EPA/NHTSA Phase 2 Fuel Efficiency and Greenhouse Gas Standards for Heavy-Duty Trucks:

Projected Effect on Freight Costs

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Introduction

In August 2011 the U.S. Environmental Protection Agency (EPA) and the Department of Transportation's National Highway Traffic Safety Administration (NHTSA) together issued final rules for the world's first-ever program to reduce greenhouse gases (GHG) and improve the fuel efficiency of medium- and heavy-duty trucks. Generally referred to as "Phase 1" standards, these regulations apply to new vehicles manufactured in model years 2014 – 2019. The Phase 1 standards divide all medium- and heavy-duty trucks into three classes – heavy duty pick-ups and vans, vocational vehicles, and combination trucks. The most stringent standards are applied to the combination truck-tractors used to pull trailers for hauling freight. To comply with the Phase 1 standards for model years 2017 through 2019 truck-tractors are expected to use, on average, between 10% and 23% less fuel per mile than model year 2010 trucks.

EPA and NHTSA are now formulating a proposal for "Phase 2" rules which will apply to new medium- and heavy-duty trucks manufactured in 2020 and later model years. It is not yet clear how stringent the proposed Phase 2 standards will be, but leading environmental and energy efficiency advocacy organizations are encouraging EPA/NHTSA to set bold fuel efficiency and greenhouse gas targets in Phase 2, based on evidence that there are a suite of cost-effective and commercially available technologies to further improve the efficiency of heavy trucks. Advocates are also encouraging EPA/NHTSA to regulate commercial trailers for the first time in Phase 2 – something EPA and NHTSA declined to do during Phase 1. Regulation of commercial trailers in Phase 2 was also recommended by a technical committee convened by the National Academies to advise EPA and NHTSA on development of the Phase 2 regulations. While commercial trailers do not have engines, their aerodynamic characteristics and rolling resistance significantly influence the total amount of fuel used by a combination truck-trailer carrying freight. There is ample evidence that fuel efficiency and greenhouse gas standards applied to new commercial trailers could significantly increase the benefits achieved by more stringent Phase 2 standards for trucks.

With respect to freight trucks, our analysis indicates that EPA/NHTSA's Phase 2 fuel efficiency and greenhouse gas standards will likely cause freight costs to fall. There are two opposing effects on freight costs. First, the standards will increase the cost of new trucks and trailers since additional technologies will be required to meet the more stringent standards. This will tend to increase per-mile freight hauling costs since these incremental equipment costs will need to be recovered. On the other hand, the standards will reduce the amount of fuel required to haul a given amount of freight a given distance, which will reduce per-mile freight costs more than the increase in equipment costs, thus leading to a net reduction in freight costs. Fuel is a significant driver of freight costs; it is estimated that on average fuel purchases now account for approximately 39% of total freight costs, and that amortization of equipment purchase or lease costs account for an additional 11%.[1]

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[1] American Transportation Research Institute, *An Analysis of the Operational Costs of Trucking: A 2013 Update*, September 2013. The remaining 50% of per-mile freight hauling costs can be attributed to driver wages and benefits; equipment repair and maintenance; permits, licenses and tolls; and insurance. Data is for 2012.

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This report summarizes the results of an analysis of how net freight shipping costs would change if EPA and NHTSA set bold fuel efficiency and greenhouse gas targets for combination trucks and trailers in Phase 2. The Phase 2 scenario for combination trucks and trailers analyzed here is shown in Table 1, along with the Phase 1 targets already adopted by EPA/NHTSA and set to go into effect beginning this year.

This Phase 2 scenario was developed by the *American Council for an Energy Efficient Economy* and the *Union of Concerned Scientists*, based on a review of data regarding the potential engine and vehicle technologies that could be used to meet more stringent Phase 2 fuel efficiency and greenhouse gas standards. These targets were judged to be commercially and technically feasible based on a range of technologies that are either already commercially available or under development.

Table 1 Analyzed EPA Phase 2 Fuel Efficiency and Greenhouse Gas Stringency Scenario

Metric	Equipment	EPA Phase 1		EPA Phase 2	
		Model Year 2014 - 2016	**Model Year 2017 - 2019**	**Model Year 2020-2024**	**Model Year 2025+**
Reduction in Fuel Use (gal/mi) compared to MY2010	Sleeper cab	21%	23%	31%	39%
	Day cab	11%	13%	22%	29%
	Van Trailer	NA	NA	8%	15%
Incremental Increase in Purchase Cost Compared to MY2010 [1]	Sleeper cab	$7,875	$8,107	$11,357	$26,513
	Day cab	$3,353	$3,954	$7,204	$17,188
	Van Trailer	NA	NA	$3,200	$4,450
[1] *Per truck or trailer compared to 2010 model, in current (2014) dollars*					

To meet the above model year 2020 and 2025 targets for fuel reduction relative to current trucks, it is expected that multiple approaches would be needed. The compliance pathway in this scenario includes:

- improvements to the aerodynamics of both trucks and trailers;

- use of low-rolling resistance single-wide dual tires on both trucks and trailers;

- various engine improvements to reduce engine friction, and improve air handling and heat transfer in the cylinder;

- use of automated manual transmissions;

- use of auxiliary power units for over-night idle reduction on sleeper cab-equipped trucks; and

- exhaust waste heat recovery using a "bottoming cycle"[2].

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[2] In a bottoming cycle, engine exhaust is routed through a heat exchanger to produce steam, which is used to drive a small turbine to produce electricity. The electricity generated could be used to power vehicle auxiliary systems (lights, air conditioning, air compressor, etc.) or could be

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The above scenario for combination trucks is part of an over-all Phase 2 stringency scenario that targets a fleet average 40% reduction in per-mile fuel use for MY2025 trucks compared to MY2010 trucks. However, as with the Phase 1 standards the above scenario assumes that EPA and NHTSA will set more stringent standards for combination trucks than for other types of commercial trucks, and that they will set more stringent standards for the sleeper cab-equipped trucks used for long-haul operations than for the day cab-equipped trucks typically used for local and regional hauls. This scenario also assumes that, as they did in Phase 1, EPA and NHTSA will set interim standards applicable in the first few years of the rule (MY 2020 – 2024), and more stringent final standards applicable starting in MY2025.

Note that the typical purchase price of a new sleeper cab-equipped truck ranges from $103,000 to $116,000, and the typical purchase price of a new dry van trailer ranges from $22,000 to $27,000.[3] Therefore this analysis assumes that strong EPA/NHTSA Phase 2 fuel efficiency and greenhouse gas standards will increase the cost of new trucks by as much as 25%, and will increase the cost of new dry van trailers by as much as 20%.

1   Results of Analysis

1.1 Baseline Performance

For this analysis, the effect of more stringent EPA/NHTSA Phase 2 fuel efficiency and greenhouse gas standards on freight costs were evaluated against a "baseline" scenario in which EPA and NHTSA maintain truck fuel efficiency and greenhouse gas standards at Phase 1 levels indefinitely, with no further increases in stringency. Figure 1 plots the projected change in fleet average fuel economy for the freight hauling combination truck fleet, and the projected change in fleet average freight rates, under the baseline scenario.

As shown, even without more stringent EPA Phase 2 standards the average fuel economy of the freight hauling fleet is projected to increase from 5.9 MPG in 2015 to 7.5 MPG in 2040, based on the phase-in of more fuel efficient trucks that meet EPA/NHTSA Phase 1 fuel efficiency and greenhouse gas standards. At the same time, average freight hauling rates are projected to increase from $1.85/mile in 2015 to $3.00/mile in 2040.

Despite reductions in fuel use (gallons per mile) from more efficient trucks, average net freight rates under the baseline scenario are projected to rise steadily due to projected fuel price ($/gal) inflation, and general inflation affecting other freight hauling costs (labor, maintenance, insurance, etc.). Also included in the baseline cost analysis is the expected

used to provide motive power in combination with the engine, via an electric drive motor (hybrid system).

[3] Price Digest, *Truck Blue Book* and *Commercial Trailer Blue Book, 2012,* Penton Media Inc. Cited truck prices based on 2012 International 9000 series, Kenworth T800, Volvo VNL 670, Freightliner Coronado, and Peterbilt 387 trucks, all with high-roof sleeper cab. Cited trailer prices are for 2012 53-ft dry van trailers from Great Dane, Wabash National, Utility Trailer, and Stoughton Trailer.

increase in new truck purchase costs in order to comply with EPA/NHTSA Phase 1 fuel efficiency and greenhouse gas standards, as shown in Table 1.
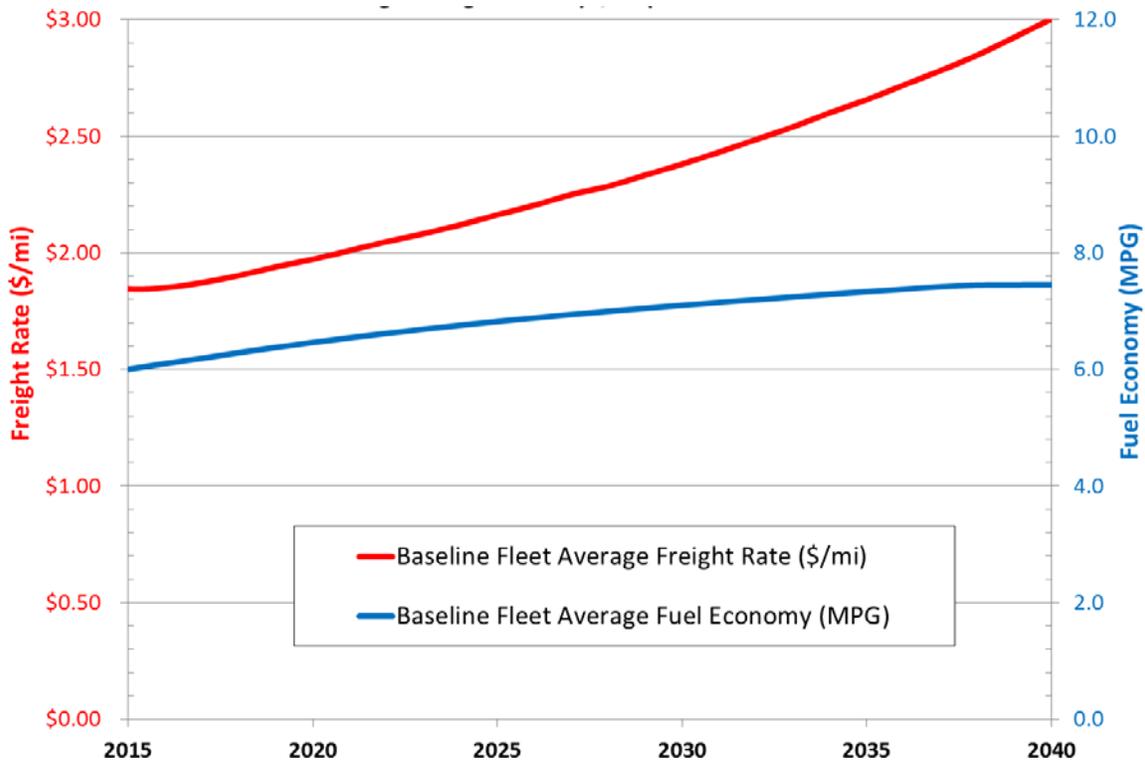
Figure 1 Baseline Fleet Average Fuel Economy (MPG) and Freight Rates ($/mi)

1.2 Effects of Modeled EPA/NHTSA Phase 2 Stringency Scenario

The projected change in fleet average freight truck fuel economy that would result from the modeled EPA/NHTSA Phase 2 stringency scenario is shown in Figure 2. As shown, the modeled Phase 2 truck standards are projected to increase fleet average fuel economy from 7.5 MPG (baseline) to 9.0 MPG in 2040. If the modeled Phase 2 trailer standards are also included, projected fleet average fuel economy in 2040 rises to 9.9 MPG, a 32% increase over baseline levels.
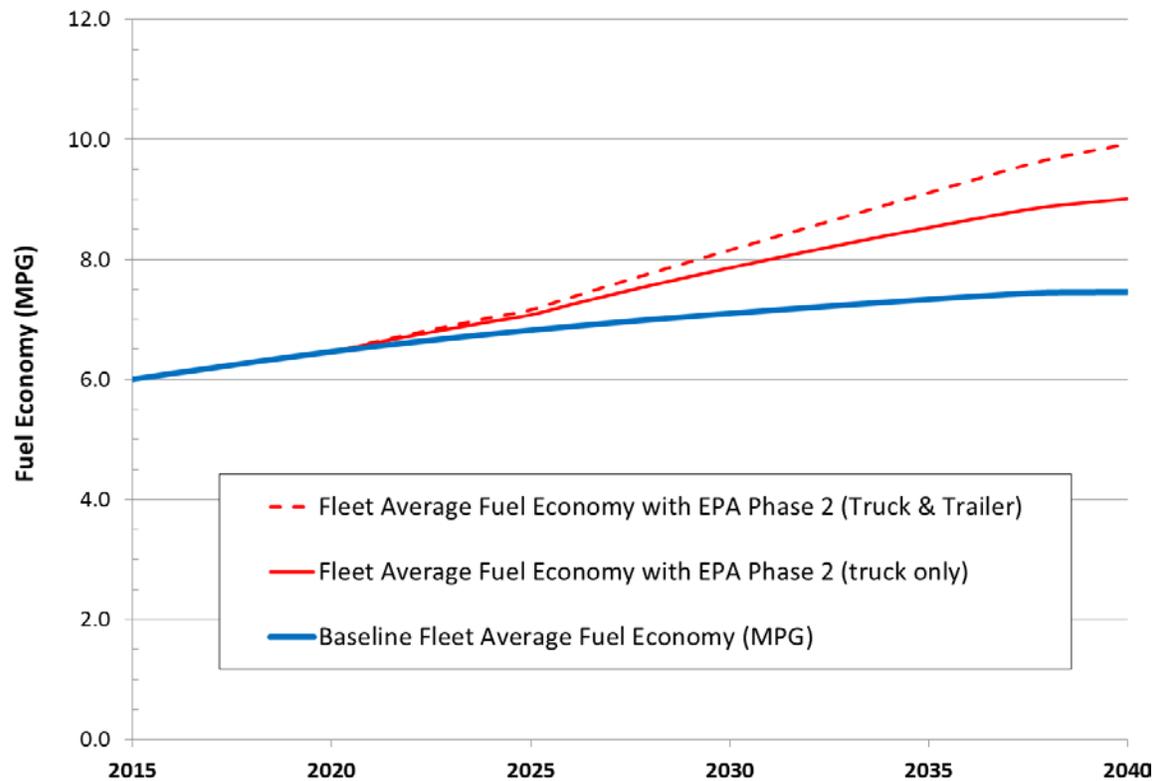
Figure 2 Projected Fleet Average Fuel Economy with Modeled EPA/NHTSA Phase 2 Standards

The projected effects of the modeled EPA/NHTSA Phase 2 stringency scenario on freight hauling costs are shown in Figures 3 – 5.

Figure 3 shows, for each model year between 2020 and 2040, the projected change in operating costs ($/mile) compared to the baseline scenario for a new sleeper cab-equipped truck pulling a new trailer, both of which meet the modeled Phase 2 stringency standards for that model year. As shown in Figure 3, the incremental purchase cost of a new sleeper-cab equipped truck and trailer that meet the modeled EPA/NHTSA Phase 2 fuel efficiency and greenhouse gas standards are projected to increase freight costs by $0.05/mile for model year 2020 equipment in its first year of operation. This incremental equipment cost is projected to rise to $0.13/mile for model year 2040 equipment. At the same time, fuel costs are projected to fall by $0.21/mile for model year 2020 equipment, and these fuel cost savings are projected to increase to $0.41/mile for new equipment purchased in 2040. The net cost savings attributed to the modeled EPA/NHTSA Phase 2 fuel efficiency and greenhouse gas standards are projected to be $0.17/mile for new model year 2020 equipment, and this net savings is projected to increase to $0.28/mile for new model year 2040 equipment.
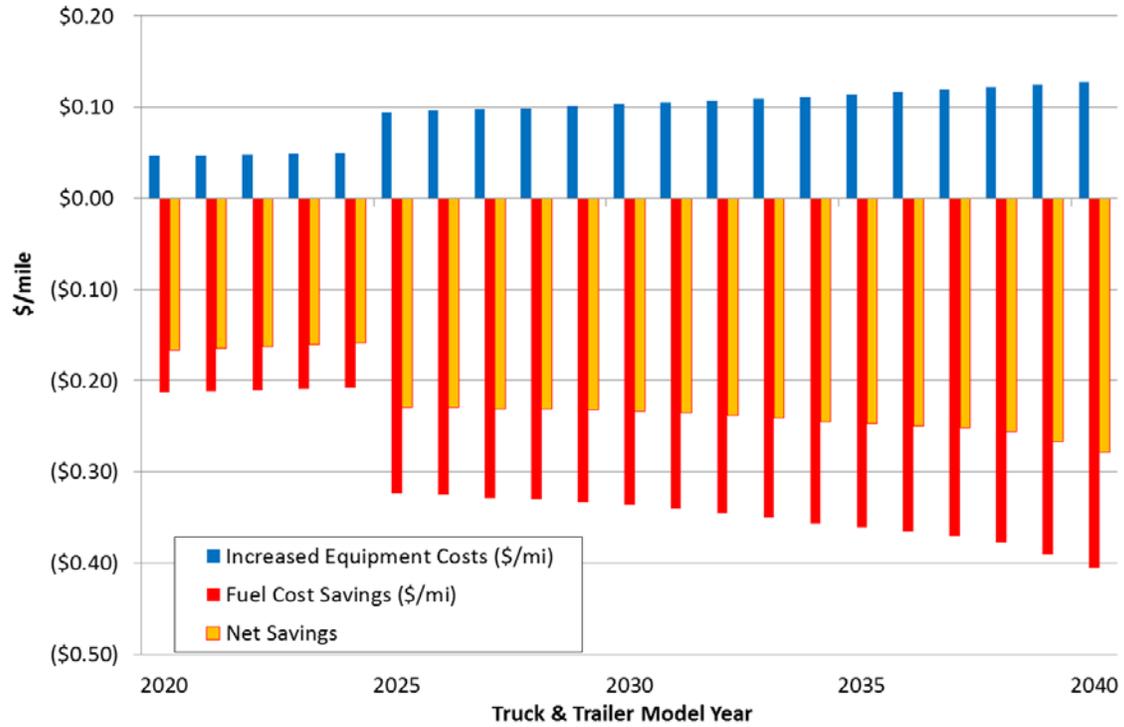
Figure 3 Effect of EPA/NHTSA Phase 2 Standards on Freight Costs (New Sleeper Cab).

Figure 4 shows the same information as Figure 3, but for new day cab-equipped trucks pulling new trailers.
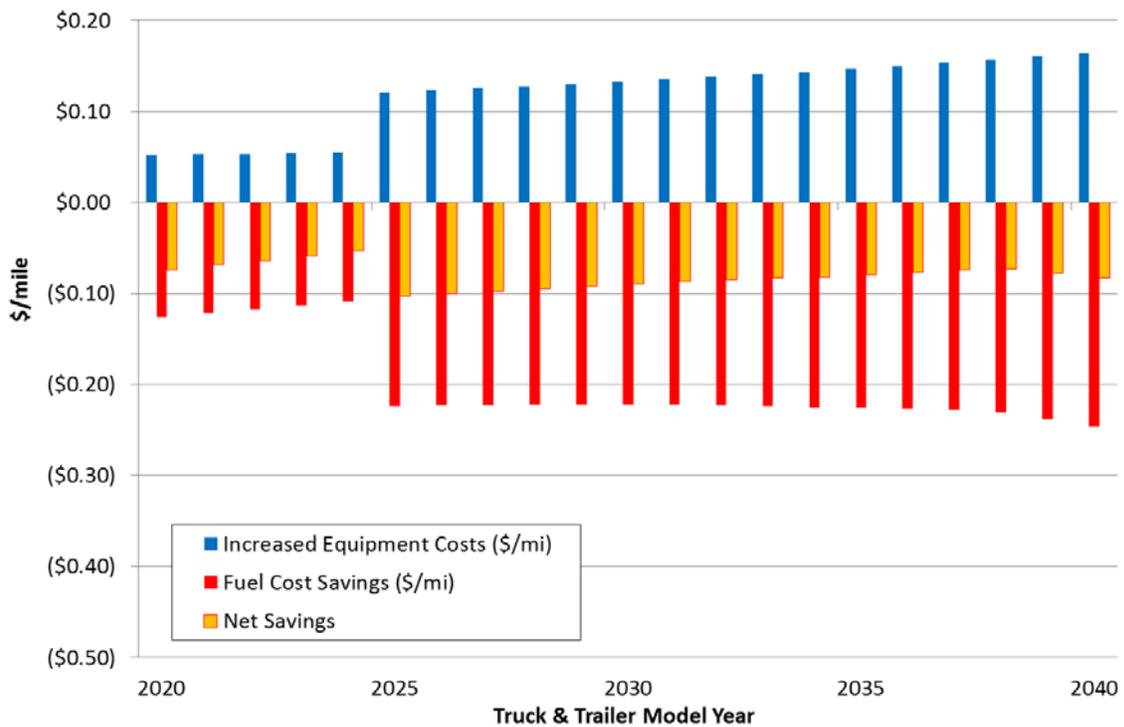
Figure 4 Effect of EPA/NHTSA Phase 2 Standards on Freight Costs (New Day Cab)

As shown in Figure 4, the net savings from the modeled EPA/NHTSA Phase 2 fuel efficiency and greenhouse gas standards are lower for day cab-equipped trucks. For these trucks, the net savings are projected to be $0.07/mile for new model year 2020 equipment, rising to $0.08/mile for new model year 2040 equipment.

Figure 5 shows, for each calendar year, the projected change in fleet average operating costs ($/mile) compared to the baseline scenario, based on the percentage of total fleet miles projected to be operated each year by new trucks and trailers meeting the more stringent Phase 2 standards.

As shown in Figure 5, fleet average net savings from the modeled EPA/NHTSA Phase 2 fuel efficiency and greenhouse gas standards are projected to be less than $0.02/mile between 2020 and 2025, but they are projected to rise steadily as a greater percentage of fleet miles are driven by trucks that meet the Phase 2 standards, reaching $0.21/mile in 2040.
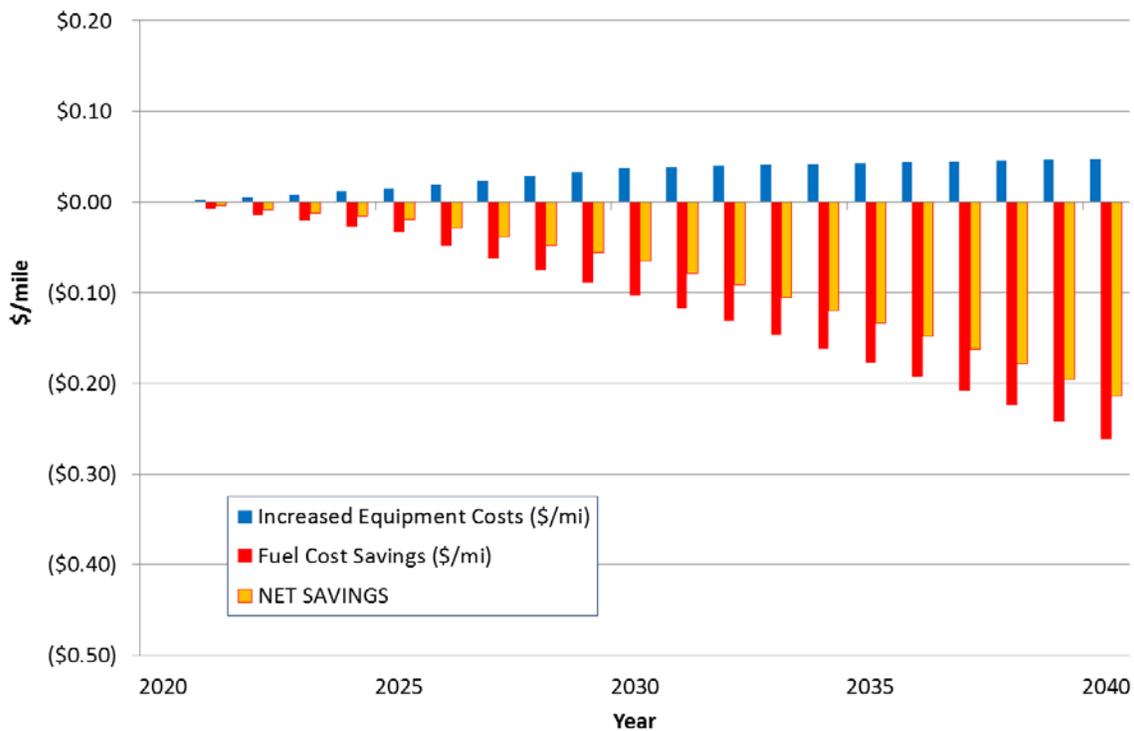
Figure 5 Effect of EPA/NHTSA Phase 2 Standards on Fleet Average Freight Costs

1.3 Potential Impact on Freight Rates

This analysis shows that if EPA and NHTSA impose more stringent Phase 2 truck and trailer fuel efficiency and greenhouse gas standards, freight companies that purchase and operate new equipment after 2025 could potentially see their net operating costs fall by as much as 10% for long hauls (sleeper cab) and up to 4% for local and regional hauls (day cab), compared to the baseline scenario.

As some of these operating cost savings are passed on to customers, as would be expected in such a competitive marketplace, freight rates will likely fall. Thus it will be cheaper to move products by truck when bold Phase 2 fuel efficiency and greenhouse gas standards are in place than it would be under the baseline scenario without strong Phase 2 standards.

Figure 6 plots the potential maximum effect of the modeled Phase 2 fuel efficiency and greenhouse gas standards on future freight rates, assuming that all operating cost savings are passed on to customers.[4] As shown, by 2040, fleet average freight rates with the modeled EPA/NHTSA Phase 2 standards in place could be up to 7% lower than they would be if EPA and NHTSA did not impose stringent Phase 2 fuel efficiency and greenhouse gas standards for new trucks.
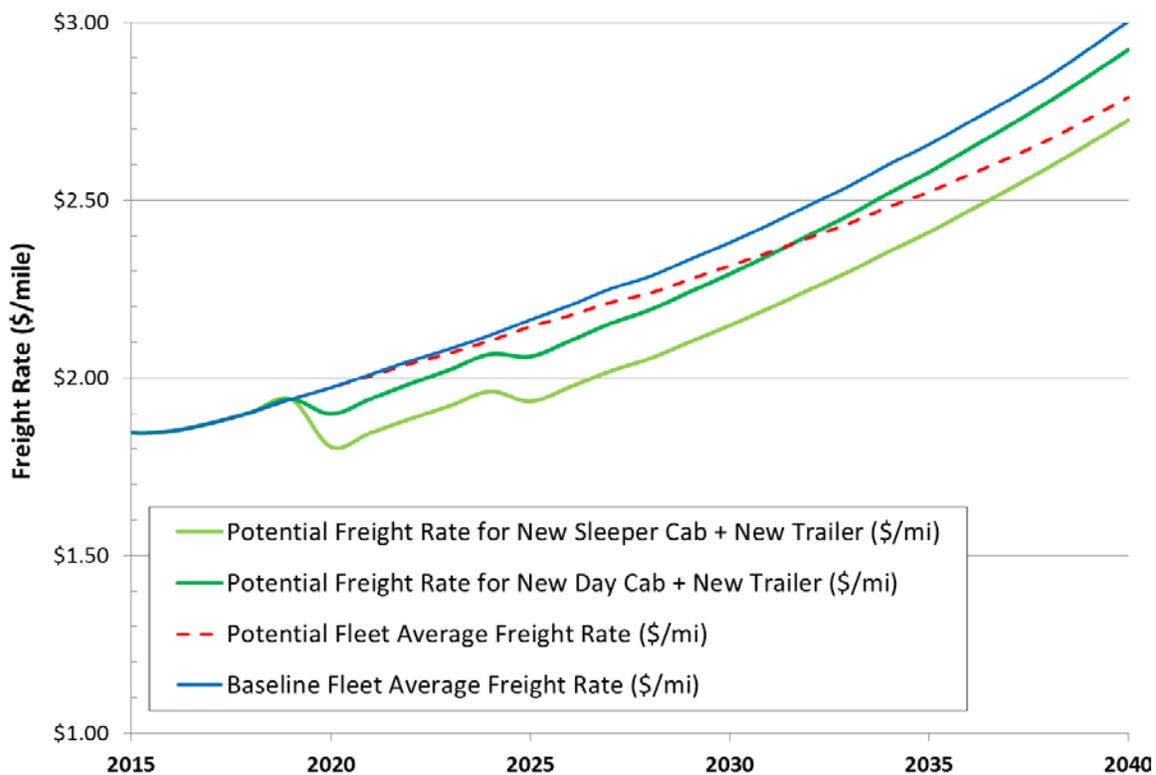
Figure 6 Projected Potential Freight Rates Resulting from EPA/NHTSA Phase 2 Standards

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[4] The projected cost savings will likely be shared between trucking companies and their customers.

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2 Methodology & Data Sources

2.1 Methodology

For this analysis, fleet average fuel use (gallons/mile) for each calendar year was calculated based on the average fuel use and the percentage of total fleet miles driven by trucks of each model year in the fleet that year, using formula1:

$$\text{Average Fuel Use [gal/mi]} = \sum (\text{Fuel Use}_{MY\,A}) \times (\%\ \text{Fleet Miles}_{MY\,A})$$

Formula 1

The average fuel use for all trucks prior to model year 2015 was assumed to be 0.168 gal/mi (5.95 MPG) for sleeper cabs and 0.175 gal/mi (5.70 MPG) for day cabs. For each subsequent model year of truck, average fuel use was calculated by applying the appropriate reductions from Table 1 to match either the baseline or Phase 2 scenario. Averages were calculated separately for sleeper cab and day cab trucks and the over-all fleet average was calculated assuming that 80% of fleet miles are driven by sleeper cabs and 20% by day cabs.

Additional reductions in average fuel use from EPA/NHTSA Phase 2 compliant trailers were then calculated in the same way using the appropriate fuel use reduction from Table 1 and the projected percentage of fleet miles driven by trailers of each model year in the fleet.

The percentage of total fleet miles driven by trucks and trailers of each model year in each calendar year was determined based on historical annual fleet turnover to new trucks and trailers and the annual mileage accumulated by trucks and trailers over their life (see below).

To calculate the incremental equipment cost ($/mile) of both EPA/NHTSA Phase 1 and Phase 2 compliance, for each model year the incremental costs shown in Table 1 were escalated to the correct year using general inflation rates and then annualized by assuming that this cost would be financed using a typical commercial loan at 8% interest rate. For trucks the loan was assumed to be for 5 years and for trailers 10 years. Total annual costs for the "loan" were then divided by annual truck or trailer mileage in each year of the loan to get average per mile incremental costs for that year. To calculate fleet average compliance costs in each calendar year, per mile costs for each model year of truck and trailer were multiplied by the percentage of fleet miles driven by that model year truck or trailer and summed (similar to the way fleet average fuel economy was calculated).

Fuel costs ($/mile) – both for new trucks of each model year and the fleet average in each calendar year - were calculated by multiplying the projected fuel price ($/gal) for that year times average fuel use (gal/mi) for the truck or fleet in question.

For each calendar year the projected baseline total freight rate ($/mile) is composed of projected fuel costs, plus projected Phase 1 compliance costs, plus "other" (non-fuel) costs. The non-fuel portion of the baseline freight rate was calculated by escalating 2014 non-fuel costs by the assumed general inflation rate for each year.

2.2   *Assumptions and Data Sources*

2014 Average Freight Rate, Average Fuel Price, and Fleet Average Fuel Economy

The 2014 assumed average freight rate of $1.87/mile comes from DAT Solutions, DAT Trendlines ™; National Average Van Rates, Spot Market, Feb 2013 - Feb 2014.

Note that the American Transportation Research Institute (ATRI, *An Analysis of the Operational Costs of Trucking: A 2012 Update*, Sept 2012) estimates that U.S. average costs of freight hauling were $1.71/mile in 2011. However, this estimate does not include company profits.

The 2014 assumed average fuel price of $3.91/gallon comes from the U.S. Department of Energy, Energy Information Administration, *U.S. No 2 Diesel Ultra Low Sulfur (0-15 ppm) Retail Prices,* and is an average of reported monthly prices from March 2013 - February 2014.

The 2014 assumed fleet average fuel economy of 5.9 miles per gallon (0.169 gal/mi) for combination trucks was taken from Oakridge National Laboratory's *Transportation Energy Databook, Edition 32* (July 31, 2013), Table 5.2, Summary Statistics for Class 7-8 Combination Trucks, 1970-2011. Data is for 2011.

2015 – 2040 Average Fuel Price and General Inflation Rate

The assumed average fuel price ($/gallon) and general inflation rate for each year between 2015 and 2014 were taken from the U.S. Department of Energy, Energy Information Administration *Annual Energy Outlook 2014 (Early Release)*, Petroleum Product Prices, Reference Case. Average diesel fuel prices were assumed to be $3.72/gallon in 2015, rising to $7.84/gallon (nominal) in 2040. Assumed fuel price inflation varies from year to year but averages 2.5% over the analysis period.

The assumed general inflation rate (applied to incremental equipment costs and other non-fuel operational costs of freight hauling) varies from 1.1% to 2.3% annually over the analysis period.

Freight Fleet Make-up and Usage

Assumptions about the composition and usage of the current freight truck fleet, which were used to calculate the percentage of annual fleet miles operated by trucks and trailers of each model year in each calendar year, are shown in Table 2 along with the data source for each assumption.

Consistent with EPA/NHTSA modeling for their Phase 1 fuel efficiency and greenhouse gas rule, this analysis assumes that sleeper cab equipped trucks operate more miles annually than day cab equipped trucks, and that as trucks age their annual mileage accumulation falls of significantly. Sleeper cab equipped trucks used for long haul operations are assumed to accumulate 130,892 miles during their first year in service, falling to 85,838 miles during their fifth year, and even fewer miles in subsequent years.

Table 2 Assumed Freight Fleet Make-up and Usage

Metric		Value	Unit	Source
% of In-Use Fleet Miles	Sleeper Cab	80%	%	US EPA, RIA, Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, August 2011, page 6-10
	Day Cab	20%	%	
Ratio of In-use Trailers to Trucks		3.1		Based on Bureau of Transportation Statistics, "State Transportation Statistics," 2011; Table 5-1 Vehicle Registrations and Table 5-2, Trailer Registrations, data for 2010; 5.775 million trailers and 1.889 million truck-tractors
Ratio of new trailer to new truck purchases		1.73		R.L Polk & Co., "New Commercial Class 8 Tractor and Trailer (24-foot to 65-foot) Registrations between 1986 and 2011," R.L Polk & Co., Editor 2012: Southfield, MI.
Annual Turnover to New	Trucks	4.8%	%	Historical average 1986 - 2006, based on Transportation Energy Data Book, Table 5.2 (total fleet size) and Polk New Truck Registrations
	Trailers	2.7%	%	= Truck Turn-over rate x Ratio of New Trailers to New Trucks ÷ Ratio of In-use Trailers to Trucks
Annual Mileage First Year	Sleeper cab	130,832	mi	US EPA, RIA, Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, August 2011, Table 2-28 (2015 MY Combination Tractor). This assumption is from EPA MOVES model
	Day Cab	67,000	mi	U.S. Census Bureau, 2002 Vehicle Inventory & Use Survey, average for new trucks with primary operation of less than 200 miles per day
Annual Turnover of Fleet Miles to New Trucks (first year in service)		9.3%	%	Historical average 1986 - 2006, based on fleet turnover to new trucks and mileage driven in first year
Change in Annual Truck Mileage from year to year	yr 2 - 5	-10%	%	US EPA, RIA, Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, August 2011, Table 2-28 (2015 MY Combination Tractor). These assumptions are from EPA MOVES model
	yr 6 - 10	-7.5%	%	
	yr 11 - 15	-6.5%	%	
	yr 16 - 30	-4.0%	%	
Annual Trailer Mileage		21,837	mi	= 163,692 mill fleet miles [TEBD Table 5.2] ÷ (2.452 mill trucks [TEBD Table 5.1] x 3.1 trailer/truck)
Annual Turnover of Fleet Miles to New Trailers		2.7%	%	Same as trailer turnover; assumes level mileage accumulation throughout trailer life

Day cab equipped trucks, which are used primarily for local and regional hauls which return to base every day, are assumed to accumulate 67,000 miles during their first year, falling to 44,000 miles in their fifth year.

Less is known about how trailers accumulate mileage throughout their in-service life. This analysis uses a conservative assumption that annual mileage accumulation for trailers is steady throughout their life, at an average of 21,837 miles per year. On average trailers accumulate significantly less mileage annually than trucks because there are approximately three trailers in service for every truck.

Historically, annual heavy truck purchases are responsive to general economic conditions and are therefore highly variable from year to year. This analysis assumes that a consistent 4.8% of the existing fleet will turn over to new trucks each year. This is the average annual turnover rate of the fleet between 1986 and 2006, not including the most recent recession and slow recovery (2007 – 2011), when annual truck purchases and fleet turnover were unusually low. Based on 4.8% of the fleet turning over to new trucks each year, and the fact that new trucks are assumed to operate more miles annually than the fleet average, this analysis assumes that 9.3% of fleet miles are operated by brand new trucks each year.

Based on the average ratio of trailer to truck purchases between 1986 and 2006, the ratio of in-use trailers to trucks, and an assumption of constant annual mileage accumulation for trailers, this analysis assumes that 2.7% of fleet miles are operated by brand new trailers each year.

Amortization of EPA Compliance Costs

This analysis assumes that the incremental compliance cost of EPA/NHTSA Phase 1 and Phase 2 fuel efficiency and greenhouse gas standards will be amortized over five years for trucks and 10 years for trailers. The assumption of five year amortization for trucks is based on a number of factors:

- There is anecdotal evidence that many large fleets keep new trucks for 5-6 years and then sell them into the used market.

- Many finance companies that advertise commercial truck loans list five years (60 months) as a typical term for their loans

In effect this analysis assumes that the incremental costs of EPA/NHTSA Phase 1 and Phase 2 compliance will be fully paid by the first owner of each truck, and will not be reflected in used truck values. This is a conservative assumption.

This analysis uses a longer amortization period for trailers because there is significant anecdotal evidence that trailers have a much longer in-service life than trucks. For example, data from Price Digest, Commercial Truck and Trailer Blue Book, indicates that a 5-year old used truck is valued at approximately 40% of the price of a new truck, while a 5-year old used trailer is valued at approximately 70% of the price of a new trailer. The value of used trailers does not fall to 40% of the price of new until the trailer is 10-years old.

APPENDIX A

BASELINE WITHOUT EPA PHASE II

	Calendar Year →	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Fleet Average Fuel Economy	MPG	5.90	6.00	6.10	6.19	6.29	6.38	6.46	6.54	6.62	6.69	6.76	6.82	6.88
Fleet Average Freight Rates	$/mile	$1.87	$1.85	$1.85	$1.87	$1.90	$1.94	$1.97	$2.01	$2.05	$2.08	$2.12	$2.16	$2.20

CHANGE IN US AVERAGE FREIGHT COSTS ($/mile) DUE TO EPA PHASE 2 FUEL ECONOMY STANDARDS

	Calendar Year →	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
New Sleeper Cab + New Trailer	Δ Truck Costs							$0.023	$0.024	$0.024	$0.024	$0.025	$0.059	$0.060
	Δ Trailer Costs							$0.023	$0.024	$0.024	$0.025	$0.025	$0.035	$0.036
	sub-total Equipment							$0.046	$0.047	$0.048	$0.049	$0.050	$0.094	$0.096
	Δ Fuel Cost (truck)							($0.161)	($0.159)	($0.157)	($0.154)	($0.152)	($0.216)	($0.215)
	Δ Fuel Cost (trailer)							($0.051)	($0.053)	($0.054)	($0.055)	($0.056)	($0.108)	($0.110)
	sub-total Fuel							($0.213)	($0.212)	($0.211)	($0.209)	($0.208)	($0.324)	($0.325)
	TOTAL							($0.166)	($0.164)	($0.163)	($0.160)	($0.158)	($0.230)	($0.230)
	% Δ from baseline							-8.4%	-8.2%	-8.0%	-7.7%	-7.5%	-10.6%	-10.4%
New Day Cab + New Trailer	Δ Truck Costs							$0.029	$0.029	$0.030	$0.030	$0.031	$0.074	$0.076
	Δ Trailer Costs							$0.023	$0.024	$0.024	$0.025	$0.025	$0.035	$0.036
	sub-total Equipment							$0.052	$0.053	$0.054	$0.055	$0.056	$0.110	$0.112
	Δ Fuel Cost (truck)							($0.074)	($0.069)	($0.064)	($0.058)	($0.053)	($0.105)	($0.102)
	Δ Fuel Cost (trailer)							($0.051)	($0.053)	($0.054)	($0.055)	($0.056)	($0.108)	($0.110)
	sub-total Fuel							($0.126)	($0.122)	($0.118)	($0.113)	($0.109)	($0.213)	($0.212)
	TOTAL							($0.074)	($0.069)	($0.064)	($0.059)	($0.053)	($0.103)	($0.100)
	% Δ from baseline							-3.7%	-3.4%	-3.1%	-2.8%	-2.5%	-4.8%	-4.5%
FLEET AVERAGE	Δ Truck Costs							$0.000	$0.002	$0.005	$0.007	$0.009	$0.012	$0.015
	Δ Trailer Costs							$0.000	$0.001	$0.001	$0.002	$0.003	$0.003	$0.004
	sub-total Equipment							$0.000	$0.003	$0.006	$0.009	$0.012	$0.015	$0.019
	Δ Fuel Cost (truck)							$0.000	($0.006)	($0.011)	($0.016)	($0.021)	($0.026)	($0.037)
	Δ Fuel Cost (trailer)							$0.000	($0.001)	($0.003)	($0.005)	($0.006)	($0.008)	($0.011)
	sub-total Fuel							$0.000	($0.007)	($0.014)	($0.021)	($0.027)	($0.034)	($0.048)
	TOTAL							$0.000	($0.004)	($0.008)	($0.012)	($0.015)	($0.019)	($0.029)
	% Δ from baseline							0.0%	-0.2%	-0.4%	-0.6%	-0.7%	-0.9%	-1.3%

EFFECT OF EPA PHASE 2 HDV FUEL ECONOMY STANDARDS — FLEET AVERAGE FUEL ECONOMY

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
FLEET AVERAGE FUEL ECONOMY	Truck Stds Only	5.90	6.00	6.10	6.19	6.29	6.38	6.46	6.60	6.73	6.85	6.97	7.08	7.25
	Truck & Trailer Stds	5.90	6.00	6.10	6.19	6.29	6.38	6.46	6.61	6.76	6.90	7.03	7.16	7.37

APPENDIX A

BASELINE WITHOUT EPA PHASE II

Calendar Year →		2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Fleet Average Fuel Economy	MPG	6.94	7.00	7.05	7.10	7.15	7.20	7.24	7.29	7.33	7.38	7.42	7.45	7.45	7.46
Fleet Average Freight Rates	$/mile	$2.25	$2.29	$2.33	$2.38	$2.43	$2.49	$2.54	$2.60	$2.66	$2.72	$2.78	$2.85	$2.92	$3.00

EFFECT OF EPA PHASE 2 HDV FUEL ECONOMY STANDARDS

	Calendar Year →	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
New Sleeper Cab + New Trailer	Δ Truck Costs	$0.061	$0.062	$0.063	$0.064	$0.066	$0.067	$0.068	$0.070	$0.071	$0.073	$0.074	$0.076	$0.078	$0.079
	Δ Trailer Costs	$0.037	$0.037	$0.038	$0.039	$0.039	$0.040	$0.041	$0.042	$0.043	$0.044	$0.045	$0.046	$0.047	$0.048
	sub-total Equipment	$0.098	$0.099	$0.101	$0.103	$0.105	$0.107	$0.109	$0.112	$0.114	$0.116	$0.119	$0.122	$0.124	$0.127
	Δ Fuel Cost (truck)	($0.216)	($0.216)	($0.216)	($0.217)	($0.218)	($0.220)	($0.221)	($0.224)	($0.225)	($0.227)	($0.228)	($0.231)	($0.239)	($0.248)
	Δ Fuel Cost (trailer)	($0.113)	($0.114)	($0.117)	($0.120)	($0.123)	($0.126)	($0.129)	($0.133)	($0.136)	($0.139)	($0.143)	($0.147)	($0.152)	($0.158)
	sub-total Fuel	($0.329)	($0.330)	($0.333)	($0.336)	($0.341)	($0.345)	($0.350)	($0.357)	($0.361)	($0.366)	($0.371)	($0.378)	($0.391)	($0.405)
	TOTAL	($0.231)	($0.231)	($0.232)	($0.233)	($0.235)	($0.238)	($0.241)	($0.245)	($0.247)	($0.250)	($0.251)	($0.256)	($0.267)	($0.278)
	% Δ from baseline	-10.3%	-10.1%	-10.0%	-9.8%	-9.7%	-9.6%	-9.5%	-9.4%	-9.3%	-9.2%	-9.0%	-9.0%	-9.1%	-9.3%
New Day Cab + New Trailer	Δ Truck Costs	$0.077	$0.078	$0.080	$0.081	$0.083	$0.085	$0.086	$0.088	$0.090	$0.092	$0.094	$0.096	$0.098	$0.100
	Δ Trailer Costs	$0.037	$0.037	$0.038	$0.039	$0.039	$0.040	$0.041	$0.042	$0.043	$0.044	$0.045	$0.046	$0.047	$0.048
	sub-total Equipment	$0.114	$0.116	$0.118	$0.120	$0.123	$0.125	$0.127	$0.130	$0.133	$0.136	$0.139	$0.142	$0.145	$0.148
	Δ Fuel Cost (truck)	($0.099)	($0.095)	($0.092)	($0.089)	($0.086)	($0.083)	($0.081)	($0.078)	($0.075)	($0.072)	($0.068)	($0.067)	($0.069)	($0.071)
	Δ Fuel Cost (trailer)	($0.113)	($0.114)	($0.117)	($0.120)	($0.123)	($0.126)	($0.129)	($0.133)	($0.136)	($0.139)	($0.143)	($0.147)	($0.152)	($0.158)
	sub-total Fuel	($0.211)	($0.210)	($0.209)	($0.209)	($0.209)	($0.209)	($0.210)	($0.211)	($0.211)	($0.211)	($0.211)	($0.213)	($0.221)	($0.228)
	TOTAL	($0.098)	($0.094)	($0.091)	($0.089)	($0.086)	($0.084)	($0.082)	($0.081)	($0.078)	($0.075)	($0.072)	($0.071)	($0.076)	($0.080)
	% Δ from baseline	-4.3%	-4.1%	-3.9%	-3.7%	-3.5%	-3.4%	-3.2%	-3.1%	-2.9%	-2.8%	-2.6%	-2.5%	-2.6%	-2.7%
FLEET AVERAGE	Δ Truck Costs	$0.019	$0.022	$0.026	$0.030	$0.030	$0.031	$0.031	$0.032	$0.033	$0.033	$0.034	$0.035	$0.035	$0.036
	Δ Trailer Costs	$0.005	$0.006	$0.007	$0.008	$0.009	$0.009	$0.010	$0.010	$0.011	$0.011	$0.011	$0.011	$0.011	$0.012
	sub-total Equipment	$0.024	$0.028	$0.033	$0.038	$0.039	$0.040	$0.041	$0.042	$0.043	$0.044	$0.045	$0.046	$0.047	$0.048
	Δ Fuel Cost (truck)	($0.047)	($0.057)	($0.067)	($0.077)	($0.087)	($0.097)	($0.107)	($0.117)	($0.127)	($0.137)	($0.147)	($0.158)	($0.169)	($0.181)
	Δ Fuel Cost (trailer)	($0.015)	($0.018)	($0.022)	($0.026)	($0.030)	($0.035)	($0.039)	($0.045)	($0.050)	($0.055)	($0.061)	($0.066)	($0.073)	($0.080)
	sub-total Fuel	($0.062)	($0.076)	($0.089)	($0.103)	($0.117)	($0.132)	($0.146)	($0.162)	($0.177)	($0.192)	($0.208)	($0.224)	($0.242)	($0.262)
	TOTAL	($0.038)	($0.047)	($0.056)	($0.065)	($0.078)	($0.092)	($0.105)	($0.120)	($0.134)	($0.148)	($0.163)	($0.178)	($0.195)	($0.214)
	% Δ from baseline	-1.7%	-2.1%	-2.4%	-2.7%	-3.2%	-3.7%	-4.1%	-4.6%	-5.0%	-5.5%	-5.9%	-6.3%	-6.7%	-7.1%
FLEET AVERAGE FUEL ECONOMY	Truck Stds Only	7.41	7.57	7.71	7.86	8.00	8.14	8.27	8.40	8.53	8.66	8.78	8.88	8.95	9.01
	Truck & Trailer Stds	7.57	7.77	7.96	8.16	8.35	8.54	8.73	8.92	9.11	9.30	9.49	9.67	9.80	9.93