Steel Market Development Institute (SMDI)

- SMDI is a business unit of the American Iron and Steel Institute (AISI).
- SMDI’s Automotive Applications Council (AAC) member companies jointly fund pre-competitive steel applications research.
- AAC works with auto manufacturers, tier suppliers, universities and government agencies to promote steel-intensive automotive solutions.
Automotive Mixed Material History
Historical Evolution of Advanced High-Strength Steel (AHSS) for Automotive Market
Historical Evolution of AHSS for Automotive Market

THE KEY TO A BETTER ENVIRONMENT

#SteelMatters
@DriveUsingSteel
Historical Evolution of AHSS for Automotive Market
Historical Evolution of AHSS for Automotive Market

[Graph showing the evolution of AHSS specifications over time, with a peak in 2000.]
Historical Evolution of AHSS for Automotive Market

The key to a better environment

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Steel Successes in New Vehicle Lightweighting

2016 Chevrolet Malibu
-300 lbs. | 136 kg

2016 Honda Pilot
-300 lbs. | 136 kg

2015 Ford Edge
-129 lbs. | 59 kg

2015 Chrysler 200
-71 lbs. | 32 kg

2015 Chevrolet Colorado
-200 lbs. | 90 kg

2016 Volkswagen Passat
-185 lbs. | 85 kg

THE KEY TO A BETTER ENVIRONMENT

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Lightweighting Potential of AHSS–Design Approaches

25% fleet-average BIW weight reduction with 3-G and Emerging AHSS

2-G: Grade and Gauge optimization only

3-G: Geometry, Grade, and Gauge Optimization

THE KEY TO A BETTER ENVIRONMENT

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FutureSteelVehicle (FSV), introduced in 2011, demonstrates mass reduction through new steel grades and manufacturing processes:
- 97% use of HSS and AHSS on body-in-white
- Several parts showed lower mass over alternative materials such as roof rails, rear rails and the tunnel
- These technologies have been demonstrated on several 2015 models
2015 Chevrolet Colorado

- Redesigned with significantly more AHSS
- Decreased mass and improved stiffness, reduced noise and vibration
- Over 72 percent of the main cab structure is high-strength or AHSS

Source: Great Designs in Steel 2015
Mass Reduction – Variable Thickness B-Pillar

- Center Pillar Outer Reinforcement
  - Hot stamped Tailor Rolled Blank
  - Performance tuning
  - Mass efficiency

Source: Great Designs in Steel 2015
Mass Reduction – Pickup Box

✧ AHSS provide increased payload capability while reducing mass compared to stamped-steel designs

✧ Roll Form Platform minimizes thinning for increased durability

Source: Great Designs in Steel 2015
Mass Reduction – Laser Welded Blank Door Inners

✚ Door Inners
✚ Laser Welded Blank
✚ Performance tuned
✚ Mass efficiency

Source: Great Designs in Steel 2015
Body Structure Designed for Service

- Upfront design mindful of service and repair
- Unique service assemblies created to support robust repair procedures

Bolt-On components provide access for maintenance and repair

Ease of service and post repair quality

Internal reinforcements and body sealing

Engine support tools and trend set for fit & finish

Source: Great Designs in Steel 2015
2015 Ford Edge

- DP1000 tubes along top of body side (A-pillar to C-pillar) and in D-pillar for improved stiffness
- The solid body structure provides a good platform for improved suspension

Source: Great Designs in Steel 2015
2016 Nissan Maxima

✧ 980 and 1180 MPa advanced high-strength steel is concentrated in the Maxima’s A-pillar, side roof rail and B-pillar areas for added strength

✧ High-strength steel contributes significantly to the Maxima’s top-level safety performance

Source: Great Designs in Steel 2015
2016 Honda Pilot

- Shed nearly 300 pounds by adopting a new platform and wider use of high- and ultra-high-strength steel which reduced noise, improved handling and increased rigidity.

Source: Honda
Summary of Steel Benefits

✧ **Strong**: With its unique properties and processing flexibility, AHSS is an efficient material to design for occupant protection and lightweighting.

✧ **Lightweight**: AHSS can significantly reduce a vehicle’s structural weight by up to 30 percent and can cut total life cycle CO₂ emissions.

✧ **Affordable**: Mass reduction is achieved without the high cost penalties associated with use of alternative materials.

✧ **Sustainable**: Steel is continuously recycled and the most recycled material globally.
AHSS Environmental Benefits – WorldAutoSteel SUV Study

Aluminum versus Steel Intensive Body Structure, Closures, Suspension & Sub-frames

Baseline
Conventional
Steel = 930 kg

-32% lighter
630 kg

-25% lighter
698 kg

(The key to a better environment)

#SteelMatters @DriveUsingSteel
DRIVING EMISSIONS ARE ONLY A PIECE OF THE PUZZLE

Current focus by regulators in efforts to reach 54.5 mpg by 2025

MANUFACTURING EMISSIONS

2.0 - 2.5 kg CO$_2$e/kg Steel
11.2 - 12.6 kg CO$_2$e/kg Al

DRIVING EMISSIONS

RECYCLING

Steel is the only automotive material that is continuously recyclable without loss of product strength and integrity
AHSS Environmental Benefits – WorldAutoSteel Light SUV Study

✧ 5,000 different scenarios
✧ AHSS vehicle: lowest life cycle emissions every time

Best Case Scenario (kg of CO2e)

Worst Case Scenario (kg of CO2e)
Status of Future Steel Grades

<table>
<thead>
<tr>
<th>Yield Strength (MPa)</th>
<th>Tensile Strength (MPa)</th>
<th>Total Elongation (%)</th>
<th>Uniform Elongation (%)</th>
</tr>
</thead>
<tbody>
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<td>≥800</td>
<td>≥1200</td>
<td>≥30</td>
<td>≥20</td>
</tr>
<tr>
<td>≥1200</td>
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<td>≥25</td>
<td>≥8</td>
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</tbody>
</table>

Source: WorldAutoSteel

THE KEY TO A BETTER ENVIRONMENT
2015 Auto/Steel Partnership Projects

**Body Projects**
- AHSS Stamping
- Stamping Tooling Optimization
- Non-Linear Strain Path
- Joining High C-Equivalent Steels
- Delayed Cracking
- Hemming of Thin Gauge AHSS
- Repairability of AHSS
- Fracture Prediction

**Chassis Projects**
- Gas Metal Arc Welding of AHSS
- Fatigue in AHSS Fusion Joints
- AHSS Corrosion Protection
- Weld Modeling
- Steel Testing Harmonization
- Technology Transfer
- AHSS Supplier / Stamper Training

**All Vehicle Systems**

**New Project Strategies**
- AHSS Sample Bank
- AHSS Grade Readiness
- AHSS Technology Roadmap
Trends in Automotive Materials Competition

✧ Truck and SUV body structures remain steel as a result of high-value lightweighting

✧ Hang on parts remain the “materials battleground”
  ✧ Advances in door and bumper designs provide long term growth for steel
  ✧ Suspension / chassis parts also present opportunities for steel

✧ SMDI is working with automakers to develop optimized steel designs for lightweighting and performance at the highest value to their customer
A Strong Business Case for Steel Lightweighting

✧ Collaboration between automakers and steelmakers at an all-time high
✧ Affordability and environmental advantages of steel vehicles resonate with consumers
✧ Existing and emerging grades will extend steel’s lightweighting capability and drive value higher
✧ With very few exceptions, automakers can meet their weight reduction goals with steel and without increased use of alternative materials