Auto/Steel Partnership: Advanced High-Strength Steel Research and Development

Dr. Roger A. Heimbuch
Auto/Steel Partnership

Project ID: lm_23_heimbuch
OUTLINE OF PRESENTATION

• Overview of the Auto/Steel Partnership (A/SP)

• Strategy

• Overview of Advanced High-Strength Steel Research and Development
MEMBERS OF A/SP - Chartered in 1987

ArcelorMittal

GM

SeverStal North America

CHRYSLER

USS

Ford

NUCOR
MISSION STATEMENT

The Auto/Steel Partnership (A/SP) leverages the resources of the automotive, steel and related industries and is an organization dedicated to:

• Developing solutions where steel is the "competitive material of choice" in a changing automotive market;

• Using inter-company and inter-industry cooperative programs to ensure the success of the member companies;

• Resolving, proactively, governmental regulatory agency requirements and customer needs
PARTNERSHIP STRATEGY

To achieve the Vision, the Auto/Steel Partnership:

- Evaluate, prioritize and completes projects that meet the vision
- Communicates the technical results and benefits to the automotive industry
THE PARTNERSHIP LINKAGES

Auto/Steel Partnership

Chrysler LLC, Ford Motor Company, General Motors Corporation

ArcelorMittal, Nucor Corporation, Severstal North America, United States Steel Corp

AISI, IISI, WorldAutoSteel Consortia Partnerships

CANMET

National Laboratories

Department of Energy (DOE)

NSF

Academia

Contractors
FreedomCAR GOALS

FreedomCAR Goals:

- Mass Reduction (50%)
- Affordable Cost (less to +5%)
- Durability/Life (same)
- Recyclability
- Develop/Transfer Technology
• A/SP approached USAMP for funding

• DOE agreed to fund steel projects based on potential shown by ULSAB Projects

• USAMP/DOE support is about $18 million/year
USAMP CONE STAGES

Input into OEM’s or Supplier’s cone

Input to the USAMP cone

Demonstrated Feasibility

Technical Feasibility

Concept Feasibility

Strategic Alignment - ties into Vision

Technologic risk

time

Today (Application Feasibility)

Tomorrow (Technical Feasibility)

far out (Concept Feasibility)

Technology Planning Process
OVERALL STRATEGY

STEEL

Materials

Manufacturing

Design
STEEL STRATEGY - GAP

Future Opportunity
Third Generation AHSS

Tensile Strength (MPa)

Elongation (%)
A/SP PROJECT PORTFOLIO

Lightweighting

Enabling

On-Going
A/SP PROJECT PORTFOLIO

Lightweighting

Lightweight Chassis Structures
Future Generation Passenger Compartment Validation
Mass Compounding
Mass Efficient Architecture for Roof Strength (MEARS)
Benchmarking

Enabling

On-Going
A/SP PROJECT PORTFOLIO

**Lightweighting**
- Lightweight Chassis Structures
- Future Generation Passenger Compartment Validation
- Mass Compounding
- Mass Efficient Architecture for Roof Strength (MEARS)
- Benchmarking

**Enabling**
- Advanced High-Strength Steel Stamping
- Hydroforming Materials and Lubricants
- Advanced High-Strength Steel Joining Technologies
- Joining Strategy Steering Committee

**On-Going**
- AHSS Application Guidelines

2009 DOE Merit Review
A/SP PROJECT PORTFOLIO

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- Fatigue Characteristics
- Strain Rate Characterization
- Tribology
- 3rd Generation of AHSS (NSF)

On-Going
- AHSS Application Guidelines
A/SP PROJECT PORTFOLIO

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- Lightweight Chassis Structures
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- 3rd Generation of AHSS (NSF)

**On-Going**
- AHSS Application Guidelines
- Technology Transfer

www.a-s.org

2009 DOE Merit Review
A/SP PROJECT PORTFOLIO

**Lightweighting**
- Lightweight Chassis Structures
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**On-Going**
- AHSS Application Guidelines
- Technology Transfer

2009 DOE Merit Review
Preliminary A/SP Technical Roadmap: **Design**

**Prioritized Goals**
- **Ongoing**
- **Future**

**Timeline**

<table>
<thead>
<tr>
<th>Year</th>
<th>2008</th>
<th>2010</th>
<th>2012</th>
<th>2014</th>
<th>2016</th>
<th>2018</th>
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<tbody>
<tr>
<td><strong>FPGC</strong> (Reduce mass 25%)</td>
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<td><strong>MEARS</strong> (Mass parity)</td>
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<td><strong>LW Chassis</strong> (25% mass reduction)</td>
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<td><strong>LW Suspension</strong></td>
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<td><strong>Durability modeling</strong></td>
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<td><strong>Fuel efficient utility vehicles</strong></td>
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<td><strong>Mass Compounding effects and validation</strong></td>
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<td><strong>Optimize joint designs:</strong></td>
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<td><strong>Architecture for advanced powertrains</strong></td>
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<td><strong>Identify future steel material requirements</strong></td>
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<td><strong>Full vehicle body structure optimization</strong></td>
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<td><strong>Part consolidation</strong></td>
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**2009 Priority**
Next generation of BIW mass reduction with 3rd generation steel with new material and processes. Reduce mass by 10%.

www.a-asp.org

2009 DOE Merit Review
Preliminary A/SP Technical Roadmap: **Materials**

- **Reduced Mass / Improved Fuel Economy**
- **Performance Requirements (Safety, Durability, NVH, Quality)**
- **Cost Reduction / Avoidance**
- **Environmental**
- **Globalization**
- **Competitive Material Assessment**
- **Faster Concept to Production**

**Prioritized Goals**
- Ongoing
- Future

**Timeline**
- **Completed**
- **Ending 2009**
- **2009 Priority**
- **Work done by others**

<table>
<thead>
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<tr>
<td><strong>Tribology:</strong> (TGT: Assess effect of AHSS on die wear)</td>
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<td><strong>Fatigue of AHSS MIG weld joints</strong></td>
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<td><strong>NSF project (TGT: Develop Gen-3 AHSS)</strong></td>
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<td><strong>Steel Testing and Harmonization</strong></td>
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<td><strong>Mississippi State University Projects</strong></td>
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<td><strong>Freedom Car</strong></td>
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<td><strong>Strain Rate Characterization</strong></td>
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<tr>
<td><strong>Develop commercial production of 3rd generation AHSS</strong></td>
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<td><strong>3rd generation fatigue</strong></td>
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<td><strong>Conduct benchmarking evaluation of lightweight vehicles</strong></td>
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<td><strong>TWIP, L-IP &amp; Stainless steel</strong></td>
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<td><strong>Develop standard testing for embrittlement failures</strong></td>
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<td><strong>Bubble steel</strong></td>
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<td><strong>Laminate steels</strong></td>
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<td><strong>Mixed Material Solutions</strong></td>
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**Auto/Steel Partnership**

*wwwa-sp.org*
Preliminary A/SP Technical Roadmap: Manufacturing & Processing Enablers

Prioritized Goals
- Ongoing
- Future

Timeline

2008  | 2010  | 2012  | 2014  | 2016  | 2018
---|---|---|---|---|---
**Completed**
HSS Forming (validation of new tools for springback and failure prediction)
Alternative Forming
Hydroforming
Mg TWBs for crash applications
Thermal Drilling
Paint surface appearance
TWT manufacturing

**Ending 2009**
Stamping processes for 3rd generation HSS

**2009 Priority**
Quenched and Partitioned steel

**2014**
AHSS Applications Guidelines

**2016**
Joining of AHSS (TGT: Weld schedules for AHSS)
Joining processes for 3rd generation HSS

**2018**
NAAMS

A/SP Technology Roadmap

2009 DOE Merit Review
SUCCESS AND FUTURE OPPORTUNITIES

Mass Reduction Opportunity

- MILD STEELS
- CONV HSS
- AHSS with MASS COMPOUNDING
- AHSS

With Steel Strategy & DOE Support

Without DOE Support

FreedomCAR GOAL

Time

- 1970
- 1980
- 1990
- 2000
- 2010
- 2020
- 2030

Technology Decision

3rd GENERATION
FreedomCAR & A/SP GOAL ALIGNMENT

**FreedomCAR:**
- 50% Mass Reduction
- Affordable Cost
- Life/Durability
- Develop/Transfer Technology
- Recyclability

**Auto/Steel Partnership:**
- 40% Mass Reduction
- Affordable Cost
- Life/Durability
- Develop/Transfer Technology
- Recyclability