ALIXPARTNERS GLOBAL AUTOMOTIVE OUTLOOK
20TH EDITION

AlixPartners

2023 Global Automotive Outlook

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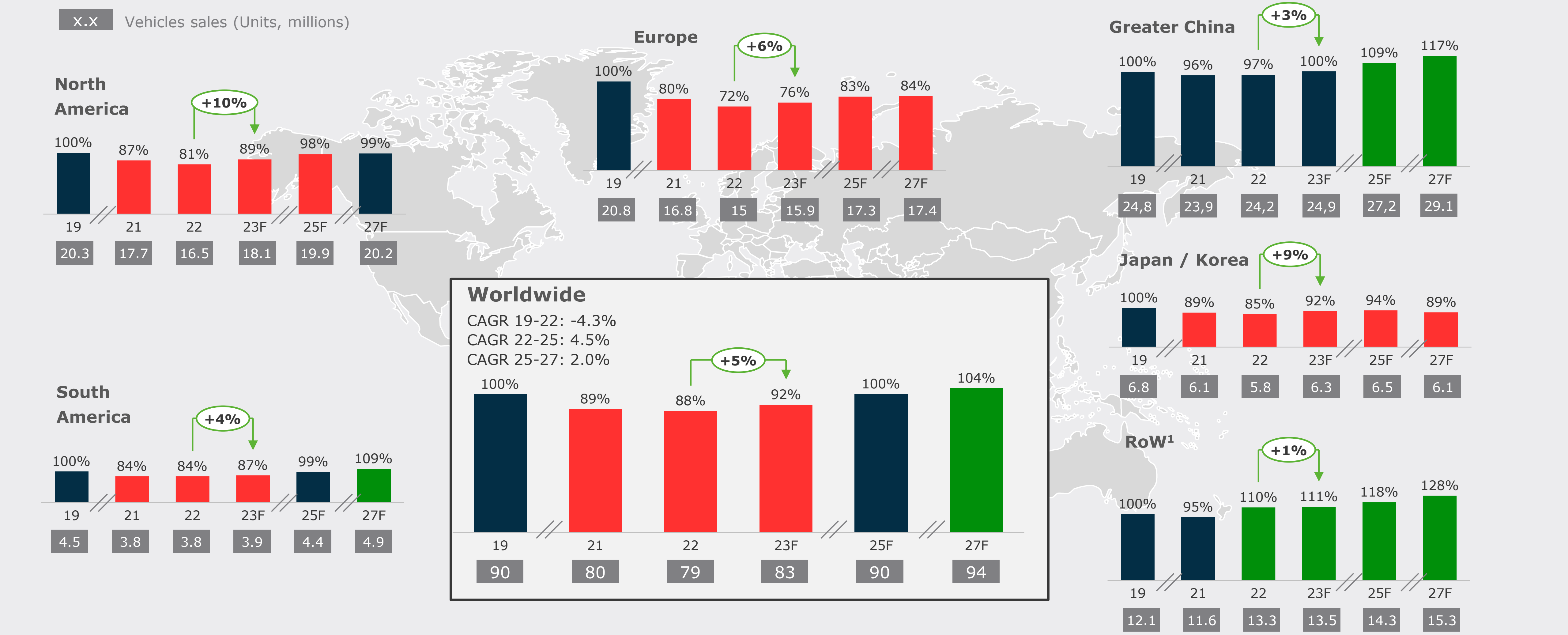
AlixPartners' forecasts: Global sales up 5% this year, to 92% of pre-Covid level, with NA up 10%, Europe up 6%, and China up 3%

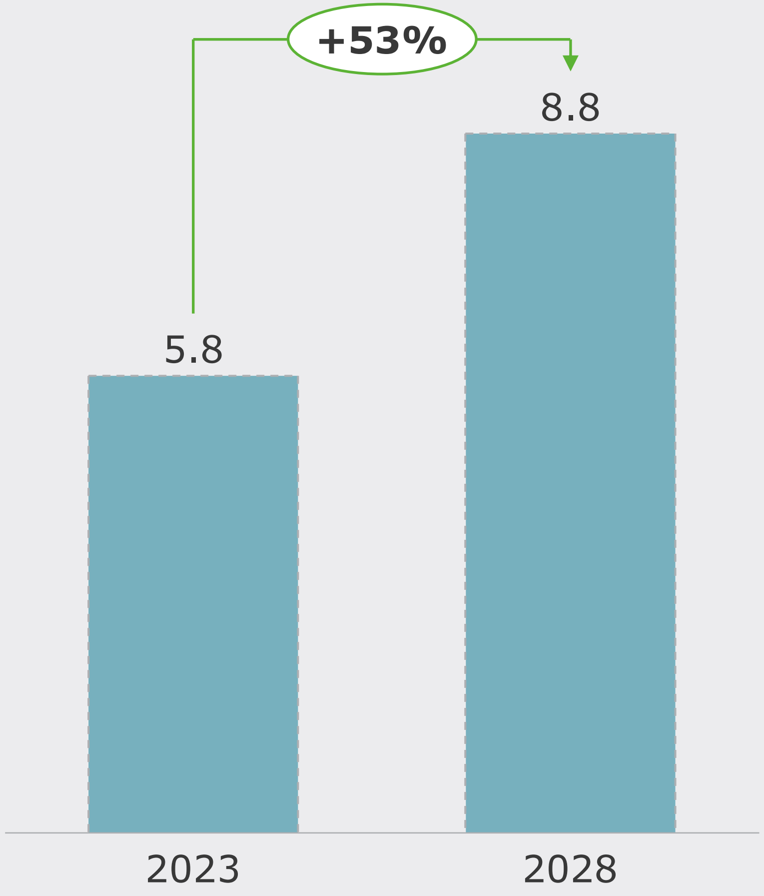
Global light vehicle sales (indexed to 2019 sales, millions of vehicles sold)



Note: WW numbers may not sum up due to rounding
1 Middle East/Africa, South Asia
Source: S&P Global Mobility, AlixPartners analysis

Semiconductors: Easing wafer constraints allow production of 85 million vehicles this year – production fully unconstrained by 2025

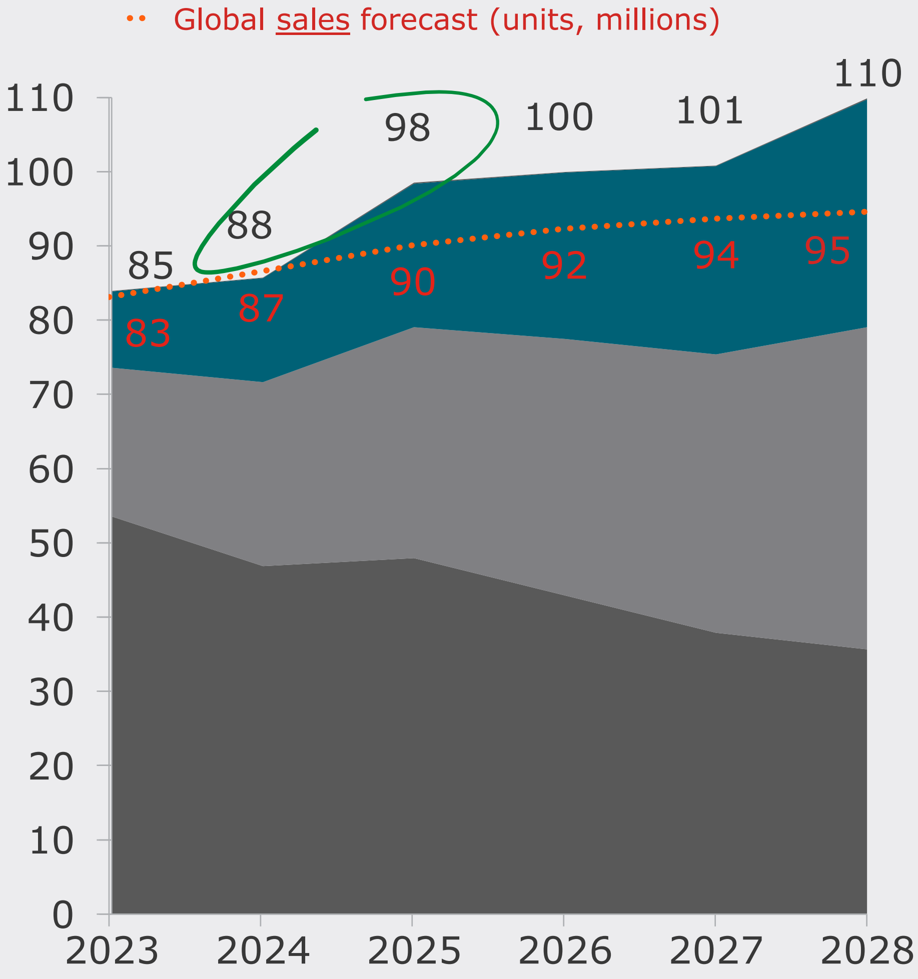
Wafer supply[1] allocated to automotive (m)



Microchips per vehicle

	2023	2028
BEV	~2,300	~2,600
HEV	~2,000	~2,500
ICE	~1,000	~1,100

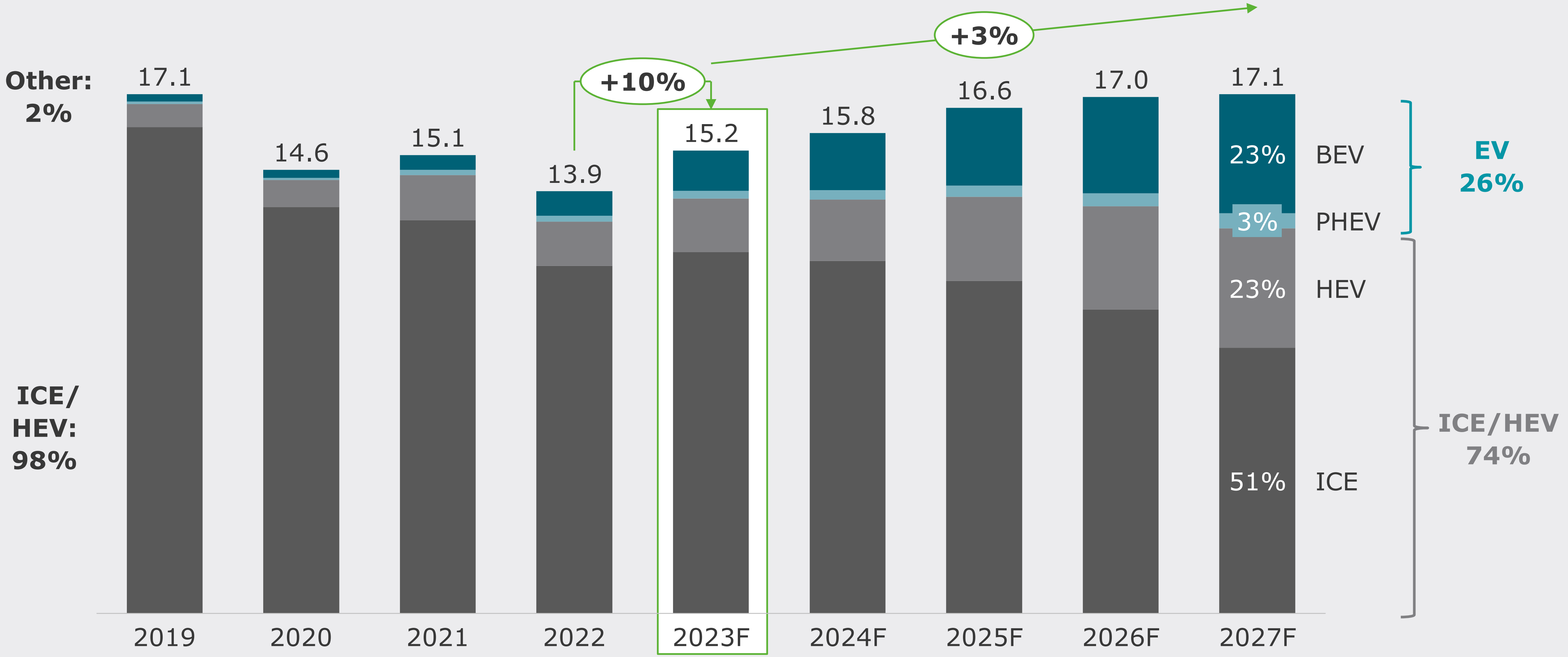
Max. vehicle production[2] (units, millions)



1 Auto wafer supply estimated based on allocation to manufacturers with Auto portfolio, primarily 45-90nm with trace shares from other node sizes
2 Based on existing and announced fab capacity of 200mm equivalent wafers, as of Q4, 2022
Source: WSTS World Fab Forecast figures, automotive semi capacities by current and future suppliers (in build up and announced) for "Analog" and "MCU/MPU" categories, S&P Global Mobility, AlixPartners analysis

U.S. forecast: Up 10% in '23, to 15.2 million, driven by EV introductions and pent-up demand – but long term, affordability to mute growth

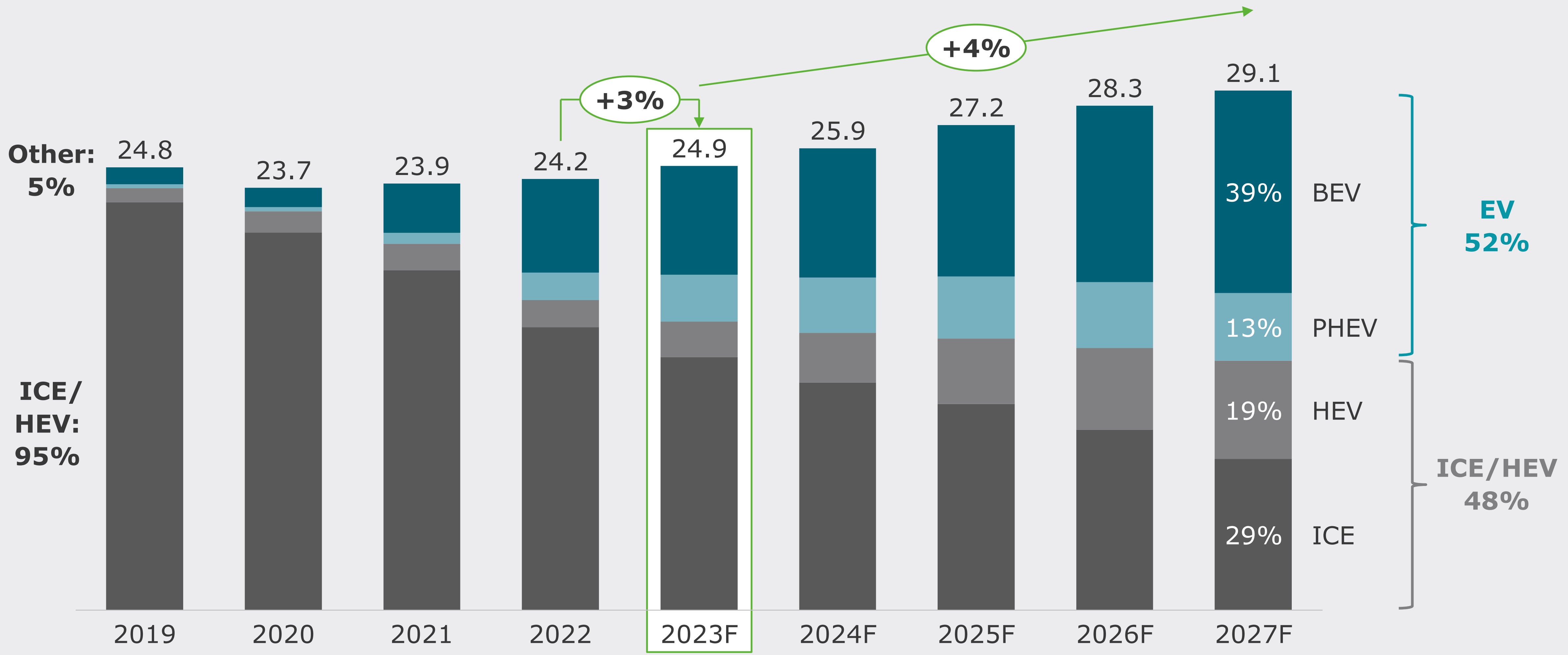
U.S. Total Light Vehicle Sales Volume (Units, millions)



Source: S&P Global Mobility, EV-Volumes, AlixPartners analysis

China forecast up 3%, to 24.9 million – and averaging 4% per year through 2027 to 29m vehicles (52% of which EVs)

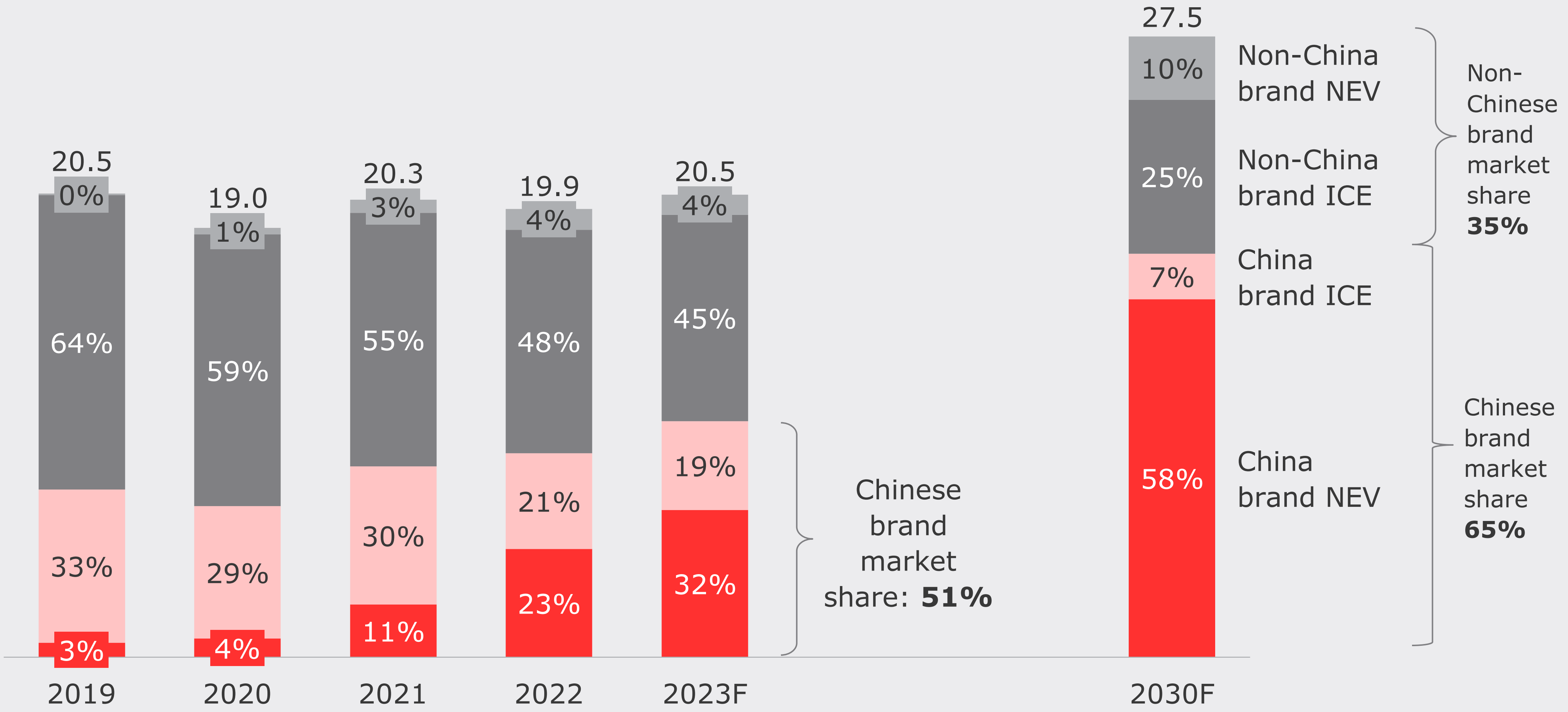
China Light Vehicle Sales Volume (Units, millions)



Source: China auto insurance registration data, S&P Global Mobility, AlixPartners analysis

Chinese brands will likely outsell foreign brands in China in 2023 for the first time in decades, and take 65% of the Passenger Vehicle market by 2030

China passenger vehicle (PV) sales by brand country of origin (Units, millions)



*Notes: PV sales = China domestically-produced passenger vehicles only, **does not include light commercial vehicles**; ICE = Internal combustion Engine; NEV = New Energy Vehicle = PHEV and BEV

Source: China auto insurance data, TF securities, AlixPartners analysis

Chinese EV brands are much better than non-China OEMs at delivering what new and tech-savvy Chinese consumers most want

Customer ranking by category for top 3 Chinese & foreign[1] BEV models (250k-350k RMB price segment)

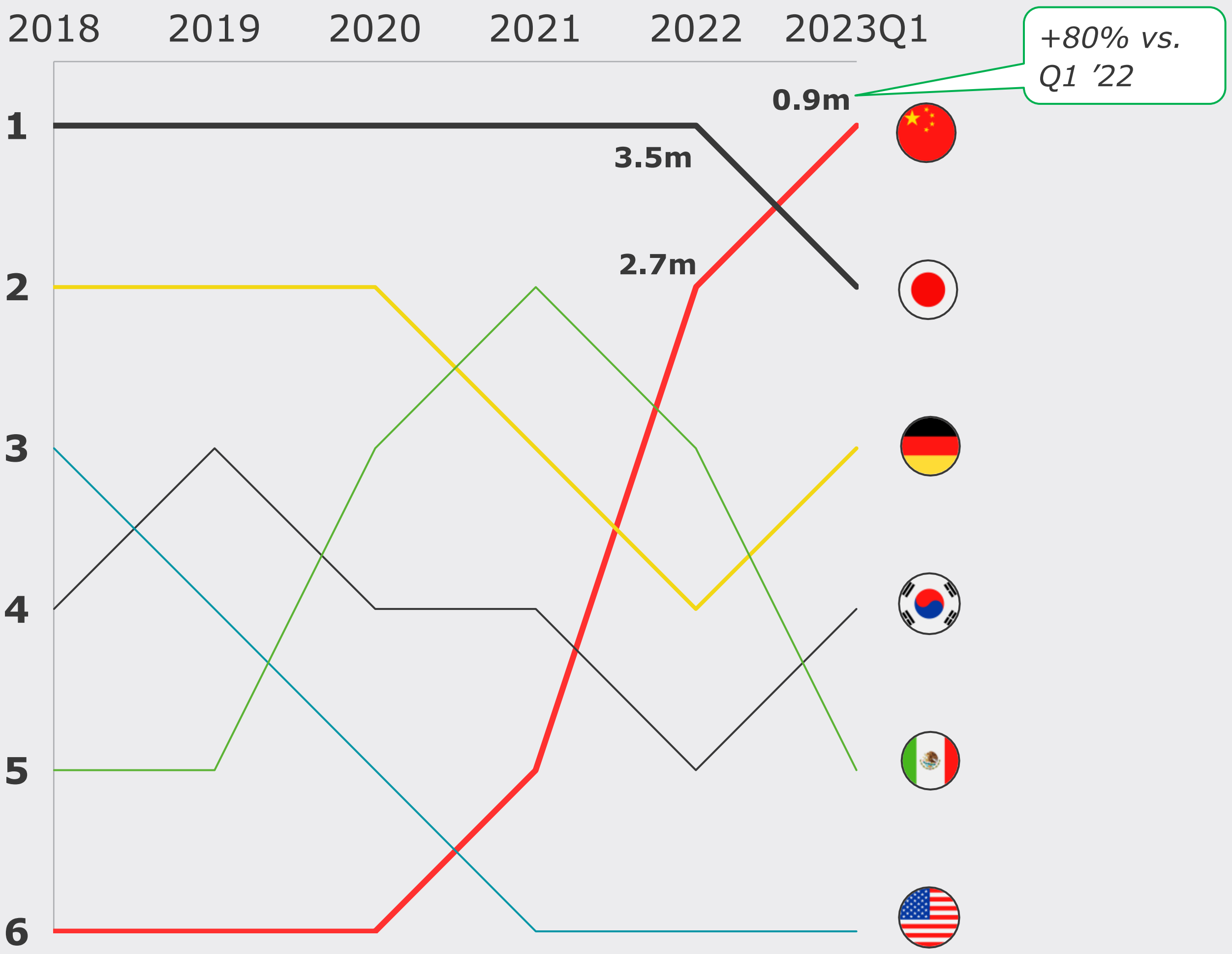
Aspect Rank	OEM Ranking	Higher					Lower
1	Exterior styling	XPENG	BYD	ZEEKR	Tesla	VW	BMW
2	Interior design	ZEEKR	BYD	XPENG	BMW	VW	Tesla
3	Tech features[2]	ZEEKR	BMW	BYD	XPENG	Tesla	VW
4	Handling	BMW	Tesla	ZEEKR	VW	XPENG	BYD
5	Power	BMW	Tesla	ZEEKR	VW	BYD	XPENG
6	Space	Tesla	BYD	ZEEKR	VW	BMW	XPENG
7	Comfort	BMW	Tesla	VW	ZEEKR	BYD	XPENG

Top-3 China brands | Top-3 non-China brands

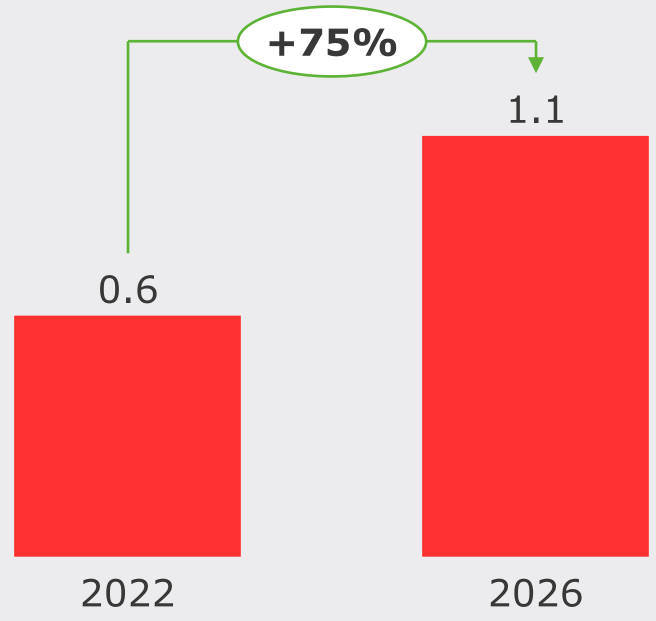
1 Chinese: BYD-Han, Geely Zeekr-001, XPENG-P7; Foreign: Tesla-Model Y, VW-ID.4, BMW-iX3,
2 Such as infotainment, ADAS, connectivity, etc.
Source: Dongchedi.com, AutoHome.com, AlixPartners NEV consumer survey 2022, AlixPartners analysis

China became the world's largest exporter in Q1, but Chinese OEMs growth in Europe may be still limited – for now

Auto export country ranking by volume



Sales volume in EU by Chinese OEMs[1]

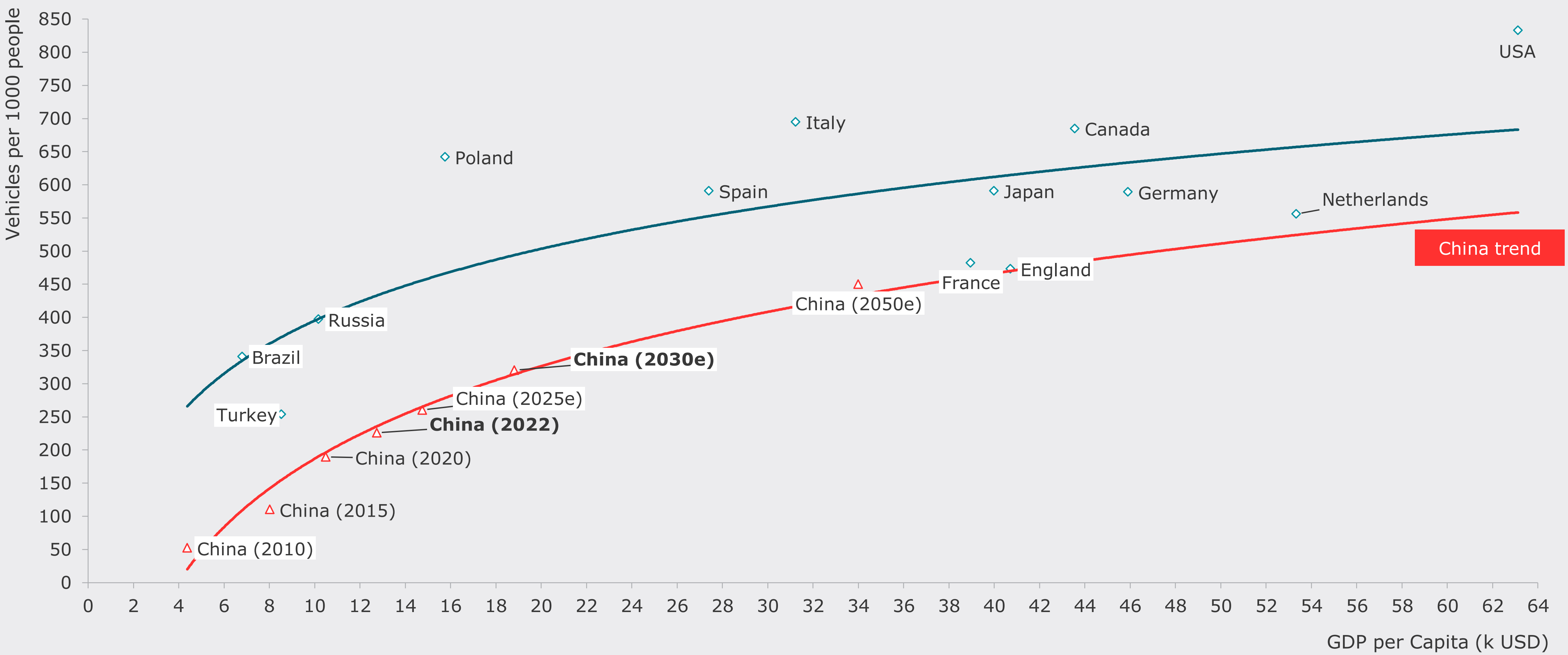


	2022	2026
Chinese OEM[1] market share in Europe	~4%	~6%

1 Includes BYD, Chang'an, Geely SGM-Wuling, GAC, Great Wall, Chery, SAIC, FAW, Dongfeng, Li Auto, NIO, etc.
Source: CAAM, S&P Global Mobility, US Department of Commerce, AUENSA, Marklines, AlixPartners analysis

Chinese OEMs can benefit from long term local market growth, as China vehicle per capita at 2030 is expected to be still significantly below Western countries'

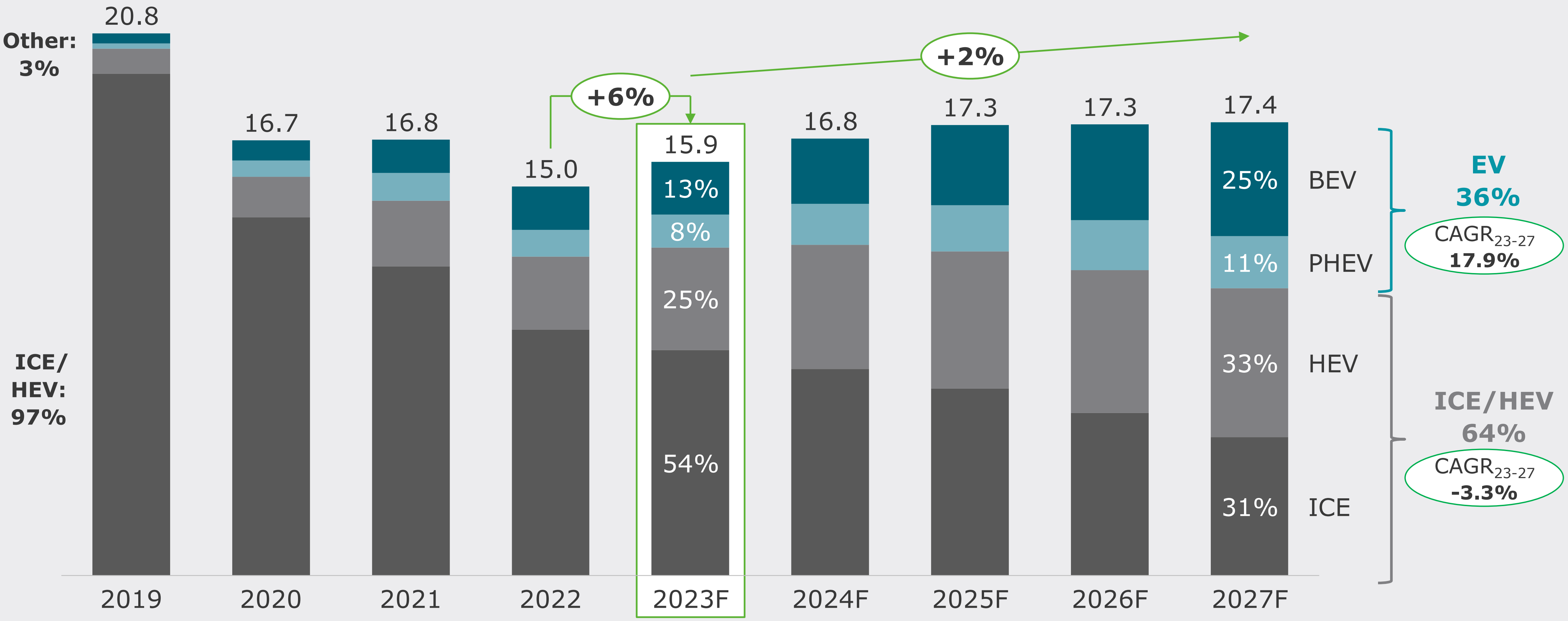
Vehicle ownership per capita by country / region ('22)



Source: Auto Home, United Nations Statistics, AlixPartners Analysis

Europe forecast: Total sales up 6% in this year due to BEV, but up only 2% CAGR through 2027 and never close to prior trend levels

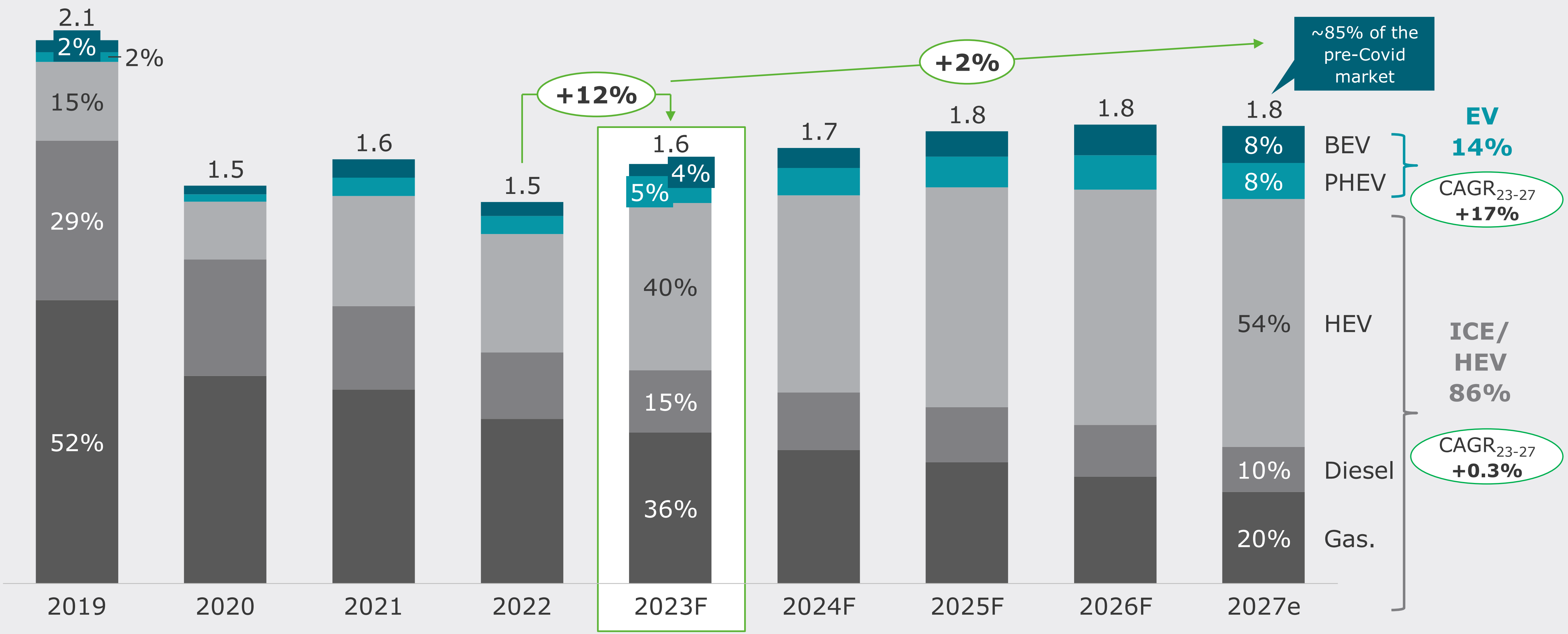
Europe[1] Light Vehicle Sales Volume (Units, millions)



1 EU 27 + Non-EU 13 countries
Source: S&P Global Mobility, AlixPartners analysis

After rebound in 2023, Italy will plateau at 1.8m sold vehicle until 2027 (85% of pre-COVID level) with EV share lagging behind vs. other EU countries

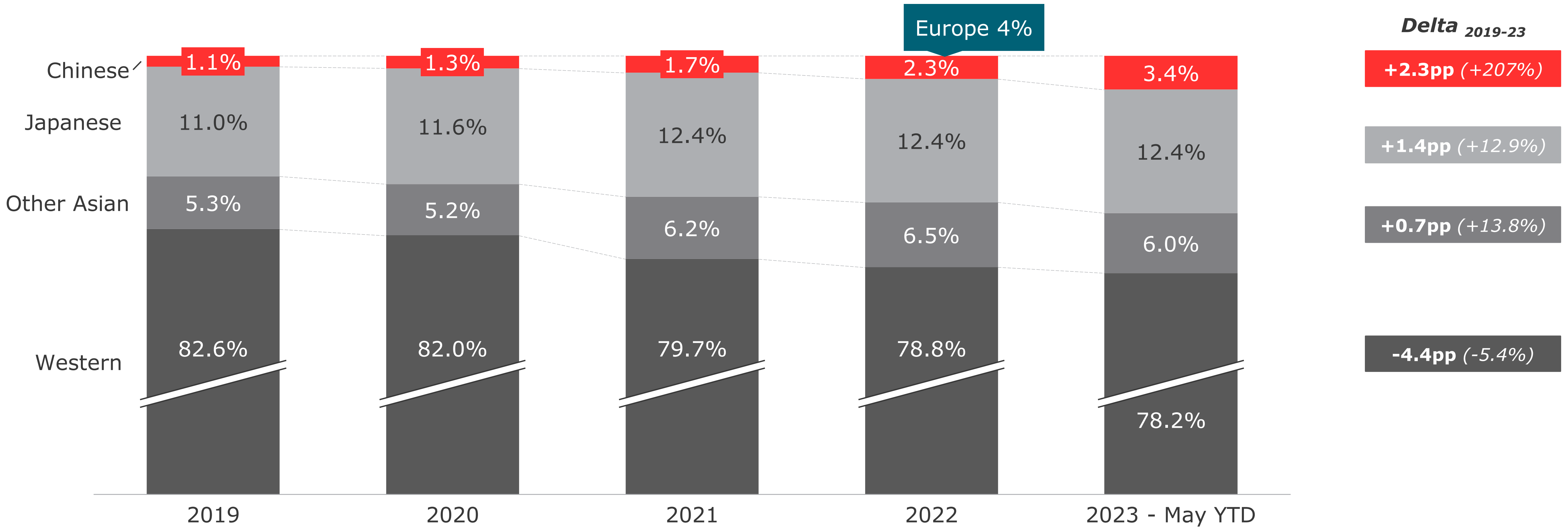
Italy light vehicle sales forecast (Units, millions)



Source: IHS Markit (Light Vehicle Sales Forecast, May 2022) – AlixPartners analysis

Non-Western brands increased penetration from '19, mainly driven by Chinese OEMs that reached 2.3% in '22 and headed to further increase share in '23

Market Share of new Passenger Cars registered in Italy by OEM region (%)

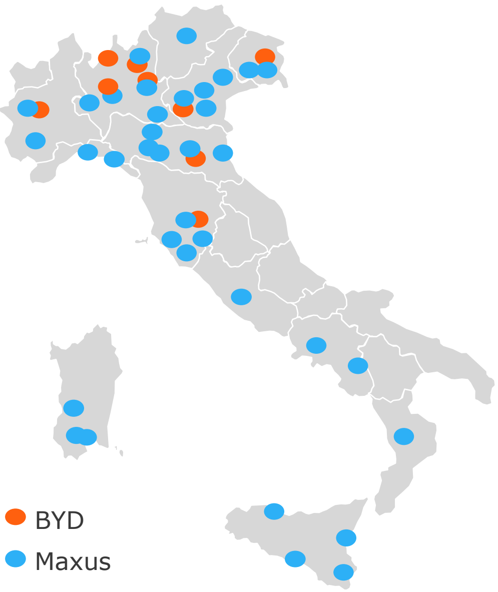


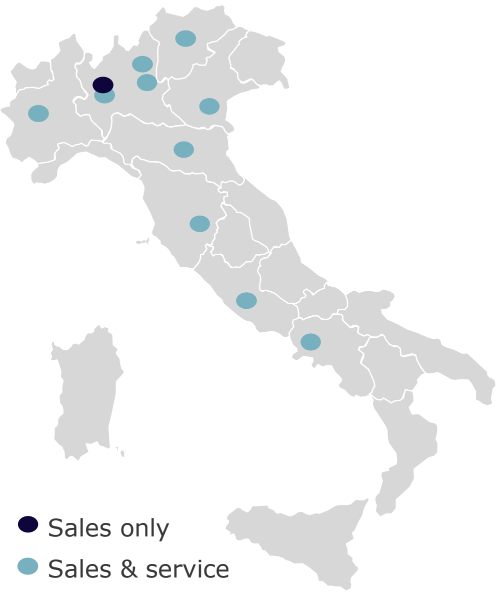
Chinese OEMs: Link&Co., Great Wall, Polestar, MG, EVO (DR motor – imported & rebranded), Volvo/ Geely
Japanese OEMs: Toyota, Lexus, Nissan, Infiniti, Suzuki, Mazda, Honda, Mitsubishi, Subaru
Other Asian OEMs: Kia, Hyundai, Mahindra, Ssangyong
Western OEMs: Alfa Romeo, Citroen. Ds, Fiat, Jeep, Lancia, Maserati, Opel, Peugeot, Audi, Cupra, Lamborghini,
Seat, Skoda, Volkswagen, Dacia, Renault, Ford, BMW, Mini, Mercedes, Smart, Dr Motor, Jaguar, Land Rover, Porsche, Tesla, Ferrari, Other Aston Martin

Source: UNRAE; AlixPartners analysis

Beside traditional approach, Chinese OEMs are also betting big on new sales and distribution models – which one will prove to work best?

Sales model	**Multi-brand Franchise Dealer**	**Showroom (monobrand) + online sale and subscription**	**Owned Flagship Center (Sale and Service)**	**Mono/Multi-brand Dealers**
Example OEMs	***BYD / Maxus***	***Polestar/ Lynk***	***Tesla***	***Stellantis***





- BYD/ Maxus with **multi-brand car dealers**
- **Maxus** relying on **Koelliker network** (EV);
- **BYD developing its network,** currently covering only North Italy

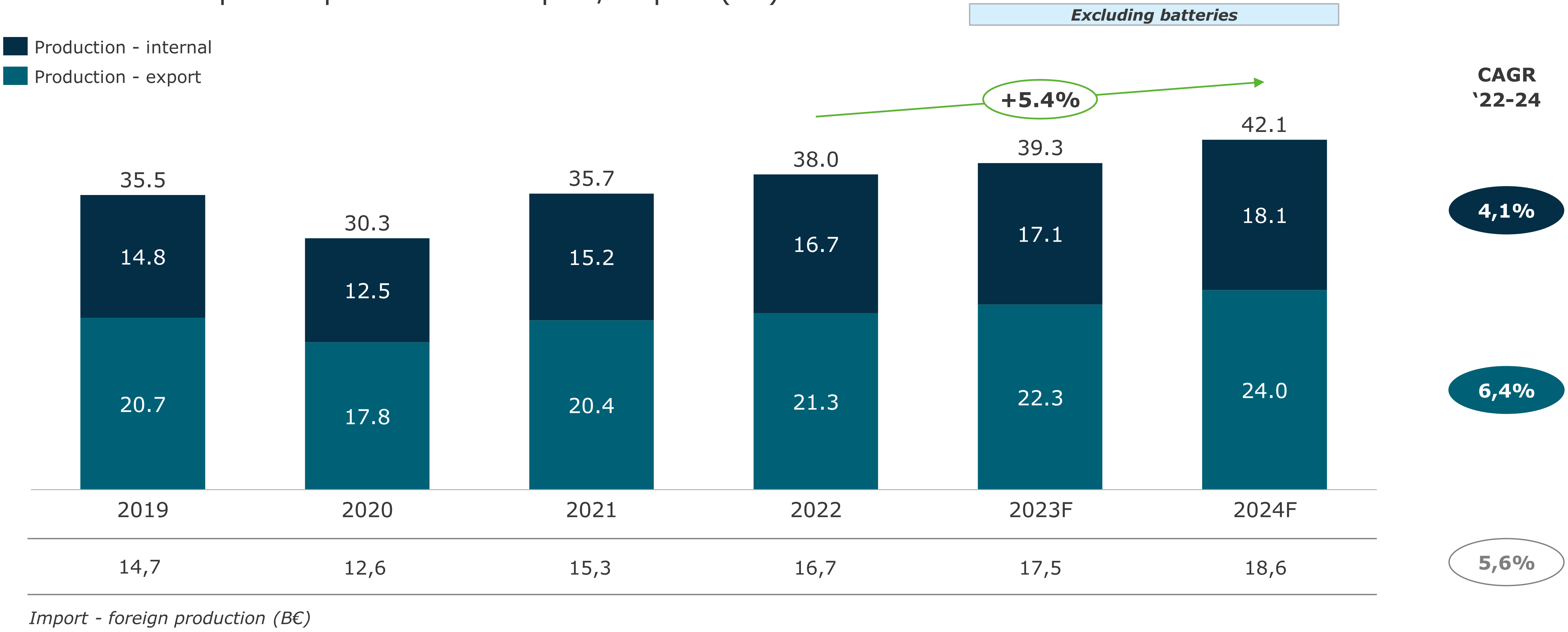
- Polestar/ Lynk with **monobrand showrooms** + **online purchasing and home delivery** (leverage of Volvo network)
- Lynk offers **subscription model**

- Tesla with a **direct distribution strategy**: owned monobrand centers- online sales in **US**
- **Mobile service** assistance
- Footprint under development, limited presence in mid-south Italy

- Established OEMs with a **large number** of **sales and service network**
- Sales points in **mono/multi brand and in part owned**

Italy component production expected to grow at +5.4% yearly in ’22-’24, mainly driven by export (+6.4%)

ITA Vehicle component production - Import/ Export (B€)



In scope: all **components and parts** (cars), **tires** (cars + other Vehicles), **all transmission systems** as bearings, gears, chains, distributors, etc. (cars + other vehicles + Industrial)
Not in scope: batteries, engines, glasses, paints

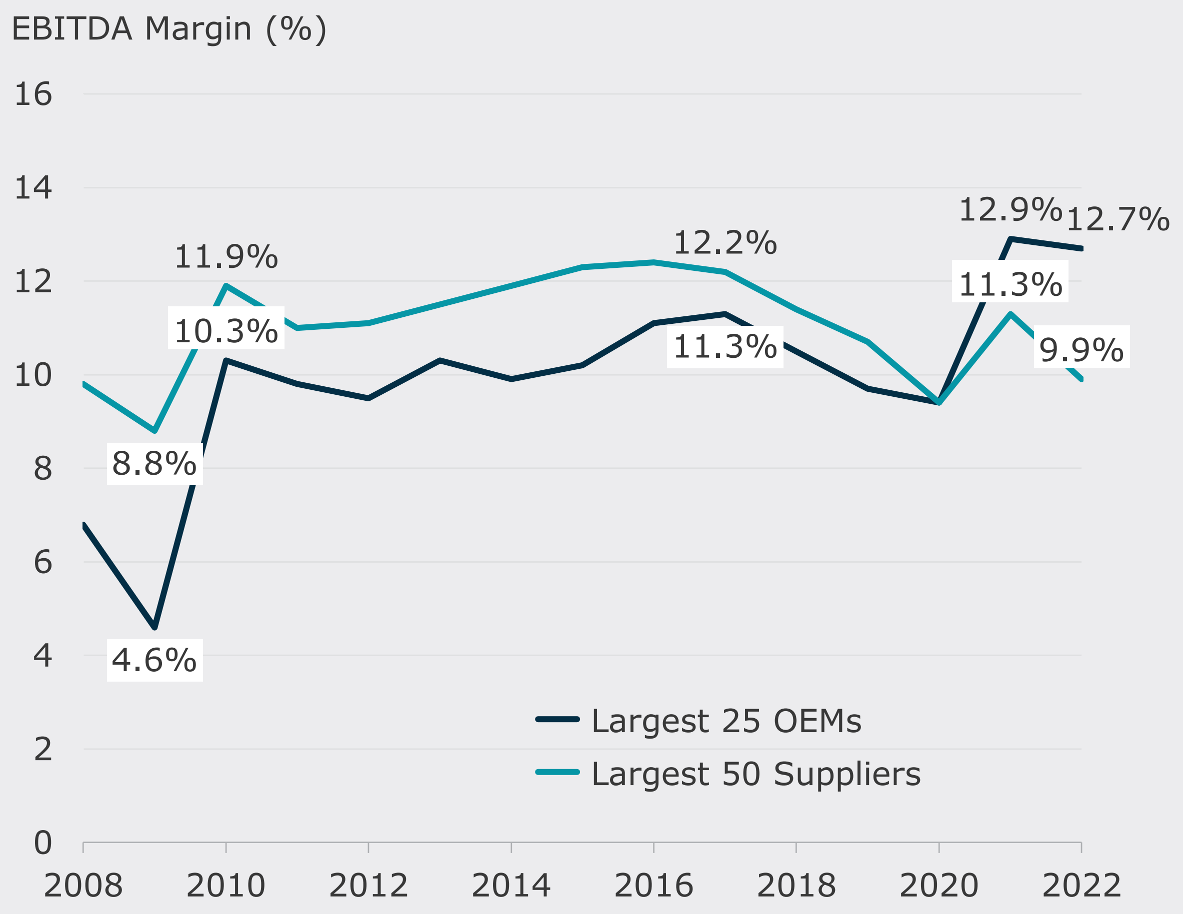
Consolidated automotive players should reflect on radically new ways of doing business to meet future disruptive competition from Chinese brands

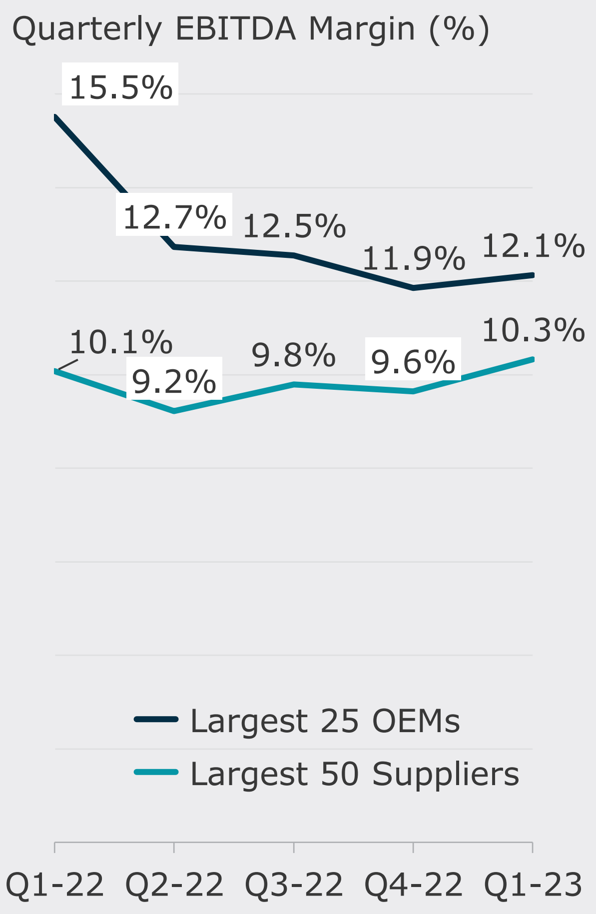
Traditional approach		*Emerging approach*
Engineering-driven Compete in traditional vehicle attribute battlegrounds (e.g., ride-and handling, power, NVH, crash safety)	**Vehicle attributes**	**New Tech-driven** Differentiate in new consumer battlegrounds (e.g., styling and intelligent / connected technology) – strive for "good enough" in traditional attributes
"Defender" mindset Integrated ICE/BEV business with dealership sales model – capital investments in EVs considered vs. other traditional options	**Business set-up**	**"Newcomer" mindset** Dedicated, "nothing-to-lose" NEV business with independent investment decisions, innovative sales models
Get it right Very (very) structured approach to vehicle development – model year/ face lift approach	**Approach to speed and risk**	**Get it fast** Speed-to-market and cost prioritized over other factors – "Consumer goods-like refresh rate"

Priorities / Trade-offs

Profitability: OEMs experienced record margin but pricing power is eroding, while war for profit pool rebalancing will continue

Profitability (EBITDA Margin %, Top 25 OEMs and Top 50 suppliers)

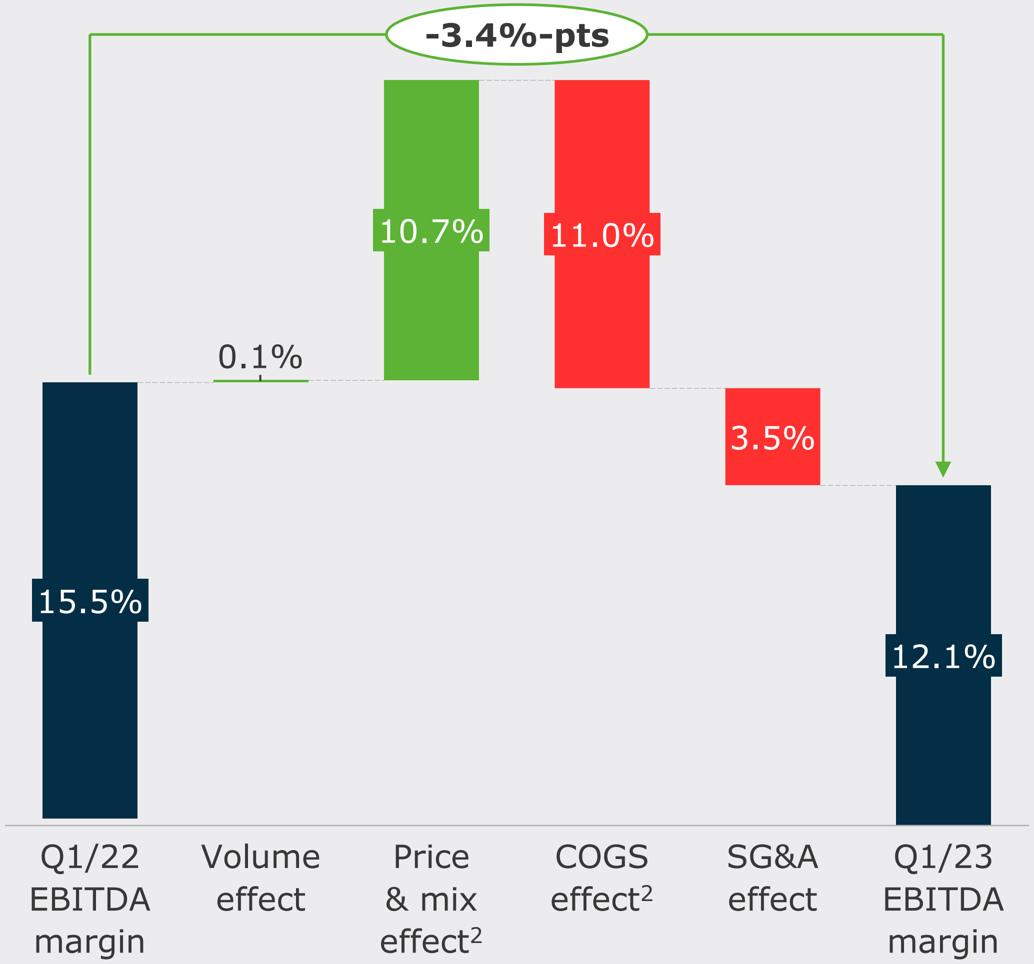




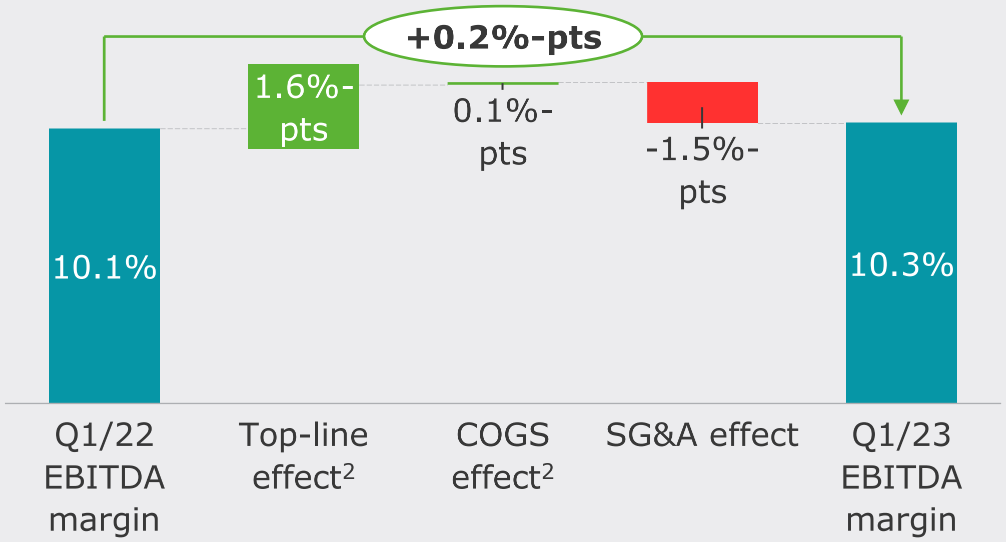
Source: S&P Capital IQ, Company annual reports, AlixPartners' analysis

After seeing pricing lag costs for two years, suppliers found some price relief while both OEMs and Suppliers saw labor increases

EBITDA change – top global OEMs[1]



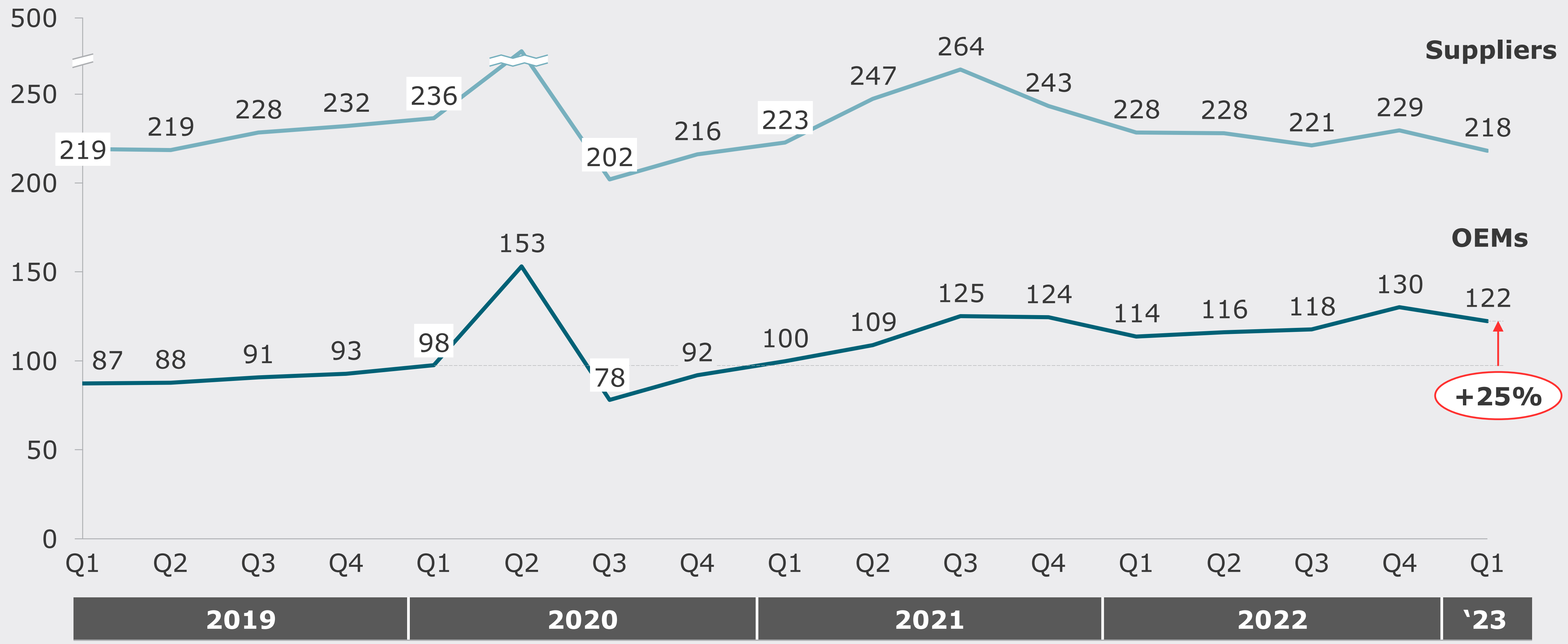
EBITDA change – top global suppliers[3]



1 Top 25 OEMs; Subset of OEMs with available data
2 Including foreign exchange effect
3 Top 50 Suppliers; extrapolated from small subset of suppliers with available data on volume impact
Source: S&P Capital IQ, S&P Global Mobility, Company annual reports, AlixPartners analysis

Productivity: U.S. suppliers have stabilized at pre-pandemic levels; OEMs now have 25% more employees per 1,000 vehicles produced

Employees per thousand vehicles produced, United States

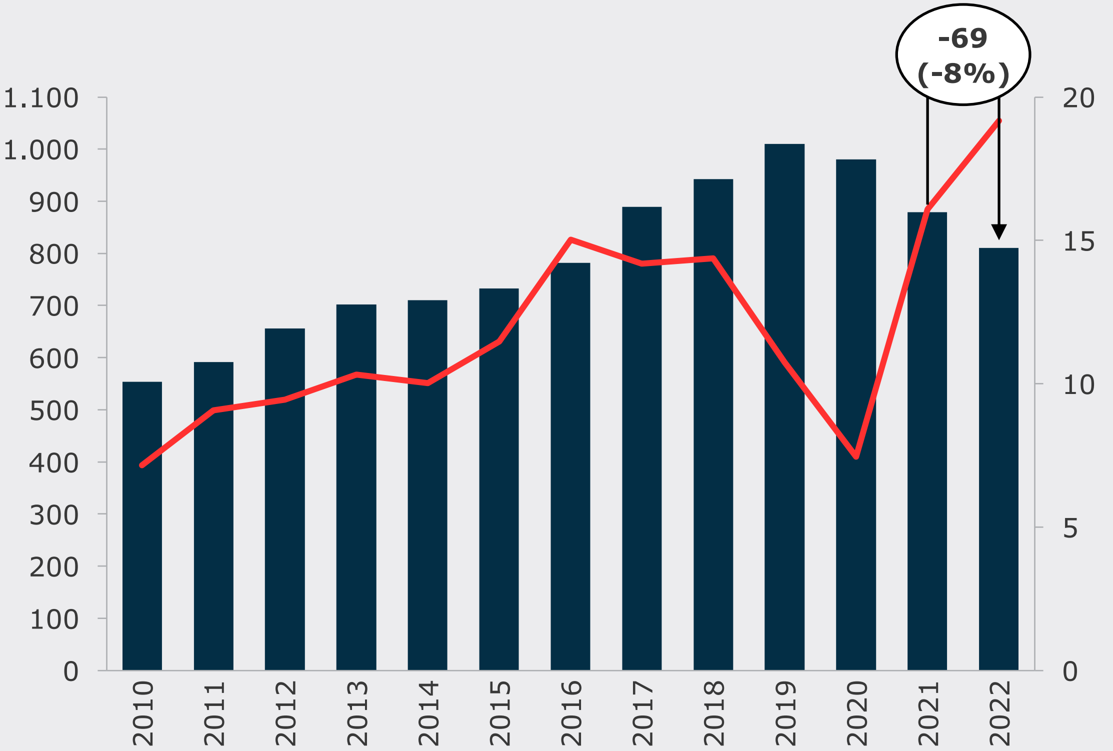


1 Includes U.S. Totals for NAICS 3361 Motor vehicle manufacturing and NAICS 3363 Motor vehicle parts manufacturing
Source: U.S. Bureau of Labor Statistics, S&P Global Mobility for vehicle production volumes

Supplier net debt is up 27% in 2022, while OEMs' is down 8% - suppliers need to manage cash as interest coverage ratio has meaningfully deteriorated

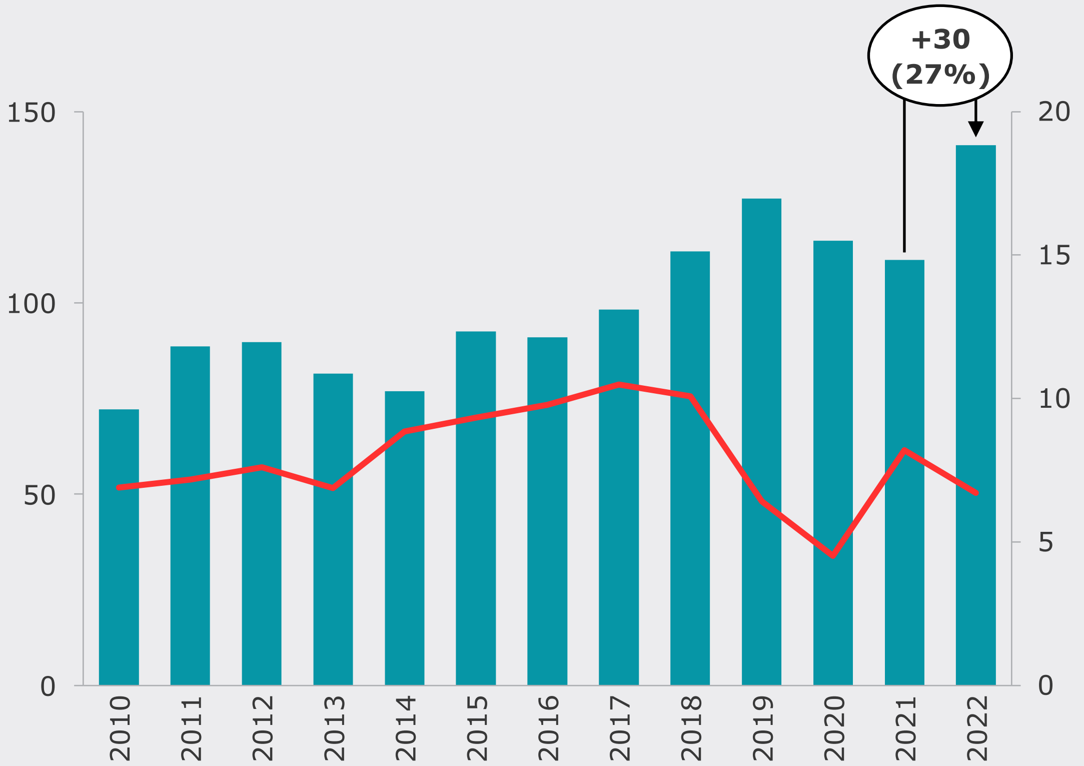
Largest 25 OEMs[1] (incl. Finance Cos)

Net debt ($ billion)[3] — Interest coverage ratio (EBIT/ interest expense, x)



- Total industrial debt decreased by $94 billion (-8% YoY) as OEMs paid back revolver drawdowns and other borrowings; cash decreasing by $36Bn YoY as OEMs redeployed additional cash
- Interest coverage ratio of the top 25 OEMs reached 19.2x in 2022 as debt was paid down and profitability was very strong

Largest 300 Suppliers[2]

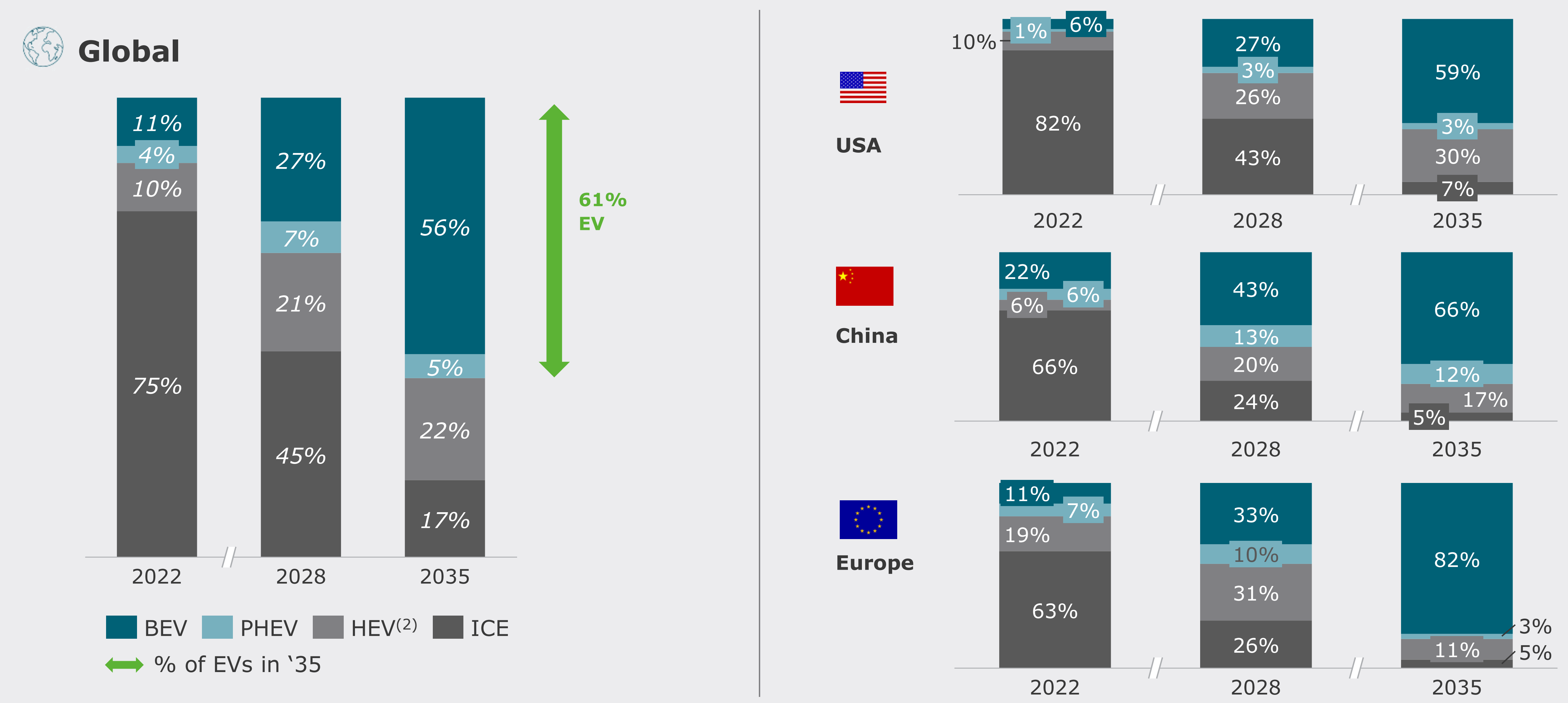


- Total debt stayed nearly constant (+$6 billion), with cash declining by $24 billion, leading to net debt increasing 27% YoY
- Interest coverage ratio fell to 6.7x in '22 from 8.2x in '21. With suppliers facing continued challenges in 2023 as well as increased debt service costs, we expect interest coverage ratio to come under further pressure

Source: S&P Capital IQ, Company annual reports, AlixPartners' analysis
1. Subset of OEMs with available yearly financials for 2022
2. Subset of Suppliers with available yearly financials for 2022 (excl. Bosch, Mahle and others)
3. Net debt = Short-term + long-term liabilities – cash and cash equivalents (includes financial debt for OEMs)

Route to electrification continues by 2035, BEVs to be the majority in all major sales regions – 59% in the United States, 66% in China, 82% in Europe

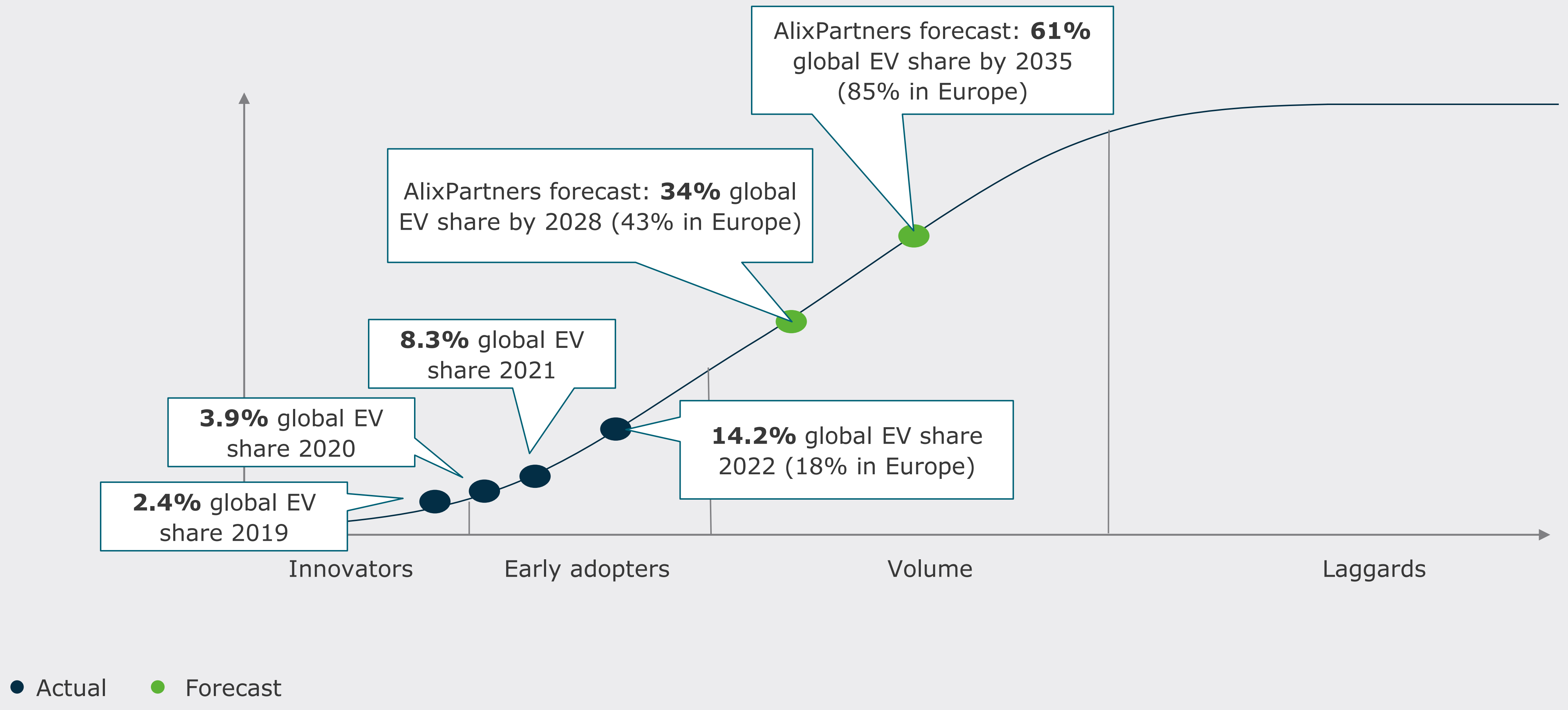
Evolution Of Light Vehicle[1] Powertrain Distribution (% of Sales Volumes)



(1) Light Vehicles: Passenger Cars and Light Commercial Vehicles (2) Full/mild hybrid electric vehicles
Source: AlixPartners powertrain forecast

EVs are still in the early-adopter stage; next up will be the "time-to-market" and "cost and competitiveness" phases

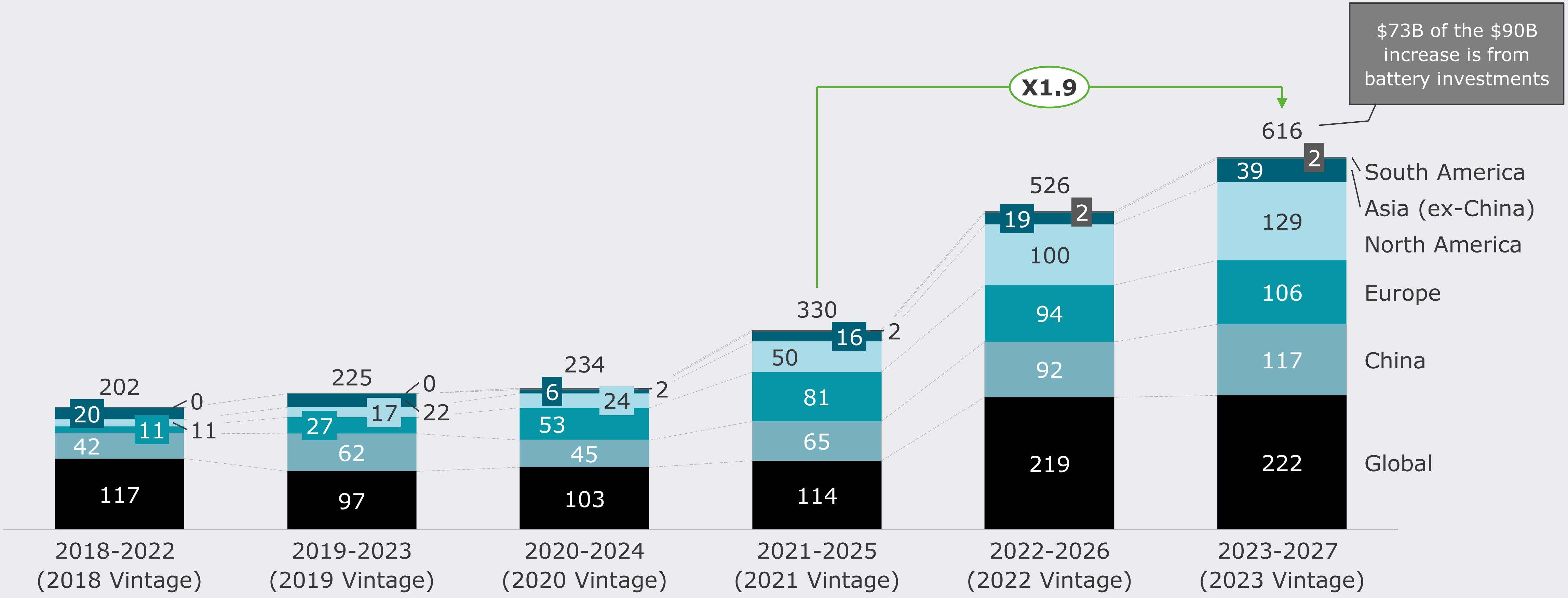
NEV (BEV + PHEV) Adoption Curve



Source: EV-volumes.com; AlixPartners powertrain forecast

EV investment announcements have doubled in the last 2 years, reaching ~ $616 billion through 2027, mainly driven by batteries

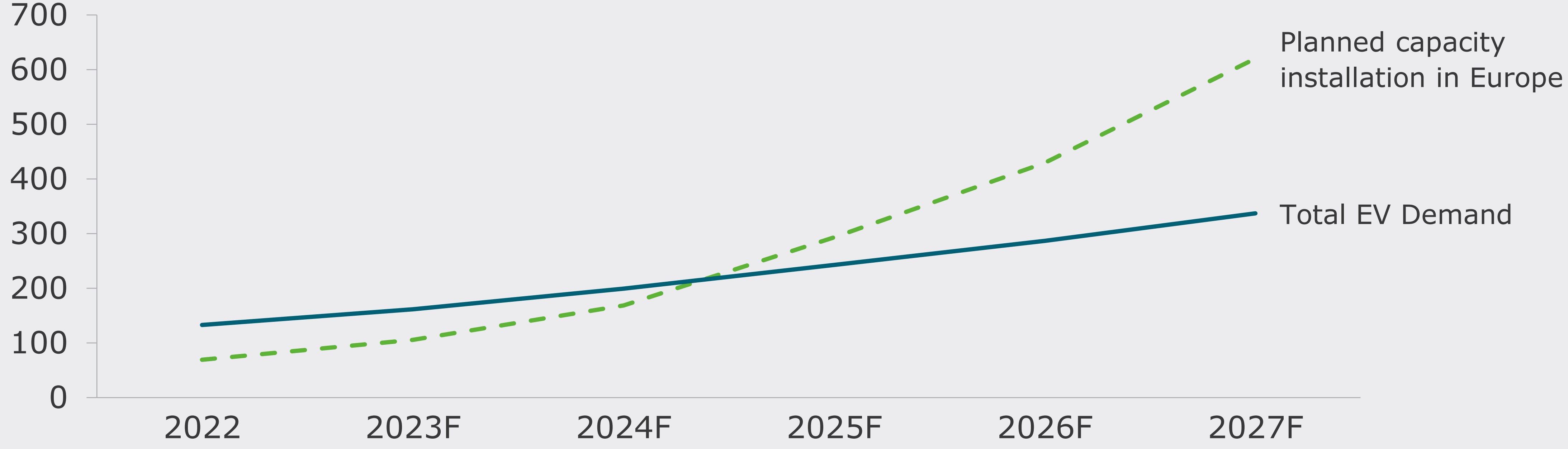
EV Investment Announcements by target regions ($ billion) – Rolling 5 Yr Period



Note: Global Investments including non-region-specific targeted announcements - Vintage performed in March each year
Source: Press Research, Company Reports, AlixPartners analysis

Starting from 2025 Europe is expected to have enough capacity to become self sufficient on batteries

Total EV demand vs growth of installed capacity (GWh)



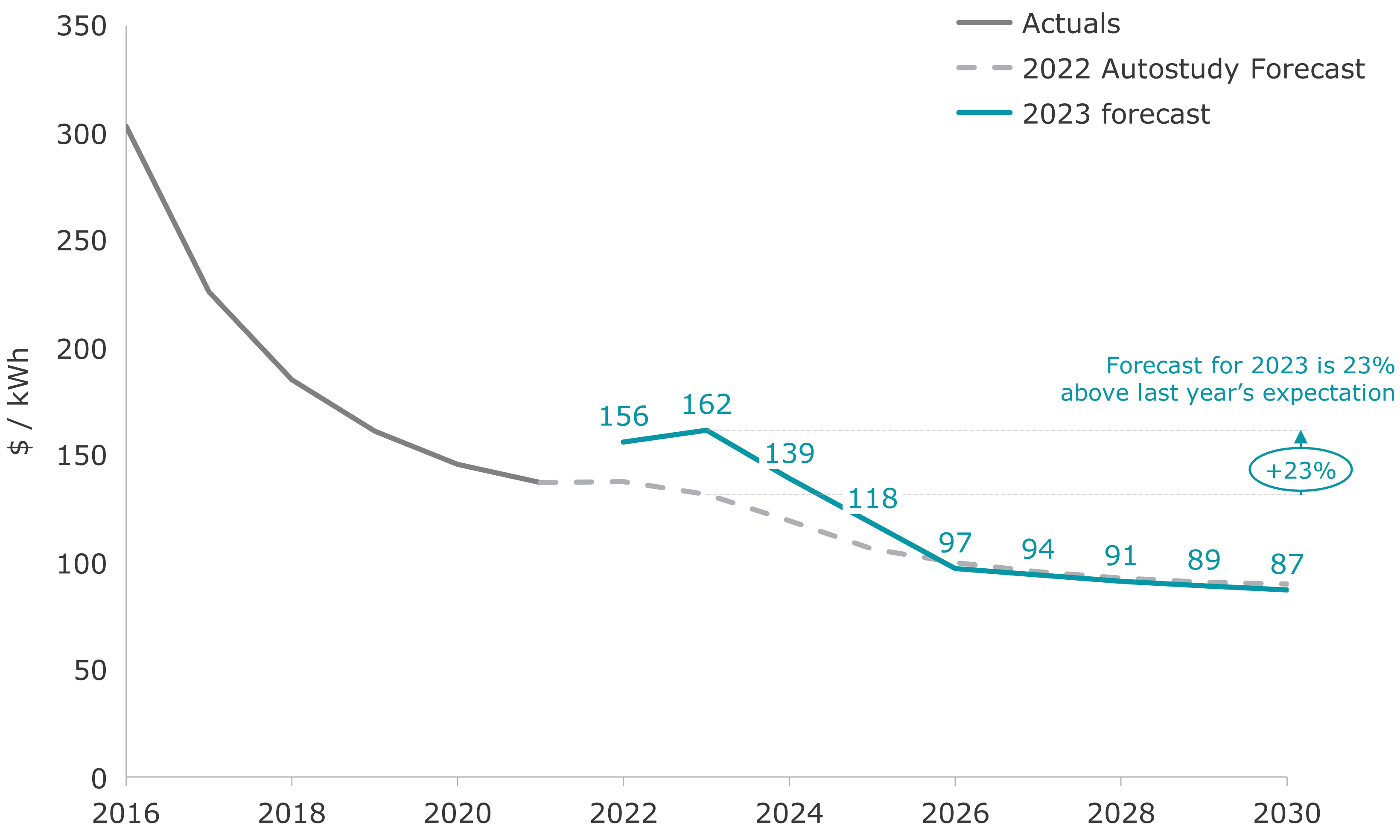
	2022	2023F	2024F	2025F	2026F	2027F
Total EV demand GWh	150	200	268	383	400	480
Foreign battery dependency	~85% →			~10%		

EU Battery dependency calculated considering available local capacity and assuming a 6-15 months additional timeline to phase new local battery source (testing, etc.); timeline does not include any OEM cost consideration that can delay resourcing

Source: EUROSTAT, T&E battery risk report, battery-News gigafactory report, S&P data, AlixPartners analysis

Battery cost: peak on material costs will require 4 years to recover, but should get below 100$/kWh from 2026

Projected Battery Pack Cost per kWh ($)



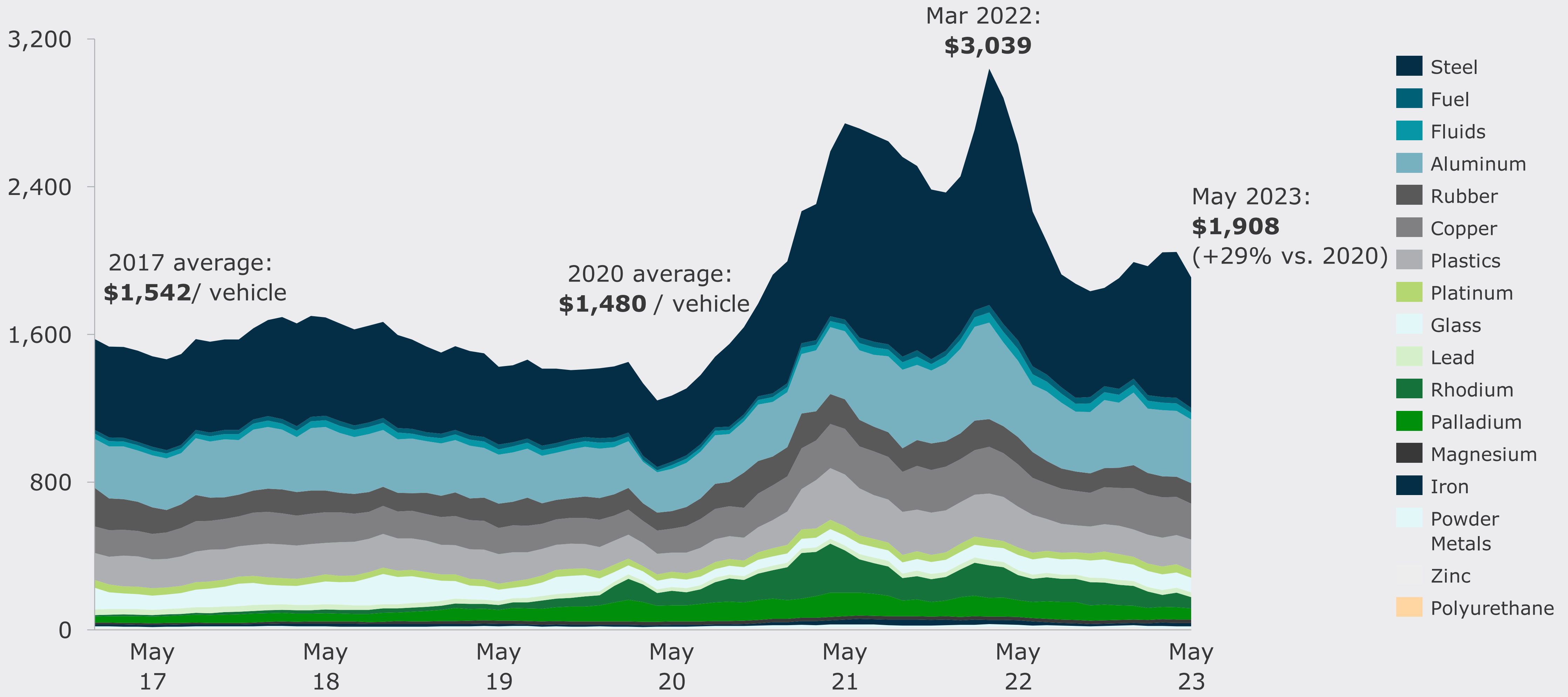
Comments

- Battery Pack Cost has been decreasing steadily for the past 10 years
- **In 2022 battery pack cost increased for the first time**, driven by **raw material** and **global energy prices**:
  - **High demand** pushed pricing of **lithium** to an all-time high in 2023; however, we expect this to drop significantly into 2024
  - The recent **Ukraine-Russia conflict** also had a major impact on supply chains (Russia is #3 global producer of Nickel and #2 of Cobalt)
  - **Global energy prices** had a material impact in 2022 in particular, however prices are expected to decline form mid-2023 onwards
- We now expect battery costs across 2022-2025 to be on **average 15-20% higher than our forecast last year**, continuing to put pressure on **battery manufacturer's margins**
- Assuming there are no further issues with raw materials supply chain, Battery Pack Costs are expected to continue to decline **mainly driven by technology improvements to** <$100/kWh in 2026

Source: Goldman Sachs, BNEF, IHS, Cairns Energy, ICCT, AlixPartners analysis

Raw-material costs down more than 1/3rd since March 2022, making non-indexed supplier material inflation adjustments harder

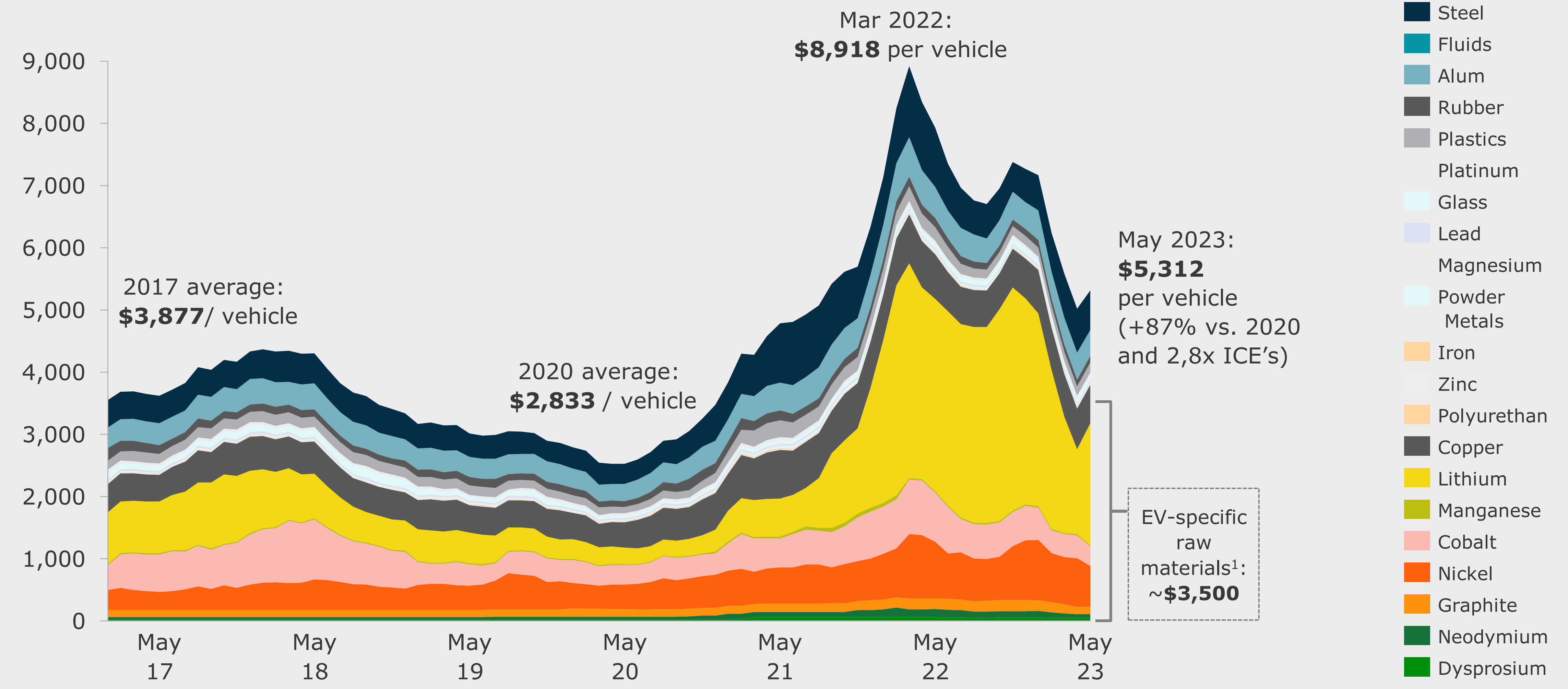
ICE-Vehicle: Costs Per Vehicle For Key Raw Materials Based On Spot Price ($ per unit)



Source: AlixPartners European Light Vehicle Raw-Materials Index

BEV raw-material content is now $5,312 in May 2023, 40% below 2022 peak but 2x the 2020 trough level (NMC 622)

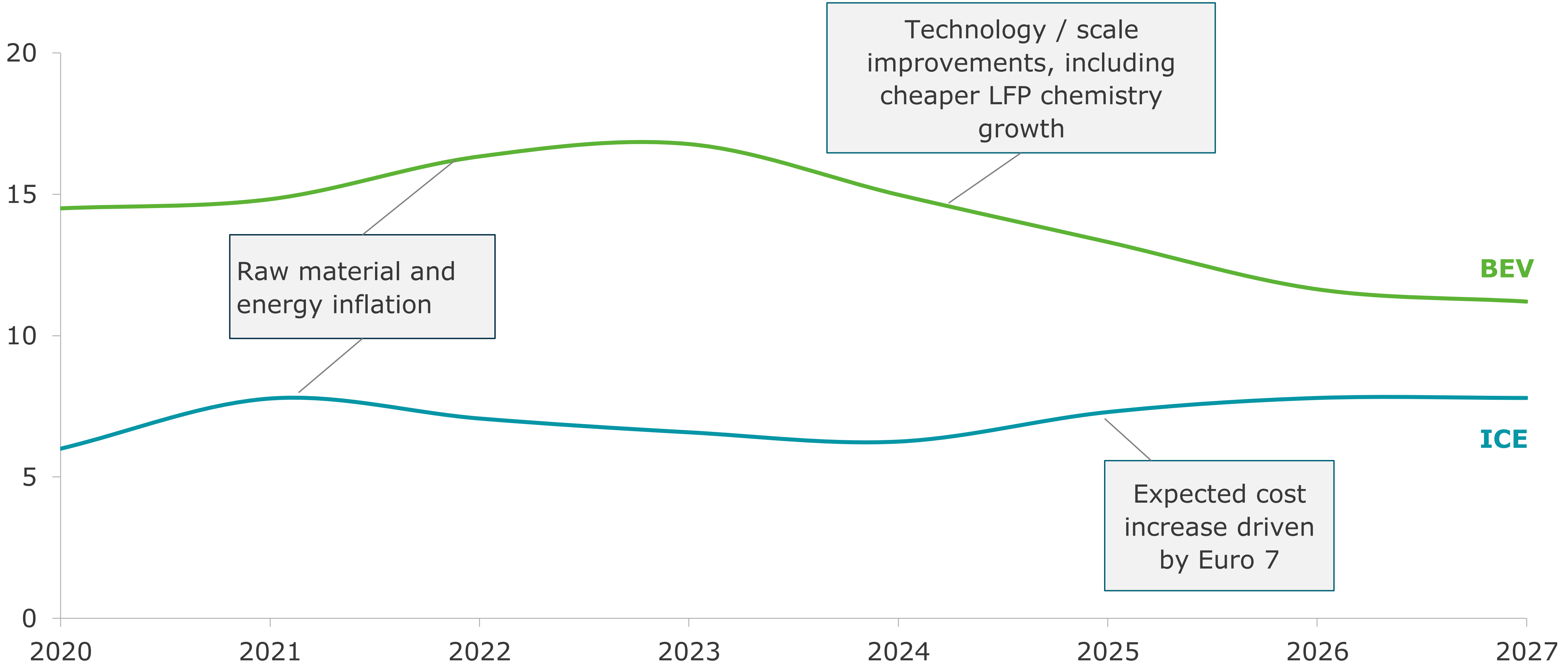
NMC 622 BEV: Costs Per Vehicle For Key Raw Materials Based On Spot Price ($ per unit)



Note: **60KWh NMC622** battery configuration was used to estimate battery specific raw material costs / **Note**: BEV batteries lithium processed in China / 1. Include 60% of full copper content as specific to EV
Source: AlixPartners European Light Vehicle Raw-Materials Index

BEVs continue to have a variable-cost penalty vs ICE with parity not expected in the next years. Focus on cost competitiveness is key

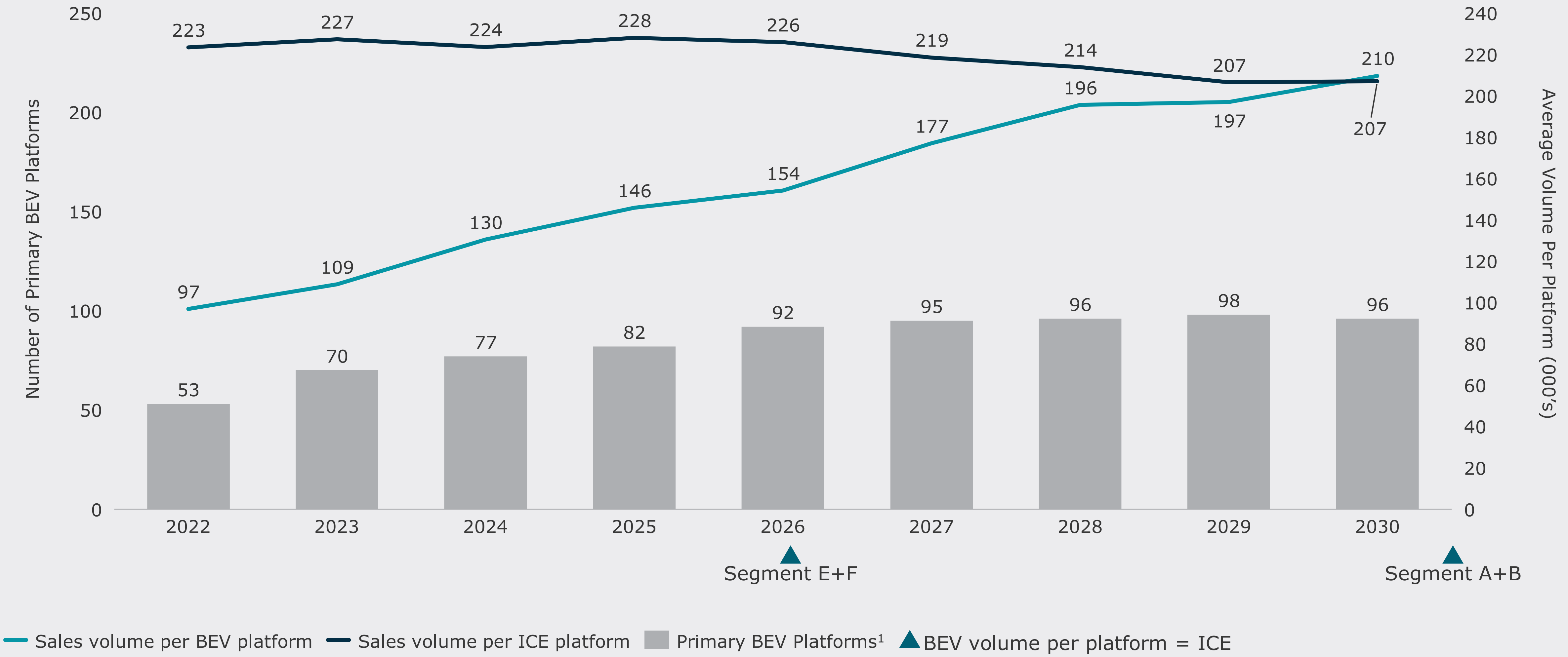
BEV vs ICE Cost Parity Outlook



1.ICE (BEV): Engine 90 hp (135 hp – PMM), Weight 1137 kg (1502 kg), Sales price: $19.8k ($35.2k), BEV battery 52 kWh (400 km range)
2.ICE (BEV): Engine 248 hp (313 hp – AC Induction), Weight 1825 kg (2445 kg), Sales price: $52.6k ($79.5k), BEV battery 95 kWh (500 km range)
Source: Ford capital market April 2021 transcript, GM press release, Volkswagen press release, AlixPartners analysis

BEVs sales per platform will remain below traditional ICE programs through 2030, limiting E&RD and fixed costs absorption – Opportunity for BEV platform sharing?

Average Volume per platform comparison – ICE vs. BEV (‘000 veichles per platform)



1 BEV Platforms are those expected to generate >80% volume from BEV through 2030; excludes exotics and ultra-premium platforms
Source: AlixPartners Analysis, S&P Sales Forecast

Key takeaways

Market resumes growth near-term as supply-constraints are easing, longer-term demand is slowing
(compared to 2019: Europe: -16%, NA: -1%, China: +17%)

China becoming world's biggest car exporter in Q1/ 2023, surpassing Japan. Western OEMs need to learn from Chinese OEMs and use the next 3-5 years to prepare themselves in their home markets and become more competitive in China

OEMs outperformance of suppliers is decreasing, as pricing power is eroding; suppliers must address record debt of +$30bn compared to 2022 and tightening liquidity

EV growth at a steady pace with a global market share of 13.3% (+5% compared to 2022), not accelerating further; OEMs need to shift focus from market share to scale to reach profitability

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WHEN IT REALLY MATTERS.

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