“Opportunities for Aluminium Components in Automotive Applications”

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Brazil

CBMM

beta

ALUMINIUM IN AUTOMOTIVE INDUSTRY

Aluminium in Automotive Industry

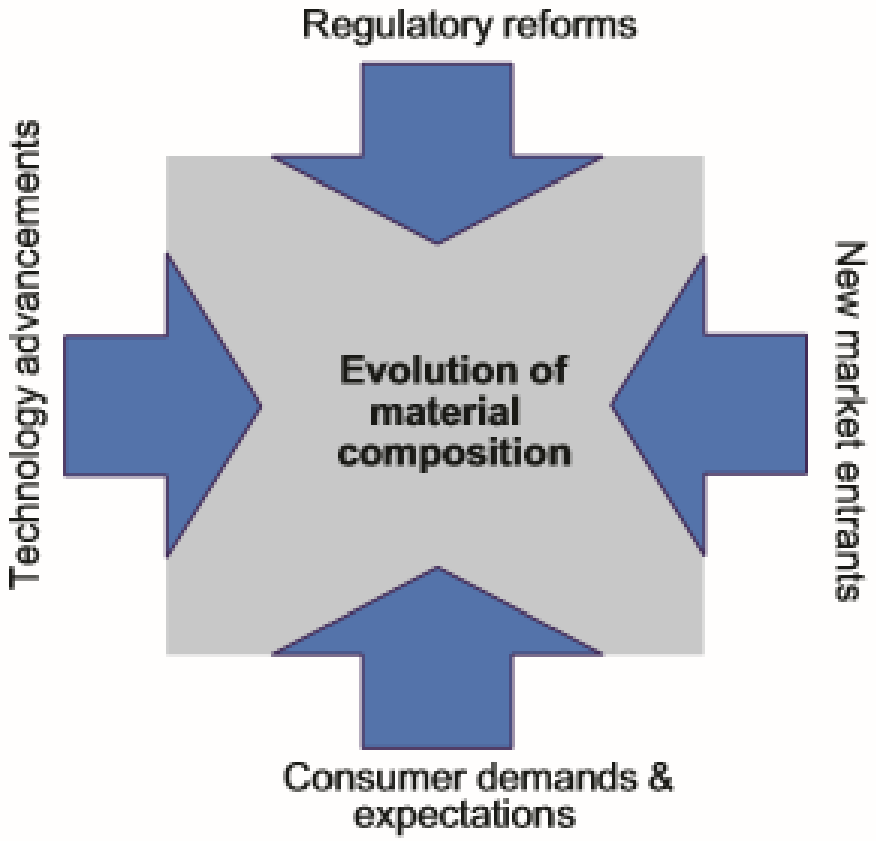
Rolled Products

Cast & Extruded Aluminium

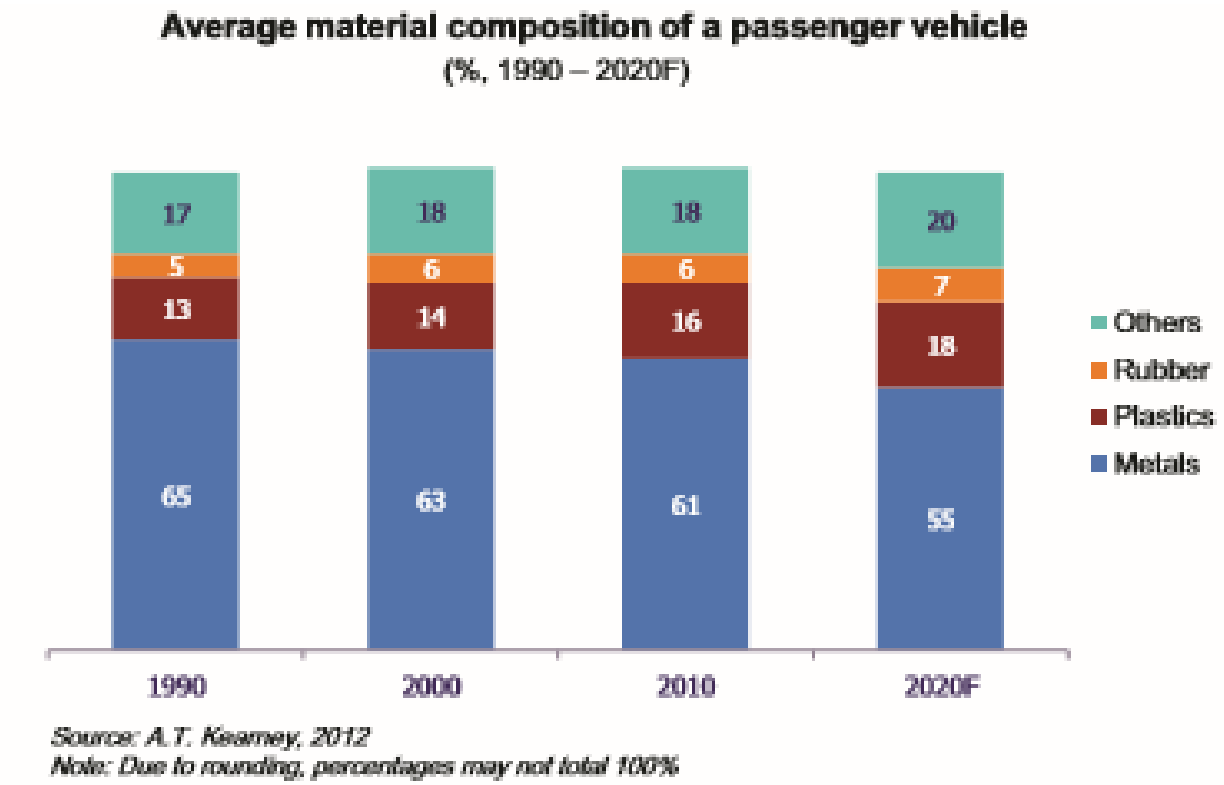
ALUMINIUM IN AUTOMOTIVE INDUSTRY

Material application strategy

Key drivers of material composition evolution



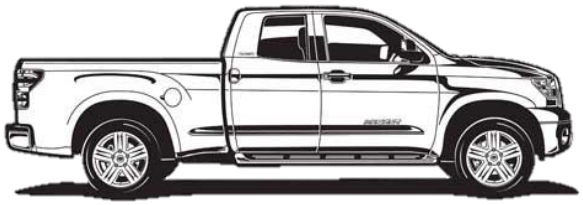
Material application strategy



Aluminium in Automotive Industry

- ✓ The usage of aluminum in automobiles has been gradually increasing;
- ✓ Improves vehicle performance. Reduces CO2 emissions and Boosts fuel economy;
- ✓ Pound for pound, aluminum can absorb twice the crash energy of mild steel and it can provide a weight savings of up to 50 percent compared with the traditional mild steel structure. We must keep in mind that the AHSS evolution in the last years was impressive and it is economic competitive.

- ✓ Aluminum is the second-most used material in automobiles
- ✓ It has the potential to become the most-used, as new aluminum alloys are made to deliver more value than steel.
- ✓ At the end of a vehicle's life nearly 90 percent of the aluminum, on average, is recycled.



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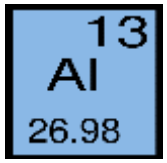

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Better performance and new possibilities

http://marketrealist.com/2015/12/auto-industrys-aluminum-usage-increasing/
http://www.aluminum.org/product-markets/automotive

Aluminium in Automotive Industry

From mass-market vehicles like the Ford F-150 to luxury cars like Audi, Mercedes Benz and Land Rover, aluminum is increasingly the “material of choice” for automakers thanks to its strength and environmental advantages.

Ford’s F-150 pickup truck. Aluminum accounts for roughly 25% of the curb weight of the 2015 F-150.

http://www.forbes.com/sites/greatspeculations/2015/05/20/trends-in-steel-usage-in-the-automotive-industry/#879257178659

Material application strategy

Overview of current BIW material composition strategies

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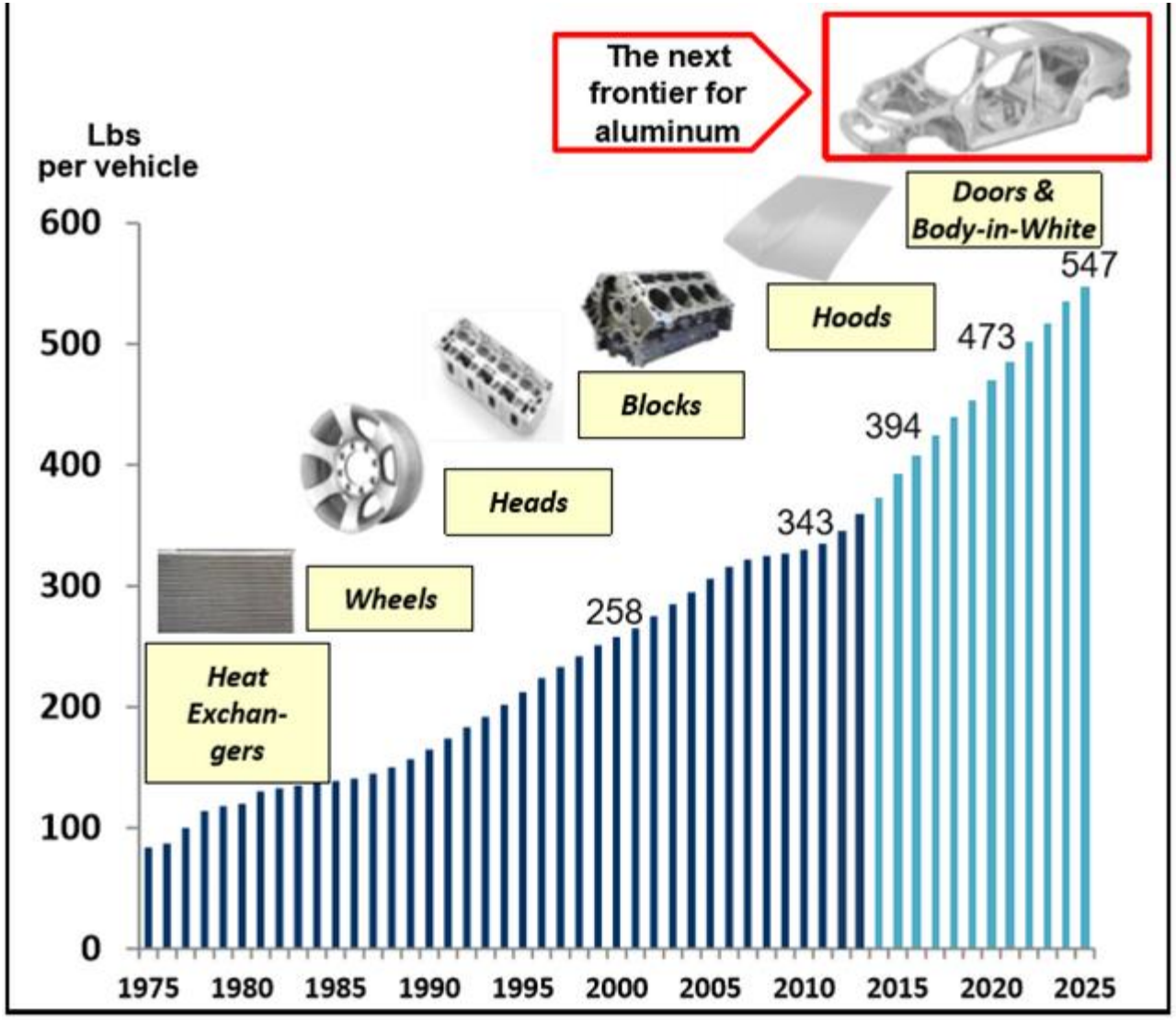
Source: ENDAG, 2012
Note: Weight reduction and cost figures are as per the 2012 research study by ENDAG that determined maximum feasible weight reduction in passenger vehicles using 2011 Honda Accord as its baseline vehicle.

Accelerating Aluminum use in Automotive



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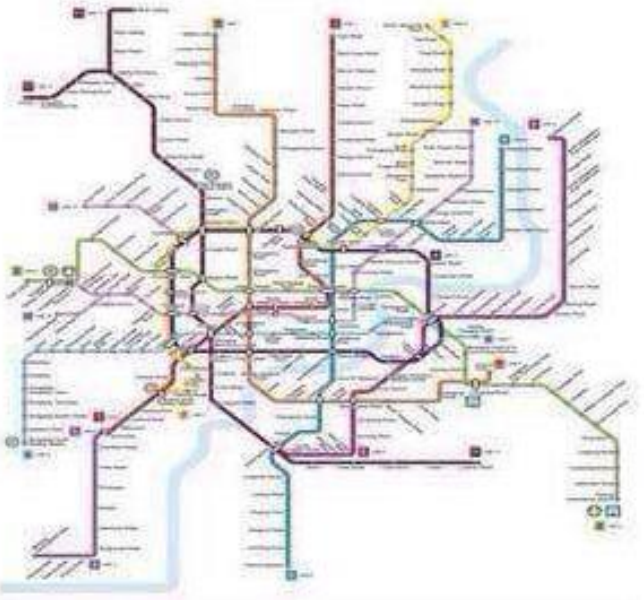
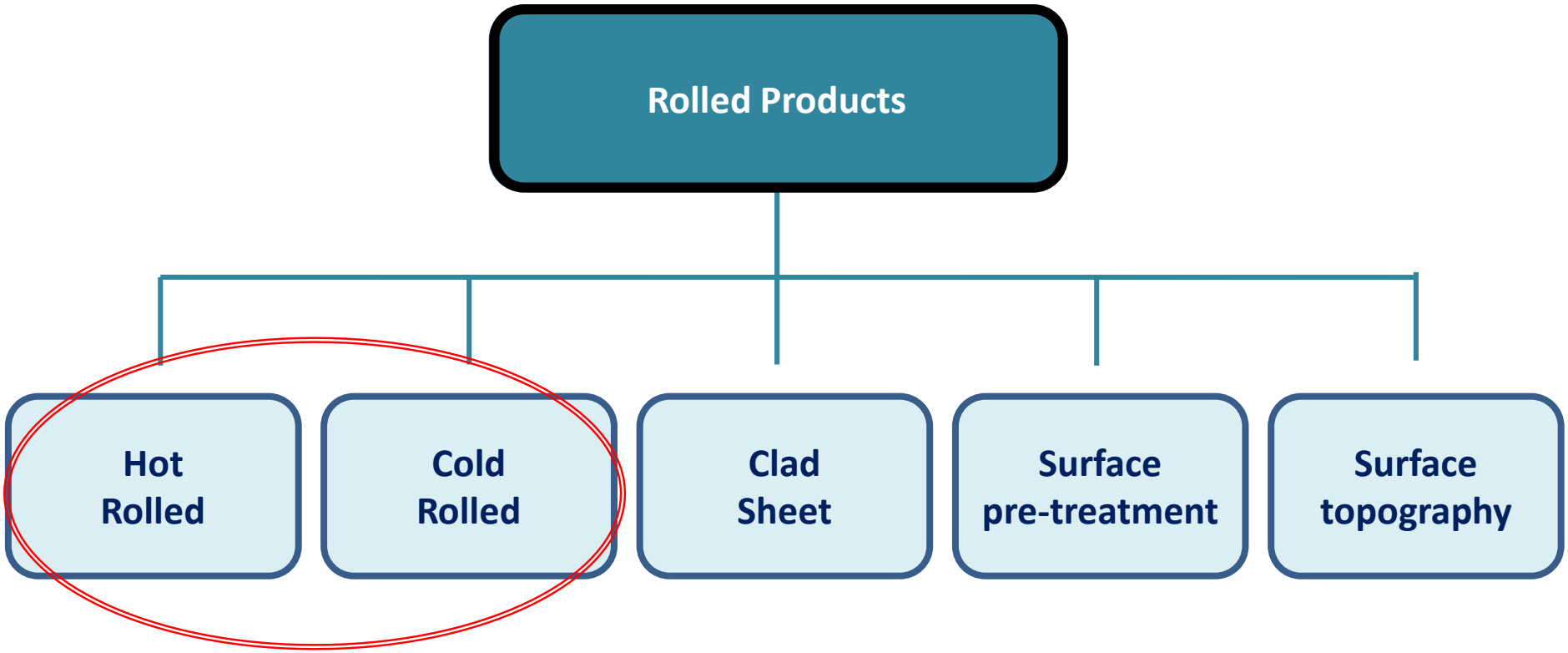
Growth

Rio de Janeiro, 1993 	Xangai, 1993 (sem metrô)
Rio de Janeiro, 2013 	Xangai, 2013 

ROLLED PRODUCTS

Rolled Products



Automotive applications

- Rolled products:
  - Plate;
  - Sheet;
  - Foil;
  - Welded tubes.

The second largest fraction of aluminium in automobile applications.

- Weight reduction.
- Enhancement of part performance.

DC rear axle cradle

BMW fabricated wheel

Special alloys and tempers have been developed and are in use that provides the properties needed to meet the specific quality requirements of the various parts.

Sheet products are provided with special surface topographies, claddings as well as with pretreatments for lubrication, joining and painting by coil coating processes.

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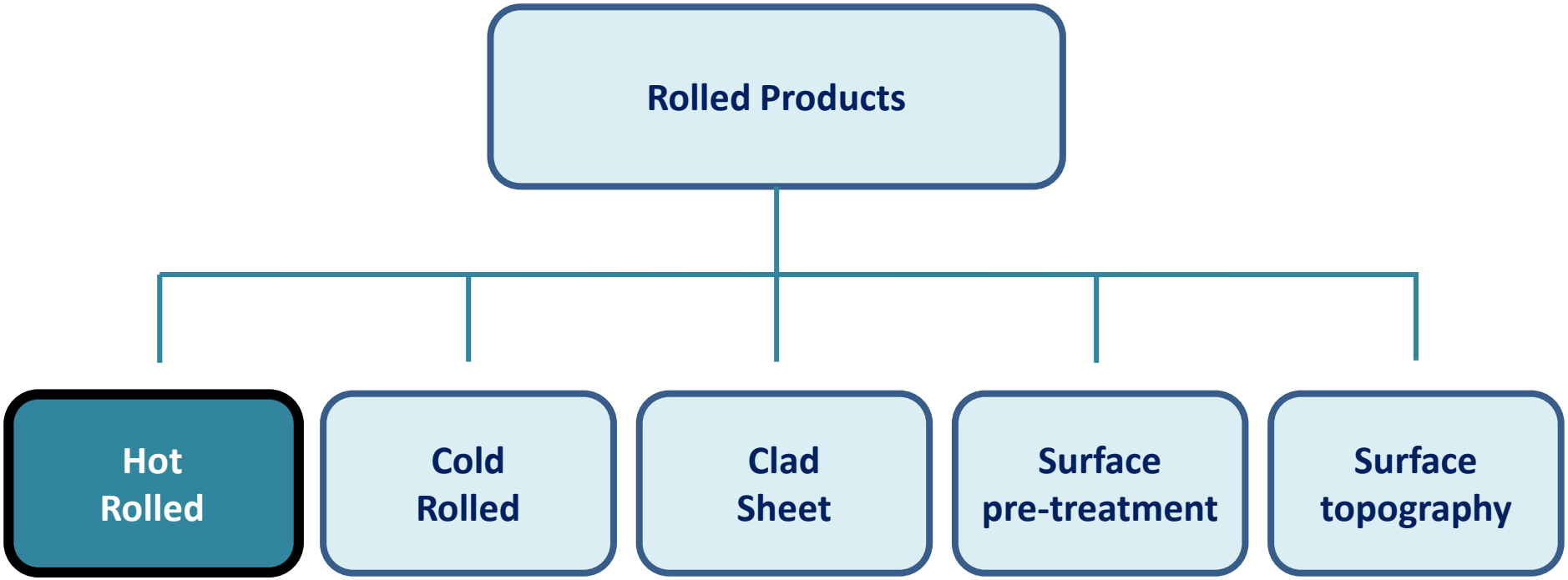
Rolled Products



Hot Rolled

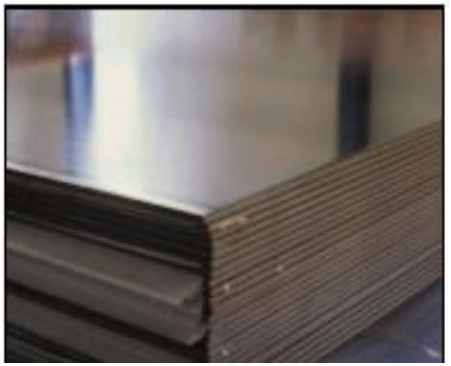
- ✓ Sheet can be **processed** directly to **final gauge** by hot rolling.
- ✓ This process is **very economical**, but available alloys and tempers are **limited.**
- ✓ Dimensional tolerances: typically ± 0.30 to ± 0.40 mm.

- **Structural parts**
  - Wheel Stock
  - Suspension components
  - Body reinforcements

Longtudinal coil shearing

Hot rolled coil

Hot rolled plate



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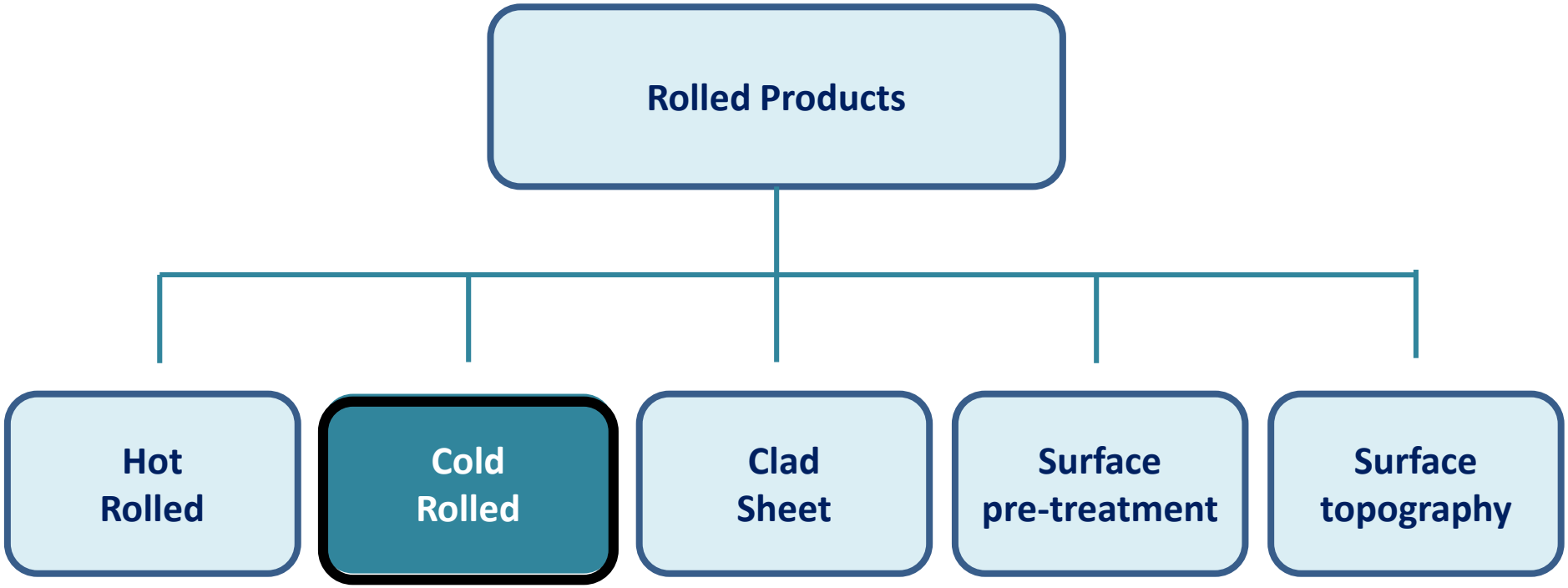
Rolled Products



Cold Rolled

- Cold rolled products are sheet or plate, where the final gauge is processed by cold rolling.
- Often additional annealing treatments are necessary to adjust the properties specified by customers.

- Main characteristics
  - Narrow tolerances on shape and dimensions.
  - Thickness tolerances - depend on the type of alloy, sheet or strip thickness range and rolling width, and are listed in standards EN 485-4.

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CAST & EXTRUDED ALUMINIUM

Cast Aluminium

- ✓ Casting is a simple, inexpensive and versatile way of forming aluminum into a wide array of products.
- ✓ The automotive industry is the largest market for aluminum casting.
- ✓ Cast products make up more than half of the aluminum used in cars.
- ✓ Over 95% of the aluminum die-casting produced in the U.S is made from post-consumer recycled aluminum
- ✓ Automobile makers are now focusing on collaborating with the part die casting manufacturers in order to produce fuel-efficient and lightweight automobiles.

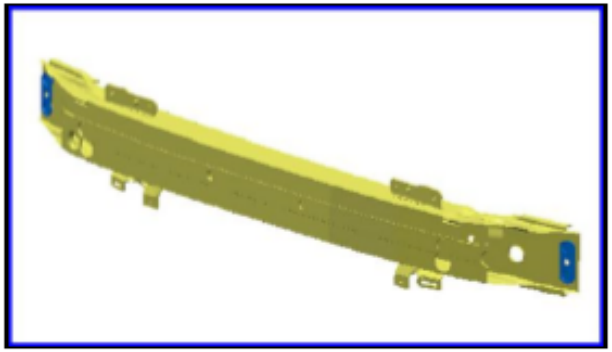
Car engine is produced through the aluminum casting process.

Cast aluminum transmission housings and pistons have been commonly used in cars and trucks since the early 1900s.

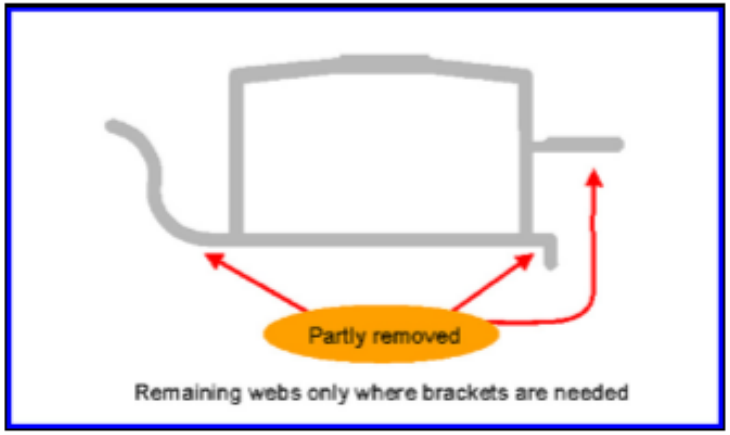
http://www.aluminum.org/industries/processing/castings
http://www.prnewswire.com/news-releases/us-automotive-parts-aluminum-die-casting-market-2015-2020-300158819.html

Extruded Aluminium

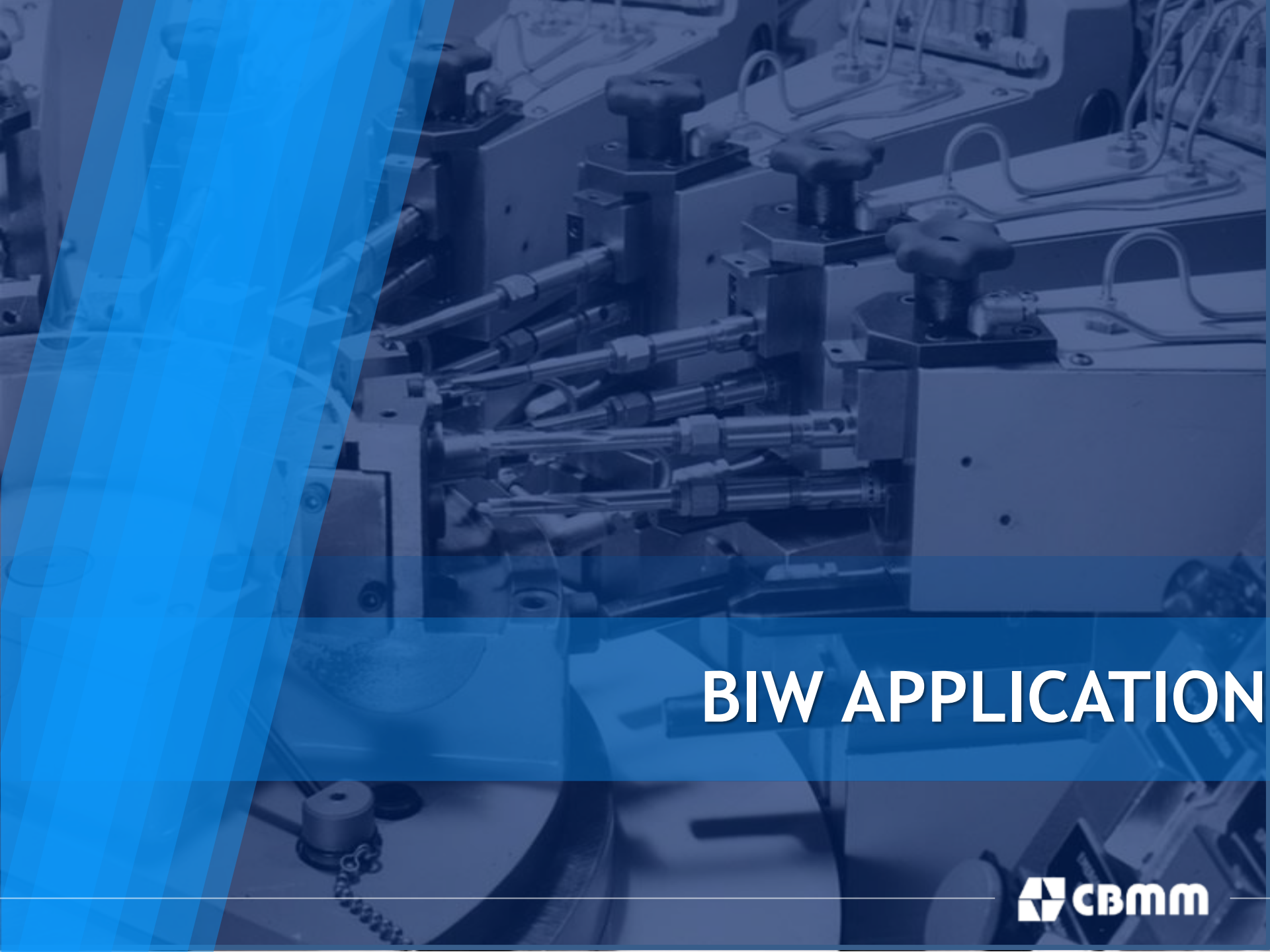
External webs can be used as brackets. Areas where the webs are not necessary can be removed. See bumper beam below.



A bumper beam, a formed hollow extrusion where webs are cut away in areas not necessary



Profile cut of the bumper beam



BIW APPLICATION

Main Applications

Overview of current BIW material composition strategies

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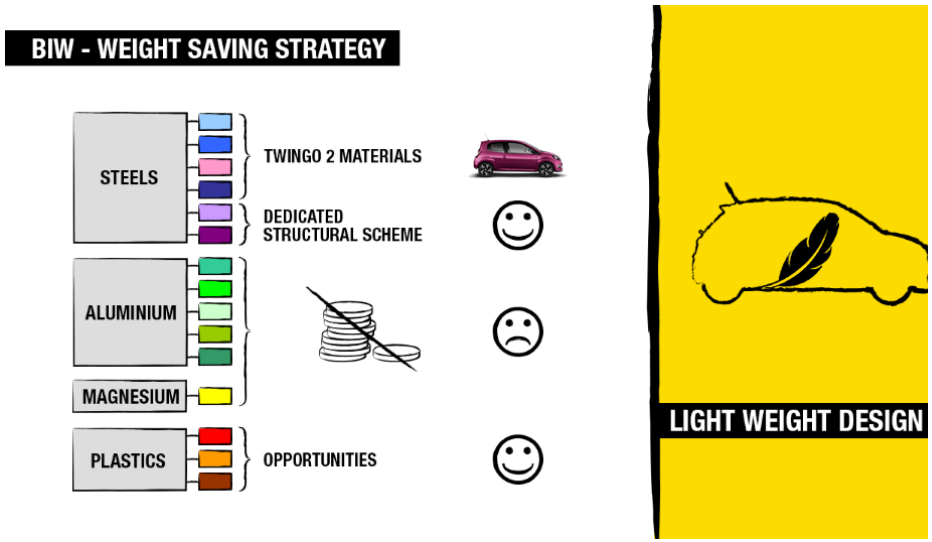


2. Material mix in the body-in-white including doors and closures

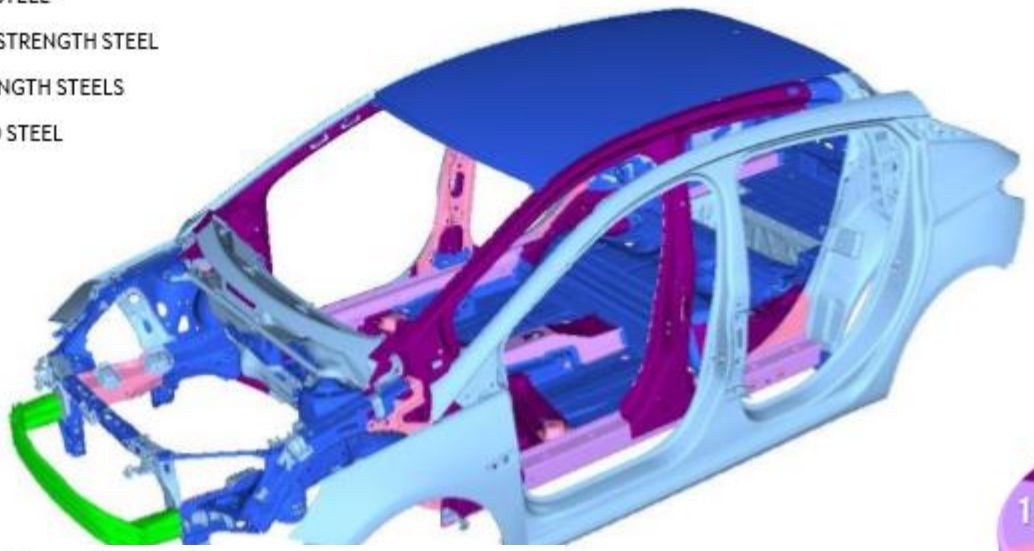
Based on metallurgical/chemical material classes

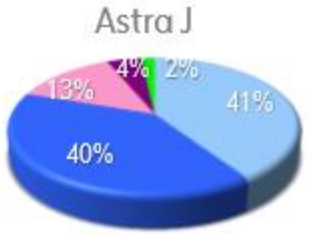
	Materials: corresponding metallurgical classes	RGB colour code	%
Steels	Low Strength Steels: Mild steels	R 153, G 204, B 255	38
	High Strength Steels (HSS): High Strength Interstitial-free Steels (HSIF), Bake Hardening Steels (BH), High Strength Low Alloy Steels (HSLA)	R 051, G 102, B 255	43
	Advanced High Strength Steels (AHSS): Dual Phase Steels (DP), Transformation Induced Plasticity Steels (TRIP)	R 255, G 153, B 204	2
	Stainless steels: Austenitic stainless steels	R 051, G 051, B 153	
	Ultra High Strength Steels (UHSS): Complex Phase Steels (CP), Martensitic Steels (MS)	R 204, G 153, B 255	11
	Press Hardened Steels (PHS)	R 128, G 000, B 128	3
Aluminium	Aluminium sheets: 7xxx series	R 051, G 204, B 153	
	Aluminium sheets: 6xxx series	R 000, G 255, B 000	
	Aluminium sheets: 5xxx series	R 204, G 255, B 204	
	Aluminium extrusion profiles	R 153, G 204, B 000	
	Cast aluminium	R 051, G 153, B 102	
	Magnesium	R 255, G 255, B 000	
Plastics	Fibre reinforced plastics	R 255, G 000, B 000	
	Duroplastics, including Sheet Molding Compound (SMC)	R 255, G 153, B 000	1
	Thermoplastics	R 153, G 051, B 000	2
	Other materials, namely:_____	R 192, G 192, B 192	

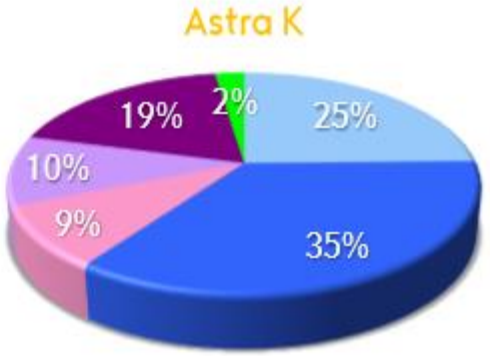
Main Applications

LIGHTWEIGHT – MATERIAL GRADES BODY

- MILD STEEL
- HIGHSTRENGTH STEEL
- ADVANCED HIGHSTRENGTH STEEL
- ULTRA HIGHSTRENGTH STEELS
- PRESS HARDENED STEEL
- ALUMINIUM







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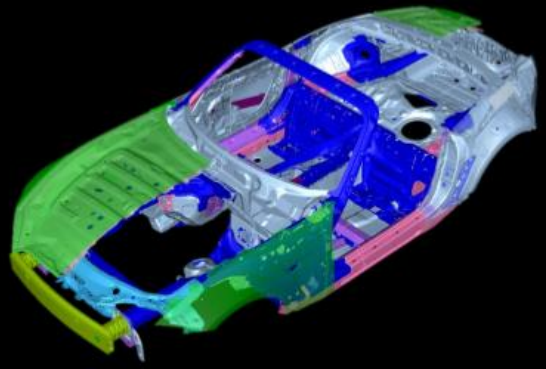
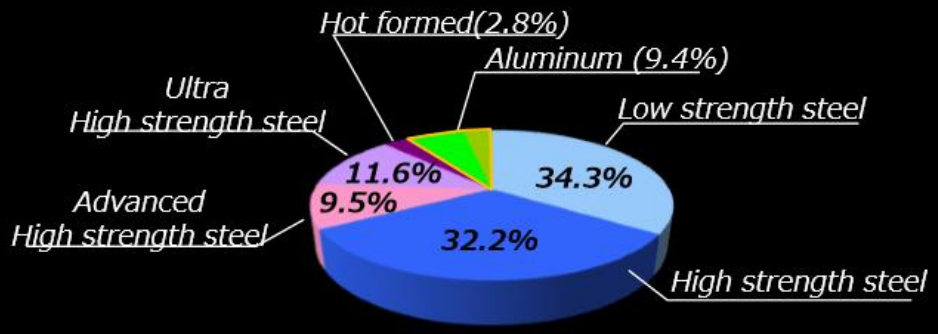
Main Applications

Structural Evolution

Realization of Feeling of Lightness

- Realized Weight Reduction of -38.6 kg (WIB) .





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Feeling Car Responds
Directly to your Intention

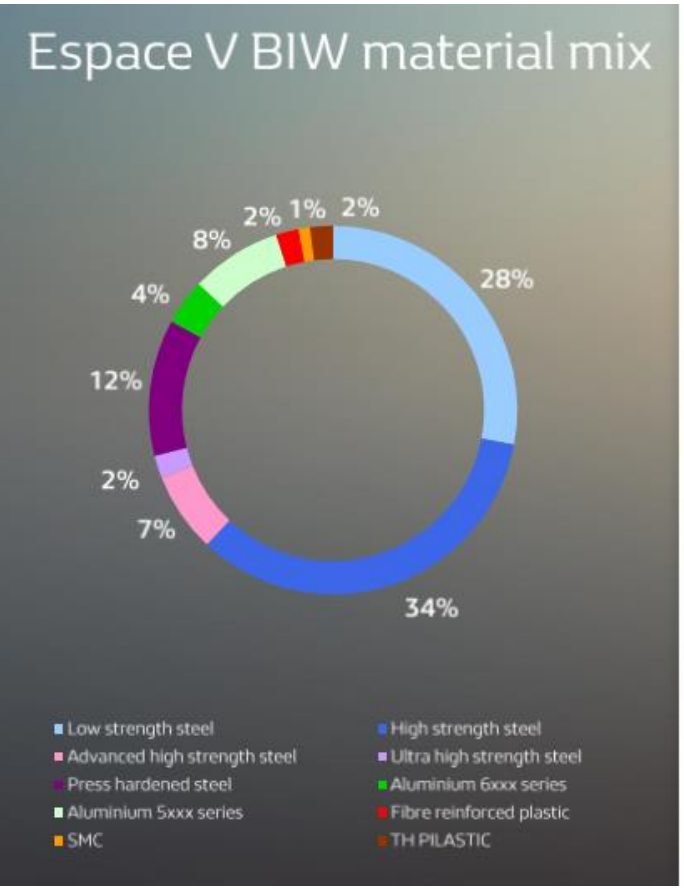
Kan Sensation

Feeling of Lightness

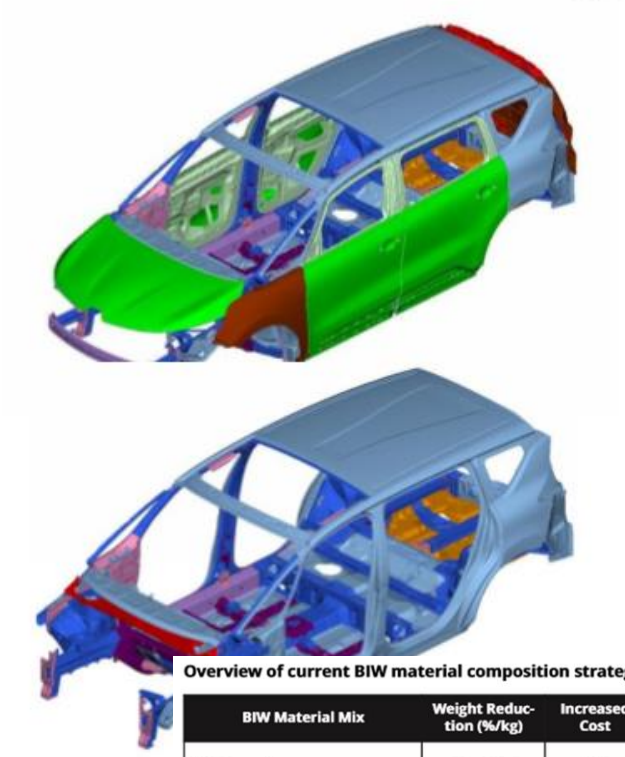
Feeling of Openness

mazda SKYACTIV TECHNOLOGY

Main applications



RENAULT
Passion for life



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Main applications

ultra®–lightweight design

Lightweight design: approach in different steps

geometric lightweight design | material lightweight design

Lightweight degree and complexity increase

Level 0

Potential for conflict: styling, package and influences on production

Level 1

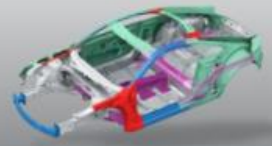
Enhancing material grades e. g. hot–formed steel, e. g. the Audi A3

Level 2

Material substitution of hang on parts
e. g. the Audi A6

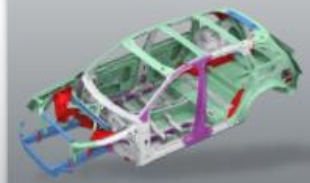
Level 3

Material substitution of large assembly units of car body structures
e. g. the Audi TT



Level 4

Full Material Mix in Body Structure



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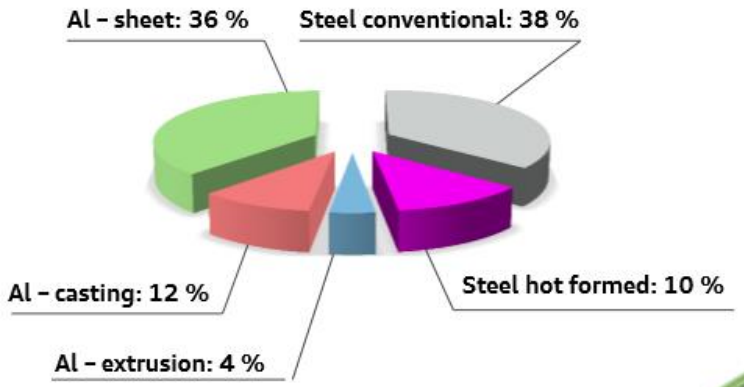
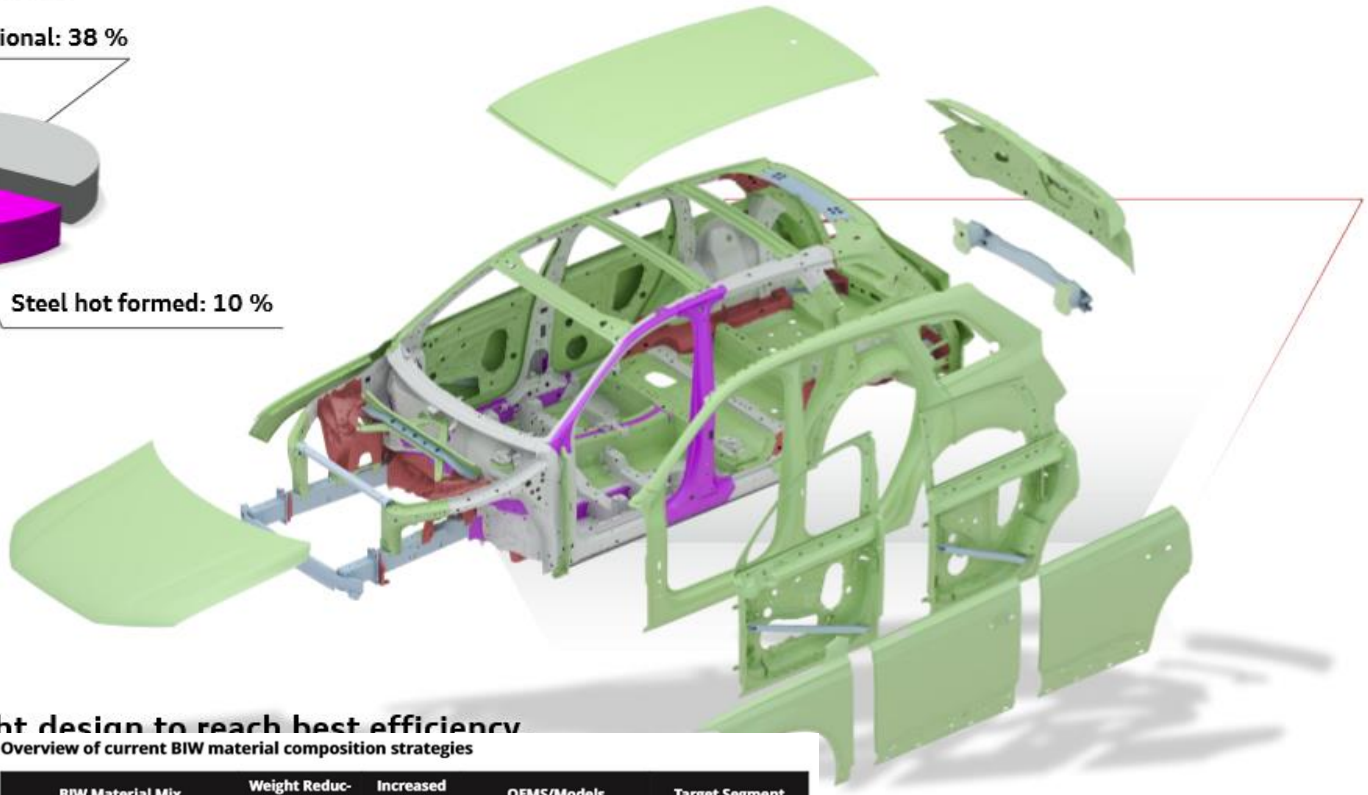
Main applications

ultra®–lightweight design

Material mix details





Part based lightweight design to reach best efficiency

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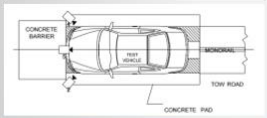
Main applications

THE TRUTH ABOUT TRUCKS: SAFETY

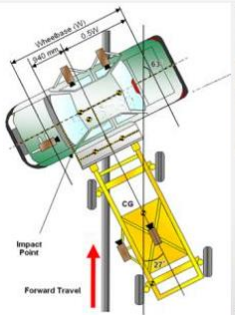
The 2015 F-150 is the Toughest, Smartest, Most Capable and Safest F-150 Ever

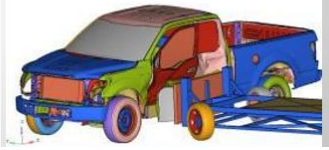
NHTSA 5 STAR OVERALL SAFETY RATING

FRONTAL CRASH



SIDE CRASH

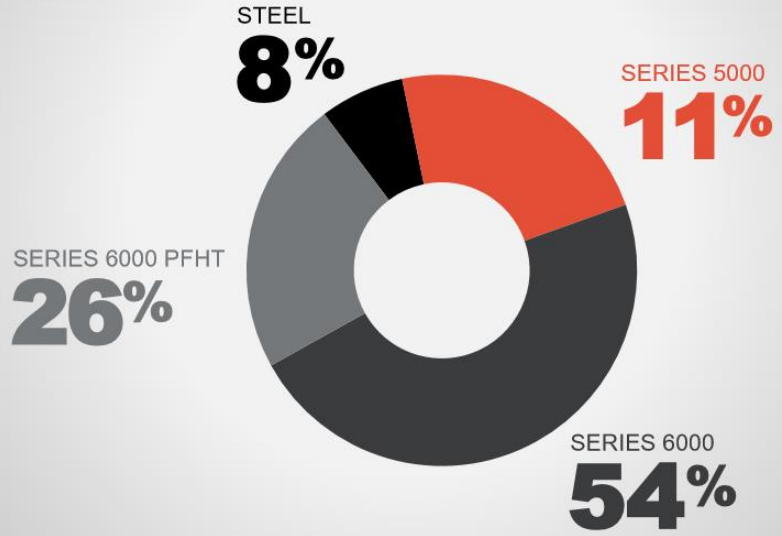




TOUGH

MATERIAL USAGE

2015 F-150
Body Structure



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Transportation Sheet Products

CAB Body Sheet

- Ac-200 and AC-300 development status
  - Final development loops at Novelis
  - Technical data not yet available
- Key features
  - Very good formability
  - Skin quality
  - Uni-alloy concept
  - Bake hardening
  - Good crash resistance (similar to AA5754)
- Typical applications
  - Door inner
  - Side wall
  - Crash relevant parts

Crash samples: Ac-300 T61 2.5mm gauge, Rp ~ 220MPa

CONCLUSION

Aluminium in Automotive Industry

- Aluminum growth depends on:
  - ✓ Regional availability – implemented supply chain;
  - ✓ Size of vehicle – OEMs strategy;
  - ✓ Economic business cases.
- Normal steps of evolution: casting – extruded – Rolled.
- More clear application in passengers cars but also good examples for trucks & trailers.
- Best in class platform: Always multi material strategy – best engineering approach.


THANK YOU
JWP
Engineering & Consulting
CBMM