

**A LOOK BACK AT EPA'S COST AND OTHER
IMPACT PROJECTIONS FOR MY 2004-2010
HEAVY-DUTY TRUCK EMISSIONS STANDARDS**

**Patrick Calpin and Esteban Plaza-Jennings
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American Truck Dealers
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ABSTRACT:

In 1997, 2000, and 2001, the U.S. Environmental Protection Agency (EPA) published rules establishing a series of new emissions mandates for heavy-duty trucks to be phased-in between model years (MY) 2004 and 2010.¹ Typical of EPA's motor vehicle standards, these "technology forcing" mandates analyzed the development and implementation of new emission control strategies and technologies.

The adoption of these new control strategies and technologies directly resulted in higher prices for new heavy-duty trucks. These mandates also resulted in significantly higher operating costs, attributable largely to increased maintenance requirements, reduced reliability, and lower fuel economy. Together, these higher prices and operating costs led to significant disruptions in the new truck marketplace. These included significant layoffs caused by unprecedented truck pre-buys and sales "cliffs," capital constraints for truck and engine manufacturers (OEMs), suppliers, and dealers; and the departure of certain businesses from the heavy-duty truck market.

This paper examines the degree to which, and possible reasons why, EPA's estimated regulatory impact dramatically underestimated real world costs of the regulation. An analysis of actual sales data, including cost escalators associated with the MY 2004-10 standards, shows that EPA underestimated compliance costs by a *factor of 2-5*. These higher-than-projected costs resulted in, among other things, significantly lower-than-projected new truck sales which necessarily reduced the environmental benefits associated with these standards. While it is an important issue, this paper does not attempt to quantify the degree to which EPA's projected environmental benefits were not realized.

I. THE 2004-2010 TRUCK EMISSIONS MANDATES

As shown in Table 1, the MY 2004-10 truck standards largely were designed to reduce emissions of three diesel fuel combustion byproducts; nitrogen oxides (NO_x); particulate matter (PM), and non-methane hydrocarbons (NMHC). A 1998 legal settlement required seven truck engine OEMs to comply with the MY 2004 mandates two years early (MY 2002). All other engine and truck OEMs began compliance starting with MY 2004.

The second set of mandates began to phase-in in MY 2007. As shown in Table 1, they were designed to reduce MY 2002-04 emissions by roughly 90 percent. The 0.01 g/bhp-hr. PM standard took effect in 2007, with tighter NO_x and NMHC standards phased in over three years.

¹62 Fed. Reg. 54694, *et seq.* (October, 21, 1997); 65 Fed. Reg. 59896, *et seq.* (October 6, 2000); 66 Fed. Reg. 5001, *et seq.* (January 18, 2001). The model year for heavy-duty trucks typically begins on January 1 (*ie.*, MY 2004 runs from 1/1/04-12/31/04).

Table 1: EPA MY 2004-10 Truck Emissions Targets

Regulation	NOx	PM	NMHC
2004	2.5 g/bhp-hr	0.10 g/bhp-hr	2.5 g/bhp-hr
2007-10	1.2- 0.20 g/bhp-hr	0.01 g/bhp-hr	0.14 g/bhp-hr

To meet the MY 2002-10 mandates, engine and truck OEMs had to design, test, and incorporate a host of new strategies and technologies. Cooled exhaust gas recirculation (EGR), which reduces NOx emissions by displacing oxygen with inert gases during combustion, was the primary compliance strategy for almost all truck and engine OEMs. EGR often necessitated that changes be made to the trucks themselves (e.g., to accommodate larger cooling systems). To address tighter MY 2007-10 NOx standards, most engine and truck OEMs chose selective catalytic reduction (SCR), an aftertreatment strategy that reduces emissions by injecting a catalyst or diesel exhaust fluid (DEF) into the exhaust stream. PM emission reductions were addressed largely with aftertreatment technologies such as filters and traps.

II. THE REACTION OF NEW TRUCK CUSTOMERS TO EPA’S STANDARDS

Implementation of EPA’s MY 2004-2010 emissions mandates directly resulted in higher truck prices, increased operating costs, reduced reliability, and lower fuel economy performance, which caused dramatic disruptions to the new truck marketplace. As detailed later in this paper, EPA’s regulatory analyses grossly underestimated these impacts or missed them altogether.

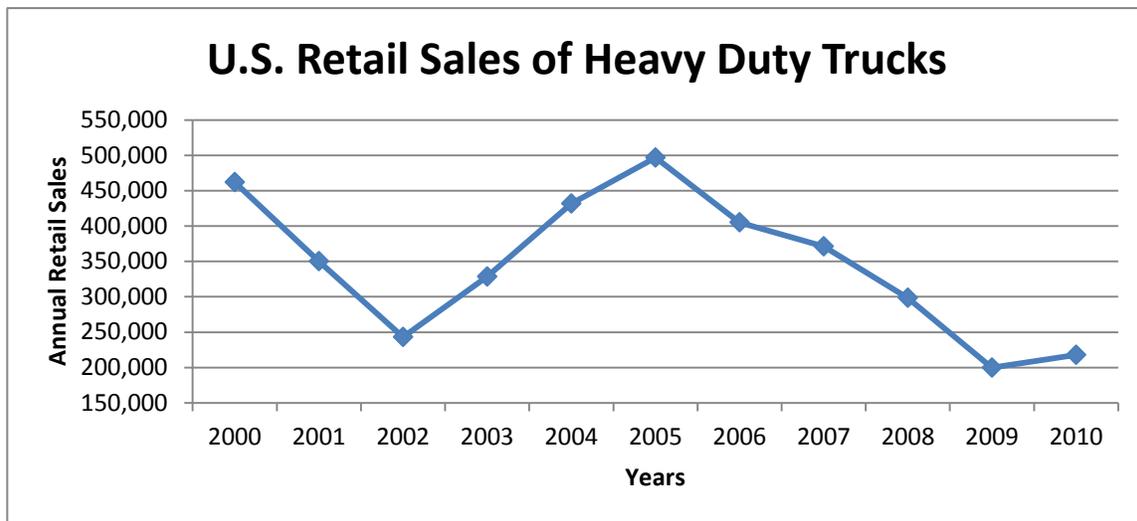


Figure 1: Annual U.S. Retail Sales for Class 4-8 Heavy-Duty Trucks.²

Many informed prospective new truck purchasers rushed to “pre-buy” trucks with pre-compliant technologies to avoid the effects of EPA’s mandates. As seen in Figure 1 below, a surge of orders came in for pre-MY 2004 equipment, after which orders slumped significantly. Also, in 2006, orders surged for pre-MY 2007 equipment, and then fell off precipitously. Lastly,

²All data from Ward’s Communications.

in the 2009 time-frame, orders poured in for pre-MY 2010 equipped trucks.³ In each instance, the marketplace anticipated and sought to avoid the higher prices and poorer performance of compliant technologies. As detailed later in this section, these marketplace distortions led to employment swings, capital constraints, and even some business failures⁴.

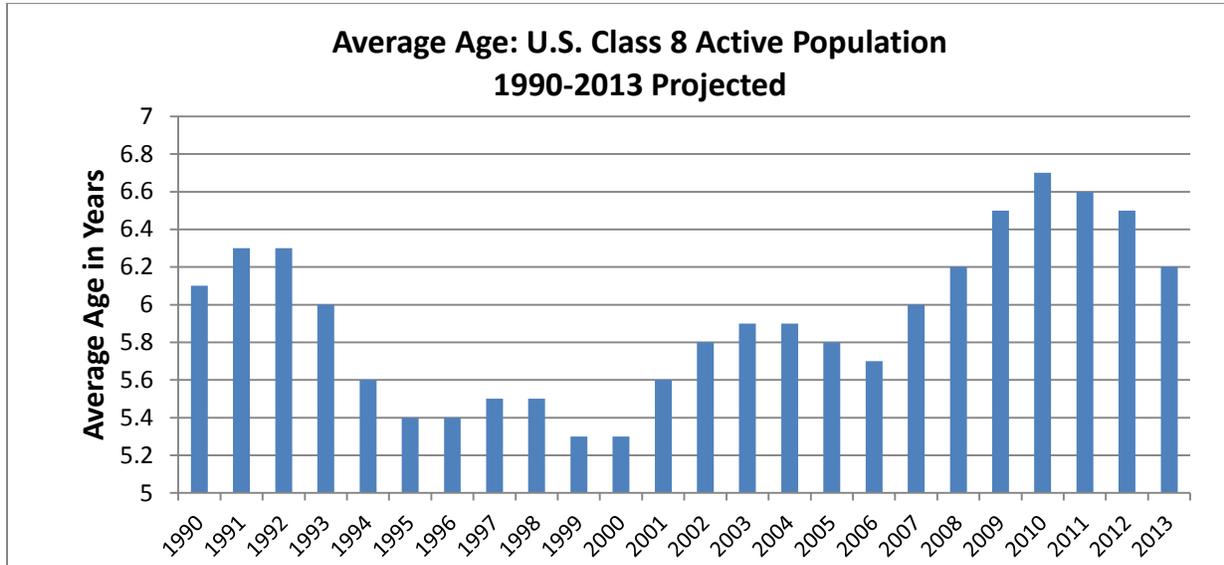


Figure 2: Average Age of Heavy-Duty Truck Fleet 1990-2013⁵

A National Economic Research Associates (NERA) survey concluded that pre-buy purchases made in anticipation of the MY 2007 standards totaled an additional 104,077 units in 2005 and 2006.⁶ This was followed by a decline of 149,272 units in 2007 and 2008.⁷ The pre-buy in 2009 was less pronounced and somewhat difficult to separate out from a significant decline in commercial truck demand that year related to the severity of the economic recession. In fact, sales of Class 8 trucks hit their lowest level since 1991.⁸ In addition, many operators elected to hold onto their older trucks for longer than they otherwise would have, predictably incurring the higher operating costs and reliability risks of doing so. When faced with higher truck pricing and lower truck performance, prospective new truck customers acted rationally. This reluctance to buy new trucks has resulted in an aging truck fleet largely made up of trucks built prior to 2004. As evidenced by Figure 2 below, the commercial truck fleet now averages 6.6 years of age, about 11 months older than the historical average dating back to 1979.⁹ This

³ Jim Mele, *Economists See Milder Pre-Buy in '09*, Fleet Owner (January 22, 2008).

⁴Truck and engine OEMs temporarily or permanently exiting the heavy-duty market at least in part due to EPA's mandates include Caterpillar Inc., Sterling Trucks, General Motors Medium-Duty Truck (Chevrolet/GMC), Mitsubishi-Fuso Truck of America, Inc., Hino Trucks, and UD Trucks Co.

⁵Saum, Chairman, Beltway Companies, presentation to Diesel Technology Forum, June 17, 2011, graphic by ACT Research, LLC.

⁶ NERA, *Customer Behavior in Response to the 2007 Heavy-Duty Engine Emission Standards: Implications for the 2010 NOx Standard*, page 11. (November 14, 2008).

⁷ Ibid.

⁸ Commercial trucks generally are categorized by gross vehicle weight rating (GVWR) and vehicle class. EPA further defines "heavy-duty vehicles" as light heavy-duty (Classes 2B-5; 8,500-19,500 GVWR), medium heavy-duty (Classes 6-7; 19,501-33,000 GVWR) and heavy heavy-duty (Class 8; 33,001 and above GVWR).

⁹ Daley and Clothier, *Oldest Trucks Since 1979 May Mean Output to Rise 56%*, Bloomberg (November, 19, 2010).

aging fleet of older, higher polluting trucks is counterproductive to the pollution reduction targets EPA hoped to meet with its mandates.¹⁰

These pre-buys and decisions by operators to keep older trucks longer had a significant economic impact. EPA acknowledged the market disruptions caused by the new regulations but waved them off as business cycle activity not necessarily related to the new emissions standards.¹¹ This was hardly the case as the pre-buys occurred in tandem with the new emissions mandates. For example, when faced with declining sales following the pre-buy, Volvo laid off 300 workers in March of 2001 and another 300 workers in April of that year.¹² In 2006, Volvo's Deputy Chief Executive Officer warned that the new environmental regulations would cause such a precipitous decline in sales that Volvo would have no choice but to lay off more people.¹³ Volvo ended up laying off nearly 600 workers in 2006; the direct result of the new emissions mandates.¹⁴ Also in 2006, Peterbilt cut their workforce by almost half.¹⁵ Freightliner laid off nearly 1,800 workers in 2007,¹⁶ followed by another layoff of 2,100 workers, and the complete shut down a manufacturing plant in 2009.¹⁷

Fleet purchasers echo these numbers. Fleets pre-bought new trucks in 2006 to reduce their average fleet age in preparation for the MY 2007 standards.¹⁸ Fleet managers cited concerns over cost and decreased reliability as a main motivating factor.¹⁹ As noted above, in addition to causing significant economic disruptions, these pre-buy/cliff cycles concurrently reduced projected environmental benefits as the adoption of new and more environmentally friendly technologies was delayed.

Other prospective purchasers turned to the used truck market.²⁰ Additionally, there has been a surge in truck rebuilding activity, often involving glider kits.²¹ Glider kits are new truck frames and bodies typically married to used or rebuilt powertrain and suspension components. Like with used trucks, glider kits do not use new technology engines, further reducing the environmental benefits predicted by EPA to result from its standards.²²

¹⁰ Thornton, Dorothy, *et. al. Compliance costs, regulation and environmental performance: Controlling truck emissions in the US*. Regulation & Governance (2008).

¹¹ Diesel Progress, *10 Questions with Margo Oge, Office of Transportation and Air Quality*, EPA (February 2007).

¹² The Roanoke Times, *More Layoffs Ahead at Volvo* (March 29, 2001).

¹³ Forbes.com, *Big Trucks on a Bumpy Road* (November 16, 2006).

¹⁴ The Sun, *Volvo to Lay Off 600 at Hagerstown Plant* (October 28, 2006)

¹⁵ The Tennessean, *Peterbilt to Cut Ranks by Half* (November 28, 2006)

¹⁶ Napa Valley Register, *Truck Maker Announces Layoffs* (January 28, 2007).

¹⁷ World Truck News, *Freightliner Plans Massive Charlotte-Area Layoff* (January 28, 2009).

¹⁸ Tire Business, *Strong Economy Bodes Well for Trucking*, (January 2, 2006)

¹⁹ Leone, *Carriers Split Viewpoints on Benefits Of Buying Before 2010 Regulations*, Transport Topics (March 24, 2008).

²⁰ Owner-Operators Independent Drivers Association (OOIDA) data shows that the percentage of its members buying new trucks has dropped by 30 percent. Scott Greneth (Professional driver and member of OOIDA), Testimony before the House Committee on Oversight and Government Reform, (October 12, 2011).

²¹ Transport Topics, *Glider Kits Give New Life to Trusty, Older Trucks* (January 17, 2011).

²² When the marketplace avoids EPA-mandated vehicles, it both diminishes projected environmental benefits and calls into question EPA's estimates of private benefits and costs. This is also a concern with EPA's MY 2017-2025 light-duty greenhouse gas (GHG) proposal and the expected second round of GHG rules for commercial trucks.

III. EPA'S PROJECTED COSTS OF COMPLIANCE

1. Fixed Costs

EPA conducted studies analyzing and projecting the effects of the MY 2004-10 rules.²³ Projected regulatory benefits included improved environmental quality and human health, while projected costs²⁴ focused on control strategies and technologies necessary for compliance. EPA broke out its projected compliance costs for light heavy-duty, medium heavy-duty, and heavy heavy-duty trucks and engines. Due to data constraints, this paper examines only the projected and actual compliance costs associated with medium heavy-duty and heavy heavy-duty trucks.

EPA's cost projections were made for a nine-year time frame and accounted for decreasing fixed and variable costs. As shown in Table 2 for heavy heavy-duty trucks, EPA projected that MY 2004-2005 trucks meeting MY 2004 standards would incur average costs of \$803. For MYs 2006-2008, EPA projected a \$688 average per vehicle MY 2004 standards compliance cost, with the decrease due to a 20 percent learning curve on fixed costs. For MYs 2009-2012, EPA projected average per vehicle MY 2004 compliance costs of \$368, a decrease reflecting the expiration of fixed costs by MY 2009, and a 20 percent learning curve for variable costs.

²³ EPA, *Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines*, (September, 1997); EPA, *Regulatory Impact Analysis: Control of Emissions on Air Pollution from Highway Heavy-Duty Engines*, EPA 420-R-00-010 (July 2000); EPA, *Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*, EPA 420-R-00-026 (December 2000).

²⁴ EPA's projected costs appear to represent an average marginal cost/per truck based on a Retail Price Equivalent (RPE) for emission control technologies. Specifically:

Costs of control include variable costs (for incremental hardware costs, assembly costs, and associated markups) and fixed costs (for tooling, R&D, and certification). For technologies sold by a supplier to the engine manufacturers, costs are either estimated based upon a direct cost to manufacture the system components plus a 29 percent markup to account for the supplier's overhead and profit, or when available, based upon estimates from suppliers on expected total costs to the manufacturers (inclusive of markups). Estimated variable costs for new technologies include a markup to account for increased warranty costs. Variable costs are additionally marked up to account for both manufacturer and dealer overhead and carrying costs. The manufacturer's carrying cost was estimated to be four percent of the direct costs accounting for the capital cost of the extra inventory, and the incremental costs of insurance, handling, and storage. The dealer's carrying cost was marked up three percent reflecting the cost of capital tied up in inventory.

EPA, *RIA*, EPA 420-R-00-026 at v-2 (December 2000).

Neither EPA's projected costs nor the actual costs discussed here-in include the application of the 12% federal excise tax or state sales taxes.

Table 2: EPA’s Projected Heavy Heavy-Duty Compliance Costs (Costs are in 1999 dollars)

MY Year	2004 Standards ²⁵	2007-10 Standards ²⁶
2004	\$803	N/A
2005	\$803	N/A
2006	\$688	N/A
2007	\$688	\$3,227
2008	\$688	\$3,227
2009	\$368	\$2,618
2010	\$368	\$2,618
2011	\$368	\$2,618
2012	\$368	\$1,866

Table 2 also shows similar EPA projections for the MY 2007-10 standards, suggesting that for MYs 2007-2008, the average per vehicle cost of compliance would be \$3,227. Due to an assumed 20 percent learning curve on fixed costs, EPA projected this average per vehicle cost would drop to \$2,618 for trucks built in MYs 2009-11. For MY 2012, EPA projected average per vehicle compliance costs for the MY 2007-10 standards to decline to \$1,866, the result of a 20 percent learning curve applied to the variable costs.

EPA conducted similar cost projections with similar adjustment factors for medium heavy-duty trucks and engines. Table 3 shows projected average medium heavy-duty truck costs of \$657 to meet the MY 2004 standards for MYs 2004-2005, dropping to \$571 for MYs 2006-2008, and dropping further to \$275 for trucks built in MYs 2009-2012.

Table 3: EPA’s Projected Medium Heavy-Duty Compliance Costs (Costs are in 1999 dollars)

Year	2004 Standards ²⁷	2007-10 Standards ²⁸
2004	\$657	N/A
2005	\$657	N/A
2006	\$571	N/A
2007	\$571	\$2,564
2008	\$571	\$2,564
2009	\$275	\$2,096
2010	\$275	\$2,096
2011	\$275	\$2,096
2012	\$275	\$1,412

²⁵ EPA, *RIA*, EPA 420-R-00-010 at 88 (July 2000). EPA only gives cost estimates for the 2004, 2006, and 2009 MYs. Based on an oral conversation with EPA staff, Table 2 uses these same numbers to fill the gaps in between.

²⁶ EPA, *RIA*, EPA 420-R-00-026 at V-38 (December 2000). EPA only gives cost estimates for the 2007, 2009, and 2012 MYs. Based on an oral conversation with EPA staff, Table 2 uses the same numbers to fill the gaps in between.

²⁷ See footnote 25.

²⁸ See footnote 26.

Table 3 also shows EPA's projected average medium heavy-duty truck compliance costs for the MY 2007-10 standards to be \$2,564 for MYs 2007-2008, \$2,096 for MYs 2009-2011, and \$1,412 for trucks built for MY 2012.

2. Operating Costs

In addition to projecting direct vehicle cost increases, EPA estimated some of the indirect costs associated with its mandates, designating them as "life-cycle operating costs." According to EPA,

Operating costs include the cost for vehicle and engine maintenance, and the cost for vehicle consumables such as fuel, oil, filters and tires. The new standards and technologies introduced beginning in 2007 are expected to change vehicle operating costs.²⁹

Indeed, EPA estimated increased life-cycle operating costs of \$3,785³⁰ for a MY 2007 Class 8 truck, in *addition* to a \$3,227 higher up front price. This paper does not attempt to compare EPA's estimated life-cycle operating costs to actual operating costs. However, data suggests that DPF and trap maintenance intervals have occurred much more often than projected, at \$300-500 per service. This is particularly true for units in vocational use.³¹ Moreover, the lost earnings associated with trucks out of service, due to reliability issues, far exceed any service and parts costs associated with these mandates. As discussed below, real and perceived increased operating costs, along with real and perceived declines in performance, significantly contributed to the marketplace disruptions arising from EPA's standards.

IV. ACTUAL PER TRUCK COMPLIANCE COSTS VS. EPA COST PROJECTIONS

Actual individual sales data and widely reported pricing information paint a clear picture of the higher per truck costs resulting from compliance with EPA's mandates. The primary data used in this paper to analyze actual per truck costs were individual sales invoices and OEM sales documents covering truck sales involving the majority of heavy-duty truck and engine OEMs.³² Many invoices contained specific cost line items (surcharges or escalators) delineating cost increases attributable to the MY 2004-10 mandates. These surcharges are understood to reflect the wholesale costs (to the dealer) of the emission reduction strategies and technologies used. They do not include dealer mark-ups (if any) or taxes.

For example, certain Western Star truck invoices listed specific escalators labeled "2002/2004 Engine Emissions Escalator...\$4,148.00." and certain Volvo invoices read "2007 EPA surcharge net/net no discount...\$7,500" A November 20, 2009, Peterbilt dealer bulletin detailing 2010 pricing read, in part:

²⁹ EPA, *RIA, EPA 420-R-00-026* at V-29 (December 2000).

³⁰ EPA life-cycle operating costs, in 1999 dollars, do not include increased fuel economy costs.

³¹ Steve Sturgess, *2010 DPF Maintenance*, Trucking Info (January 22, 2010).

³² The number of surcharge data points do not represent all potentially available data for all regulated truck OEMS, but rather data readily available from surveyed dealers.

Effective with the January 1, 2010, price level, a surcharge will be added to the invoice for chassis built with a 2010 EPA emissions compliant after-treatment. This surcharge is non-discountable and will be applied as follows: ISX...\$9,250 Surcharge...ISL, PX-8, PX-6 - \$7,000.

Figure 3 below shows the average surcharge, by OEM, for MY 2010 compliant heavy heavy-duty trucks. These escalators account only for costs associated with the MY 2010 round of emissions mandates. According to vehicle/engine manufacturers, compliance costs associated with the MY 2004 and MY 2007 mandates were incorporated into base invoice price of MY 2010 compliant trucks.³³ The EPA comparative cost projection shown also does not include compliance costs for the MY 2004 and MY 2007 standards. *On average, actual cost increases for MY 2010 compliant heavy heavy-duty trucks were nearly three times what EPA projected.*

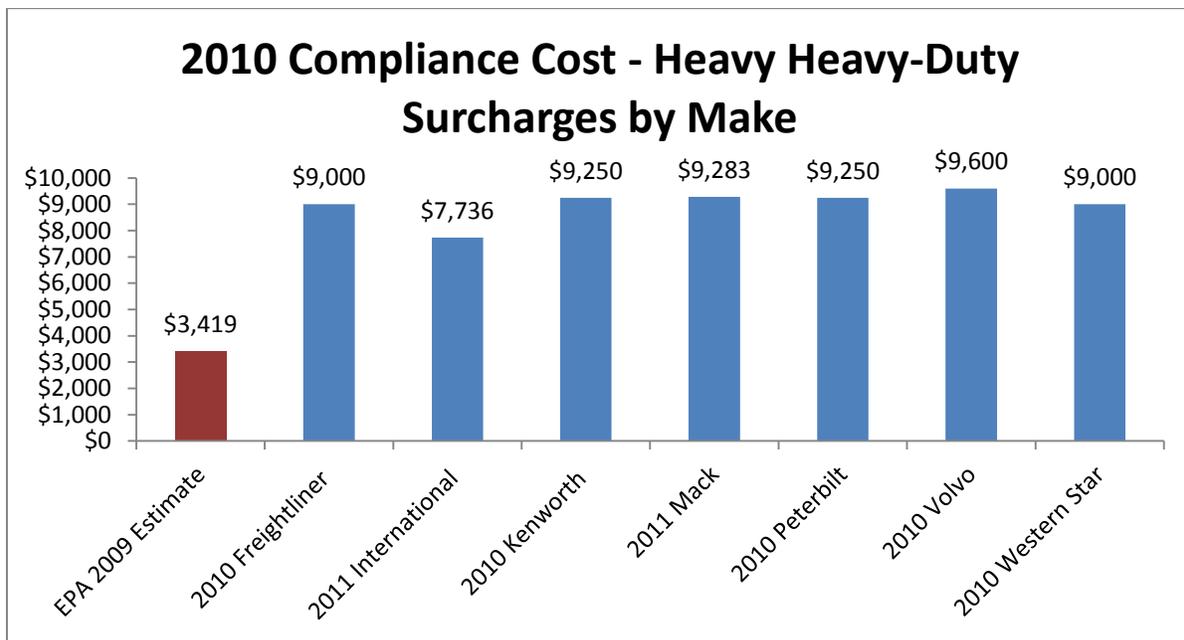


Figure 3: 2010 Compliant Heavy Heavy-Duty Surcharges by OEM.³⁴

Figure 4 below shows the average MY 2010 surcharge, by OEM, associated with MY 2010 compliant medium heavy-duty trucks. Again, EPA’s projection, provided by comparison,

³³ In other words, the surcharges only account for the costs associated with meeting a specific level of emission standards. For example, the 2004 surcharge accounts for the 2.5 g/bhp-hr NOx standard (figure 6), the 2007 surcharge accounts for the 1.2 g/bhp-hr NOx standard (figure 5), and the 2010 surcharge accounts for the 0.20 g/bhp-hr NOx standard (figures 3 & 4). In order to calculate total regulatory costs, these incremental costs must be added together.

³⁴The X-axis lists truck OEMs and year of invoice. The Y-axis lists per vehicle regulatory compliance premiums. Dollars are standardized to 2010 with surcharges adjusted for inflation. The EPA estimate is a MY 2009 projection made in December 2000, inflation adjusted. This is used because EPA only made per vehicle cost increase estimates for MY 2007, 2009, and 2012. Figure 3 uses the 2009 cost increase to be conservative, since using the 2012 estimate would likely undervalue EPA’s cost predictions for MY 2010 trucks.

does not include MY 2004 and MY 2007 compliance costs. *On average, actual cost increases for MY 2010 compliant medium heavy-duty trucks were over two times what EPA projected.*

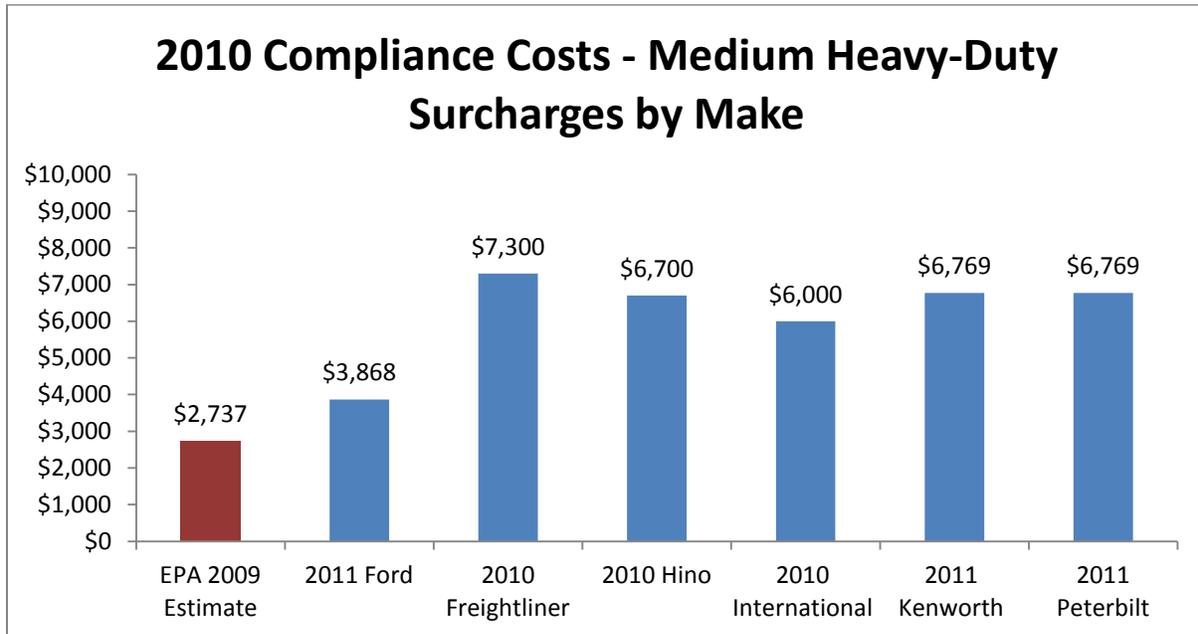


Figure 4: 2010 Compliant Medium Heavy-Duty Surcharges by OEM.³⁵

Figure 5 below shows the average MY 2007 surcharge, by OEM, associated with MY 2007 compliant heavy heavy-duty trucks. Again, EPA’s projection, provided by comparison, does not include MY 2004 compliance costs. *On average, actual cost increases for MY 2007 compliant medium heavy-duty trucks were nearly two times what EPA projected.*

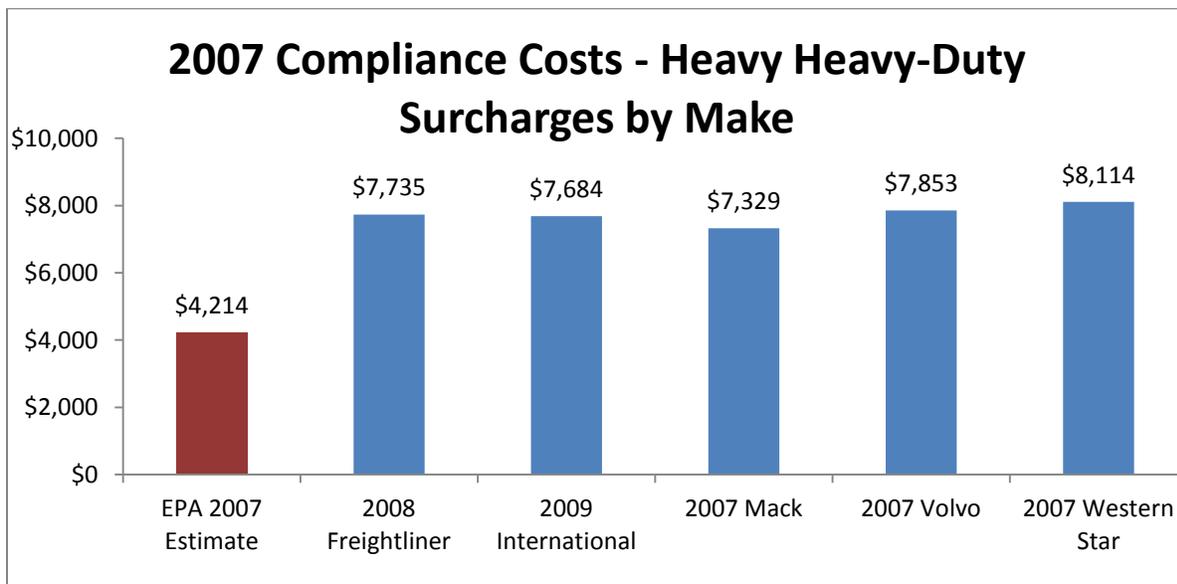


Figure 5: 2007 Compliant Heavy Heavy-Duty Surcharges by Truck OEM³⁶

³⁵ Please see foot note 34.

Figure 6 below shows the average MY 2004 compliant surcharge, by OEM, associated with MY 2004 compliant medium heavy-duty trucks, along with EPA’s projection. *On average, actual cost increases for MY 2004 compliant heavy heavy-duty trucks were up to five times what EPA projected.*

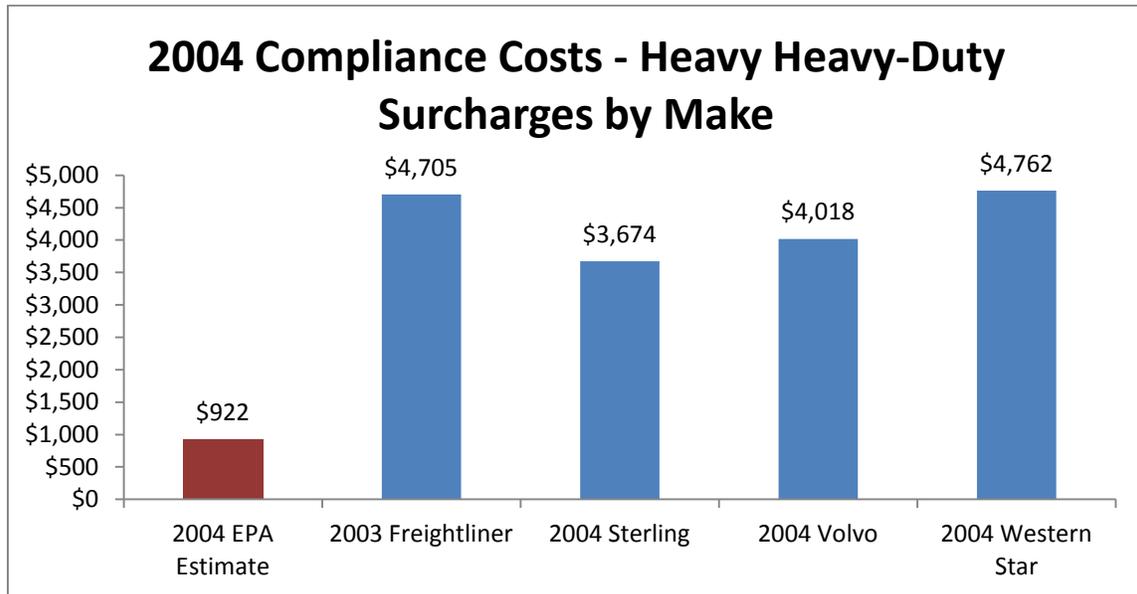


Figure 6: 2004 Compliant Heavy Heavy-Duty Surcharges by Truck OEM³⁷

Figures 3-6 show that EPA’s cost analyses underestimated *by two to five times* the actual costs of compliance with the MY2004-10 truck emissions mandates. As shown in Figure 7 below, it is possible to total up average per truck compliance costs for the MY 2004-2010 standards. According to representatives from various manufacturers, this comparison is appropriate because, as described above, each round of surcharges does not include costs incurred to comply with the prior round(s) of emissions mandates. *A comparison of EPA’s total projected costs for heavy heavy-duty trucks versus actual data for four OEMs shows that on average, actual cost increases were 4 times what EPA projected.*³⁸

³⁶The X-axis lists truck OEM and year of invoice. The Y-axis lists the per vehicle regulatory compliance premium. Dollars are standardized to 2010 with surcharges adjusted for inflation. Notably, a 2005/2008 retrospective study conducted by NERA Economic Consulting and Air Improvement Resource, Inc. similarly projected that, on average, heavy heavy-duty truck prices would increase by \$7,000 to meet the MY 2007 standards.

³⁷ The X-axis lists truck OEM and year of invoice. The Y-axis lists the per vehicle regulatory compliance premiums. Dollars are standardized to 2010 with surcharges adjusted for inflation. EPA’s MY 2004 estimate is based on its first year projection for a MY 2004 compliant vehicle. See Table 3. The 2003 Freightliner invoice is comparable to the MY 2004 EPA as both reflect compliance with the same standard.

³⁸ OOIDA attempted to calculate a total average per truck regulatory cost figure associated with the MY 2004-2010 standards. OOIDA’s analysis, based on MSRP values and increased warranty costs, calculates that EPA’s rules caused truck prices and warranty costs to increase an average of \$20,000-30,000. Scott Grenerth (Professional driver and member of OOIDA), Testimony before the House Committee on Oversight and Government Reform, (October 12, 2011).

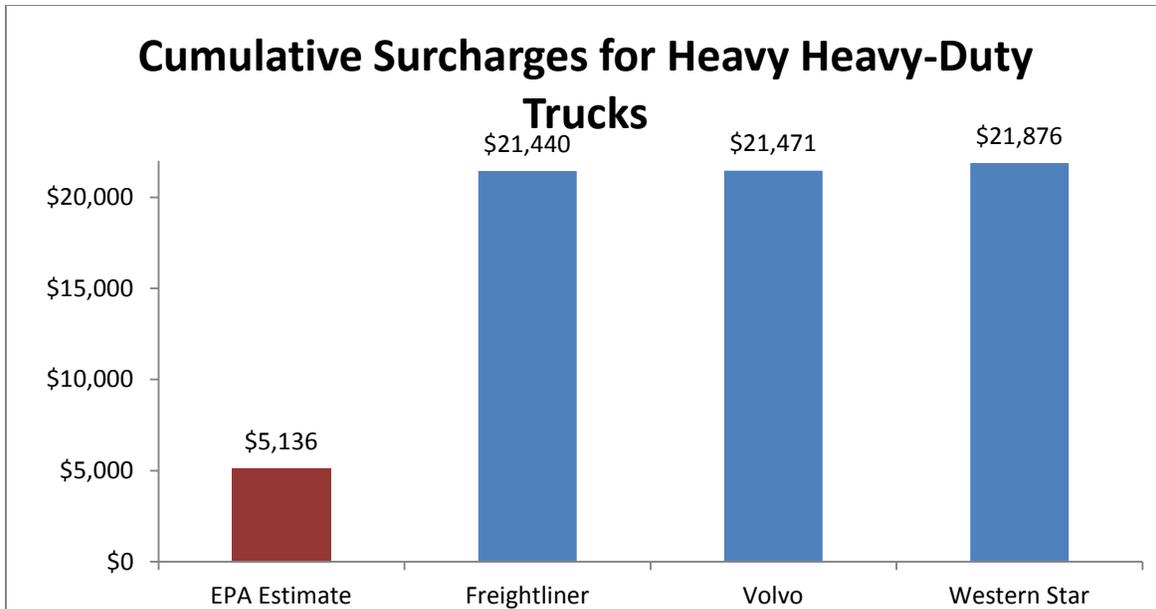


Figure 7: EPA Projection of Total MY 2004-2010 Heavy Heavy-Duty Compliance Costs Compared To Actual Total Surcharges for Three OEMs³⁹

V. OTHER CONCERNS ARISING OUT OF EPA’S MY 2004-2010 TRUCK EMISSIONS MANDATES THAT CONTRIBUTED TO MARKETPLACE DISRUPTIONS

1. Decreased Truck/Engine Reliability

In 2000, EPA stated that, “engine manufacturers have been very successful in developing a mix of technologies to lower PM and NOx concurrently while continuing to improve fuel economy and engine durability.”⁴⁰ This may have been the case up until the MY 2004-2010 standards took effect, but experience with their implementation paints a different picture. Particularly with respect to trucks and engines designed to meet MY 2004 and 2007 standards, fleets and owner-operators have experienced significant reliability, operating cost, and fuel economy concerns. A recent J.D. Power and Associates study suggests that:

With the new technology required to meet emissions standards, today’s engines simply are more problematic than the previous generation. So, while it’s possible that manufacturers can continue to improve the quality of the engines, it’s unlikely that they’ll quickly get back to the pre-2004 levels.⁴¹

J.D. Power’s conclusions are supported by individual fleet experiences. For example, it has been reported that for the eighth largest carrier in the U.S., “maintenance costs for Schneider’s 2007

³⁹ EPA’s estimate is the sum of projected MY 2004, 2007, 2010 costs. Actual compliance cost totals are the sum of each OEM’s MY 2004, 2007, and 2010 surcharges. All numbers are adjusted for inflation to 2010 dollars. The three OEMs shown are the only ones for which surcharge data was available for all three compliance rounds.

⁴⁰ EPA, *RIA*, EPA 420-R-00-010 at 26 (July 2000).

⁴¹ J.D. Power, *Heavy-duty Engine Quality, Satisfaction Up Since Last Year*, Commercial Carrier Journal (September 1, 2011)

model trucks were about 28.2% higher than vehicles manufactured before October 2002.”⁴² Reliability is critical for commercial fleets and owner-operators both because of the costs of keeping trucks in operation and the even greater potential costs associated with out-of-service equipment.⁴³ In addition to higher truck prices and operating costs, anticipated reliability issues are often cited as contributing to the marketplace disruptions discussed herein.⁴⁴

2. Decreased Fuel Economy Performance

For its MY 2004 rule, EPA projected that fuel injection and variable geometry turbochargers would offset the fuel economy penalties of EGR systems. In fact, EPA even projected that its MY 2004 rules would decrease fuel consumption by as much as 1.5 percent.⁴⁵ For its MY 2007-2010 rule, EPA projected no declines in fuel economy performance.⁴⁶

EGR systems may be effective at reducing NO_x emissions, but they undeniably reduce the fuel economy performance that would otherwise have been achieved. For example, Judy McTigue, director of marketing and planning research for Kenworth Trucks, stated that “2007-compliant engines equipped with exhaust gas recirculation systems suffered a fuel economy penalty of 5% to 9%.”⁴⁷ EGR systems also contributed to a loss of 50 to 100 horsepower from heavy-duty engines.⁴⁸ According to OOIDA, this fuel economy penalty equates to a truck consuming an extra 800 additional gallons of fuel per year, on average.⁴⁹ At \$4.00/per gallon, that is an extra \$3,200/year/truck that EPA failed to account for in its projections. In addition, EPA also failed to account for the proportionate amount of extra GHGs emitted, ironic given that the agency has since issued a rule governing GHGs from commercial trucks and is in the process of developing a second. Not unlike reliability concerns and higher prices, lower fuel economy performance is often cited as a major reason why fleets and owner-operators avoided purchasing trucks equipped with engines designed to meet the MY 2004 and 2007 standards. Subsequent introduction of SCR has mitigated EGR-related fuel economy performance degradations, but the new truck fleet has yet to reach pre-MY 2004 fuel economy levels.⁵⁰

VI. LESSONS LEARNED: EXPLAINING EPA’S GROSS UNDERESTIMATIONS

In light of the dramatic marketplace impacts that directly resulted from the actual regulatory costs associated with EPA’s MY 2004-2010 truck emissions mandates, it is

⁴² Leone, *Carriers Split Viewpoints on Benefits Of Buying Before 2010 Regulations*, Transport Topics (March 24, 2008).

⁴³ Scott Greneth (Professional driver and member of OOIDA), Testimony before the House Committee on Oversight and Government Reform, (October 12, 2011).

⁴⁴ Deborah Lockridge, *The Pre-Buy Ride*, Heavy Duty Trucking (August, 2007).

⁴⁵ EPA, *RIA*, EPA 420-R-00-010 at 85 (July 2000).

⁴⁶ EPA, *RIA*, EPA 420-R-00-026 at V-29 (December 2000).

⁴⁷ Fleet Owner, *Dealing with DEF*, (October 22, 2010).

⁴⁸ *Ibid*

⁴⁹ U.S. House, Committee on Oversight and Government Reform, Sub-Committee on Regulatory Affairs, Stimulus Oversight, and Government Spending, *Running on Empty How the Obama Administration's Green Energy Gamble Will Impact Small Business & Consumers*, Hearing (October 10, 2011).

⁵⁰ Volvo Trucks North America, *SCR and Fuel Efficiency* (2009)

incumbent upon the agency to review and resolve the flaws with its cost projection methodology. By misjudging future regulatory costs, EPA (and other agencies) not only give an inaccurate picture of the negative impacts arising from those costs, but also overstate potential benefits. In this case, the dramatic new truck sales disruptions resulted in a delay of the environmental benefits projected for the “timely” introduction of cleaner engine-equipped trucks. As stated above this paper makes no attempt to quantify the actual benefit reductions associated with real-life compliance, however, the fact that they were significantly reduced is undeniable.

1. Long-Lead Time Rulemakings: A Mixed Blessing

EPA began to analyze the costs and benefits of its MY 2004-2010 truck emissions mandates in 1997. At the time, the agency touted the positive aspects of codifying future mandates well before they are to take effect by stating:

In previous rules to set heavy-duty engine emission standards, EPA has typically allowed engine manufacturers about four years of preproduction lead time. This four-year lead time, the period called for in the Clean Air Act, has given manufacturers sufficient opportunity to complete the research, development, retooling, and certification efforts necessary to comply with promulgated emission standards. The requirements for the 2004 model year do not follow this pattern. The Statement of Principles and the Advance Notice of Proposed Rulemaking gave the engine manufacturers a good idea of the level of the emission standards and other related requirements a full eight years before 2004.⁵¹

Longer than necessary lead times are beneficial in principle, but can have significant unintended consequences where “technology forcing” standards are involved and compliance depends on hard-to-predict variables. All things being equal, the further away projections occur from an intended effective date, the less likely an agency will be able to accurately predict which technologies and strategies will be used, what they will cost, and whether and what degree they will be affordable and acceptable to potential customers.

2. NO_x Reduction Technologies

The Regulatory Impact Analysis (RIA) for EPA’s MY 2007-2010 rules was drafted in 2000, a full seven to ten years before actual implementation.⁵² EPA recognized then that while enhanced EGR would serve as the primary NO_x reduction compliance technology for the MY 2004 emissions standards, it would be insufficient to meet the more stringent MY 2007-2010 mandates. In 2000, EPA predicted specifically that, in conjunction with EGR, NO_x adsorbers would be needed to achieve the 0.20 g/bhp-hr target. EPA did not predict and thus did not project the costs associated with SCR, the emission control strategy ultimately elected by most OEMs. EPA did not focus on SCR because, at the time, the agency lacked the assurances necessary to approve it as an enforceable approach. EPA was concerned specifically with urea

⁵¹ EPA, *Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines*, at 83 (September 1997).

⁵² EPA, *RIA*, EPA 420-R-00-026 (December 2000).

infrastructure issues and user compliance mechanisms.⁵³ Despite an officially neutral stance, EPA indicated a bias for NOx adsorbers over SCR,⁵⁴ publically acknowledging its difficulty in recognizing that NOx adsorbers would have anything but wide application to address MY 2010 standards.⁵⁵

EPA's support for NOx adsorbers arose out of a preference for hardware-only solutions versus approaches involving both hardware and operator input. This bias conflicted with significant OEM preferences for SCR, in part based on experience with using the technology in Europe.⁵⁶ In the end, most engine OEMs elected to adopt SCR technology to meet the MY 2010 0.20 g/bhp-hr target, consistent with policies issued by EPA.⁵⁷

The NOx adsorber vs. SCR experience supports two points:

1. The further out in time compliance dates are set and the further ahead technologies and strategies are analyzed, the greater the likelihood projections will be wrong. Such uncertainties may be reduced by, among other things, providing for, analyzing, and projecting a range of potential compliance options.
2. Uncertainties inherent in cost/benefit analyses may be reduced by shortening the time frames in question and by providing for a range of costs and benefits for any given technology or strategy analyzed. Obviously, the SCR NOx reduction strategy, never rigorously analyzed in the EPA RIAs associated with these standards, ended costing significantly more to implement than what EPA projected NOx adsorbers would cost.

VI. CONCLUSION

All regulatory mandates have consequences, some intended and recognized, others either unintended or ignored. These consequences often involve real costs to the regulated entities and to, as in this case, related parties such as customers and employees. Forecasted public and private benefits can end up being dramatically overstated. Thus, it is incumbent upon EPA (and all regulatory agencies) to properly analyze, characterize, and project the costs and benefits of its proposals, especially where long lead times and production mandates are involved. Failing to do so only serves to undermine the efficacy of the regulatory process.

In this instance, EPA underestimated the up-front cost premiums associated with its truck mandates by a factor of 2-5 times. In addition, EPA also failed to accurately analyze and project

⁵³ Johnson, *EPA Quietly Works Against Promising Engine Technology*, Transport Topics (January 6, 2003).

⁵⁴ *Ibid.*

⁵⁵ Malloy, *2010 Options Could Force Radical Leap*, Transport Topics (March 15, 2004).

⁵⁶ SCR is 'the only solution on earth today' that will meet the new regulations, said Pierre Lecoq, SVP, Global Product Development, Volvo Powertrain in Abramson, *Volvo Says SCR the Only Way to Meet 2010 Emission Rules*, Transport Topics (October 18, 2004); "DDC [Detroit Diesel Corporation] and Freightliner LLC, the nation's largest producer of Class 8 trucks, and others favor the use of urea because it can boost fuel economy in trucks and help achieve EPA's emissions targets for 2007" in Wislocki, *Urea supporters ready to seek EPA approval for SCR engines*, Transport Topics (September 8, 2003).

⁵⁷ See *e.g.*, 76 Fed. Reg. 312886, *et seq.* (June 7, 2011).

higher truck operating costs, reduced truck reliability, and lower truck fuel economy performance. Consequently, EPA's mandates resulted in significant and costly marketplace disruptions and reduced regulatory benefits. Notably, dealers are beginning to see instances of emissions tampering in their shops and on their used truck lots, suggesting how aggressive mandates also may not achieve desired benefits.

Unless mandated by statute, EPA should avoid promulgating mandates many years in advance covering long time periods as doing so necessarily involves uncertainty regarding key factors influencing the cost and performance of compliance strategies and technologies.