Eco-Friendly Interior Materials

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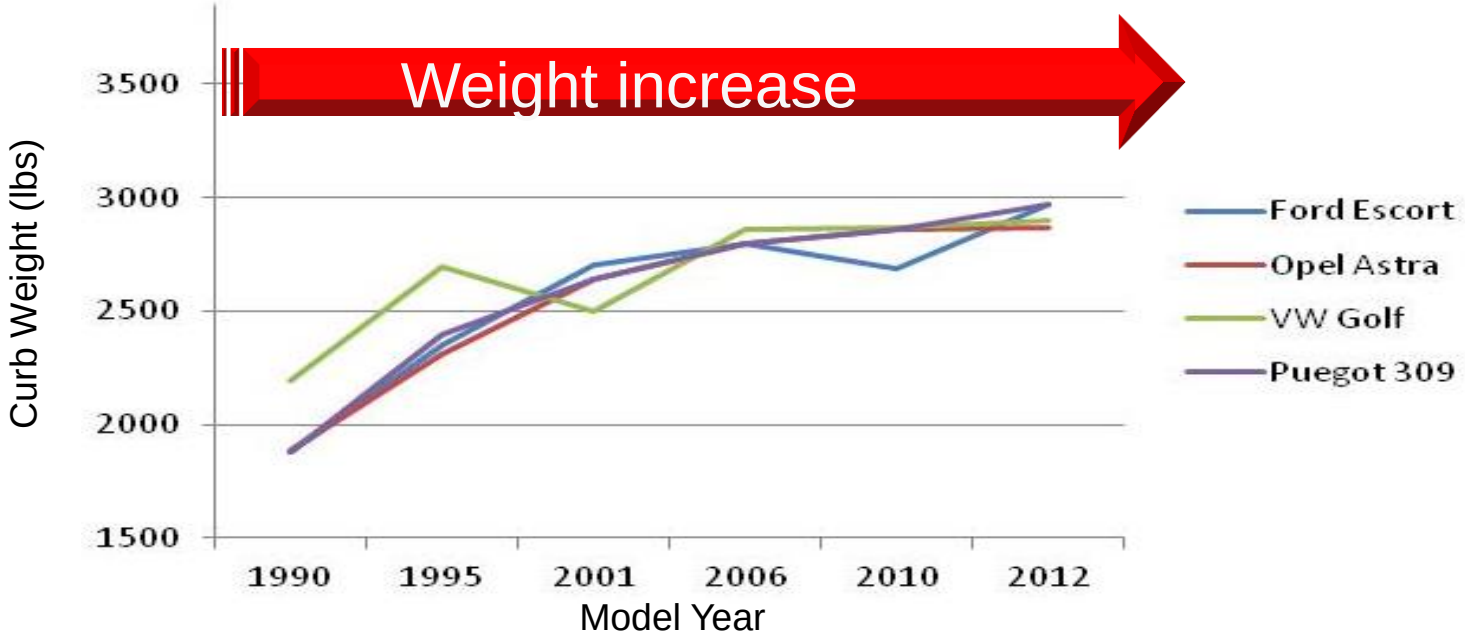
IAC
International Automotive Components

Agenda

- Fuel Economy
- Interior Automotive Trends
- Sustainability
- Natural Fiber Based Composites
- Environmental Stewardship
- Summary

Vehicle Curb Weight Change*
Lower Mid-Size Segment



Weight increase due to design change(s) and added electronics/safety

*adapted from IHS Automotive

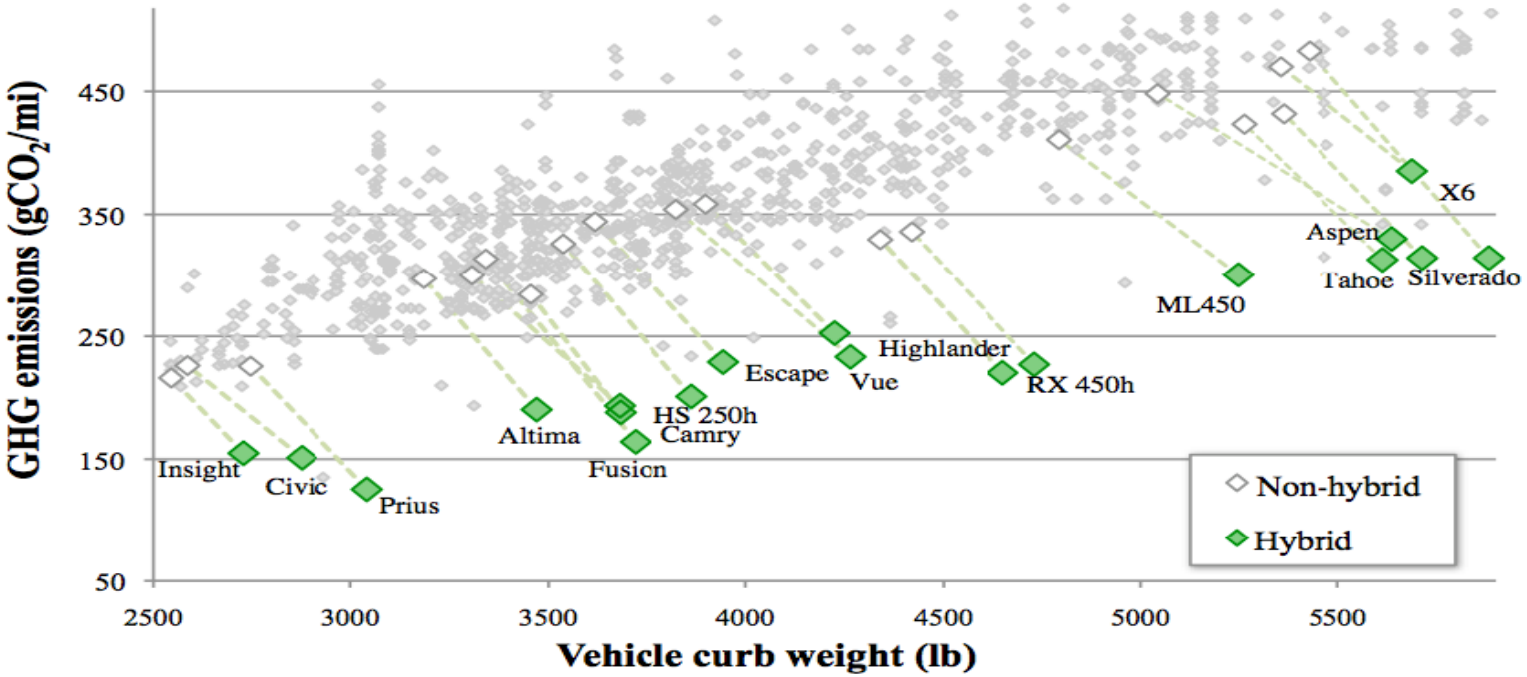
Lightweighting
Legislative Emission Standards*

Country/Region	Regulatory Metric[a]	Standard Design Element
United States	FE (mi/gal); GHG (CO_2 e/mi)	Size indexed
European Union	CO_2 (CO_2/km)	Mass indexed
China	FC (l/100 km)	Mass indexed
Japan	FE (km/l)	Mass indexed
Canada	GHG (CO2 e/mi)	Size indexed
South Korea	FE (km/l)	Engine size indexed
Australia	FC (l/100 km)	Flat
Taiwan	FE (km/l)	Engine size indexed
a. GHG = greenhouse gas, FE = fuel economy, FC = fuel consumption		

US standards will reflect 54.45 mpg and 166 gCO_2/mi by 2025

*Source: UC Davis

Mass Creep Effect on GHG Emissions*



Hybrid powertrains add approx. 9% to vehicle weight

*Source: CARB/UC Davis

Vehicle Lightweighting Strategy
Cost of Fuel Efficiency*

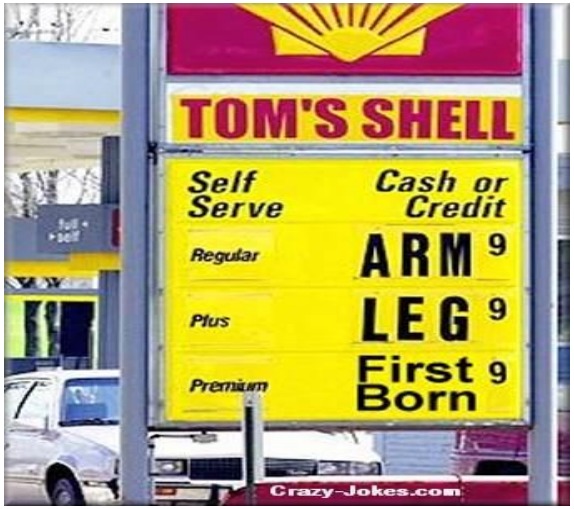
Technology	Weight (+/-) (lbs)	Fuel Economy Improvement (%)	Cost per 1% FE gain ($)
Turbocharged gasoline (with downsizing)	- 44	10	26
Turbocharged diesel (vs NA gasoline)	+ 220	30	43
Lightweighting (Al/Mg)	- 617	10	98 - 163
Advanced stop-start	+ 11	5	52

Technology advances can reduce fuel consumption but mass may be compromised

*Source: Knibb Gormezano & Partners

Weight Impact on Fuel Consumption

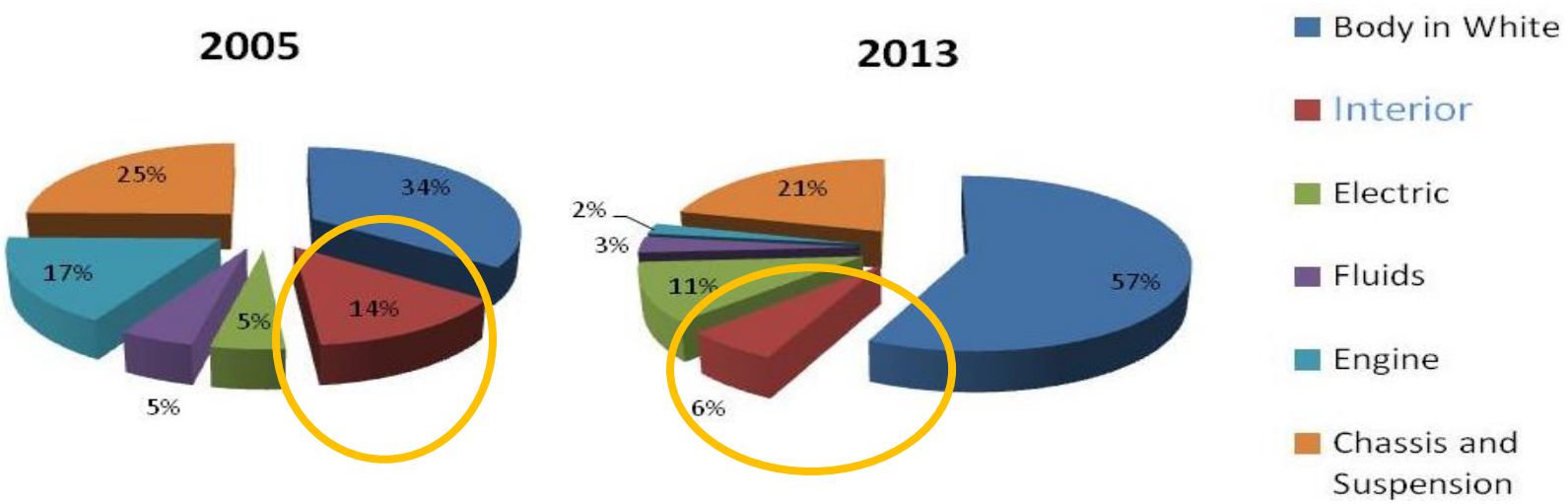
10% Weight Reduction = 5-7% Improvement in Gas Mileage



- **Average curb weight 3,755 lbs**
- **6% weight save = 37 lbs**
- **2025 CAFE standard is 60% more aggressive**

To meet 2025 emission standards vehicle weight must be decreased by 370 lb

Module Weight Distribution per Car*



The interior portion of the vehicle has moved from 14% to 6% of the total weight

*adapted from Source = Audi

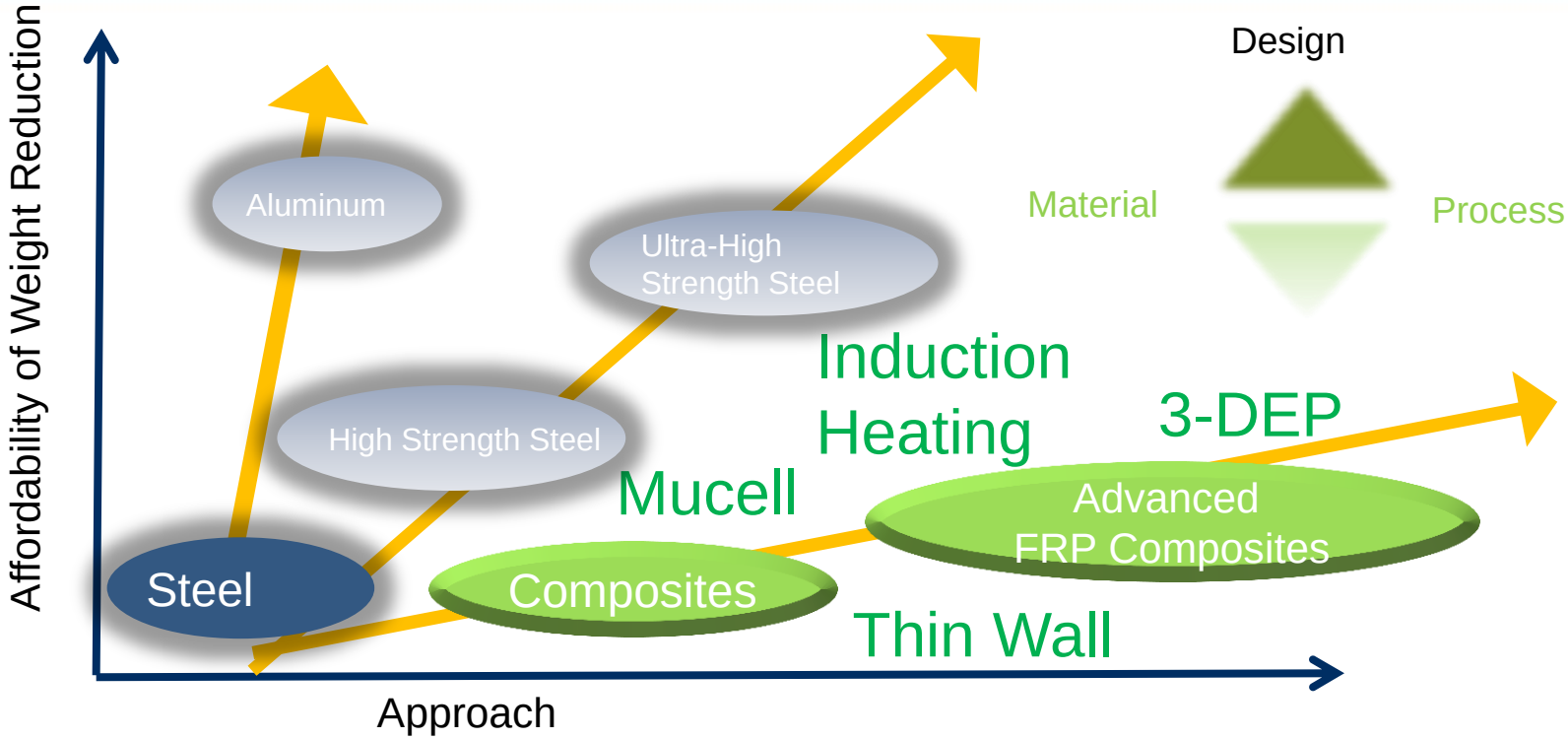
Interior Market Drivers
Interiors that Look, Sound, and Feel Better Than Ever

Consumer Trends

- Sustainable materials
- Improved fuel economy
- Improved haptics
- Craftsmanship
- Personalization
- Connectivity
- Quiet / less noise

Market is trending to interior component alternatives to fill the gap between hard and foam in place that incorporate natural materials

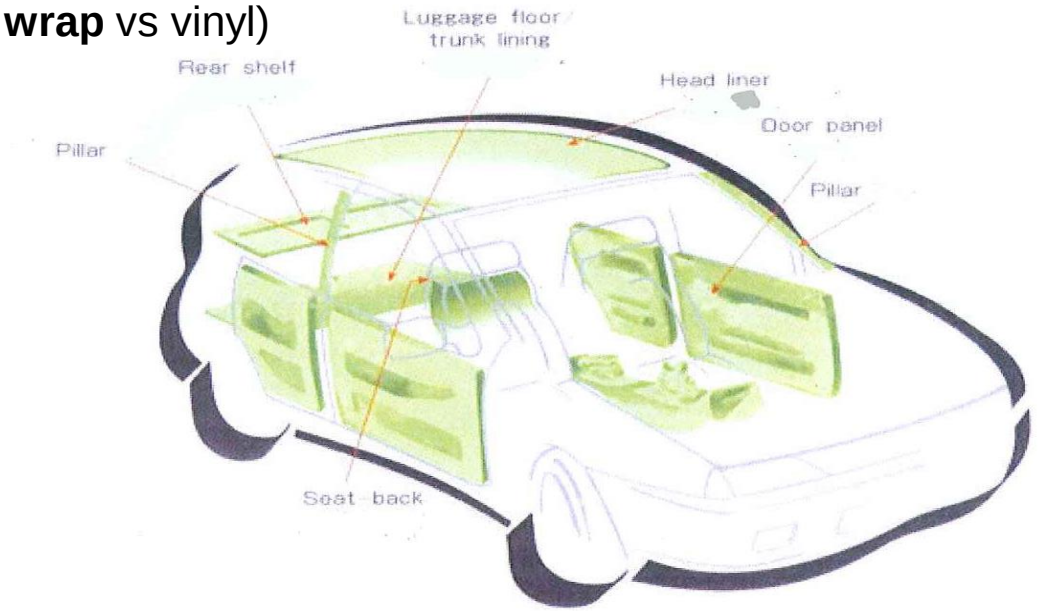
Progress in Weight Reduction through Materials Technology



Multi-material and Process approach to achieve performance and weight

Environmental and Sustainable Component Applications

- Virtually every component in the vehicle interior is capable of being manufactured with sustainable material:
  - Instrument Panel Skins (**leather wrap** vs vinyl)
  - Headliner (kenaf based)
  - Seats
  - Foam (NOP seat and IP)
  - Carpet (bio-based polyol)
  - Package Tray
  - Load Floor
  - Hard Trim (**bio-fillers**)
    - Door Bolsters
    - IP Pillars
    - GB Doors/Bins



Environmental and Sustainable Targets

Optimize

- Utilize Correct Materials for Each Application
- Utilize Renewable/Natural Resources
- Utilize Recycled Materials- PIR & PCR

Reduce

- Reduce/Eliminate Shipments to Landfill – (manage waste streams)
- Reduce Part Weight
- Reduce Carbon Footprint

Improve

- Improve Product Performance
- Improve Product Competitiveness

Renewable Resins & Sustainable Solutions

Renewable/Bio-based materials

- Soy-based and castor-oil based urethane foams
- Bio-based polymer use in components (PHA)
- Bio-based or natural fillers/reinforcements

Recycled Materials

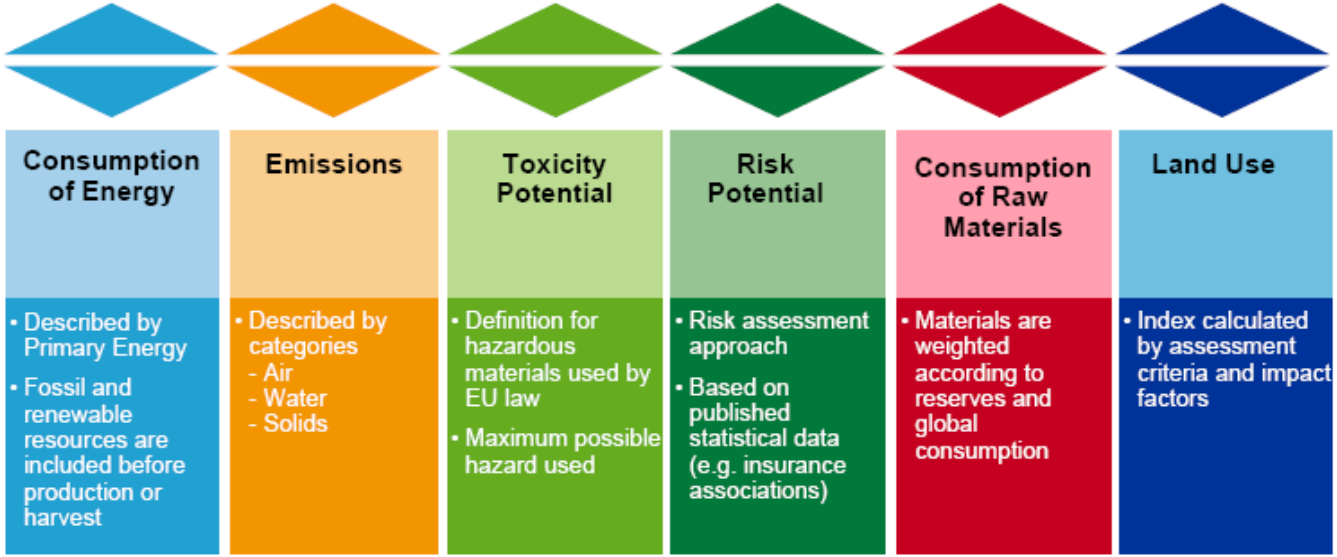
- Post Industrial Recyclate from sources outside of IAC
- Post Consumer Recyclate
- ‘Home” regrind – develop innovative outlets for scrap streams

Lightweight Materials

- Foamed (CFA)
- Gas Insertion Process, e.g., Mucell
- Nano fillers and additives

Environmental Impact Over Product Lifecycle
Life Cycle Analysis (LCA)

- Evaluate the impact of component production (including freight and recyclate)



**Data acquisition and calculation is done according to ISO 14040 and 14044 (ecological part)*

Interior Trim
Carbon Fiber/ Natural Fiber Mat Technology

General Description

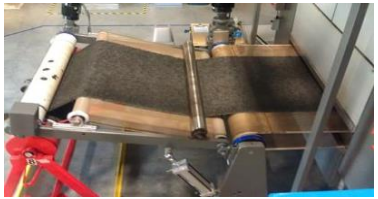
Molding process to provide flat or 3-dimensional fiber mats that are compressed to make trim substrates

Key Benefits

- Less weight- reduce part thickness to 1.5-2.0mm
- Eco-friendly use of raw material, renewable resource, and recycled content
- Improved performance with less weight
- Increase design flexibility if used with pre-formed mats
- Potential replacement for glass filled products
- Lower energy in manufacturing versus glass fibers (60%)
- Potential improvement in force deflection response for impact testing

Comparison to Current Products

- Weight save as compared to injection molded/ woodstock bolster/ natural fiber of 35-50%
- Cost neutral
- Utilizes re-claimed material (carbon fiber)



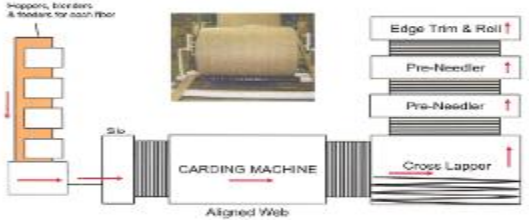
CF/NF rolled good and pre-formed mat

Provides equivalent performance at reduced weight

Natural Fiber Bolster Manufacturing Process

Local Raw Material

Opening/ Blend with PP Binders



Produce Mat on Carding/Needle Line

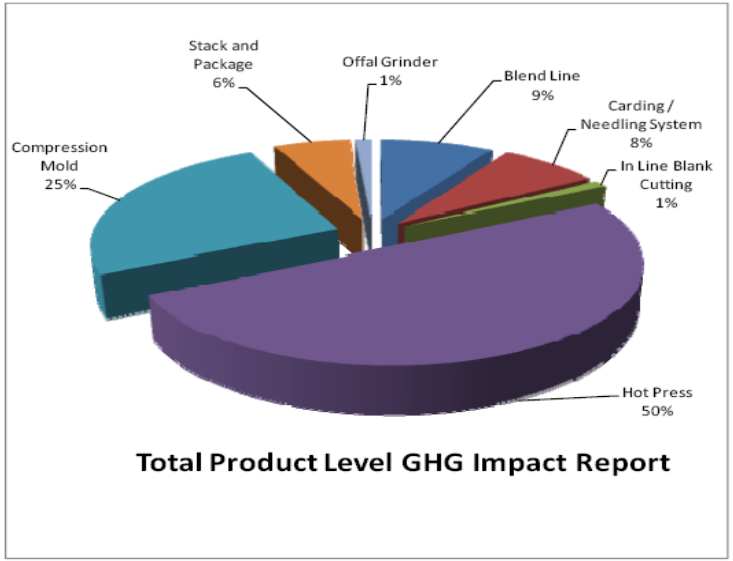
Cut Blanks

Heat Mat and Compression Mold

Pack

Carbon Footprint
Green House Gas Impact*

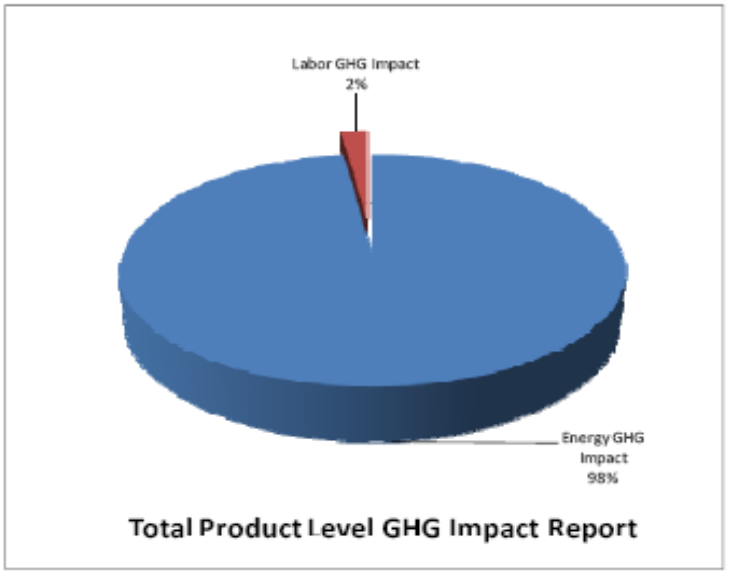
Natural Fiber Bolster



Total GHG Impact per Part: $0.0016

VS.

ABS Bolster



Total GHG Impact per Part: $0.9432

*assume \$2.35 CO_2 / ton

Summary

- **Weight reductions being mandated**
- **Natural Fiber Based Materials Emerging**
  - Local raw material stream to meet GHG emission standards
  - Cost effective Solutions required
  - OEMs beginning to embrace sustainable materials
  - Performance standards cannot be compromised
- **Recycling must be envisioned up front**