OLIVER WYMAN

VDA | Verband der Automobilindustrie

FAST 2030 - SUMMARY

FUTURE AUTOMOTIVE INDUSTRY STRUCTURE UNTIL 2030

THE IMPACT OF CURRENT TRENDS ON VALUE CREATION AND THEIR IMPLICATIONS FOR THE AUTO INDUSTRY

MAY 2018

MARSH & McLENNAN COMPANIES

Study outline

Outline

- The automotive industry remains **on track for success** – **also in recent years**. After the crisis years 2008–10, both OEMs and suppliers have experienced a prosperous phase
- However, this might turn out to be a short-lived chapter in light of the "**Mighty Seven Industry Trends"** – a perfect storm of transformative technologies and changing customer behavior – which challenge the core business pillars the industry is built on
- As a consequence, the shape of automotive **value creation is expected to simultaneously shift in three dimensions until 2030** – horizontally between vehicle systems, vertically between industry players, and regionally
- **Nine new business models** are emerging and auto suppliers have to not only foster **holistic performance improvement**, but also **re-define their role and operating model** in order to retain competitiveness

Sources

- **More than 100 expert interviews** with global top managers in the automotive industry as well as further external industry specialists
- Triangulation of a **vast set of market publications, industry reports, and other external sources** to gather additional both quantitative and qualitative insights on current and future developments
- Insights from **Oliver Wyman's global internal expert network, knowledge repository and recent intellectual proprietary** on industry dynamics and transformative trends (amongst others, "E-Mobility 2035 study", "Mobility 2040 study", "HMI point of view")

Value creation model

- **Scenario-based impact quantification of different trends** (e.g. autonomous vehicles, powertrain electrification) **on automotive value creation until 2030;** scenarios defined on individual trend levels (e.g. "breakthrough" vs. "stay as-is")
- The model's **unique feature is the granular assessment of value shifts** by region, vehicle system, player archetype, vehicle segment, and value creation type (production vs. R&D) – hence, **simultaneous disclosure of multidimensional shifts**
- As a result, the model comprises more than 30 variables and **>800,000 output data fields per future scenario**

Limitations

- **Forecast horizon 2030** – some directional views on the time beyond
- **Consolidation of suppliers tiers on one level** ("automotive suppliers")
- **No separate display** of value creation from **pure software development**
- **No consideration of value shifts aside vehicle production** (e.g. aftermarket business and mobility services)
- Vehicle types aggregated into **premium, volume & small vehicle segments** incl. pickup trucks and commercial vans

Authors

Automotive Practice
Detroit

- Over 25 year of consulting and auto industry experience
- Co-Lead: Global Supplier
- Focus on enterprise-wide improvements/restructuring and corporate, product and technology strategies
- Extensive international work in the US, Mexico, EU, Japan, and Korea
- Author of various Oliver Wyman studies e.g:.
  - o Digital Industry/ Industry 4.0
  - o E-Mobility 2035
  - o Management of Obsolescence

Automotive Practice
Munich

- Over 10 years consulting in the automotive industry
- Oliver Wyman Global Supplier Team
- Focus on strategy development, operations improvement and transformations
- Author of various Oliver Wyman studies e.g:.
  - o FAST 2025
  - o Value and Cost Migration
  - o E-Mobility 2035

Automotive Practice
Munich

- Five years of consulting and auto industry experience
- Focus on strategic business transformation, (digital) business model development, and mobility services
- Extensive international work with focus on all of Europe

Automotive Practice
Berlin

- 10 years of consulting and auto industry experience
- Focus on growth and portfolio strategies, mergers and acquisitions and new (digital) business models
- Expert in disruptive automotive industry trends
- Extensive international work experience in Germany, India, North and South America

Content

1. **Status:** Current status of the automotive industry
2. **Trends:** Current and emerging trends changing the automotive industry
3. **Value:** Automotive value creation development until 2030
4. **Impact:** Areas of impact and strategic business model options for automotive suppliers

1

STATUS:
Current status of the automotive industry

Current status of the automotive industry – Overview

Overall, the automotive industry remains strong and continues to grow; suppliers are well positioned, but the road ahead is challenging

1 | Strong global growth of the automotive industry

Light vehicle production has grown to ~95 mn vehicles in 2017

+3%
CAGR (2010-2017)

2 | Regional value shifts in key markets

Emerging markets have been the key growth drivers with China leading at…

+15%
CAGR (2005-2017)

3 | Pressure both from need for increased customer value and on prices

Concurrently, products have become more complex at unchanged price levels

x1.6
PATENTS (2008-2016)

4 | Healthy profit margins for suppliers

Despite the tension, suppliers have shown sound financial performance

EBIT MARGIN
(average, 2015)

5 | …but increasing challenges for suppliers emerge

Disconnect between growth, new tech, and organizational readiness manifests in multiple issues such as quality

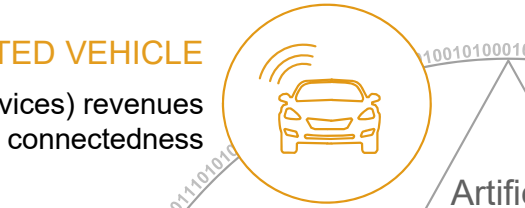
Source: Oliver Wyman analysis

2

TRENDS:
Current and emerging trends changing the automotive industry

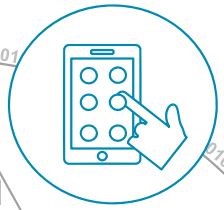
The Mighty Seven – Automotive industry trends until 2030

Seven fundamental trends drive the automotive industry until 2030, enabled and accelerated by Digitalization, AI and Machine Learning



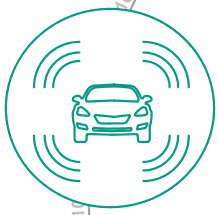
CONNECTED VEHICLE

Additional safety and (services) revenues through increasing connectedness



HUMAN-MACHINE-INTERFACE

New and digitized control concepts for driver/car interaction

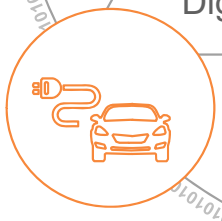


AUTONOMOUS VEHICLES

Progression of today's partially automated driving into fully driver-less vehicles

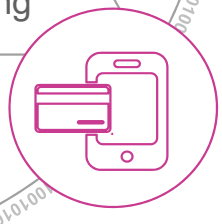
CHANGING CUSTOMER STRUCTURE

Partial replacement of individual vehicle buyers by large fleet or group buying driven by mobility-on-demand services



E-MOBILITY

Increasing electrification of powertrains, resulting in decreasing penetration of ICEs



NEW DISTRIBUTION CHANNEL PAY-PER-USE

Provision of selected vehicle features as pay-per-use for certain target groups of vehicle owners

DIGITAL INDUSTRY

Increasing digitization of processes through predictive and adaptive data capability

Source: Oliver Wyman analysis

Changing customer structure

TREND

- Increasing shift from vehicle ownership to usership ("mobility on demand")
- New mobility fleet operators enter the market and increasingly replace individual vehicle buyers

DRIVERS

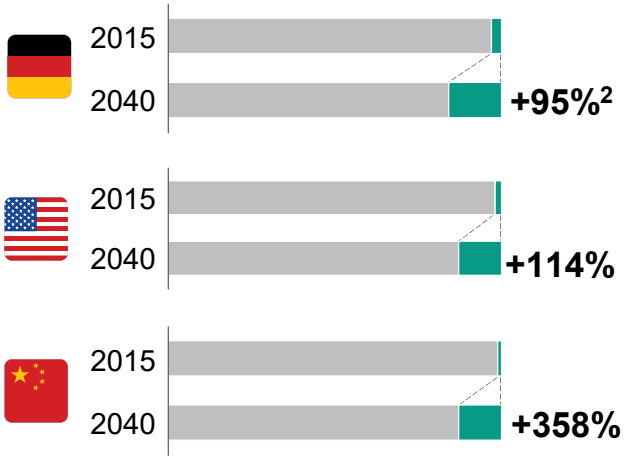
URBANIZATION

CUSTOMER PREFERENCES

DEMOGRAPHIC CHANGE

TREND REALIZATION

Mobility spend for passenger transport 2015 vs. 2040 by mode; total vs. 2015



Other modes of transport

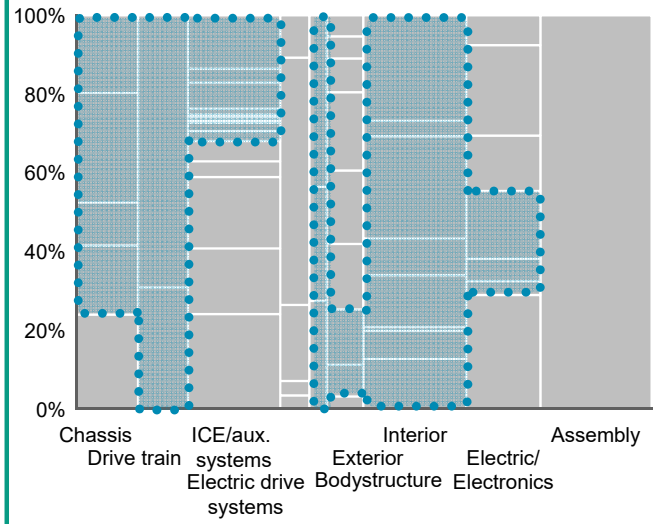
- Bus
- Air
- Smart mobility services
- Train
- Private car

Individual mobility services

- Car sharing
- Car rental
- Ride hailing

IMPACT ON VALUE CREATION

Value creation per vehicle module (2017)



Key potential impact on:

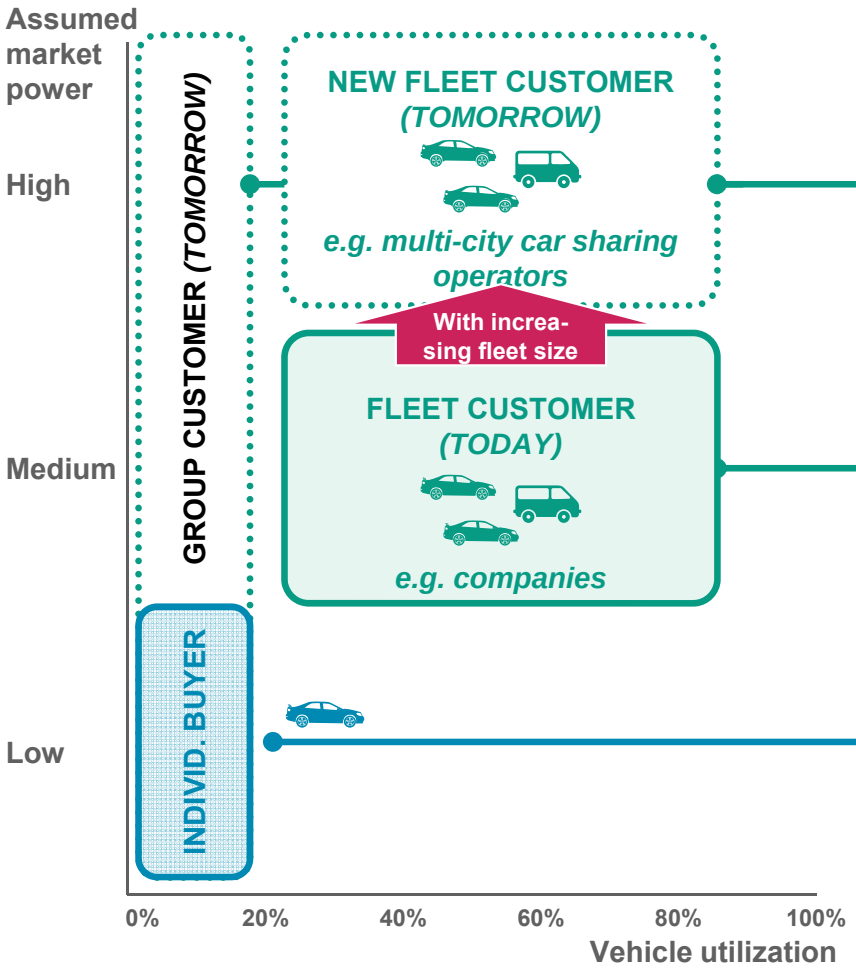
- Overall **vehicle design** to be more robust/low-maintenance, and less safe (for AD vehicles only)
- **Vehicle interior** to be more **functional** to meet customer usage patterns (e.g. robust materials, self-cleaning systems)

Source: Oliver Wyman study "Mobility 2040", Oliver Wyman analysis

Changing customer structure – Automotive value chain under attack

With particular vehicle usage patterns and increasing market power, fleet and group-buying customers could change today's picture of value creation

Vehicle utilization/bargaining power per customer type
Illustrative



VEHICLE USAGE PATTERN	USE OF MARKET POWER TO…	IMPLICATION ON VALUE CREATION
Mobility Fleets • **Changing** vehicle users (>100 p.a./veh.) • **High** vehicle utilization **Corporate customer** • Same as individual	• **Negotiate price discounts**/favorable **master agreement conditions**	◑ *Decrease in margins and price pressure*
	• Demand **individual vehicle options** (e.g. very durable interior materials, rotatable rear-seats (in two rows),…)	● *Develop/produce new components in addition to existing portfolio*
• **Changing** vehicle users (>100 p.a./veh.) • **High** utilization	• Negotiate **price discounts**/favorable **master agreement conditions**	◑ *Decrease in margins and price pressure*
• **Limited number** of vehicle users (Ø 1–2) • **Low** utilization	• Negotiate **price discount** or free extras (e.g. free floor mats)	○ *Very limited decrease in margins (if any)*

● High potential impact ◑ Medium potential impact ○ No or very limited potential impact

Source: Oliver Wyman analysis

New distribution channel pay-per-use

TREND

- Customers ask for **individualized, selective, on-demand mobility** and service solutions, captured by pay-per-use business models
- These business opportunities occur in a variety of vehicle modules, opening up **new revenue generation models**

DRIVERS

CUSTOMER PREFERENCES

TECHNOLOGY

TREND REALIZATION

Potential development pay-per-use

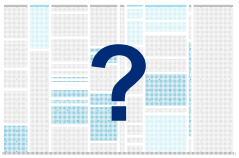
2017

Pay-per-use functions/services are technically feasible and envisioned

2030

Pay-per-use will be implemented in specific, best suitable (sub-)modules

2060

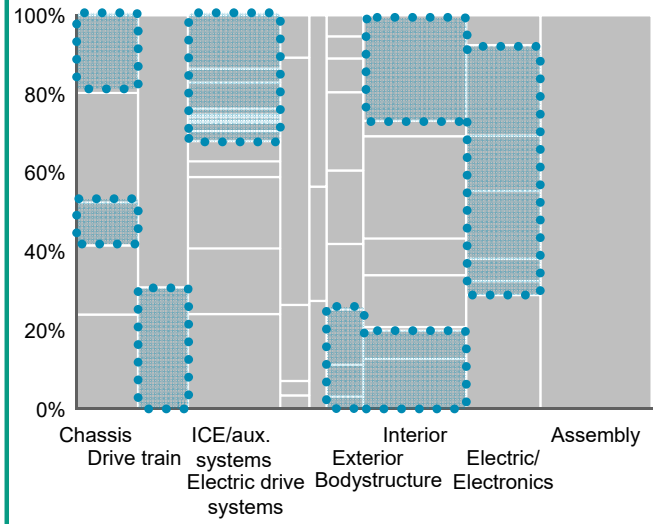


+ Near-vehicle pay-per-use services (e.g. streets, infrastructure, etc.)

Pay-per-use functions/services become more the rule than exception

IMPACT ON VALUE CREATION

Value creation per vehicle module (2017)



Key potential impact on:

- **Interior functions**, e.g. massage, park assistant and 3D sound
- **Performance features**, e.g. add. HP/kW and battery range extension
- **Exterior functions**, e.g. infrared/laser light, rain sensor

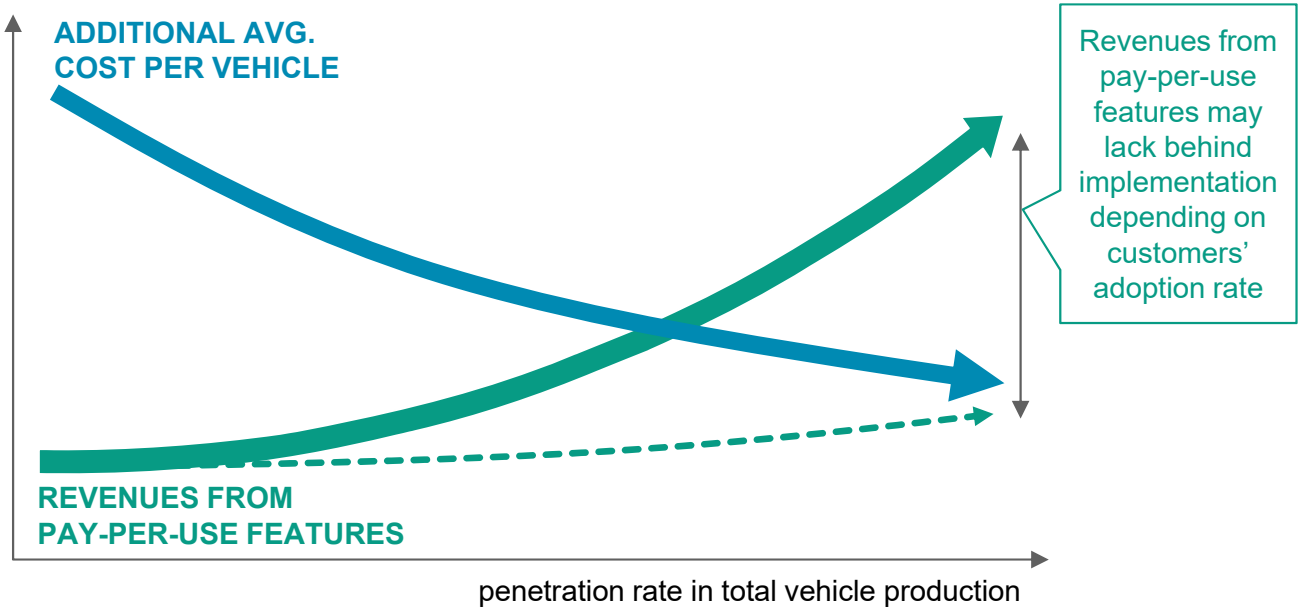
Source: Oliver Wyman analysis

New distribution channel pay-per-use

The interplay of increasing pay-per-use penetration and thus, component requirements, will significantly affect suppliers' cash flows

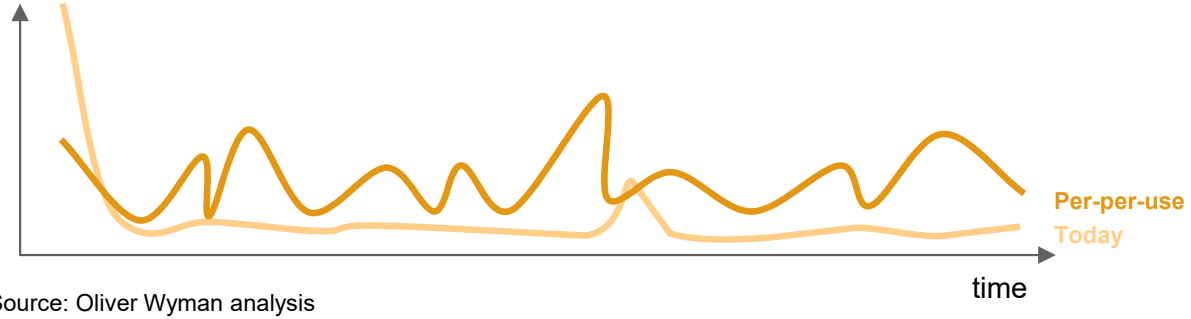
Potential development of pay-per-use and value creation impact

Exemplary cost and revenues for one pay-per-use feature



Cash flows for pay-per-use features vs. traditionally built-in components

Cash flow per vehicle over vehicle lifecycle



Source: Oliver Wyman analysis

Comments

- By **incorporating** components that allow **pay-per-use features, total cost per vehicle would increase**, while no revenues are generated at vehicle sale unless negotiated as higher fixed prices to the OEM upfront
- With increasing penetration in new vehicles sales, **cost per component could decrease** through economies of scale/standardization/lower variability
- However, **revenues and finally profits from pay-per-use are highly dependent** on customer acceptance, the consequent adoption rate and OEMs willingness to pass-through pay-per-use revenues
- Additionally, **cash flows would differ significantly** compared to today as revenues are generated only when customers are using features

Digital industry

TREND

- Digitization of processes through predictive and adaptive data capability:
- **Digitization and optimization** of core processes to support target customer experience
- Build up of superior data analytics, machine learning and "big data" competencies to deliver one holistic **customer-centric experience**

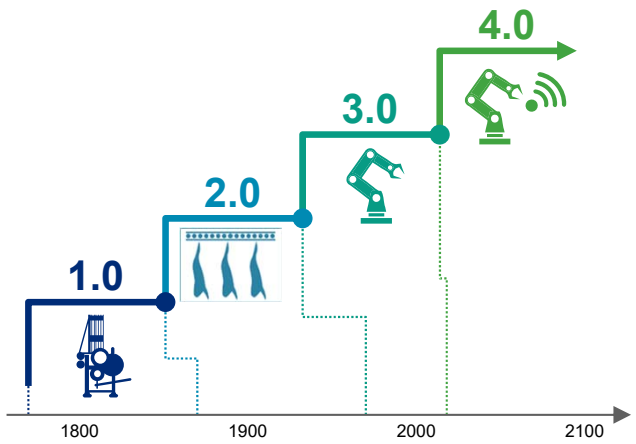
DRIVERS

CUSTOMER PREFERENCES

TECHNOLOGY

TREND REALIZATION

Development of the industrial era



1.0 Usage of water- and steam-power for mechanical manufacturing

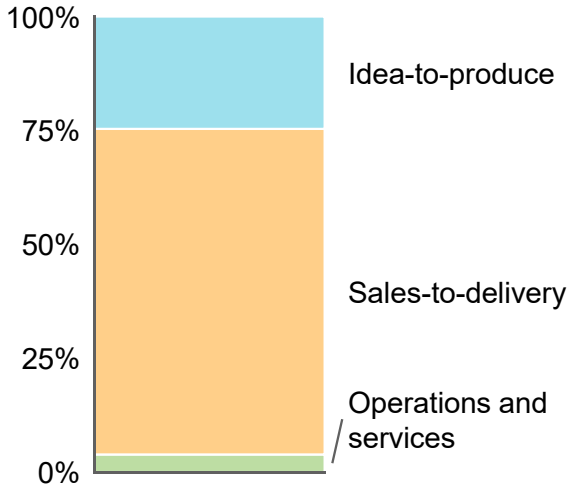
2.0 Electrically-powered mass production based on the division of labor

3.0 Leverage of electronics and IT to achieve further automation of manufacturing

4.0 **Cyber-Physical Systems to integrate production systems as well as product and production process**

IMPACT ON VALUE CREATION

"Digital industry" potential in 2030
Margin impact[1]



5% **Average impact** relative to industry revenue in 2030

1. Gross effect not including downside, basic production efficiency and pricing effects as well as specific business case considerations (i.e. investments); Value spaces were estimated based on industry-specific cost structures and were applied on approximated global value creation in 2030 (GDP growth assumed); Source: Oliver Wyman "Digital Industry" study

Digital industry

Driven by changing customer preferences and new technical solutions, the "Digital Industry" is gaining ground

Changing customer preferences

- Product individualization
- Permanent connectivity
- Personalization through Big Data
- Product as a service
- Hassle-free solutions
- Willingness to share data

Digital automotive industry

Technical enablers

- Data availability
- Declining technology costs
- Mechanical development progress
- Accelerating innovation cycles
- New production techniques
- Changing R&D patterns

Source: Oliver Wyman analysis

E-Mobility – Overview

TREND

- **Electrified vehicles** are emerging as alternative powertrains to the internal combustion engine

DRIVERS

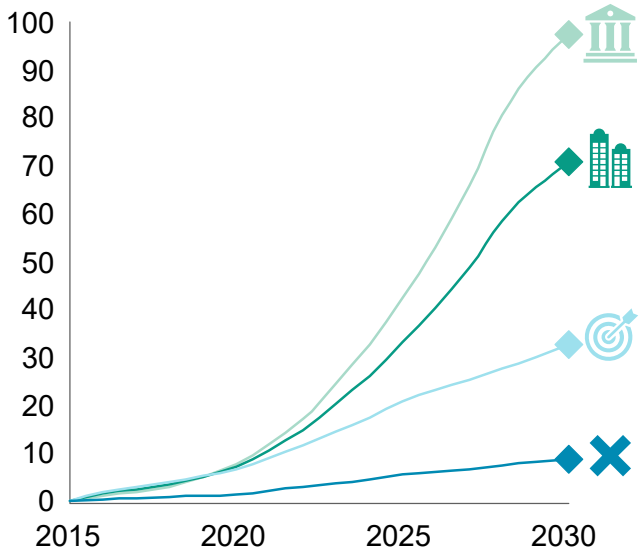
REGULATION

INFRASTRUCTURE

TECHNOLOGY

TREND REALIZATION SCENARIOS

Ramp-up new EV sales 2015–2030 (%)



Strong legislation (full ICE ban)

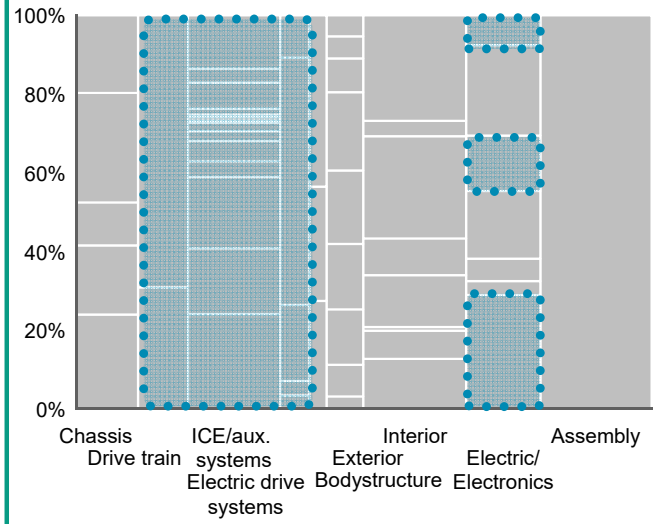
Urban legislation (bans) and incentives

Focus on incentives for urban areas

No further legislation or incentives

IMPACT ON VALUE CREATION

Value creation per vehicle module (2017)



Main impact on:

- **Complete powertrain**, replacing combustion engine with fuel tank and exhaust system by battery with electric infrastructure
- **Electrics/electronics systems** related to E-Mobility (e.g. BMS and battery wiring)

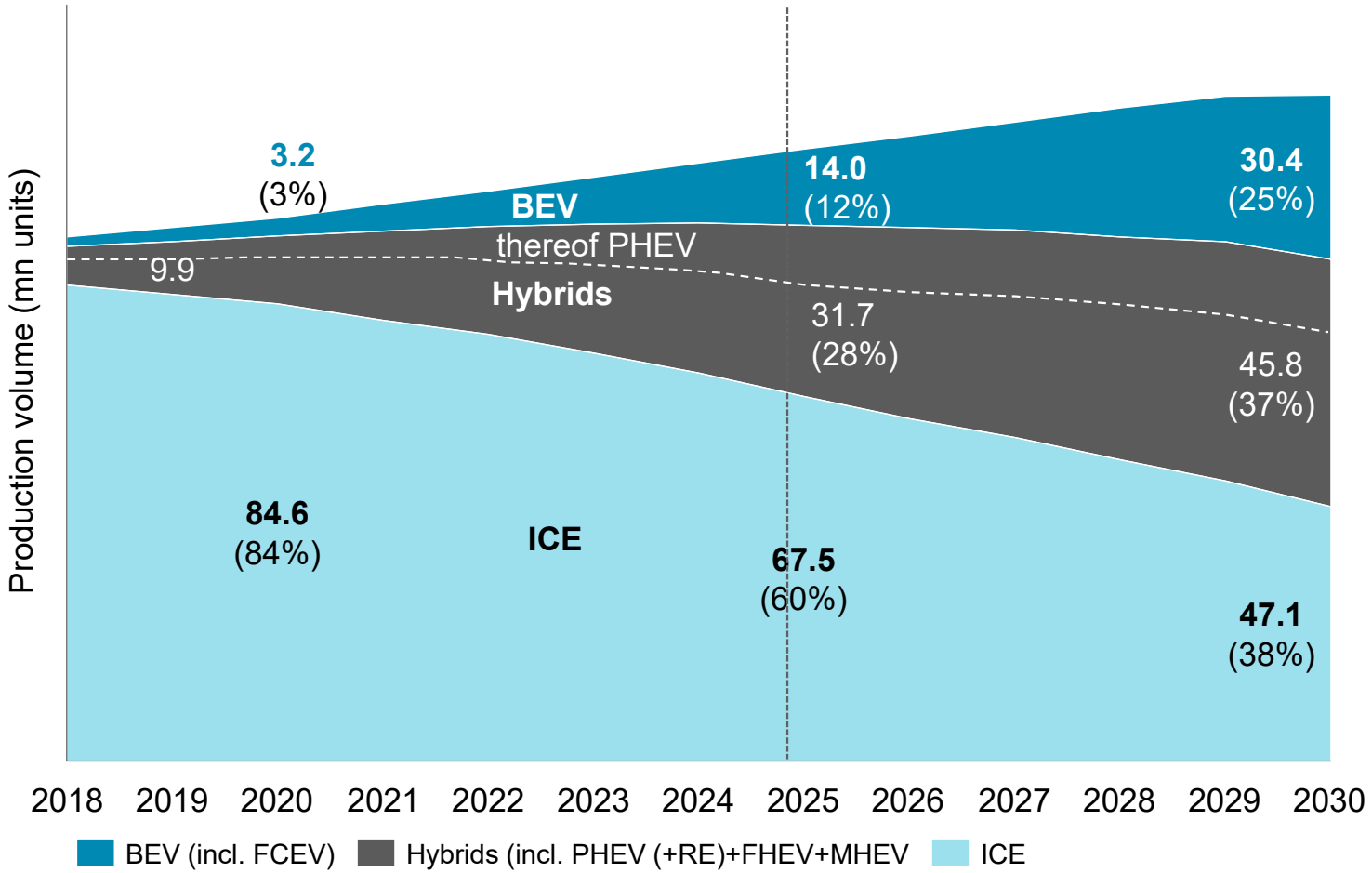
Source: Oliver Wyman analysis

E-Mobility – Ramp-up curve market penetration

E-mobility as first "Game-Changer"; traditional ICEs, hybrids and battery electric vehicles will co-exist in global context until 2030

Global ramp-up scenario for alternative powertrain technologies

Production volume in million units (% share of total)



Comment

- **Strong ramp-up** of e-mobility already between **2020 and 2025**
- Tightening emission regulation will result in **>60% of all vehicles sold** being electrified to some extent to meet given targets by 2030
- **PHEV** will overall only play a **minor role** due to above-average cost of technology
- Electrification will differ essentially by region by 2030:
  - **China:** due to regulation, one out of three cars sold will be fully electric
  - **Africa/South America:** no prevailing of EVs by 2030
  - **W. Europe:** 25% BEV share
  - **Japan/N. America:** relatively high share of hybrids (~60%)

ICE = Internal Combustion Engine; HEV = Hybrid Electric Vehicle; PHEV = Plug-in Hybrid Electric Vehicle; REEV = Range-Extended Electric Vehicle; BEV = Battery Electric Vehicle; FCEV = Fuel-Cell Electric Vehicle; Source: Oliver Wyman analysis

Autonomous vehicles – Overview

TREND

- **Advanced driver assistance systems** are already reality and allow the owner to hand over “driving” to the vehicle in certain situations
- Partially automated (L2) driving will progress into fully automated (L5) in the long run

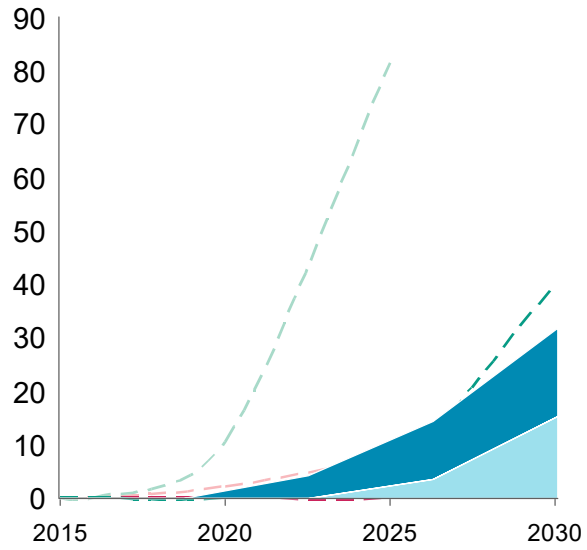
DRIVERS

SAFETY

COMFORT

TREND REALIZATION

New autonomous vehicle sales (# LV)[1]



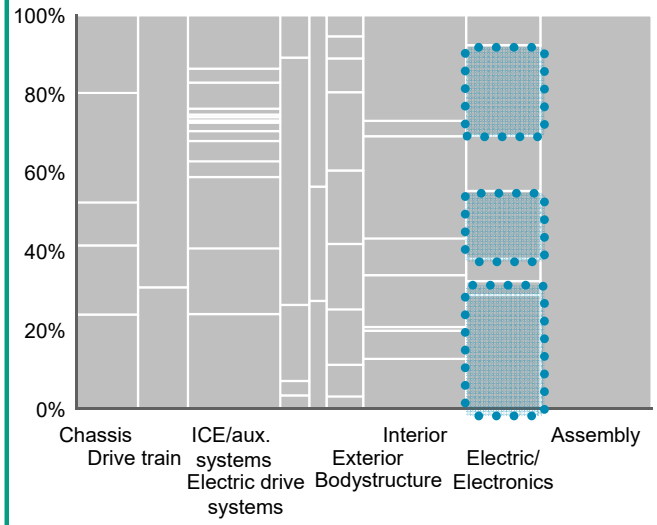
Base case: Automation Level 2/**Level 4**

Best case: Automation Level 2/**Level 4**

Worst case: Automation Level 2/**Level 4**

IMPACT ON VALUE CREATION

Value creation per vehicle module (2017)



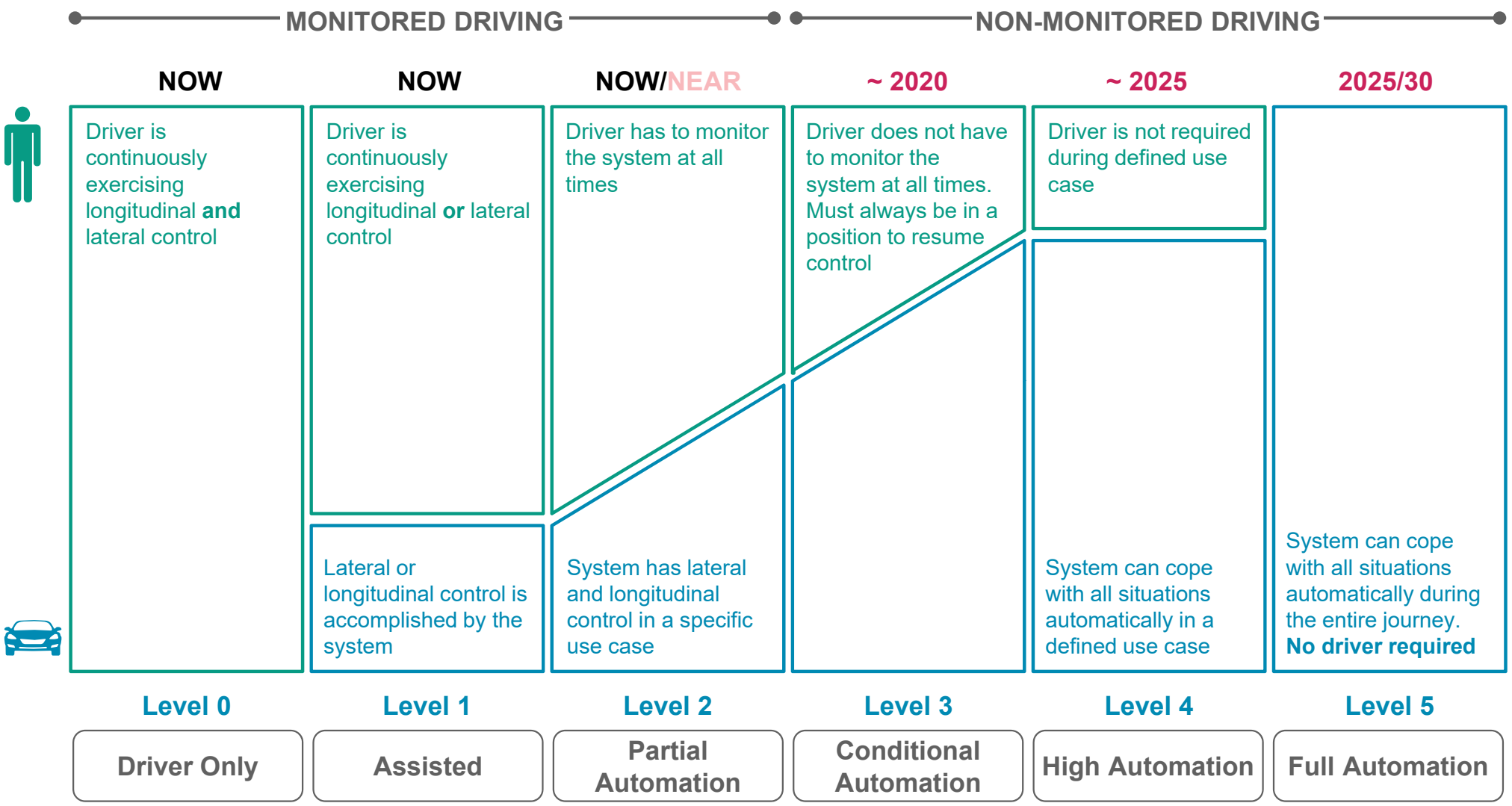
Main impact on electric/electronics systems:

- **Sensors** (incl. camera, radar etc.)
- **Information** and **communication** (maps/V2X communication)
- **Actuation**
- **Control unit** (“Intelligence”)

1. Level 2 = Partial automation, where drivers still have to monitor the system at all times but systems takes over control in specific use cases; Level 4 = High automation, i.e. driver is not required during defined use case; Source: a16z. NHTSA, SAE, Oliver Wyman analysis

Autonomous vehicles – The evolution has already begun

Autonomous driving is still in early stages but is expected to reach full automation levels between 2025 and 2030



Source: NHTSA, SAE, Oliver Wyman analysis

Human-Machine-Interface (HMI)

TREND

- Technological advancements and consumer pull for convenience and comfort will further drive the **shift from analog to more intuitive and augmented** HMI technology

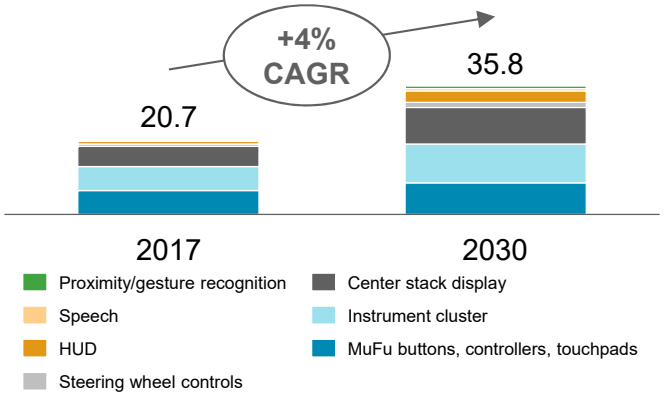
DRIVERS

CUSTOMER EXPECTATION

DIGITALIZATION

TREND REALIZATION

Automotive HMI market, 2017 vs. 2030 (in € BN)



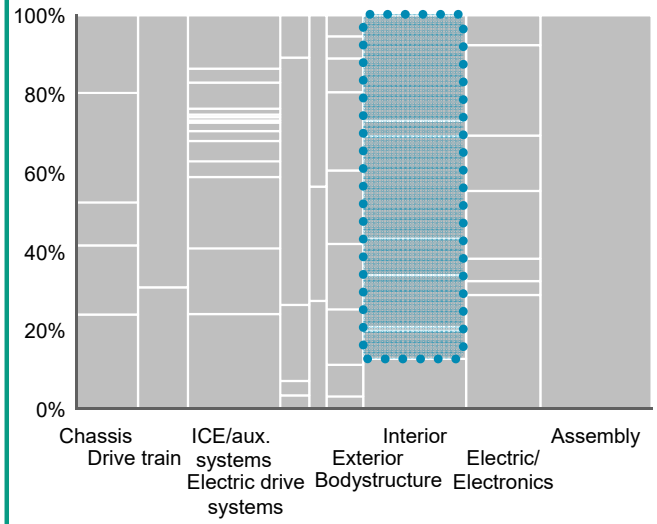
+19% CAGR **Proximity/gesture/voice recognition** Fast growing, but smallest HMI market

+15% CAGR **Head-up displays (HUD)** Fast growing segment, becoming the fourth largest HMI market by 2030

+5% CAGR **Center stack display** Moderately growing, becoming the largest HMI market by 2030 (joint pole position with instrument cluster category)

IMPACT ON VALUE CREATION

Value creation per vehicle module (2017)



Main impact on cockpit through ongoing digitalization:

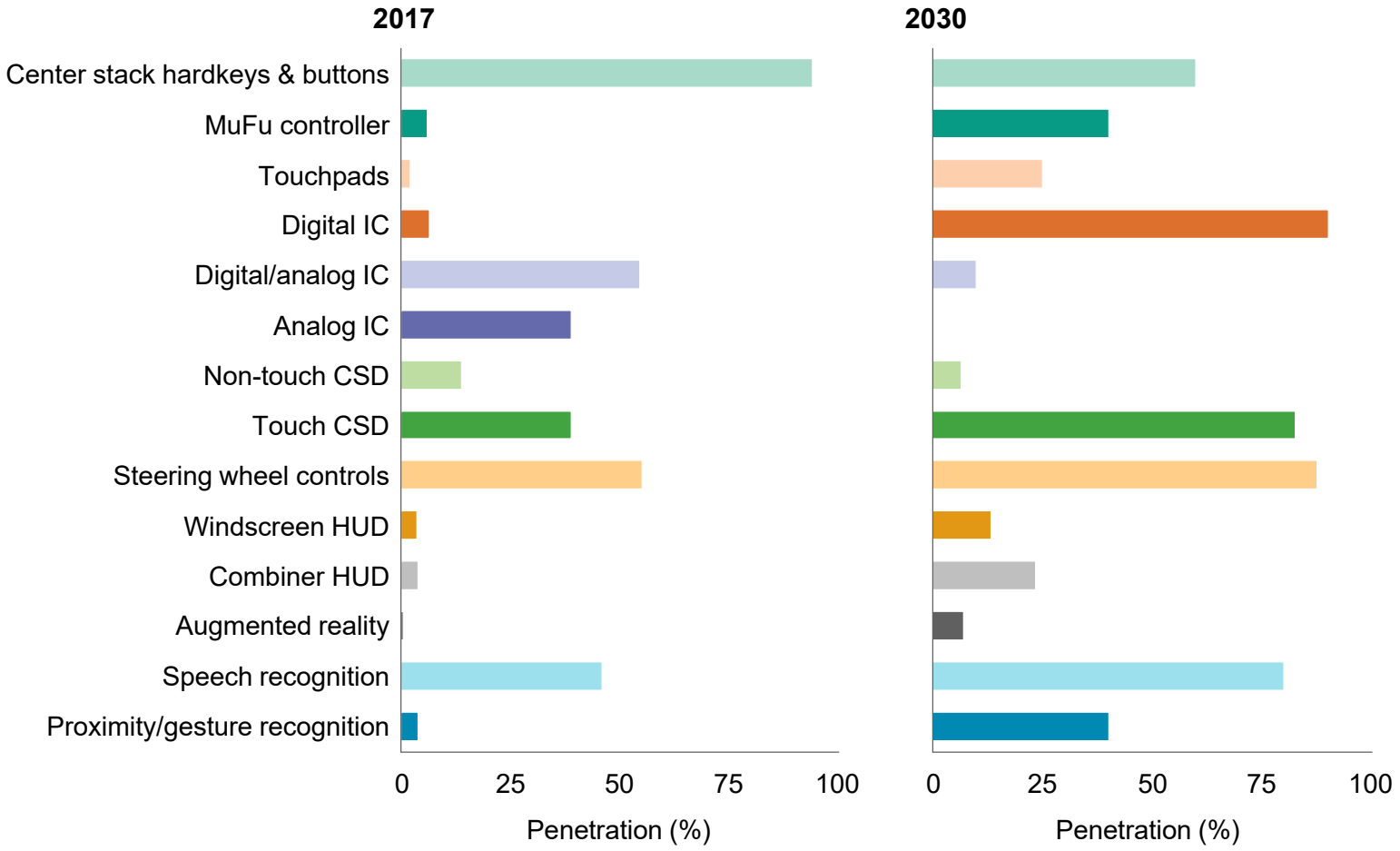
- (Central stack) displays
- Multifunctional controls
- Digital instrument cluster
- HUDs
- …

Source: Oliver Wyman analysis

HMI – Increasing demand for comfort and connectedness

Currently emerging technologies are expected to reach > 50% penetration already before 2030; ongoing digitalization of controls and instruments

Penetration rate of HMI technologies
In % of total vehicles, 2017–2030



Note: MuFu = Multi-Function, CSD = Center stack display, IC = Instrument cluster, HUD = Head-up display
Source: Oliver Wyman HMI Point of view

Comments

- The future cockpit will deliver an increasingly **intuitive, innovative and personalized user experiences**
- This next-generation HMI is expected to prevail until 2030, smartly combining **voice control**, **touchscreens** and **conventional controls** depending on **application** and **passengers**
- Development will be fueled by ongoing **vehicle automation**, and – predominantly – the achievement of **critical mass** together with **increasing functions/components integration**

Connected vehicle

TREND

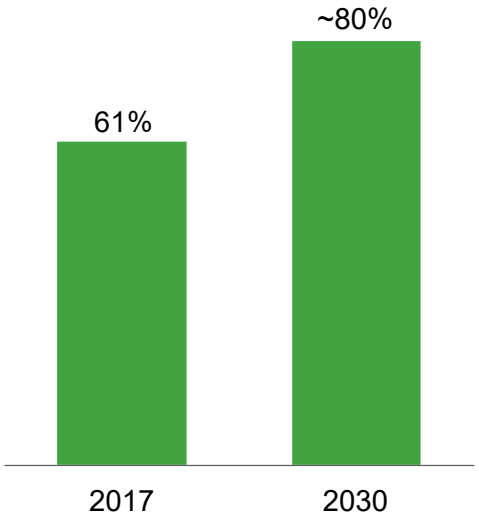
- **Urbanization** and the **demographic change** put “digital natives” in the driver seat
- Consumer expectations shift, making **individualization** and convenient device/service **integration** key
- Further, continuous **smart device and mobility** availability is fueled by the rate of change of converging industries

DRIVERS

URBANIZATION · DIGITALIZATION · DEMOGRAPHIC CHANGE

TREND REALIZATION

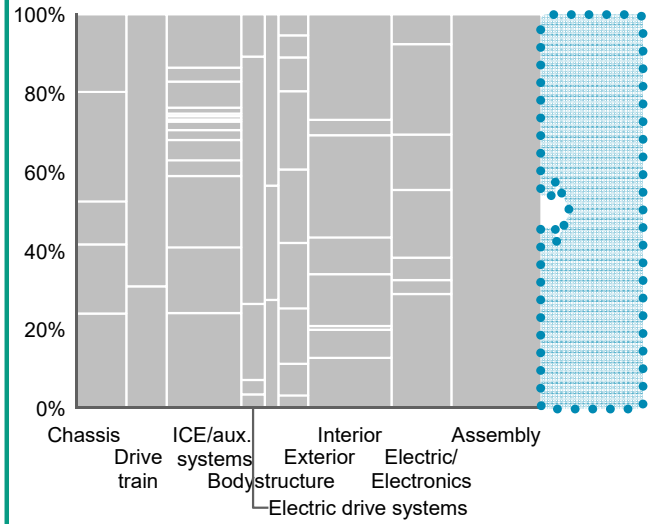
Penetration rates of embedded connectivity units in LV production



SAMSUNG · DAIMLER · Google · BMW · GM · lyft · Uber · ATU Auto-Teile-Unger · TARGOBANK · Microsoft

IMPACT ON VALUE CREATION

Value creation per vehicle module (2017)



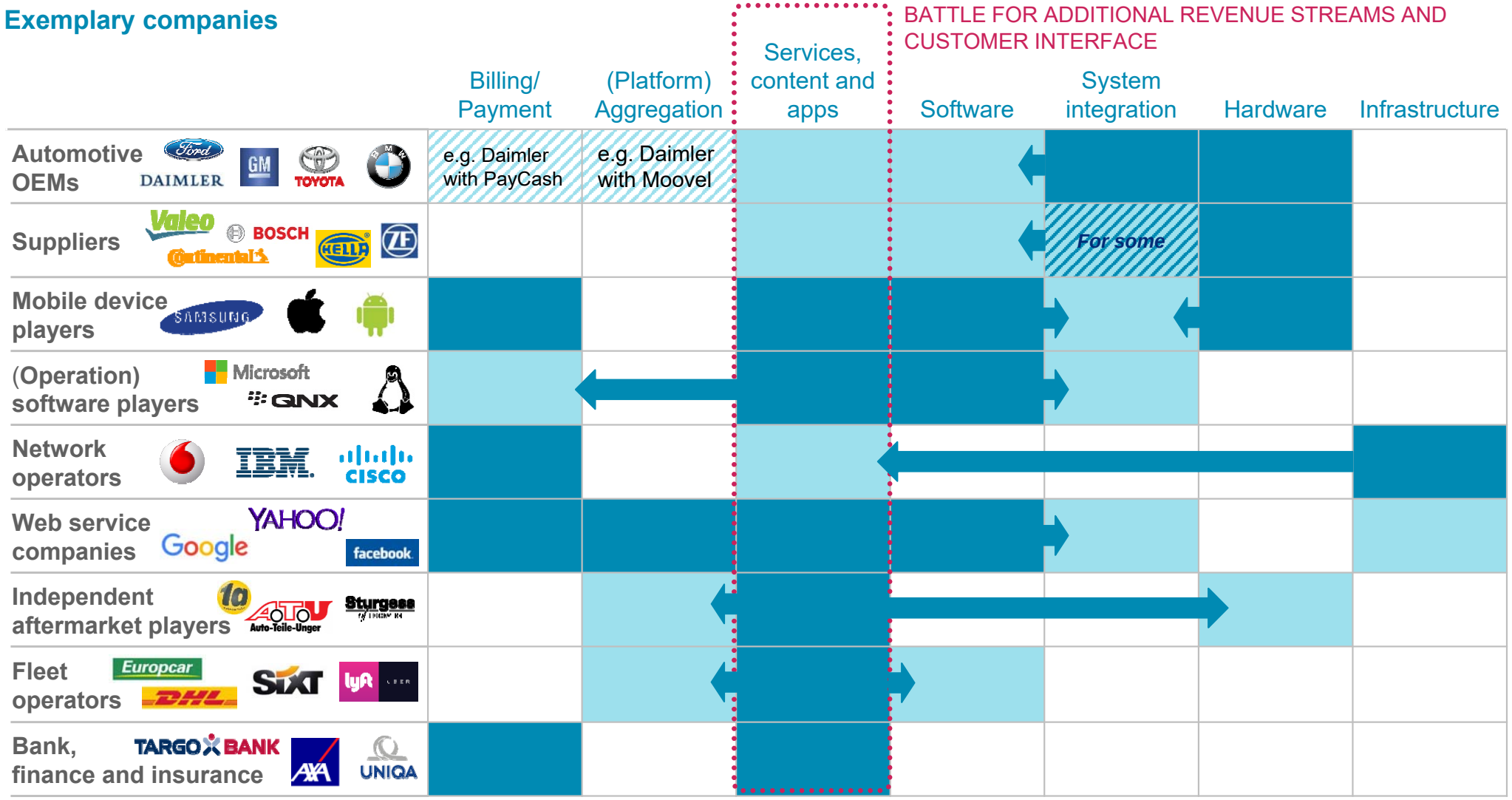
Main impact by creating add-on connected services, such as:

- Telematics-enabled **insurance services**
- **Fleet management** services
- **Safety and remote** services

Source: Oliver Wyman analysis

Connected vehicle – Battlefield for revenues and customer access

Consequently, many players of the connected car ecosystem are getting into position with a focus on entering and monetizing (data based) services



Source: Oliver Wyman analysis

3

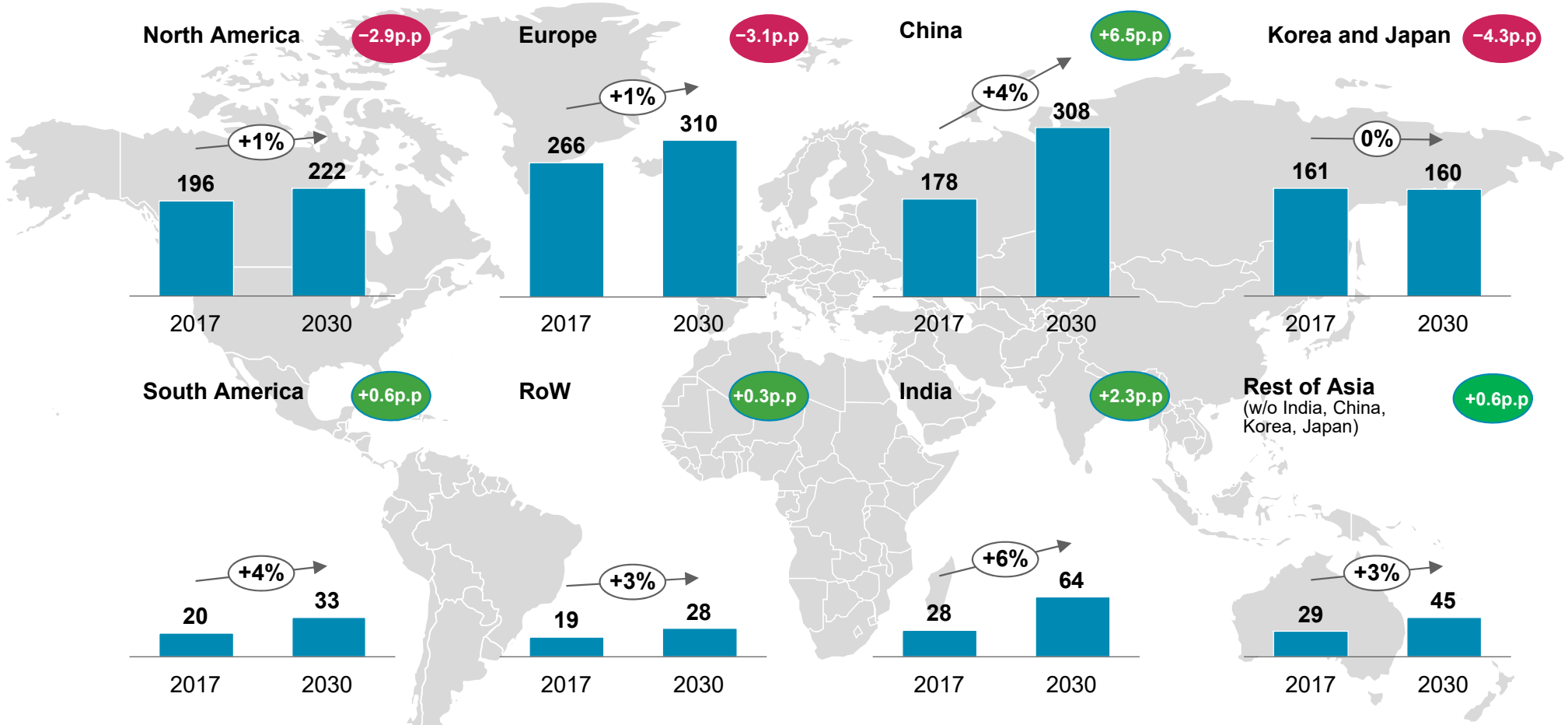
VALUE:
Automotive value creation development until 2030

Regional shifts in automotive value creation until 2030

Emerging markets continue to catch-up and gain around 10 p.p. value creation share by 2030

Development of value creation by region/segment

In € BN



X.X% CAGR (Compound annual growth rate)

Change in share of total value creation 2017 vs. 2030

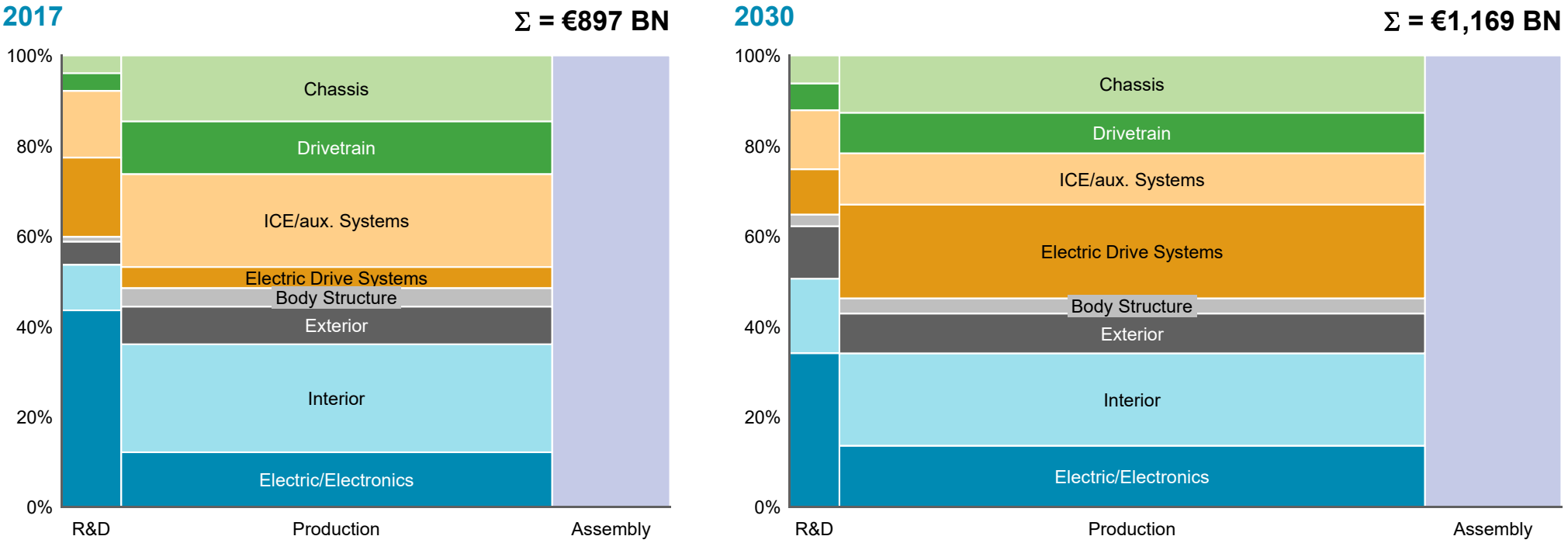
Source: Oliver Wyman value creation model

Horizontal shifts in automotive value creation until 2030

Value creation continues to grow along most steps of the value chain and modules with strong shift from value creation in ICE to electric drive systems

Development of value creation

In % of total



Comment

- **E-drive gains** significantly share (+14%)
- In contrast traditional **ICE powertrain and auxiliary systems loose** share continuously
- Comparably **high growth of E/E** eased by today's high level of R&D efforts to rapidly foster trend technologies
- **Body-in-white, chassis and interior** expected to **grow below market**; But also in these categories **growth pockets exist**

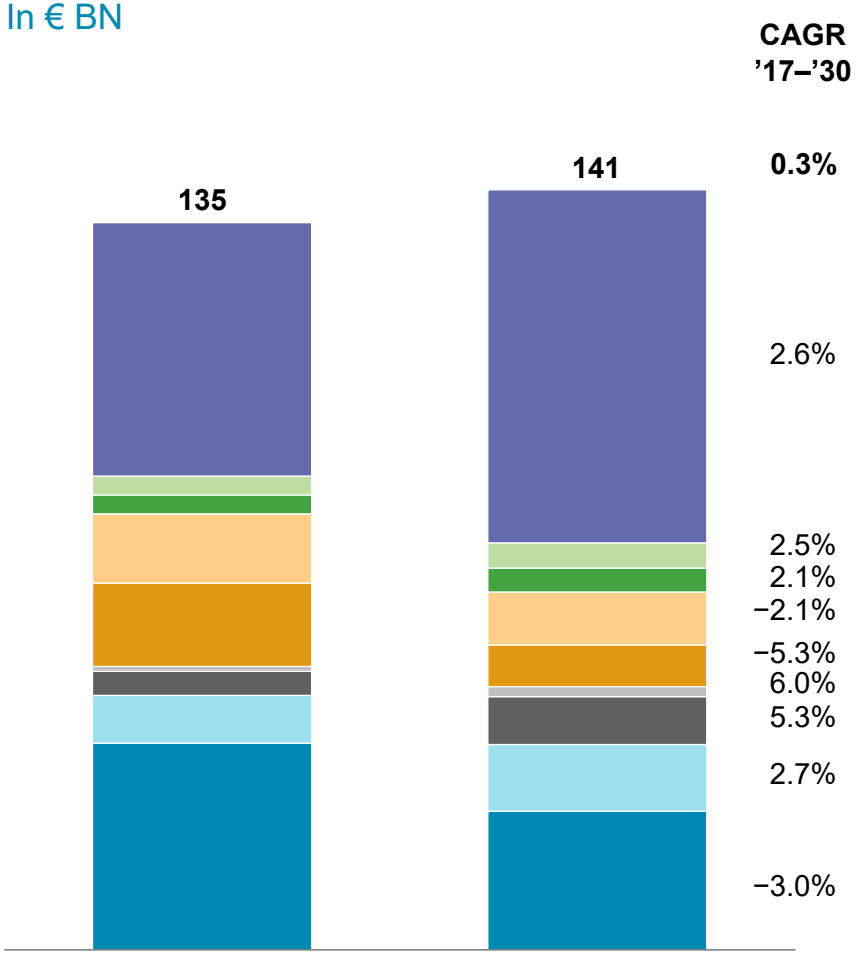
Source: Oliver Wyman value creation model

Horizontal shifts in automotive value creation until 2030

Shifts in value creation include a decreasing share of electric drive and electric and electronic (E/E) in R&D, but increase share in production

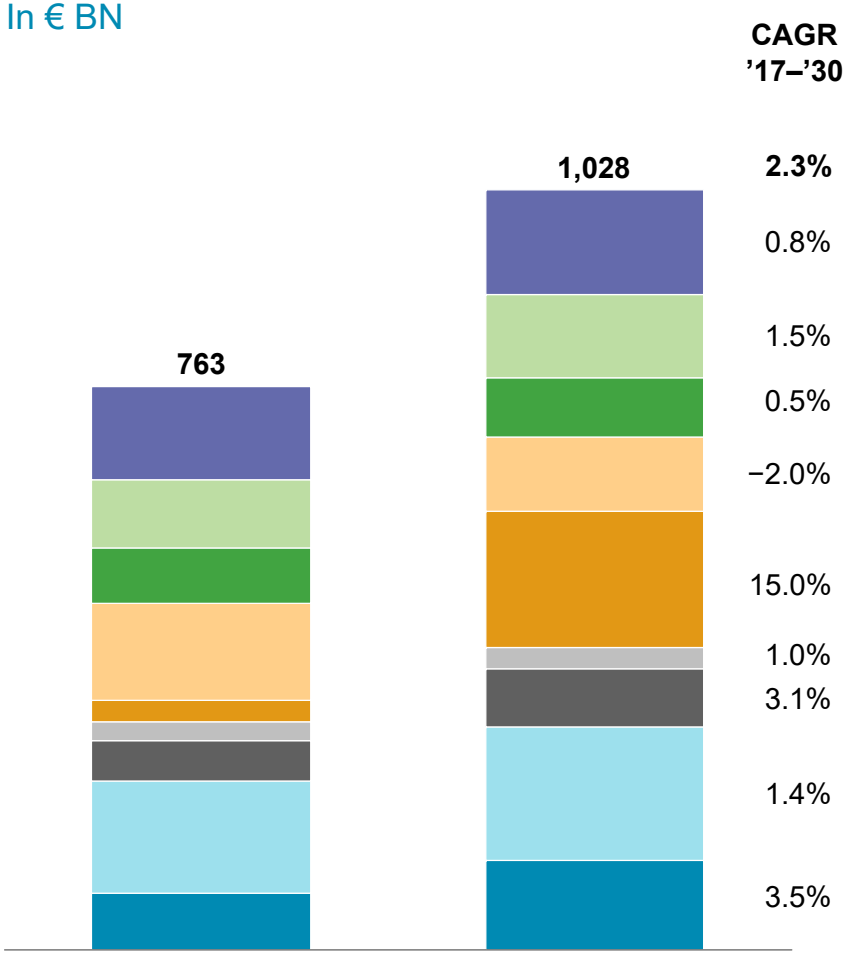
Development of value creation – R&D

In € BN



Development of value creation – Production

In € BN



Assembly | Chassis | Drivetrain | ICE/aux. Systems | Electric Drive Systems | Body Structure | Exterior | Interior | E/E

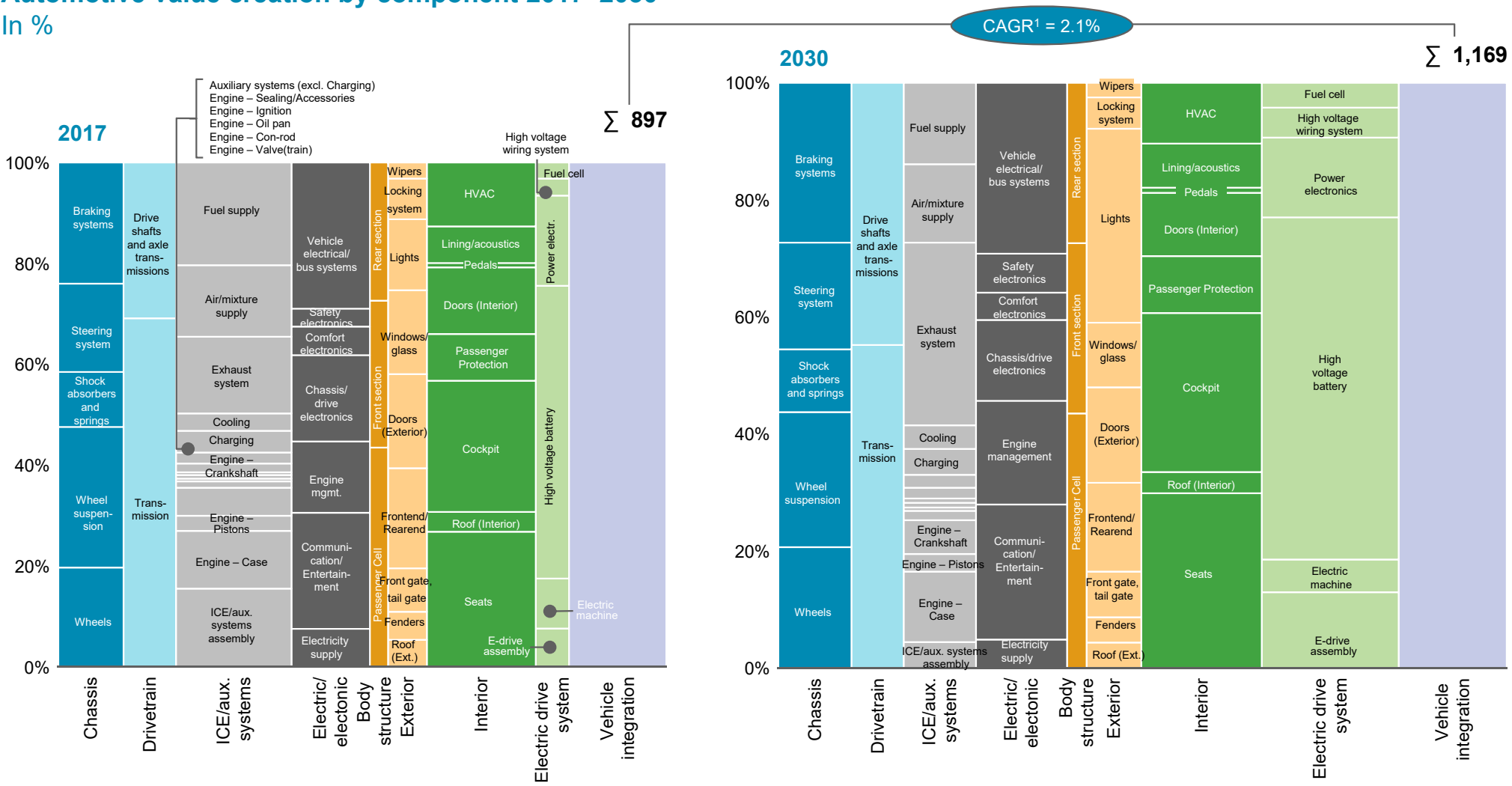
Source: Oliver Wyman value creation model

Horizontal shifts in automotive value creation until 2030

Significant shifts in value creation will also happen within the different vehicle systems at a sub-system, module and even component level

Automotive value creation by component 2017–2030

In %

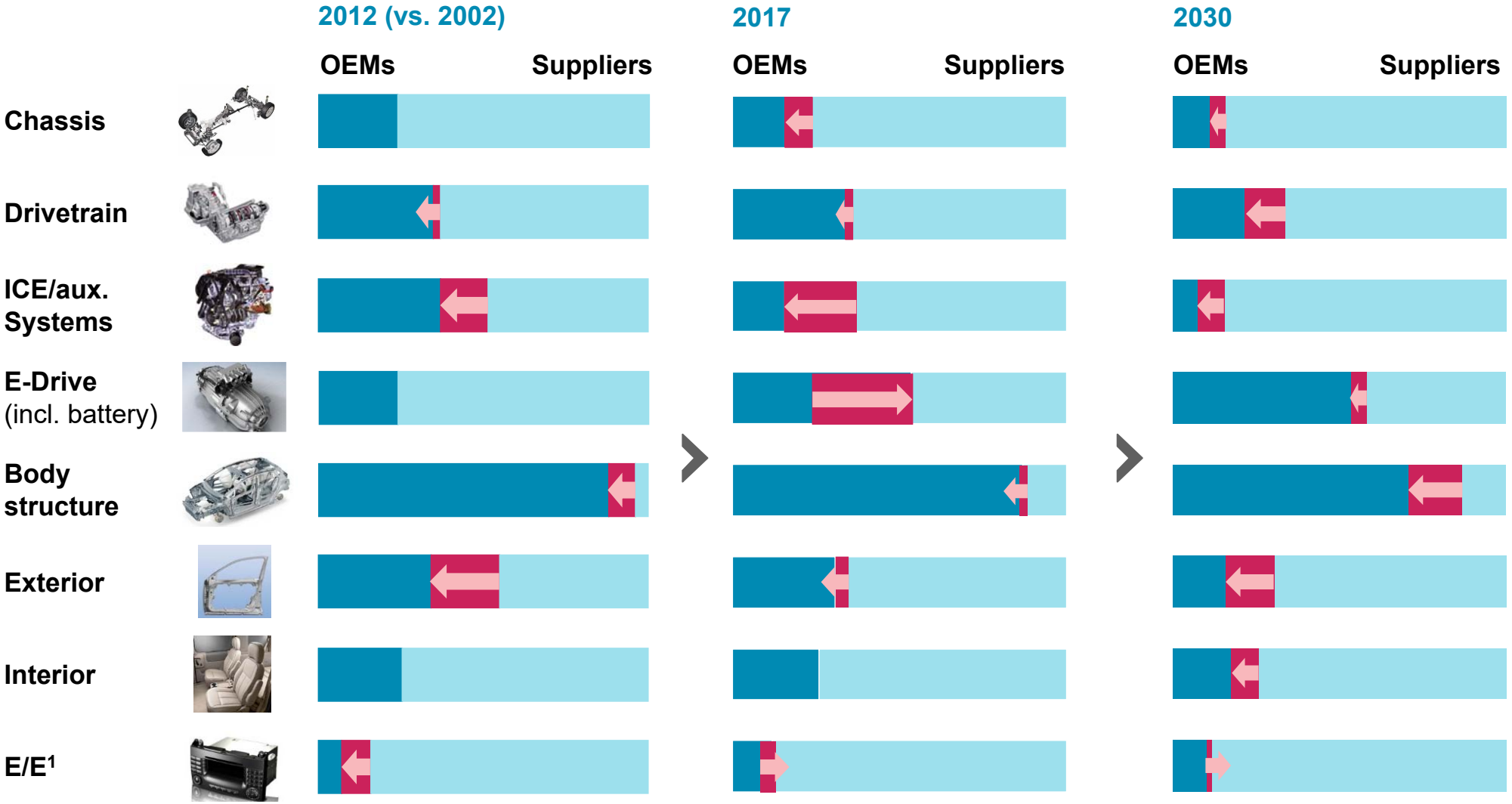


1. Compound annual growth rate

Source: Oliver Wyman value creation model

Vertical shifts in automotive value creation until 2030

Outsourcing from OEMs to suppliers will continue but slow down; in E-Drive, OEMs will gradually build up own competence and rely for ADAS on suppliers



1. Driven by advancement of ADAS and autonomous driving (AD)
Source: Oliver Wyman value creation model

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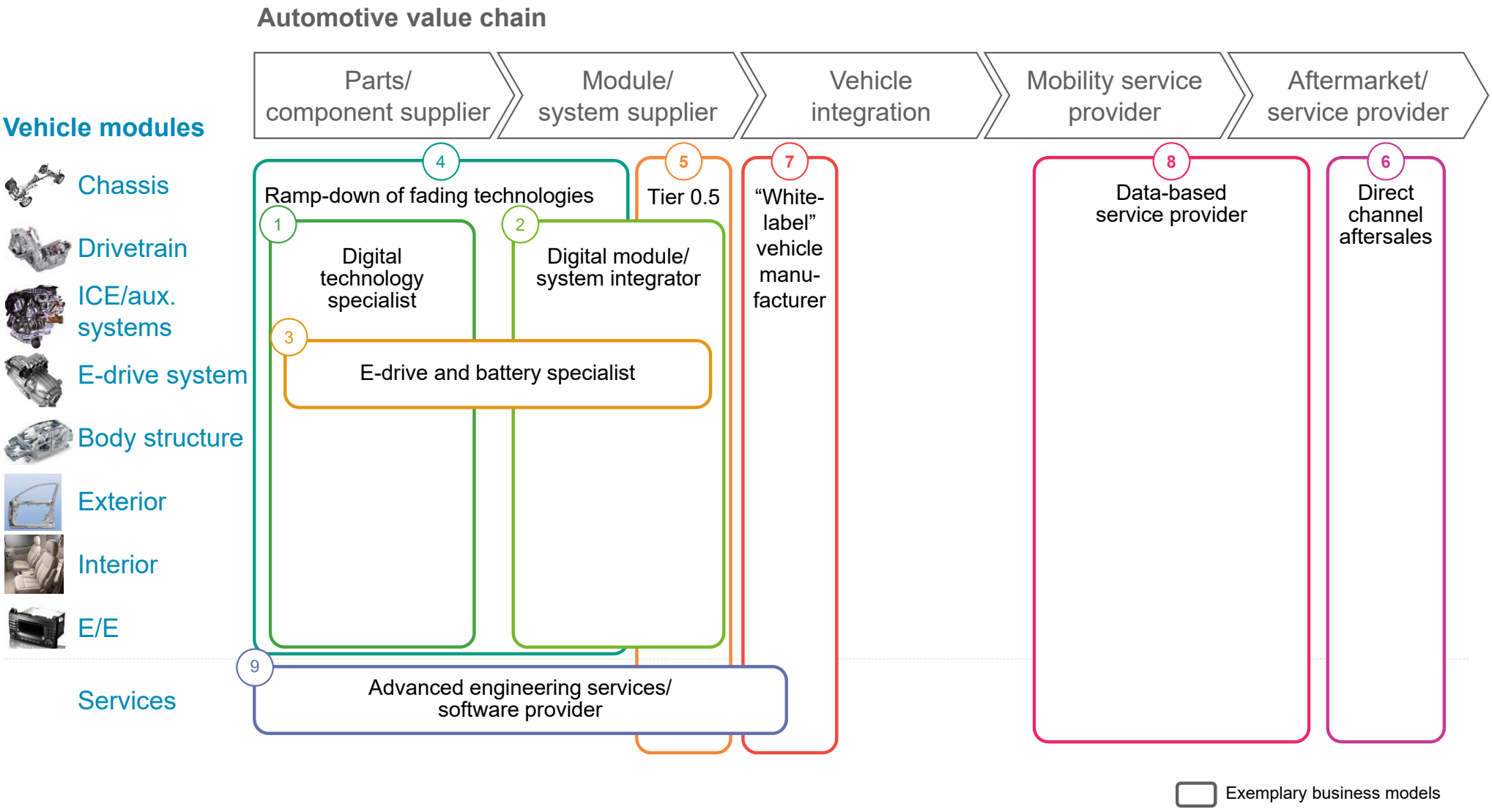
IMPACT:
Areas of impact and strategic business model options for automotive suppliers

Supplier business models 2030

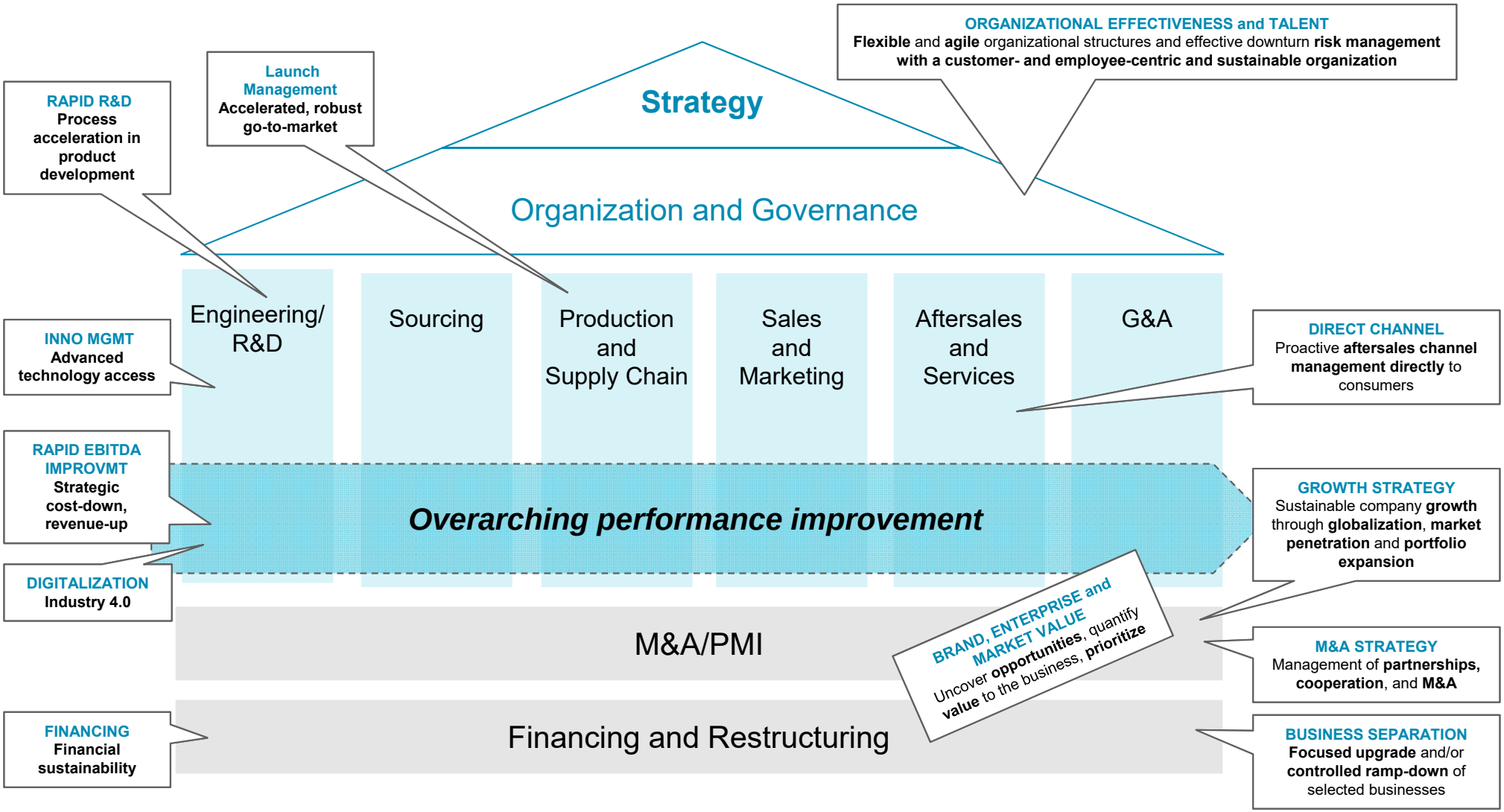
Driven by the current and emerging trends, new supplier business models are being established along the automotive value chain



Source: Oliver Wyman analysis

Impact on Suppliers & OEMs: Many fronts

Holistic performance improvement to absorb investment and cost pressure will be required for suppliers and OEMs alike to remain competitive



Source: VDA, Oliver Wyman analysis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VDA
Verband der
Automobilindustrie