Accelerating the Transition to Electric School Buses

How schools, lawmakers and utilities can work together to speed the transition to zero emissions buses

ENVIRONMENT AMERICA
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U.S. PIRG
Education Fund

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ELECTRIC BUSES AMERICA

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Cover: An electric school bus serving the Bay Shore Union Free School District, NY. Credit: Wikimedia Commons

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Executive summary

THE VAST MAJORITY of school buses in the United States run on diesel, a fossil fuel that has been shown to cause numerous health problems, including asthma, bronchitis, and cancer. Diesel exhaust is also a greenhouse gas, which contributes to climate change. However, there is an alternative: zero-emission battery electric school buses.

The technology is here, and electric school buses are ready to roll, but the question remains: how do schools pay for them? While electric buses can save schools money over the lifespan of the bus, the initial price tag of a new electric bus can turn many schools off to the idea of electrification. In many cases, assistance from federal grant programs and loans are needed in order to finance such a purchase. In addition to these programs, utility investment, financing strategies and vehicle-to-grid technology provide promising opportunities that can help schools ease the transition and accelerate toward a zero-emission electric future.

Electric utilities have a lot to gain from the large-scale adoption of electric school buses, and could play a major role in supporting the transition. Electric buses can expand and stabilize the grid, provide surplus energy storage, and increase energy demand. By providing discounted rates on electric bus charging and building charging infrastructure, utilities can help speed the adoption of electric buses. Utilities can also support electric buses by investing in infrastructure for bus charging in depots and on routes, helping to finance the upfront purchasing costs of electric buses, and introducing smart charging systems to maximize integration of renewable energy. Several utility companies have already launched programs to help school districts adopt electric buses, including Dominion Energy in Virginia and Portland General Electric in Oregon.

Particularly promising options are vehicle-to-grid technology and Pay-As-You-Save programs. Vehicle-to-grid technology allows buses to send stored energy back to the grid. When equipped with vehicle-to-grid technology, electric buses can use their batteries for energy storage, providing a service to the grid by reserving and selling electricity back at times of high demand.

Pay-As-You-Save (or PAYS), or a tariffed on-bill program, is an agreement where the customer chooses to install a more energy efficient and cost-effective system, and the utility company covers the initial extra cost of the new technology. As the customer saves on their energy costs, the customer repays the utility company over the lifespan of the bus. These opt-in tariffs allow for customers to choose options that while more costly upfront, can save money and energy in the long run.

By pairing vehicle-to-grid technology and PAYS, each electric bus could save school districts up to $130,000 per electric bus.

Recommendations:

The transition to a clean, renewable transportation sector, and a more widespread clean energy economy requires coordination between school districts, lawmakers, and utility companies.

School districts should:

- Commit to transitioning to 100% all-electric buses by 2030, with a plan to phase out the purchase of new diesel buses immediately.
- Use any and all financing methods available, including state and federal grant programs.
- Engage with local utilities to help accelerate the adoption of electric buses.

Lawmakers should:

- Work with utilities and regulators to develop effective electric bus investment programs that protect ratepayers and consumers.
- Develop grant programs to assist school districts with the additional upfront cost of electric bus procurement.
- Commit to clean energy by tightening fuel efficiency and greenhouse gas emissions standards.
- Subsidize research and development in electric bus technology, including vehicle-to-grid.

Utility companies should:

- Make a commitment to renewable energy.
- Reduce emissions, increase grid capacity, and earn money by assisting school districts in financing electric school buses and investing in the charging infrastructure necessary for large-scale adoption.
- Launch vehicle-to-grid and PAYS pilot programs, and scale up as soon as practical.
- Establish bulk purchase savings programs to further lower the cost barrier to procurement for school districts.

Introduction

EACH DAY BUSES carry millions of children to and from school, and move millions more Americans around our cities. But most of the buses on the road are diesel, powered by dirty fossil fuels, polluting our communities, endangering the health of children, and putting our climate at greater risk.

Nearly 95 percent of America's school buses run on diesel.[1] Diesel exhaust has been linked to several serious health risks, including increased rates of respiratory illnesses.[2] Diesel exhaust is internationally recognized as a cancer-causing agent[3] and classified as a likely carcinogen by the U.S. Environmental Protection Agency.[4]

We have the technology to start building cleaner, healthier cities and neighborhoods. Transitioning to all-electric school bus fleets would avert 5.3 million tons of greenhouse gas emissions each year,[5] keeping our air cleaner and our communities healthier—all while saving school districts money to invest in the classroom.

To clean our air and protect our health, cities and school districts should commit to transitioning to 100% all electric buses by 2030, and do so by phasing out the procurement of diesel buses immediately. As school districts nationwide commit to electrification, the electric bus market will grow and become more competitive.

Although electric buses can save hundreds of thousands of dollars over their lifespan when compared to diesel, the initial procurement cost of even a single electric bus can sometimes be nearly triple that of a diesel bus.[6] As the technology advances, the price will likely decrease, but this initial investment as a lump sum is still a barrier to procurement, particularly for school districts with tight budgets. While the price of electric buses remains high, in order to accelerate their adoption, financing solutions that can help schools handle the initial cost are necessary.

There are several strategies that school districts and policy makers can employ to offset the upfront cost. Local, state and federal governments can help school districts finance the transition to electric buses by providing grants, loans and other programs to alleviate the upfront cost. But one of the most promising strategies that could help spur large-scale adoption is fostering greater utility investment and financing options.

Government Grants and Funding Sources for Electric Buses

SEVERAL FEDERAL, regional, and state grant and incentive programs already exist, which can be used to help supplement other funding sources and offset some of the upfront costs of making the switch to electric buses. Cities and states should work to make these types of programs more accessible for transit agencies and school districts to use for the purchase of electric buses.

The federal government already offers a number of grant programs that can be used to off-set the upfront costs of electric buses. For transit agencies, there is the Low-or-No Emission grants program,[7] the Congestion Mitigation and Air Quality Improvement program[8] and the State of Good Repair program.[9] For school districts, there is the School Bus Rebate Program[10] and others.

A zero-emission electric school bus in front of the California State Capitol building. Photo: Wikimedia Commons

As Senator, now Vice-President Kamala Harris introduced the Clean School Bus Act, which if passed, would allocate $1 billion over 5 years to the Department of Energy to fund a nationwide Clean School Bus Grant Program.[11]

States can also allocate funding towards clean school bus projects. The California State Legislature, for instance, authorized the California Energy Commission to allocate over $94 million to its School Bus Replacement Program, a program that helps schools across the state replace old diesel buses with clean-energy electric.[12] The legislature also passed a bill in 2020 that would provide funding for electric vehicle charging infrastructure for school districts in the state.[13]

States could also use funds from regional cap-and-invest programs, such as the Transportation and Climate Initiative in the northeast and Mid-Atlantic states, to finance electric school bus procurement.[14]

Many states have leveraged the Volkswagen Environmental Mitigation Trust Fund to help finance the purchase of electric buses. The fund was established after courts in the U.S. and Europe fined the automobile company Volkswagen $30.4 billion for violating clean air standards.[15] Nearly $3 billion of this money was allocated to states to help purchase low to no emissions vehicles, including electric buses.[16]

And finally, cities and school districts can use traditional funding and financing mechanisms to pay for electric buses, such as municipal bonds and local option transportation taxes.[17]

All of these government-led financing programs have helped launch the electric bus movement in the U.S. However, at the current pace, these programs have not, and will not, be enough to support large-scale adoption. That's where utility companies could make a difference.

Utility Programs and Investment

ELECTRIC UTILITIES HAVE a lot to gain from the large-scale adoption of electric school buses, and could play a major role in supporting the transition. In short, electric buses can expand and stabilize the grid, provide surplus energy storage, and increase energy demand. And by providing discounted rates on electric bus charging and building charging infrastructure, utilities can help speed the adoption of electric buses. Utilities can also support electric buses by investing in infrastructure for bus charging in depots and on routes, helping to finance the upfront purchasing costs of electric buses,[18] and introducing smart charging systems to maximize the integration of renewable energy.[19] Several utility companies have already launched programs to help school districts adopt electric buses, including Dominion Energy in Virginia[20] and Portland General Electric in Oregon.[21]

Private investment from utility companies and vehicle-to-grid technology can be cost-effective options for school districts looking to electrify their school bus fleets.

Utility Investment

Because utilities have a lot to gain from bus fleet electrification, they should be willing to implement policies and invest in infrastructure that makes widespread electrification possible. By providing beneficial rate structures for electric bus charging, and supporting charging infrastructure, utilities can help speed the adoption of electric buses.

Utilities can help support electric buses by investing in infrastructure for bus charging in depots and on routes, by developing special rate structures to help make charging buses more economical, by helping to finance the upfront purchasing costs of electric buses, and by introducing smart charging systems to help maximize integration of renewable energy.[22]

For example, in Oregon, Portland General Electric is partnering with the transit agency TriMet to enable Oregon's first all-electric bus route.[23] The utility will install and operate six electric bus charging stations and help Tri-Met purchase an additional electric bus.[24] Likewise, in California, Twin Rivers Unified School district has worked with its local utility to build the largest electric school bus fleet in the country. Sacramento Municipal Utilities District (SMUD) has not only agreed to a rate structuring deal with the district but has also provided $1 million for the purchase of new charging equipment.[25]

Utilities are also well positioned to establish bulk purchase savings programs to further lower the cost barrier to procurement for school districts.

Vehicle-to-grid

Vehicle-to-grid (V2G) technology allows electric buses to put their stored energy back to the grid, which can benefit both schools and utility companies. This technology can bring in revenue for schools

that switch to electric buses, and can pay dividends for utility companies as well – by providing stability, extra capacity, and emergency power to the grid when necessary. Since electric school buses charge at night, during periods of low demand, they place minimal strain on the grid in the first place. Schools can then sell the electricity stored in the electric bus batteries back to the grid during outages, weather emergencies, and other periods of low energy supply or high energy demand.

Here's how it works:

First, an electric bus is designed to be able to remove energy from the grid as well as put energy back into the grid.

If a school owns an electric bus, the electric bus battery can serve as energy storage for the grid when the bus is not in operation. The utility pays the school districts for this extra storage capacity and for the energy it sends back to the grid.[26]

The energy company sees increased grid capacity and energy consumption while the school earns money from the utility, and saves on fuel and maintenance costs.[27]

Here's the end result:

The bus provides stability to the grid, allowing for integration of intermittent sources of energy, including renewables. The school gets paid for providing the bus as an asset to the grid, and also saves hundreds of thousands of dollars on gas and maintenance costs.[28] Early vehicle-to-grid studies with electric school buses in three school districts in California found each bus could generate more than $6,000 each year by sending extra electricity back to the grid during periods of high demand.[29] Meanwhile the community as a whole benefits from less noise and air pollution.

CASE STUDY – VIRGINIA

In 2019, Dominion Energy announced that it would be partnering with local Virginia school districts to help accelerate the transition to 100% zero-emission school bus fleets.[30] Sixteen localities have been selected, and 50 electric buses are planned to roll out this year, with a second phase of 1000 electric buses by 2025.[31] The second phase has yet to be approved by the Virginia legislature.[32]

Under the program, school districts will pay the same cost as they would to replace a regular diesel bus, and Dominion Energy will offset the additional cost for the electric school bus and related charging infrastructure. When not in use, the electric bus batteries can be used as energy storage via vehicle-to-grid technology, providing stability to the grid when energy use is high.[33] However, Dominion under Dominion's plan, the utility will retain control over the bus batteries[34], thereby restricting school districts' ability to freely use their buses and raising questions about whether schools are really gaining as much from this project as they could.

The first phase of Dominion's project, which is underway, is covered by Dominion's base rate, meaning there are no additional costs to Dominion customers.[35]

ELECTRIC BUSES AS PRIVATE SOLAR STORAGE

Vehicle-to-grid technology treats electric bus batteries as storage, which can be used to expand the energy capacity of a utility's grid. Electric bus batteries can also be used for energy storage from solar panels. If the school district invests in solar energy for its buildings, it has the potential to use its electric buses as storage for periods of low energy capture.[36]

Pay-As-You-Save

Pay-As-You-Save (PAYS) is a type of program that can be used in addition to adopting vehicle-to-grid technology. Under this strategy, a school district would be able to procure a new electric bus, and the utility would cover a portion of or all of the incremental cost of a new diesel bus.

Pay-As-You-Save, or a tariffed on-bill program, is an agreement where the customer chooses to install a more energy efficient and cost-effective system, and the utility company covers the initial extra cost of the new technology. As the customer saves on their energy costs, the customer repays the utility company over the lifespan of the bus.[37] These opt-in tariffs allow for customers to choose options that while more costly upfront, can save money and energy in the long run.[38]

When applied to the bus fleet electrification, tariffed on-bill programs allow utility companies to help pay the surplus costs associated with purchasing an electric bus: the charging infrastructure, batteries, and just the extra cost of the bus

Kids board a school bus. Photo: Marissa Tucker

itself. By doing so, utilities can lower the barrier to procurement for school districts with tight budgets. Rather than pay everything all at once, school districts can pay over time, and ultimately save more than they repay.[39]

Here's how it works:

First, the utility agrees to cover the cost of the battery and charging station for each new electric bus.

Second, the school allows the utility to put a small charge on the school's monthly energy bill to recover, over time, the initial investment cost accrued by the utility company. This tariffed on-bill structure would need to be approved and regulated by the state's Public Utilities Commission.

Third, this charge is capped below the estimated savings that the school enjoys by running an electric bus along its routes instead of diesel, but high enough to recover its costs within the bus warranty timeframe.

Finally once the utility's initial investment is repaid, the monthly charges end, and the school district continues to save on energy costs while retaining ownership of the bus and the battery.

Here's the end result:

Upfront, the school gets an electric bus for the price of a diesel bus. The electric bus saves the school money in the long run, allowing it to repay the utility company over time and still save money right from the start of the program. The utility gains approximately $100,000 in sales over the lifespan of each new electric bus, and bus operators, schoolchildren and community members all benefit from clean, diesel emission-free air.[40] The school district does not need to go into debt to finance the electric bus, they simply use a fixed portion of their energy savings to repay the utility over the lifespan of the bus. Utilities can also create flexibility in the financing structure to allow for unexpected maintenance costs.

Public/Private Coordination

In addition to school districts receiving grant funding for fleet electrification, utility companies can also seek assistance from state and local governments. State-funded clean fuels credits that go to private utility companies can then be used to help finance public projects, like school bus fleet electrification.

Depending on variations between states in gas prices, bus routes, electricity costs, and more, the benefits of private financing methods like vehicle-to-grid technology and PAYS may vary. This makes public financing all the more important to help accelerate the transition to electric. State and federal grant programs, such as the California Energy Commission's School Bus Replacement Program or federal bills like the Clean School Bus Act can further reduce the cost recovery time frame. If a bill like the Clean School Bus Act were to be signed into law, school districts could receive up to $2 million to finance electric school buses and infrastructure. Electric bus companies can also establish bulk purchase savings programs, and continue research and development into lowering the cost of zero-emission battery technology.

CASE STUDY – OREGON

In January of 2020, Portland General Electric (PGE) announced plans to partner with four school districts in the Portland area on a school bus fleet electrification project. Selected school districts will receive approximately $2 million in funding to pay for the incremental cost of four new electric school buses as well as charging infrastructure. PGE will also provide site assessments, cost-benefit analysis, vehicle and charger selection support, charging infrastructure installation, driver and mechanic training, utility rate optimization and stakeholder engagement, as well as other technical assistance.[41]

The project is supported by the sale of Oregon Clean Fuels Program credits, which PGE receives from private electric vehicle ownership, and aggregates on behalf of residential customers who charge their electric vehicles at home.[42] The Oregon Clean Fuels Program, a publicly funded program created by the Oregon Department of Environmental Quality, aims to reduce Oregon's transportation emissions by 10% by 2025.[43] PGE participates in the program as a provider of low-carbon transportation fuel, and the proceeds from the sale of credits PGE receives are used to promote and support transportation electrification.

Potential Savings from PAYS and Vehicle-to-Grid

Electric school buses provide profound environmental and public health benefits. Switching to electric buses with zero tailpipe emissions significantly reduces exposure to the localized pollutants. Electric buses are also much cleaner than their diesel or natural gas counterparts. But school districts can also benefit from significant cost savings due to the reduced fuel and maintenance costs of electric buses. While the scenario outlined below takes into account some degree of variability in V2G savings, it is worth noting that gas prices, charging infrastructure, and other costs may vary over time and geographic location, and that V2G is still a new technology with limited application.

Back of an electric school bus. Photo: Flickr

Partnering with utility companies that have implemented a PAYS program and vehicle-to-grid technology, school districts should be able to save hundreds of thousands of dollars per electric bus. Here's how:

Cost of new diesel school bus:	$110,000[44]
Cost of new electric school bus:	$312,600[45]
Difference in cost (covered using PAYS financing strategy):	$312,600 – $110,000 = $202,600
Electric School bus fuel costs:	$0.19 per mile[46]
Diesel School bus fuel costs:	$0.82 per mile[47]
Lifespan of electric school bus:	approx. 16 years[48]
Avg annual bus mileage:	12,000[49]
Avg. electric annual fuel costs:	$0.19 (12,000 miles) = $2,280
Avg. diesel annual fuel costs:	$0.82 (12,000 miles) = $9,840
Avg. annual fuel savings:	approx. $7,600
Annual maintenance savings:	$4,400[50]
Total lifetime fuel/maintenance savings:	$7,600 + $4,400 = $12,000(16) = $192,000
Lifetime revenue from V2G:	$200,000[51] to $250,000[52]
Revenue/savings over lifespan of bus:	$392,000 to $442,000
Savings with PAYS recovery cost and upfront cost included:	
Low estimate:	$392,000 – ($202,600 + $110,000) = $79,400
High estimate:	$442,000 – ($202,600 + $110,000) = $129,400

With assistance from utility companies and vehicle-to-grid technology, school districts can save between $80,000 and $130,000 over the next 16 years by replacing their fleets with V2G-equipped all-electric zero emission school buses. These savings will only increase as V2G technology improves, therefore investment in this technology is essential.

AMPLIFYING ENVIRONMENTAL BENEFITS AND COST SAVINGS WITH RENEWABLE ENERGY

Renewable energy is better for the climate, *and* it generates more energy at a lower cost than fossil fuels.[53] Therefore, a renewable grid would further increase energy savings for school districts. The transportation sector, while the largest polluter, still only contributes a portion of the total emissions in the United States.[54] And while plugging buses into the electric grid is preferable to filling them up with diesel fuel, the buses become even cleaner when powered by renewable energy. Therefore, the green energy future requires cooperation and sustainable development among all sectors of the economy, and pairing electric vehicle technology with a 100% renewable energy grid composed of solar and wind power technology is the ideal combination for a cleaner and healthier future.

Recommendations

ELECTRIC SCHOOL BUSES are here, and they're ready to hit the streets.

The transition to a clean, renewable transportation sector, and a more widespread clean energy economy requires coordination between school districts, lawmakers, and utility companies. Not only this, but utility companies have the power to rapidly expedite the transition away from polluting diesel buses to healthier, more efficient and sustainable electric buses.

School districts should:

- Commit to transitioning to 100% all-electric buses by 2030, with a plan to phase out the purchase of new diesel buses immediately.
- Use any and all financing methods available, including state and federal grant programs.
- Engage with local utilities to help accelerate the adoption of electric buses.

Lawmakers should:

- Work with utilities and regulators to develop effective electric bus investment programs that protect ratepayers and consumers.
- Develop grant programs to assist school districts with the additional upfront cost of electric bus procurement.
- Commit to clean energy by tightening fuel efficiency and greenhouse gas emissions standards.
- Subsidize research and development in electric bus technology, including vehicle-to-grid.

Utility companies should:

- Make a commitment to renewable energy.
- Reduce emissions, increase grid capacity, and earn money by assisting school districts in financing electric school buses and investing in the charging infrastructure necessary for large-scale adoption.
- Launch vehicle-to-grid and PAYS pilot programs, and scale up as soon as practical.
- Establish bulk purchase savings programs to further lower the cost barrier to procurement for school districts.

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