Steel Industry Actions for Green Car Manufacturing
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WorldAutoSteel
Automotive Group of the World Steel Association

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Today’s presentation

- Trends
- Opportunities
- Steel Industry Investment
- LCA: Importance to Industry and Environment
Trends
Driving the industry: stringent regulation
Driving design: lightweighting, fuel economy

- Aluminium/AHSS Ford F-150
  - All aluminium outers “military grade”
  - All AHSS frame
Driving design: lightweighting, fuel economy

- 67% Advanced High-Strength Steels
- HSS rails, cross members, A- and B-pillars, roof rails, rocker panels
- UHSS rocker panels and underbody

NEW 2014 SILVERADO ADDS HIGH-STRENGTH STEELS TO BOOST TOUGHNESS

Material Strength

- <140 MPa
- 180-300 MPa
- 300-400 MPa
- 500-1,000 MPa
- 400-500 MPa
- 1,000+ MPa

Percentage based on part count of major panels and extensions. Body side outers and roof panel not shown but included in count.
Driving design: lightweighting, fuel economy

VW Passat Euro-spec debut

- Turbodiesel and plug-in hybrid variants
- 85 kg lighter overall
- 33 kg in the BIW
- HSS and hot-formed steels plus aluminium
- + 20% fuel economy
Driving design: lightweighting, fuel economy

Hyundai Intrado Concept (Fuel Cell)

Toyota FV (Fuel Cell)

Chevrolet Bolt EV

BMW i3 (BEV)
Opportunities
Auto Mass Benchmarking - Methodology

- **Mass Benchmarking Using Statistical Methods Applied to Automotive Closures**, Paper No. 2015-01-0574

  Co-Authored by:
  - Dr. Donald Malen, University of Michigan Adjunct Associate Research Scientist, Department of Integrative Systems + Design, and
  - Jason Hughes, Business Development Director, A2Mac1 Automotive Benchmarking

- **New Paradigm in Automotive Mass Benchmarking**, reporting on research conducted by EDAG International (based on the SAE methodology)
Auto Mass Benchmarking – Traditional Analysis

- **Key Questions:**
  - What is an aggressive yet reasonable mass target?
  - What are key design features of mass efficient designs?
  - How will material selection influence mass?

- **Direct comparison benchmark approach:**
  - Reference vehicle is selected having –
    - Roughly the same dimensions as the vehicle under design
    - What is thought to be a mass efficient design
    - Representative materials for comparison
  - The reference vehicle is disassembled and mass is measured
Auto Mass Benchmarking – Statistical Analysis

- Process of comparing systems across an industry
- Provides a snapshot of industry performance:
  - Range of performance for systems in the market
  - The current best performance
- Answers benchmarking questions using a large vehicle database

![Graph showing Door Frame Mass vs. Area of Door Frame for Steel and Aluminum averages and efficient designs.](image-url)
Key Study Findings

1. Mass efficiency of steel designs vary drastically
2. Efficient steel closes the gap with efficient aluminium
3. Mass savings at component structure level not realized at system level
4. Narrow margin in vehicle curb weights – steel vs. aluminium
5. Yet untapped potential for steel mass reduction
Mass efficiency of today’s steel designs vary drastically

19.9 kg
Heaviest Steel Door

16.3 kg
Average Steel Door

12.9 kg
Efficient Steel Door

+22%  -21%

Download the report at www.worldautosteel.org
Compared to efficient steel designs, mass savings gap with aluminium significantly reduces

- Average Steel Bumper: 6.3 kg
- Efficient Steel Bumper: 3.3 kg (50% reduction)
- Efficient Aluminium Front Bumper: 3.0 kg
- Only: -0.3 kg (11% reduction)

Download the report at www.worldautosteel.org
Mass savings achieved with aluminium at the component structure level often not realized at the system level (compared to average steel)

Download the report at www.worldautosteel.org
Curb Weight Impact

- Narrow margin in vehicle curb weights between vehicles using efficient steel body structures and aluminium body structures.

- Efficient Aluminium
  - Reduces Curb Weight by 9.3%

- Efficient Steel
  - Reduces Curb Weight by 6.5% (currently)

Download the report at www.worldautosteel.org
Steel Industry Investments
More than a decade of R&D
Untapped potential – Auto Mass Benchmarking

- There is yet untapped mass savings potential for steel.

Download the report at www.worldautosteel.org
Advanced High-Strength Steels Application Guidelines

Version 5.0 Released in 2014:

- Compilation of the latest global best stress-strain curves publicly available
- Detailed discussions of metallurgy and fabrication processes
- Addresses tough forming and joining issues
- Member training completed in Q4, 2015
- Requirement – Active Dissemination!

Available at www.worldautosteel.org
Reinforce – Application Technical Service

- We’re The New Kid on the Block!
- AHSS products have known variation
- Manufacturing windows are very small
Conclusions: changing future mobility
IIHS Automotive – Industry Growth Forecast

Global Production

Source: IIHS Automotive
Ricardo – Future Vision Presentation

There are three core challenges for the Automotive Sector that we must address and solve in the next 20-30 years:

- Zero Fatalities
- Driver Assistance
- Autonomous Control

- Safety & Security

- Environment & Emissions
  - Increasing efficiency, electrification & low carbon fuels
  - Zero impact on Air Quality

- Sustainable Manufacture
  - Design for whole Life Cycle
  - Material re-use
  - Next challenge likely to be Water Use

Source: Ricardo Engineering
Evolving Trends

- Circular Economy
- Autonomous Vehicles
Life Cycle Assessment

Important metric to avoid unintended consequences
The Problem with Tailpipe Only GHG Emissions Regulations...

Now: Conventional Gasoline Vehicle
- Vehicle production: 25%
- Use Phase: 70%
- Recycling: 5%

What will change?
- In the future: Battery Electric Vehicle
- Vehicle production: 57%
- Use Phase: 40%
- Recycling: 3%

Source: Ricardo Study, Preparing for a life cycle CO2 measure, 2011, p.52
Trends that drive future material designs

- Millennials and Their Disinterest in Driving?
- Mega/global Platforms
- Autonomous Vehicles
- Alternative powertrains
- Internet of Vehicles (IOV’s)
- Circular Economy and strong focus on sustainability

Steel Remains Highly Relevant
Reinventing steel

CARS Magazine

October 1953

1970s — Body-on-Frame

1980s — Uncoated

Body-Frame-Integral

1080s — Galvanized Rust Resistant

“ The day of the passenger car made primarily of iron and steel is on the wane giving ground to aluminum, magnesium and plastics.”

2000s — Mild & HSLA

Advanced High Strength Steels

2010s — Advanced High-Strength Steels

Gigapascal Strength Steels

“The day of the passenger car made primarily of iron and steel is on the wane giving ground to aluminum, magnesium and plastics”.

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Thank you for your attention.

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