

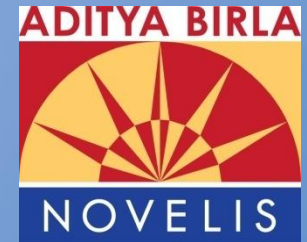
Aluminum's Role in Meeting Future Heavy Truck Fuel Economy Standards



An Aluminum Association Webinar
www.aluminumintransportation.org

Defining Who We Are

The Aluminum Association's Aluminum Transportation Group (ATG)



Why We are Here Today

- To meet the tough new fuel economy and emissions regulations proposed by the Obama Administration, next generation commercial vehicles will need to be lighter, cleaner and more fuel efficient – and aluminum delivers on all fronts
- Agenda
 - Introductions
 - Situation Analysis
 - Third-Party Research
 - Q & A

Introductions



Harry Siegel

ATG Executive Committee
Business Development
Director
Sapa Extrusions



Doug Richman

ATG Executive and
Technical Committees
Vice President
Engineering
Kaiser Aluminum

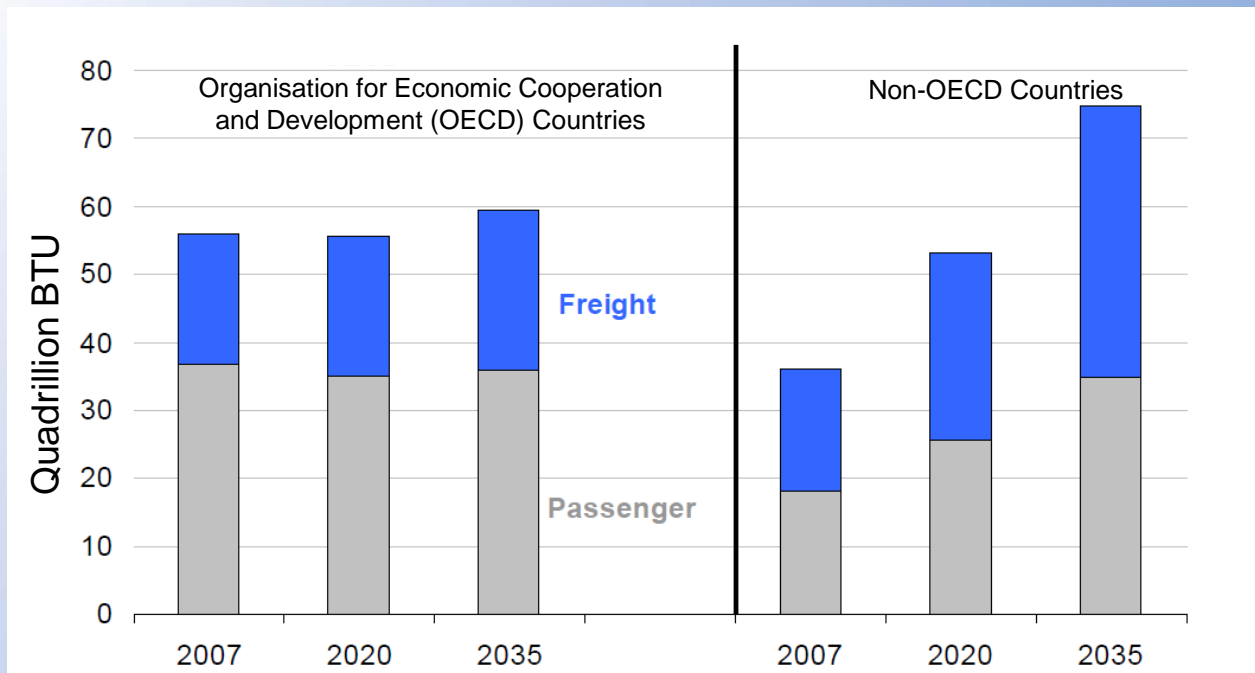


Todd Summe

ATG Technical Committee
Division Manager Product
Design & Development
Alcoa

Many Challenges Facing the Commercial Vehicle Industry Today

Transportation Energy Consumption



Freight energy use increasing faster than passenger energy use

- Rising energy costs
- Growing concern over greenhouse gas emissions
- Federal mandates continue to add weight to heavy-duty vehicles
- First-ever fuel efficiency standards proposed

Federal Mandates Add Weight

New emissions technologies have reduced fuel economy and increased weight

Emissions Mandate	Average Weight Impact (lbs.)	Fuel Economy Impact of Emissions Technologies
2002 EPA Engine Emissions	+150	-8%
2007 EPA Engine Emissions	+400	-3%
2010 EPA Engine Emissions (SCR)	+300	+3%
TOTAL	850 lbs.	-8%

Landmark Fuel Standards for Trucks Proposed



- First-ever fuel efficiency standards for medium- and heavy-duty trucks proposed
- Seeking emissions reductions between 10 and 20%
- Applies to largest vehicles on the road, including semi-trucks, buses, delivery vans, garbage trucks and heavy-duty work trucks

Return on Investment Higher When Combined with Other Improvements

A Systems Approach to Efficiency

Vehicle Design

Aerodynamics

Powertrain

Rolling Resistance



Impact of Weight Reduction on Improving Freight and Fuel Efficiency



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ATG Technical Committee
Division Manager Product Design & Development
Alcoa

Study Quantifies Aluminum's Impact on Freight Efficiency

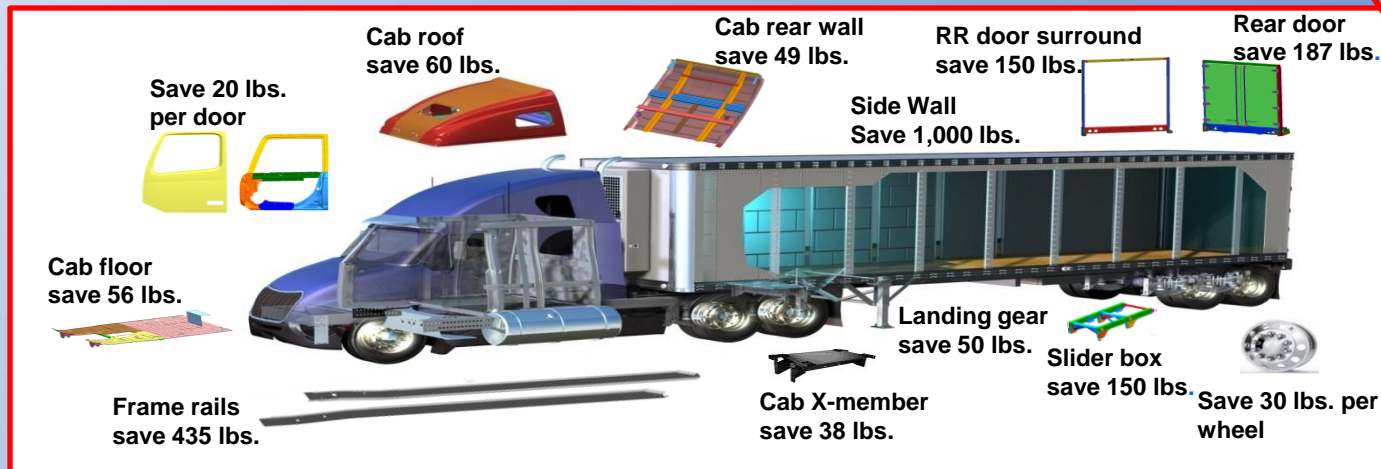
- **Objective**
 - Quantify fuel economy impact of weight reduction with aluminum specific to U.S. drive cycles
- **Methodology**
 - Analytical simulation (Ricardo)
- **U.S. drive cycle simulations**
 - EPA HWFET
 - WVU Interstate
 - HUDDS
- **Load conditions**
 - Un-loaded, ½ GVW Load, GVW
- **Engine and transmission**
 - Displacement: 13-liter, diesel
 - 10-speed automated manual transmission (AMT)
- **Vehicle specifications**
 - Frontal area: 10.68 m²
 - Coefficient of drag (C_d): .60 (baseline)



Photo Credit: East Manufacturing

Vehicle Configurations Studied

	Tractor (lbs.)	% Weight Saved	Trailer (lbs.)	% Weight Saved	Tractor & Trailer (lbs.)	% Weight Saved
Conventional (baseline)	16,000		13,500		29,500	
“Traditional” Lightweighting	15,500	3.1%	12,500	7.4%	28,000	5.1% (1,500 lb)
“High” Aluminum Content	14,500	9.4%	11,700	13.3%	26,200	11.2% (3,300 lb)



Payload Configurations Studied

Vehicle Configuration	Tractor Mass (lbs.)	Trailer Mass (lbs.)	Payload (lbs.)	Total (lbs.)
Conventional (baseline)	16,000	13,500	50,500	80,000 GVW
"Traditional" Lightweighting	15,500	12,500	52,000	80,000 GVW
"High" Aluminum Content	14,500	11,700	53,800	

6.5% more payload
→ 6.5% fewer trips

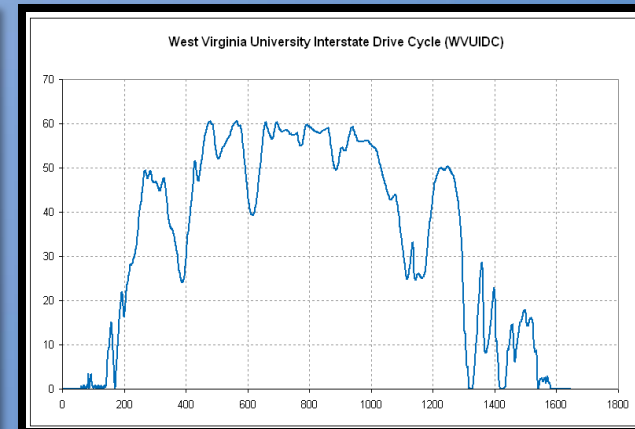
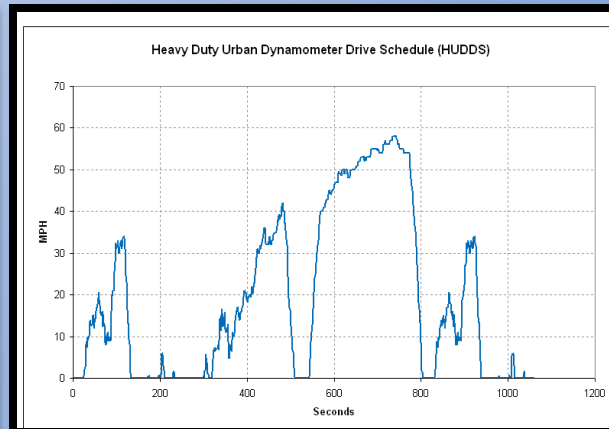
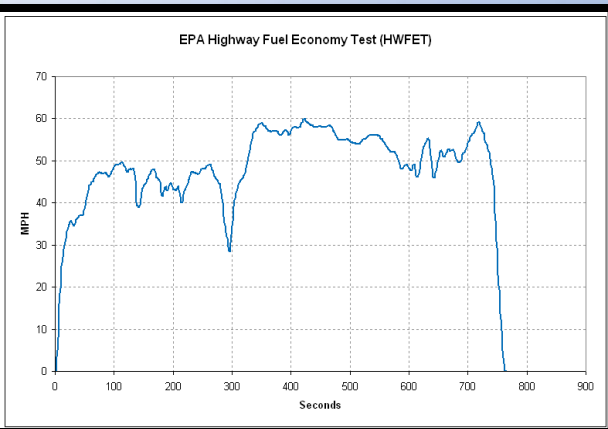
Payload Configurations Studied

Vehicle Configuration	Tractor Mass (lbs.)	Trailer Mass (lbs.)	Payload (lbs.)	Total (lbs.)
Conventional (baseline)	16,000	13,500	50,500	80,000 GVW
			25,250	54,750 half load
			0	29,500 unloaded
"Traditional" Lightweighting	15,500	12,500	52,000	80,000 GVW
			25,250	53,250 half load
			0	28,000 unloaded
"High" Aluminum Content	14,500	11,700	53,800	80,000 GVW
			25,250	51,450 half load
			0	26,200 unloaded

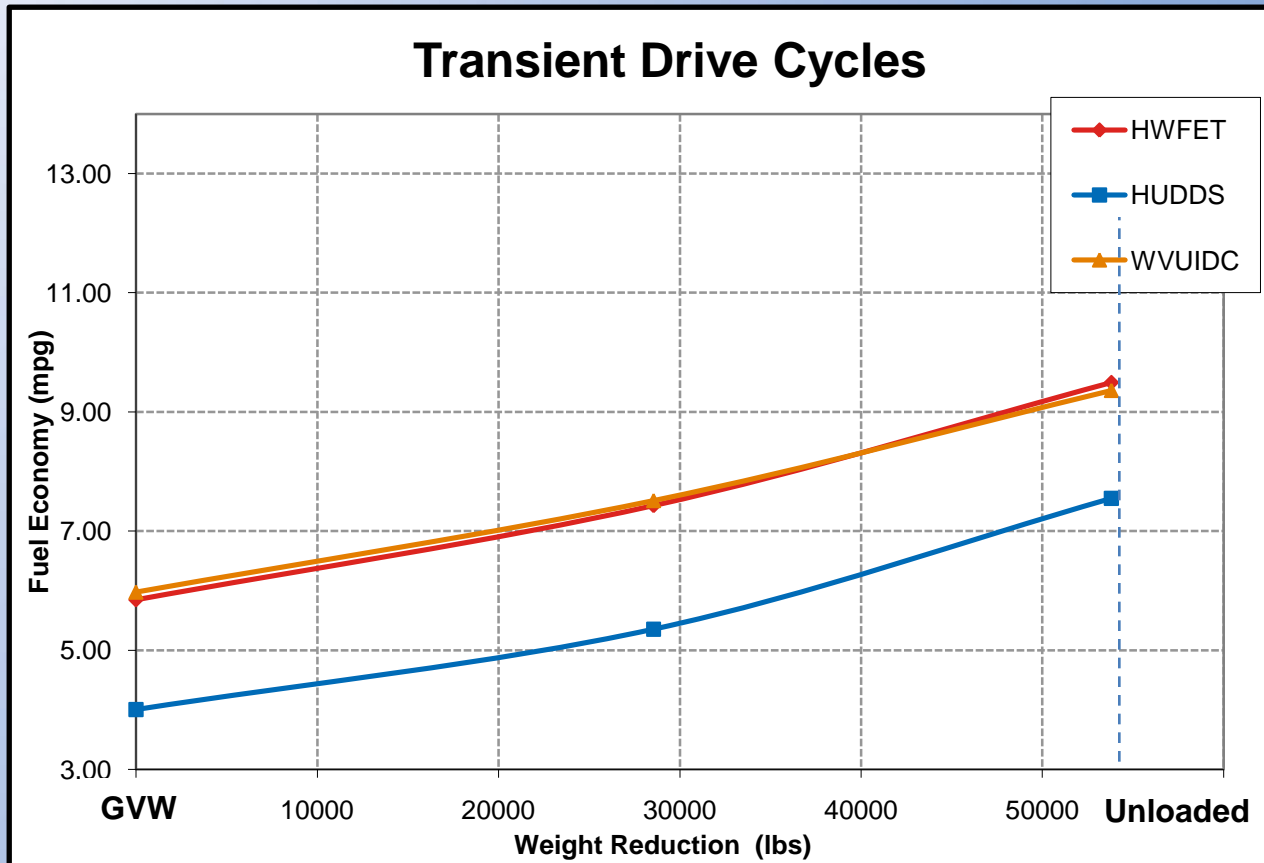
11.2% mass saved

U.S. Drive Cycles Simulated Via Physics-Based Model

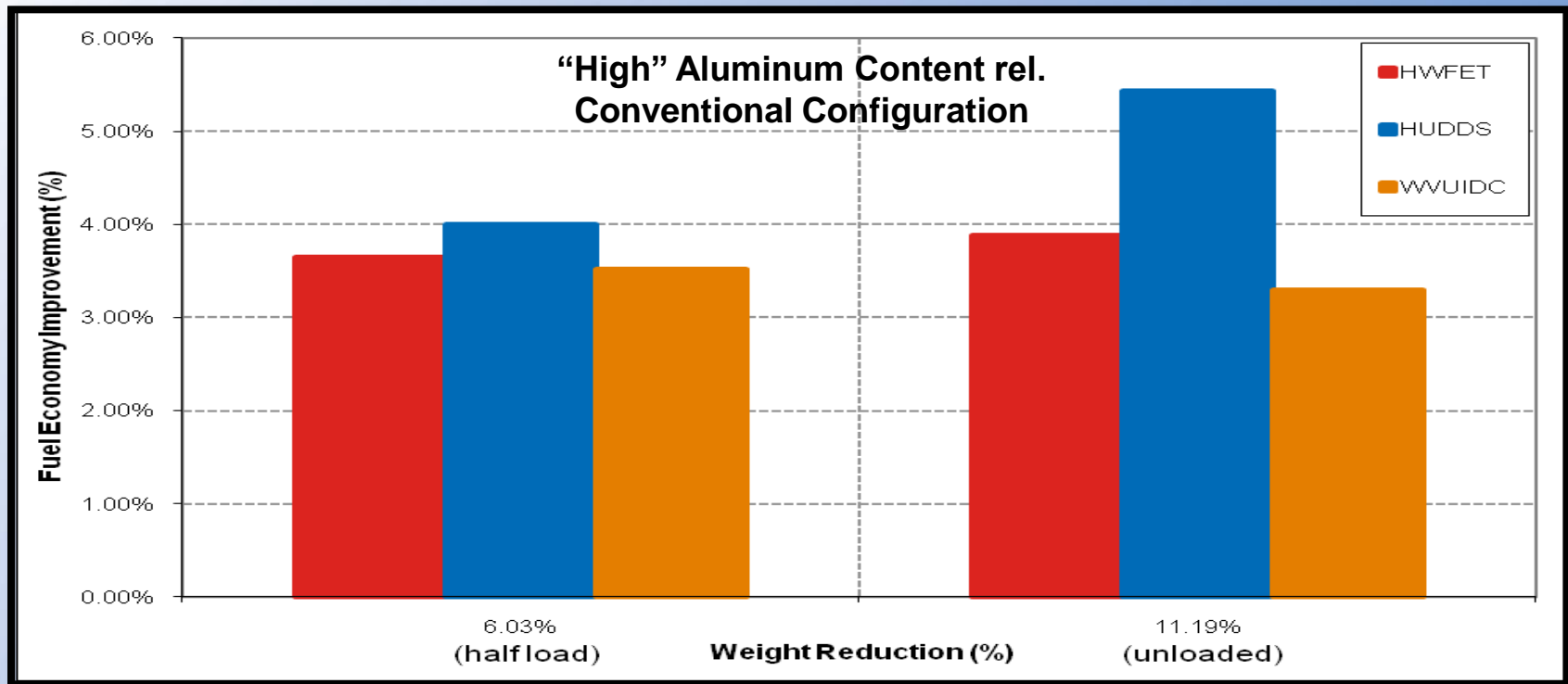
- **Highway Fuel Economy Test (HWFET)**
 - One of EPA’s official highway cycles
 - Duty cycle designed for medium to high speed operation, no mid-cycle stops
- **Heavy-Duty Urban Dynamometer Drive Schedule (HUDDS)**
 - One of EPA’s drive cycles for heavy-duty vehicles
 - Several idle and start-stop positions
 - Many acceleration and deceleration events
- **West Virginia University Interstate Drive Cycle (WVUIDC)**
 - Simulates interstate operation
 - Speeds vary from medium to high, many moderate acceleration events



Weight Savings Increases Fuel Economy for All Drive Cycles

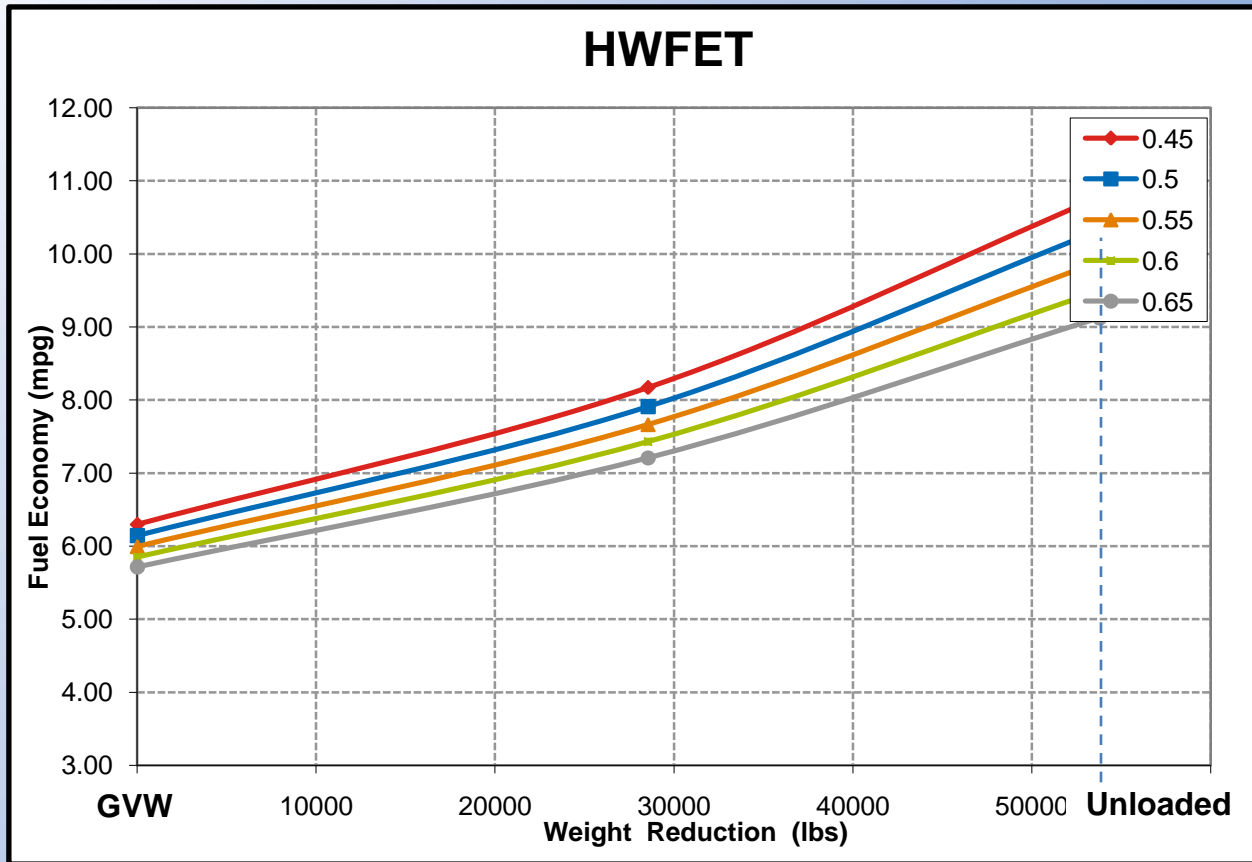


Weight Savings Increases Fuel Economy for All Drive Cycles



- Largest impact on “urban” (more stop-and-go) schedules

Weight Reduction and Aerodynamic Improvements are Complimentary



- Weight savings has greater impact at lower drag coefficient
- 3,000 lb. reduction equivalent to 0.05 C_d improvement

“High” Aluminum Content Truck

Aluminum Impacts Fleet Freight Efficiency

“High” Aluminum Content – 3,300 lb. Weight Reduction

Payload (% GVW)	% Annual Miles*	Fuel Efficiency Improvement
0 – 25 %	10 %	4.1 %
25 – 75 %	25 %	3.7 %
75 – 100 %	65 %	6.5 %
	Fleet Average =	<u>5.7 %</u>

6.5% more
payload /
fewer trips

* Average results from Aluminum Association Heavy-Duty Truck Use Survey

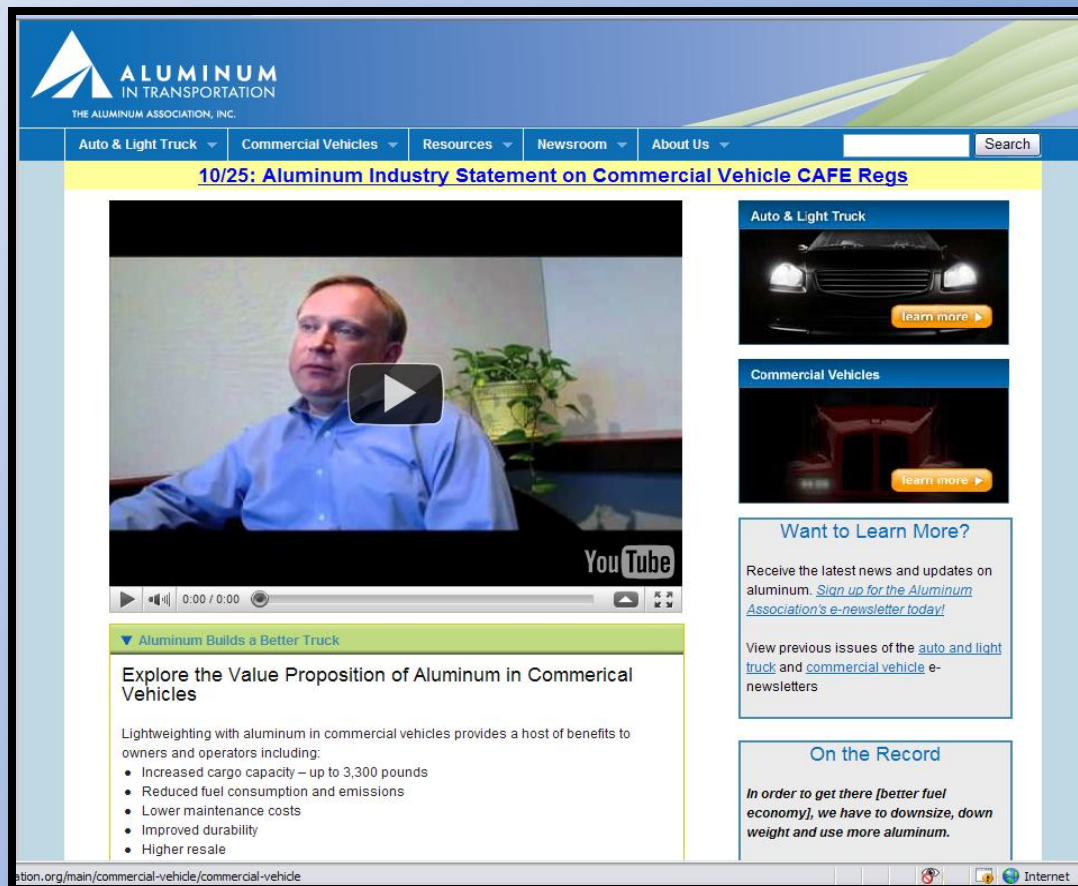
Aluminum is a Part of the Solution

- ***More payload***
 - Carry 3,300 lbs or 6.5% more cargo at GVW
- ***Improved fuel efficiency***
 - As high as 1,612 gallons each year for a weight constrained vehicle
 - Nearly **one billion gallons** of diesel annually for the current U.S. fleet
- ***Reduced CO₂ emissions***
 - Up to 17.9 tons annually for a weight constrained vehicle
 - Approximately **10 million tons of CO₂** per year for the current U.S. fleet



Online Resources For You

www.aluminumintransportation.org



The screenshot displays the website's interface. At the top left is the logo for ALUMINUM IN TRANSPORTATION, THE ALUMINUM ASSOCIATION, INC. A navigation menu includes links for Auto & Light Truck, Commercial Vehicles, Resources, Newsroom, and About Us, along with a search box. The main content area features a yellow banner with the headline "10/25: Aluminum Industry Statement on Commercial Vehicle CAFE Regs". Below this is a video player showing a man in a blue shirt speaking. To the right of the video are two featured sections: "Auto & Light Truck" with a car image and "Commercial Vehicles" with a truck image, both with "learn more" buttons. Below these is a "Want to Learn More?" section with a sign-up link for the e-newsletter and a link to view previous issues. At the bottom right is an "On the Record" section with a quote: "In order to get there [better fuel economy], we have to downsize, down weight and use more aluminum." A footer at the bottom left shows the URL "ation.org/main/commercial-vehicle/commercial-vehicle" and a small "Internet" icon on the right.

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View previous issues of the [auto and light truck](#) and [commercial vehicle](#) e-newsletters

On the Record

In order to get there [better fuel economy], we have to downsize, down weight and use more aluminum.

ation.org/main/commercial-vehicle/commercial-vehicle

Questions & Answers

*To submit your question:
Use the Questions section in your Control
Panel on the right side of the screen*



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