XII.
Declarations

6. Dana Lowell, M.J. Bradley & Associates (including Memorandum re: Excess Emissions from Non-Enforcement of EPA Glider Standards ("MJB Report"))

DECLARATION OF DANA M. LOWELL

I, Dana M. Lowell, declare as follows:

1. I am the Senior Vice President & Technical Director of M.J. Bradley & Associates LLC (M.J. Bradley), a strategic environmental consulting firm with offices in Washington, D.C. and Concord, Massachusetts. I have worked in M.J. Bradley's advanced vehicle technology group for over thirteen years, providing strategic analysis, project management, and technical support to mobile source emissions reductions programs. I received my Bachelor of Science degree in Mechanical Engineering from Princeton University, and my Master in Business Administration from the New York University Leonard N. Stern School of Business.

2. I understand that EPA's recent non-enforcement action allows manufacturers and suppliers to exceed limits under current regulations that cap production at 300 uncontrolled gliders per year. I further understand that this EPA action immediately increases allowable production of non-compliant glider vehicles through 2019.

3. In the appended report, I have conducted analysis to estimate the magnitude of excess emissions and associated health impacts that will result from

EPA's decision to decline to enforce the emission standards applicable to heavy-duty "glider" trucks.

4. I used assumptions in U.S. Environmental Protection Agency modeling, an estimated number of available production allowances, and 2017 glider registration data to calculate the annual excess emissions of nitrogen oxides ("NOx") and particulate matter ("PM") caused by EPA's non-enforcement action.

5. The analysis estimates that EPA's decision not to enforce these standards will result in at least 11,190 additional non-compliant glider vehicles being produced and sold in 2018-2019.

6. I used EPA's Motor Vehicle Emission Simulator (MOVES) modeling system to project resultant emissions from these additional glider vehicles. The analysis shows that the estimated number of additional gliders produced and sold in 2018 and 2019 will result in excess emissions of almost 23,000 tons of excess NOx and over 300 tons of excess PM in 2019, compared to an equal number of new trucks with new engines compliant with current emission standards.

7. Over their lifetime, these 11,190 glider trucks are associated with more than 430,000 tons of excess NOx and more than 7,300 tons of excess PM. Based on EPA methodologies for analyzing the health effects of PM 2.5 emissions, the 11,190 additional gliders estimated to be produced and sold in 2018-2019 will

result in \$6.7 - \$14.5 billion in additional health-related damages. This includes an estimated additional 760 – 1,746 premature deaths.

8. The appended report describes these conclusions in greater detail and sets forth the methodologies and information used to arrive at these results.

I declare under penalty of perjury that the foregoing is true and correct.

Dana M. Lowell

Dated: July 13, 2018

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To: Alice Henderson, EDF

From: Dana Lowell, MJB&A

Date: July 16, 2018

Re: **Excess Emissions from Non-Enforcement of EPA Glider Standards**

As requested, MJB&A conducted analysis to estimate the magnitude of excess emissions and associated health impacts that will result from EPA's decision to decline to enforce the emission standards applicable to heavy-duty "glider" trucks. These standards were adopted by EPA in October 2016, as one element of updates to the Code of Federal Regulations, Title 40, Parts 1037 and 1068 (40 CFR 1037, 1068)[1]. These standards, which required that most gliders be equipped with engines compliant with current new engine emission standards, were to be fully implemented as of the 2018 model year. In November 2017, the current administration proposed to repeal these standards, based on a new interpretation that gliders do not constitute "new motor vehicles" within the meaning of the Clean Air Act, and therefore EPA cannot regulate the engines installed in gliders as "new motor vehicle engines".[2]

EPA has not yet finalized that repeal proposal, though on Friday, July 6, 2018, the agency issued a broad-based memorandum indicating it would not enforce the 2016 final rule glider provisions. In particular, the memo stated that:

> *"EPA will exercise its enforcement discretion with respect to the applicability of 40 C.F.R. § 1037.635 to Small Manufacturers that in 2018 and 2019 produce for each of those two years up to the level of their Interim Allowances as was available to them in calendar year 2017 under 40 C.F.R. § 1037.150(1)(3)" and that "EPA will exercise its enforcement discretion with respect to Suppliers that sell glider kits to those Small Manufacturers to which this no action assurance applies."*

EPA likewise indicated that it was planning additional actions to weaken or eliminate glider standards, including "extending the compliance date applicable to Small Manufacturers to December 31, 2019".

Small Manufacturer Interim Allowances available in 2017 were determined by each manufacturer's highest annual production of glider kits and glider vehicles for any year from 2010 to 2014[3]. EPA has not publicly stated the magnitude of these allowances; however, based on actual new glider truck registrations in calendar year 2017

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[1] U.S. Environmental Protection Agency, *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles—Phase 2*, Federal Register, Vol. 81, No. 206, pg 73478-74274Tuesday, October 25, 2016.

[2] U.S. Environmental Protection Agency, *Repeal of Emission Requirements for Glider Vehicles, Glider Engines, and Glider Kits,* Federal Register, Vol. 82, No. 220, pg 53442 – 53449, Thursday, November 16, 2017.

[3] All current glider manufacturers qualify as small manufacturers eligible for Interim Allowances, in accordance with the definitions in the regulation.

we estimate that the total number of allowances that EPA will provide to small manufacturers in 2018 and 2019 will be at least 6,595 glider units per year. This would equate to an additional 5,595 gliders per year, above the more limited Small Manufacturer allowances available under the glider provisions included in the October 2016 final rule[4], estimated by EPA at the time to total 1,000 units per year for all manufacturers. For the remaining 6 months of 2018, this would mean, on average, over 930 additional glider sales per month, or about 30 additional glider sales per day.[5]

EPA's blanket decision to cease enforcing the more stringent limits on 2018 -2019 sales of glider trucks with non-compliant engines will mean that a substantial number of newly manufactured cab/chassis will likely enter service in 2018 and 2019 as glider trucks equipped with older, used engines that per EPA's MOVES emissions model[6] emit nitrogen oxides (NOx) at rates twenty-eight times the emission rates of trucks equipped with new, compliant engines, and that emit up to ten times as much particulate matter (PM). Recent testing conducted by EPA shows that real-world emissions from gliders with used engines could be even higher.

Based on the estimated number of allowances that will be available, and recent trends in glider sales, MJB&A projects that EPA's decision not to enforce the glider standards in the 2016 final rule will result in at least 11,190 excess non-compliant gliders[7] being sold in 2018-2019. If EPA extends compliance deadlines and ultimately repeals the glider standards, 50,000 – 100,000 additional non-compliant gliders could be sold through 2025.

See Table 1 for a summary of the projected excess emissions, based on EPA's MOVES model, that will result from these additional gliders with non-compliant engines expected to be sold in 2018 and 2019. As shown, the excess gliders produced in 2018-2019 will emit almost 23,000 tons of excess NOx and over 300 tons of excess PM in 2019. Annual NOx emissions from these glider trucks will peak in 2020 at over 30,000 tons, and annual PM emissions will peak in 2022 at almost 500 tons. In 2025 over 95 percent of these gliders will likely still be on the road and will still be emitting over 24,000 tons excess NOx and over 400 tons excess PM per year.

Some of these glider trucks produced in 2018 – 2019 will likely still be on the road in 2049, and by then their cumulative life-time excess emissions will total more than 430,000 tons NOx and more that 7,300 tons PM.

Based on EPA's analysis of the health effects of $PM_{2.5}$, and $PM_{2.5}$ precursors[8] emitted by onroad vehicles, the life-time excess emissions from a single glider truck with a non-compliant used engine will cause health-related

[4] For each small manufacturer, in 2018 and later years annual allowances for production of gliders with non-compliant engines was set at the manufacturer's highest annual production between 2010-2014, or 300 glider units per year, which ever was lower.

[5] To the extent there is pent-up demand for gliders, as EPA's no action letter suggests, these averages may underestimate near-term sales impacts.

[6] This is a detailed model, based on years of collected certification and in-use test data, which is used by EPA to estimate emissions from a range of onroad vehicles, both for annual emissions inventory development and for evaluating the effect of regulatory programs. See: U.S. Environmental Protection Agency, *Motor Vehicle Emission Simulator (MOVES),* https://www.epa.gov/moves.

[7] Over and above the estimated 1,000 non-compliant gliders per year allowed under the 2016 final rules.

[8] $PM_{2.5}$ is particulate matter with aerodynamic diameter less than 2.5 microns. Virtually all PM emitted by diesel vehicles is $PM_{2.5}$. $PM_{2.5}$ precursors are substances, including NOx, that contribute to formation of secondary $PM_{2.5}$ in the atmosphere.

damages, including increased mortality and morbidity, with a monetized value of $0.6 - $1.3 million[9]. Over their life-time the estimated 11,190 additional gliders that EPA will now allow to be produced in 2018-2019 will therefore result in $6.7 - $14.5 billion in additional health-related damages[10]. This includes an additional 760 – 1,746 premature deaths.

Table 1 Estimated Excess Emissions from Non-enforcement of Glider Rules in 2018 and 2019

Gliders built in 2018-2019			2018	2019	2020	2025	2035	2045
Additional Gliders on the road [1]			5,595	11,190	11,190	10,910	10,463	10,071
Annual Excess Emissions	NOx	Tons	7,583	22,749	30,250	24,348	10,649	3,804
	PM	Tons	101.7	305.0	423.3	419.1	183.3	65.5
Cumulative Excess Emissions	NOx	thousand tons	7.6	30.3	60.6	197.3	363.2	431.5
	PM	thousand tons	0.10	0.41	0.83	3.10	5.96	7.13

Source: MJB&A analysis

BACKGROUND – GLIDER RULES

Glider trucks are newly manufactured cab/chassis that incorporate used engines rather than new engines. The production and sale of glider trucks was originally allowed under 40 CFR 86.004-40, 1037, and 1068 to accommodate situations where relatively new vehicles were damaged extensively, but without destroying the engine. EPA allowed an owner to purchase a newly manufactured cab/chassis and transfer the old engine to this new vehicle without that engine then having to meet the emission standard for the model year applicable for the new cab/chassis.

As shown in Figure 1, prior to 2010 annual sales of gliders were less than 1,200 vehicles[11]. Between 2009 and 2015 glider sales increased by an average of more than 1,300 per year, reaching over 8,500 in 2015. Glider sales

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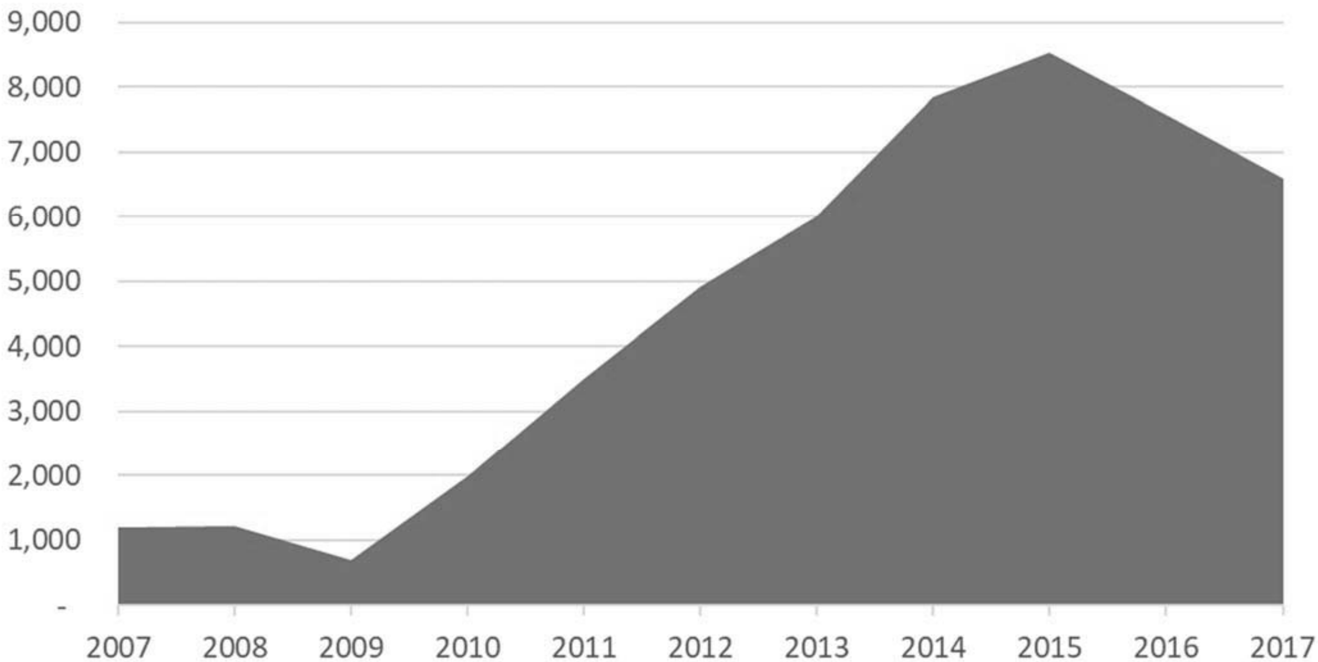
[9] Environmental Defense Fund, et al; *Comments of Environmental Defense Fund, the Environmental Law & Policy Center, and WE ACT for Environmental Justice on the Environmental Protection Agency's Proposed Rule, Repeal of Emission Requirements for Glider Vehicles, Glider Engines, and Glider Kits, 82 Fed. Reg. 53,442 (November 16, 2017), EPA-HQ-OAR-2014-0827*, Appendix B, Potential Emission and Health Impacts of Glider Kits, Table 6. This analysis is based on data from U.S. Environmental Protection Agency, *Technical Support Document, Estimating the Benefit per ton of Reducing PM2.5 Precursors from 17 Sectors*, January 2013.

[10] The range of emission damage estimates derives from two different methodologies for calculating health effects which EPA identified in the scientific literature, as well as the use of two different discount rates (3% and 7%) to calculate the net present value of out-year effects. These values are in 2013 dollars.

[11] Registrations of gliders made with cab/chassis from one major manufacturer, PACCAR, are estimated for the years 2007 – 2014; data on actual registrations was unavailable due to inconsistencies in the way the manufacturer coded the model year in the Vehicle Identification Number of glider kits it sold. Between 2015 and 2017 PACCAR supplied glider kits for 44 percent of the glider trucks registered in those years, and this graph assumes that PACCAR had the same market share in prior years.

fell slightly in 2016 and 2017, likely reflecting the anticipated restrictions that would have been imposed by EPA's 2016 final glider rules, and also mirroring a decline in the over-all heavy-truck market.

Figure 1 Annual U.S. New Glider Registrations, 2007 -2017



Source: IHS/Polk Automotive[12]

Information submitted to EPA as comments in response to their proposed glider rules[13] indicates that most glider trucks sold in the last few years have been put in service with model year 2003, or earlier, engines. These engines are well past their initial emission warranty period and emit NOx at rates twenty-eight times or more the emission

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[12] IHS/Polk Automotive maintains a database of all new vehicle registrations in the U.S each year, which is compiled from data provided by the motor vehicle departments in all 50 states. For each vehicle the database includes information on the model year, vehicle type/configuration, manufacturer, and vehicle owner (entity that registered it). The vehicle information is based on data encoded by the primary manufacturer in the unique Vehicle Identification Number (VIN) assigned to each vehicle. For glider trucks, only the manufacturer of the glider kit (cab/chassis) is encoded. Information about the secondary glider truck manufacturer that purchased the kit, installed a used engine, and sold the final vehicle to a user is not encoded in the VIN. Vehicles are registered by the end-user – the entity that purchased the glider truck from the secondary manufacturer.

[13] EDF et al., *Comment on Environmental Protection Agency's Proposed Rule, Real of Emission Requirements for Glider Vehicles*, at 22 (Jan. 5, 2018), EPA-HQ-OAR-2014-0827-4863; citing Glider Engines, and Glider Kits, Redacted Letter from Charles Moulis to William Charmley, Nov. 15, 2017, EPA-HQ-OAR-2014-0827-2379, https://www.regulations.gov/document?D=EPA-HQ-OAR-2014-0827-2379 ("Nearly all engines for recent glider production are 1998-2002 pre-EGR engines.").

rate of new engines compliant with current EPA new engine emission standards[14]. These older engines also emit ten times or more PM than new engines. Based on the comments received, EPA indicates that virtually all glider trucks are Class 8 (gross vehicle weight rating >33,000 pounds) combination truck-tractors. These vehicles are typically used for both short-haul (regional) and long-haul freight applications. When used for long-haul freight, annual vehicle mileage can exceed 100,000 miles in the first six to eight years of a truck's life.

In response to this recent, significant, increase in annual glider sales EPA included new restrictions on glider production in the 2016 final rule, beginning with the 2017 model year, and phasing into an annual limit of 300 gliders per small manufacturer starting in 2018. EPA estimated that this would result in limiting total glider vehicle sales with non-compliant engines to approximately 1,000 per year in 2018 and later years[15]. The agency noted this was in line with the original intent of allowing used engines to be recycled into new glider vehicles.

METHODOLOGY AND ASSUMPTIONS

To conduct this analysis MJB&A used assumptions for annual vehicle mileage throughout a truck's life, annual vehicle survival rates, and engine emission rates contained in EPA's Motor Vehicle Emission Simulator (MOVES) Model[16], to estimate total annual emissions of NOx and PM each year that a truck is in service. This was done for both Class 8 tractors and Class 8 single-unit trucks.

See Figures 2 and 3 which summarize these estimates for Class 8 tractors. The data shown in Figures 2 and 3 for model year 1998 – 2003 trucks, and 2017 and later trucks, are consistent with assumptions used by EPA, when conducting an analysis of glider emissions in response to comments received on the original proposed glider rule[17]. Annual values for Class 8 single unit trucks follow a similar pattern but are lower in magnitude due to assumed lower annual mileage per vehicle.

As shown, as a group of trucks ages, annual emissions per truck of both NOx and PM decrease, due primarily to lower annual miles driven, but also due to retirement of some of the original trucks in the group. In addition, these graphs clearly illustrate that trucks with older engines (model year 1998 - 2003) have significantly higher emissions each year than trucks with model year 2017 and later engines, which meet current, more stringent EPA new engine emission standards. Over 30-years, a glider truck with a used 1998-2003 model year engine will emit 41.5 tons more NOx and 0.68 tons more PM than a truck with a new, model year 2017 engine.

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[14] This estimate is based on EPA's MOVES emissions model. Recent testing by EPA indicates that real world emissions from glider trucks with used engines could actually be significantly higher.

[15] Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles— Phase 2, 81 Fed. Reg. 73585 (Oct. 25, 2016) ("EPA believes that its changes will result in the glider market returning to the pre-2007 levels, in which fewer than 1,000 glider vehicles will be produced in most years.").

[16] U.S. Environmental Protection Agency, *Motor Vehicle Emission Simulator (MOVES),* https://www.epa.gov/moves

[17] U.S. Environmental Protection Agency, EPA-420-R-16-901, August 2016, *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles -Phase 2 Response to Comments for Joint Rulemaking, Appendix A to Section 14 – Sensitivity Analysis of Glider Impacts.* In their analysis EPA did not estimate emissions from model year 2004 - 2006 trucks.

Figure 2 Projected Annual NOx Emissions, Class 8 Tractors (tons/year/original vehicle)

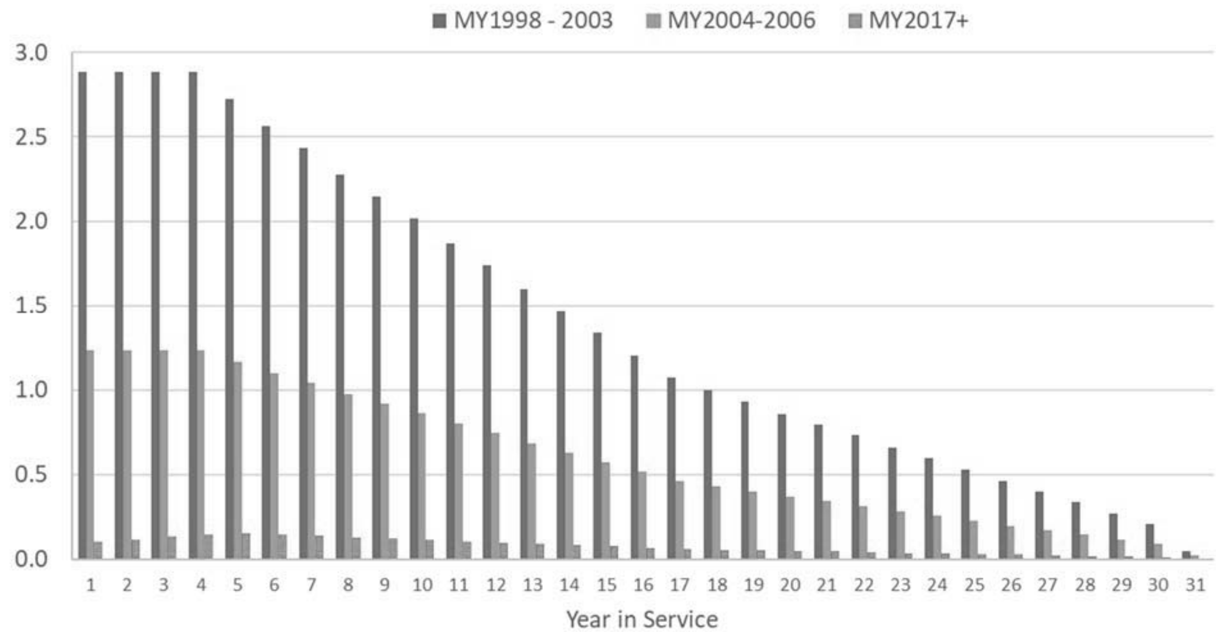
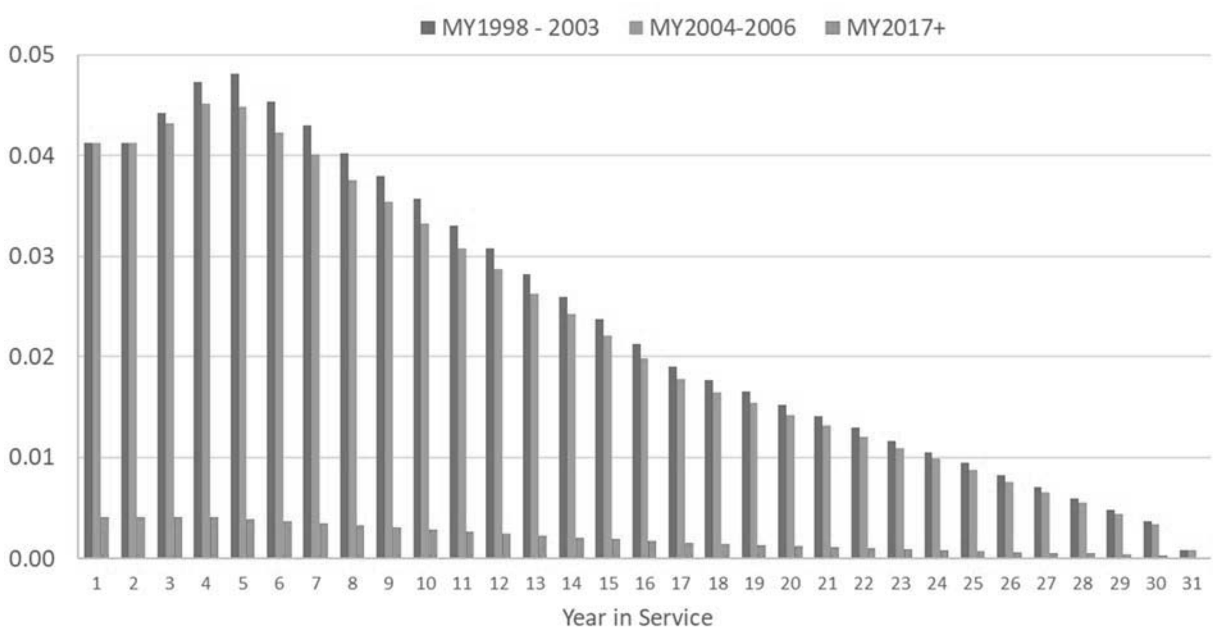


Figure 3 Projected Annual PM Emissions, Class 8 Tractors (tons/year/original vehicle)



Available evidence indicates that most glider vehicles that have entered service in the past 5 years have been equipped with used engines originally manufactured between model year 1998 and 2003. Approximately 1.1 million Class 8 trucks were sold in the U.S. between 1998 and 2003, of which approximately 800,000 were truck-tractors[18]. According to EPA truck survival assumptions, at least 79,000 of these trucks have likely already been retired – the engines from these retired trucks are the source of used engines installed in gliders. Based on EPA's assumed truck survival rates, and projected annual glider sales, there will likely be a sufficient supply of used engines from this group of trucks (model year 1998 – 2003) to supply the glider market through at least 2030, after which the used engines installed in gliders might start to come from trucks originally sold in model years 2004 – 2006. In any event, the used engines installed in glider trucks built in 2018 and 2019 will almost certainly continue to come from this older age group because glider manufacturers will likely continue to install used engines originally manufactured prior to model year 2003 for as long as possible. Engines manufactured beginning in model year 2004 were required to comply with more stringent emission standards which necessitated implementation of exhaust gas recirculation (EGR) to reduce NOx emissions. These technology changes for model year 2004 and later engines increased maintenance requirements and reduced fuel economy compared to earlier model year engines.

For this analysis we assumed that the number of glider trucks produced in both 2018 and 2019 would be equal to the number sold in 2017 (6,595 units each year).[19] This is a conservative estimate as it represents the number of Small Manufacturer Interim Allowances actually used in 2017; under EPA's recently announced non-enforcement action the same number of small manufacturer allowances that were available in 2017 will also be made available in 2018 and 2019.[20]

This will result in at least 13,190 new gliders being put on the road in 2018 and 2019. Under EPA's original 2016 glider rule a more limited small manufacturer exemption was allowed, which EPA estimated at the time to amount to 1,000 allowable units per year with non-compliant engines. As such, EPA's decision not to enforce the 2016 final glider provisions in 2018 and 2019 will likely result in at least 11,190 additional new gliders with used, non-compliant engines entering service.

To calculate emissions from these non-compliant gliders, the number of excess gliders sold each model year (5,595 in 2018 and 5,595 in 2019) was multiplied by the model year 1998 – 2003 annual emissions factors (Figures 2 and 3) for each future year the trucks would be in service. For each calendar year, total non-compliant glider emissions for both model years (2018 and 2019) were then summed. The calculation was then repeated for the same number of "compliant" trucks equipped with model year 2017+ engines. For each calendar year the "excess" emissions that will result from repeal of the glider rules was calculated by subtracting the estimated emissions from compliant trucks from estimated emission from non-compliant trucks.

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[18] Based on annual new truck registrations tracked by IHS/Polk Automotive.

[19] These actual sales figures for 2017 are consistent with, though slightly higher than, EPA's projection of the highest annual sales of gliders in model years 2010-2014. *See* EPA, Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 Response to Comments for Joint Rulemaking at 1961 (August, 2016). This could be due both to the fact that actual sales exceeded projections (as the data suggests) and because the 2017 allowable cap is very likely higher than the sales in any individual year between 2010 and 2014.

[20] It is possible that not all allowances *available* in 2017 were used, so the available allowances in 2018 and 2019 under EPA's non-enforcement action may be higher than 6,595 units.

To calculate the monetized value of negative health effects associated with these excess NOx and PM emissions, we used per-truck estimates developed by the Environmental Defense Fund[21], using the same incidence-per-ton methodology that was previously employed by EPA to evaluate the effect of limiting glider truck sales[22]. Both the EDF and EPA analyses relied on prior work done by EPA to estimate the health effects of directly emitted particulate matter, as well as the health effects of secondary PM formed in the atmosphere due to emission of PM precursors, including NOx[23]. This prior work by EPA indicates that emissions from onroad vehicles in 2020 will produce negative health effects with a monetized value of $7,000 - $17,000 per ton of NOx emitted and $350,000 - $860,000 per ton of PM emitted (2010 dollars). The estimated monetized damages of both PM and NOx emissions (2010 $/ton) increase slightly for emissions in later years.

Using these $/ton values, and estimates of annual excess emission per glider, the EDF analysis estimates that life-time excess emissions from 1,000 glider trucks equipped with used, non-compliant engines, will produce $0.6 - $1.3 billion in emission damages (2013$), or $0.6 - $1.3 million in damages per glider truck[24]. The estimated health effects include 68 – 156 premature deaths per 1,000 glider trucks[25]. As noted above, for the remainder of 2018, on average, EPA's non-enforcement decision will likely result in 30 additional glider sales per day. At these average values, each day's worth of sales, over their lifetime, would result in between 2.0 and 4.7 premature mortalities.

EDF also used EPA's COBRA model to do a more detailed analysis of the health effects of excess glider emissions[26]. The COBRA model is a detailed model that can be used to calculate health effects from emission

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[21] Environmental Defense Fund, et al; *Comments of Environmental Defense Fund, the Environmental Law & Policy Center, and WE ACT for Environmental Justice on the Environmental Protection Agency's Proposed Rule, Repeal of Emission Requirements for Glider Vehicles, Glider Engines, and Glider Kits, 82 Fed. Reg. 53,442 (November 16, 2017), EPA-HQ-OAR-2014-0827*, Appendix B, Potential Emission and Health Impacts of Glider Kits, Table 6.

[22] U.S. Environmental Protection Agency, EPA-420-R-16-901, August 2016, *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles -Phase 2 Response to Comments for Joint Rulemaking, Appendix A to Section 14 – Sensitivity Analysis of Glider Impacts.*

[23] U.S. Environmental Protection Agency, *Technical Support Document, Estimating the Benefit per ton of Reducing PM2.5 Precursors from 17 Sectors*, January 2013.

[24] This is consistent with, but slightly higher than EPA's estimate of $0.3 - $1.1 million in life-time emission damages per glider truck. See footnote 22.

[25] Environmental Defense Fund, et al; *Comments of Environmental Defense Fund, the Environmental Law & Policy Center, and WE ACT for Environmental Justice on the Environmental Protection Agency's Proposed Rule, Repeal of Emission Requirements for Glider Vehicles, Glider Engines, and Glider Kits, 82 Fed. Reg. 53,442 (November 16, 2017), EPA-HQ-OAR-2014-0827*, Appendix B, Potential Emission and Health Impacts of Glider Kits, Table 6.

[26] COBRA was developed specifically for use in local and state assessments of energy and environmental programs. One relevant aspect of COBRA is that on-road mobile sources are broken down into several categories, including heavy-duty diesel vehicles. See User's Manual for the Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool

changes at the county, state, or national level. EDF's estimates of total monetized health effects from the COBRA model were consistent with their results using the incidence-per-ton methodology[27].

(COBRA), Version: 3.0, U.S. EPA (Sept. 2017). https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool.

[27] Environmental Defense Fund, et al; *Comments of Environmental Defense Fund, the Environmental Law & Policy Center, and WE ACT for Environmental Justice on the Environmental Protection Agency's Proposed Rule, Repeal of Emission Requirements for Glider Vehicles, Glider Engines, and Glider Kits, 82 Fed. Reg. 53,442 (November 16, 2017), EPA-HQ-OAR-2014-0827*, Appendix B, Potential Emission and Health Impacts of Glider Kits, Tables 7 and 8.

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Dana has worked in MJB&A's advanced vehicle technology group since 2004, providing strategic analysis, project management, and technical support to mobile source emissions reduction programs. His mobile source project work includes evaluation and implementation of advanced diesel emissions controls, alternative fuels, and advanced hybrid and fuel cell electric drives, as well as development and implementation of diesel emissions testing programs for a range of onroad and nonroad heavy-duty vehicle types. Dana brings to clients a wealth of practical knowledge and experience, the real-world perspective of a major fleet operator, and a proven track record in technology implementation.

Dana has 25 years professional experience in the transportation and government sectors. Prior to joining MJB&A, Dana spent seven years as the Assistant Chief Maintenance Officer for Research & Development at MTA New York City Transit's Department of Buses. In his role with NYC Transit, Dana was responsible for both evaluation and implementation of clean fuel technology programs, including technology and vehicle testing, emissions testing and fleet emissions modeling, component/vehicle specification, maintenance program analysis, applications engineering support, financial analysis, budget development and planning, procurement support, and project management. Under his leadership, NYC Transit developed and executed an aggressive program to implement new technologies fleet-wide, resulting in the creation of NYC Transit's Clean Fuel Bus Program to reduce exhaust emissions from the fleet of 4,500 fixed-route transit buses.

Areas of Expertise

- Advanced vehicle emissions reduction technologies
- Vehicle technology development and deployment
- Transit maintenance management
- Vehicle emissions testing
- Diesel inspection and maintenance programs
- Transit vehicle specification and procurement support
- Life cycle cost modeling and financial analysis
- Project management

A recognized electric drive and clean fuel expert within transit, Dana has made numerous presentations at industry conferences and workshops sponsored by APTA, TRB, SAE, US EPA, the Canadian Urban Transit Association, the Electric Power Research Institute, the National Parks Service and the World Bank. He has also served on advisory committees for the Harvard Center for Risk Analysis and the US EPA's Environmental Technology Verification Program.

Representative MJB&A Projects

- New York City E3 Electric Truck Demonstration Project
- New York EV Charging Infrastructure Roadmap
- TransLink Low Carbon Fleet Plan

- NRDC State-Level Plug-in Electric Vehicle Cost-Benefit Analysis
- Ceres Plug-in Vehicle Charging Infrastructure Analysis
- TCI Northeast Charging Infrastructure Gap Analysis
- Environmental Defense Pipeline Blowdown Emissions and Mitigation Options
- Milwaukee County Transit Alternative Fuel Analysis
- TransLink – Alternative Fuel Transit Options and Modeling Tool
- Characterization of LNG Peak Shaving Facilities – Proof of Concept
- City of Pittsburgh Fleet Sustainability Analysis
- New York State Energy Research & Development Authority, Pricing Strategies to Reduce Grid Impacts of Electric Vehicles in New York
- New Transit Vehicle Technology Consultant, Advanced Transit Vehicle Consortium, Los Angeles County Metropolitan Transportation Authority
- New York City Marine Ferry Emissions Test Program
- New York Power Authority Fleet Analysis – Options to Reduce GHG Emissions
- CSX CNG Locomotive Feasibility Analysis
- EDF/Ceres, Effect of EPA Phase 2 Fuel Efficiency Regulations on Freight Rates
- Comparison of Fuel Economy & Emissions from Modern Diesel, CNG, and Hybrid Buses
- Federal Motor Carrier Safety Administration, Recommended Updates to Safety Regulations to Accommodate Electric Drive Vehicles
- Refinery Gas Engine Test Program
- Federal Motor Carrier Safety Administration, Training Program for Commercial Vehicle Inspectors in Detecting Fuel Leaks from CNG, LNG, and LPG Vehicles
- Port Authority of Allegheny County Bus Fleet Emissions Analysis
- BAE Systems, Hybrid Bus Fuel Economy Testing
- New York City Business Integrity Commission, Analysis of "Age-out" Policy Options to Reduce Emissions from Commercial Refuse Trucks in New York City
- Environmental Defense Fund, Policy Options to Reduce Fugitive Emissions from Natural Gas Production Facilities
- ICCT, Policies to Address Electric Vehicle-Grid Integration
- ICCT, Evaluation of Methane Leakage from LNG Marine Fuel Bunkering
- Clean Air Task Force, Diesel Emissions Reduction Policy Toolkits
- Clean Air Task Force, Diesel Black Carbon Climate Comparisons
- New York Power Authority, Hybrid School Bus In-Service Demonstration Program
- Federal Motor Carrier Safety Administration, Recommended Updates to Safety Regulations to Accommodate Natural Gas Vehicles
- Regulatory Support to Heavy-duty Diesel Engine Manufacturers for Transition from EPA Tier 2 to EPA Tier 3/4 Regulations

- BAE Systems, Technical Marketing Support and Analysis for Sales of Hybrid-Electric Transit Buses
- Federal Motor Carrier Safety Administration, Guidelines for The Use of Hydrogen Fuel in Commercial Vehicles
- ICCT, Analysis of Trailer Technologies Available to Increase Freight Vehicle Efficiency
- American Clean Skies Foundation, Natural Gas for Marine Vessels, U.S. Market Opportunities
- American Bus Association, Comparison of Coach Bus Service to Amtrak and to the Essential Air Service Program
- ICCT, Policy Options to Address Urban Off-Cycle NOx Emissions from Euro IV/V Trucks
- Chelsea Collaborative, TRU Electrification at New England Produce Center
- Volpe Transportation Center, Fuel Cell Bus Life Cycle Cost Model
- Volpe Transportation Center, Fuel Cell Bus Maintenance Manual & Training Program
- New York Power Authority, Green Fleet Options Analysis
- Clean Air Task Force, Technical Support for Diesel Emission Reduction Policy Development
- Great Lakes Towing, Emissions Testing of SCR-equipped Marine Power Barge
- Conservation Law Foundation, Review of Massachusetts Policies to Reduce GHG from the Transportation Sector
- ICCT, Support for Heavy-Duty Vehicle Fuel Economy/GHG Regulation
- American Lung Association, Technical Support for Energy Policy Development
- CSX, Gen-set Locomotive Emissions Testing
- Keyspan Energy Delivery, Current and Proposed Transportation Technology Review
- Environment Canada, Oil Sands Sector Emission Reduction Feasibility Study
- Translink/GVTA, Bus Technology Demonstration Program, Phase 1, 2, 3 & 4
- Massachusetts Bay Transportation Authority (MBTA), In-service CNG Bus Test Program
- MBTA, Development of an Enhanced Bus Emissions Monitoring and Control Program
- American Bus Association, Transit Modes & GHG Offset Analysis
- Nicholas Institute, BEST BUS Life Cycle Cost and Emissions Model
- PANYNJ, Brooklyn Cruise Terminal Shore Power Feasibility Study
- Massachusetts Department of Environmental Protection, Diesel Engine Retrofits in the Construction Industry: A How to Guide
- STAPPA/ALAPCO, Guidance for the Control of Fine Particulate Matter Emissions from Industry Sectors
- ESP, U.S./Mexican Border Remote Sensing Emissions Testing Project
- Environmental Defense, New York City Idling Emissions Calculator
- NRDC, MTA New York City Transit Bus Fleet Emissions Analysis
- NESCAUM, Region 1 and Region 2 Marine Engine Repower Project
- Northeast Utility Truck Retrofit Program

Prior Work Experience

July1996 – May 2004	MTA New York City Transit, Department of Buses *Assistant Chief Maintenance Officer, Research & Development*
March 1993 – June 1996	MTA New York City Transit, Dept. of Capital Programs *Manager of Capital Investment Analysis*
Feb 1990 - Feb 1993	City of New York, Office of Management and Budget *Supervising Project Manager, Value Engineering*
Sept 1985 – Sept 1989	United States Army, 299th Engineer Battalion *Battalion Adjutant; Combat Engineer Platoon Leader*

Education

Leonard N. Stern School of Business, New York University, New York, NY

Masters of Business Administration; co-major in Management and Operations Management, 1995
Mayor's Graduate Scholarship; Dean's Award for Academic Excellence

Princeton University, Princeton, NJ

Bachelor of Science in Mechanical Engineering, 1985
Summa Cum Laude; Phi Beta Kappa; Tau Beta Pi
Four-year R.O.T.C. scholarship; Distinguished Military Graduate

Professional Activities

- NESCAUM/MassDEP training on short-lived climate forcers, 2010
- Massachusetts Department of Environmental Protection and MASS Highway diesel retrofit training, 2008
- Chair of Hybrid Bus Working Group, Electric Bus Subcommittee; American Public Transit Association, September 1999 – May 2003
- Member, Technical Advisory Panel for Project C-10 - Transit Bus Technology Related Research; Transit Cooperative Research Program
- Member, Technical Council; Transit Standards Consortium, November 2000 – December 2002
- Member, Technical Screening Committee, FY 2000 Research Program; Transportation Research Board
- Organizer and Session Chair, SAE TOPTEC: Hybrid Electric Vehicles in the Bus & Truck Markets; SAE International, New York, NY, May 2000

- Panelist, Alternative Fuels CUTRcast web-panel session; Center for Urban Transportation Research, July 2000; www.nctr.usf.edu/netcast/altfuels.htm
- Member, Technical Review Panel; U.S. Environmental Protection Agency Environmental Technology Verification Program, November 2000
- Member, Advisory Panel on Alternative Propulsion Technologies; Harvard Center for Risk Analysis, October 1999
- Trainer on alternative fuel technologies; National Park Service Training Session on Alternative Transportation Systems, Philadelphia, PA, November 1999
- Member, Peer Review Panel, South Boston Piers Area Transit Way, Massachusetts Bay Transportation Authority, Boston, MA
- Member, Clean Propulsion & Support Technology Committee, American Public Transportation Association

Conference Presentations

- International Association of Ports and Harbors Conference, IAPH 2013
- ICCT International Workshop on Reducing Air Emissions from Shipping, Shanghai, China, 2012
- IUAPPA, World Clean Air Congress, 2010
- Transportation Research Board Annual Meeting, 2006
- World Resources Institute/USAID Workshop on Coupling GHG Reductions with Transport & Local Emissions Management, 2005
- World Bank Training Session on Diesel Pollution, 2004
- World Bank Clean Air Initiative – Diesel Days, Washington DC, January 2003
- Philadelphia Diesel Difference Conference, Philadelphia, PA, May 2003
- Diesel Engine Emissions Reduction (DEER) Conference, US Department of Energy, Newport, RI, August 2003
- EPA-NESCAUM Diesel Retrofit Workshop, New York, NY, October 2003
- SAE Truck and Bus Meeting, November, 2003
- Better Air Quality for Asia Workshop (BAQ 2003), World Bank, Manila, Philippines, December 2003 – video presentation
- Transportation Research Board, 2002 Annual meeting, January 2002
- APTA 2002 Bus & ParaTransit Conference, American Public Transit Association, May 2002
- EESI/NESEA Congressional Briefing on Cleaner Transportation Technologies, Washington, DC, May 2002
- APTA 2001 Bus & ParaTransit Conference, American Public Transit Association, May 2001
- CUTA Annual Conference, Canadian Urban Transportation Association, June 2001

- World Bank Clean Air Initiative Workshop for Lima and Callao, Lima, Peru, July 2001
- World Bus and Clean Fuel Expo 2001, August 2001
- North East Sustainable Energy Association (NESEA), Energizing Schools 2001 Conference, October 2001
- SAE Truck and Bus Meeting, November, 2001
- Transportation Research Board, 2000 Annual meeting, January 2000
- APTA 2000 Bus & ParaTransit Conference, American Public Transit Association, May 2000
- Electric Bus Users Group Workshop, Electric Power Research Institute, March 2000
- Diesel Emissions Control Retrofit Workshop, Corning Inc., March 2000
- Board of Directors Alternative Fuels Workshop, Washington Metropolitan Area Transit Authority, July 2000
- SAE Hybrid Electric Vehicles TOPTEC, May 1999
- Bus Technology & Management Conference, American Public Transit Association, May 1998
- NAEVI 98, North American EV & Infrastructure Conference and Exposition, December 1998

Publications

- Moynihan, P, Danos, T, Seamonds, D and Lowell, D, "Evaluation of Exhaust Emissions from Two Repowered Passenger Ferries Equipped with Oxidation Catalyst After-Treatment" submitted to Rolls-Royce Marine North America, Inc. for the NYSERDA NYC Private Ferry Fleet Emissions Reduction Program – Phase V, December 2014
- Lowell, D, "Electric Drive Vehicle Systems, Draft Final Report" Federal Motor Carrier Safety Administration, July 2014
- Lowell, D., Seamonds, D., "Coming Soon To a Fleet Near You: EPA/NHTSA Fuel Efficiency and GHG Standards For Medium- and Heavy-Duty Trucks", Environmental Energy Insights, May 2014
- Lowell, D., "Short-term Climate Impact of Diesel Emission Reduction Projects", Clean Air Task Force, December 2013
- Lowell, D., "Comparison of Modern CNG, Diesel and Diesel Hybrid-Electric Transit Buses: Efficiency & Environmental Performance", November 2013
- Lowell, D., "Port Authority of Allegheny County Bus Fleet Emissions 2005 – 2019", Pittsburgh Foundation, October 2013
- Lowell, D., Seamonds, D., "New York City Commercial Refuse Truck Age-out Analysis", Environmental Defense Fund and New York City Business Integrity Commission, September 2013
- Wang, H., Lutsey, N., Lowell, D., "Consideration of the Lifecycle Greenhouse Gas Benefit from Liquefied Natural Gas as an Alternative Marine Fuel", submitted to International Maritime

Organization, Sub-committee on Bulk Liquids and Gas by Institute of Marine Engineering, Science and Technology (IMarEST), October 2013

- Lowell, D., "NYPA Hybrid Electric School Bus Evaluation Project, Phase 2 FINAL REPORT", New York Power Authority, September 2013
- Whitman, A., Lowell, D., Balon, T., "Electric Vehicle Grid Integration in the U.S., Europe, and China: Challenges and Choices for Electricity and Transportation Policy", International Council on Clean Transportation and Regulatory Assistance Project, July 2013
- Lowell, D. and Seamonds, D., "Supporting Passenger Mobility and Choice by Breaking Modal Stovepipes: Comparing Amtrak and Motor Coach Service", July 2013, American Bus Association Foundation
- Sharpe, B., Clark, N. and Lowell, D., "Trailer Technologies for increased heavy-duty vehicle efficiency: technical, market, and policy considerations", White Paper, International Council on Clean Transportation, June 2013
- Lowell, D., FMCSA-RRT-13-044, "Natural Gas Systems: Suggested Changes to Truck and Motor Coach Regulations and Inspection Procedures", Federal Motor Carrier Safety Administration, March 2013
- Lowell, D., Balon, T., Van Atten, C., Curry, T., Hoffman-Andrews, L., "Natural Gas for Marine Vessels: U.S. Market Opportunities", American Clean Skies Foundation, 2012
- Sharpe, B., Lowell, D., "Certification Procedures for Advanced Technology Heavy-Duty Vehicles: Evaluating Test Methods and Opportunities for Global Alignment", SAE International, SAE 2012-01-1986, 2012
- Lowell, D., "Clean diesel versus CNG buses: Cost, air quality, & climate impacts", Clean Air Task Force http://www.catf.us/resources/publications/files/20120227-Diesel_vs_CNg_FINAL_MJBA.pdf, 2012
- Lowell, D. and Kamaketé, F., "Urban off-cycle NOX emissions from Euro IV/V trucks and buses: Problems and solutions for Europe and developing countries", White Paper No. 18, International Council on Clean Transportation, march 2012, http://www.theicct.org/urban-cycle-nox-emissions-euro-ivv-trucks-and-buses
- Moynihan, P., Balon, B., Lowell, D., "NESCAUM Region 2 Marine Ferry and Tug Repower Project FINAL REPORT", NESCAUM, 2011
- Lowell, D., Bongiovanni, R., "Chelsea Collaborative New England Produce Center TRU Electrification FINAL REPORT", Chelsea Collaborative, 2011
- Lowell, D., Seamonds, D., "Alternative Fueled Fleet Vehicle Analysis", Electric Power Research institute, EPRI 1023045, 2011
- Lowell, D., Curry, T., Hoffman-Andrews, L., Reynolds, L., "Comparison of Essential Air Service Program to Alternative Coach Bus Service: Keeping Rural Communities Connected", American Bus Association Foundation, September 2011
- Lowell, D., Balon, T., Danos, T., "Bus Technology & Alternative Fuels Demonstration Project Phase 4 Final Report", Greater Vancouver Transportation Authority, 2011

- Balon, T., Clark, N., Moynihan, P., Lowell, D., "Development of a Combined Oxidation System and Seawater Scrubber to Reduce Diesel NOx Emissions from Marine Engines Final Report", Houston Advanced Research Center, New Technology Research & Development Program N-40, 2011
- Balon, T., Moynihan, P., Lowell, D., Danos, T., Seamonds, D., "CSX Genset Switcher#1317 Locomotive Emission Testing FINAL REPORT", NESCAUM, 2010
- Park, D, Curry, T, Lowell, D., Balon, T.H., Piper, S, "Implications of Introducing Hydrogen Enriched Natural Gas in Gas Turbines", Atlantic Hydrogen, Inc, January 2010
- Lowell, D., Balon, T., Seamonds, D., Leigh, R., Silverman, I., "The Bottom of the Barrel: How the Dirtiest Heating Oil Pollutes Our Air and Harms Our Health", Environment Defense Fund, 2009
- Posada, F., Lowell, D. (editor), "CNG Bus Emissions Roadmap: from Euro III to Euro VI", international Council on Clean Transportation, 2009
- Lowell, D., "Lower Manhattan Construction, Construction Equipment Retrofit Case Study", Clean Air Task Force, 2009
- Lowell, D., Seamonds, D.G., "Evaluation of Vehicle Emissions Reduction Options for the Oil Sands Fleet", Environment Canada, March 2008
- Lowell, D., Balon, T.H., "Setting the Stage for Regulation of Heavy-Duty Vehicle Fuel Economy & GHG Emissions: Issues and Opportunities," International Council on Clean Transportation, March 2008
- Lowell, D., Balon, T. H., Danos, T. J., Moynihan, P.J., "Diesel Engine Retrofits in the Construction Industry: A How To Guide", Massachusetts Department of Environmental Protection, January 2008.
- Lowell, D., Balon, T., "Brooklyn Cruise Terminal Shore Power Feasibility Analysis", Port Authority of New York and New Jersey, 2008
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- Lowell, D., Chernicoff, W., Lian, F., "Fuel Cell Bus Life Cycle Cost Model: Base Case & Future Scenario Analysis", U.S. Department of Transportation, DOT-T-07-01, June 2007
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