**AUTOMOTIVE**

# Autonomy and Mobility

19 October 2016 | Tokyo, Japan

**Jeremy Carlson**, Principal Analyst

+1 310 524 4065, jeremy.carlson@ihsmarkit.com

# Contents

# Trends in technology

# Sensors

**New sensor technologies extend automated driving functionality and increase electronics content in the vehicle.**

| LIDAR | 77 GHz SRR | Trifocal camera | Central ADAS ECU |
|---|---|---|---|
| Valeo + Ibeo<br><br>Quanergy, TriLumina, LeddarTech and solid-state sensors<br><br>Velodyne investment by Ford and Baidu | Delphi<br><br>Bosch<br><br>Current use case and forecast volumes evolve into 79 GHz SRR segment | ZF TRW<br>Delphi<br>Valeo<br><br>Volvo XC90<br><br>Tesla Model S update | Delphi + Audi<br>Autoliv + Mercedes<br><br>Delphi + Mobileye<br><br>BMW + Intel? |

**New generations of sensors attract investment, will change in-vehicle architectures and computing, and introduce new high-tech suppliers.**

# Deep learning

**High-performance computing advances are coming soon to automotive.**

| NVIDIA | Mobileye | Intel | Partnerships |
|---|---|---|---|
| Industry leader with multiple choices<br><br>DGX-1 designed for deep learning<br><br>Widely used hardware but uphill battle to get inside production cars | Industry leader in vision systems<br><br>*Semantic abstraction* to define problems and train solutions<br><br>Fleet learning with Tesla and common in production cars | Nervana Systems USD400-mil. acquisition<br><br>Nervana Neon framework<br><br>Xeon Phi processors with Nervana accelerator chip expected in 2017 | Delphi + Mobileye<br>BMW + Baidu<br>Denso + Morpho<br><br>NXP<br>CEVA<br>Xilinx<br>Synopsys<br>Cadence |

**Deep learning enabling artificial intelligence will introduce new approaches to system design and management over time.**

# Mapping and localization

**Many forms of localization will support automated and autonomous driving.**

| Content layers | HERE \| TomTom | Google | Startups |
|---|---|---|---|
| Relative localization helps to position the vehicle in space<br><br>Crowd-sourced data overlaid on base map<br><br>Mobileye REM and others | High-definition maps with LIDAR sensors<br><br>Many content layers<br><br>HERE - sensor data harvesting from German 3 enabling services to all OEMs | High-definition maps with LIDAR sensors<br><br>Multiple layers of content<br><br>New to auto industry | Civil Maps<br><br>Mapbox<br><br>NVIDIA<br><br>Uber<br><br>Dynamic Map Planning Co. (Japan) |

**Map data and content layers must coexist and complement each other. Crowd-sourcing and sharing are critical to successful scale.**

# Market dynamics

# Regulation

**Regulatory activity is already influential, but it becomes one of the most important market forces for ADAS.**

| NCAP | Voluntary agreements | Standards and guidance | Sharing economy |
|---|---|---|---|
| US NCAP adding 7+ new ADAS in 2018<br><br>Euro NCAP continues to move forward on new AEB features<br><br>Little to no activity from other countries | US commitment for standard AEB by 2022<br><br>Will effectively make AEB standard everywhere in a few years, with rare local model exceptions<br><br>What's next? | ISO 26262 + ASIL<br><br>New automated vehicle guidelines (next slide)<br><br>Progress on cybersecurity and driver distraction guidance in US | Open question everywhere today<br><br>Even China allowed ride-hailing services in legal grey zone<br><br>Regulation likely to be defined by the current market |

**Guidance will shape the future of automotive technology. Regulatory decisions will impact how the sharing economy evolves.**

# USDOT Federal Automated Vehicles Policy – Four Topics

- Vehicle Performance Guidelines
  - 15 assessment criteria including certification, data recording & sharing, cybersecurity, consumer education, and vehicle automation functions
  - Meet / Does Not Meet / Not Applicable
- Current Regulatory Tools
  - Letters of interpretation
  - Exemptions from existing standards
  - Rulemaking
  - Recall authority
- Model State Policy
  - Division of federal and state roles
  - FED—Policy | STATE—Licensing, and…
  - Vehicle testing and safety inspections
  - Traffic laws, registration & insurance
- New Tools & Authorities
  - Pre-market approval
  - Post-sale software regulation
  - Enhanced recordkeeping & data collect

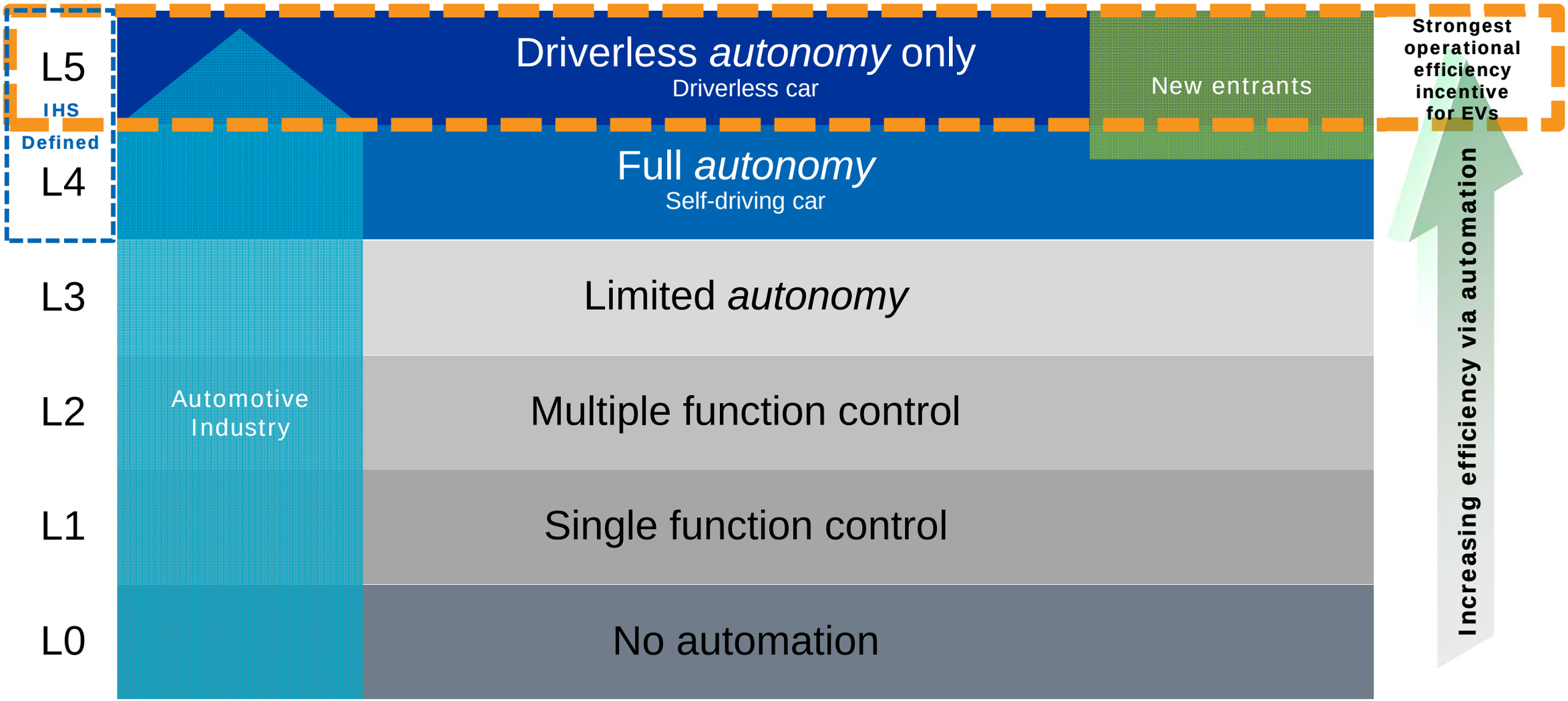
# Automakers

**OEMs racing to deploy new tech via myriad strategies, as gap between luxury and mass market narrows and startups challenge perennial luxury leaders.**

| Luxury leaders | Tesla | Mass market | Startups |
|---|---|---|---|
| Volvo XC90 / S90<br>BMW 7 Series<br>Tesla Model S<br><br>2017 Mercedes E<br>2017 Audi A8 | Autopilot 2.0 coming<br><br><u>Standard hardware?</u><br>Trifocal camera<br>1 x front radar<br>4 x corner radar<br>+ OTA update<br><br>Taking algorithms further in-house | Still mostly packages of ADAS options but moving forward<br><br>Nissan Piloted Drive roadmap to 2020 | Atieva<br><br>Faraday Future<br><br>NextEV<br><br>LeEco<br><br>Karma |

**Deployment of automated driving tech is one of the most strategic decisions an OEM faces, with regulation and evolving mobility also major factors.**

# Automation evolving

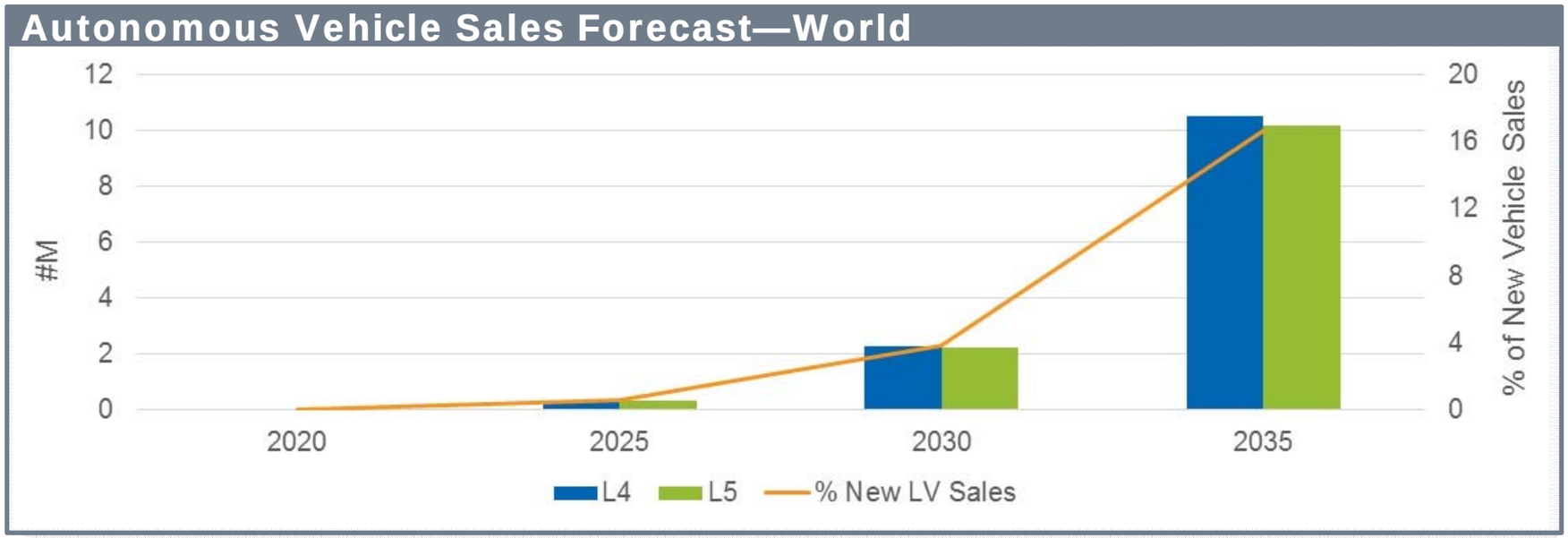


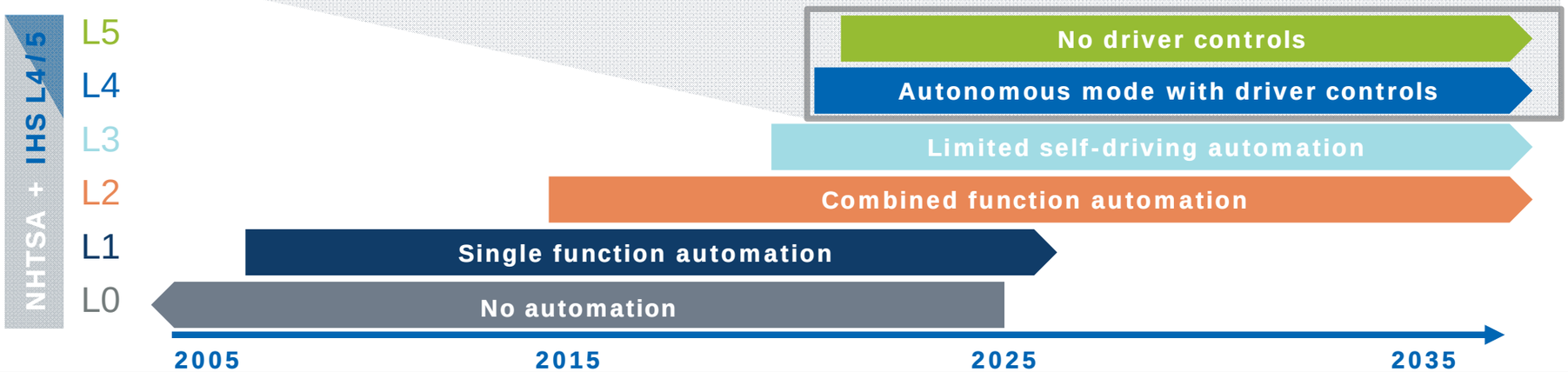



Based on NHTSA levels of automation
NHTSA Level 4 comprises IHS levels 4+5

**SOURCE: IHS Automotive**
***Autonomous Driving Service***

# Autonomous Vehicle Forecast—June 2016



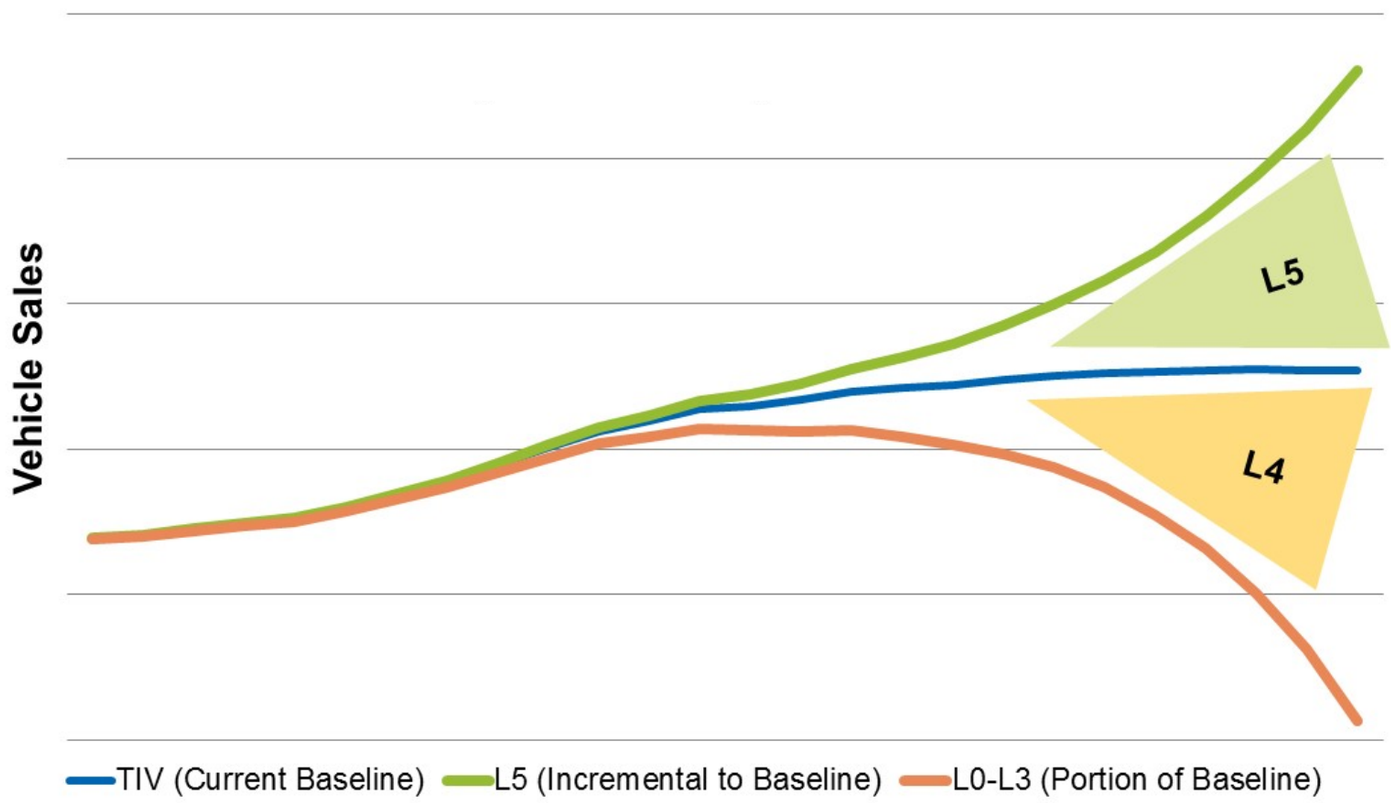






**SOURCE: IHS Automotive**
***Autonomous Driving Service***

# Autonomy scenario: Industry impact visualized

## Autonomous vehicle sales impact scenario




Source: IHS Markit



**As autonomous vehicles arrive, the market impact is split between:**

1. Replacing or updating **current** forecast volumes

2. Adding incremental volume **beyond current** forecast

**Autonomous vehicles can broadly correlate to mobility service models:**

L4 – **Car sharing**

L5 – **Ride hailing**



**SOURCE: IHS Automotive**
***Autonomous Driving Service***

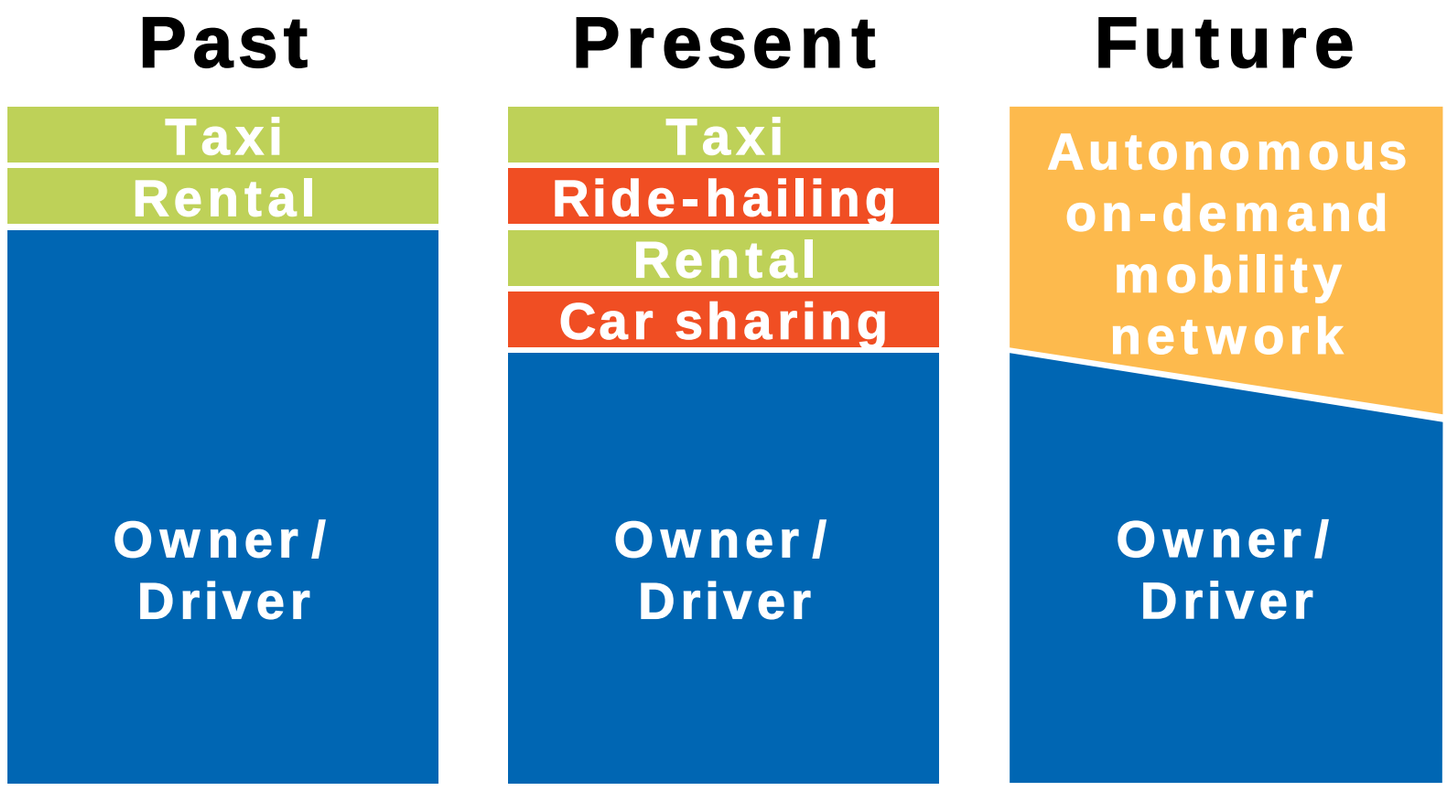
# Mobility

**New mobility services are evolving quickly and challenging traditional tech development, market deployment, and consumer exposure.**

| Uber | Ride-hailing | Car sharing | Automakers |
|---|---|---|---|
| Determined and acting quickly<br><br>Acquire and deploy plus shed losses<br><br>Uber + Volvo<br>Uber + Toyota<br>Uber + Otto | Didi wins in China<br><br>Daimler merging MyTaxi + Hailo<br><br>VW + Gett<br><br>GM + Lyft<br><br>Delphi in Singapore | Smaller fleets but consistent users and often profitable<br><br>Rental car companies adding new tier of service<br><br>OEMs starting their own services | Ford _____<br><br>BMW iNext<br><br>Uber XC90<br><br>Chevrolet Bolt |

**OEMs and suppliers are investing heavily to understand the market, seize opportunities, and capture early market share that can be adapted later.**

# Car-based urban mobility is reshaping transportation



# Mergers and acquisitions

**Supply chain and ecosystem consolidation plus mobility services are fueling partnerships and M&A activity—and new players are coming.**

| Didi + Uber China | Suppliers | Automakers | Tech companies |
|---|---|---|---|
| Most significant consolidation in mobility to date<br><br>Good for Didi & Uber<br><br>Negative for drivers and users because of reduced competition and fewer subsidies | Uber + Otto<br><br>ZF + TRW + Ibeo<br><br>Delphi + Ottomatika<br><br>Freescale + Cognivue<br><br>Lear + Arada | Ford co-lead investor in Velodyne<br><br>Tesla + Solar City<br>GM + Cruise<br><br>Renault-Nissan + Sylpheo<br><br>German mobility | Baidu co-lead investor in Velodyne<br><br>Intel + Itseez<br>Intel + Nervana<br><br>Samsung interest in Magneti Marelli? |

**Changes in the supply chain and in consumer-facing markets will continue to force the industry to rethink and reposition within a changing landscape.**

# Summary

**Vehicle technology evolves quickly, but complexity, deep learning and new data will change system design.**

**Crowd-sourced map and OEM-owned driving data will further increase the value of connectivity and update-able hardware.**

**Technology deployment happens more quickly than ever. Planning becomes even more important.**

**Mobility services will change how automakers approach the market, plan products, and position their brand.**

**Strategic investments and acquisitions help secure valuable opportunities in a rapidly evolving transportation industry.**

THANK YOU!

DANKE

ありがとうございました

DANK U WEL

MERCI

謝謝

OBRIGADO

GRAZIE

감사합니다

TAKK

GRACIAS

धन्यवाद


**IHS Markit Customer Care:**

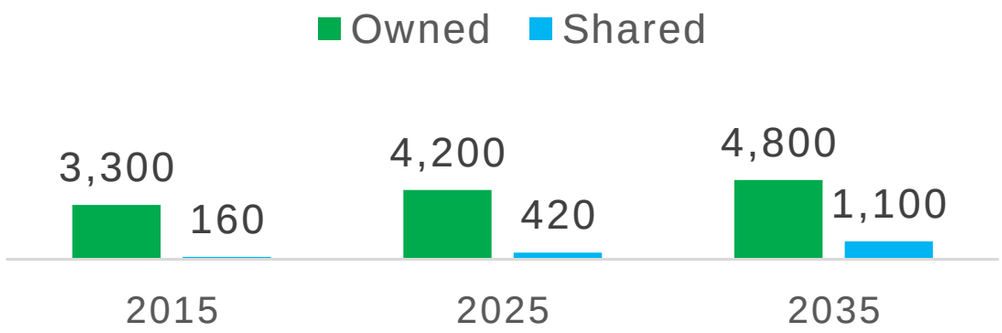
CustomerCare@ihsmarkit.com
Americas: +1 800 IHS CARE (+1 800 447 2273)
Europe, Middle East, and Africa: +44 (0) 1344 328 300
Asia and the Pacific Rim: +604 291 3600



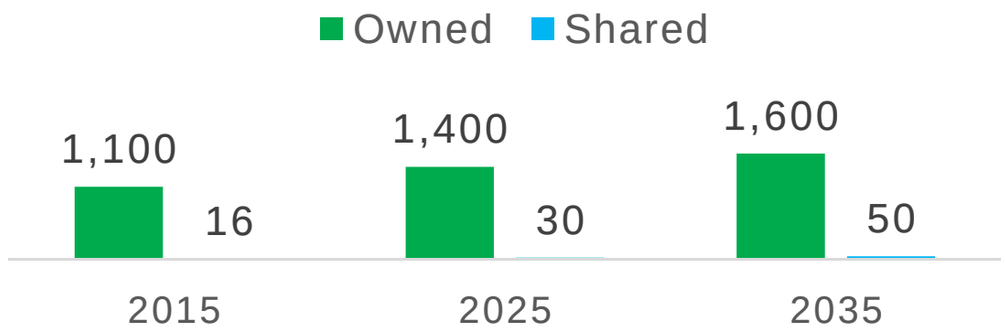

IHS Markit™

# Where we are going: Scenario

## Total daily trips (millions)




## Vehicle parc (millions)




| Owned parc | 1.1B | 1.4B | 1.6B |
|---|---|---|---|
| Average trips/day | 3 | 3± | 3± |
| Total trips/day | 3.3B | 4.2B | 4.8B |

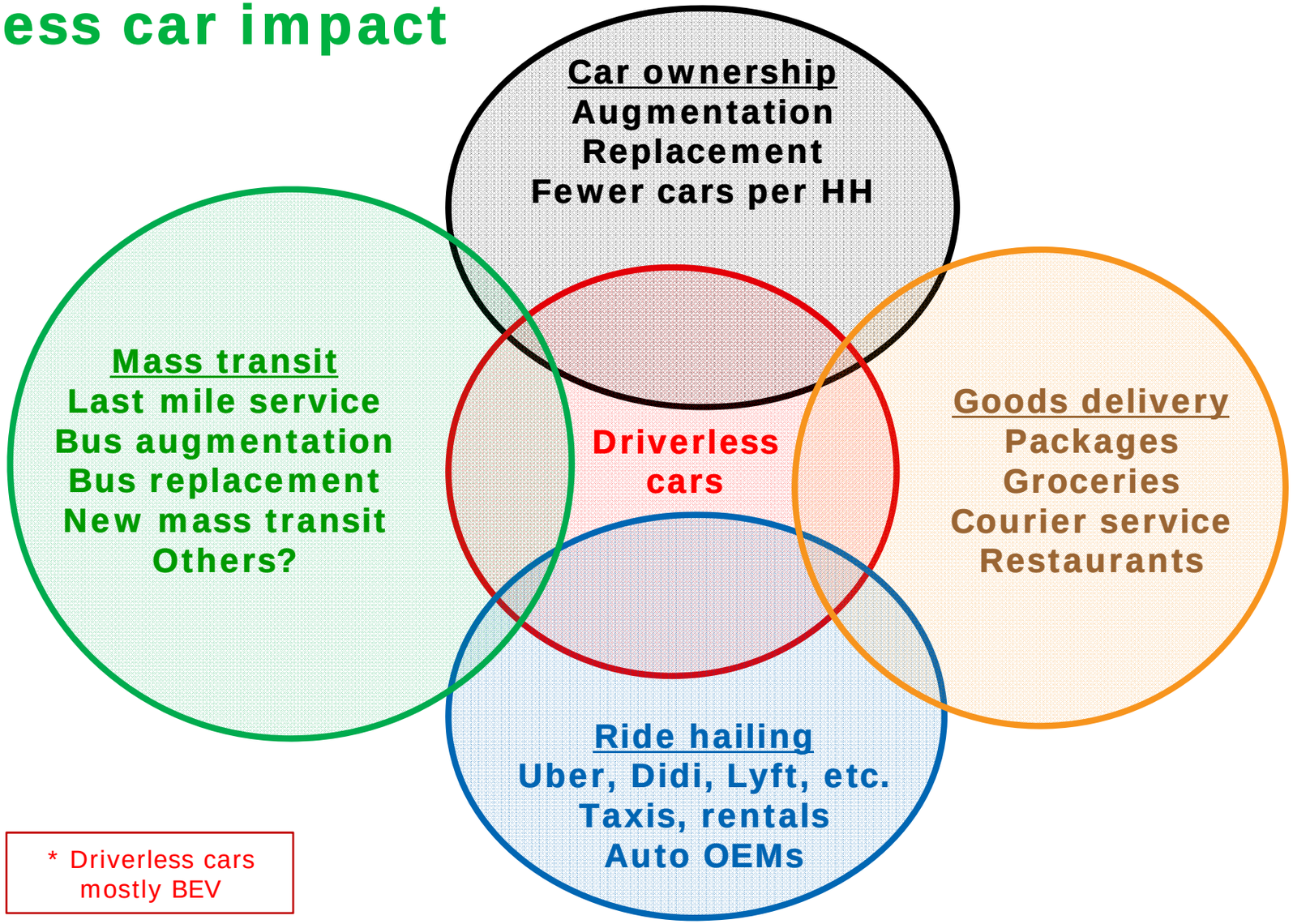
| Shared parc | 16M | 30M | 50M |
|---|---|---|---|
| Average trips/day | 10 | 14+ | 22+ |
| Total trips/day | 160M | 420M | 1,100M |

**Driverless car mobility scales extremely well compared with current cars. Smaller fleets operate efficiently and make mobility available to more people.**



**SOURCE: IHS Automotive**
***Autonomous Driving Service***

# Driverless car impact




* Driverless cars mostly BEV

# Medium and heavy commercial vehicles (MHCVs)

**Automated driving technology will also have significant impact on MHCVs.**

| European leaders | Japan | Automated, not autonomous | Outlook |
|---|---|---|---|
| Daimler Freightliner & Future Truck 2025 | NEDO 2013 platoon demonstration | Will require driver supervision of operation and freight even if platooning | Automated driving as early as 2022 |
| Volvo, Scania | Isuzu-Hino collaboration result | Driver likely required for first and last mile | Likely most popular in US and Europe |
| All have strong light vehicle ADAS portfolios to leverage | Pilot program possible in FY 2018 | Efficiency benefits are still realized | Can help address driver shortages by repositioning job as high-tech |
| Uber joins the game? | 2020 Olympics? | | |

**Operational and logistics efficiencies will transform transportation of goods.**

## IHS Markit Customer Care:

CustomerCare@ihsmarkit.com
Americas: +1 800 IHS CARE (+1 800 447 2273)
Europe, Middle East, and Africa: +44 (0) 1344 328 300
Asia and the Pacific Rim: +604 291 3600