AlixPartners
when it really matters

Betting Big in Electrification and Autonomous

AlixPartners Global Automotive Outlook 2018 – EMEA Release

June 2018

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Global long term growth slowing down

- Western Europe set to shrink - European market kept up by Eastern European demand
- First dip in OEM profitability due to increasing investment
- Suppliers profitability still on the up

Diesel slowdown continues: Forecast to be <25% of sales in Europe by 2020

- Concerns over CO2 target achievement
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- EV investment breaking through with $255bn invested between now and 2022
- China leading the way in EV rollout - but Europe catching up
- $100/kWh cells threatened by Cobalt and Nickel prices
- Private infrastructure investment driving up the Electric cost/km

Autonomous roll out may be slower than we think

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- Consumer expectations mis-aligned with current capabilities

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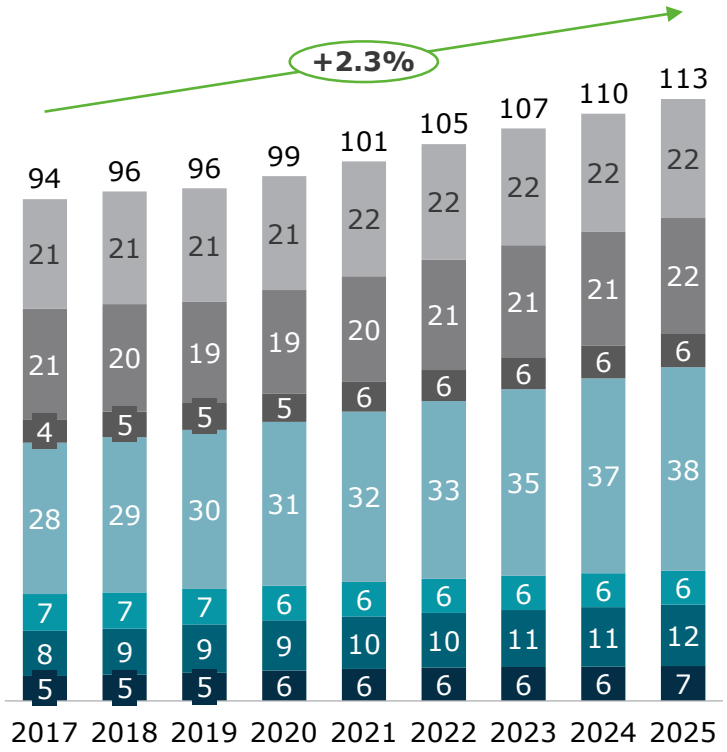
Autonomous roll out may be slower than we think

- High annual investment of +€55bn with many competing players
- Consumer expectations mis-aligned with current capabilities

Global industry sales outlook: 2.2% annual growth through 2025, mainly driven by China, South America, Eastern EU and South Asia

Global light-vehicles sales volume [# m]

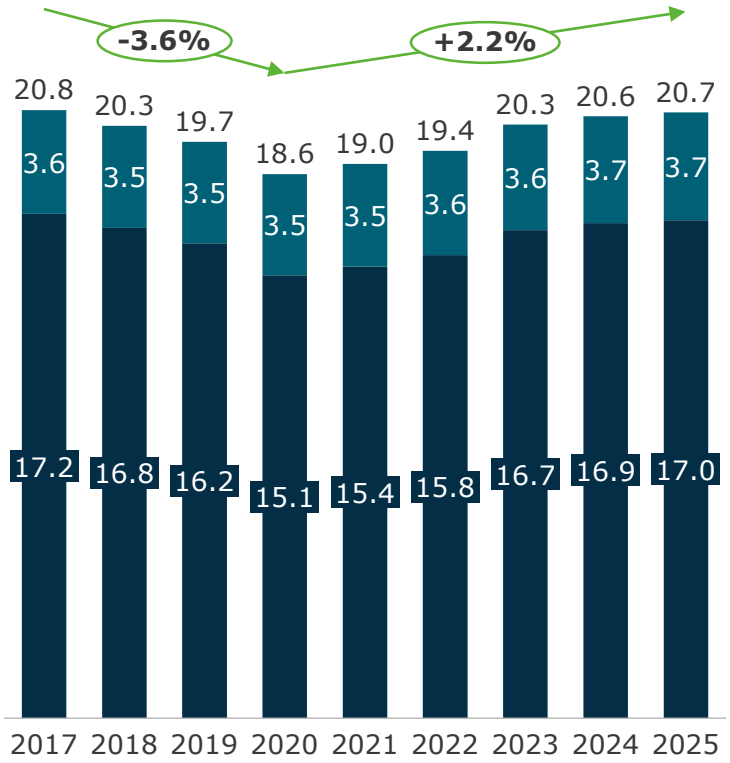


	CAGR '10-'17	CAGR '17-'25	Units (Delta m)	
Europe	1.6%	1.0% ▲	1.7	Eastern Europe to lead the growth. Germany to suffer
North America	5.8%	(-0.1)% ▼	0.9	Late-cycle nature of the current sales environment
South America	(-2.3%)	4.9% ▲	2.0	Brazil to proceed along its recovery path
Greater China	7.3%	3.8% ▲	9.8	China global engine of growth, despite slow down
Japan/Korea	1.0%	(-1.0%) ▼	(-0.5)	Market saturation
South Asia	4.1%	3.9% ▲	3.1	Expansion of middle class in India
MEA	(-0.8%)	4.3% ▲	1.9	Saudi Arabia to lead the growth in Middle East
Total	**3.8%**	**2.2%**	**18.8**	

Source: AlixPartners analysis @ 2018 (China, US, Japan, Germany, India, France, UK, Italy, Brazil, South Korea, Russia, Iran, South Arabia) – IHS March 2017 release (Rest of the World)
Notes: Greater China – China, Hong Kong, Taiwan; South Asia – Australia, India, Indonesia, Malaysia, New Zealand, Pakistan, Philippines, Singapore, Thailand, Vietnam; MEA: Algeria, Bahrain, Egypt, Iran, Israel, Kuwait, Morocco, Oman, Qatar, Rest of World, Saudi Arabia, South Africa, Tunisia, United Arab Emirates. North America – United States, Canada, Mexico

North American sales outlook: a trough of 18.6M in 2020 (with threats including rising interest rates)

US/Canada/Mexico light-vehicle sales [# m]

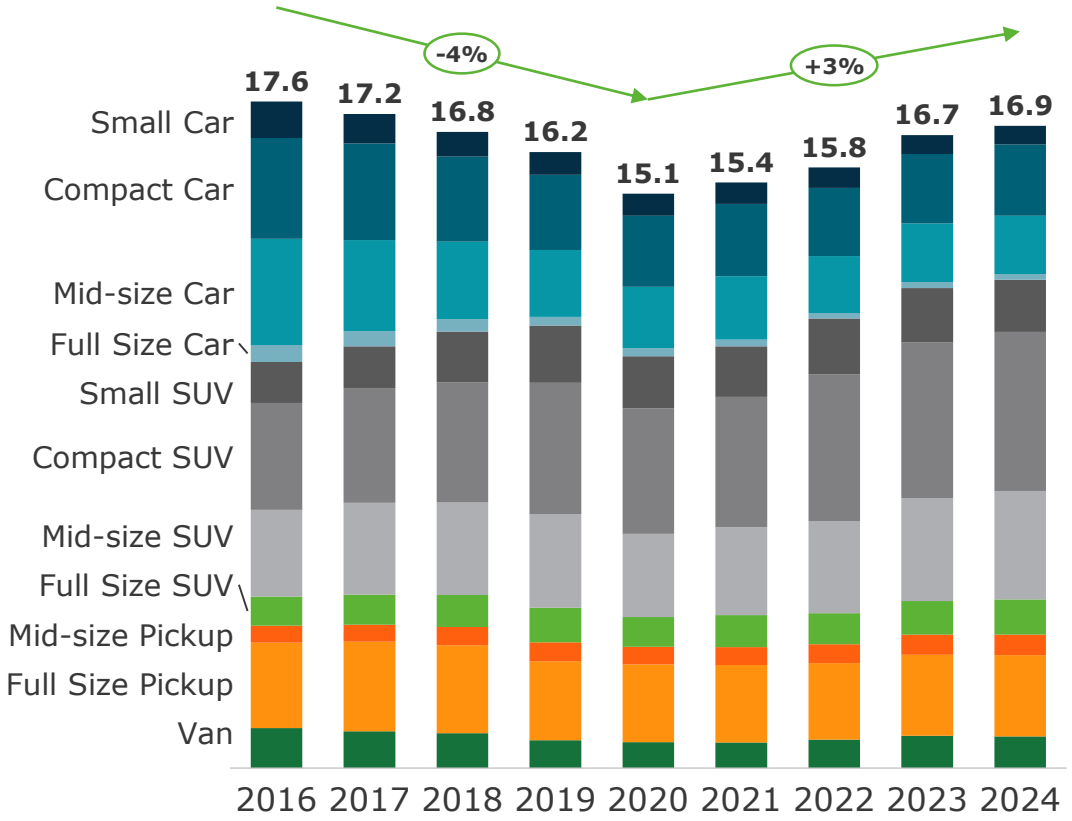


	CAGR '17-'25	Units (Delta m)	
Rest of North America	0.5% ▲	0.1	Demand of new cars will continue to ease, mainly as result of the aging of the Baby Boom population in the U.S. and Canada and urban millennials' purchasing fewer vehicles due to ready access to ride-sharing
United States	(-0.2%) ▼	(-0.2)	2016 cyclical peak as positive economic factors fail to add further demand through to 2019, and market moved from demand-pull to over-supply push. Used car price drops c.10% and modest interest rate increases take buyers away from new cars
Total	**(-0.1%)**	**(-0.1)**	

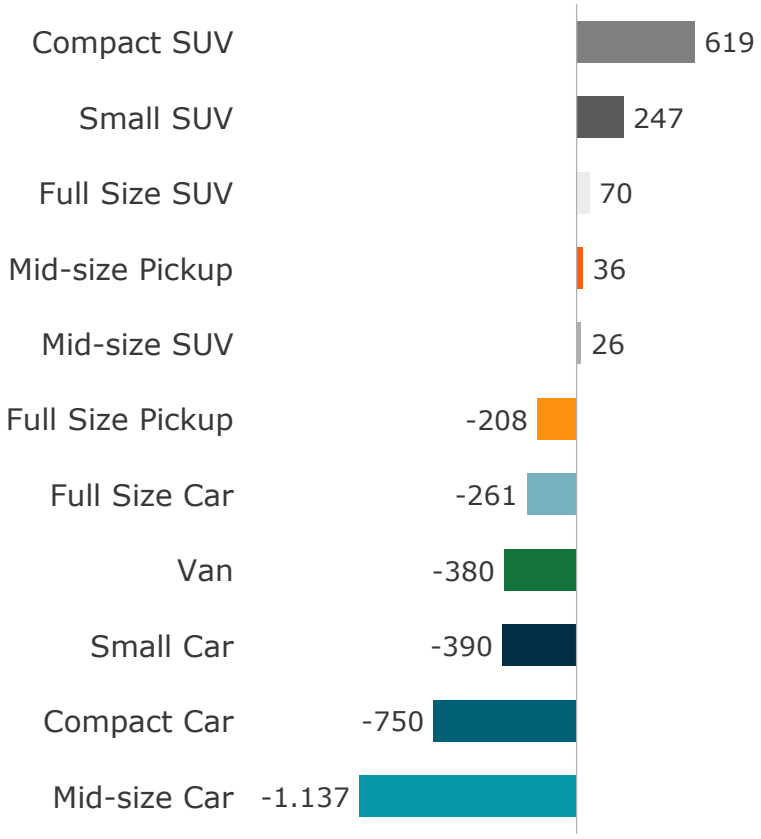
Source: AlixPartners analysis @ 2018 (US) – IHS March 2018 release (Canada, Mexico)
Notes: North America – United States, Canada, Mexico

AlixPartners' US sales forecast: a downturn (not plateau), to 16.8M in 2018 and a trough of 15.1 in 2020

AlixPartners US Light Vehicle Sales Forecast [#m]



Peak ('16) to Trough ('20) Difference [#000s]

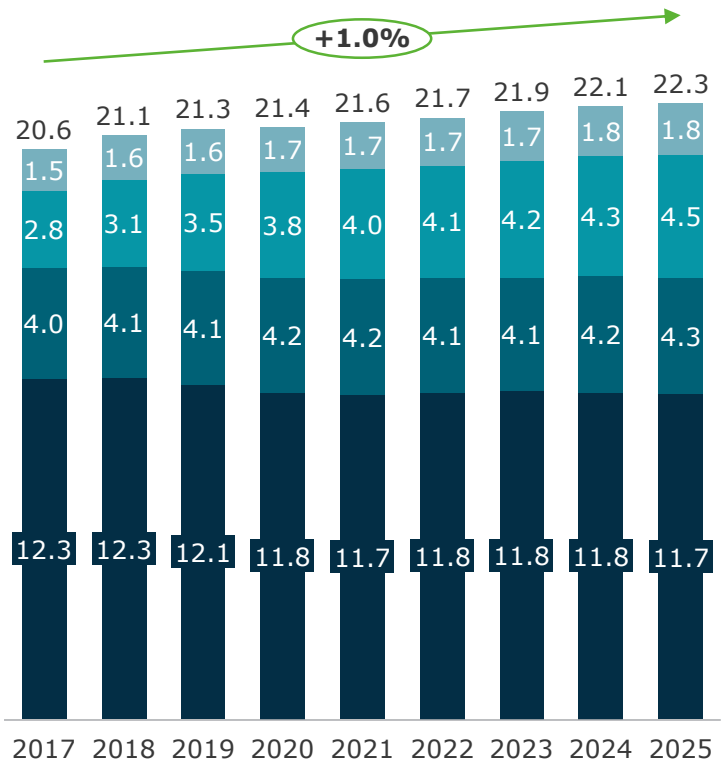


2016 was a peak year for total US light vehicle sales, but 0.3% below 2015 in retail sales, showing the switch to "push" market

Source: AlixPartners US Sales Forecast; Base-scenario with a controlled reversion to normal interest rate and inflation relationship with GDP growth below 2%, OEM pricing and production remaining disciplined in the face of declining demand from buyers moving to Used

European sales outlook: 1.0% annual growth through 2025, mainly driven by Eastern countries, offsetting Western declines

European light-vehicle sales [# m]

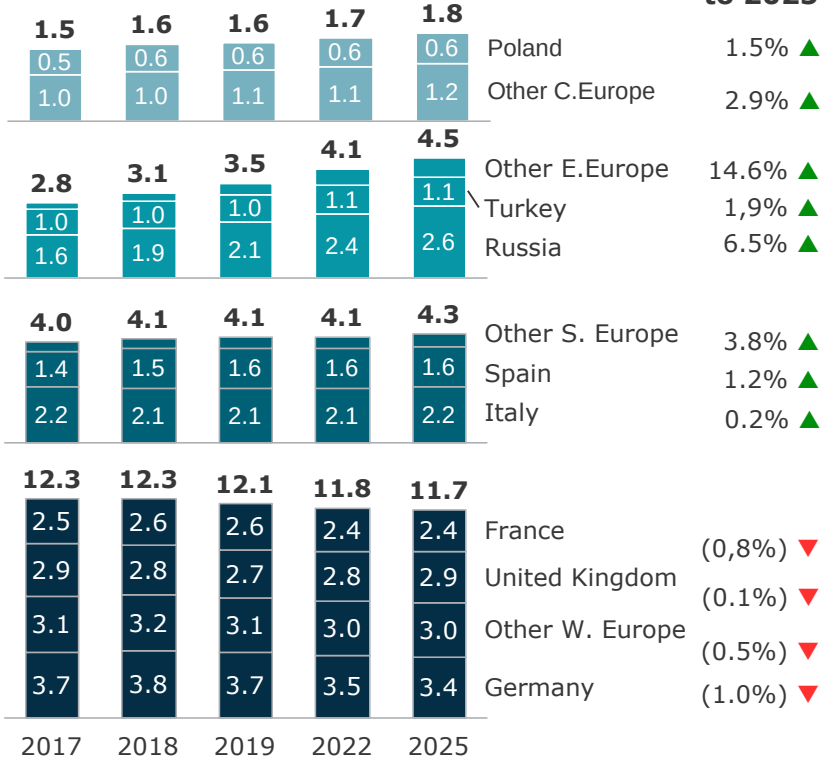


	CAGR '17-'25	Units (Delta m)	
Central	2.4% ▲	0.3	Poland to lead the growth with improving macroeconomics fundamentals
East	6.0% ▲	1.6	Eastern Europe growth mainly driven by Russia and Turkey. Increase of disposable income and industry investments
South	0.9% ▲	0.3	Limited growth of Italy and Spain, along with macroeconomic trend
West	(0.6%) ▼	(0.6)	German market expected to suffer due to market saturation and effect of emissions regulation on car prices
Total	**1.0%**	**1.6**	

Source: AlixPartners analysis @ 2018 (China, US, Japan, Germany, India, France, UK, Italy, Brazil, South Korea, Russia, Iran, South Arabia) – IHS March 2017 release (Rest of the World)
Notes: West Europe – Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxemburg, Malta, Netherlands, Norway, Sweden, Switzerland, United Kingdom; Central Europe – Bosnia, Bulgaria, Croatia, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Serbia, Slovakia, Slovenia; South Europe – Greece, Italy, Portugal, Spain; East Europe – Belarus, Kazakhstan, Russia, Turkey, Ukraine, Uzbekistan

Western Europe sales outlook: 0.6% annual shrinkage to 2025 (diesel downturn and Brexit uncertainty); East fuelling growth

European light-vehicle sales [# m]

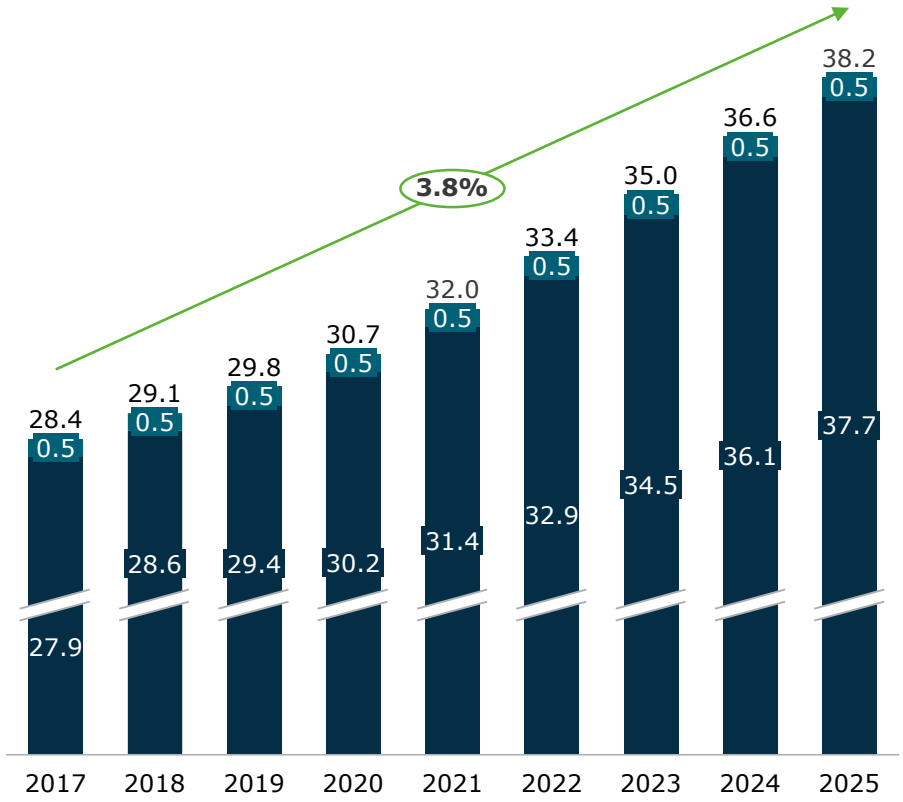


	CAGR '17-'25	Units (Delta m)	
Central	2.4% ▲	0.3	Poland GDP and unemployment are expected to improve in 2019 (respectively, up to 3,7% and down to 3,9%)
East	6.0% ▲	1.6	Russia growth is mainly driven by a macro-economic recovery and investment made by western OEM
South	0.9% ▲	0.3	GDP in Spain is expected to grow 2% to 2021. Fleets are outgrowing the market in Italy and Spain
West	(0.6%) ▼	(0.6)	Western Europe market is going to slow down as it reaches saturation. German and France will be the most impacted UK market is expected to suffer less, even if it will remain stagnant in the next years due to Brexit (uncertainty, decreasing purchasing power of households for economic downturn and currency FX)
Total	**1.0%**	**1.6**	

Source: AlixPartners analysis @ 2018 (Germany, France, UK, Italy, Russia) – HIS March 2018 release (Rest of Europe)
Notes: West Europe – Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxemburg, Malta, Netherlands, Norway, Sweden, Switzerland, United Kingdom; Central Europe – Bosnia, Bulgaria, Croatia, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Serbia, Slovakia, Slovenia; South Europe – Greece, Italy, Portugal, Spain; East Europe – Belarus, Kazakhstan, Russia, Turkey, Ukraine, Uzbekistan

Greater China sales outlook: growth to 38M units in 2025 —though slowing down due to market maturity

Greater China light-vehicle sales [# m]

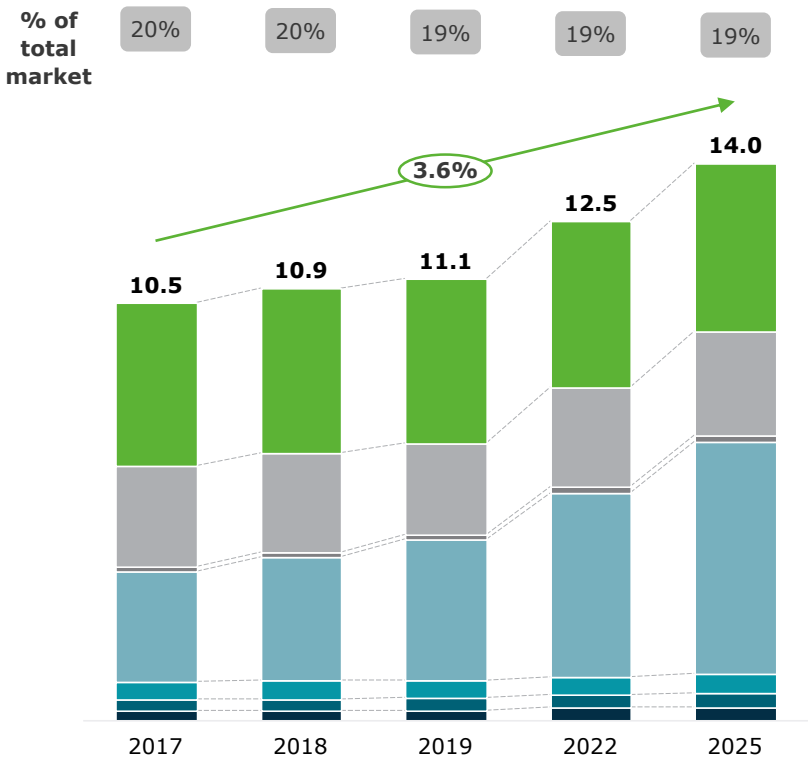


	CAGR '10-'17	CAGR '17-'25	Units (Delta m)	
Hong Kong, Macau, Taiwan	4.9% ▲	1.3% ▲	0.1	A stable macro economic development the three regions of China having a mature vehicle market
China (Mainland)	7.4% ▲	3.8% ▲	9.7	A stable macroeconomic environment. Vehicle market grows in parallel with the GDP after a period of contraction due to the purchasing tax. Extended stimulation of new energy vehicles market
Total	**7.3%**	**3.8%**	**9.8**	

Source: AlixPartners analysis @ 2018 (China) – IHS March 2018 release (Rest of Greater China)
Notes: Greater China – China, Hong Kong, Taiwan

Premium-vehicles outlook: China to become largest market by 2022, with 9.7% annual growth, while overall growth slows

Premium-vehicle sales [# m]

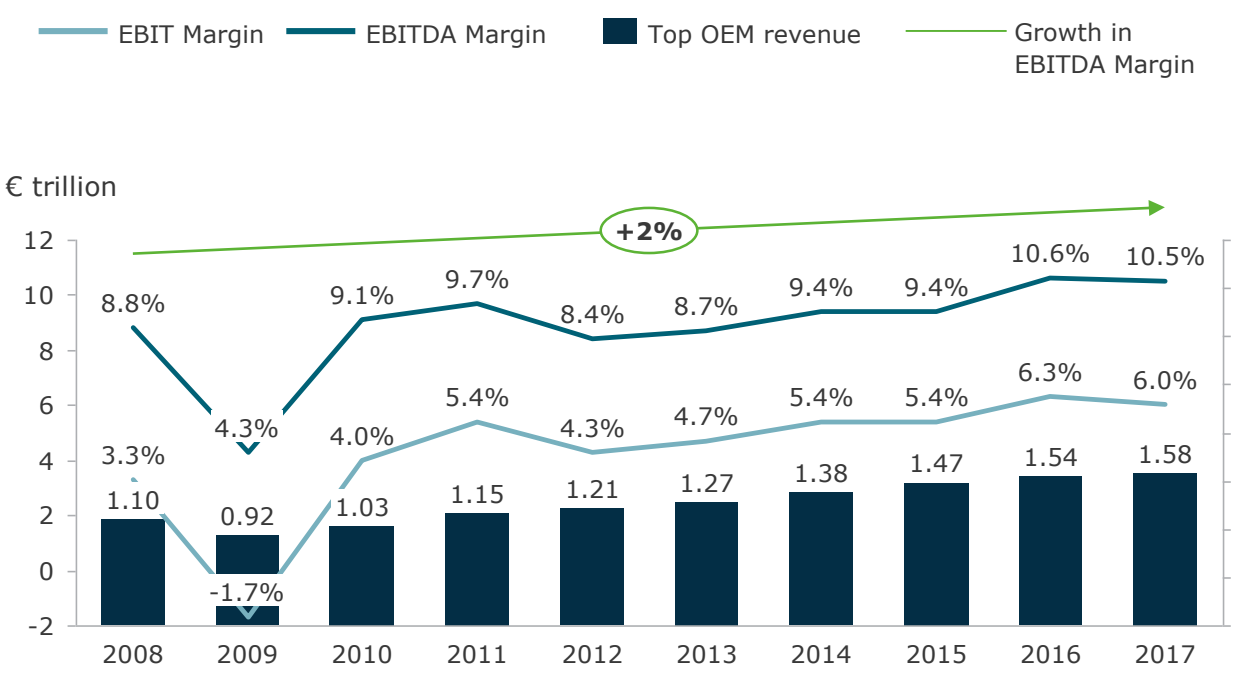


	CAGR '10 –'17	CAGR '17 –'25	Units (Delta m)	
Europe	5.7% ▲	0.2% ▲	0.1	Stagnant market German OEMs to keep leadership, but losing market share in favour of JLR, Volvo, Tesla and FCA
North America	6.4% ▲	0.5% ▲	0.1	Limited growth, mainly driven by Tesla (expected to reach 50% of Daimler volumes in 2025)
S.America	7.1% ▲	4.9% ▲	0.0	Limited premium market
Greater China	20.8% ▲	9.7% ▲	3.1	Premium to outgrow the market (x2). Volvo (Geely) expected to triple premium volumes share vs German leaders
Japan/Korea	12.9% ▲	0.6% ▲	0.0	Volkswagen to grow among German OEMs, Hyundai to grow the fastest (+250%)
South Asia	10.1% ▲	2.3% ▲	0.1	Limited premium market
MEA	(0.0%)	5.1% ▲	0.1	Limited premium market
Total	**8.8%**	**3.6%**	**3.5**	

Source: AlixPartners analysis @ 2018 – IHS March 2017 Release
Notes: Greater China: China, Hong Kong, Taiwan; South Asia: Australia, India, Indonesia, Malaysia, New Zealand, Pakistan, Philippines, Singapore, Thailand, Vietnam; MEA: Algeria, Bahrain, Egypt, Iran, Israel, Kuwait, Morocco, Oman, Qatar, Rest of World, Saudi Arabia, South Africa, Tunisia, United Arab Emirates. North America: United States, Canada, Mexico
Top Cars: Premium brands (e.g. Ferrari), Other luxury cars (e.g. Volkswagen Tuareg)

Automaker revenues at record high but first dip in profitability in five years; overall levels still above historical trending profit

Top 25 OEM Passenger Car Revenue, [€Trillion], EBITDA [%] and EBIT [%] – 2008 - 2017



Volumes (M units)

71	64	78	80	80	84	87	89	92	94

- Ongoing **rise of OEM passenger car revenues** due to recovering economies (+3% YoY)
- **Europe leading growth with +4% YoY**
- In the US revenue flat with 2% YoY
- Asia-Pacific revenue up 1% YoY
- Profitability dragged down by **difficulties in Asia/ Pacific region** related to cost base inflation and exchange rate pressures
  - Europe successfully focuses on cost efficiency driving 14% YoY increase in EBITDA
  - Asian players fail to offset exchange rate changes and rising expenses. South Korean players strongly impacted by trade sanctions from China. Regional profitability fell 11%
  - US profitability lags Europe but is improving, up 3% YoY

OEMs: VW, Toyota, GM, Ford, Renault-Nissan, Hyundai-Kia, FCA, Honda, Daimler, BMW, PSA, JLR, Suzuki, Geely, Changan, Subaru, Tesla, Dongfeng, Mazda, Great Wall Motor Company, SAIC
Source: CapitalIQ, Public data, AlixPartners analysis

Despite dip in profitability, R&D and CAPEX has grown to +€200bn amongst top-13 automakers, up 55% since 2012

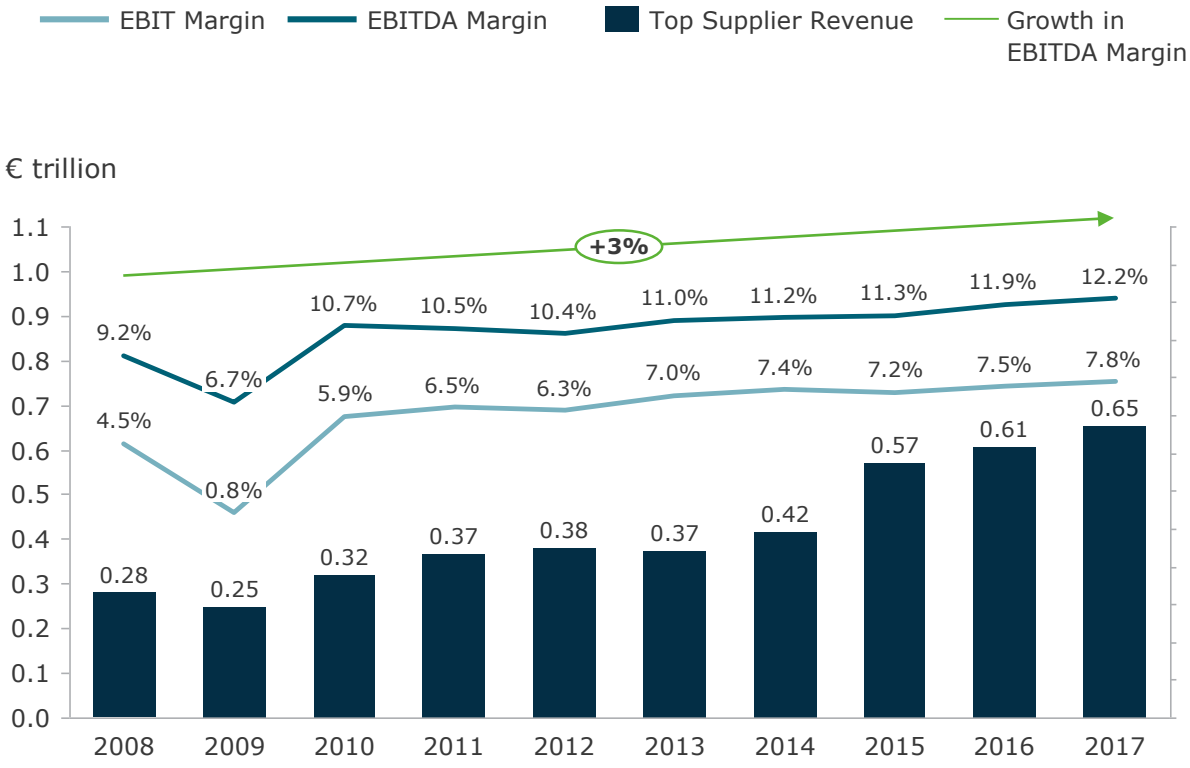
Investments in CAPEX and R&D per OEM, FY17[1]

	Revenue	Growth 2016/17	Units	EBITDA Margin	Change 2016/17	EBIT Margin	Change 2016/2017	CAPEX	R&D	Invest (CAPEX + R&D)	Invest (CAPEX + R&D)/Car
	b EUR	%	m Units	%	Bps	%	bps	b EUR	b EUR	b EUR	EUR/car
VW	158	5%	10,1	13%	*+3.1*	5.9%	*+3.1*	12.6	13.1	25.7	2.552
Toyota	211	-3%	9,0	10%	*-2.5*	6.7%	*-2.6*	28.4	8.7	37.1	2.272
GM	119	-5%	9,6	17%	*+2.5*	8.0%	*+0.44*	24.4	6.5	30.9	1.451
Ford	129	3%	6,6	9%	*-1.7*	5.6%	*-1.9*	6.2	7.1	13.3	2.016
Ren-Nissan	148	-2.2%	9,4	9%	*+0.4*	5.2%	*+0.5*	17.5	6.7	24.2	1.551
Hyundai-Kia	129	1%	7,3	4.5%	*-1.6*	2.0%	*-1.7*	4.3	1.4	5.7	784
FCA	101	-1%	4,7	12%	*+1.3*	7.0%	*+1.0*	8.7	4.3	13.0	2.755
Honda	86	-5%	3,7	11%	*+3.8*	4.9%	*+3.5*	5.1	5.8	10.9	2.972
Daimler	95	6%	2,8	14%	*+0.5*	9.7%	*+0.6*	5.5	7.2	12.7	4.577
BMW	89	2%	2,5	14%	*-0.4*	8.9%	*-0.0*	7.0	6.1	13.1	5.309
PSA	48	29%	3,6	10%	*-1.4*	5.8%	*-0.2*	2.7	2.9	5.6	1.569
JLR	29	9%	0,6	10%	*-0.1*	6.8%	*-0.5*	3.7	0.4	4.1	6.793
Suzuki	24	1%	2,9	14%	*+1.8*	8.8%	*+2.1*	1.7	1.1	2.8	954
Total	**1,367**	**1%**	**74**	**11%**		**7%**		**128**	**72**	**199**	**2735**

[1]Reported financials for passenger car segments, GM Toyota and Nissan total capex includes the purchase of leased vehicles, Purchases of leased vehicles excluded in spend per vehicle
Currency conversion: Yen/ EUR 0.008426, GBP/ EUR 1.1980, USD/EUR 0.8871, KRW/EUR: 0.00008
Source: Public data, AlixPartners Analysis

Suppliers growing faster than automakers: 3% 2008-2017 CAGR vs. 2% for automakers globally

Top 50 Tier 1 & 2 Suppliers Revenue, [€Trillion], EBITDA [%] and EBIT [%] – 2008 - 2017

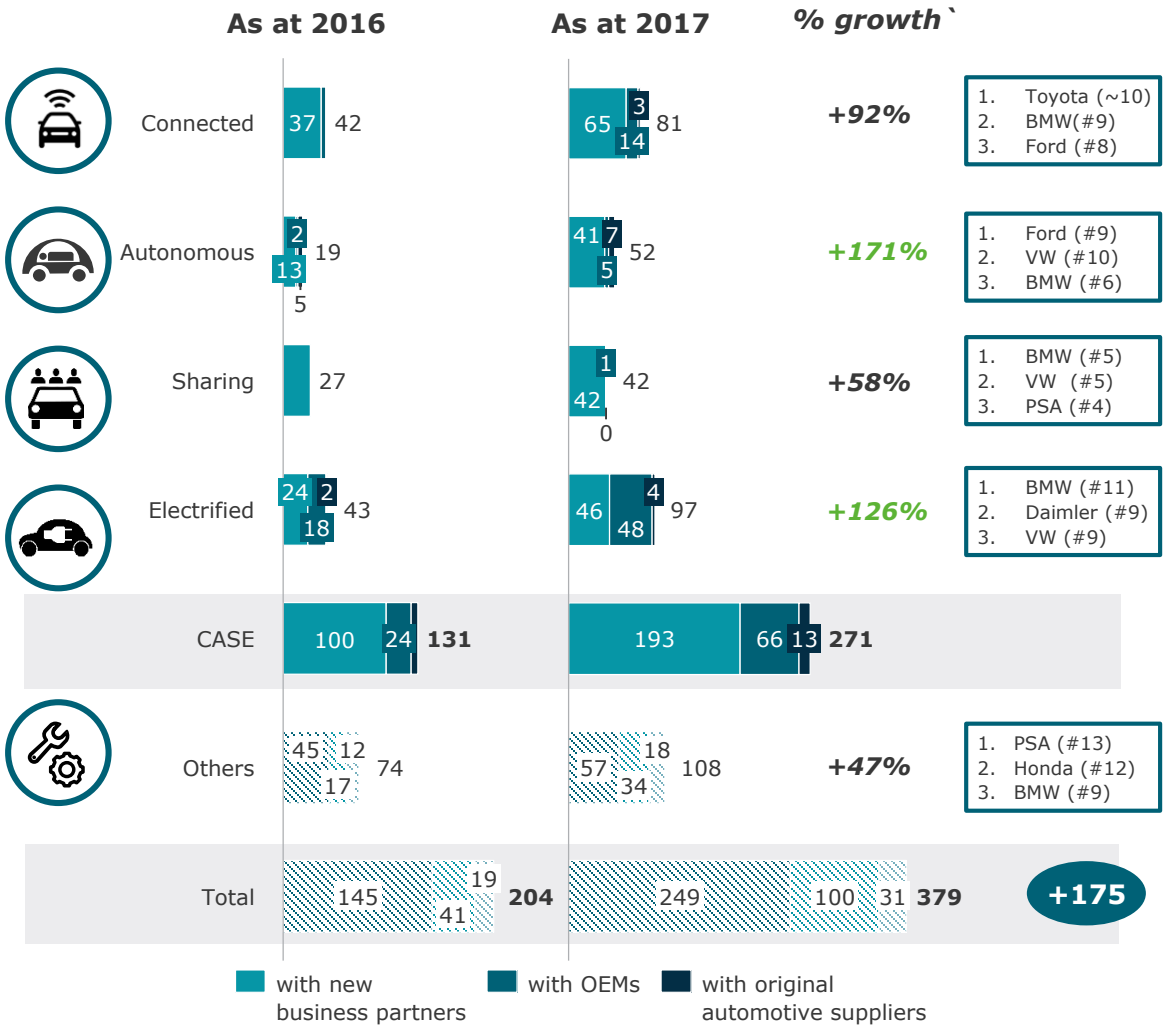


- **Top 50 supplier revenues up by 10% CAGR to €0.65t in 2017**
- Compared to historical low of 2009, up by 13%
- **2017 Revenues up 8%** (€0.4t) compared to 2016
- Overall EBIT% rises 0.3% from 7.5% in 2016 to 7.8% in 2017
- EBITDA up 0.3% from 11.9% in 2017 to 12.2% in 2016
- 2008 to 2017 top 50 supplier growth faster than OEM growth (2008 to 2017 CAGR)
  - Revenue: Suppliers = 10% vs. OEMs = 4%
  - EBITDA: Suppliers = 13% vs. OEMs = 2%
  - EBIT: Suppliers = 17% vs. OEMs = 7%

Top 50 Tier 1 or Tier 2 Suppliers sub-set included: Robert Bosch, Aisin, JCI, Denso, Bridgestone, Magna, Continental, Alfa S.A.B, Goodyear, Delphi, Faurecia, TRW, ZF, Toyota, Lear, Valeo, Eaton, Visteon, Calsonic, JTEKT, Benteler, Dana, Freudenberg, GKN, Mahle, Federal Mogul, Autoliv, Calsonic, Tenneco, Rheinmetall, Hella etc.
Source: Capital IQ, Historical exchange rates

Industry partnerships: partnerships in Electrification and Autonomous more than doubled in 2017

Numbers of OEM partnerships entered 2016 + 2017 by category [#]



Comments

- **271 active partnerships in CASE in 2017** vs 131 in 2016
- **Connected:** 81 partnerships in 2017; 30% of CASE partnerships formed
- **Autonomous:** 52 partnerships active in 2017 (19% share of CASE), mainly driven by new partnerships in the US and Germany
- **Sharing:** low growth on previous year to 42 partnerships; 11% of total share
- **Electrification:** strong growth on 2016; largest share of all CASE related partnerships (36% in 2017)
- 8% of partnerships were formed with traditional auto suppliers, 26% with other OEMS, whilst **66% of partnerships were formed with new business partners from industries outside of auto** (Telecommunication /Telematics, IT/Software, Mobility service provider, Utilities & EV charging system manufacturer)

Source: Alixpartners' analysis of press releases, annual reports and company presentations

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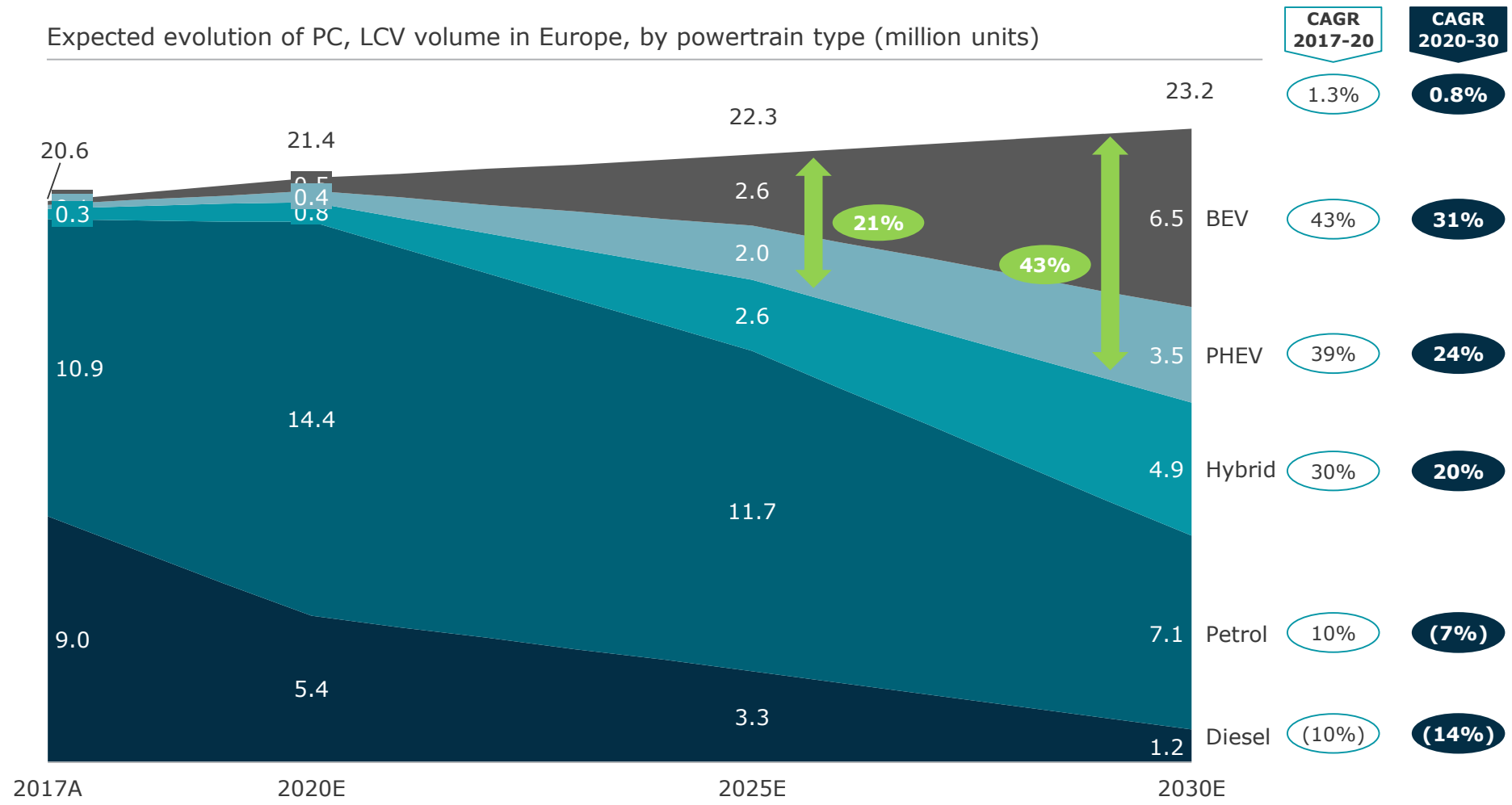
AlixPartners forecast: By 2025 BEVs and PHEVs will be at least 20% of EU sales, with diesel declining faster than anticipated

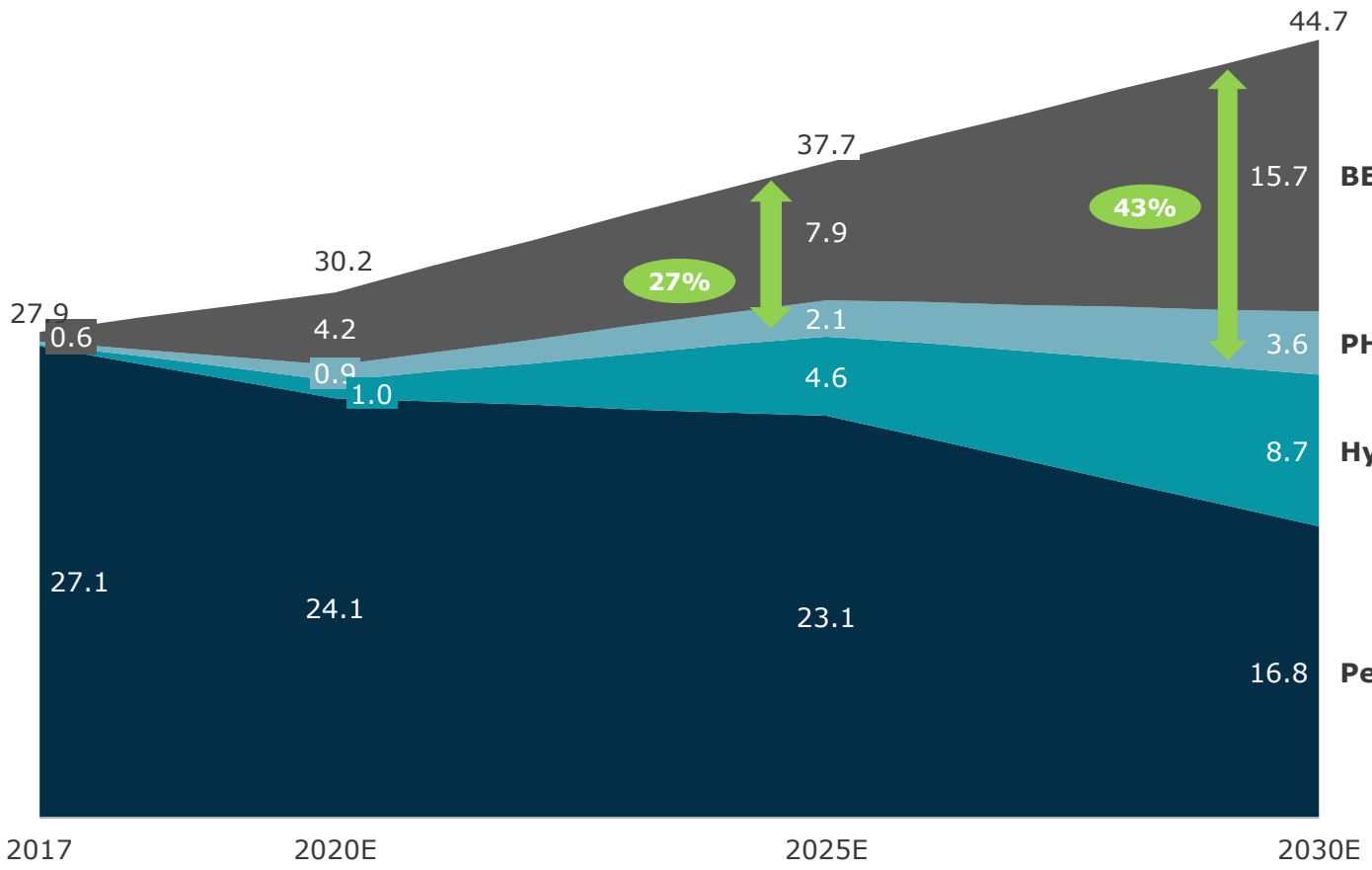
Expected evolution of PC, LCV volume in Europe, by powertrain type (million units)



Source: AlixPartners Powertrain market forecast

By 2025, BEVS and PHEVs to be 27% in China; China driving e-mobility now but leadership role under threat from RoW

Expected Evolution of PC, LCV volume in Mainland China, by powertrain type (million units)



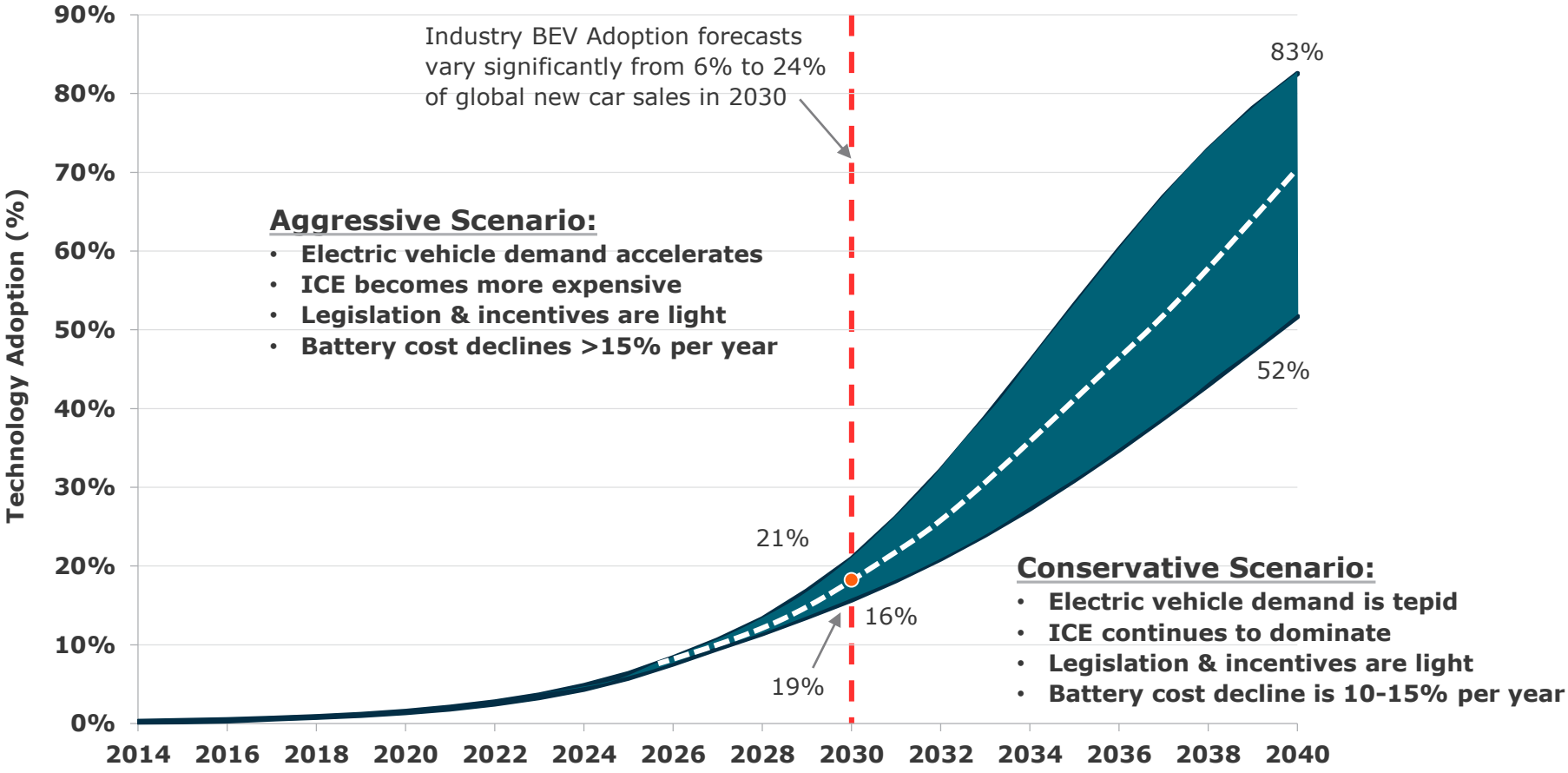
	CAGR 2017-20	CAGR 2020-30
BEV	95%	14%
PHEV	93%	15%
Hybrid	81%	24%
Petrol	-4%	-4%
	3.2%	1.9%

Note: By 2025, ICE will be largely dominated by fuel-saving technology with less than 4.5 l/100km consumption

Sources: EV-volumes.com, AlixPartners research

AlixPartners US EV adoption forecast ranges between 16-21% new car sales by 2030

US Electric Vehicle Adoption Forecast (BEV) under two Scenarios

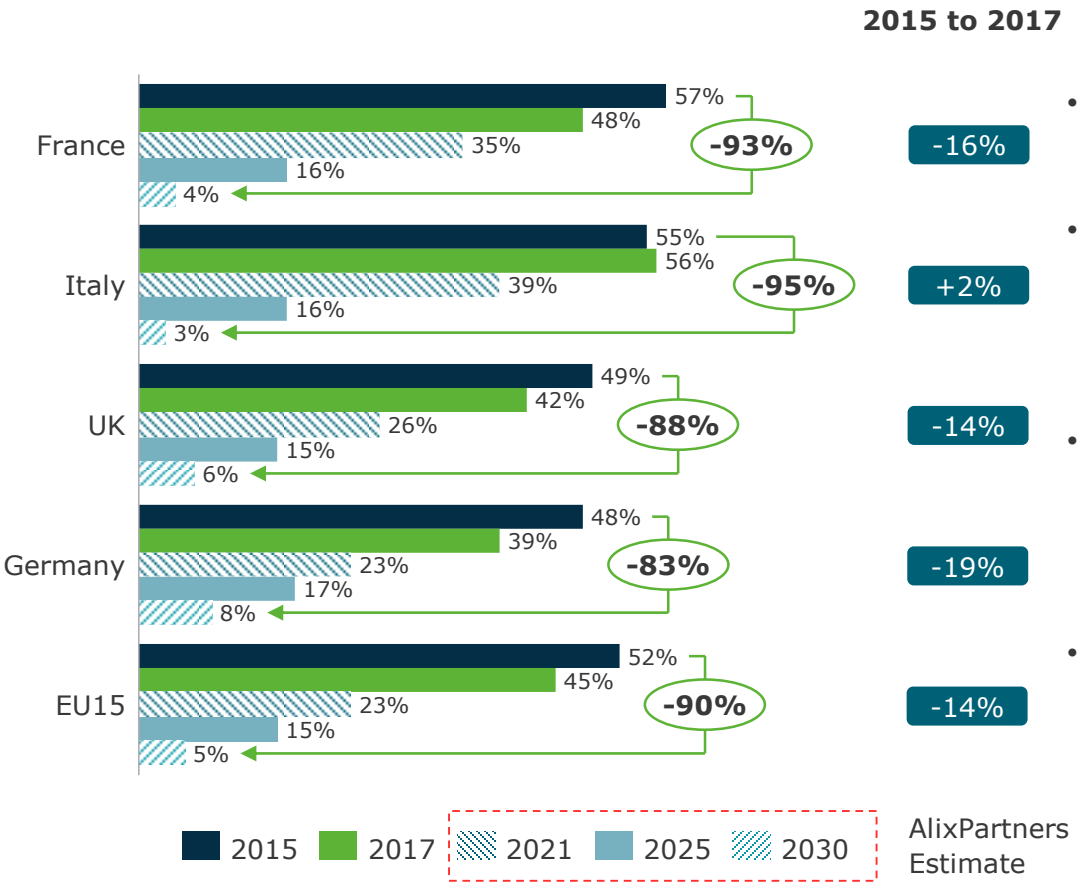


1. Based on top down evaluation of adoption of similar automotive technologies and adjusted based on potential effect of various drivers
2. Conservative scenario benchmarks adoption characteristics of power brakes and power locks
3. Aggressive scenario benchmarks adoption characteristics of driver airbag, electronic stability control, ABS, and side-airbag

Source: Industry research, AlixPartners analysis

Diesel dropped to 45% of EU new vehicle sales in 2017 – set to become a niche powertrain by 2030 at c. 5%

European diesel market share 2015 to 2030 (estimated for passenger cars), [%]

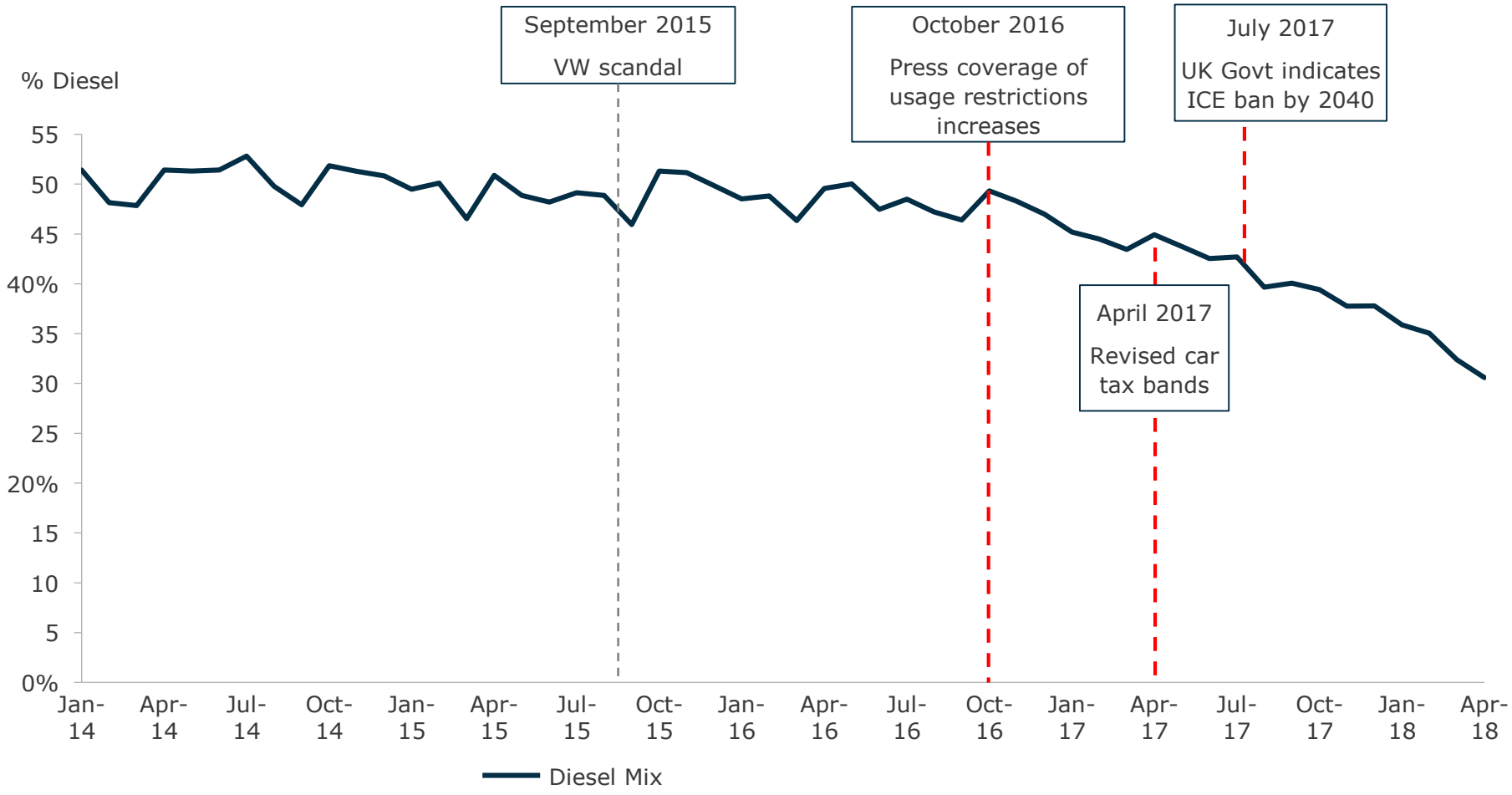


- Europe's diesel share has already fallen from 52% to 45% between 2015 and 2017
- Meeting the NOx RDE targets as the conformity factor accelerates between 2017 and 2023 and will further increase diesel powertrain costs of diesel
- Combined with longer term country level bans, OEMs are starting to respond by planning the removal of diesel variants and investment in diesel technology
- By 2030 expect that diesel will only be used in high mileage, large premium vehicles that can absorb additional costs of aftertreatment technologies

Source: Alixpartners research, JATO, IHS

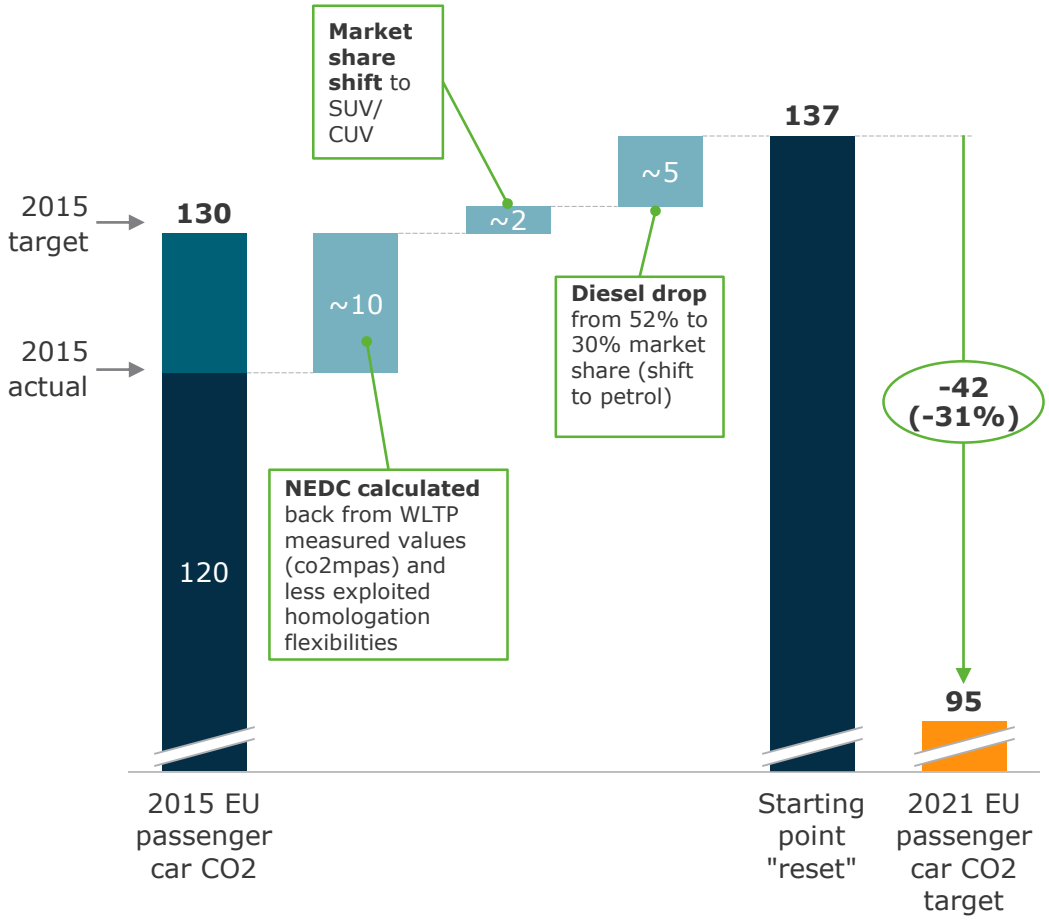
Consumers highly sensitive to disincentives: diesel sales held up under negative press, but plunged when restrictions introduced

UK Diesel mix – January 2014 to April 2018 – UK example



The shift away from Diesel will make achieving the EU passenger car CO2 targets an even greater challenge

The 2021 CO2 challenge (CO2 emissions g/km)

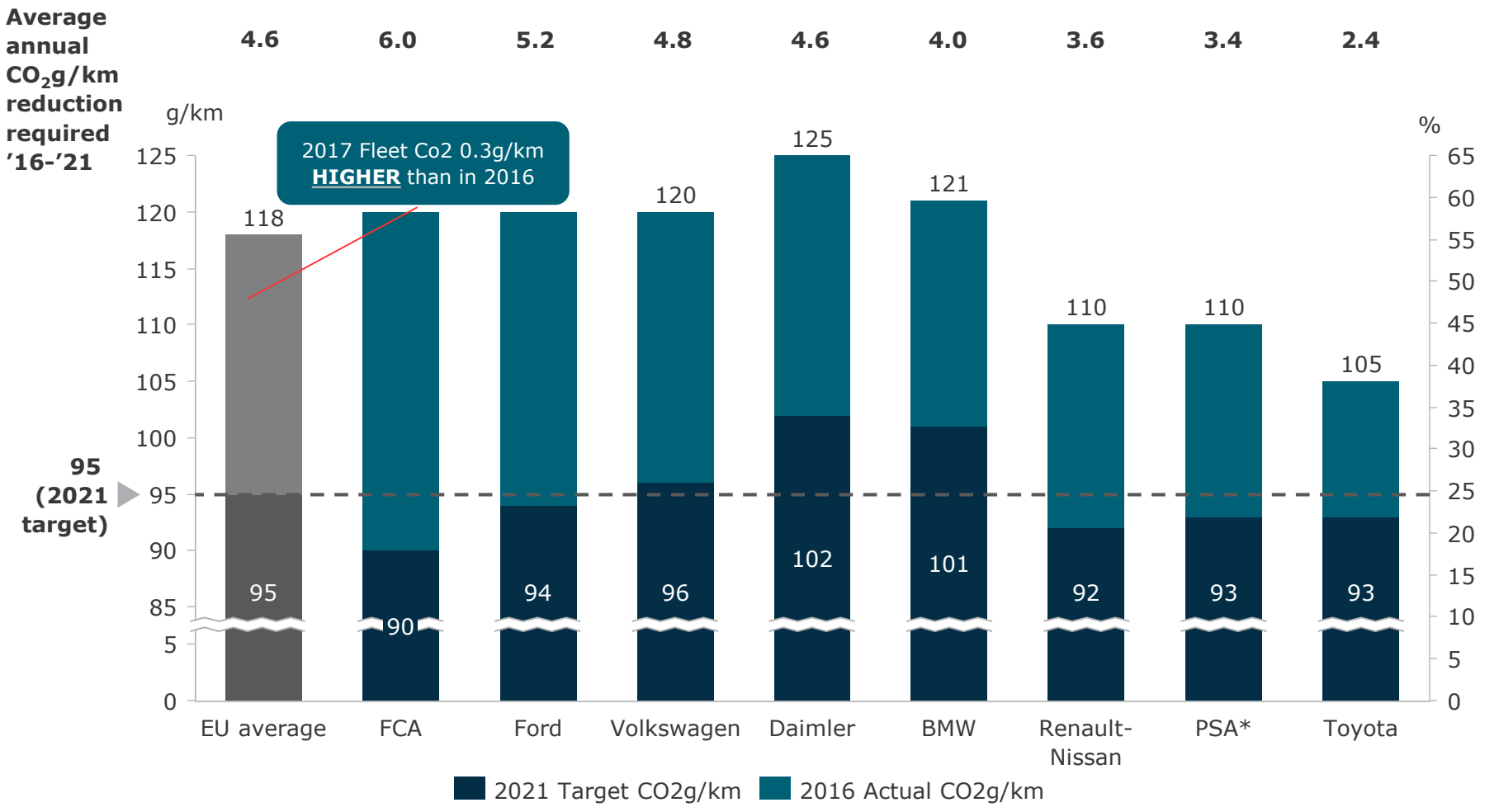


- The EU fleet has been **improving its emissions performance by 1-2g/km year on year**
- Despite delivering on the 2015 interim target; adverse factors have **set the fleet back by c.17g of CO2**
  - **NEDC to WLTP**; c. 10g on fleet averages based on real world testing
  - **Larger Bodystyles**; c. 2g from continued shift to larger vehicle style sales (SUV/CUV)
  - And now a further c. 5g based on a more **rapid reduction in the lower CO2 emissions Diesel sales**
- Historic improvement trend of **1-2g/km per year is no longer enough**.
- **Greater electrification/hybridisation is the only answer for automakers**

Source: AlixPartners research, IHS

The EU fleet needs to deliver a 4.6% reduction per year through to 2021, however in 2017 overall EU CO_2 increased 0.3g/km

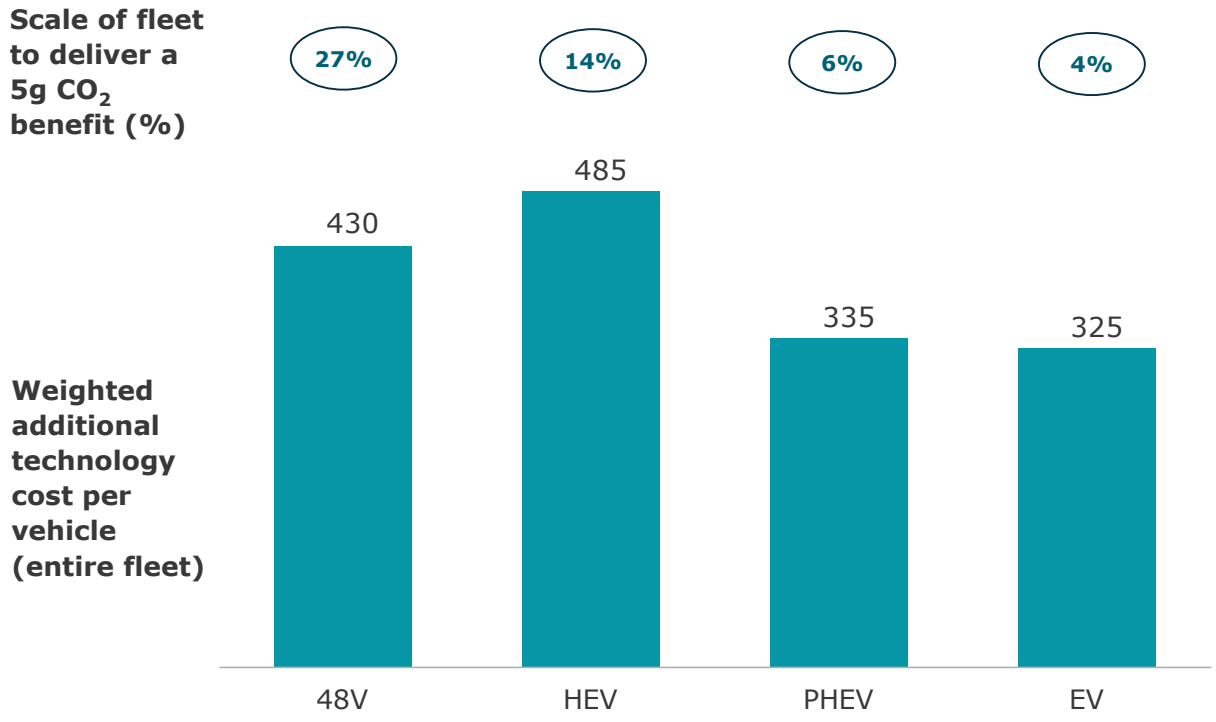
EU and OEM 2021 g/km CO_2 targets – status at 2016



Source: AlixPartners research, CO2 data based on ICCT
* PSA includes Opel/Vauxhall

Automakers face a range of options to meet the 5g impact of Diesel's reduction; potential average cost per vehicle now €485

Example average cost per vehicle technology options to meet 5g CO2 impact (€ per vehicle);



Per vehicle impact	48V	HEV	PHEV	BEV
CO2 reduction	15%	30%	65%	100%
Additional vehicle cost (€k)	€1,600	€3,500	€5,000	€7,800

- Based on an average 2017 fleet sales of 15.1m[1] vehicles with:
  - 45% Diesel
  - 50% Petrol
  - 3% hybrid
  - 1% BEV
  - 1% Other
- **48V/HEV strategy**; easy to transition existing platforms in the short term, but is ~€100m per OEM more expensive than BEV or PHEV. In the long term, full fleet adoption of 48V cannot meet 2030 CO2 targets alone
- **BEV/PHEV strategy**; will incur lower OEM costs and require smallest volume of vehicles (4 - 6% of the fleet total)

Source: ACEA EU(27) 2017 data, AlixPartners analysis

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Electrification growing at pace however growth may be slowed by changing business models and commodity markets

- EV investment breaking through with $255bn invested between now and 2022
- China leading the way in EV rollout - but Europe catching up
- $100/kWh cells threatened by Cobalt and Nickel prices
- Private infrastructure investment driving up the Electric cost/km

Autonomous roll out may be slower than we think

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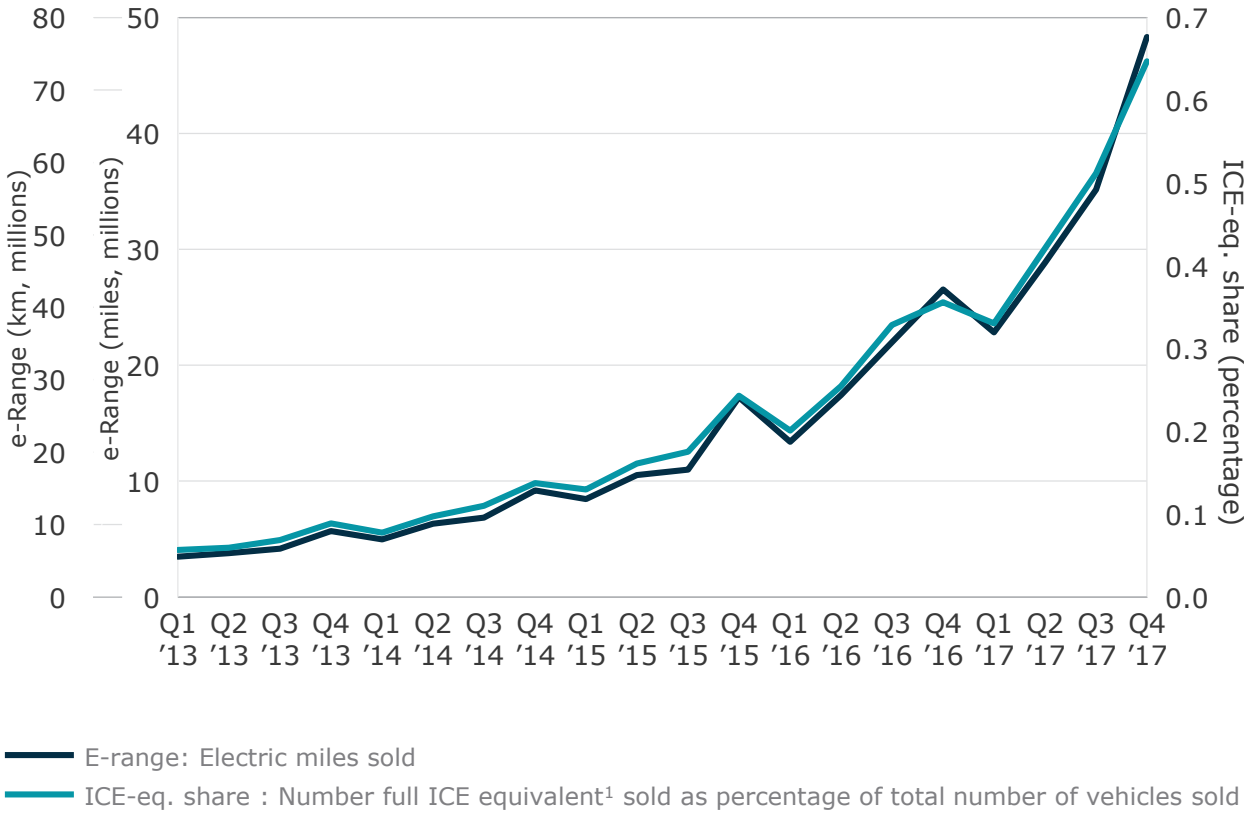
- Consumer expectations mis-aligned with current capabilities

Electrification: "e-range" & "e-share" in AlixPartners Index doubled Q417 vs. Q416



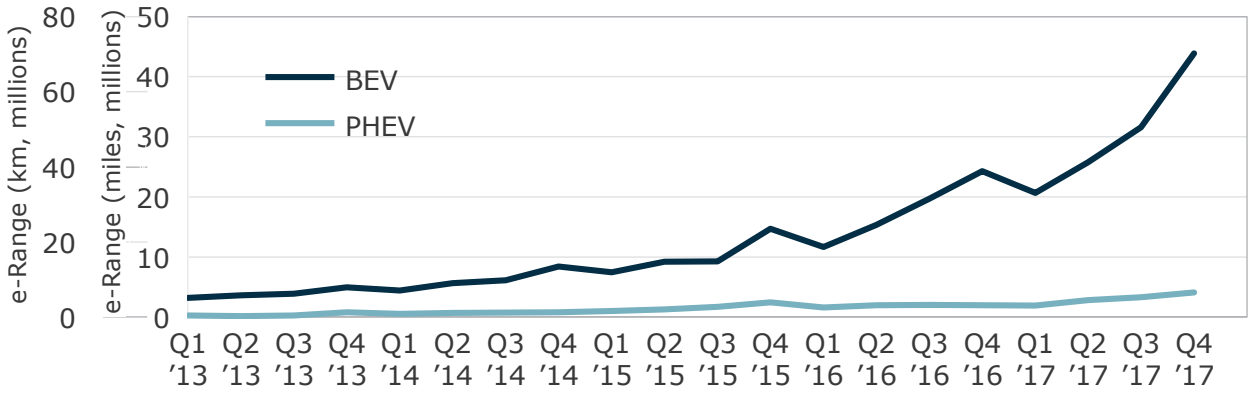
	Q4 2016	Q4 2017
Number of BEV, PHEV, FCEV sold:	251,235	446,586
E-Share: / E-share:	0.36%	0.65%
Market share:	1.05%	1.86%
Average e-Range:	106 miles (170 km)	108 miles (174 km)

[1] Electric range/311miles (500km) defining the equivalent full ICE vehicle share
Sources: IHS Markit, EV-volumes.com, AlixPartners research

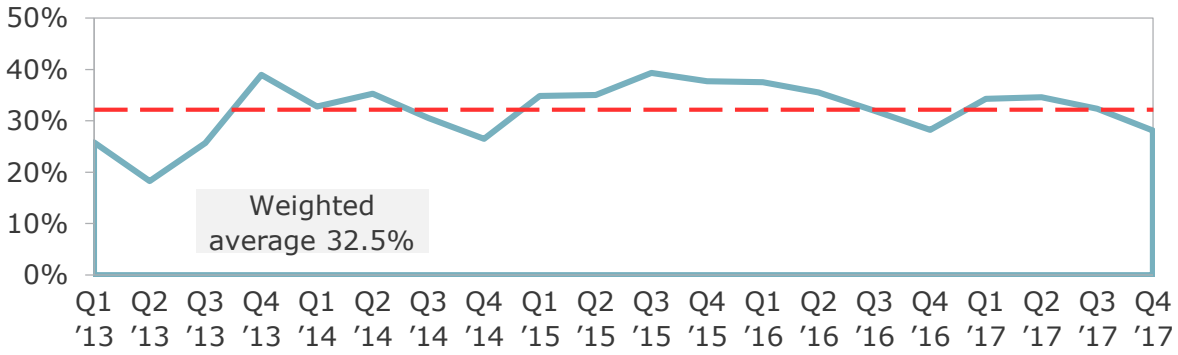
e-Range by propulsion; PHEVs continue to average c.32% share of all EVs sold (2013-2017); no clear trend pro/contra PHEVs

AlixPartners Automotive-Electrification Index

e-Range by propulsion



Share of PHEVs within total number of electric vehicles sold

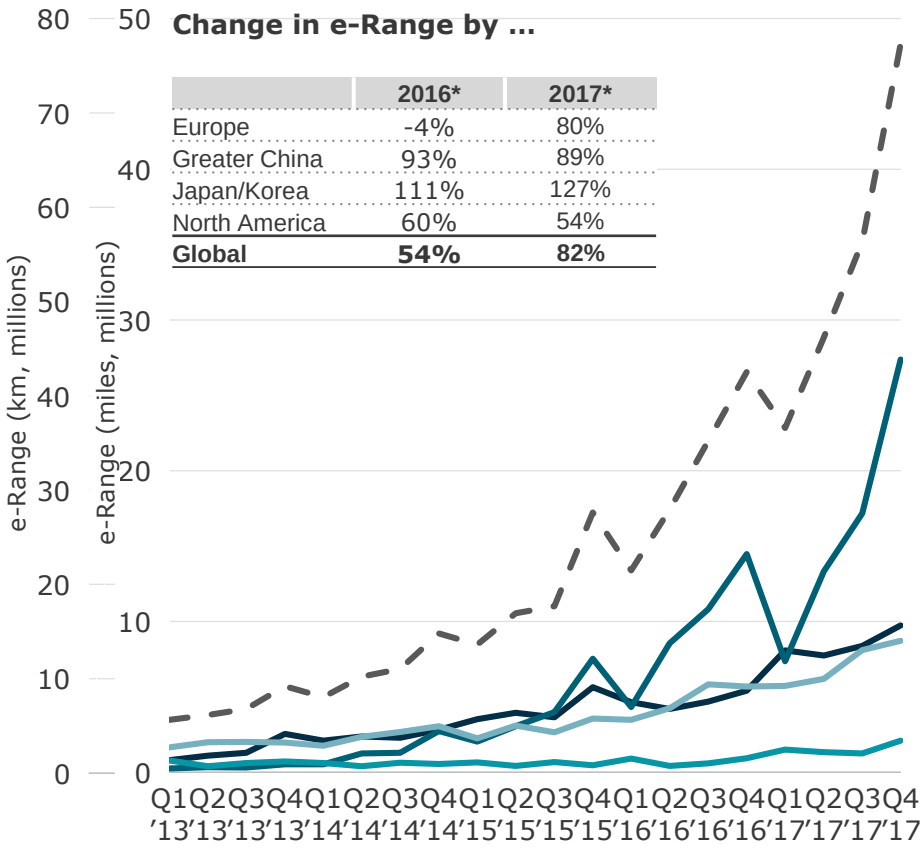


	Q4 2016	Q4 2017
Number vehicles sold		
BEV	179,686	320,344
PHEV	70,737	125,174
FCEV	812	1,068
Market share:		
BEV	0.75%	1.33%
PHEV	0.29%	0.52%
Average e- Range (miles):		
BEV	135	137
PHEV	28	33

[1] Electric range/311miles (500km) defining the equivalent full ICE vehicle share
Sources: IHS Markit, EV-volumes.com, AlixPartners research

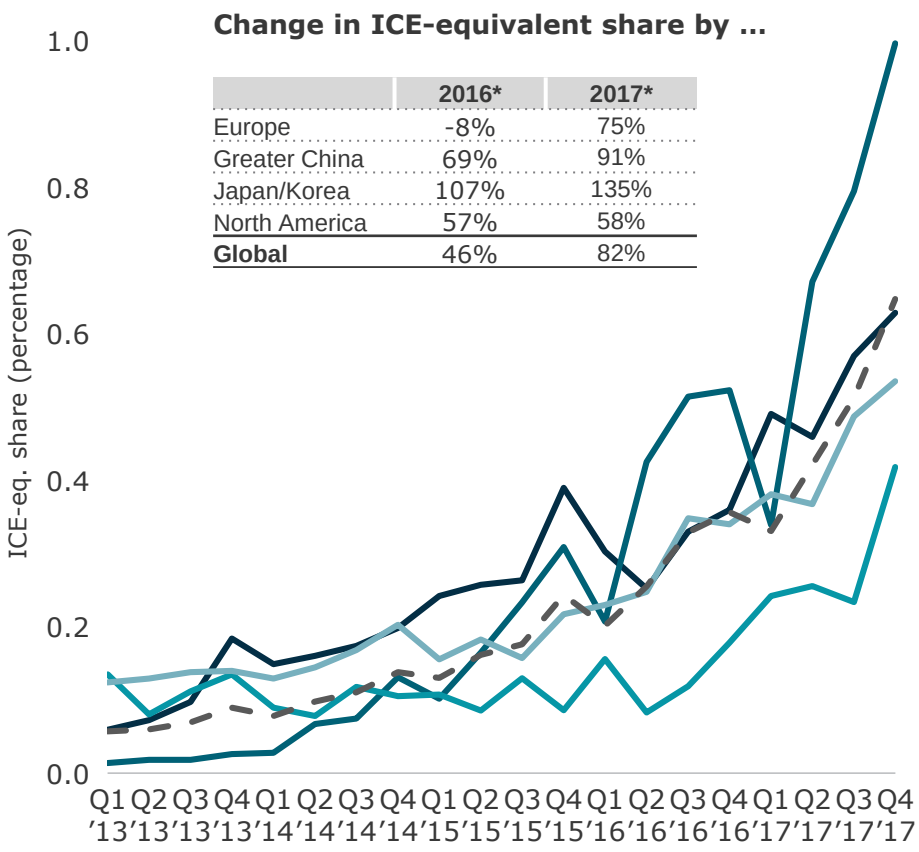
e-Range and ICE-equivalent share by region: Europe up 75% in ICE-equivalent share

e-Range: regions by quarter (Q1 '13 to Q4 '17)



	2016*	2017*
Europe	-4%	80%
Greater China	93%	89%
Japan/Korea	111%	127%
North America	60%	54%
Global	**54%**	**82%**

ICE-eq. share: regions by quarter (Q1 '13 to Q4 '17)



	2016*	2017*
Europe	-8%	75%
Greater China	69%	91%
Japan/Korea	107%	135%
North America	57%	58%
Global	46%	82%

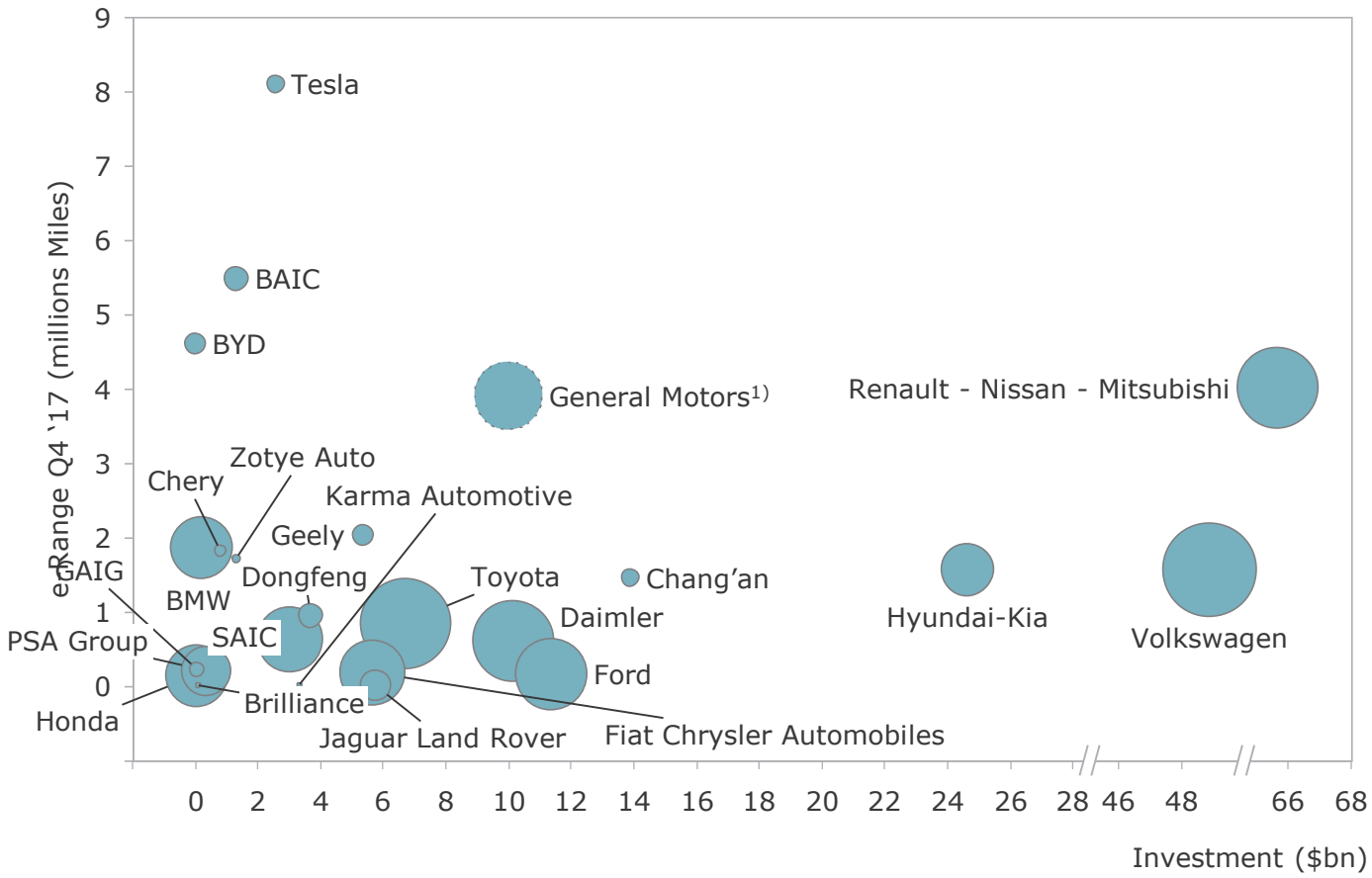
Key: Europe, Greater China, Japan/Korea, North America, Global

* Change Q4 previous year to Q4 particular year

Sources: IHS Markit, EV-volumes.com, Automaker responses, AlixPartners research

Automakers' EV-related investments vs. their rankings in the AlixPartners Automotive-Electrification Index (*true* electric range)

E-Range Q4 '17 / announced investments (2016-2023) - $bn



- Volkswagen's recent large investments announcement is a key element to get capture EV share
- Fiat Chrysler and Jaguar Land Rover have both planned considerable investments to capture growth in the space
- BYD, BAIC, and Tesla have a first mover advantage, however at risk given competitive pressure

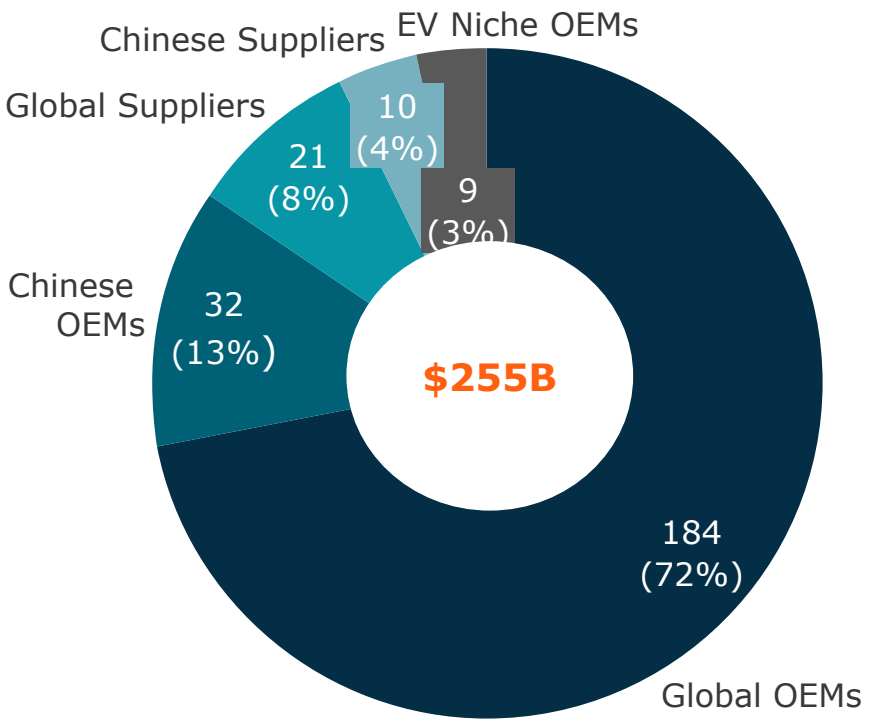
Revenues

EV landscape is becoming more competitive and expected to dramatically change in the near future – not every investment will result in improvement of competitive position

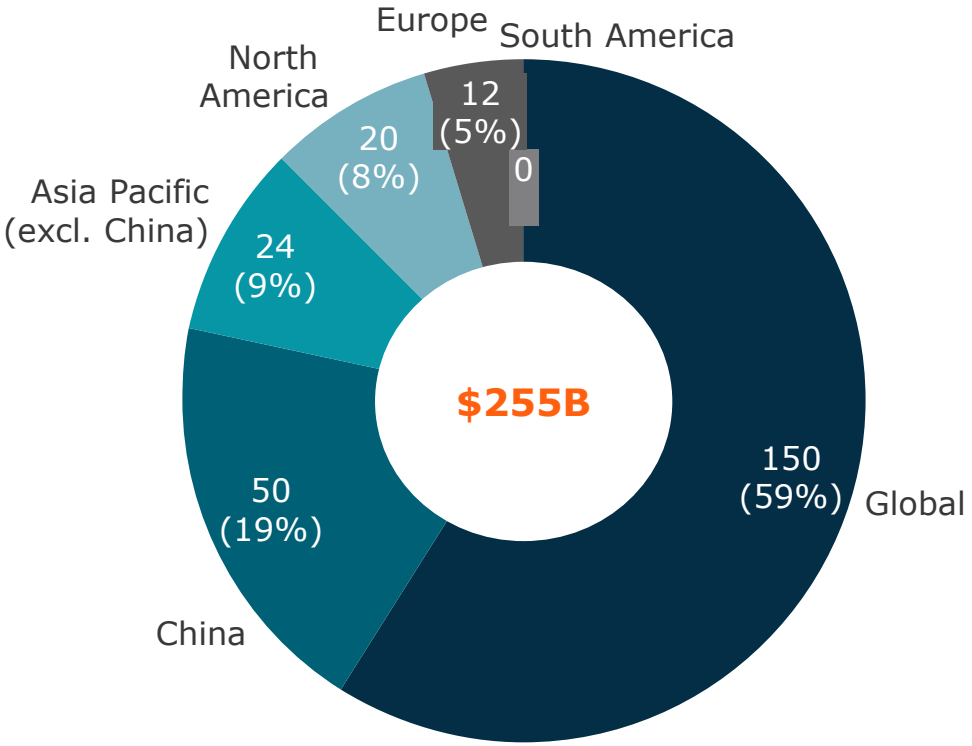
GM does not provide EV Investment information however announced the launch of at least 20 vehicles by 2023, estimated at 10bn investment
Source: AlixPartners research

$255B being invested in EVs in next 8 years vs. ~$25B last 8 years, with China receiving $50B directly

Total Investments announced by investor type by 2023 ($bns)



Total investment announced by Target Geography by 2023 ($bns)

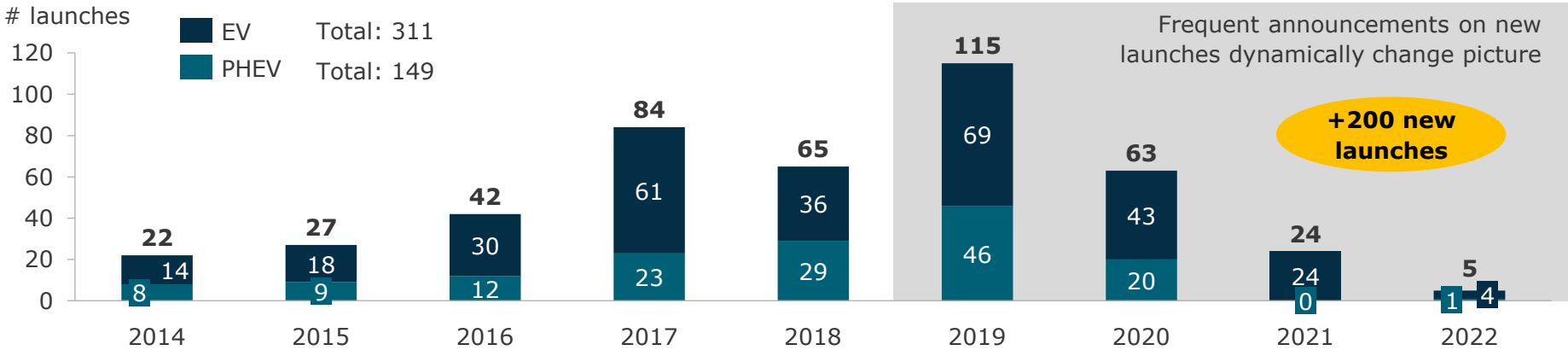


More than $100B of Global Investment linked to VW and Renault-Nissan-Mitsubishi – both companies stating that China is a core EV Growth Market

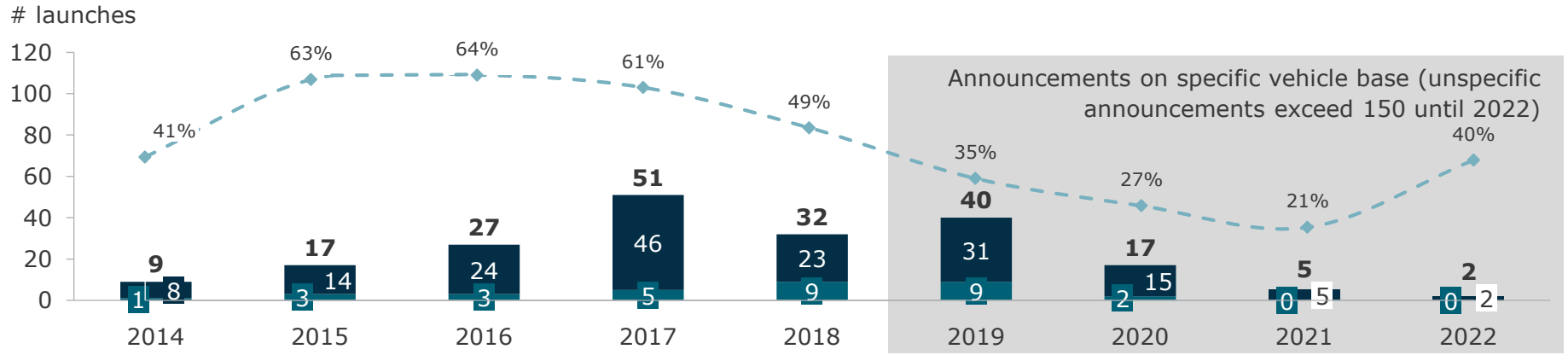
Note: Global Investments include announcements that are not region specific (e.g. launch of product lines), supplier investment have been increased by 35% to account for estimated supplier involvement in EV
Source: Press Research, Company Reports, AlixPartners analysis

200+ EV model launches expected globally by 2022, including >60 in China; RoW catching up share of global launches by 2021

Global EV and PHEV launches

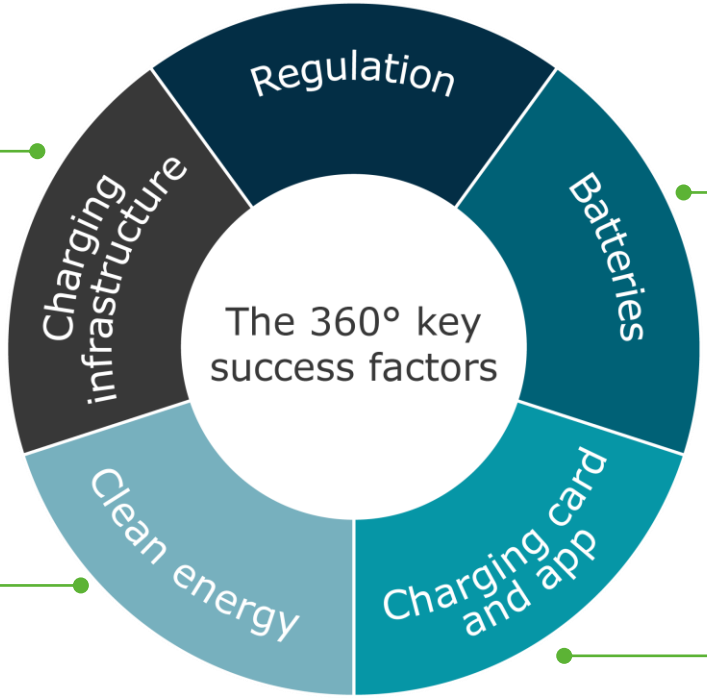


China EV and PHEV launches (% share of Global)



Sources: EV-volumes.com, AlixPartners research

The 360° concern of the Auto industry: Will all key enablers progress enough to continue rapid growth in EV adoption?



Realistic and stable goals that will allow the industry to invest without the fear of stranded costs

$100/KW packs safe reliable with no disruption risk in supply chain

Above 500km range (NEDC)

Easy access to public charging stations for convenient charging on-the-go

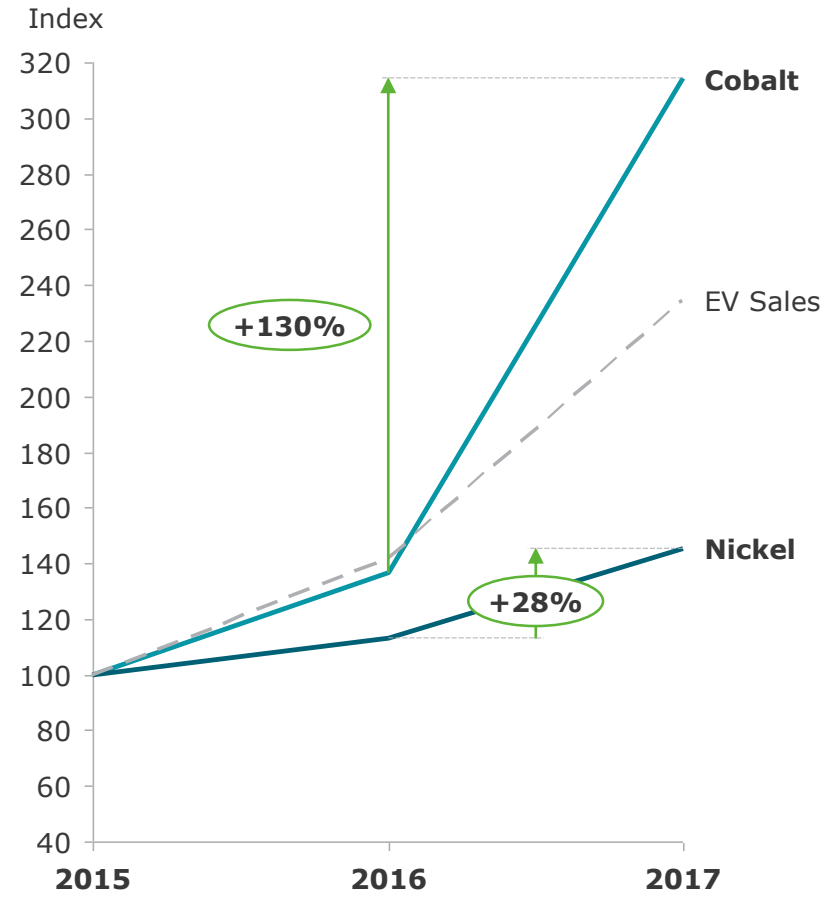
Supply the option to use clean Energy for e-charging stations (public and at home)

From an easy and safe charging solution (e-charging station) to intelligent solutions that can be integrated into smart home and cities

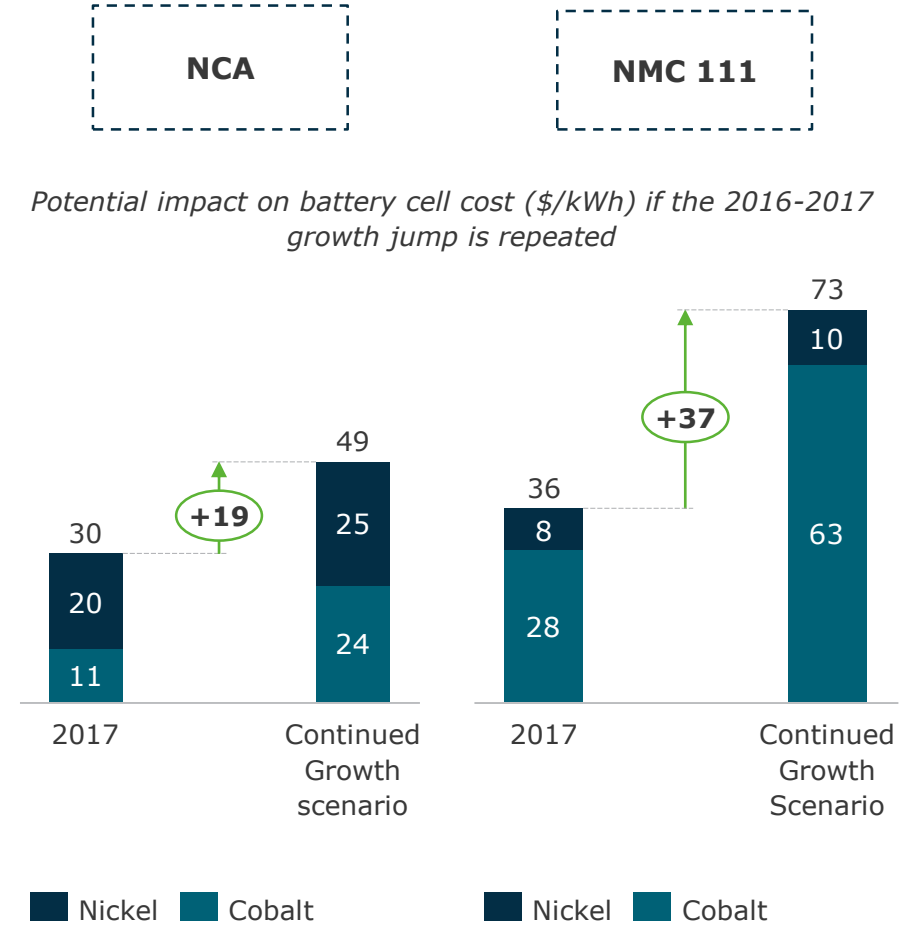
Source: AlixPartners Research

Continued sharp increases in key raw material costs of Cobalt and Nickel likely to challenge a sustainable $100/kWh cell price target

Cobalt / nickel price evolution [Index 100=2015]



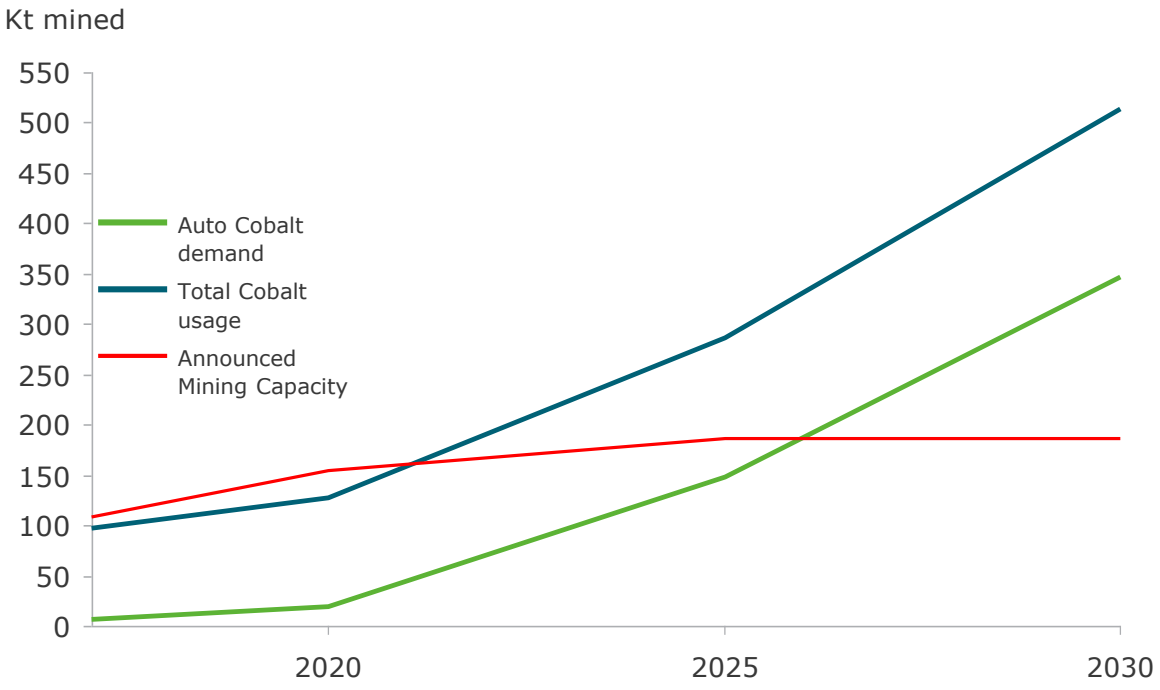
Potential Cell cost content of Cobalt and Nickel, 2017A to potential 2020E ($/kWh)



Source: AlixPartners Analysis, Capital IQ, Bloomberg, Public announcement
Note: 2020 price assuming continued increase at rates seen in 2016 to 2017

Cobalt demand will rapidly increase as EV sales grow; significant risk of supply constraints if no alternative resources identified

AlixPartners EV Cobalt Demand: Annual production vs Auto demand, Kt mined production



2017		2030	
Typical Cobalt per vehicle (BEV)[1]	7-17 kgs	Typical Cobalt per vehicle (BEV)[1]	6-8 kgs

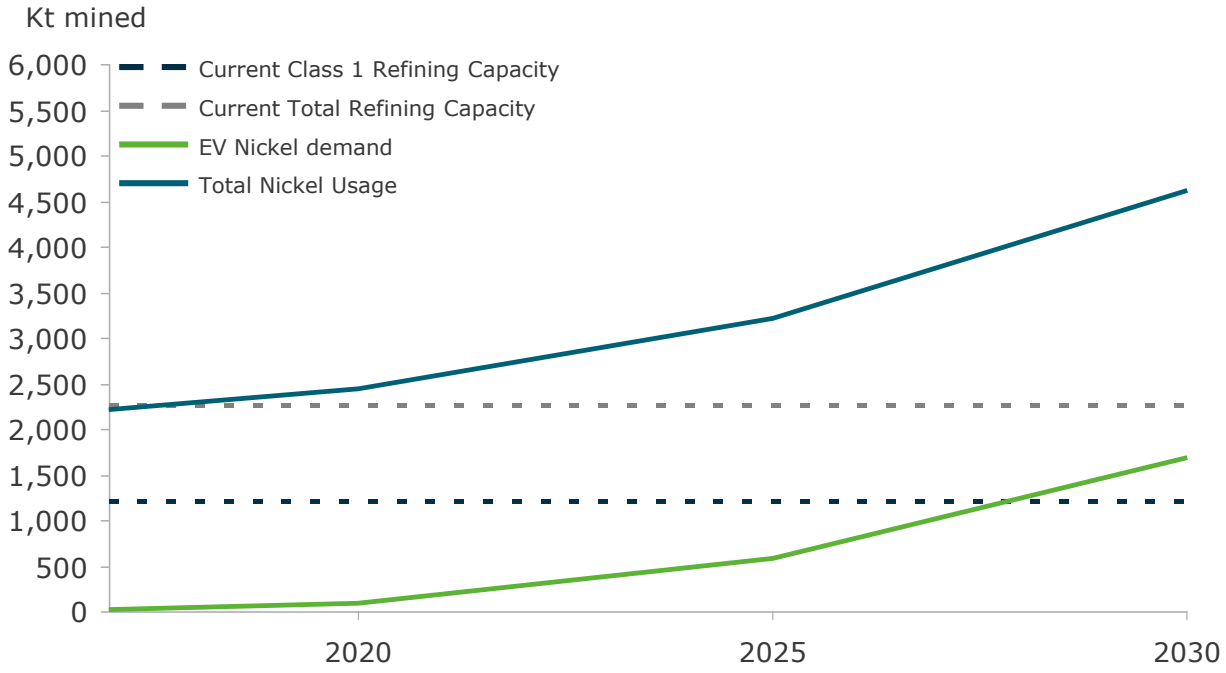
- 2018-2020: **Democratic Republic of Congo produces 2/3 of all global Cobalt** following opening of Katanga; **China refines c. 50% of all Global Cobalt**
- 2020-2025: Global **cobalt demand** may start to **out-strip global mining capacity driven by EV battery demand**
- 2025-2030: Further **BEV/PHEV adoption likely to drive auto cobalt demand alone above current global mining capacity**
- Additional resource capacity or substitution technology e.g. non-Cobalt chemistries, potentially necessary to address supply chain constraint

Notes: Demand based on AlixPartners global assumptions for EV adoption and Cobalt Consumption model
1: Based on an average battery size of 45KWh in 2017 and 54KWh in 2030

Source: AlixPartners Analysis, US Geo Survey Data 2018, Glencore Annual report 2017, GLG Cobalt Outlook 2018

Class 1 (auto grade) Nickel demand increasing from EVs; price increases likely as new refining capacity investment required

AlixPartners EV Nickel Demand: Annual production vs Auto demand, Kt mined production



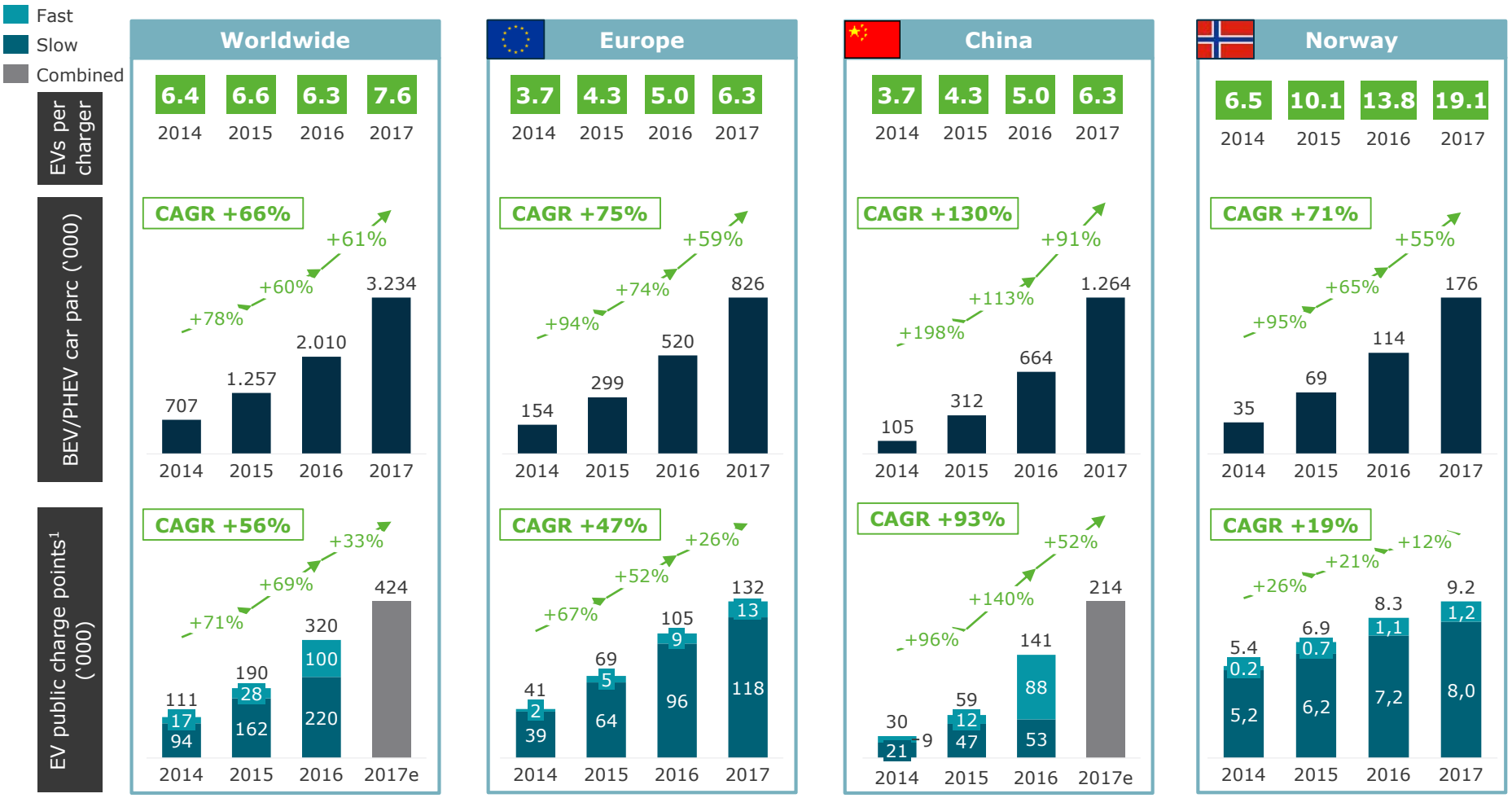
2017		2030	
Typical Nickel per vehicle (BEV)[1]	17-43 kgs	Typical Nickel per vehicle (BEV)[1]	47-51 kgs

- **Current auto Nickel demand** (33kt) **negligible** proportion of 2,200kt global demand requirement
- **EVs require** nickel sulphate from **Class 1 nickel** (purest form), that has seen **little capacity investment** in the past due to **depressed prices** (c.50% of total production) and high cost of refinery investment
- Further **Class 1 investment** is **required to support rising EV demand**, but will naturally require higher prices to support refinery investment costs
- **Future technologies use more Nickel** not less (i.e. NMC 811, eLNO), **exacerbating** the demand for Class 1 nickel and potential **future price increases**

Notes: Demand based on AlixPartners global assumptions for EV adoption and Nickel Consumption model
1: Based on an average battery size of 45KWh in 2017 and 54KWh in 2030

Source: AlixPartners Analysis, US Geo Survey Data 2018,

Public charging infrastructure continues to lag EV sales globally; Norway's EV park still growing despite lowest charger density

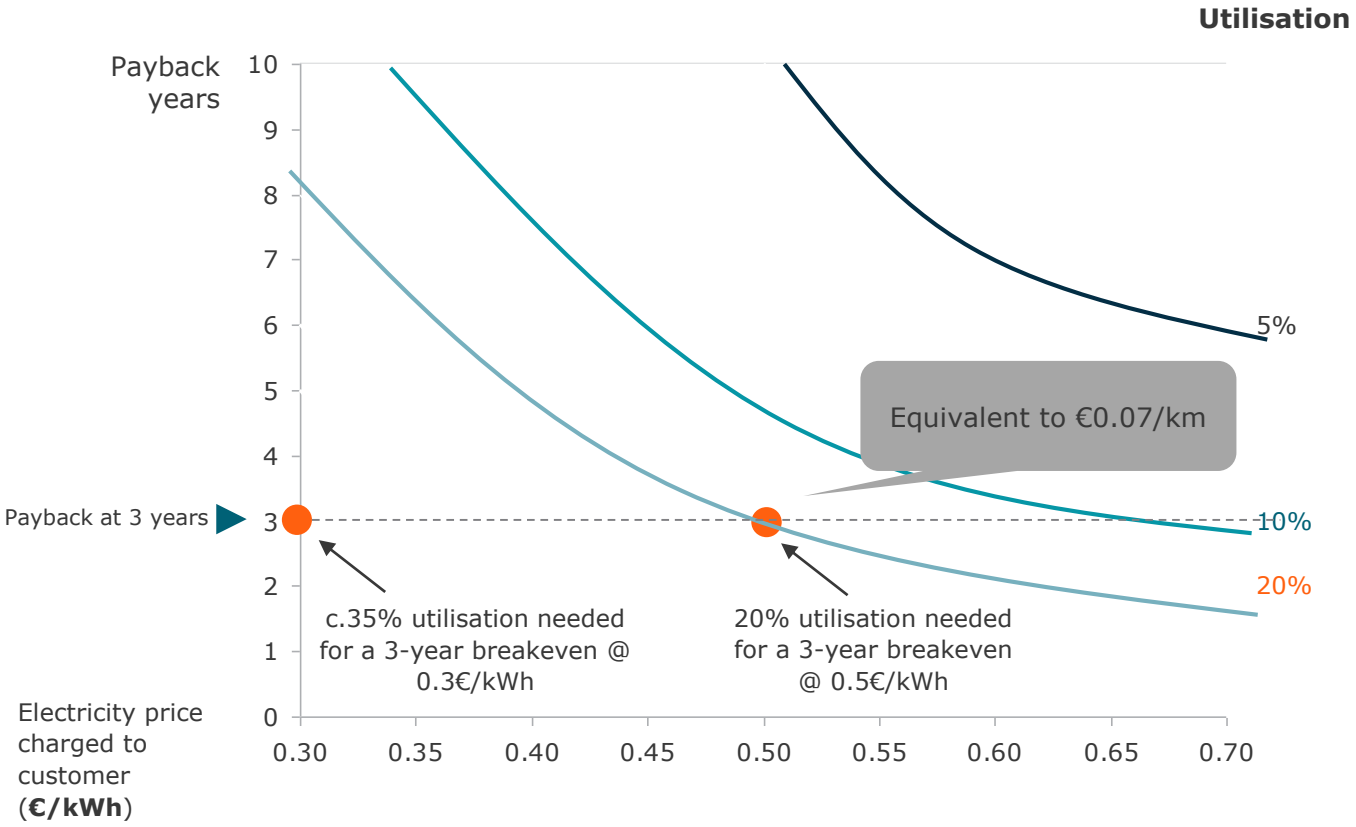


Norway charger density drop while EV sustaining market share growth: reflecting higher charger utilization and/or different charging behavior, e.g. charging more from home

Source: AlixPartners analysis

Cost per km for EVs still generally lower than ICE; risk of this cost increasing as private charging investors seek better returns

Charger investment payback scenario based on €/kWh invoiced



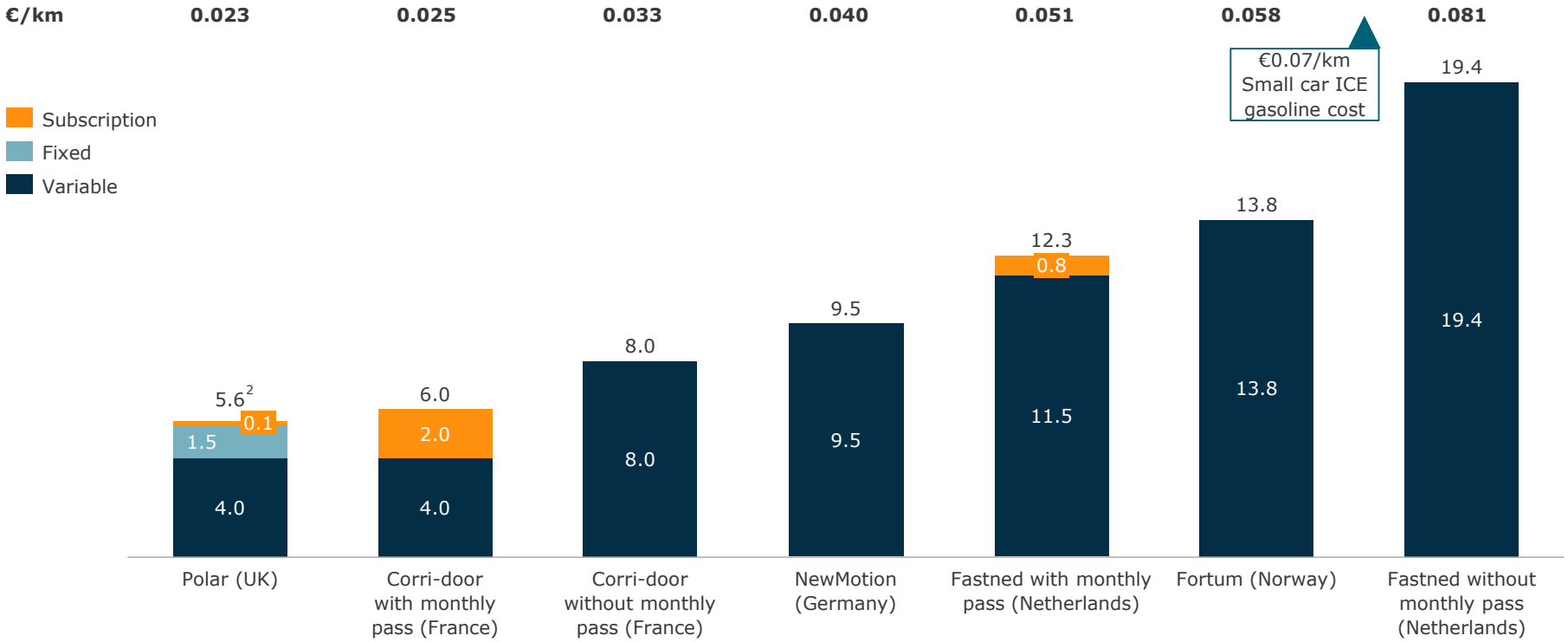
Comments

- Typical fuel costs range between €0.07-0.08/km
- The cost of electricity for EVs at retail prices are much lower at c.€0.03
- Increasing private investment in charging is going to result in shorter investment payback targets
- Whilst current private charging costs are still below the cost/km of traditional fuel – higher return requirements will need to push the cost/km of electricity towards that of traditional fuel – unless utilisations can be increased

Source: AlixPartners analysis,

Public fast EV charging pricing scheme varies across operators; e.g. EV refill price higher than ICE in Netherlands in one case

Renault Zoe charging refill cost[1] @ 50KWh according to pricing schemes across Europe (€)

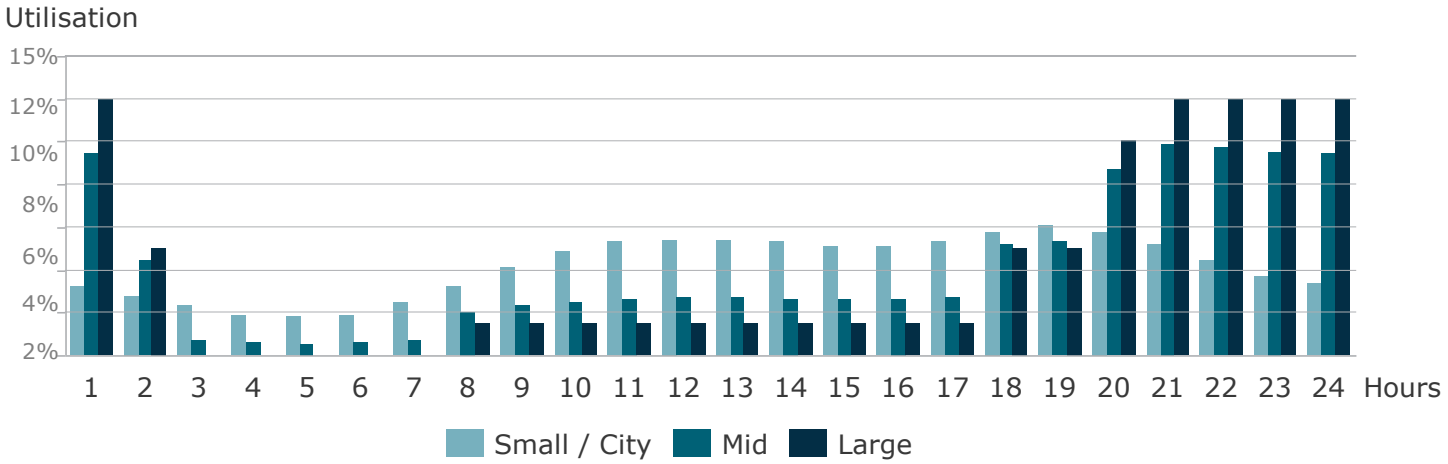


	Polar (UK)	Corri-door with monthly pass (France)	Corri-door without monthly pass (France)	NewMotion (Germany)	Fastned with monthly pass (Netherlands)	Fortum (Norway)	Fastned without monthly pass (Netherlands)
Subscription	€8.95/month	€30/month	-	-	€11.99/month	-	-
Fixed	€1.4 connection fee	-	-	-	-	-	-
Variable	€0.12/kWh	€0.50/5min charge	€1.00/5min charge	€0.29/kWh	€0.35/kWh	€0.42/kWh	€0.59/kWh

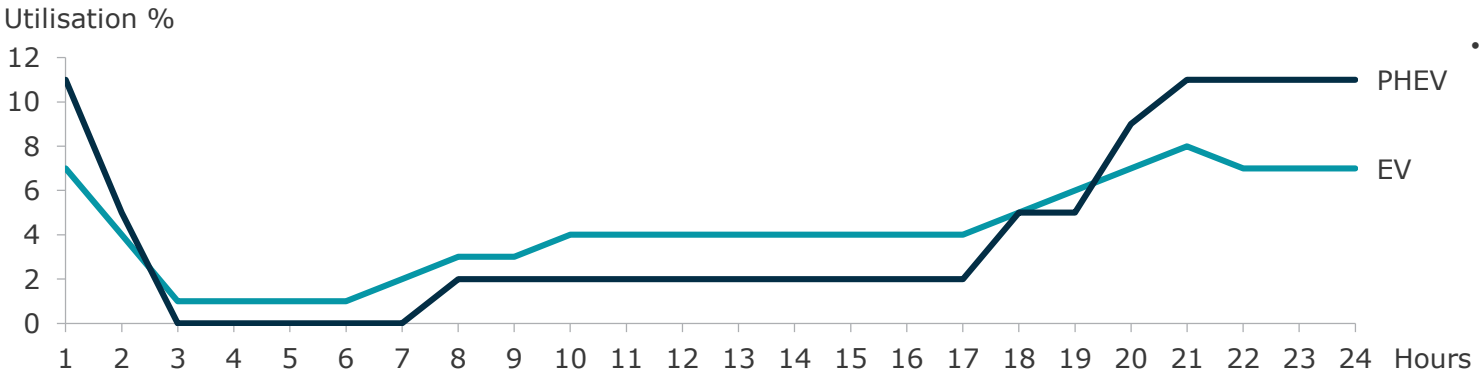
[1] 80% recharge of a 41KW battery (= 240km autonomy) [2] 15 charges per month assumed; £/€ = 1.14 & NOK/€ = 0.105 (ECB)
Source: Web research, AlixPartners analysis

Charger utilisations however remain at <12% on average – making it more difficult to drive returns at the lower cost per km

Typical utilization of charge facility for PEVs, by vehicle size and hour [as % of total demand]



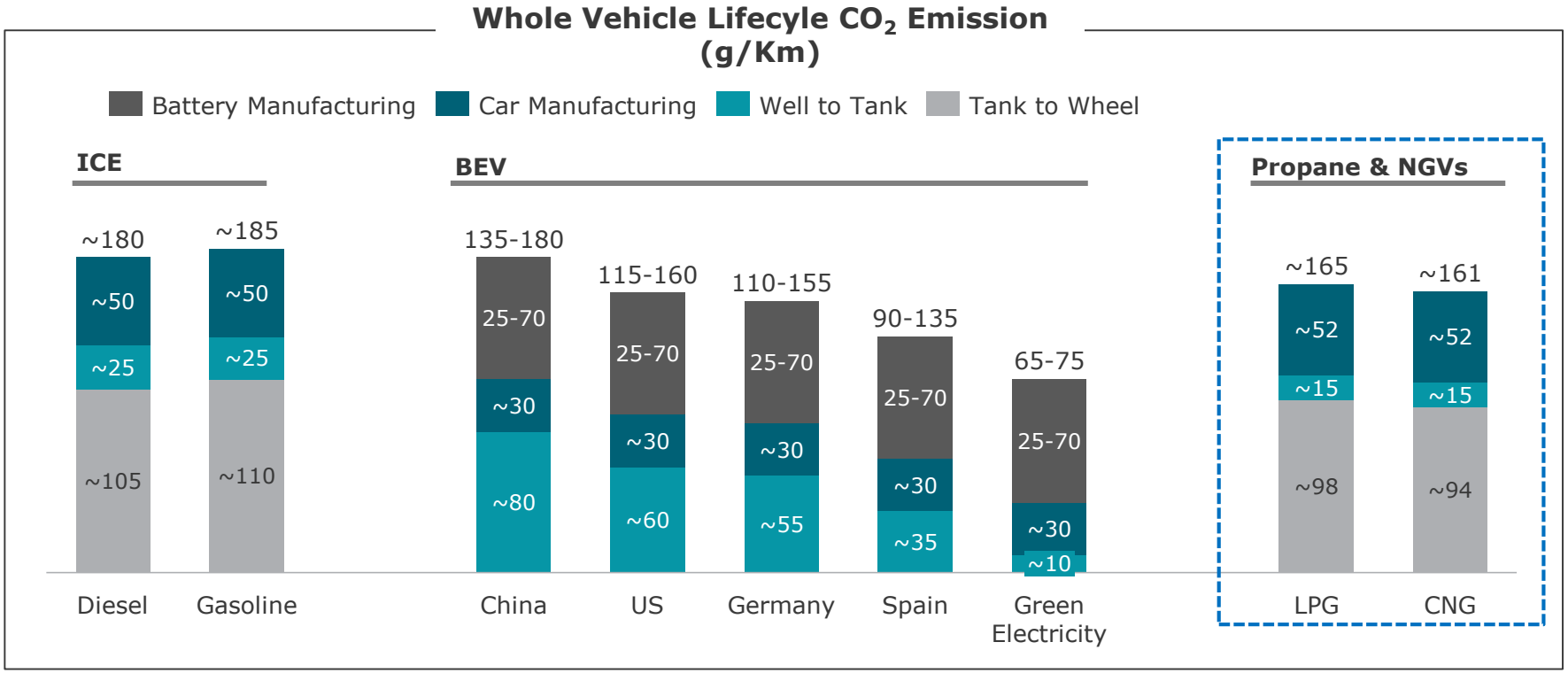
Typical utilization of charge facility for PEVs, by type and hour [as % of total demand]



- Small and city cars will prevail in the small/city car segment, while PHEV are supposed to prevail in the large one
- The medium size segment likely contain an near percentages of EV and PHEV, with the former in slight majority
- Day-hours charging facilities would be mostly for communal use and required to be of the «fast» type L3 or L2
- Night time charging is likely to happen more on private/household facilities, at lower charge speed and possibly for some time on «slow» type charging appliances, L1 type

Source: AlixPartners Research

Propane and NGV technology also presents an alternative to BEV with an existing established infrastructure



- NGVs produce 3-5% CO_2 emission less than NGV-LPG vehicles in whole vehicle lifecycle
- NGVs allow 10% – 18% CO2 emission reduction in Tank-to-Wheel cycle and about 40% in Well-to-Tank phase vs. ICEs
- NGVs produce 15-30% CO_2 emission more than BEVs in whole vehicle lifecycle
- NGVs show full compliance with 2021 ETS rules (95g/Km)

Assumption: compact car (C-segment) as reference vehicle (4.1 l/100 km diesel; 4.8 l/100 km gasoline; 35.6 kWh battery), 120,000 km lifetime average grid emissions in China, Germany, Spain in 2017; EV manufacturing (excl. fuel cell and battery) 40% less energy-intensive than ICE manufacturing; Natural Gas CO2 emission reduction vs. gasoline engine: LNG: 10%, CNG: 18%
ICE: Internal Combustion Engine; BEV: Battery Electric Vehicle; NGV: Natural Gas Vehicle (Port Fuel Injection - PFI)
SOURCE: Expert interviews, AlixPartners analysis

CNG refuelling infrastructures are less expensive if compared to Electrical recharge network with same coverage

CNG Refilling Stations Infrastructure

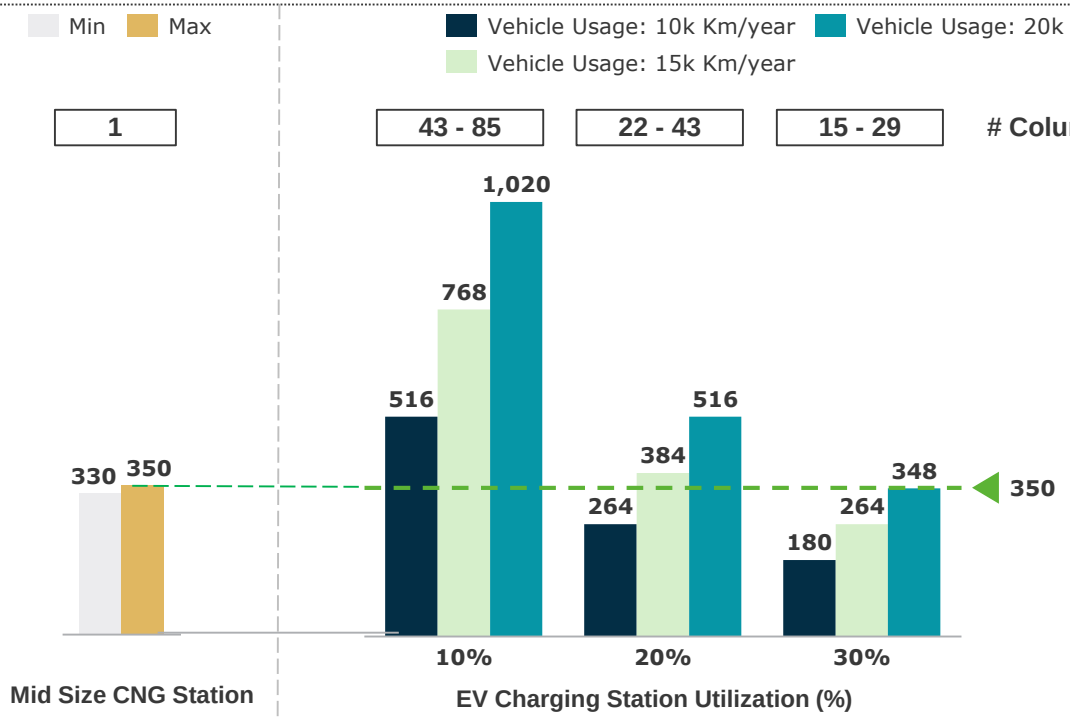
Mid size refuelling station with two dispensers, 150 - 160 average daily refuelling

Electrical Recharge Network

Charging station based on 22 kW, dual port column

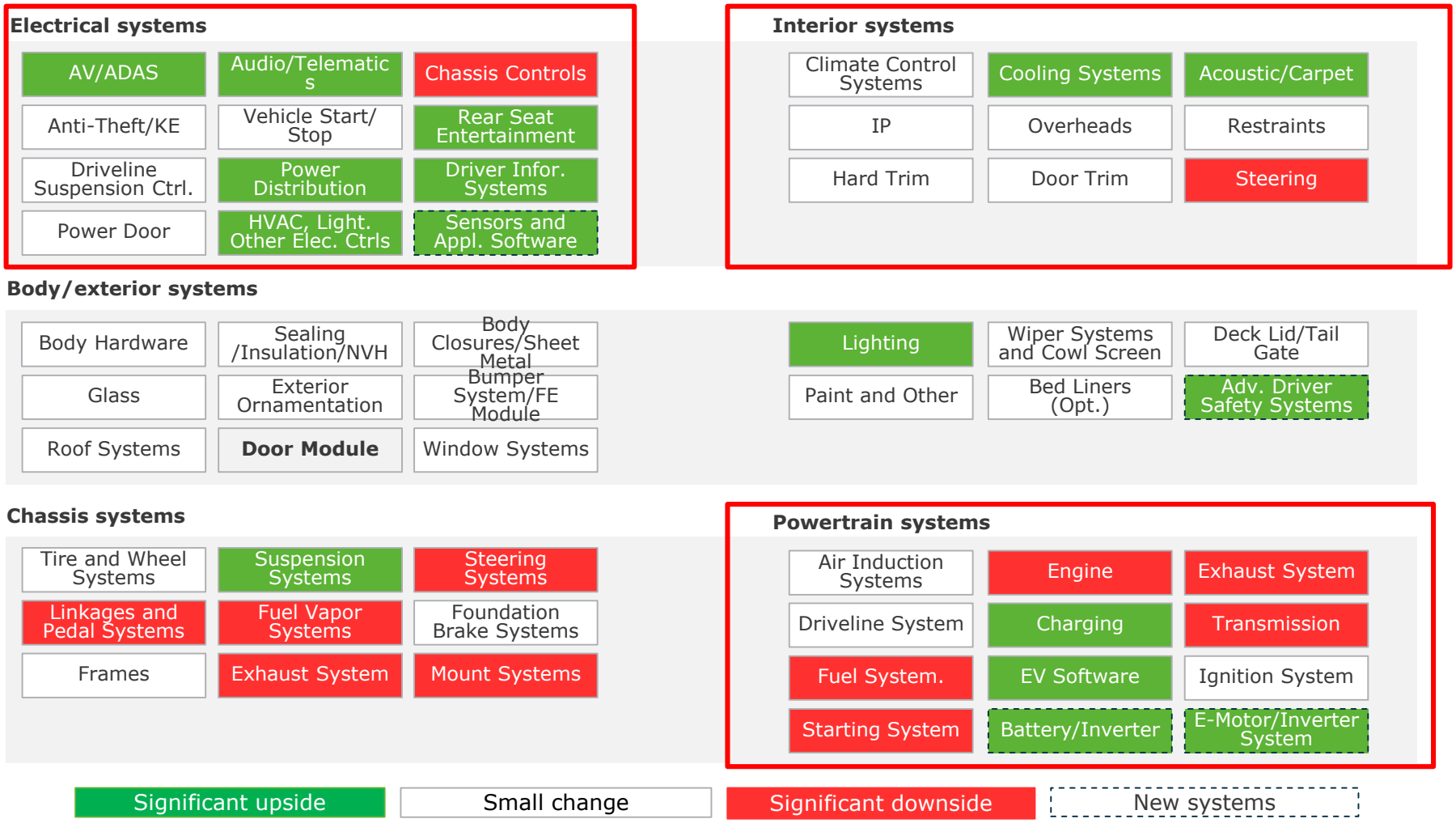
Cost of Coverage – Total Cost for additional coverage of 1.000 cars (KEur / 1.000 cars)

- Currently EV charging columns utilization is 5-10%
- EV charging columns low utilization is due to their operating model (max utilization foreseeable is 25 – 30%):
  - long charging time pushing users to full recharging (e.g. during the night) instead of multiple short recharging
  - self-service refill causes long idle periods
- CNG stations utilization in countries with developed fleet is about 50%



EV recharging column: total price 12k€ (including HW, labour and mobilization)
CNG station: equip. & dispensers 190-200k€, electrical cabinet 60k€, infrastructure connect. 30-40k, building 50k€

A heat map of how supplier segments are expected to be affected by the EV (and AV) transition



Source: AlixPartners analysis,

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- High annual investment of +€55bn with many competing players
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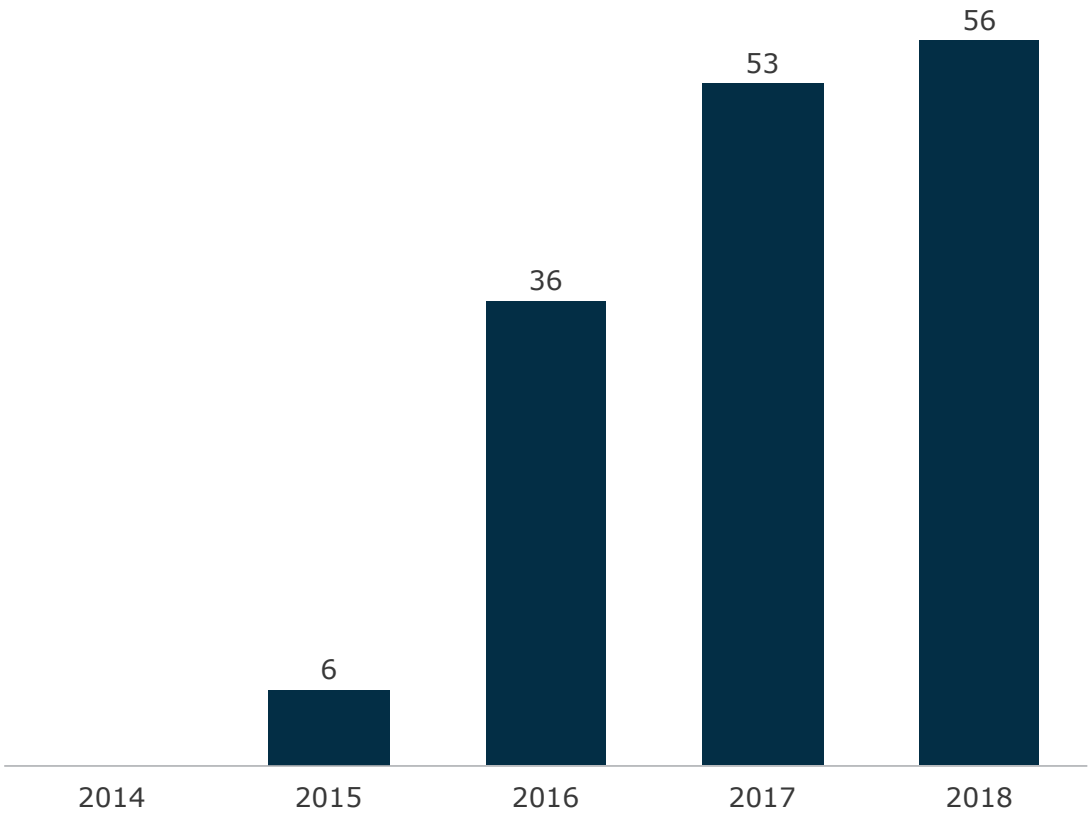
Investment in autonomous vehicles exceeds €55bn as companies continue to try to get first mover advantage

Autonomous vehicle ecosystem investment (2015 – 2017), €bn



Note : Includes automaker and tech company investments, acquisitions, investments, and partnerships

Notable investments / acquisitions

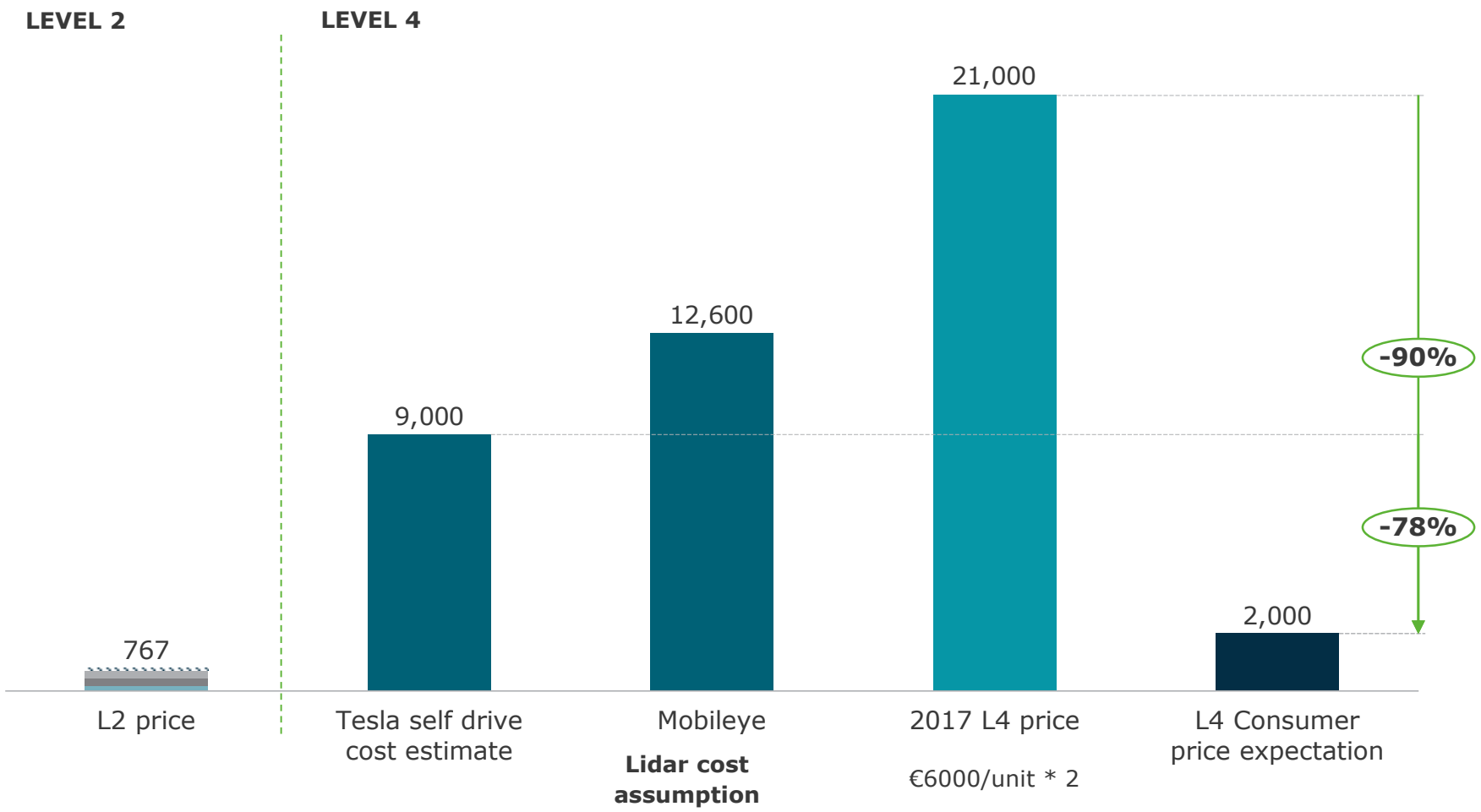
- **Estimated > €4B**
  - GM / Cruise : €1bn
  - GM investment : €1bn
  - Softbank / GM: €2bn
- **Estimated > €26bn**
  - Intel / Mobileye: €13bn
  - Qualcomm / NXP
- **Estimated > €1-2bn**
  - Uber / Otto : €580m
- **Estimated > €2bn**
- **Estimated > €2B**
  - Ford / Argo AI: €1B

Investment levels are still approaching zenith; total investment levels will continue to rise

Source: Brookings Institute, Bloomberg, AlixPartners analysis, Goldman Sachs

With consumer's expecting to pay c.€2000 for Level 4 Autonomy, planned production systems will need to reduce in cost by 80-90%

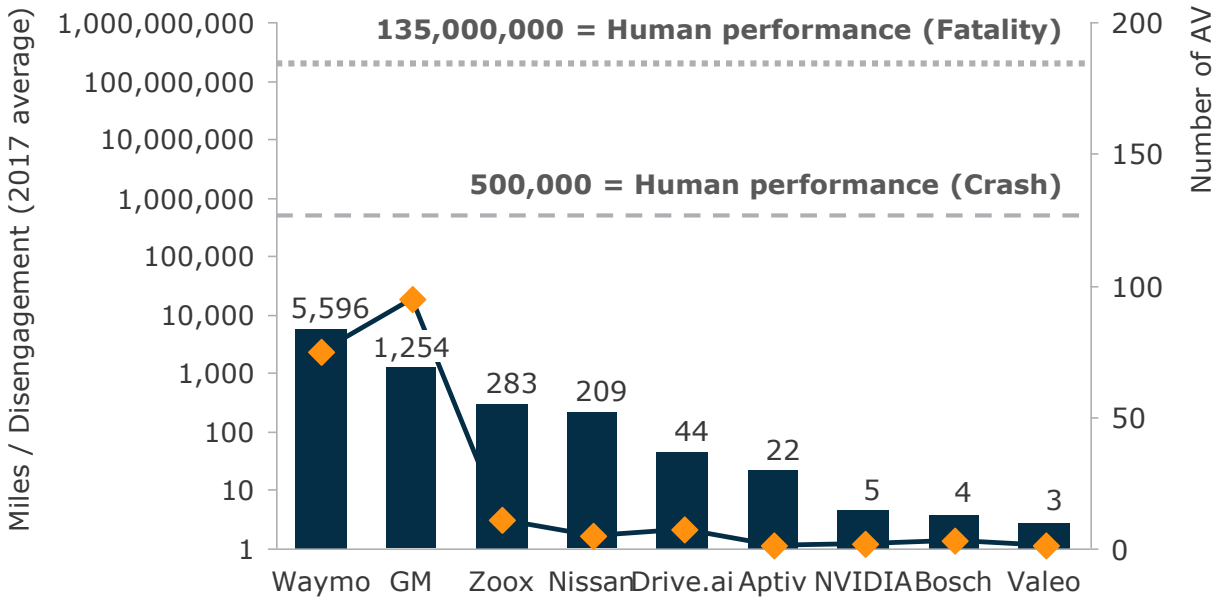
Current Estimated Price of Autonomous level 2 vs 4 (€ per Vehicle)



Source: AlixPartners ADAS cost model, 2018 AlixPartners Autonomous Vehicles Consumer Survey

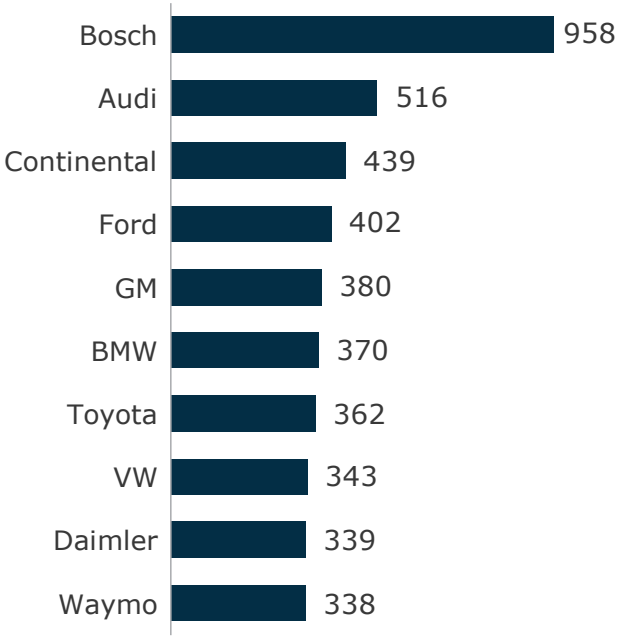
Testing data shows Waymo and GM are in the lead; other companies are developing AV, with some choosing to protect IP

Disengagement report results (California)



- Test data is only available from California - 50+ companies have permits with 2017 seeing 19 entities operating 230 vehicles
- GM gaining in terms of miles tested, and miles per disengagement
- Waymo exceeded 7M miles tested globally, with 353K California miles in 2017; giving company a significant database of mapping and data
- Tesla now collects mapping and driving data from cars on road ; and has stopped testing and submitting data to the Californian DMV

Patent applications (till 2017)

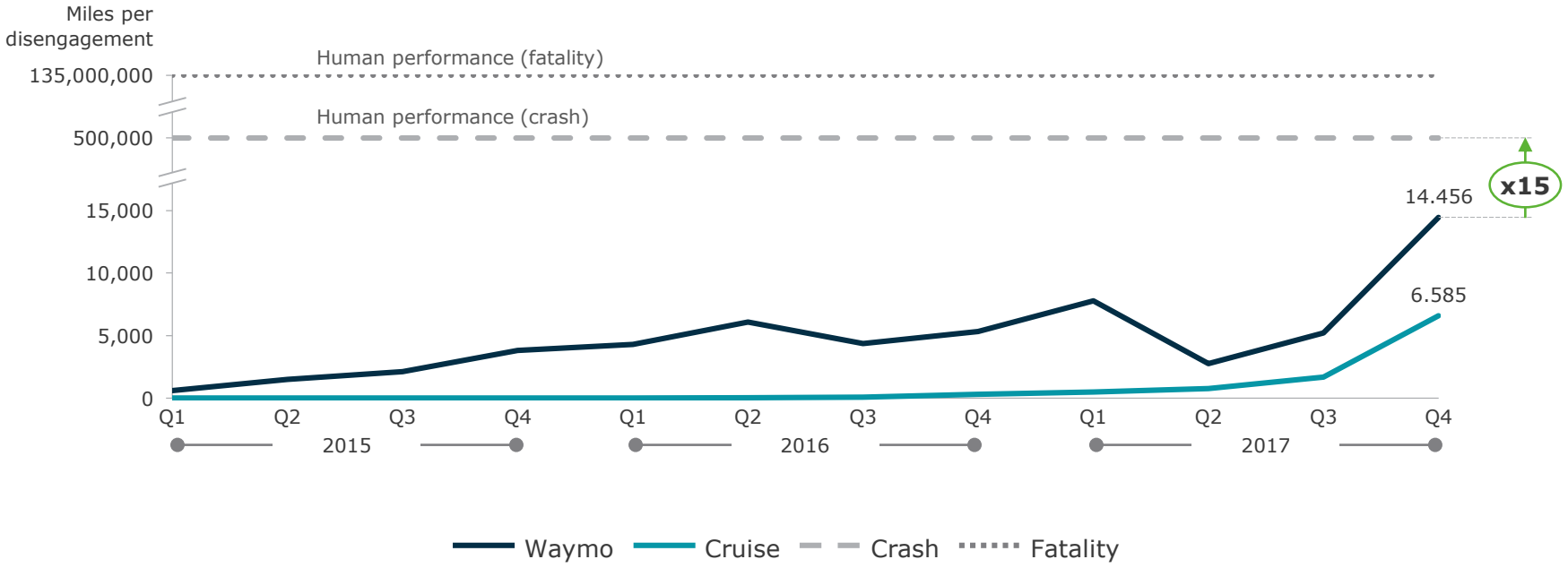


- Patent data indicates **with some choose to disclose / protect their progress more than others**
- Patent count shows suppliers are trying to carve out AV space
- Many companies are still in the race, trying to capture first mover advantage or not giving up

Source: Ars Tecnica, Thelastdriverlicense.com, California DMV

AV-technology is rapidly improving, but at 1 disengagement per 15k miles driven is still far from human-level reliability

Quarterly Miles per disengagement vs human level performance (miles)

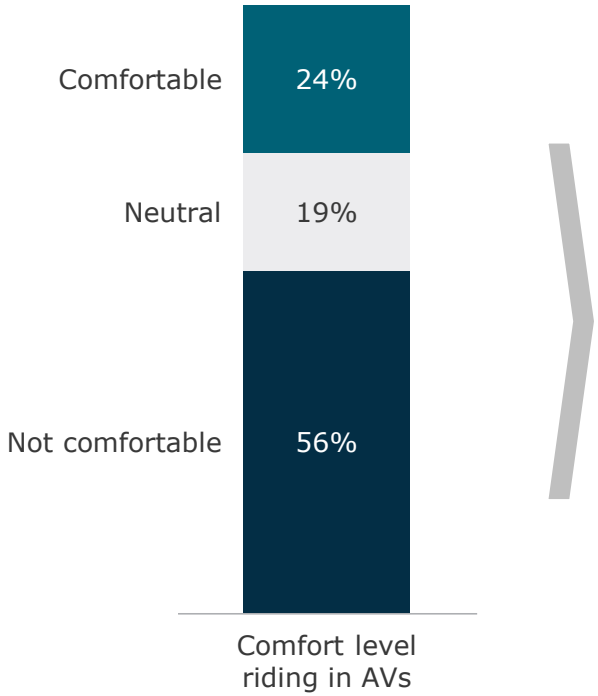


- Mile per disengagement highly volatile as additional complications arise by increasing the test conditions from 'simple' to 'complex' to include adverse weather, light and dense population and traffic
- Matching basic human performance will require >0.5 million miles without disengagement
- Current levels and rate of improvement indicate this will not be achieved until 2023

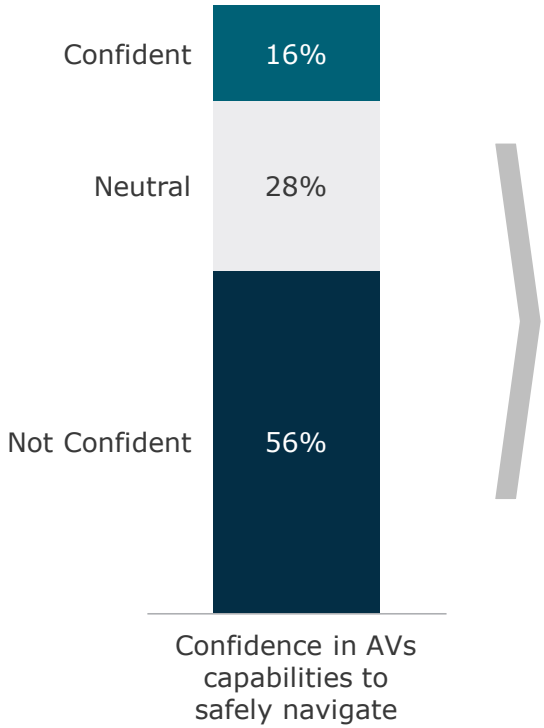
Source: Whatcar.com reliability survey

Based on 2018's technology, consumer confidence does not seem high; 57% consumers unlikely to purchase one if available today

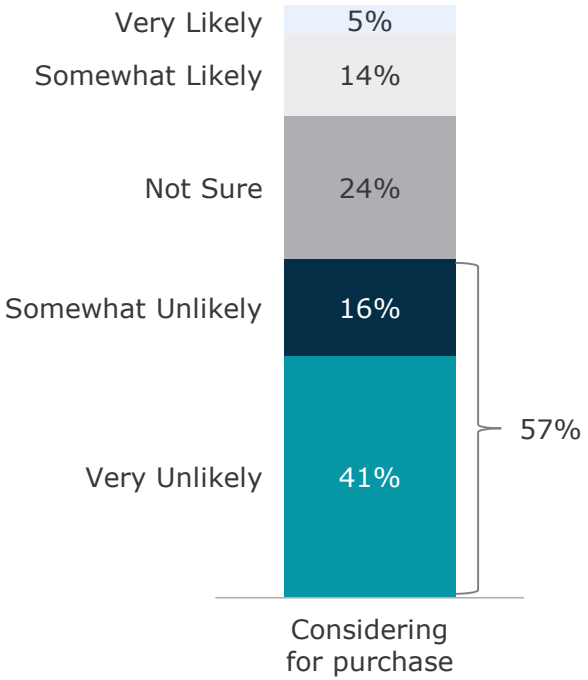
Where consumers lack comfort with riding / traveling in AVs



Coupled with lack of confidence AVs can navigate safely



Translates to 57% unlikely to purchase AVs if available today

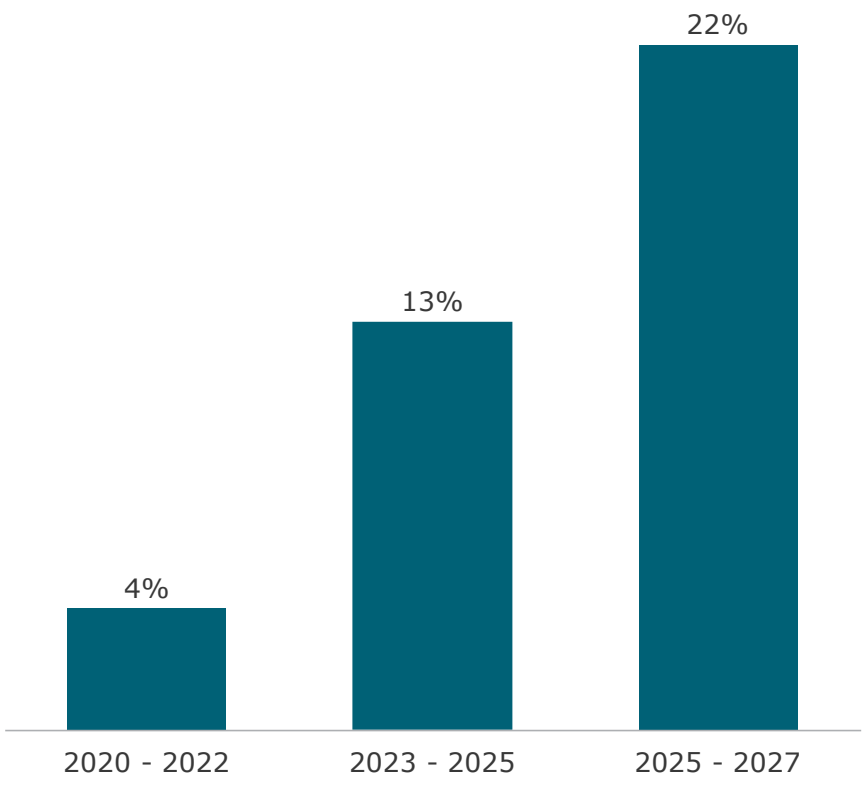


High profile coverage of accidents and fatalities likely to further inhibit consumer appetite for AVs

Assuming autonomous / self-driving vehicles are available, how confident are you in the abilities of the autonomous / self-driving vehicles to safely navigate you or family or friends from one place to another?
Source: AlixPartners 2018 Autonomous Vehicle Survey, AlixPartners analysis

But AV adoption is likely to be swift and significant, with 1 in 5 consumers[1] willing to consider purchasing AV by 2027

Customer purchase consideration for AV over time



Based on level 4 autonomy available by 2020.

Commentary

- **Significant percentage, 22% of consumers will be open to purchasing AV by 2027:**
  - Slow initial acceptance of Level 4 AVs upon introduction, at only 4%
  - Rapid growth and acceptance, with 22% of consumers in the market expected to purchase AVs
- **AV purchase consideration will be spurred by regulatory environment and OEM investments:**
  - Level 3 AV features will be required from safety regulation implementation in North America, Europe and other regions
  - OEMs have signaled intent to field level 4 / 5 AV for sales by 2020
- **Customers consideration for ADAS features ranges with exponential growth for accepted products:**
  - Customer acceptance and adoption for ACC and cruise control ranged from 7%-13% in first 10 years
  - Surround view parking systems grew 150% from 2014-16

Q21 - If autonomous / self-driving vehicle (higher level or fully automated) are available for purchase by the consumer population, when do you see yourself buying an autonomous / self-driving vehicle?
Q30 - Knowing what you know now, how likely would you purchase an autonomous / self-driving vehicle?
1: Based on AlixPartners US Consumer Autonomous Vehicle Survey

Source: May 2018 AlixPartners Autonomous Vehicle Survey