AluMag®

North America 2015 9th - 11th of Nov

AUTOMOTIVE LIGHTWEIGHT

PROCUREMENT SYMPOSIUM

Cobo Center, Detroit, USA

SYMPOSIUM FOCUS

- Aluminum
- Carbon Fibre
- Composites
- High Strength Steel
- Magnesium

The 3rd Automotive Lightweight Procurement Symposium to be focused on automotive lightweighting, supply / process chain and procurement management, will take place in Detroit from the 9th – 11th of Nov 2015. The symposium is held in the days leading up to the "ALUMINUM USA" exhibition taking place at the Cobo Center, Detroit, Michigan (Walking distance to symposium venue)

ATTENDING COMPANIES:

BOCAR GROUP, Ford, DAIMLER, NACFE, Gibbs Die Casting, UACJ, AluMag, NISSAN, CARBON WAR ROOM, GM, StrikoWestofen Group, NanoAl, SEISSENSCHMIDT, Remy, RioTintoAlcan, GRÄNGES, MARTINREA, ESD The Engineering Society of Detroit, NNi Training and Consulting Inc., MARTINREA HONSEL, Al Circle, HT Honda Trading, Automotive Insight, RUSAL, atieva, MERITOR, EXEDY Corporation, nemak, Sumitomo Corporation, ITOCHU, BHARAT FORGE GLOBAL HOLDING, MOTORINDIA, ALMAMET, ALMAG Aluminum SMARTER · BETTER · FASTER, Rane Expanding Horizons, Rassini, LINAMAR, VERSEVO NET SHAPE SOLUTIONS, TENNECO, NEUMAN ALUMINIUM RAUFOSS, JOGMEC, HONDA, FCA FIAT CHRYSLER AUTOMOBILES, alift, SUBARU

EXHIBITORS:

EJOT, kurtz ersa, BOCAR GROUP, ACTech, WHITEHALL INDUSTRIES, CPC, BHARAT FORGE ALUMINIUMTECHNIK, ALUMINUM BLANKING COMPANY, INC.

ORGANIZING PARTNERS & SPONSORS

Reed Exhibitions, ALUMINUM USA, ESD The Engineering Society of Detroit, BOCAR GROUP, kurtz ersa

AluMag®
Europe 2016 27th - 29th of Nov
AUTOMOTIVE LIGHTWEIGHT
PROCUREMENT SYMPOSIUM
Hilton Hotel in Duesseldorf, Germany

AluMag®
Asia 2016 6th - 8th of July
AUTOMOTIVE LIGHTWEIGHT
PROCUREMENT SYMPOSIUM
Jumeirah Himalayas Hotel in Shanghai, China

AluMag®

Europe ■ India ■ Americas ■ Asia

THE MARKET DEVELOPER

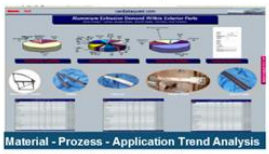
AluMag is "The Market Developer" that successfully penetrates new markets, creates business and localize leading supplier for your company. AluMag access any promising markets and open doors for your business – regardless of region, market, application, material, process or product. AluMag makes you successful – worldwide!

AluMag® offers the four following services - worldwide:

Market Research

- Aluminium Extrusion Customer Database
- Foundry & Tool Maker Database
- Automotive Application, Material & Process Analyses
- Various Industrial Application Research & Analyses

AluMag as your provider of automotive research and forecasting studies, offers you and your business, the market intelligence you need to realize the best strategic decisions



Material - Prozess - Application Trend Analysis

Large variety of market accesss, local & global:

- business database with 6,970+ companies and 18.700+ contacts
- 150+ satisfied customers worldwide
- Arranged 20+ roadshows/events since 2008

Extrusion Application

Your Benefits:

- Learn about your [potential] clients and competitors
- Obtain an inside view of the market
- Identify opportunities and threats
- Minimize risk and optimize profits
- Position your company successfully
- Based on data off the shelf, secondary re-search and interviews, AluMag generates validated researches

Market Development

- Analysis & Development of Market Opportunities
- Accelerate Market Penetration
- Manage New Product Launches
- Establish a Sales Force Sales on Demand

AluMag guides and supports your organization globally through the different market development phases until we have successfully launched, implemented or executed your project.

Map of activity - SAMPLES

Manage and integrate each aspect of your organization by initiating, planning, con-trolling, executing and closing out a new project. AluMag offers liaison mana-gement services as an addition to our customer's staff by bringing in the resources that define us.

JATCO Head Quarters Meeting in Japan

Your Benefits

- Analysis and development of Markets
- Realize opportunities
- Accelerate market penetration
- Establish a sales force
- Provide warehousing and distribution services
- Manage new product launches
- Sales on demand

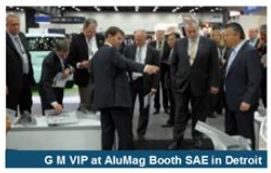
Roadshows / Events

- Organization of Technical & Commercial Roadshows
- Oversea Commercial & Technical Events
- Host In-House Events & Presentation
- Common Technology Booth at Leading Exhibitions

AluMag roadshows, tech-meetings and symposia are the first class events used by exhibitors and guest as a unique benchmark platform.

Daimler Sindelfingen as Roadshow Location

The AluMag think tank events are bringing in decision makers and executives in EUROPE, ASIA and NAFTA.



G M VIP at AluMag Booth SAE in Detroit

Upcoming Events:

- 2015 Nov: Automotive Lightweight Procurement Symposium in Detroit, USA
- 2016 April Common tech- booth at the SAE World Congress in Detroit, USA
- 2016 Jul: Automotive Lightweight Procurement Symposium in Shanghai, China
- 2016 Nov: Automotive Lightweight Procurement Symposium in Duesseldorf, Germany.

Strategic Localization

- Warehousing & Distribution Service
- Supplier & Tie-up Localization
- Identification & Trade-off of new Technology
- Foreign Market Business Cases and whose Realization

AluMag has the global expertise to search, identify, evaluate and validate potential strategic business opportunities for expansions and partnerships that will assist your business growth plans regionally and globally

On-Site Greenfield Planning Meeting

Services for:

- Search, develop and present potential acquisition candidates for regional and global business expansions
- Localization of new manufacturing / service sites for business expansions
- Identification of new technology supplier development related to products, processes and materials
- Search, develop and present potential business partners / suppliers to support regional and/or global supply programs
- Evaluate potential competitor profiles for new or existing business in non-presence geographies
- Evaluate new emerging technologies and processes for business expansions

Are you:

- **looking for specific data, information and outlook about product, material, customer, supplier, technologies, ...**
- **want to discuss your project, increase sales, access new markets, ...**
- **interested to participate in one of our roadshows / events or organize your customized showcase ...**
- **looking to localize, expand into new markets, countries, tie-up targets, ...**

please contact your AluMag Team to receive a quote or proposal

CONTACTS & PROJECT TEAM

Mr. Jost GÄRTNER
Managing Partner

AluMag® Automotive GmbH
Kirchplatz 1a
58706 Menden
GERMANY
Tel.: +49 2373 929492
j.gaertner@alumag.de

German & English

Mr. Roberto BOEKER
Managing Partner

AluMag® Automotive LLC
42056 Michigan Avenue
Canton, MI 48188
USA
Cell: +1 248 962 5086
r.boeker@alumag.de

English & German & Spanish

Mr. Thomas KATCHMARK
New Business Development Manager
AluMag® Automotive LLC
20929 Sunnydale
Farmington Hills, MI 48336
USA
Cell: +1 313 410 0865
t.katchmark@alumag.de

English

Mr. Jesper LARSEN
Manager Market Research

AluMag® Scandinavia
Byagervænget 69
8330 Beder
DENMARK
Cell: +45 2573 8790
j.larsen@alumag.de

German & English & Danish

Ms. Ying ZHOU
Project Coordinator
Japan & China
AluMag® Automotive GmbH
Kirchplatz 1a
58706 Menden
GERMANY
Cell: +49 172 6415876
y.zhou@alumag.de

German & English & Chinese & Japanese

Mr. Ricardo SCHOER
Senior Consultant

AluMag® Automotive LLC
Av. San Antonio 189-131
Col. Napoles 03810
MEXICO
Cell: +52 55 4002 0501
r.schoer@alumag.de

English & German & Spanish

N. America Automotive Lightweight Procurement Symposium

2015 9th – 11th Nov

Cobo Center One Washington Blvd. Detroit, Michigan, 48226 USA

AluMag Automotive GmbH
Jost GAERTNER
Managing Partner

Cell: +49 172 6000569
j.gaertner@alumag.de
www.alumag.cc

AluMag Automotive LLC
Roberto BOEKER
Managing Partner

Cell: +1 248 9625086
r.boeker@alumag.de
www.alumag.cc

AluMag®

Europe ■ India ■ Americas ■ Asia

THE MARKET DEVELOPER

Index

Company Speechs by:

Agenda

Agenda: (Is Continuously Being Updated)

Monday The 9th Of November – Cobo Center, Detroit

05:30pm - 07:30pm

Pre-registration and Welcome

Reception

Tuesday The 10th Of November – Cobo Center, Detroit

08:30am – 09:15am

Registration

Morning Coffee / Tea

09:15am – 09:30am

Welcome:

Mr. Jost GAERTNER - Managing Partner At AluMag Automotive GmbH

09:30am – 10:25am

Opening Keynote: Mr. Craig RENNEKER - Chief Engineer, New A/T Programs & Component – Transmission & Driveline Engineering At Ford Research & Innovation Center

Lightweight Transmission & Driveline Components: Practical Challenges

10:25am – 11:00am

Break for Refreshments/Coffee/Tea, Snacks, Networking, Tech Exhibition

11:00am – 11:45am

Paper 1: Mr Mike ROETH – Executive Director At North American Council for Freight Efficiency (NACFE) & Operations Leader – Carbon War Room

Paper 1: Mr. Karl MAYER – Director Product Line Management At Meritor

Lightweighting Heavy Duty Class 8 Tractors and Trailers

11:45am – 01:45pm

Break for Lunch, Refreshments, Networking, Tech Exhibition

01:45pm – 02:25pm

Paper 2: Mr Ryan BROWN – Director Of Sales At StrikoWestofen America

Analysis Of Cost Drivers When Buying Lightweight Solutions / Materials & The Elimination Of These

02:30pm – 03:10pm

Paper 3: Mr. Lothar HARTMANN – Managing Director Foundry Machines & Trimming Presses At Kurtz GmbH

Chassis & Suspension Weight Reduction By LPDC Aluminum With Hollow Cross Sections

Mr. Kevin CROY - NAFTA Sales Manager Foundry Machines & Trimming Presses At Kurtz GmbH

03:15pm – 03:45pm

Paper 4: Mr. Jörg MANTWILL – Director Sales At Bharat Forge Aluminiumtechnik GmbH & Co. KG

HCM And Aluminum Forging – Partnership To Birth Chassis Parts' Safety

03:45pm – 04:15pm

Break for Refreshments/Coffee/Tea, Snacks, Networking, Tech Exhibition

04:15pm – 04:55pm

Paper 5: Mr. Gary F. RUFF - President and Chief Executive Officer, Ruff and Associates, LLC 8/12 - Present

Advanced Counter Pressure Casting Process for Light-Weighting of Auto and Truck Chassis and Suspension Components

05:00pm – 05:55pm

Closing Keynote: Mr. Gilberto SALDIVAR – New Projects Group Manager At Bocar Group

Key Factors To Achieve Mechanical Properties In Lightweight Structural Parts

05:55pm – 06:00pm

Summary:

Mr. Roberto BOEKER – Managing Partner At AluMag Automotive LLC

Agenda

06:00pm - 08:00pm

Dinner Speech:

Mr. Richard KLEIN -
Responsibility Strategic Planning - Business Development & German Business At BOCAR

Wednesday The 11th Of Nov – Cobo Center, Detroit

08:15am – 08:55am

Mr. Ali JAMMOUL – Global Director Body Exterior And Safety Engineering At Ford

Body Lightweighting

09:00am – 09:40am

Paper 1: Dr. Gerald COLE – President At Light Weight Strategies LLC

Light Weighting the Automotive Industry - The Road to 2025 CAFÉ

09:45am – 10:25am

Paper 2: Mr. Laurence CLAUS - President At NMI Training & Consulting Inc. & Technical Consultant To EJOT Fastening Systems LP USA

EJOT Fastening Solutions Enable Lightweight Body-in-white Assembly

10:25am – 11:00am

Break for Refreshments/Coffee/ Tea, Snacks, Networking, Tech Exhibition

11:00am – 11:40am

Paper 3: Dr. Akio NIIKURA - General Manager R&D Division At UACJ Corp.

UACJ's Global Strategy And Approach To The Automotive Aluminum Market

11:45am – 12:05pm

Paper 4:
Mr. Lawrence E. BROWN – Executive Director At Lightweight Innovations For Tomorrow

Lightweight Innovations For Tomorrow!!!!

12:10pm – 12:40pm

Closing Keynote:
Ms. Laura ANDERSON – CEO At Aluminum Blanking Company

The Story Behind Aluminum's Sourcing Evolution: A North America Perspective

12:40pm – 12:45pm

Summary:

Mr. Jost GAERTNER, Managing Partner At AluMag Automotive GmbH

12:45 pm – 01:30pm

Reception Speech With Snacks & Finger Food

Mr. Michael KOEHLER - Industry Vice President At Reed Exhibitions USA

01:30pm – 05:30pm

Individual Or Guided Visit At The 2015 "Aluminum USA" Exhibition

EXHIBITOR

Aluminum Blanking Company
USA, 48340-1854 Pontiac / Michigan
Tel.: +1 248 3384422
http://www.albl.com

ACTech North America
USA, 48108 Ann Arbor / Michgan
Telefon: +1 734 9130091
www.rapidcastings.com

Bharat Forge Aluminiumtechnik
GER 09618 Brand-Erbisdorf
Tel.: +49 37322 474 747
www.bharatforge.com

Auma Engineering Products
USA 48393 Wixom MI
Tel.: +1 248 9609330
www. BOCAR.com.mx

C.P.C. USA
USA, 92630 Lake Forest / California
Tel.: +1 949 830 7797
www.cpcmachines.ilindenmachines.com

EXHIBITOR

EJOT Fastening Systems LP
USA 48393 Wixom MI
Tel.: + +1 262 612 3550
http://www.ejot-usa.com

Kurtz GmbH
GER 97892 Kreuzwertheim
Tel.: +49 9342 807 0
http://www.kurtzersa.de

StrikoWestofen GmbH
GER 51643 Gummersbach
Tel.: +49 2261 709 10
www.strikowestofen.com

Automotive Insight Skilled. Trusted. Proven.

Dr. Gerald COLE
President

Automotive Insight
USA, 48009 Birmigham / MI

Tel.: +1 248 626 3232
www.automotiveinsight.net

TITLE

Light Weighting the Automotive Industry - The Road to 2025 CAFÉ

ABSTRACT

By 2025, the U.S. automotive industry will have to average 54.5 mpg (4.3l/100km) Corporate Average Fuel Economy (CAFÉ). While new/improved powertrain technology is critical, 25-40% of the new CAFE will require significant vehicle mass reduction including using lightweight structural materials. This presentation discusses new developments in light metals (aluminum and magnesium), non-metals (plastics and carbon-fiber reinforced composites), and conventional heavy metals (iron and steel). Aluminum components used to be simple castings, requiring minimal fatigue strength and elongation. Now, vacuum die castings, stampings, forgings and extrusions can be used in structural applications where higher quality processing is required to improve elongation and strength. New grades of lightweight (i.e. thinner) ultra-high strength steels can save over 1/3 the mass vs heavier conventional mild steels but require more expensive processing. Engines can be lighter in compacted graphite cast iron than in aluminum because of its higher strength at higher combustion temperature and pressures. Lightweight materials often require specialized processing and assembly techniques to produce components and hybrid assemblies and require unique joining/bonding, and corrosion-inhibiting techniques. The presentation will examine lightweighting strategies of Asian, American and, European marques and the materials, component designs and assembly techniques to achieve the required corporate CAFÉ.

Light Weighting the Automotive Industry
The Road to 2025 CAFE

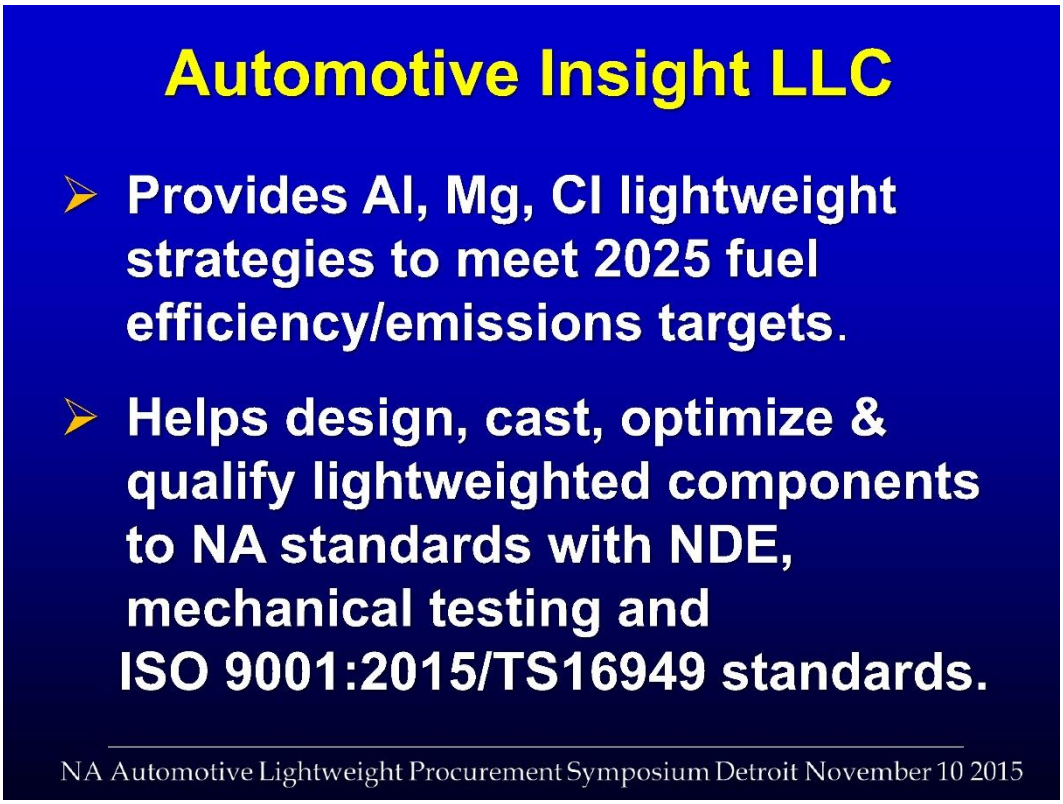
Gerald S Cole, PhD, FASM
Director Lightweight Operations
Automotive Insight LLC, Troy MI USA
Ford Motor Company Sr. Staff Tech Specialist (retired)

gcole@automotiveinsight.net

Organization of Presentation

- Who Is Automotive Insight LLC
- CO_2 emissions, CAFÉ
- Importance of mass reduction
- Automotive materials (S,A,P,M,MM)
- Joining different materials
- MR in select vehicles…Ford F150
- Summary and Conclusion


Automotive Insight LLC
automotiveinsight.net
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Automotive Insight LLC
Provides Al, Mg, CI lightweight strategies to meet 2025 fuel efficiency/emissions targets.
Helps design, cast, optimize & qualify lightweighted components to NA standards with NDE, mechanical testing and ISO 9001:2015/TS16949 standards.
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Automotive Insight LLC

- Connects die casters with NA OEM's/Tier 1's.
- Facilitates JV/M&A partnering between Asian and NA die casters to enhance NA supply base capabilities.

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

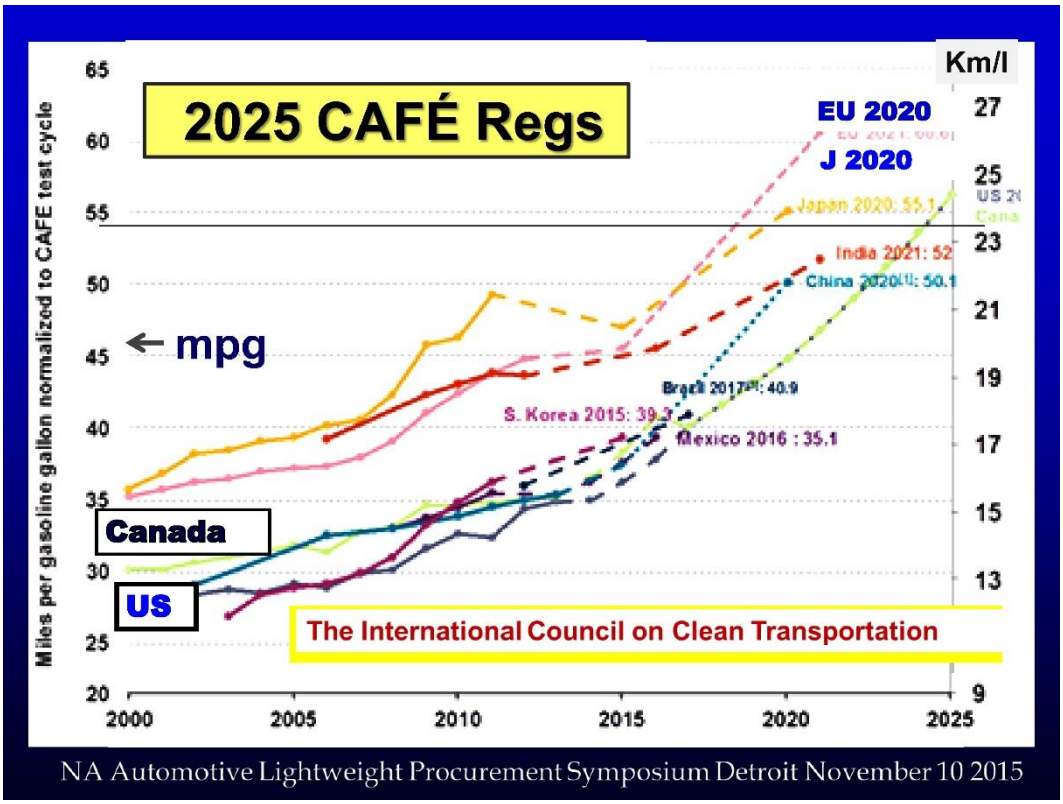
There is a major effort by NA governments to reduce emissions via improved CAFÉ

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

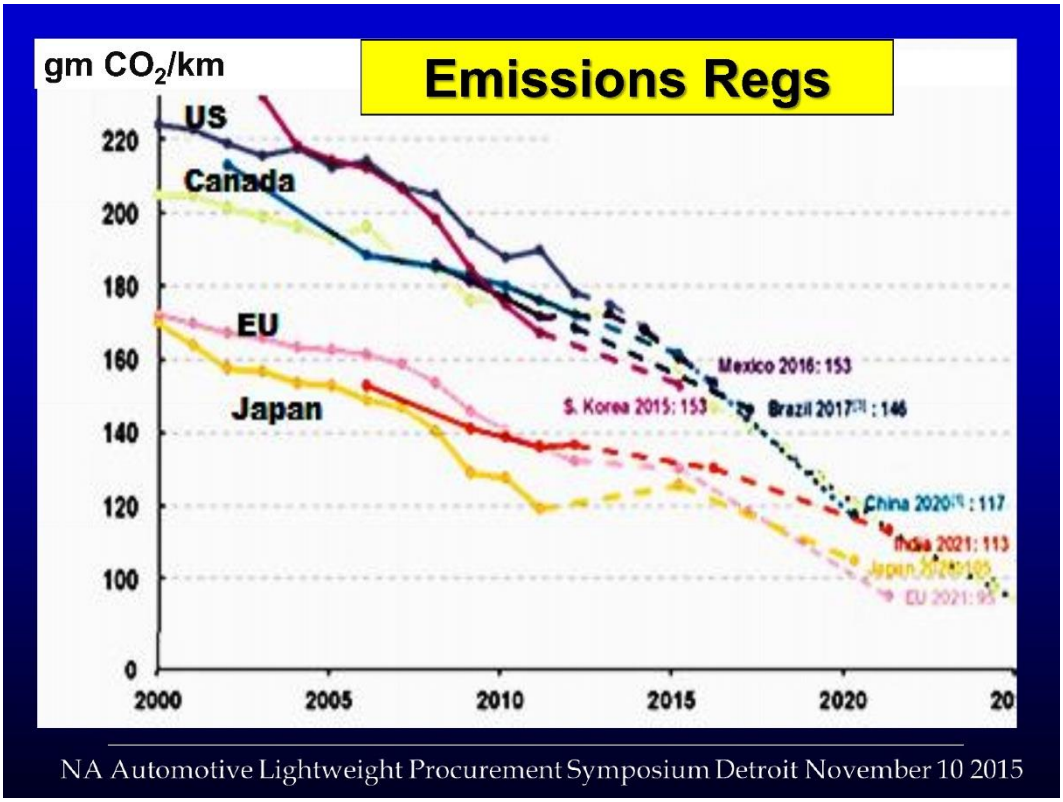
2010: 22.4 mpg
2011: 27.3 mpg
2012: 33.3 mpg car
25.4 mpg truck
2016: Fleet av 35mpg
39.5 mpg cars
30 mpg trucks.
2025: 54.5 mpg

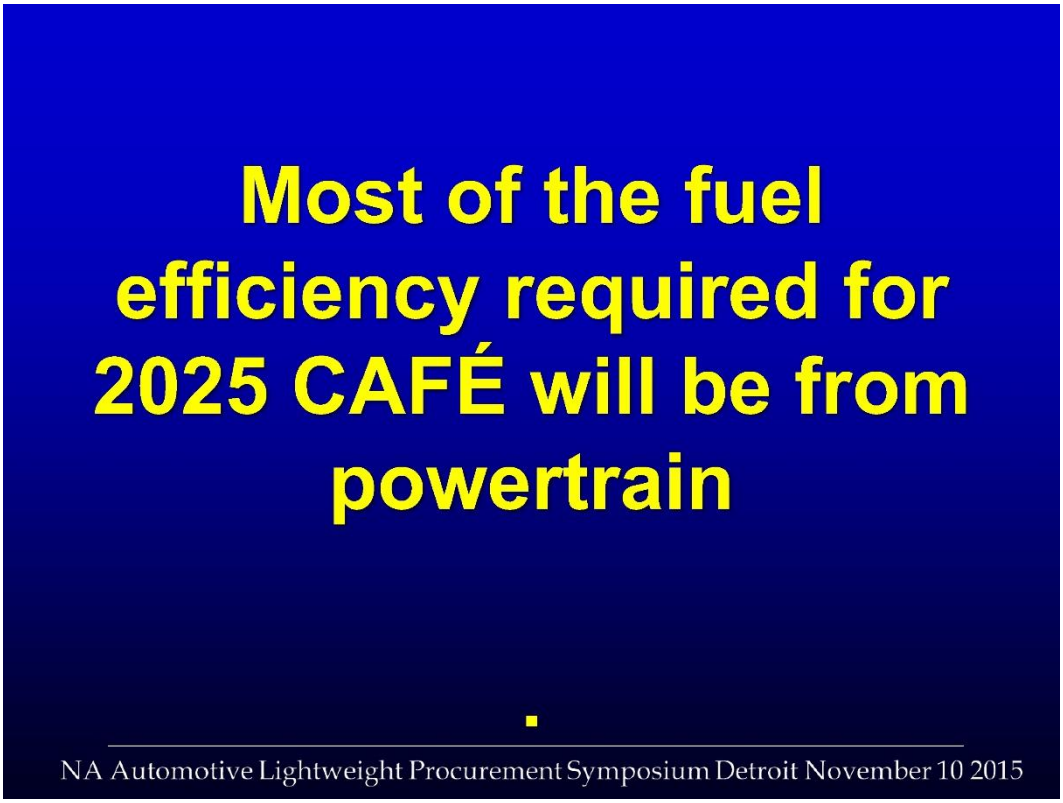
Actual standards are vague. Credits exist for electric, hybrid, H_2 & E85.

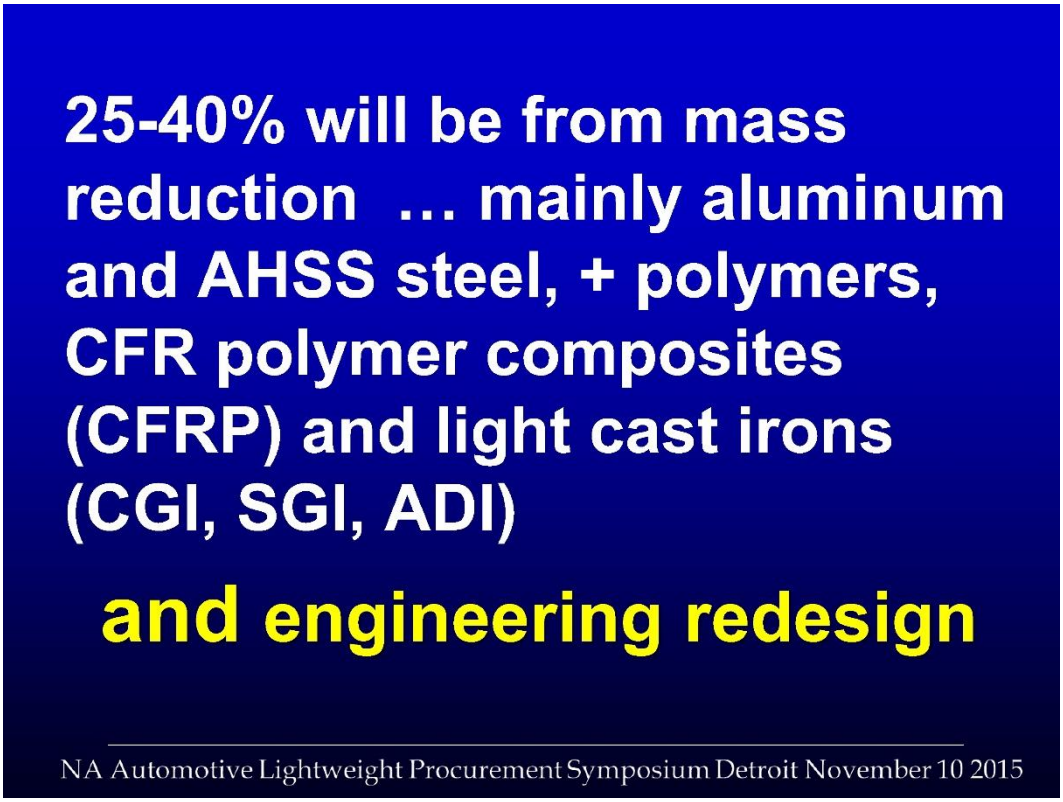
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

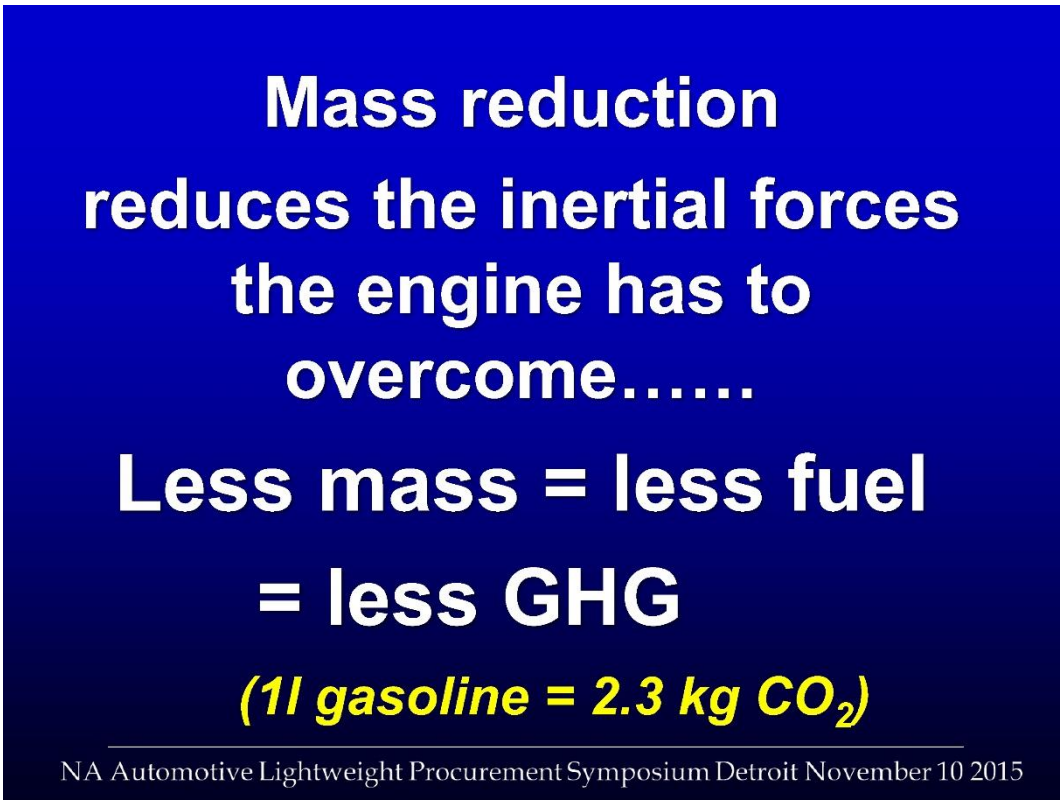


NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


gm CO_2/km
Emissions Regs
US
Canada
EU
Japan
Mexico 2016: 153
S. Korea 2015: 153
Brazil 2017[N] : 146
China 2020[N] : 117
India 2021: 113
EU 2021: 95
220
200
180
160
140
120
100
0
2000
2005
2010
2015
2020
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Most of the fuel efficiency required for 2025 CAFÉ will be from powertrain
.
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


25-40% will be from mass reduction … mainly aluminum and AHSS steel, + polymers, CFR polymer composites (CFRP) and light cast irons (CGI, SGI, ADI)
and engineering redesign
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

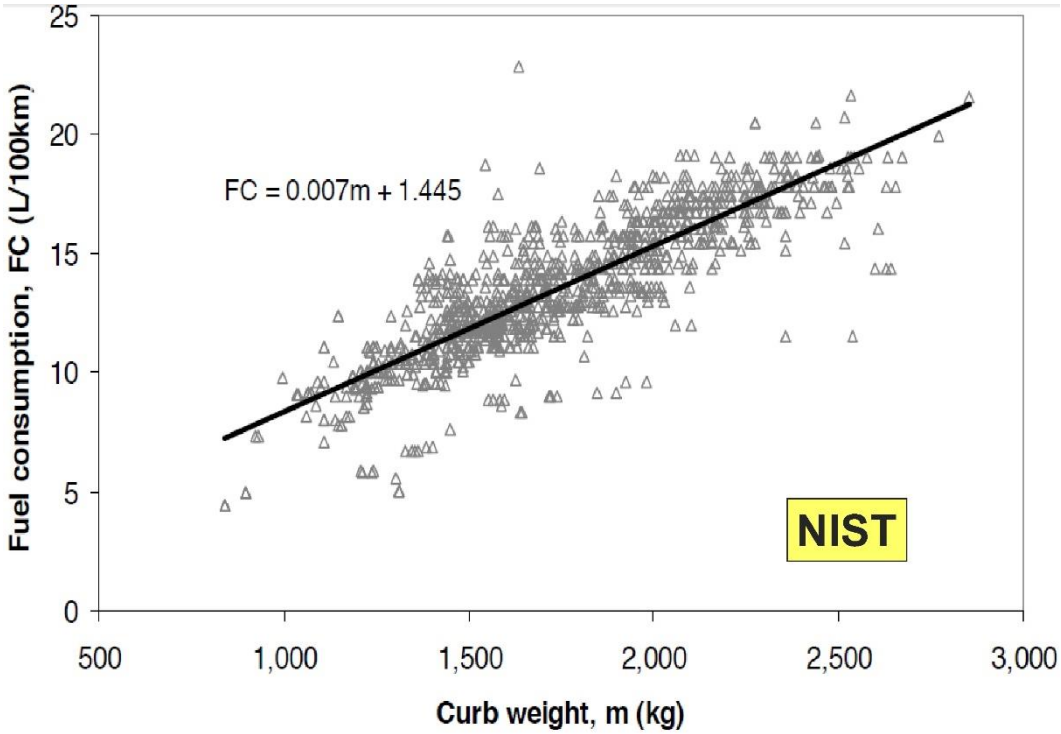

Mass reduction
reduces the inertial forces the engine has to overcome……
Less mass = less fuel
= less GHG
(1l gasoline = 2.3 kg CO_2)
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Typically 10% MR equates to 3-6% FE or ER improvement.

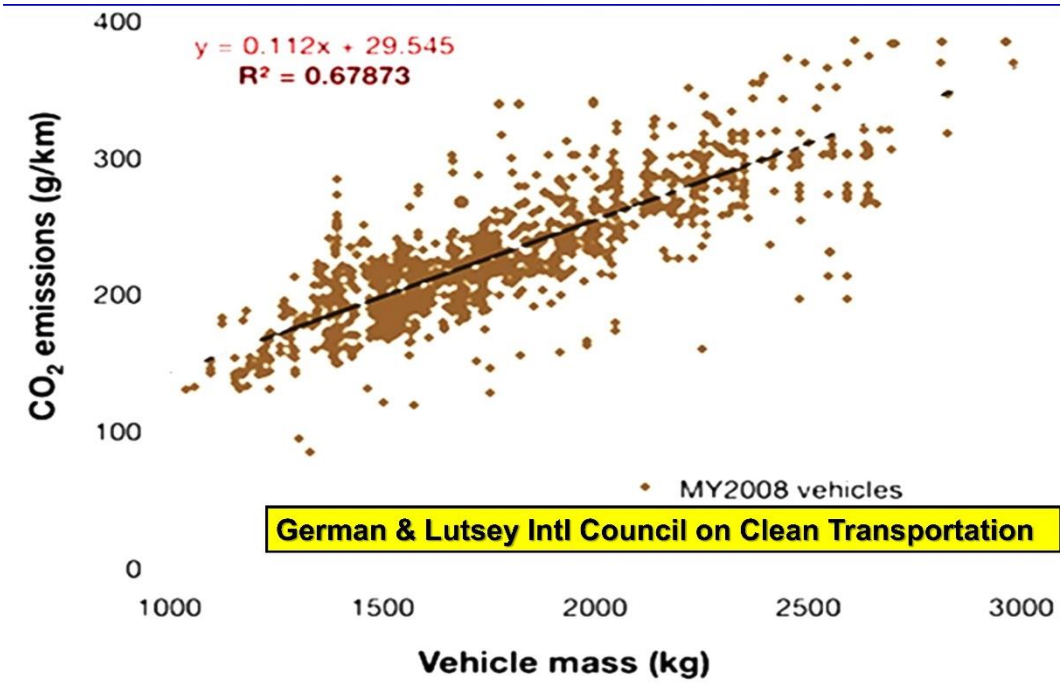
IF THERE IS MASS COMPOUNDING

1 k MR results in secondary MR via downsizing: powertrain, suspension, brakes, wheels, fasteners, a further 0.25-0.5 k

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015



NA Automotive Lightweight Procurement Symposium Detroit November 10 2015



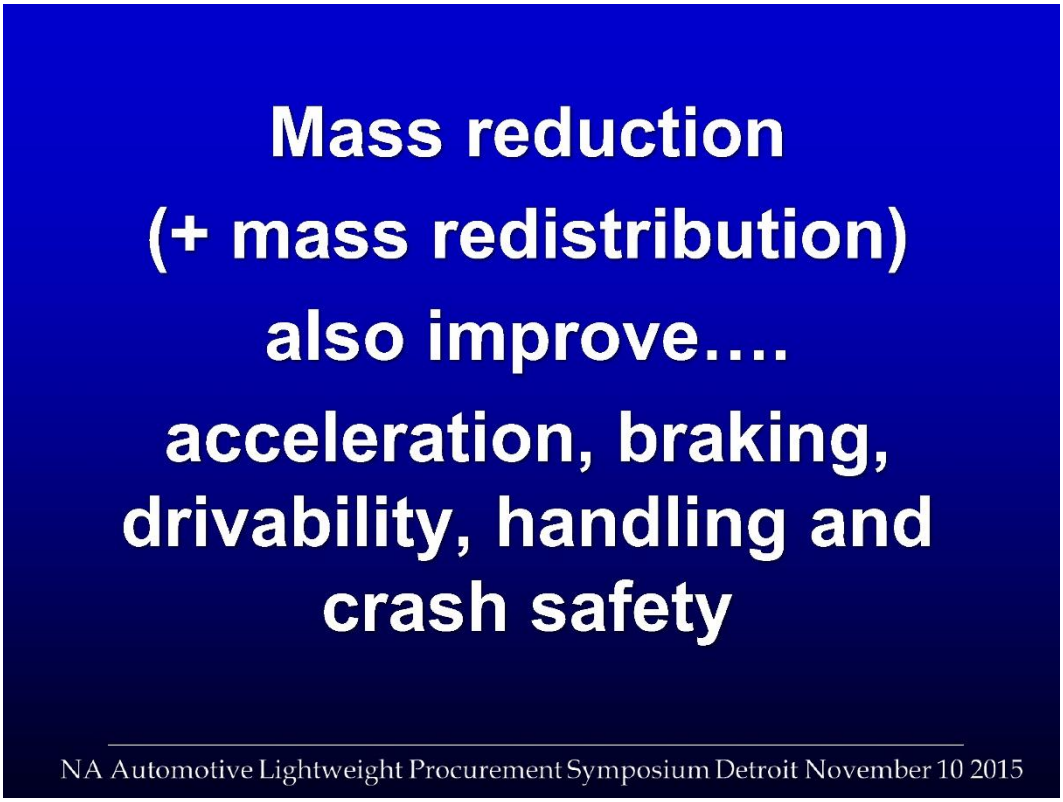
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

(6/19/2015) EPA, DOT Proposed GHG/Fuel Efficiency Standards for Heavy-Duty Trucks

10% MR reduces fuel by 5-10%

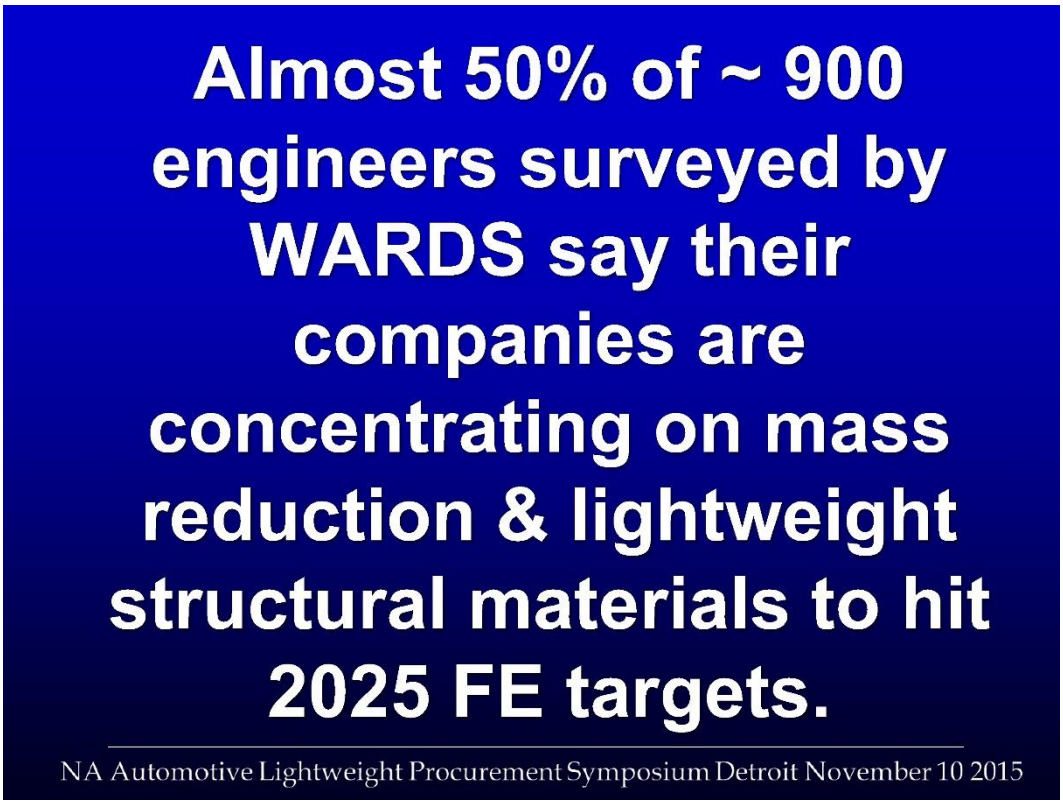
- 10 Cast Al wheels save 400 #
- Al axle hubs save 120 # vs iron or steel
- Al clutch housing saves 50 # vs iron
- Downsized engine saves over 700 #
- Composite Ft axle springs save 70 #

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Mass reduction
(+ mass redistribution)
also improve….
acceleration, braking, drivability, handling and crash safety
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


All auto companies are now designing 3-5% annual mass reduction as a strategic requirement for new product development.
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Every vehicle component is being scrutinized from door latches to headlights, powertrain, body-in-white & body panels
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Almost 50% of ~ 900 engineers surveyed by WARDS say their companies are concentrating on mass reduction & lightweight structural materials to hit 2025 FE targets.
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Mazda Strategy

- MR is centerpiece of product planning. It is an essential technology in its environmental performance.
- Δ MR will be 110 kg from next generation of each model = 5 % FE increase for each new car.

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Koichi Kamiji, Sr Chief Engineer for Auto Safety, Honda R&D

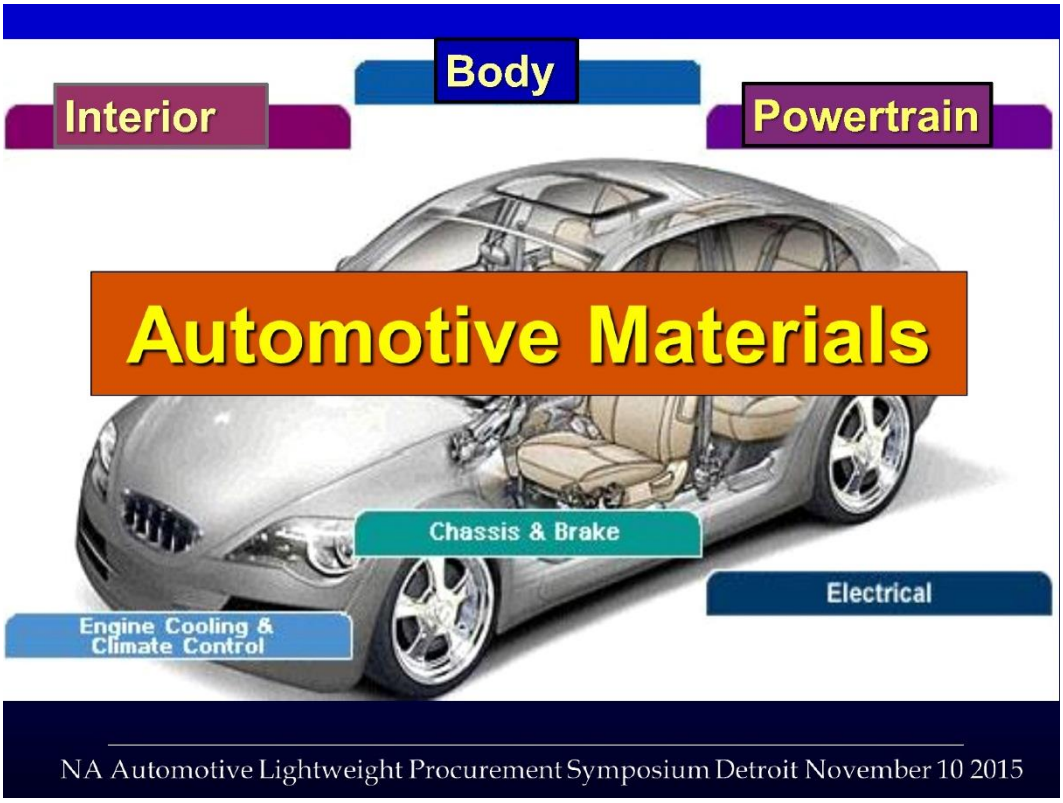
The premium of MR requires

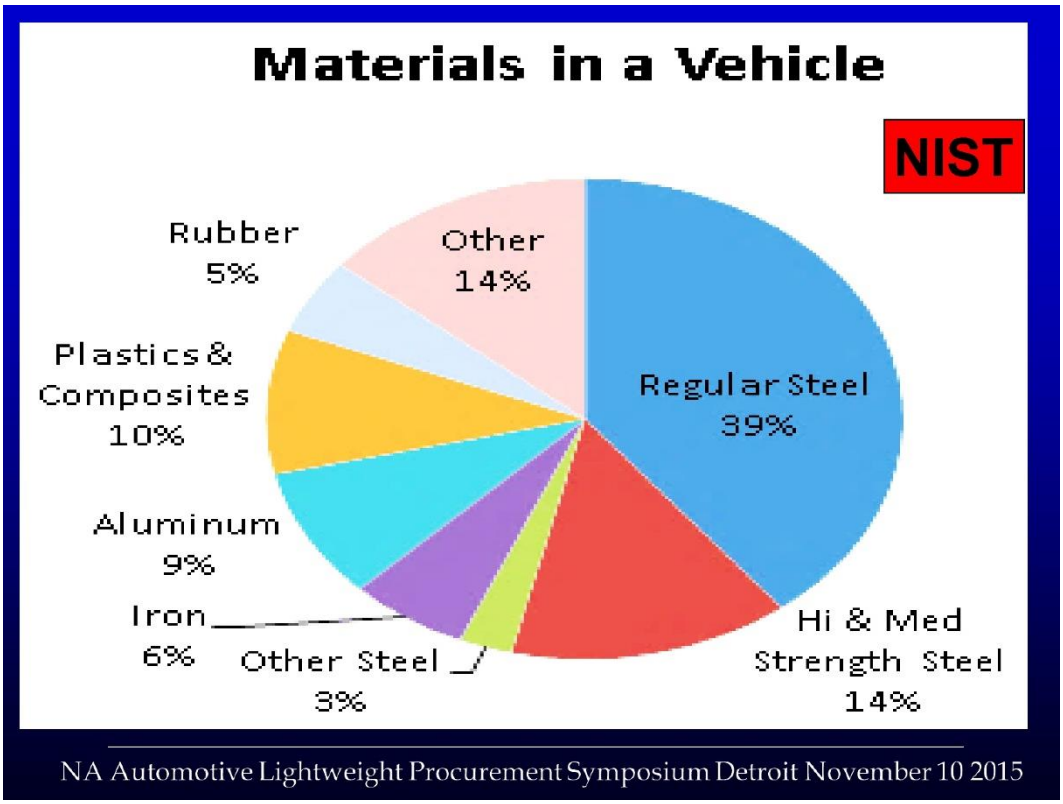
- *Not only new lightweight materials*

BUT

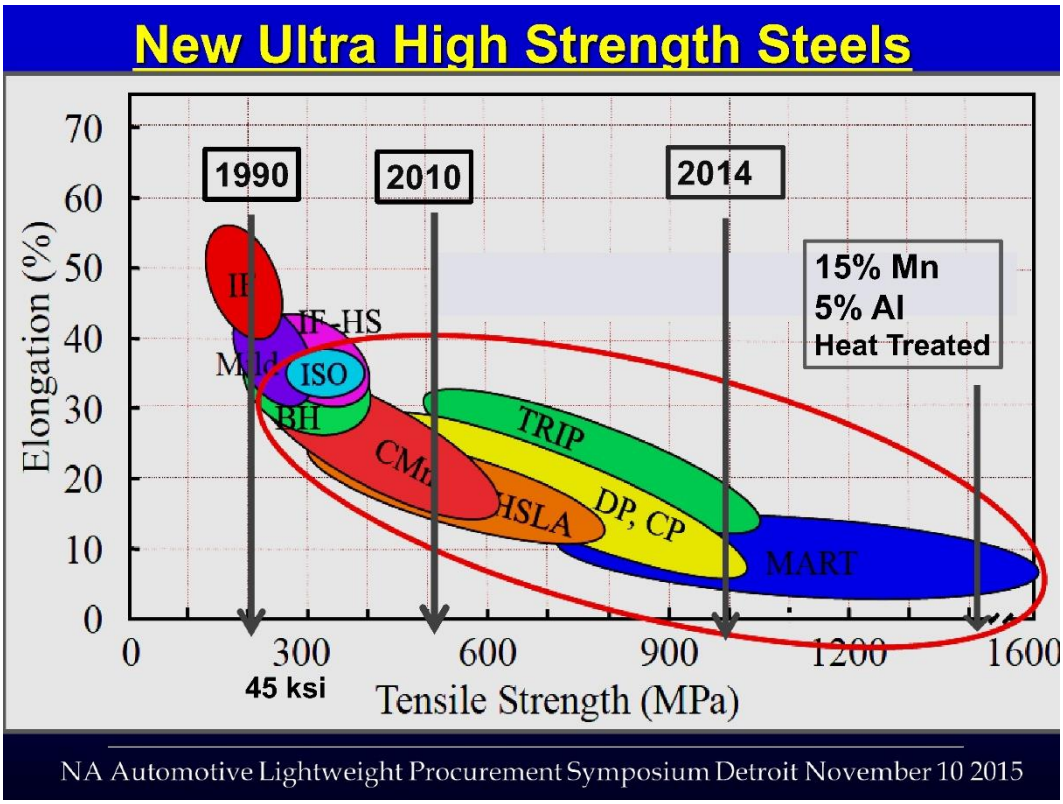
- Shaving grams from any component not related to safety"
- New engineering/design architectures,
- Advanced cabin safety technologies

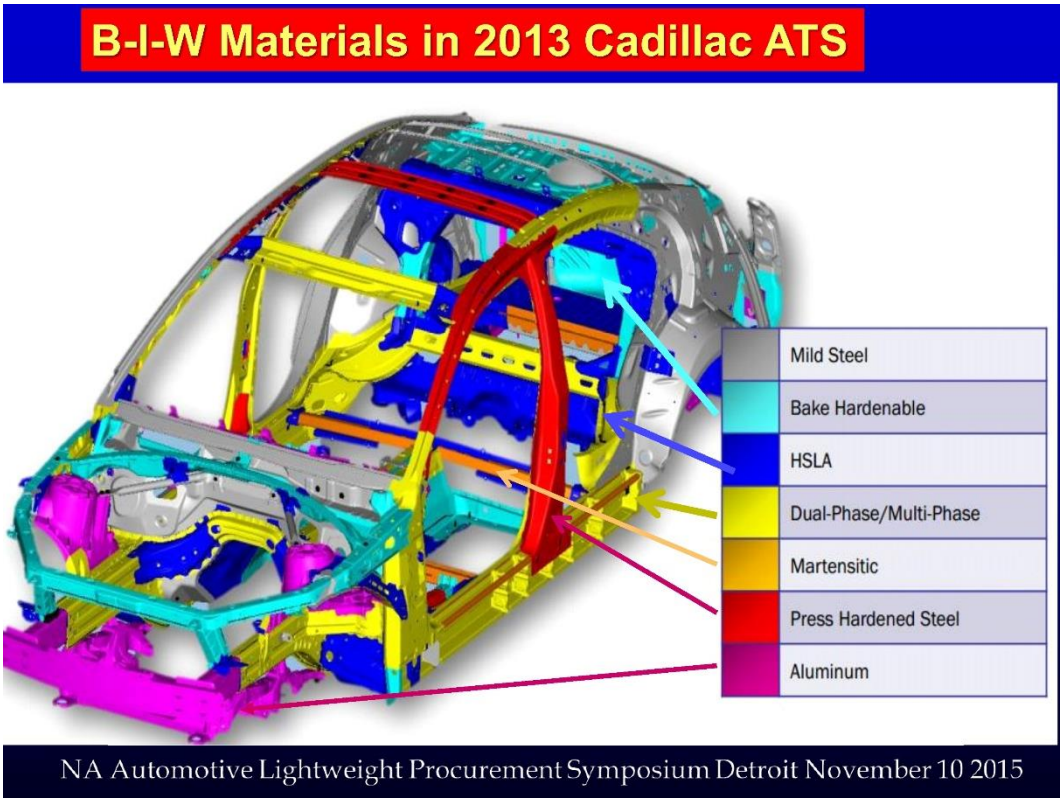
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

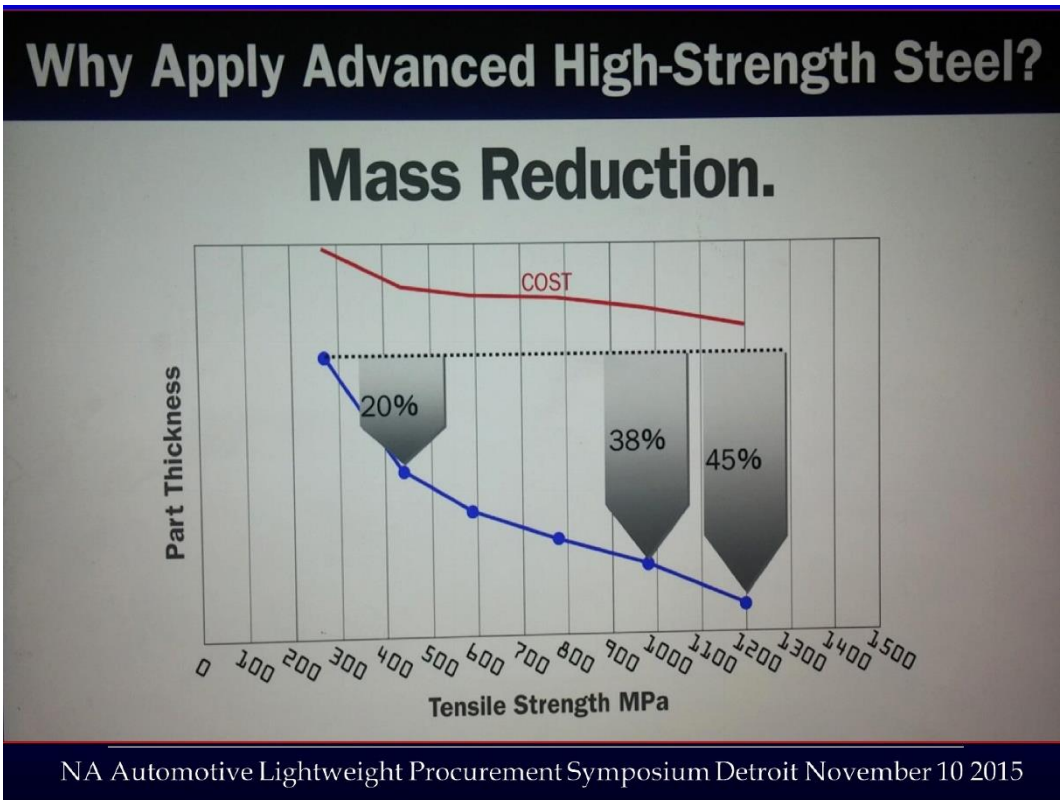

Body
Interior
Powertrain
Automotive Materials
Chassis & Brake
Electrical
Engine Cooling & Climate Control
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

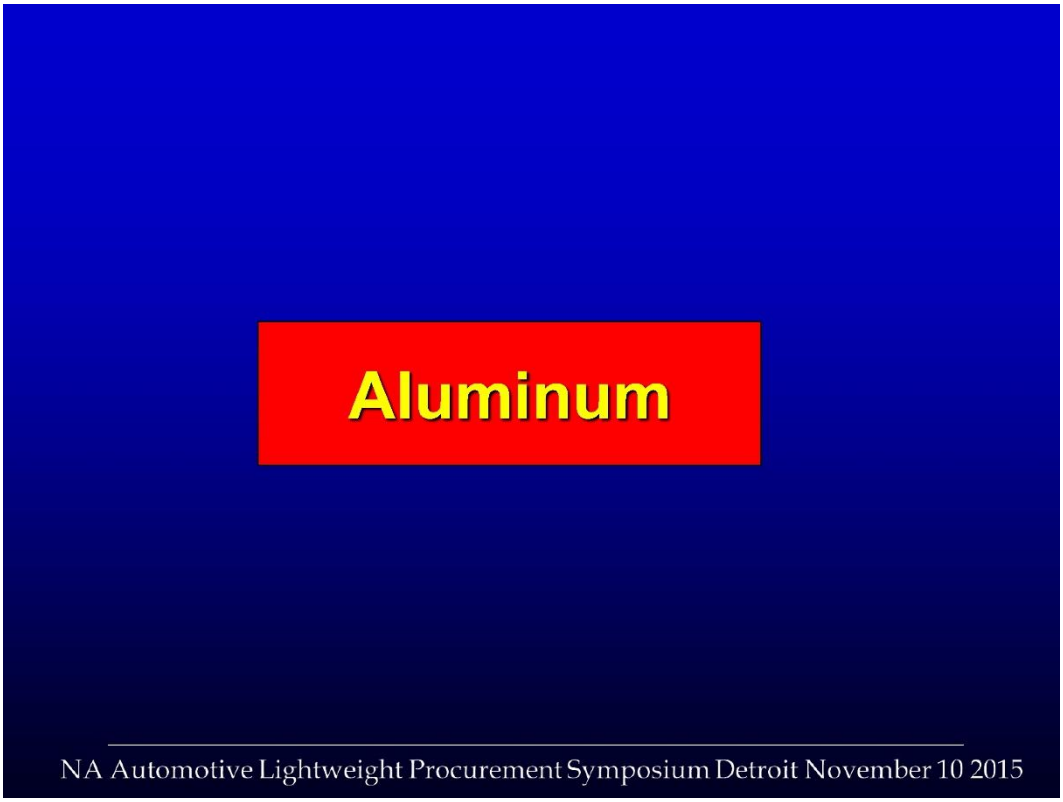

Materials in a Vehicle
NIST
Rubber 5%
Other 14%
Plastics & Composites 10%
Regular Steel 39%
Aluminum 9%
Iron 6%
Other Steel 3%
Hi & Med Strength Steel 14%
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

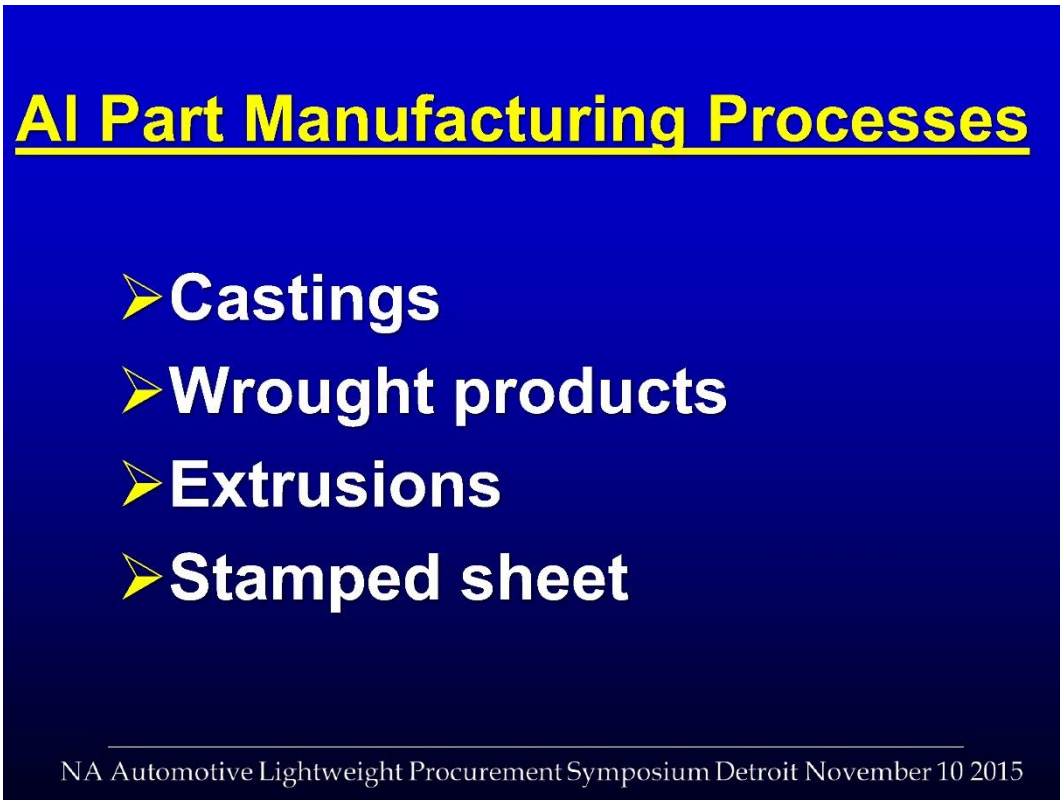

Steel
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


New Ultra High Strength Steels
1990
2010
2014
15% Mn
5% Al
Heat Treated
IF
IF-HS
ISO
BH
CMn
HSLA
TRIP
DP, CP
MART
Elongation (%)
70
60
50
40
30
20
10
0
0
300
600
900
1200
1600
45 ksi
Tensile Strength (MPa)
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

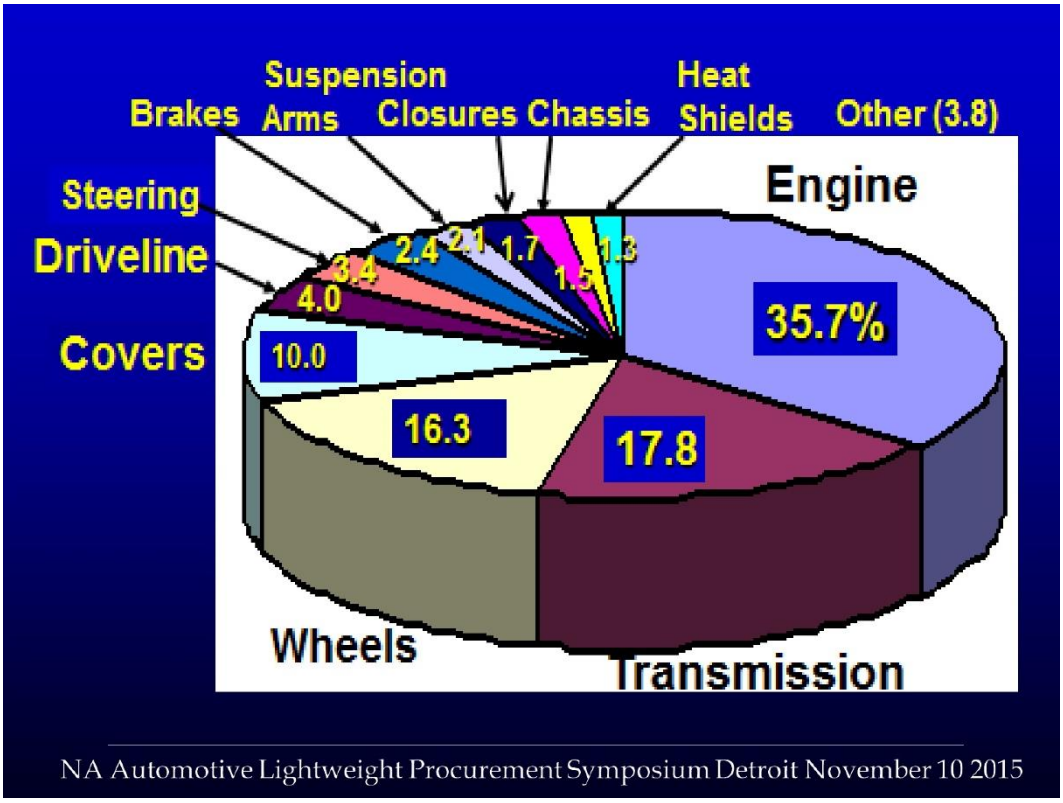

B-I-W Materials in 2013 Cadillac ATS
Mild Steel
Bake Hardenable
HSLA
Dual-Phase/Multi-Phase
Martensitic
Press Hardened Steel
Aluminum
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

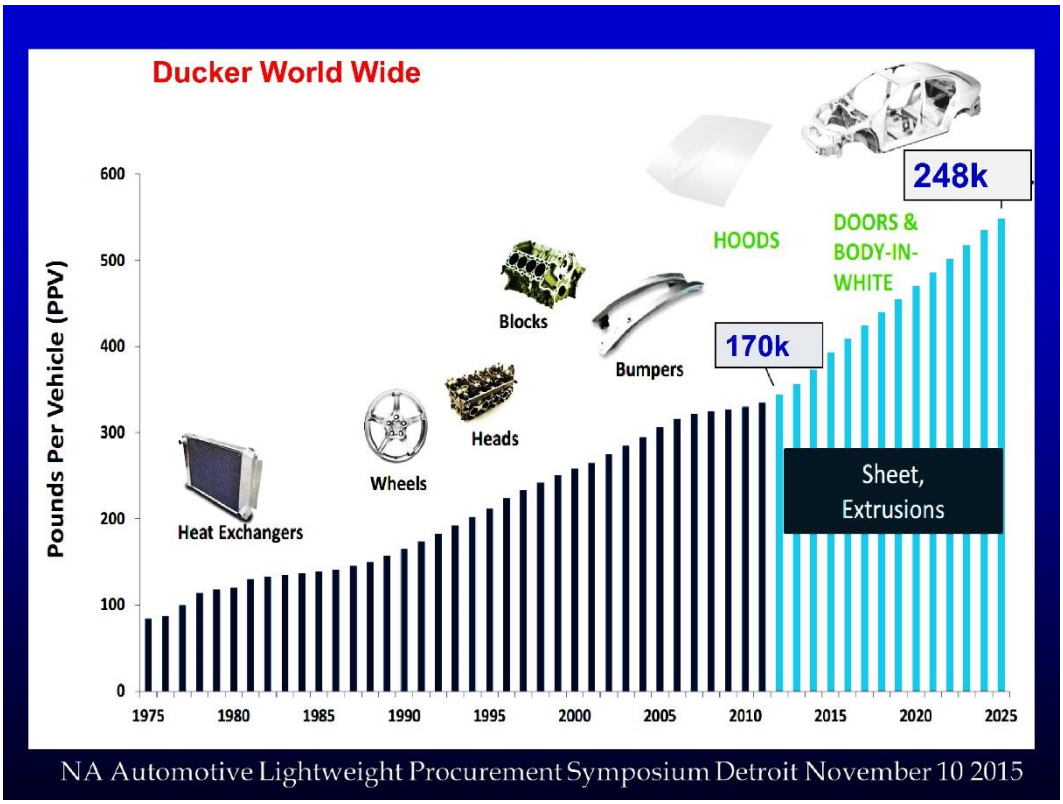

Why Apply Advanced High-Strength Steel?
Mass Reduction.
COST
20%
38%
45%
Part Thickness
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
Tensile Strength MPa
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

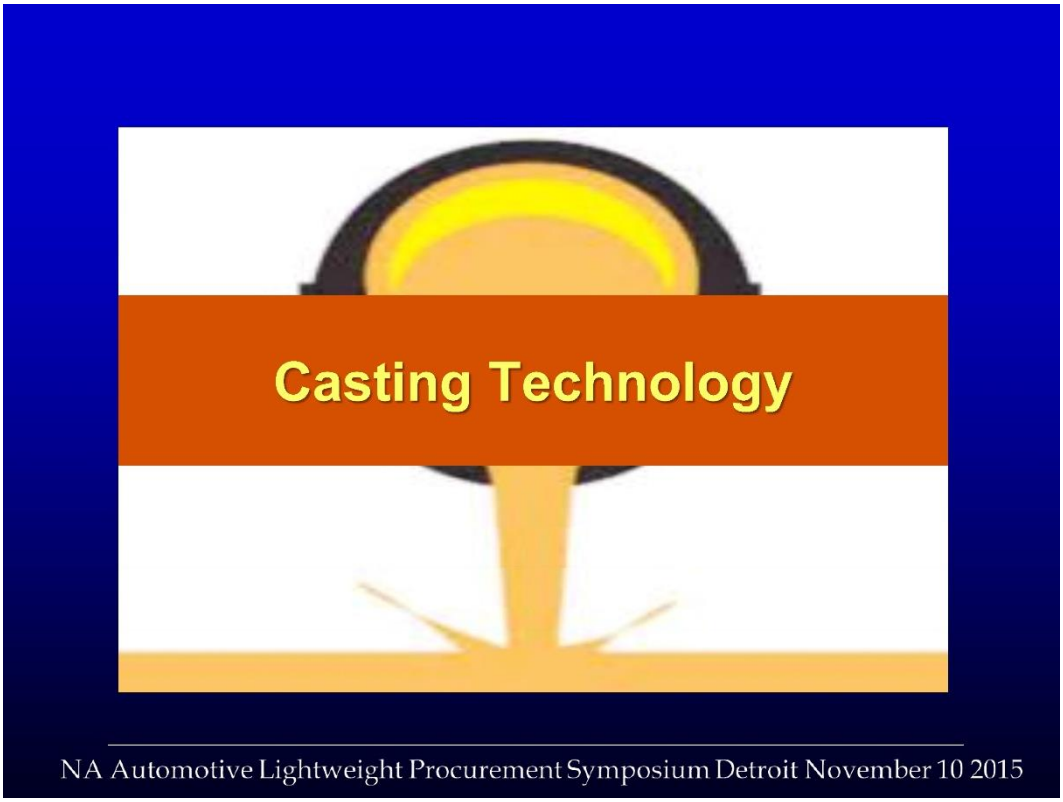

Aluminum
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Al Part Manufacturing Processes
Castings
Wrought products
Extrusions
Stamped sheet
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Automotive Insight

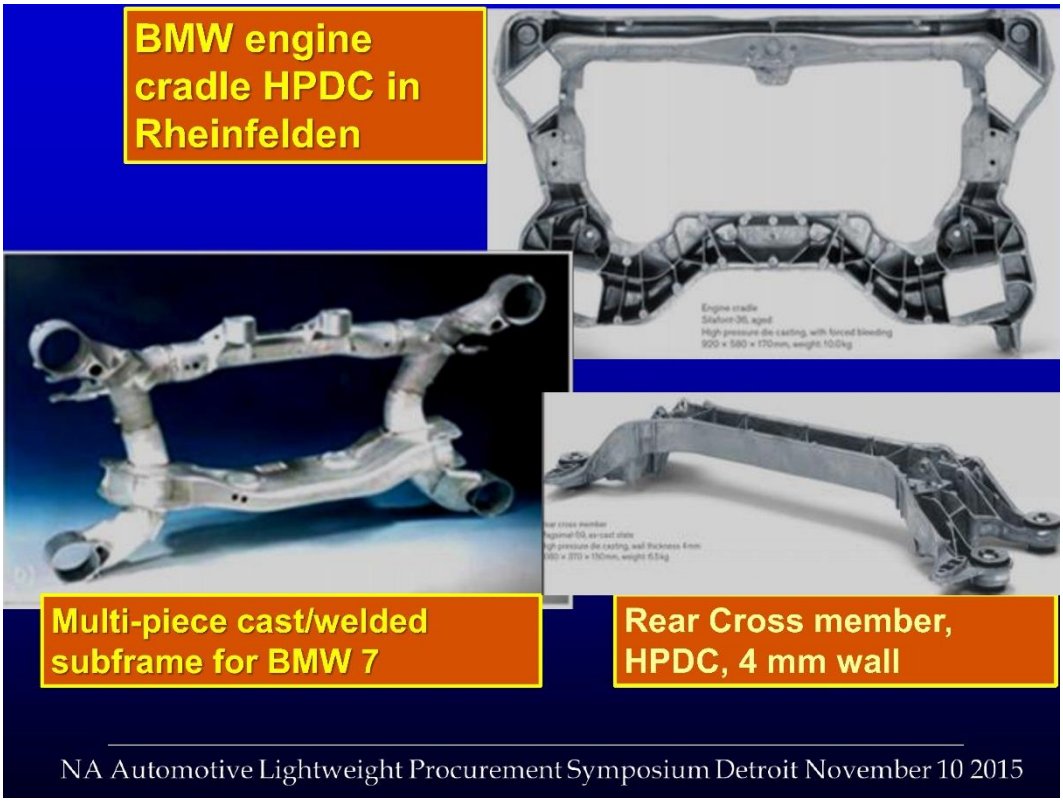


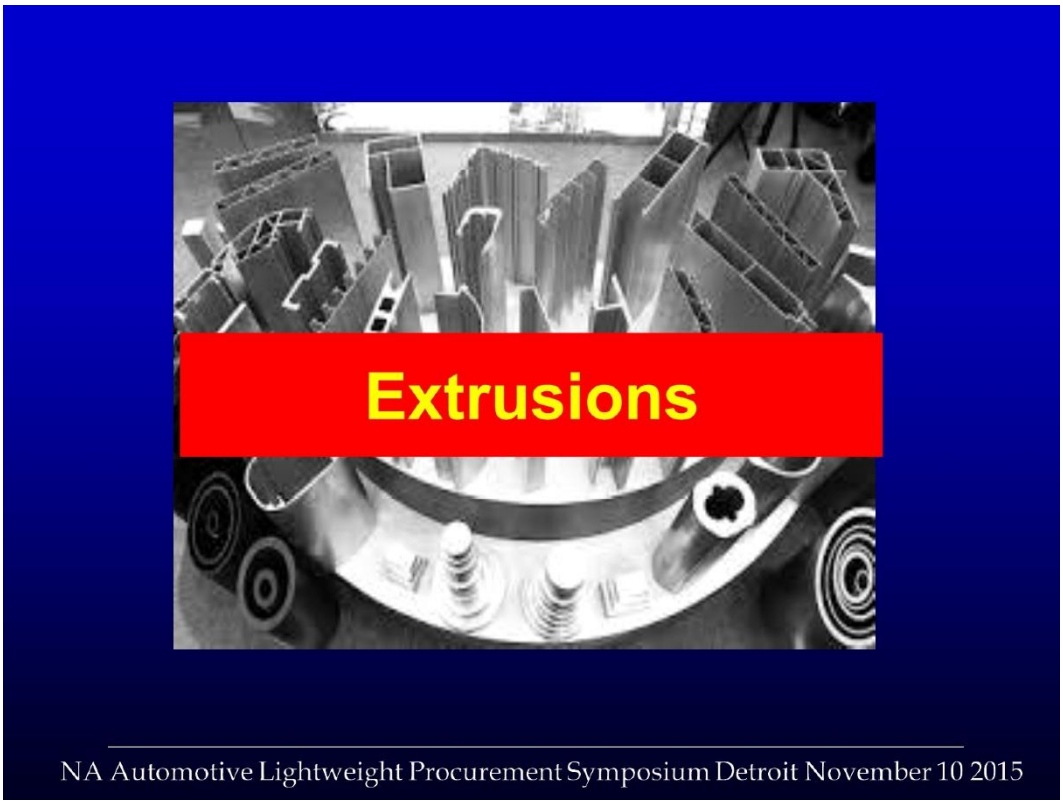


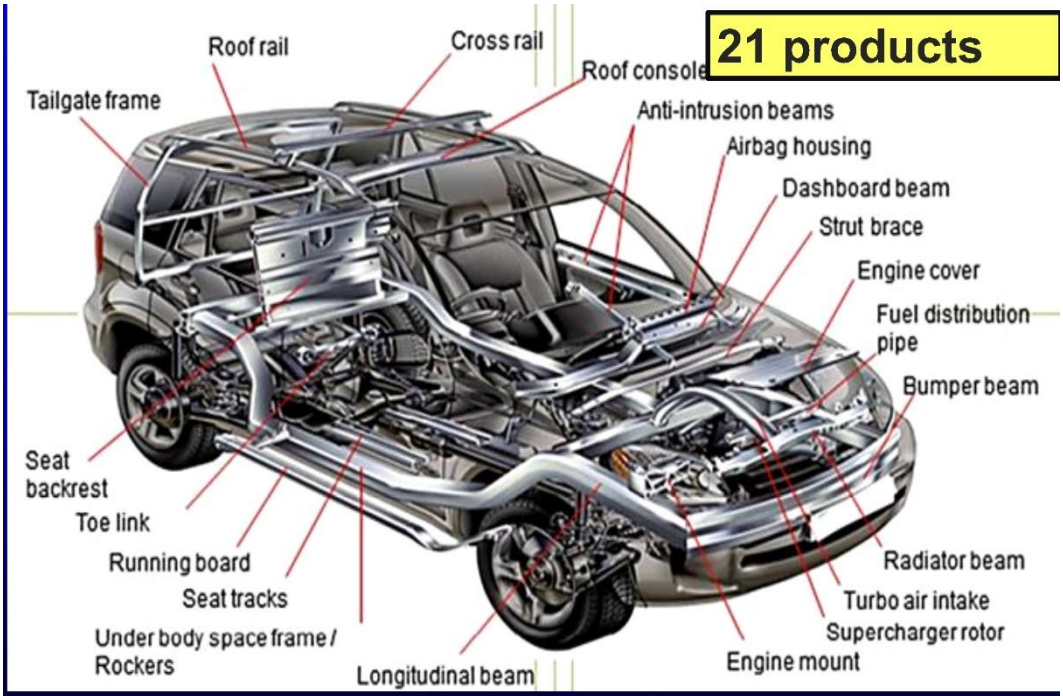


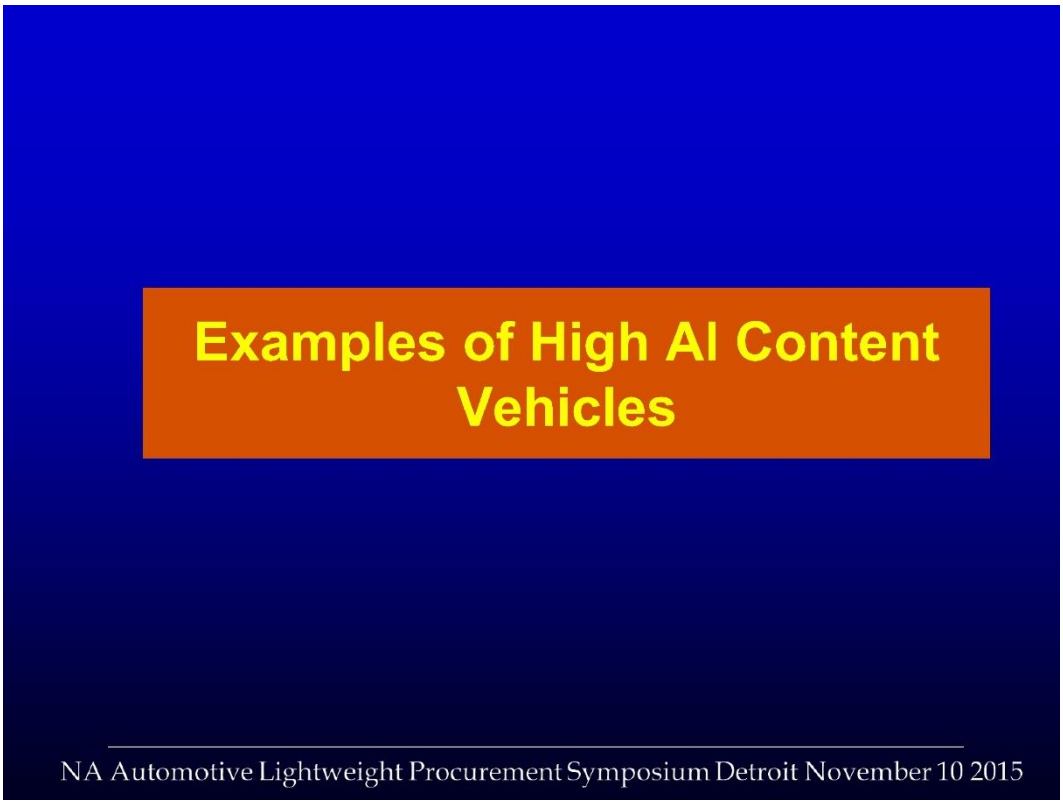
- New CAE, casting processes (LP/vacuum HPDC), & heat treat increase quality & improve fatigue & tensile properties.
- HPDC dominates for most engine blocks, heads, manifolds & transmissions .. But there are porosity & fatigue-related defects.

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


BMW engine cradle HPDC in Rheinfelden
Multi-piece cast/welded subframe for BMW 7
Rear Cross member, HPDC, 4 mm wall
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Extrusions
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


21 products
Roof rail
Cross rail
Roof console
Tailgate frame
Anti-intrusion beams
Airbag housing
Dashboard beam
Strut brace
Engine cover
Fuel distribution pipe
Bumper beam
Seat backrest
Toe link
Running board
Seat tracks
Under body space frame / Rockers
Longitudinal beam
Radiator beam
Turbo air intake
Supercharger rotor
Engine mount
Al Extrusion Council
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

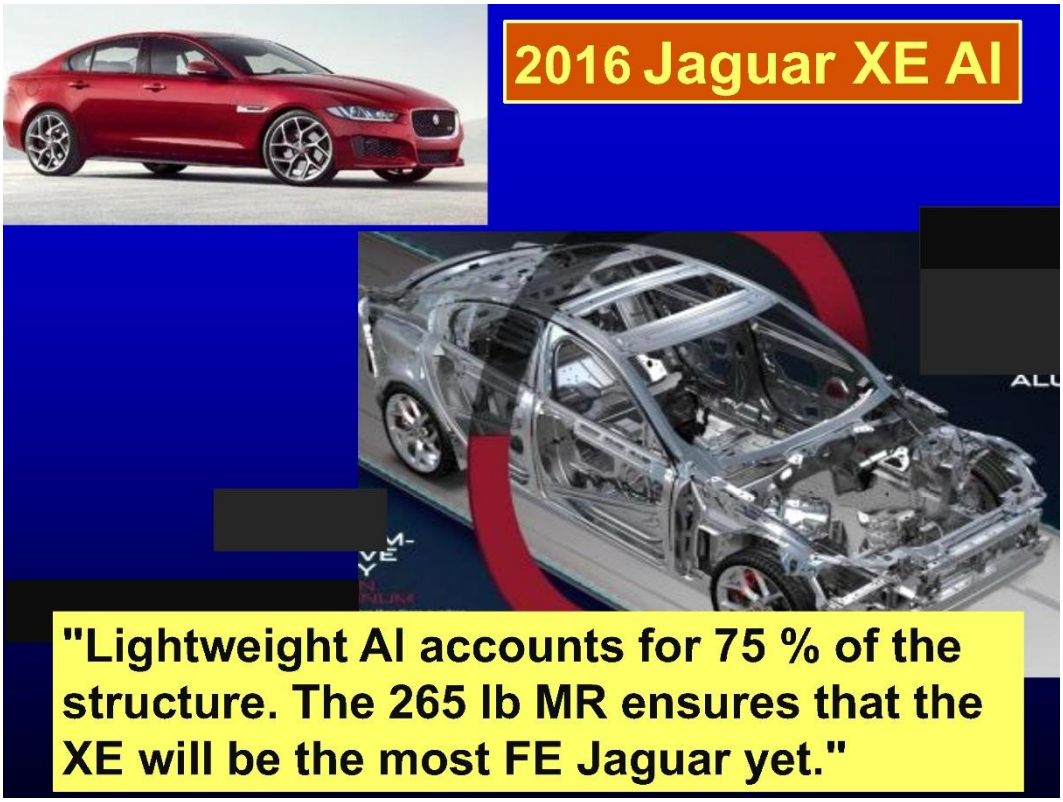

Examples of High Al Content Vehicles
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

2013 Range Rover Sport

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

- **561 kg** conventional Al & 20% higher strength AC600 PX alloy used in the sheet intensive body.
- Al 356/T6 heat treated cast alloy used for structural applications in control arms, knuckles, sub-frames & instrument panel.
- Fuel efficiency increased by ~15 % from 23 mpg to 26 mpg

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015



- More Al Vs previous: body sides, hood & fenders are stamped 6000-series. HPDC Al front suspension towers give greater stiffness.
- Self-piercing rivets/structural adhesives.
- Advanced hot-formed B steel in rear members & B-pillar reinfs.
- Mg alloys in front-end carrier & cross-car beam.

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

2015 Ford F-150 pickup truck

Most novel Al–intensive vehicle.

@ 770,000 units,

#1 vehicle sold globally

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Al body

AHSS frame

- **High-strength alloy 6000-T4: dent resistant, formable, Class A surface. 30 kg extrusions. All skins collected and recycled by Alcoa**
- **4000 rivets. New Alcoa pretreatment & adhesives.**

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

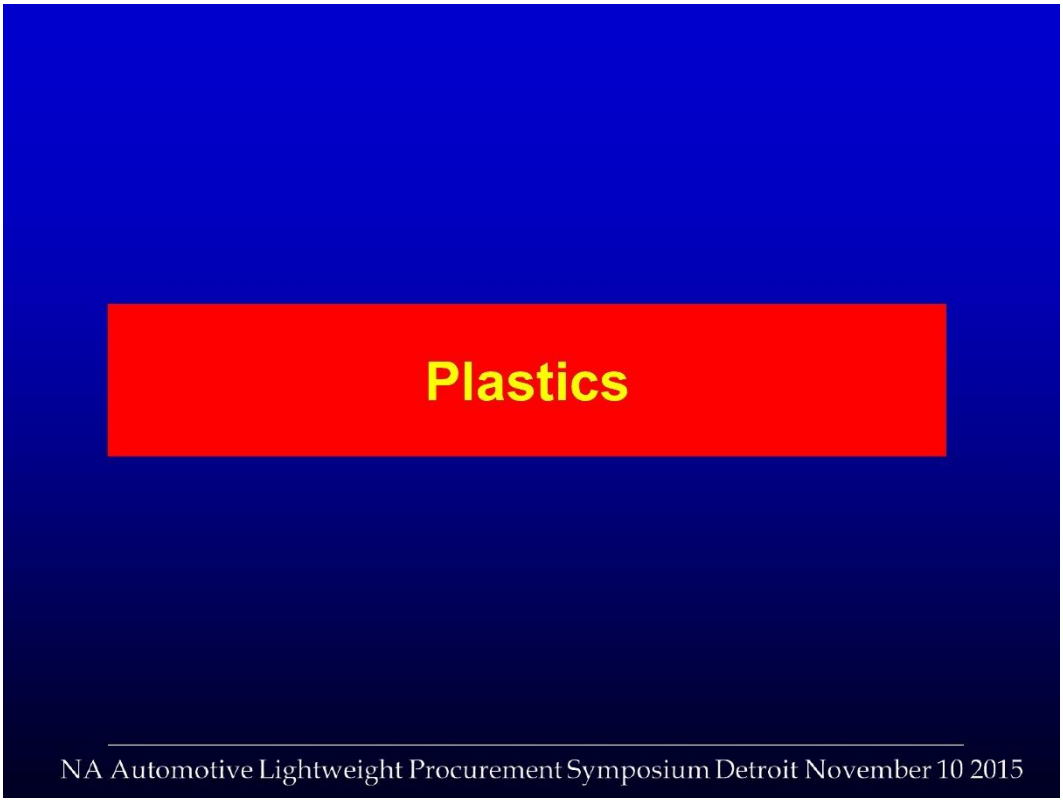
- 450 kg total Al: 300 kg in cargo box, body, hood, tailgate
- Chassis/frame: 77% HSS vs 23%
- Low mass CGI engine block *
- *~318 kg lighter (+ 12-13%)*
- 8-20% better fuel efficiency (~30 mpg)

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Ducker

- By 2025, 18% of vehicles will have all-Al bodies compared with < 1% now. By 2025, 70% of pickups could be Al intensive.
- It's a big risk but worth the effort.

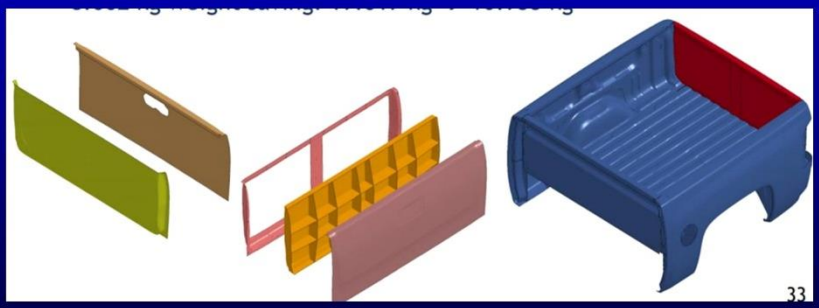
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Plastics
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Plastics Poised for Comeback
OEM's intensifying their search for MR ideas. Plastics ~ 50 % lighter vs comparable steel parts in fenders and other exterior pieces on Renault, Peugeot, Citroen, Mitsubishi and Chery vehicles.
But good computer models of crash are lacking
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Truck Bed

Steel replaced by blend of PBT or PET & polycarbonate, + polypropylene reinforced with long glass fibers



- **MR 8.66 kg (19.62 – 10.96 kg)**

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Plastic

Door Intrusion Beam

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

BMW Lightweighting

"There is no way around making cars lighter. Steel has reached its limit, and carbon fiber reinforced composites (CFRPs) are now

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

DCT (a Detroit-based company) developed a 15% C-fiber (7 µm, 50:1 aspect ratio) 85% epoxy resin blend paste.

- 1 mm paste sprayed & cured onto 0.6 mm steel sheet increased dent resistance ~ 0.8 mm thick sheet

= 20% mass reduction at no cost.

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

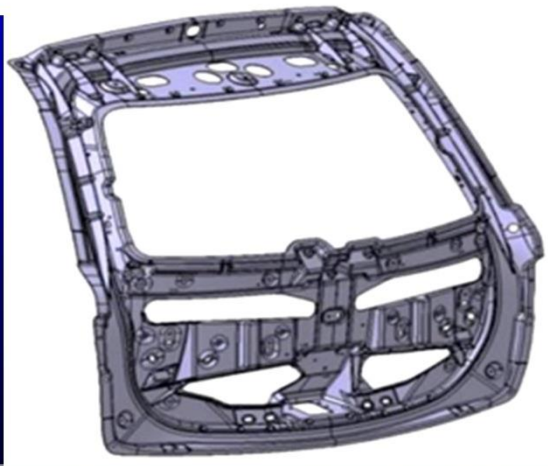

Magnesium
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


>170 kg many HPDC Mg parts DVPR certified/ installed on global vehicles over past 35 years
But the average NA vehicle contains only 6 kg
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Lincoln MKT liftgate armature

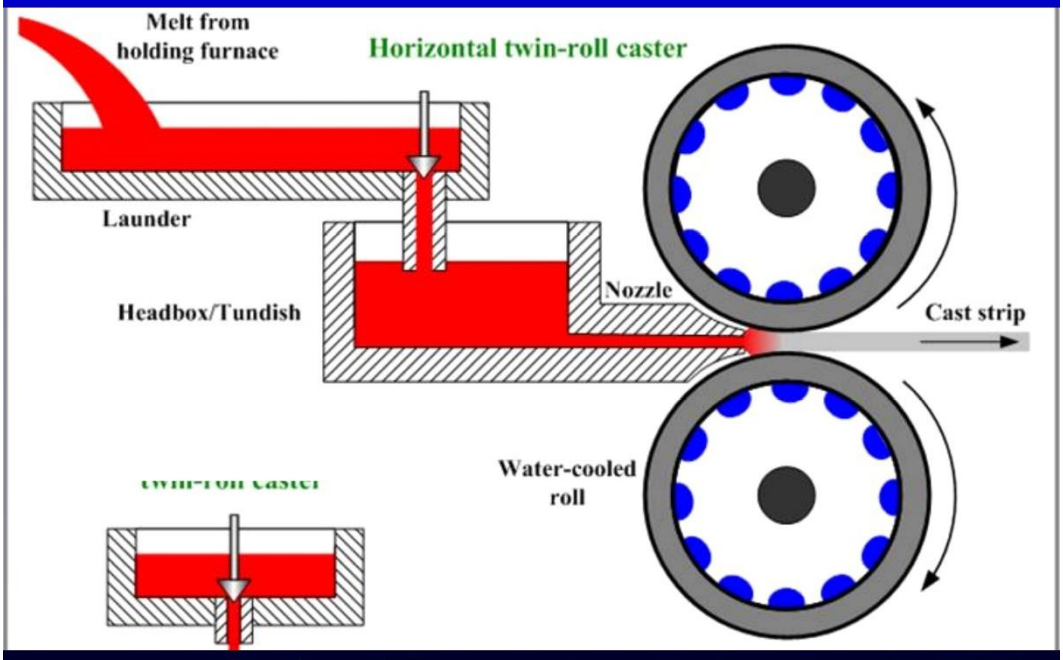
Cast Mg has tooling cost advantage over stamped Al & steel at low volumes.

Mg weighs 10kg vs steel at 20kg



NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

POSCO Next Gen Mg Technology



NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Renault Samsung Motors and POSCO invested $1.9 m to develop Mg sheet for a trunk and rear seat that weighed 1.4kg, saving 2.2kg vs the equivalent steel component… a 61 % MR.

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

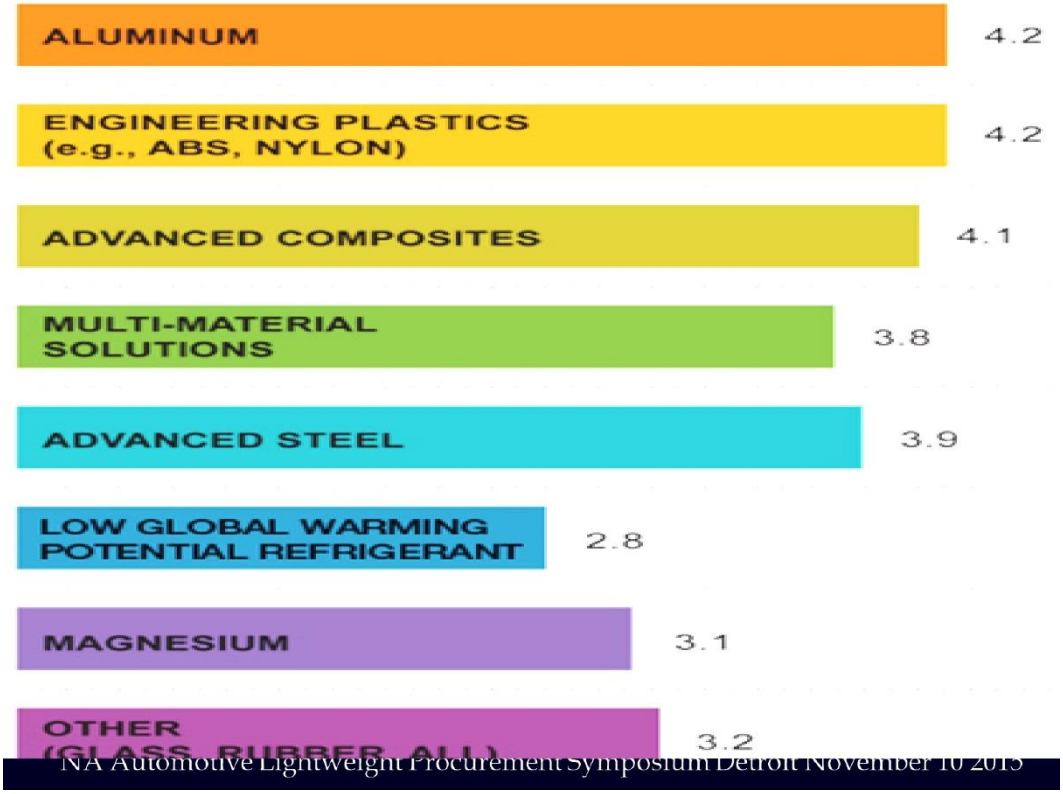
Porsche 911 Uses POSCO Mg Skin for Roof

Vehicle weight reduced by 10 kg. 30 % lighter than Al
Light roof lowers CofG, improves stability.

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Multimaterial Construction
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


SAE Survey
Rank which materials will help you reach fuel economy standards
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015



Ford Advanced Prototype Fusion

- 19-inch CFRP wheels, Δ 42%
- Composite coil springs, Δ 57%
- SS-coated Al rotors Δ39 % vs CI
- CFRP seats
- Chemically toughened laminate windows, Δ35%
- 40% MR engine block

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

BMW M3

CFRP strut brace, driveshaft, roof panel (-40% vs steel)
Al control arms, wheel hubs, subframes, hood, front panels
Engine: Twin wire arc-coated cylinder walls vs CI liner,
Mg Sump …(-10 kg),

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Joining and Assembly of Hybrid Structures

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

- Assembling hybrid structures requires unique joining, bonding & corrosion-inhibiting techniques ….requiring novel structural adhesives
- But there are concerns……
  - Crash modeling
  - Manufacturing models, SPC

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

- Surface preparation (primers)
- Adhesion properties of epoxies, hot melts, phenolics, acrylics
- Chemical reactions
- Cure time affected by environment (RH, temperature),
- Joint mechanical durability affected by fatigue & corrosion
- no good FMEA failure models

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

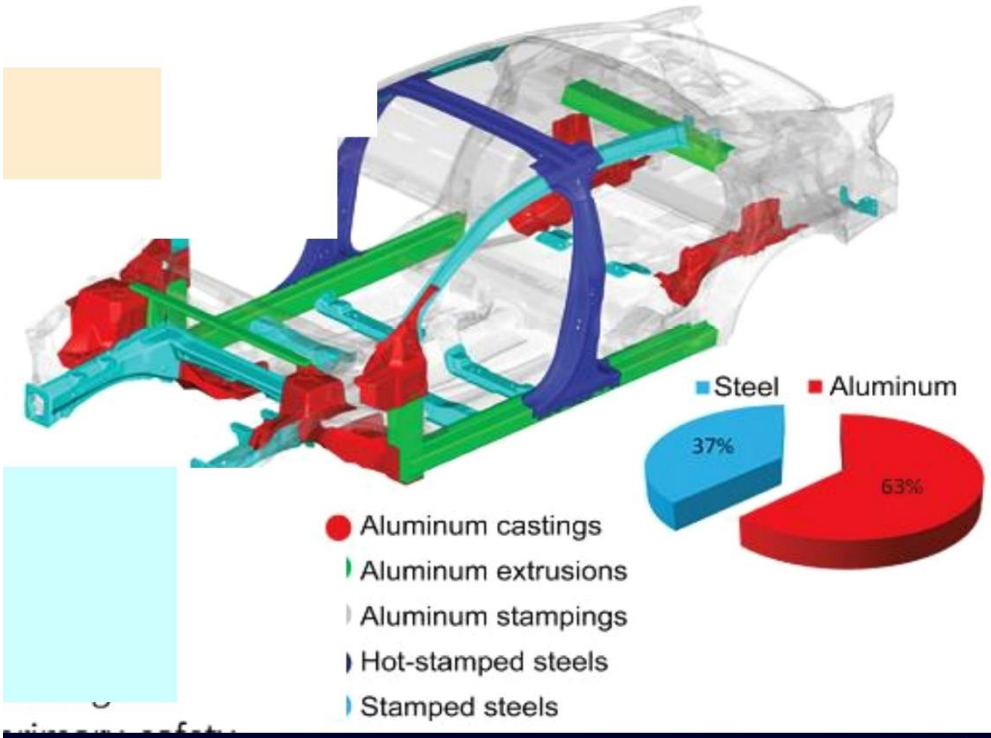
Ford (+Magna) LightWeight Concept (Multi-material) Mixed Materials

D. Wagner, M. Zalucek (Ford)
J. Conklin, T. Skszelk (Magna Intl)

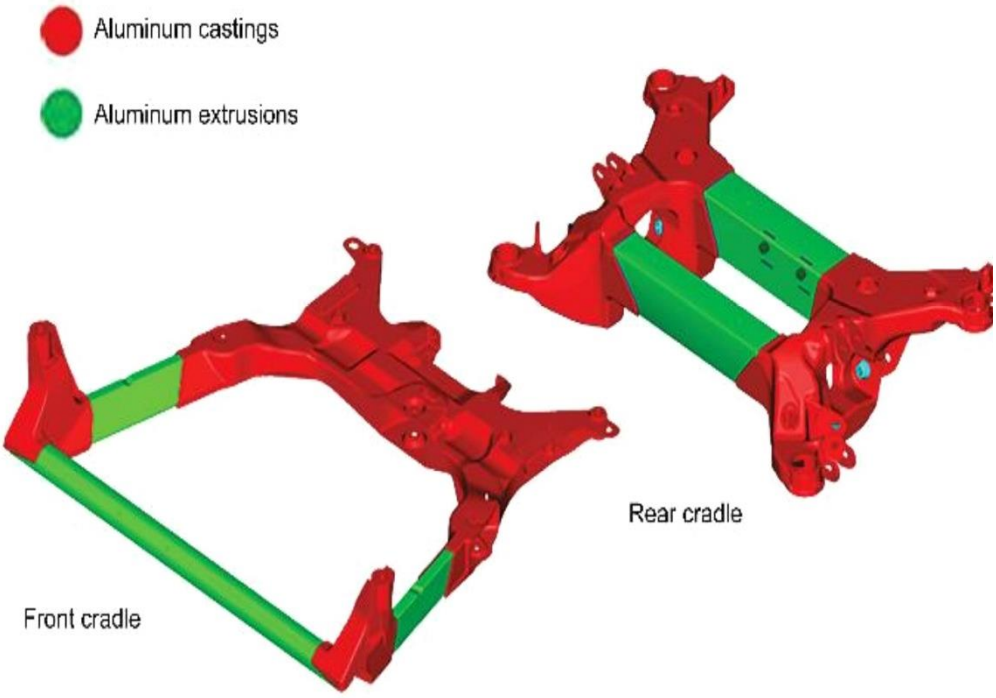
SAE 2015
ASM Advanced Materials & Processes, March

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015



NA Automotive Lightweight Procurement Symposium Detroit November 10 2015



NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Weight Reduction of Vehicle Subsystem

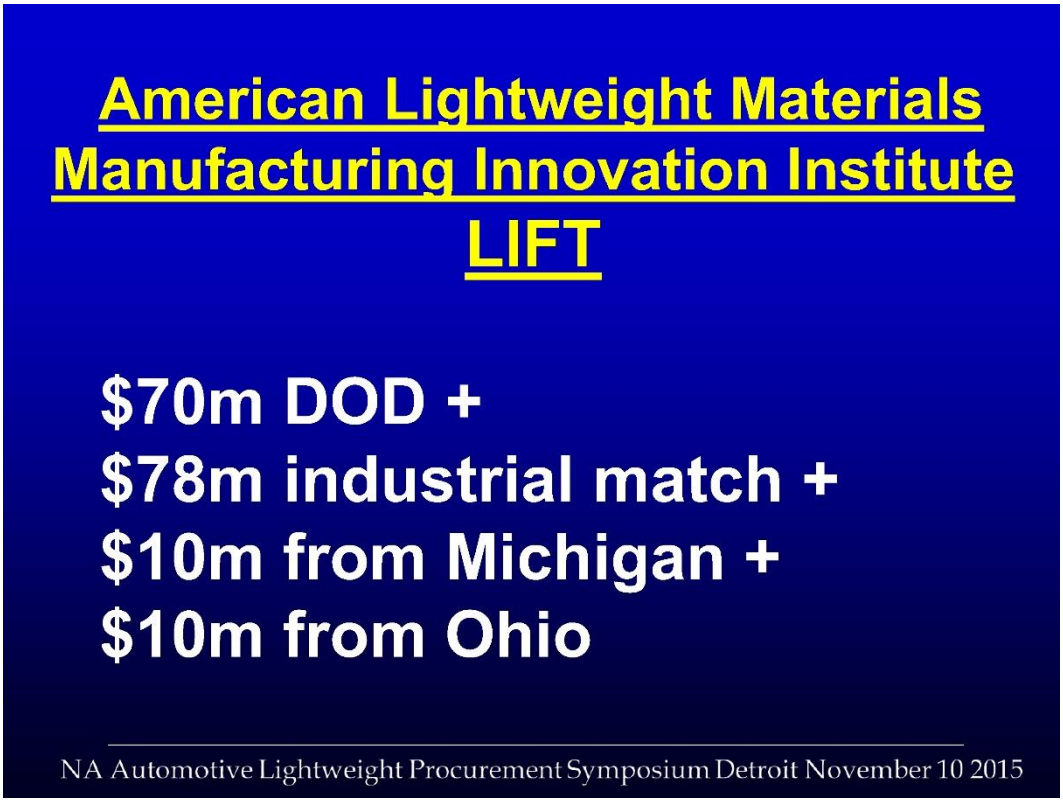
Vehicle systems and subsystems	2013 Ford Fusion weight, kg	MMLV weight, kg	MMLV curb weight, %	MMLV weight reduction, kg	MMLV weight reduction, %
1. Body	525.0	400.4	33.5%	-124.6	-23.7%
2. Interior	260.4	202.7	17.0%	-57.7	-22.2%
3. Chassis	355.0	260.0	21.8%	-95.0	-26.8%
4. Powertrain	337.0	263.1	22.0%	-73.9	-21.9%
5. Electrical	57.0	49.5	4.1%	-7.5	-13.1%
A. Assembly	25.0	19.5	1.6%	-5.5	-22.0%
Total vehicle	**1559.4**	**1195.2**	**100%**	**-364.2**	**-23.4%**

Material	2013 Fusion	MM LV
AHSS	418	67
Conventional	414	290
Cast Iron	50	20
DC Al	146	148
Stamped Al	13	144
Extruded Al	16	67
Forged Al	0	10
Magnesium	2	16
Plastic	235	177
TOTAL	1560	1195 kg

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Governments are pushing emissions reduction and fuel economy
They fund lightweighting RTD as a way to achieve their goals
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


NIST- New National Center for Automotive Lightweighting
Investigate how new vehicle materials hold up in collision, which is strongly influenced by material, part shape and stresses from body forming.
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


American Lightweight Materials Manufacturing Innovation Institute LIFT
$70m DOD +
$78m industrial match +
$10m from Michigan +
$10m from Ohio
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Establish regional manufacturing ecosystem to move cutting edge light metals out of lab & into commercial/ military: cars, trucks, planes & ships.
Help educate next generation manufacturing technical workforce.
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015



MFERD

Magnesium Intensive Front End R&D Project

(100 engineers and scientists from the 3 countries)

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Goal

- Demonstrate casting, extrusion, sheet & joining techniques of Mg in auto body structures.
- Predict & validate performance of Mg: crashworthiness, corrosion, fatigue & durability
- Part is 38 kg lighter than typical front-end steel structure.

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

Cost of Mass Reduction

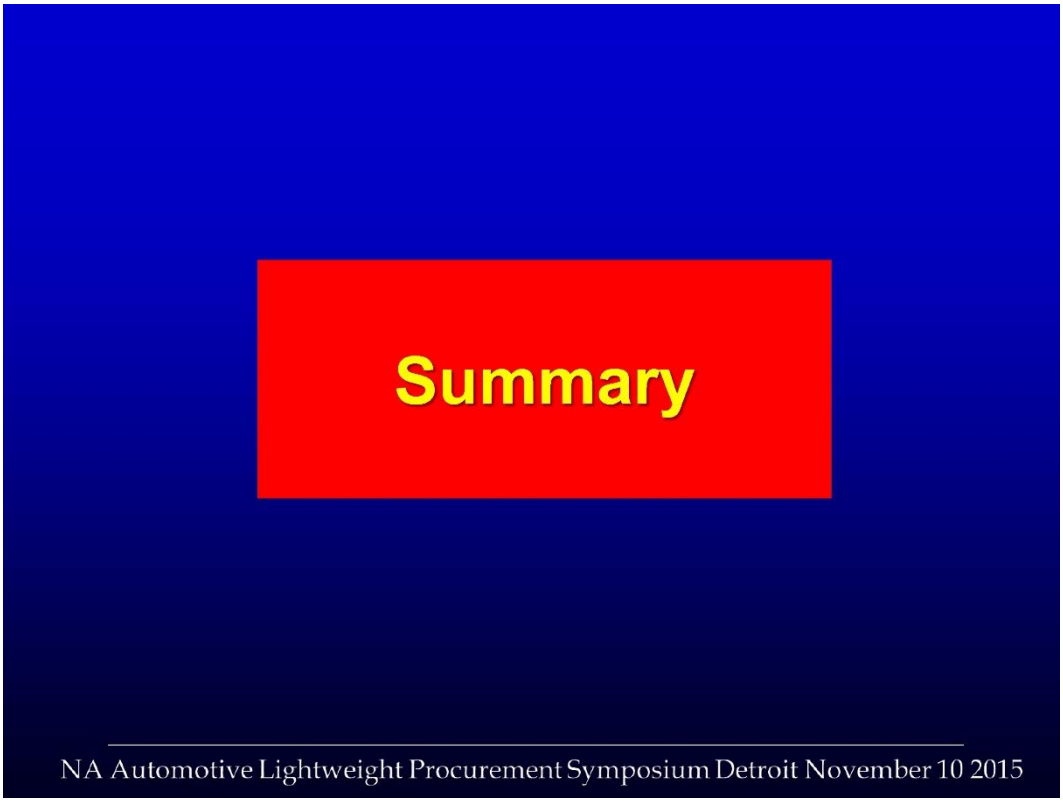
"How much will OEM's pay to meet CAFÉ requirements".

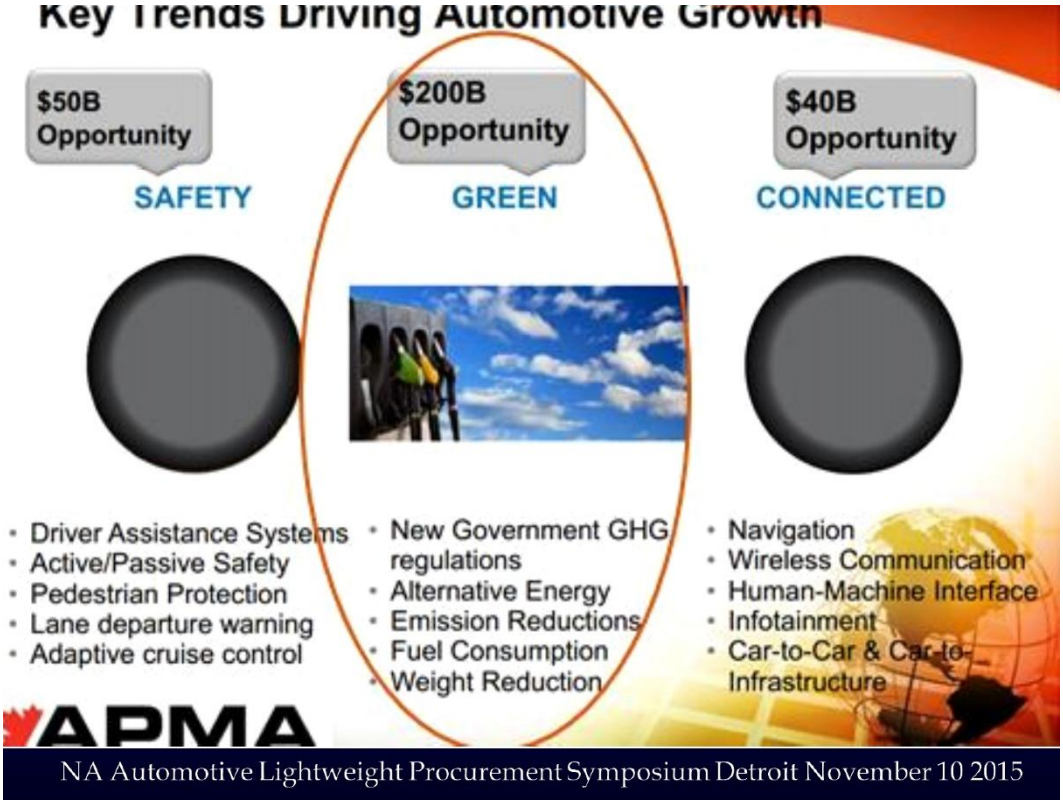
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

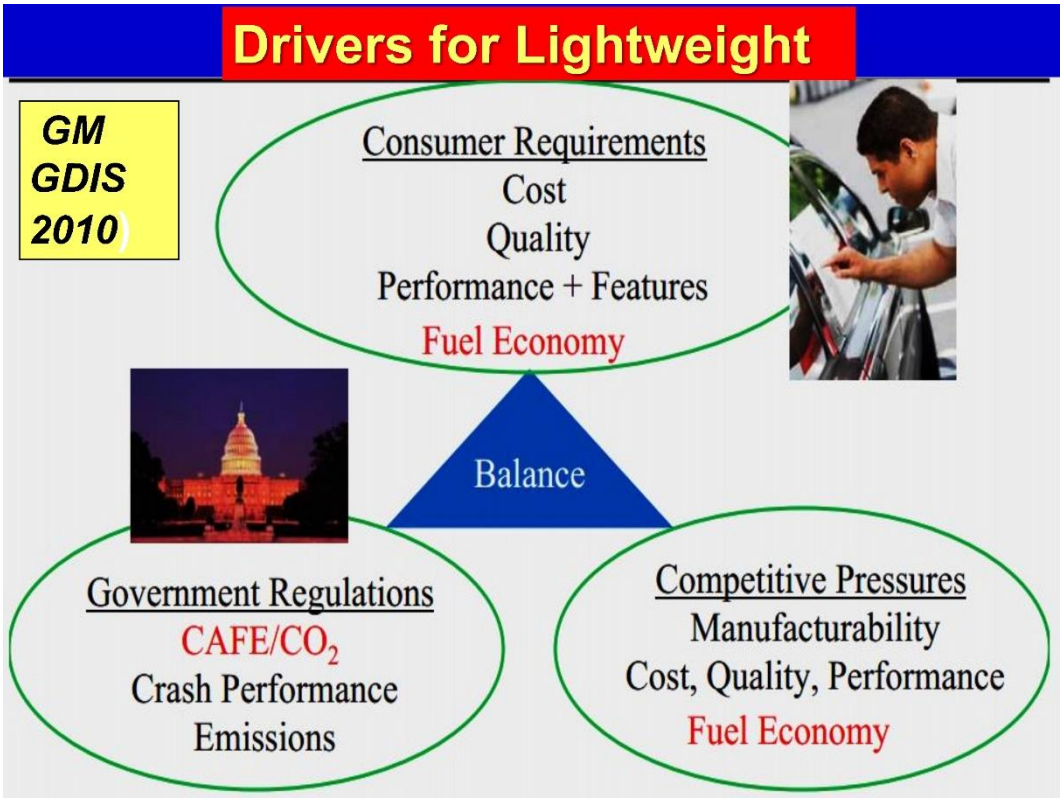
Mass Reduction Costs

- Ducker report (2011):
  - 10% MR costs $500/vehicle
- C.A.R. study (2013):
  - 15 % MR costs $1,160/vehicle
- MIT study (2008) Cost of Δ1% FE:
  - $130 Diesel,
  - $110-220 Hybrid PT,
  - $80-$180 Mass Reduction
- Ford (2015) $3.18 per lb in suspension

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015


Summary
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

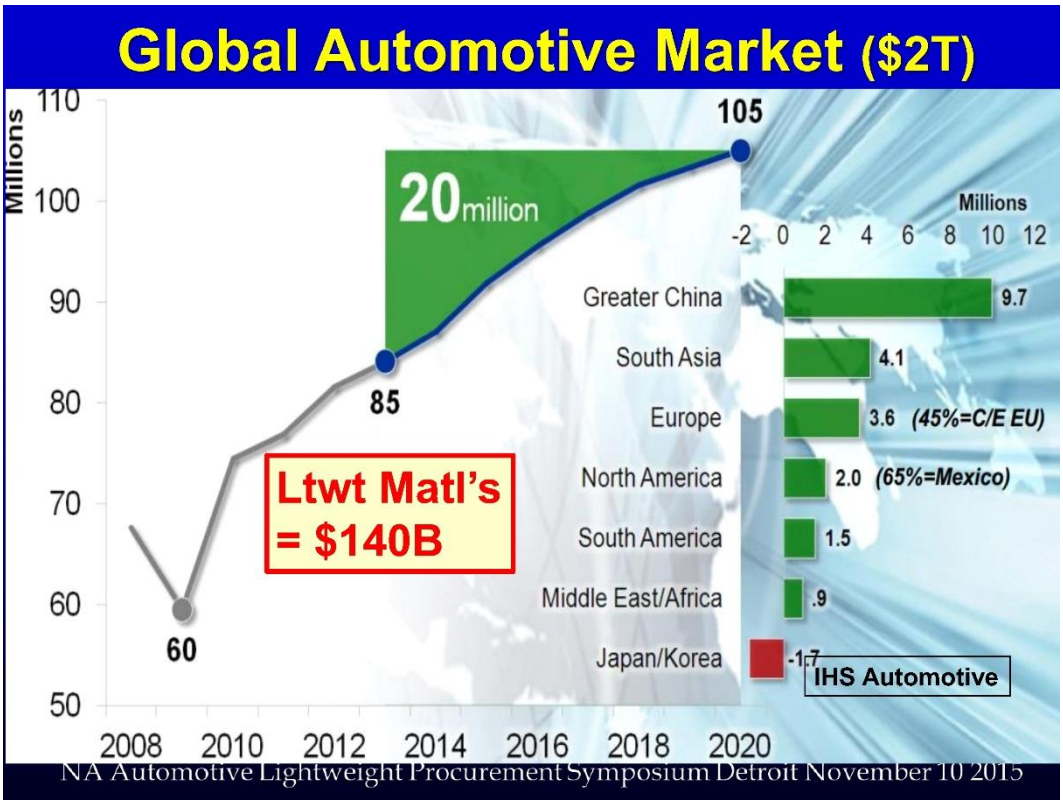

Key Trends Driving Automotive Growth
$50B Opportunity
SAFETY
$200B Opportunity
GREEN
$40B Opportunity
CONNECTED
• Driver Assistance Systems
• Active/Passive Safety
• Pedestrian Protection
• Lane departure warning
• Adaptive cruise control
• New Government GHG regulations
• Alternative Energy
• Emission Reductions
• Fuel Consumption
• Weight Reduction
• Navigation
• Wireless Communication
• Human-Machine Interface
• Infotainment
• Car-to-Car & Car-to-Infrastructure
APMA
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

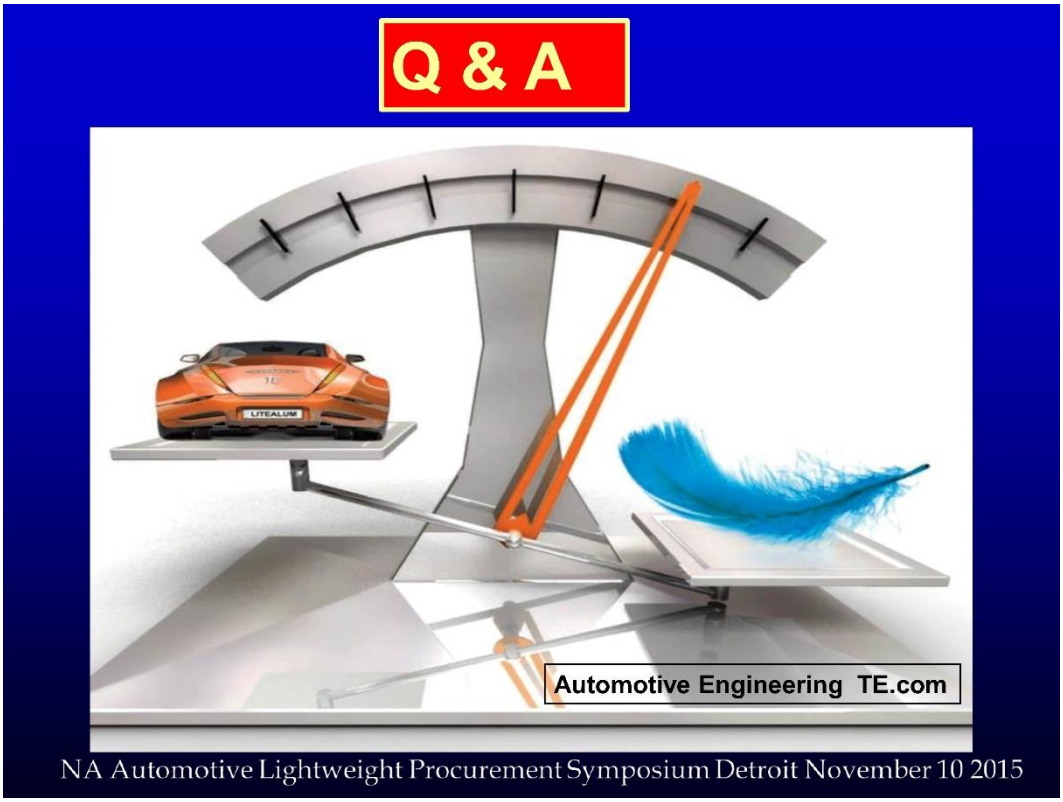

Drivers for Lightweight
GM
GDIS
2010)
Consumer Requirements
Cost
Quality
Performance + Features
Fuel Economy
Balance
Government Regulations
CAFE/CO_2
Crash Performance
Emissions
Competitive Pressures
Manufacturability
Cost, Quality, Performance
Fuel Economy


Material Challenges
(ASM 4/13/2015)
Automotive lightweighting is the key to achieve the challenging goals of vehicle:
➢Weight reduction,
➢Fuel efficiency and
➢Performance improvement
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

- Weight reduction requires new materials to have a higher specific strength and stiffness.
- Multi material solutions are the key to successfully develop affordable safe & fuel efficient vehicles: robust & efficient joining technology is crucial

NA Automotive Lightweight Procurement Symposium Detroit November 10 2015




Q & A
LITEALUM
Automotive Engineering TE.com
NA Automotive Lightweight Procurement Symposium Detroit November 10 2015

We Welcome You To Our Next Event

Organized by AluMag

CONTACTS & PROJECT TEAM

Mr. Jost GAERTNER
Managing Partner
AluMag® Automotive GmbH
Kirchplatz 1a
58706 Menden
GERMANY
Tel.: +49 2373 929492
j.gaertner@alumag.de

German & English

Mr. Jesper Ove LARSEN
Manager Market Research
AluMag® Scandinavia
Byagervænget 69
8330 Beder
DENMARK
Cell: +45 2573 8790
j.larsen@alumag.de

German & English & Danish

Mr. Roberto BOEKER
Managing Partner
AluMag® Automotive
42056 Michigan Avenue
Canton, MI 48188
USA
Cell: +1 248 962 5086
r.boeker@alumag.de

English & German & Spanish

AluMag®
Europe ■ India ■ Americas ■ Asia
THE MARKET DEVELOPER

Mr. Ricardo SCHOER
Senior Consultent
AluMag® Automotive
Av. San Antonio 189-131
Col. Napoles 03810
MEXICO
Cell: +52 55 4002 0501
r.schoer@alumag.de

English & German & Spanish

Ms. Ying ZHOU
Project Coordinator Japan & China
AluMag® Automotive GmbH
Kirchplatz 1a
58706 Menden
GERMANY
Cell: +49 172 6415876
y.zhou@alumag.de

German & English & Chinese & Japanese

Mr. Thomas KATCHMARK
New Business Development Manager
AluMag® Automotive
20929 Sunnydale
Farmington Hills, MI 48336
USA
Cell: +1 313 410 0865
t.katchmark@alumag.de

English