Automotive Body Sheet
Aluminum and Steel Market

AMM DRI and Mini-Mills Conference
Sept 2014
# Automotive Potential

<table>
<thead>
<tr>
<th></th>
<th>2013</th>
<th>2025</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Auto Build</td>
<td>81.2 M</td>
<td>100 – 125M</td>
</tr>
<tr>
<td>NA Auto Build</td>
<td>15.4 M</td>
<td>20 – 22 M</td>
</tr>
<tr>
<td>Average AL use in NA vehicle:</td>
<td>364 lbs.</td>
<td>550-650 lbs.</td>
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<tr>
<td>Total Auto AL NA Consumption</td>
<td>5.1 B lbs.</td>
<td>8 – 10 B lbs.</td>
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<tr>
<td>Total NA Total AL Sheet</td>
<td>.7 B lbs.</td>
<td>3 – 5 B lbs.</td>
</tr>
<tr>
<td>Total NA Extrusion</td>
<td>27 lbs/auto</td>
<td>49 lbs/auto</td>
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Notes:
- Some forecast 100 Global Build By 2020
- 85%+ of new application aluminum growth will be wrought alloy
- Of the wrought alloy growth 85% is sheet, 15% is extrusion
- 2013 auto sheet was around .3 billion pounds with F150 auto sheet may grow to .8 billion in 2014 and 1.3 billion in 2015
Global Reduction of CO2

Key Region/Country Absolute and Annual CO2 Rate Comparison

- EU: Baseline 2020: 95
- US: Baseline 2025: 107
- Japan: Baseline 2020: 105
- China: Baseline 2015: 185

Annual Rate:
- US: 1.5% annually
- China: 4.7% annually
- Japan: 3.9% annually
- EU: 2% annually

Notes:
[1] China’s target reflects gasoline fleet scenario. If including other fuel types, the target will be lower.

Source: Patrik Ragnarsson Automotive & Transport Technical Manager Europe Aluminium Association
NA Automotive Challenge

• Average Fleet 34.1 MPG By 2016 Achievable
• Average Fleet 54.5 MGP By 2025 Barriers

• The Challenge:
  “Double MPG and cut CO2 emission by 50% by 2025 while maintaining safety, comfort, product size mix, customer features, functionality, and HP to weight ratio to maintain performance.”
Weight savings is expected to provide 3 to 6 miles per gallon of fuel economy improvement by 2025. Aluminum directly or indirectly will provide much of this savings.

Ducker Worldwide (adjusted)

2025 Sources of Improvement in CO2 Reduction and Real Fuel Economy

- Internal Combustion, Transmission and other Improvements
- HEV, PHEV and EV
- Weight Reduction

*Other improvements include drag & friction reduction, Aerodynamics, HVAC optimization

20 more MPG
## Steels Available to OEMs

<table>
<thead>
<tr>
<th>Category</th>
<th>Quality Grade</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low and ultra low carbon steels</td>
<td>CQ</td>
<td></td>
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<tr>
<td></td>
<td>DQ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DDQ</td>
<td></td>
</tr>
<tr>
<td>Extra Deep Drawing Quality</td>
<td>EDDQ</td>
<td></td>
</tr>
<tr>
<td>Conventional High Strength Steels</td>
<td>IF steels</td>
<td>IF180 - IF300</td>
</tr>
<tr>
<td></td>
<td>Bake Hardening steels</td>
<td>180 BH - 300 BH</td>
</tr>
<tr>
<td></td>
<td>Carbon manganese steels</td>
<td>CMN250</td>
</tr>
<tr>
<td>High Strength Low Alloy Steels</td>
<td></td>
<td>HSLA260 - HSLA420</td>
</tr>
<tr>
<td>Advanced/Ultra High Strength Steels</td>
<td>Dual Phase steels</td>
<td>DP450 - DP 1180</td>
</tr>
<tr>
<td></td>
<td>Complex Phase steels</td>
<td>CP600 - CP1180</td>
</tr>
<tr>
<td></td>
<td>TRIP steels</td>
<td>TRIP590 - TRIP980</td>
</tr>
<tr>
<td></td>
<td>Martensite steels</td>
<td>MS780 - MS980</td>
</tr>
<tr>
<td></td>
<td>TWIP steels</td>
<td>TWIP1-5</td>
</tr>
<tr>
<td></td>
<td>Boron or Press Hardened Steels &amp; Generation Three Steels</td>
<td>M980 - M1500</td>
</tr>
</tbody>
</table>

All Raw Materials Consulting
OEM View of Savings Weight

Body and Closure Weight Savings Cost Curve
Excludes Cost Savings from Engine Resize and other Weight Reduction Compounding

The new steels are very cost effective, but do not save enough weight

Ultimately OEMs must add more weight savings and cost with aluminum

Cumulative Cost

Cumulative Kilograms Saved per Vehicle
North American Light Vehicle Production Forecasts

Source: I.H.S., Ducker Analysis
Is auto production growth the shining star for the US steel industry?

- Materials will prosper

- Mild steel will lose a significant portion of existing automotive real-estate to:
  - Aluminum
  - Advanced Steel
  - Other materials
New Aluminum Programs

- 2013 Range Rover
  - Aluminum Body
  - 31.4 MPG Fuel Economy
  - Over 900 lbs. weight savings

- 2015 Model Ford F150
  - Aluminum Body
  - 570 pounds of finished sheet
  - 1000 lbs total aluminum
  - ?? MPG/20 %
  - 700 lbs. weight savings

“Huge Risk”
“Big Reward”
### 2012 B&C Part Volume
- **81%**: Mild and HSLA
- **18%**: AHSS/UHSS
- **1%**: All Raw Materials Consulting
- **1%**: Consulting

### 2015 B&C Part Volume
- **71%**: Mild and HSLA
- **6%**: AHSS/UHSS
- **2%**: Aluminum Sheet
- **2%**: Aluminum Extrusions
- **1%**: Aluminum VD Castings

### 2020 B&C Part Volume
- **52%**: Mild and HSLA
- **31%**: AHSS/UHSS
- **15%**: Aluminum Sheet
- **1%**: Aluminum Extrusions
- **1%**: Aluminum VD Castings

### 2025 B&C Part Volume
- **33%**: Mild and HSLA
- **23%**: AHSS/UHSS
- **2%**: Aluminum Sheet
- **2%**: Aluminum Extrusions
- **1%**: Aluminum VD Castings

Source: Ducker Intelligence
As NA approaches a steady state on aluminum sheet shipments for light vehicles, end of life aluminum sources and the closed loop recycling of engineered scrap will decrease the need for primary aluminum to 45% in 2035 from 80% in 2015.
Automotive growth in the US impact on scrap

- Engineered Prompt Scrap:
  - Over next 10 years mix of mild steel body sheet scrap could be reduced by some 30%, replaced by aluminum scrap
  - Aluminum scrap is planned to be efficiently closed loop recycled directly with primary aluminum mills
Automotive growth in the US impact on scrap

- Automotive Post Consumer Scrap:
  - Percentage of mild steel will diminish slowly over next 10 years mix replace by aluminum and advanced steels with volumes peaking 20 years
  - Post aluminum body scrap needs to be segregated to realize maximum value
  - Scrap collections and processing will adjust processes and handling
Long Range Concerns:
- Will premium foundry grade bundles be effected resulting in iron foundries changing scrap mix and melting practices?

- What will impact to steel and mini-mills be?
Conclusions:

- Steel industry and OEMs need to develop closed loop recycling of engineered scrap:
  - Ensure maximize value
  - Maintain cost margin over aluminum
- Market publications will adjust grades and prices to reflect changes in market materials and demand
- Will scrap users see significant change due to alloy changes in scrap mix over time?
Conclusions

- Automotive scrap processing will be challenged
- Steel industry will have winners:
  - Aluminum rolling mills
  - Advance steel & low cost mild steel producers
  - Nimble and efficient scrap companies

- Losers:
  - High cost mild steel production
  - Limited capability scrap companies
Thank You

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