Trends in the truck & trailer market

Market study

Munich, August 2018

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Management summary

- We expect **four main trends, new Logistics, Electrification/alternative drives, Autonomous trucks and Digitalization ("LEAD"),** to shape the CV industry over the next decade – yet autonomous vehicles (Level 4/5) barely roadworthy before 2023
- These four megatrends, as well as a set of region-specific drivers, are expected to **lead to a continued positive development** of the **truck & trailer market** over the coming years
- E.g., on average, Europe's production of **medium/heavy duty trucks and buses >8 t** is expected to **grow by 1.3% p.a. until 2020**. The main growth driver will be **Eastern European countries**
- **European Trailer** production **continuously grew by 5% p.a. until 2017** driven by Western Europe. In the **coming years the market is expected to remain rather flat**
- **CV systems technology upgrade** prior to 2023 is expected to be mainly driven by "conventional" business metrics with main drivers being **regulatory "push"** (increased safety/emission levels) and **operator "pull"** (TCO improvement)
- In future, the largest share of value in tractor trucks will remain with powertrain and cabin, however **connectivity solutions and driver assistance systems** are expected to **gain importance** – **Demand for ADAS** (particularly LDWS, ACC, AEBS) is expected to increase further
- Market growth of related component systems in Europe is expected to **outperform the truck and bus production growth rate** (CAGR 2016-22E): Market growth p.a. of braking systems: 3.5-4%, powertrain: 7-8%, steering systems: 9-10%, ADAS: 10-12%
- For **trailers**, analysis of selected components shows a similar pattern – while today, the largest share of value in a standard trailer lies in chassis and structural elements, a clear **shift towards connectivity systems** is expected
- In this context, a set of key success factors for the truck and trailer market was identified – **reputation and customer relationship** are most important from the customer perspective for both OESs and OEMs; **High product quality and delivery reliability are also important factors,** however they are all considered an **obligatory condition and a standard qualifier**
- As **differentiating factors**, besides price competitiveness, **technical capabilities and power to innovate** are considered essential USPs for market players and expected to further increase in importance, given the underlying market trends

Source: Roland Berger

A. Megatrends in the commercial vehicle industry

We expect four main trends to shape the commercial vehicle industry over the next decade

Key trends for the truck and trailer market

New Logistics

- Changes in the logistics landscape will affect today's customer structure of truck & trailer OEMs – Further growth of large fleets expected
- Moreover, new players and business models will evolve as the transport industry continues to change towards a digital platform ecosystem
- Overall, stronger specialization of players (asset heavy vs. asset light) is expected

Electrification/ alternative drives

- CV electrification is driven by regulation and local emission optimization
- In Europe: need for low/zero emission buses and inner-city delivery vehicles
- Low TCO benefits limit pull effect from fleets
- OEMs are facing heavy investment demands – New vehicle architectures required
- Suppliers may benefit from increase in value add, e.g. electric axles

Autonomous trucks

- Automated trucks address several challenges: hours-of-service, safety, driver shortages and fuel costs
- Fast payback of investment can only be achieved in a few applications with a high share of truck platooning in the early stages
- Significant cost savings are expected only in the long term with driverless trucks
- Safety regulation will become a major driver

Digitalization

- The evolution of digital technologies and culture will create new use cases, e.g. in the context of advanced truck & trailer telematics
- Moreover, AI-based optimization methods drive down congestion, low utilization and costs

Source: Roland Berger

The logistics landscape changes are expected to affect the current customer structure of truck & trailer OEMs

Customer structure – Status quo and trends (example Western Europe)

Customer segments		Fleet size	Market share[1)]	Trend
Segment	Definition			
Owner-driver	> Truck driver owns truck > Works as subcontractor and/or covers market niche	1	~15-25%	Affected by market consolidation but covering market niches
Small/mid-sized fleet operator	> Works as subcontractor and/or covers market niche > Lower professionalization due to lack of economies of scale	2-20	~35-40%	Affected by market consolidation due to competitive disadvantages
Municipalities	> Fleets operated by public authorities > Transport not a core function	up to 100	~5-10%	Ongoing privatization partly resulting in decreasing relevance
Special vehicle fleet operator	> Focus on specific transport needs > High professionalization in their segment	1-5	<5%	Stable demand in the coming years expected (depending on industry segment)
Large fleet operator	> Large logistics providers or large corporate fleets > Highly professionalized, e.g. some with own repair shops	>100	~25-35%	Growth due to cost advantages (e.g. due to own repair shops, improved utilization)

Trend: Decreasing Stable Increasing 1) Estimate for Western Europe

Source: Expert interviews; desk research; Roland Berger

The transport industry will continue to change towards a digital platform ecosystem

Surviving players in the logistics industry ("endgame 2030+")

Booking & optimization platforms (BOP)

> Independent platform for the management of logistics transactions
> Route and cost optimization capabilities

New players in services (especially in BOP)

Carrier, terminal operators, trucking companies (CTO)

> Asset holders and operators performing logistics tasks
> High asset and cost efficiency
> Either specialized or standardized

Profit pool shift away from the business of traditional freight forwarders

Supply chain specialists (SCS)

> Solution provider for complex or industry-specific tasks
> In-depth understanding of industry-specific supply chains

Increasing number of large freight carriers & trucking companies vs. supply chain specialists

Service providers (SP)[1)]

> New players, hardware providers and existing online players
> Provision of support services for logistics companies

Stronger specialization of players (asset heavy vs. asset light)

1) Active in multiple industries

Source: Roland Berger

Further new logistics business models will emerge – Today, still mostly related to city transport

New logistics business models – Examples

Same-day delivery – ***shutl.com***: Realization of shortest delivery times with attractive pricing on basis of a broad network of carriers and partnerships.

Own car as delivery box – ***Volvo Drop-off/Pick-up System***: Testing of a system that allows consumers to have their shopping delivered straight to their car.

Route optimization – ***Routific***: Smart trucks are navigated by GPS and telematics data to ensure optimized route and capacity utilization.

Smart Trucks – ***DHL***: DHL combines advanced technology with dynamic route planning in its vehicles to increase efficiency in both pickup and delivery.

City freight consolidation platform – ***CARGONEXX***: Brokerage service for bundling of shipments from different wholesalers/ manufacturers to serve customers within one specific area.

senden24 offers spontaneous urban instant delivery. For B2B, B2C and C2C. Service available 24/7. Pickup within 5 min. Delivery within 1 hour. On demand. Any place. Any time.

Smartlane is an easy-to-use web-based delivery management software focusing on automated tour planning and optimizing as well as simplified process controlling.

City freight consolidation platform – ***Cargo hopper***: Provision of efficiently bundled shipments through electric transportation vehicles.

Digital logistics agents – ***Senndder***: Digital logistics agent and full forwarding service for entire transportation route. Avoiding different sub-contractors reduces transportation costs. ***InstaFreight*** follows the same business model.

FTL[1] freight brokerage for shippers and carriers – ***Transfix***: Manufacturers & distributors can connect with a truck driver network shipping long-haul freight across the U.S. Parties are connected by a mobile app.

Shared logistics concept – ***Gogovan***: Offering of logistics-on-demand, e.g. in Hong Kong – Currently >26,000 registered drivers.

Potential city logistics concepts – ***FreightExchange***: Without a specific time schedule, hitchhiking is the most efficient mean of transportation as operators can sell unused capacity to businesses that need to ship goods.

RYTLE provides the first holistic and interconnected concept of city logistics. Consists of a unique cargo bike called MOVR, a standardized BOX and a mobile HUB.

Quiqup is a London-based on-demand delivery company formed in 2014. Founded originally to let consumers order anything for local same-hour delivery, Quiqup has since expanded its proposition to provide last mile delivery to businesses of any size and sector.

1) Full truck load

Source: Company information; Roland Berger

Regulation, for example access restrictions in cities, is expected to drive electrification of trucks and buses

Overview of selected city access restrictions – Examples

London

Future restrictions

- In **2019** an **Ultra Low Emission Zone** (ULEZ) will be established
- Until **October 2021** it will cover the same area as the **congestion charge zone** – Thereafter **expansion** to an area bounded by North & South Circular
- **Trucks, buses and coaches** need to meet **Euro VI** emission standards
- **Daily charges** if restrictions are not met

Paris

- Since **July 2016**, **all vehicles** must reach at least **Euro 1 emission standards**
- Between 2017 and 2020, **Euro 2, 3 and 4 will be phased out**
- The anti-pollution plan further envisages a **ban on old diesel vehicles** and a complete ban on diesel cars by 2020
- **Free parking** for electric vehicles

Hamburg

- **Partial access restrictions** have been put in place (April 2018) on specific routes into the city for **trucks not meeting Euro VI** standards
- Further and **more restrictive access restrictions expected** in other German cities until **2019** (e.g. Stuttgart)

Expected impact on buses and trucks

A possible diesel ban or ICE ban could significantly influence the transportation sector as well as the public transport sector as there are a multitude of applications for inner-city driving:

MDT: Delivery trucks for shops; **HDT:** Construction sector; **Bus:** Local transportation

Source: Press; Roland Berger

Aside from regulation, applicability of BEV and HEV strongly depends on respective use cases

Use cases for BEV/HEV – Examples

Use case	Intracity / urban		Construction	Long haul	Short haul
					
Segment	Medium duty	Medium duty	Medium duty	Heavy duty	Heavy duty
Characteristics					
Travel dist. p.a.	~40,000 km	~40,000 km	~20.000 km	~100.000 km	~75,000 km
Tank volume	100-300 l	100-300 l	100-300 l	500-700 l	300-500 l
Fuel type	Diesel	Diesel	Diesel	Diesel	Diesel
Ø mileage per day	≤ 50 km	>100 km	50-100 km	>100 km	<100 km
Highway use	low	low/medium	low/medium	high	medium
Indication of priority based on TCO BEV	today 2021 2025 2030	today 2021 2025 2030	today 2021 2025 2030	today 2021 2025 2030	today 2021 2025 2030
vs.					
HEV	today 2021 2025 2030	today 2021 2025 2030	today 2021 2025 2030	today 2021 2025 2030	today 2021 2025 2030

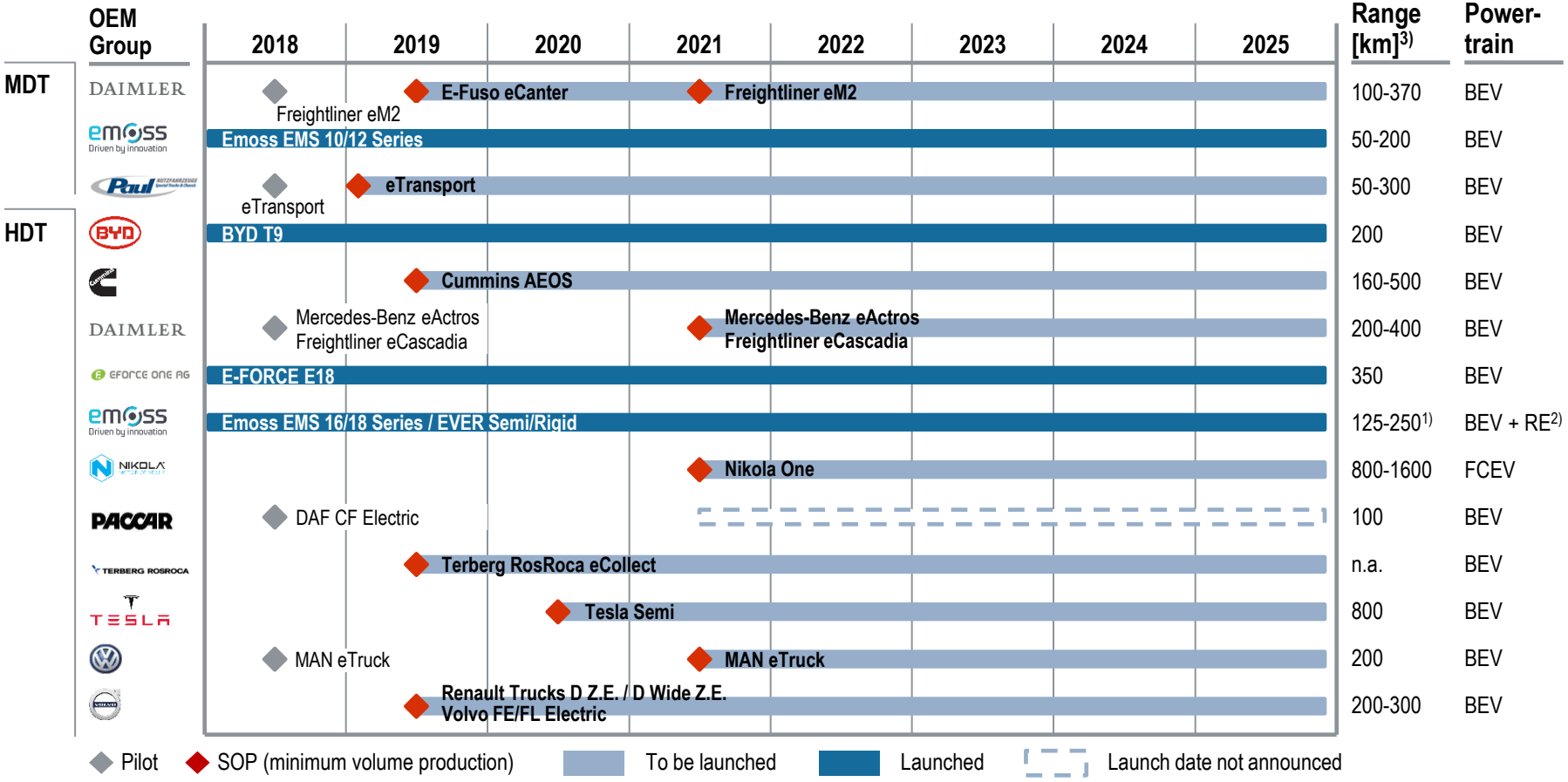
= Expected focus of new vehicle registrations (Europe 28) ≥ 1% of total registrations

Source: Company information; expert interviews; Roland Berger

Launch of several new xEV-MDT/HDT models is planned for the coming years – Multiple third-party outfitters already active

Planned SOPs of selected xEV-MDT/HDT models

Selection



1) EVER Semi/Rigid range >250 km 2) CNG/LPG Range extender; EVER Semi/Rigid only 3) According to company announcements

Source: Official company information; press research; IHS; Roland Berger

The emergence of autonomous driving is one of the key disruptive trends and will trigger changes in products and services

Technology roadmap autonomous driving

Stage 0
No Automation

Driver is fully engaged all the time, warning signals might be displayed

✓

Stage 1
Driver Assistance

Automation of individual function, driver fully engaged – Driver may be "feet off" (when using ACC) or "hands off" (when using Lane Keep Assist)

✓

Stage 2
Partial Automation

Automation of multiple functions, driver fully engaged – Driver may be both "feet-off" and "hands off", but eyes must stay on the road

Advanced testing phase

Stage 3
Conditional Automation

Automation of multiple functions, driver responds to a request to intervene – Driver may be "feet-off", "hands off" and "eyes off", but must be able to resume control quickly

>2020

Stage 4
High Automation

Automated in certain conditions, driver not expected to monitor road – Driver has no responsibility during automated mode

>2025

Stage 5
Full Automation

Situation independent automated driving – Driver has no responsibility during driving

>2030

Increasing influence on future truck product and service concepts

Source: SAE, Roland Berger

The evolution of digital technologies and culture will create new use cases, for example, in the context of advanced truck & trailer

Truck telematics data and potential use cases (examples)

Truck management

- **Mileage**
- **Distance traveled**
- **Engine performance**
- **Tire pressure**

Use cases:

> Predictive maintenance
> Remote diagnostics
> Engine and fuel consumption improvements real time
> Platooning
> …

Driver management

- **Travel profile**
- **Driver behavior**
- **Entertainment**

Use cases:

> "Pay how you drive"
> Location-based services
> Warnings for inappropriate driving
> …

Logistics management

- **Navigation**
- **Parking**
- **Location**
- **Route planning**
- **Freight optimization**

Use cases:

> Parking assistance (search, payment, etc.)
> Fleet management
> Last mile information to customer
> …

Other

- **Toll**
- **Driver assistance**
- **Theft protection**
- **Marketing**

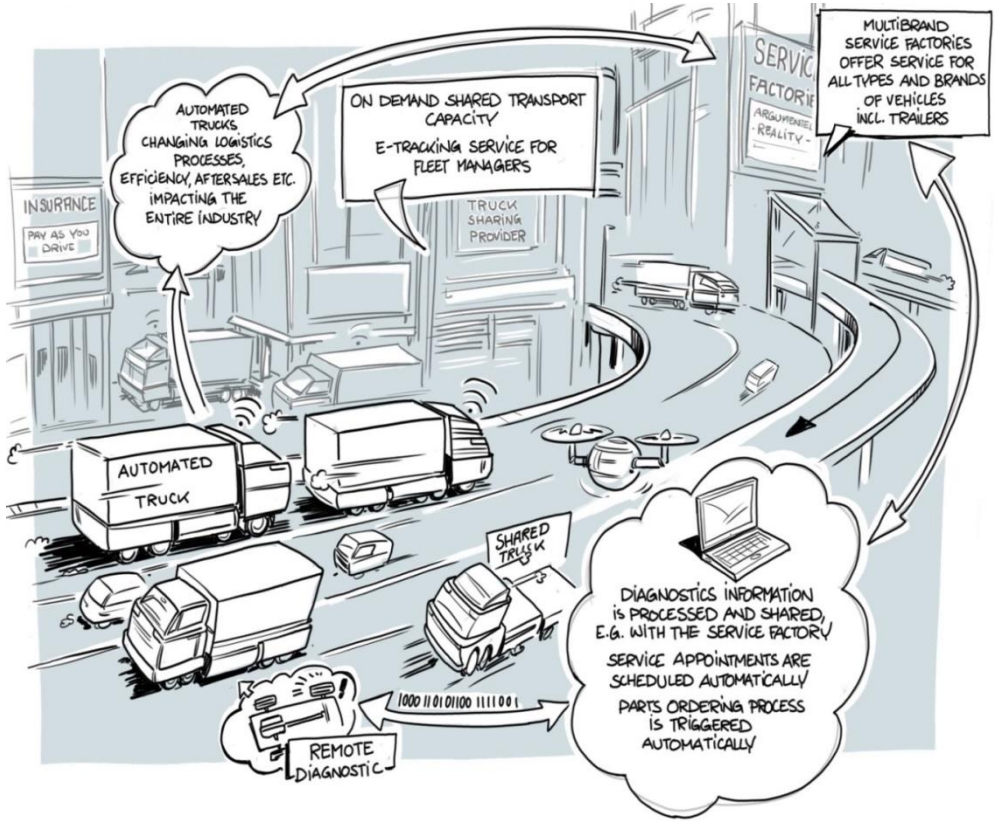
Use cases:

> eCall
> Road assistance including augmented reality
> Vehicle tracking and theft protection
> Remote truck steering
> "Take a lunch break – 20% off"
> …

Source: Roland Berger

Digitalization will drive the creation of a completely new truck service scenario in the future

Future service scenario



Prediction

Integrated solutions Same-day delivery

REMOTE DIAGNOSTICS ***SMART MOBILITY***

COST/TCO EFFICIENCY Online check-in

Differentiated offering via multibrand **AUTOMATED TRUCK**

Vehicle specialization & standardization **Smart Logistics**

Augmented reality

TELEMATICS SOLUTIONS

Professionalization

Real-time data

DIGITALIZATION **ON-DEMAND SHARED MOBILITY**

Aftersales cooperation

e-tracking service **LAST MILE CONCEPT**

Fleet management ***Applications*** Dynamic pricing

COMMUNITY **Service factories**

Value-based pricing

SMART DATA *Seamless customer journey*

Transparency of players

ONE-STOP SHOPPING

DISRUPTION

Source: Roland Berger

The speed with which the four megatrends develop depends on related regulation – Overall, regulatory pressure is increasing

Overview: Regulation and regulatory pressure – Example Europe

Vehicle/technology-related regulation

Type	Reg. pressure	Rationale
Emission standards	◔	Further tightening of emission standards announced and expected (incl. CO_2)
Zero emission zones	◕	Zero/low emission zones planned especially for urban areas in key EU markets (e.g. GER, IT, NL, UK)
Special regulations for electric vehicles	○	Beneficial regulatory impact expected for xEV trucks
Size & load	◔	Easing of restrictions (e.g. Germany 2017) – Further liberalization expected
Safety	◑	Tightening of standards discussed by EU commission including mandatory installation of certain ADAS
Platooning	◑	As a form of autonomous driving is expected to be fostered by regulatory framework
Autonomous driving	◑	Favorable regulatory framework expected to be introduced fostering autonomous driving

Transportation-related regulation

Type	Reg. pressure	Rationale
Cabotage restrictions	◔	European Commission enforcing liberal cabotage rights – Expected to push for further liberalization
Tolls & road charges	◑	Increasing pressure due to rising tolls (e.g. AT, CH) and introduction in new countries (e.g. EST)
Driving times and rest periods	◕	Strict regulation by the European Commission in place – Enforcement to be intensified in future (e.g. FR, BE)
Minimum wages	◑	Increasing pressure on logistics providers due to introduction of minimum wages e.g. in Germany
Self-employment of drivers	◑	Stricter enforcement of existing regulation against quasi-self-employment to combat pressure on wages
Cross-border order placement[1)]	◑	Stricter enforcement of existing regulation to combat pressure on wages by drivers from Eastern European countries

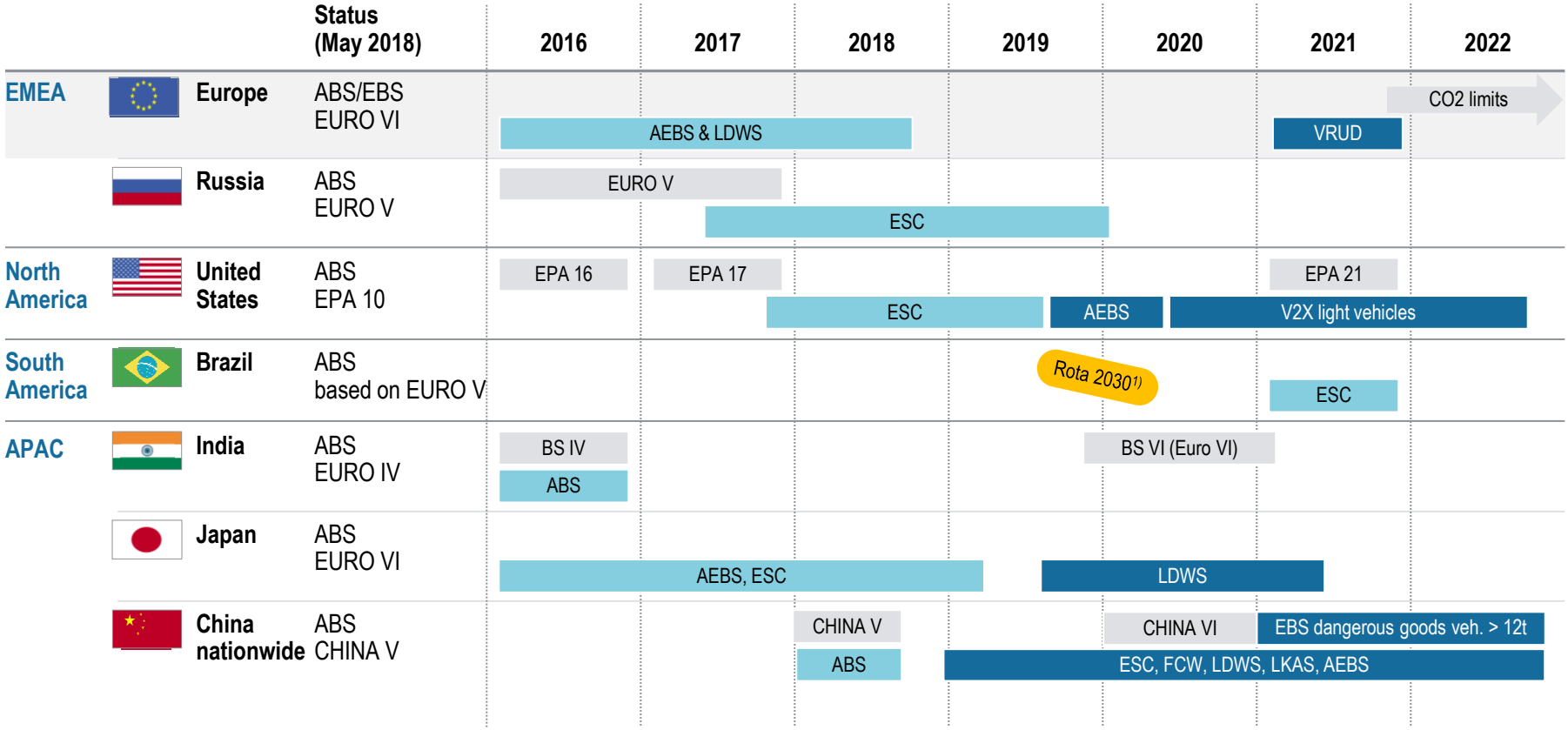
Expected regulatory pressure: ○ Very low ● Very high 1) Trucking companies can disposition orders to foreign countries only via employing subsidiary and not local subsidiary

Source: Market expert interviews, Roland Berger

The regulatory push is considered the major driving force for technology upgrades within commercial vehicle systems globally

Key regulations by region

Selection

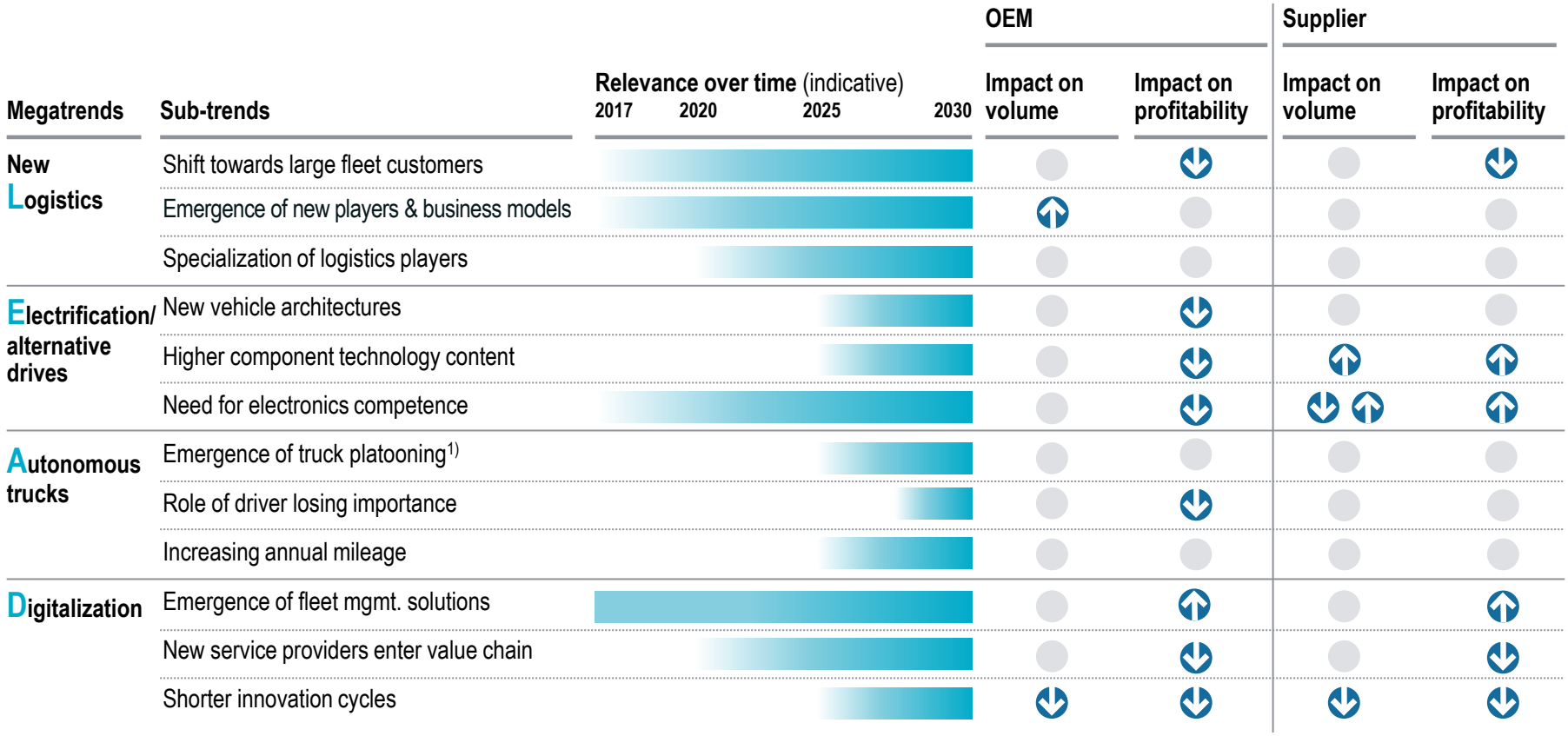


1) Approved on 15.05.2018, government intends to stimulate energy efficiency and vehicle safety, details to be confirmed

Source: Market research; Market expert interviews; Roland Berger

"LEAD" dimensions are expected to shape the truck and trailer market until 2030

Key trends and implications for the truck and trailer market – Example Europe



Positive influence | Negative influence | No/limited influence

1) Depending on region, e.g. early adoption in US likely

Source: Roland Berger

B. Truck & trailer market development (spotlight on Europe)

This study covers medium and heavy trucks, buses >8t and trailers – Global focus, with a regional spotlight on Europe

Regional and country scope of this study

Truck and bus production

- **Europe[1)]**
- **North America**
- **South America**
- **APAC[2)]**
- **China**

Trailer production

Western Europe

- Austria
- Belgium
- Croatia
- Denmark
- Finland
- France
- Germany
- Ireland
- Italy
- Luxembourg
- Netherlands
- Norway
- Portugal
- Serbia
- Spain
- Sweden
- Switzerland
- United Kingdom

Eastern Europe

- Belarus
- Bulgaria
- Czech Republic
- Estonia
- Hungary
- Latvia
- Lithuania
- Poland
- Romania
- Russia
- Slovakia
- Slovenia
- Ukraine
- Turkey[3)]

1) Including Russia/CIS and Turkey 2) Japan, Korea and India only 3) Considered for truck/bus production; excluded in trailer analysis

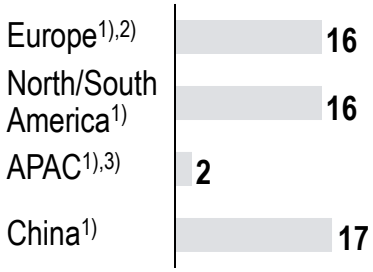
Source: Roland Berger

Roland Berger has conducted approximately 80 interviews with market experts to evaluate the truck & bus and trailer market

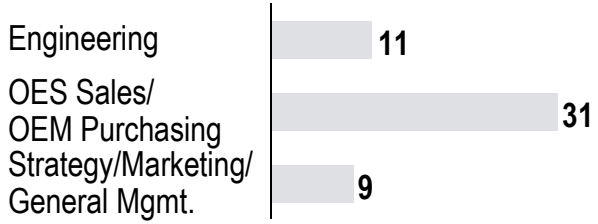
Overview of market expert interviews conducted [#]

Interviewees truck & bus

By geography

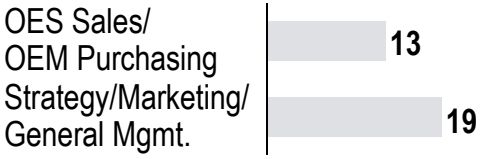


By expertise



Σ 51

Interviewees trailer



Σ 32

1) Other markets were also covered in interviews 2) Including Russia/CIS and Turkey 3) China excluded

Source: Roland Berger

In Europe, besides the impact of megatrends, a set of region-specific drivers will determine the development of the market

Key drivers for the truck and trailer market – Example Europe

Market drivers			Relevance	Direction of influence	Description
Factors	Macroeconomic	GDP development[1)]	●	↗	Short/mid-term GDP in Europe will drive global truck and trailer demand. Stronger growth for Eastern European countries is forecast.
		Business climate change	◕	→	Short-term indicator with high impact on volatility of truck/trailer business, currently stable in Europe.
		Construction sector	◕	↗	Growth of construction sector to have positive impact on truck and trailer demand.
	Transport	Development of transport tonnage km	●	↗	Long-term factor of overall transport volume creates the increasing transportation demand driving the truck/trailer industry, especially in the smaller European countries.
		Development of modal split: Road vs. other transport	◕	→	Road transport vs. other modes of transport (e.g. rail, waterways) is expected to be stable overall.
		Fuel prices	◑	↗	Fuel prices are expected to remain low in the medium term, helping freight forwarders significantly, which also positively impacts truck/trailer demand.
	Socioeconomic	Emission regulations	◔	→	Emission regulations are expected to put more pressure on the truck industry – High predictability for OEMs from long-term emission standard cycles.
		Regulatory environment changes	◕	↗	Positive impact expected on truck and trailer demand from implemented/proposed regulatory changes regarding driver assistance and less cabotage restrictions.
		Population	◔	↗	Population is expected to increase slightly in most regions – Marginal positive impact on truck and trailer demand.
Overall				↗	**Favorable trends overall**

● High relevance ○ Low relevance ↑ Positive influence ↓ Negative influence

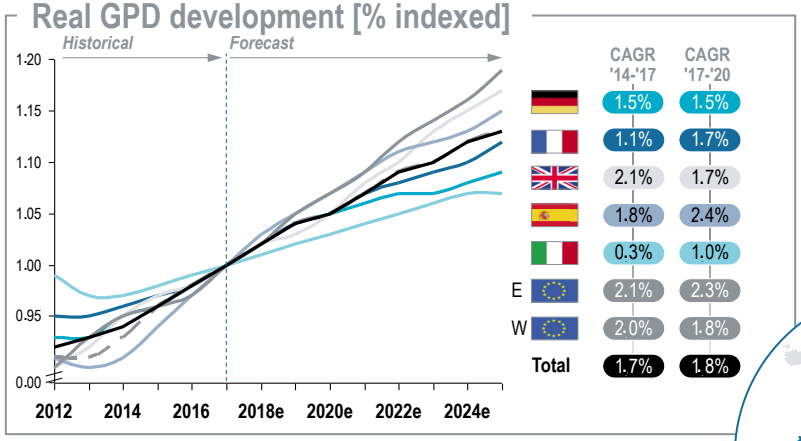
1) Including development of raw material prices, in particular in Brazil

Source: Market research; interviews with market participants; Roland Berger

Forecasts of major truck & trailer market drivers in Europe indicate a further positive development over the upcoming years

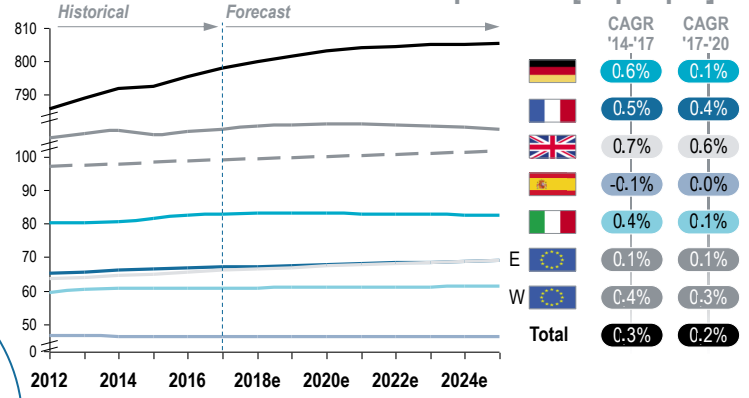
Development of the key truck & trailer market drivers

Real GPD development [% indexed]



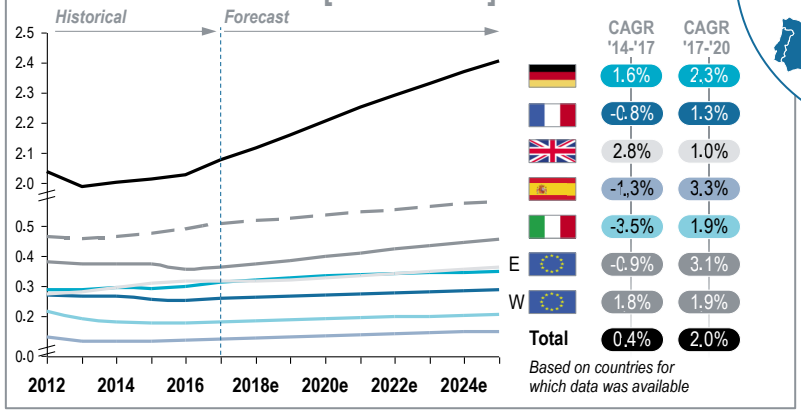
	CAGR '14-'17	CAGR '17-'20
Germany	1.5%	1.5%
France	1.1%	1.7%
UK	2.1%	1.7%
Spain	1.8%	2.4%
Italy	0.3%	1.0%
E	2.1%	2.3%
W	2.0%	1.8%
Total	1.7%	1.8%

Population [m people]



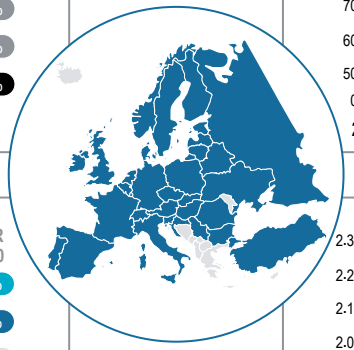
	CAGR '14-'17	CAGR '17-'20
Germany	0.6%	0.1%
France	0.5%	0.4%
UK	0.7%	0.6%
Spain	-0.1%	0.0%
Italy	0.4%	0.1%
E	0.1%	0.1%
W	0.4%	0.3%
Total	0.3%	0.2%

Construction sector[1] [EUR trillion]

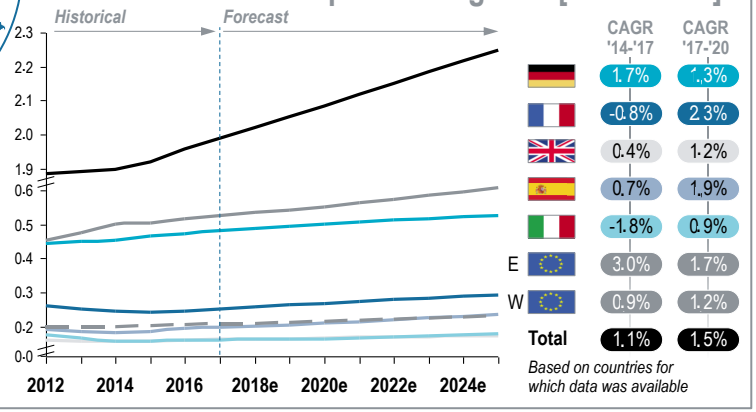


	CAGR '14-'17	CAGR '17-'20
Germany	1.6%	2.3%
France	-0.8%	1.3%
UK	2.8%	1.0%
Spain	-1.3%	3.3%
Italy	-3.5%	1.9%
E	-0.9%	3.1%
W	1.8%	1.9%
Total	0.4%	2.0%

Based on countries for which data was available



Road transport tonnage km [trillion tkm]



	CAGR '14-'17	CAGR '17-'20
Germany	1.7%	1.3%
France	-0.8%	2.3%
UK	0.4%	1.2%
Spain	0.7%	1.9%
Italy	-1.8%	0.9%
E	3.0%	1.7%
W	0.9%	1.2%
Total	1.1%	1.5%

Based on countries for which data was available

Germany · France · UK · Spain · Italy · Eastern Europe · Rest of Western Europe · Total

1) Gross output (real) general construction and specialized construction as well as repair activities for buildings, civil engineering and infrastructure works

Source: Oxford Economics; IHS; Progtrans; Roland Berger

In the short and mid term, the truck and bus market is expected to be mostly impacted in three dimensions

Clean Mobility

Emission reduction by:

> Tightening of CO_2 emissions standards for heavy-duty vehicles
> Enhanced aerodynamic efficiency
> Electrification (primarily metro areas)

Safe Mobility

Reduction of road accidents by:

> New road safety policies
> Implementation of additional safety features (e.g. blind spot detection etc.)

Connected and Automated Mobility

Enhanced safety and traffic flow through:

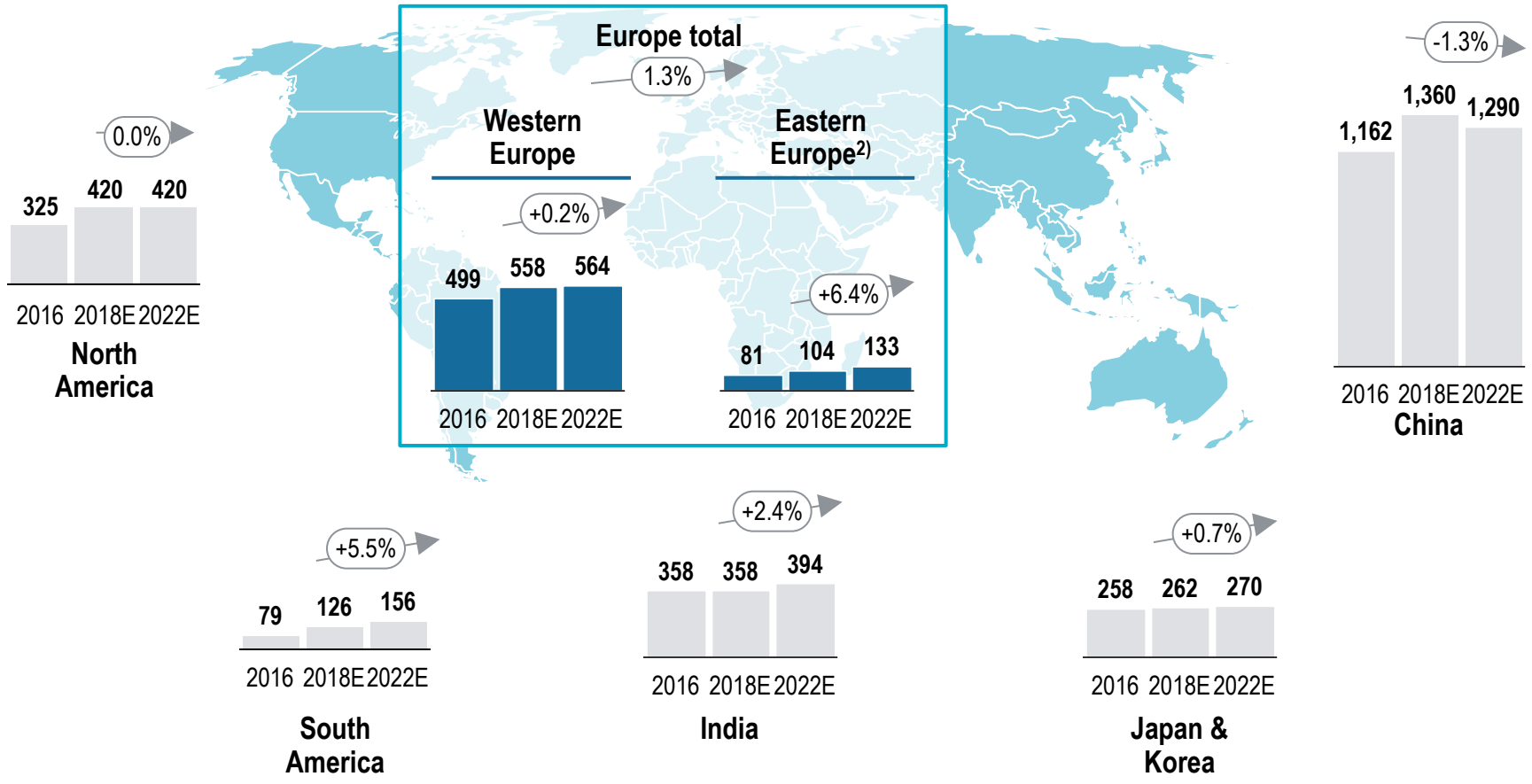
> V2V/V2X communication (CACC platooning)
> Increased assisted driving up to Level 3 (enhanced ADAS systems)

> Clean and safe mobility lead to **higher demand** for vehicles with **advanced safety features** and better fuel economy/**less emissions**, achieved through
  – **ADAS (Level 0-2)**, such as advanced emergency braking, lane-keeping assist and cyclist detection systems for trucks
  – **Technology upgrades of CV systems**, such as automatic manual transmission and engine emissions systems
> Those trends are expected to take effect within **short and mid-term implementation** (until 2022)
> **Autonomous driving**, fully automated platooning, etc. are expected to materialize **long term** (after 2023)

Source: Market research; Roland Berger

Production of medium/heavy duty trucks and buses is on the rise globally – For Europe, approx. 1% annual increase expected

Annual truck and bus production[1] [k units] by region and CAGR, 18E-22E



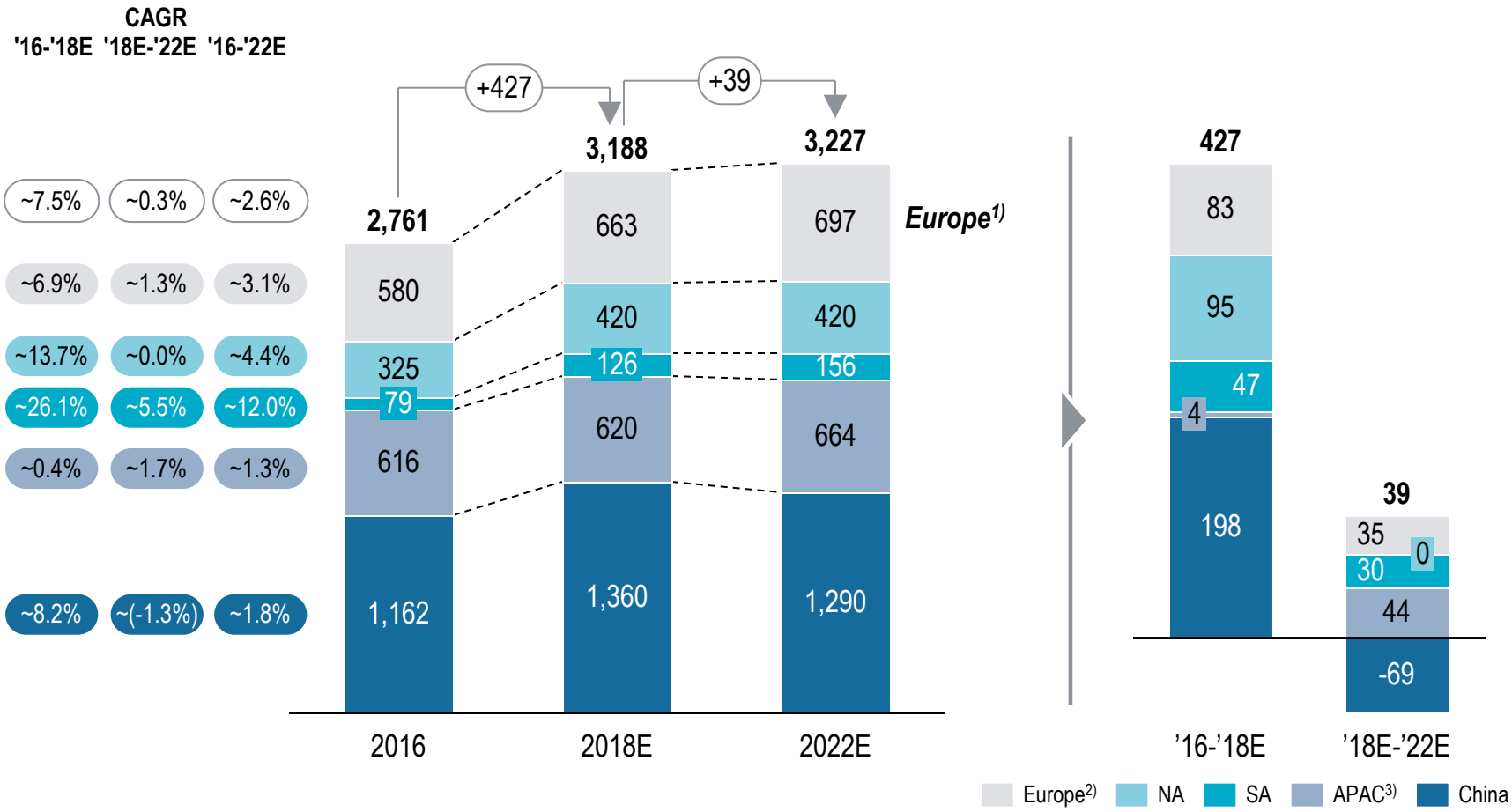
1) For medium/heavy duty trucks and buses >8 t 2) Including Russia/CIS and Turkey

x% = Compound annual growth rate 2018-2022

Source: IHS; Roland Berger

Global medium / heavy truck and bus production with strong CAGR '16-'18E (7.5%) and almost no growth '18E-'22E (CAGR 0.3%)

Truck and bus production[1] 2016-18E-22E ['000] and delta analysis ['000]

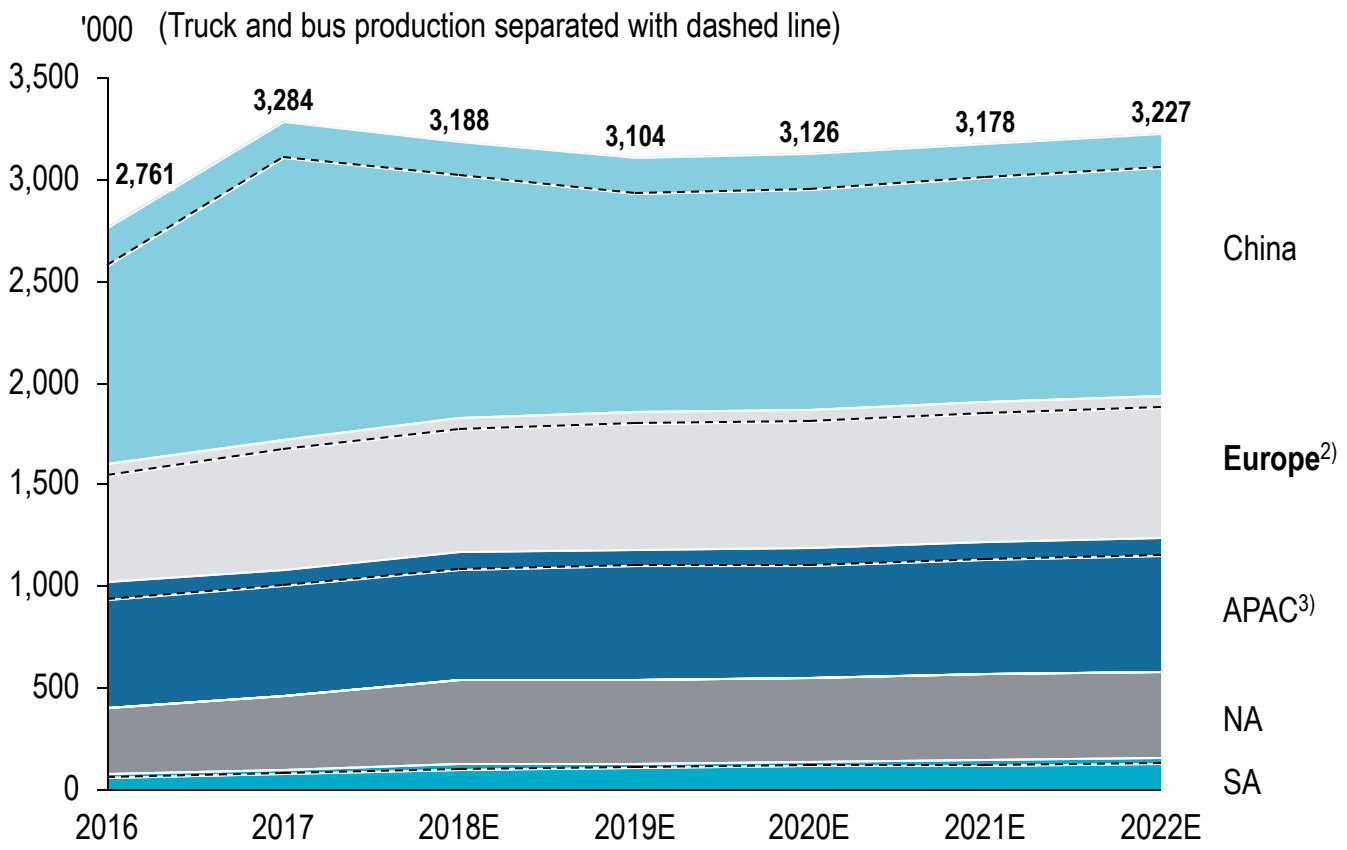


1) for medium/heavy duty trucks and buses >8 t 2) Including Russia/CIS and Turkey 3) China excluded. APAC defined as Japan, Korea and India

Source: Market expert interviews; Roland Berger

Trucks account for 84% of global truck and bus production on average (2016-22E)

Truck and bus production[1] by region, 2016-22E



Share of global truck and bus production

> Truck and bus production in China accounts for 42% of global production on average (2016-22E)
> Europe accounts for 21%, APAC for 20% and North America for 13% of global production on average (2016-22E)

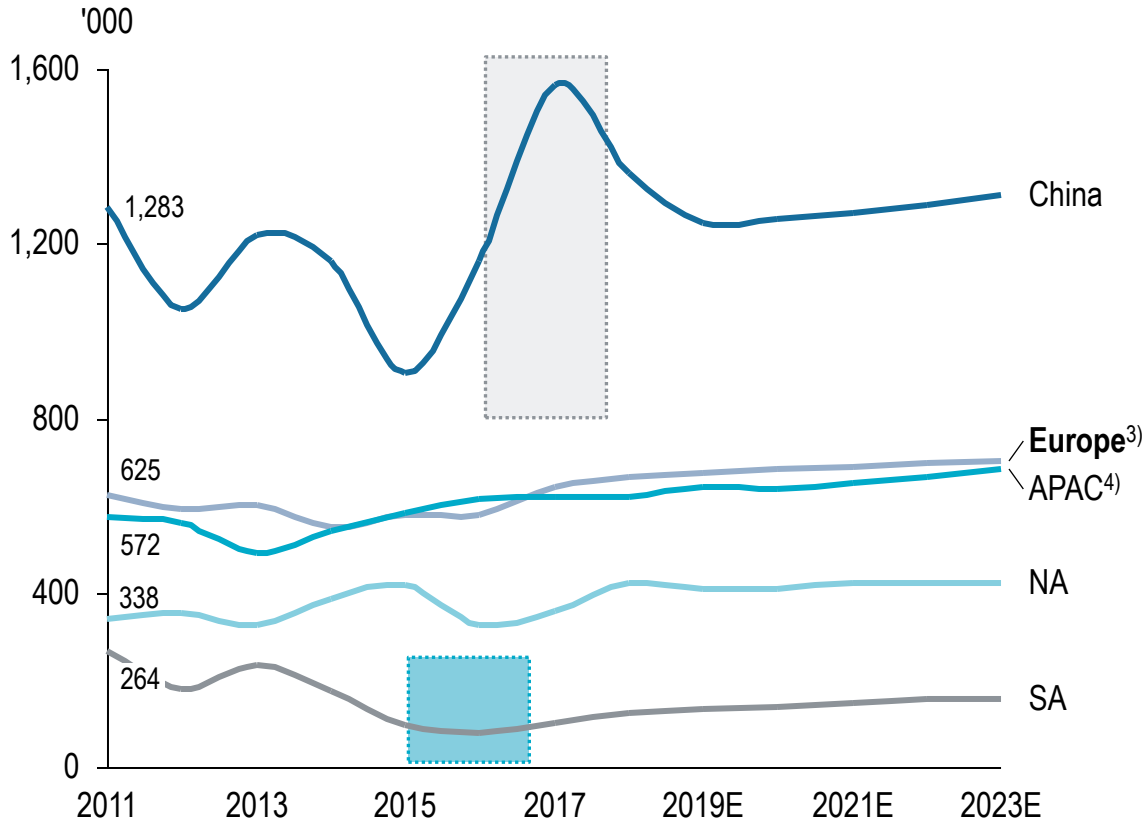
Share of bus production in region

> Production rate for buses is not reported separately in USA due to similar platform
> Share of bus production is highest in South America with 25% on average (2016-22E)
> Share of bus production is lowest in Europe with 9% on average (2016-22E)

1) for medium/heavy duty trucks and buses >8 t 2) Including Russia/CIS and Turkey 3) China excluded. APAC defined as Japan, Korea and India
Source: Market expert interviews; Roland Berger

Spotlight: Tightening emission standards (for diesel engines as of January 2018) led to a massive "pre-buy" effect in China in 2017

Truck and bus production[1] by region, 2011[2]-23E



Volatile T&B production rate in China

> Weak macroeconomics in 2015
> China accounted for the largest share of global truck and bus production increase from 2016 to 2018
> Tightening emission standards (nationwide):
  – CHINA V (similar to EURO V) required for new diesel vehicle registration from January 2018
  – CHINA VI type approval in 2020

South American economy recovers after recession in 2015/16

> T&B production increases only gradually from a low basis
> Hence governments adopt a cautious approach to new regulations so as not to jeopardize recovery

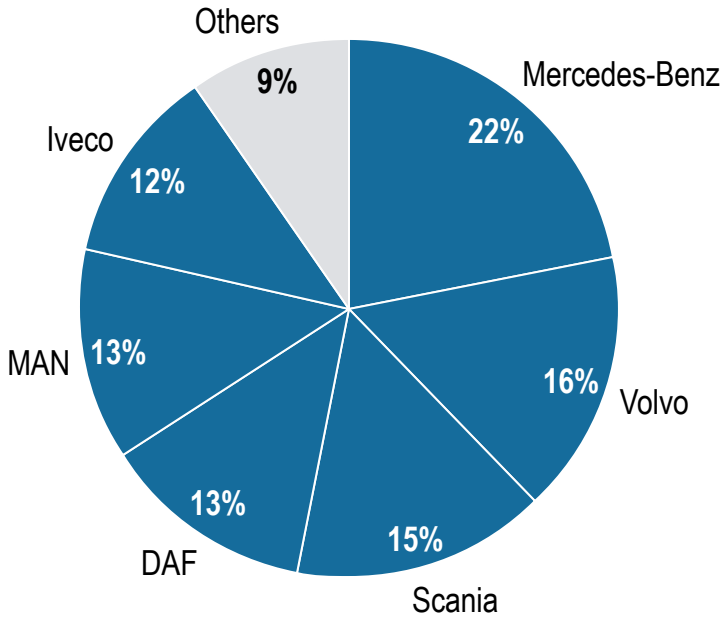
1) for medium/heavy duty trucks and buses >8 t 2) actual figures are shown for 2011 3) Including Russia/CIS and Turkey
4) China excluded. APAC defined as Japan, Korea and India

Source: Market expert interviews; Roland Berger

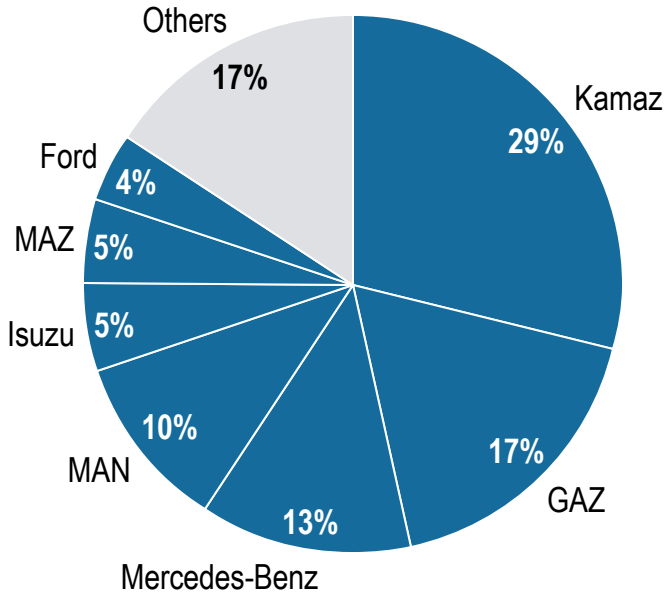
Key regional truck markets in Europe are dominated by local OEMs – Top 5 players typically account for >70% of production

Medium/heavy duty truck production by region and by OEM, 2017 [%][1)]

Western Europe



Eastern Europe[2)]

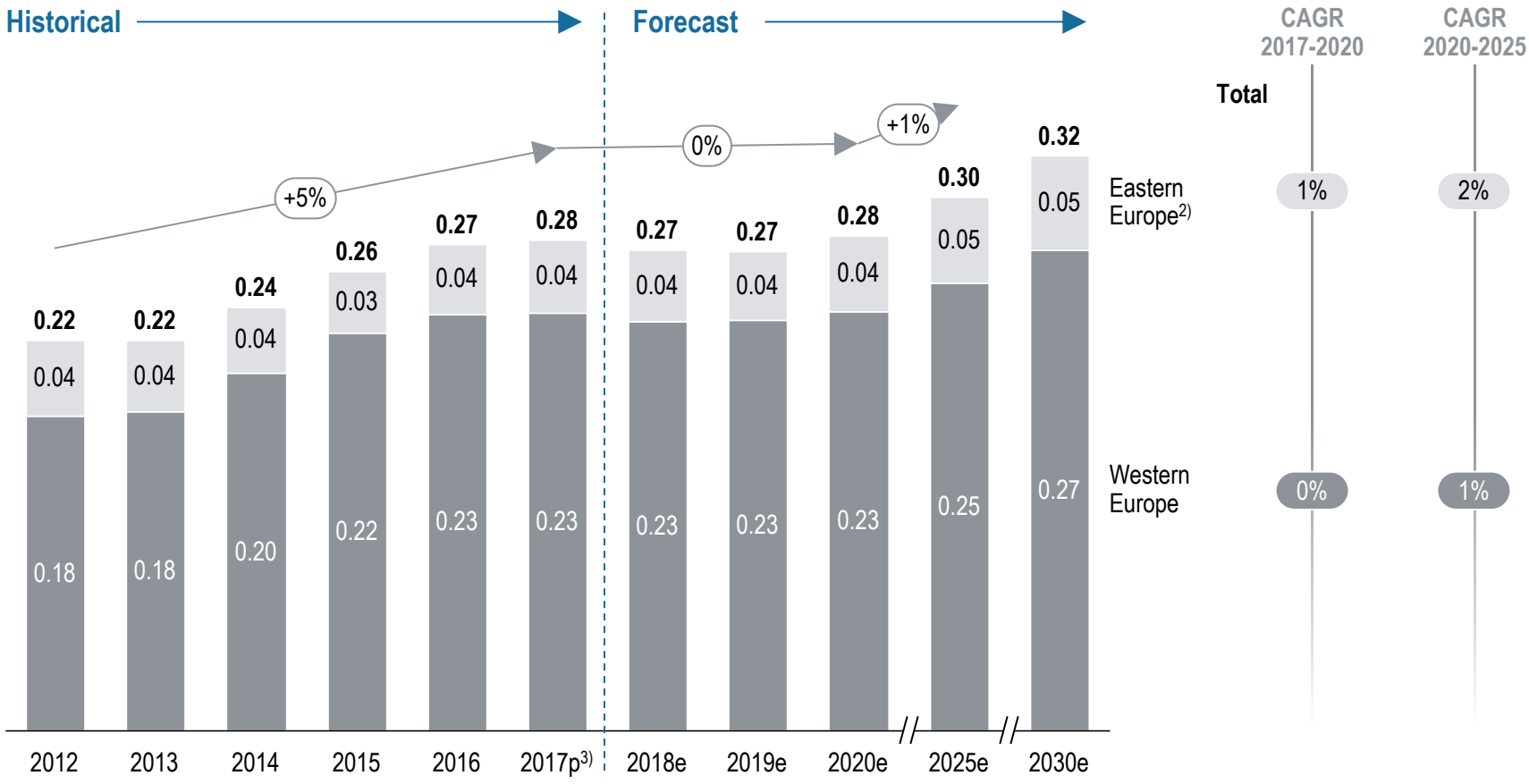


1) Excluding buses 2) Incl. Russia and Turkey

Source: IHS Automotive; Roland Berger

Trailer production in Eastern Europe shows slightly stronger growth than in Western Europe

European trailer[1] production by region, 2012-30 [m units]

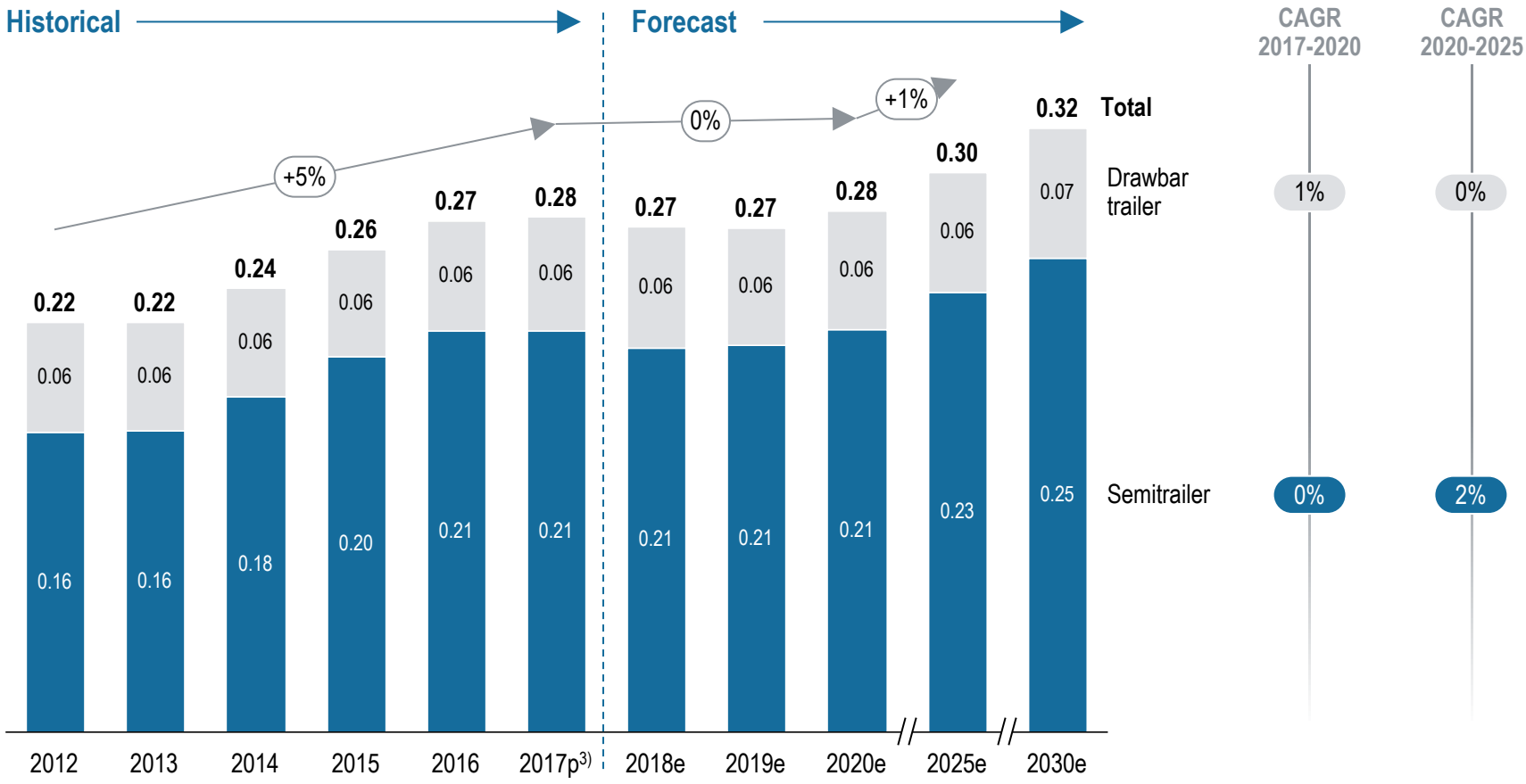


1) Medium/heavy duty commercial vehicle trailers; 2) Incl. Russia, excl. Turkey; 3) Prognosis, Q1 2017 analyzed and data forecast till end of 2017 based on market interviews/data analyses

Source: Clear International; local market research; interviews with market experts; Roland Berger

Semitrailers constitute the majority of trailer production – Production share of drawbar trailers declining long term

European[1] trailer[2] production by vehicle segment, 2012-30 [m units]

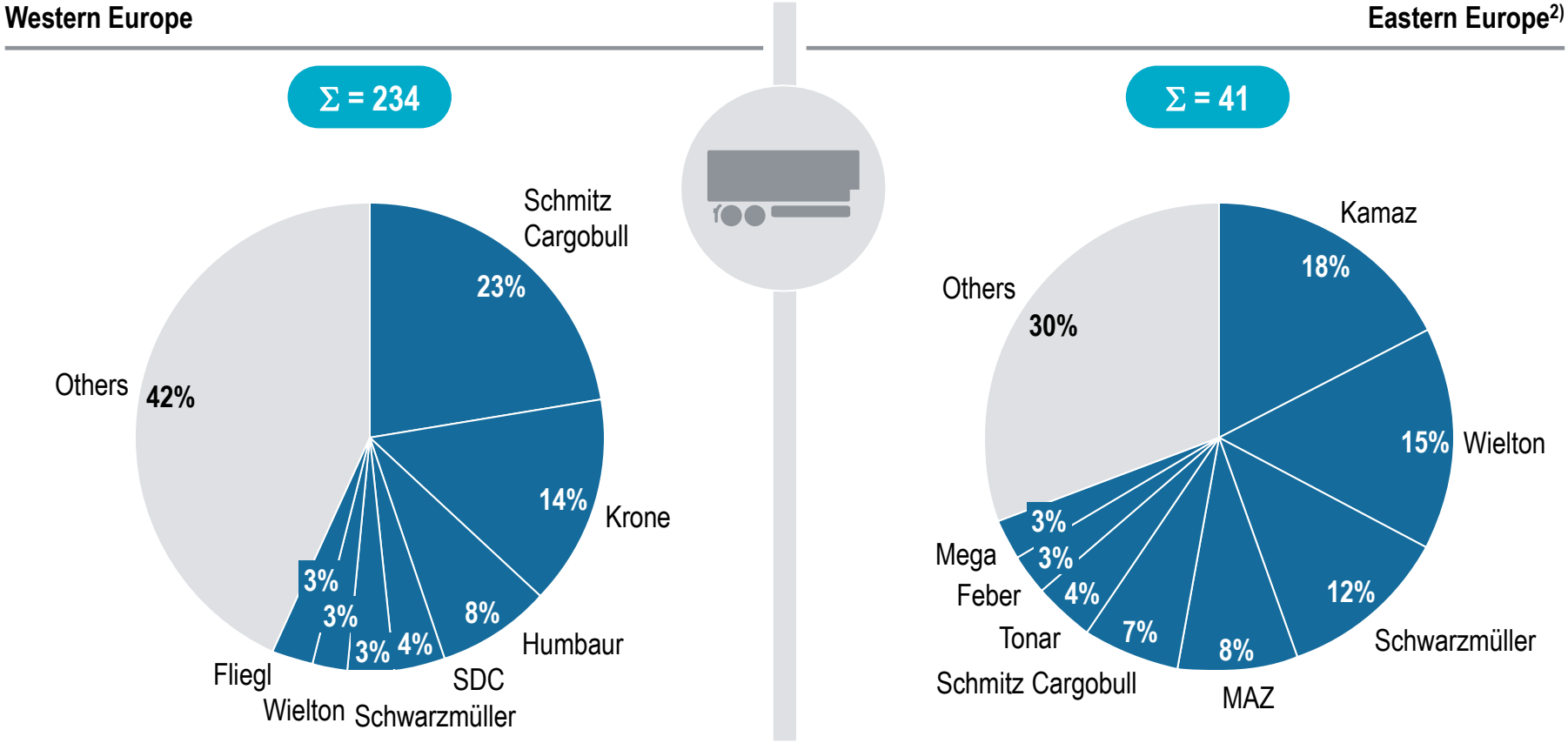


1) Incl. Russia, excl. Turkey; 2) Medium/heavy duty commercial vehicle trailers; 3) Prognosis, Q1 2017 analyzed and data forecast till end of 2017 based on market interviews/data analyses

Source: Clear International; local market research; interviews with market experts; Roland Berger

The trailer production market is still fragmented with a multitude of smaller specialized companies

Trailer[1] production by region and by trailer manufacturer, 2017 [%, k units]



1) Medium/heavy duty commercial vehicle trailers; 2) Incl. Russia, excl. Turkey

Source: Clear International; local market research; interviews with market experts; Roland Berger

C. Impact on truck & trailer component suppliers (examples)

Today, the largest share of value in a standard truck tractor lies in powertrain and cabin; increasing value of connectivity systems in future

Truck tractor – Content per vehicle [% of EUR][1)]

Indication based on standard European HDT (>15t GVW)

Powertrain

- Engine
- Transmission/ steering
- Exhaust system

40-45%

Cabin

25-30%

- Exterior
- Interior
- Electrics/electronics
- Comfort/safety

Chassis

20-25%

- Axles
- Brakes
- Suspension
- Wheels/tires

Systems/connectivity

<5%

- ADAS
- Infotainment
- Telematics

= Value add by OEM vs. suppliers; "+" = high value add by OEM, "-" = high value add by supplier

= Sample component for deep dive

1) Average content per vehicle as OEM cost after assembly, considering penetration rates

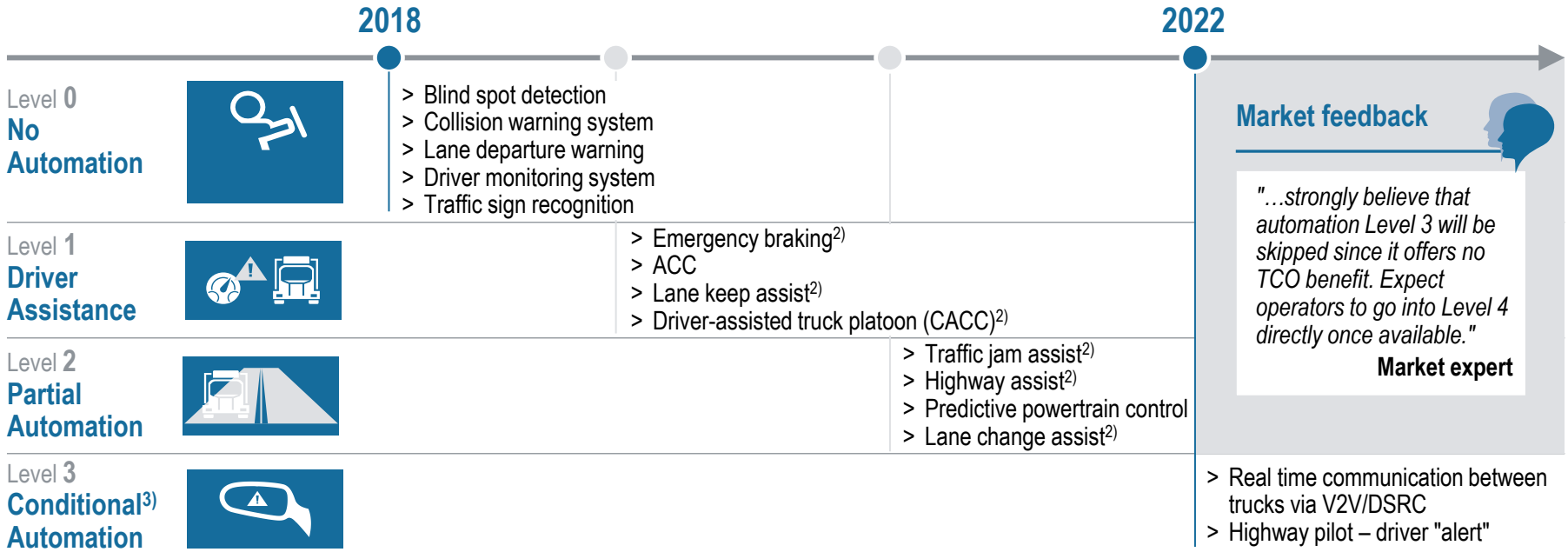
= Overall component value from low to high

= Development of value share until 2030

Source: Roland Berger

Braking systems and intelligent steering systems are key enablers for increased ADAS penetration by 2022

Automated commercial vehicle development paths with focus by 2022[1)]



> Level 1-2 is primarily implemented in Western Europe and to a lesser extent in North America – Equipment rates of ADAS (Level 1-2) are expected to increase globally due to increasing road safety standards
> CACC Platooning (Level 1) realized by decreasing minimum distance between multiple trucks and synchronization of braking via V2V
  – Improved fuel economy (up to -10%) only achieved with experienced drivers of platoon lead vehicle
  – CACC Platooning expected to remain a niche application within next 5 years (primarily tested by large fleets) since TCO effect is not consistent or easy to reap
> Automated truck platooning expected once Level 4/5 permits driverless trucks (significant TCO reduction), expected for >2025

1) Timeline shows when market penetration of viable applications is expected
2) Advanced steering and braking systems as enabler for ADAS
3) Level 3 requires systems with basic redundancy capabilities

Source: ERTRAC; market expert interviews; Roland Berger

Technology upgrade due to regulatory push/operational pull is expected to be a main driver of future market value growth

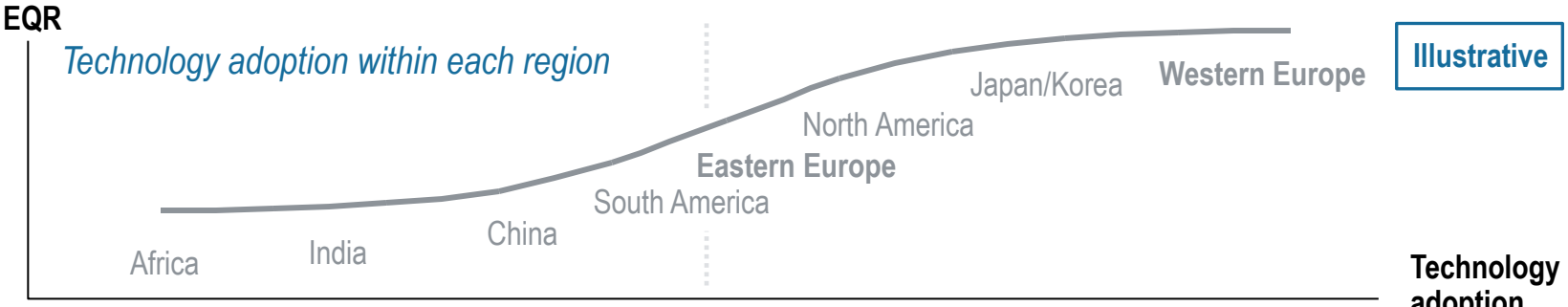
Regulatory push

Type	Description	Major impact on
Emission standards	Further tightening of emission standards announced and expected (incl. CO_2)	Engine air
Safety	Tightening of standards, including mandatory installation of certain ADAS	Braking and steering systems
Zero/low emission zones	Zero/low emission zones planned, esp. for urban areas in key markets	Electrification

Techno-logy upgrade of CV systems

Operational pull

Type	Description	Major impact on
Reduction of total cost of ownership (TCO)	Better fuel economy	Powertrain
	Reduced driver strain	Transmission, ADAS
	Optimized damage and operational costs	Braking and steering syst., ADAS
Driver shortage	US trucking industry facing growing driver shortage	ADAS, Transmission



- Further tightening of emission standards
- Increasing road safety standards
- In general sufficient driver availability

- High awareness for safety and sustainability topics
- Driver shortage drives demand for comfort/safety systems
- Optimization of total cost of ownership (TCO)

Source: Market research; Roland Berger

Major technology upgrades for CV systems related to braking, steering, ADAS and powertrain are expected within the next 5 years

Braking systems

- Shift from drum to disc brakes
- Implementation of brake controls, such as EBS[1] and ESC[2]

Steering systems

- Shift from mechanical to actuated (torque overlay) steering
- Increased capability for automated change of vehicle direction (e.g. highway lane change)

ADAS

- Increased penetration of ADAS tags along enhanced braking and steering systems (e.g. AEBS[3], LDWS[4])

Key enablers for further levels of automation (Levels 3-5)

Powertrain

- Shift from manual to automated manual (AMT) and fully auto-mated transmissions
- Implementation and advancement of engine emission regulation, such as EGR[5]
- E-mobility starting to evolve, primarily in (Chinese) metro areas

1) Electronic braking system 2) Electronic stability control 3) Autonomous emergency braking system 4) Lane departure warning system 5) Exhaust gas recirculation

Source: ERTRAC, market expert interviews; Roland Berger

Varying technology standards and equipment rates indicate further potential for market growth of selected CV systems

2016-2022

Established technology	Technology upgrade	Current equipment rates and trend in technology upgrades per region					
		West. Europe	East. Europe	NA	SA	APAC[4]	China
Drum brake systems	Disc brake systems[1]	● →	◔ ↗	◔ ↗	◔ ↗	◔ ↗	◔ ↗
ABS	EBS, ESC	● →	◔ ↗	◔ ↗	◔ →	◔ ↗	◔ ↗
Manual transmission	Semi/fully automated transmission	◔ ↗	◔ ↗	◔ ↗	◔ ↗	◔ ↗	◔ ↑
	Engine air	◔ →	◑ ↗	◑ →	◔ →	◔ ↑	◔ ↑
Mechanical steering	Torque overlay steering	○ ↗	○ ↗	○ ↗	○ →	○ ↗	○ ↗
	ADAS[2]	◔ ↗	○ →	◔ ↗	○ →	○ →	○ ↗

● 100% EQR[3] of technology upgrade ○ 0% EQR of technology upgrade ↑ Significant increase of EQR ↗ Increase of EQR → No significant change of EQR

1) Disc brake is already established in Western Europe 2) Systems defined as FCW, LDWS/LKAS, AEBS, ACC, Blind spot assist 3) Equipment rate 4) China excluded

Source: Market expert interviews; Roland Berger

Spotlight on China: Chinese OEMs are expected to increasingly upgrade into advanced CV systems supplied by Western OES

- China as the single largest global market for CVs has started to embrace increasing safety and emission standards – albeit starting from a very low penetration level
- Primary market focus is on the upgrade from drum to disc brakes and correspondingly an increased deployment of braking systems (particularly highway transportation)
- Prospectively the market is expected to also adopt ADAS, that are currently barely implemented in China – regulation will be a significant accelerator: Starting from 2019 ESC, FCW, LDWS and AEBS will sequentially become mandatory
- China is forecast to provide a significant growth opportunity for CV systems given low penetration levels for advanced braking systems and ADAS. Market experts forecast that Chinese CV OEMs will increasingly upgrade from currently local sourcing of mechanical components to advanced CV systems supplied through Western OES

Market feedback

"There is indeed a trend from drum brakes to disc brakes due to safety considerations and government regulations. In order to gain more market share, many local companies are trying to transform or extend their business to involve themselves in the disc brake business. However, the foreign manufacturers have already captured some competitive advantages in this business. Foreign brands have occupied 60% to 70% of the disc brake market."

Chinese market expert

Source: Market expert interviews; market research; Roland Berger

Market development is derived bottom up using three main drivers: Equipment rates, unit prices and truck / bus production

Main drivers of the market model

1 Equipment rates[1)]

Equipment rates[1)] per component and region

Split by systems
- Braking systems
- Powertrain
- Steering systems
- ADAS

2 Unit prices

Unit prices[2)] per component and region

Split by systems
- Braking systems
- Powertrain
- Steering systems
- ADAS

3 Truck and bus production

Truck and bus production per region from 2016 to 2022E

Split by region
- Europe[3)]
- North America
- South America
- APAC[4)]
- China

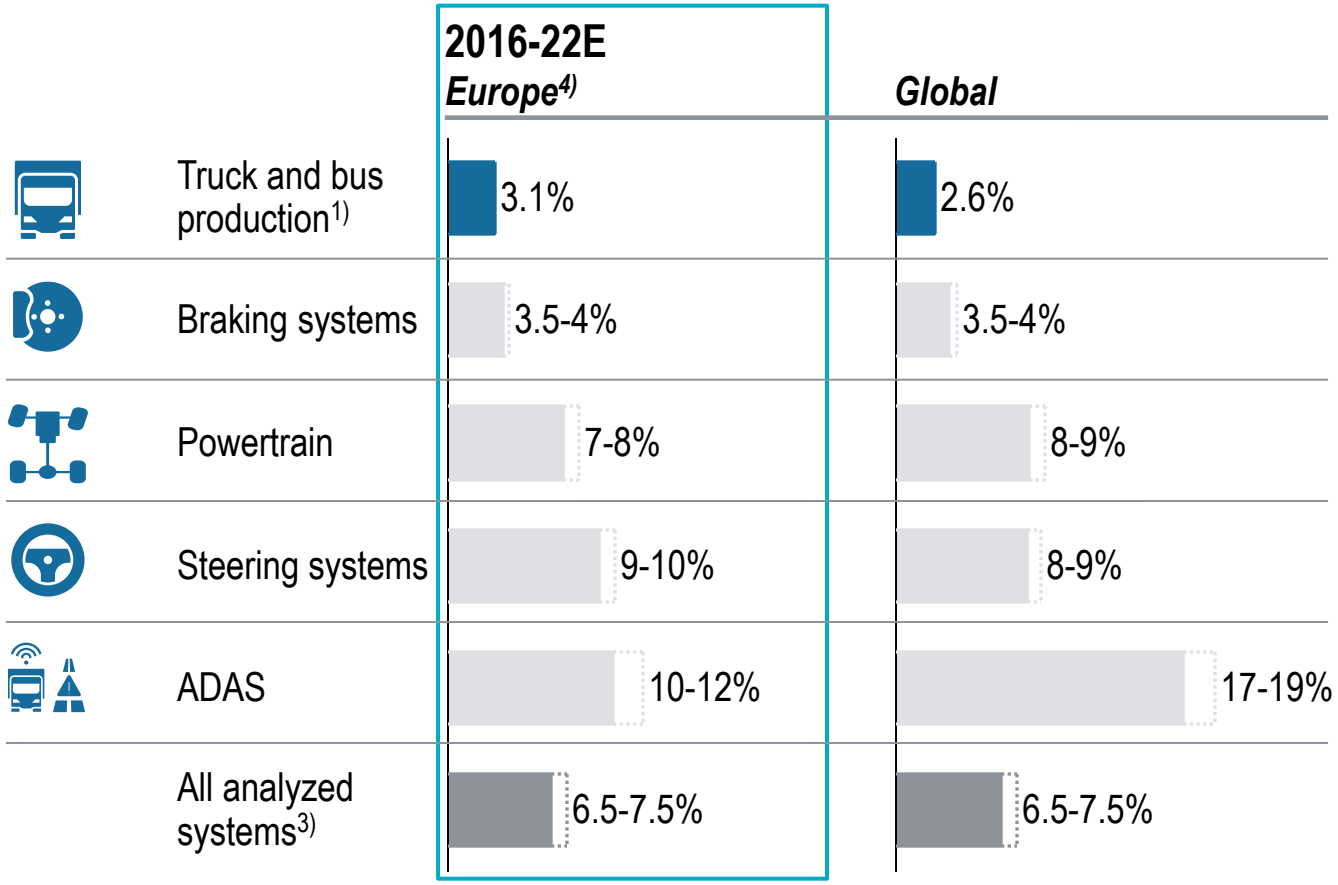
Output
- Value-based CAGR[5)] and volume per system and region from 2016 to 2022E with intermediate timesteps 2016-18-22
- Content (component value) per vehicle

1) Equipment rate defined as portion of newly built vehicles equipped with corresponding component 2) Based on market expert interviews, unit prices are expected to remain stable except for disc brakes in Europe and North America – industrial cost/product optimization offsetting inflationary price increases; Further price sensitivity analyses were not conducted for this market report 3) Including Russia/CIS and Turkey 4) China excluded 5) Market growth defined as increase of value of units equipped into newly built Commercial Vehicles

Source: Roland Berger

Results of market analysis indicate consistent outperformance of CV systems growth vs. truck/bus production

Truck and bus production[1] growth and CAGR[2] of selected CV systems



- Braking systems remain the backbone of the CV systems market, are expected to grow stronger (~50%) than global truck and bus production
- ADAS are forecast to generate the highest relative as well as absolute increase of value in global CV systems market
- High growth expected of powertrain and steering systems due to technological upgrade as enabler for safety features and subsequent autonomous driving capabilities

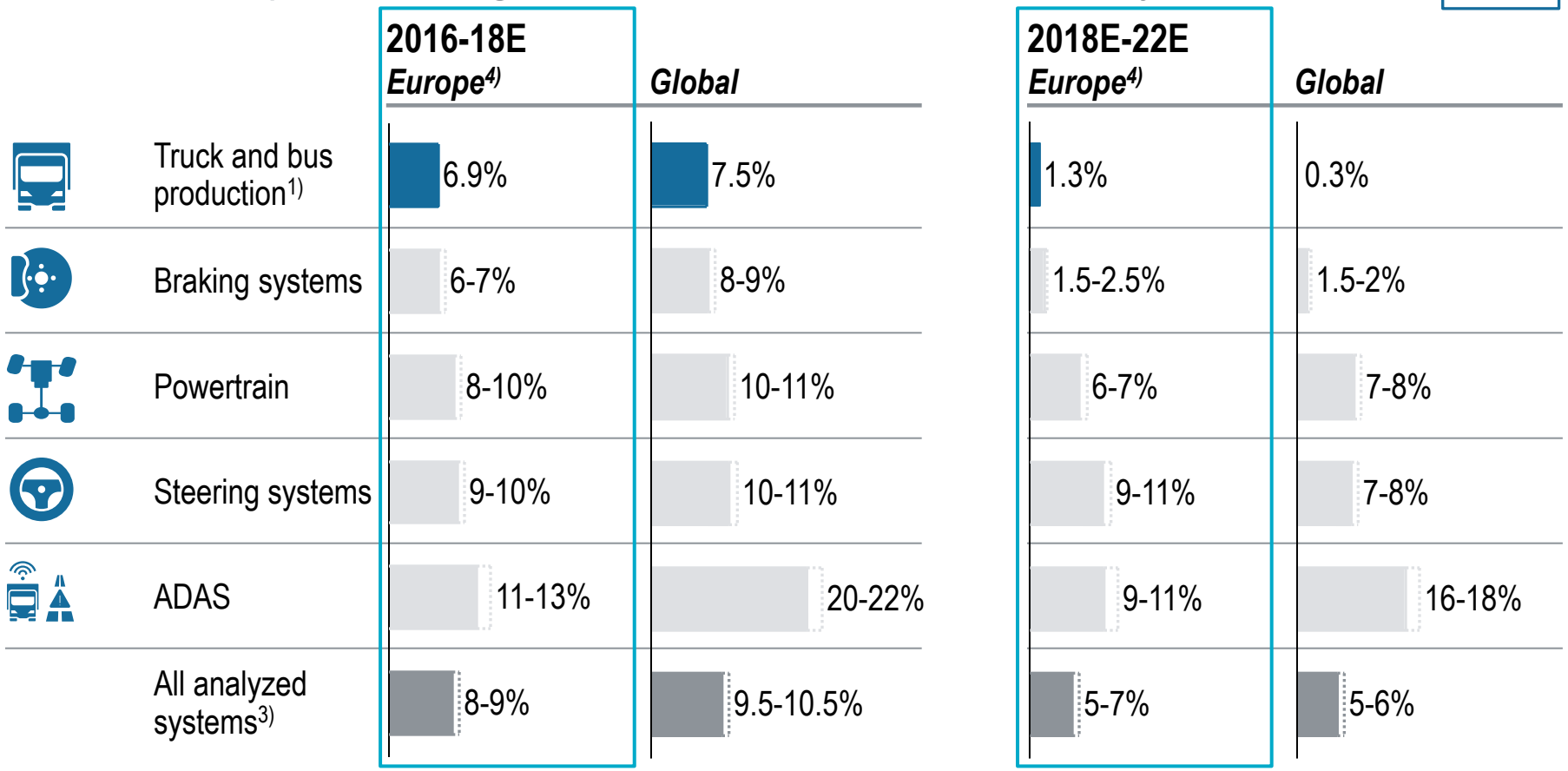
1) For medium/heavy duty trucks and buses >8 t 2) Based on market value 3) CAGR (2016-22E) of absolute value of market growth of the four analyzed component systems
4) Including Russia/CIS and Turkey

Source: Market expert interviews; Roland Berger

Results of market analysis indicate consistent outperformance of CV systems growth vs. truck/bus production

Truck and bus production[1] growth and CAGR[2] of selected CV systems

Backup

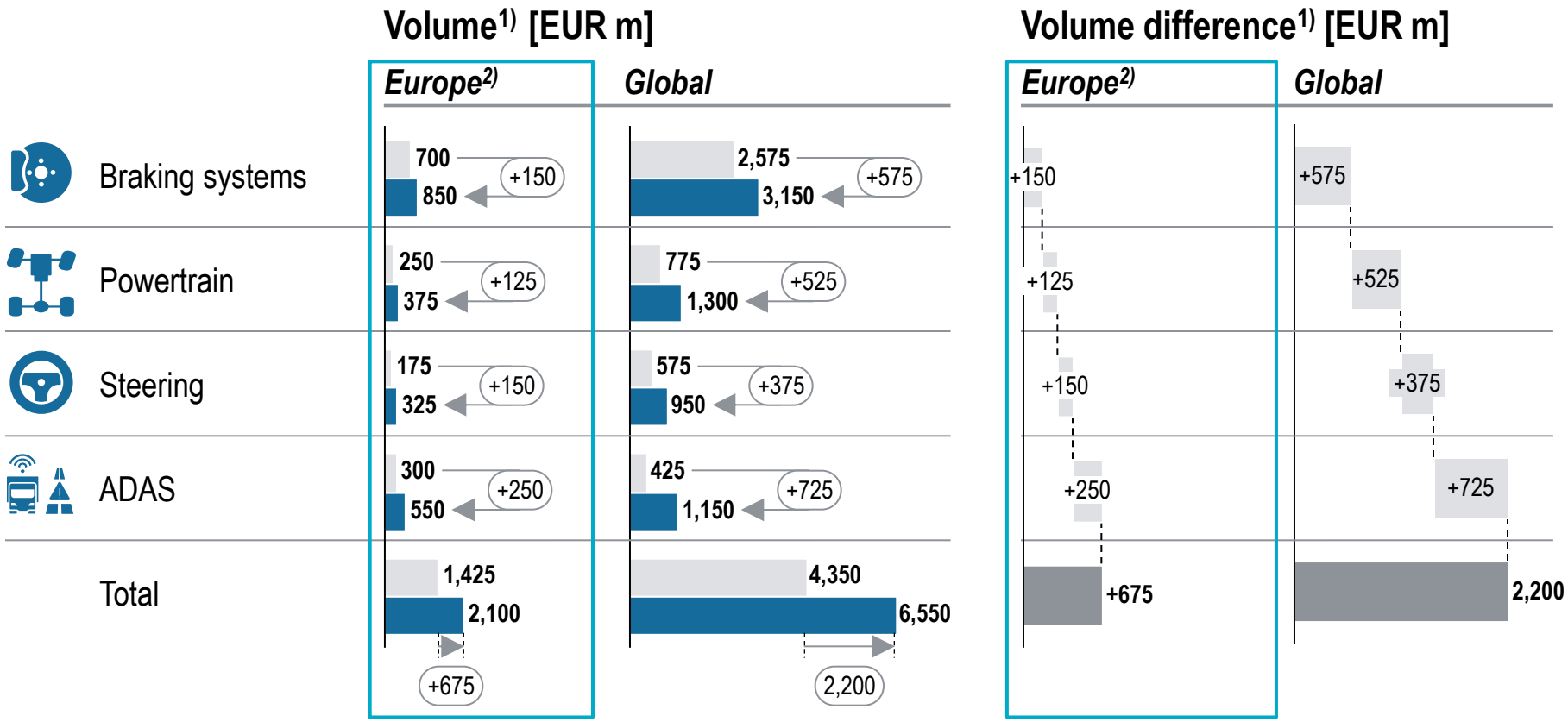


1) For medium/heavy duty trucks and buses >8 t 2) Based on market value 3) CAGR (2016-18E and 2018E-22E) of absolute value of market growth of the four analyzed component systems 4) Including Russia/CIS and Turkey

Source: Market expert interviews; Roland Berger

Braking systems will remain a backbone of the CV systems market – Even stronger increase expected from higher ADAS penetration

Volume of selected CV systems (2016-22E)

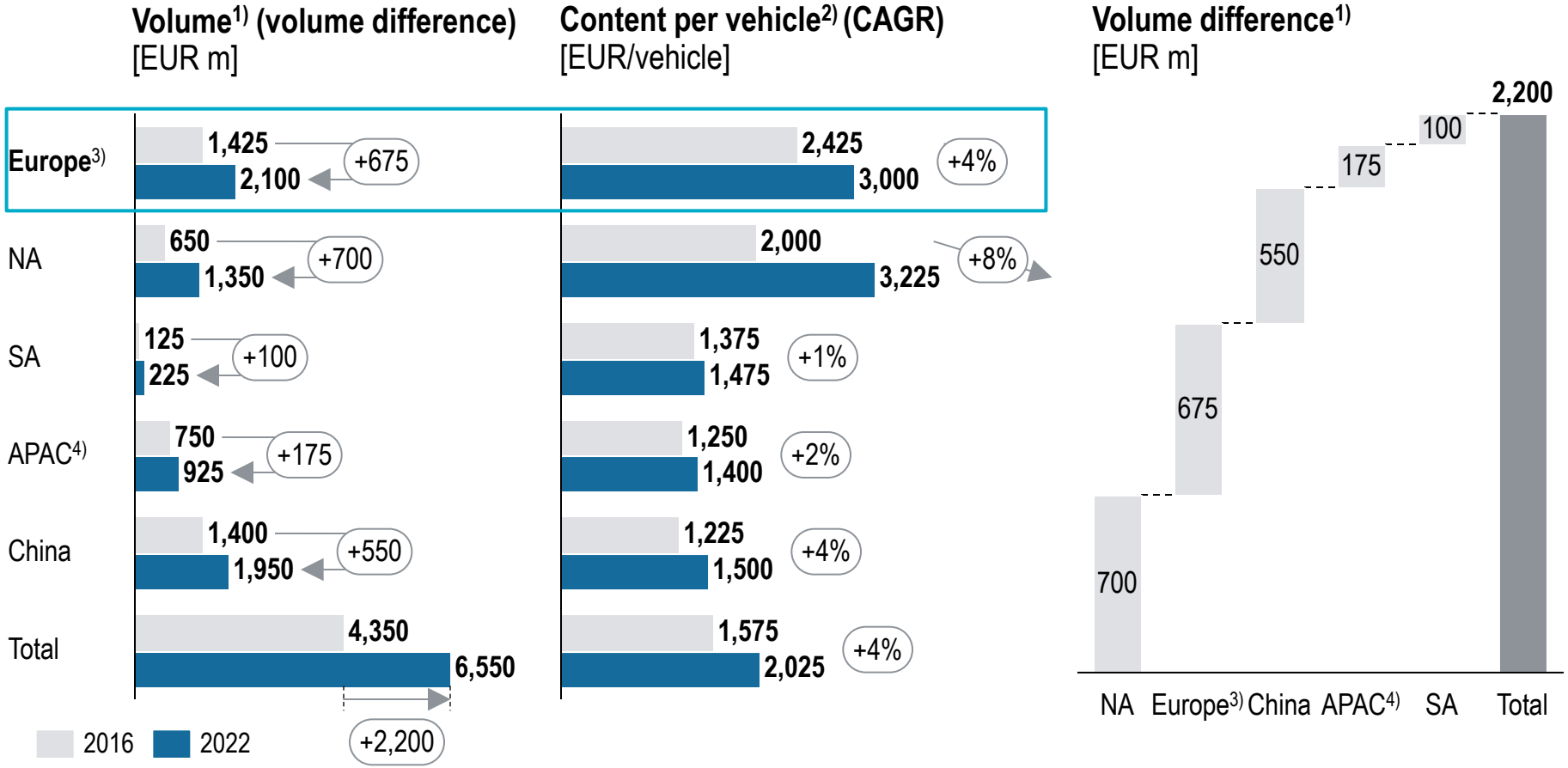


1) Rounded to nearest EUR 25 m 2) Including Russia/CIS and Turkey

Source: Market expert interviews; Roland Berger

Geographically, Europe is expected to provide the second largest absolute increase, after North America

Volume and content per vehicle of selected CV systems by region (2016-22E)

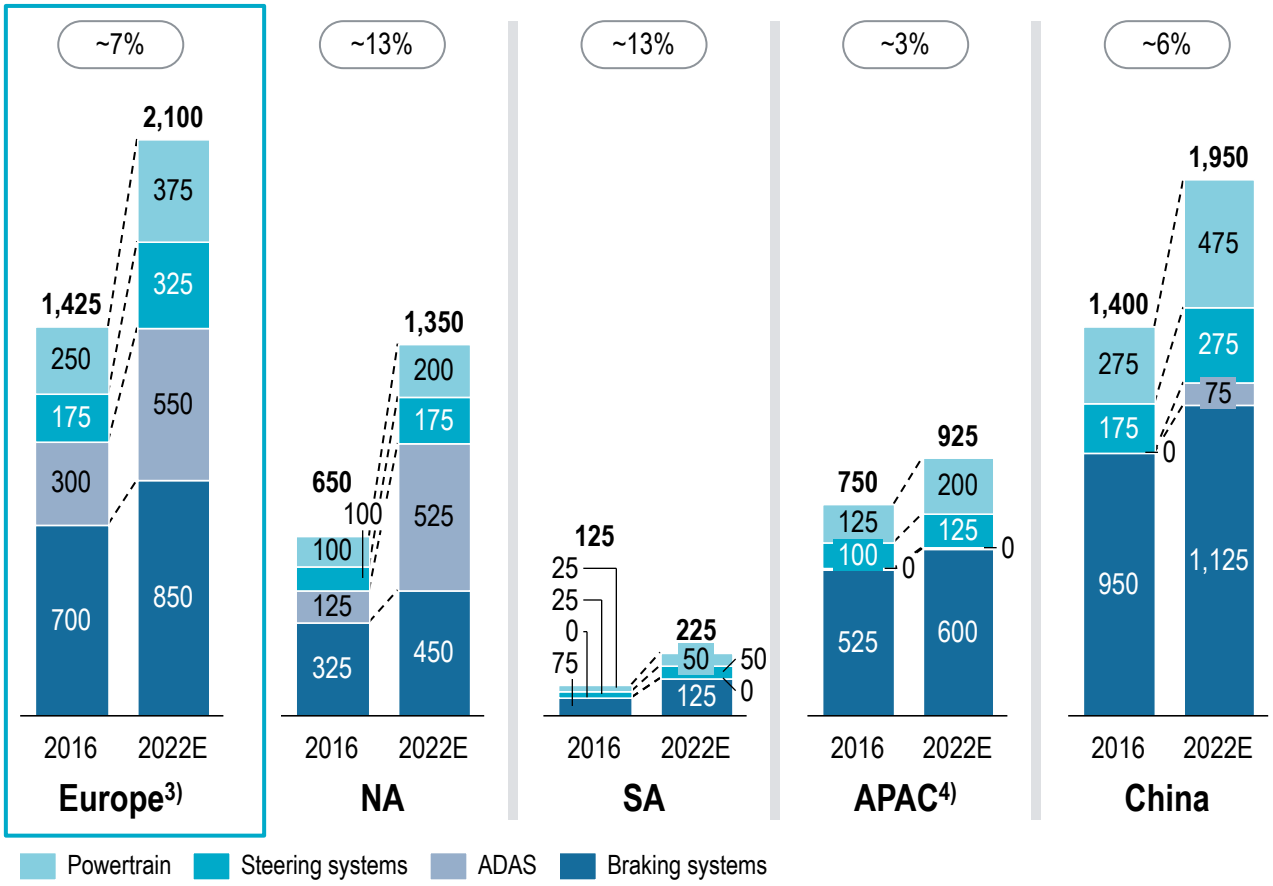


1) Rounded to nearest EUR 25 m 2) Rounded to nearest EUR 25 3) Including Russia/CIS and Turkey 4) China excluded

Source: Market expert interviews; Roland Berger

Braking systems will continue to play a major role in all regions, ADAS increase mainly in Europe and North America

Volume[1] [EUR m] for selected CV system and CAGR[2] (2016-22E) per region



- Market growth of braking systems mainly due to shift from drum to disc brake, unit prices are expected to remain constant
- Shift to disc brakes mainly due to tighter safety regulations and TCO benefits
  - Increased safety (shorter braking distance) and reduced damage costs
  - Slower shift in APAC given low truck speeds
- Overall, strong growth of disc brakes[5] greater than growth of truck and bus production
- Regulations for reduced stopping distance push demand for advanced brake control systems, such as EBS and ESC
  - Disc brakes combined with advanced brake control systems yield best stopping performance

1) Rounded to nearest EUR 25 m 2) Rounded to the nearest zero 3) Including Russia/CIS and Turkey 4) China excluded

Source: Market expert interviews; Roland Berger

Today, the largest share of value in a standard trailer lies in chassis and structural elements; shift towards connectivity systems expected

Trailer – content per vehicle [% of EUR][1)]

Indication based on standard European trailer

Chassis

- Axles
- Brakes
- Suspension

Structural elements

- Exterior
  - > Body parts
  - > Landing gear
  - > Side wings
  - > Tail
  - > Lighting
  - …
- Interior
- Electrics/electronics

50-55%

45-50%

<2%

Systems/connectivity

- ADAS
- Telematics

= Value add by trailer OEM vs. suppliers; "+" = high value add by trailer OEM, "-" = high value add by supplier

= Sample component for deep dive

1) Average content per vehicle as trailer OEM cost after assembly, considering penetration rates

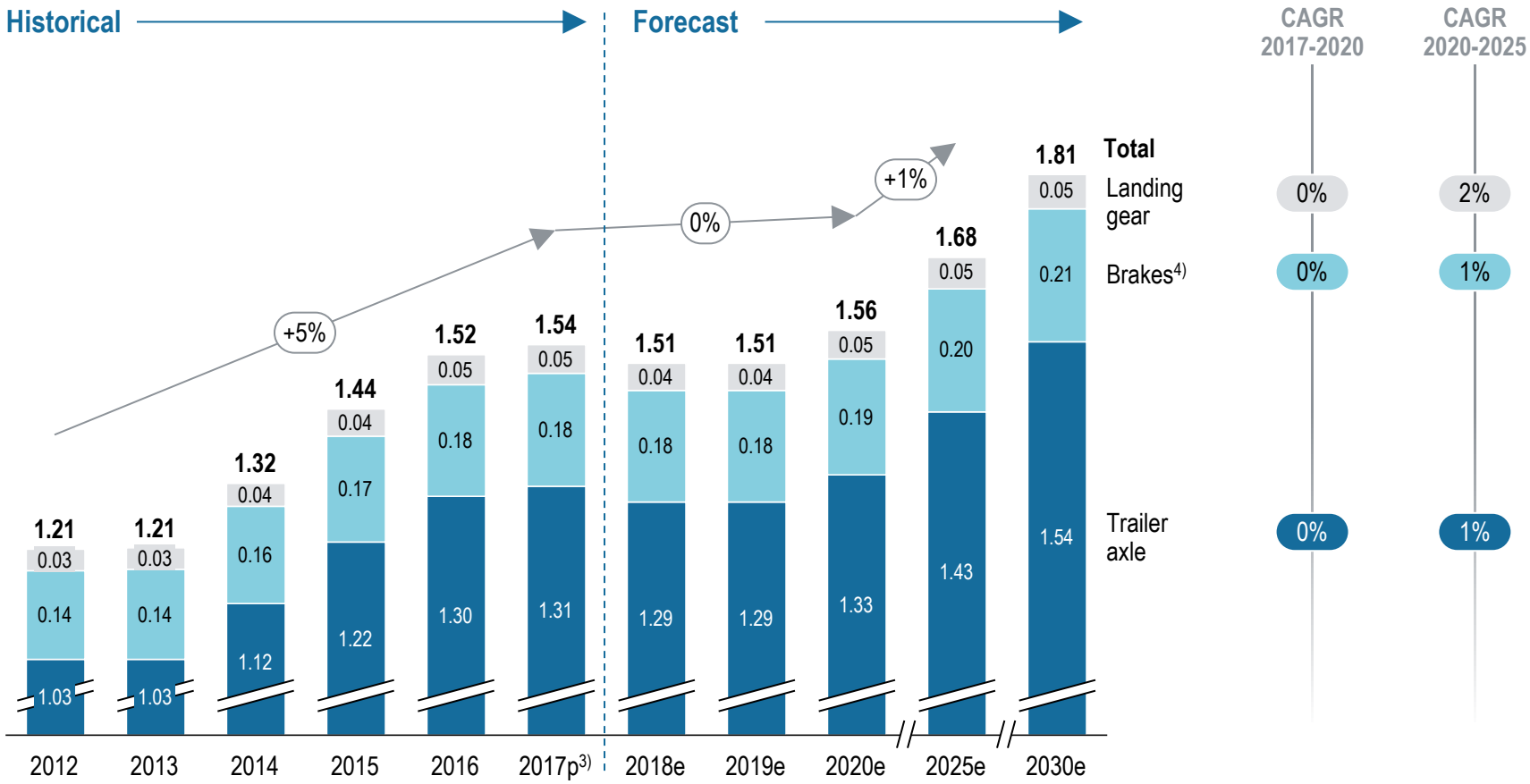
= Overall component value from low to high

= Development of value share until 2030

Source: Roland Berger

Example: The European trailer first-fit market for axles, brakes and landing gear is estimated at ~EUR 1.5 bn in 2017

European[1] trailer[2] first-fit component market by product, 2012-30 [EUR bn]



Notes: All CKD fitted components are considered in country of assembly. First-fit market (excl. aftermarket); 1) Incl. Russia, excl. Turkey; 2) Medium/heavy duty commercial vehicle trailers; 3) Prognosis, Q1 2017 analyzed and data forecast till end of 2017 based on market interviews/data analyses 4) Comprising the brake caliper, brake disc and pads

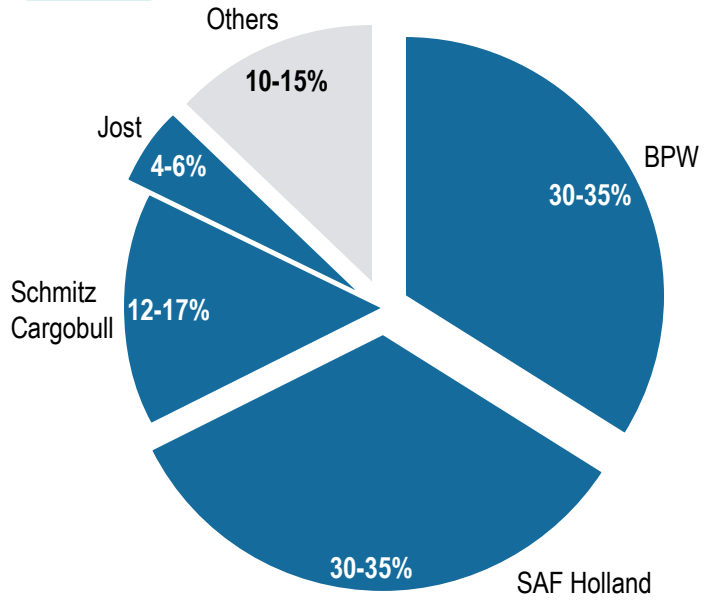
Source: Clear International; local market research; interviews with market experts; Roland Berger

Example: The competitive landscape for landing gears is dominated by large suppliers, while more fragmented for trailer axles

Indicative European[1)] trailer first-fit component production shares, 2016 [%]

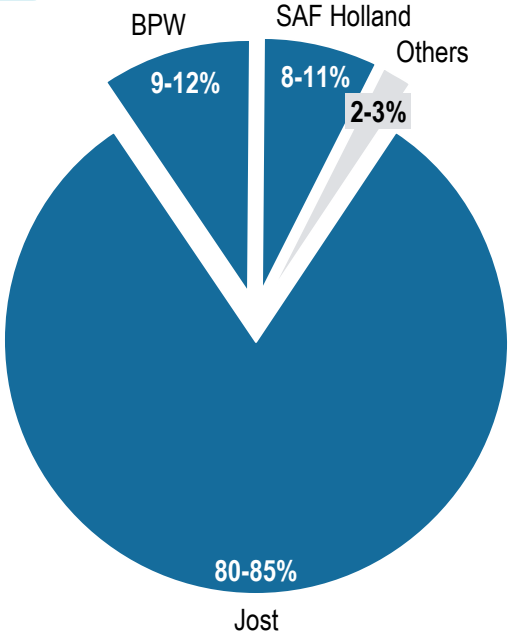
Trailer axle

∑ = ~780 k



Landing gear

∑ = ~214 k



1) Western and Eastern Europe, incl. Russia, excl. Turkey

Source: Annual reports; company information BPW, Knorr-Bremse, SAF Holland, Schmitz Cargobull; expert interviews; Roland Berger

To succeed in the European truck & trailer components market, power to innovate and technical capabilities will become even more important

Key success factors from OEM customer point of view

Success factors	Importance	
Strong brand and reputation	●	> Strong brand and reputation as one of the most important of the key success factors in Europe > Major lever to achieve price premium
Strong customer relationship	●	> Strong customer relationships (fleets) and broad customer portfolio serving both truck and trailer OEMs > Effective customer approach based on a combined push and pull strategy for OE and aftermarket customers
Competitive prices/TCO	◕	> Prices remain one of the key criteria – Customers are highly price sensitive > Western European customers are more likely to consider the full TCO
High technical capabilities	◕	> Advanced product features help secure volume in the market > Technical capabilities as one potential USP for many market players
Power to innovate	◕	> Power to innovate and capabilities for new variants and products are necessary for differentiation > Innovation through cooperation and disruptive thinking are of increasing importance
High delivery performance	◕	> Basic delivery performance is considered an order qualifier, however Just in Time (JIT)/Just in Sequence (JIS) performance and short-term delivery can also be used as a differentiator vs. competitors
High quality	◕	> Basic requirement as order qualifier incl. meeting technical product specifications as well as OEM defined ppm ratios > Due to fixed industry standards, individual differentiation via quality is not possible
Geographic proximity and local content	◑	> Local content depends on regulation and market specifics and is very important for many markets with specific requirements > Homologation and local production adjustments required for certain markets

Increasing importance due to shift of content value in vehicles/trailers

● High ○ Low

Source: Interviews with market participants; Roland Berger

D. Roland Berger

Roland Berger is the only leading global consultancy of German heritage and European origin

Roland Berger at a glance

Source: Roland Berger

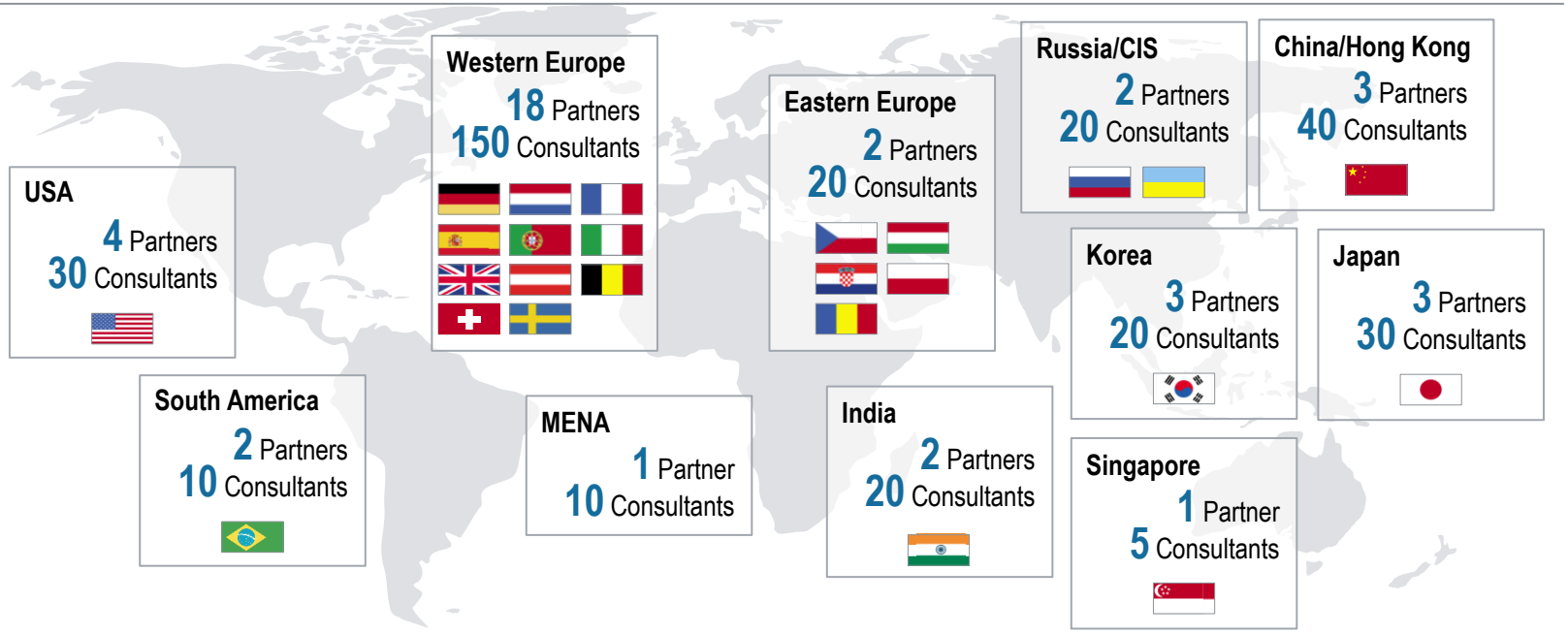
Our Automotive Competence Center comprises five clusters and has a truly global footprint with more than 300 consultants worldwide

Automotive Competence Center – Functional clusters and global presence

Our clusters

- Suppliers
- Product creation & technology
- Financial & mobility services
- **Commercial vehicles, agri. & construction**
- Marketing, sales & aftersales

Our global presence



Source: Roland Berger

Roland Berger is the leading consultancy for the global commercial vehicle industry

Our value proposition

- We are a **trusted advisor** in the commercial vehicle industry with a **longstanding track record** at **OEMs** and **suppliers** around the globe
- We have a global team of **specialized consultants** for the commercial vehicle industry as well as our own **network of top-class experts** with longstanding experience in the commercial vehicle industry
- We are considered **thought leaders** and in our **studies** and **projects** we develop **responses** to the **topics of tomorrow** within the commercial vehicle industry
- We cover **all functional areas** within the commercial vehicle industry, **developing implementable solutions** for our clients
- We distinguish ourselves by a **pragmatic approach, excellent** and **fast results** as well as a **cooperative work environment** with our clients – For this reason independent studies rank us as **#1 in implementation**
- We employ new and agile work methods to develop solutions, supported by our **analytics team** and our **digital hub 'Spielfeld'** in Berlin

Source: Roland Berger

Within our Automotive Competence Center we have a strong team of experts dedicated to the commercial vehicle industry

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Partner,
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Source: Roland Berger

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Source: Roland Berger

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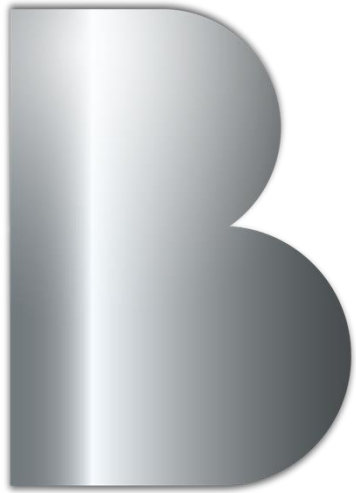

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