

# **Total Vehicular Energy Use Management**

## **Randall Scheps**

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**[www.autoaluminum.org](http://www.autoaluminum.org)**

# Aluminum Builds a Better Car

**Mass Reduction**



**Better Fuel Economy**



**Infinitely Recyclable**

**Reduced Emissions**



**Improved Safety**

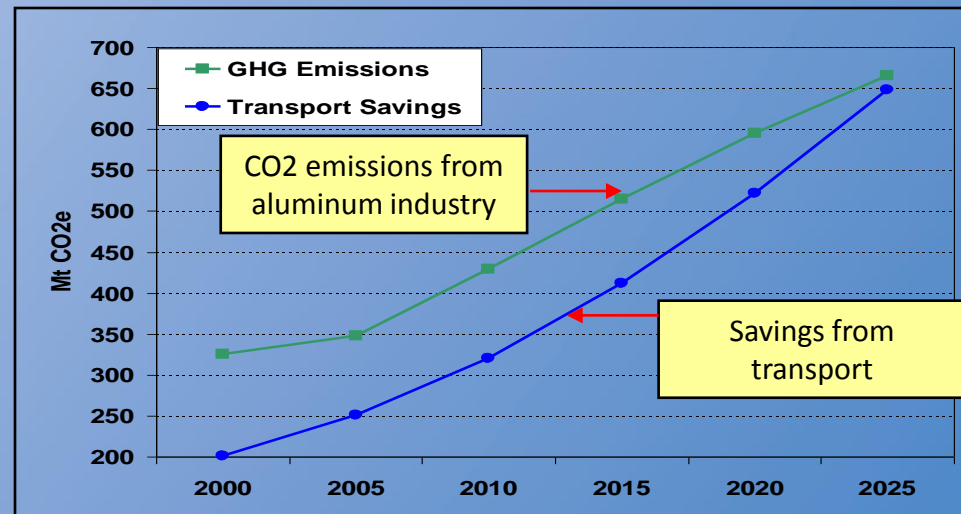
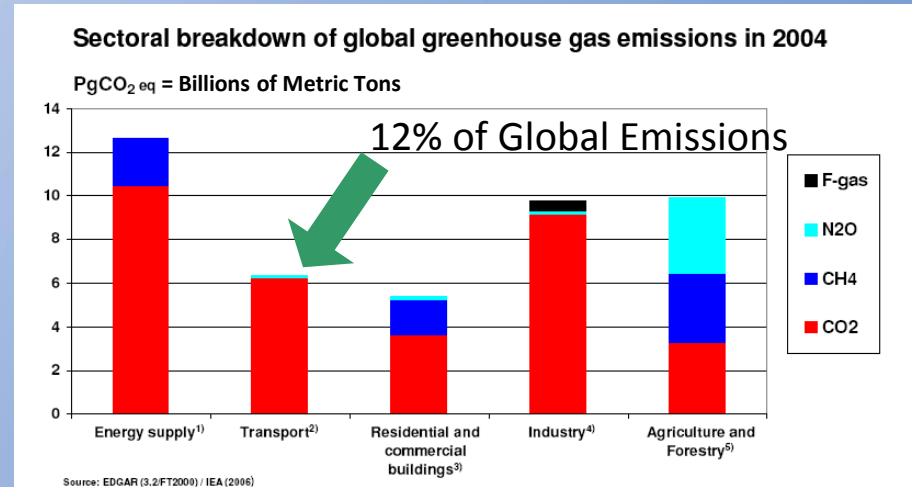


**Enhanced Performance**



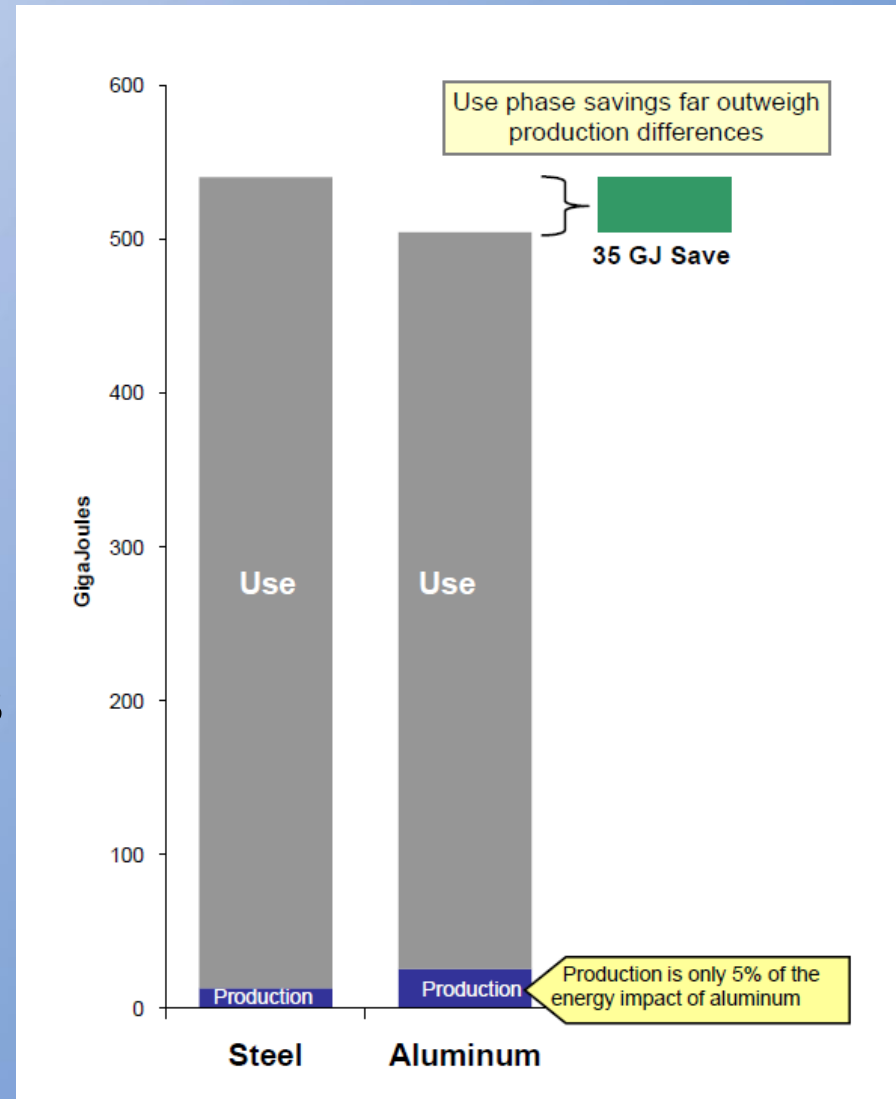
# Aluminum Helps Reduce CO<sub>2</sub>

- Aluminum already saving 300M metric tons of CO<sub>2</sub> annually
- Bigger reductions possible
- Highly complimentary with advanced drivetrains
- Carbon neutral by 2025

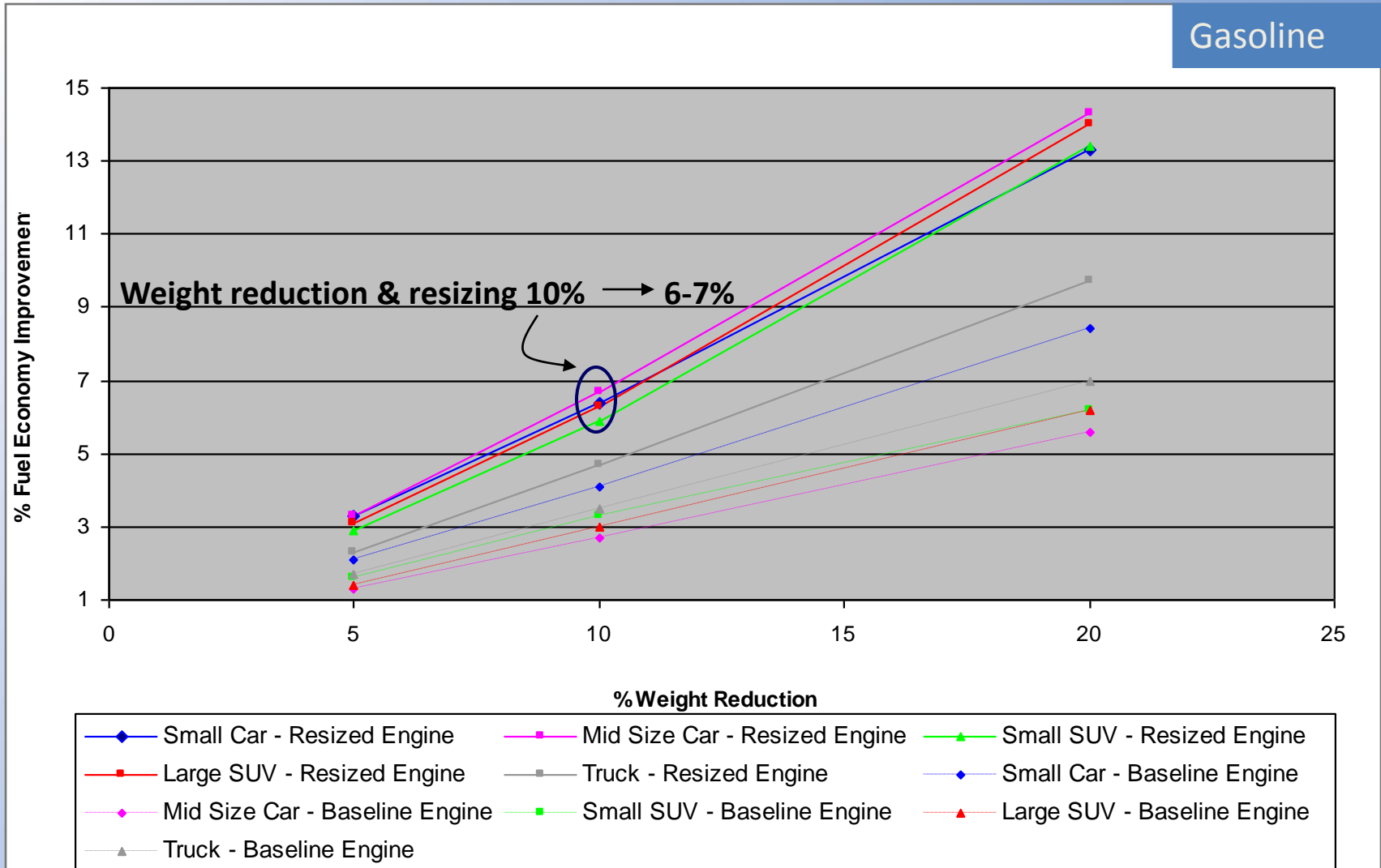


# Aluminum Delivers Life Cycle CO<sub>2</sub> Savings

- Most CO<sub>2</sub> emissions occur in the use phase
- Aluminum production represents only 5% of the life cycle energy
- Each pound of aluminum replacing steel saves 22.9 pounds of CO<sub>2</sub> net
- Cradle to cradle sustainable



# Ricardo Study: Aluminum Provides Fuel Economy Benefits



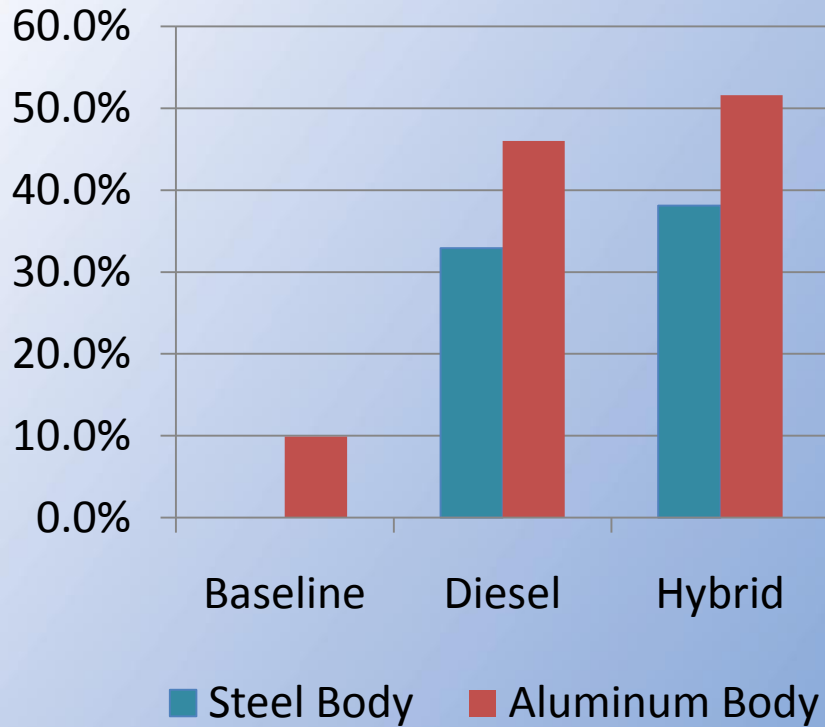
# Secondary Weight Savings Add Value

## Mass and Cost Savings by Component

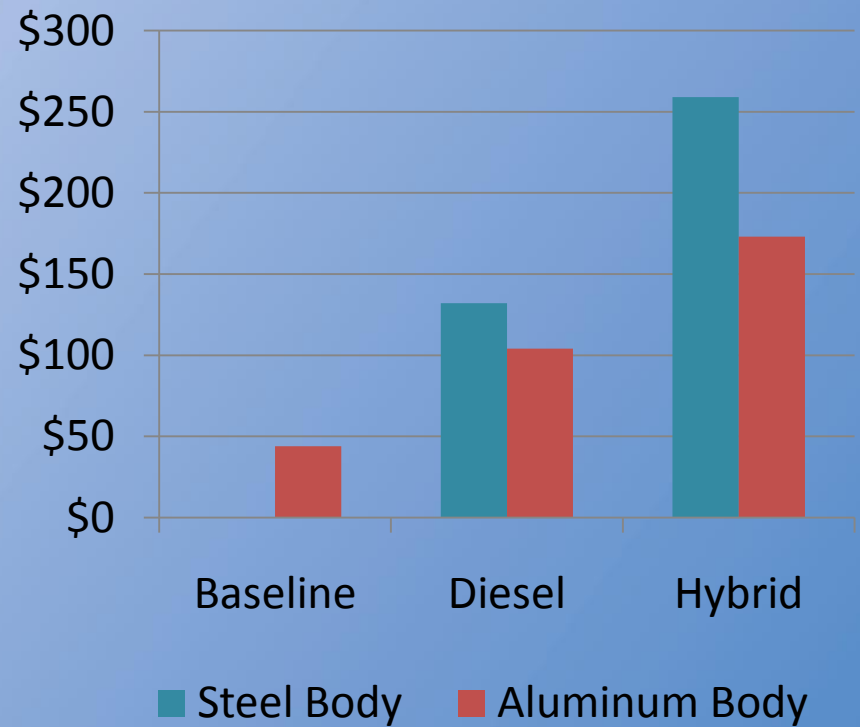
	Baseline Steel		Baseline Aluminum		Differentials			
	Mass (kg)	Cost (\$)	Mass (kg)	Cost (\$)	Mass (kg)	Cost (\$)	Mass (%)	Cost (%)
<b>Body</b>	433	\$2,665	270	\$3,295	163	-\$630	37.58%	-23.63%
<b>Secondary</b>								
Engine	257	\$2,535	219	\$2,160	38	\$375	14.78%	14.78%
Energy Storage	18	\$53	16	\$45	3	\$8	14.78%	14.78%
Transmission	79	\$1,177	67	\$1,151	12	\$26	14.78%	2.22%
Driveshaft/Diff/Axle	110	\$1,397	99	\$1,304	11	\$93	9.59%	0.00%
Cradle	36	\$83	21	\$134	15	-\$51	41.70%	-60.75%
Corner Suspension	48	\$220	40	\$198	8	\$22	15.96%	10.16%
Braking System	49	\$420	41	\$377	8	\$43	16.37%	10.13%
Steering System	28	\$580	22	\$491	7	\$89	23.45%	15.36%
Fuel PV Cost	0	\$9,342	0	\$8,071	0	\$1,272	0.00%	13.61%
TOTAL MANUFACTURING	1,564	\$14,871	1,288	\$14,974	275	-\$103	17.61%	-0.69%
RETAIL PRICE	0	\$23,819	0	\$23,964	0	-\$144	0.00%	-0.61%
TOTAL OWNERSHIP	0	\$51,520	0	\$50,344	0	\$1,176	0.00%	2.28%

# IBIS Study: Aluminum Adds Value to Alternative Powertrains

Percent Increase in MPG



Cost per 1 MPG Increase



# Leading Experts Agree: Lightweighting “Very Important” to Reach CAFE Levels

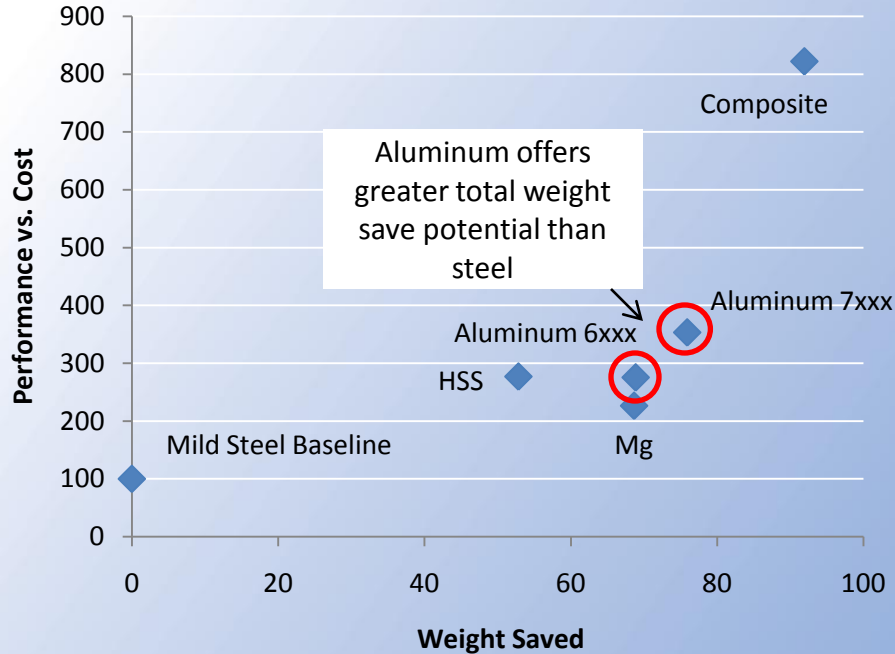
- **25%** – Fuel economy improvement to come from weight savings, as predicted by **material experts** and **body engineers**
- **50%** – Fuel economy improvement to come from weight savings, as predicted by **powertrain experts**
- Lightweighting is the only option that improves safety and fuel economy simultaneously

*“We’ll need to spend more resources to develop lightweight structures to boost fuel mileage – but we won’t necessarily need expensive and exotic materials like carbon composites.”*

*-Gerhard Schmidt  
Chief Technical Officer & Vice President  
Ford Motor Company*

# Aluminum vs. Other Materials

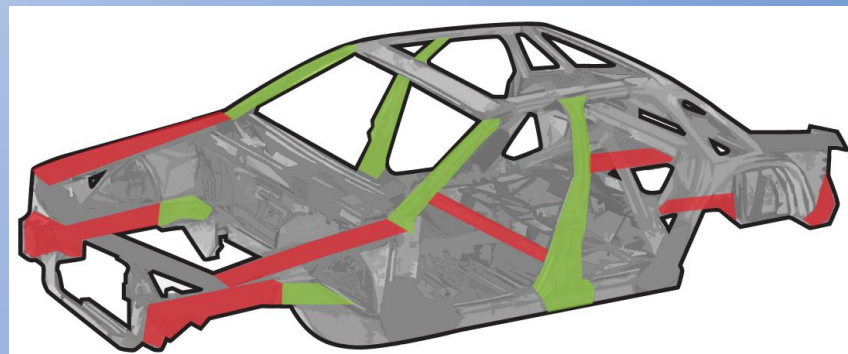
## Strength Applications



## Stiffness Applications

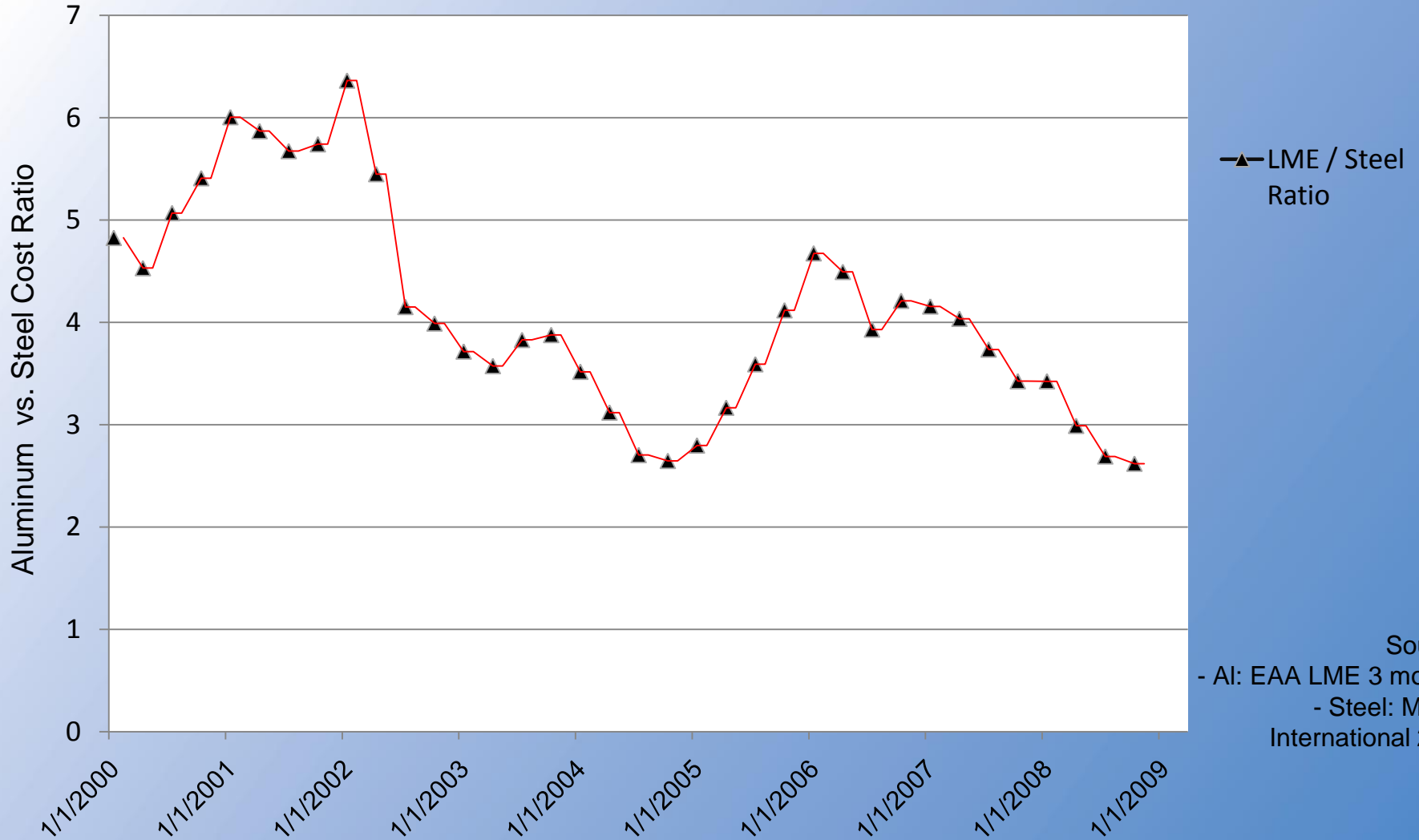


## Strength-Constrained Areas of the Body



# Aluminum's Economics Tell Positive Story

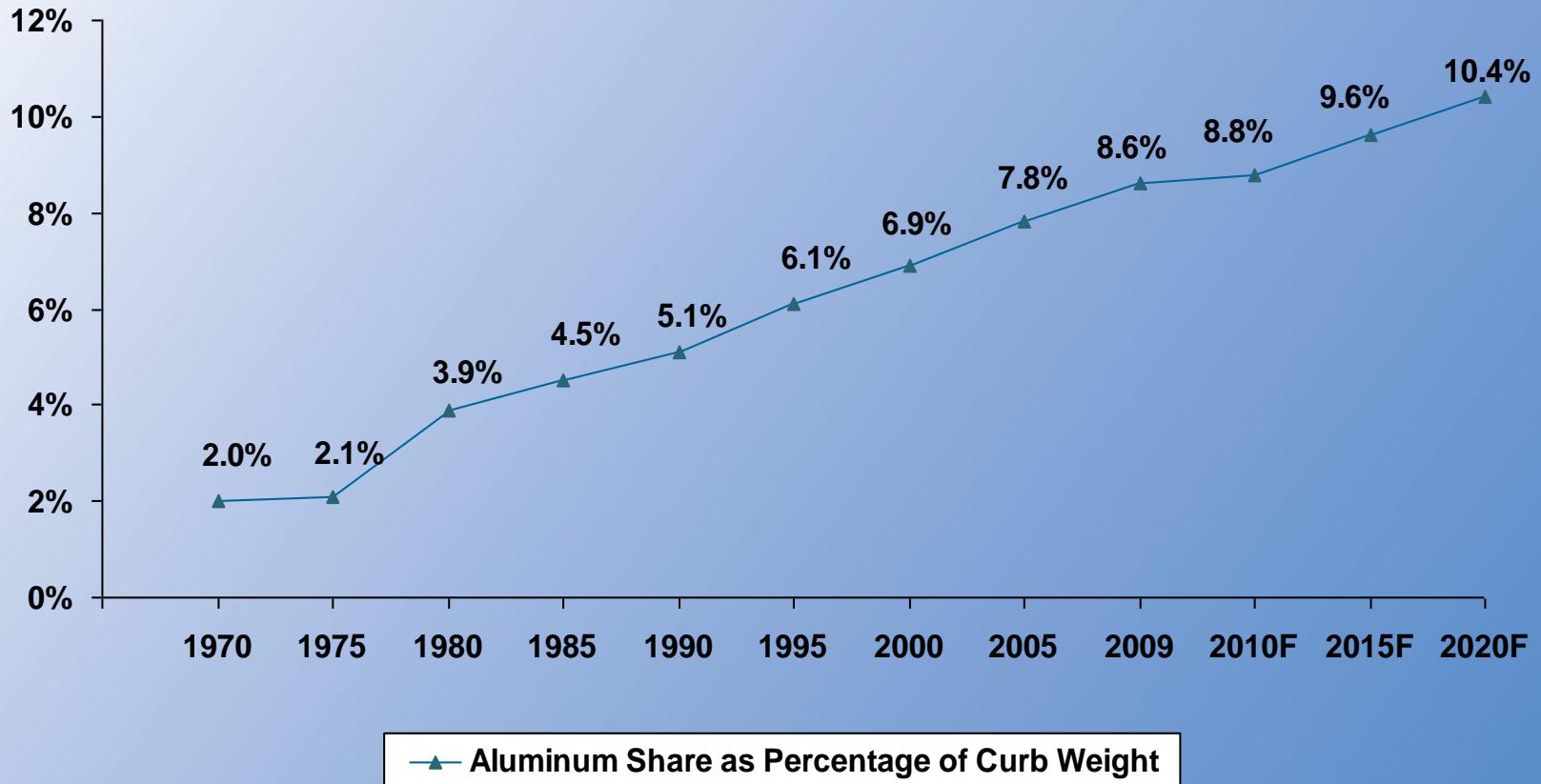
**Price Development  
 Aluminum vs. Steel**



Source:  
 - Al: EAA LME 3 months  
 - Steel: MEPS  
 International 2008

# Auto Aluminum Use At All-Time High

North American Light Vehicle Aluminum  
Content Continues to Climb

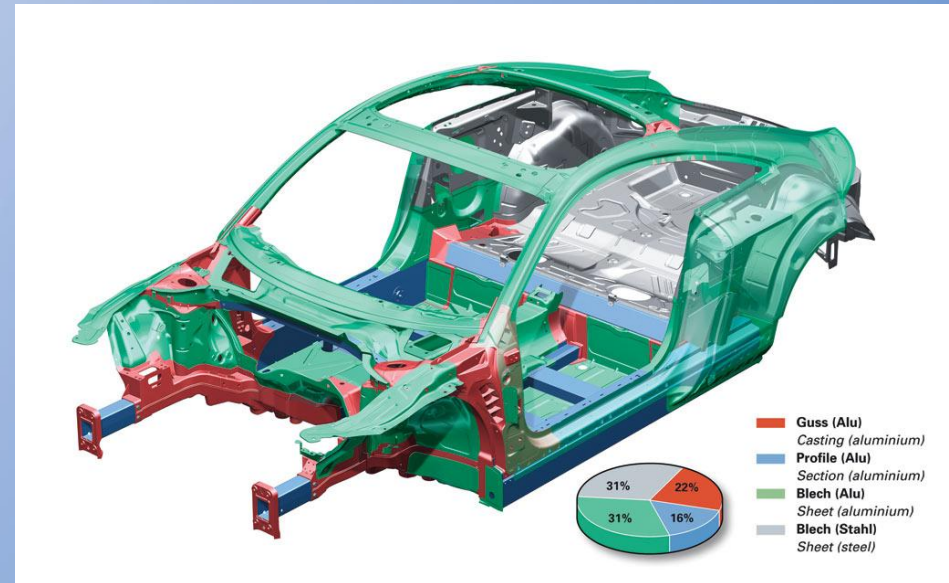


# Aluminum Success Stories and Growth Opportunities

	<u>Component</u>	<u>Aluminum Share</u>
Success Stories	» Heat exchangers	100%
	» Pistons	100%
	» Transmission cases	> 98%
	» Cylinder heads	> 98%
	» Wheels	> 69%
	» Engine blocks	> 69%
	» Drive shafts	> 50%
Growth Areas	» <u>Knuckles</u>	> 39%
	» <u>Hoods</u>	> 22%
	» <u>Control Arms</u>	> 15%
	» <u>Bumper</u>	> 11%
	» Cradles/sub-frames	> 10%
	» Body in White	
	» Wiring Harness	

# Aluminum Builds a Better Car

- Light
- Strong
- Safe
- Saves fuel and CO<sub>2</sub>
- Cradle to cradle sustainable
- Economic
- Part of the solution



Audi TT

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