



Efficiency, Environment, Safety

Benteler Automotive - Lightweight Competencies -

高效, 环保, 安全
本特勒车体结构轻量化方案

Shaofei Qu	曲少飞
CEM for Asian OEMs	亚太客户工程经理
Product Group Structures	车体结构事业部
Benteler Automotive	本特勒汽车工业

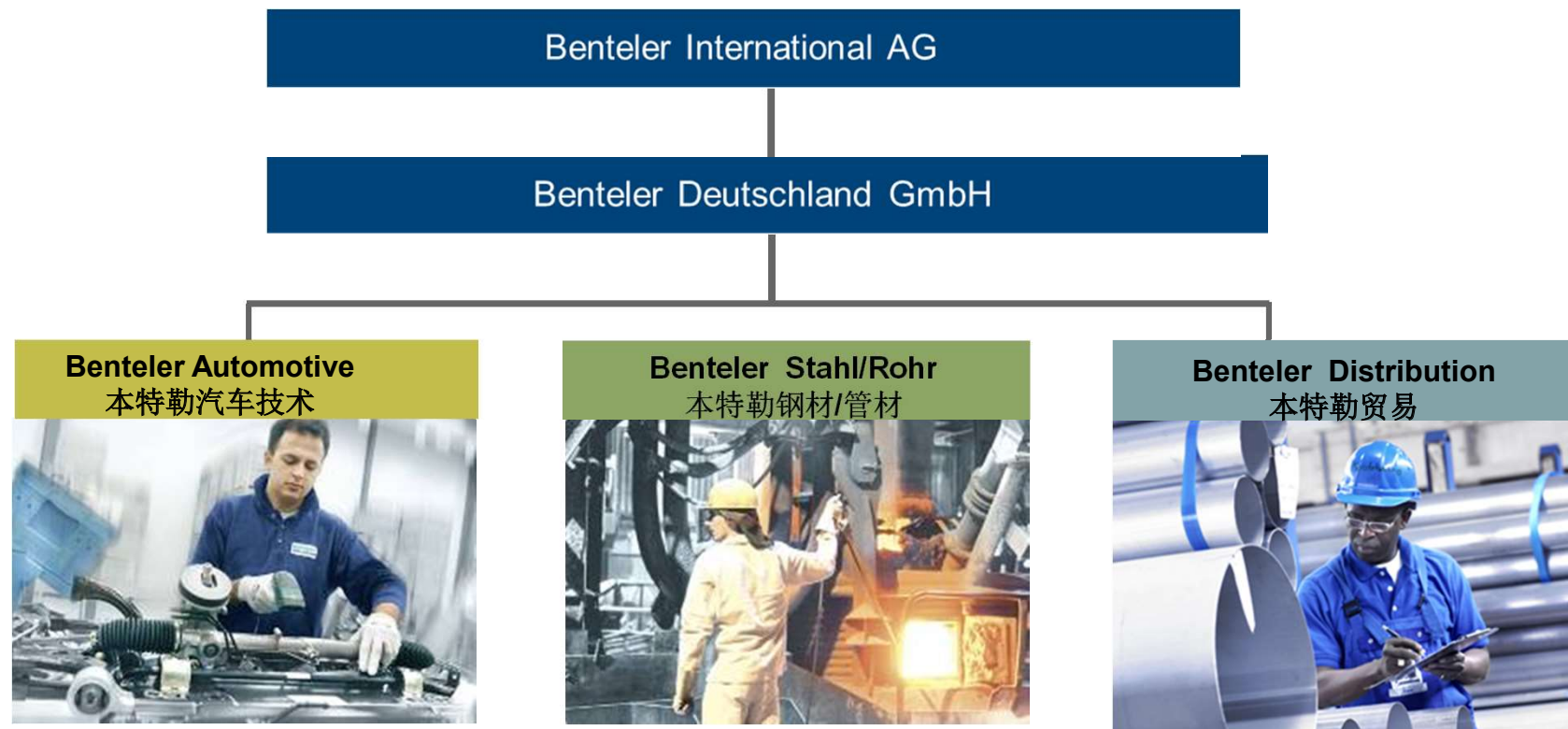
- **Benteler Group**
本特勒集团

- **Automotive Lightweight Demands**
汽车业轻量化需求
- **BIW Lightweight Approach and Examples**
车身轻量化趋势及案例
- **CCB / CMS Today and Tomorrow**
仪表盘支架总成和防撞梁系统现状及趋势
- **Trends in Automotive Materials**
汽车用材料的发展趋势

Benteler Group / 本特勒集团

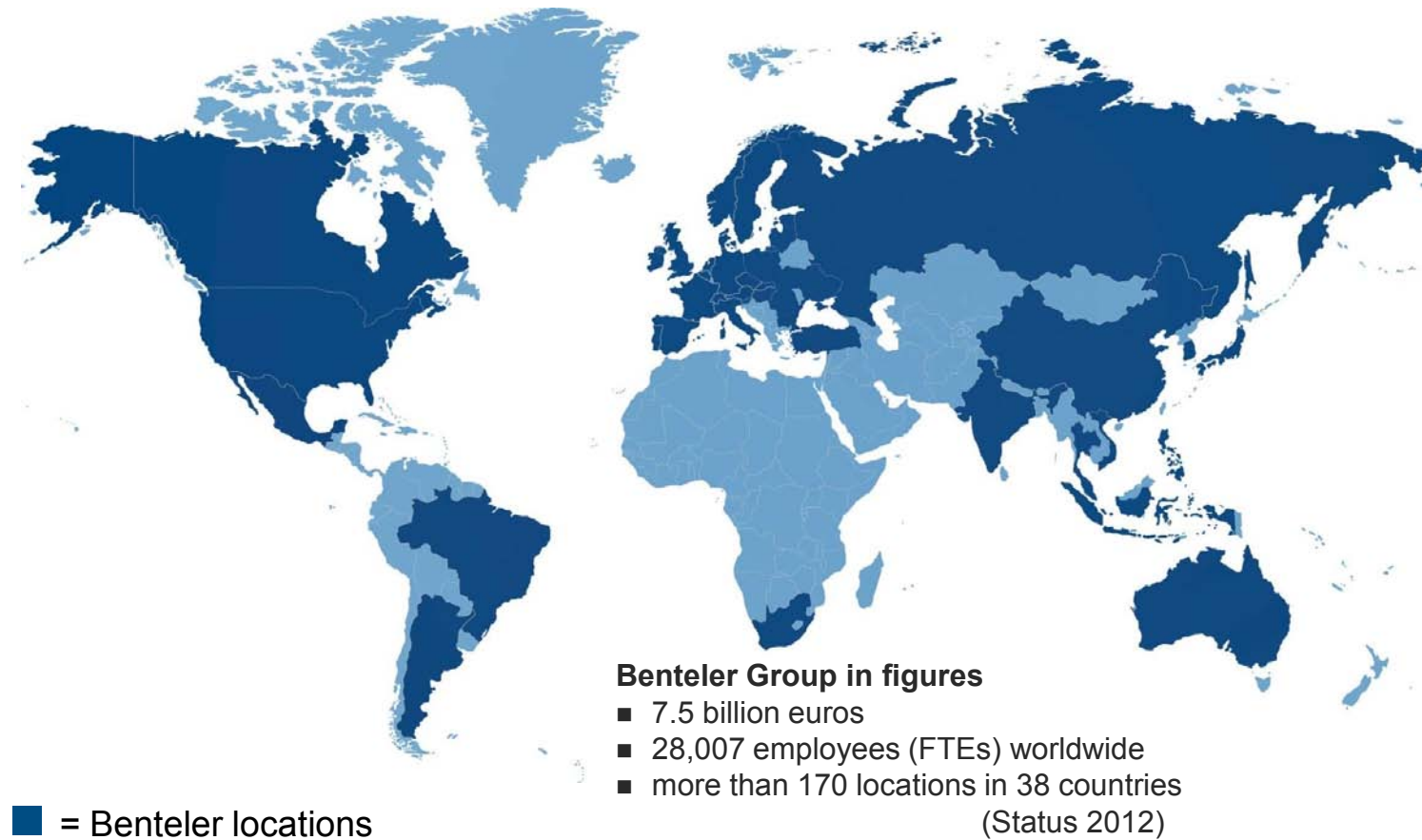
Company Structure 公司结构

Under the strategic management holding, Benteler International AG, the operative business is organized into three legally independent business divisions within Benteler Deutschland GmbH
本特勒集团旗下拥有相对独立的三大公司，分别涉及不同的商务领域。



Benteler Group / 本特勒集团

Worldwide Activities 全球业务状况



Benteler Automotive / 本特勒汽车工业

Product Groups and Competence Business 产品事业部和衍生业务



Benteler Automotive / 本特勒汽车工业



Product Group Structures 车身结构产品事业部

Structures



Door beams
Pillar reinforcements

IP-Supports

Bumper beams

Roof rails
Side rails
Body assemblies

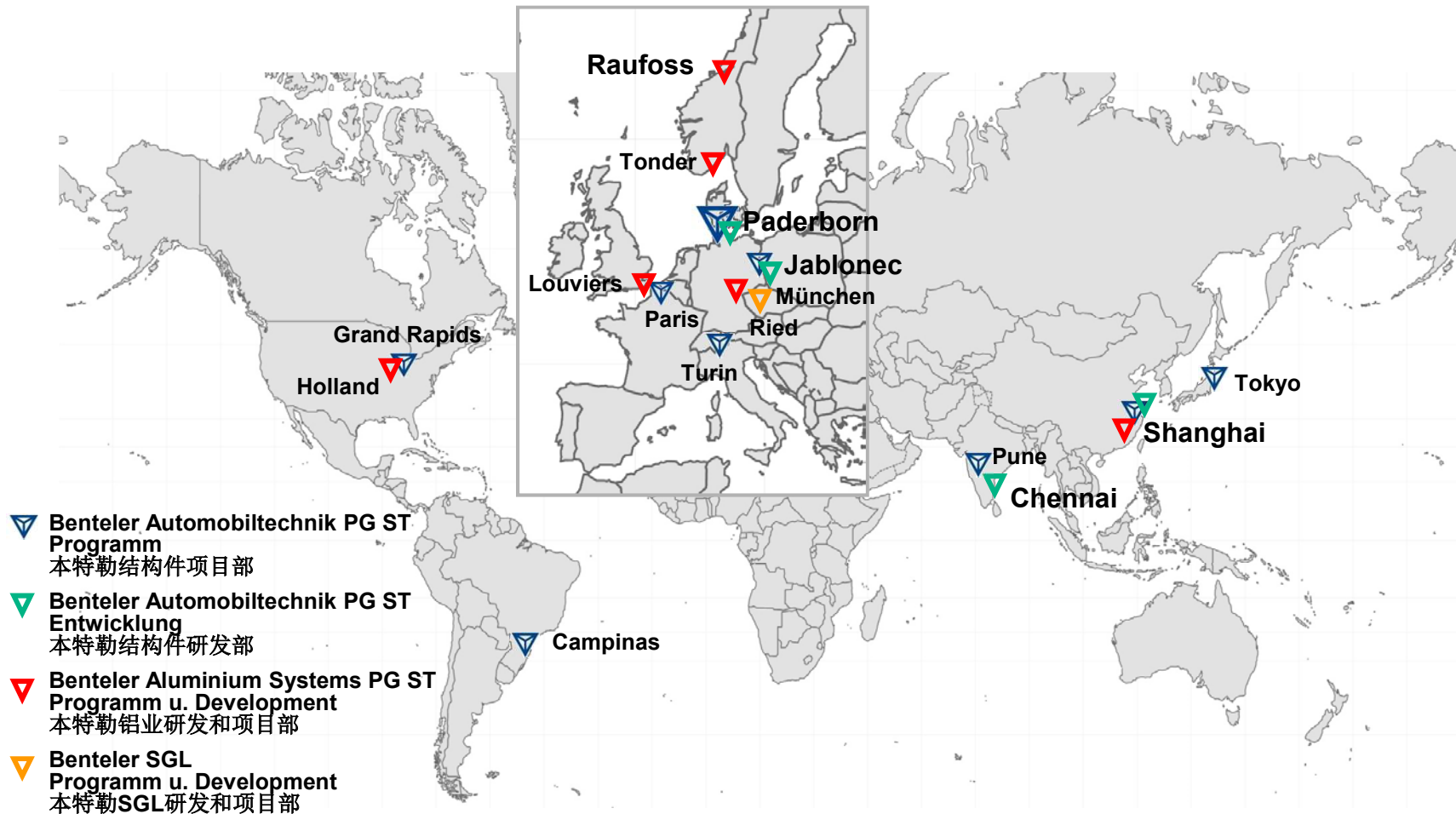
Aluminium parts

Hotform parts
Coldform parts

UHSS

Benteler Automotive / 本特勒汽车工业

Development and Program Locations 研发中心分布图



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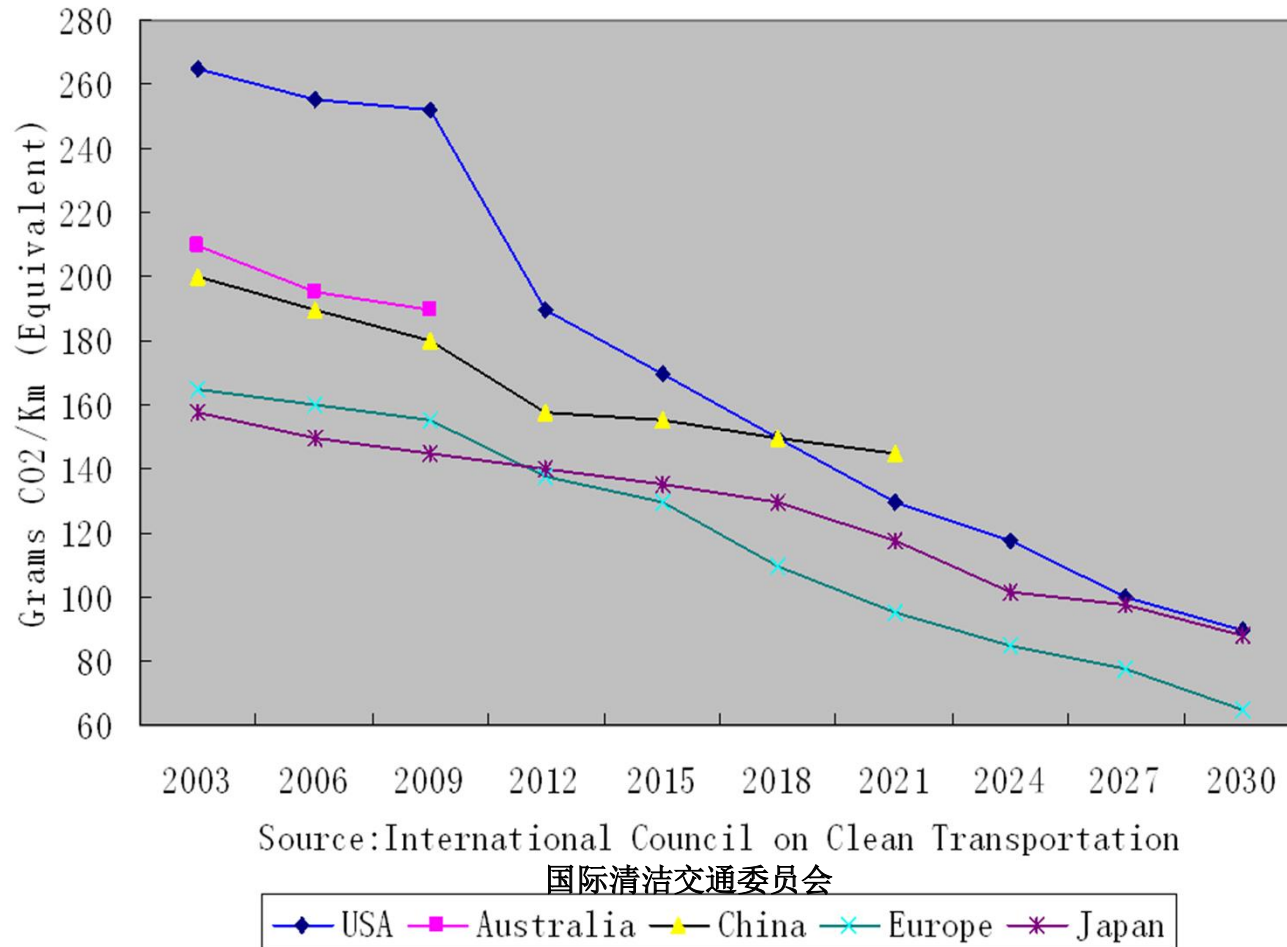
Source: im4S

Automotive Lightweight Demands



Automotive Lightweight Demands

CO₂ Regulations Worldwide 全球二氧化碳法规



Automotive Lightweight Demands

CO₂ Regulations in the EU 欧盟二氧化碳排放法规



In an integrated approach, CO₂ emissions will **gradually** be limited to **120g/km** (“integrated approach”: carmakers to achieve 130 g/km through technical improvements, remaining 10 g/km shall come from complementary measures):

在整合的方案中，CO₂排放量将逐步限制到120g/km（“整合方案”：汽车生产商通过技术改进达到130g/km,剩下的10g/km通过其他方案解决）

2012: 65% of new cars sold have to average 130 g/km CO ₂	65%的销售新车平均排量达到130g/km
2013: 75% ~	75%的销售新车平均排量达到130g/km
2014: 80% ~	80%的销售新车平均排量达到130g/km
2015: 100% of new cars sold have to average 130 g/km CO ₂	100%的销售新车平均排量达到130g/km

Fines per car sold when exceeding target:

超过目标排放数值每辆售出车辆的罚金:

Between 2012 and 2018: 2012-2018年间:

EUR 5 for the 1st gram of CO ₂	超过1克罚金5欧
EUR 15 for the 2nd gram ~	超过2克罚金15欧
EUR 25 for the 3rd gram ~	超过3克罚金25欧
EUR 95 for the 4th and each subsequent gram	超过4克以上罚金95欧

From 2019 从2019年开始:

EUR 95 for each gram over the target 每超过一克罚金95欧

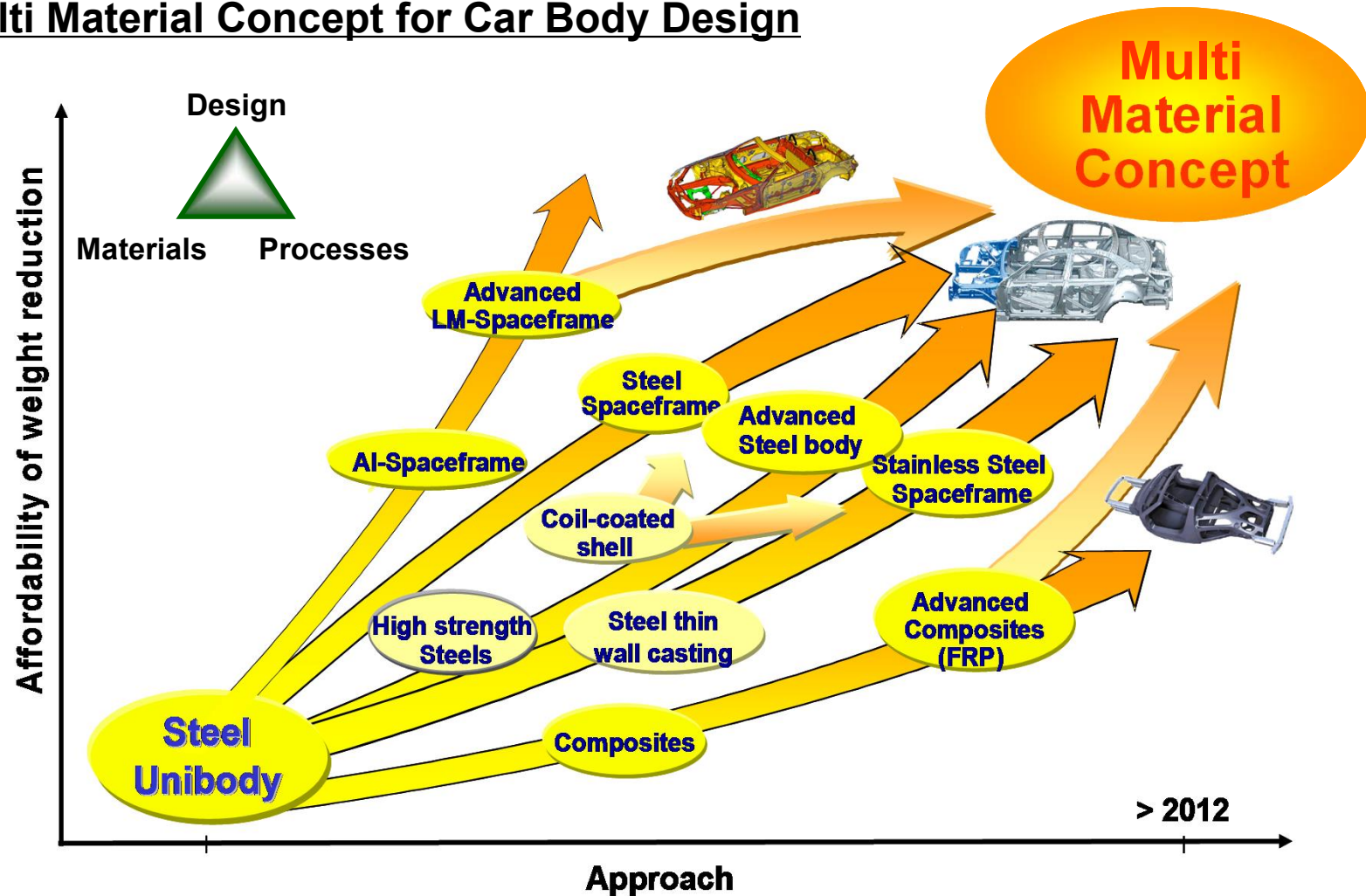
Influence on vehicle 影响:

- more lightweight solutions are required
对轻量化提出更多的要求



Automotive Lightweight Demands

Multi Material Concept for Car Body Design



Source: Volkswagen, 2002

Automotive Lightweight Demands

Product Group Strategy 车体结构产品事业部战略

Past 过去

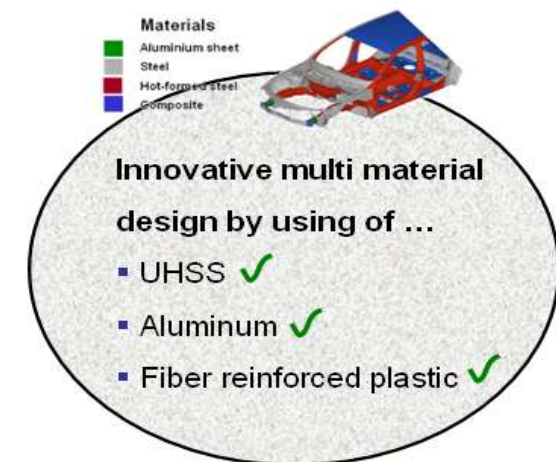
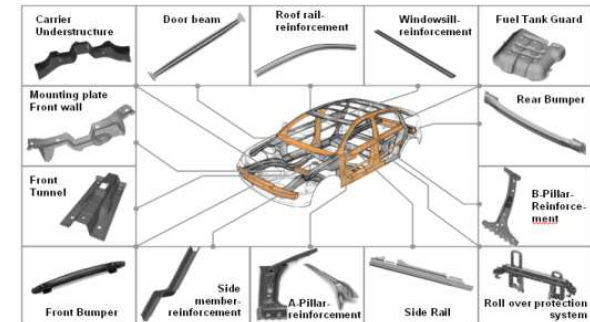
Manufacturer of steel press parts for body and hang on components
车身冲压件的生产商

Present 现在

Supplier of innovative lightweight structural solutions for body applications for improved crash properties with main focus on steel and aluminum
主要围绕钢材和铝合金，旨在提供具有高碰撞性能的创新型轻量化方案

Future 未来

Supplier for multi material body solutions with focus on steel, aluminum and fiber reinforced plastics
着重于钢材、铝合金和纤维增强塑料，提供多材料组合应用的车身结构解决方案



Expanding of our competence to a multi material supplier 扩大优势成为多材料方案供应商

Automotive Lightweight Demands

Core Competencies & Product Portfolio 核心竞争力&产品系列

Core competencies

- High development capability for structural solutions
- High process competencies on UHSS forming and joining
- High competence in lightweight materials such as UHSS steel, aluminum and fiber reinforced plastics

核心竞争力

- 优秀的车身结构方案开发能力
- 领先的超高强度钢成型和拼接工艺
- 超高强度钢，铝和增强塑料等轻量化材料的高度竞争力



Product portfolio

- Body components and assemblies (e.g. A/B/C-pillars, sill, tunnel)
- Bumper systems
- Cross Car Beams
- Active safety systems (e.g. roll over protections)

产品系列

- 车身件和总成件
(例如A/B/C柱，门槛，中央通道)
- 仪表盘支架
- 防撞梁系统
- 主动安全系统
(例如翻滚保护系统)

Supplier for safety and lightweight body solutions 提供安全和轻量化的车身

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BIW Lightweight Approach and Examples

Product Family 产品大类

BIW / SC 白车身部件



IPS / CCB 仪表板支架总成

FRONT/REAR CMS 前后保总成

热成型及超高强钢的更广泛应用
碳纤维材料在新能源汽车上的应用

Aluminium IP

hydro form design

Passive Pedestrian
Protection Systems

Increasing hot forming & UHSS content
CFRP application in new energy vehicles

design

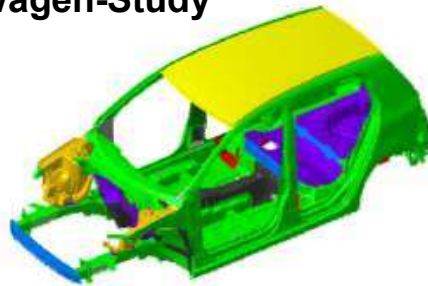
Aluminum
Bumper

BIW Lightweight Approach and Examples

Multi-Material Design

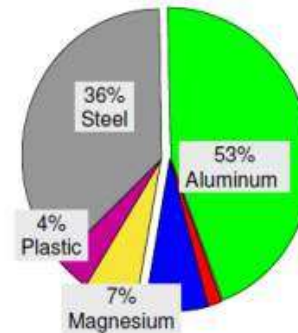
基于多材料混合的车身设计

Volkswagen-Study

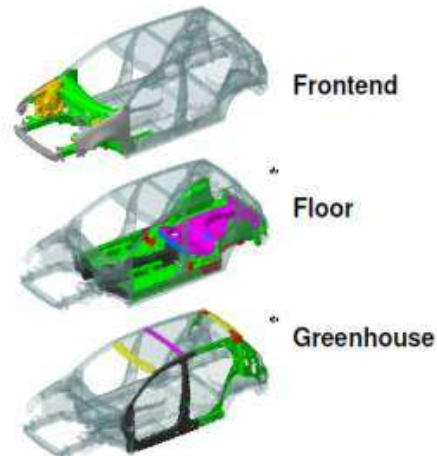
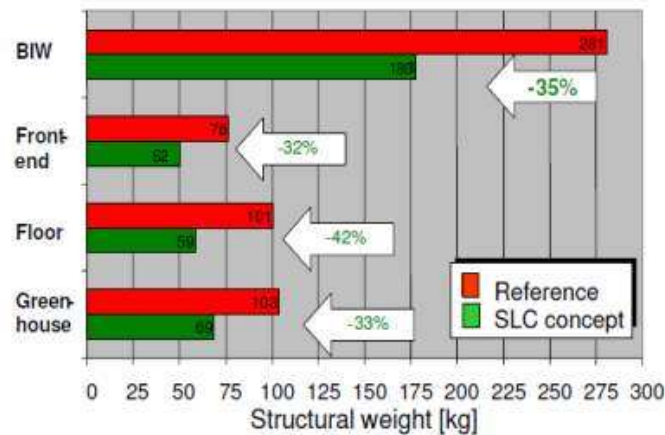


Applied Materials

- Aluminium sheet (80kg)
- Aluminium cast (13kg)
- Aluminium extrusion (3kg)
- Steel (66kg)
- Magnesium (11kg)
- Fibre reinforced plastic (7kg)



Weight SLC BIW: 180kg (Δm -101kg)



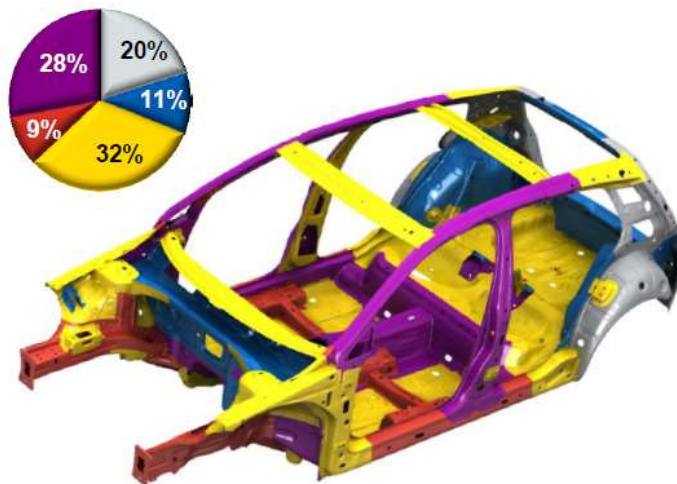
Weight reduction of -101 kg by multi-material solution

BIW Lightweight Approach and Examples

Steel Intensive Design

基于钢材的车身设计

GOLF VII



- Mild Steel
- High-Strength Steel
- Highest-Strength Steel
- Advanced-High-Strength Steel
- Ultra-High-Strength Steel, hot formed

Weight saving:

- structural weight reduced by about 100 kg
 - Electrics - 6 kg
 - Drive train - 40 kg
 - Chassis - 26 kg
 - Body - 37 kg

Lightweight design measures:

- High-strength and higher-strength types of steel, reduced sheet thickness (TRB)
- Only using material where it is needed
- Optimal geometry of profiles and surfaces

Source: DLR

2013-08-28_Lightweight_Design_The_Vanguard_of_Automotive_Engineering_HEF_MM_V_final_fuer_PP_Hi_gekuertzt.pdf

BIW Lightweight Approach and Examples

Steel / Aluminum Hybrid Design

基于钢铝混合的车身设计

Audi TT 2nd. Generation



Weight saving:

- Weight of body: 206 kg
- Reference body in steel would be 48% heavier
- Pure Al body would be 12% lighter

Lightweight design measures :

- Multi-material-design
- Shell and space frame structure combined

Aluminum 69%

- Sheet metal 63 kg
- Cast components 45 kg
- Extruded profiles 32 kg

Sheet 31%

- Sheet metal 66 kg

Source: DLR

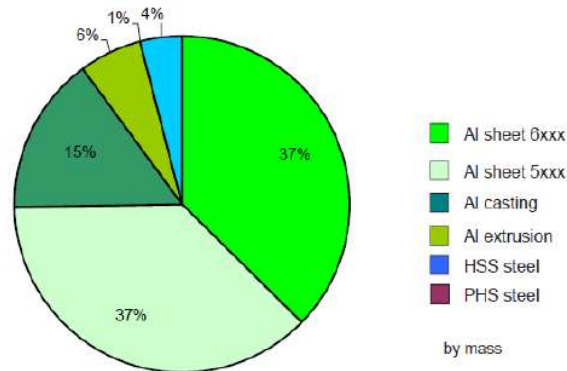
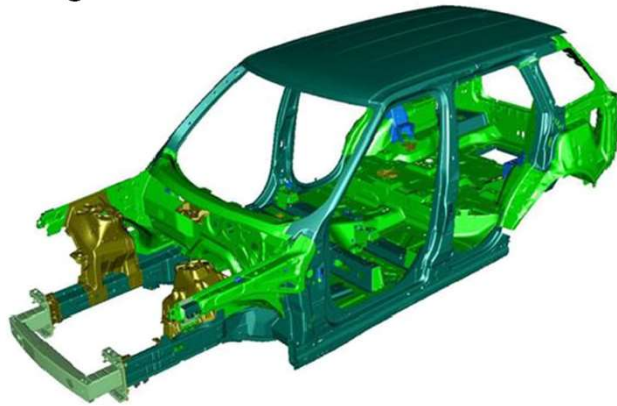
2013-08-28_Lightweight_Design_The_Vanguard_of_Automotive_Engineering_HEF_MM_V_final_fuer_PP_Hi_gekuertzt.pdf

BIW Lightweight Approach and Examples

Aluminum Intensive Design

基于铝合金的车身设计

Range Rover V



Weight saving:

- Vehicle about 420 kg lighter than its predecessor
- Weight saved in basic shell approx. 39% (almost 180 kg)

Lightweight design measures:

- External skin panels between 0.9 and 1.5 mm
- All body joints riveted or bonded
- Side parts compressed in a single aluminum component
→ Fewer body joints
- High-strength Al AC300 for the crash structure

Source: DLR

2013-08-28_Lightweight_Design_The_Vanguard_of_Automotive_Engineering_HEF_MM_V_final_fuer_PP_Hi_gekuertzt.pdf

BIW Lightweight Approach and Examples

CFRP Design on New Energy Vehicles

基于CFRP的新能源汽车的车身设计

BMW i3



Weight saving:

- Vehicle total weight approx. 1195 kg with battery
- Approx. 300 kg saved through new material and purpose-built design

Lightweight design measures:

- Material combination CFC + aluminum
- Bi-modular design
 - "Life" module - CFC monocoque body
 - "Drive" module - crash and structural components, Al chassis



Source: DLR
2013-08-28_Lightweight_Design_The_Vanguard_of_Automotive_Engineering_HEF_MM_V_final_fuer_PP_Hi_gekuertzt.pdf

BIW Lightweight Approach and Examples

Hot Forming Application in BIW

热成型在白车身上的应用

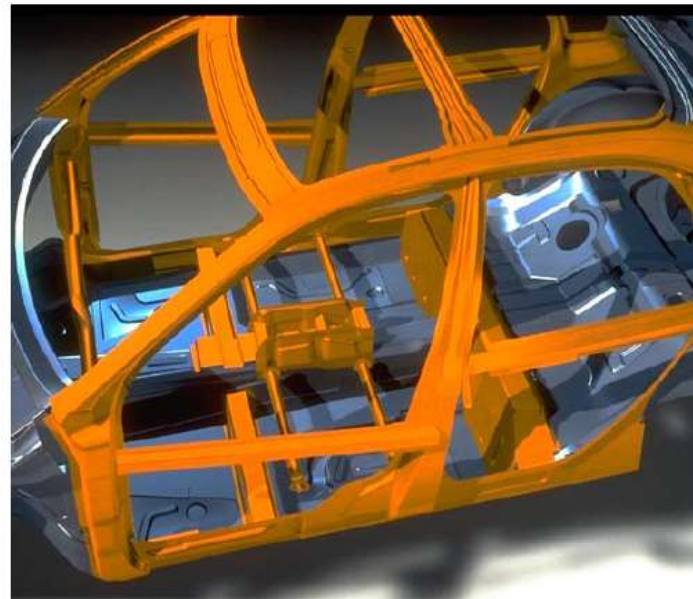
source: AutoSteel.org



VOLVO

Body structure **Safety cage 1**

“A rigid framework surrounding the occupants which creates a support for the interior safety equipment and provides a survival space for the vehicle occupants in case of a crash”

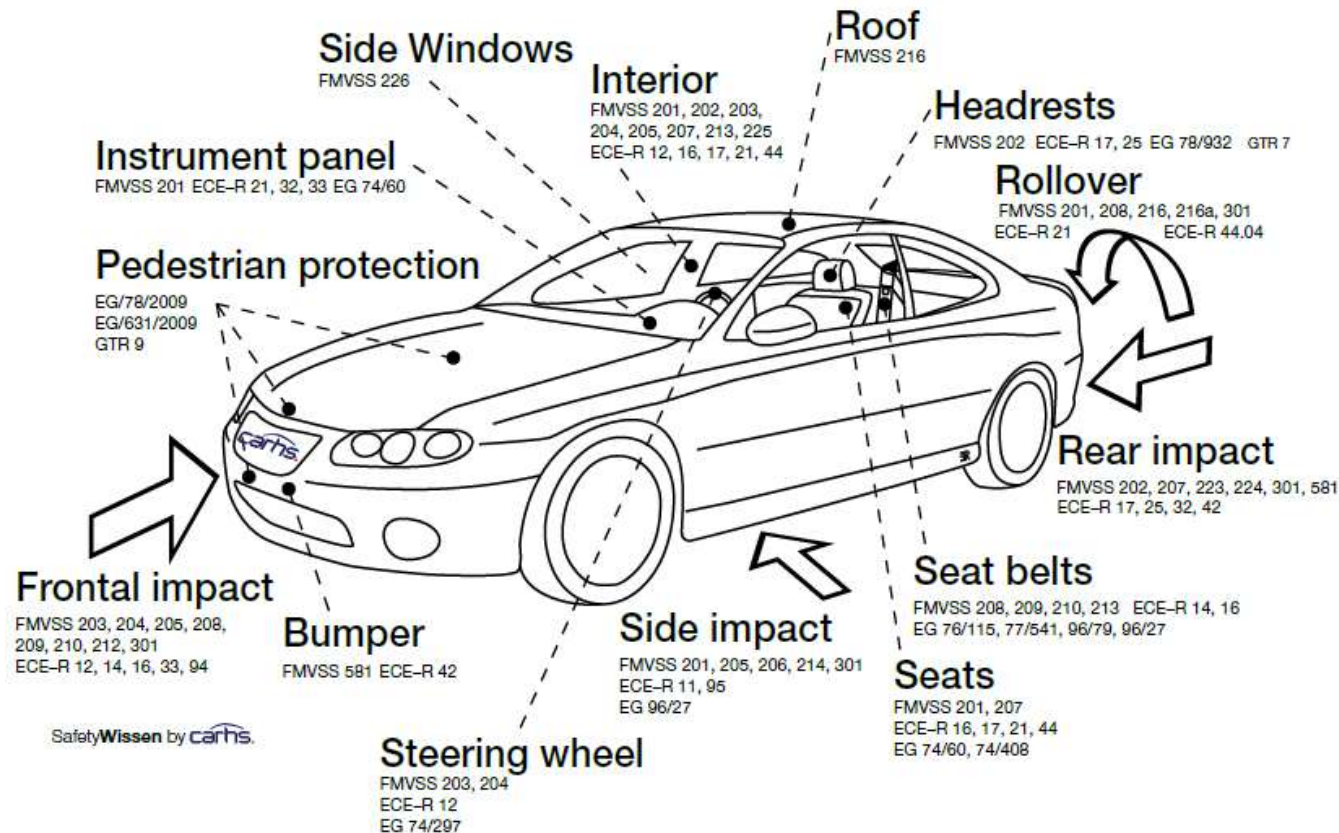


BIW Lightweight Approach and Examples

Crash Regulation in Europe and USA

欧美碰撞要求

source: Carhs

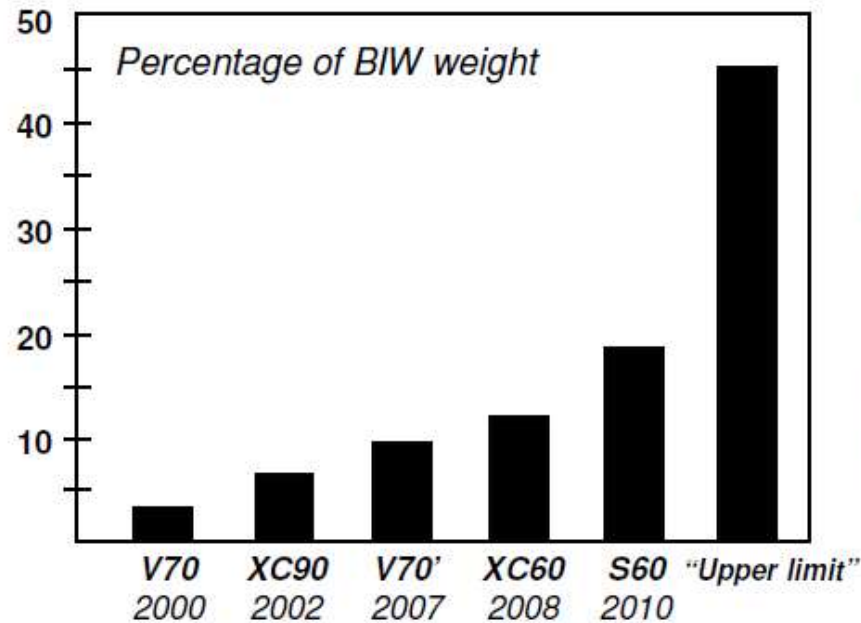


BIW Lightweight Approach and Examples

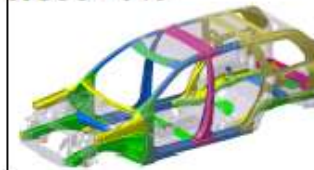
Example – Hot Forming Usage in Volvo 沃尔沃热成型应用实例

source: EuroCarBody

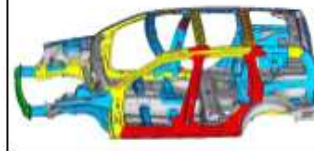
Usage of Boron steel through Volvo models



XC90 - 7%



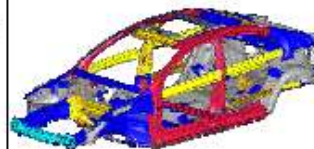
V70 - 10%



XC60 - 11%



S60 - 17%



"Upper limit" - 45%
With unchanged strength
and crash performance

BIW Lightweight Approach and Examples

Example – Hot Forming Usage in Volvo

沃尔沃热成型应用实例

Source: <https://www.media.volvocars.com>

**Hot Forming Boron Steel
> 40% in new XC90**



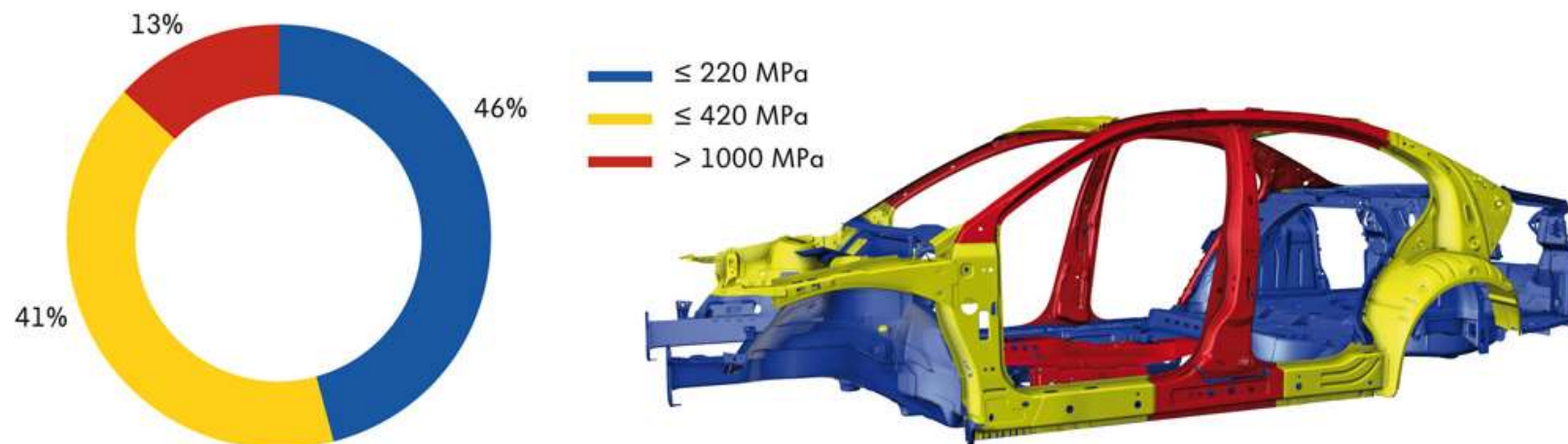
BIW Lightweight Approach and Examples

Example – Hot Forming Usage in New Jetta

新捷达热成型应用实例

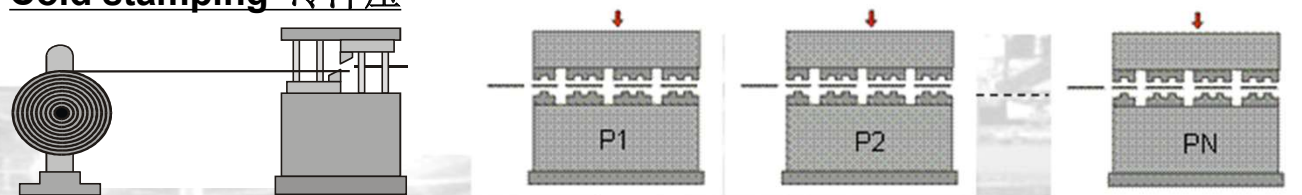
source: <http://www.france-metallurgie.com>

**Hot Forming Boron Steel
= 13% in new Jetta**



UHSS - stamping

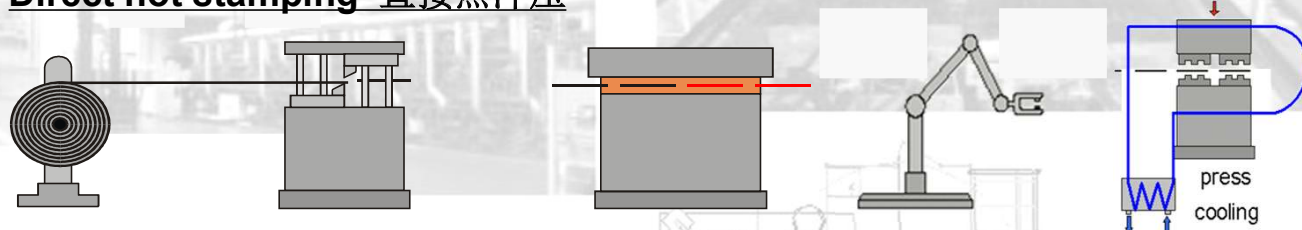
Cold stamping 冷冲压



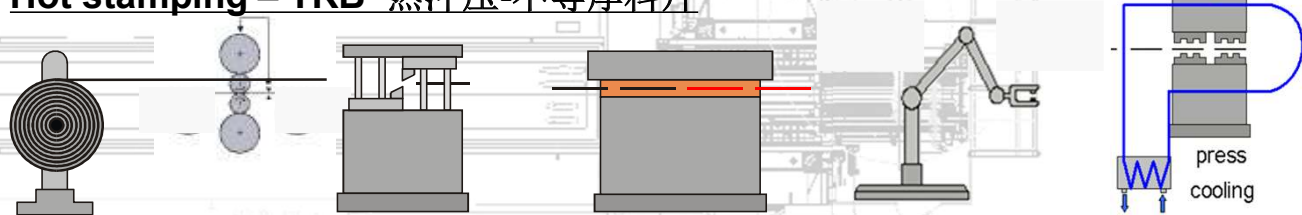
Legend 说明



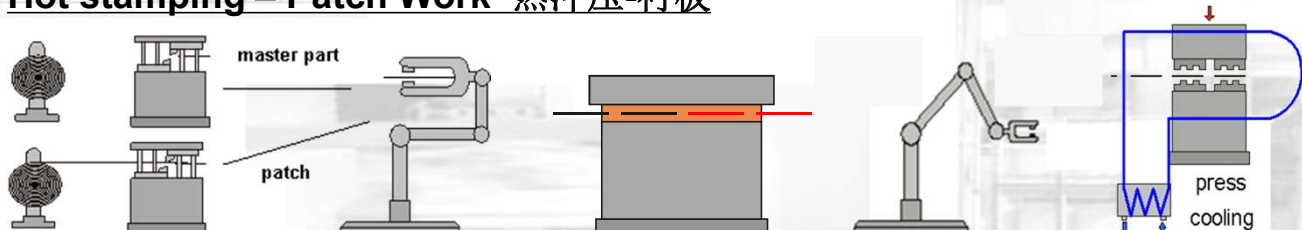
Direct hot stamping 直接热冲压



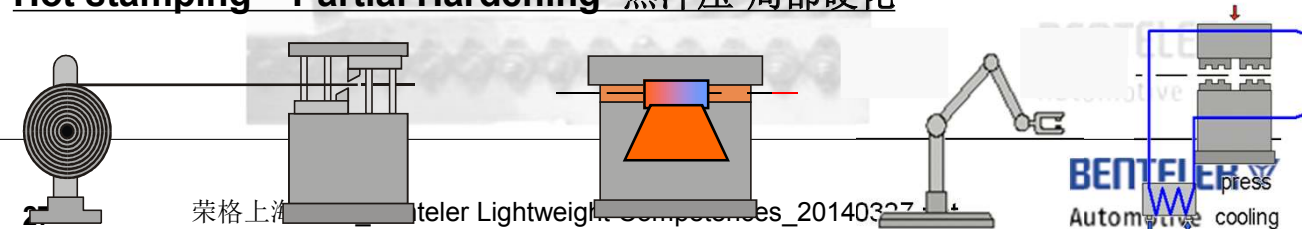
Hot stamping – TRB 热冲压-不等厚料片



Hot stamping – Patch Work 热冲压-衬板

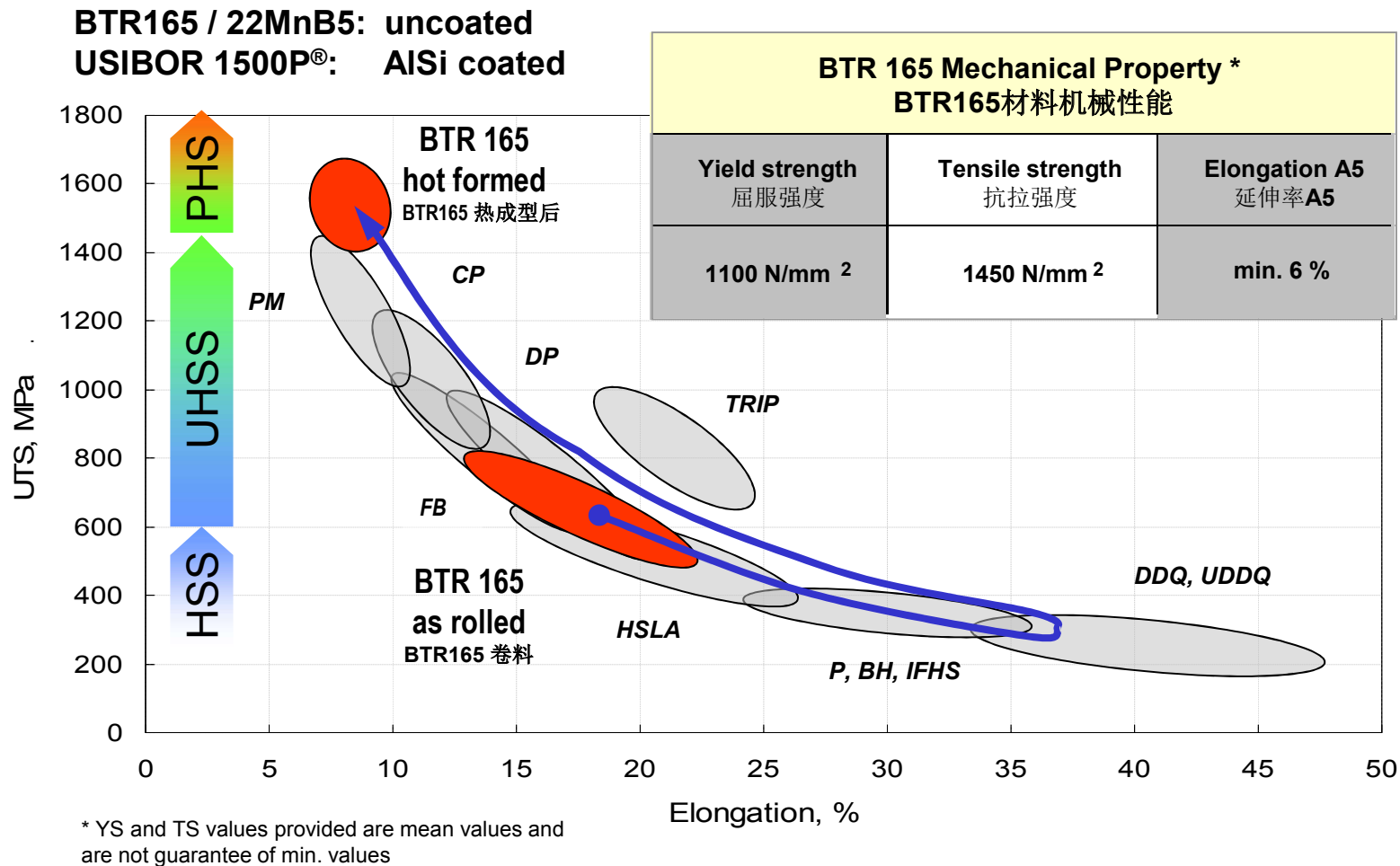


Hot stamping – Partial Hardening 热冲压-局部硬化



BIW Lightweight Approach and Examples

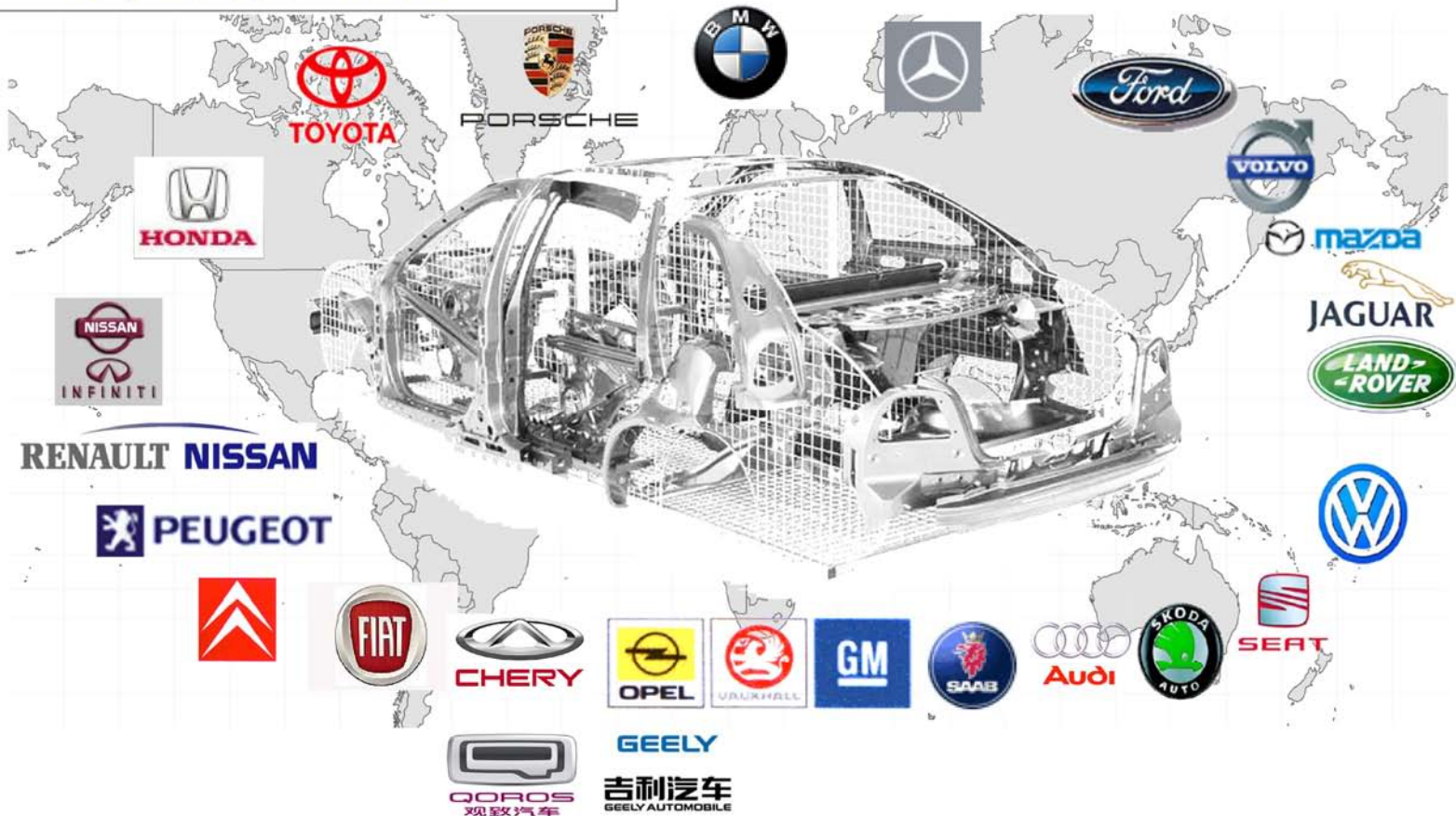
Hot Forming Material 热成型材料



BIW Lightweight Approach and Examples

Hot Forming Customer Portfolio 热成型产品客户

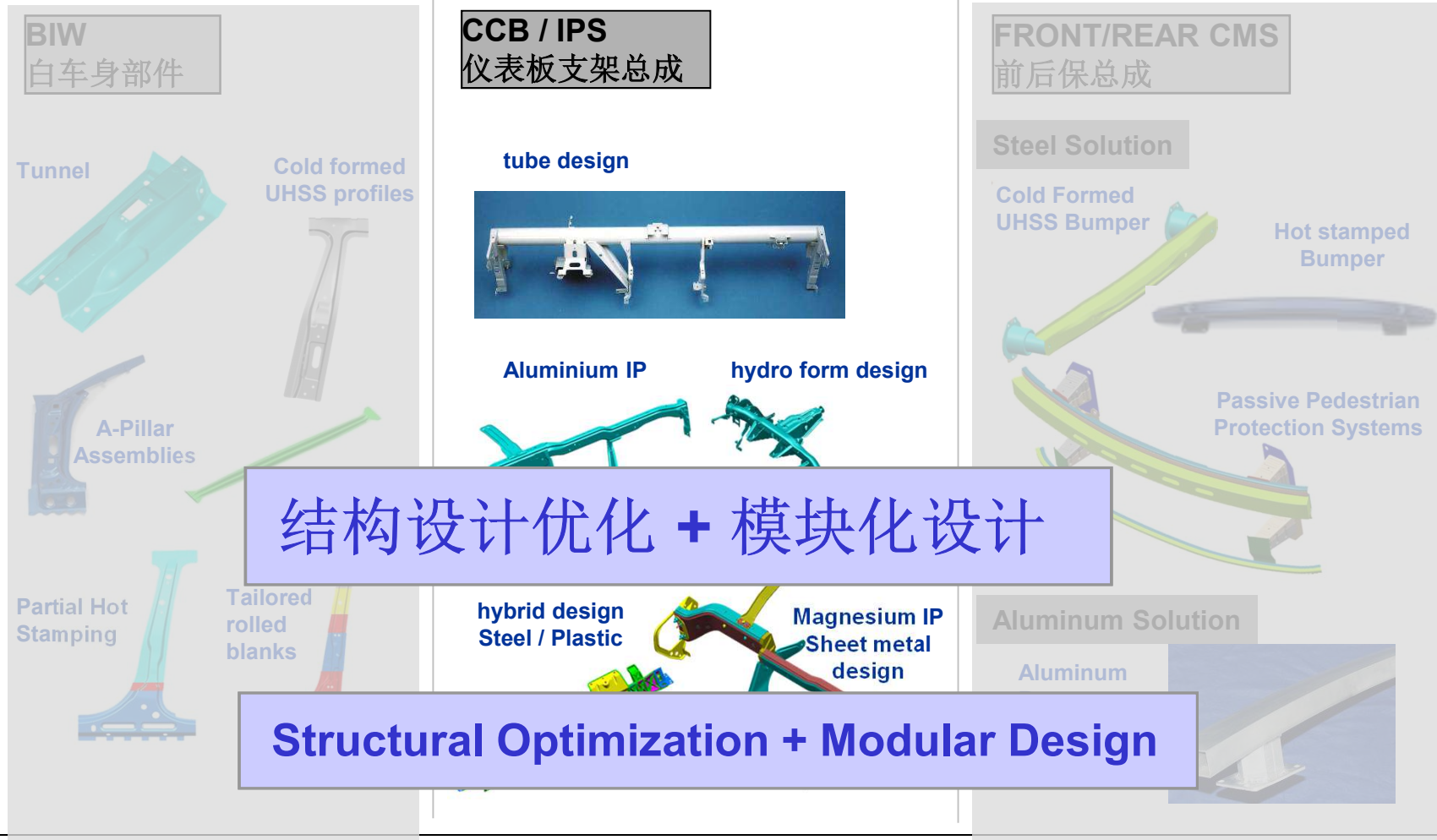
50+ hot forming lines world wide
Experience since 1991



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CCB Today and Tomorrow

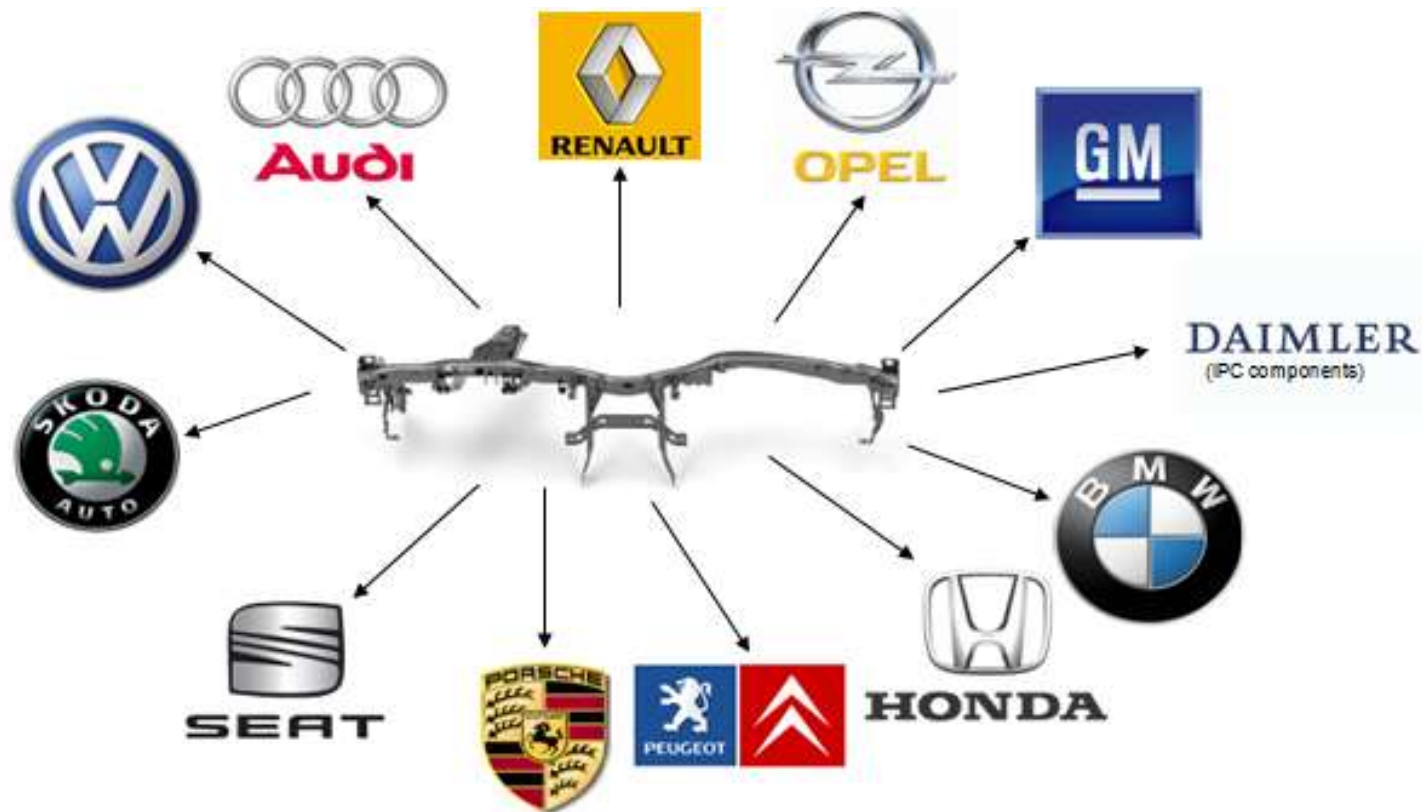
Product Family 产品大类



CCB Today and Tomorrow

Benteler CCB – Customer Overview

本特勒仪表盘支架总成 – 全球客户



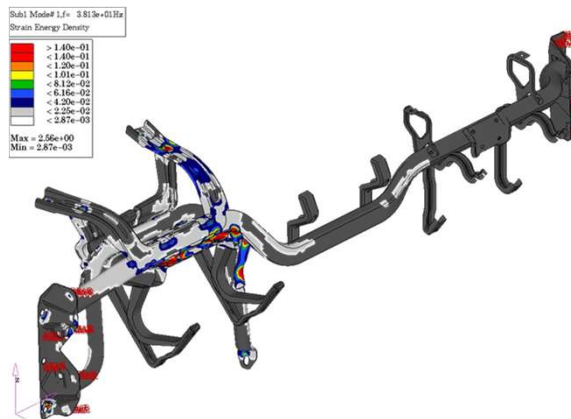
CCB Today and Tomorrow

Benteler CCB – Lightweight Supplier

本特勒仪表盘支架总成 – 轻量化产品提供商

本特勒的优势

1. Full service supplier, from concept to mass production
提供一站式服务，从方案设计，仿真验证，样件生产，性能实验到批量生产；
2. Based on steel, Aluminum or hybrid materials
基于钢材，铝合金或者混合材料设计；
3. Fulfill strength/stiffness/NVH requirements etc.
满足客户对于强度、刚度、NVH等要求



8.9 kg
steel tube

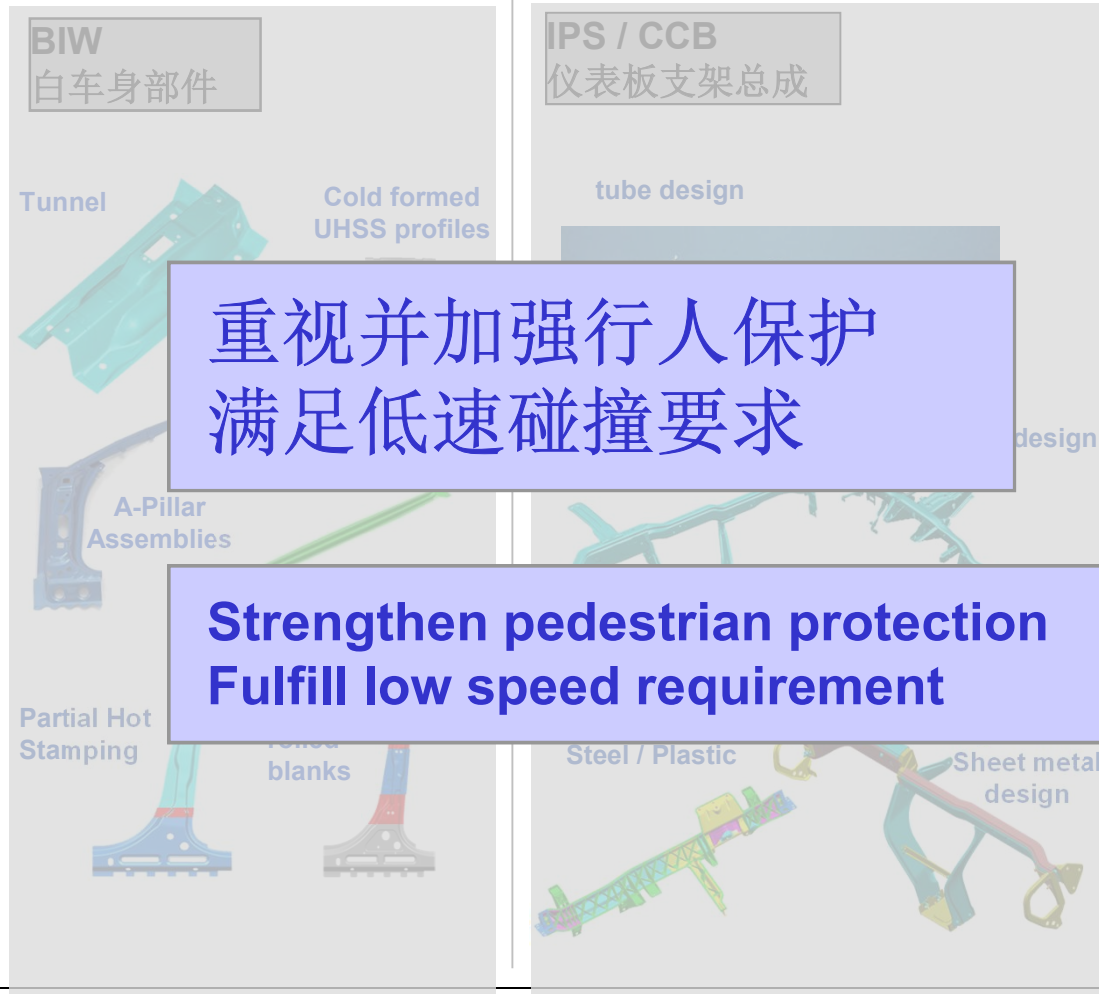


6.3 kg
Alu clamped shell

Aluminum offers about 30% weight saving potential than steel solution.
铝合金相比基于钢材的设计，可以减轻约30%的重量。

CMS Today and Tomorrow

Product Family 产品大类

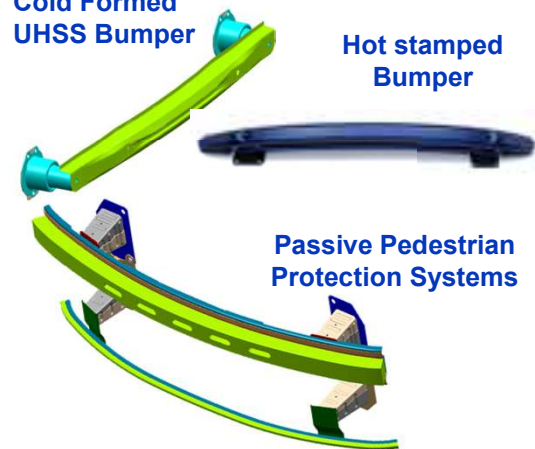


FRONT/REAR CMS 前后保总成

Steel Solution

Cold Formed
UHSS Bumper

Hot stamped
Bumper



Aluminum Solution

Aluminum
Bumper



CMS Today and Tomorrow

Benteler CMS Development 本特勒CMS产品开发

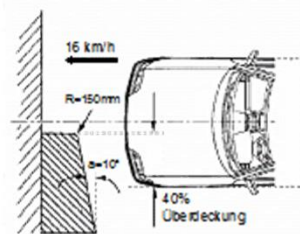
Benteler Strength 本特勒的优势

1. Full service supplier, from concept to mass production
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2. Based on steel, Aluminum or hybrid materials
基于钢材，铝合金或者钢铝混合材料设计；
3. Fulfill domestic/overseas low speed requirements
满足国内外低速碰撞的法律法规要求；
4. Fulfill static/dynamic loading and functional requirements
满足静态/动态载荷和其他功能要求。

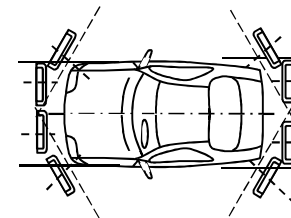
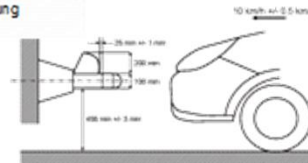


Pedestrian Protection

AZT Test



RCAR Bumper Test
IIHS Bumper Test



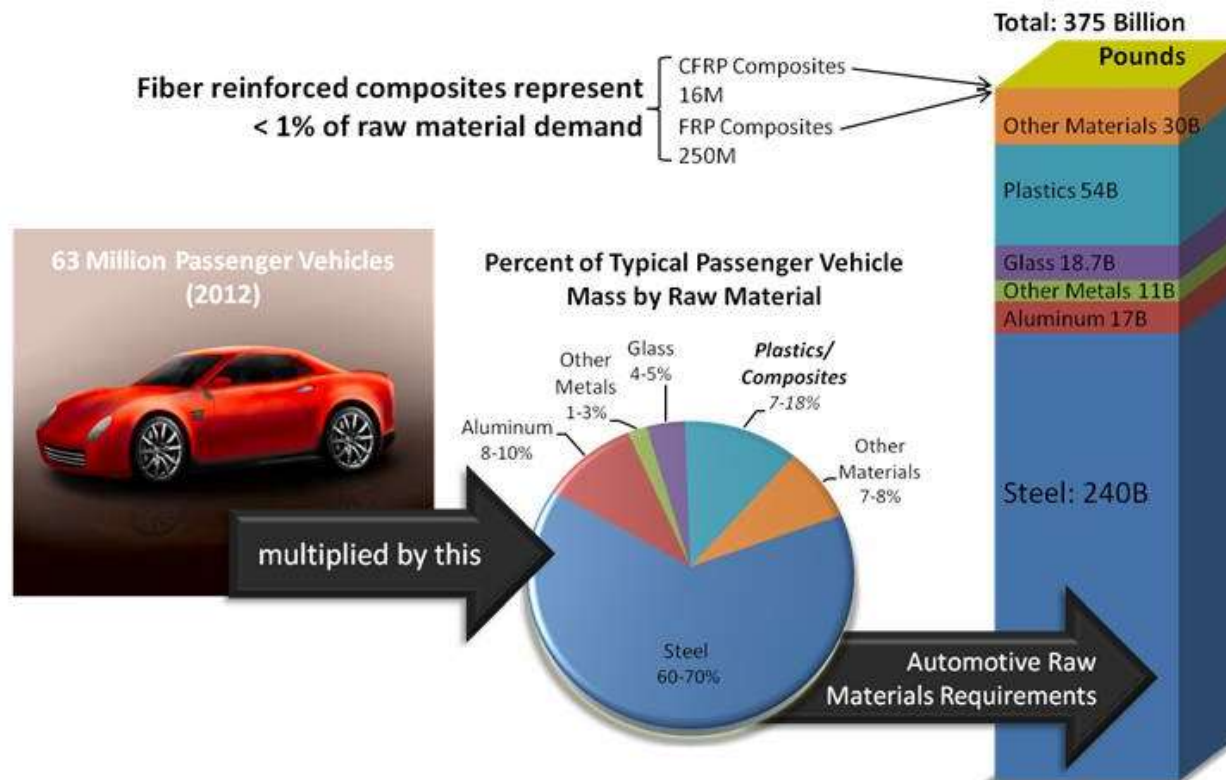
ECE R42
FMVSS 581
GB17354

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Trends in Automotive Materials

Automotive Raw Materials Perspective 乘用车原材料使用比例



December 9, 2013

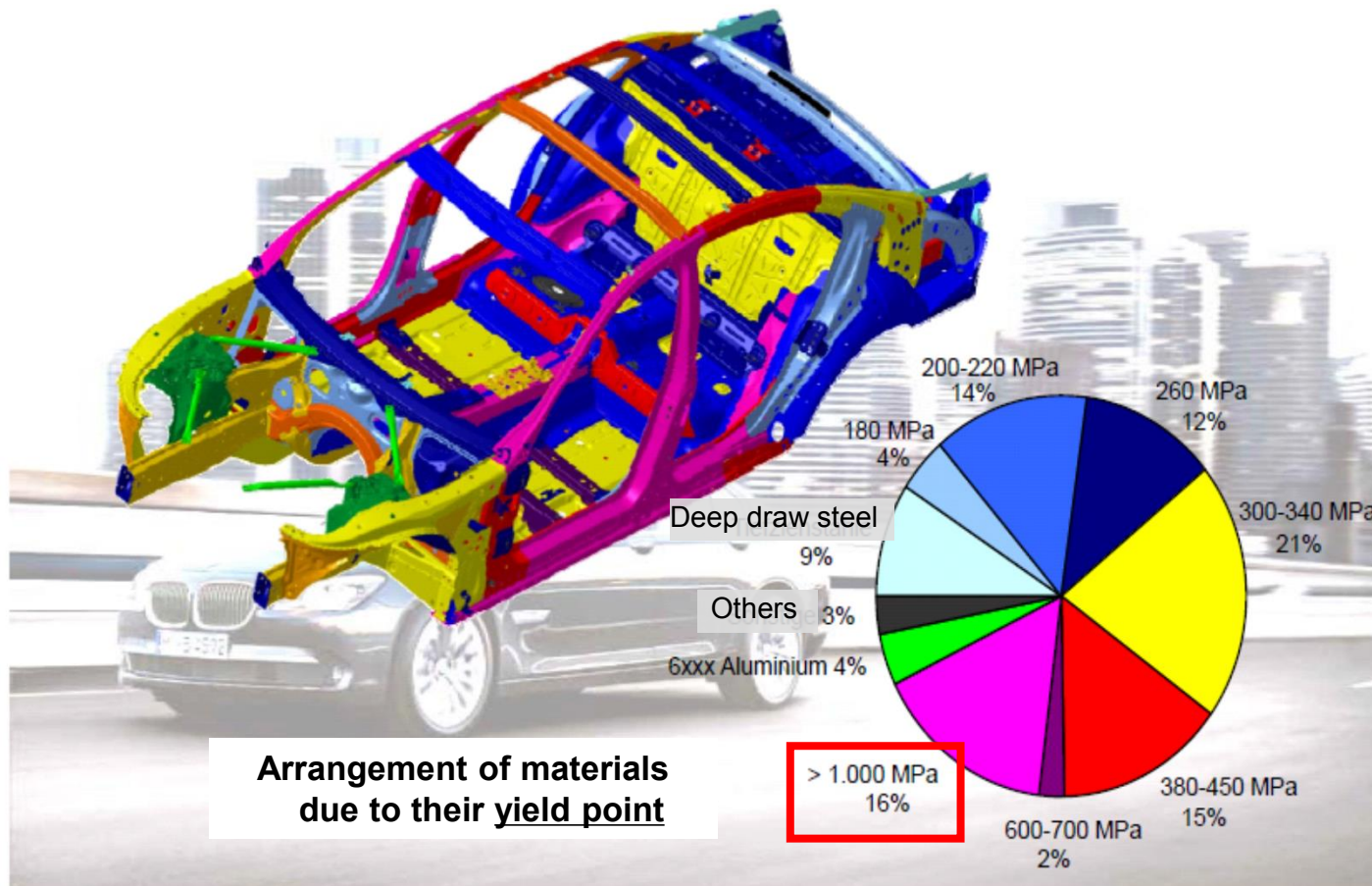
Emerging Opportunities and Challenges for Carbon
Fiber in Passenger Automobiles

Slide 142

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Trends in Automotive Materials

Example – Hot Forming Usage in Car Body



Trends in Automotive Materials

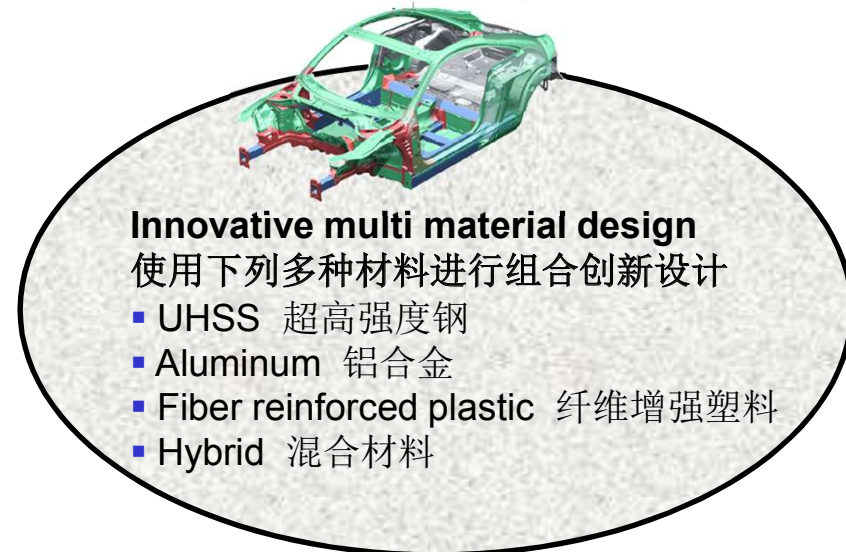
Market Trends in Lightweight Solutions 车身轻量化趋势

Today 当今



- **Weight reduction by using modern steels**
使用先进钢材进行减重
- **HSS and UHSS hot and cold formed**
高强度和超高强度热 / 冷成型钢
- **Weight saving of 30kg in BIW**
车身减重30kg

Future 未来



- **Weight reduction by using HYBRID solutions**
使用混合材料减重
- **Same crash and stiffness performance**
碰撞和刚度性能相同
- **Weight saving of >60kg in BIW**
车身减重大于60kg



**Thank you for your
Attention!**

