

The Aluminum Advantage

Commercial Vehicle Applications

Todd Summe

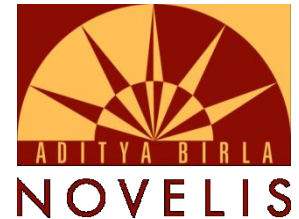
Technical Committee, The Aluminum Association's
Aluminum Transportation Group

Division Manager, Product Design & Development – Alcoa

www.autoaluminum.org



Defining Who We Are

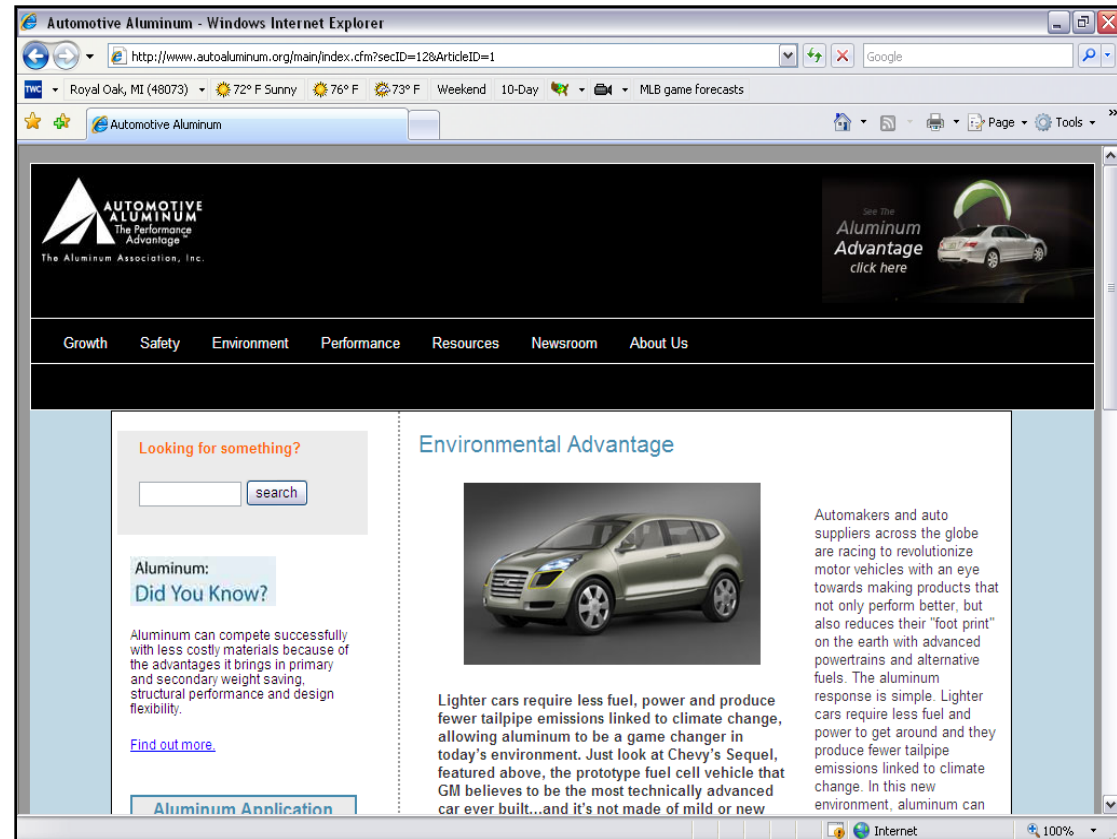


The Aluminum Association, Inc.



Our Mission

- Central resource for the automotive industry on aluminum
- Promote research and programs highlighting advantages
- Expanding mission to include commercial vehicles



Aluminum Builds a Better Vehicle

Mass Reduction



Better Fuel Economy



Reduced Emissions



Improved Safety



Enhanced Performance



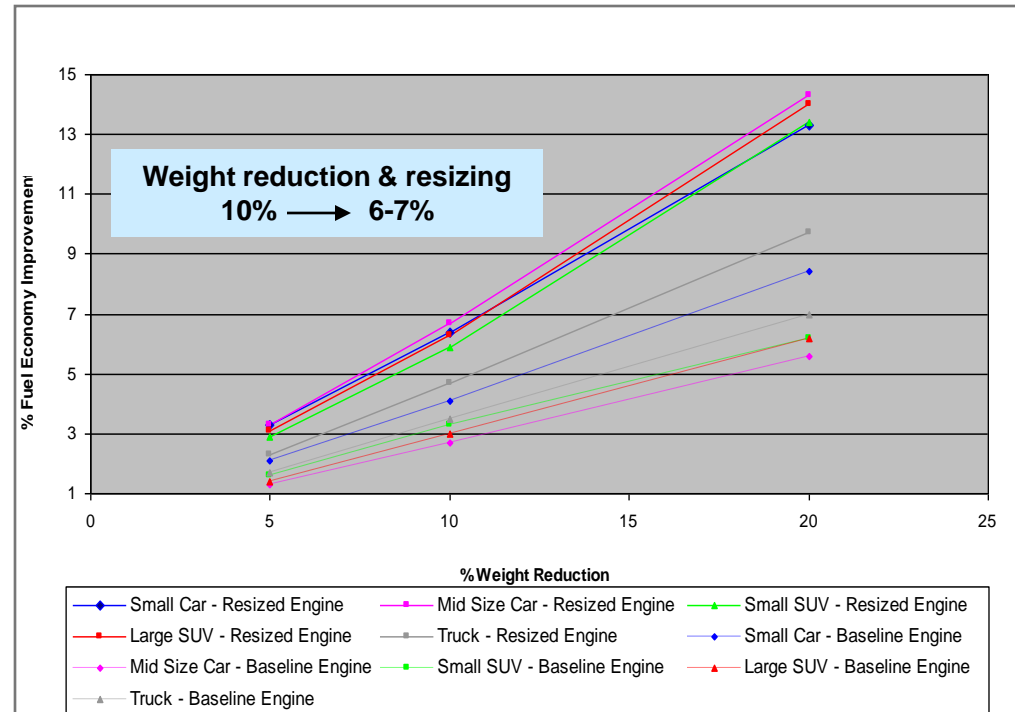
Infinitely Recyclable



Research Validates Benefits of Lightweighting

ASSOCIATION SPONSORED RESEARCH

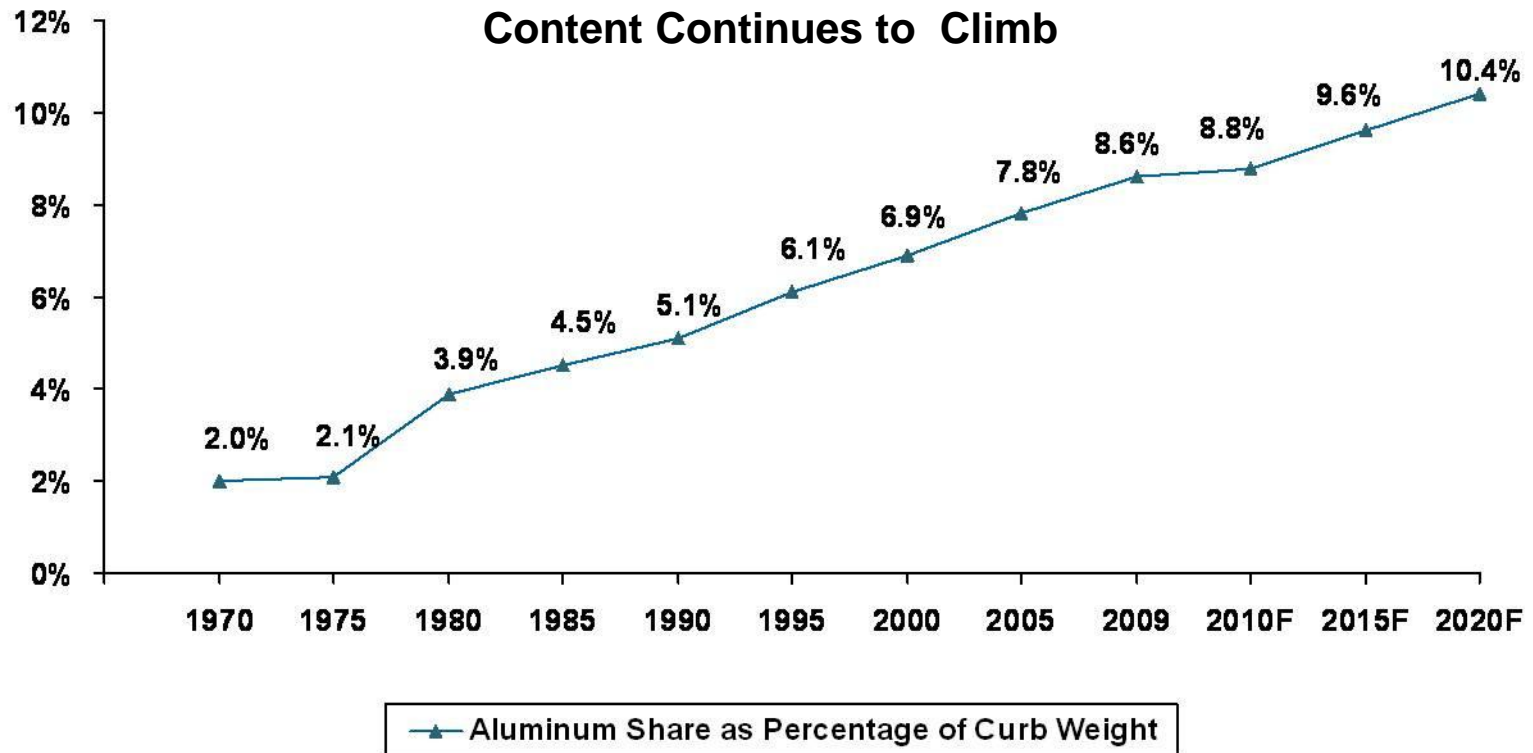
- Safety: Size vs. Weight (DRI 2004)
- Vehicle Structure: Manufacturing and Lifecycle Cost Analysis (IBIS 2005)
- Improving Sustainability in the Transport Sector Through Weight Reduction and the Application of Aluminum (IAI 2006)
- Benefit Analysis: Use of Aluminum Structures in Conjunction with Alternative Powertrain Technologies in Automobiles (IBIS 2008)
- Aluminum Growth Study (Ducker 2009 & 2006)



Impact of Vehicle Weight Reduction on Fuel Economy for Various Vehicle Architectures (Ricardo 2007)

Validation Leads to Continuous Growth

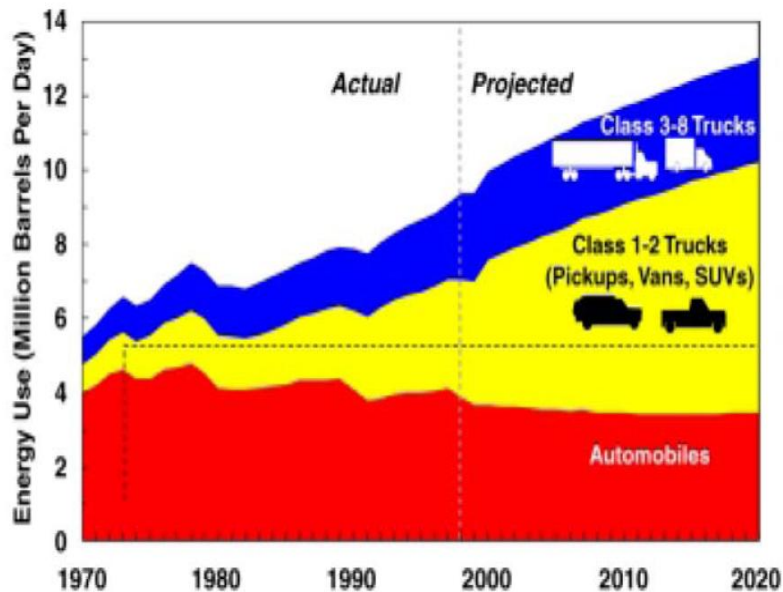
North American Light Vehicle Aluminum Content Continues to Climb



Why We Are Here Today

- Apply our auto industry model to the commercial vehicle industry
- Lightweighting with aluminum can help you tackle the challenges
 - Auto companies and other third-parties acknowledge aluminum's value proposition will help them meet 2016 CAFE standards
- Overview
 - Industry challenges
 - Value proposition
 - Weight saving benefits
 - Research and data

Challenges Facing Industry



Of the 83 million barrels of crude oil used per day, trucks account for more than half of the oil used in transportation and its share is projected to increase

- Rising energy costs
- Growing concern over greenhouse gas emissions
- Federal mandates continue to add weight to heavy-duty vehicles
- Weak economy

Source: International Energy Outlook 2005; U.S. EIA

Why Aluminum for Commercial Vehicles?

THE VALUE PROPOSITION

- Increased payload
- Lower maintenance costs
- Reduced fuel consumption
- Reduced greenhouse gas emissions
- Improved durability
- Higher resale value
- Infinitely recyclable



According to the U.S. EPA, a 10% drop in truck weight reduces fuel use between 5-10%

Truck Owners See Value in Lightweighting

Benefits of Reducing Truck Weight
(Heavy-Duty Truck Owners Only - Multiple Mentions)

	Heavy-Duty Trucks Total	Over the Road	Vocational	Pickup & Delivery
Payload capacity	50%	50%	50%	50%
Fuel economy	39%	41%	29%	52%
Don't know	21%	22%	24%	12%
Wear and Tear	4%	4%	4%	5%
Maintenance costs	3%	2%	4%	2%
Lighter components (general)	2%	2%	1%	2%
More power/higher performance	2%	4%	0%	2%
Emissions	1%	1%	2%	0%
Life of vehicle	1%	0%	1%	2%
Operating costs	1%	0%	3%	0%
Safety	1%	0%	1%	5%
Vehicle design	0%	0%	1%	0%
Other	0%	0%	1%	0%

Source: Alcoa 2008, Q4 research

Aluminum Already on the Road

- Cab structure
- Trailer side walls and structure
- Flatbeds/tippers/dump bodies
- Forged aluminum wheels
- Frame cross members
- Coal trucks
- Fifth wheel
- Fuel tanks
- HVAC components
- Landing gear
- Tank bodies
- Bellhousing

The average Class 8 Tractor today contains 1,000 lbs. of aluminum



How Much Weight is Being Saved?



Aluminum wheels on a tractor can save 30 lbs. each for a total savings of 300 lbs.

Tractor

- Axle hubs = 120 lbs.
- Centrifuse brake drums = 100 lbs.
- Clutch housing = 50 lbs.
- Front axle leaf springs = 70 lbs.

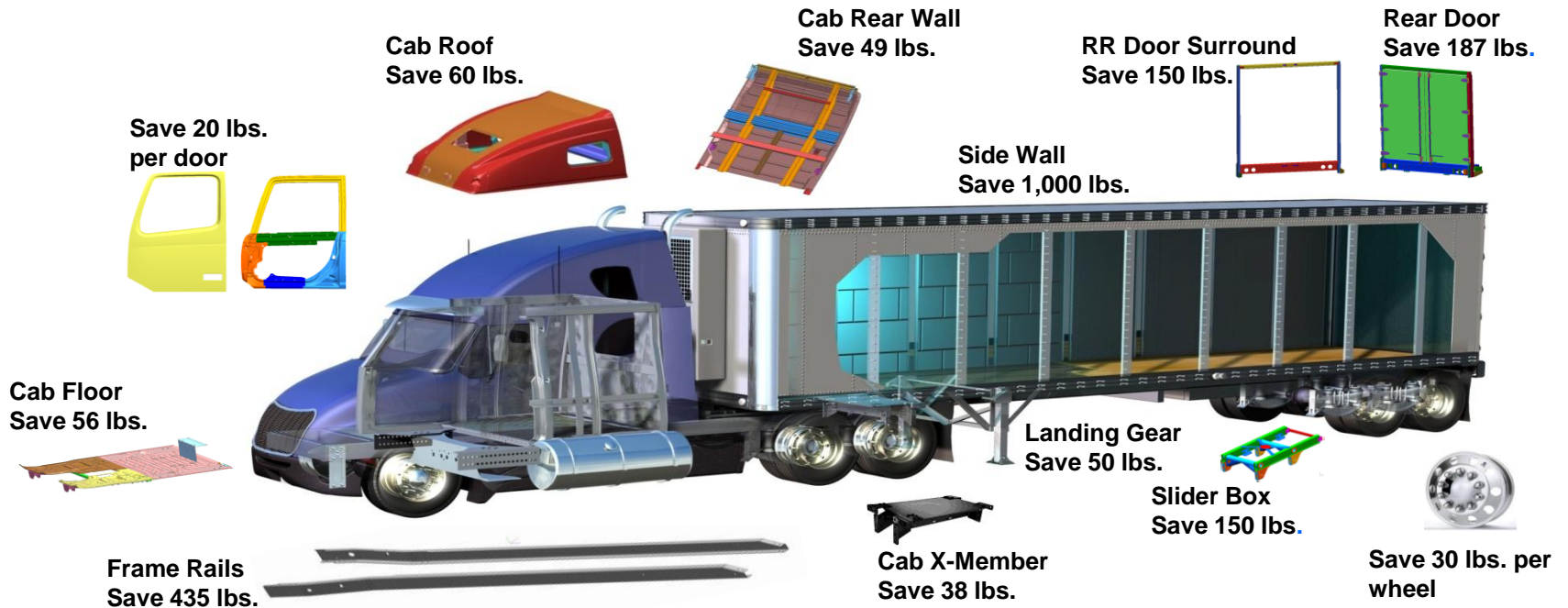
Trailer

- Roof posts = 75 lbs.
- Floor joists = 300 lbs.
- Upright posts = 600 lbs.
- Hubs and wheels = 900 lbs.

Source: U.S. EPA Weight Reduction Fact Sheet 2004

Emerging Technologies Save More Weight

3,500 lbs. weight savings potential



Research Supporting Our Value Proposition

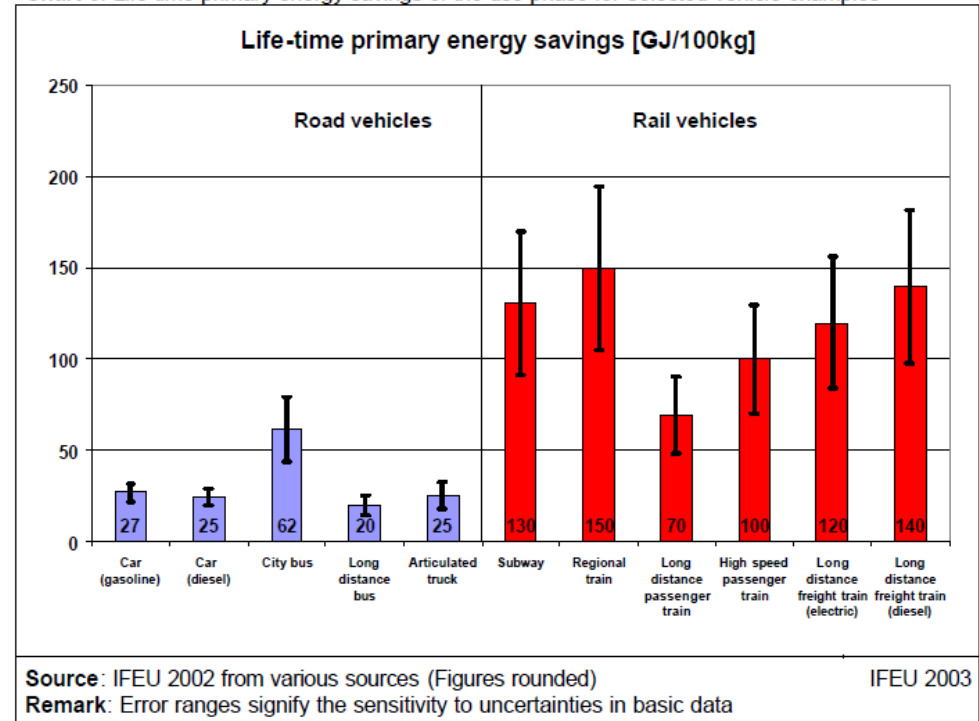
- Potential Savings as a Result of Weight Reduction (IFEU Heidelberg 2003)
- Improving Sustainability in the Transport Sector via Weight Reduction and Application of Aluminum (IAI 2006)
- Case Study: China Bus Project (Alcoa 2008)
- Impact of Weight on Rolling Resistance and Fuel Economy (Smithers 2009)
- Simulator Data (Major Tire Manufacturer 2007)



IFEU Heidelberg Research Findings

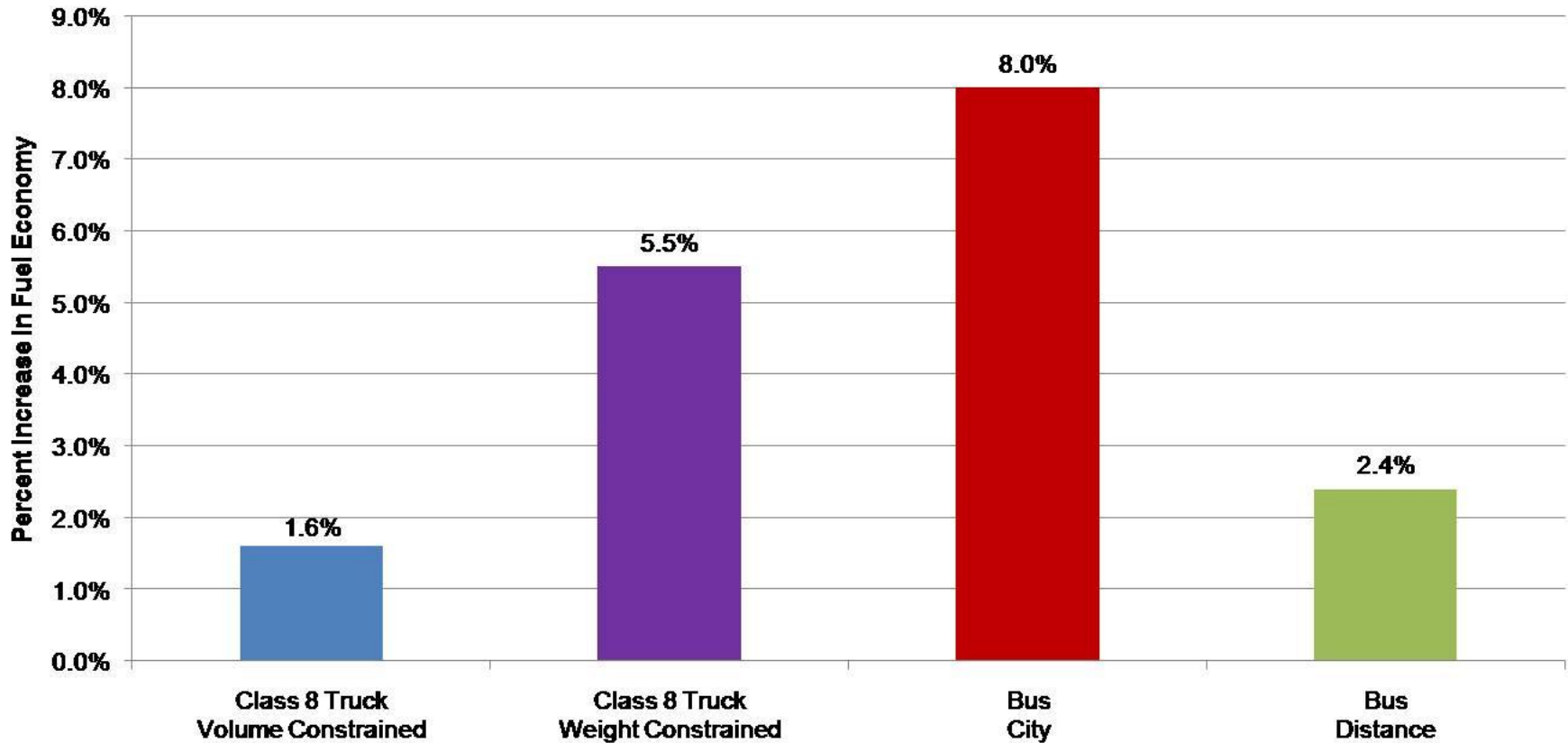
- Results based on real-world experience of truck OEMs
- Weight is a factor in truck and bus fuel economy
- Trucks and buses represent a large potential fuel savings
- Duty cycle dependant

Chart 3: Life time primary energy savings of the use phase for selected vehicle examples



Source: IFEU, SGKV 2002

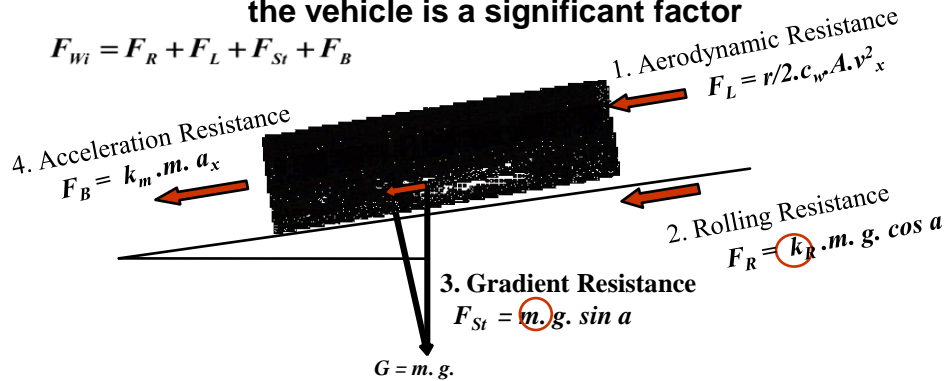
Estimated Fuel Economy Benefit from 10% Weight Reduction



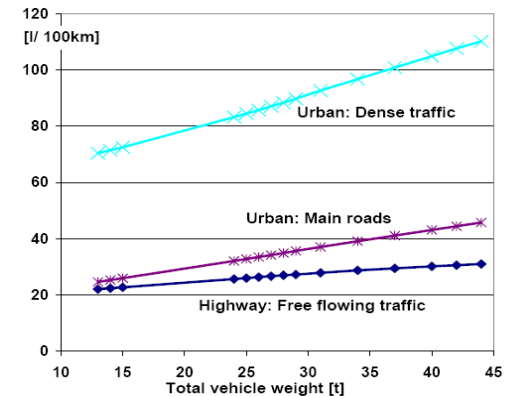
Source: IFEU, SGKV 2002

Impact More Pronounced in Urban Setting: Bus Example

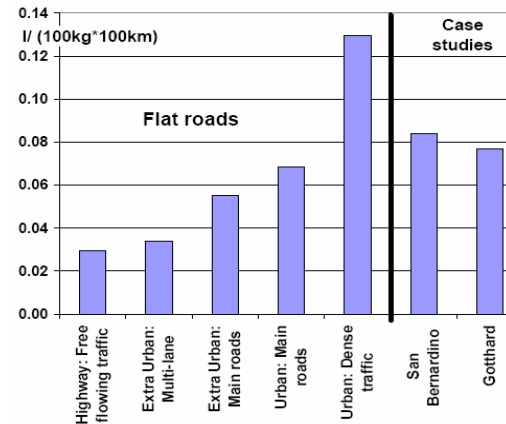
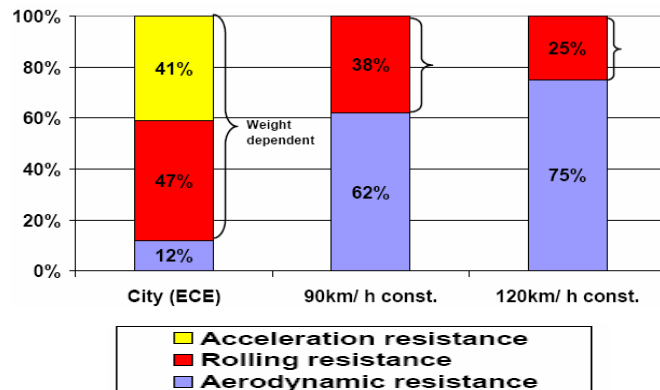
Physical resistances have an impact on vehicle fuel efficiency and mass of the vehicle is a significant factor



Duty cycle is important factor

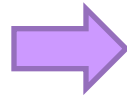


Impact is more pronounced in urban setting

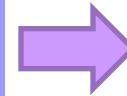


China Bus Project: Real World Success

**Weight
Reduction of
1,400 kg (12%)**



**>6% Fuel
Economy
Improvement**



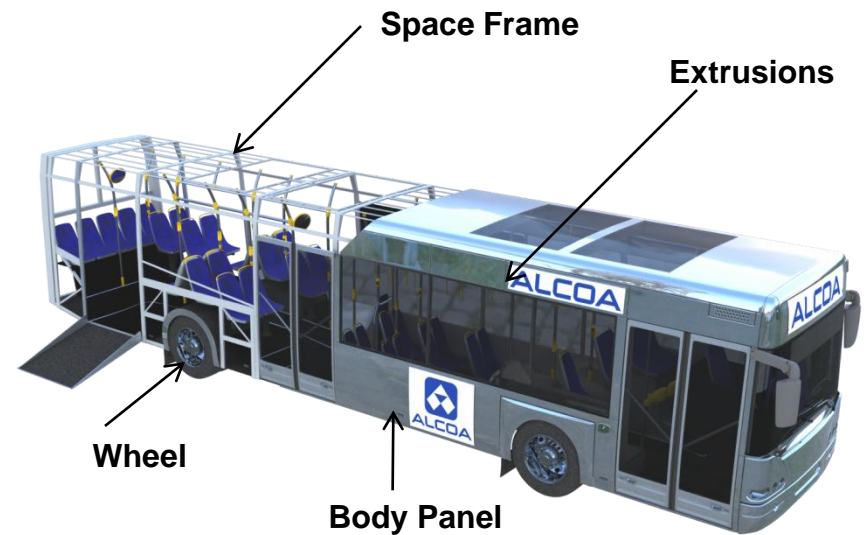
**50 Tons of
CO₂ Lifetime**

Value – Ecological

- Reduction in CO₂ emissions
- Reduced road surface wear and tear

Value – Financial

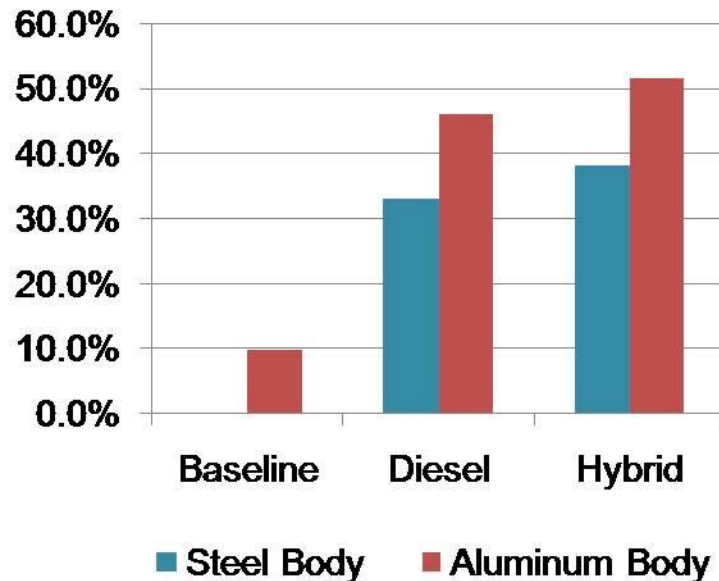
- Less fuel
- Maintenance savings (tires, brakes, suspension)
- Improved corrosion resistance
- Payback of 2-3 years



Relevant Auto Study: Aluminum Adds Value to Alternative Powertrains

Larger Fuel Savings

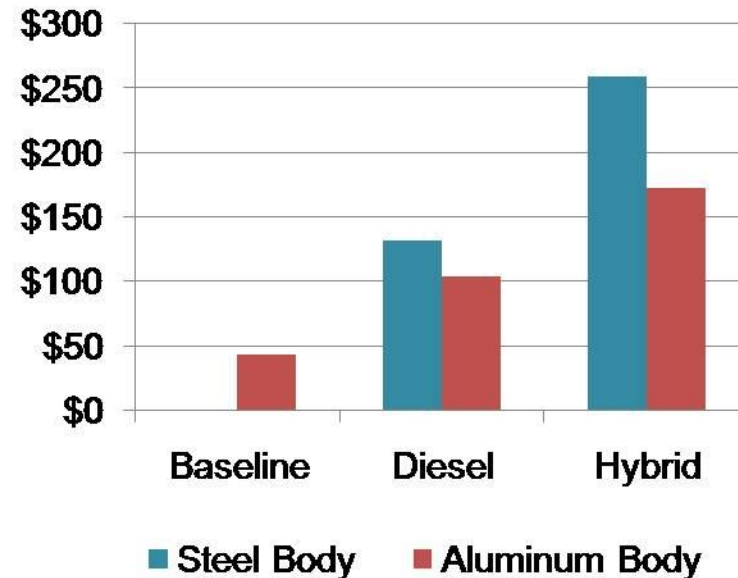
Percent Increase in MPG



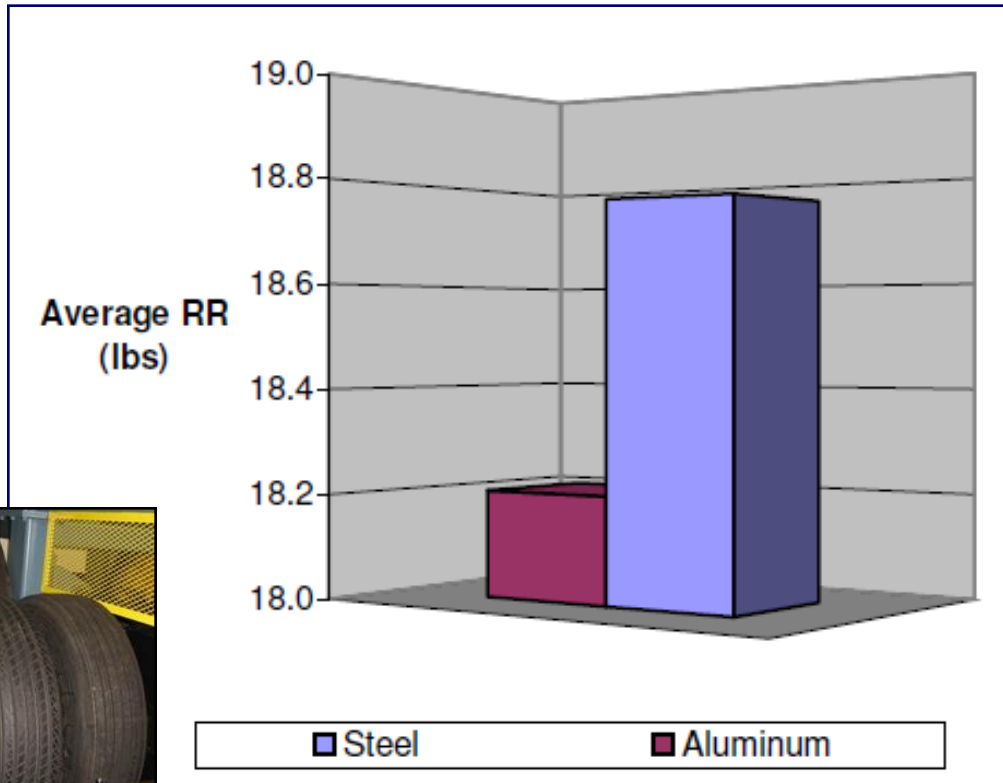
+

Lower Vehicle Cost

Cost per 1 MPG Increase



Aluminum Wheels Pay Fuel Economy Dividends



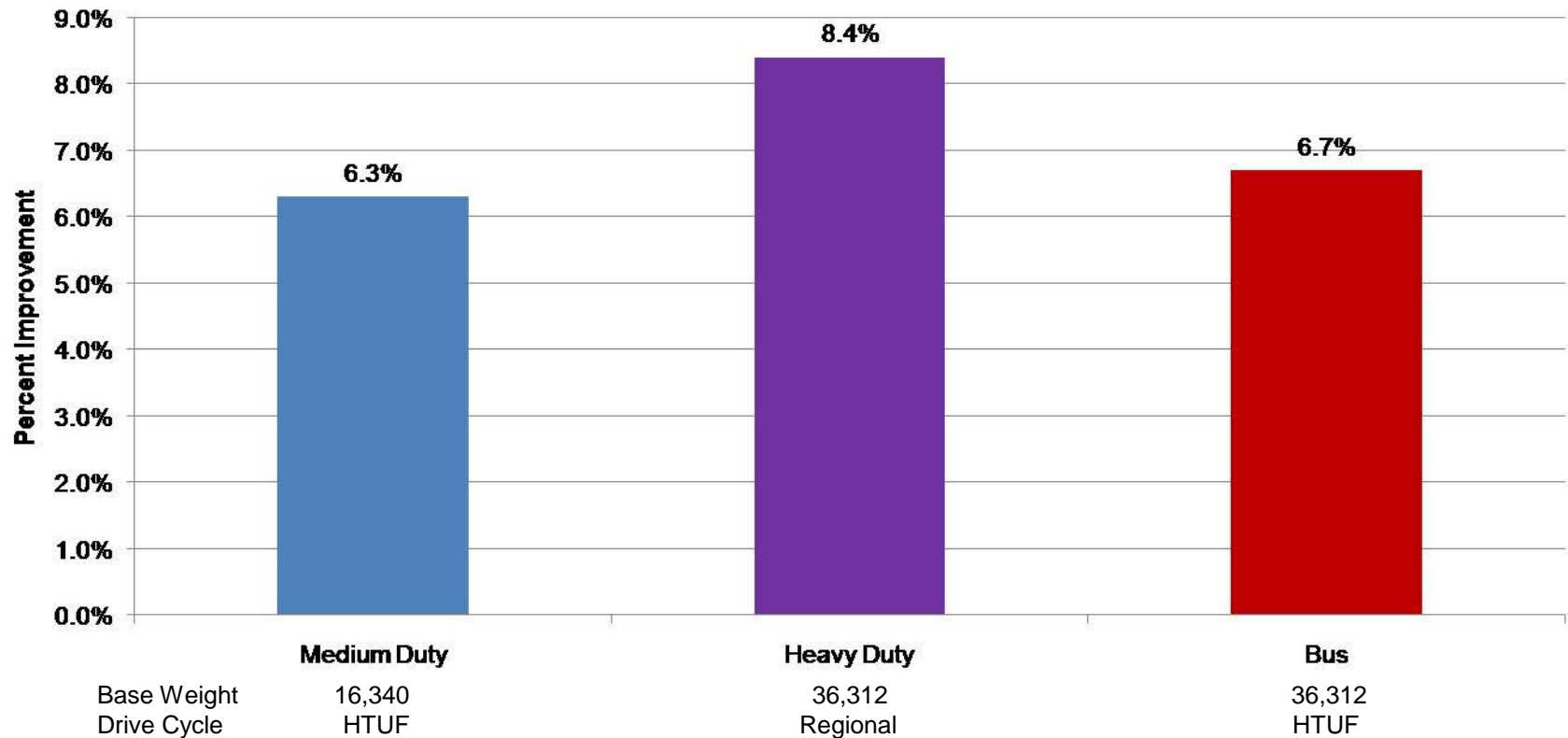
An aluminum wheel can improve tire rolling resistance by up to 3% over a comparable size steel wheel

3% less rolling resistance
=1% fuel savings

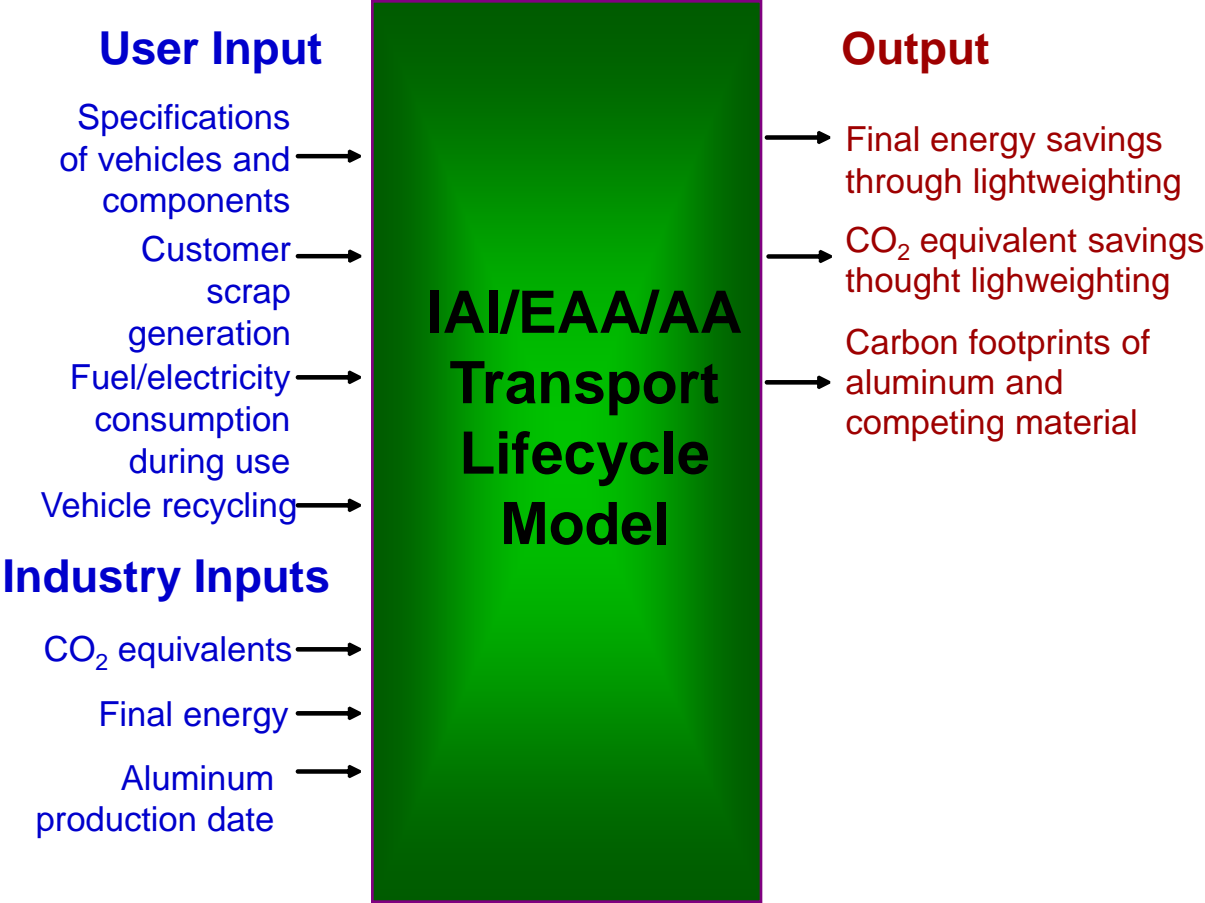
Source: Smithers Scientific Services

Major Tire Manufacturer Simulator Data

Fuel Economy Improvement Per 10% Weight Save



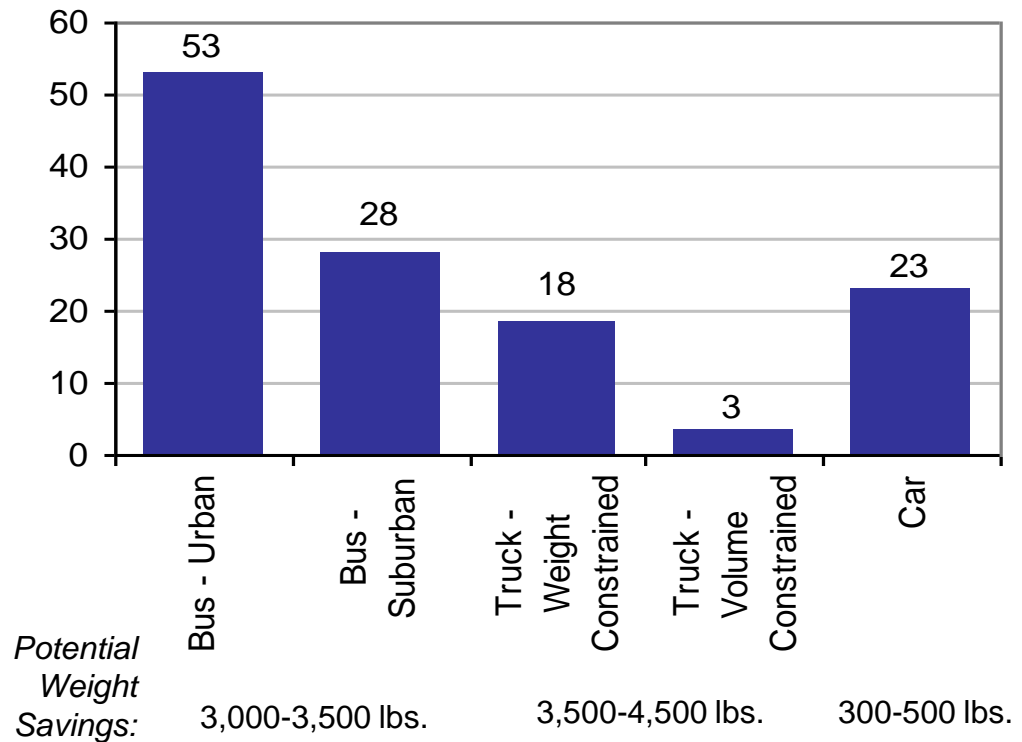
IAI Transport Model Illustrates Potential CO₂ Savings from Lightweighting



IAI: Aluminum Helps Reduce CO₂

- Auto aluminum already saving 300 million metric tons of CO₂ annually
- Including CO₂ impact of aluminum production
- Use-phase savings far outweigh production CO₂ generation
- Recycled aluminum uses 95% less energy

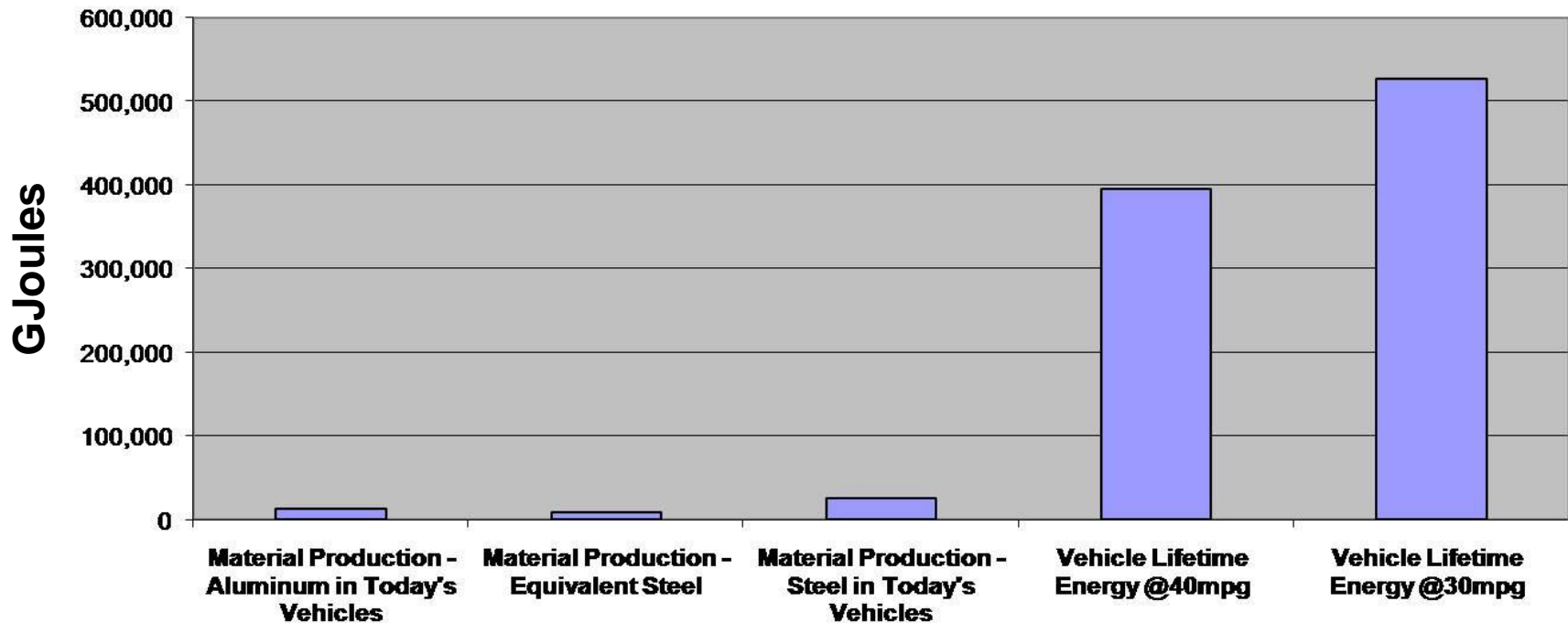
Specific Savings
(Tons of CO₂ per ton of weight save)



Source: IFEU, 2003

Use-phase Savings Outweigh Production Energy Generation

Lifetime Energy Consumption



Source: Alcoa – Automotive Example

Aluminum is a Part of the Solution

More Payload AND Lower Costs

- One ton of weight reduction = up to 2,000 gallons of diesel per year
- Lower maintenance costs
- Lower tire and brake costs

Higher residual value and durability

- Corrosion resistant parts last longer

Reduced Lifetime CO₂ Emissions

- Save 18 tons of CO₂ for every ton of aluminum you add to your fleet

Reduced dependence on imported oil

Infinitely recyclable



Help US so that we can help YOU

Research topics
Data gaps to fill



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