



STRATEGIC CONSULTING

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**“ELECTRIFICATION DISRUPTION: HOW NOT TO GET SHOCKED,  
JOLTED AND FRIED BY THE COMING SHIFT IN AUTOMOTIVE  
POWER SOURCES.”**



# Global Emissions Regulations

Despite the efforts of President Trump, global emissions regulations will increase globally (examples of key emissions regulation standards).

|             | 2015       | 2016     | 2017                       | 2018 | 2019      | 2020  | 2021     | 2022 | 2023       | 2024  | 2025  |  |
|-------------|------------|----------|----------------------------|------|-----------|-------|----------|------|------------|-------|-------|--|
| Europe      | Euro VI    |          |                            |      |           |       | Euro VII |      |            |       |       |  |
| USA         | EPA Tier 2 |          | EPA Tier 3 – Clean Air Act |      |           |       |          |      |            | Tier4 |       |  |
| Japan       | JP-9       | JP-16    |                            |      |           | JP-20 |          |      |            |       |       |  |
| South Korea | Euro VI    |          |                            |      |           |       | Euro VII |      |            |       |       |  |
| Brazil      | L6         |          |                            | L7   |           |       |          |      |            |       |       |  |
| Russia      | Euro IV    |          |                            |      | Euro V    |       |          |      |            |       | EU VI |  |
| India*      | B IV       | Bharat V |                            |      | Bharat VI |       |          |      | Bharat VII |       |       |  |
| China*      | China 5    |          |                            |      |           |       | China 6  |      |            |       |       |  |

Sources: ICCT, EPA, Expert Interviews

Notes: \*Major cities, nationwide standards one level lower than in major cities

 Euro IV  Euro V  Euro VI  Proposed Targets or under Consideration

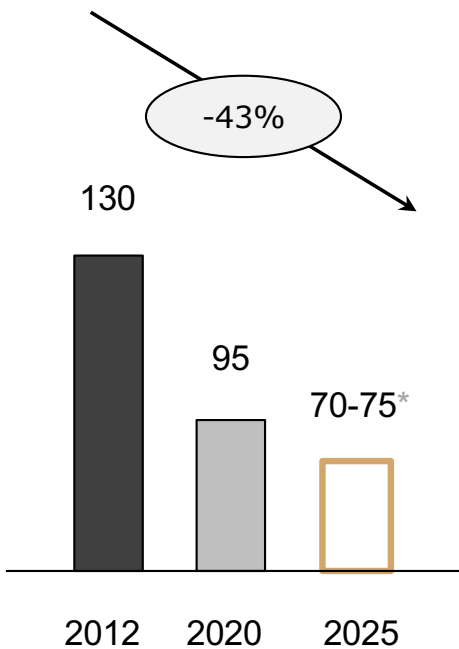


# Global Emissions Regulations

Europe has set the most stringent legislation for CO<sub>2</sub> reduction; however, regulatory pressure is driving significant improvements in all regions.

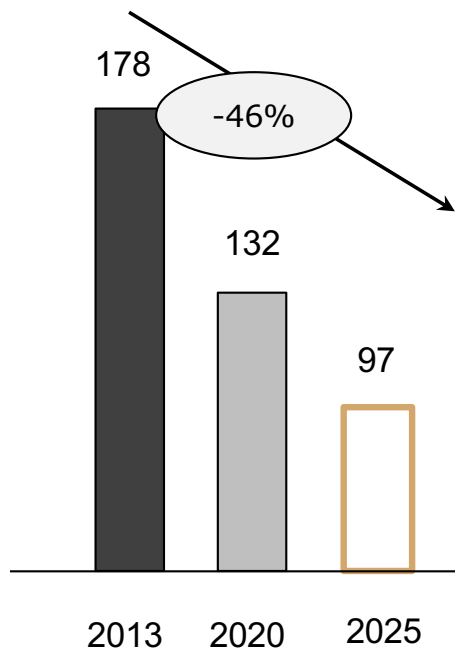
## Europe

- Corporate CO<sub>2</sub> emissions target (g/km)



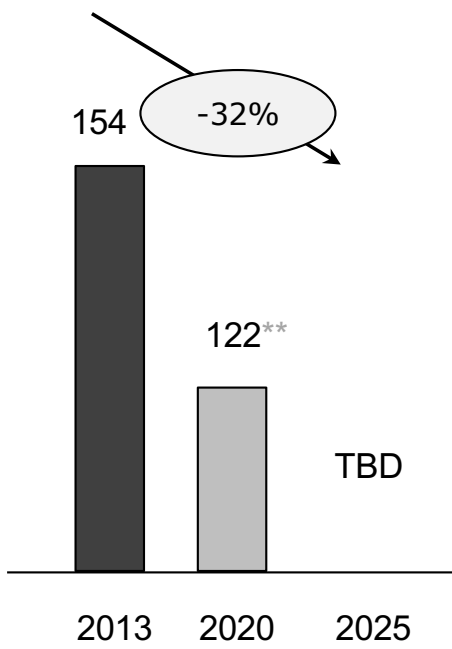
## USA

- CAFÉ (mpg)
- GHG (g/mi)
- CARB (ZEV Credits)



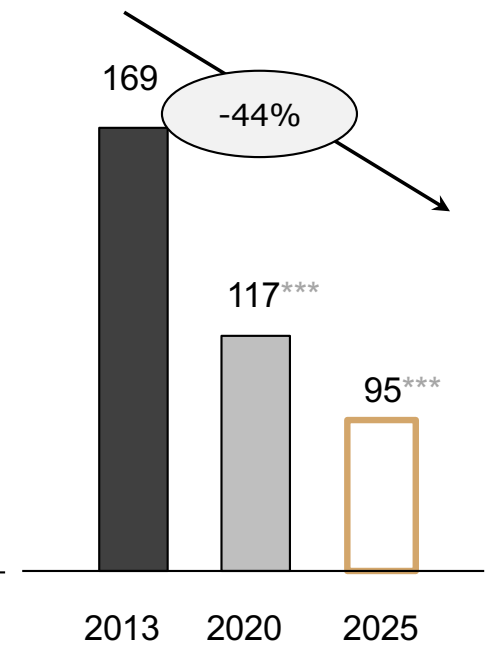
## Japan

- Fuel efficiency target (km/l)



## China

- Corporate CO<sub>2</sub> emissions target (g/km)
- Potential for fleet ZEV credits like CARB



Sources: ICCT, EPA

Notes: \*Proposed level to be incorporated between 2025-30

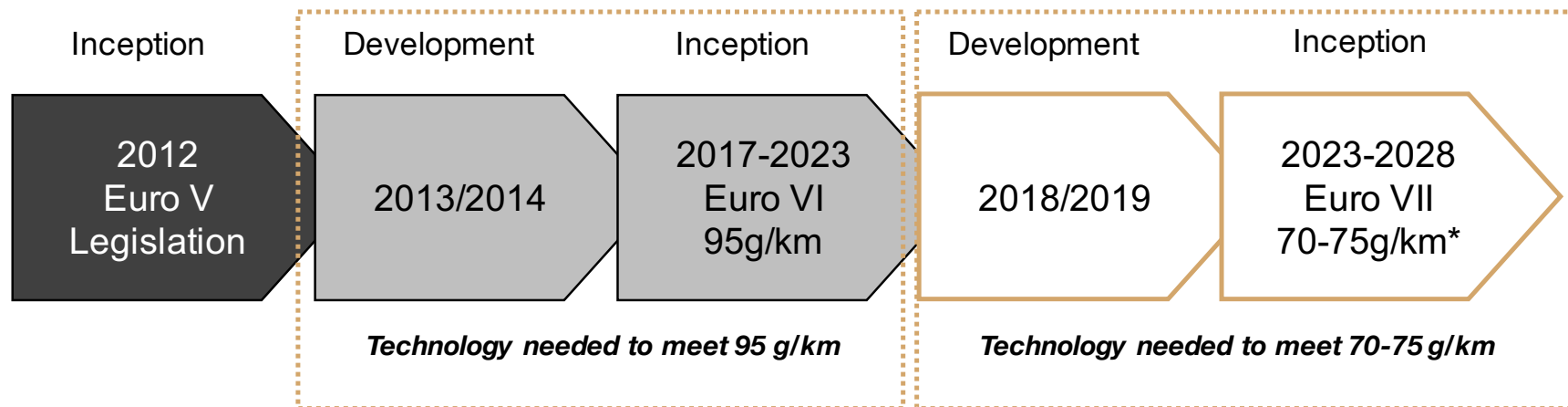
\*\* Japan meets this level today

\*\*\*Stated target for major cities, not nationwide



# Global Emissions Regulations – New Technology to Market

The European market will define the future of automotive engine architecture where new technologies are proven first, and then adoption spreads to additional global markets.



- **The Euro VI technology roadmap is established**
  - When considering standard OEM development practices, one will see that the new technology strategy to meet 95 g/km CO<sub>2</sub> has been finalized and is currently being implemented in Europe.
  - The adoption of these new technologies has started in order to meet the European 2021 targets and execution of this strategy to meet the US Tier 3 regulation will start 2021-2023.
- **The Euro VII technology roadmap is starting to become clear**
  - OEMs are starting to finalize Euro VII strategies by validating both new technologies and the associated financial business cases in order to meet the proposed 70-75 g/km CO<sub>2</sub> target.

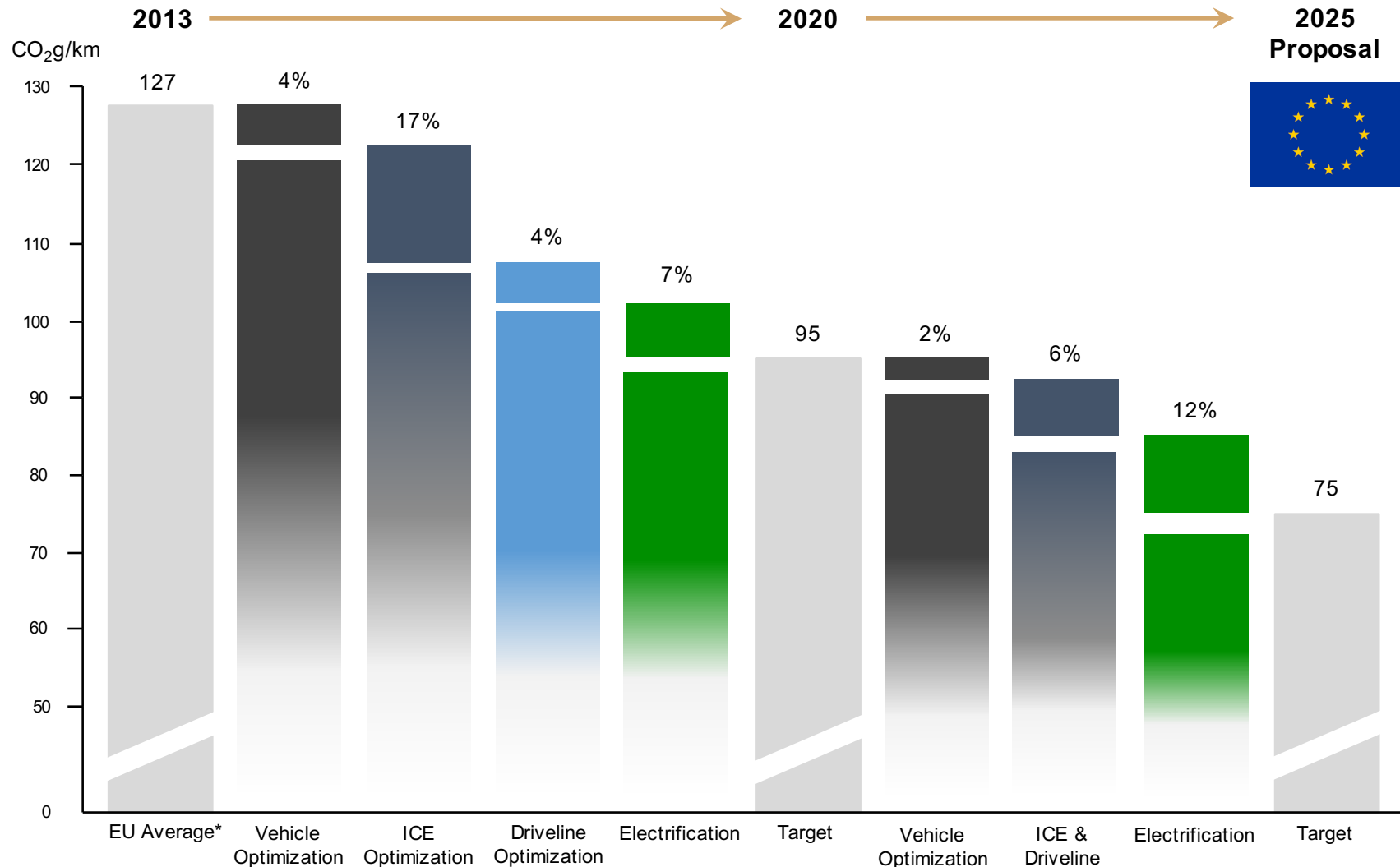
Sources: ICCT, EPA, Expert Interviews

Notes: \*Proposed level to be incorporated between 2025-30



## CO<sub>2</sub> Reduction - Roadmap to 75 g/km

This technology roadmap example from the EU shows that ICE optimization technologies will become less of a priority in the future as the utilization of electrification increases.



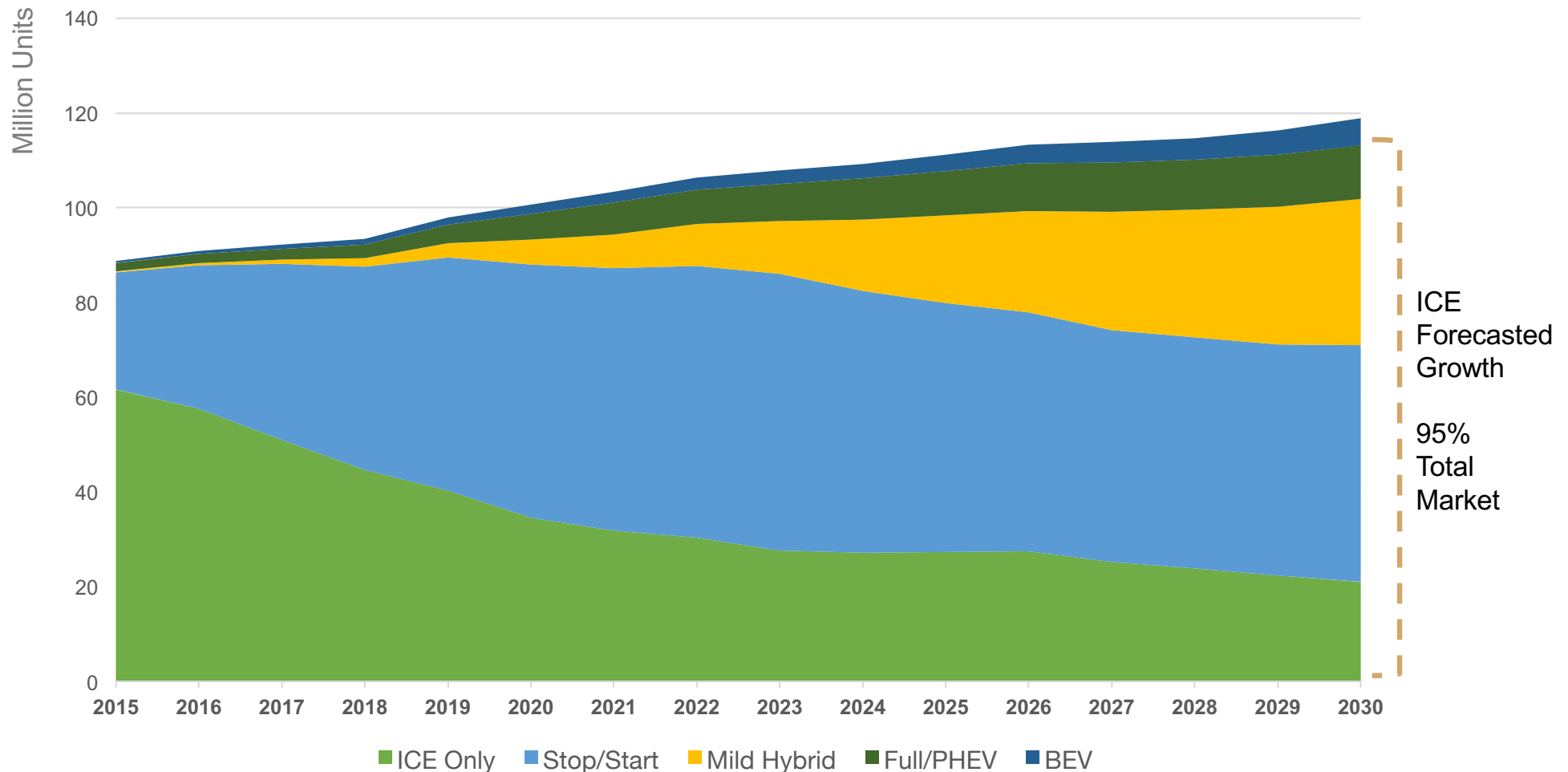
Sources: \*European Environment Agency, Expert Interviews

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## Industry Global Engine Roadmap - Baseline

Current industry forecasts don't consider technology breakthroughs or the exhausted combustion engine potential which will drive the market towards electrified vehicles. Take rates will be higher than industry prognosticators forecast today.



Sources: Analysis based on Industry forecasting source IHS Sept. 2016



## Industry Global Engine Roadmap is Understated

Electrification forecasts are understated for several reasons ...

### Why industry forecasts are understated:

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- 1. Cost of compliance is raising the cost of the ICE**
- 2. Government incentives are not going away**
- 3. Cost of batteries will decrease as range increases**
- 4. Consumer preference for EV performance**
- 5. Future regulations\***
- 6. New OEM Strategies**

*Sources: ICCT, Expert Interviews*

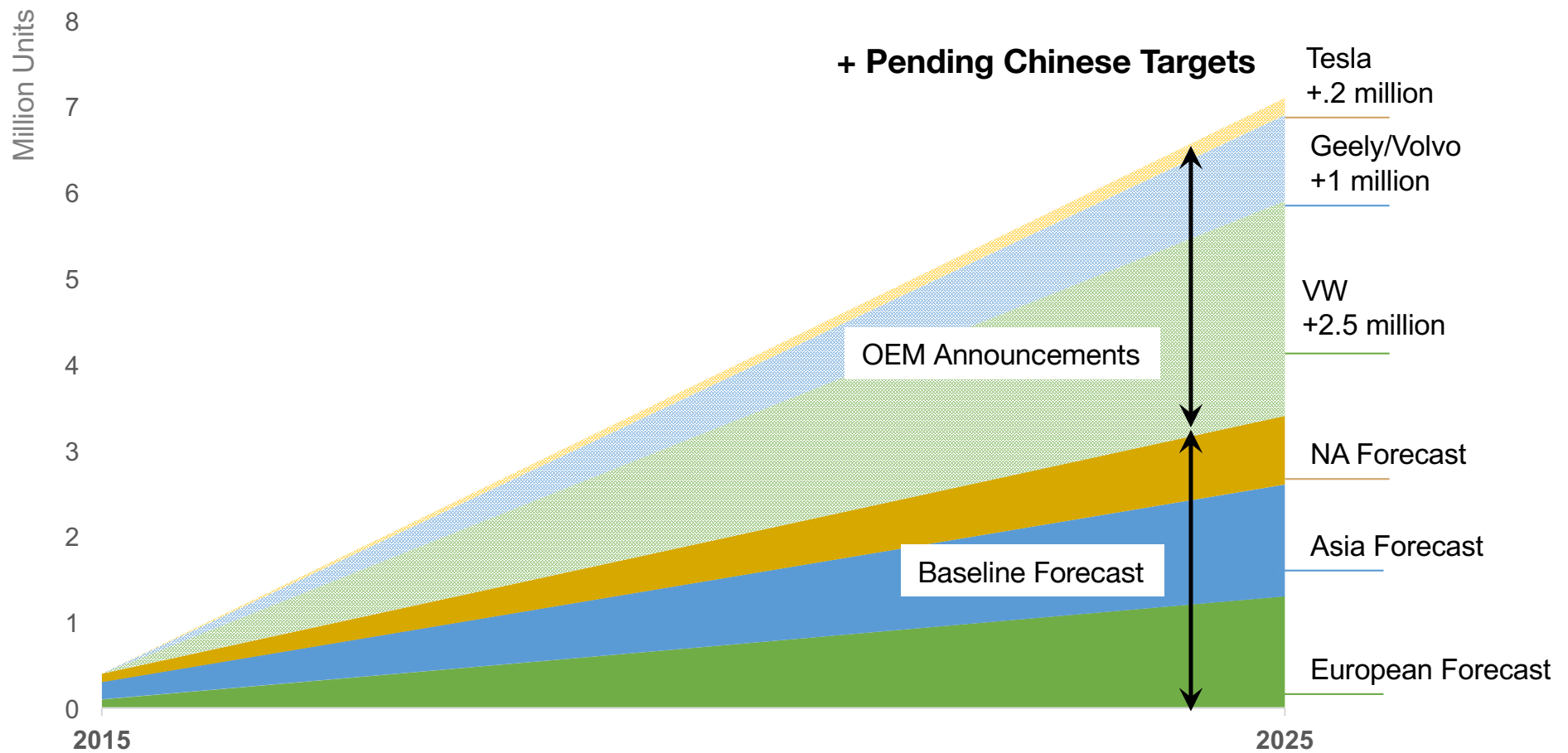
*\*US regulation targets 36.2 mpg in 2016, however 54.5 mpg in 2025 will fall under mid-term review in 2017 and a new Administration*





## BEV Forecast based on Recent OEM Announcements

When considering recent OEM announcements, pending cost breakthroughs and consumer acceptance, it is clear that vehicle electrification will come faster than currently forecasted.

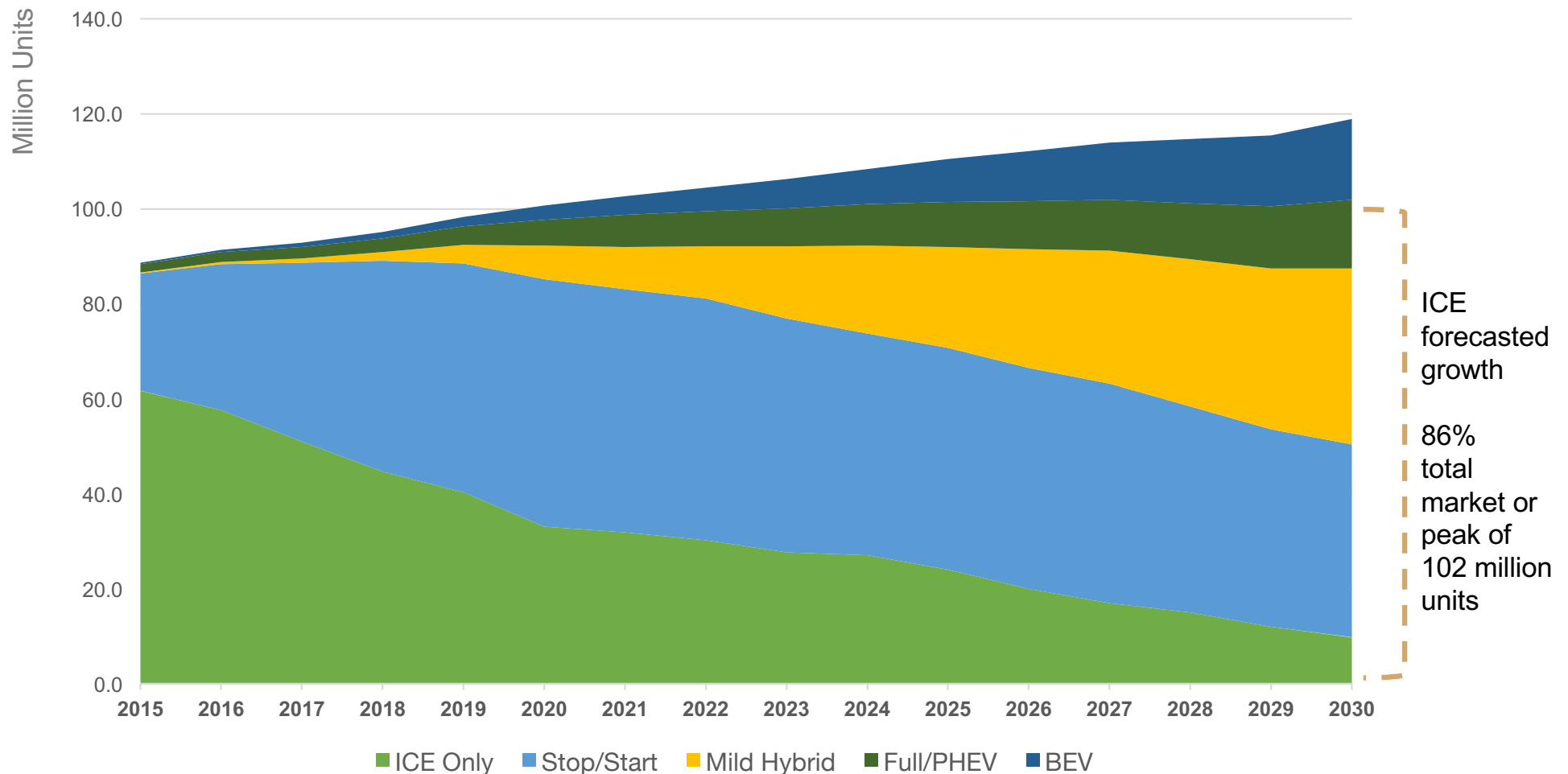


Sources: Borg Warner September 2016, IHS September 2016, Expert Interviews, Magna, Paul Eichenberg Global Research



## Industry Global Engine Roadmap – Optimistic Scenario

17 million BEVs is a likely scenario by 2030 as electrification technology adoption effects almost all vehicles produced globally.



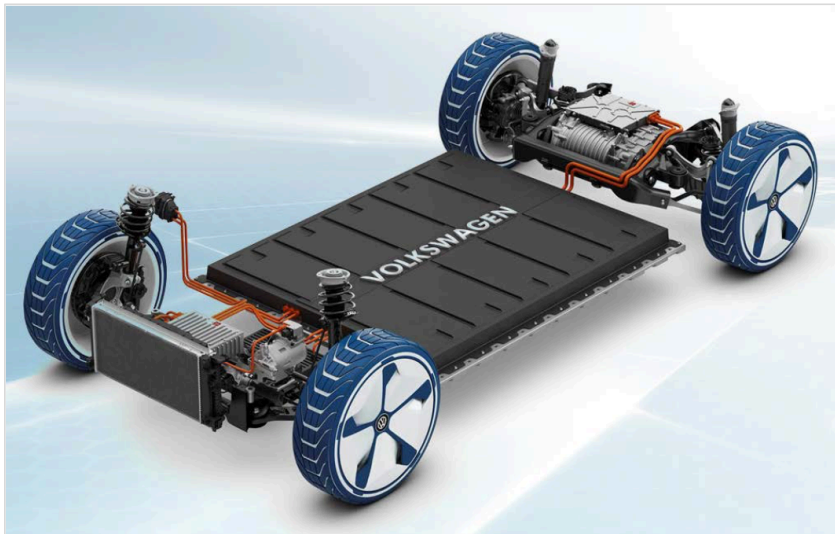
Sources: Forecast based on Paul Eichenberg global analysis, Expert Interviews



# Disruption's effect on the Automotive Industry

What does the end of the mechanical age and digital transformation mean for automotive suppliers?

## Example of Scale - VW MEB Platform:



VW has established the strategy for 2-3 million electric vehicles by 2025 and has developed the MEB platform to achieve scale across the entire group.

*Sources: VW, Expert Interviews*

## Three Main Thoughts:

- 1. Scale is critical in the electrified world and the future of automotive.** Electronic products scale differently than traditional mechanical components.
- 2. Scale and size of the opportunity in automotive will attract new entrants.** New players will come with significant competitive advantages.
- 3. Few suppliers will be able to make the transition.** Most suppliers lack electronics and software competencies to compete for these new products.



**“THE SHIFT TOWARDS ELECTRIFICATION CREATES  
TREMENDOUS OPPORTUNITIES FOR ORGANIZATIONS WHICH  
ARE PREPARED. HOWEVER, THIS DISRUPTION AND THE  
EMERGING NEW COMPETITORS, WILL LESSEN THE CHANCES OF  
SURVIVAL FOR TRADITIONAL SUPPLIERS WHO FAIL TO ACT!”  
PAUL EICHENBERG**



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