New School Year, Same Dirty Buses:

The Case for Electrifying New York's School Buses

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EXECUTIVE SUMMARY

This paper will focus on the impacts of diesel pollution from buses on the environment, including its contribution to climate change, and on public health, particularly the impact on children. Diesel emissions adversely impact air quality and human health, and the exhaust and its byproducts have been linked to lung damage and respiratory problems, cardiovascular illnesses, cancer and higher mortality rates. Children are most susceptible to the risks associated with diesel pollution, due to their developing lungs.

Unfortunately, more than 2 million children riding diesel school buses in New York State (NYS) are regularly exposed to diesel pollution while commuting to and from school. Therefore, it's no surprise that 1 in 10 children suffer from asthma statewide. Asthma is the leading chronic illness and the number one cause of school absences among children and adolescents. According to a report by the NYS Comptroller, asthma-related hospital visits cost taxpayers $1.3 billion a year.

In low-income communities and communities of color, poor air quality impacts public health at drastically higher rates. There are higher rates of diagnoses, mortality, and hospitalization for respiratory disease in these communities, and in some environmental justice neighborhoods, 1 in 4 children suffers from asthma. In New York City (NYC), where many students walk or take public transportation, the majority of school children using school buses are those who have disabilities.

The latter portion of this paper will provide an overview of school busing in NYS and the various opportunities available for cleaning up the state's school bus fleets. Federal and state programs, the Volkswagen Settlement Fund, and partnerships with utilities for vehicle-to-grid technology can help offset the higher upfront costs of electric school buses. Finally, pathways forward specific to NYC are identified, including an electric school bus pilot program, worker-owned cooperatives, and local legislation that would require contractors to clean up their school bus fleets.

IMPACTS *of* DIESEL EMISSIONS

Decades of research have been dedicated to studying the impact of diesel pollution on the environment and public health. There is consensus among experts that diesel emissions adversely impact air quality and human health. Numerous studies have linked diesel exhaust and its byproducts to lung damage and respiratory problems, cardiovascular illnesses, cancer and higher mortality rates[1][2][3][4][5]. There is also general agreement among scientists that the burning of fossil fuels—including but not limited to diesel—is the principal cause of global climate change. The following section will provide an overview of that research, and also explore the often overlooked economic and social inequities associated with diesel pollution.

Environmental Impact

A toxic cocktail of chemicals make up diesel exhaust, principally nitrogen oxides (NOx) and particulate matter (PM). Diesel exhaust may also contain minimal levels of carbon monoxide and hydrocarbons, depending on the engine model and its maintenance, and can be fatal in high concentrations.

Nitrogen oxide makes up the highest proportion of diesel emission pollution by more than 50%[6]. Nitrogen oxide from vehicles contributes to several environmental problems, including acidification of the atmosphere, which contributes to acid rain, ozone formation, and smog, which are all considerable problems in most major cities worldwide[7]. In the air, NOx emissions react with other pollutants and UV light from the sun to form a tropospheric ozone, which traps in heat within the atmosphere and accelerates climate change[8]. Road transportation, particularly diesel cars and trucks, is one of the main perpetrators of NOx emissions worldwide, and human activity produces between 40% - 70% of the NOx in the atmosphere[9].

PM makes up the second highest proportion of diesel emission pollution[10]. PM consists of small particles with a diameter of 2.5 micrometers or less, which are produced from various forms of combustion, including from motor vehicles. PM are produced at a drastically higher rate (6 to 10 times) from diesel engines than from gasoline engines. In 2016, there was 6.16 million tons of PM in the U.S.[11]

Particle emissions generally can be found in three main forms: soot, soluble organic fraction, and inorganic fraction. More than 50% of the total PM emissions are soot, which is observed as the black smoke coming out of tailpipes[12].

These emissions contribute to air, water, and soil pollution, as well as decreased visibility in cities through the production of haze and smog, the discoloration/blackening of buildings, and climate change[13].

In 2016, the EPA reports that the United States (U.S.) emitted 6,511 million metric tons of CO2 equivalent with road transportation accounting for the largest portion (28%)[14]. Medium and heavy duty vehicles, such as school buses, are responsible for nearly a quarter of the GHG emissions from the transportation sector. The U.S. Environmental Protection Agency (EPA) reported that the transportation sector consumed 60.8 billion gallons of distillate fuels in 2016. Buses used 1.7 billion gallons, whereas medium- and heavy-duty trucks made up a much larger section at 37 billion[15].

In NYS, transit contributed 7.06 million metric tons of CO2 equivalent from diesel vehicles in 2014. According to the EPA's 2014 National Emissions Inventory Report, NYS emitted 143,495.24 tons of nitrogen oxide and 6,806.86 tons of PM from all on-road mobile sources[16].

Currently, NYS has more than 40,000 school buses in operation. These diesel school buses travel almost 6 billion miles per year, primarily through residential neighborhoods, with an average fuel economy of just 7 miles per gallon[17]. At the national level, that means school bus fleets can emit 8.4 million metric tons of carbon pollution every year, despite only operating for a few hours a day, 180 days a year. That is the equivalent to the combined annual emissions of 1.4 million passenger cars[18].

Medium and heavy duty vehicles, such as school buses, are responsible for nearly a quarter of the GHG emissions from the transportation sector.

Public Health Impact

This environmental pollution poses a serious risk to public health. Pollution from traffic is highest near roads, meaning communities located near major traffic corridors are most vulnerable. Diesel air pollution can lead to decreased lung function, respiratory tract inflammation and irritation, aggravated asthma symptoms and persistent wheezing. The particulate matter from diesel exhaust are especially hazardous because they can enter deep into lower airways carrying toxic chemicals.

Although negative impacts on the lungs are the most serious threat to health, diesel air pollution also impacts other systems in the body, including the cardiovascular system. According to a 2010 study by the Health Impacts Institute, traffic-related pollution can increase the risk of death from heart disease[19]. Other studies have documented changes in cardiac physiology after short-term exposure to traffic-related pollution, suggesting a causal association[20][21][22]. Alarmingly, a separate 2017 study in Ontario Canada found that residents living closer to busy roads had higher rates of dementia[23].

Diesel exhaust is internationally recognized as a cancer-causing agent and classified as a likely carcinogen by the EPA[24]. A 2012 study conducted by International Agency for Research on Cancer shows exposure to diesel exhaust can be linked to higher rates of lung cancer and greater risk for bladder cancer. A 2017 study linked PM and ground-level ozone to higher rates of mortality, with the possibility of adverse health impacts even at levels below the national standard[25].

Some populations, including children, the elderly, and disabled are more susceptible to the negative impacts of diesel pollution. Children are more vulnerable because of their anatomy and physiology: their lungs are smaller and are still developing, and they breathe in more air per pound of body weight than an adult. According to the American Lung Association, particle pollutant exposure has been linked to increased hospitalization for asthma attacks for children living near roads with heavy traffic; slowed lung function in children and teenagers; contributed to the development of asthma in children; damage airways of the lungs; increased risk of death from cardiovascular disease; and increased risk of lower birth weight and infant mortality[26].

This heightened health risk to children makes a closer look at school buses all the more critical. The EPA reported that "older polluting school buses can lead to significant health risks for students who typically ride these buses for one-half to two hours a day[27]". In NYS, there is no requirement limiting the amount of time a child can spend on a school bus. In some cases, trips longer than an hour and a half are considered "reasonable[28]".

Economic Impact

With strong public health impacts comes significant economic costs. These costs range from tax dollars spent on treating air pollution-related illnesses through programs like Medicaid and Medicare to the direct costs families incur on medical expenses and hospitalizations, and to the indirect costs from loss of work and opportunities due to increased student absenteeism and medical appointments. In 2012, the EPA reported that the median annual medical costs of asthma were $983 per child in the U.S. By state, the lowest median was $833 per child in Arizona, and the highest median cost was $1,121 per child in Michigan[29]. NYS ranked 13th at $1,003 per child[30]. The Asthma and Allergy Foundation of America[31] estimates the total cost of asthma to society (including both direct and indirect costs) to be approximately $56 billion.

In 2015, NYS medical and absenteeism costs were approximately $2.8 billion, and have only continued to rise. In 2020, the estimated costs are expected to be $3.2 billion. That is a 16% increase over 5 years[32]. Across the states, between 12% - 22% of total asthma-attributable costs are for children, aged 0 to 17. In NYS between 2011 and 2012, the costs of asthma-related absenteeism were around $1.1 billion dollars for children under the age of 18[33], and costs of asthma hospitalizations was approximately $660 million, a 61% increase from 2002[34].

IDENTIFYING INEQUITIES

Unfortunately, as is the case with many negative environmental impacts, diesel pollution disproportionately burdens some communities more than others. For a myriad of factors detailed below, lower income communities and communities of color, especially in urban areas, face higher levels of exposure to diesel emissions and present with higher rates the negative health outcomes attributable to diesel. This is true across age groups, but for purposes of this paper, the data highlighted will focus on children.

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Location of Pollution

As mentioned above, pollution is highest in urban environments, industrial centers (including power plants), and major traffic corridors. Figure 1. from the NYS Department of Health demonstrates this occurrence: Kings County (Brooklyn), the most urban county represented, has a drastically higher rate of asthma hospitalizations than other counties across the state.

Regarding other urban centers, Buffalo is second behind NYC for air pollution due to its vast industrial sector, including industrial, manufacturing, chemical, and technologies plants[35]. The at-risk based rate for asthma emergency department visits for 2006-2010 was five times higher for children living in New York City compared to those living in the rest of the state[36].

The concentration of pollution varies even within urban centers, as demonstrated by NYC air quality differences community to community in Figure 2. Diesel pollution is worse near large traffic corridors, landfills, toxic waste sites and other places designated for undesirable land uses. Unfortunately, all too often these polluting facilities are located near low-income communities, putting these families at higher risk of the health risks associated with air pollution.

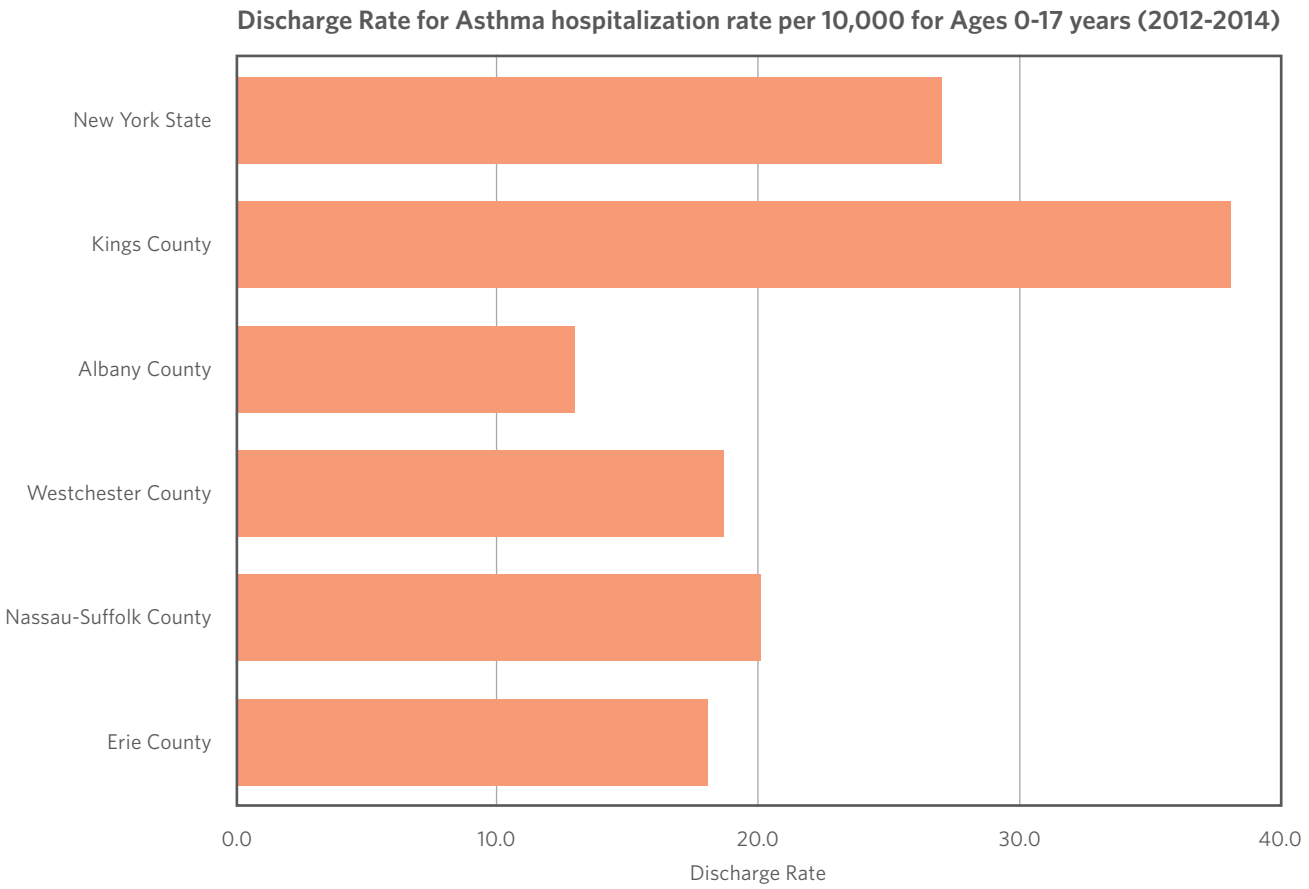

Figure 1. (New York State Department of Health, 2013)

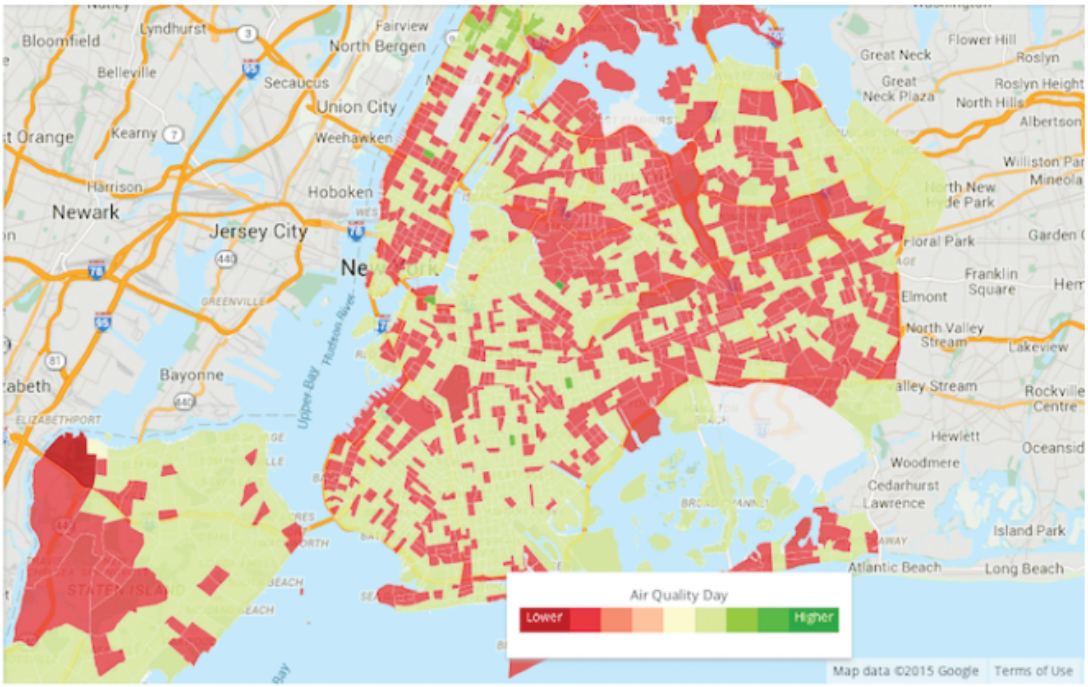

Figure 2. ([Daytime] Air Quality in New York City, 2015)[37]

Disparate Impacts by Race and Socioeconomic Status

Unfortunately, race and socioeconomic status (SES), not just geographic location, often predetermine air quality as well. Communities, especially in NYC, are often segregated by race, ethnicity, and SES. These communities often share characteristics, including "low economic development; poorer health conditions; and lower levels of educational attainment[38]". Health disparities based on social status are considered "pervasive and persistent[39]". Additionally, numerous studies have consistently shown that people of color and those living below the poverty-line live in areas that are close to major polluters, such as congested roadways and other undesirable locations[40].

Part of this connection is historical, as city planners separated urban areas along racial lines and built highways and roads through minority communities to connect urban centers to the (predominantly white) suburbs. Legacies of racial housing restrictions (known as "redlining"), segregation and racial economic disparity also play into the creation of isolated environmental justice communities[41]. Public housing and low-income housing projects are often designated in sites near high pollution. Unfortunately, all of these factors result in communities that experience lower air quality than others and thus, suffer the health impacts of air pollution at greater rates. This is often the result of policies that prioritize the economic benefits of development and need for low-cost housing over the long-term health and environmental costs of pollution on vulnerable residents.

Even within lower income communities, communities of color are disproportionately impacted. A 2013 study from the University of Minnesota found that even *after* controlling for income, there were significant differences between urban white and urban non-white communities in their air quality[42]. The disparities in exposure by race, when controlling for income, were more than two times larger than the disparities by income, when controlling for race, in urban areas. Race may even impact the likelihood of diagnosis and access to proper medical assistance through explicit and implicit bias. People of color report having different experiences when receiving medical diagnosis/assistance[4445].

In 2018, the EPA acknowledged that Non-Hispanic Blacks have a higher asthma-related mortality rate than people of other races/ethnicities[46]. Thus, children coming from lower SES and children of color, are growing up with higher rates of asthma, higher chances of limited lung function and higher risks of acquiring a variety of other chronic respiratory and cardiovascular illnesses, including cancer. These negative consequences are demonstrated at the state and locals level below.

New York City

NYC has long been a place where environmental injustices can be felt by some communities more than others, for many of the reasons described above. According to the NYC Department of Health, PM levels, specifically from trucks and buses, are 70% higher in neighborhoods in NYC with high poverty[47]. This exposure leads to more adverse health impacts. In NYC, Black children are 5 times (22%) as likely as white children (4%) to be diagnosed with asthma. Latino children were 3 times as likely (15%) and Asian children were 2 times as likely (10%)[48]. Figure 3 below demonstrates that within NYC's five boroughs, asthma rates are highest among Medicaid recipients (who must be low income in order to qualify for the program). Asthma rates are also reported higher in certain neighborhoods: Hunts Point and Longwood-Morrisania in the Bronx; East Harlem in Manhattan; Carroll Gardens-Red Hook in Brooklyn; and Arverne in Queens[49].

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Asthma Prevalence Rates Among New York City Medicaid Recipients (per 1000 Medicaid enrollees)						
	SFY 2008 - 2009		SFY 2012 - 2013		5-year Percentage Change	
	Recipients	Prevalence Rate	Recipients	Prevalence Rate	Recipients	Prevalence Rate
Bronx	82,279	118.9	103,654	130.2	26%	9.5%
Brooklyn	88,045	83.0	107,729	90	22.4%	8.4%
Manhattan	41,923	96.2	50,536	111.6	20.5%	16%
Queens	53,939	71.3	69,460	78.1	28.8%	9.5%
Staten Island	9,393	91.9	12,172	99.4	29.6%	8.2%
Citywide	279,079	90.1	347,029	98.5	24.3%	9.3%

Figure 3. ("The Prevalence and Cost of Asthma in New York State")

Capital Region

In Albany, bomb trains (trains carrying fuel oil, gas, etc.), freight trucks, and buses contribute to the deteriorating air quality and exacerbate health problems. Albany County had the highest rate of asthma hospitalizations for all ages in the Capital Region of NYS. West Hills/ South End and West End neighborhoods in Albany had 5 times the asthma emergency room rates and 4 times the asthma hospitalization rates than the rest of the state[50].

A study of 2011-2013 hospitalizations in Albany show that minority communities are disproportionately impacted by the bad air quality and were hospitalized for asthma-related symptoms at a higher rate than non-Hispanic whites. Non-Hispanic Black residents were nearly 5 times as likely and Hispanics were about 2 times as likely to be hospitalized for asthma-related symptoms as non-Hispanic Whites (6.9%), per every 100,000 persons[51].

It's evident that low income communities and communities of color across NYS suffer higher rates of asthma, air pollution and other environmental health impacts in their neighborhoods. Although the greatest source of diesel pollution comes from heavy duty trucks (such as freight and waste trucks) and buses make up a minor proportion, this paper focuses on the opportunities to reduce exposure to diesel pollution for children. Therefore, examining school busing in NYS becomes critical, as exposure for children is significant on school buses, the impacts of which are felt disproportionately by low-income children and children of color.

AN OVERVIEW *of* SCHOOL BUSING *in* NEW YORK STATE

School buses are the largest form of mass transportation in the country. Nationwide, there are over 480,000 diesel school buses carrying up to 26 million children to school each day, including 2.5 million students in NYS[5253]. NYS is the largest user of school buses in the country, with over 45,000 buses[54]. This includes buses serving public school students only, who make up 71% of the student population. Once the 630,000 students attending private schools are considered, there are approximately 60,000 total school buses.

Ownership and operation of school bus fleets varies greatly across NYS's 733 school districts. Private schools often own their own bus fleets, while K-12 public schools across the state have various approaches to pupil transportation, including district-owned and operated fleets, contracts with private companies, and even subsidized fares for public transportation. In NYC, about one-third of students ride district owned buses; one-third ride contracted buses; and one one-third ride public transit[55].

School buses are certainly more efficient than using personal vehicles in the transportation of students. In fact, in 2010 the American School Bus Council found that school buses saved parents $6 billion in fuel costs and prevented 2.3 billion gallons of gasoline from being burned[56]. However, school buses tend to be several years old and produce significant air pollution, impacting the health of residents and school children in the areas they serve, and contributing to climate change. According to a 2015 survey, the average retirement age for large (Type C and D) school buses is 16.2 years and 14.6 for smaller models. The average age of full school bus fleets is around 9 years[57].

State and Local Funding for School Busing

Decisions regarding student transportation are hyper-local, as the majority of funding for pupil transportation comes from an individual school district's operating budget. However, the New York State Education Department (NYSED) oversees school districts as they provide pupil transportation services to public and nonpublic schools. NYSED processes 5,000 contracts and extensions each year for the delivery of services by private bus contractors to more than 480 school districts[58]. While a majority of the funding for school busing is allocated at the local, school-district level, NYSED and the NYS Board of Education subsidize these operations. The 2016-17 statewide cost of school busing was approximately $2.8 billion with state aid from NYSED totaling $1.7 billion[59].

To receive non-capital transportation aid, school districts must submit claims to the NYSED. Expenses typically include the cost of transporting students to and from school, bringing students to shared programs at other schools, as well as the costs for a school district transportation supervisor, among others[60]. Transportation routes of less than 1.5 miles are not eligible for state transportation aid[61].

The estimated total of transportation aid for fiscal year 2018-19 is $1.78 billion, including Summer Transportation Aid[62]. In addition to non-capital transportation aid, the NYSED has also appropriated $105.9 million dollars dedicated to capital expenditures during the fiscal year of 2018.

The NYS State Board of Education also includes appropriations to fund transportation services under certain circumstances. Under the School Safety Zone Law, if a child lives within a school safety zone (which is a designated area within the school) the pupil may be provided transportation; however the transportation must be authorized by the Board of Education.

Routes & Distance

School districts have significant discretion regarding distance limitations under NYS's Education Law and the Commissioner's decisions. According to Education Law section 3635 (NYS EL 3635), districts must provide transportation to students who reside within 15 miles of the school. City school districts are permitted but not legally required to provide transportation. The law says that students in grades K-8 who live within two miles of the school may be required to walk, while students in grades 9-12 may be required to walk a distance of up to three miles[63].

NYLCV estimates that New York City School Buses emit as average 113,850 tons of greenhouse gases per year.

NYS EL 3635 does not contain a maximum length of time that a pupil may be expected to spend riding on a school bus. However, it is widely accepted that the en route time must be reasonable. Some factors that are considered: age of the pupil, distance between home and school, safety, efficiency, cost, available buses, the number of schools on a particular trip, and the opening and closing times of schools. Many districts attempt to limit the time en route to one hour, but there are situations because of distances traveled where it is not possible to complete the trip within one hour. A trip of one and a half hours, in particular situations, was not considered unreasonable[64].

Student Transportation in Albany

In the Albany City School District, total enrollment for the 2016-2017 school year was 8,997 students. Nearly 5,000 of those students depended on school buses and Capital District Transportation Authority (CDTA) to travel to and from school. All eligible elementary students are transported in school buses, operated by First Student Inc. while older students are provided CDTA bus passes.

Students are eligible for these services if they reside 1.5 miles or more away from their school[65]. Children may also qualify if they live in a designated transportation zone or a child-safety zone or if no CDTA routes are available in their area. First Student and CDTA buses transport students to 80 schools within the Capitol Region, including 38 public and charter schools in Albany[66].

Student Transportation in NYC

In NYC, there are 10,350 buses that travel 9,000 routes and transport 147,160 students daily, the majority of whom are students with disabilities[67]. There are currently 125 private school bus vendors, which receive $1.2 billion annually and serve 8,000 routes in NYC. Free transportation is offered to students in Grades K-2 if they live a half mile or more away from their school. Children in grades 3-6 must reside one mile or more from their school to be eligible for school busing.

Half-fare for public transportation is offered to students who live closer to their schools. Children in grades K-2 are eligible for half fare discounts if they are less than ½ mile from their school; and students in grades 3-6 are eligible for half fare if they reside between ½ - 1 mile from their school[68].

Children in grades 7–12 are generally not offered free transportation except in a small number of cases where public transit is unavailable. Instead, students are offered free fare privileges on public transit if they live one and a half or more miles from school and half fare if they reside between a ½ - 1 ½ miles from school. Certain exceptions may be granted by the Office of Pupil Transportation for students in grades 7 and 8 to use contracted bus service for elementary schools[69]. If a pupil is eligible for a MetroCard for public transportation, then they are not eligible for transportation on a contracted school bus.

As NYC's Department of Education (NYC DOE) exclusively uses contracted bus services, additional requirements are set on bus routes. Each bus route cannot exceed a total one-way route distance of five miles. Bus routes must be designed to ensure that students do not spend more than 90 minutes on a bus within a single borough (in each direction) and no more than 115 minutes if they are to travel between boroughs. However, it is required that bus routes not operate across borough and county lines[70]. In the case that "limited travel time" is specified as medically necessity for a student as part of their Individualized Education Program, they will be assigned to a short route or a bus that makes fewer stops[71]. However, there is an exception to this rule for students with disabilities, who often travel longer routes between boroughs to get to their specialized schools, often resulting in extremely long travel times.

Based on the research conducted by the New York League of Conservation Voters (NYLCV), most, if not all, school buses operating in NYC burn diesel fuel. Using the methodology

of US PIRG in their recent report, *Electric Buses: Clean Transportation for Healthier Neighborhoods and Cleaner Air,* NYLCV estimates that a school bus emits, on average, 11 tons of greenhouse gas in a year[72]. The NYC Department of Education has reported a total of 10,350 buses in 2017. Assuming that both reports are accurate, this suggests that New York City school buses emit an average of 113,850 tons of greenhouse gases per year. Over 16 years—typical bus's lifetime—this would equate to 1.8 million tons of greenhouse gases.

THE CASE *for* ELECTRIC SCHOOL BUSES

Environmental

In the U.S. roughly 95% of school buses run on diesel, which means that 95% of all school buses currently on the road contribute to diesel pollution[73]. In fact, if we were to replace all diesel school buses with all-electric models, the U.S. would eliminate an average of 5.3 million tons of greenhouse gas emissions in a single year[74]. Over 16 years, which is the average lifespan of a school bus, electric buses could eliminate 84.9 million short tons of GHG emissions. Reducing our GHG emissions not only improves the air quality in local communities, but it also helps NYS meet its emission goals and limits our contribution to global climate change.

Buses that run on natural gas are considered a viable alternative to diesel school buses, and while they are an improvement, the benefits of natural gas over electric, are overstated. Even if there are near-zero emissions emitted from natural gas buses, the extraction process of natural gas still contributes GHG and often the sites of natural gas extraction experience lower air quality and hazardous health impacts. Electric school buses are ultimately the cleanest and safest option for communities and the environment[75]. We must also transition our electric grid to greener methods of generation, including solar, wind, hydropower and others, instead of coal, which is a major GHG contributor.

Health

Numerous studies show that breathing diesel pollutants has negative impacts on human health. In 2001, a National Resources Defense Council (NRDC) study, *No Breathing in the Aisles*, estimated that 23 to 46 of every million children may eventually develop cancer from the diesel exhaust that they inhaled while traveling on a school bus. The study also found that levels of diesel exhaust inside school buses was up to 4 times higher than those in passenger cars, and that the levels were 8 times higher than a sample of average California air[76]. This study, along with others and various grassroots movements, led to the implementation of state-level and national policies regarding diesel emissions. A notable example is the passage of Diesel Emissions Reduction Act (DERA), part of the Energy Policy Act of 2005, which appropriates funds for programs that reduce diesel emissions.

These policies have made some improvement in children's health and rates of childhood asthma; however they have not eradicated the problems associated with diesel pollution. In 2015, University of Michigan and University of Washington researchers showed that children had improved lung function and lower absenteeism after schools adopted cleaner fuels and technologies. Absenteeism decreased by 8% and there was a 16% decrease in lung inflammation among children who were able to ride on retrofitted school buses. Children already with asthma showed greater improvements, with a 20-30% decrease in lung inflammation. The researchers estimated that

As technology improves and the market expands, the upfront costs of electric school buses will continue to decrease. In fact, every all-electric school bus that is currently on the road was at least partially funded by grant opportunities and partnerships.

changes in technology and fuel could reduce absenteeism by more than 14 million missed school days a year when they extrapolated their findings to the total US population[77].

Economic

Electric school buses are on the rise as improvements in technology and increased market competition offer school districts more options. The initial investment costs, which may have overwhelmed many school districts in the past, no longer pose an insurmountable barrier to using electric school buses. As technology improves and the market expands, the upfront costs of electric school buses will continue to decrease.

Additionally, electric school buses offer greater long-term savings than diesel buses[78]. Estimates from the public bus sector report that lifetime costs of a diesel bus are $1.4 million, versus an electric's $1 million[79]. According to the American School Bus Council, districts pay an average of $6,600 each year in diesel fuel costs for every school bus in operation[80]. The fuel efficiency of traditional diesel school buses is about 7 miles per gallon[81]. Electric school buses can get the equivalent fuel efficiency of 17 miles per diesel gallon. They estimate that replacing the 95% of diesel school buses in the U.S. with electric models could save more than $3 billion in diesel costs for U.S. school districts[82]. Another potential benefit—which is currently being explored in California and White Plains, New York—is the possibility of using electric buses as backup batteries for the electric grid. In theory, school districts could generate revenue from electric utility companies by offering their fleets as energy storage units[83].

One recent pilot project in the Lakeville School District in Minnesota demonstrated the economic possibilities of electric buses. Lakeville Schools' transportation company estimates the lack of maintenance and diesel costs will make up for the initial cost of purchasing the bus in 12 years or sooner, depending on potential technology and market changes[84]. Lakeville, like many other school districts, was able to alleviate some of initial cost of electric school buses through a "self-funded" program, which divided the financial costs for the bus between the bus company and the electric companies[85]. In fact, every all-electric school bus that is currently on the road was at least partially funded by grant opportunities and partnerships. Information on funding and financing programs is provided in the Funding Opportunities section.

The Market For Electric Buses

Electric buses are increasing in popularity and accessibility. In 2017, the number of electric buses grew by 83% in the U.S. and this trend is expected to continue in the coming years[86]. Electric power is an increasingly viable option as the cost of EV battery technology decreases, thereby allowing power storage. For example, a Proterra-owned city transit bus drove more than 1,000 miles on a single charge[87]. However, this trend in transit buses has not yet caught on for school buses.

Several companies, including Blue Bird, Thomas Built Buses, IC Bus, Lion Electric Co., which is part of Lion Bus, and TransTech, are currently manufacturing electric school bus models.

- Blue Bird developed its first model of an electric school bus in 1994 and was awarded a $4.4 million grant from the Department of Energy to develop an electric Type C school bus. The company is also developing several other electric bus types, including a Type D model that will produce zero emissions and drive up to 120 miles on one charge. These buses will most likely be available in late 2018, and according to Blue Bird, several school districts have already placed orders[88].

- Thomas Built Buses proposed their own model of an all-electric school bus, the Saf-T-Liner C2 Jouley. Production will begin in early 2019 for this model, which will operate on an Efficient Drivetrains Inc. PowerDrive 7000 EV powertrain, a system of control software made for electric vehicle operation. The Jouley is estimated to cover around 100 miles on a single charge[8990].

- The IC Bus Company is also developing an electric model. Their bus was created as a product of combined efforts between Volkswagen and Navistar. Their type C model, "chargE," is expected to have a 120 mile range. Manufacturing of this model will most likely start in 2019 and will be available for purchase in 2020[9192].

- Based in Quebec, the Lion Electric Co. developed a Type C electric school bus that can drive up to 155 miles on one charge. However, this model still relies on fossil fuels for heating. Currently, Lion has deployed over 150 of the eLion Type C school buses. They have also developed an all-electric mini school bus, or Type A model that runs on 100% electric power and does not require additional fossil fuel sources. The company recently delivered 13 Type C buses to Ontario and 5 Type A mini buses to White Plains[9394].

- TransTech developed the eSeries Type A bus in collaboration with Motiv Power Systems. The model is a zero-emissions electric school bus and has been released in the Sacramento area. Motiv Power Systems is seriously committed to freeing buses from dependence on fossil fuels[9596].

FUNDING OPPORTUNITIES

Volkswagen Settlement

In September 2015, the EPA sued the manufacturer Volkswagen (VW) for cheating federal emission tests. VW admitted to fraudulently rigging software to bypass pollution control systems. The illegal tampering resulted in certain vehicles releasing dangerous diesel emissions, up to 40 times the EPA compliance level, thus polluting our air. After being sued by the U.S. Government, a settlement was reached that stipulates VW must pay $14.7 billion for remediation efforts to curb excessive diesel emissions. Of that, $2.7 billion was set aside for the establishment of Mitigation Trusts in impacted states for the implementation of clean transportation programs. NYS received $127 million, which will be managed by NYS's Department of Environmental Conservation (DEC).

The Illinois Environmental Protection Agency is making a significant investment in electric school buses, and using the entire $10.8 million sum awarded to the state from the VW settlement on a plan to purchase up to three dozen plug-in buses and distribute them to school districts throughout the state. As reported by Energy News Network, this would be the largest dedicated investment in electric school buses using VW settlement funds in the nation and could potentially prevent 2.2 tons of harmful NOx, a potent greenhouse gas, from entering the atmosphere each year[97]. NYLCV's Education Fund (NYLCVEF) has been raising awareness about the benefits of electric school buses and asking Governor Cuomo and the DEC to invest NYS's settlement in electric school buses for children in environmental justice communities.

On September 5, 2018, NYS DEC released its mitigation plan for the VW settlement. Investments in clean transportation and the electrification of vehicles has been allotted a significant portion of the funding. The DEC estimates that the projects will reduce lifetime NOx emissions by at least 4,500 tons, the equivalent of removing 65,000 automobiles off the roads per year for the next decade. Further, the replacement of buses, trucks and other equipment with electric vehicles (EVs) will reduce CO2 emissions by 130,000 tons over the lifetime of these vehicles[98].

Of the 10 total eligible projects under the VW settlement, DEC earmarked 40%—approximately $52.4 million—the largest portion of the mitigation plan, for reducing diesel emissions from buses. These funds will be made available for projects that include eligible Class 4-8 School buses, shuttle buses and transit buses.

Up to 500 vehicles are anticipated to be replaced with newer diesel engines, alternative fuel, or all-electric models. The plan estimates the implementation of 100 all-electric buses and 400 new alternative fuel, electric, or diesel powered school, transit, and/or paratransit buses. Electric school buses, in particular, will be implemented within and near environmental justice communities based both on economic feasibility and community demand[99].

Federal Programs

DERA administered by the EPA, includes the Clean Diesel program, which provides support for projects that reduce diesel emissions and improve air quality. It offered grants and rebates worth up to $100 million annually through Fiscal Year 2016, and was reduced to $40 million through 2018. Additionally, the Clean School Bus Act of 2010 led to the creation of the School Bus Rebate Program (also a program of DERA administered by the EPA), which offers funding to help districts pay for buses that operate on

alternative fuels. This program was designed to encourage school bus fleet turnover so that more children have the opportunity to ride on buses that have been retrofitted for reduced emissions[100]. The program provided more than $7 million to replace and retrofit old school buses in 2017, but future funding is less certain.

The Congestion Mitigation and Air Quality (CMAQ) Improvement Program provides flexible funding for state and local governments for projects that help reduce air pollution in areas that exceed clean air standards. Funding of more than $2 billion a year is available through CMAQ through 2020.

State and Local Programs

New York State Energy Research and Development Authority (NYSERDA)'s Clean Air School Bus program was one attempt by NYS to mitigate the environmental and health burdens associated with diesel school buses. The program allowed different school districts to apply for funding for bus replacements and/or retrofitting. NYSERDA targeted its funding to ensure the greatest possible emissions reductions. However, when researchers at Cornell University examined the Clean Air School Bus program, they found it lacked equity in the distribution of resources. The study showed that there was a significant correlation between socioeconomic status of the school district and its likelihood to receive funding. The study's equity evaluation factored in racial and socioeconomic variables, such as race demographics of school enrollment, median household income, the poverty index as well as school district size and population density and the air quality attainment status at the school district level. It recommended that state programs be designed to ensure equitable and fair distribution of resources to all racial and socioeconomic group[101].

NYSERDA's New York Truck-Voucher Incentive Program was created to help reduce the cost of vehicles for truck and bus fleets operating in NYS. In 2017, there was $9 million available in voucher incentives for electric vehicles, including school buses. The program covers up to 80% of incremental costs, but cannot exceed $150,000 per vehicle. Future funding for this program is uncertain.

The NYC Alternative Fuel Vehicle-Voucher Incentive Fund has $6 million available in voucher incentives for alternative fuel vehicles. Eligible technologies include Class 2-8 EVs and all-electric conversions, Class 2b-8 hybrid vehicles and conversions, Class 2-8 CNG vehicles and conversions, and DER technologies. The fund can cover 80% of the incremental cost but cannot exceed $40,000 per vehicle/conversion of hybrids; $50,000 for V/C CNG; $60,000 for V/C All-Electric; 80% of cost of Tech and Installation Costs for DER Techs. Eligible vehicles must be registered, garaged and operate 70% in NYC's five boroughs[102].

The Zero Emission Vehicle (ZEV) and Fueling Infrastructure Rebates for Municipalities Program, administered by DEC, provides rebates to cities, towns, villages, and counties (or boroughs of NYC) for costs associated with the purchase or lease (for at least 36 months) of eligible clean vehicles, and installation of eligible infrastructure which supports public use of clean vehicles. The maximum rebate of up to $5,000 per vehicle can be used toward the cost of an eligible clean vehicle. For infrastructure projects not publically owned, the municipality can obtain a climate change mitigation easement from the owner of the property pursuant to Environmental Conservation Law (ECL) §54-1513[103].

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PATHWAYS FORWARD *in* NEW YORK CITY

Cities in the U.S. and around the world are taking the lead by committing to transition to cleaner and more efficient electric bus fleets[104]. School districts are also starting to electrify their buses. There are over 55 electric school buses currently on the roads nationwide, mostly in California. All electric buses have been funded through federal, state and/or private programs. Opportunities for electrifying school buses in NYC are explored below.

Pilot Programs

The largest pilot program in the country is currently underway in California, providing 3 school districts with 29 electric buses from e-Lion, TransTech and Motiv Power Systems. In 2016, four school districts in Massachusetts became the first state outside of California to purchase electric school buses—four in total—made by e-Lion[105]. In the fall of 2017, the first electric school bus (also manufactured by e-Lion) arrived in the suburbs of Minneapolis-St. Paul, Minnesota[106].

In the summer of 2018, the White Plains City School District in Westchester County, NY announced a pilot program for electric school buses administered by the bus contractor National Express, with five e-Lion buses. Con Edison and National Express purchased both the buses and charging infrastructure using NYSERDA's Truck Voucher Incentive Program. According to the Rockland/Westchester Journal News, the school district's contract with the utility company did not increase[107]. This pilot program is taking advantage of vehicle-to-grid (V2G) technology to advance the sustainability and affordability of the pilot even more. Using V2G, the school buses will be plugged into the electricity grid during the summer months, thereby supplementing the grid during peak demand. Con Edison will then pay National Express to use the buses for storing the electricity. NYC's Office of Pupil Transportation could pursue a pilot of this sort.

Worker Owned Cooperatives

A worker owned cooperative is another viable option. Worker cooperatives (co-ops) are businesses that put the values and interests of its workers and communities above all else. Workers at a co-op participate in the profits and decision-making of the business typically through a democratic process. Over the past 50 years, this model has been adopted and shown to be effective for improving quality of life for workers and generating wealth in industries such as agriculture, banking, and insurance, in countries all around the world.

Despite the global success of co-ops, the school bus industry has remained stubbornly unchanged. From training to a lack in technological advancements and limited collaboration between bus companies and the communities they serve, there has been a significant need for innovation in this industry.

Bus vendors operate in a consolidated market where there is limited incentive to improve services, adopt new technologies and communicate with families and workers. Busing services are paid for by school systems but experienced by families, who have little say in the contracting process. Contracts have primarily been awarded based on price with student needs and interests as a secondary concern.

A cooperatively owned and operated electric school bus company could be a solution to the current state of busing. An electric school bus only co-op would be controlled by the workers at the company, with representation on the board from the families served as well as advocates in transportation, environment and education. This would allow the workers and families to have ownership of the company, thus having a say in its operations.

Our local leaders are starting to develop an interest in electrifying buses. NYC Mayor Bill De Blasio has publically supported a transition to a 100% electric fleet and the NYC Council has invested over $9 million in worker cooperative development. A co-op could do more than just electrify its bus fleet; it could also reinvest in enhanced training and support for bus staff and at the company call center. Overall, this initiative is a way of re-imagining bus contracting and the bus ride itself to be more appealing and healthy for workers, students and their families.

Legislation

NYC Council could also use their legislative power to influence a transition away from diesel school buses. One such bill, Int. No. 455, was introduced in 2018 by Council Member Daniel Dromm of Queens. This bill seeks to phase out the use of all school buses that do not use a closed crankcase ventilation system—which protects the air inside the bus—by September 1, 2020. The bill also requires that all other school buses eventually be replaced by CNG, hybrid or all electric models after 10 years of use. Use of CNG or hybrid school buses is also limited to just 10 years of operation and must eventually be replaced with a zero emission school bus option. This bill has been referred to the Committee on Environmental Protection where it awaits a hearing.

CONCLUSION

Given the harmful environmental and public health impacts of diesel pollution, particularly on children, switching to cleaner alternatives is more critical than ever. Especially now that electric bus technology is advancing and becoming more available, leader states and cities, like NYS and NYC must step up and set an example for other states to follow. This paper laid out potential pathways forward for electrifying our state's school bus fleets. To make progress on these recommendations, key stakeholders, including environmental groups, school leaders, state, city and town officials, utility companies, bus manufacturers, and others must work together for the sake of our climate and our future generations.

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