Automotive metal components for car bodies and chassis

Global market study

Munich, February 2017

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A. Executive summary, scope and methodology of study

Executive summary

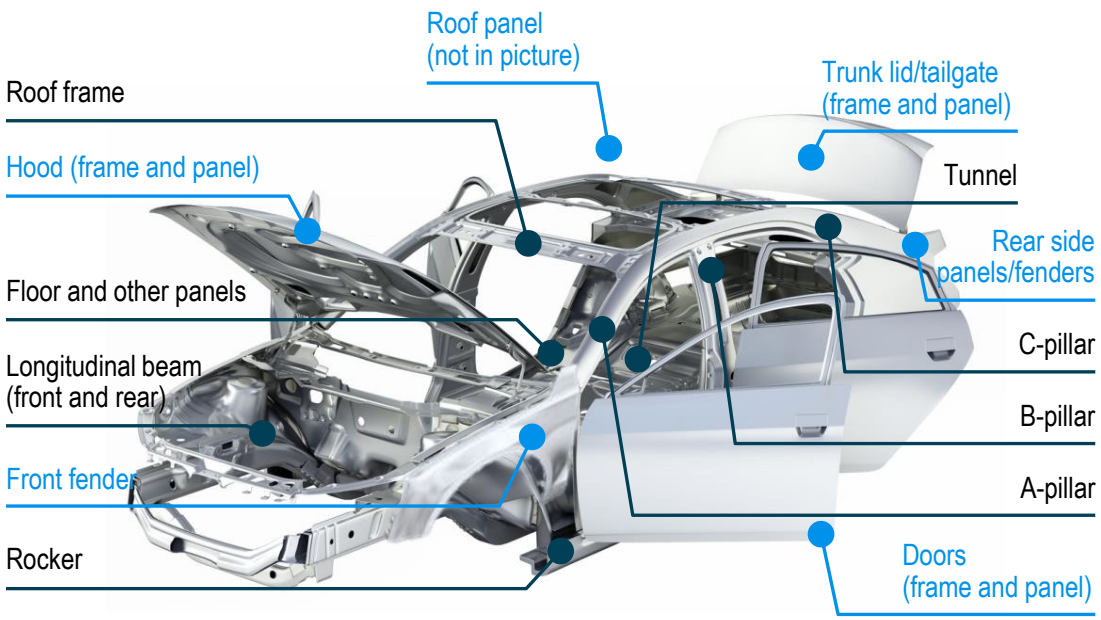
- The automotive industry is currently dominated by hype about mobility services, autonomous driving, digitization, electric powertrains, etc.
- We say **BACK TO BASICS** – the vehicles of the future, whether electric or not, will still require basic parts such as wheels, seats, chassis and bodies
- We investigated the expected development of stamped components in the body in white (BIW) and chassis
- We estimate the market for stamped components will grow from EUR 103 bn (2015) to EUR 127 bn (2025), the addressable market for suppliers from EUR 43 bn to EUR 63 bn
- Hot stamping is expected to become the industry standard for structural body components
- Current leading suppliers need to offer their technology portfolio globally – smaller market players must focus on specific products and customers

Source: Roland Berger

Our study focuses on body in white (BIW) and chassis components that are typically metal-based and stamped

Scope of the study: Stamped components for BIW and chassis components

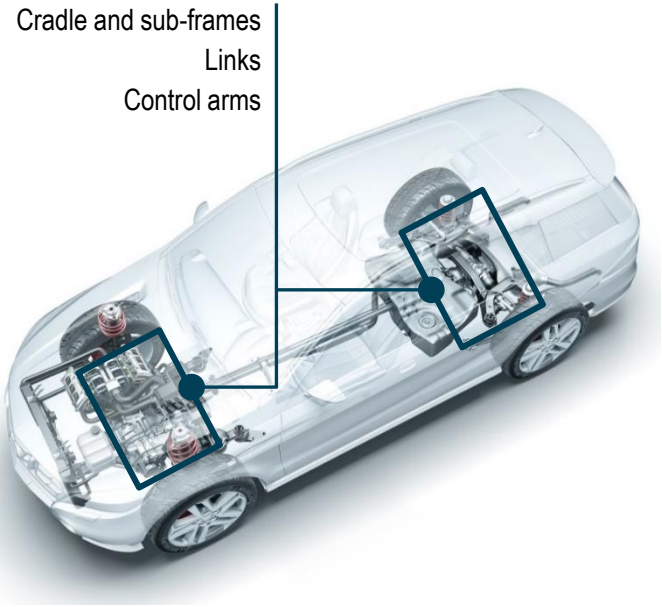
Body in white[1)]



Exterior (class A, closures) — Structural components

1) Other metal components such as seat structures and hinges are not in scope

Chassis



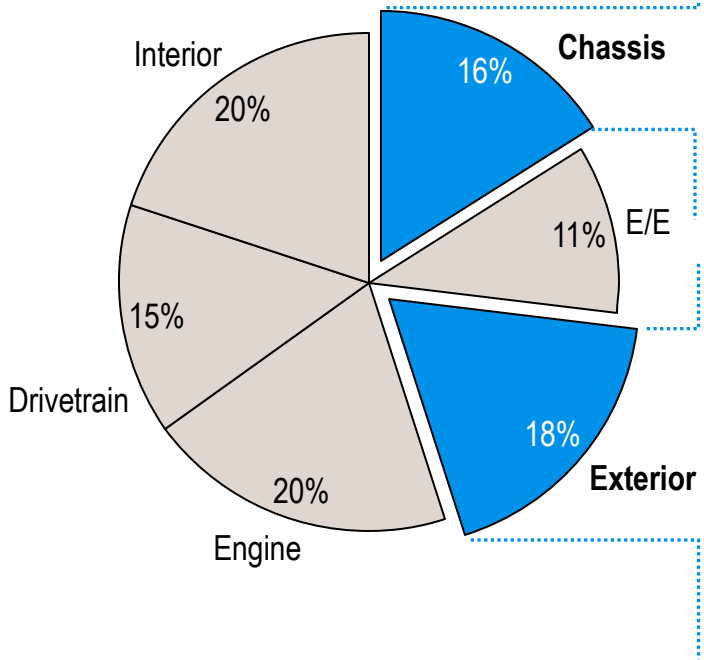
Source: Roland Berger

Chassis and exterior account for around 35% of total vehicle value – We estimate a stamped component value of EUR 1,100 per vehicle

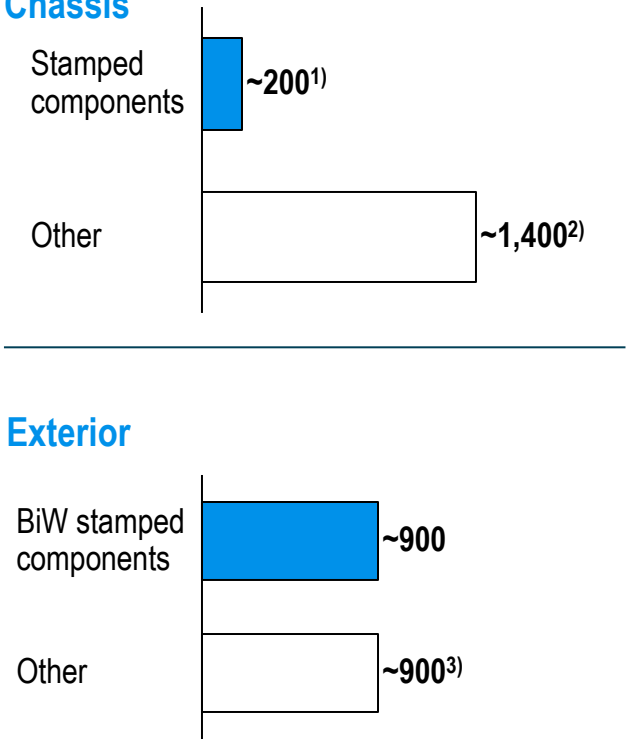
Material cost split for a compact vehicle in Europe, 2015

Material cost split

Total material cost: Approx. EUR 10,000



Scope of study [EUR per vehicle]



Comments

> Material cost split is based on a high-volume compact vehicle in Europe

> Underlying stamped BIW and chassis components are considered as Tier-1 subassemblies supplied to OEM body shops

1) Value of chassis system depends greatly on specific vehicle design 2) "Other" includes steering system, braking system, wheels, suspension, etc.
3) "Other" includes headlamps, wiper systems, bumper fascia, etc.

Source: Roland Berger

The study looks at automotive trends and assesses their impact on the stamped component market and key market players

Methodology

Trend analysis

> Identify macro-trends impacting the automotive industry

> Analyze relevant trends for the stamped BIW and chassis component market

> Derive key assumptions for market development

Market assessment

> Calculate share of stamped BIW and chassis components in overall component market

> Estimate 2025 market for stamped components by
  – Domain (BIW, chassis)
  – Region

> Perform deep dive on hot stamping market

Impact on market players

> Segment competitive landscape for BIW and chassis components

> Carry out market share analysis for key players

> Derive implications of trend analysis and market forecast for key players

Sources

> Interviews with OEMs (BIW/chassis parts purchasing departments) and BIW/chassis suppliers in Europe, Asia and North America

> External data providers (e.g. IHS)

> Desk research
  – OEM/supplier websites
  – Annual reports
  – Public conference papers

Source: Roland Berger

B. Market trends and their impact on the automotive stamping components market

We identify seven key trends in automotive in the coming decade – Weight reduction and safety are key factors impacting the market

Key automotive trends and relevance for the BIW and chassis component market

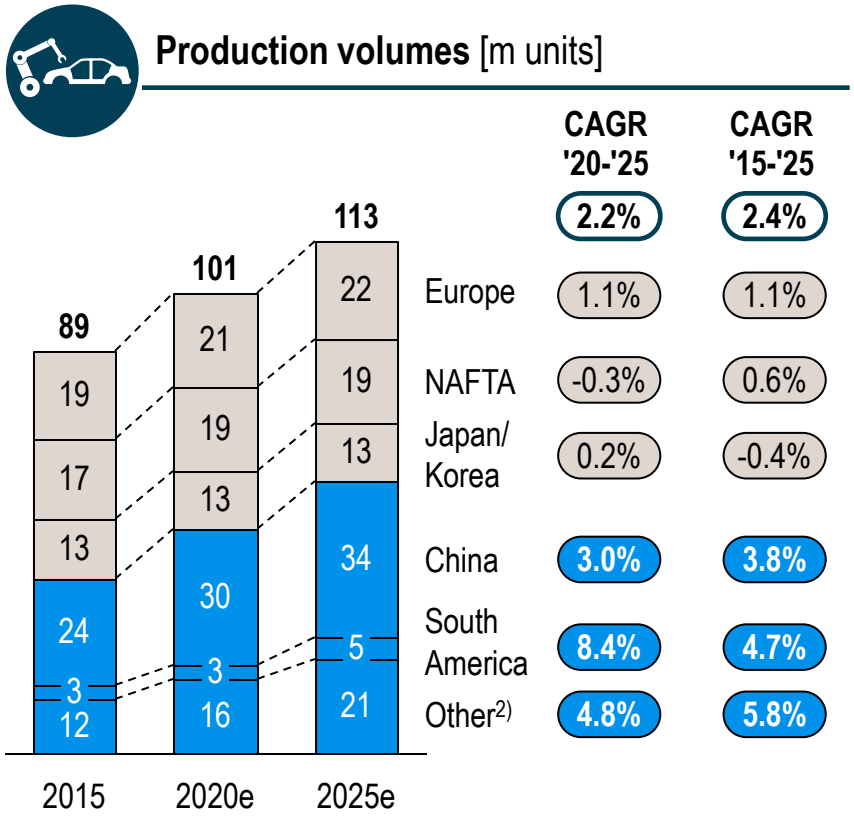
Macro-trends	Economic development/population growth	Regulation			OEM activities		
Key automotive trends	1	2	3	4	5	6	7
							
	PC/LCV demand growth	**Vehicle emissions regulations**	**Recycling regulations**	**Safety regulations**	**Price pressure**	**Standardization**	**Focus on core activities**
Description	Fueled by increasing vehicle demand (despite adverse effects, e.g. from car sharing), production is expected to grow further – however, with shifting segment/ regional structure	Weight reduction and electrification are key levers for achieving CO_2 emission targets	Recyclability requirements in established markets limit the opportunities for new materials and favor the use of steel/aluminum, for example	Current and future safety regulations focus especially on pedestrian safety and driver assistance systems; emerging markets are catching up	OEMs face increasing margin pressure (passed on to suppliers), implement cost optimization programs and further push platform strategies to serve global markets and amortize R&D expenses	Global competetion on the OEM-side and therefore also on the supplier side is increasing; global platforms further intensify supplier competition	Global OEMs in particular will focus on core activities and reduce the strong share of commodities
Stamping							
Relevance for BIW	◔	●	◔	◔	●	◔	●
Relevance for chassis	◔	◔	◑	◔	●	◔	●

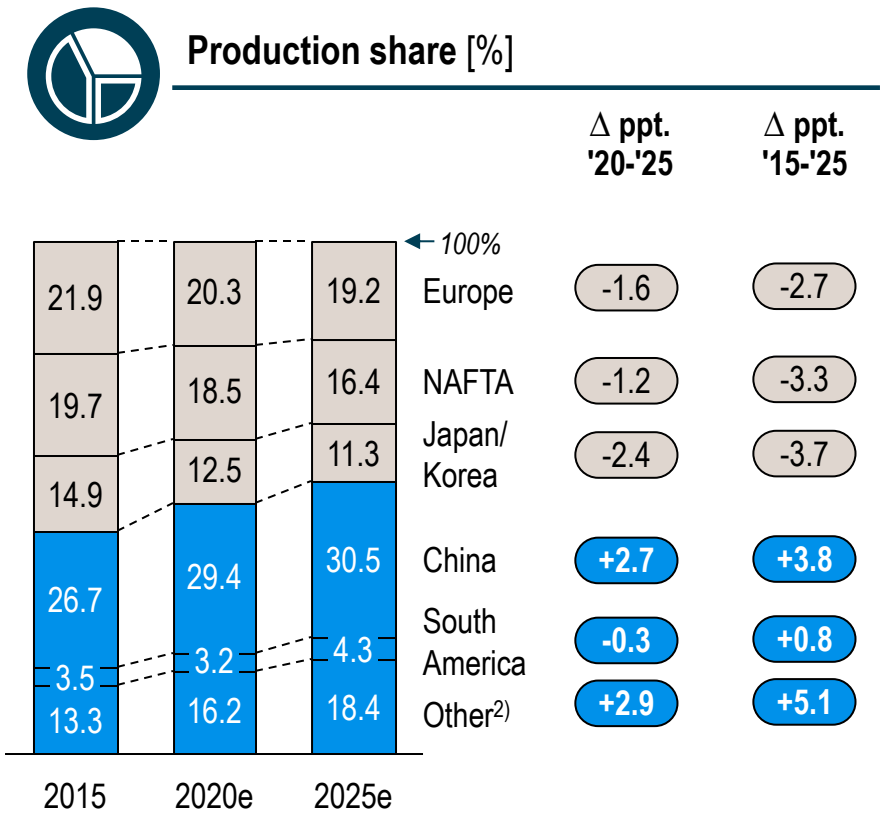
● High relevance ○ Low relevance

Source: Roland Berger

Driven by economic growth and increasing vehicle penetration, production volumes are shifting towards Asia and South America

Global light vehicle[1] production by region, 2015-2025





x% Regions with strongest expected increase through 2025

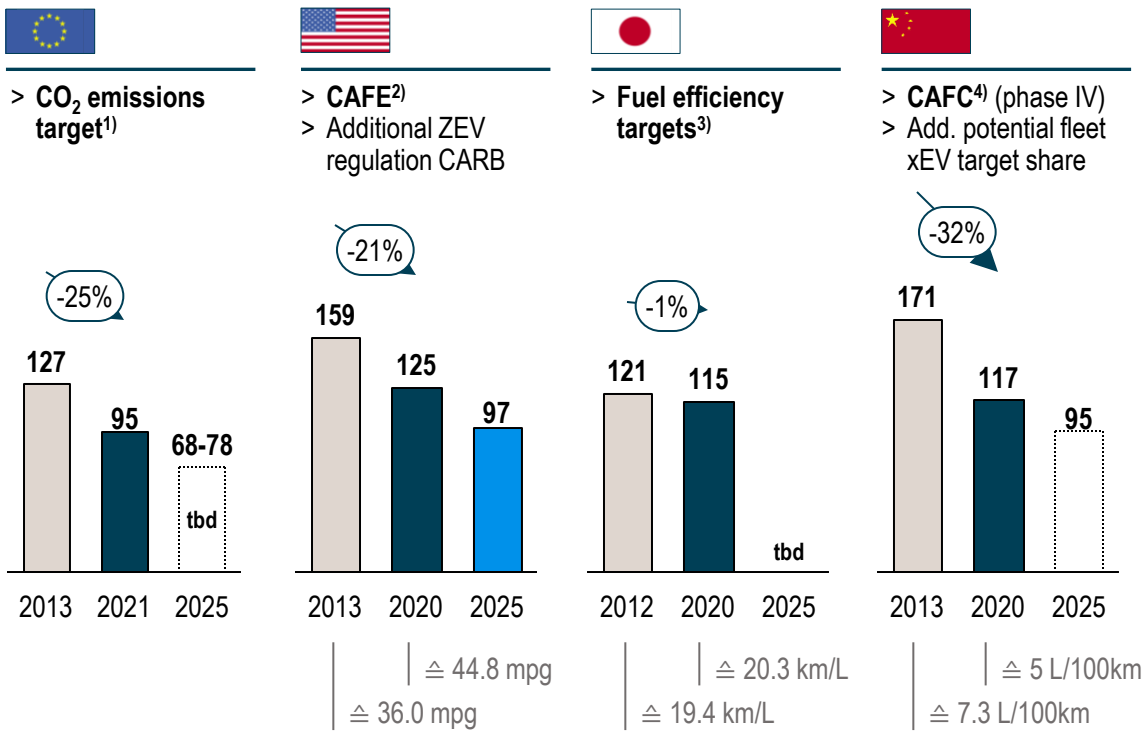
1) Light vehicles < 6t 2) India, Russia, other Asia, Middle East/Africa

Source: IHS Q1 2017; Roland Berger

Emission regulations put increased pressure on automotive OEMs to improve CO_2 levels, fuel efficiency and exhaust gas emissions

Light vehicle GHG emissions/fuel consumption [g/km] and toxic emission regulations

GHG emissions/fuel consumption (CO_2)



Toxic emissions (NO_x, PM, HC, other)

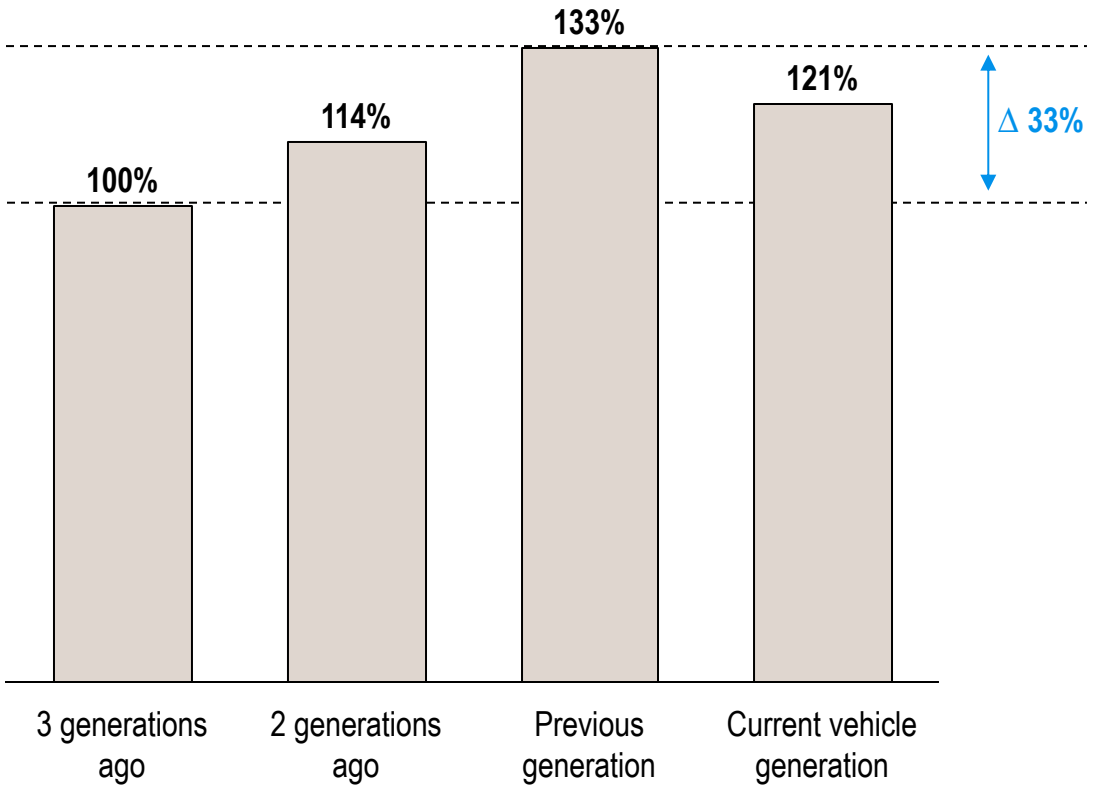
- > **2014**: Euro 6b emission standard
- > **2017**: Euro 6c with implementation of RDE, additionally WLTP
- > **2015**: CARB LEV III
- > **2017**: EPA Tier 3 Standards
- > **2009**: Post new long-term (PNLT) JC08 mode cycle
- > **2018**: Post-PNLT (PPNLT)
- > **2016**: China 5 and Beijing 5

1) Weight-based corporate average 2) Footprint-based corporate average; converted to NEDC 3) Weight-class based corporate average; showing JC08
4) Weight-class based per vehicle and corporate average

Note: GHG = greenhouse gases
Source: Press research; ICCT; Roland Berger

Vehicle weight has grown over the generations, increasing the need for lightweight materials to reduce CO_2 emissions

Average curb[1)] weight development in Europe [mid sized volume vehicle – Indexed]



Comments

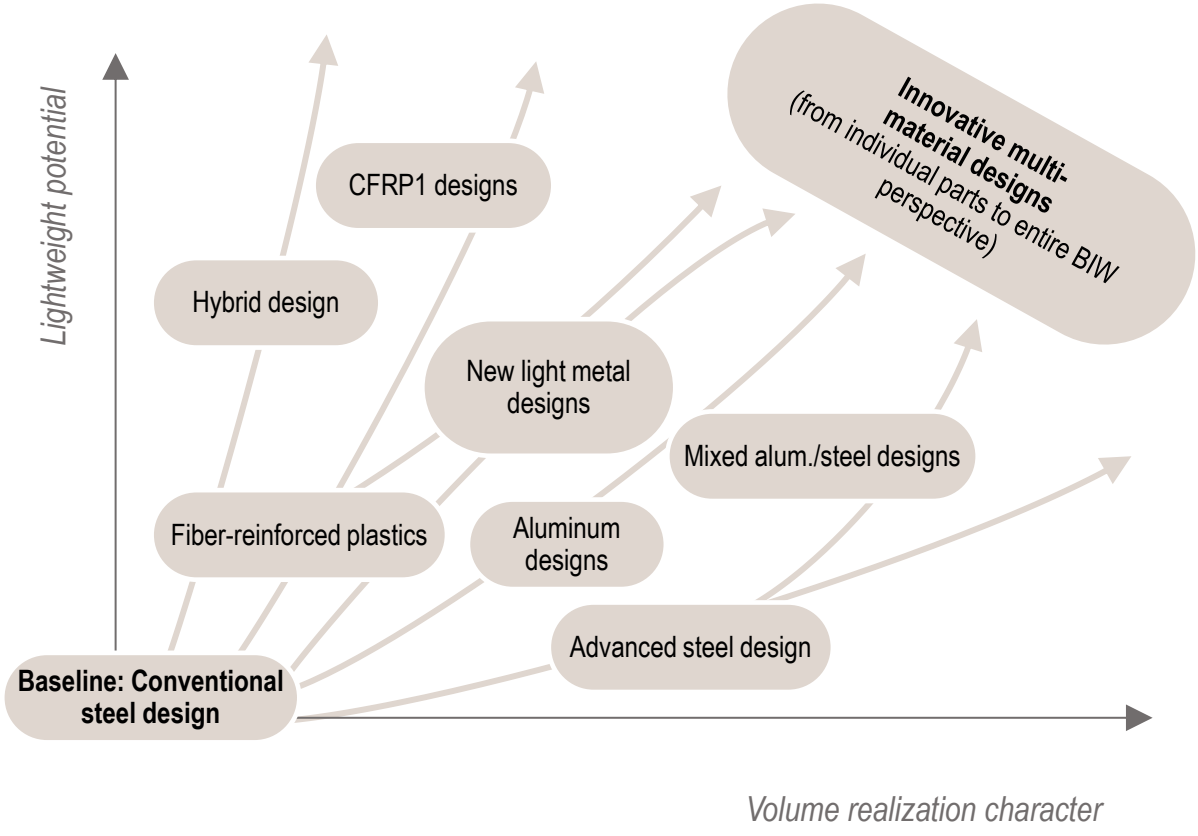
- Major drivers of additional weight in previous vehicle generations in the past
  - Stricter crash regulations
  - Increased safety features (e.g. ABS, ESP, higher brake performance)
  - Increased number of functions and convenience features (e.g. HVAC modules, electric window lifters, NVH dampening)
  - Increased vehicle dimensions
- Current tendency to reduce weight driven by various trends
  - Engine downsizing
  - Increased use of lightweight materials
  - Weight optimization-oriented vehicle design

1) Curb analysis based on following vehicles: Golf (Volkswagen); Astra (General Motors); 308, 306, 309 II (PSA); Megane (Renault/Nissan); Clio (Renault/Nissan)

Source: Press and desk research; OEM websites; expert interviews; Roland Berger

Most OEMs are converging on multi-material strategies, which use a mix of ferrous and non-ferrous metals alongside plastics

Sheet metal stampings – Key trends



Comments

> Several material paths are possible, depending on tradeoff between cost and impact (depending on model and geography)

> Comprehensive approach required that goes beyond material and joining technologies, e.g. taking into account construction/functional integration, energy consumption, recycling

> Increase of global platform volumes will need material flexibility to meet local requirements – also with regard to structural parts

Growing set of capabilities required for suppliers of sheet metal stampings

1) CFRP = carbon fiber-reinforced polymer

Source: Roland Berger

In lightweight construction, advanced steels offer the best weight reduction to savings ratio for structural body parts

Assessment of lightweight materials

Material	Relative weight	Cost of weight saving [EUR/kg]	Key advantages	Key disadvantages
Traditional steel	100%	None	> Proven material, in use for decades > Good forming capabilities > Good availability	> High specific weight > Large number of process steps required (incl. tooling)
Hot-formed steel	75-85%	low – high	> Very high strength with good formability > Attractive cost-benefit ratio for weight-saving > Variable strength through sophisticated processing (e.g. tailored tempering)	> Higher investment, sourcing and operation costs > Use limited to structural BIW components
Aluminum	50-60%	low – high	> Low specific weight and good formability > Quite high strength when semi-hot or hot-forming (7.000 series)	> Greater technical effort to join with steel parts (rivet piercing vs. spot welding) > More sensitive to surface defects > Lower formability and higher spring back[1]
Magnesium	45-55%	low – high	> Lightest specific weight for metals used in automotive applications	> Very effective coating required to avoid magnesium oxidation > Lowest formability
Composite materials	Up to 25%	low – high	> Highest performance to weight > Lower parts count (higher amount of functional integrated parts)	> Bad recyclability > Very expensive > Limited crash performance (no structural integrity)

Further detailed

1) Compared to steel

Source: Expert interviews; Roland Berger

Automotive steel stamping competes with various alternative production technologies, depending on the component

Decision factors: Steel stamping vs. alternative production technologies

Factor in technology decision	Aluminum casting	Iron casting	Cold stamping	Hot stamping	Forging	Composite materials	Plastic injection molding
Major area of use	Chassis parts	Chassis parts	Body parts	Body parts	Chassis parts	Body parts	Body parts
Weight reduction	⊕	⊖	⊖⊖	⊕	⊕ 2)	⊕⊕	⊕
Cost	⊖ 1)	⊕⊖	⊕	⊕⊖	⊖⊖	⊖⊖ 3)	⊕
Production volume	⊕⊖	⊕⊖	⊕	⊕	⊕⊖	⊖	⊕
Safety relevance[5)]	⊕	⊕	⊕⊖	⊕⊕	⊕⊕	⊖⊖ 4)	⊖⊖
In-house OEM capacity	⊕⊖	⊕	⊕	⊕⊖	⊖	⊕⊖	⊕⊖
Maintenance/repair	⊖	⊕⊖	⊕⊕	⊕⊖	⊕	⊖⊖	⊖⊖
Degree of freedom in design	⊕	⊕⊕	⊕	⊕	⊖⊖	⊕⊕	⊕⊕
Recyclability	⊕	⊕⊕	⊕⊕	⊕ 6)	⊕⊕	⊖	⊖

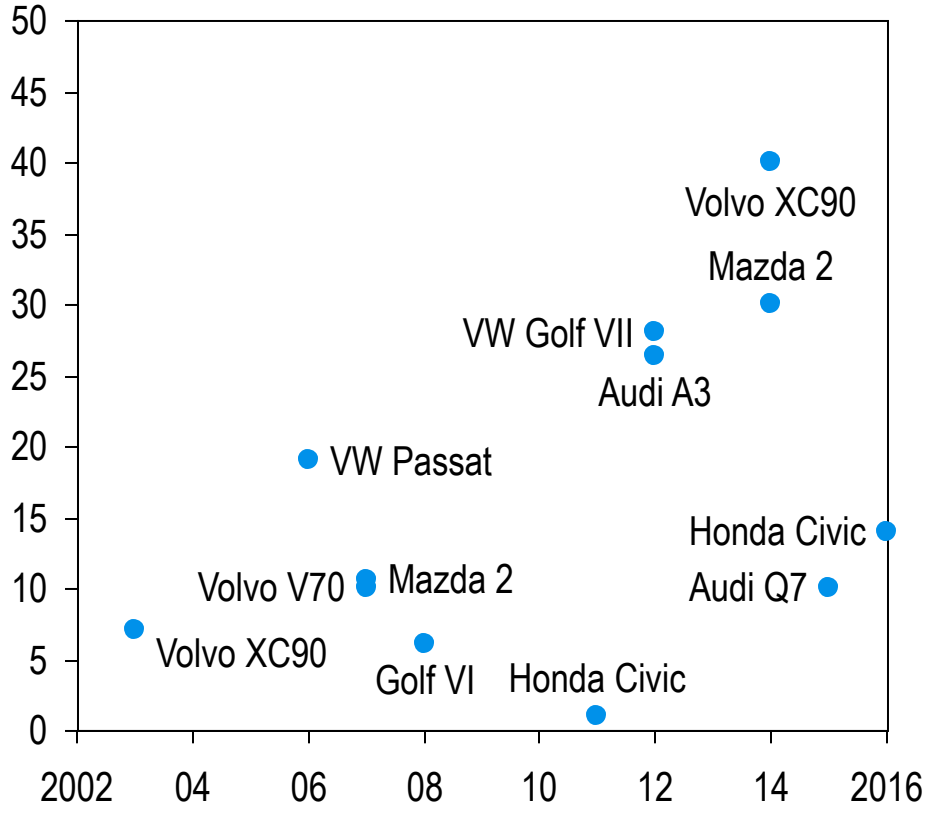
⊕⊕ Highly positive influence ⊕ Positive influence ⊕⊖ Neutral ⊖ Negative influence ⊖⊖ Highly negative influence

1) Strongly depends on chosen casting technology 2) Light metal forging parts possible 3) Can be economical for some small series (depending on form)
4) Fulfillment of high safety requirements only possible at high costs 5) Vehicle crash suitability 6) Due to large number of different alloys

Source: Desk research; interviews; Roland Berger

Hot forming is increasingly popular for BIW components – Driven by increased strength and mass reduction requirements

Share of hot-stamped steel in BIW – Sample vehicles [%]



Comments

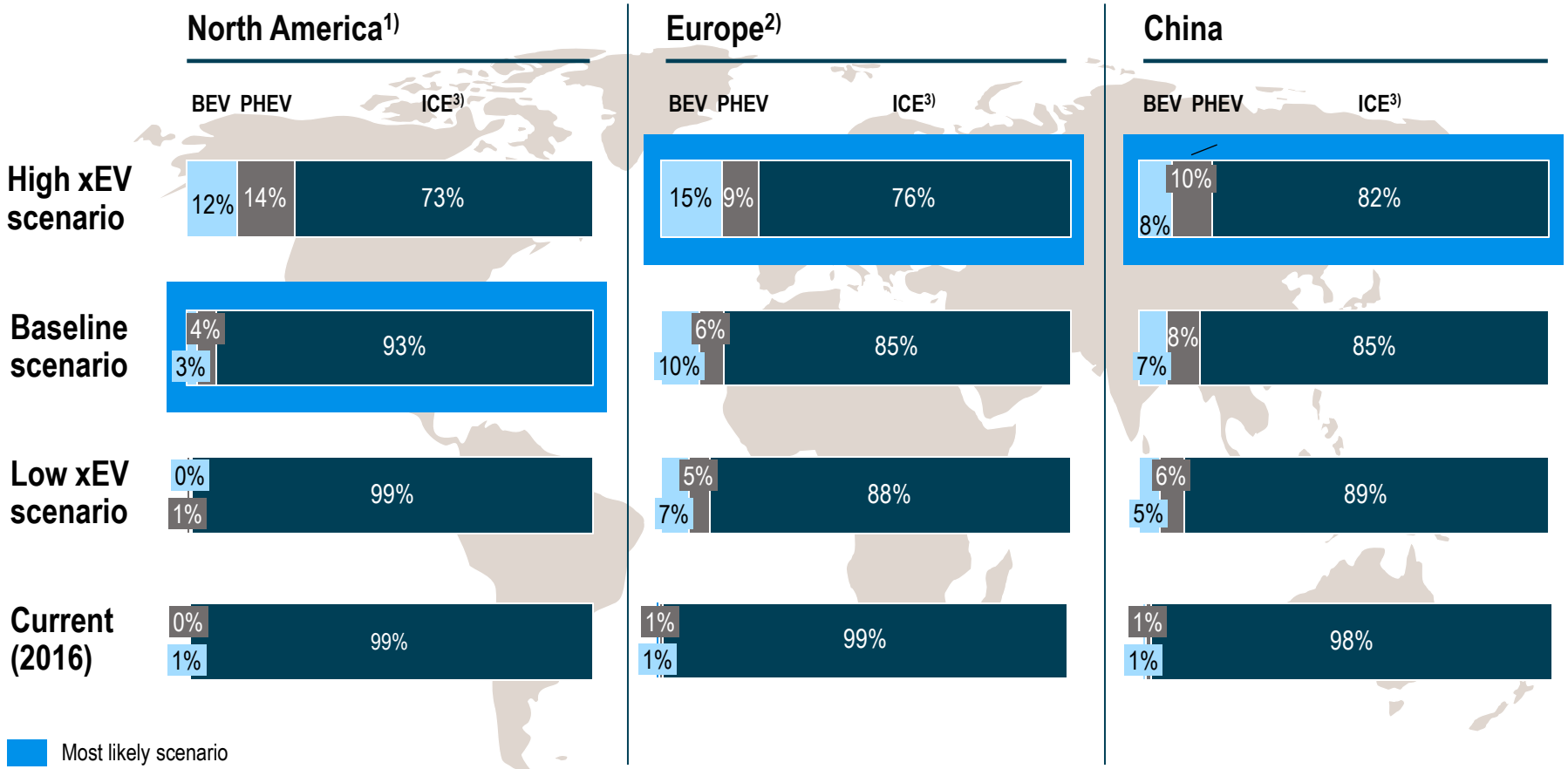
> Increasing share of hot-stamped steel in BIW is driven by certain beneficial attributes, including
  - High strength and crash resistance at relatively low cost
  - Low weight due to reduced material thickness
  - Reduced spring-back during manufacturing process (common in cold-forming process)
  - Best weight savings per additional cost compared to aluminum and plastic composites

> Also within specific models: e.g. in the Mazda 2, the current model has an approx. 30% share of hot-stamped steel, beating its predecessor model (approx. 10%) – parts made of hot steel include A-pillar, roof frame, rocker panels

Source: OEM information; expert interviews; Roland Berger

Uncertainty is growing over powertrain electrification – Various scenarios are possible for 2025

Powertrain split, 2025 [% of sales]

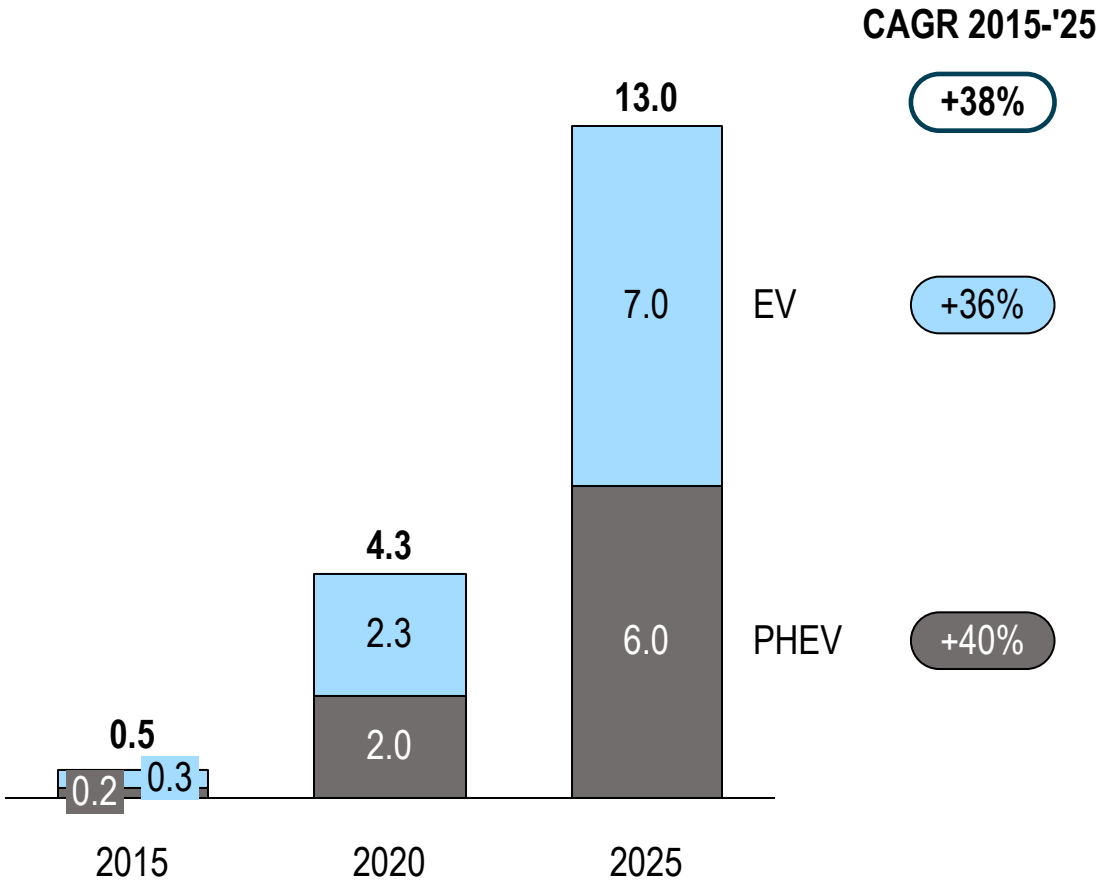


1) NAFTA 2) EU 28 3) Including full, mild and micro hybrid vehicles

Source: Roland Berger

Global EV/PHEV sales are expected to grow from 0.5 million units (2015) to 13 million units (2025)

Global EV/PHEV sales volume, 2015-2025 – Most likely scenario by region [m units]



Comments

> Development of EV and PHEV sales is mainly driven by regulation
  – All major OEMs require PHEV/EVs by 2020 to meet EU CO_2 target (95g/100 km in 2021) – further reduction in CO_2 target levels beyond 2021 will push electrified further still
  – 5l/100 CAFE regulation in China is driving electrification, as are recently published plans for EV quotas across OEMs

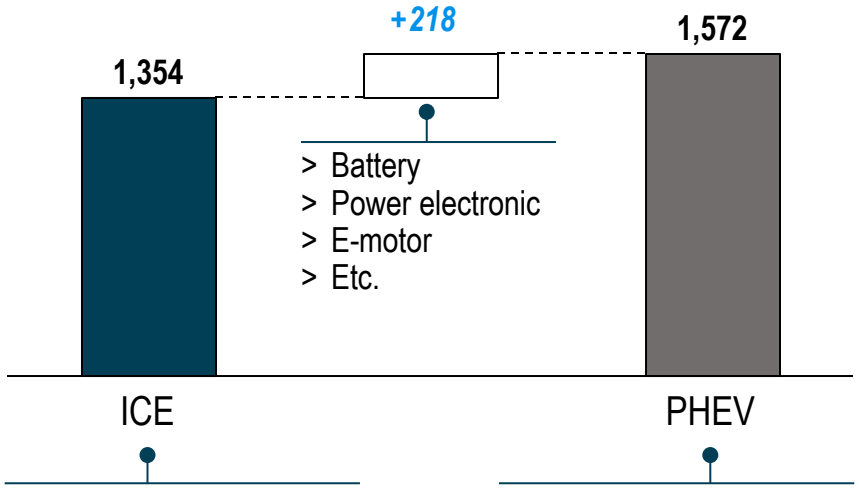
> Pressure on cell prices will continue – together with the already clear advances in volumetric energy density this could lead to significant further cost reductions, well below the currently expected 150 EUR/kWh on pack level in 2020

Source: IHS Q1 2017; press research; Roland Berger

xEVs are gaining weight, particularly due to high-voltage batteries

Weight comparison of ICE, PHEV and EV – Example: VW Golf [kg]

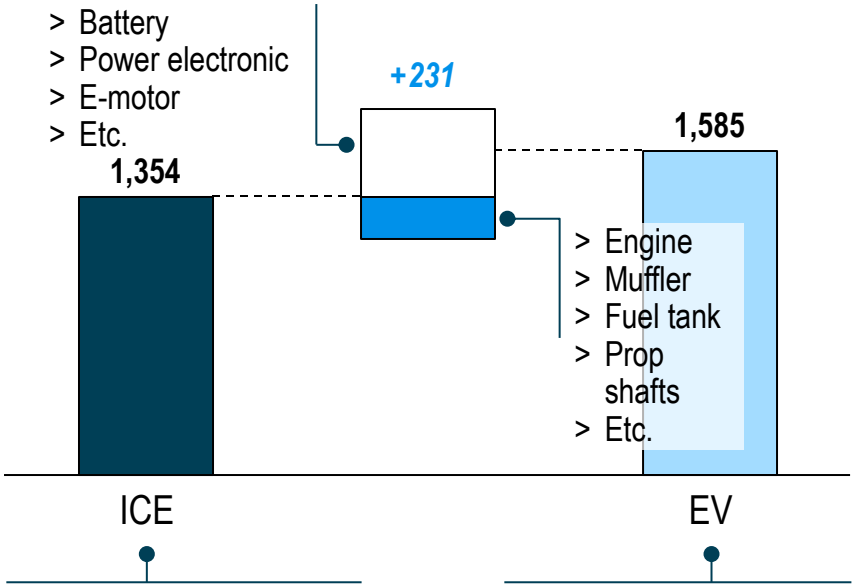
Vehicle weight ICE-PHEV



> Golf BlueMotion TDI with four-cylinder turbo-charged diesel engine
> 6-Gear-DSG
> Engine: 110 kW

> 8.7 kWh lithium-ion battery pack
> 6-Gear-DSG
> Engine: 110 kW
> E-motor: 75 kW
> System power: 150 kW

Vehicle weight ICE-EV



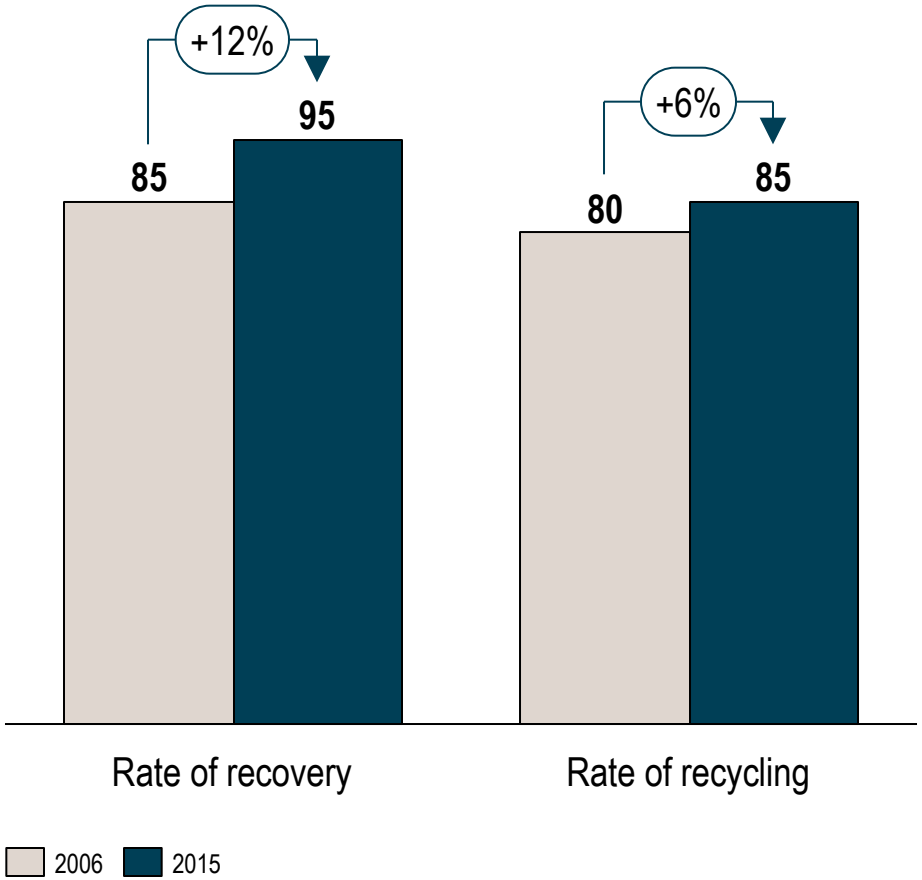
> Golf BlueMotion TDI with four-cylinder turbo-charged diesel engine
> 6-Gear-DSG
> Engine: 110 kW

> 24.2 kWh lithium-ion battery pack
> Range: 130 km
> E-motor: 85 kW

Source: OEM information; Roland Berger

Recycling and pressure to reuse vehicles is likely to grow in the coming years – Stricter EU end-of-life targets in place since 2015

EU End-of-Life Vehicle Directive – Targets [% of vehicle weight]



1) Cadmium, lead, mercury and hexavalent chromium

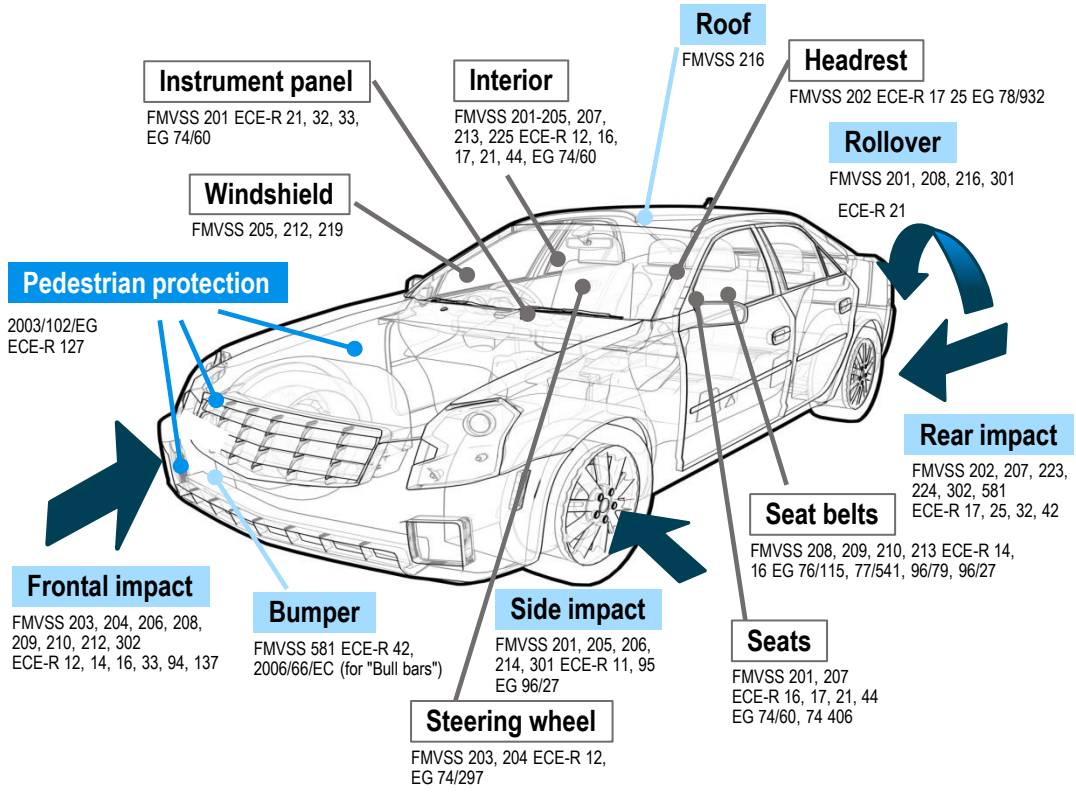
Comments

- EU End-of-Life Vehicle Directive (ELV) passed in 2000
- Directive applies to passenger cars and light commercial vehicles
- Main objectives are
  - Prevent vehicle waste and use of certain heavy metals[1)]
  - Increase reuse, recycling and other forms of recovery
  - Reduce waste disposal
- ELV reuse and recovery rate for the five biggest EU markets between 80% and 89% in 2008
- While efficient processes for recycling steel are already established, there are still barriers to recycling aluminum and particularly advanced materials, such as composites

Source: Press research; European Commission; Roland Berger

Past initiatives to improve vehicle safety have already led to major changes in material use and BIW component design

Crash regulations in Europe and US



Focus area for future initiatives Initiatives impacting BIW

Status as of 2016

Comments

> In Europe and the US, the market is driven by safety performance assessment programs such as Euro and US NCAP – OEMs aim for top, 5-star ratings due to high customer awareness

> In the past, Euro and US NCAP test requirements have focused on driver and passenger safety, with a high impact on BIW components – both material usage and component design were affected

> Future tests are expected to focus more on pedestrian safety and driver assistance programs

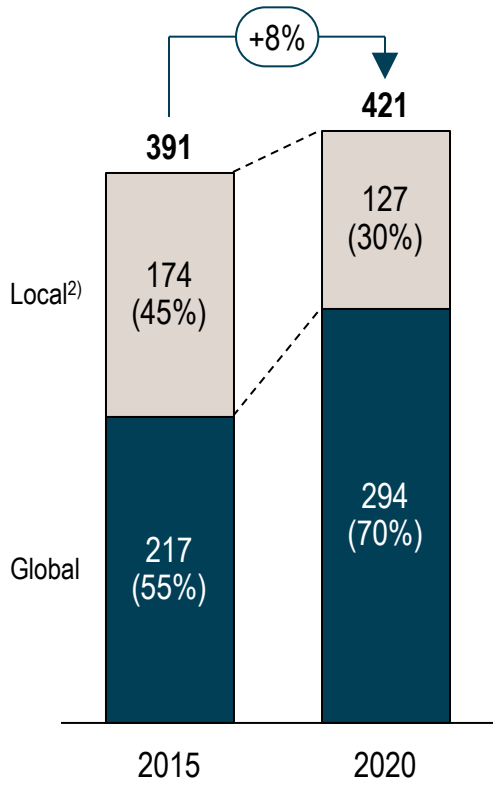
> This will not be majorly disruptive for BIW/chassis components, but
  – New required functionalities will have to be integrated (e.g. "intelligent hoods")
  – OEMs will be looking for materials that ensure a high level of design freedom, as design and specifications are impacted by the regulations

Source: Expert interviews; NHTSA; EU Commission; FIA; Roland Berger

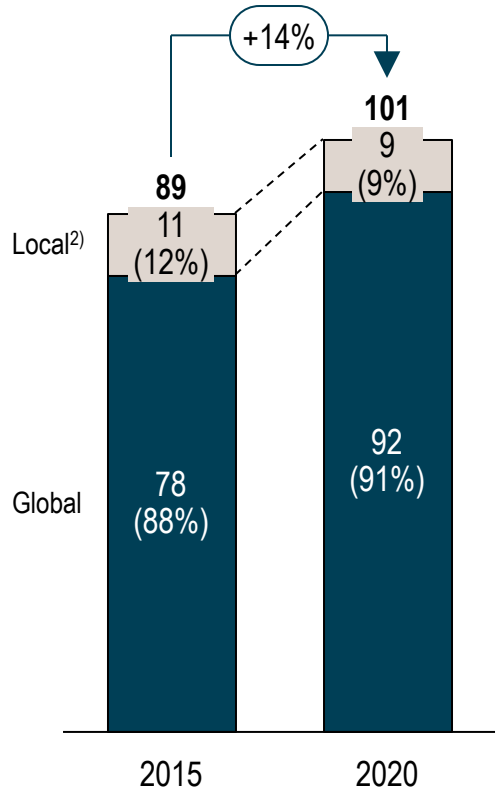
Local platforms are mostly assembled in Asia – Chinese OEMs are going global, reducing the share of local platforms in 2020

Vehicle production on global vs. local platforms

Platform types [no.] [1)]



Vehicle production [m units]



Comments

- Volume OEMs in particular plan to further increase the number of variants on one platform due to cost
- Platform development costs typically account for around 50% of total product development costs
  - Pursuing fewer but larger global platforms helps OEMs achieve greater economies of scale and efficient product launches
  - Core platforms will be used to design and mass produce vehicles across various size/price segments and brands
- OEMs are expected to increase co-development and platform sharing
- Volumes of specific components would increase from intra-platform component commonality – that means that suppliers will have to
  - Increase global production capacities
  - Identify and align with more favorable platforms

1) Only platforms with >1,000 vehicles p.a. considered 2) Platforms considered local when >1,000 vehicles p.a. in just one region

Source: IHS Q1 2017; Roland Berger

OEMs – especially international OEMs in NAFTA – are generally not planning to invest in setting up their own press shop facilities

OEM coverage of production value chain – Examples

OEM	Plant (start of product'n)	Model	Coverage of production value chain[1] Press shop	Body shop	Vehicle assembly
BMW	Spartanburg (1994)	X3, X4, X5, X6	☐	☑	☑
DAIMLER	Vitoria (2003)	Vito, V-Class	☐	☑	☑
VW	Chattanooga (2011)	Passat, Atlas	☐	☑	☑
VOLVO	Berkeley County (2018)	S60	☐	(☑) [2]	☑

"BMW has no plans to add a stamping plant in Spartanburg because of its good relationship with its supplier Magna International"

Head of production, 2014

"The South Carolina plant will be a full assembly plant minus a stamping plant, and it will have a full paint shop"

Spokesperson, 2015

1) Simplified 2) Components will be provided by suppliers in South Carolina, Europe and China. Suppliers will partly assemble components before delivery

Source: OEM websites; press research; IHS Q1 2017; Roland Berger

EU and NAFTA outsource BIW components more often than Asia – Overall, surface components outsourced less than other components

Current outsourcing rate, 2015 and future development [%]

Region	Surface components[1] (BIW) 2015	Surface components[1] (BIW) Future	Structural components (BIW) 2015	Structural components (BIW) Future	Chassis components 2015	Chassis components Future
EU (incl. Russia)	30%	↗	65%	↗	65%	↗
NAFTA	30%	↗	65%	↗	65%	↗
China	10%	↑	30%	↑	70%	↗
Japan/Korea	10%	→	25%	↑	65%	↗
South America	30%	↑	65%	↑	85%	→
Other[2]	10%	↑	25%	↑	85%	→

"In general, Chinese, Japanese and Korean OEMs are more vertically integrated, leading to a low outsourcing rate. In Europe, the outsourcing rate is similar to the US"

Production Director, Tier-1 supplier

"The majority of chassis components are outsourced, at rates of 65% and above. Only larger Asian OEMs have a below-average outsourcing rate"

VP Manufacturing Systems, Tier-1 supplier

↑ CAGR '15-'25 ≥ 4% ↗ CAGR '15-'25 0.5%≤ x < 4% → CAGR '15-'25 0 ≤ x < 0.5%

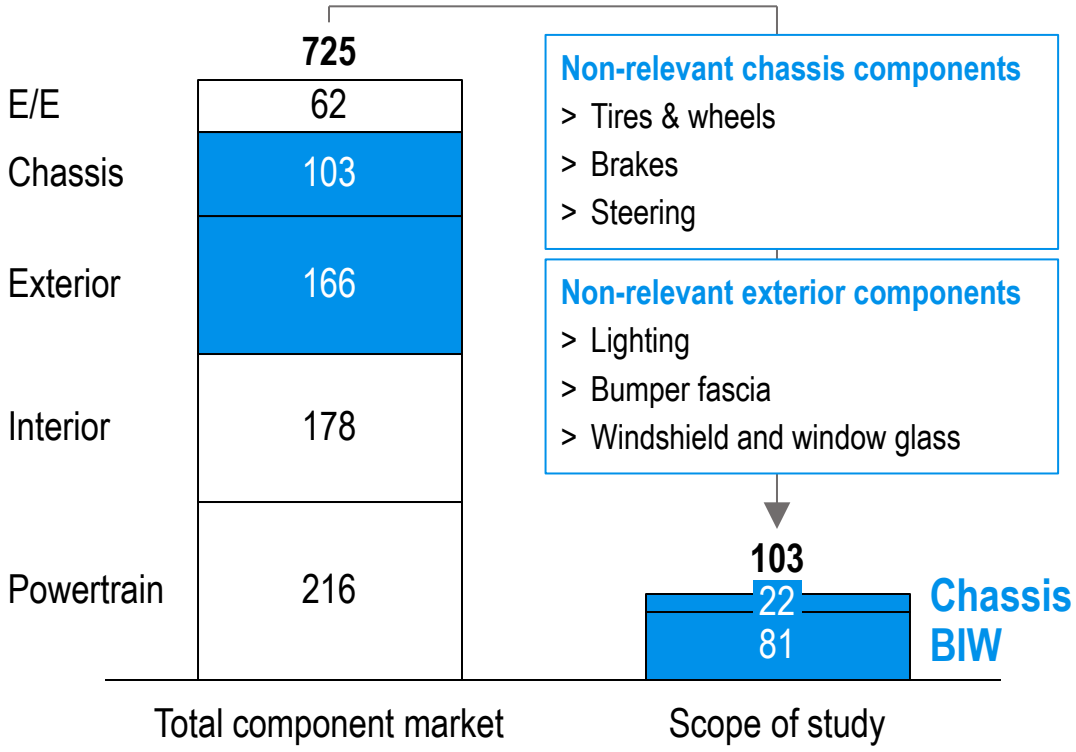
1) Skin panels, including corresponding inner parts/reinforcements
2) India, other Asia and rest of world

Source: Expert interviews; Roland Berger

C. Future development of the market and implications

Total global market for BIW & chassis stamped components is EUR 103 bn – Approximately 15% of the total component market

Global component market and total market for stamped components, 2015 [EUR bn]



Comments

> The study focused on stamped components in exterior and chassis

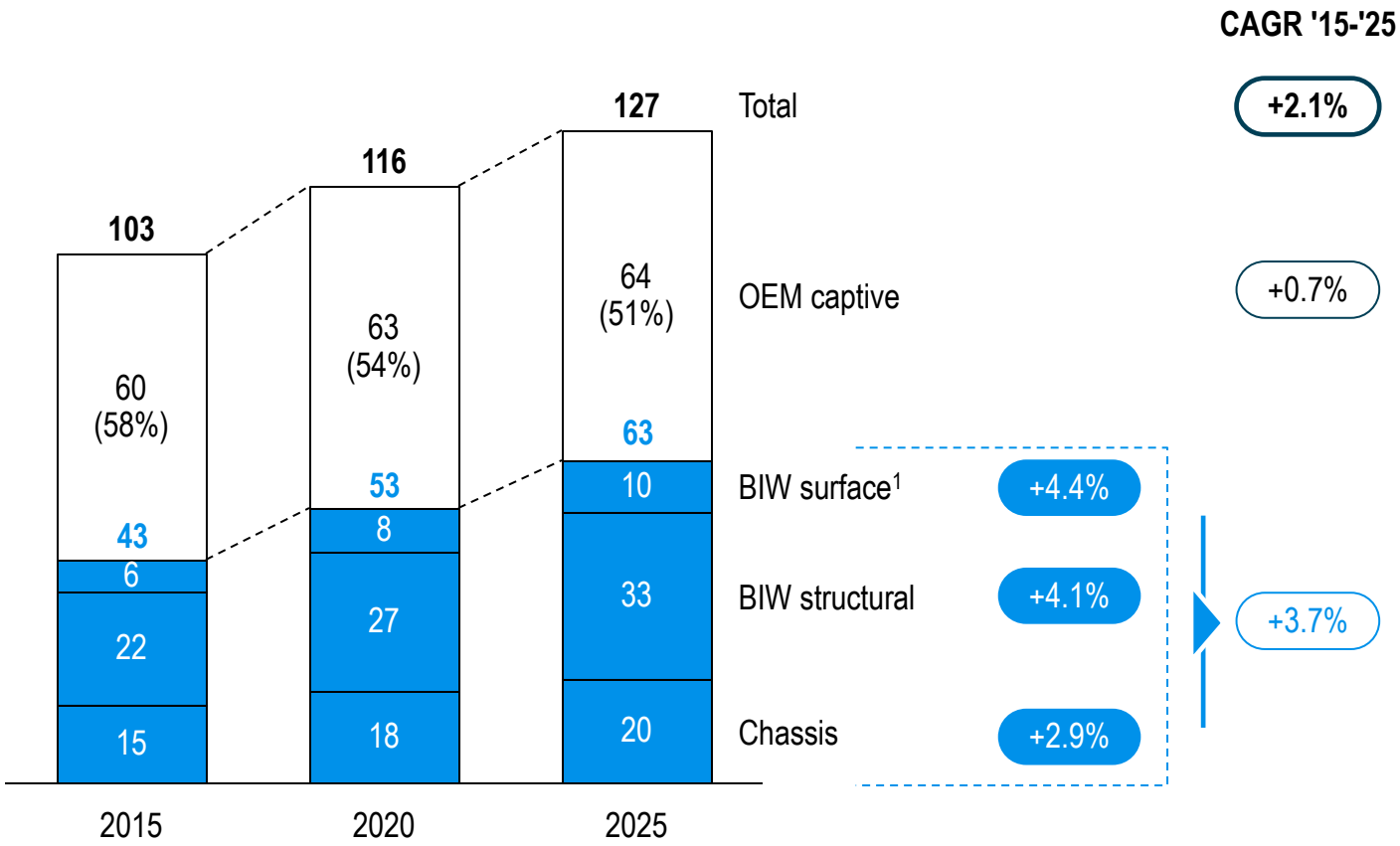
> Major chassis and exterior components are not relevant for the study, e.g. (numbers in brackets indicate global market value)

- Exterior: Lighting (EUR 15 bn), bumper fascia (12 bn), windshield & windows (8 bn), Coatings (7 bn), sealants (6 bn), other (37 bn)
- Chassis: Tires & wheels (24 bn), brakes (24 bn), steering (20 bn), other (15 bn)

Source: Roland Berger market model

Outsourcing rate is expected to grow over the next decade – Global market will be worth around EUR 63 bn in 2025

Total market, OEM captive vs. outsourced, 2015-25 [EUR bn, %]



1) Skin panels, including corresponding inner parts/reinforcements
2) Optimized product design in next vehicle generations based on same materials and general processes

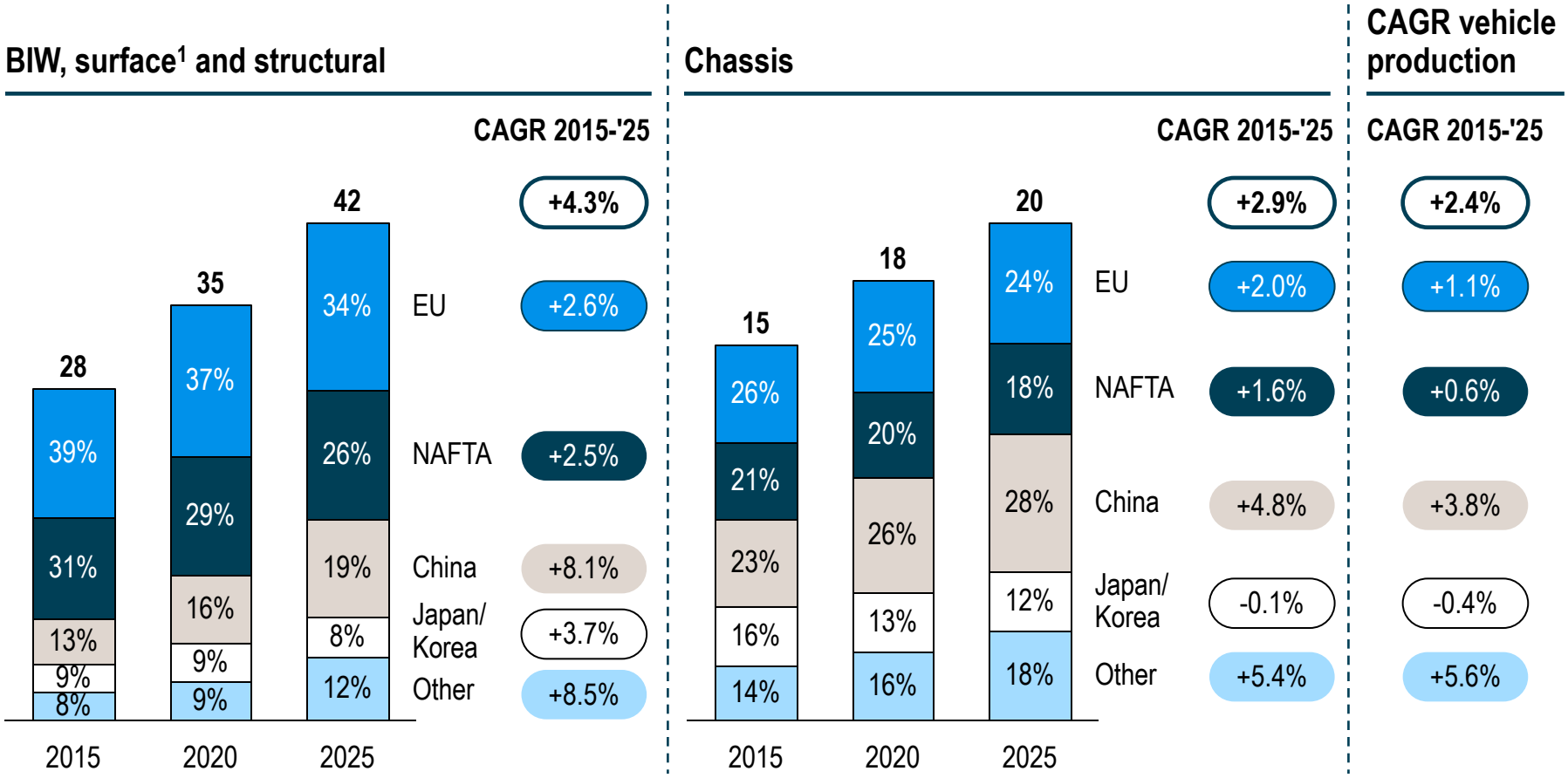
Source: Roland Berger market model

Comments

- The total market will grow in line with global vehicle production (CAGR '15-'25 2.4%)
- For suppliers, the addressable market will grow faster than the total market due to increasing outsourcing rates (42% in 2015, estimated 49% in 2020)
- Component prices assumed constant over time, as material costs are typically indexed, and minor year-on-year price reductions are balanced out by evolutionary product innovations[2)]

EU and NAFTA account for around 70% of the BIW and 50% of the chassis market – Both shares are shrinking as China expands

Addressable market by region, 2015-25 [EUR bn, %]



1) Skin panels, including corresponding inner parts/reinforcements

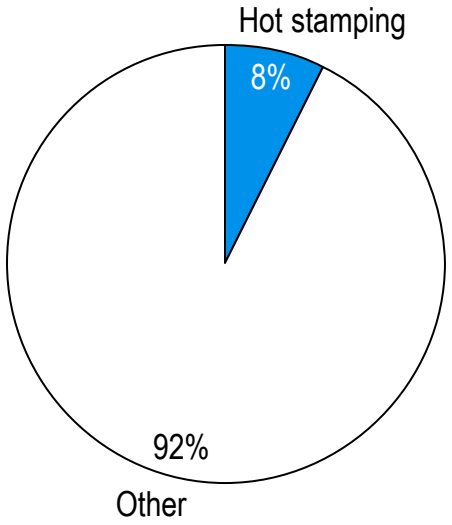
Source: Roland Berger market model

Share of hot stamping in total BIW market is expected to grow

Share of hot stamped parts in total BIW [% of market value]

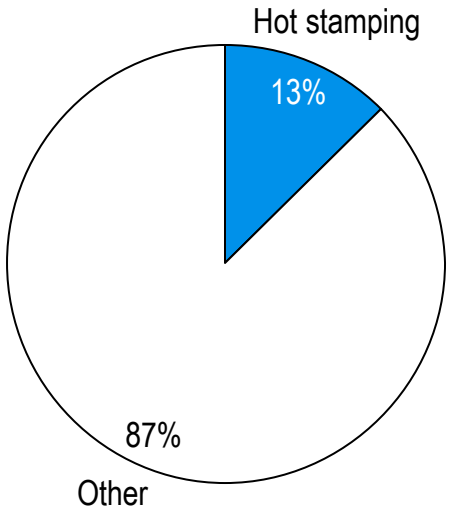
2015

Total BIW market: EUR 81 bn



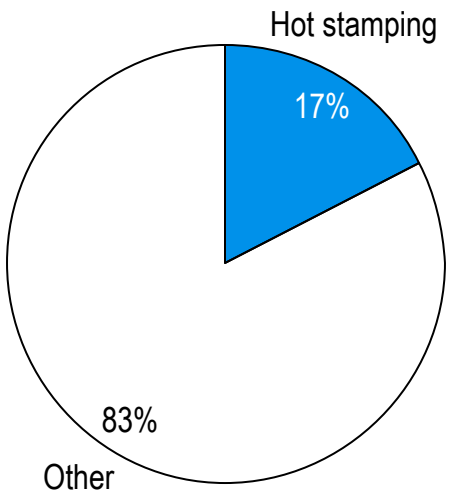
2020e

Total BIW market: EUR 91 bn



2025e

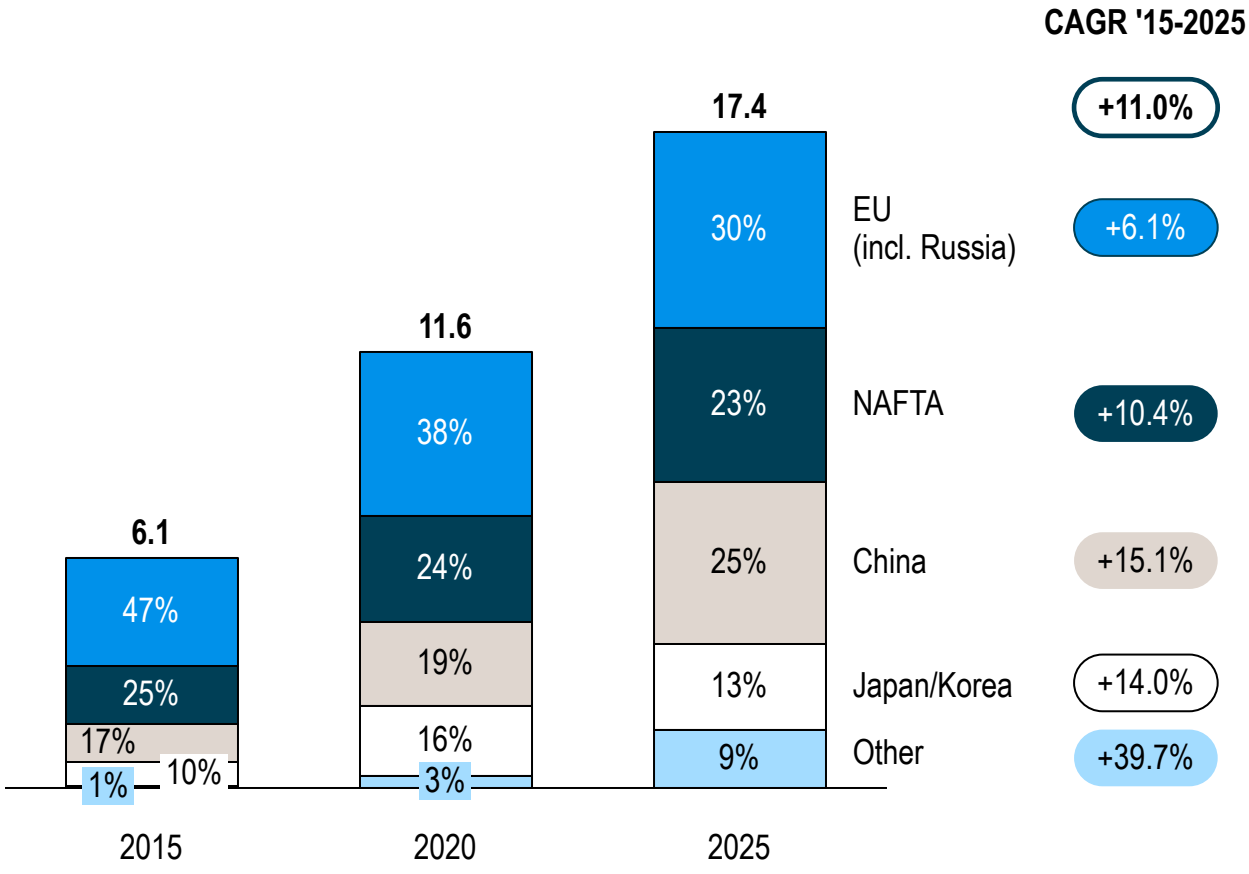
Total BIW market: EUR 100 bn



Source: Expert interviews; Roland Berger market model

Forecast growth of the hot stamping market is 11% – Significantly higher than growth of total stamping component market

Total BIW hot stamping revenues by region[1], 2015-25 [EUR bn; %]



1) Including OEM capacities

Source: Desk research; expert interviews; Roland Berger market model

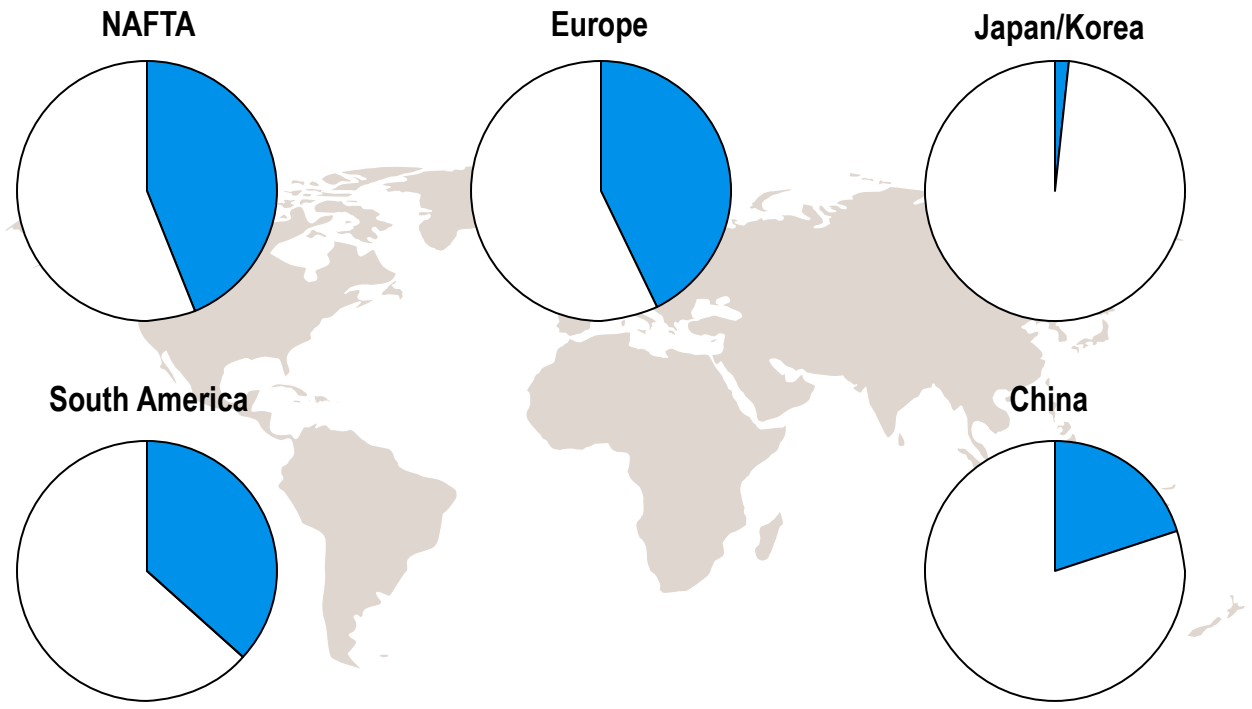
Comments

> China is the key growth driver as it is expected that its body safety structures will be adapted to European standards, including wider use of hot stamping components for structural components

> Europe has the weakest growth rate, indicating a market slowdown as the penetration of hot stamped components in the car body reaches a plateau

Three main players have a truly global market presence and major share – Asian market is less concentrated

Market shares for top-three players by region in 2015 (body and chassis components)



Source: MarkLines; press research

Comments

> Market is dominated by three global suppliers that have a significant footprint in the major automotive regions, including global technology access

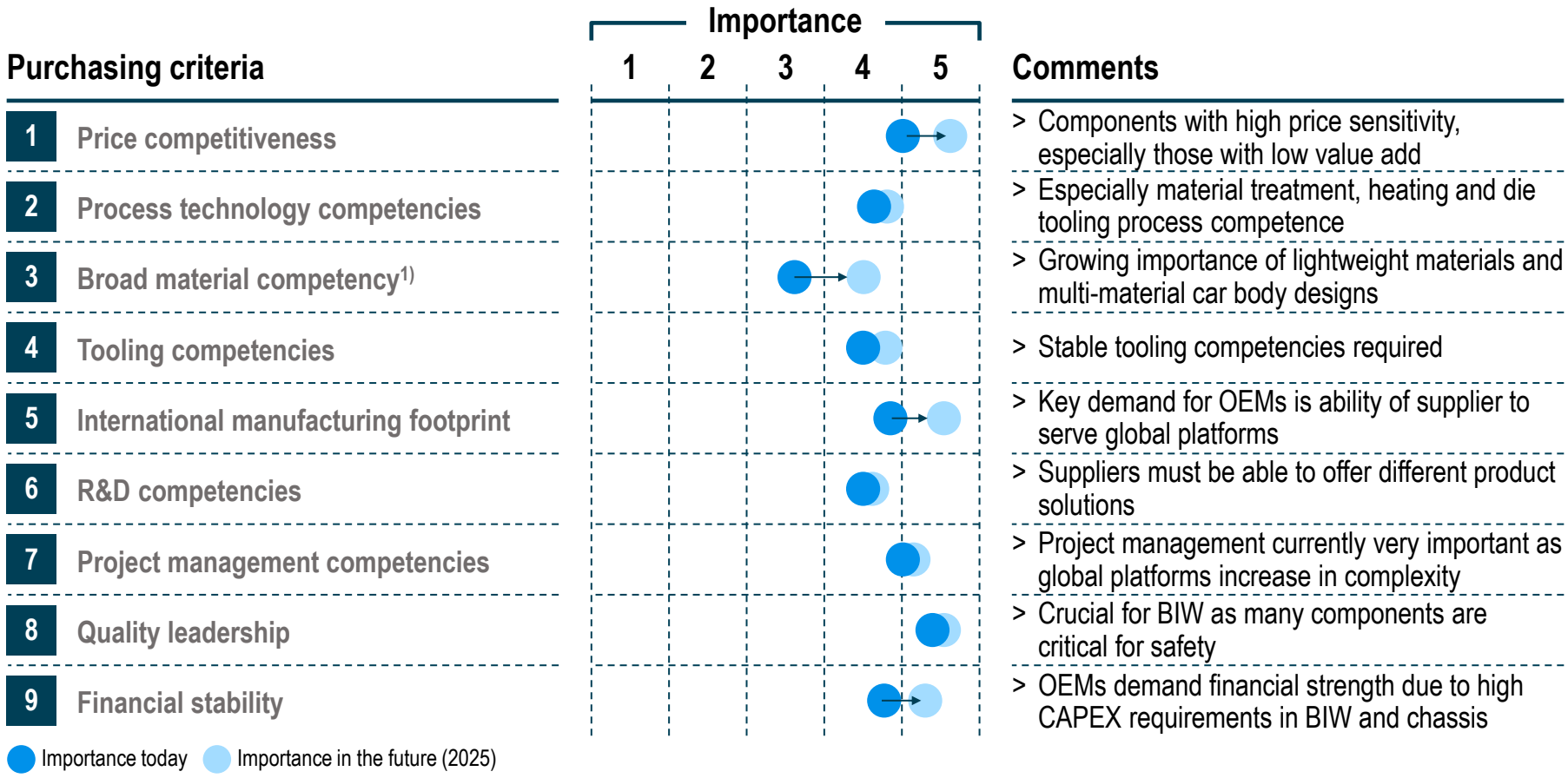
> In addition, various regional/ specialized smaller suppliers exist in each region, typically with strong relationships with their core customers

> Asia has a larger share of regional/specialized suppliers due to

- Strong OEM-supplier relationships in Japan ("captive" market for other suppliers)
- Fragmented competitive landscape in China

Price competitiveness, global presence and quality leadership are core factors for successful participation in the market

Purchasing criteria – OEMs



1) Steel, aluminum, multi material, carbon fiber, etc.

Source: Expert interviews; Roland Berger

Implications and key takeaways

- The trends identified in the study are expected to have a positive impact on stamped BIW and chassis components. As a result, the market is expected to outperform automotive production growth, offering suppliers a stable business if they can meet the following key market and purchasing criteria
  - > Cost competitiveness (process excellence)
  - > Presence in growth markets (especially China)
  - > Sufficient competencies in project management (especially global platforms)

- Although steel is expected to remain the dominant material, OEMs are likely to demand competencies in other materials. Suppliers must therefore define a material strategy and monitor the different material types

- Hot stamping technology will be the key growth driver for stamped components, almost tripling the market size to more than EUR 15 bn by 2025
  - > Risk of price pressure due to increasing competition as more suppliers start using hot stamping technology and OEMs gain a better understanding of the hot stamping cost structure through in-house competencies
  - > Further technology improvements are possible (e.g. tailored material properties), offering suppliers the opportunity to add further value

- On a macro perspective, environmental conditions are expected to remain volatile, placing special requirements on the supplier business model
  - > High degree of flexibility so suppliers can adjust operations simply and cheaply depending on OEM volumes
  - > Close monitoring of potential disruptive factors in the automotive industry – current vehicle production forecasts show growing volumes but conditions and underlying assumptions may change in the future

Source: Roland Berger

D. The Roland Berger Automotive Competence Center

The Roland Berger Automotive Competence Center

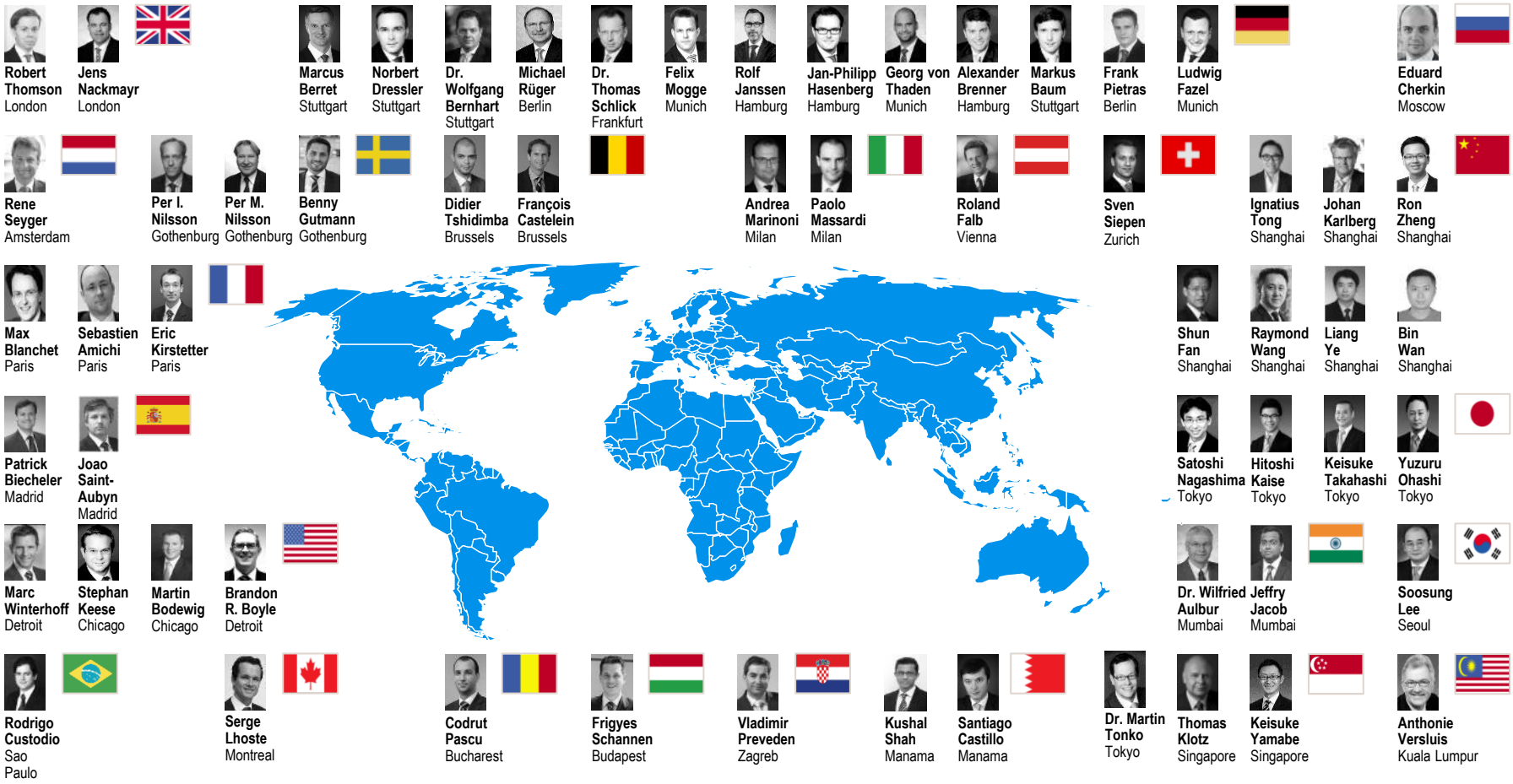
Overview

1. We support **all relevant players** in the automotive industry – OEMs, suppliers, service providers and financial investors
2. We consistently deliver projects in **all functional areas**
3. We are thought leaders, with **proven tools and studies**
4. We continuously deliver the **highest quality** to our clients

Over **2,000 projects** across the globe in the last decade, serving **all major clients** in the automotive industry

Source: Roland Berger

A strong global network



The Roland Berger Automotive Competence Center: 400+ professionals globally

Source: Roland Berger

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Source: Roland Berger


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