Comments Regarding the Repeal of Emission Requirements for Glider Vehicles, Glider Engines, and Glider Kits

Referencing docket ID number:
EPA-HQ-OAR-2014-0827

Prepared on behalf of:
Union of Concerned Scientists

by David W. Cooke, Ph.D.

Introduction

Glider vehicles have existed for decades, with historical production levels of a few hundred per year prior to 2010, and served to extend the life of the powertrain in a chassis that had a catastrophic failure. However, after the finalization of the most recent rounds of criteria pollution control regulations, a cottage industry sprang up to support the circumvention of these regulations by refurbishing old, polluting powertrains, and assembling them into brand new glider kits, selling the resulting glider vehicle as a new truck. Instead of producing a few hundred per year, the number such new trucks has grown to over 10,000 glider vehicles produced annually (Moulis 2017), with massive amounts of additional pollution the result.

In the Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2 regulation that was finalized in 2016, EPA appropriately closed this loophole. The findings supporting that rule showed clearly that glider vehicles are dangerous to public health and the environment, emitting more than 400,000 tons of excess nitrogen oxides and nearly 7,000 tons of excess particulate matter over the lifetime of every production year of glider vehicles at today's levels, resulting in up to 1600 premature deaths for every production year from the excess soot alone (EPA 2016a, Section 14 Appendix A). More recent data shows that this is likely an underestimate of the impact of these vehicles.

We urge EPA not to repeal this provision. These additional deaths should be seen as a lower bound—EPA will open the floodgates for manufacturers to ignore pollution restrictions under its proposed, misguided interpretation its authority under the Clean Air Act. Moreover, its own analysis shows that a number of claims made by supporters of the repeal are baseless, with the potential environmental ramifications even worse than suspected.

EPA must uphold its authority under the Clean Air Act to protect public health and the environment from these dangerous vehicles. The loophole should be phased out as intended under the finalized Phase 2 rule. To support this conclusion, we have responded to EPA's requests regarding safety, fleet turnover, the environmental impacts of repealing this provision of the Phase 2 regulations, and anticipated purchasing behavior.

Glider vehicles and safety

In its proposal, EPA asserts that glider vehicles are equipped with up-to-date safety features, citing comments submitted in the Phase 2 rulemaking docket. However, this is inaccurate, as glider vehicles are afforded a number of exemptions to safety regulations:

- An exemption to requirements for electronic logging devices (ELDs) exists for vehicles which were manufactured before the year 2000, when electronic engine controls were less common. However, this exemption is based on the model year of the engine, not the chassis, so brand-new glider vehicles are exempted from this requirement even though the engines like the Detroit Diesel 60 Series (DD60) installed in these vehicles are capable of satisfying the ELD mandate and other similar new vehicles are not exempted. This ELD regulation is designed to help enforce hours-of-service limits for truck drivers, which protects the safety of anyone with which they may be sharing the road. ELDs also provide protection for truck drivers from their employers, ensuring adequate logs to verify claims of harassment.
- Under 49 C.F.R. § 571.7(e), if the engine, transmission, or axles installed in a truck are not new and at least two components are from the same donor vehicle, then the assembler is not required to comply with the Safety Act. This "glider exemption" has broad ramifications—for example, glider vehicles are exempt from recent requirements for Electronic Stability Control (FMVSS 136), a rule which promised to "prevent 40 to 56 percent of untripped rollover crashes and 14 percent of loss-of-control crashes," avoiding hundreds of injuries and tens of fatalities ***every year*** (NHTSA 2015).
- Glider vehicles will be exempt from standards for emerging technologies, putting in jeopardy not just American roadway safety but leadership in vehicle manufacturing. Safety technologies which could be

left off future glider vehicles include automatic emergency braking, now required in Europe on most new heavy-duty vehicles;[1] lane departure warning and lane-keeping assist, which can aid in accident prevention (IIHS 2017); and Vehicle-to-Vehicle communication, which can further improve safety in situations where sensor- and camera-based technologies may fail.

These exemptions are even acknowledged by a glider builder in comments to the docket (Hopkins 2017), leading to reduced costs to the glider purchaser, but at what cost to the public? Because of the breadth of glider vehicles' exemption from NHTSA's safety regulations, it is difficult to assess why EPA believes that glider vehicles are equipped with "up-to-date safety features." We are additionally concerned about what these exemptions could mean for the future deployment of safety features in the truck fleet.

Heavy-duty truck fleet turnover

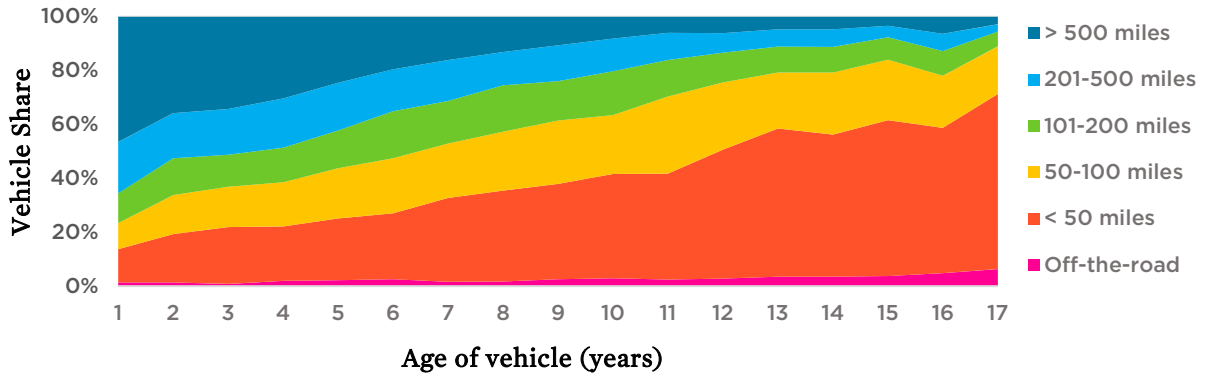
EPA has requested comment on whether limiting the availability of glider vehicles could result in "older, less safe, more-polluting trucks" remaining on the road longer. There is limited data available on truck populations; however, what data there is points to gliders ***increasing*** the population of older, more-polluting trucks, not decreasing it.

VEHICLE LIFETIME MILEAGE

The Vehicle Inventory and Use Survey (VIUS) provides the most comprehensive look at on-road truck data (US Census Bureau 2004). Unfortunately, because of funding issues, the most recent available dataset is from 2002, meaning that each and every truck in the database is at least as heavily polluting as the glider vehicles at issue. However, the outdated data still belies a significant amount of information about how trucks are used in the freight industry.

The "pre-emission" engines used in glider vehicles are generally 1998 to 2003 engines, since manufacturers were required under the consent decree to pull forward to the 2004 model year production of

FIGURE 1. Primary Range of Operation for Heavy-duty Tractors as the Vehicles Age



Tractor trucks have a significantly different pattern of use over the vehicle lifetime, moving on average from nearly 100,000 miles traveled annually when brand new to as little as 12,000 by the end of its life.

SOURCE: US CENSUS BUREAU 2004

[1] E.g., "Today, automatically intervening emergency braking assistants are mandatory for newly registered heavy-duty trucks in the EU," quoted in Daimler 2016.

engines which would meet the 2007 standards. At the time of the last VIUS, these vehicles already represented 40 percent of the tractor fleet. Moreover, as is true in the model of the industry, these vehicles drove a higher fraction of the total freight miles (60 percent), due to significantly higher annual vehicle miles traveled (VMT), 75,000 miles compared to 31,000 annual miles for the older trucks.

This has grave implications for the way in which gliders are used today—they are essentially giving new life to older engines which are barely in service, nearly quintupling the pollution generated by these engines overnight through increased use. A fifteen year-old-truck in the VIUS database averaged just 21,600 miles per year; a truck in the first two years of its life averaged nearly five times that distance, 98,800 miles. The reason for this is that new trucks do not replace the oldest trucks in the fleet—instead, the largest line haul companies purchase new trucks every few years, selling off the 3- or 4-year-old trucks on the secondary market (e.g., Fresh 2017). Those trucks then find new life in regional haul operations (e.g., Anonymous 2017a). This is clear in the VIUS data (Figure 1)—for vehicles less than two years old, 59 percent of tractor had a primary range greater than 200 miles, while for the fifteen-year-old trucks this number was just 8 percent. This is further confirmed in comments to the docket from members of the trucking industry, including both supporters of the repeal[2] and those who oppose it,[3] both of whom note that trucking companies are choosing to purchase glider vehicles instead of new vehicles.

ESTIMATING FLEET TURNOVER

The most widely cited data on heavy-duty truck scrappage comes from the Transportation Energy Data Book (Table 3.14 in TEDB36).[4] This indicates that the median lifetime of a truck is more than 18 years, showing the slowness of fleet turnover. However, combining this with the mileage schedule of the VIUS shows that while the expected statistical lifetime mileage of the average tractor would be 865,000 miles, it would cover more than half of those miles within the first five years of operation, again showing the critical importance of emissions from new vehicles.

By applying the TEDB36 rates of scrappage to VIUS, and updating with sales data for the intervening years, we can compare both the fraction of vehicles and share of miles for heavy-duty trucks with different levels of pollution control. Here, we consider them as four separate categories: 1) pre-model year (MY) 1998 engines, which not only lack any pollution controls but also had defeat devices installed; 2) MY1998-2003 engines, so-called "pre-emission engines" which lack pollution controls and are the dominant powertrain being installed in glider vehicles; 3) MY2004-2009 engines, which have some level of pollution control but fall into a phase-in period for more stringent particulate matter (PM) and nitrogen oxides (NO_x) standards; and 4) MY2010+ engines, which meet the current federal standards for PM and NO_x.

Thus far, glider sales have resulted in shifting 1.4 percent of the truck population and 2.5 percent of vehicle miles traveled to vehicles powered by MY1998-2003 engines (Table 1). While this may not represent a drastic number relative to the total share of vehicles, these older engines already contribute a disproportionate share of vehicle pollution (see section on environmental impacts). Furthermore, these are vehicles that are naturally supposed to be scrapped as part of the standard fleet turnover—glider sales since 2007 have reset the clock on 9 percent of the more heavily polluting vehicles which should have been retired. On an annual basis, this

---

[2] Docketed correspondence includes Anonymous 2017b, 2017c, 2017e, 2017f, 2017h, 2017j, 2017k; Bagshaw 2017; Erickson 2017; Freeport Transport Industries 2017; Fresh 2017; Shippee 2017; Smith 2017.

[3] Docketed correspondence includes Bass 2017; Berry 2016; Cole 2017; Cunningham 2017; Deason 2017; Dotson 2015, 2017a, 2017b; Ferguson 2017; Keck 2017; Maddox 2017; McCoy 2015; McCullough 2017; Myers 2017; Neace et al. 2017; Neitzke 2015, 2017; Niebauer 2017; Nuss 2015, 2017; Parker 2017; Spalding 2017; Wagner 2017; Watson 2017; and Watt 2017.

[4] Though multiple model years are given in the report (1970, 1980, and 1990), we concur with EPA's analysis in support of its MOtor Vehicle Emission Simulator (MOVES) that the appropriate scrappage rates are those for the 1980 model year due to its consistency with the VIUS data. The statistical lifetime miles traveled using the 1990 rates would increase by less than 20 percent, and a truck would travel half of its statistically likely lifetime mileage within the first six years of its life instead of five, which is not a substantive difference in this discussion.

year's glider sales of approximately 10,000 represent a resurrection rate of more than one quarter of the MY1998-2003 vehicles which would have otherwise been scrapped and replaced with newer vehicles with stronger pollution protections.

Looking further into the future, if we assume vehicle sales equivalent to the average of the past five years and glider sales of 10,000, the number of vehicles powered by MY1998-2003 engines will actually ***increase*** over time, and with it a commensurate increase in their share of vehicle miles traveled. This creates a significant drag on the reduction in emissions from the trucking fleet over time—in fact, this simple fleet model results in a net ***increase*** in soot over time as a result, despite the fact that glider vehicles would continue to represent just a small share of new vehicles sold. This becomes even more problematic if the glider industry continues to grow as a result of the loophole remaining open. In fact, if glider sales were to simply double by 2025 (consistent with the

TABLE 1. Estimate of turnover-related emissions with and without glider vehicle sales

Without glider loophole

Engine year	2017				2025			
	% truck pop.	% truck VMT	Emissions (grams/mile)		% truck pop.	% truck VMT	Emissions (grams/mile)	
			NOx	PM			NOx	PM
< 1998	15.4%	3.7%	8.0	0.10	5.1%	1.2%	8.0	0.10
1998-2003	16.6%	5.2%	6.0	0.10	7.3%	1.8%	6.0	0.10
2004-2009	24.1%	16.0%	2.0	0.01	12.9%	3.1%	2.0	0.01
≥ 2010	43.9%	75.1%	0.2	0.01	74.8%	93.9%	0.2	0.01
Average:			**1.1**	**0.02**			**0.5**	**0.01**

With glider loophole

Engine year	2017				2025 (steady glider production)				2025 (increasing production)			
	% truck pop.	% truck VMT	Emissions (grams/mile)		% truck pop.	% truck VMT	Emissions (grams/mile)		% truck pop.	% truck VMT	Emissions (grams/mile)	
			NOx	PM			NOx	PM			NOx	PM
< 1998	15.4%	3.7%	8.0	0.10	5.1%	1.2%	8.0	0.10	5.1%	1.2%	8.0	0.10
1998-2003	18.0%	7.7%	6.0	0.10	18.7%	8.8%	6.0	0.10	23.8%	12.7%	6.0	0.10
2004-2009	24.1%	15.9%	2.0	0.01	12.8%	3.1%	2.0	0.01	12.8%	3.1%	2.0	0.01
≥ 2010	42.5%	72.7%	0.2	0.01	63.4%	86.9%	0.2	0.01	58.3%	83.0%	0.2	0.01
Average:			**1.2**	**0.02**			**0.9**	**0.02**			**1.1**	**0.02**
% increase from loophole:			**13%**	**12%**			**90%**	**50%**			**139%**	**77%**
Glider share of emissions:			**12%**	**11%**			**47%**	**33%**			**58%**	**44%**

Note: Emissions are based on regulatory standard, not on real world values. Pre-1998 engines come from Volvo data (NRC 2010, Figure 4-2); 1998-2003 emissions relate to the consent decree requirements from these engines; the 2004-2009 values indicate a sales-weighted average phase-in of regulatory requirements; and 2010 and later are directly EPA's regulatory requirements.

growth over the past decade), there would also be a net increase in smog-forming pollution from nitrogen oxides emitted by the tractor-trailer fleet because of glider vehicles.

Rather than vehicle turnover resulting in a cleaner, safer fleet, the glider loophole over time leads not just to a dirtier truck fleet relative to what it would be without companies exploiting the loophole—it could actually end up increasing the absolute emissions from the truck fleet. Considering the degree to which states rely upon federal emissions standards for new vehicles to achieve their air quality goals and the significant share of pollution from transportation and ensuing health risk, these glider vehicles represent a major impediment to cleaner air because of the way they impede fleet turnover to new vehicles which actually meet the required emissions standards.

Environmental impact of glider vehicles

EPA has requested comment on whether limiting the availability of glider vehicles could result in "older, less safe, more-polluting trucks" remaining on the road longer. In the previous section, we showed, using industry data, the extent to which the glider vehicle allowance would extend the life of older, more-polluting engines. In this section, we seek to quantify the real-world impacts based on available test data. We focus on the shortcomings and errors in the data provided by industry supporters of the repeal and contrast that with data provided by the agency confirming the hazard these trucks cause. We then comment on how the repeal would negatively impact public health and the environment.

FITZGERALD-TENNESSEE TECH STUDY

Attached to their petition for repeal of the glider provisions in the Phase II HDV rule, Fitzgerald Glider Kits LLC, Harrison Truck Centers Inc., and Indiana Phoenix Inc. included "Exhibit 1", a letter from Philip Oldham and Thomas Brewer of Tennessee Technological University (Tennessee Tech) to Representative Diane Black (2017). The letter includes a scant amount of data provided by Tennessee Tech per tests specifically requested by Fitzgerald Glider Kits LLC and conducted at Fitzgerald's facilities (Militana 2017).

The tests conducted by Tennessee Tech fail many basic, rudimentary protocols that should be applied in any scientific testing procedure. Worse still, Tennessee Tech misrepresented the findings of these shoddily conducted tests. Below is a brief list of the most obvious shortcomings in the study:

- The tests did not follow industry-standard test procedures, using instead upon proprietary procedures from Fitzgerald which do not span the entire operating range of the engine. As such, the results are virtually meaningless and cannot be directly compared to any regulatory standard. Thus, Tennessee Tech cannot possibly justify as it did in "Summary Chart 1" that the engines "met the standard" for carbon monoxide (CO) and particulate matter (PM) because they did not conduct any such test.
- Even under the inadequate test cycle used by the researchers, Tennessee Tech did not quantify in any way the PM content of the engine—as was noted in a conversation with EPA technical staff, Tennessee Tech researchers tried to gauge the PM content ***by eye*** (EPA 2017a). Clearly, simply looking at whether a filter is dirty or not is an inadequate method of testing for PM, but even with this completely subject, unquantifiable measure it is perplexing that they did not observe any soot considering the clear results of EPA's own tests (Figure 9, EPA 2017b).
- Tennessee Tech researchers ran an unspecified 5-minute vehicle warm-up procedure. The standard industry test procedure is a 20-minute warm-up, and the required "cold start" Urban Duty Dynamometer Schedule (UDDS) cycle on which the standards are based[5] is 20 minutes long and does not raise the temperature of the selective catalyst reduction (SCR) system until full operating condition until about 10

[5] Criteria emissions for heavy-duty vehicles are set on an engine cycle, the Heavy-duty Engine Federal Test Procedure (HD FTP); however, the HD FTP is an engine test based on the HD UDDS vehicle cycle.

minutes (e.g.; Figure 17, Gosala et al. 2017). Though the warm-up procedure was unspecified, it is highly probable that it was inadequate to ensure that the modern engines tested were behaving under "hot start" conditions with the diesel emissions reduction system operating at full capacity. By following Fitzgerald's prescribed proprietary test procedure, Tennessee Tech ensured that Fitzgerald's glider engines would behave more favorably relative to a modern engine than would be captured under the more realistic conditions of the regulatory test cycles.

- Researchers did not duplicate any testing to ensure reproducibility of their results or methods. This is especially problematic given the fact that they were not using industry or regulatory standard protocols.
- The Tennessee Tech researchers used test procedures and data disclosure which are weighted not towards examining the critical pollutants at issue but towards pollutants for which the glider engines were designed to limit. PM and NO_x are the pollutants addressed under EPA's most recent heavy-duty vehicle emissions standards—as such, a well-designed test would focus on accurately assessing the differences in these two pollutants compared to a modern engine. In the case of PM, it has already been described that they did not quantitatively measure PM from the engines. With respect to NO_x, though the researchers noted that none of the engines met the standard, they did not disclose the data upon which they based this conclusion (although as was also already mentioned, their test procedures were inadequate for an apples-to-apples comparison anyway). The only quantitative data provided by Tennessee Tech were the results for CO emissions—the federal standard for CO has remained unchanged since 1988,[6] which means that the engines used in glider vehicles were required to achieve the same level as today's standards when produced. This is not the case for PM and NO_x, which is clearly indicated in EPA's own testing.
- Data was collected only at 10 second intervals, which means that researchers did not bother examining any emissions during transient operation. As was indicated in EPA's own emissions tests, transient operation is a highly polluting operating condition. The importance of transient operation is readily apparent in EPA's own glider tests, as will be discussed below.

The Tennessee Tech research is fundamentally inadequate—it lacks basic scientific rigor and reproducibility, and utilizing Fitzgerald's proprietary test procedures not only precludes comparison with regulatory standards but also results in a biased process favorable to the more polluting engines found in gliders.

EPA GLIDER VEHICLE TESTING

The Environmental Protection Agency is well-suited towards conducting vehicle tests, with ample facilities and capable technical staff, not to mention a much deeper understanding of the regulatory standards and test cycles. As such, the tests conducted by technical staff on two glider vehicles do not suffer the same lack of scientific rigor that the Tennessee Tech study showed.

The results of EPA's tests confirm that these glider vehicles are as dirty as one would expect, yielding emissions profiles consistent with 1998-2003 engines (EPA 2017b). In fact, as will be discussed below, the data collected indicates that Fitzgerald's modifications to these engines may be causing emissions in excess of those which the engines would have had when originally manufactured, leading to even greater pollution than originally anticipated by EPA regulators in the Phase II regulatory process.

Particulate emissions testing. In contrast to the Tennessee Tech researchers, EPA staff controlled the mass flow rate of the exhaust rather than merely estimating it, ensuring a more accurate sampling of the data. EPA researchers also repeated its testing for all vehicles to ensure reproducibility. However, most notable was the fact that the standard test settings the agency had previously used on modern heavy-duty vehicles resulted in an error initially due the overwhelming amount of PM pollution created by the glider vehicles—upon initial testing, the

[6] Technically, the standard for CO has remained the same since 1985, 15.5 g/bhp-hr. However, in 1988 EPA also required an additional limit on idling emissions of CO, 0.5 percent exhaust gas flow.

vehicles saturated the PM sensors, causing the system to turn off to avoid damage. EPA staff was forced to reduce the exhaust flow to the measurement apparatus by more than six-fold just to be able to measure the quantity of PM without damaging the device. Figure 9 in the EPA report clearly depict an incredibly large quantity of PM emissions—that Tennessee Tech researchers were unable to observe any amount of PM emissions illustrates a massive deficiency in their process considering the data put forward by EPA.

Glider vehicle non-compliance with emissions standards. EPA applied standard engine test protocols to the glider vehicles in order to demonstrate their compliance (or lack there-of) with regulatory standards. Utilizing the chassis dynamometer, EPA was able to run the engine installed in the glider vehicles through the two standard engine tests: FTP and Supplemental Emission Test (SET). The SET represents a steady-state test cycle—the engine is run through a pattern of loads and engine speeds, and the cycle is weighted to represent an estimate of real world emissions. As noted above the FTP was based on the HD UDDS cycle, so EPA could simply run the vehicle through the HD UDDS test under both cold-start and hot-start operation to reproduce the FTP emissions test conditions. EPA measured the power output from the dynamometer and corrected for the tire and driveline losses. The maximum torque and power are consistent with the DD60 engine installed in the vehicle.[7]

The engines installed in the glider vehicles obtained by EPA (and the vast majority of glider vehicle engines, generally) were part of a series of consent decrees with engine manufacturers following industrywide installation of defeat devices to cheat on emissions tests. In addition to the federal emissions requirements for the FTP cycle (which were given a few allowable exemptions), DD60 truck engines manufactured in the 1998-2002 timeframe were required to achieve a 6.0 g/bhp-hr NOx standard on the SET cycle[8] and maintain a 7.0 g/bhp-hr "not to exceed" (NTE) value (Finding 19, U.S District Court for the District of Columbia 1998). The NTE zone includes 9 data points measured by EPA (A100, A75, A50, B100, B75, B50, C100, C75, and C50).

Tables 12, 13, and 15 in the EPA report show glider vehicle emissions which can be compared with federal standards. To compare to the federal limits over the FTP, the cold UDDS and hot UDDS results in Tables 12 and 13

TABLE 2. EPA glider vehicle test results compared with regulatory standards

	NOx		NMHC		CO		PM	
FTP results	Ave.	Std.	Ave.	Std.	Ave.	Std.	Ave.	Std.
Glider 1 (60,000 lbs.)	6.2	4.0	0.13	1.30	3.3	15.5	0.17	0.10
Glider 1 (80,000 lbs.)	5.7	4.0	0.09	1.30	3.1	15.5	0.22	0.10
Glider 2 (60,000 lbs.)	7.1	4.0	0.12	1.30	3.2	15.5	0.11	0.10
Glider 2 (80,000 lbs.)	6.6	4.0	0.02	1.30	3.0	15.5	0.09	0.10
SET results	Ave.	Std.	Ave.	Std.	Ave.	Std.	Ave.	Std.
Glider 2 (80,000 lbs.)	6.7	6.0	0.05	1.30	0.6	15.5	0.03	0.10

NTE results	Max	Std.
Glider 2 (80,000 lbs.)	7.4	7.0

Note: Red indicates fails requirement; green indicates meets requirement; yellow indicates within measurement error of failing requirement.

[7] For example, see Fitzgerald's marketing materials (Fitzgerald Glider Kits 2017), indicating a maximum torque of 1650 ft.-lbs. (2240 Nm) and maximum power of 500 hp (achieved from approximately 1400 to 1800 rpm).
[8] The European test protocol for the Euro3 test standard required under the consent decree (European Stationary Cycle, or ESC) is essentially identical to the SET used by EPA.

are combined with a 1:6 weighting, as in the federal procedure. Table 15 appropriately weighs the pollutants according to the defined SET weighting. Only the 9 datapoints which overlap both the SET and NTE zone can be compared to the NTE requirements.

Table 2 shows that glider vehicles exceed regulatory requirements for 1998-2002 engines under nearly all test conditions for PM and NO_x, the chief pollutants of issue—not only do these vehicles pollute more than modern tractor-trailers, but they also pollute more than would have been allowed when the engine was originally manufactured. Glider vehicles are only able to meet 1998-2002 standards for non-methane hydrocarbons (NMHC) and CO, which had not been updated since 1985 and are not a significant source of heavy-duty vehicle pollution.

The difference between the SET and FTP results for PM are reflective of the steady-state nature of the SET test rather than an indication that the vehicle would adequately control pollution. The SET cycle does not capture the transient operation and ensuing poor air-fuel mixture combustion control present in older engines which results in excessive real-world pollution.

That glider vehicles exceed the standards under which the engines were originally built is possibly related to glider vehicle assemblers like Fitzgerald selling customers a proprietary engine tuning package. For instance, the DD60 is available from Fitzgerald in an "in-house reman" configuration designed for improved fuel economy.[9] It is likely that as the engine is tuned towards fuel economy, it is done so at the expense of increasing the emissions of NO_x (Figure 3, Cooke 2015).

GREENHOUSE GAS EMISSIONS AND FUEL ECONOMY

In oral and written testimony to the agency, a number of supporters have expressed the opinion that glider vehicles provide greenhouse gas emissions benefits. However, this claim ignores industry's improvements in engine efficiency since these older, polluting engines were first manufactured, and it overstates the potential lifecycle benefits of remanufacturing.

Downstream emissions from fuel use. Supporters of the repeal of the glider vehicle provisions often cite increased fuel economy as a reason why glider vehicles are desirable. However, this claim ignores the heavy-duty vehicle greenhouse gas emissions and fuel economy standards which began in 2014.

Diesel emissions control systems deployed to meet the criteria emissions standards which glider vehicles circumvent did initially result in a decrease in fuel economy (Figure 4-2, NRC 2010); however, numerous improvements have since been made to the SCR+DPF systems to diminish the overall fuel consumption of these EPA2010-compliant engines (p. 2-4, NRC 2014). Furthermore, heavy-duty engine fuel consumption and greenhouse gas emissions standards are driving further improvements.

As part of its chassis testing of glider kits, EPA measured the fuel consumption and greenhouse gas emissions of glider vehicles as well as comparable modern vehicles, one from the 2014 model year (MY) and another from MY2015. Because only hot-start transient data was provided for the MY2014 vehicle, we will focus on the MY2015 results. To compare the test cycle results for the tested vehicles to real-world operation, we utilize the same weighting of the transient and steady-state highway tests as is used in the Phase 2 standards—the standards for a Class 8 sleeper cab are weighted 95 percent towards highway steady-state operation, with just 5 percent transient operation. We further utilize the 1:6 ratio of cold- to hot-start transient operation to make up that 5 percent of operation. In this way, it is possible to use the CO_2 emissions data provided in Figure 18 to estimate the difference in fuel consumption glider vehicles would achieve on the regulatory test cycle compared to the MY2015 vehicle.

A comparison of the data for the MY2015 truck to the two glider vehicles results in a fuel consumption benefit for the glider vehicles of 8 to 10 percent. The Cummins ISX15-600 engine found in the MY2015 truck is

[9] Tommy Fitzgerald, Jr.: "We set the engine up to where it can be more efficient. Fuel economy benefits are achieved through special programming of the engine's electronic module and from the external and internal parts used in the engine rebuilding process." Quoted in Jaillet, J. 2014.

certified to achieve 1 percent higher greenhouse gas emissions than the 2017 engine standard (CARB 2016). Therefore, we can estimate from this data that glider vehicle powertrains are as much as 7 to 9 percent more fuel-efficient than the average 2017 Phase 1 engine. This is likely an overestimate of the efficiency of these engines—data provided by Volvo shows a brake-specific fuel consumption of 440 g CO2/bhp-hr for a "pre-emissions" engine (Figure 4-2, NRC 2010), and 2017 model year engines are required to meet a 460 g CO2/bhp-hr standard on the same test cycle, thus yielding just a 4.3 percent improvement for the pre-emissions engine over an average 2017 engine.

Comparing this current advantage to where the industry is headed makes clear just how quickly any possible short-term fuel economy advantage for glider vehicles disappear. For comparison, the Phase 2 standards would lead to a 6.4 percent reduction in fuel consumption for sleeper cabs from the engine alone (p. 2-132, EPA 2016b), while downspeeding by altering the final drive ratio yields another 3.8 percent[10] because of the shift in modern diesel powertrain design to lower and lower speed, something of which the much older glider engines will not be able to take advantage. This is consistent with industry expectations: the largest heavy-duty engine manufacturer (Cummins) sees up to 15 percent improvement possible for tractor engines during the Phase 2 rule (Table 1, Mormino 2015).

It is clear within the timeframe of the Phase 2 rule that the ***average*** fuel consumption improvement of tractor engines will well exceed any current benefit which glider vehicles may provide today. Therefore, not only does increasing the lifetime of these engines result in additional criteria emissions which result in reduced air quality and adverse public health impacts, but it also results in additional greenhouse gas emissions and fuel consumption by forestalling the deployment of more efficient Phase 2 engines, in direct contrast to the intentions of the Phase 2 regulations.

Upstream emissions from manufacturing. Supporters have claimed that there is a clear greenhouse gas emissions benefit from remanufacturing, with one testifier even suggesting that everyone should buy a glider to recycle (Clark 2017); however, this severely overstates the share of lifecycle emissions associated with the manufacture of heavy-duty vehicles.

Utilizing the latest version of GREET2 (ANL 2017), it is possible to estimate the manufacturing emissions associated with a tractor. Sizing the relative share of powertrain, drivetrain, chassis, truck body, wheels, and accessories according to NRC 2010, as well as adjusting the weights of the fossil fuel derived tires and lubricants, and using EPA's standard tare weight of 19,000 pounds for a tractor yields total vehicle cycle emissions (which includes manufacture, maintenance, and end-of-life) of 40 metric tons CO_2-equivalent. This estimate is also equal to scaling the heavy-duty vehicle cycle emissions per weight in the GHGenius lifecycle emissions model ($(S\&T)^2$ Consultants 2013) to 19,000 pounds, affirming the reasonableness of this approach.

The vast majority of these emissions would remain unchanged for a glider vehicle—emissions associated with the maintenance of lubricants and tires will remain constant, a new body is still manufactured, etc. However, there is some small benefit associated with not having to recast the engine, along with utilizing refurbished transmission and axle—Fitzgerald cited an 85 percent reduction in energy, and this is consistent with the GREET2 model's share of emissions associated with machining a cast-iron part compared with the part's total emissions. However, even applying an 85 percent reduction to all emissions associated with the manufacture of the powertrain and transmission would yield a benefit of just 7.8 metric tons.

The amount of emissions avoided by remanufacturing the engine are equivalent to the refining, distribution, and combustion of just over 600 gallons of diesel fuel—that's just a couple weeks' worth of fuel use for the average trucker and amounts to ***less than 1 percent of the vehicle's expected total lifecycle emissions***. And, because there is a fuel consumption and emissions disbenefit from these engines over the lifetime of the Phase II rule, as outlined above, these vehicles would still on net be higher emitters of greenhouse gas emissions over the total vehicle lifecycle than the other new tractors covered in the rule.

[10] Based on a reduction in final drive ratio from 2.7 to 2.31 (Figure 2-28 and Table 2-32, EPA 2016b).

It is simply not credible to suggest that there is a significant emissions benefit to the remanufacture of these engines. Furthermore, given the extremely low share of total vehicle emissions relating to the manufacture of these vehicles, particularly compared with fuel usage, we urge EPA to continue to focus on emissions benefits which are direct and verifiable.

PUBLIC HEALTH IMPACTS OF EXCESS EMISSIONS

These vehicles will result in severe health consequences for affected communities, ranging from more asthma attacks to premature deaths. Diesel exhaust has been recognized as being carcinogenic by the World Health Organization's Agency for Research on Cancer (WHO 2012). NO_x is the primary ingredient in smog and is known to cause asthma attacks and cardiovascular harm. Particulate matter also contributes to asthma attacks and is linked to heart attacks, strokes, lung cancer, and premature deaths.

EPA estimated in its initial rule that the amount of pollution from gliders sold each year would cause up to 1,600 premature deaths annually (EPA 2016a). Based on the analysis in the previous section, this should be seen as a conservative estimate—chassis data show that these vehicles pollute even more than when the engine was new, and this previous estimate is based on glider sales plateauing instead of continuing on their current upward trajectory and doesn't take deaths from NOx pollution into account (Moulis 2017). Our estimates in Table 1 indicate that despite rules in place designed to ratchet down these harmful emissions to protect human health and welfare, the glider loophole is creating a pathway which would lead to increasing emissions from the truck fleet. The largest assemblers of dirty glider trucks exploited an oversight of regulation for many years and are now fighting to allow unlimited numbers of these deadly polluters on the roads forever. Even in this proposed rulemaking, EPA acknowledged that this action would put children's health at risk (Federal Register 82 (220), p. 53448).

The health impacts of this pollution are not equally distributed. Residents of low-income communities and communities of color are more likely to live near busy roads and freight hubs, where exposure to pollution from heavy-duty vehicles and freight is greater (Hricko et al. 2014, Houston et al. 2014). Working, living, playing, and exercising near busy roads has been found to increase the risk of health impacts—19 percent of Americans live near a busy road, but that number increases to 27 percent for people of color (Rowangould 2013). Additionally, the median income near busy roads is roughly 10 percent below the local average, or 20 percent lower for people of color.

Implementation of the 2007 and 2010 emissions standards for heavy-duty trucks has helped to decrease health risks for the most vulnerable populations after more than a decade of little progress (Propper et al. 2015). The continued sale of glider vehicles puts this progress in jeopardy.

This proposal to continue to allow unfettered sales of heavily polluting glider vehicles puts our most vulnerable citizens at further risk and goes directly against the mandate of the EPA to protect the health and welfare of Americans.

Economic impacts to small businesses

As part of the extensive stakeholder engagement which resulted in the HDV Phase 2 regulations, EPA created a small-business advocacy review panel, which solicited input from glider vehicle assemblers, among others. The provisions for glider vehicles at issue were the result of this extensive process.

The central focus to date has been on the economic impacts this provision may have on glider manufacturers. However, one of the petitioners (Indiana-Phoenix) reported that the Phase II regulations would result in an ***increase*** in jobs due to the need to hire additional employees to ensure compliance (p. B7, EPA 2015). Another petitioner (Fitzgerald) has noted that they are set up to be profitable under a 300-vehicle cap (Berg 2013). Therefore, it is not clear why there is such concern about these few particular businesses.

EPA's own economic analysis has noted that the potential small business impacts for repealing the glider provision rightly extend beyond glider assemblers themselves. Glider vehicle sales have taken away from new

vehicle sales. This significantly affects dealerships who have invested in the sale and service of vehicles which abide by pollution regulations, as has been heavily docketed (see footnote 3). New vehicle dealerships cite losses in sales in recent years ranging from 10 to 30 percent due to having to compete with glider vehicle dealers who ignore IRS and EPA regulations on new vehicles in order to provide heavily polluting vehicles at a deep discount relative to new vehicles. Moreover, these losses in new vehicle sales also mean a loss in jobs not just within the dealership but also servicing new vehicles. Such jobs require a higher degree of training owing to the complexity of a modern diesel engine, and that means better pay. Turning back the clock and increasing the lifetime of less complex engines means a workforce less capable of working on modern diesel engines which have long since evolved past the low-tech engines being put into glider vehicles. Moreover, such engines are frequently serviced "in-house," which means that there is not, in fact, dedicated service personnel, further ***reducing*** the number of job opportunities in the truck sector.

Some small truck companies have commented in support of the repeal, claiming that the sale of glider vehicles has allowed them to lower operating costs. However, this ignores the cost to the American people due to the pollution generated by these trucks and, in turn, the truckers operating them. In fact, numerous supporters of repeal have explicitly stated that the reason they purchased glider vehicles is simply to avoid pollution controls, even noting minimal differences in fuel economy (e.g., Anonymous 2017d, 2017g, 2017h, 2017i, Fresh 2017). Pollution control in this sector is currently internalized in the market by ensuring fair upfront costs to all new vehicles. Clearly plenty of trucking companies do not need to resort to excessively polluting our highways in order to provide American consumers with their goods—there's no reason to subsidize inefficient businesses seeking to externalize the costs of doing business. Trucking companies bid for freight against each other—if some trucking businesses are struggling to compete, that is not a problem with the trucks but the business model of those failing companies.

Summary

EPA must not repeal the glider vehicle provisions finalized in the HDV Phase 2 regulations because:

- Glider vehicles extend the lifetime of highly polluting engines which would otherwise naturally be replaced in the market with cleaner-burning diesel engines;
- Tests of these glider vehicles indicate that not only do these vehicles fail modern pollution standards, but that they are likely being modified by glider vehicle assemblers to pollute even more than when they were first manufactured;
- The excess pollution of nitrogen oxides and particulate matter from glider could cause emissions from the trucking sector to grow, even as regulatory standards on other new vehicles should result in dramatic reductions over time;
- This increased pollution will result in thousands of premature deaths and other adverse public health impacts, with low-income communities and communities of color being disproportionately affected;
- Glider vehicles will also result in increased fuel use and increased greenhouse gas emissions compared to the other new vehicles covered by the Phase 2 regulation;
- This repeal would benefit a small subset of companies who have invested in antiquated technology while creating an unfair market, slowing the creation of more advanced, skilled jobs and undermining American workers.

EPA has an opportunity to put heavy-duty trucks on a more sustainable path by maintaining the Phase 2 regulations as finalized. If the agency moves forward with the repeal, they will be ignoring their legal obligation to protect public health while simultaneously undermining an industry that has spent billions of dollars to reduce the environmental and health impacts of American consumerism.

References

(S&T)[2] Consultants. GHGenius 4.03: A model for lifecycle assessment of transportation fuels. Online at ***https://ghgenius.ca/downloads.php***.

Anonymous. 2017a. Anonymous public comment received on December 12, 2017. EPA-HQ-OAR-2014-0827-2475.

Anonymous. 2017b. Anonymous public comment received on December 13, 2017. EPA-HQ-OAR-2014-0827-2546.

Anonymous. 2017c. Anonymous public comment received on December 13, 2017. EPA-HQ-OAR-2014-0827-2552.

Anonymous. 2017d. Anonymous public comment received on December 13, 2017. EPA-HQ-OAR-2014-0827-2560.

Anonymous. 2017e. Anonymous public comment received on December 13, 2017. EPA-HQ-OAR-2014-0827-2564.

Anonymous. 2017f. Anonymous public comment received on December 13, 2017. EPA-HQ-OAR-2014-0827-2565.

Anonymous. 2017g. Anonymous public comment received on December 15, 2017. EPA-HQ-OAR-2014-0827-2589.

Anonymous. 2017h. Anonymous public comment received on December 26, 2017. EPA-HQ-OAR-2014-0827-4265.

Anonymous. 2017i. Anonymous public comment received on December 27, 2017. EPA-HQ-OAR-2014-0827-4481.

Anonymous. 2017j. Anonymous public comment received on December 28, 2017. EPA-HQ-OAR-2014-0827-4491.

Anonymous. 2017k. Anonymous public comment received on December 28, 2017. EPA-HQ-OAR-2014-0827-4493.

Argonne National Laboratory (ANL). 2017. The Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) Model, 2017 release. Online at ***https://greet.es.anl.gov/***.

Bagshaw, G. 2017. Comment submitted on behalf of Bagshaw Trucking. EPA-HQ-OAR-2014-0827-2576.

Bass, D. 2017. Comment submitted on behalf of Shipley Motor Equipment Company. EPA-HQ-OAR-2014-0827-4611.

Berg, T. 2013. "The Return of the Glider: Sales have been booming, but will the trend continue?" ***Truckinginfo.com.*** Online at ***www.truckinginfo.com/channel/equipment/article/story/2013/04/the-return-of-the-glider.aspx***.

Berry, S. 2016. Supplemental comments of the Volvo Group concerning glider vehicles. May 26. EPA-HQ-OAR-2014-0827-1966.

Bruckner, C. Letter to EPA Administrator Scott Pruitt, on behalf of Bruckner Truck Sales. EPA-HQ-OAR-2014-0827-2488.

California Air Resources Board (CARB). 2016. Executive order A-021-0642-1. Online at ***www.arb.ca.gov/msprog/onroad/cert/mdehdehdv/2016/cummins_hhdd_a0210642r1_14d9_0d20-0d01.pdf.***

Clark, F.D. 2017. Oral testimony during public hearing on the repeal of emission requirements for glider vehicles, glider engines, and glider kits. Transcript not available, but written testimony docketed at EPA-HQ-OAR-2014-0827-4281.

Cole, C. 2017. Letter to EPA Administrator Scott Pruitt, on behalf of Bruckner Truck Sales, Shreveport, Louisiana. EPA-HQ-OAR-2014-0827-4382.

Cooke, D.W. 2015. Comments concerning greenhouse gas emissions standards and fuel efficiency standards for medium- and heavy-duty engines and vehicles (Phase 2). EPA-HQ-OAR-2014-0827-1329.

Cunningham, R. 2017. Letter to EPA Administrator Scott Pruitt, on behalf of Worldwide Equipment, Inc. EPA-HQ-OAR-2014-0827-2398.

Daimler. 2016. Mercedes-Benz Trucks: Safety: New assistance systems: Active Brake Assist 4 emergency: braking assistant featuring pedestrian recognition and: Sideguard Assist. June 17. Online at ***http://media.daimler.com/marsMediaSite/en/instance/ko.xhtml?oid=12367326.***

Deason, J. 2017. Letter to EPA Administrator Scott Pruitt, on behalf of Brucker Truck Sales, Wichita Fall, Texas. EPA-HQ-OAR-2014-0827-4386.

Dotson, J. 2017a. Letter to EPA Administrator Scott Pruitt, Senator Mitch McConnell, and Congressman Andy Barr, on behalf of Worldwide Equipment Enterprises, Inc.-Lexington. EPA-HQ-OAR-2014-0827-2399.

Dotson, T.L. 2015. Comments to greenhouse gas emissions and fuel efficiency standards for medium- and heavy-duty engines and vehicles—Phase 2, on behalf of Worldwide Equipment Enterprises, Inc. EPA-HQ-OAR-2014-0827-0948.

Dotson, T.L. 2017b. Letter to EPA Administrator Scott Pruitt, on behalf of Worldwide Equipment Enterprises, Inc. EPA-HQ-OAR-2014-0827-2385.

Environmental Protection Agency (EPA). 2015. Final report of the Small Business Advocacy Review panel for the greenhouse gas emissions and fuel efficiency standards for medium- and heavy-duty engines and vehicles—Phase 2. Submitted to EPA Administrator Gina McCarthy, January 15. EPA-HQ-OAR-2014-0827-0149.

Environmental Protection Agency (EPA). 2016a. Response to Comments for Joint Rulemaking, Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2, EPA-420-R-16-901, p. 1964.

Environmental Protection Agency (EPA). 2016b. Greenhouse gas emissions and fuel efficiency standards for medium- and heavy-duty engines and vehicles—Phase 2: Regulatory impact analysis. EPA-420-R-16-900.

Environmental Protection Agency (EPA). 2017a. EPA Tennessee Tech Glider Emissions Testing Discussion 11072017. EPA-HQ-OAR-2014-0827-2416.

Environmental Protection Agency (EPA). 2017b. Chassis dynamometer test of two recent model year heavy-duty on-highway diesel glider vehicles. EPA-HQ-OAR-2014-0827-2417.

Erickson, D. 2017. Comment to the docket submitted December 13, 2017. EPA-HQ-OAR-2014-0827-2558.

Ferguson, K.D. 2017. Letter to EPA Administrator Scott Pruitt on behalf of Tri-County Truck Center. EPA-HQ-OAR-2014-0827-4471.

Fitzgerald Glider Kits. 2017. Detroit 60 series. Online at ***www.fitzgeraldgliderkits.com/detroit-60-series.***

Freeport Transport Industries. 2017. Letter to EPA received on December 27, 2017. EPA-HQ-OAR-2014-0827-4267.

Fresh, R.K. 2017. Letter to EPA on behalf of WJW Associates, LTD. EPA-HQ-OAR-2014-0827-2459.

Gosala, D.B., A.K. Ramesh, C.M. Allen, M.C. Joshi, A.H. Taylor, M. Van Voorhis, G.M. Shaver, L. Farrell, E. Koeberlein, J. McCarthy Jr., and D. Stretch. 2017. "Diesel engine aftertreatment warm-up through early exhaust valve opening and internal exhaust gas recirculation during idle operation," ***International Journal of Engine Research,*** September 20 (OnlineFirst). DOI: 10.1177/1468087417730240. Online at ***http://dx.doi.org/10.1177/1468087417730240.***

Hopkins, J. 2017. Comment to the docket submitted November 29, 2017. EPA-HQ-OAR-2014-0827-2448.

Houston, D., W. Li, and J. Wu. 2014. Disparities in exposure to automobile and truck traffic and vehicle emissions near the Los Angeles—Long Beach Port Complex. American Journal of Public Health 104(1):156–164. Online at ***http://dx.doi.org/10.2105/AJPH.2012.301120***.

Hricko, A., G. Rowland, S. Eckel, A. Logan, M. Taher, and J. Wilson. 2014. Global trade, local impacts: Lessons from California on health impacts and environmental justice concerns for residents living near freight rail yards. International Journal of Environmental Research and Public Health 11(2):1914–1941. Online at ***http://dx.doi.org/10.3390/ijerph110201914.***

Insurance Institute for Highway Safety (IIHS). 2017. "Lane departure warning, blind spot detection help drivers avoid trouble," ***Status Report*** 52 (6), 1. Aug. 23. Online at ***www.iihs.org/iihs/sr/statusreport/article/52/6/1.***

Jaillet, J. 2014. "Gliders 101: Five common questions about glider kits answered," ***Overdrive***. Online at ***www.overdriveonline.com/gliders-101-five-common-questions-about-glider-kits-answered/.***

Keck, J. 2017. Letter to EPA Administrator Scott Pruitt on behalf of Grande Truck Center. EPA-HQ-OAR-2014-0827-4384.

Maddox, J. 2017. Letter to EPA Administrator Scott Pruitt on behalf of TriState Truck Center. EPA-HQ-OAR-2014-0827-4472.

McCoy, D. 2015. Letter to EPA and NHTSA regarding greenhouse gas emissions and fuel efficiency standards for medium- and heavy-duty engines and vehicles—Phase 2: Extension of comment period, on behalf of Truck Country of Wisconsin. EPA-HQ-OAR-2014-0827-1468.

McCullough, J. 2017. Letter to EPA Administrator Scott Pruitt RE: Opposition to Glider Volume Repeal. EPA-HQ-OAR-2014-0827-4609.

Militana, L. 2017. "TTU involved in Fitzgerald EPA fight," ***Herald-Citizen***, July 16. Online at ***http://herald-citizen.com/stories/ttu-involved-in-fitzgerald-epa-fight,22242***.

Mormino, B. 2015. Comments in response to greenhouse gas emissions and fuel efficiency standards for medium- and heavy-duty engines and vehicles—Phase 2, submitted on behalf of Cummins Inc., October 1. EPA-HQ-OAR-2014-0827-1322.

Moulis, C. 2017. Memo to William Charmley, EPA, November 15. EPA-HQ-OAR-2014-0827-2379.

Myers, J. 2017. Letter to EPA Administrator Scott Pruitt on behalf of Brucker Truck Sales, Tye and San Angelo, Texas. EPA-HQ-OAR-2014-0827-4473.

National Highway Traffic Safety Administration (NHTSA). 2015. FMVSS No. 136: Electronic Stability Control Systems on Heavy Vehicles, Final Regulatory Impact Analysis. NHTSA-2015-0056-0002.

National Research Council (NRC). 2010. Technologies and approaches to reducing the fuel consumption of medium- and heavy-duty vehicles. Online at ***www.nap.edu/catalog/12845/technologies-and-approaches-to-reducing-the-fuel-consumption-of-medium-and-heavy-duty-vehicles.***

National Research Council (NRC). 2014. Reducing the fuel consumption and greenhouse gas emissions of medium- and heavy-duty vehicles, phase two: First report. Online at ***www.nap.edu/catalog/18736/reducing-the-fuel-consumption-and-greenhouse-gas-emissions-of-medium-and-heavy-duty-vehicles-phase-two***.

Neace, R, B. Gibson, J. Leonard, S. Johnson, J. Judy, J. Banks, G. Hunter, and R. Stiteler. 2017. Letters to EPA Administrator Scott Pruitt on behalf of Worldwide Equipment, Inc. EPA-HQ-OAR-2014-0827-2400.

Neitzke, R.A. 2015. Comments to greenhouse gas emissions and fuel efficiency standards for medium- and heavy-duty engines and vehicles—Phase 2, on behalf of GATR Truck Center. EPA-HQ-OAR-2014-0827-1010.

Neitzke, R.A. 2017. Letter to EPA Administrator Scott Pruitt on behalf of GATR Truck Center. EPA-HQ-OAR-2014-0827-4474.

Niebauer, M. 2017. Letter to EPA Administrator Scott Pruitt on behalf of Legacy Truck Centers, Inc. EPA-HQ-OAR-2014-0827-4378.

Nuss, R.W. 2015. Comments to greenhouse gas emissions and fuel efficiency standards for medium- and heavy-duty engines and vehicles—Phase 2, on behalf of Nuss Truck and Equipment. EPA-HQ-OAR-2014-0827-0918.

Nuss, R.W. 2017. Letter to EPA Administrator Scott Pruitt on behalf of Nuss Truck and Equipment. EPA-HQ-OAR-2014-0827-2388.

Oldham, P.B. and T. Brewer. 2017. Letter to the Honorable Diane Black from the Office of the President, Tennessee Tech, June 15. Online at ***www.epa.gov/sites/production/files/2017-07/documents/hd-ghg-fr-fitzgerald-recons-petition-2017-07-10.pdf.***

Parker, S.E. 2017. Letter to EPA Administrator Scott Pruitt on behalf of Baltimore-Potomac Truck Centers. EPA-HQ-OAR-2014-0827-2396.

Propper, R., P. Wong, S. Bui, J. Austin, W. Vance, Á. Alvarado, B. Croes, and D. Luo. 2015. Ambient and emission trends of toxic air contaminants in California. Environmental Science and Technology, September 4. Online at ***http://pubs.acs.org/doi/abs/10.1021/acs.est.5b02766.***

Rowangould, G.M. 2013. A census of the U.S. near-roadway population: Public health and environmental justice considerations. Transportation Research Part D: Transport and Environment 25:59–67. Online at ***http://dx.doi.org/10.1016/j.trd.2013.08.003***.

Shippee, D. 2017. Comment to the docket submitted December 28, 2017. EPA-HQ-OAR-2014-0827-4487.

Smith, C. 2017. Comment to the docket submitted November 28, 2017. EPA-HQ-OAR-2014-0827-2434.

Spalding, J. 2017. Comment to the docket submitted November 27, 2017. EPA-HQ-OAR-2014-0827-2426.

United States Census Bureau. 2004. Vehicle inventory and use survey, 2002. United States Department of Commerce. Online at ***www.census.gov/svsd/www/vius/2002.html.***

United States District Court for the District of Columbia. 1998. Consent decree for United States of America v. Detroit Diesel Corporation. Online at ***www.epa.gov/sites/production/files/documents/detroit-cd.pdf.***

Wagner, Z. 2017. Letter to EPA on behalf of Gateway Truck and Refrigeration. EPA-HQ-OAR-2014-0827-4429.

Watson, J.T. 2017. Letter to EPA Administrator Scott Pruitt on behalf of Northern Ohio Truck Center, Inc. EPA-HQ-OAR-2014-0827-4381.

Watt, J.N. 2017. Letter to EPA Administrator Scott Pruitt on behalf of Watt's Truck Center. EPA-HQ-OAR-2014-0827-4429.

World Health Organization (WHO). 2012. IARC: Diesel engine exhaust carcinogenic. Press release from the International Agency for Research on Cancer, June 12. Online at ***www.iarc.fr/en/media-centre/pr/2012/pdfs/pr213_E.pdf.***