Novelis Aluminium New Progresses in Auto BiW Lightweight Applications

Presented by
James Liu
Managing Director, Novelis China
Agenda

- Overview: Aluminum Sheet in Automotive Applications
- Explosive Growth Ahead
- Novelis – Leading the Way
- The Jaguar XJ Example
A Little Bit of History

1970

Porsche 928 (hood, fender, door)

1980

Daimler S Class (hood, decklid)

Land Rover Discovery 1 (hood, fender, door)

1990

Audi A2 (sheet)

Audi A8 ASF (single sheet supplier)

2000

Jaguar XJ with full aluminium body

Audi A6 (curved blanks)

Novelis Fusion™
In BMW 5 series, 7 series and GT.
Novelis wins BMW supplier innovation award

2010

2013 All-aluminum body Mercedes SL

Aluminium goes global:
Extended aluminium usage in automotive BIW also in smaller car and truck segments

Not just aluminum, Novelis Aluminum.
The need to reduce CO₂ emissions is the #1 driver globally for increased adoption of Aluminum

- Weight reduction: 100 kg
- Fuel reduction: 0.3 – 0.5 L/100 km
- Reduction incl. 2nd-ary measures: 0.8 – 1.1 kg CO₂/100 km

Lightweight design is key to sustainable mobility, globally

Auto CO₂ Emission Trend (in g/km)

July 2011: New CAFE standards of 54.5 mpg for American vehicle fleets by 2025
- CO₂ emissions reduced to 102 g/km

- CO₂ emissions reduced to 112.5 g/km

Source: International Council on Clean Transportation (ICCT)

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Weight Reduction Improves Fuel Economy

<table>
<thead>
<tr>
<th></th>
<th>Passenger Vehicle</th>
<th></th>
<th>Truck</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base Engine</td>
<td>Downsized Engine</td>
<td>Base Engine</td>
</tr>
<tr>
<td>Gasoline</td>
<td>3.3 %</td>
<td>6.5 %</td>
<td>3.5 %</td>
</tr>
<tr>
<td>Diesel</td>
<td>3.9 %</td>
<td>6.3%</td>
<td>3.6 %</td>
</tr>
<tr>
<td>PEV</td>
<td>6.3 % *</td>
<td></td>
<td>5.7 % *</td>
</tr>
<tr>
<td>PHEV</td>
<td>6.3 % *</td>
<td></td>
<td>5.7 % *</td>
</tr>
</tbody>
</table>

* Miles/KWH

Source: Ricardo Consulting Engineers

Not just aluminum, Novelis Aluminum.
Virtuous Circle of Weight Reduction

Reduced body weight creates a virtuous circle of weight reduction.

Every 100kg saved in the vehicle mass saves around 2% in fuel consumption.

8% better fuel efficiency overall as a direct result of the weight saving.
LWV Strategy – BIW weight save

39% 180kg LIGHTER THAN THE STEEL EQUIVALENT

Competitor B CD car body +23 kg
Competitor A Small SUV body +85 kg

EuroCarBody, Oct 2012

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Body Complete Material Breakdown

- Al sheet 6xxx: 37%
- Al sheet 5xxx: 15%
- Al casting: 6%
- Al extrusion: 4%
- HSS steel: 1%
- PHS steel: 1%

by mass

EuroCarBody, Oct 2012

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Aluminium – Material of Choice

Reduced Weight
Up to 40% weight reduction in key automotive components

High Strength
Great strength and energy absorption

Resistance to Corrosion
Aluminium oxide coating prevents corrosion

Excellent Formability
Excellent class-A surface, sharp design

Recyclability
Nearly 90% of auto aluminium is recovered and recycled

Adaptability
Strong thermal and electrical conductivity

Source: EAA

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Not just aluminum, Novelis Aluminum.
## Material Competition – material?

<table>
<thead>
<tr>
<th>Material</th>
<th>Price</th>
<th>Pot weight saving (vs. steel)</th>
<th>Use/applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>$4-6/kg</td>
<td>20-45%</td>
<td>Hang on’s, moving into structure</td>
</tr>
<tr>
<td>Steel</td>
<td>$1.3/kg</td>
<td>10%</td>
<td>Main structure, body shell, safety crash</td>
</tr>
<tr>
<td>Titanium</td>
<td>$33-105/kg</td>
<td>50%</td>
<td>For rigidity parts low series</td>
</tr>
<tr>
<td>Magnesium</td>
<td>$13-26/kg</td>
<td>30-50%</td>
<td>Complex use with coating</td>
</tr>
<tr>
<td>Carbon Fiber</td>
<td>$52-105/kg</td>
<td>50%</td>
<td>Crash, high strength-rigidity, skin ??</td>
</tr>
</tbody>
</table>

Source: Dr Füller, New Developments in Sheet Metal Forming
Schwabenlandhalle Fellbach, 04./05. Mai 2010
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North American Auto Market

- Uses 90kg more Aluminum (90% of which is FRP) in 2025
- Combined with other materials, this saves 180kg/vehicle
- Estimated cost for weight savings <$1000/vehicle
- No compromise in vehicle size
- 10% weight reduction equals 5–7% fuel economy improvement

Not just aluminum, Novelis Aluminum.
North American Auto Market

80 kg FRP/vehicle * 15M vehicles/year

= 1.2M tons/year finished parts

= >2M tons/year FRP Coil

= ~ 2x current Novelis North American Total FRP Production

THIS WOULD REQUIRE:
European Story

Europe will increase aluminum content by >25 kg/vehicle by 2025.
European Story

25 kg FRP/vehicle * 20M vehicles/year
= 500 kt/year finished parts
= >800 kt/year FRP Coil
= ~.8x Europe Novelis Capacity

THIS WOULD REQUIRE:

Not just aluminum, Novelis Aluminum.
If Asia realizes *just over 50%* of the growth expected in North America...
Asian Story

45 kg FRP/vehicle * 35M vehicles/year
= 1.6M tons/year finished parts
= >2.6M tons/year FRP Coil

THIS WOULD REQUIRE:

5 New Integrated Plants like Oswego
20 New Cash Lines
Aluminum in Perspective – vs. Steel

- Steel FRP demand will significantly increase despite material substitution
- Large long-term growth potential for aluminum: Although AL-BiW will have a strong CAGR\textsubscript{11-25} of 15-20%, it will remain a small player in comparison to steel

2011: 30 Mio Tons FRP BiW Demand

Steel: 99%
Al: 1.1%

2025: 50 Mio Tons FRP BiW Demand

Steel: ~89%
Al: 11%

CAGR: ~18%

Note: Vehicle production calculated using a 6% CAGR from 2011 to 2016 and a 3% CAGR from 2016 to 2025. Assumed average vehicle weight of 1,440 kg and 27% BiW composition.
Automotive Sheet in Perspective – vs. Can

Today

- 4.7 Mt
- 340 kt

2016

- 5.7 Mt
- 1.2 Mt

2020

- 6.7 Mt
- 1.8 Mt

2025

- ~8 Mt
- ~5 Mt

Source: Novelis global FRP fact base and projections

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Where Do You Find Our Products Today?

Not just aluminum, Novelis Aluminum.
Where Do You Find Our Products Today?

- 117 different models with Novelis Aluminium FRPs
- 4.5 million vehicles with Novelis Aluminum for structural parts and/or body panels
Novelis – Partner of Choice for Automotive OEMs

Customers
more than two dozen
of the most recognized
automobile brands
in NA, Europe and Asia

Global Organization
& global availability of specs

World leader
for automotive
aluminum sheets
(share >50%)

High-quality
exterior body sheet
in both Europe & NA

Not just aluminum, Novelis Aluminum.

Process and
engineering expertise
second to none in the
aluminum industry

Novelis Fusion™
breakthrough
multi-alloy sheet
Novelis Automotive – Innovation & Partnership

- Novelis wins the BMW Supplier Innovation Award 2011 in Lightweight Construction category
- One-piece aluminum door inner with Novelis Fusion material used in the BMW 5 Series, GT and 7 Series

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6xxx Series Alloys - Anticorodal®-300T61

In comparison to 5754 equivalent part

- 20% Weight save achieved – circa 6kg per vehicle
- 9% Cost save per vehicle
- 12000 tonnes CO₂ reduced from fleet tailpipe emissions
Ac-600 PX: Outer and Structural Applications

- Balanced alloy especially designed and optimized for high strength and severe hemming requirements
- Due to superior in-service strength ideal for down-gauging skin and structure sheets
- All-around alloy that can be used for hoods, fenders, roofs as well as for structural parts
- Ideal candidate for mixed steel-aluminium applications

Range Rover Evoque Roof in Ac-600
Novelis to Build First Manufacturing Plant in China

Newest Automotive Expansion Provides Unmatched Global Footprint

April 11, 2012

November 7, 2011

Novelis Presented with BMW Supplier Innovation Award

Industry leader Novelis was presented today with BMW’s Supplier Innovation Award in the Lightweight Construction category for its Novelis Fusion™ product which provides auto manufacturers with a 25% weight reduction over steel...

Sept. 13, 2011

Jaguar Land Rover Selects Novelis as Sole Supplier of Aluminum Sheet for Its Range Rover Evoque

Novelis is the preferred aluminum supplier of Jaguar Land Rover, one of the branch leaders in the use of weight-saving metals in its range of products. These include the Jaguar XJ, XF and XK models, as well as Land Rover Defender, Discovery, Range Rover and Range Rover Sport.

June 1, 2011

Novelis Driving Ahead: Investment to Make Cars Lighter

Investment in North America will increase capacity to serve US automakers to produce lighter vehicles that emit less CO₂....

May 21, 2012

Novelis Supplies Innovative Aluminum Solutions for New 2012 Mercedes-Benz SL

Automaker launches first all-aluminum body

Novelis, the world’s largest producer of rolled aluminum and the world’s leading supplier of aluminum sheet to the automotive market, announced today that its material will be featured extensively in the newly launched 2012 Mercedes-Benz SL. The latest-generation model marks the first full-production vehicle from Mercedes with a structure designed in aluminum...
Novelis Expands into China

Novelis China
120,000 metric tons per year by 2015
Ground-Breaking Ceremony on Nov 15th 2012
2012年11月15日奠基仪式

Not just aluminum, Novelis Aluminum.
The 1st Specialized Al Auto BiW Production Plant in China
Novelis Worldwide Footprint

Novelis Footprint
- Employees: 10,770
- Revenues: $11.1 Billion
- FRP Shipments: 2,838 kt
- Operations: 26
- Countries: 10

The Aditya Birla Group at a Glance
- Revenues of $40 billion
- 133,000 employees
- Operations in 36 countries
- Major player in aluminum, copper, cement, viscose staple fiber, carbon black, insulators, fertilizer and more

<table>
<thead>
<tr>
<th>Region</th>
<th>Employees</th>
<th>Revenues</th>
<th>Shipments</th>
<th>Revenues</th>
<th>Shipments</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>3,100</td>
<td>$4 billion</td>
<td>1,064 kt</td>
<td>4,360</td>
<td>875 kt</td>
</tr>
<tr>
<td>South America</td>
<td>1,710</td>
<td>$1.3 billion</td>
<td>375 kt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>4,360</td>
<td>$3.8 billion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asia</td>
<td>1,600</td>
<td>$1.8 billion</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Based on FY2012 results; reported in US dollars.

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Novelis Automotive—The Global Player

Global Customer Supply Base

**Oswego & Kingston**
- Alloys: 5xxx / 6xxx
- Gauge: 5xxx / 6xxx up to 4mm (O)
- Pre-treat

**Nachterstedt & Sierre**
- Alloys: 5xxx / 6xxx
- Gauge: 5xxx up to 4.0mm
  - 6xxx up to 3.0mm (N)
  - 6xxx up to 2.0mm (S)
- Pre-treat
- Laser Blanking (N, S)

**Changzhou**
- Alloys: 5xxx / 6xxx
- Gauge: 5xxx / 6xxx up to 4mm
- Pre-treat

**Ulsan**
- Alloys: 5xxx
- Gauge: 5xxx up to 4mm

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Novelis Global Investments

USA
Oswego
240kt heat treatment expansion

Brazil
Pinda
200kt hot/cold rolling & recycling expansion

Germany
Norf
New recycling center with 50kt capacity

Korea
Yeongju
Fusion casting, 400kt rolling & recycling capacity expansion

China
Changzhou
Heat treatment line with 120kt

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Body Complete Weight

Competitor data based upon LWB derivative data.
[1] - A2mac1 data
[2] - JLR Teardown data

EuroCarBody, 21st Oct 2009

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Jaguar XJ Body Structures Materials

EuroCarBody, 21st Oct 2009

Not just aluminum, Novelis Aluminum.
Jaguar XJ Body Closure Materials

6111-T4 meets the following requirements:

- Suitable for all Class A exterior panels
- Sufficient formability to achieve Jaguar style
- Compatibility with deep drawing press lubricants

• Weight saving of 20%+ over X350
• Material cost savings

New XJ body side material selected AA6111 T4PD. Panel thickness = 1.2mm
Prior X350 used NG5754 at panel thickness = 1.5mm

EuroCarBody, 21st Oct 2009
IIHS Side Impact

Innovative B Post Composite Reinforcement

- DP 800 Steel provides bending strength
- GRP moulding maintains section integrity
- ESA allows full section integration & absorbs steel to aluminum expansion rates

EuroCarBody, 21st Oct 2009

Not just aluminum, Novelis Aluminum.
Pedestrian Impact
Deployable Bonnet System: Bonnet Design

- Modified ‘hexageneous’ bonnet inner design to improve weight
- CAE led with many hours of optimisation
- Reinforcement necessary to control deployment loads & stiffness

Bonnet outer, Alum 1.1mm

Bonnet inner, Alum 1.2mm

Latch reinf, Alum 1.5mm

Reinforcer, Alum 1.5mm
Thank you!

Novelis