THE PEW CHARITABLE TRUSTS

Fuel Efficiency for the Long Haul

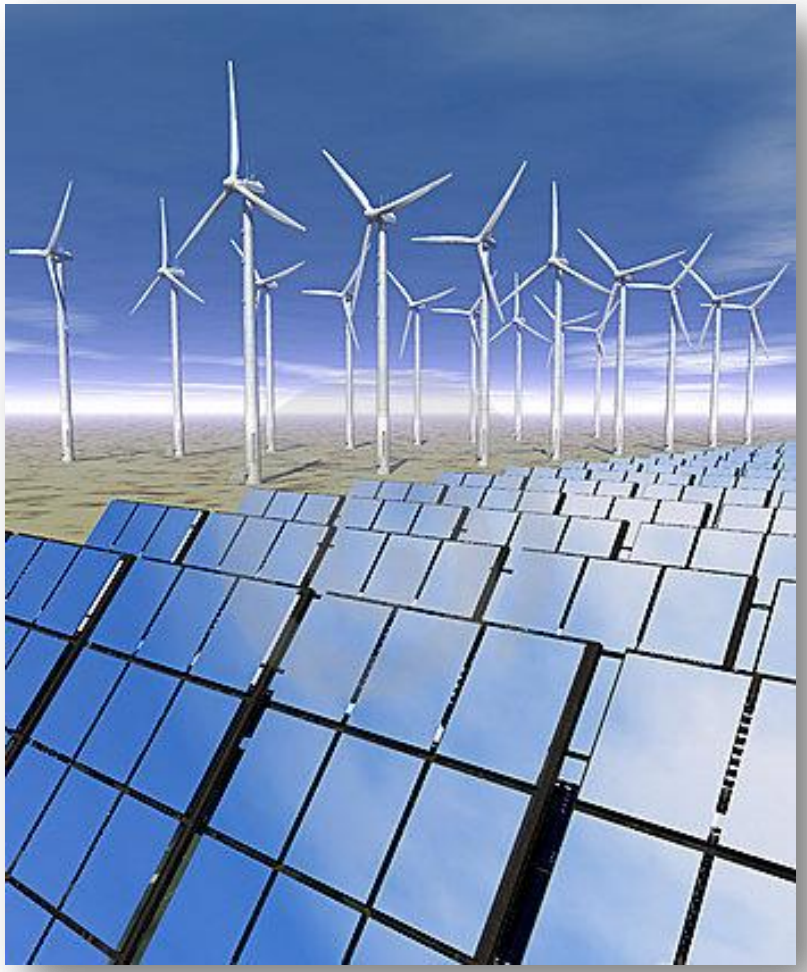
An overview of proposed standards for medium- and heavy-duty vehicles

Clean Energy Initiative

Our goal is to accelerate the clean energy economy for its national security, economic and environmental benefits.

The initiative promotes the adoption of key changes to U.S. energy policy in four sectors:

- Industry
- Utilities
- Transportation
- Research and development



Our Research

Global Investment

Innovation and Competitiveness

National Security

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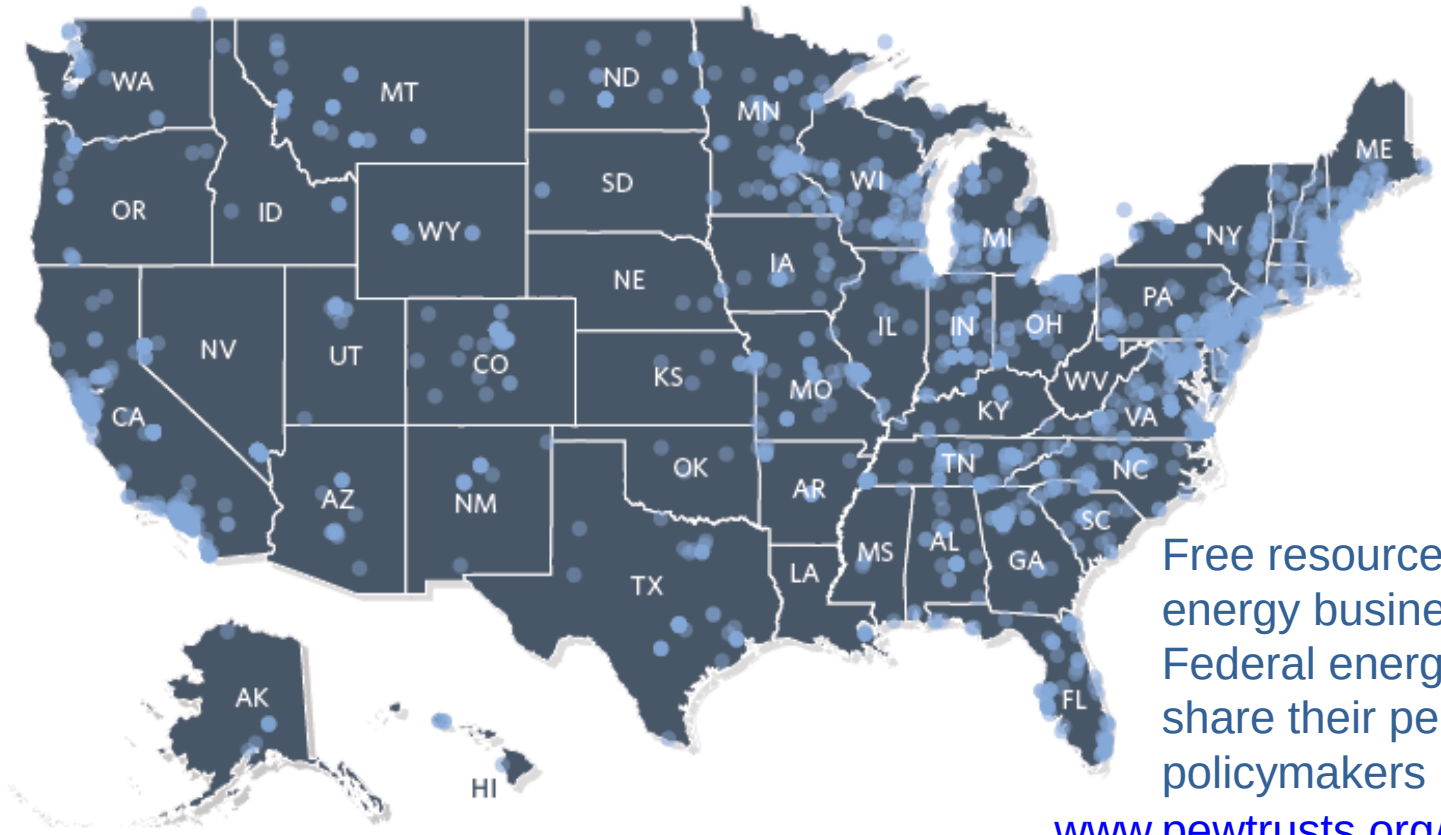
Pew Clean Energy Business Network Member Locations

More than 3,000 business leaders nationwide



Free resource to inform clean energy business leaders about Federal energy policy and share their perspectives with policymakers

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Heavy-duty Vehicle Sector

- Variety of vehicles – delivery vans, tractor-trailers, garbage trucks, and buses
- Second largest and fastest growing segment of U.S. transportation
- Trucking revenue topped $700 billion in 2014
- Second phase of efficiency standards

Today's Speakers

Chuck Moulis, Senior Environmental Engineer, U.S. Environmental Protection Agency (EPA)

Jim Tamm, Fuel Economy Division Chief, National Highway Traffic Safety Administration (NHTSA)

Mike O'Connell, Senior Director Fleet Supply Chain, Frito-Lay North America, a division of PepsiCo

Bill Van Amburg, Senior Vice President, CALSTART

Proposed Phase 2 Fuel Efficiency and GHG Emission Standards for Heavy-Duty Vehicles

AUGUST 24, 2015

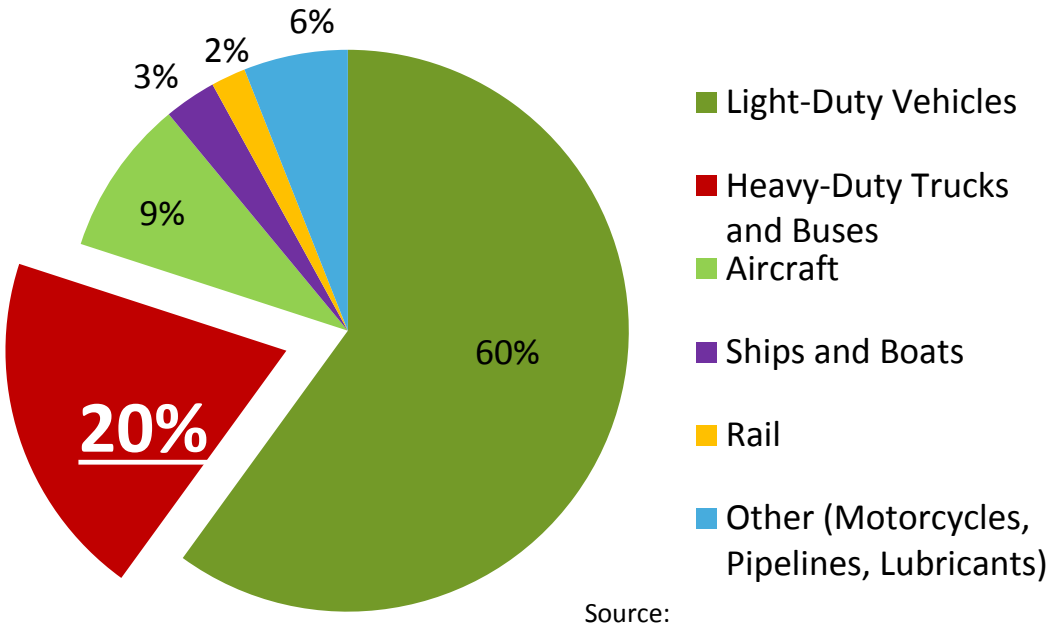
Presentation Overview

- Background information
  - Heavy-duty sector characterization
  - Phase 1 highlights: began in 2014 – fully phased-in by 2018
- Phase 2 proposal
  - More ambitious and longer-term standards
  - Builds upon successful Phase 1 program structure
  - Cost-effective, see key facts and figures
  - Proposal invites comment on both proposed standards and alternative standards that achieve 2027 stringency levels in 2024/2025

Background

U.S. Transportation Sector Energy Use

- Heavy-duty vehicles responsible for about one fifth of the energy use and GHG emissions from transportation sources
- In terms of energy use, heavy-duty vehicles are also the fastest growing transportation sector in the U.S. and globally



Source:
U.S. Energy Information Administration
Annual Energy Outlook 2014

Heavy-Duty Truck Categories

65% of HD Fuel Consumption and GHG Inventory (together)

Line-Haul Tractors

Line-Haul Trailers
(currently unregulated Federally)

Standards in g/ton-mile and gallons/1000 ton-miles

Vocational Vehicles
21% of HD Fuel Consumption and GHG Inventory






Standards in g/ton-mile and gallons/1000 ton-miles

Large Pickups & Vans
14% of HD Fuel Consumption and GHG Inventory


Standards in g/mile and gallons/100 miles

Phase 1 Highlights

- Phase 1 heavy-duty fuel efficiency and GHG standards began in 2014
  - First-ever standards for heavy-duty vehicles, will be fully phased in by 2018
  - A coordinated national program: manufacturers produce a single fleet to comply with all federal standards
  - Manufacturers are complying with “off-the-shelf” technologies
  - Very cost-effective technologies lead to fuel-savings greater than the technology cost—all standards “pay back”

Additional Phase 1 Details

- Heavy-duty pickup and van program is similar to light-duty program
  - Vehicle certification is based on testing a complete vehicle
- Other heavy-duty vehicles include:
  - Engine certification based on EPA's existing criteria pollutant test procedures
  - Computer simulation certification of *vehicle* performance (without engine, transmission and axle) – instead of actual vehicle testing

Phase 2 Proposal

Proposed Phase 2 Program

- Proposed Phase 2 standards would begin:
  - In 2018 for EPA trailer standards, which were not regulated in Phase 1
  - In 2021 for NHTSA trailer standards, and EPA and NHTSA tractor, trailer, vocational vehicle and HD pickup and van standards
    - EISA requires NHTSA to provide at least 4 years lead time
- All Phase 2 standards would be fully phased in by 2027
- Technologies that would meet the proposed performance based standards
  - Nearly full use of established technologies – with additional optimization
  - Increasing use of emerging and advanced technologies by 2027
- Also proposing improvements to computer simulation compliance program to recognize new technologies, and to include the engine and transmission in the vehicle standards

Projected Phase 2 Improvements

- Technology-advancing standards that phase in through model year (MY) 2027
  - Incrementing standards in 2018-2026 to ensure steady progress toward 2027 standards

	2027 CO2/Fuel Consumption Reductions (by vehicle subcategory)
Tractors *	18 - 24%
Trailers	3 - 8%
Vocational Vehicles *	12 - 16%
Pick-ups & Vans *	18%

* Includes engine improvements

Summary* of Phase 2 Proposal, GHG and Fuel Reductions, Costs and Benefits

	Proposed Phase 2 MY 2018-2029 (in addition to Phase 1)*
Fuel reductions (Billion Gallons)	70 - 77
GHG reductions (MMT CO_2eq)	960 - 1040
	Billions of 2012$
Vehicle costs	-$25
Fuel savings (pre-tax)	$159 - 175
GHG, non-GHG & other benefits	$90 - 95
Net benefits	$224 - 245

* Values shown in this table are representative values for 3% discount rate
Preamble and Draft Regulatory Impact Analysis present a range of estimates of costs and benefits to reflect range of analytical baselines, discount rates and modeling approaches.

Per Vehicle Costs

- Cost increase shown represents *average* 2027 vehicle vs. *average* Phase 1 vehicle
  - Fleet-average standards enable vehicle market to include a wide range of technology levels and cost impacts
  - 2021 and 2024 standards would lead to gradual introduction of new technology and gradual increase in costs

Per Vehicle Cost and % Increase in Typical Vehicle Price*

	Projected Average Cost Increase for MY 2027 Vehicle (Relative to 2018 vehicles)
Tractors	$11,700 <12% cost increase
Trailers	$1,200 <5% cost increase
Vocational Vehicles	$3,400 <5% cost increase
Pick-ups/Vans	$1,300 <3% cost increase

*Assumed vehicle prices: $100,000+ for tractors, $25,000+ for trailers, $70,000+ for vocational vehicles and $40,000+ for HD pickups/vans

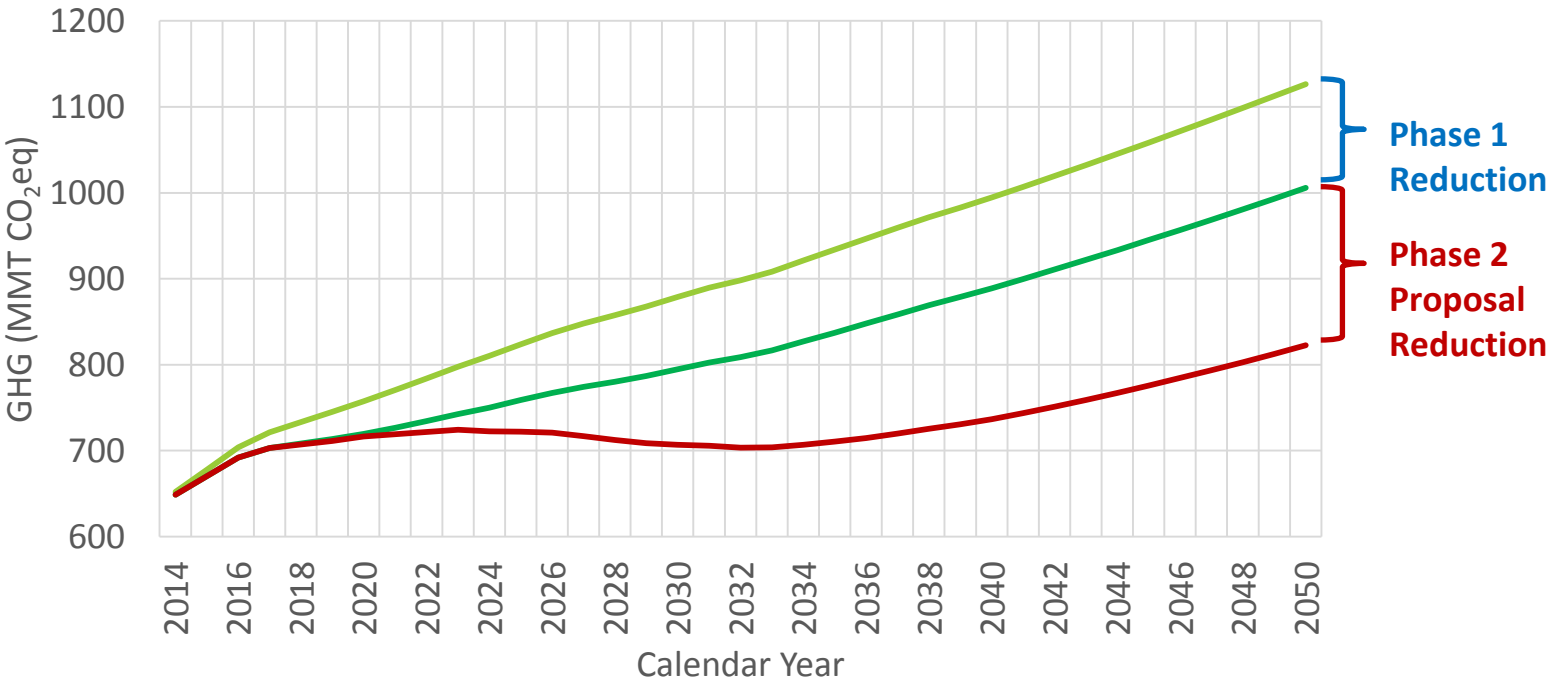
Vehicle Paybacks for Proposed Standards

- Standards would achieve large fuel savings that "pay" for the cost of the technology
- Favorable payback periods
  - Purchasers will generally get what they pay for – bigger fuel savings for purchasers opting for more technology
  - Customers that finance vehicles may see immediate payback where monthly fuel savings exceed increase in monthly payment
  - Very quick paybacks for tractors, pick-ups and vans
- Vocational Vehicles (buses, refuse trucks, etc.)
  - Vocational paybacks longer because of fewer miles travelled each year
  - But vocational owners keep trucks longer – typically values net savings from longer payback periods

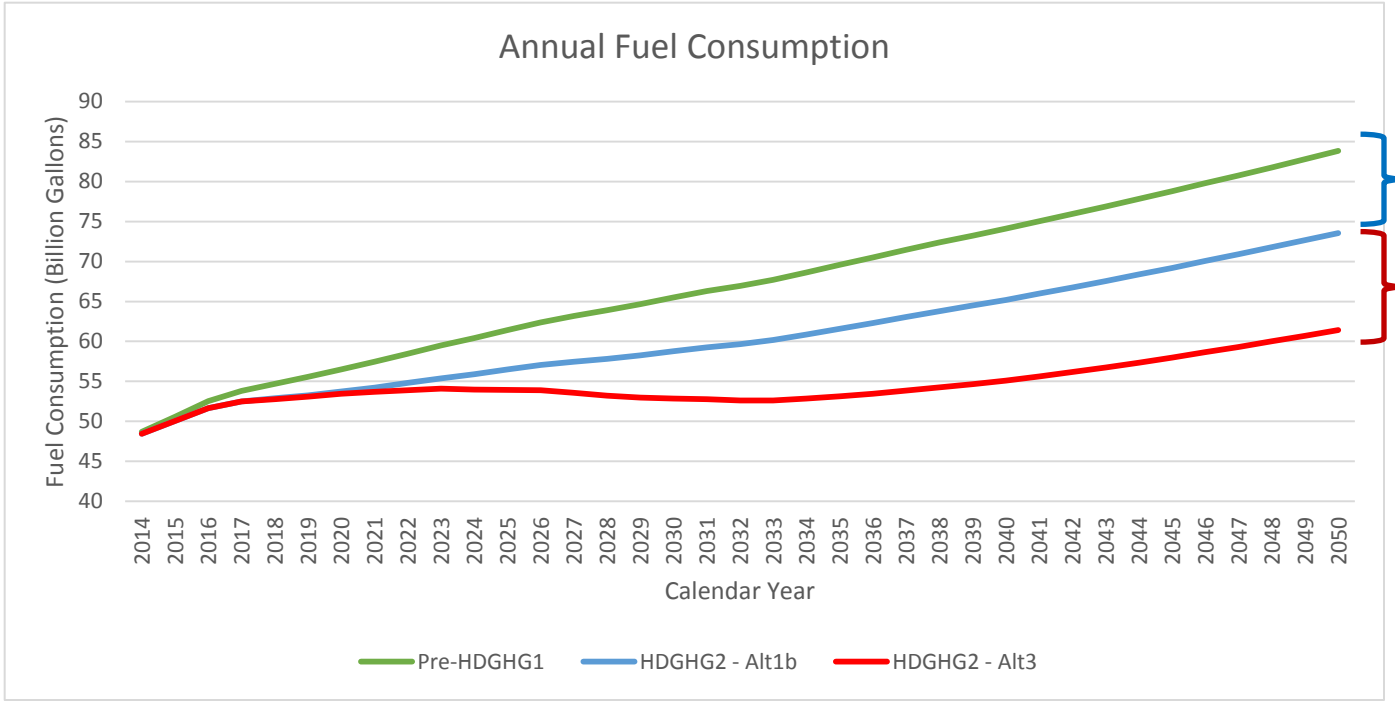
Payback Period for Typical MY 2027 Vehicles

Tractors/Trailers	2nd year
Vocational Vehicles	6th year
Pick-ups/Vans	3rd year

Annual GHG Reductions from Adding Phase 2 Proposal to Existing Phase 1



Annual Fuel Savings from Adding Phase 2 Proposal to Existing Phase 1



Small Business Impacts

- Regulatory Flexibility Act directs agencies to separately consider impacts of rulemakings on small businesses
- EPA also required by SBREFA to convene a SBREFA Panel with SBA and OMB to formally consider ways to minimize impacts on small businesses, Panel Report available in EPA's rulemaking docket
- Affected small businesses include trailer manufacturers, alternative fuel converters, and specialty vehicle manufacturers
- Agencies proposing flexibilities consistent with SBREFA Panel Report

Alternative Phase-In Schedule That Would Achieve Greater Reductions Sooner ("Alternative 4")

- Agencies are confident that proposed standards would be achievable under the proposed schedule
  - We have some reasons to believe standards could be implemented even sooner
  - But some outstanding questions remain at the time of the proposal
- Proposal extensively highlights for comment a specific alternative phase-in of the proposed standards—two to three years earlier
- Proposal emphasizes that if additional information becomes available in support of the alternative phase-in, the agencies may finalize some or all aspects of the alternative standards
- These alternative standards would achieve significant additional fuel consumption and GHG reductions, with associated incremental costs, shown on the next slide

Summary* of Alternative Phase-In Schedule, GHG and Fuel Reductions & Costs and Benefits

	Proposed Phase 2 MY 2018-2029	"Alternative 4" MY 2018-2029
Fuel reductions (Billion Gallons)	70 - 77	80-87
GHG reductions (MMT CO_2eq)	960 - 1040	1090 - 1166
	Billions of 2012$	Billions of 2012$
Vehicle costs	-$25	-$33
Fuel savings (pre-tax)	$159 - 175	$181 - 198
GHG, non-GHG & other benefits	$90 - 95	$100 - 104
Net benefits	$224 - 245	$248 - 269

* Values shown in this table are representative values for 3% discount rate
Preamble and Draft Regulatory Impact Analysis present a range of estimates of costs and benefits to reflect range of analytical baselines, discount rates and modeling approaches.

Next Step: Comment Period

- Public comment period is open through September 17
- Agencies will carefully consider all public comments before issuing the Final Rule

PEPSICO

PepsiCo's Holistic Approach to Fleet Management

Mike O'Connell
Senior Director, Fleet Supply Chain, Frito-Lay North America, A Division of PepsiCo

Performance with Purpose

Performance with Purpose is our goal to deliver top-tier financial performance while creating sustainable value for all stakeholders. We strive for a World Class Fleet.

Reliability

Provide safe, dependable vehicles for all of our associates and the customers we share the roads with everyday

Sustainability

Respecting the environment and our communities by working to reduce green house gases while becoming one of the most fuel efficient fleets in America

Capability

Retain a powerful team of fleet professionals that provide world class service

Finding the Right Mix

PEPSICO

We are innovating our fleet practices to make it increasingly efficient and sustainable, and to reduce our impact on the environment

Alternative Fuels

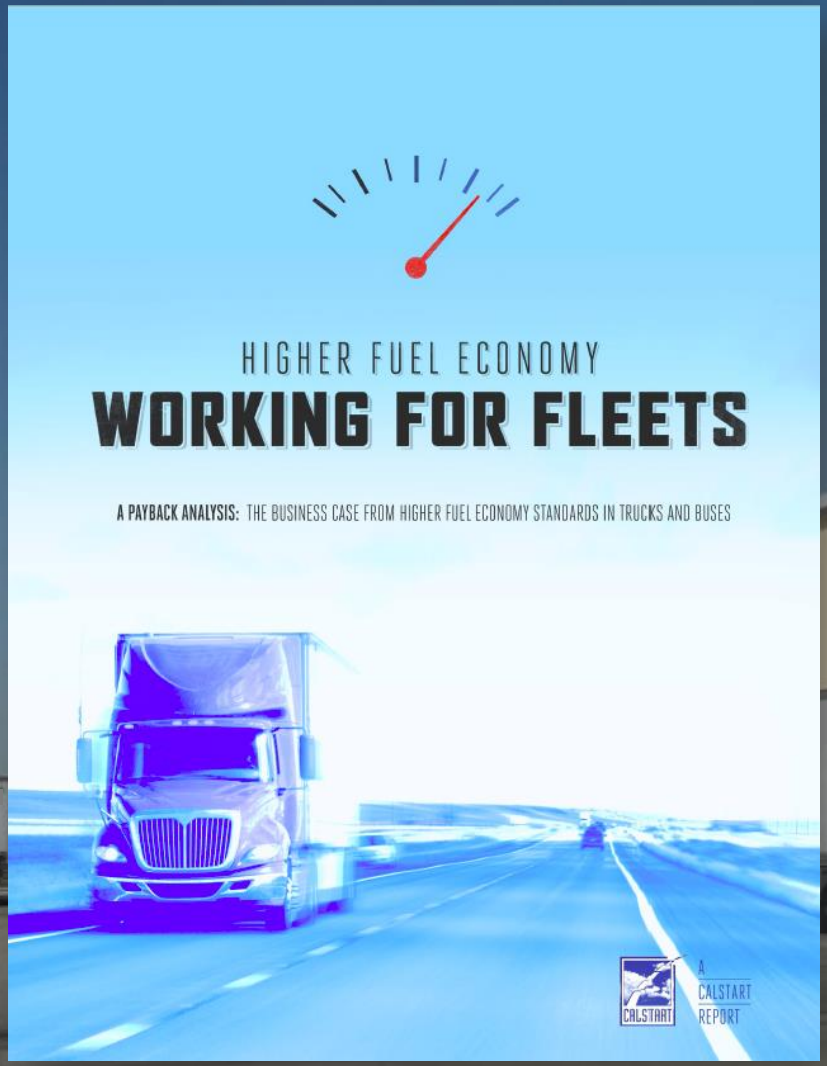
Natural gas, propane, bio-fuels, as well as other fuel sources are being explored and tested

Hybrids and EVs

Hybrids and electric vehicle testing and implementation utilized in the right drive cycle

People Power

Driver training, routing efficiently, no idle programs and GPS systems remain important components to fuel efficiency



Higher Fuel Economy – Working for Fleets

Pew Charitable Trusts Webinar

Fuel Efficiency for the Long Haul

August 24

Bill Van Amburg, CALSTART

Agenda

- HIGHER FUEL EFFICIENCY – WORKING FOR FLEETS
  - Key Findings Overview
  - Approach
  - Fleet Survey
  - Findings Details
  - Recommendations

Top Level Findings

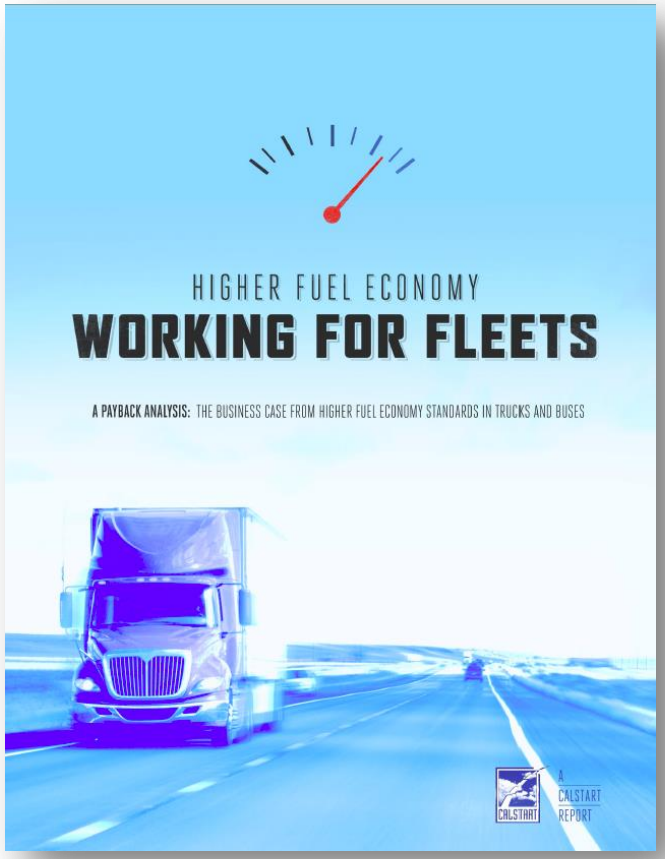
There is a payback from proposed higher fuel economy rules, addressing a core fleet concern.

High-mileage operations could see investments in fuel-efficient technologies paid back in as little as nine months.

Each fleet is different. But in every scenario we modeled there is a reasonable business case to be made for higher fuel economy in trucks and buses.

Additional Key Findings

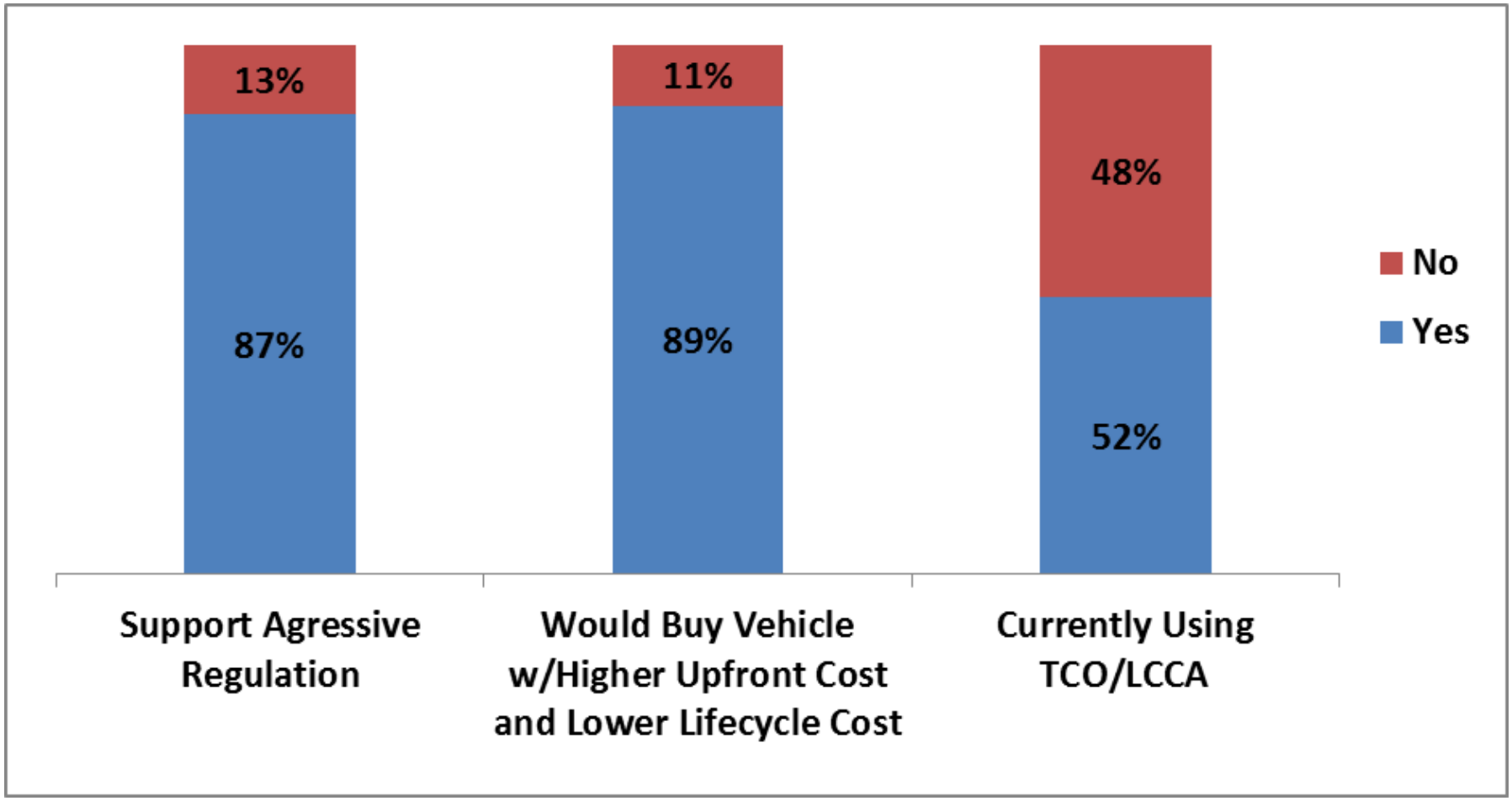
- 87 percent of fleet managers surveyed support increased fuel economy rules
- The higher cost of technology is fleet's biggest worry
- BUT - 89 percent said would pay higher costs to get lifecycle savings
- Other concerns: reliability, maintenance
- Report looked at 7 truck use categories, big rigs to pick-ups, documented reasonable payback periods in all but a few cases
- Payback periods are largely dependent on how vehicles used and mileage driven



Study Approach

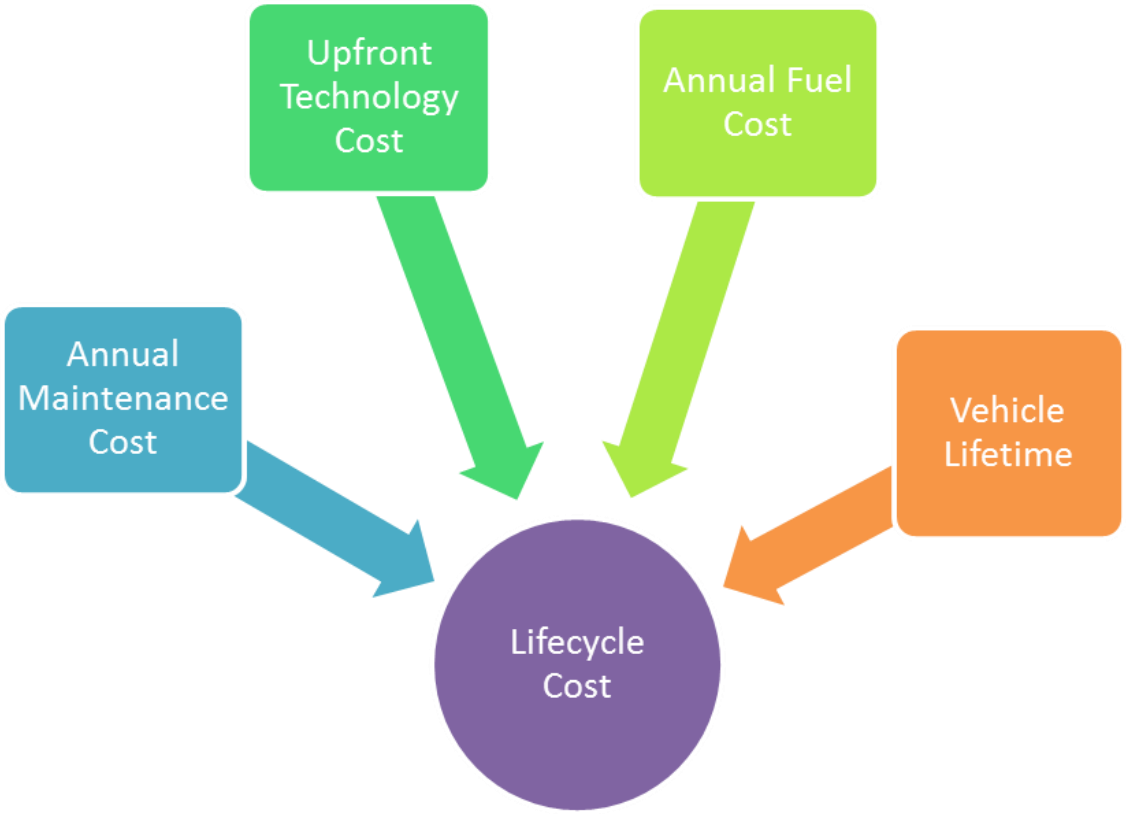
- ✓ Understand fleet interests and concerns about increased fuel efficiency
- ✓ Validate a fleet-based cost model to assess potential payback of increased fuel efficiency
- ✓ Populate model with potential high and low costs of package of technologies that could achieve up to a 40% increase in fuel efficiency – customized to 7 different vehicle use profiles
- ✓ Use fleet inputs on their real-world fuel economy experiences for baseline – run payback assessment

Fleet Survey Highlights



Modified Life Cycle Cost Assessment

- Fleets validated core elements of a LCCA
- For purposes of analysis, could not include maintenance costs (still unknown)
- Also resale cost not modeled
- Key variables: upfront cost, fuel cost, fuel use/mileage, vehicle life (to determine if payback occurs in life time of vehicle)



Vehicle Use Profiles

Heavy Duty

Over the Road

Description: Service between distribution centers, tractor-trailer combinations for line-haul highway driving

Short Haul/ Regional

Description: Service between cities, drayage, and day cabs that use tractor-trailer combinations for local/regional work

Medium Duty

Urban

Description: Cargo, freight, and delivery mostly in urban/ suburban environments, including refuse trucks and school buses

Rural/ Intracity

Description: Cargo, freight, and delivery collection similar to previous but with higher mileage and reduced stop-and-go applications

Work site support

Description: Utility trucks, construction, and other vehicles with significant idle time.

Class 2B Trucks and Vans

Pickups/ Vans

Description: Heavy pickups and vans in commercial fleets

Technology Packages

	Heavy Duty		Medium Duty			Class 2b Trucks & Vans
	Over-the-Road	Short Haul Regional	Urban	Rural Intra-city	Work Site Support	
						
Engine Optimization	●	●	●	●	●	●
Waste Heat Recovery	●	◑	◑	○	○	○
Transmission & Driveline Improvement/ Integration	●	●	●	●	●	●
Hybridization	○	◑	●	◑	●	●
Improved Aerodynamics	●	●	◑	◑	○	○
Electrification of Accessories	●	●	◑	◑	●	◑
Wheels & Tires	●	●	◑	◑	○	◑
Weight Reduction	●	●	◑	◑	◑	◑

- Fleets helped ID tech they thought of best value for profiles
- Tech costs from NRC/NAS and TRB reports; fuel from DOE/EIA

Legend

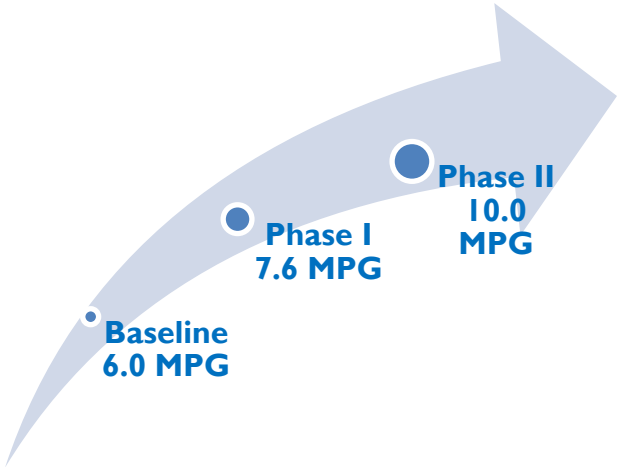
● Provides the most potential for fuel consumption reduction

◑ Provides some potential for fuel consumption reduction

○ Provides limited potential for fuel consumption reduction

Class 8 OTR

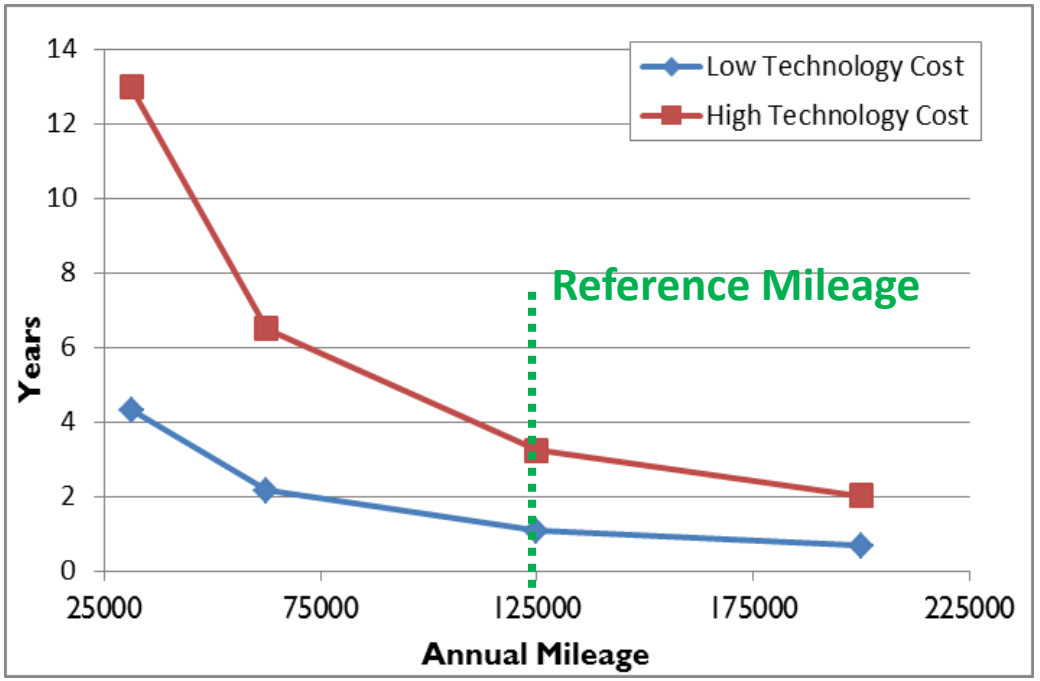
Heavy-Duty Over-the-Road	Fuel Consumption Reduction	
	Min.	Max.
Engine Optimization	8.7%	15.0%
Waste Heat Recovery	4.0%	6.0%
Transmission & Driveline	7.0%	7.0%
Hybridization	3.0%	5.0%
Improved Aerodynamics	11.0%	12.0%
Electrification of Accessories	2.0%	4.0%
Wheels & Tires	3.0%	6.0%
Weight Reduction	2.4%	2.4%
Totals (Phase I & II)	34.7%	45.3%
Totals (Phase II)	**18.2%**	**30.6%**



Phase II - Low Cost
- $14,000

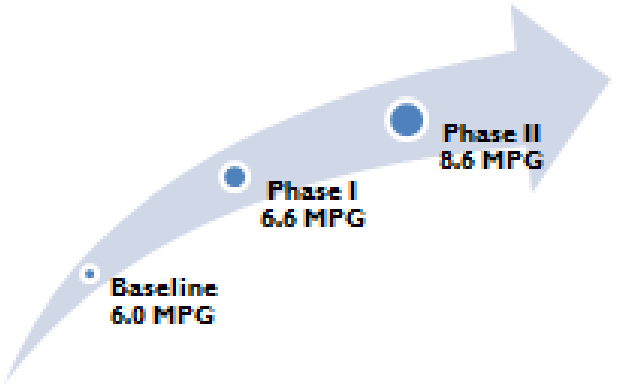
Phase II - High Cost
- $42,000

Modeled 24% FE improvement for Phase 2



EPA 2

Heavy-Duty Short-Haul / Regional	Fuel Consumption Reduction	
	Min.	Max.
Engine Optimization	8.7%	15.0%
Waste Heat Recovery	-	-
Transmission & Driveline	7.0%	7.0%
Hybridization	-	-
Improved Aerodynamics	5.5%	5.5%
Electrification of Accessories	2.0%	4.0%
Wheels & Tires	3.0%	6.0%
Weight Reduction	2.4%	2.4%
Totals (Phase I & II)	*25.6%*	*34.2%*
Totals (Phase II)	**18.3%**	**27.0%**



Phase II - Low Cost

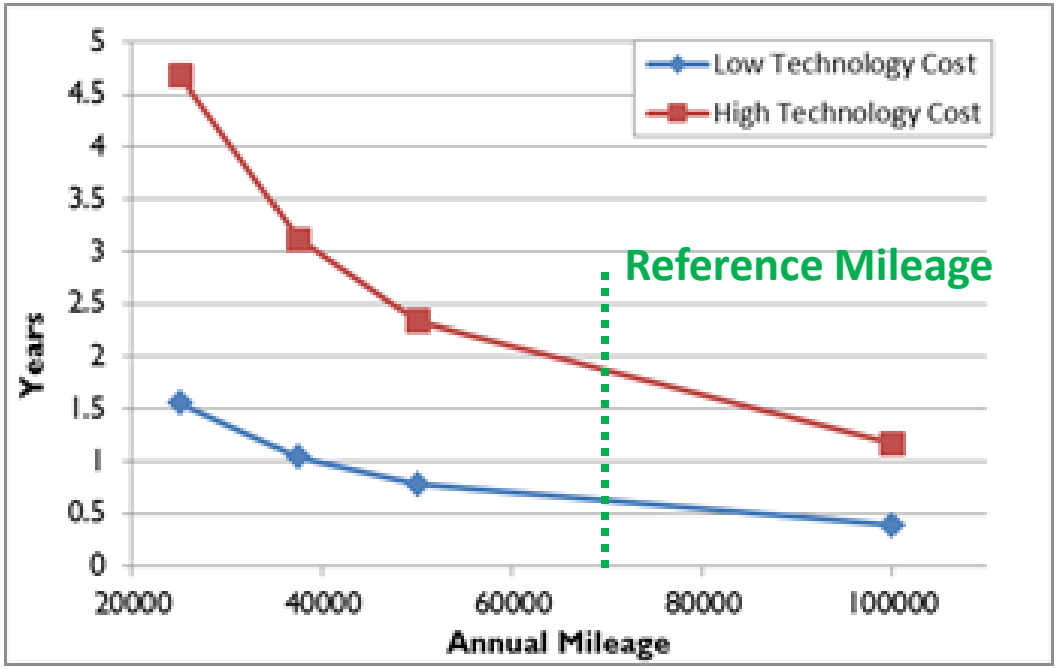
- $4,500

Phase II - High Cost

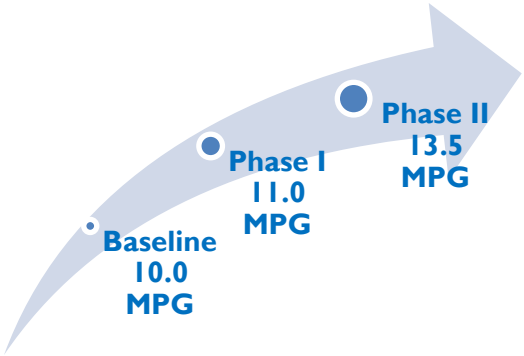
- $13,500

Class 8 Short-Haul/ Regional

Modeled 23% FE improvement for Phase 2



Medium-Duty Rural / Intra-city	Fuel Consumption Reduction	
	Min.	Max.
Engine Optimization	4.9%	9.6%
Waste Heat Recovery	-	-
Transmission & Driveline	8.0%	10.0%
Hybridization	-	-
Improved Aerodynamics	5.0%	8.0%
Electrification of Accessories	2.0%	4.0%
Wheels & Tires	2.0%	4.0%
Weight Reduction	-	-
Totals (Phase I & II)	20.2%	31.0%
Totals (Phase II)	**14.3%**	**21.9%**



Phase II - Low Cost

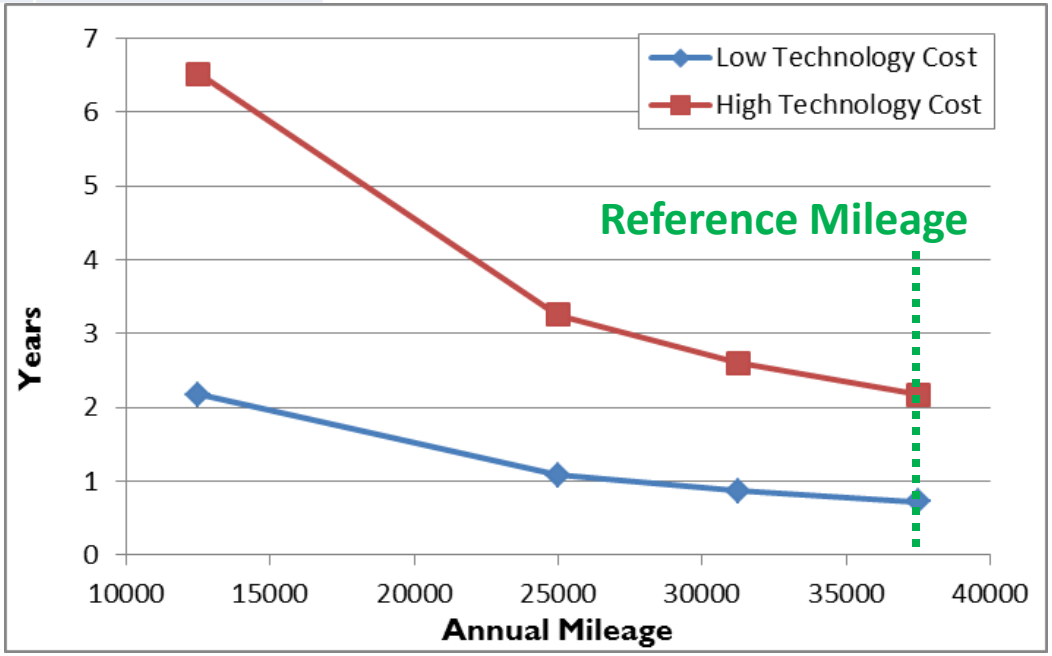
- $1,500

Phase II - High Cost

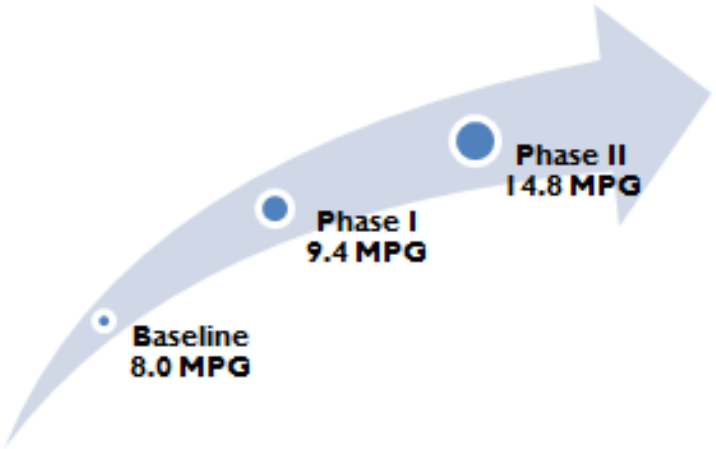
- $4,500

MD Rural/ Intra-City

Modeled 18% FE improvement for Phase 2



Medium-Duty Urban	Fuel Consumption Reduction	
	Min.	Max.
Engine Optimization	4.9%	9.6%
Waste Heat Recovery	-	-
Transmission & Driveline	8.0%	10.0%
Hybridization	20.0%	40.0%
Improved Aerodynamics	2.0%	4.0%
Electrification of Accessories	2.0%	4.0%
Wheels & Tires	1.0%	2.0%
Weight Reduction	-	-
Totals (Phase I & II)	*33.5%*	*55.9%*
Totals (Phase II)	**21.4%**	**47.9%**



Phase II - Low Cost

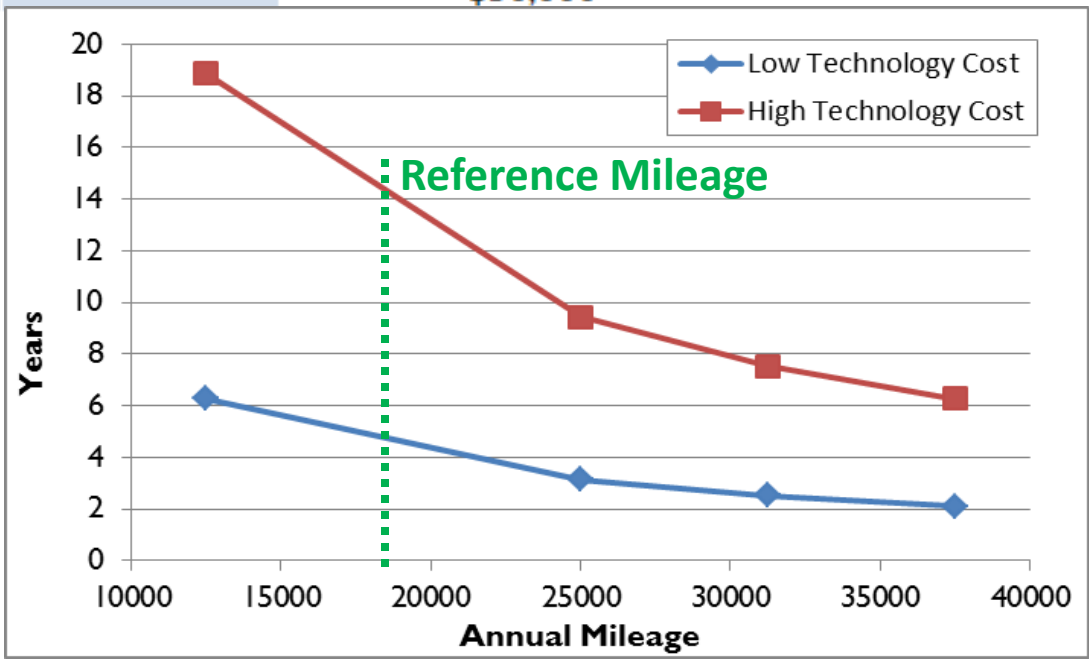
- $10,000

Phase II - High Cost

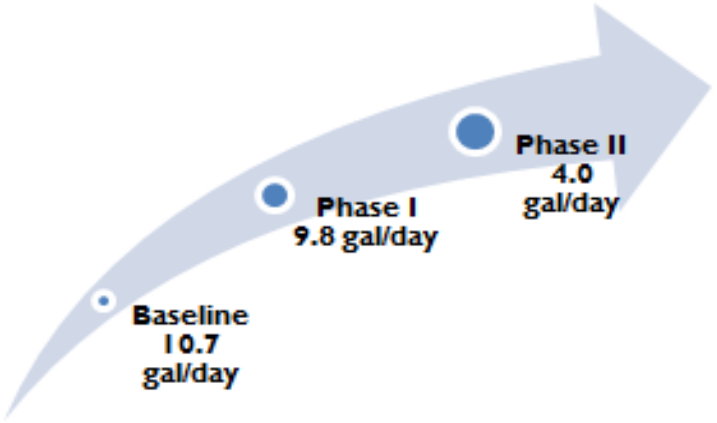
- $30,000

MD Urban

Modeled 36% FE improvement for Phase 2



Medium-Duty Work Site Support	Fuel Consumption Reduction	
	Min.	Max.
Engine Optimization	4.9%	9.6%
Waste Heat Recovery	-	-
Transmission & Driveline	8.0%	10.0%
Hybridization	40%	52%
Improved Aerodynamics	1.0%	2.0%
Electrification of Accessories	-	-
Wheels & Tires	1.0%	2.0%
Weight Reduction	-	-
Totals (Phase I & II)	*48.5%*	*62.6%*
Totals (Phase II)	*45.3%*	*59.2%*



Phase II - Low Cost

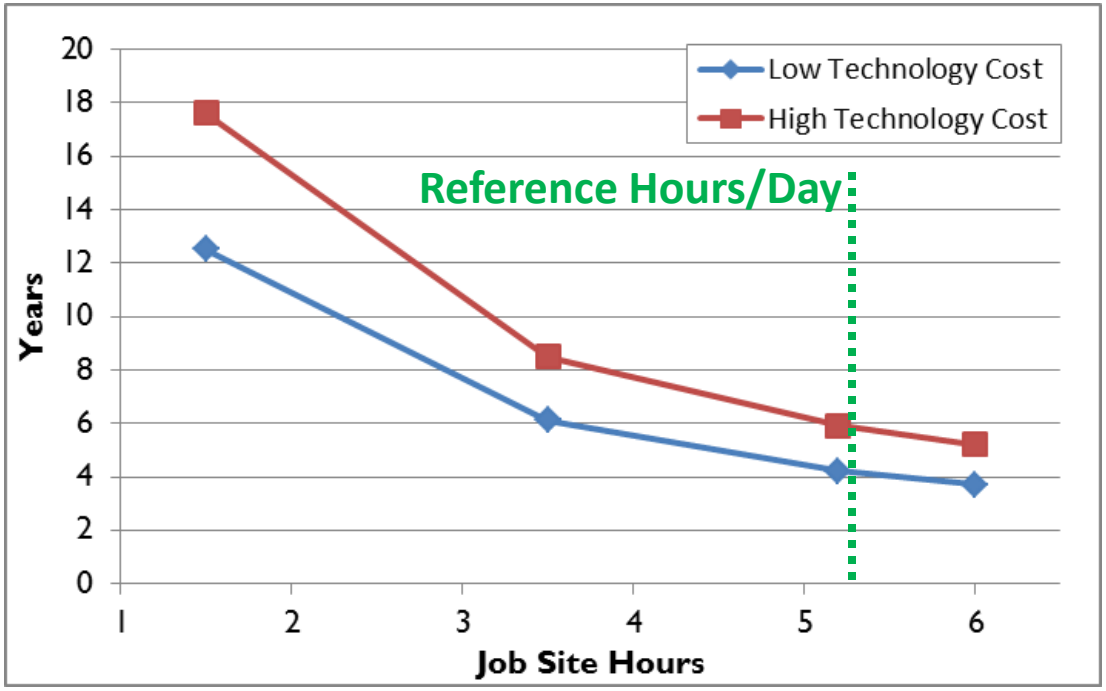
- $25,000

Phase II - High Cost

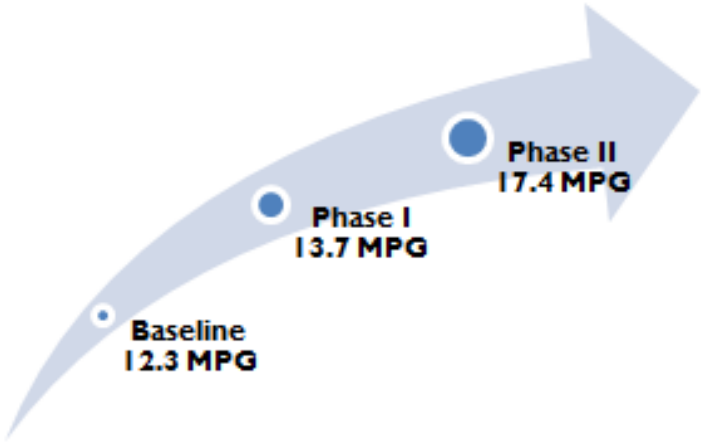
- $35,000

MD Worksite Support

Modeled 59% FE improvement for Phase 2



Class 2B Trucks & Vans Gasoline	Fuel Consumption Reduction	
	Min.	Max.
Engine Optimization	9.7%	15.1%
Waste Heat Recovery	-	-
Transmission & Driveline	7.5%	7.5%
Hybridization	4.0%	4.0%
Improved Aerodynamics	3.0%	3.0%
Electrification of Accessories	2.0%	4.0%
Wheels & Tires	2.0%	2.0%
Weight Reduction	1.6%	1.6%
Totals (Phase I & II)	*26.5%*	*32.3%*
Totals (Phase II)	**18.1%**	**24.6%**



Phase II - Low Cost

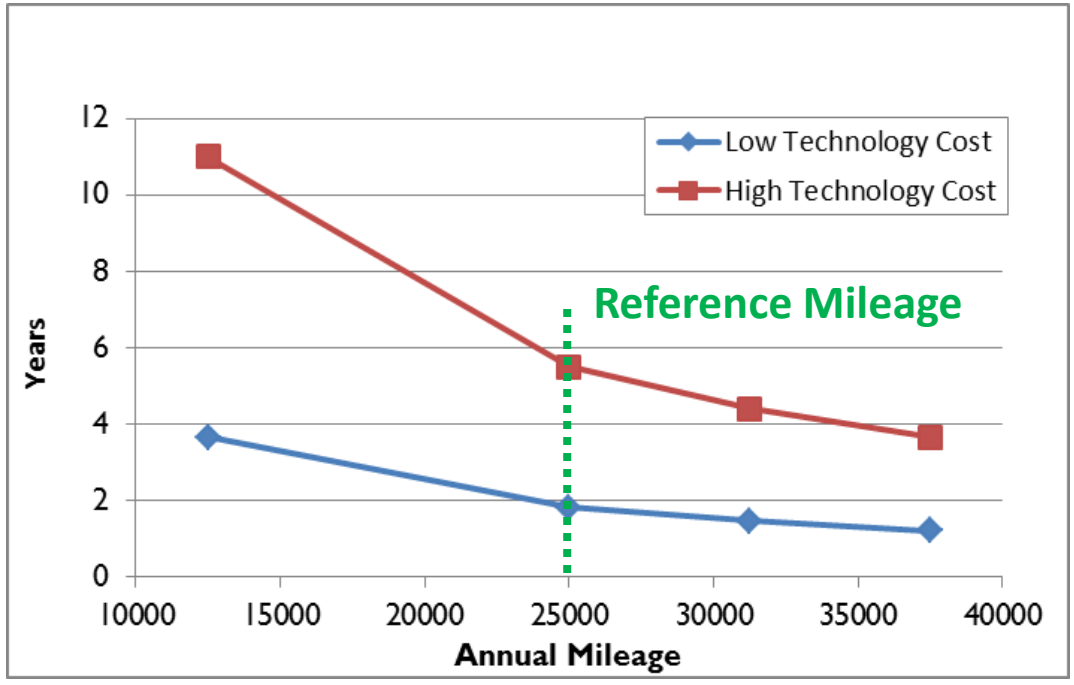
- $2,000

Phase II - High Cost

- $6,000

Class 2B Gasoline

Modeled 21% FE improvement for Phase 2



EPA 3

Modeled Higher FE Assumptions Than Current EPA/NHTSA Rule

	Alt 3 Draft Rule	Report
Class 8 OTR	24%	24%
Class 8 Regional (Regional?)	16%?	21%
MD Urban (Urban)	16%	36%
MD Sub/Rural (Multipurp?)	16%	18%
MD Worksite		59%
Class 2B	16%	21%

Observations

- EPA/NHTSA payback assumptions appear reasonable from independent assessment
- Higher fuel economy levels than the current rule proposes could still provide solid, reasonable fleet payback – “off cycle” tech could add significant reductions
- Fleet concerns about maintenance, reliability align with EPA/NHTSA design for long rule horizon, stair-step efficiency increases

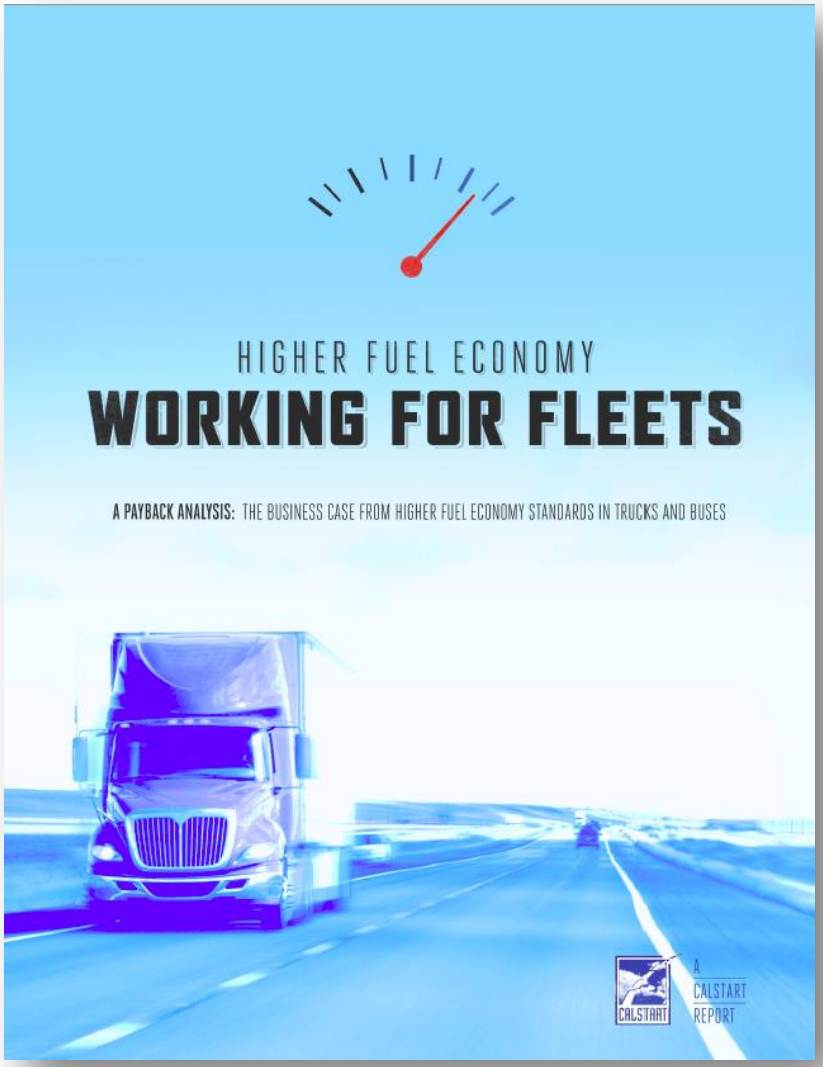
Recommendations

For Fleets:

- *Match Newest Vehicles to Best (High Fuel Use) Applications*
- *Collect Baseline Use Data*
- *Use a Modified LCCA and Payback Metrics*
- *Institute Fuel Efficiency Training and Tracking*

For Agencies/OEMs

- *Provide Fleets with Application-Specific Reliability Data*
- *Provide More Analysis Around Maintenance Impacts*
- *Expand Regulatory Support for Innovative Tech and Idle Reduction*



- Report is available on-line: **www.calstart.org**

CALSTART

Public Participation

- www.regulations.gov
- NHTSA Docket ID No. NHTSA-2014-0132
- EPA Docket ID No. EPA-HQ-OAR-2014-0827
- Comment period open through September 17th

For More Information

www.epa.gov/otaq/climate/regs-heavy-duty.htm

www.nhtsa.gov/fuel-economy

www.pepsico.com/Purpose/Performance-with-Purpose

www.calstart.org/

www.pewtrusts.org/fuelefficiency