Automotive industry: The next 10 years

Xavier Mosquet, Managing Director and Senior Partner
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)

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<tr>
<td>4 years</td>
<td>(62–65)</td>
<td>4</td>
<td>11</td>
<td>13</td>
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<td>3 years</td>
<td>(71–73)</td>
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<td>12</td>
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<td>3 years</td>
<td>(76–78)</td>
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<td>3 years</td>
<td>(83–85)</td>
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<td>3 years</td>
<td>(92–94)</td>
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<td>5 years</td>
<td>(96–00)</td>
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<td>9 years+?</td>
<td>('10–18)</td>
<td>5</td>
<td>12</td>
<td>13</td>
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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)

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<tr>
<td>5 years</td>
<td>(94–99)</td>
<td>5</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>12</td>
<td>10</td>
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<td>2 years</td>
<td>(06–07)</td>
<td>5</td>
<td>12</td>
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<td>14</td>
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<td>10</td>
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<td>5 years+?</td>
<td>(14–18)</td>
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<td>12</td>
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Source: BCG analysis, IHS Markit, US Bureau of Economic Analysis
Economic momentum is weakening

GDP growth forecasts (%)

Source: BCG Henderson Institute, Bloomberg, IMF
Slowdown has started

Global light vehicle sales by region 2010-2031 Units (M)

Japan/Korea  Middle East/Africa  South America  South Asia  North America  Europe  Greater China  CAGR (compound annual growth rate)

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)

- Decrease initially fueled by weakening auto demand. Drop will accelerate due to macro-downturn
- 9-15% drop in car sales in 2021 trough following slowdown in 2019/2020

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

- Less severe 5-10% drop in car sales in 2021 trough

Shift to electrification

**CO₂/km targets (cars, NEDC)**

- EU
- US
- China

**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

<table>
<thead>
<tr>
<th>National financial incentives</th>
<th>No VAT¹ &amp; purchase tax</th>
<th>No purchase tax²</th>
<th>€6 000</th>
<th>€4 000³</th>
<th>€4 000</th>
<th>Max €6 500⁴</th>
<th>€6 500⁵</th>
<th>Max €6 500⁴ &amp; no purchase tax⁶</th>
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<tr>
<td>Free road tolls</td>
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<tr>
<td>Free public car parks</td>
<td></td>
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<td>✓</td>
<td>✓</td>
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<td>Access to dedicated lanes</td>
<td></td>
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<td>✓</td>
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<td>Registration quota exemptions</td>
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<td>BEV shares in 2018 sales of passenger cars</td>
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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.
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)
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

### Trips per day (M)

**New York City**

<table>
<thead>
<tr>
<th>Year</th>
<th>Taxi (yellow cab + green cab)</th>
<th>Ride sharing</th>
<th>Other</th>
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<tbody>
<tr>
<td>2010</td>
<td>0.5M</td>
<td></td>
<td></td>
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<tr>
<td>2019</td>
<td>1.0M</td>
<td>0.3M</td>
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<tr>
<td>Steady state?</td>
<td>1.5M</td>
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% Share of total miles:
- 2010: 1.4%
- 2019: 3%
- Steady state: 4.5-6%

### Total share of Miles (%)

**Downtown Manhattan**

<table>
<thead>
<tr>
<th>Year</th>
<th>Other/Private</th>
<th>Ride Hailing</th>
<th>Taxi</th>
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<tbody>
<tr>
<td>2010</td>
<td>11%</td>
<td>0%</td>
<td>89%</td>
</tr>
<tr>
<td>2019</td>
<td>6%</td>
<td>6%</td>
<td>87%</td>
</tr>
<tr>
<td>Steady state</td>
<td>6%</td>
<td>6%</td>
<td>64%-82%</td>
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Source:
- BCG analysis, Uber, Goldman Sachs Research, NYC.gov, New York City Taxi & Limousine Commission

Note: Assuming that current regulations capping the ride hailing numbers are capped.
To support the future mobility, industry will need new talents

Today
Single focus engineer

Tomorrow
Cross-functional tinkerer

"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

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

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).

~20-30k

~5k

10yr supply of computer-focused grads entering mobility industry

~4-6x

~20-30k

10yr demand for computer-focused graduates in mobility industry

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