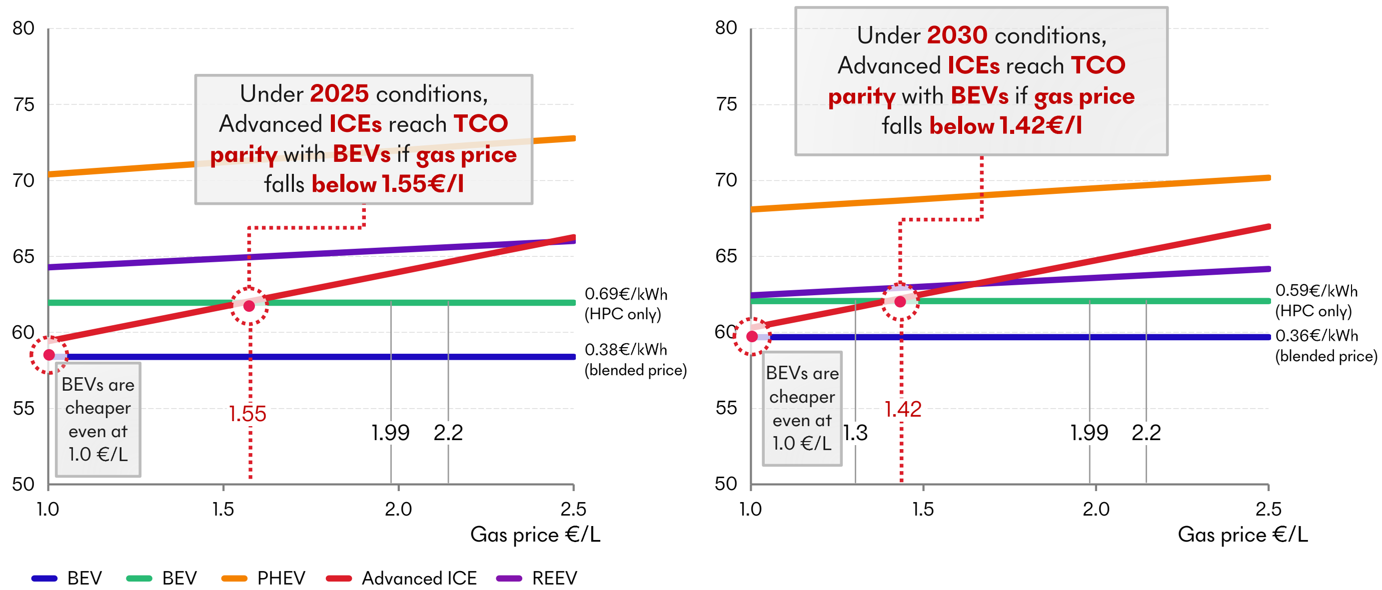
FIGURE 25: 5-YEAR TCO SENSITIVITY IN DIFFERENT GAS SCENARIOS FOR AN AVERAGE DRIVER IN EUROPE

In 2025, owning & driving a BEV is cheaper at 1.0 €/L for blended electricity price & 1.55 €/L when charging on HPC

5-year TCO
D segment, 2025 (in k€), 0.69€/kWh

In 2030, owning & driving a BEV becomes even more favorable, with parity of HPC vs. fuel at 1.42€/l

5-year TCO
D segment, 2030 (in k€), 0.59€/kWh

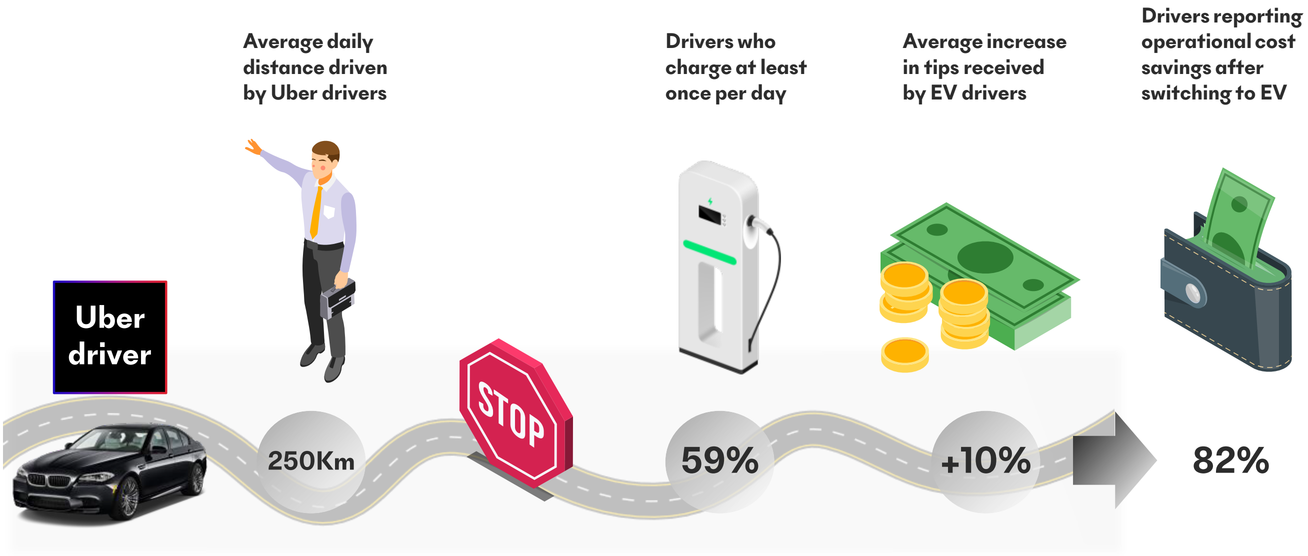


Note : BCG model assumptions – Energy efficiency gains PHEV/BEV/REEV in 2030 : 12% – PHEV utility factor: 53%; REEV utility factor: 65%;
TCO analysis does not include current resale value discount. D-segment used as an example of the highest cost savings. Assuming a driving distance of 11879km/year
Source: BCG Powertrain model ; BCG analysis

4) Sensitivity to distance: Uber drivers riding 250 km/day save on average €300/ month when using a BEV vs. any mature and scalable alternative, on top of delivering a better experience for users

The economic and user experience impact of using a BEV is even more tangible for professional drivers, such as Uber drivers who drive on average 250km/day. The Uber driving platform has committed to transitioning its platform to 100% battery electric vehicles (BEVs) by 2030. In France, to foster EV adoption by drivers and lower upfront costs up to €8k per vehicle, the company has set up a €75 million fund as of 2021. As of H1 2025, 20% of Uber vehicles operating in France are already fully electric, and over 90% are either electric or hybrid. Among drivers who have made the switch to BEV, 82% report they have lower operational costs from both maintenance & driving, with the latter reaching up to €300/month. Moreover, user experience is improved for both drivers & users: 93% of drivers report being satisfied with their EV—highlighting the alignment of electric mobility with the operational needs of high-mileage professionals, and users tend to give on average 10% higher tips than for other types of vehicles.

FIGURE 26: BEVS' IMPACT ON UBER DRIVERS & CUSTOMERS – FRANCE EXAMPLE



Source : Uber France

5) <u>Sensitivity to utility factor:</u> BEVs lead on cost across all usage profiles

Even under wide-ranging usage scenarios, BEVs continue to hold a firm lead on cost. Whether PHEVs are driven mostly on electricity (up to 80%) or only sparingly (as low as 15%), or REEVs operate with utility factors between 15% and 65%, BEVs remain the cheapest option in a 5-year TCO calculation under our set of assumptions. BEV 5-year TCO proves resilient across the board, with D-segment BEVs saving drivers between €1.6k and €2.9k per year compared to PHEVs, and €1.0k to €1.2k compared to REEVs (figure 27).

FIGURE 27: 5-YEAR TCO SENSITIVITY TO UTILITY FACTOR ON D-SEGMENT

D segment		Utility factor	UPFRONT COSTS	YEARLY & 5-YEAR OPERATING COSTS (Gas station, Charging, Maintenance)	TOTAL 5-YEAR TCO	ADDITIONAL COSTS/YEAR vs. BEV	DETAIL ON USE CASE
BEV SEGMENT		100%	~€51.8k	~€1.3k/y x5y	~€58.3k	-	Assuming €2.6k subsidies & average charging cost of 0.38€/kWh
PHEV SEGMENT	Private fleet	15%	~€56.2k	~€3.3k/y x5y	~€72.7k	+€2.9k	Driver using a company vehicle and fuel card, with no personal fuel cost
PHEV SEGMENT	Commuter	50%	~€56.2k	~€2.0k/y x5y	~€66.1k	+€1.6k	Driver charges at home and can commute using electric motor only
REEV SEGMENT	ICE heavy	15%	~€54.4k	~€2.0k/y x5y	~€64.2k	+1.2k	Latest info on average usage in China
REEV SEGMENT	EV optimized	65%	~€54.4k	~€1.8k/y x5y	~€63.1k	+€1.0k	Utility factor stated by Li Auto (Chinese REEV leader, 2023)
ICE SEGMENT		0%	~€50.4k	~€2.7k/y x5y	~€63.9k	+€1.1k	-

XX% Utility factor

13,194 km driven annually[1]

1. European average
Note: TCO analysis does not include current resale value discount
Source: BCG analysis

6) Sensitivity to energy efficiency gain: energy efficiency gains have no major impact on BEVs cost advantage

Energy efficiency gains have only a limited impact on operating costs and represent an additional upside for BEVs by contributing to lower upfront costs in new models. At similar energy efficiency gains from 12% to 17%, driving a D-segment BEV is €1.4-1.7k/year cheaper than a PHEV and €0.5-0.6/year cheaper than a REEV (figure 28).

FIGURE 28: 5-YEAR TCO SENSITIVITY TO ENERGY EFFICIENCY GAINS ON D-SEGMENT

D segment	Efficiency gains	UPFRONT COSTS	YEARLY & 5-YEAR OPERATING COSTS (Gas station, Charging, Maintenance)	TOTAL 5-YEAR TCO	ADDITIONAL COSTS/YEAR vs. BEV at similar efficiency gains	DETAIL ON USE CASE
BEV SEGMENT	12%	~€53.7k	~€1.2k/y x5y	~€59.7k	-	-
BEV SEGMENT	17%	~€50.4k	~€1.2k/y x5y	~€56.2k	-	Savings applied to 37% of the total cost, resulting in a 6.2% price decrease from 2025 to 2030
PHEV SEGMENT	12%	~€56.2k	~€2.1k/y x5y	~€66.9k	+€1.4k	BCG model based on a 53% utility factor
PHEV SEGMENT	17%	~€54.3k	~€2.1k/y x5y	~€64.8k	+€1.7k	20% share of battery in upfront cost leading to an upfront cost reduction of ~1.9k€ vs. base case
REEV SEGMENT	12%	~€53.7k	~€1.7k/y x5y	~€62.2k	+0.5k	Based on a 65% utility factor stated by Li Auto[1] (Chinese REEV leader, 2023)
REEV SEGMENT	17%	~€50.8k	~€1.7k/y x5y	~€59.1k	+€0.6k	32% share of battery in upfront cost leading to an upfront cost reduction of ~2.9k€ vs. base case
ICE SEGMENT		~€51.4k	~€2.8k/y x5y	~€65.1k	vs BEV 12% +€1.1k; vs BEV 17% +€1.8k	-

XX% Efficiency gains

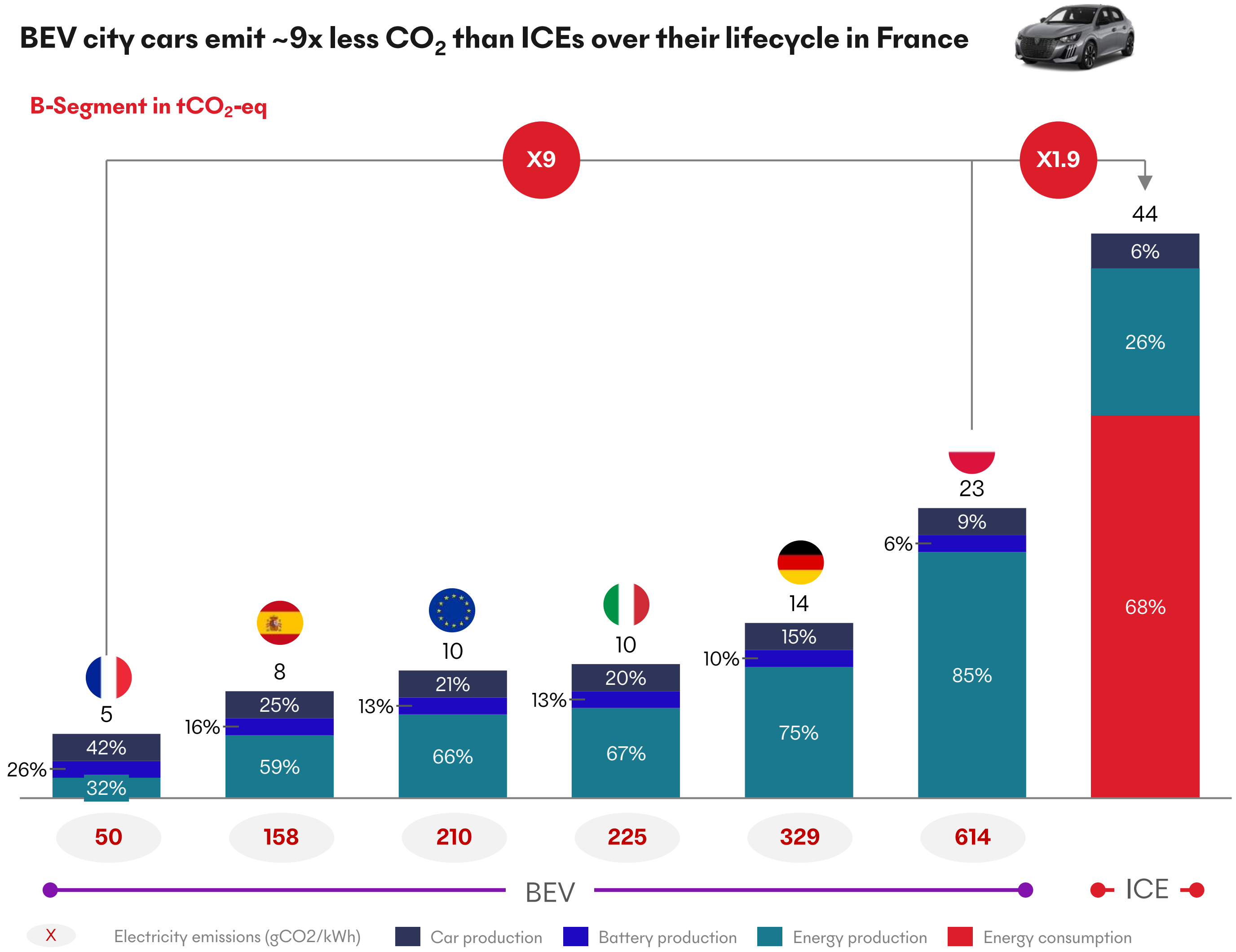
13,194 km driven annually[1]

1. European average
Note: TCO analysis does not include current resale value discount
Source: BCG analysis

b. BEVS OFFER LOWER LIFECYCLE CO2 EMISSIONS

BEVs structurally outperform ICEs in Europe in terms of lifecycle CO2 emissions, across vehicle segments and grid intensities. ICE's emissions are primarily driven by fuel consumption, accounting for more than 90% of their CO_2 footprint over their lifecycle. On the contrary, the core of CO_2 impact of BEV is concentrated at the production stage, particularly from the battery. CO_2 emissions from car & battery production are higher for a BEV than an ICE car (3.4 tCO2 vs. 2.7 on average for a city car – B-segment). Nevertheless, even in countries with carbon-intensive electricity grids, BEVs consistently outperform ICEs: B-segment BEVs emit between 1.9 to 9 times less CO_2 depending on grid mix, current carbon intensity being 50gCO2/kWh in France vs. 329gCO2/kWh in Germany and 614gCO2/kWh in Poland in 2023 (see figure 29). BEVs reach carbon parity with ICEs quickly, within 9,100 kilometers driven with Poland's energy mix. On that note, when operated with high electric utility factors, PHEVs and REEVs could be considered as bridge technologies to contribute to emissions reduction targets in the medium term. Especially in segments or regions where full electrification faces near-term barriers such as rural areas, high-mileage users without home charging, or in zones with limited grid capacity.

FIGURE 29: B-SEGMENT ("SMALL-CITY") CAR EMISSIONS FOR LIFECYCLE EMISSIONS OF VEHICLES AND WITHOUT CONSIDERING BATTERY RECYCLING EFFECT



Note: Assumes ICE use of traditional fuels; lifecycle mileage of 225,000 km
Source: IEA EV life cycle assessment calculator ; European Environment Agency (2023) ; BCG analysis

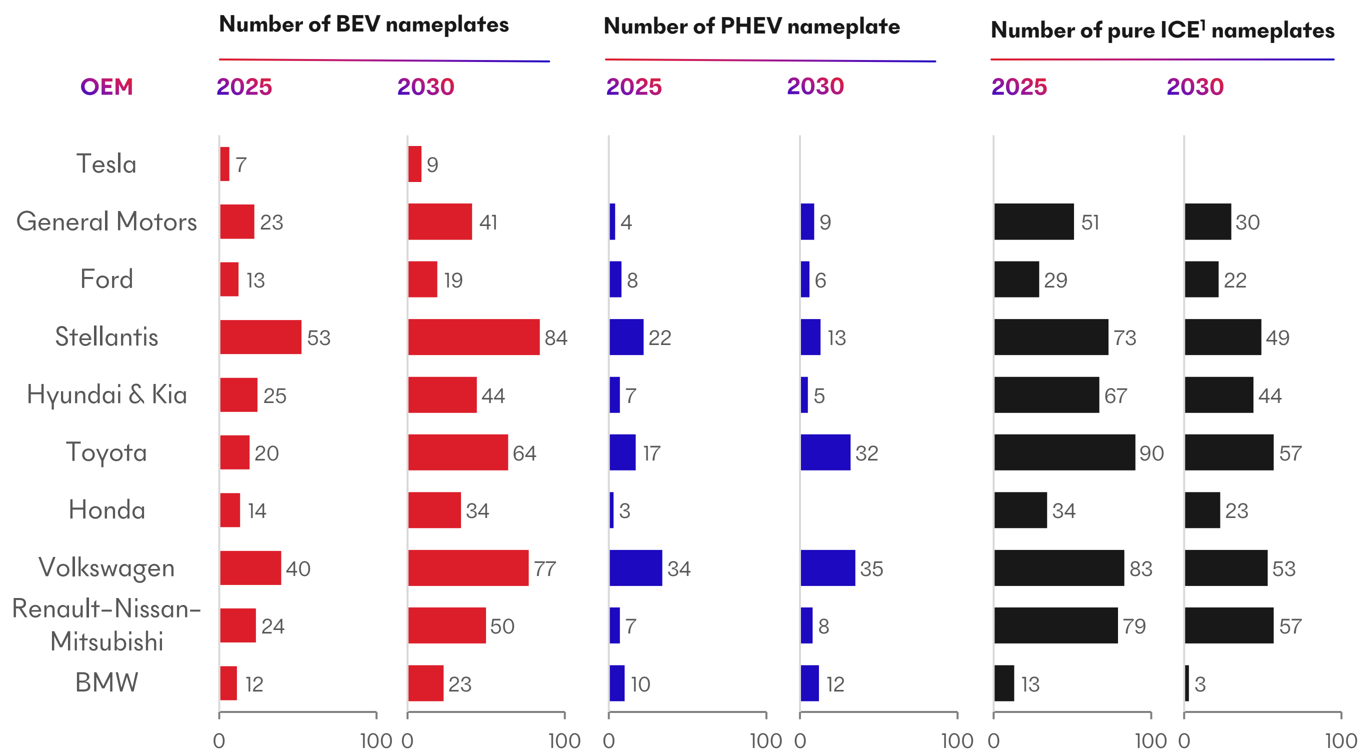
c. OEMS ARE NOW FOCUSING INNOVATIONS ON BEVs

Chinese manufacturers have been shaping the competitiveness of the EV landscape, leveraging years of state-backed investments in the full EV value chain. China has reshaped the automotive landscape with strong government investments in the EV industry, a predictable regulatory framework, and binding NEV quotas [34] , leading to higher BEV penetration (29% BEV sales in 2024).

European automotive OEMs are catching up on EV innovations. For instance, Volkswagen is investing heavily in battery innovation through its PowerCo subsidiary, developing a "unified cell" technology to cut battery costs by up to 50%[35]. It is also building multiple gigafactories across Europe to localize production and scale cutting-edge battery technologies. BMW's Neue Klasse EV platform, set to launch in 2025, promises radical improvements in range, charging speed, and digital experience—built on proprietary e-drive technology and 800V battery systems[36].

As a result, major OEMs have announced they will nearly double their offer of BEV models by 2030, addressing the product fit question, while pure ICE nameplates will phase out (see figure 30).

FIGURE 30: OEM PRODUCT PORTFOLIO PROGRESSION 2025-2030 ACROSS POWERTRAINS



1. ICE does not include hybrids or mild-hybrids
Source: S&P Global Mobility LV Powertrain FC (2/2024); BCG analysis

[34] New Energy Vehicles sales quotas requiring a minimum percentage of their annual vehicle sales to OEMs
[35] volkswagen-group.com
[36] bmw.com

d. THE EV TRANSITION BRINGS PRIVATE INVESTMENTS & JOBS

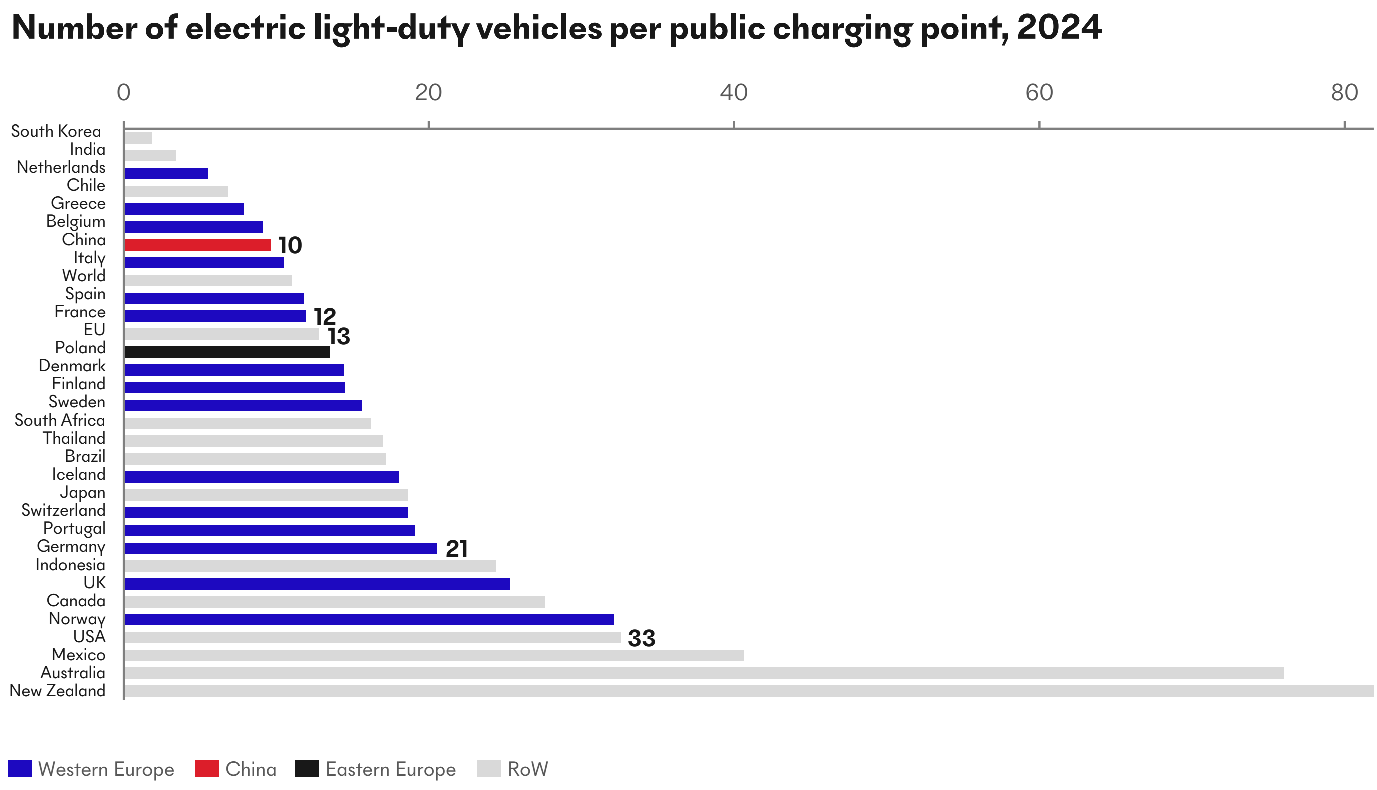
The mobility ecosystem has been investing massively in the EV transition globally, with estimates up to $1 trillion of private investments and research and development required globally from 2018 to 2030 for this transition. Both OEMs and private capital funds invest significantly in the EV mobility ecosystem, with OEMs spending c.€30 bn/year on R&D globally [37], and private capital investors investing $16.7 bn in 2024, only when accounting for private equity and venture capital $20M+ deals on EV, EV charging, Autonomous Vehicles and ODM (On-Demand Mobility) sectors. In Europe, the mobility sector attracted $1.1 bn in PE and VC deals above $20 M, with roughly half of that funding directed to charging infrastructure (see figure 32).

Beyond OEM investments, charging infrastructure requires significant private capital and is now widely available in Europe. Western Europe counts more than 1 million public charging points and 13 EV/CP (vs. 33 EV/CP in the US), mitigating range anxiety. As a comparison, there were c.120,000 fuel stations[38] for 256 million cars registered in 2023 (i.e. 2,100 cars/fuel station). In Western Europe, the existing charging infrastructure is already generally sufficient to meet the current needs of the electric vehicle fleet, on top of about 7 to 8 million private charging points, both at home and at work. In 2024, the European Union counts around 13 EVs per public charging point, with 77,000 ultra-fast-charging points (>150kW) and 71,000 fast-charging points (between 22 kW and lower than 150kW) vs. 50,000 in the USA (for both fast and ultra-fast chargers[39]). Disparities exist between countries. France, for instance, has around 12 EVs per public charging point in addition to over 2 million private charging points, while Germany has 21 EVs[40] per public charging point and around 700,000 private charging points[41].

The European Union is slightly less well equipped in charging infrastructure than China, having around 10 EVs per charging point and better equipped than the United States, counting around 33 EVs per charging point (see figure 31). Although numbers suggest that Europe is lagging behind China in charging infrastructure, in fact, this only reflects differing demand patterns. In China, drivers depend heavily on public charging infrastructure, especially in large cities. By contrast, European EV drivers benefit from greater home-charging access, reducing reliance on public charging points.

[37] 2022 global R&D spend from Mercedes, BMW, BYD, Tesla, VW Group, Stellantis & Ferrari
[38] National Fuel Industry Associations
[39] IEA
[40] IEA
[41] National Centre for Charging Infrastructure

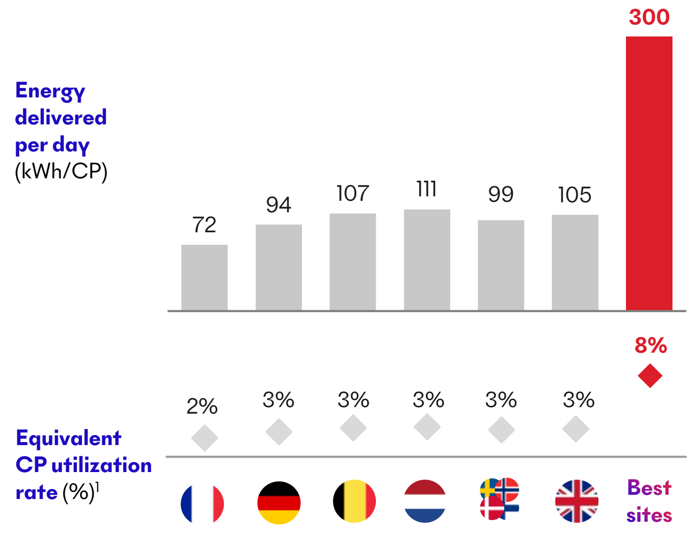
FIGURE 31: NUMBER OF ELECTRIC LIGHT-DUTY VEHICLES PER PUBLIC CHARGING POINT, 2024

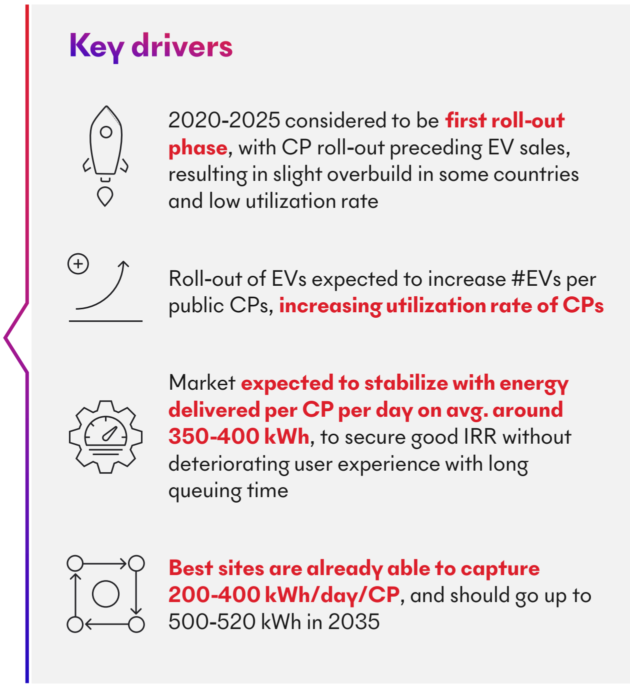


Source: IEA global EV outlook 2025; BCG analysis

Public charging stations are currently in sufficient number in Europe for EVs on the road, as charging points are used on average 3 to 8% of the time, demonstrating that charging infrastructure roll-out has been ahead of EV car sales in Europe. The 2020-2025 period is considered as the first roll-out phase, with charging point roll-out preceding EV sales, resulting in slight overbuild in some countries and low utilization rate. In 2024, High Power Charging points (HPC) delivered an average of 70-100 kWh per day per HPC, equivalent to a utilization rate of 2-3% (assuming an average power output of 150 kW per HPC), depending on countries. Best sites only capture up to 300 kWh per day per HPC, equivalent to ~8% of utilization rate, indicating a current relative underutilization of charging network (see figure 32).

FIGURE 32: ENERGY DELIVERED PER DAY (KWH/CP) AND EQUIVALENT UTILIZATION RATE IN BCG EV CHARGING MODEL, HPC ONLY, 2024





1. Assuming average power output per High Power Charging Point of 150 kWh
Source: BCG analysis; Expert interviews

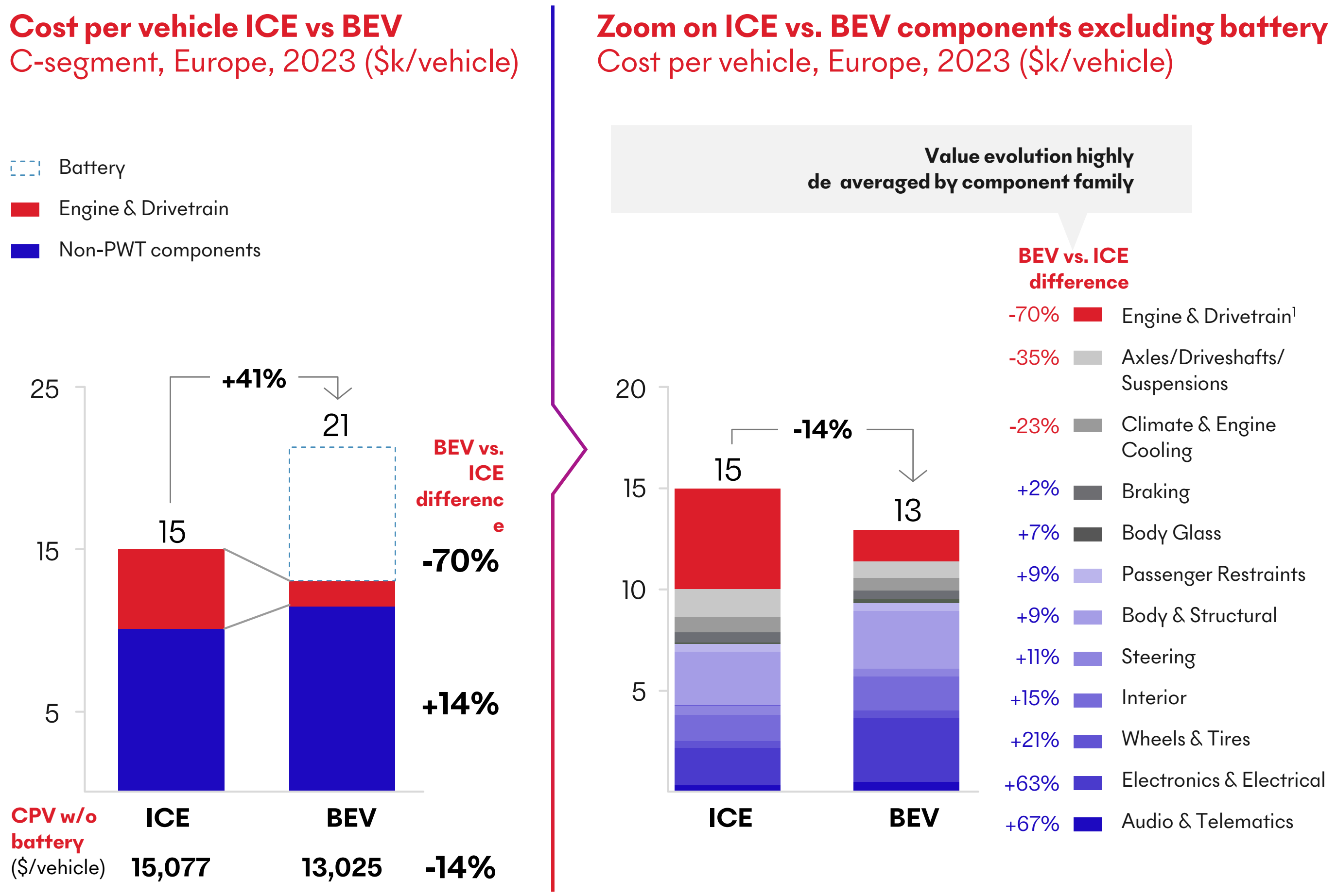
CPOs are ready to expand their networks, closely tracking the growth of the EV fleet on the road. CPOs are securing strategic locations in city centers, along major highways, and near high-traffic commercial zones. Site location is closely analyzed by CPOs before being rolled out, based on traffic information, population density and competitive intensity. They reflect a data-driven approach, anticipating where electric vehicles will be needed most—not just today, but five to ten years from now. CPOs are deploying infrastructure ahead of EV fleet growth.

The charging sector is also a growing source of employment, expected to represent more than 190,000[42] jobs by 2035. This sector represented 58,000 local jobs across Europe in 2024. With continued expansion, the industry is expected to grow by an additional 68,000 jobs by 2030 and 130,000 jobs by 2035, reaching a total of 126,000[43] jobs by 2030 and 191,000[44] jobs by 2035. New jobs will span construction, electrical work, engineering, software development, and corporate operations, demonstrating the broad economic impact of charging infrastructure deployment.

Beyond battery and powertrain, the transition to EV benefits the automotive supply chain in Europe, as for some parts, a BEV contains more valuable components than ICE. While BEVs reduce cost for components such as engines, suspensions and air conditioning, they also lead to moderate growth for suppliers in body glass and braking, and significant growth in Telematics and Electronics (see figure 33). As a result, the shift to BEV should not be a net loss for the European automotive industry, but rather a redistribution of value within the industry. Suppliers can adapt their strategy by doubling down on BEV components with strong growth and emphasizing cost efficiency in others.

[42] ChargeUp Europe 2025 state of the industry
[43] ChargeUp Europe 2025 state of the industry
[44] ChargeUp Europe 2025 state of the industry

FIGURE 33: BEV & ICE COMPONENT COSTS COMPARISON FOR C-SEGMENT, EUROPE, 2023



1. Engine & Drivetrain encompassing different components for ICE and BEV
Source: S&P Global Mobility LV Powertrain EP forecast (Sep. 2024); Capital IQ; Annual Reports; BCG Powertrain Model; BCG Profit Pool Model; BCG Analysis

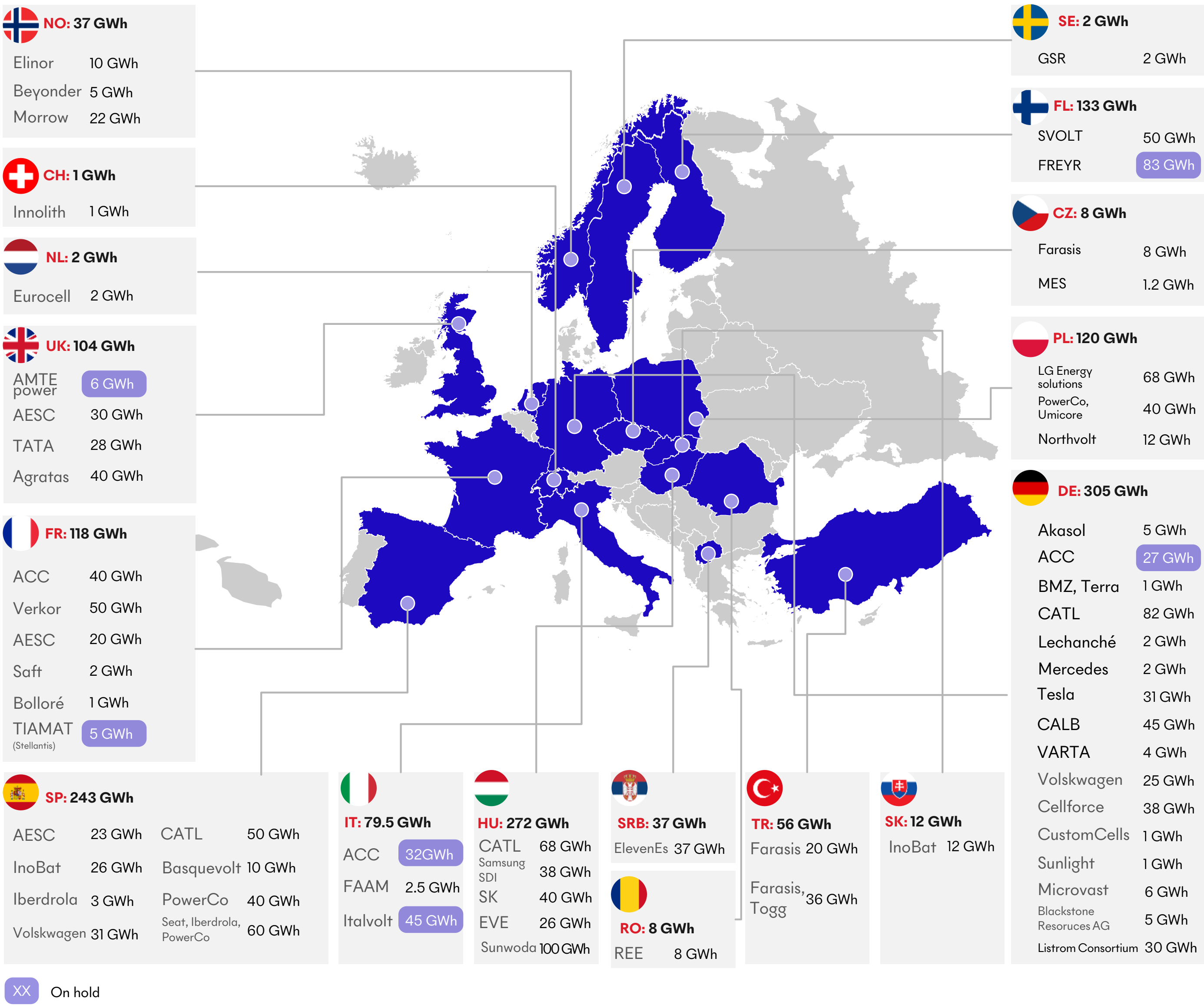
Transition to EVs in Europe also has a positive socio-economic impact in adjacent industries: current European announcements of battery manufacturing factories reach c.€60 bn of capex investments and should generate about c.100,000 direct jobs[45] by 2030.

Europe is rapidly expanding its battery production footprint, with OEMs, Asian incumbents, and European startups investing in gigafactories expected to deliver over 1100 GWh of annual capacity by 2030[46] (see figure 34).

[45] Number of direct jobs based on public information and extrapolation on average labor requirement of battery production, considering degree of automation

[46] Capacity based public announcements, considering all announced projects, including projects on hold (ACC Belgium, PSA Germany, Northvolt Germany, Italvolt Italy, AMTE Power UK, Freyr Norway) and excluding discontinued projects (Northvolt Sweden, Svolt Germany, Farasis Germany)

FIGURE 34: ANNOUNCED BATTERY MANUFACTURING GIGAFACTORIES IN EUROPE



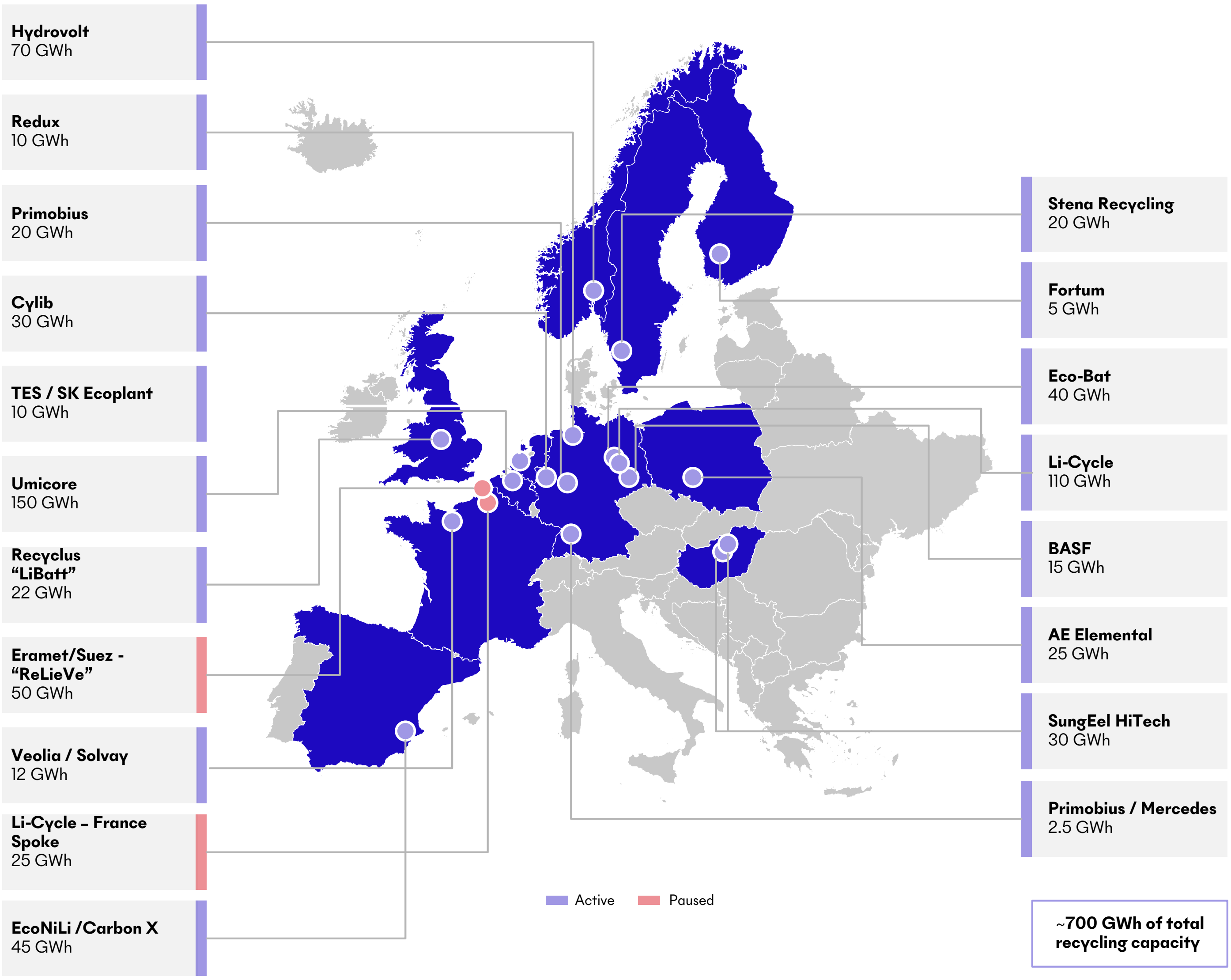
Source: BCG analysis; eSource Q3 2024; Effective manufacturing capacity includes ramp-up time

Battery recycling development in Europe will also translate into socio-economic impact, with a slightly longer timeframe due to a car lifecycle, with c. €4 bn of investments and c. 1,500 direct jobs expected to be created by 2035. As of 2025, battery-recycling projects already announced in Europe should bring 700 kt of recycling capacity and about 800 direct jobs[47] (see figure 35). Transport & Environment has a higher estimate, with 1390 kt of recycling capacity by 2030.[48] To meet over 1 Mt of recycling demand in Europe by 2035, additional investments are expected to reach €4 bn. In addition, EU regulation on minimum recycled content and recycling targets could bring additional benefits if they were to be linked with local content requirements.

[47] Based on public announcements, considering all announced projects, including projects on-hold (Li-Cycle France, Eramet/Suez ReLieVie) and excluding discontinued projects (Revolt/Northvolt Sweden)

[48] Includes low and medium risk categories at 530 and 860kt respectively

FIGURE 35: ANNOUNCED BATTERY RECYCLING PLANTS IN EUROPE

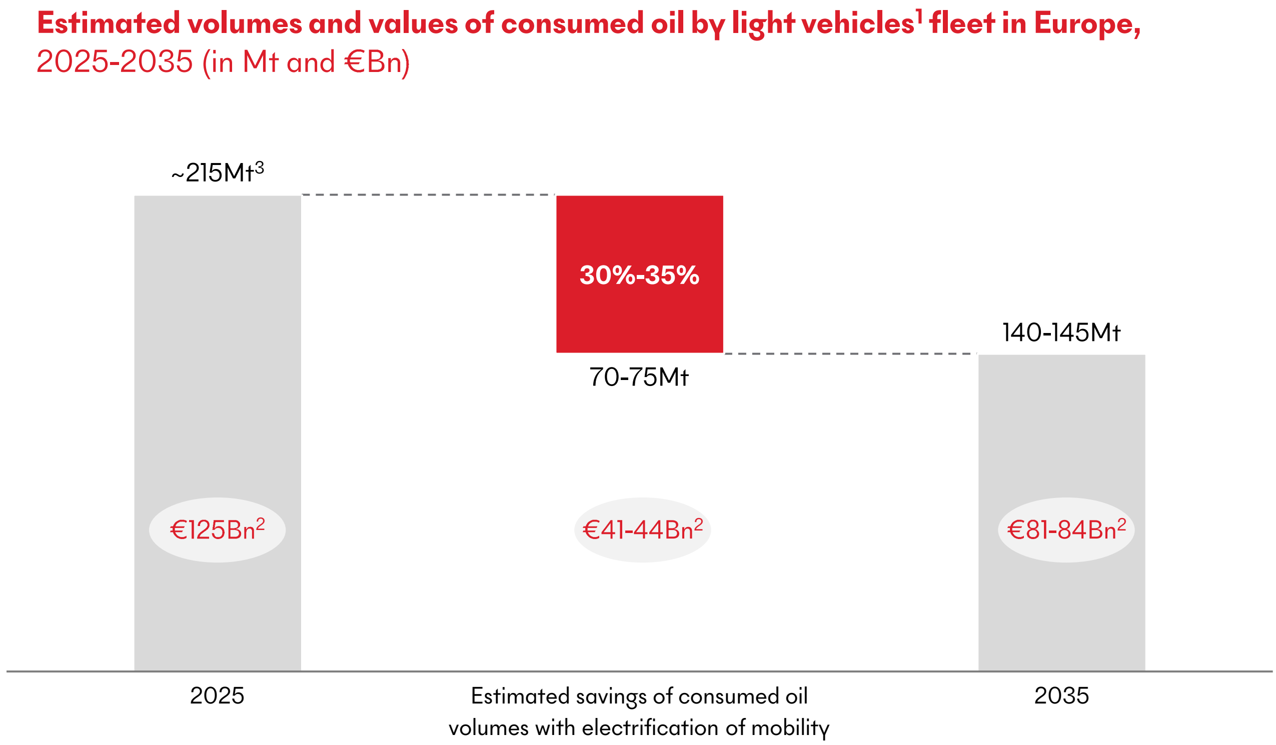


e. DRIVING ELECTRIC CONTRIBUTES TO EUROPEAN AUTONOMY

Driving electric plays a direct role in strengthening European autonomy by reducing dependence on imported fossil fuels—particularly oil, a resource for which the EU remains heavily reliant on external suppliers. By shifting toward BEVs, powered increasingly by domestically generated renewable electricity, Europe can reclaim control over a strategic component of its energy system. This transition not only enhances energy security but also redirects economic value toward local industries—from renewable energy production to battery manufacturing and grid infrastructure. In a geopolitical landscape shaped by volatility in global energy markets, electrifying mobility can play an important role for European autonomy.

By 2035, light-vehicle electrification would avoid 15% of current oil imports in Europe, **i.e. €40-45 bn.** If the electrification path reaches the forecasts, Europe could cut its oil imports for light vehicle road transport by 30-35% by 2035 vs. 2025, corresponding to 70-75Mt[49] of avoided imported oil. This would represent around 15% of total oil imports by Europe vs. today – marking a significant step toward greater energy independence and resilience[50] along with an ability to use this amount of money for other purposes.

FIGURE 36: ESTIMATED SAVINGS OF CONSUMED OIL WITH MOBILITY ELECTRIFICATION



1. Including ICEs, Diesel, PHEVs, HEVs, MHEVs and BEVs; 2. Assuming €0.58Bn per Mt; 3. Based on BCG model
Source: BCG analysis

[49] Assuming average yield of 0.7L/kg based on 0.88kg/L oil density and 58% of distilled volume

[50] As per BCG model, assuming constant number of vehicles, c.30% of BEV fleet by 2035, 3% consumption efficiency on ICE & diesel average consumption and 25% for PHEV

4. PHEVs & REEVs appear as bridge technologies in Europe

a. ELECTRIFICATION COMES IN SEVERAL WAVES, WITH PHEV & REEVs AS BRIDGE TECHNOLOGIES TOWARDS BEVs

The shift toward electric mobility has unfolded in three waves over the past two decades, each marking a new chapter in the transformation of the automotive landscape: Testing the waters in the 2000s, jump-start in the 2010s and toward mass adoption in the 2020s.

2000-2010: Testing the waters – The HEV age

The 2000s marked the experimental phase of BEVs, with global OEMs tentatively entering the space through small-scale pilots and limited-production models. Immature battery technologies (e.g., NiMH and early Li-ion chemistries) and high vehicle costs hampered efforts by companies such as GM and Nissan, rendering BEVs unattractive to the mass market. Tesla's launch of the original Roadster in 2008 introduced a new vision for premium electric mobility, but infrastructure gaps and limited regulatory support meant that BEV penetration remained below 0.01%. This period marked also the breakthrough success of the Toyota Prius, widely recognized as the first mainstream hybrid vehicle and a pivotal moment in automotive electrification. This wave built the technical foundation for future EV development.

2010-2020: EV jump-start – The PHEV age

The 2010s marked a turning point for electric mobility, driven by Tesla's launch of the Model S, X, and 3, and the entry of major OEMs like VW and Mercedes into the EV game. Regulatory incentives, especially in China—where license lotteries and subsidies accelerated urban adoption—helped narrow the cost gap with ICEs. Battery costs dropped sharply, largely thanks to Tesla’s vertically integrated advancements in Li-ion technology, while hybrid technologies matured and set the stage for PHEVs and REEVs.

Charging infrastructure began to take shape, with home charging becoming more accessible and early public networks starting to roll out. Charging infrastructure also began to expand, with home and public options emerging, and the EU's Directive 2018/844 reinforced this shift by mandating new and renovated buildings be EV-ready.

2020 – today: The BEV age

In the 2020s, BEVs reached industrial maturity, with battery costs dropping below $100/kWh and model offerings expanding across segments, leading to over 14% of new car sales in Europe. Regulatory measures became significantly more ambitious. Packages like the EU's "Fit for 55" are now enforcing strict zero-emission targets, effectively banning ICE vehicles in new sales by 2035. Fast-charging infrastructure has rapidly expanded, and new players—especially from China—are intensifying market competition, pushing European OEMs to accelerate innovation and localize production.

FIGURE 37: EV ADOPTION WAVES OVER THE LAST TWO DECADES

BEV | Rearview of BEV adoption shows 3 stages of the rollout

	Testing the waters 2000's	**Jump-start** 2010's	**Achieving mass** 2020's
BEV market characteristics	~19% CAGR <0.01% % powertrain BEV	~68%+ CAGR ~3% % powertrain BEV	~66%+ CAGR 14%+ % powertrain BEV
OEM moves (selective)	• Early attempts & failures by different OEMs (e.g., GM, Nissan) focused mainly on mass market • Tesla introduces Roadster in 2008	• Tesla introduces Model S (2013), X (2015) and 3 (2017) • Major OEMs join BEV market by 2012-13 (VW, Mercedes...)	• New market entrants esp. in China joining pure BEV competition
Key regulation	• Regulation mostly tightening emissions standards & introducing early fleet quotas for ZEV	• Increasing financial regulations to bridge TCO gap for buyers • Add. incentives for BEV adoption (e.g., China license lottery)	• Full-scale regulation enforcing transition away from ICE toward ZEV (e.g., EU Fitfor55)
Technology Li-ion real 2022 $/kWh[2]	• Immature technology (e.g., lead-acid & NiMH batteries[1] in GM EV1) • Roadster first Li-Ion comm. BEV	• Rapid tech improvements & cost declines (led by Tesla's own in-house Li-ion improvements)	• Li-Ion battery packs reach <200$/kWh
Infrastructure k number of charging points[1]	• Little to no public charging infrastructure	• Home charging offered by OEMs (e.g., Tesla Roadster) bridging infrastructure buildup	• Full-scale charger build-out esp. of fast chargers, incl. by pure charging players (e.g., EnBW)

1. Nickel-metal hydride

b. BEVs OFFER LOWER COSTS, HIGHER ENERGY EFFICIENCY, AND STRONGER CO2 EMISSIONS PERFORMANCE COMPARED TO PHEVs

Under typical driving conditions, BEVs are less expensive to buy and less expensive to drive than PHEVs. New BEVs cost on average 2,450€ less than a similar large (D-segment)[51] PHEV, and 4,500€ less than a comparable mid-size / small-SUV (C-segment) PHEV. They are also less expensive to drive, with annual savings ranging from €700 to €2,000 depending on the utility factor. BEVs remain more cost effective regardless of the charging mode compared to a PHEV, respectively saving €9,300 over 5 years when charged privately[52] and €10,100 when charged on fast public chargers[53].

BEVs benefit from a structural advantage in energy efficiency, driven by their single powertrain and lower mass. A D segment BEV consumes just 17.4 kWh/100 km, compared to ~40.4 kWh/100 km for a vehicle with dual energy sources in private usage with a 40-50% utility factor (including ~4.8 L/100 km of fuel). This efficiency edge remains significant. Even modest gains highlight the BEV's potential: a 17% battery efficiency improvement could reduce the 5-year TCO of a D-segment BEV by ~6% (from ~€59.7k to ~€56.2k), versus ~3% for other formats (from ~€66.9k to ~€64.8k).

BEVs offer a more predictable and transparent CO_2 profile across driving conditions, thanks to their fully electric drivetrain. PHEVs paved the way for fully electric mobility development and contribute to the elaboration of key technology bricks. However, the CO_2 impact has been overrated. Under WLTP testing[54], PHEVs register only 37 39 g CO_2-eq/km, but real-world data show private PHEVs emitting ~80 g CO_2-eq/km, the double of the regulated figure (see figure 38), and corporate fleets faring even worse at ~175 g CO_2-eq/km. This is due to actual utility factors[55] of 45-50% for private users and 10-15% for company cars, while the assumption in current WLTP models places it at 80%. From 2025, updated EU regulations will revise WLTP utility factor assumptions to better reflect real-world conditions, reinforcing the case for fully electric solutions.

BEVs consistently outperform on lifecycle CO_2 emissions, regardless of the energy mix, with a carbon advantage often materializing before 20,000 km driven. Over their lifecycle, BEVs generate up to around two times less CO_2 emissions than an equivalent PHEV[56] (assuming 50% utility factor) with 17 t CO_2-eq vs. 28 t CO_2-eq before recycling. And it almost doubles in case of a 15% utility factor, at 46 t CO_2-eq.[57] As the European energy mix continues decarbonizing by 2030[58], the spread will become even higher (see figure 39).

[51] e.g. €4,470 in France and €1,280 in Spain

[52] Corresponding to a charging done at home exclusively and assuming electricity price of €0.25/kWh; based on 5-year TCO

[53] Corresponding to a charging done on public fast charger exclusively (HPC) and assuming electricity price of €0.69/kWh; based on 5-year TCO

[54] Worldwide Harmonized Light Vehicles Test Procedure: A global standard for measuring vehicle emissions, fuel consumption, and electric range. ICCT (2022): Real-world usage of plug-in hybrid vehicles in Europe

[55] Utility factor is defined by % of km driven with electric motor vs. fuel

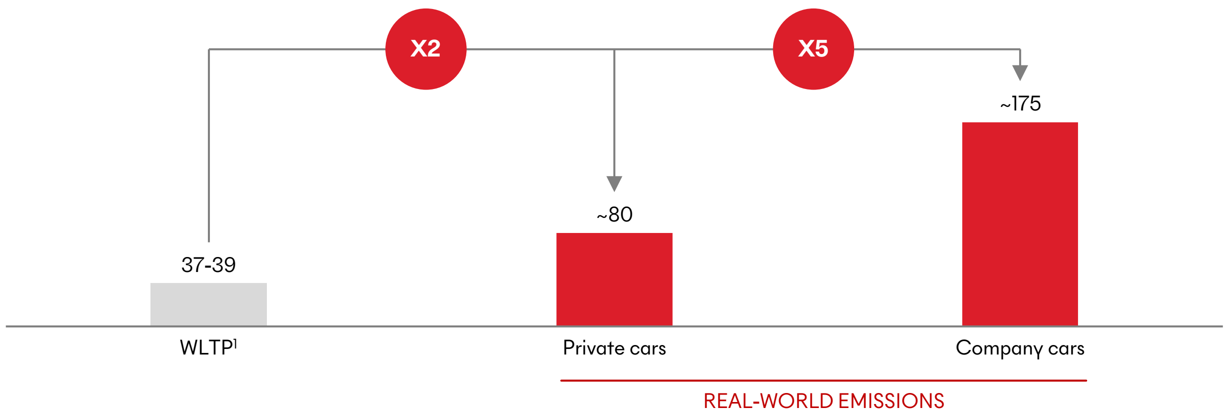
[56] Without battery recycling upside

[57] Considering carbon intensity of 210gCO2/kWh in Europe in 2025

[58] Considering carbon intensity of 110gCO2/kWh in Europe in 2030

FIGURE 38: **WLTP VS. REAL-WORLD PHEVs** D-SEGMENT EMISSIONS FOR AVERAGE USAGE IN gCO2/KM, IN EUROPE IN 2022

Real-world emissions for PHEV is on average 2-5 times higher than theoretical one
D-segment in gCO_2-eq/km, Europe 2024



1. Data from ICCT 2022 Real-world usage of plug-in hybrid vehicle
Source: IEA life cycle assessment ; BCG model ; BCG analysis

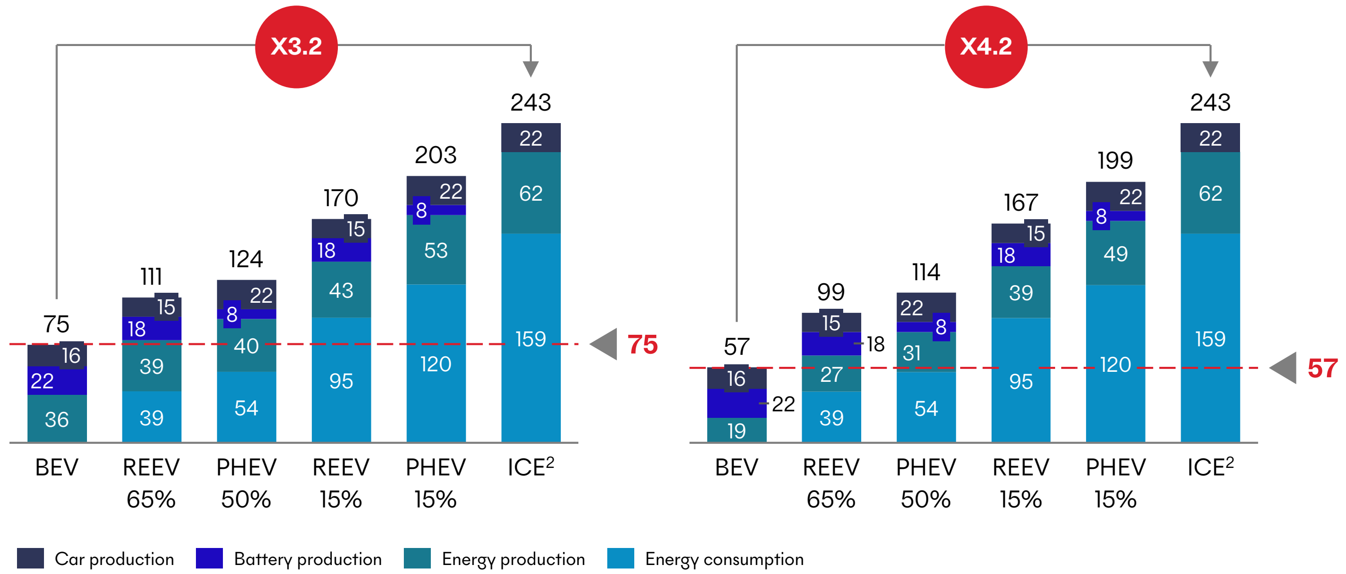
FIGURE 39: D-SEGMENT LIFECYCLE EMISSIONS FOR AVERAGE USAGE BY TYPE OF EV IN gCO2-EQ, IN EUROPE IN 2024 & 2030

Lifecycle BEVs emissions are 3.2× lower than ICEs with Europe's average carbon intensity

D-segment lifecycle emissions in gCO_2-eq/km
Europe 2024 (210gCO_2/kWh)

BEVs' CO2 edge over ICEs will grow as Europe's electricity decarbonates

D-segment lifecycle emissions gCO_2-eq/km
Europe 2030 (110gCO_2/kWh)

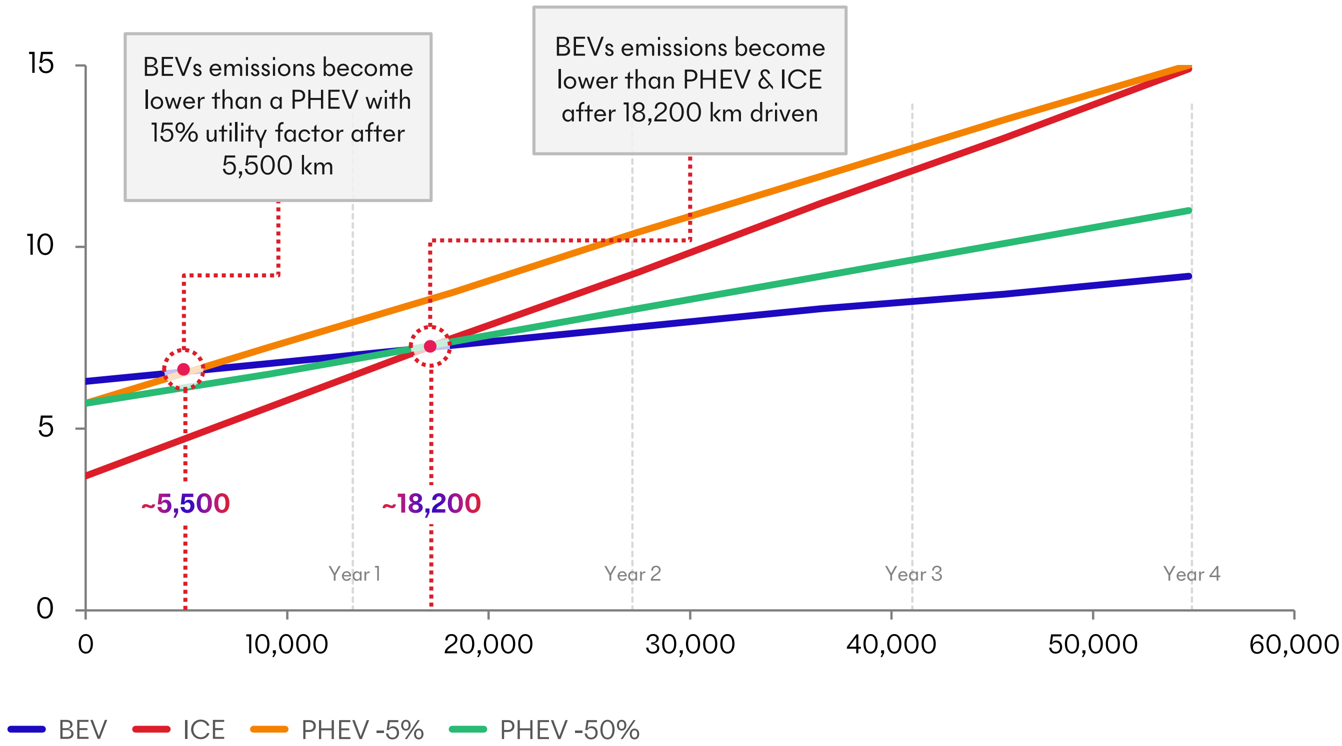


1. Assumes 300km of battery autonomy for BEV 2. Assumes traditional fuels
Note : ~225000km driven ; BEV consumption: 17.4kWh/100km; Fuel consumption: 7.1l/100km for ICE & 4.8l/100km for PHEV 50% utility factor (6.3l/100km for 15%). REEV consumption 5.0l/100km & 17.4kWh/100km
Source: IEA EV life cycle assessment calculator ; European Environment Agency (2023) ; BCG analysis

Even in Germany[59], where the electricity grid is still relatively carbon-intensive, BEVs remain the most effective option to reduce lifecycle CO2 emissions for medium-sized cars. BEVs outperform both ICEs and PHEVs (with a 50% utility factor) after just ~18,200 km of driving corresponding to less than two years of use. And for less electrified PHEV use—at a 15% utility factor—the emissions crossover comes far earlier, at only ~5,500 km (see figure 40).

FIGURE 40: CO2 EMISSIONS BY DRIVEN DISTANCE, FOCUS GERMANY

C-segment BEVs[1] in Germany have lower CO_2 emissions than PHEVs and ICE after ~18,200km – C-segment in tCO_2-eq and km, Germany (329gCO_2/kWh)



1. Assumed a 200km range battery
Source: IEA EV life cycle assessment calculator ; European Environment Agency (2023) ; BCG analysis

c. REEVs DO NOT SOLVE THE CO2/COST EQUATION

REEVs vehicles are typically large SUVs and pair a battery pack with an ICE generator that recharges the battery when the autonomy is low. Unlike PHEVs, the ICE range extender never drives the wheels directly but functions solely to replenish the battery. By using a smaller battery than BEVs (average driving range of 180 km for REEVs in China), and subsequently requiring less lightweight material, paired with a smaller ICE than PHEVs, REEVs achieve lower bill of materials costs than BEV and PHEV of the same category[60]. The range extender delivers extended driving range, using fuel, which intends to facilitate customer adoption by alleviating range anxiety.

[59] 329gCO2/kWh in Germany vs 50g in France vs 210g European average

[60] Source: JP Morgan analyst report, 2024

FIGURE 41: THE ANATOMY OF A RANGE-EXTENDED ELECTRIC VEHICLE

1	**Engine:** Double-overhead-cam, 25-valve, 3.6-liter Pentastar V-6 rated at 271 hp and 226 pound-feet of torque; aluminum block and heads, variable valve timing
2	**Generator and front-drive motor:** 3-phase permanent magnet with 202-kW peak output and 130-kW continuous output. 96 percent regeneration efficiency/AC permanent magnet with 250-kW output at 350 volts
3	**Fuel tank:** 27-gallon capacity
4	**Rear-drive motor:** AC permanent magnet with 248-kW output at 350 volts

REEVs have lately come to the attention of EU stakeholders as a potential alternative to PHEV, as they represented 24% of sales in 2024 in China. Their success is linked to China's dense cities and lack of private charging opportunities, allowing to reduce frequency of public charging visits. This is not like Europe, which benefits from greater home-charging access and strong public charging point infrastructure as described above. Additionally, REEVs are not part of European OEMs' portfolios today, and roadmaps focus on BEVs and PHEVs. Given development time and investment required for REEVs, European OEMs face limited opportunity to fully capitalize on this technology until the 2035 ICE ban. As a result, and under current European context, REEVs' long-term viability should be compromised by higher TCO and emissions, even under stringent utility factor assumptions. However, they may be a transitory solution for some customers that remain reluctant to buying an EV as their next vehicle, as a progressive shift to EV before making the switching in their following purchase; and remain valuable in high-mileage, grid constrained and rural applications until the EV charging infrastructure catches-up.

Despite the cost and range advantages provided by the range , BEVs continue to outperform REEVs on key metrics. In terms of energy efficiency, a REEV has more efficient combustion engines than PHEV, HEV and ICE, while BEVs still have the most efficient electric motors. Indeed, REEVs have slightly lower consumption for the combustion engine than PHEVs as a REEV engine is used to recharge batteries instead of driving the wheels. Yet, REEVs are usually heavier with larger battery than PHEVs and additional weight of the generator compared to BEVs (see figure 41). Moreover, effective utility factor of REEVs is low, ranging from 65% as per official data from Chinese automaker Li Auto for 2024[61], to 15%, as forecasted by some OEMs and experts when projecting utility factor of European customers. REEVs are €1.0k-€1.2k/year more expensive than BEVs[62], respectively for 15% and 65% utility factors.

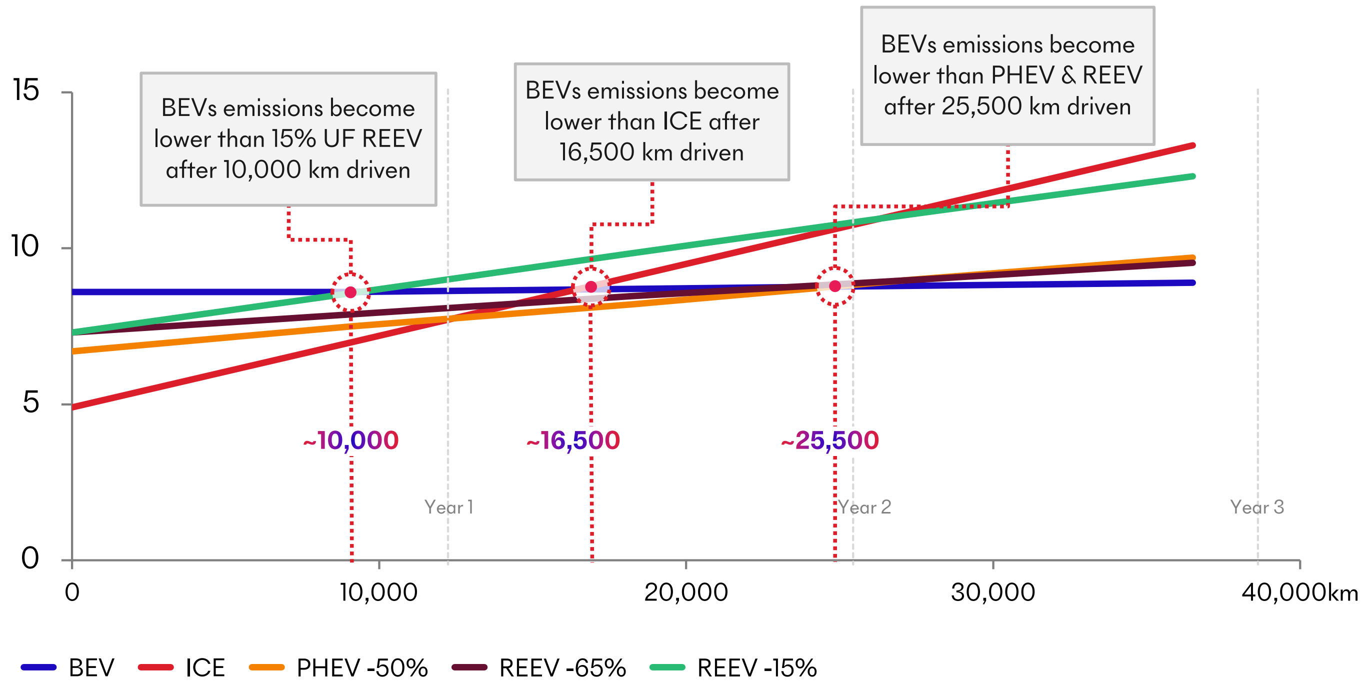
When it comes to emissions, the environmental performance of REEVs largely depends on their utility factors but emits more than BEVs. At similar utility factor, REEVs emit less than ICEs and PHEVs. At current European carbon intensity [63] , REEVs emit 111 to 170 gCO_2-eq/km for respectively 65% and 15% utility factors while BEVs emit only 75 gCO_2-eq/km, on the D-segment and over their lifecycle (i.e.225,000 km, see figure 39). Even in Poland, where the electricity grid is the most carbon-intensive [64], REEVs still underperform BEV lifecycle emissions.

On D-segment in France, REEV emissions become higher than BEV after around 10,000 km driven (equivalent to 1 driving year) at 15% utility factor and after around 25,500 km driven (equivalent to 2 driving years) at 65% utility factor. (See figure 42).

[61] Li Auto data 2024
[62] For a D-segment car in France, based on 5-year TCO in 2025
[63] 210 g CO_2/kWh
[64] 614 g CO_2/kWh

FIGURE 42: CO2 EMISSIONS BY DRIVEN DISTANCE, FOCUS FRANCE

D-segment BEVs[1] in France have lower CO_2 emissions than alternatives after ~25,500km – D-segment in tCO_2-eq and km, France ($50gCO_2/kWh$)



1. Assumed a 300km battery
Source: IEA EV life cycle assessment calculator ; European Environment Agency (2023) ; BCG analysis

5. Charge France & partners' key actions to take across the full spectrum of mobility and automotive stakeholders

To pave the way for a full electric light mobility roll out in Europe by 2035 and beyond, public and private sector leaders need to join forces. Our work sheds light on opportunities and levers that can accelerate the electric mobility transition across mobility and automotive stakeholders. The steps below outlined by Charge France can help forming the blueprint for a green and resilient economy of electric mobility that will also reinforce European competitiveness.

FIGURE 43: KEY ACTIONS TO TAKE

6 actions to take across the full spectrum of mobility and automotive stakeholders, including regulators

Stakeholders		Charge France & partners recommended actions
Policy makers	1	**Firm up the 2035 ICE phase-out and intermediary milestones** to foster EV transition and private investments
	2	**Direct incentives favoring BEVs over PHEVs, REEVs, and ICEs**, through tax reductions (e.g., corporate tax reduction for EVs in Belgium & Portugal), by lowering cost of public charging, especially for households with limited access to private charging infrastructure, and by fostering local EV supply chain
Mobility ecosystem	3	**Join forces to build a seamless "blended" driving & charging experience,** through leasing & financing solutions or partnerships between OEMs, CPO, recyclers
	4	**Foster upskilling initiatives to transition smoothly white & blue collars toward electrical expertise** and adapt current production facilities, contributing to reinforce European sovereignty
Automotive ecosystem	5	**Create a Unique Selling Proposition for electrified mobility made in Europe** (e.g. battery passport)
	6	**Highlight fact-based benefits of BEVs** to guarantee that consumers are properly informed

a. POLICY MAKERS

As the shift to electric mobility accelerates, decision makers should reduce ambiguity and sharpen focus for all stakeholders. They should do this by fostering public support and share market conditions to foster investments and achieve milestones. To achieve this, they should prioritize three types of actions: firming up the 2035 tailpipe emission phase-out timeline, favoring fully electric vehicles over less efficient bridge technologies like PHEVs and REEVs, and deploying targeted public funding and incentives to support EV adoption and EV European value chain resilience.

FIRM UP THE 2035 ICE PHASE-OUT TIMELINE AND INTERMEDIARY MILESTONES

Upholding the 2035 tailpipe emission phase-out target is essential to ensure the entire automotive ecosystem embarks on a deep, robust, and lasting electric mobility transition.

To achieve Europe's Net Zero ambitions, decarbonizing the transport sector is crucial. BEVs are on track to represent 40–55% of new light vehicle sales by 2030, with full alignment towards 100% BEV sales by 2035 still achievable. OEMs have demonstrated that they do not comply in advance but when they must, as per the 2020 target despite high undercompliance in 2019 with most OEMs at 10+ g/km over the target. The 2030 and 2035 targets require faster EV adoption due to increased ambition, but with maturing technology and promising 2025 data, these goals are achievable. Slowing down now would risk jeopardizing existing investments and hinder OEMs from staying competitive in the global shift to electrification. In addition, while PHEVs and REEVs can only play a transitional role since they underperform BEVs on emissions (BEVs emitting 2x less than REEVs and 60% less than PHEVs), cost (respectively 1,600 to €2,900 and 1,000 to €1,200 per year more than a BEV), and efficiency (BEVs twice as efficient as PHEVs). Questioning that BEV may not be the key sustainable long-term solution adds ambiguity and may hit consumer confidence.

DIRECT INCENTIVES FAVORING BEVs OVER PHEVs, REEVs, AND ICEs

Various incentives & funding mechanisms have been implemented across Europe in recent years, sometimes temporary and often heterogenous across neighboring countries. Efforts must now focus on enforcing effective, lasting and consistent incentives, such as corporate tax reductions, lowering price of public charging, and supporting the most critical steps of the EV supply chain for Europe (e.g. battery recycling).

Most European countries have been using a set of incentives to lower upfront costs, both for corporate fleets and private cars. Incentives towards corporate tax relief has shown strong potential to encourage businesses to prioritize EVs over ICEs and bridge technologies like REEVs and PHEVs. Corporate fleets represent around 60% [65] of new car purchases in Europe, making them an effective target for EV incentives—not only to accelerate large-scale adoption, but also to supply the second-hand market. Since 2023 in Belgium, companies can deduct 100% of all expenses related to BEVs, including purchase, lease, maintenance and insurance, from their taxable

[65] Transport Environment (T&E)

income which significantly contributed to boost EV sales in the corporate segment, while also creating a ripple effect that has accelerated adoption among private consumers. At the same time, they have phased out the corporate tax deduction on ICE from 2028. This incentive mechanism significantly contributed to the fact that Belgium is leading EV transition with around 40% of EVs sold in 2024 while the European average hovers around 15%. To foster BEV adoption for private cars, incentives that seek to reduce the cost of public charging and making the TCO more transparent may also be pursued. Lowering cost of public charging, especially for households with limited access to private charging infrastructure at home or at work, would be a key enabler, possible when lowering the fixed component of grid tariffs (i.e. TURPE[66] mechanism in France). On top of supporting adoption through targeted social leasing schemes for low and medium income, car-dependent households, maintaining a robust level of EU-wide e-credit incentives for EV charging is crucial. These incentives stem from the EU's RED III directive, which mandates national implementation across member states. In France, this is being operationalized through the TIRUERT [67] scheme. Moreover, great emphasis is needed on making the TCO more transparent to end customers. One approach could be to add fuel cost estimates into leasing offers, thereby illustrating the economic advantage of BEV vs. alternatives.

To speed up the electric mobility transition, public funding should focus on strategic segments of the EV value chain—such as battery recycling—that are vital to strengthening Europe's industrial autonomy. Building a robust domestic e-mobility ecosystem, from EV components to chargers, is essential. Battery recycling reduces reliance on critical material imports, enhances supply chain resilience, and lowers lifecycle emissions, reinforcing Europe's self-sufficiency. As batteries account for approximately 40% of an EV's total value, cell and module production are the cornerstone of the value chain, and developing recycling capabilities in Europe allows this value to be retained within the region—ultimately giving Europe greater control over its EV sector than it had with ICEs. Around 10% of total labor hours for car construction are done for battery manufacturing and assembly for BEVs, which could be localized in Europe in case of recycling, which is not the case for component manufacturing, a step representing 7% more labor hours for ICEs compared to BEVs.

[66] Tarif d'Utilisation des Réseaux Publics d'Electricité

[67] Titre de Reconnaissance de l'Utilisation d'Énergie Renouvelable dans les Transports

b. MOBILITY ECOSYSTEM

The transition toward electric mobility demands a holistic transformation of the mobility ecosystem's structure and how it operates. This includes the integration of charging infrastructure into urban planning, the emergence of new partnerships between OEMs, CPOs, and energy providers, and the large-scale upskilling of the automotive workforce to meet the demands of electrification.

JOIN FORCES TO BUILD A SEAMLESS "BLENDED" DRIVING & CHARGING EXPERIENCE

As consumers transition from ICE to EV, their expectations around convenience, reliability, and ease of use must be met.

Fragmented charging networks and inconsistent user interfaces can quickly become barriers to EV adoption. By joining forces across the mobility ecosystem (OEMs, Charge Point Operators (CPOs), leasing providers, and recyclers), stakeholders can deliver an integrated experience that combines vehicle access, charging infrastructure, transparency and circular economy principles into one cohesive journey.

For example, Tesla has developed its own charging network and now owns and operates more than 60,000 Superchargers worldwide [68]. This collaboration enables bundled services, real-time digital solutions, and interoperable systems, ultimately boosting user satisfaction, confidence, and adoption rates—all while reinforcing the economic sustainability of the EV ecosystem (e.g., SPARK alliance facilitating access to charging networks as announced in April 2025).

FOSTER EUROPEAN SUPPLY CHAIN & UPSKILLING INITIATIVES TO TRANSITION SMOOTHLY WHITE & BLUE COLLARS TOWARD ELECTRICAL EXPERTISE

As concerns over job losses grow across Europe, it is essential to implement ambitious upskilling & reskilling initiatives to support the transition of both white-collar and blue-collar workers toward competencies related to electrification.

As the automotive sector moves away from combustion engines and toward electrification, both white-collar and blue-collar workers must acquire new skills related to electric powertrains, battery systems, and digital technologies. Without targeted upskilling initiatives, there is a risk of large-scale job displacement, skills mismatches, and delays in adapting production systems. By proactively training the existing workforce and adapting production facilities, stakeholders can ensure a smooth and inclusive transition, safeguard employment, and maintain industrial competitiveness. Moreover, investing in local talent and capabilities reinforces European sovereignty, which reduces dependence on external expertise and ensures the continent retains control of its electric mobility value chain. This calls for strategic workforce planning from large industrial players—ideally in partnership with universities and technical institutes—and potentially backed by public funding. As a recent example, Germany has started to

[68] Tesla.com

consider converting automotive factories into defense production sites and retraining displaced auto-sector workers. Similar initiatives that would strengthen the skills of the European labor force in green tech and mobility electrification are essential. Another example is from 2022, when Renault Group, Renault Trucks, Forvia, the Conservatoire National des Arts et Métiers (CNAM), Ingénieurs 2000, NextMove and academic institutions built the E-Mobility Industry Academy (EMIA) to equip professionals and students with the skills required for the electric mobility sector. In addition, the European Commission launched the European Battery Academy (EBA Academy) in 2022, a strategic initiative to address the growing skills gap in Europe's rapidly expanding battery industry. It is managed by EIT InnoEnergy, under the umbrella of the European Battery Alliance (EBA), and is supported by a €10 million grant from the EU's REACT-EU recovery fund. Lately, the Battery School has been bringing together industry experts and academics to train on battery-related professions. These examples demonstrate how coordinated talent strategies can accelerate the shift to electrification while strengthening Europe's industrial base.

c. AUTOMOTIVE ECOSYSTEM

To fully unlock the potential of electric mobility, the European automotive ecosystem must play a proactive role in shaping both product differentiation and market perception.

CREATE A UNIQUE SELLING PROPOSITION FOR ELECTRIFIED MOBILITY MADE IN EUROPE

In an increasingly globalized EV market, where vehicles and components from Asia and the U.S. dominate, Europe must differentiate its offer and create a European Supply Chain for EV.

The European automotive ecosystem needs to establish a strong and distinctive value proposition for electrified mobility "made in Europe"—not just as a competitive advantage, but as a foundation for industrial resilience and consumer trust. Tools like the battery passport—a digital product record that traces the origin, composition, environmental footprint, and recyclability of batteries—can serve as a powerful lever. Such transparency adds value to European-made products, reinforcing standards in sustainability, ethical sourcing, and circularity.

HIGHLIGHT FACT-BASED BENEFITS OF BEVs

Despite the increasing number of electric vehicles in the market, misconceptions and lack of familiarity still stand as barriers to broader adoption.

Ensuring that consumers are well-informed and confident in their choices requires greater transparency, especially regarding bridge technologies like PHEVs. Clear disclosure of emissions performance under typical driving conditions, transparency around electric range and battery usage limitations are essential. For instance, BEV and PHEV both rank "A" according to the French Environment & Energy Management Agency's (ADEME) labelling, while their lifecycle emissions are very different. Current revision of the Car Labelling Directive should ensure such transparency. This point also includes access to test drives and first-hand experience of the different products for informed choices.

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