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Automotive industry: The next 10 years

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FILIÈRE
AUTOMOBILE
& MOBILITÉS

Markets

Trends

Implications

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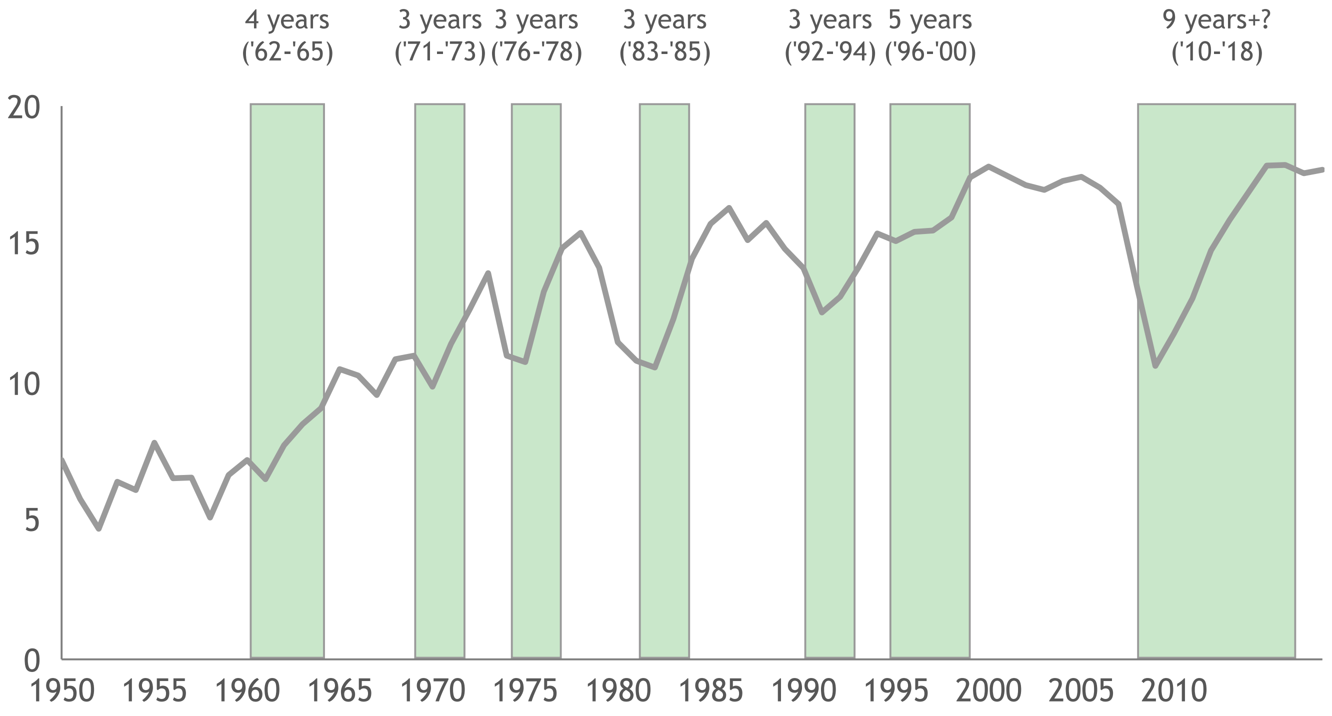
Auto sector has enjoyed an unprecedented period of growth

Nine years is the US's longest stretch of growth since 1950 without a >2% drop or multiyear stagnation

United States vehicle sales
(millions of units)



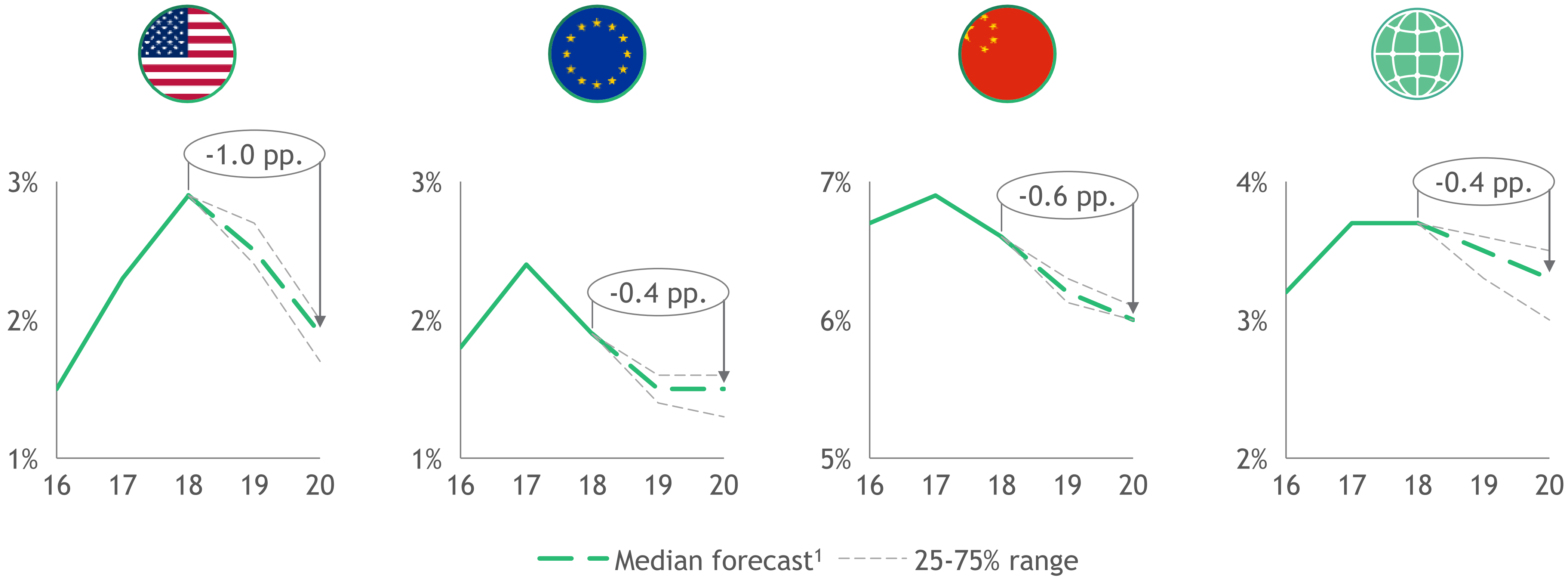
Five years is the EU's longest stretch of growth since 1999 without a >2% drop or multiyear stagnation

Europe Union vehicle sales
(millions of units)

Source: BCG analysis, IHS Markit, US Bureau of Economic Analysis

Economic momentum is weakening

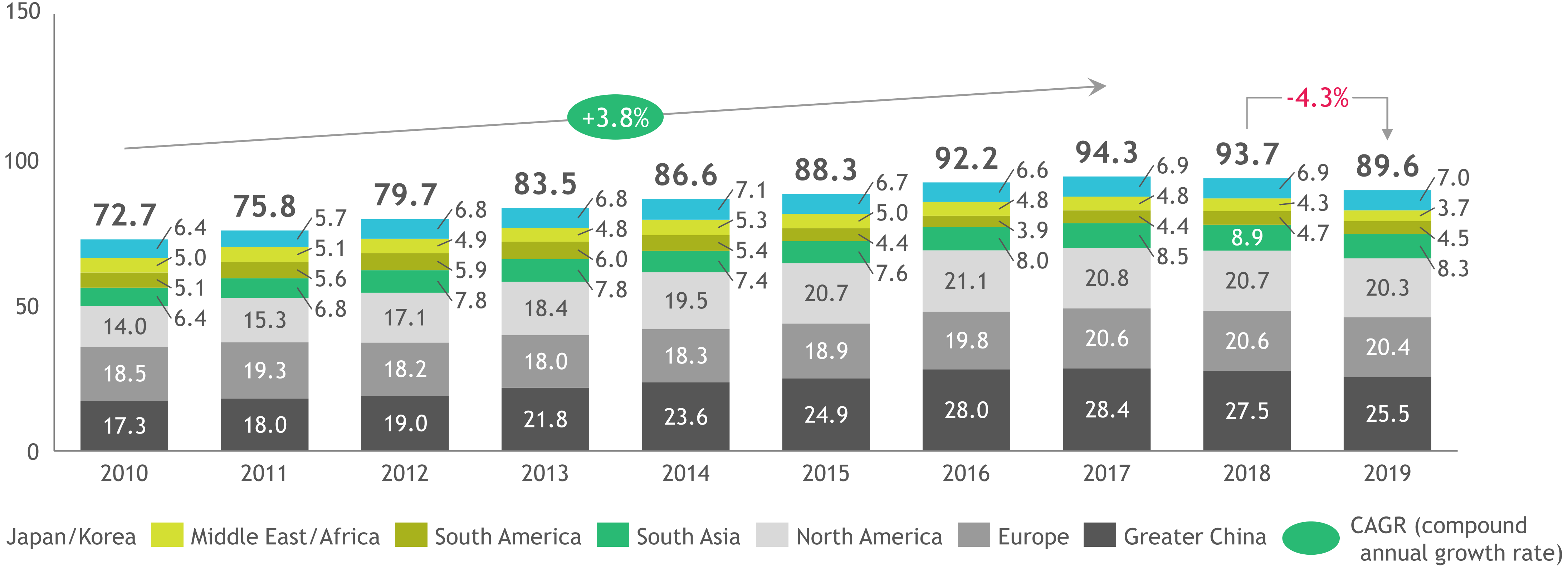
GDP growth forecasts (%)



1. Based on analyst forecasts compiled by Bloomberg (89 forecasts for US, 46 for Eurozone, 65 for China, 33 for world), 2. Duke Fuqua CFO Survey, Dec 2008
Source: BCG Henderson Institute, Bloomberg, IMF

Slowdown has started

Global light vehicle[1] sales by region 2010–2031 Units (M)

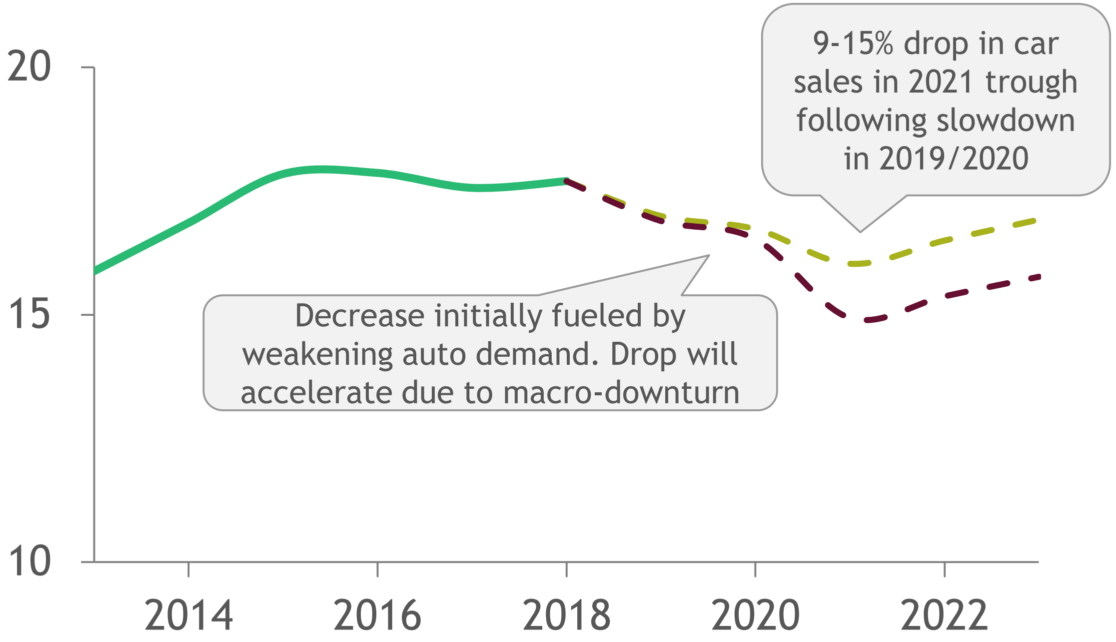


Region	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Japan/Korea	6.4	5.7	6.8	6.8	7.1	6.7	6.6	6.9	6.9	7.0
Middle East/Africa	5.0	5.1	4.9	4.8	5.3	5.0	4.8	4.8	4.3	3.7
South America	5.1	5.6	5.9	6.0	5.4	4.4	3.9	4.4	4.7	4.5
South Asia	6.4	6.8	7.8	7.8	7.4	7.6	8.0	8.5	8.9	8.3
North America	14.0	15.3	17.1	18.4	19.5	20.7	21.1	20.8	20.7	20.3
Europe	18.5	19.3	18.2	18.0	18.3	18.9	19.8	20.6	20.6	20.4
Greater China	17.3	18.0	19.0	21.8	23.6	24.9	28.0	28.4	27.5	25.5
Total	72.7	75.8	79.7	83.5	86.6	88.3	92.2	94.3	93.7	89.6

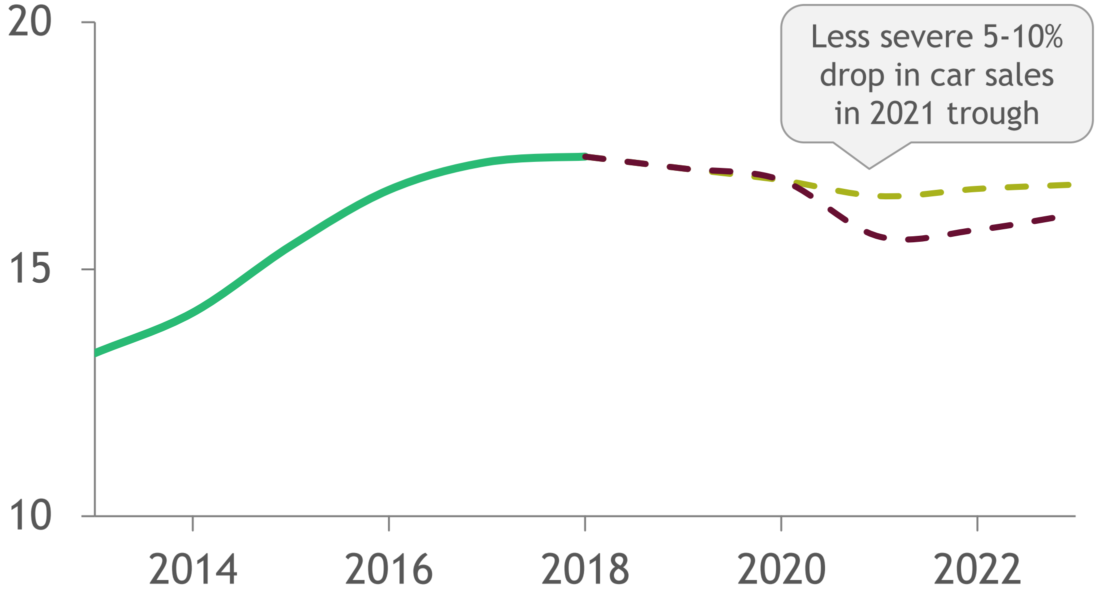
1. Light vehicles = passenger cars + light trucks < 6t GVW
Note: Regions defined according to IHS definition
Source: BCG analysis, IHS Markit (November 2019)

Car sales will decline by 9%–15% in the US and 5%–10% in the EU by 2021

US total new car sales 2003–2023
(millions of units)



EU total new car sales 2003–2023
(millions of units)

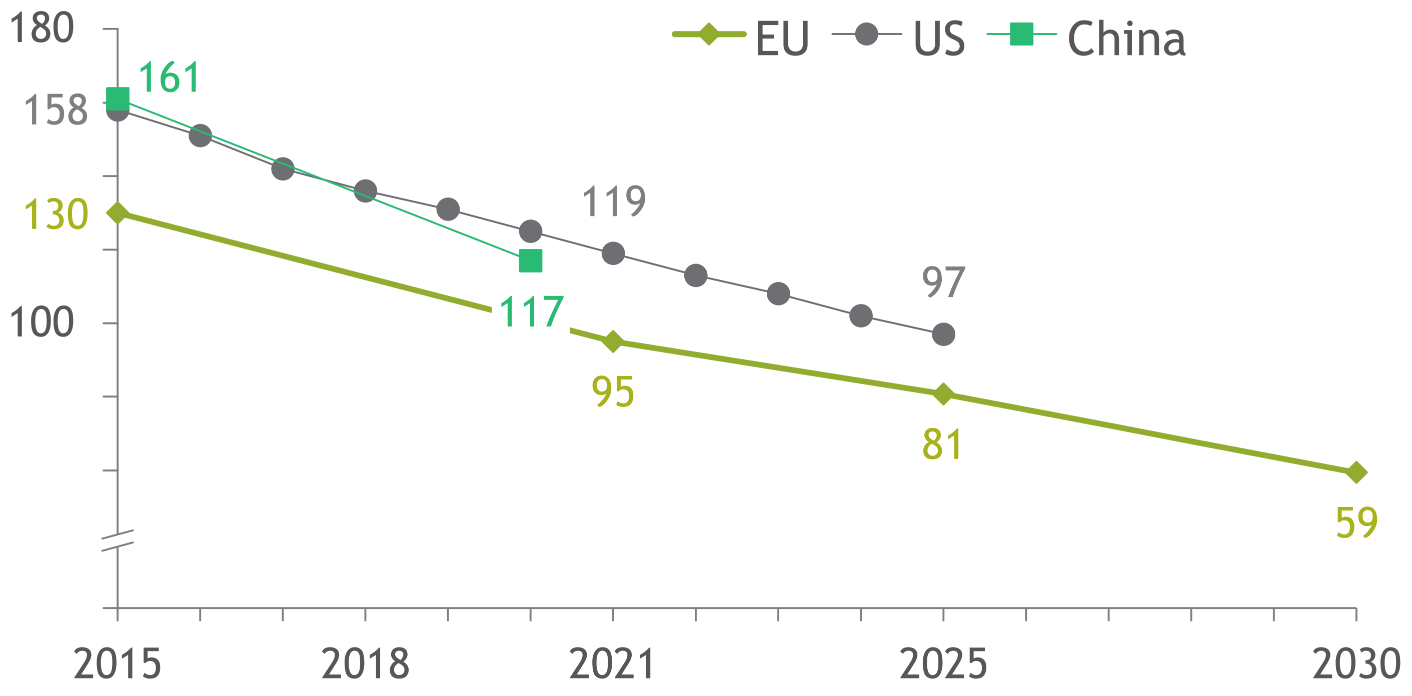


Historic — Average downturn — Major downturn

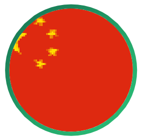
Source: BCG analysis, IMF, US Bureau of Economic Analysis, Federal Reserve, CBO, US Census Bureau, EIA

Shift to electrification

CO_2/km targets (cars, NEDC)

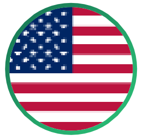


NEV sales targets (cars)



China

3-4% in 2020

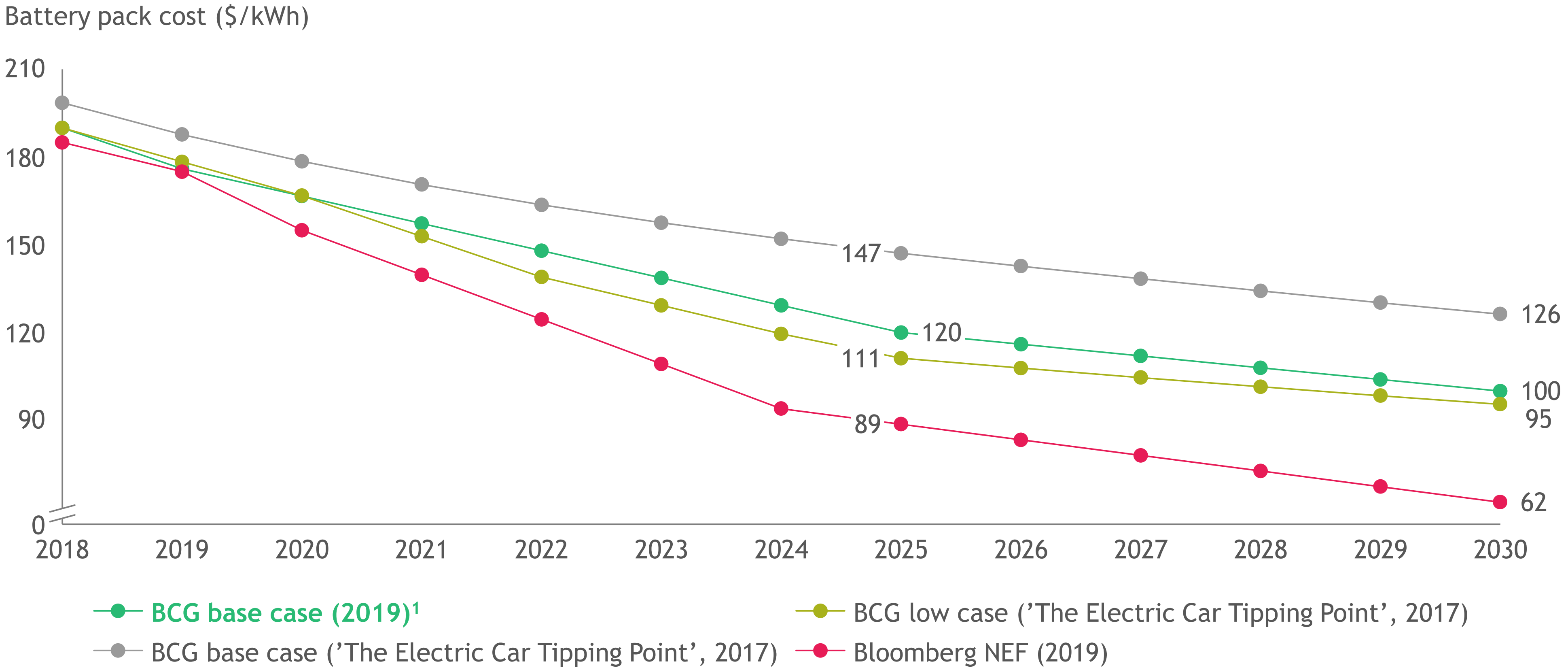


California

3-4% in 2020
8-9% in 2025

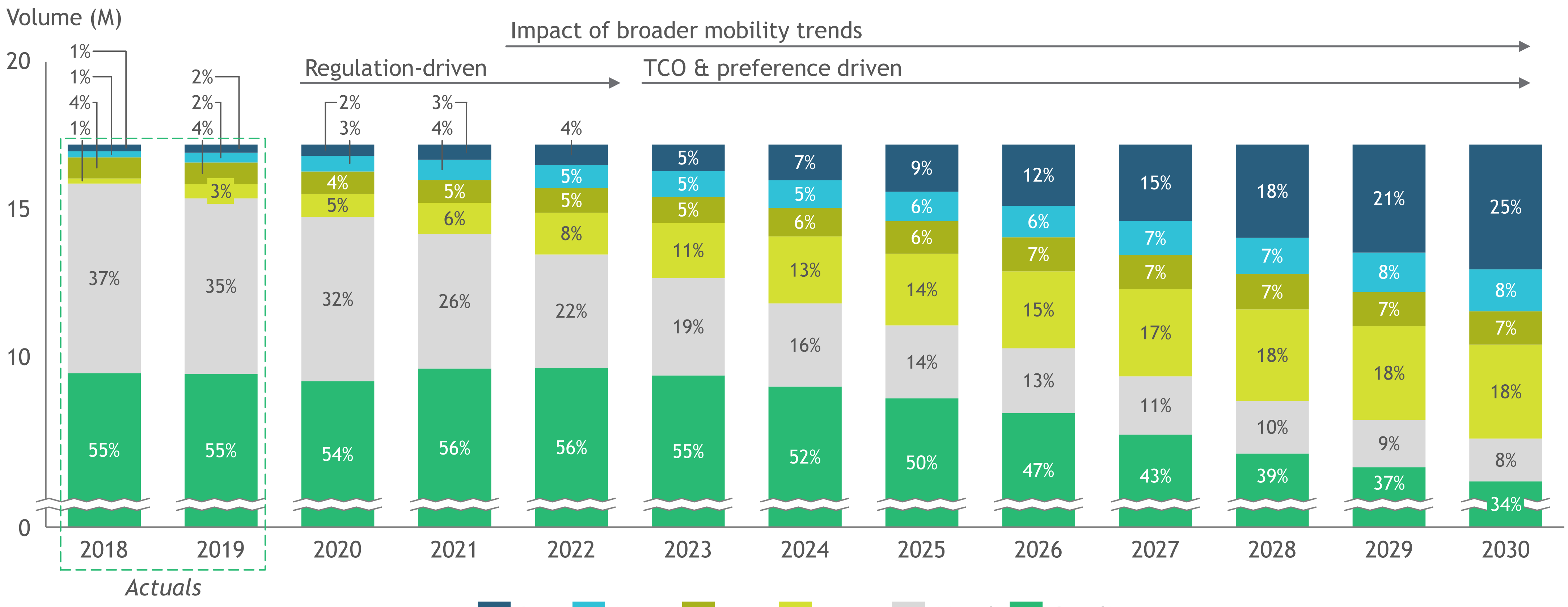
Note: In the EU, objective set at 147g/km for light commercial vehicles in 2021 (125g/km in 2025 and 101.5g/km in 2030)
Source: BCG, ICCT

Battery pack costs are declining as fast as our most aggressive 2017 projection



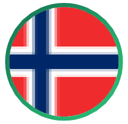
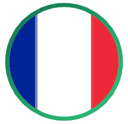
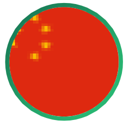
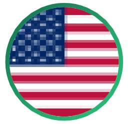
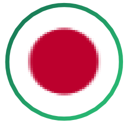
1. Based on BCG 2019 forecast for BEV/Pouch cells; different cell and pack designs or chemistries will drive different costs
2. Conversion from cell to pack cost using a pack factor of 1.4.
Source: BCG analysis and forecast, expert interviews with battery manufacturers and auto OEMs, Bloomberg New Energy Finance

BCG new electric cars forecast to 2030 for Europe



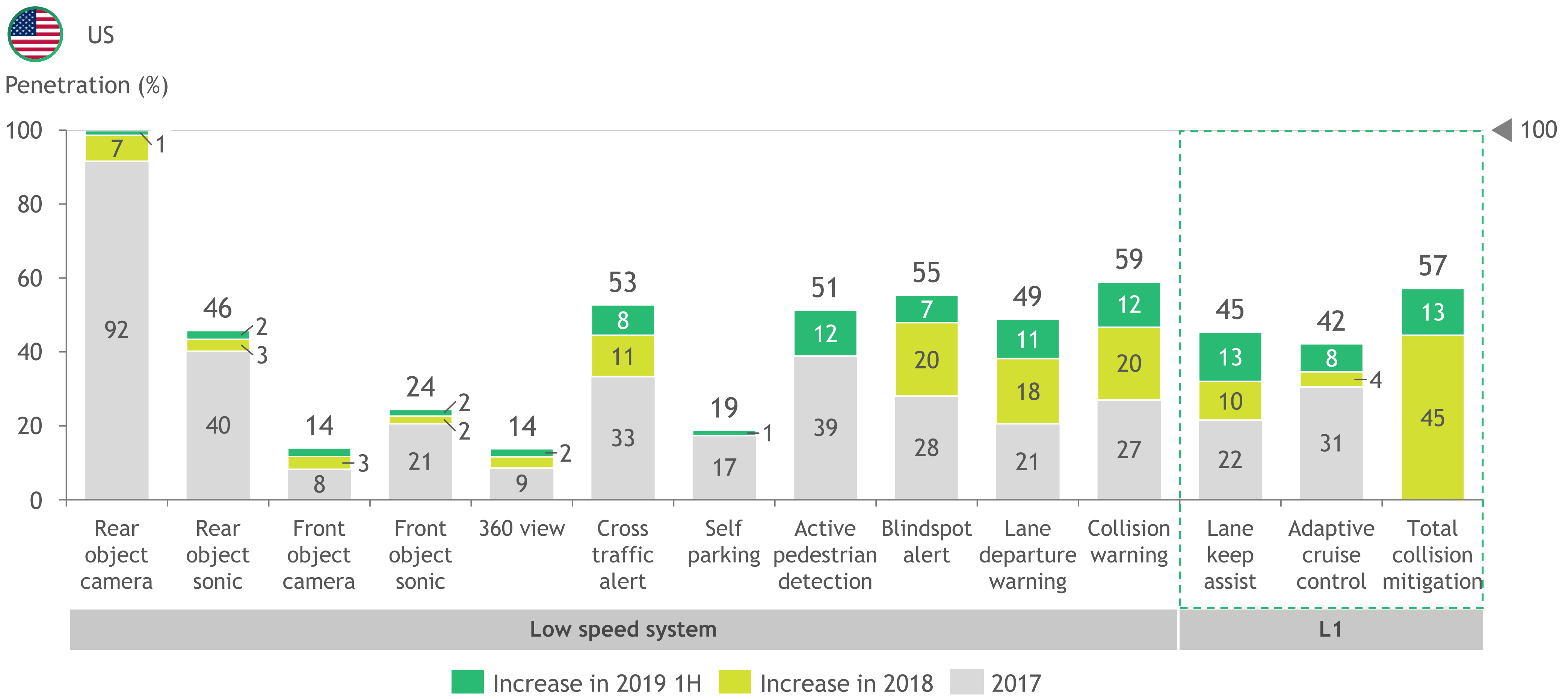
Note: BEV = Battery electric; PHEV = plug-in hybrid electric; HEV = full hybrid electric; MHEV = mild hybrid electric
Source: BCG analysis and forecast

Financial and non-financial incentives remain critical

								
National financial incentives	No VAT[1] & purchase tax	No purchase tax[2]	**€6 000**	€4 000[3]	€4 000	Max €6 500[4]	€6 500[5]	Max €6 500[4] & no purchase tax[6]
Financial incentives introduction date	2001	2010	**2008**	2016	2011	2014	2009	2009
Free road tolls	✓				London			
Free public car parks	✓	✓	Paris	Stuttgart				
Access to dedicated lanes	✓ (bus lanes)						California	
Registration quota exemptions						✓ (Beijing & Shanghai)		
BEV shares in 2018 sales of passenger cars	**31%**	**5.4%**	**1.4%**	**1.0%**	**0.7%**	**3.3%[7]**	**1.4[8]%**	**0.5%**

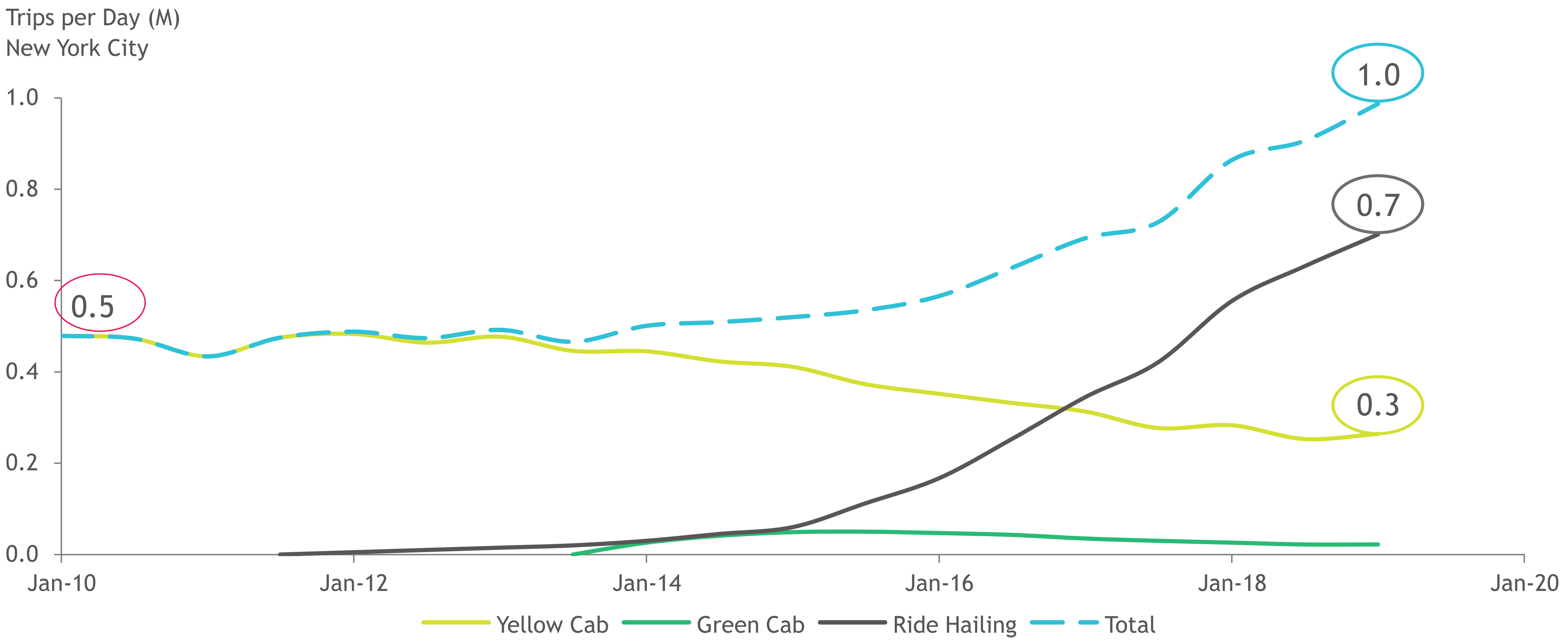
Note: 1. 25% 2. 10-30% 3. Vehicles <60k€ 4. Depending on range 5. Tax credits 6. 3% 7. 10-15% in Beijing & Shanghai 8. Passenger cars + trucks, ~10% in 30 Californian cities
Source: BCG

Significant growth in Driver's Assistance, then Autonomy



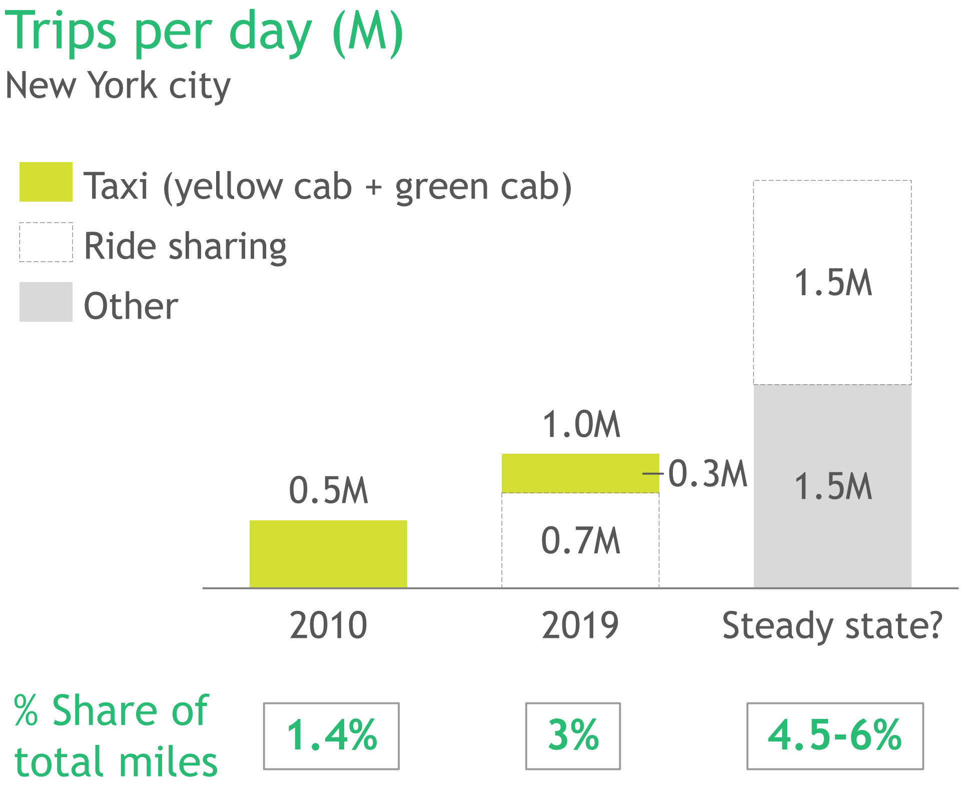
Note: Functionality is independently assessed (e.g. one vehicle counts for both blind spot alert and lane keep assist)
Source: BCG analysis, Factory-Installed Electronic/ADAS Equipment, Wards Auto, 2017-2019MY

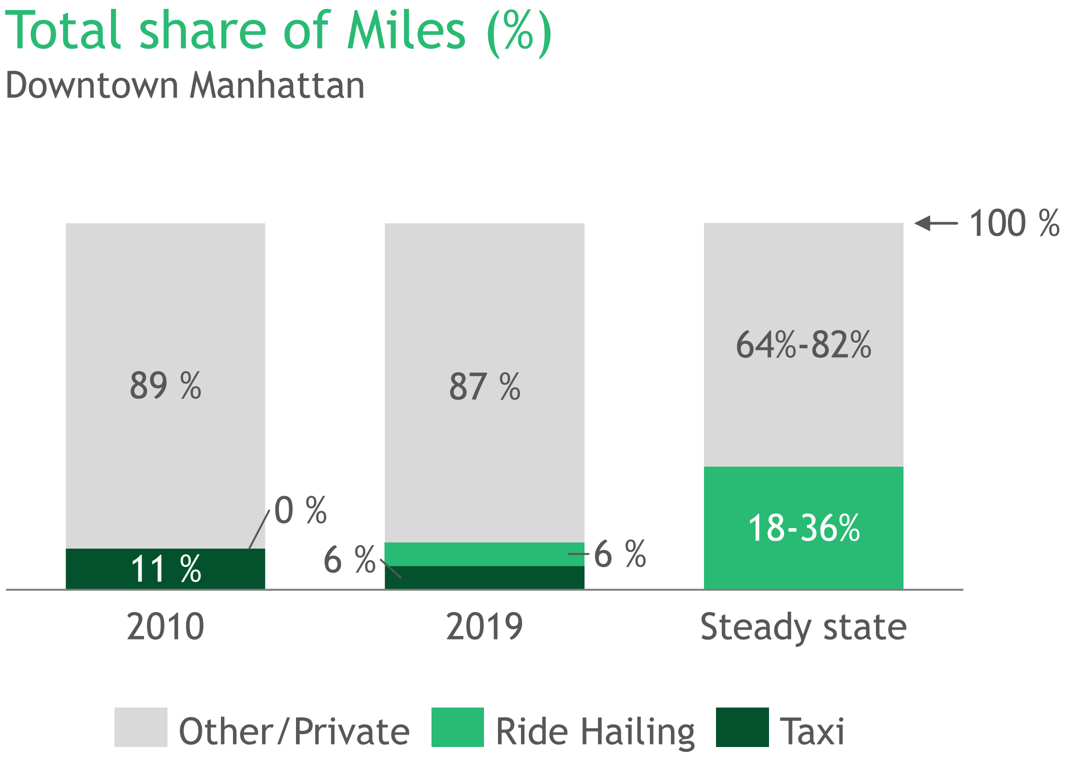
Shared mobility: in New York ride hailing took share from taxis but also grew the overall market by 100%…



Note: Ride Share 2011 – 2015 estimated
Source: BCG analysis, New York City Taxi & Limousine Commission

… and expected to further grow the market, if not capped through regulations





Note: Assuming that current regulations capping the ride hailing numbers are capped
Source: BCG analysis, Uber, Goldman Sachs Research, NYC.gov, New York City Taxi & Limousine Commission

To support the future mobility, industry will need new talents

Today
Single focus engineer

Tomorrow
Cross-functional tinkerer

AI/ML/Robotics System level thinking

Software Math and physics

Skills non-exhaustive

"Mobility centric training"
will be required to develop future talent

"Aerospace engineering was created 100 years ago because it required a systems based approach and a similar program is required for new mobility

- Professor, Top US Tech university

"We need people that are mobility specialists that can be pillars of deep competency within the company

- Senior executive, U.S. OEM

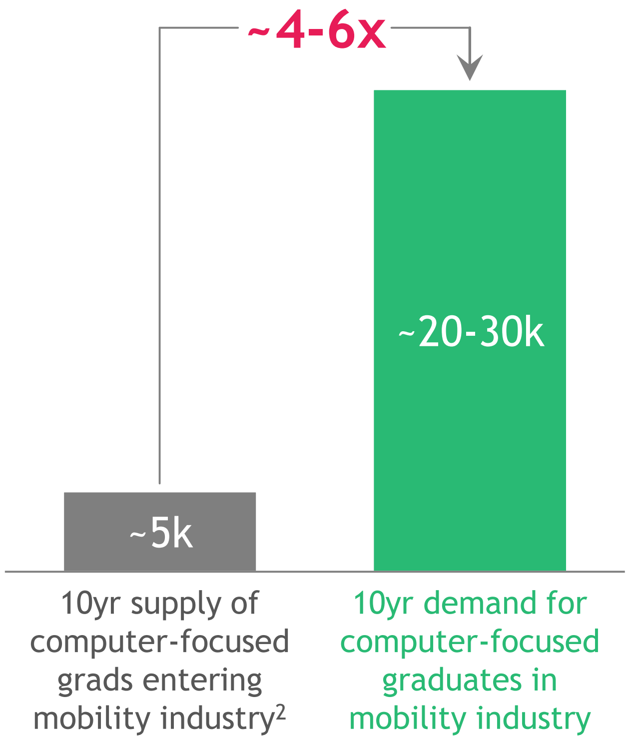
Source: Expert interviews and job posting analysis

… significantly more than the supply

~20-30k

Computer-focused graduates
(For context: 200-300% of computer-focused jobs in auto today)

Significant skilled trades and other engineering jobs to be created for new mobility



4-6x

Growth needed in computer-focused graduates entering the mobility industry across both the U.S. and Michigan[3], to keep up with growing demand

Note: %'s for context based on BLS data showing ~10k computer-focused FTEs and ~50k engineering FTEs in auto today.
Range based on estimate that between 60-100% of university-level jobs remain physically located in the U.S.
Assumed % entering mobility industry = % entering to auto industry today.
Assumed ~30% of national demand for computer-focused graduates are needed in Michigan (MI has ~30% of university-level auto jobs today).

What does it mean for the industry?

Prepare for slowdown

Long term stable growth

All electric

Software and new talents

Global Scale

We are ready to shape the future…

with you!

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Mobility Innovation