Clean Buses for New York Kids

How Electric School Buses Can Create Healthy Communities, Good Jobs, and Clean Rides for Kids in New York

By Ian Elder, Jobs to Move America

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Executive Summary

Before the COVID-19 pandemic, more than 2 million New York students relied on the state's 46,000 school buses to get to and from school each day. The vast majority of these school buses are powered by diesel engines, which are major producers of toxic emissions and greenhouse gases, with an outsized impact on children, school bus workers, and environmental justice communities.

Electric school buses (ESBs), which emit no tailpipe pollutants, have proven effective in the field and have been successfully deployed at two sites in New York State. ESBs are available with ranges large enough to cover most school bus routes; planning, learning, and coordination are necessary for successful ESB deployment.

The largest barrier to widespread deployment of ESBs is price: ESBs currently cost triple the price of comparable diesel buses. Many ESB operators have reported lower fuel and maintenance costs for ESBs, and ESBs have the potential to earn revenue by providing vehicle-to-grid (V2G) services; however, these cost savings are not yet enough to make ESBs affordable. The best way to hasten the transition to ESBs is to provide significant purchase subsidies, which will boost production and lower prices over time.

Some federal ESB funding has come from the Diesel Emissions Reduction Act and the Congestion Mitigation and Air Quality Improvement Program, which helped fund two major pilots in New York. At the state level, New York has recently released funds from the Volkswagon settlement for electric school buses through its New York Truck Voucher Incentive Program, which will help fund up to fifty ESBs.

Job quality standards in automotive manufacturing have decreased over the last several decades; at the same time, jobs in New York school bus operations have been at risk. State laws that prohibit best-value contracting in school bus contracting and commodities purchasing make it harder for the state to promote good jobs. By enacting progressive procurement practices, New York can maintain job quality for school bus drivers, attendants, and technicians; create good jobs in ESB manufacturing; and ensure that marginalized workers have access to these opportunities.

School buses are well suited to electrification: they have relatively short duty cycles and lower range requirements than many other fleet vehicles. Operators must coordinate with their utilities on the installation of charging equipment, electricity pricing, and potentially the provision of V2G services. The New York Public Service Commission's make-ready order provides valuable funding for infrastructure and fleet assessment services.

V2G can potentially provide crucial revenue to school districts and play an important role in providing the storage necessary to incorporate renewable energy sources. However, the technology is in very early stages of implementation; ConEdison's school bus V2G pilot may be the only deployment in the state so far.

POLICY RECOMMENDATIONS

New York State Policies

- Create a large and stable funding stream for electric school buses. One promising avenue is the New York Climate and Community Investment Act, under consideration in the 2021 legislative session. It would use proceeds from a price on air pollutants to fund environmental initiatives, including ESBs, and advocates are pushing for it to include progressive procurement policies to create good green jobs.
- Adopt California's groundbreaking zero-emission vehicle mandate for manufacturers: the Advanced Clean Trucks regulation. Passing the regulation would create important market signals and help hasten the transition for school buses and other medium- and heavy-duty vehicles.
- Create a New York Jobs Plan for school bus procurements to promote good jobs and inclusive hiring in school bus manufacturing and to incentivize manufacturers to produce locally.
- Require best-value procurement for school transportation contracts. Best-value procurement for school bus services would allow fleet operators to compete on quality and community benefits, not just price, and would improve job quality and stability for school bus drivers, attendants, and technicians.

New York City Policies

- Facilitate the creation of a major ESB pilot. So far, the city has purchased two ESBs. However, the city has the opportunity to lead on ESBs by deploying eight to twelve buses.
- Pass a citywide electric school bus mandate. A mandate may be the fastest and most efficient way to ensure a quick transition to ESBs, which will provide major environmental health benefits to New York children and to the communities where school buses operate. As of February 2021, there was a proposal before the City Council to mandate a transition to electric school buses; this report suggests that an even faster transition may be possible.
- Implement an electrification policy for any municipalized school bus operations. In 2020 the New York City Department of Education created a new nonprofit organization to take over the operations of a major city school bus contractor. New York City can lead the way on school bus electrification by setting an aggressive policy to transition the organization's fleet to ESBs while promoting good jobs through progressive procurement practices.

Introduction

Every day, New York's school buses safely transport more than 2 million students to and from school. Thanks to school buses, students in New York can get to and from school even when they live far away and their parents are unable to drive them. But yellow school buses have a big disadvantage: as heavy-duty, diesel-burning vehicles, they impose major environmental and health burdens on the students, drivers, technicians, and communities they come into contact with. Technological fixes, such as particulate matter filters and oxidation catalysts, have significantly cut some of the worst pollution. But even with these improvements, modern diesel buses emit harmful quantities of particulate matter, nitrogen oxides, and carbon monoxide while also contributing to our consumption of greenhouse-gas-emitting fossil fuels.

Fortunately, we are now at the cusp of a technological development that could eliminate the negative impacts of school bus pollution in the near future. Electric school buses (ESBs) emit little or no tailpipe pollution,[1] and their total emissions of greenhouse gases are much lower than diesel buses, particularly in relatively low-carbon electrical grids such as New York's.[2]

The potential advantages of electrifying our school bus fleets are enormous. In addition to the health and environmental benefits, ESBs present a valuable opportunity to create high-quality jobs. Progressive procurement policies and effective organizing can help ensure that the jobs created in the heavy-duty electric vehicle (EV) supply chain are safe, pay well, and provide career opportunities for people from underrepresented populations, including women, Black workers, Indigenous workers, other workers of color, veterans, and formerly incarcerated people.

Electric school buses provide the opportunity to increase access to high-road jobs and to improve the environment while providing students with safe, healthy rides to school. This report presents an overview of the state of ESB technology and examines available funding sources, grid considerations, and policy pathways that advocates, parents, workers, school districts, and policymakers can pursue to promote the deployment of ESBs in a way that creates the maximum benefit for New York residents.

Section I: School Bus Services in New York

USE OF SCHOOL BUSES IN NEW YORK

Before the COVID-19 pandemic, New York State's school bus fleets transported approximately 1.8 million public school students, representing 71 percent of the state's public school population.[3] New York school districts also transported more than 600,000 private school students daily—more than any other state. There are approximately 46,000 yellow school buses in the state, second only to Texas, which has roughly 48,000.[4] New York's school buses represent 9.6 percent of school buses in the nation.

If New York converted its school bus fleet to electric vehicles, it could lead a much-needed revolution in the student transportation sector, eliminating students' exposure to dangerous emissions from combustion engines in the very vehicles that are meant to transport them safely to school. It would also make a significant impact on the state's carbon footprint and, if done right,

[1] Some ESBs use fossil fuel–powered heaters, which emit pollution; others rely on electric heaters, which completely eliminate bus emissions but decrease vehicle range.

[2] Ready for Work: Now Is the Time for Heavy-Duty Electric Vehicles (Cambridge, MA: Union of Concerned Scientists, 2019), 7, *https://www.ucsusa.org/sites/default/files/2019-12/ReadyforWorkFullReport.pdf.* Because a lot of electricity is still generated through the combustion of fossil fuels, electric vehicles still cause greenhouse gas (GHG) emissions; the less carbon-based a state's grid is, the greater the reduction in GHG emissions compared to diesel vehicles.

[3] "Pupil Transportation Statistics," School Bus Fleet, 2020, *https://www.schoolbusfleet.com/download?id=10117405&dl=1.*

[4] "Pupil Transportation Statistics."

Figure 1. A Type A school bus. Photo by Kentaro Toma on Unsplash.

help create good green jobs in New York and other manufacturing centers in the country.

As in most states, school bus procurement in New York is a highly dispersed process because it is mostly managed by school districts or by the private companies that many school districts hire to run their transportation operations. School districts manage approximately half of New York State's school bus operations; the other half of school bus operations are contracted out. In New York City, contractors perform all school bus operations.[5]

The state does play several important roles in student transportation, however. The state Department of Education approves bus purchases by districts as well as proposed transportation contracts. The state also subsidizes a substantial portion of districts' transportation costs through state aid. The Office of General Services (OGS) negotiates statewide commodity purchase contracts with school bus dealers, and districts are encouraged to take advantage of these contracts.

Legal Requirements

Relative to the rest of the United States, New York relies heavily on school buses to transport its students. In large part, this is because most districts are required to provide transportation, even to private school students.[6] At a minimum, most districts must provide transportation for younger students living at least two miles from school, or three miles for high school students.

Many school districts provide transportation more generously than required. For example, Rochester, Syracuse, and Yonkers all provide transportation for students living more than 1.5 miles from school, and sometimes closer for younger students. New York City provides bus service for K–2 students living at least a half mile from school and for students in grades 3 to 6 living at least a mile away. Older students receive free public transit passes.[7]

All schools are required to provide transportation for students with disabilities to attend special classes and programs, as specified by their individualized education plans.[8] In many cases,

[5] This may be changing: the Department of Education has created a nonprofit organization to run some school bus operations. This development is discussed in more detail in Section IV.

[6] New York State Education Law, Section 3635.

[7] New York City Chancellor's Regulation A-801.

[8] New York State Education Law, Section 4402(4)(a).

special education students receive home-to-school service.

Nationwide, school buses are replaced an average of every fifteen years for Type C and D (standard and large) school buses and every fourteen years for Types A and B (small buses).[9] If New York were to replace all its retiring buses in a given year with ESBs, it would need to procure more than three thousand of them—more than the current combined ESB manufacturing capacity of two of the three main North American ESB makers: Lion Electric and Blue Bird.[10]

SCHOOL BUS TERMINOLOGY

School buses are divided into Types A, B, C, and D, according to their size and shape. Type A is the smallest school bus. These buses are often used to transport special education students, who often receive door-to-door service.[11] Drivers sometimes refer to these as vans.

Type C buses are conventional school buses with the engine in front of the windshield.[12] Type B buses are in between Types A and C in size; they are relatively uncommon.

Type D buses are also called transit-style buses. They seat the largest number of passengers. There are currently several models of ESBs of Types A, C, and D.

STUDENT TRANSPORTATION OCCUPATIONS IN NEW YORK

The main occupations in school bus transportation are transportation manager or director, driver, attendant, and technician. In New York there are approximately 49,390 school bus drivers—slightly more than one per bus. In 2018 school bus drivers in the state earned a mean hourly wage of $20.11.[13] School bus monitors, also known as attendants or matrons, help keep students on the bus safe and often assist students with special needs. There are approximately 19,430 school bus monitors in New York, and in 2018 these workers earned a mean hourly wage of $15.06.[14]

School bus technicians make up a much smaller portion of the workforce, with an average of one technician for every twenty-two school buses in a fleet.[15] If this ratio holds in New York, there are approximately 2,100 school bus technicians in the state. According to an industry survey, these employees earn an average of $19.90 per hour.[16] School bus drivers, attendants, and technicians in New York are often represented by unions, including local affiliates of the Amalgamated Transit Union, the Transport Workers Union, and the International Brotherhood of Teamsters.

One manufacturer of school buses is located in New York. Trans Tech is located in Warwick, manufactures Type A school buses (including an all-electric model), and employs more than sixty workers. According to the company, it sells between six hundred and eight hundred school buses a year and had sold twenty electric school buses as of February 2021.[17] The statewide economic impact of school bus manufacturing is not limited to Trans Tech, however, since the company uses several New York suppliers.

Section II: Economics and Performance of Electric School Buses

By far, the biggest barrier to the wide-scale deployment of electric school buses is cost. Currently, an ESB costs at least three times as

[9] "Maintenance Survey," School Bus Fleet, March 2020, *https://www.schoolbusfleet.com/download?id=10117417&dl*.

[10] Both manufacturers claim the capacity to make one thousand electric school buses per year.

[11] Michael Cordiello (president, Amalgamated Transit Union Local 1181-1061), conversation with author, August 19, 2020.

[12] New York Codes, Rules, and Regulations, Title 17, Section 720.1.

[13] "Occupational Employment and Wages, May 2018, 53-3022 Bus Drivers, School or Special Client," US Bureau of Labor Statistics, *https://www.bls.gov/oes/2018/may/oes533022.htm*.

[14] "Occupational Employment and Wages, May 2019, 33-9098 School Bus Monitors and Protective Service Workers, All Other," US Bureau of Labor Statistics, *https://www.bls.gov/oes/current/oes339098.htm*.

[15] Nichole Schlosser, "Maintenance Survey 2020," School Bus Fleet, *https://www.schoolbusfleet.com/maintenance/10117417/maintenance-survey-2020.*

[16] Schlosser, "Maintenance Survey 2020."

[17] Miguel Ortiz (sales staff, Trans Tech), email correspondence with author, February 4, 2021.

Figure 2. A Type C school bus. Photo by Tomas Eidsvold on Unsplash.

Figure 3. Type D school buses. Photo by James Day on Unsplash.

much as an equivalent diesel bus. The New York State–negotiated contract price for a standard-size diesel Blue Bird Vision Type C school bus is $105,743; the price of the electric version from the same dealer is $345,765.[18] In addition to the price of the bus, the cost of installing the necessary infrastructure can be substantial. Costs vary widely depending on the technology used and the characteristics of the bus yard, but infrastructure can cost a fleet operator anywhere from $2,000 to $80,000 per bus.[19]

The best way to reduce the ESB price differential is to expand the market through reliable subsidies. Across a wide range of technologies, prices historically tend to drop dramatically as production increases.[20] For example, the price of electric vehicle batteries has dropped steeply over the past decade. Bloomberg New Energy Finance reported in 2019 that prices had already fallen by 87 percent compared to 2010, from more than $1,100 per kilowatt-hour (kWh) to $156 per kWh, and predicted that by 2023 prices would fall by an additional 35 percent, to $100 per kWh.[21]

Electric school buses can have lower fuel and maintenance costs than diesel buses, which can result in significant savings in operating costs. Because ESB engines are more efficient than diesel engines, they are often much cheaper to fuel—depending on the relative costs of diesel fuel and electricity. In practice, results from ESB pilot projects have been positive but mixed as fleet operators have become more adept at making full use of planned charging tools (discussed further in Section V).

Maintenance costs for ESBs are also expected to be lower than those for diesel buses because of the relative simplicity of electric motors and the cleanliness of electricity as a fuel. However, most of the ESBs currently in use are still under warranty, and it will take time to get a comprehensive sense of ESB maintenance costs.

Although ESBs can potentially provide significant savings on fuel and maintenance costs, these savings can vary dramatically, and fleet operators will need to perform their own assessments. Electric utilities and bus dealers can be valuable resources for districts attempting to better predict these cost savings. For the time being, savings on fuel and maintenance are currently too small to make up for ESBs' higher purchase and installation costs. All in all, we are probably still at least ten years away from having accurate total-cost-of-ownership estimates for ESBs.

A final potential cost mitigator is the development of vehicle-to-grid (V2G) services. Because school buses have large batteries and long, predictable periods during which they are not being used, they may be able to generate revenue by providing services to the electric grid, such as releasing electricity back to the grid during peak usage hours. Such services are cutting edge and cannot yet be counted on for revenue, but they appear promising. For example, Dominion Energy plans on subsidizing more than one thousand electric school buses in Virginia to benefit from ESB energy storage capabilities. Vehicle-to-grid considerations, including a V2G demonstration project in White Plains, are discussed further in Section V.

In terms of performance, ESBs have proven to work reliably for fleet operators that have overcome the challenges of paying for them. Anecdotally, many ESB operators reported that they experienced problems in the first few months after putting their buses into service

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[18] "40524-23000 School Buses: Award Summary," New York Office of General Services, September 15, 2020, *https://online.ogs.ny.gov/purchase/spg/pdfdocs/4052423000Summary.pdf*.

[19] Costs Associated with Non-Residential Electric Vehicle Supply Equipment (Washington, DC: US Department of Energy, 2015), *https://afdc.energy.gov/files/u/publication/evse_cost_report_2015.pdf*. The largest determinant of this cost is whether the operator chooses Level 2 AC chargers or Level 3 DC fast charging. DC chargers can be three times as fast as AC chargers but are between three and eighteen times more expensive to purchase and install. ESBs can use either type, but not all models can use both.

[20] Béla Nagy, J. Doyne Farmer, Quan M. Bui, and Jessika E. Trancik, "Statistical Basis for Predicting Technological Progress," PLoS ONE 8, no. 2: e52669, *https://doi.org/10.1371/journal.pone.0052669*.

[21] "Battery Pack Prices Fall as Market Ramps Up with Market Average at $156/kWh in 2019," BloombergNEF, December 3, 2019, *https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/.*

but that they were able to resolve these issues fairly quickly by working with the manufacturer or dealer. For example, ESB deployments in White Plains (in Westchester County) and Bay Shore (in Suffolk County) both faced initial challenges in cold weather, which led to some downtime early on. In both cases, the fleet operators were able to fix the issues and achieved high reliability thereafter.[22]

Section III: Funding Investments in Electric School Buses

We've seen that cost is the main barrier keeping school districts from investing widely in electric school buses, and experience shows that the best way to bring down cost is to manufacture at scale. Manufacturing ESBs at scale, however, is a challenge when school districts cannot afford to purchase them in the first place. This chicken–egg problem illustrates the need for smart, serious government investment in electric school buses. This section describes national and state-level funding streams that are currently available to support ESB purchases and to help drive economies of scale.

NATIONAL FUNDING SOURCES

Volkswagen Diesel Emissions Environmental Mitigation Trust Fund (VW Funds)

From 2006 to 2015, Volkswagen engaged in a scheme to evade Environmental Protection Agency (EPA) emissions requirements on several of its vehicles.[23] The EPA sued the company, and in 2016 the company agreed to settlement payments totaling up to $14.7 billion.[24] One of these payments included establishment of a $2.93 billion trust fund to support the replacement of diesel engines with cleaner technology.[25] New York was allocated $127,691,807 from the VW funds. Of this amount, $52,411,527 (41 percent) has been dedicated to the replacement or repowering of transit buses, shuttle buses, and school buses.[26]

In its beneficiary mitigation plan, the New York State Department of Environmental Conservation (DEC) stated its intent to use the money to purchase approximately one hundred all-electric transit buses and "400 new electric, alternative fuel, or diesel-powered school and paratransit buses." The plan stated a preference for all-electric technology when possible and that priority would be given to environmental justice communities. DEC's plan also includes funding for school bus chargers, commonly known as electric vehicle supply equipment (EVSE).[27]

Diesel Emissions Reduction Act (DERA)

The Diesel Emissions Reduction Act (DERA) is a federal statute enacted as part of the US Energy Policy Act of 2005. Implemented by the EPA, DERA provides three lines of funding for new ESBs: the National Grants Program, the School Bus Rebates Program, and the State Grants Program.

The State Grants Program, while helpful for diesel mitigation, provides funds on the order of $500,000 to New York annually—not enough to support significant ESB purchases. Similarly, the School Bus Rebates Program has been successful in helping replace thousands of the nation's oldest and worst-polluting buses; however, until late 2020, the subsidy of $15,000 to $20,000 was too small to support ESB

[22] See the White Plains case study in Section V and the Bay Shore case study in Section III.

[23] Jack Ewing, "Volkswagen Says 11 Million Cars Worldwide Are Affected in Diesel Deception," New York Times, September 22, 2015, *https://www.nytimes.com/2015/09/23/business/international/volkswagen-diesel-car-scandal.html*.

[24] Hiroko Tabuchi and Jack Ewing, "Volkswagen to Pay $14.7 Billion to Settle Diesel Claims in US," New York Times, June 27, 2016, *https://www.nytimes.com/2016/06/28/business/volkswagen-settlement-diesel-scandal.html*.

[25] "Volkswagen Clean Air Act Civil Settlement," *https://www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement*.

[26] "VW Environmental Mitigation Trust—Semi Annual Report," New York State Department of Environmental Conservation, January 16, 2020, *https://www.vwenvironmentalmitigationtrust.com/sites/default/files/2020-01/NY%20Semi%20Annual%20Report%20July%20to%20Dec%202019%2001162020.pdf.pdf*.

[27] Clean Transportation NY (Albany: New York Department of Environmental Conservation, 2019), 19, *https://www.dec.ny.gov/docs/air_pdf/vwcleantransportplan19.pdf*.

purchases. In October 2020, the EPA announced a higher level of funding for ESBs—up to $65,000.[28] This increase is a significant improvement and could help fund the purchase of ESBs if combined with state and local funding sources.

In contrast, DERA's National Grants Program provides the most robust support for diesel emission reduction projects. Funds are awarded on a competitive basis to government entities and transportation nonprofits, and the maximum funding request per application is $2.5 million.[29] National Grants allow for federal funding of up to 45 percent of the cost of an electric bus.[30] Projects are prioritized according to a number of factors, including fleets operating in areas with poor air quality and fleets serving environmental justice communities.[31] Grant recipients can combine DERA funds with state or local subsidies but cannot combine DERA funds with other federal grants or with VW fund money.[32] Contractors cannot apply for DERA grants, but school districts can apply for grants for buses that may be used by their contractors.

In 2020 the program planned to award approximately $44 million in funds[33] and between two and eight grants in each of the ten EPA regions. EPA Region 2, which includes New York, New Jersey, Puerto Rico, and the US Virgin Islands, was slated to receive $4.3 million.

For a school district lucky enough to win a DERA National Grant (such as Bay Shore; see box), this program could enable the purchase of several electric school buses. However, as a competitive grant program with limited funding spread out across a broad range of projects, the National Grants Program would need to be significantly expanded to play a meaningful role in facilitating ESB deployment around the country.

Congestion Mitigation and Air Quality Improvement Program

The Congestion Mitigation and Air Quality Improvement Program (CMAQ) is another federal funding source states can use to subsidize purchases of electric school buses. Administered by the Federal Highway Administration (FHWA), the program distributes funds to state governments, which use the money to pay for projects that reduce congestion and improve air quality in nonattainment areas.[34] The program funds up to 80 percent of the incremental cost of alternative fuel vehicles (for instance, about $190,000 for a Type C bus), which is likely enough to achieve parity in total cost of ownership between ESBs and diesel school buses.

The FHWA estimated that New York would receive $197,491,169 in CMAQ funding in 2020.[35] Of that amount, the New York State Department of Transportation (NYSDOT), which administers the state's CMAQ funds, allotted $10 million to the New York Truck Voucher Incentive Program (NYTVIP), which supports school bus purchases (discussed below).[36] Even though the CMAQ program can pay for up to 80 percent of the incremental cost of electric vehicles, NYSDOT has set much lower subsidy limits for electric school buses funded through NYTVIP using CMAQ funds (approximately $120,000 for a Type C bus).

NEW YORK STATE FUNDING SOURCES

New York Truck Voucher Improvement Program

The NYTVIP is the most valuable subsidy reliably available to New York school bus

[28] 2020 Diesel Emissions Reduction Act (DERA) School Bus Rebates Program Guide (Washington, DC: US Environmental Protection Agency, 2020), *https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P101030H.pdf*.

[29] 2020 DERA National Grants Request for Applications (Washington, DC: Environmental Protection Agency, 2020), *https://www.epa.gov/sites/production/files/2019-12/documents/2020-dera-national-grants-competition-12-2019.pdf*.

[30] 2020 DERA National Grants, 29.

[31] 2020 DERA National Grants, 1–2, 19.

[32] 2020 DERA School Bus Rebates Program Guide, 27.

[33] 2020 DERA National Grants, 1.

[34] "Congestion Mitigation & Air Quality Improvement Program (CMAQ)," Federal Highway Administration, March 2016, *https://www.fhwa.dot.gov/fastact/factsheets/cmaqfs.pdf*. Nonattainment areas are areas that do not meet national ambient air quality standards for ozone, carbon monoxide, or particulate matter.

[35] "Estimated Highway Apportionments Under the FAST Act," Federal Highway Administration, 2016, *https://www.fhwa.dot.gov/fastact/est-fy20162020apports.xlsx*.

[36] New York Truck Voucher Incentive Program Implementation Manual (Albany: New York State Energy Research and Development Authority, 2020), 7, *https://portal.nyserda.ny.gov/servlet/servlet.FileDownload?file=00Pt000000R4WXbEAN*.

Case Study

Bay Shore Schools and Suffolk Transportation Service Electric School Bus Deployment

Suffolk County in Long Island is home to New York's second-largest deployment of electric school buses to date. The Bay Shore School District and its contractor, Suffolk Transportation Service (STS), worked together to successfully apply for a DERA National Grant of $695,500, which helped pay for four fifty-five-passenger Type C electric Blue Bird buses and the necessary chargers and infrastructure.[37]

According to Richard Gallagher, director of transportation at Bay Shore Schools, the buses currently work very well, after some initial difficulties operating in wintry conditions.[38] For example, some of the electronic controls did not work in the cold, and low temperatures reduced battery performance. STS and Bay Shore Schools successfully solved both issues by affixing wind blockers to the fronts of buses and wrapping batteries in blankets.[39]

The contractor and the district have the buses running regular routes, with approximately three-hour duty cycles. Two of the buses have to charge in the middle of the day to complete their shifts.

Overall, Gallagher said he was delighted to be able to transport students in clean buses at no additional cost to the district.

John Corrado, STS's president, stated in November 2019 that his company was looking to bring ESBs to Brentwood and Central Islip schools shortly.[40] According to Gallagher, STS upgraded its bus depot to be able to charge ten ESBs, which required installing a new transformer.

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[37] "New York Contractor, District Roll Out 4 Electric School Buses," School Bus Fleet, November 22, 2019, *https://www.schoolbusfleet.com/news/736497/new-york-contractor-district-roll-out-4-electric-school-buses*.

[38] Richard Gallagher (transportation director, Bay Shore Schools), conversation with author, September 22, 2020.

[39] Richard Gallagher, conversation with author.

[40] Rachel O'Brien, "Bay Shore Goes Green and Saves Some Green with Conversion to All-Electric Buses," Newsday, November 20, 2019, *https://www.newsday.com/long-island/suffolk/bus-electric-epa-grant-carbon-footprint-1.38733204*.

operators seeking to replace old diesel school buses with battery electric school buses. The program is administered by the New York State Energy Research and Development Authority (NYSERDA), a state agency that works to deploy clean energy, with technical assistance from CALSTART, a nonprofit consultant. The NYTVIP uses money from the VW funds and CMAQ to provide vouchers for point-of-sale discounts for low- and zero-emission vehicles. Until December 2020, only CMAQ funds were available for electric school buses; however, on December 29, 2020, NYSERDA announced that it would start to make Volkswagon funding available for school buses as well.

School districts and fleet operators can now use NYTVIP funding from either source; however, the advantage of VW funds is that they provide much larger vouchers: up to $200,000 for a Type C bus,

as opposed to $120,000 using CMAQ funds.[41] For both funding sources, the size of the voucher depends on the size of the bus. As of the end of 2020, only one school district, White Plains, had taken advantage of NYTVIP funds, and it did so with additional financial and technical support from ConEdison. The new, larger vouchers using VW funds will likely make it possible for many districts and contractors to afford to invest in ESBs for the first time. NYSERDA announced an initial investment of $2 million, with additional investments to come and plans to fund a total of approximately fifty ESBs.[42]

NYTVIP vouchers require that purchasers scrap a currently operating, older diesel bus for each discounted bus they buy.[43] This requirement to scrap old buses guarantees that heavy-polluting diesel buses are taken off the road forever; however, it can also be a challenge for some bus fleets seeking to purchase electric school buses.[44] Some operators use newer buses and typically sell and replace buses before the end of their useful lifetimes. This practice would preclude these fleets from using NYTVIP money.[45]

The NYTVIP school bus voucher is designed to ensure that the new buses it funds are equitably distributed. Funds are split equally between upstate and downstate. The program limits the school bus vouchers to five per school district, except in New York City, which could have up to twenty. (The district total includes both contractor-owned and district-owned buses.) Contractors are limited to twelve buses total, even if they serve several school districts. Finally, school buses purchased under the program must either be domiciled within designated disadvantaged communities or serve such communities.

Section IV: Procurement of School Buses and School Bus Services

In addition to practical considerations such as funding and performance, transitioning to electric school buses involves a range of overlapping policy issues. In particular, this section discusses the critical importance of using inclusive procurement in the transition to ESBs to ensure that the public gets the most benefit from its investment.

Student transportation is a public service, paid for by the public. We, our families, and our neighbors are the ones who fund, benefit from, and are impacted by the choices our elected officials make in how our children are transported to and from school. School bus procurement policy can have a major impact in at least three different ways: it can dramatically improve air quality and health outcomes for students and neighborhoods; it can help ensure high job quality for school bus drivers, attendants, and technicians; and it can help create good jobs for the workers who manufacture school buses.

Electric School Buses for Healthy Children and a Better Climate

Diesel bus emissions have serious negative impacts on the health of students who ride the buses. Studies have shown that particulate matter pollution is more severe inside the cabin of a bus than outside the bus or on the roadway.[46] Because of their growing lungs, children may be especially susceptible to developing or exacerbating respiratory illnesses from diesel

[41] New York Truck Voucher Incentive Program Implementation Manual, 17.

[42] Adam Ruder (NYSERDA staff member), conversation with author, August 4, 2020. NYSERDA provided an additional $500,000 in this round of VW funding to give discounts for compressed natural gas school buses; see New York Truck Voucher Incentive Program Implementation Manual.

[43] New York Truck Voucher Incentive Program Implementation Manual, 24. Model years 1992–2009 qualify for replacement.

[44] Richard Gallagher, conversation with author.

[45] This requirement applies to all NYTVIP vouchers, whether funded by CMAQ or the VW funds. It is a legal requirement of all VW funds but not of CMAQ funds generally.

[46] Sara Adar, Jennifer D'Souza, Lianne Sheppard, Joel D. Kaufman, Teal S. Hallstrand, Mark E. Davey, James R. Sullivan, Jordan Jahnke, Jane Koenig, Timothy V. Larson, and L. J. Sally Liu, "Adopting Clean Fuels and Technologies on School Buses," American Journal of Respiratory and Critical Care Medicine 191, no. 12 (June 15, 2015): 1413–21, *https://dx.doi.org/10.1164%2Frccm.201410-1924OC*.

exhaust.[47] Cleaner buses are associated with lower absenteeism rates and higher test scores.[48]

The depots where school buses park are major sources of pollution, with negative impacts for school bus employees and local communities. Every day, drivers, attendants, and technicians are exposed to high levels of emissions at bus depots.[49] According to New York Lawyers for the Public Interest, school bus depots in New York City are predominantly located in environmental justice communities that are already impacted by severe air pollution.[50]

Now that electric school bus technology is available, we have the unprecedented opportunity to radically reduce the emissions that students, workers, and families are exposed to. The faster we are able to transition to ESBs, prioritizing the communities most severely impacted by pollution, the faster we will be able to improve environmental justice outcomes and provide healthier rides to school for our children.

Good Jobs for School Bus Drivers, Attendants, and Technicians

Contracting out school bus operations is a common choice for school districts in New York, especially for large-city school districts. In such cases, the district hires a company to own and operate school buses on its behalf. Unfortunately, school districts are currently required by state law to award transportation contracts to the lowest bidder,[51] which makes it challenging for districts to ensure that contractors maintain good job quality standards or use ESBs.

The issue is especially acute in New York City, where all school bus operations are contracted out and school bus workers currently face serious job instability due to the state's bidding rules.[52] The city bids its school bus contracts out by routes, which means that companies can gain or lose business depending on how many routes they win. Companies that lose routes have to lay off employees.

For more than three decades, it was industry practice for the city's Department of Education to require companies to rehire laid-off workers at their previous wage levels, but in 2011 the New York State Court of Appeals decided that the practice violated state law.[53] Since that time, nonunion contractors have underbid incumbent companies, resulting in mass layoffs of experienced school bus workers. With the school transportation industry on the cusp of a revolution in school bus technology, now may be the opportune time to improve school bus contracting practices as well.

High-Road Manufacturing for Electric School Buses

Manufacturing is still a critically important sector in New York as well as in the United States as a whole. Historically, it has been a major source of well-paying jobs; manufacturing jobs still pay better than comparable nonmanufacturing jobs.[54] Currently, manufacturing represents 5.9 percent of private-sector jobs in the state, and in eight New York counties it represents more than 25 percent of all jobs.[55]

Unfortunately, manufacturing faces major constraints and trends that limit the sector's potential to be an equitable source of good jobs. First of all, although manufacturing

[47] John Wargo, Children's Exposure to Diesel Exhaust on School Buses (North Haven, CT: Environment & Human Health, 2002), *https://www.ehhi.org/reports/diesel/dieselintro.pdf*.

[48] Wes Austin, Garth Heutel, and Daniel Kreisman, "School Bus Emissions, Student Health, and Academic Performance," Economics of Education Review 70 (June 2019): 109–26, *https://doi.org/10.1016/j.econedurev.2019.03.002*.

[49] Michael Cordiello, conversation with author.

[50] Testimony of Justin Wood before the New York City Council Committee on Education, October 16, 2018.

[51] New York State Education Law, Section 305.

[52] The New York City Department of Education is in the process of municipalizing one of its contractors through a nonprofit organization. The change will affect approximately 10 percent of its school bus routes.

[53] L&M Bus Corp. v. New York City Dept. of Education, 17 NY3d 149 [2011].

[54] Susan Helper, Timothy Krueger, and Howard Wial, Why Does Manufacturing Matter? Which Manufacturing Matters? (Washington, DC: Brookings Institution, 2012), *https://www.brookings.edu/wp-content/uploads/2016/06/0222_manufacturing_helper_krueger_wial.pdf*.

[55] Ken Pokalsky, Manufacturing by the Numbers: A Profile of New York's Manufacturing Sector by Jobs, Wages and Regional Impact (Albany: Public Policy Institute of New York State, 2018), *http://www.ppinys.org/reports/2018/18-0142-PPI-Manufacturing-by-the-Numbers-Report.pdf*.

has provided good jobs to many people with and without college degrees, it has often disproportionately excluded certain groups, including women, people of color, and formerly incarcerated people.[56] Making efforts to include these communities in job and apprenticeship opportunities would address these inequities and ultimately benefit companies that choose to develop a diverse and highly skilled workforce.[57]

Second, many US manufacturers have pursued strategies that focus on compensating employees as little as possible. For example, many firms have moved to regions of the United States with weak labor rights standards; others have used staffing agencies to avoid paying workers benefits.[58] These strategies have shrunk wages and worsened working conditions for many employees in the manufacturing sector and have limited the potential of firms to compete on innovation and quality. Alternatively, manufacturers could pursue high-road strategies, provide continuous training and compensation to their employees, and seek employees' collaboration. Highly skilled workers improve the ability of firms to innovate and respond to consumer and industry demands.[59]

Government has a role to play in promoting a diverse workforce in manufacturing, and one of the policy options that can help achieve this is inclusive procurement. Agencies can use inclusive procurement policies to give preference to manufacturers that practice equitable, inclusive hiring and that create high-quality, lifelong careers for people from all backgrounds. New York can transition to clean electric school buses and create good inclusive jobs at the same time; doing so will take committed organizing by New Yorkers and bold leadership by elected officials.

The policies outlined below represent components of a comprehensive plan to electrify New York's bus fleet, protect good school bus jobs, and ensure high standards for school bus manufacturing work. None of these policies alone will achieve all these goals; however, they are useful building blocks for an effective school bus procurement policy that will improve the lives of families and workers across New York.

STATEWIDE POLICIES

Create a Reliable Funding Stream for Electric School Buses

The most serious obstacle to deploying ESBs is funding. Without large and reliable subsidies, it is currently impossible for districts to afford ESBs. At the same time, creating a heavy and consistent demand for ESBs will be one of the most effective ways to drive down their price. Unfortunately, securing funding during the COVID-19 pandemic could prove harder than ever, with state and local budgets cut to the bone.

One promising way to solve this puzzle is to create new streams of funding that are directly connected with combating pollution and climate change. California has had major success with this approach so far: the state has already used smog abatement fees, license plate surcharges, and cap-and-trade auction proceeds to subsidize the purchase of hundreds of ESBs. These policies work as both a disincentive to pollute and as a source of investment in clean technologies.

New York's environmental and social justice advocacy communities are working to follow California's example and even improve on its model. In 2019 a broad coalition called NY Renews successfully pushed for the passage of the Climate Leadership and Community Protection Act (CLCPA), which set aggressive greenhouse gas reduction targets for the state. (Jobs to Move America is a member of NY

[56] Robert Pollin, James Heintz, and Jeanette Wicks-Lim, Strengthening US Manufacturing through Public Procurement Policies (Amherst, MA: Political Economy Research Institute, 2015), *https://www.peri.umass.edu/publication/item/download/605_a6fd493d6b-72d04391e94f421be0f501*.

[57] Cedric Herring, "Does Diversity Pay? Race, Gender, and the Business Case for Diversity,"American Sociological Review 74, no. 2 (April 1, 2009): 208–24, *https://doi.org/10.1177%2F000312240907400203*.

[58] Catherine Ruckelshaus and Sarah Leberstein, Manufacturing Low Pay: Declining Wages in the Jobs That Built America's Middle Class (New York: National Employment Law Project, 2014), *http://stage.nelp.org/wp-content/uploads/2015/03/Manufacturing-Low-Pay-Declining-Wages-Jobs-Built-Middle-Class.pdf*.

[59] Helper et al., Why Does Manufacturing Matter?

Renews.) The coalition is currently promoting a measure called the Climate and Community Investment Act (CCIA), which would help achieve the CLCPA's targets by putting a price on pollutants and using the proceeds to invest in green technologies, reduce the state's carbon footprint, and create family-supporting jobs.

If the CCIA is passed, it could provide an ideal funding source for ESBs. Advocates are pushing for the CCIA to include a version of the US Employment Plan (discussed below) and a policy called the Local Employment Plan, which together would encourage fair compensation and inclusive hiring for many of the jobs the act creates. Passing the CCIA, along with dedicated funds for replacing old diesel school buses with ESBs, would help accelerate deployment of ESBs across the state and create good jobs in school bus manufacturing.

California has also implemented a low carbon fuel standard, which is a price incentive for less climate-intensive transportation fuels such as electricity. New York is considering joining a similar program: the Transportation Climate Initiative (TCI), a multistate cap-and-trade agreement that would cap the sale of gasoline and diesel fuel. If implemented, TCI could potentially provide funding for electric school buses. However, environmental justice advocates have argued that the proposal is not tailored to addressing disproportionate impacts of pollution in marginalized communities.[60]

Implement Advanced Clean Trucks in New York

To transition as quickly as possible to ESBs, it will help to not only increase demand through subsidies but also to increase supply by setting zero-emission vehicle targets for manufacturers. Subsidies can temporarily boost the market for a new technology and hopefully result in enough increased production to drive down prices. Mandatory targets, on the other hand, set clear expectations for manufacturers and electric utilities, providing market certainty, which makes it easier to plan for investments in electric vehicles and EV infrastructure.[61] State EV mandates have so far proven highly effective at increasing adoption of electric passenger vehicles.[62]

In June 2020, the California Air Resources Board adopted the Advanced Clean Trucks (ACT) regulation, which requires that a certain percentage of the heavy-duty road vehicles each manufacturer sells in the state be zero-emission vehicles. These percentages increase each year, from 9 percent of new sales in 2024 to 75 percent of new sales in 2035.[63] It has been estimated that ESBs will achieve total cost of ownership parity with diesel buses between 2025 and 2030, which may mean that ESBs could transition much more quickly than the time frame specified in the ACT rule. However, the regulation will be extremely valuable in helping transition the entire medium- and heavy-duty vehicle sector in California to zero-emission vehicles on a predictable time scale.[64]

The ACT rule is possible because the federal Clean Air Act allows California to obtain a waiver to adopt emissions regulations stronger than federal standards without being preempted by federal law. Other states, in turn, may adopt whatever rules California passes without fear of federal preemption.[65] New York Senate Bill S8765A, introduced in 2020 by former state

[60] Sarah Shemkus, "Justice Advocates Keep Pressure on Transportation Emission Pact Planners," Energy News Network, October 15, 2020, *https://energynews.us/2020/10/15/northeast/justice-advocates-keep-pressure-on-transportation-emission-pact-planners/*.

[61] Matthew N. Metz and Janelle London, "State Vehicle Electrification Mandates and Federal Preemption," Michigan Journal of Environmental & Administrative Law 9 (2020): 433–82, *https://doi.org/10.36640/mjeal.9.2.state*.

[62] Lia Cattaneo, Plug-in Electric Vehicle Policy: Evaluating the Effectiveness of State Policies for Increasing Deployment (Washington, DC: Center for American Progress, 2018), *https://www.americanprogress.org/issues/green/reports/2018/06/07/451722/plug-electric-vehicle-policy*.

[63] California Air Resources Board, Final Regulation Order—Advanced Clean Trucks, submitted January 29, 2021, *https://ww3.arb.ca.gov/regact/2019/act2019/fro2.pdf*. These percentages would apply to Type C and Type D school buses; requirements for Type A school buses would start at 5 percent in 2024 and increase to 55 percent by 2035.

[64] Conner Smith, Electric Trucks and Buses Overview (Washington, DC: Atlas Public Policy, 2019), *https://atlaspolicy.com/wp-content/uploads/2019/07/Electric-Buses-and-Trucks-Overview.pdf*.

[65] Clean Air Act, Public Law 88-206, 88th Cong., 1st sess. (December 17, 1963), Section 209, 42 U.S.C. § 7543.

senator Jen Metzger, would implement the ACT regulations in New York. Also in 2020, New York committed to work with fourteen other states and the District of Columbia to rapidly transition to zero-emission medium- and heavy-duty vehicles; adopting a mandate such as the ACT rule could be an important step toward meeting that commitment.[66]

Create a New York Jobs Plan for School Bus Procurements

New York can use inclusive procurement policies to help cultivate a high-road manufacturing sector for school buses. Half of the state's school buses are purchased, owned, and operated by school districts; if the state were to use inclusive procurement practices, it could have a significant positive impact on school bus manufacturing.[67]

One example of inclusive procurement in practice is the US Employment Plan (USEP), which several transit agencies, including the Metropolitan Transit Authority (MTA), have used to promote good jobs and inclusive hiring in the manufacture of transit buses and trains. When agencies include the USEP in their requests for proposals (RFPs), they allow manufacturers to improve their chances of selection by committing to creating jobs with family-sustaining wages and inclusive hiring practices.[68]

Following the model of the USEP, the state could create a New York Jobs Plan (NYJP) policy to improve jobs in school bus manufacturing and create good jobs in New York. To implement such a policy, agencies would include provisions in their RFPs for school buses that require bus dealers to include NYJPs, with information about the wages and benefits of manufacturing workers, the number of jobs to be created, and how they plan to hire inclusively. Manufacturers with strong NYJPs would receive extra points in the bid evaluation process.

New York currently has centralized procurement for district-owned school buses, and legislation will be necessary to incorporate NYJPs into the process. School districts have the power to purchase their own buses, a process that is typically managed by the district's transportation director. However, districts are highly encouraged to purchase their buses using contracts established by the state's OGS,[69] which will not approve expenditures greater than the state contract price.[70]

Although OGS does not directly purchase school buses, it issues competitive solicitations for bus dealers and signs contracts with the lowest bidder. State agencies and school districts can then purchase school buses from dealers using statewide contracts. OGS's current statewide school bus contract, which extends through November 30, 2021, includes ESB models for Types A, C, and D. Only government entities, such as school districts, can purchase vehicles through OGS contracts.[71]

Having a statewide contract for school buses is a helpful tool for school districts; however, this process could be even more beneficial if OGS were able to incorporate inclusive procurement practices. Currently, state law requires that contracts for commodities be awarded to the

[66] "Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding," NESCAUM, July 13, 2020, *https://www.nescaum.org/documents/multistate-truck-zev-governors-mou-20200714.pdf*.

[67] "Pupil Transportation Statistics," School Bus Fleet, 2017–18, *https://www.schoolbusfleet.com/download?id=10117405&dl=1*.

[68] The USEP was developed by experts at Jobs to Move America, the Brookings Institution, the University of Southern California's Program for Environmental and Regional Equity, and the Political Economy Research Institute and was approved by the US Department of Transportation for use by transit agencies. For a discussion of how the USEP has been used to promote good jobs in transit bus and train manufacturing, see Jobs to Move America's report on battery electric transit buses: Christy Veeder, "Transforming Transit, Realizing Opportunity," Jobs to Move America, July 2019, *https://jobstomoveamerica.org/resource/transforming-transit-realizing-opportunity/*.

[69] "Pupil Transportation Economical and Efficient Practices," New York State Education Department, April 19, 2018, *http://www.p12.nysed.gov/schoolbus/TransDirector/htm/economical_practices.htm*.

[70] Or the statewide median cost if there is no state contract for the vehicle. Kathy Beardsley, R. Fiddemon, M. Los, S. Morrison, M. Mosher, D. Rowe, and J. Tamburello, Reference Guide to Transportation Aid (Castleton, NY: State Aid & Financial Planning Service, October 2020), 11, *https://www.questar.org/wp-content/uploads/2020/10/Final-Reference-Guide-Transportation-Aid-Guidebook-2020-21.pdf*.

[71] "School Buses (Statewide): How to Use This Contract," New York Office of General Services, December 2016, *https://online.ogs.ny.gov/purchase/spg/pdfdocs/4052423000HowToUse.pdf*.

BODY MAKE	BODY MODEL	BUS TYPE	SELLERS	PRICE
Trans Tech	SST	Type A	Leonard Bus Sales	$312,765.08
Collins Bus	DH500	Type A	WNY Bus Parts/ Factory Direct Bus Sales	$292,231.60
Microbird	G5	Type A	New York Bus Sales/JP Bus & Truck Repair	$229,655.32
Blue Bird	Vision	Type C	New York Bus Sales/JP Bus & Truck Repair	$345,764.79
Thomas Built	C2	Type C	Matthews Buses/ Nesco Bus and Truck Sales	$347,893.72
Blue Bird	All American	Type D	New York Bus Sales/JP Bus & Truck Repair	$362,605.42

Table 1. Electric buses available for purchase using New York OGS's statewide school bus contract. Source: "40524-23000 School Buses: Award Summary," New York Office of General Services, September 15, 2020, *https://online.ogs.ny.gov/purchase/spg/pdfdocs/4052423000Summary.pdf*.

lowest bidder, but legislation could require state agencies such as OGS to use best-value contracting when purchasing rolling stock or machines.[72] Unlike lowest-bidder contracting, best-value contracting allows officials to evaluate bidders on price as well as on past performance, labor practices, environmental considerations, and other relevant factors. Using best-value procurement would allow OGS, or any other agency that procures school buses, to give preference to bidders that make NYJP commitments to offer family-supporting wages and benefits, and take active steps to hire workers from marginalized populations.

Require Best-Value Procurement for School Transportation Contracts

State law should be amended to require school districts to award bus contracts according to best value, which is the bidding method used by most state agencies for service contracts.[73] School transportation requires skill, experience, and enormous care. Bus drivers and attendants work directly with New York's children and are responsible for creating a safe environment for them as they go to and from school. The lowest bidder is not necessarily the highest quality; in many cases, the exact opposite may be true.

School districts should be allowed to determine what additional factors beyond price to consider when awarding school bus contracts, and labor practices should explicitly be permitted as a consideration. Employees who are fairly compensated and respected at work are likely to be happier and better at their jobs, and good employers are more likely retain skilled, experienced drivers, attendants, and technicians. Best-value contracting for school transportation contracts would help ensure that New York students receive the best possible services.

[72] New York State Finance Law, Section 163(3)(a)(2).

[73] New York State Finance Law, Section 163(4)(d).

Case Study

New York City Department of Education Electric Bus Pilot

New York City has initiated a small pilot program to test out the use of electric buses. Under the pilot, the city's Department of Education (DOE) budgeted $1.25 million to replace four gasoline-powered buses with Type A electric buses, which the DOE plans to operate.

The DOE is working with the Department of Citywide Administrative Services to purchase the buses using OGS's contracting system, which had only two models of electric buses available at the time the pilot was announced in December 2018. (Now there are six.)[74]

The pilot is intended as a proof of concept to test the functionality of ESBs and "ultimately make a recommendation for the specifications on an RFP should the DOE consider a large scale investment in the future," as Alexandra Robinson, then executive director for pupil transportation at DOE, testified in a hearing on a bill to electrify the city's school buses over time.

The buses were to debut at the start of the 2019–2020 school year. Due to a delay in purchasing the buses, the time frame for deploying the ESBs is uncertain.[75]

[74] Alexandra Robinson, "Testimony of the New York City Department of Education on Int. 455," New York City Department of Education, December 17, 2018, *https://legistar.council.nyc.gov/View.ashx?M=F&ID=6950101&GUID=1492B311-B583-4E3E-BE50-8334D056EE48*.

[75] Clayton Guse, "The City Was Supposed to Have Electric School Buses This Year—They're Nowhere to Be Found," New York Daily News, September 5, 2019, *https://www.nydailynews.com/new-york/ny-environmental-advocates-electric-school-buses-20190905-swoy3m56cnak5k-ciopqmtaekny-story.html*.

NEW YORK CITY POLICIES

Facilitate the Creation of a Major Bus Pilot

Although two of its neighboring counties have deployed ESBs with a high level of success, New York City has so far had limited experience with them (see box). A large, successful pilot in the city would demonstrate to local leaders that ESBs are a viable technology and help build the momentum for a rapid transition to ESBs. Because of the statewide, national, and global attention the city receives, an ambitious pilot could also help build the case for ESBs nationally.

One promising way to implement a pilot would be to use NYTVIP funds to purchase as many school buses as possible under the program and to deploy them through New York City's new nonprofit school bus contractor, New York City School Bus Umbrella Services (NYCSBUS; discussed later in this section). This approach would allow city officials maximum oversight of the program and increase the program's visibility. A pilot of eight to twelve buses would be much larger than the largest deployments in the state but would still likely be small enough for success.

Pass a Citywide Electric School Bus Requirement

Passing a citywide electric school bus requirement would be a strong demonstration of leadership on climate change and environmental justice, and would send a market signal to manufacturers that the largest school bus fleet in the nation is serious about transitioning to electric.

The City Council has already introduced one piece of legislation, Intro 455-2018, which would

phase in ESBs over time. If this bill were passed, starting in the year 2040, all retiring school buses would have to be replaced with ESBs. With citywide standards, school bus companies operating under new or renewed contracts would have to comply with the ESB fleet requirements. However, it is likely that ESBs will achieve cost parity with diesel school buses well before 2040. Parity could be achieved even more quickly if New York leads the way by establishing an aggressive school bus electrification target. Given the rate at which electric school buses are approaching cost parity with diesel buses, this report recommends replacing all retiring school buses with ESBs starting no later than 2025.

Implement an Electrification Policy for Any Municipalized School Bus Operations

The city has initiated a process of municipalizing part of its school bus fleet. In October 2020, Mayor Bill de Blasio announced that a new city-created nonprofit, NYCSBUS,[76] would purchase and take over the operations of Reliant Transportation, one of the city's largest contractors with approximately one thousand buses.[77] The new organization should lead by example by setting an aggressive policy for electrifying school buses. At the same time, the city should promote high-quality jobs in school bus manufacturing by requiring NYJPs when it procures school buses.

ADDITIONAL POLICY CONSIDERATIONS

Any policy to fund ESBs must take environmental justice concerns into consideration. Many lower-income communities and communities of color are disproportionately affected by fossil fuel emissions. Another concern is bus age: even though all diesel buses emit harmful toxins, older school buses can be significantly more harmful than newer ones. When designing ESB policies, prioritizing ESB rollout in frontline communities and making sure that older diesel buses are retired first will result in an ESB transition with greater and more equitable environmental benefits.

Section V: Integrating Electric School Buses with the Grid

The use of electricity for fuel requires EVs to plug into the vast, highly complicated, and fragile electrical grid. Electricity is usually not generated where it is used and requires specialized infrastructure to transport; it is also difficult to store at large scale and so must be used in the exact moment it is generated. The wholesale price of electricity in New York varies every five minutes. Because of the unique challenges of using electricity as a fuel, transitioning a school bus fleet to ESBs is not as simple as replacing rolling stock. Fleets must work with power utilities to ensure that the necessary infrastructure exists and that the operator understands what it will be paying for electricity.

THE ELECTRICAL POWER INDUSTRY IN NEW YORK

Wholesale Energy Markets and NYISO

Historically, power companies were vertically integrated monopolies, which meant that utility companies owned power-generation plants, transmission infrastructure, and distribution infrastructure. Because it is extremely inefficient to duplicate facilities such as transmission towers, power lines, substations, and transformers, power distribution is seen as a natural monopoly and distribution utilities are regulated as such.

Generators of electricity, on the other hand, can successfully compete to create and sell power. For that reason, New York has chosen to deregulate, or decouple, its electricity markets.

[76] This is an arms-length organization, so technically it does not represent a full municipalization. For example, NYCSBUS's school buses will belong to the nonprofit, not the city.

[77] "Mayor de Blasio Announces Long-Term Investment in Bus Transportation for City Students," New York City, October 13, 2020, *https://www1.nyc.gov/office-of-the-mayor/news/710-20/mayor-de-blasio-long-term-investment-bus-transportation-city-students*.

Electricity generators compete in the market to provide wholesale power, which is resold and distributed by utilities. The prices generators charge are determined by electricity markets, which are managed by a nonprofit organization called the New York Independent System Operator (NYISO).

NYISO manages energy and grid services markets that could be valuable for owners of storage, such as ESB fleets, to participate in through V2G (discussed in greater detail later in this section). Fleet operators can also earn V2G revenue through utilities, but independent system operator (ISO) markets could in many cases provide a higher return. It may also be possible for fleets to earn revenue from both the distribution-level (utility) and transmission-level (NYISO) markets at the same time.

Electricity Distribution and the Public Service Commission

The prices that privately owned utilities can charge customers for electricity are tightly regulated by a New York State government body called the Public Service Commission (PSC) and set forth in documents called tariffs. Tariffs are established in quasi-judicial proceedings called rate cases. The public has the right to participate in rate cases. In a rate case, the PSC determines how much a utility needs to charge for electricity to earn what it considers a reasonable return on investment. The main factors the PSC considers are the utility's operating expenses and capital costs. This sounds simple enough, but it is immensely complex in practice.

First of all, not all kilowatt-hours are equally expensive to deliver. The greater the maximum power needed at a site, the more a utility has to spend building the infrastructure to deliver power there. However, figuring out the best and fairest way to charge consumers for higher demand is a difficult policy challenge. For example, it might help the grid in the long run to encourage the use of electric vehicles by charging fleets lower electricity prices. Whether such incentives are allowed is something that could be decided in a rate case.

Second, the prices utilities can charge for delivering electricity are largely based on how much capital investment they make. But what kinds of capital investment are allowed? Could infrastructure for electric school buses count? The answer to this question has important implications for the deployment of electric vehicles.

To integrate with the grid, school bus depots must have the necessary electric infrastructure and communications technology. This includes both electric wiring at the site and the EVSE. Additionally, utilities sometimes have to make upgrades in power distribution to the depot itself.

Normally, consumers are responsible for all upgrades on their side of the meter. This often includes trenching and running wires to the EVSE.[78] Utilities usually pay for the distribution infrastructure leading up to the site. However, if regulators approve what is known as a make-ready program, utilities are able to invest in upgrading infrastructure at the depot as well—everything except for the EVSE itself.[79]

In July 2020, the New York PSC approved a major make-ready program for light-duty vehicles. The program also includes a $15 million make-ready pilot for medium- and heavy-duty vehicles, which, if expanded into a full program, would significantly lower infrastructure costs for school bus fleet operators.

The PSC's make-ready order also adopted a statewide fleet assessment service. The program allows utilities to provide fleets with a full analysis of their customers' electrification proposals, including the costs of upgrading a depot and a description of the possible energy pricing options

[78] "Order Establishing Electric Vehicle Infrastructure Make-Ready Program and Other Programs," New York Public Service Commission, July 16, 2020, *http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B6238DD07-3974-4C4E-9201-3E339E311916%7D*.

[79] Some make-ready programs allow utilities to pay for EVSE, but the New York PSC's order does not.

available to the fleet.[80] School bus fleets planning to electrify should take advantage of this service.

Finally, the PSC regulates how utilities compensate school bus fleet operators for local grid services provided by batteries. These rules play a big role in how much revenue fleet operators can earn from V2G.

Utilities in New York

The four largest electric power distribution companies in the state of New York are, in order of decreasing sales in megawatt-hours:

1. Consolidated Edison of New York (ConEdison)
2. Niagara Mohawk Power Corporation (National Grid)
3. New York Power Authority (NYPA)
4. Long Island Power Authority (LIPA)[81]

ConEdison and National Grid are for-profit corporations known as investor-owned utilities (IOUs). IOUs are regulated by the PSC, and as a group they distribute most of the electricity sold in the state. NYPA and LIPA are state-owned corporations. LIPA has contracted out its management to a for-profit company, the Public Service Enterprise Group (PSEG), which serves under LIPA's authority. NYPA is a different sort of business: its main activities are generating and transmitting electricity (mostly hydro) and selling power to a small number of very large customers, such as the MTA. NYPA also offers a program called ReCharge New York to sell inexpensive hydroelectric power to New York businesses, which could potentially help ESB fleet operators save money on charging.

ELECTRICITY PRICING

To minimize their charging costs, fleet operators should work with their utilities to gain a full understanding of how they will be charged for their electricity usage. Electricity pricing for commercial-scale customers such as schools and electric school bus operators is complex and variable, and operators can often choose from a variety of pricing options.

Electricity costs consist of supply charges and delivery charges. The supply charge is the total cost of energy consumed and depends on the wholesale price of that energy at the time and place it is consumed. (These are the prices determined by NYISO's markets.) Utilities pass this wholesale price directly on to consumers. Delivery charges, on the other hand, are the regulated rates that utilities charge consumers for delivering electricity, and they ultimately pay for the infrastructure that distributes electricity.

To calculate energy bills for commercial customers, utilities take into account both the total energy the user consumes and the customer's maximum power needs. Electric power is measured in watts (W) or kilowatts (1 kW = 1000 W), units that describe the instantaneous amount of work that can be done by the electricity (analogous to horsepower in a gas-powered car). Energy is measured in kilowatt-hours (kWh), and refers to the total work over time that could be done by that electricity (analogous to gallons of gas in a car).

Demand Charges

Unlike residential customers, whose electricity bills mostly depend on the total energy they consume, commercial-scale customers (like electric bus fleets) must also pay demand charges based on the maximum power they draw during a billing cycle. The idea behind demand charges is that delivering more power to a site requires more robust infrastructure (similar to how a fire hydrant needs bigger, heavier pipes than a drinking fountain, even if the fountain uses more water over time).

Electric school bus charging requires a lot of power: 19 kW for a single bus using a Level 2 AC charger and often more than 50 kW for a bus

[80] "Order Establishing Electric Vehicle Infrastructure Make-Ready Program and Other Programs."

[81] Annual Electric Power Industry Report (Washington, DC: US Energy Information Administration, 2018).

ORGANIZATION	TYPE	ROLE	RELEVANCE TO SCHOOL BUSES
New York Independent System Operator (NYISO)	nonprofit	Regulates wholesale energy markets and transmission	Approves tariff that determines the value of transmission-level grid services that V2G-enabled buses could provide
Public Service Commission (PSC)	state government agency	Regulates investor-owned utilities	Regulates what electrification incentives IOUs can provide; approves tariff for distribution-level grid services
New York State Energy Research and Development Authority (NYSERDA)	state government authority	Coordinates and supports research, development, and deployment of energy-efficiency technologies and renewable energy sources	Manages NYTVIP; may manage, coordinate, or promote future programs to incentivize the adoption of electric vehicles
New York Power Authority (NYPA)	state government authority	Operates one-third of New York's transmission lines and generates nearly one-third of its power, mostly through hydroelectric; supplies power to the MTA	Could potentially provide inexpensive power to large electric school bus fleets through the ReCharge New York program
Investor-owned utilities (IOUs) such as ConEdison	for-profit corporations	Provide electrical distribution services to the vast majority of the state	Connect bus depots to grid; provide electric services to fleet owners; provide technical assistance on infrastructure needs and electricity pricing

Table 2 Summary of New York energy organizations and their importance to electric school buses.

using DC fast charging.[82] When a district or bus fleet deploys several ESBs, fueling could result in a significant increase in the fleet's demand charge.

Time-of-Use Rates

Depending on the utility, commercial-scale customers can elect to be billed flat rates for service regardless of when they use electricity or to be billed under a time-of-use rate. The time-of-use rate is much lower during off-peak hours (at night) and higher during peak hours (such as early evening). Time-of-use rates are likely to be favorable to school bus fleets, especially those that can do most of their charging at night. School buses have another advantage when it comes to time-of-use rates: demand charges for off-peak hours can be extremely low during the non-summer months on time-of-use rate plans.

For illustrative purposes, consider a hypothetical bus fleet in ConEdison's service territory (New York City and Westchester County) with ten electric buses with 155-kWh batteries that expend their entire usable capacity every day and charge only at night using 19-kW Level 2 chargers. Assume that buses charge twenty days a month. If the buses are the only item on the electricity bill, an approximate calculation of the monthly delivery charges during the school year,

[82] With smart charging, charging a fleet with DC fast charging could nonetheless be comparable in maximum demand to charging a fleet with AC charging.

DELIVERY CHARGES	RATE I (FLAT)	RATE III (VOLUNTARY TIME-OF-USE)
Customer charge*	$0.00	$12.45
Demand charge—first 5 kW	$152.77	$0.00
Demand charge—more than 5 kW	$3,910.90	$1,035.50
Energy delivery charge**	$520.80	$195.92
Total delivery charges	**$4,584.47**	**$1,243.87**

Table 3 Estimated delivery charges for a ten-bus ESB fleet under two pricing scenarios, using the current ConEdison electricity tariff, service classification 9.[83] *The customer charge is a monthly fee charged to all customers using a given rate plan. **The energy delivery charge is the amount charged by the utility for the total amount of energy used.

according to fixed and time-of-use rate structures, is illustrated in Table 3.[83]

This example also illustrates the importance of demand charges—in both scenarios, they represent the majority of the delivery charge. On top of these charges, the fleet operator would have to pay the supply charge for the energy consumed, which would be the same in both scenarios. Because the buses charge at night, supply charges would be low.

Managed Charging

To take advantage of time-of-use rates and minimize demand charges, it is essential to control when buses charge so that charging takes place during off-peak hours and is spaced out to prevent spikes in power demand. This would be extremely challenging to accomplish through plugging and unplugging buses by hand, but fortunately there is charging equipment and software that can automatically charge buses in an optimal way. The service provided by these systems is called managed charging or smart charging, and it can result in much lower demand charges,[84] lower time-of-use charges, less wasted energy from the charging system, and slower battery degradation.[85] An expert interviewed for this report who works with medium- and heavy-duty electric vehicles emphasized that managed charging is critical for any heavy-duty charging application to avoid excessive fueling costs.[86]

Electric Vehicle Incentive Rates

In some states, utilities have experimented with creating special electricity rates to incentivize fleets to electrify. These incentive rates must be approved by the state's public utility regulators. For example, San Diego Gas & Electric has applied for approval of a special EV high-power charging rate that would provide a discount for DC fast charging and medium- and heavy-duty vehicle charging.[87] However, New York utilities

[83] "Schedule for Electricity Service," Consolidated Edison Company of New York, September 1, 2020, *https://www.coned.com/_external/cerates/documents/elecPSC10/electric-tariff.pdf, 451*. This calculation is for any month in the school year except for June and September, which are more expensive. The calculation assumes that all buses are charged at the same time; however, with managed charging, the maximum power could potentially be reduced from 190 kW to 124 kW, which would significantly reduce the demand charge in both pricing scenarios.

[84] Justine Sears, Bethany Whitaker, and Tom McCarran, Electric School Bus Pilot Project Evaluation (Winooski: Vermont Energy Investment Corporation, 2018), *https://www.veic.org/Media/default/documents/resources/reports/veic-ma-doer-electric-school-bus-pilot-project.pdf*.

[85] Anderson Hoke, Alexander Brissette, Kandler Smith, Anna belle Pratt, and Dragan Maksimovic, "Accounting for Lithium-Ion Battery Degradation in Electric Vehicle Charging Optimization," IEEE Journal of Emerging and Selected Topics in Power Electronics 2, no. 3 (September 2014): 691–700, *https://doi.org/10.1109/JESTPE.2014.2315961*.

[86] James Di Filippo (staff researcher at UCLA Luskin Center for Innovation), conversation with author, September 4, 2020.

[87] John A. Pacheco, "Application of San Diego Gas & Electric Company (U 902-E) for Approval of Electric Vehicle High Power Charging Rate," San Diego Gas & Electric Company, July 3, 2019, *https://www.sdge.com/sites/default/files/regulatory/A.19-07-xxx%20EV%20Application%207%203%2019_0.pdf*.

do not currently offer energy price incentives for fleets.[88]

Encouraging EV use is a long-term strategy of many utilities, and utilities may be willing to experiment with new rate structures in order to incentivize transportation electrification. PSEG Long Island, for example, is piloting a special time-of-use rate for residential customers who charge their vehicles at night but still need to use some power during the day.[89] Additional experience with ESBs may make a case for special rates for electric fleets; for example, rate structures may be designed to give fleets that mostly charge at night some flexibility to charge during the day.

VEHICLE-TO-GRID APPLICATIONS

Because of their size and predictable duty cycles, school buses may be the ideal vehicles for testing and deploying V2G services—in this case having EV batteries provide services to the electric grid. These services include peak shaving, in which batteries release power to the grid during energy peaks to reduce the need to power up additional fossil fuel–burning plants, and frequency regulation, in which batteries charge or discharge to help the grid maintain a constant AC frequency. During the school year, school buses are used for only a portion of the day, and during the summer they often go completely unused. Summer also happens to be when East Coast utilities face the highest constraints and can pay the most for V2G services.[90]

Vehicle-to-grid is not only useful for school bus owners; it will also help improve grid reliability and environmental justice outcomes as we depend increasingly on renewable energy sources such as wind and solar. To keep the grid working properly, the amount of power being generated must always be equal to the amount of power used. This presents a serious challenge for utilities because energy usage and generation are both in constant flux and because utility-scale storage is rare and expensive. The storage provided by off-duty ESBs through V2G could play a major role in evening out peaks in electricity usage and generation.

Another promising way for school districts to generate value from their school bus batteries may be vehicle-to-building (V2B) services. Instead of returning energy to the grid, V2B uses spare energy stored in batteries to lower a school's grid electricity demand during peak periods. It may be easier to implement V2B than V2G; on the other hand, V2B relies on buses having extra energy during peak periods and is only practical for buses that can park at the school—which in many cases excludes schools that use private contractors.

Implementing V2G in New York Electric School Buses

In most cases, the best way for a fleet to start exploring the possibility of implementing V2G is to reach out for assistance in developing a business model. Fleet operators can seek help from nonprofits, consultants, government agencies, utilities, and ESB manufacturers.

It is possible for a fleet operator to offer V2G services to its utility, with NYISO, or both. With the utility, the main approach is to charge the bus when power is inexpensive, at night, and to sell electricity back to the utility when it is most expensive, during the day. The central question for V2G business models with the utility is: Can fleet operators earn more money selling electricity at peak hours than it costs them to charge their buses?

This can be a difficult question to answer. The amount that IOUs pay for energy resources, including batteries, is determined by a formula known as the "value of distributed energy resources" (VDER),[91] which takes into account

[88] Marc Riccio (vice president for sales at Highland Electric Transportation), conversation with author, September 30, 2020.

[89] PSEG Long Island, Utility 2.0 Long Range Plan 2018 Update, 34-35 (Uniondale, NY: PSEG Long Island), 2018.

[90] The Vision for a Greener Grid (Rensselaer: New York ISO, 2020), *https://www.nyiso.com/documents/20142/2223020/2020-Power-Trends-Report.pdf/dd91ce25-11fe-a14f-52c8-f1a9bd9085c2*.

[91] PSEG Long Island isn't regulated by the PSC but by the Long Island Power Authority. It has its own version of VDER that was designed in

several factors: the time- and location-based value of the electricity provided, the ability to decrease energy usage during peaks, the ability to reduce utilities' need for grid upgrades, and the provision of renewable energy. There is currently a range of perspectives within the ESB community about whether the current VDER formula in New York allows a viable business model for V2G.

Vehicle-to-grid with NYISO, on the other hand, often involves the provision of grid services that do not necessarily require batteries to discharge large amounts of energy but may require high power capacity. For NYISO business models, the central question often is: Can the fleet earn enough from providing grid services to offset the higher costs of infrastructure?

Once the fleet operator has a rough idea of the business models it wants to explore, it should reach out to its utility, NYISO, or both to start the process of interconnecting its batteries with the grid.[92] Utilities and NYISO both can provide feasibility studies (for a cost) to determine whether the fleet's plan is technically feasible, what sorts of infrastructure upgrades would be necessary to implement it, and how much those upgrades might cost.

Fleet operators can then refine their business models to include the anticipated infrastructure costs. If they decide to continue, the next step is to formally apply for interconnection with their utility or with NYISO. The interconnection process is what allows an energy resource—anything from an EV battery to a wind farm—to provide energy or services to the grid. It includes a detailed application and study so that the utility or ISO can fully understand the technical specifications of the energy resource and how well the grid at the school bus depot can accommodate the resource.

If the interconnection request is approved, the fleet operator will then work with its utility to install the necessary infrastructure and complete the interconnection process. Although the infrastructure upgrades necessary for V2G are not the same as those needed to charge buses,[93] it may be prudent to time infrastructure upgrades for charging and V2G in a way that minimizes redundant costs.

As of the writing of this report, the one known heavy-duty V2G project in operation in New York was the White Plains/ConEdison electric school bus demonstration project. Experience from the White Plains demonstration project suggests that V2G can be technically challenging to put in place.

The potential for V2G to earn revenue for school districts and improve our grid is considerable. However, before V2G can become widespread in the state, there are challenges to overcome. It is currently possible to interconnect electric school buses to the grid and provide V2G services in New York, at least in some cases.[94] To fully deploy V2G technology, the state should run more demonstrations, establish reliable business models, and refine its regulations. Wide-scale V2G use will also depend on school districts and fleet operators that can take the lead and demonstrate the potential of V2G in practice.

part for consistency with the PSC's program.

[92] Energy Storage Interconnection Guide (Albany: New York State Energy Research and Development Authority, 2020), *https://www.nyserda.ny.gov/-/media/Files/Programs/Energy-Storage/energy-storage-interconnection-guide.pdf*.

[93] Michael Voltz (director of energy efficiency and renewable energy at PSEG), conversation with author, October 7, 2020.

[94] Michael Voltz, conversation with author.

Case Study

White Plains ConEdison Demonstration

ConEdison is running a demonstration project in White Plains in Westchester County. The project is testing out five Lion Electric school buses in daily operations while showing how V2G can work in New York State. This is currently the largest ESB deployment in the state.

The White Plains electric school bus demonstration project is part of a larger New York PSC initiative called Reforming the Energy Vision. The initiative seeks to modernize the state's grid by promoting energy efficiency, renewable energy use, more sophisticated energy markets, and the integration of distributed energy resources, including school bus batteries.

Demonstration Project Details

ConEdison and its partners are attempting to prove the viability of using electric school buses to provide needed grid storage when they are not being used for pupil transportation. If the demo is successful, it could accelerate the adoption of electric school buses by significantly improving their economics.[95]

In this demo, ConEdison is subsidizing the cost of five electric school buses and chargers by 25 percent of their total cost, plus the full costs of implementing V2G technology. The project also took advantage of subsidies from NYTVIP.

The fleet operator, a school bus contractor called National Express, owns the buses and operates them during the school year. During the summer, ConEdison hopes to use the storage capacity of the bus batteries to alleviate peak loads in the afternoon. The buses will charge from 11 p.m. to 5 a.m., when electricity is cheapest and most plentiful. From 1 p.m. to 7 p.m., when energy usage is highest, the buses will send power back into the grid.

Ongoing Results from the Demonstration

ConEdison's demo began in fall 2018 when the five Lion Electric buses entered service. After some initial challenges, ConEdison reported that the buses performed well at transporting students, with high driver satisfaction and 98 percent uptime during the first half of 2019.[96] However, the project faced a number of difficulties implementing V2G and was not able to start testing until fall 2020.

The main problem National Express initially encountered was that after-market heaters installed on the buses resulted in mechanical issues, which temporarily lowered the buses' uptime to 80 percent.[97] After this issue was resolved, the operator reported uptimes of 95–98 percent.

Sergio Alfonso, transportation director for the White Plains School District, reported that he was initially concerned about the buses' ability to handle long or hilly routes and to operate in cold

[95] REV Demonstration Project Outline: Electric School Bus V2G, Initial Project Filing to New York Public Service Commission re: Case 14-M-0101 (New York: Consolidated Edison of New York, 2018), 22.

[96] 2019 2Q Quarterly Progress Report—REV Demonstration Project: Electric School Bus V2G, Project Update to NY Public Service Commission re: Case 14-M-0101 (New York: Consolidated Edison of New York, 2020), 4.

[97] 2018 4Q Quarterly Progress Report—REV Demonstration Project: Electric School Bus V2G (New York: Consolidated Edison of New York, 2019).

weather, and that he had carefully monitored which buses went on which routes. Given the buses' recent performance, however, he said he no longer had those concerns and that he now leaves the buses' use completely up to the fleet operator's discretion. The buses are used on a variety of routes and sometimes on field trips.[98] Given the health and environmental benefits provided by electric school buses, he said, "I'm not going to stop until we have an entire electric fleet."

The implementation of V2G has been more challenging. The project's initial provider of V2G components, BTG, couldn't deliver the necessary computer boards, so the team brought on a new contractor, Nuvve, a San Diego–based company that specializes in charging and V2G technology.[99] By January 2020, it appeared that the project team had mostly resolved its engineering challenges. The team also addressed issues with V2G software that did not originally work as expected.[100] In October 2020, ConEdison completed the interconnection process and was fully ready to begin V2G operations.[101]

Because of these challenges, ConEdison has not been able to fully test one of the most important questions of the pilot: how well the buses' batteries handle the increased volume of charging from V2G. As of September 2020, the team planned to make up for lost time during 2020–2021 by using V2G throughout the school year instead of just during the summer.[102]

In short, the project team has had a high level of success using the buses for transportation and has only had to address minor obstacles. Implementing V2G, however, has required new engineering, suggesting that V2G may still be a cutting-edge technology.

[98] Sergio Alfonso (transportation director, White Plains School District), conversation with author, October 30, 2020.

[99] 2019 1Q Quarterly Progress Report—REV Demonstration Project: Electric School Bus V2G (New York: Consolidated Edison of New York, 2019).

[100] 2019 4Q Quarterly Progress Report—REV Demonstration Project: Electric School Bus V2G (New York: Consolidated Edison of New York, 2020).

[101] 2020 3Q Quarterly Progress Report—REV Demonstration Project: Electric School Bus V2G (New York: Consolidated Edison of New York, 2020).

[102] Brian Ross (project specialist, ConEdison), conversation with author, September 9, 2020.

Conclusion

It is now possible for New York to begin the process of replacing its old diesel buses with clean electric school buses. Electrification can bring enormous benefits for the health of children in New York State and for those living in environmental justice communities. The transition to ESBs can also provide opportunities to create good manufacturing jobs and improve procurement practices in school bus services.

This report has addressed several challenges to deploying ESBs across the state, the foremost being the large price differential between ESBs and their fossil fuel counterparts. The coronavirus pandemic has exacerbated this problem by putting enormous pressure on state and municipal budgets. At the same time, the pandemic highlights the importance of prioritizing public health, especially in low-income communities and communities of color; many such neighborhoods are not only severely impacted by air pollution but also have been the hardest hit by coronavirus.[103] Research by Harvard's School of Public Health suggests that

[103] Samrachana Adhikari, Nicholas P. Pantaleo, and Justin M. Feldman, "Assessment of Community-Level Disparities in Coronavirus Disease 2019 (COVID-19) Infections and Deaths in Large US Metropolitan Areas," JAMA Network Open, July 28, 2020, *https://doi.org/10.1001/jamanetworkopen.2020.16938*.

these problems are not unrelated, as higher estimated lifetime exposure to particulate matter pollution has been associated with higher levels of COVID-19 mortality.[104]

Fortunately, there are promising solutions on the horizon. State proposals to limit greenhouse gas emissions while raising revenue for climate solutions, such as the CCIA, could raise the needed funds for a large statewide deployment of ESBs. In the meantime, VW funds can be used for larger pilot programs, including in New York City. While investing in clean buses, the state can establish procurement standards that help create good jobs with inclusive hiring in school bus manufacturing. Finally, the transition provides a valuable opportunity to rethink school transportation contracting and to implement best-value contracting.

Electric school buses have the potential to improve the air we breathe, reduce climate impacts, and create good green jobs. Together, advocates, workers, and policymakers can work to achieve these outcomes through the transition to ESBs.

METHODOLOGY

This report analyzed current New York state and local regulations along with available data and literature on the operational, economic, and regulatory considerations for school bus fleet operators considering a switch to zero-emission vehicle technology.[105] The report drew from information on the structure of the school bus and electrical power industries, New York state and local procurement procedures, and funding sources for medium- and heavy-duty electric vehicles in the state. This report also benefited from the expertise of practitioners in energy, electric vehicles, environmental protection, and the school bus industry.

[104] X. Wu, R. C. Netherly, M. B. Sabath, D. Braun, and F. Dominici, "Air Pollution and COVID-19 Mortality in the United States: Strengths and Limitations of an Ecological Regression Analysis," Science Advances 6, no. 45 (November 4, 2020), *https://doi.org/10.1126/sciadv.abd4049*.

[105] This report does not constitute legal or financial advice and is for informational purposes only.

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