



# The Aluminum Advantage for Sustainable Transportation

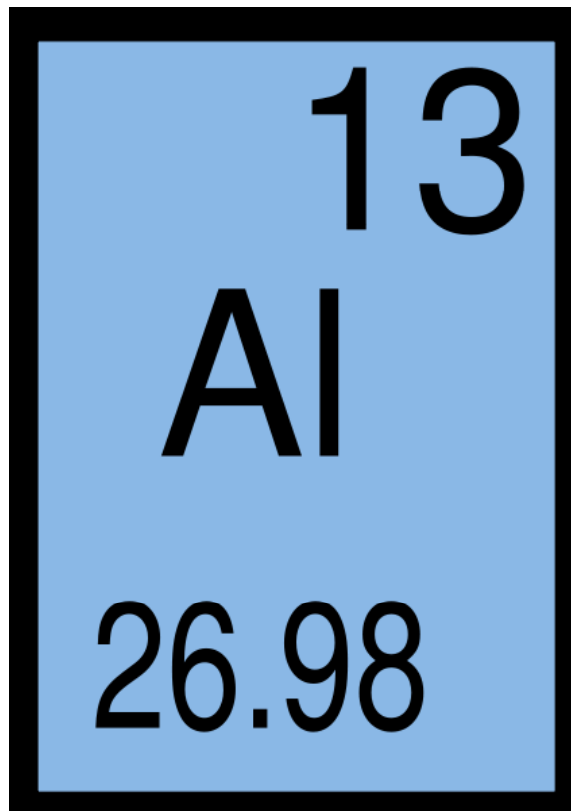
## Green Truck Summit

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March 09, 2010



## Did You Know?



- 73% of all aluminum produced since 1888 is still in use today
- Recycled aluminum uses 95% less energy to produce than primary output
- The aluminum industry cut CO<sub>2</sub> factory emissions by 86% from 1990 to 2006, with the goal of achieving carbon neutrality by 2030
- Aluminum can eliminate 30 tons of lifecycle CO<sub>2</sub> emissions and increase payload by 3,300 lbs. in weight-constrained heavy trucks



## Why Aluminum for Commercial Vehicles?

- Increased cargo capacity
- Reduced fuel consumption and emissions
- Lower maintenance costs (e.g. tire wear, corrosion, etc.)
- Increased resale value
- Cradle to cradle solution





# 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 Increases Payload and Fuel Economy

## Lightweighting Options

- Cab structure
- Forged aluminum wheels
- Hubs
- Frame cross members
- Fuel tanks
- Box trailer side walls and structure



## Weight-Savings Potential

- Flatbeds
- Tank bodies

1,500 lbs.\*

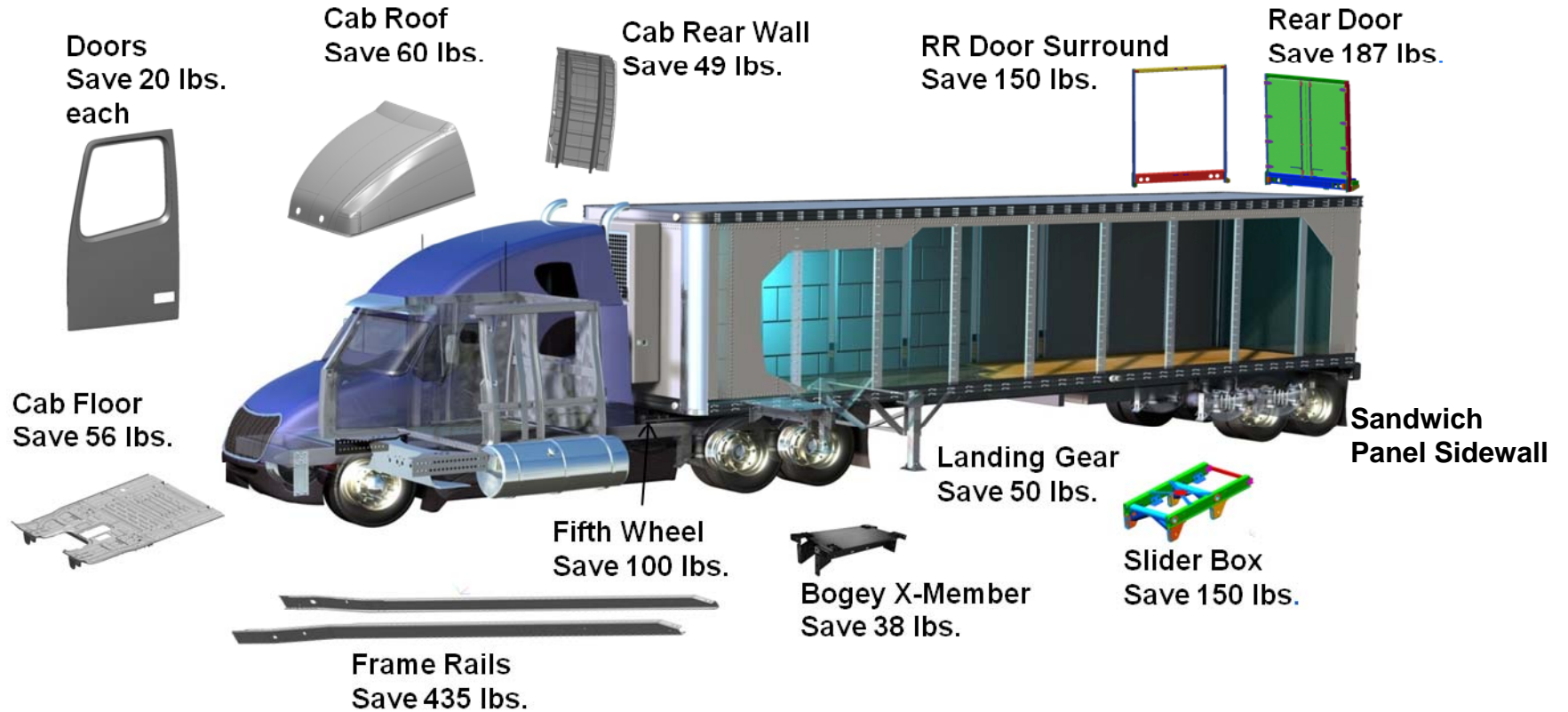
3,500 lbs.

7,000 lbs.

\* Relative to base truck & box trailer



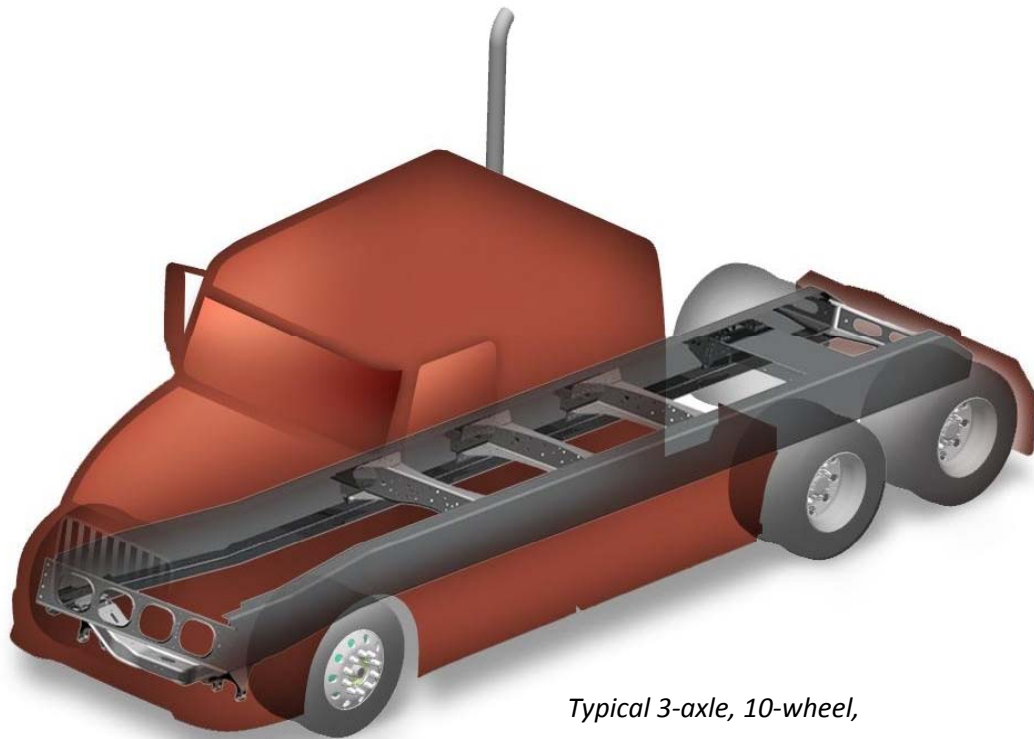
# Emerging Solutions Provide More Benefit



**Aluminum Solutions = 3,300 lbs more cargo in box vans**



# Class 8 Truck Aluminum Frame



*Typical 3-axle, 10-wheel,  
over-the-road Tractor Frame*

Truck Frame Weight		
Steel	Aluminum	Weight Save
1,200 lb	660 lb	540 lb

## Benefits

- **Lighter Than Steel** – 45% lighter frame
- **As Durable As Steel** – fatigue & corrosion resistant aerospace alloy sheet
- **More Payload Than Steel** – more payload = more revenue for truckers
- **Greener Than Steel** – 9,000 lbs of CO<sub>2</sub> saved over lifetime of truck



# China Bus Project Validates Value Proposition

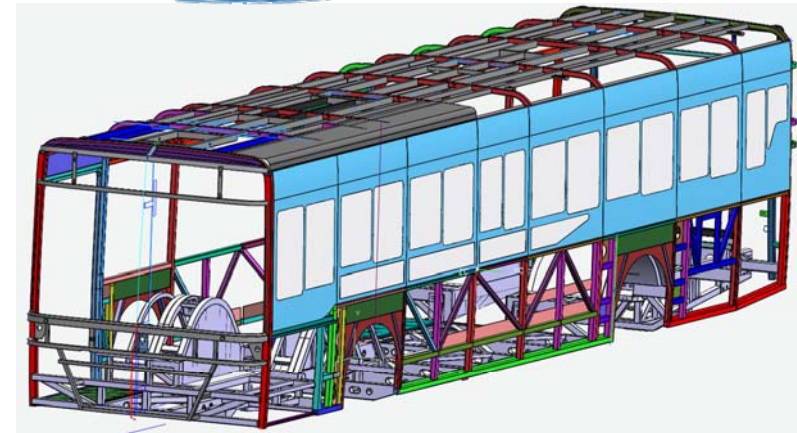
## Project Summary

- Partnered with the world's largest bus OEM – Yutong
- Alcoa designed spaceframe body
- Alcoa forged aluminum wheels
- Alcoa Huckspin fasteners



## Results

- Body is 46% lighter than steel body
- 1400 kg weight save overall (12% of bus total)
- 6% better fuel economy (5,000 gal saved)
- 50 Tons of CO2 saved over life





# Sustainable Solution Options - City Bus Example

Steel Bus	Aluminum Bus	Aluminum Bus + Added Content	Aluminum Bus with Hybrid Drive
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Added Aluminum Content

- Chassis
- Wheel hubs
- Fuel tanks
- Suspension and brake parts

Design Summary	Steel chassis / Steel body	Steel chassis / Aluminum body	Aluminum chassis / Aluminum body	Steel Chassis / Aluminum body
Curb Weight (kg)	12,140	10,720 (12% reduction)	9,900 (18% reduction)	12,500
Fuel Economy Improvement	-	6 % **	9% **	30%
CO2 reduction (per bus over life)	-	50 MT **	75 MT **	250 MT
Cost Difference	-	↑	↑	↑↑↑ *

\* Aluminum body weight reduces drivetrain costs by approx. \$35K relative to that for steel body

\*\* Drive train resizing for lighter vehicle could result in 3% more improvement



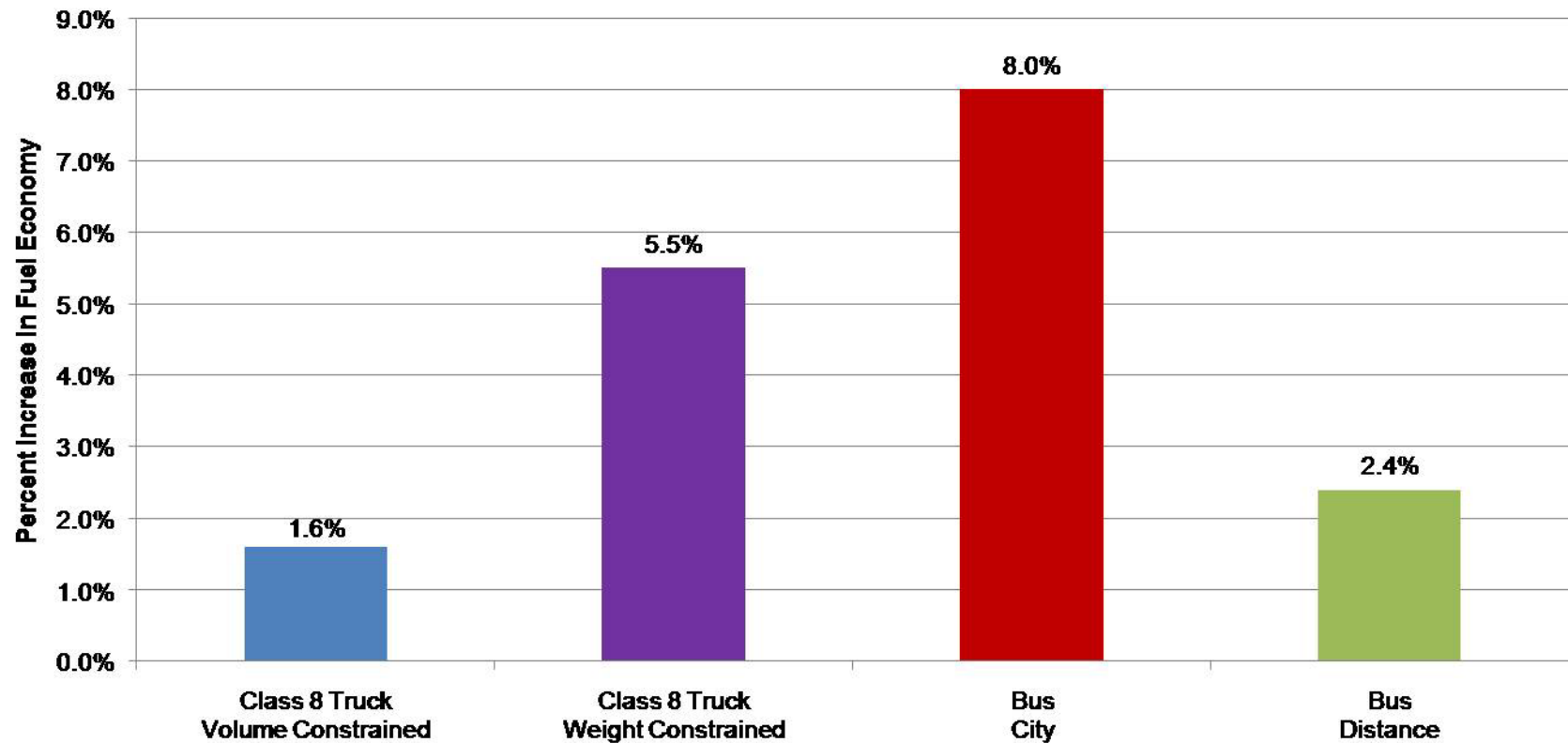
# Research Supports Lightweighting with Aluminum

- Fuel Savings via Weight Reduction (IFEU Heidelberg 2003)
- Fuel Savings in Class 8 truck-trailer weight reduction studies (Alum Assoc. & Ricardo)
- Aluminum Wheels Reduce Rolling Resistance (Smithers 2009)
- Improving Sustainability in the Transport Sector via Weight Reduction and Application of Aluminum (IAI 2006)





# Fuel Economy Increase from 10% Weight Reduction

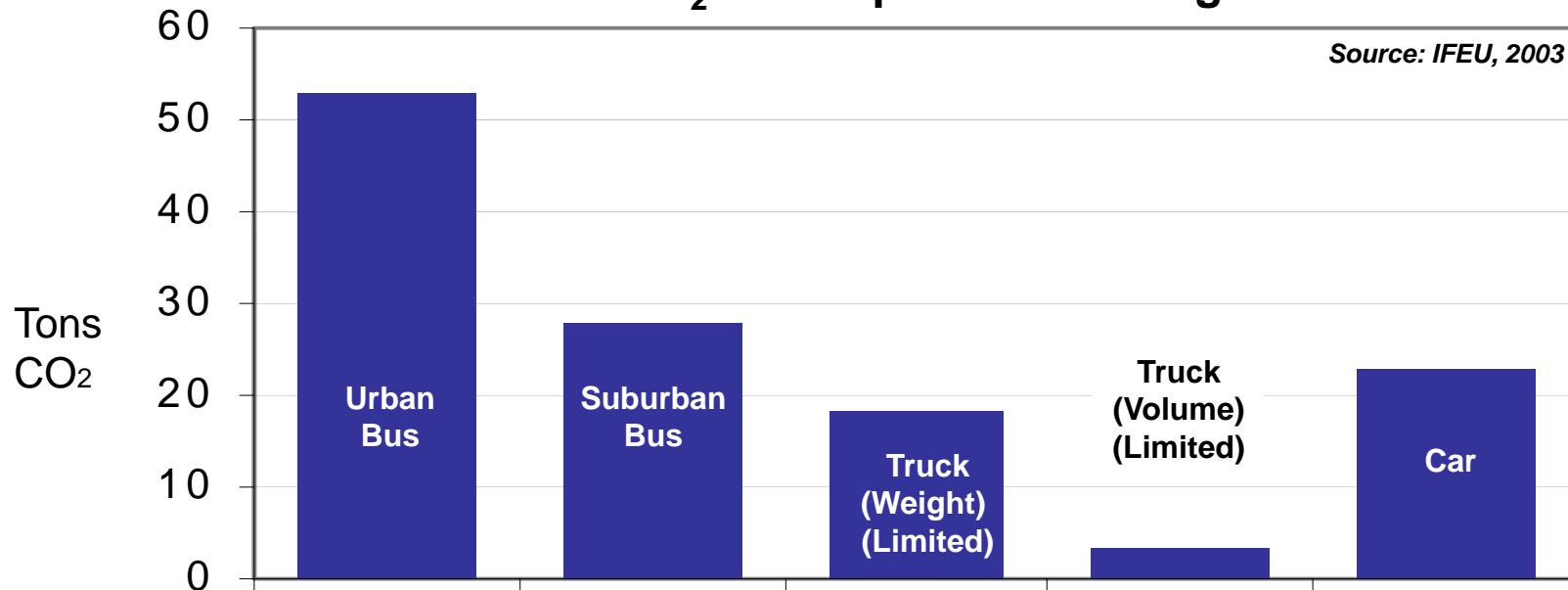


Source: IFEU, SGKV 2002



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

## Lifetime CO<sub>2</sub> Saved per Ton of Weight Saved



**Aluminum Solutions Presented = 30 tons CO<sub>2</sub> save for a weight limited truck \***

\* Based on 3,300 lbs weight saved and drive cycles in IFEU study



# Aluminum Intensive Truck/Trailer Study



## **Study Overview/Assumptions**

- (7) Class 8 trucks configurations at various weights/loads
- Drive Cycles incl. EPA Highway Fuel Economy Test & Heavy Duty Urban Dyno Drive
- Lightweight Aluminum Tractor/Trailer (3,300 lbs. less weight for dry box van)

## **Study Results** *(aluminum intense tractor/trailer vs. baseline conventional tractor/trailer)*

- **Improved Fuel Economy:** up to 5% improvement (load and drive cycle dependant)
- **Higher Payload Capacity:** 6% more capacity due to overall vehicle weight reduction
- **Reduced CO<sub>2</sub> Emissions @ GVW:** 900–1,600 gallons of diesel (10–18 tons of CO<sub>2</sub>) saved\*

\*Over 100,000 miles, assumes 6% fewer trips



## Aluminum is a Part of the Solution

### ■ **More payload AND lower costs**

- One ton of weight reduction = up to 3,400 gallons of diesel per lifetime
- Carry more cargo
- Lower maintenance costs
- Lower tire and brake costs

### ■ **Improve fuel economy**

- 10% weight reduction = up to a 5.5% improvement in fuel economy for Class 8 Truck

### ■ **Reduce lifetime CO<sub>2</sub> emissions**

- Save 18 tons of CO<sub>2</sub> for every ton of aluminum you add to your fleet

