



AUTOMOTIVE

Autonomous Driving

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Sensors

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

LIDAR

Valeo + Ibeo

**Quanergy,
TriLumina,
LeddarTech and
solid-state sensors**

**Velodyne investment
by Ford and Baidu**

77 GHz SRR

Delphi

Bosch

**Current use case and
forecast volumes
evolve into 79 GHz
SRR segment**

Trifocal camera

**ZF TRW
Delphi
Valeo**

Volvo XC90

Tesla Model S update

Central ADAS ECU

**Delphi + Audi
Autoliv + Mercedes**

Delphi + Mobileye

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

Industry leader with multiple choices

DGX-1 designed for deep learning

Widely used hardware but uphill battle to get inside production cars

Mobileye

Industry leader in vision systems

Semantic abstraction to define problems and train solutions

Fleet learning with Tesla and common in production cars

Intel

Nervana Systems USD400-mil. acquisition

Nervana Neon framework

Xeon Phi processors with Nervana accelerator chip expected in 2017

Partnerships

Delphi + Mobileye
BMW + Baidu
Denso + Morpho

NXP
CEVA
Xilinx
Synopsys
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.

HERE TomTom	Google	Content layers	Startups
<p>High-definition maps with LIDAR sensors</p> <p>Multiple layers of content</p> <p>Popular and incumbent suppliers</p>	<p>High-definition maps with LIDAR sensors</p> <p>Multiple layers of content</p>	<p>Relative localization to position the vehicle in space</p> <p>Crowd-sourced data overlaid on base map</p> <p>Mobileye REM and others</p>	<p>Civil Maps</p> <p>Mapbox</p> <p>NVIDIA</p> <p>Uber</p> <p>Dynamic Map Planning Co. (Japan)</p>

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

US NCAP adding 7+ new ADAS in 2018

Euro NCAP continues to move forward on new AEB features

Little to no activity from other countries

Voluntary agreements

US commitment for standard AEB by 2022

Will effectively make AEB standard everywhere in a few years, with rare local model exceptions

What's next?

Standards and guidance

ISO 26262 + ASIL

New automated vehicle guidelines expected in US

Steady progress on cybersecurity and driver distraction guidance in US

Sharing economy

Open question everywhere today

Even China allowed ride-hailing services in legal grey zone

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.**

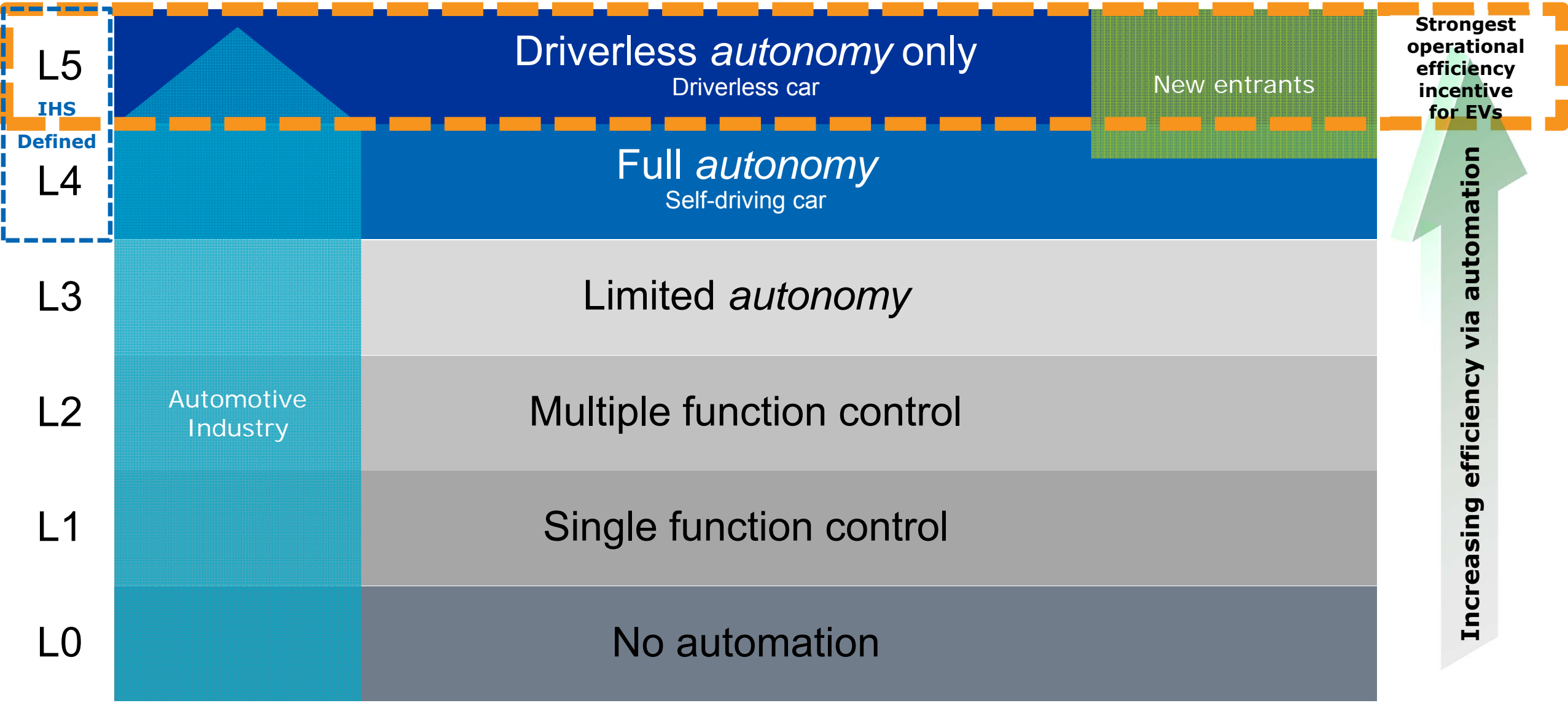
Automakers

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

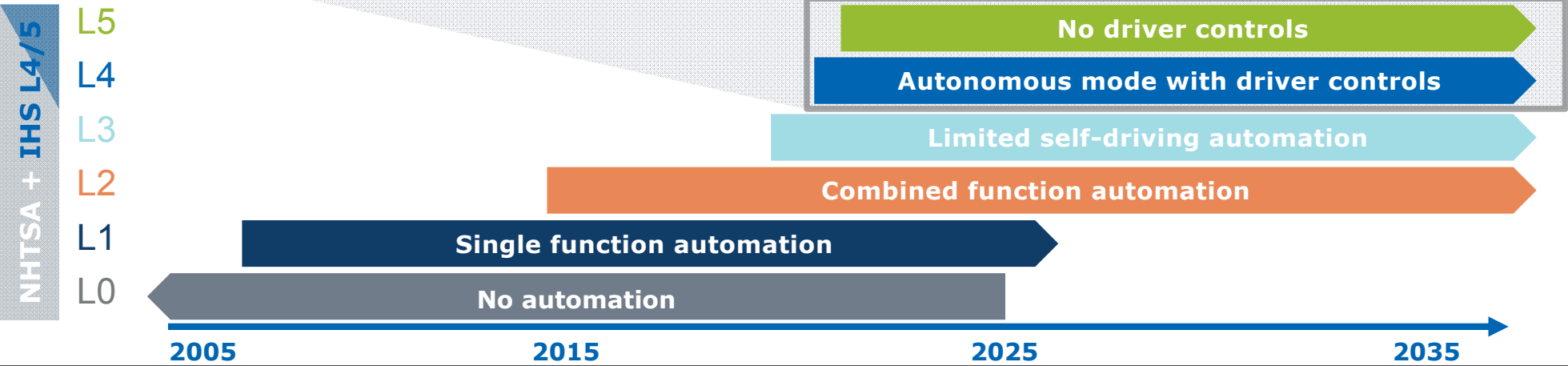
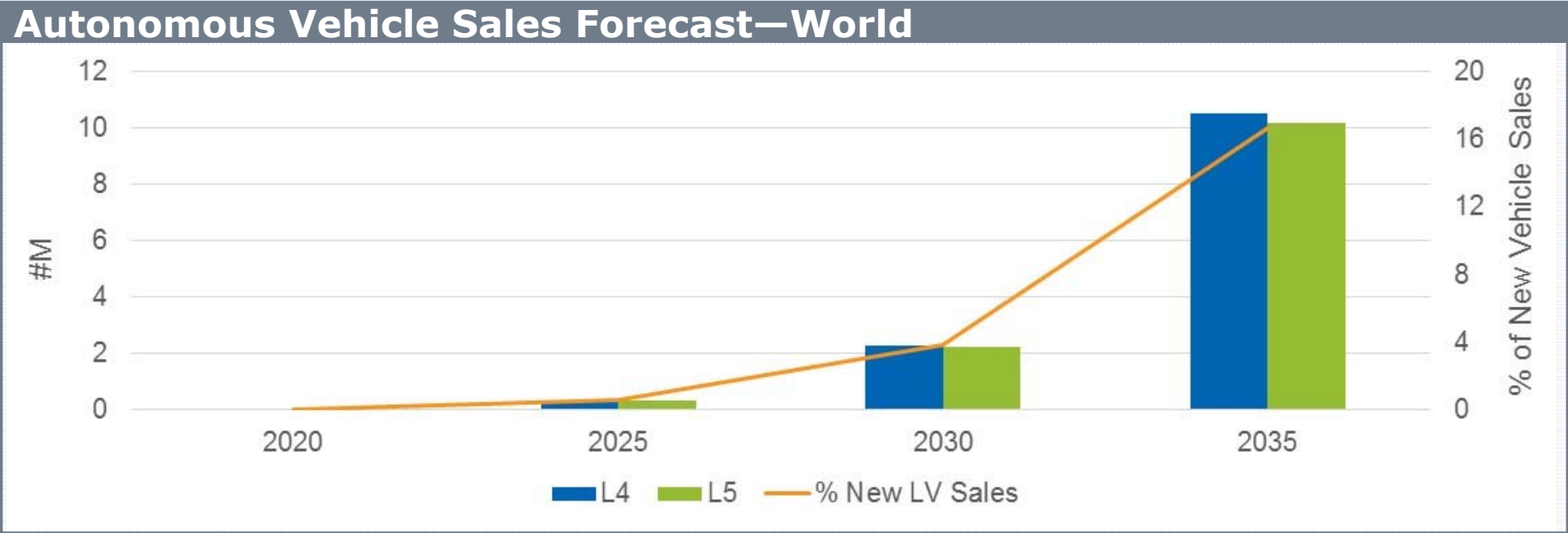
Luxury leaders	Tesla	Mass market	Startups
<p>Volvo XC90/S90 BMW 7 Series Tesla Model S</p> <p>2017 Mercedes E 2017 Audi A8</p>	<p>Autopilot 2.0 coming</p> <p><u>Standard hardware?</u> Trifocal camera 1 x front radar 4 x corner radar + OTA update</p> <p>Taking algorithms further in-house</p>	<p>Still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

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

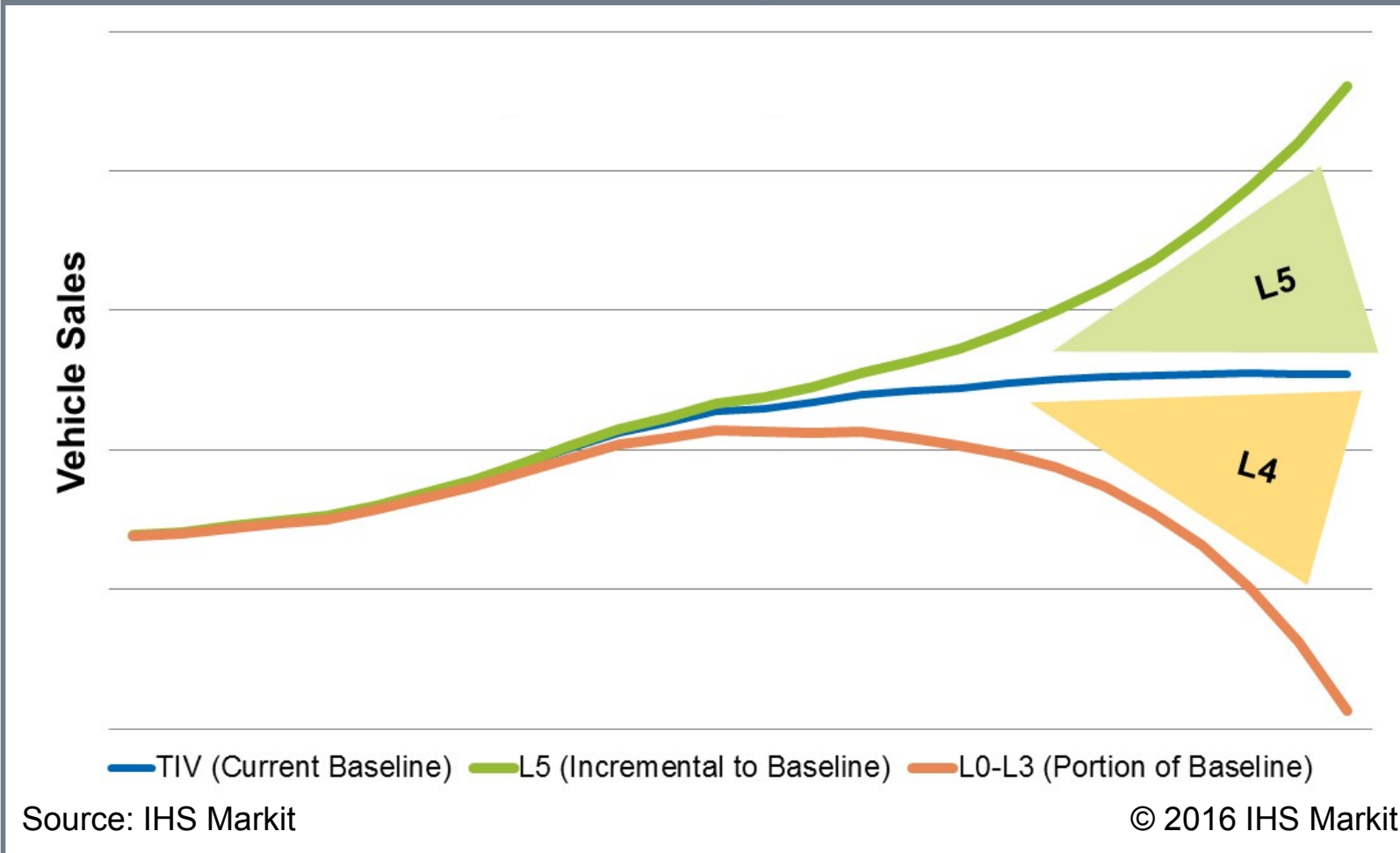


Autonomous Vehicle Forecast—June 2016



Autonomy scenario: Industry impact visualized

Autonomous vehicle sales impact scenario



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

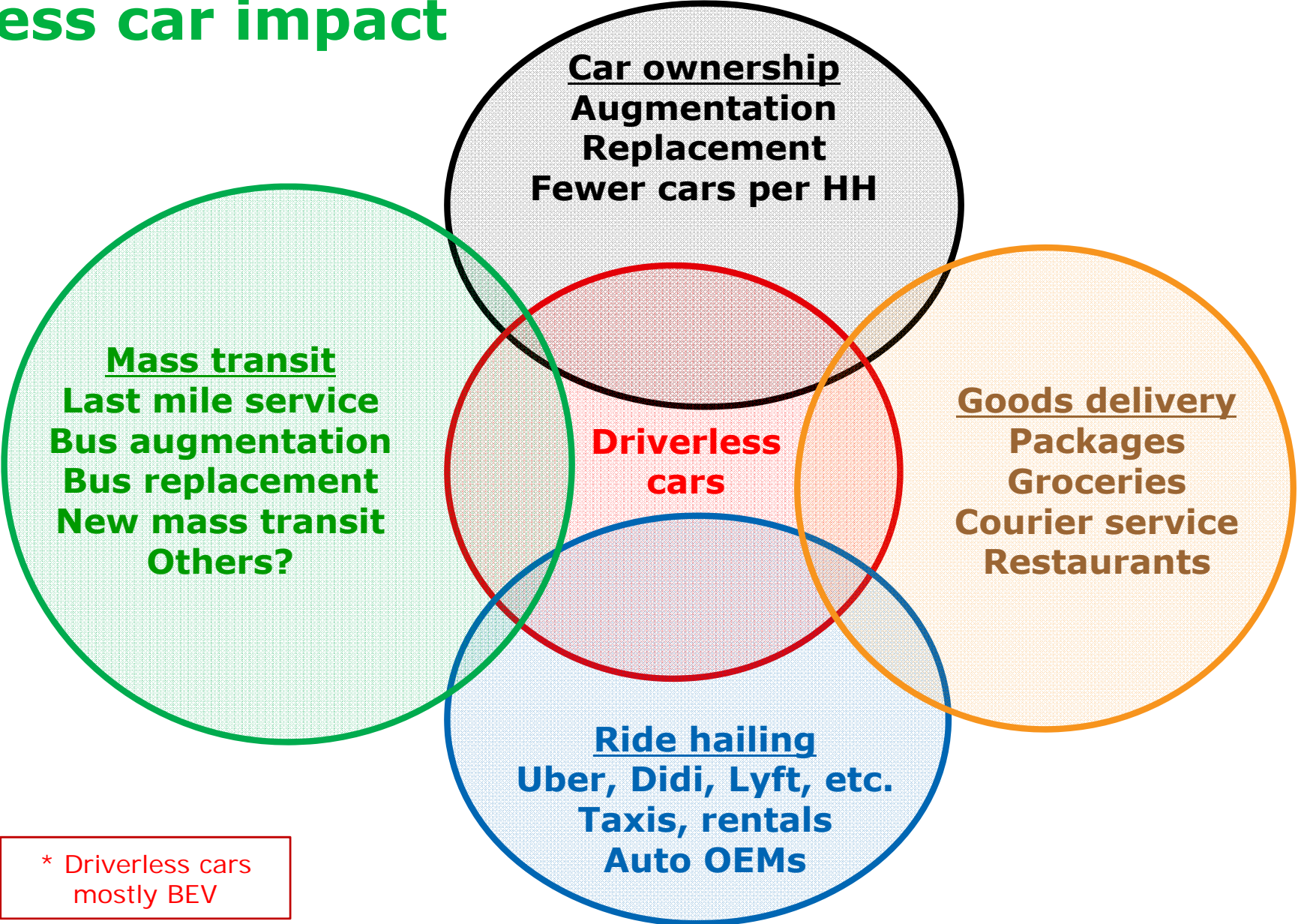
1. Replacing or updating **current** forecast volumes
2. Adding incremental volume **beyond current** forecast

Autonomous vehicles can broadly correlate to mobility service models:

L4 – **Car sharing**

L5 – **Ride hailing**

Driverless car impact



Mobility

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

Uber

Determined and acting quickly

Acquire and deploy plus shed losses

**Uber + Volvo
Uber + Toyota
Uber + Otto**

Ride-hailing

Didi wins in China

Daimler merging MyTaxi + Hailo

VW + Gett

GM + Lyft

Delphi in Singapore

Car sharing

Smaller fleets but consistent users and often profitable

Rental car companies adding new tier of service

OEMs starting their own services

Automakers

Ford _____

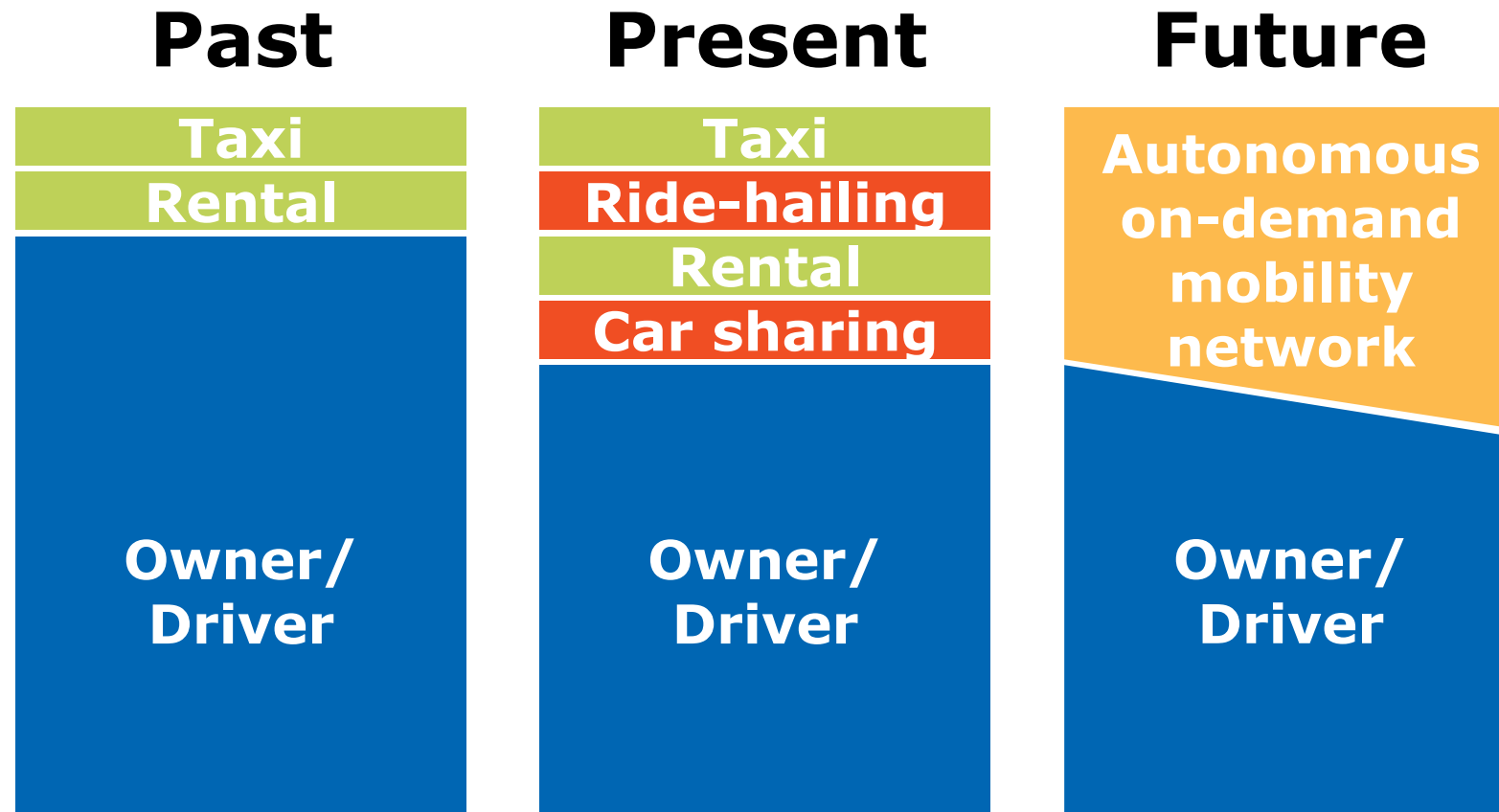
BMW iNext

Uber XC90

Chevrolet Bolt

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

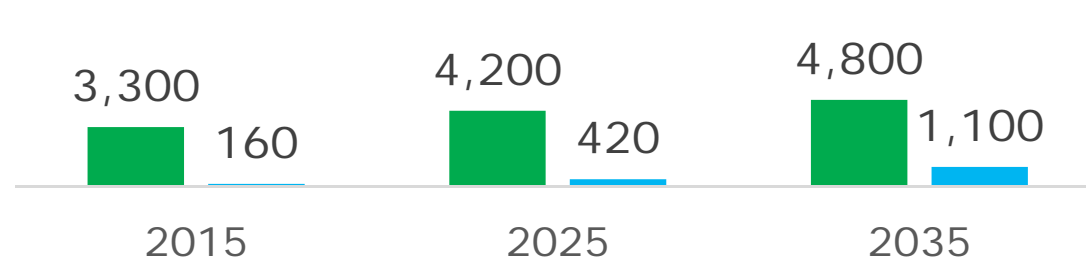
Car-based urban mobility is reshaping transportation



Where we are going: Scenario

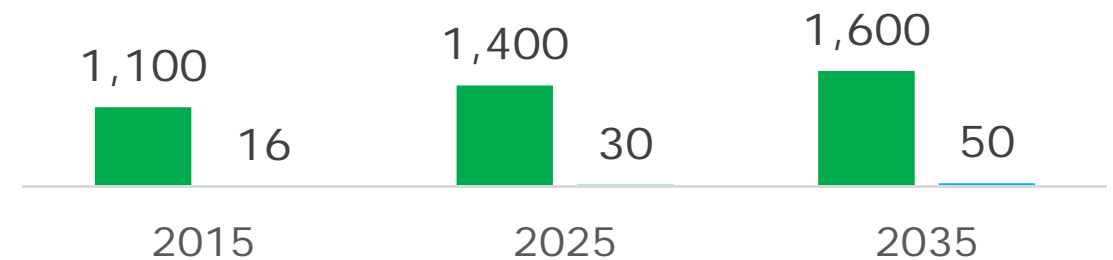
Total daily trips (millions)

■ Owned ■ Shared



Vehicle parc (millions)

■ Owned ■ Shared



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.

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

Most significant consolidation in mobility to date

Good for Didi & Uber

Negative for drivers and users because of reduced competition and fewer subsidies

Suppliers

Uber + Otto

ZF + TRW + Ibeo

Delphi + Ottomatika

Freescale + Cognivue

Lear + Arada

Automakers

Ford co-lead investor in Velodyne

Tesla + Solar City

GM + Cruise

GM interest in Lyft?

German OEMs investing in mobility

Tech companies

Baidu co-lead investor in Velodyne

**Intel + Itseez
Intel + Nervana**

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 and deep learning change the way systems are designed.

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!

ありがとうございました

謝謝

감사합니다

धन्यवाद

DANKE

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GRAZIE

GRACIAS

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OBRIGADO

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Medium and heavy commercial vehicles (MHCVs)

Automated driving technology will also have significant impact on MHCVs.

European leaders

**Daimler Freightliner
& Future Truck 2025**

Volvo, Scania

**All have strong
light vehicle ADAS
portfolios to leverage**

Uber joins the game?

Japan

**NEDO 2013 platoon
demonstration**

**Isuzu-Hino
collaboration result**

**Pilot program
possible in FY 2018**

2020 Olympics?

Automated, not autonomous

**Will require driver
supervision of
operation and freight
even if platooning**

**Driver likely required
for first and last mile**

**Efficiency benefits
are still realized**

Outlook

**Automated driving as
early as 2022**

**Likely most popular
in US and Europe**

**Can help address
driver shortages by
repositioning job
as high-tech**

Operational and logistics efficiencies will transform transportation of goods.