Lightweighting –
*Integral to Future Compliance*

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Contents

• Setting The Stage
• A Decade of Structural Change
• BIW Material Shifts
Mature Markets LV Sales Forecast
Replacement demand is key driver – loyalty critical to OEMs

LV Sales Forecast (millions, 2005 – 2022)

Little growth in developed markets – competition becomes more severe

Source: IHS Automotive
Global Light Vehicle Production
Global Growth Takes a Turn


Millions

71 60 89 100 106

29 million 11 million 6 million

2015 – 22 Growth Volume, CAGR%

China 7.7, 4.0%
S Asia 4.3, 6.4%
EU 2.5, 1.6%
NA 1.3, 1.1%
MEA 1.3, 7.5%
S Amer 0.8, 3.5%
Jap/Kor -0.9, -1.0%

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• Shift to global structures within B through D segments is apparent at +72% of global volume with contribution to growth of +79% through 2022

• Growth in China, India and NA fed from global B & C segment structures = enhanced scale economies
Global Production by Bodytype

- SUV has doubled since 2002 to be the predominant bodytype – global platforms
US: Light Vehicle Sales Forecast
Sales peak approaching; return to previous long-term trend level possible

Affordability driven by higher l-rates, legislated content and urbanization slows sales momentum

Source: IHS Automotive, current light vehicles sales forecast
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Compliance Gaps Emerge
Without New Technologies, OEMs Will Not Comply

- Extreme focus on larger offerings with substantial gaps
- OEMs will require several costly technologies to comply into the next decade
- Powertrain, Efficiencies, Lightweighting then Electrification

Compliance Gap is expected powertrain mix without incremental technologies – lightweighting, electrification etc.

Note: Global Sales Segment
Three Disruptive Realities
Industry Participants Adapt or Die ….

**Electrification**
- S/S >> Plug-in Mild Hybrid >> Full Hybrid >> BEV
- Enablers – Legislation, 48V, mass reduction
- Implementation depends on segment, geography, scale, infrastructure and customer purchase capability
- How does the ICE and accessories adapt through this process? What about transmissions and driveline?

**Automated Driving**
- Speed of implementation depends more on legislation versus technical capability
- Several disruptors enter with little patience for automotive timelines, processes and structure
- Will the lack of driver intervention alter content and structure of the powertrain?
- Areas of the vehicle materially altered by automated driving: Interior, Powertrain, Electrical & Chassis

**Shared Mobility & Connected Car**
- New generations live in a more global, urban and environmentally-friendly world
- Ride sharing and reduced/limited driver input changes ownership, maintenance and use structures
- Impact on municipalities, healthcare, dealer/service infrastructure, need for a license
- How does shared mobility alter the vehicle cycle, supply base, insurance, aftermarket and safety?

What timeline is your organization expecting? What are the optimal strategies?

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<thead>
<tr>
<th>2015-2020</th>
<th>2020-2025</th>
<th>2025+</th>
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<tbody>
<tr>
<td>PHEVs</td>
<td>Increased Electrification</td>
<td>BEVs &amp; Infrastructure</td>
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<td>Level 2 &gt;&gt; 3 Driving</td>
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<td>Level 3&amp;4 &gt;&gt;&gt; 5</td>
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<td>Uber/Lyft</td>
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World: Automotive Materials Cost Index

Falling commodity prices reducing production costs – profit margins strengthen for now

Materials Costs in Typical 3500lb US Vehicle

-51% from 2011

Impending Cost Cliff?
- Rise of lightweighting raises material, joining and capital costs
- Electrification drives battery, motor and control costs
- Faster cadence reduces amortization schedules
- Safety regulations are not abating
- Increased demand for ADAS, infotainment and connectivity content

Source: IHS Automotive Material Cost Index of combined commodities, monthly data
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Material Change Priority by System/Location in BIW

- Dependent upon OEM, Segment, Cost/Availability & Compliance Gap
- Material Shift by importance Assumptions (By Segment)
  - Hood
  - Decklid
  - Closures
  - Fenders
  - Shock towers
  - Crossmembers, rockers, rad supports, tunnels & pillars
  - Apertures (Mixed Materials)
  - BIW bodies (Mixed Materials)

Source: Honda

BIW Structure (Above)
IHS BIW analysis also includes hood, fenders, closures, roof and decklids
Material Forecast Analysis
Total NA LV Industry By Pounds

Total BIW declines despite growth in CUVs and rising NA output

Source: April 2016 Material Forecast
Material Forecast Analysis
Aluminum Sheet & Cast/Extrusions by Component

New capacity, need for lightweighting determines mass by OEM

- Closures (Hood, Decklid, Doors) accounts for over 55% of all Aluminum volume by 2025

2015-2022 % Growth
Aluminum Cast: 260%
Aluminum Sheet: 346%

Source: April 2016 Material Forecast
**Summary**

- Nearing the end of the current sales cycle though NA production is bolstered by import substitution and export growth.
- Several factors will lead to impending cost pressures – how the industry adapts to new tradeoffs and competitive pressures will determine success.
- Body-in-white (BIW) structures will significantly alter during the coming decade, depending upon segment, region, cost and other factors.
- While aluminum sheet will gain in utilization - first in mature vehicle markets with aggressive legislation, aluminum cast/extrusions will rise to replace steel in engine structure and applications.
- Material adoption will be transitional; compliance requirements, capital structures, competitive realities, I/P and supplier relationships will all be critical.

*Suppliers need to adopt a proactive stance to planning.*