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From Yellow to Green

Reducing School Transportation's Impact on the Environment

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BELLWETHER EDUCATION PARTNERS

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This is part of a series of publications on school transportation policy, including:

1. **From Yellow to Green: Reducing School Transportation's Impact on the Environment**
2. **Intersection Ahead: School Transportation, School Integration, and School Choice**
3. **School Crossing: Student Transportation Safety on the Bus and Beyond**

These policy briefs build on our 2019 slide deck "The Challenges and Opportunities in School Transportation Today" and our 2017 report "Miles to Go: Bringing School Transportation into the 21st Century."

Key Takeaways

Diesel buses and personal vehicle trips for school transportation emit millions of tons of greenhouse gases per year into the environment, which contribute to global warming, and expose children to harmful pollutants that can affect their health and academic performance. What would it take for the yellow school bus — and school transportation systems as a whole — to go green? There are several impact reduction strategies districts can consider, with a range of cost and effectiveness implications:

- Idling time reduction
- Diesel retrofits
- Propane and CNG buses
- Electric buses
- Walking and biking

Beyond environmental benefits, some impact reduction strategies can create long-term savings for districts by reducing fuel use, maintenance needs, and energy costs. This brief examines cases of electric school bus pilots, pros and cons of impact reduction strategies, funding streams for environmental improvements, and recommended next steps for states and districts to lessen the environmental impact of the journey to school.

Introduction

The primary goal of every school transportation system is getting students to school safely and on time each day. To do so, America's fleet of roughly 480,000 school buses drives nearly 3.5 billion miles every year.[1] More than half of students also travel to school in personal vehicles, contributing millions more miles for school transportation.

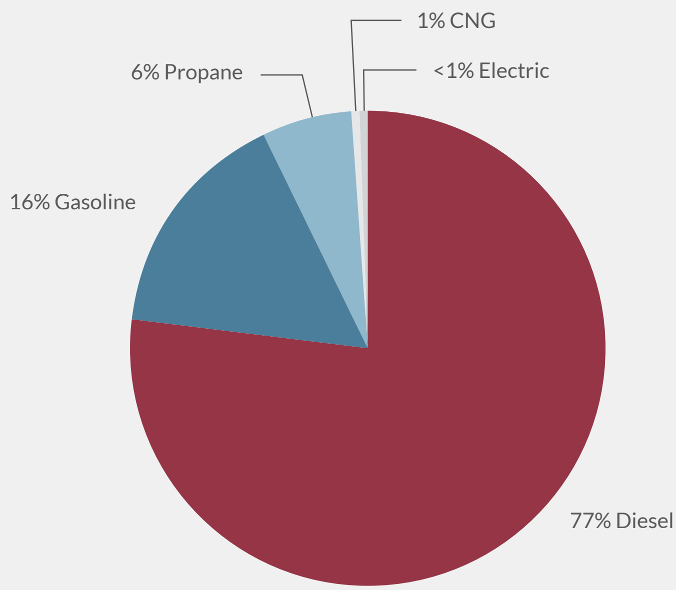
All of these vehicles emit millions of tons of greenhouse gases per year into the environment — contributing to global warming — and expose children to harmful pollutants that can affect their health and academic performance.

While school transportation is often a necessity for students and families, daily trips to and from school have significant environmental effects for students and their communities. All of these vehicles emit millions of tons of greenhouse gases per year into the environment[2] — contributing to global warming — and expose children to harmful pollutants that can affect their health and academic performance.[3]

However, most school transportation systems look much the same today as they did 50 years ago. The vast majority of school buses still run on diesel fuel,[4] which uses more petroleum and can cause more harm to the environment than other fuel options.[5] Propane, compressed natural gas (CNG), and electric options accounted for less than 8% of all school bus sales in 2017.[6] In contrast, 40% of public transit buses run on alternative fuels, as many public transit systems have invested in modern fuel technologies to reduce environmental impact.[7]

So what would it take for the yellow school bus — and school transportation systems as a whole — to go green?

Figure 1 School Bus Sales, by Fuel Type, 2017



Source: James Blue, "Subtle Shifts in School Transportation Industry's Fuel Mix," *School Bus Fleet*, May 23, 2018, https://www.schoolbusfleet.com/article/729882/subtle-shifts-in-school-transportation-industry-s-fuel-mix.

Investing in environmentally friendly school buses is one way to limit the impact of school transportation on air quality and global warming. Clean air technologies can reduce the amount of greenhouse gases (GHGs) and pollution emitted by diesel buses. Replacing diesel buses with alternatively fueled options can also lessen the environmental effects of school transportation. For example, propane and CNG school buses can reduce emissions when used instead of older diesel buses, and electric buses offer greater environmental benefits than all other vehicle options.

Recent studies have found that children riding on buses with new fuels and technologies experienced lower exposures to air pollution, improved respiratory health, reduced rates of absenteeism, and improvements in test scores.

Students riding the bus have a lot to gain from cleaner, greener school buses: Recent studies have found that children riding on buses with new fuels and technologies experienced lower exposures to air pollution, improved respiratory health, reduced rates of absenteeism, and improvements in test scores.[8] And over the long term, environmentally friendly school buses may save money for school districts due to reduced fuel and maintenance costs.[9]

High up-front costs are the primary reason why school transportation systems have made few investments in environmental improvements. It is challenging for many school districts to make large capital investments in their bus fleets. When budgets are tight, new buses are rarely a top priority versus teaching and learning expenses. Alternatively fueled buses cost more than the typical diesel bus and require new infrastructure like fueling and charging stations, as well as additional training for staff. Propane and CNG school buses cost 9% and 33% more than a new diesel school bus, respectively. Electric school buses are particularly expensive — costing more than triple the price of a typical diesel bus — due in part to the high cost of their batteries. A few districts and vendors are paving the way on electric school bus fleets in collaboration with local utilities and other agencies, but districts need additional funding and support in order for more school transportation systems to adopt green technologies in the future.

Greener school transportation systems must also go beyond school buses. About a third of students ages 5–17 travel to school on school buses, compared with 54% who ride in private vehicles.[10] On an individual vehicle basis, a car has less environmental impact than a diesel bus, but it is also much less efficient, as school buses can carry as many passengers as roughly 36 cars.[11] Meanwhile, only 13% of students travel to school by walking, biking, or public transit, which can reduce the number of vehicles needed for school transportation. Reducing unnecessary private vehicle trips, and encouraging active, environmentally friendly modes of transportation when possible, should be key parts of reducing the environmental footprint of school transportation.

All students should have a safe and reliable way to get to school that is also safe for the environment and students' health.

All students should have a safe and reliable way to get to school that is also safe for the environment and students' health. When states, districts, and schools think about providing transportation services, environmental and health effects must be part of the conversation. In this brief, we will:

- Provide data on the environmental effects of various school transportation options, including school buses, personal vehicles, and other modes
- Analyze the environmental impact and cost implications of strategies for cleaner, greener school transportation systems
- Present three case studies on programs piloting the use of electric school buses and highlight what lessons can be learned from these efforts
- Make recommendations for states, districts, and other education and transportation leaders to evaluate the costs and benefits of new technologies, alternative fuels, and other impact reduction strategies, and to ultimately support more widespread adoption of these approaches

We hope this brief will encourage more districts and states to consider school transportation measures that will reduce negative effects on the environment, improve students' health, and provide long-term cost savings for schools and districts.

Glossary

FUELS

Diesel Diesel fuel is refined from oil and used in the diesel engines found in most freight trucks, trains, and buses. Before 2015, diesel fuel sold in the United States contained high quantities of sulfur, which creates more harmful emissions.[12] In 2006, the U.S. Environmental Protection Agency issued requirements to reduce the sulfur content of diesel fuel, which phased in over time.[13] Most of the diesel fuel now sold in the United States for use in vehicles is ultra-low sulfur.[14]

Propane Propane is an alternative fuel that's been used to power light-, medium-, and heavy-duty vehicles for decades. It is stored onboard vehicles in tanks pressurized to about 150 pounds per square inch — about twice the pressure of an inflated truck tire.[15]

Compressed natural gas (CNG) Natural gas is predominantly made up of methane. CNG, which can be used to power light-, medium-, and heavy-duty vehicles, is produced by compressing natural gas to less than 1% of its volume at standard atmospheric pressure. CNG is stored onboard vehicles at high pressures — up to 3,600 pounds per square inch.[16]

Electricity Electricity can be produced from a variety of energy sources, including oil, coal, nuclear energy, hydropower, natural gas, wind energy, solar energy, and stored hydrogen. All-electric vehicles use electricity as their primary fuel, and hybrid electric vehicles use electricity along with other fuels to improve overall efficiency. Electric vehicles store energy in batteries that can be charged by the electrical grid. These vehicles do not produce tailpipe emissions. However, if they are powered by electricity generated from the burning of fossil fuels like petroleum or natural gas, as opposed to renewable options like solar and wind energy, then there are still emissions from that energy production.[17]

EMISSIONS AND POLLUTANTS

Greenhouse gases (GHGs) GHGs, primarily consisting of carbon dioxide, are emitted from a variety of sources, including burning fossil fuels like oil, coal, and natural gas. When there are increased concentrations of these gases, more heat is trapped in the atmosphere, contributing to global warming.[18]

Carbon monoxide (CO) CO is a colorless, odorless gas that can be harmful when inhaled in large amounts. Breathing air with a high concentration of CO reduces the amount of oxygen that can be transported in the bloodstream to critical organs like the heart and brain. According to the U.S. Environmental Protection Agency (EPA), the largest sources of CO in outdoor air are cars, trucks, and other vehicles that burn fossil fuels.[19]

Nitrogen oxides (NOx) NOx — including nitrogen dioxide — are harmful to human health and the environment. Breathing air with a high concentration of NOx can aggravate respiratory diseases, particularly asthma, and lead to respiratory symptoms like coughing and wheezing. NOx is emitted by burning fuel from cars, trucks, and buses, power plants, and other equipment.[20]

Particulate matter (PM) PM is a mixture of solid particles and liquid droplets found in the air. These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. When inhaled, PM can cause health problems by lodging deep in the lungs and entering the bloodstream.[21]

Volatile organic compounds (VOCs) VOCs are emitted as gases from certain solids or liquids and are found in many household products, solvents, and fuels. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects, including:

- Eye, nose, and throat irritation
- Headaches, loss of coordination, and nausea
- Damage to the liver, kidneys, and central nervous system[22]

Environmental Impact of School Transportation

A growing body of evidence has documented the negative effects that emissions and air pollution from fossil fuels can have on the environment and children's health. Many of these emissions and pollutants are created by buses and cars. Data on the precise environmental impact of school buses and school transportation in general are not available; however, there are research and data on the environmental impact of vehicle transportation more generally, today's nationwide fleet of school buses, and the relative environmental impact of different school transportation vehicles.

In 2018, the United States consumed a total of about 315 billion gallons of petroleum products,[23] about 28% of which were used for transportation, including cars, trucks, buses, trains, ships, and airplanes.[24] The use of petroleum leads to the emission of greenhouse gases (GHGs). In 2017, these emissions totaled more than 7 billion tons, and roughly 29% resulted from transportation.[25] While emissions have declined since 2005 — due in part to the increased use of natural gas and renewable energy — recent estimates suggest that there was an uptick in 2018.[26]

Transportation emissions also contribute to air pollution. In 2017, highway vehicles created many billions of pounds of pollutants,[27] including:

- Nearly 38 billion pounds of carbon monoxide (CO)
- More than 7 billion pounds of nitrogen oxides (NOx)
- Roughly 750 million pounds of particulate matter (PM)
- About 3.6 billion pounds of volatile organic compounds (VOCs)

School Buses

There are nearly 480,000 school buses being used for school transportation in the United States, traveling a total of nearly 3.5 billion miles each year. Roughly 95% of these school buses are powered by diesel fuel.

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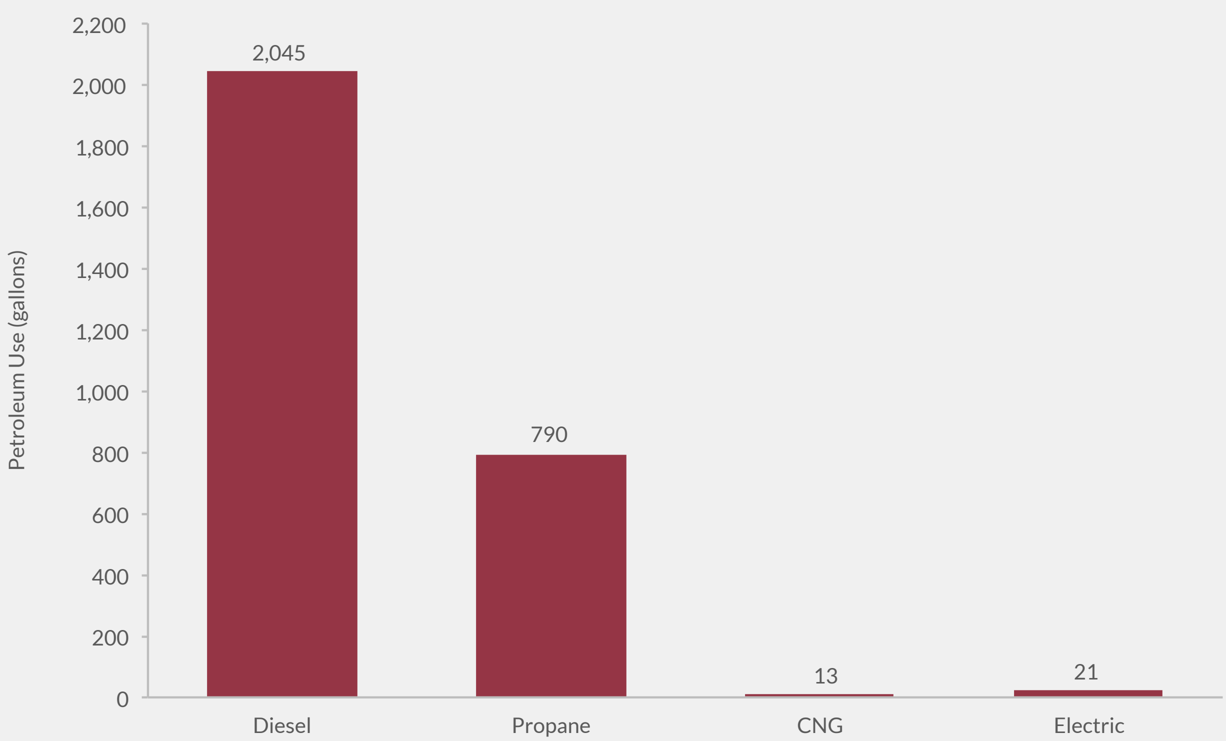
Roughly 95% of these school buses are powered by diesel fuel. The U.S. Environmental Protection Agency (EPA) implemented standards for cleaner diesel fuel in 2006, and about 40% of the current fleet is equipped with related "clean diesel" technology, which can substantially reduce emissions and pollutants. Beyond diesel, propane and CNG options account for about 1% of school buses each, and less than 1% are electric.[29]

Although non-diesel school buses only compose a small percentage of the total school bus fleet, these buses can have environmental advantages over their diesel counterparts. When compared to the most recent models of diesel buses — 2010 and newer — propane and CNG buses do not significantly improve air quality. But when these buses are used to replace older diesel buses, they can reduce air pollutant emissions considerably.[30]

Figure 2 Average Annual Petroleum Use Per Bus, by School Bus Fuel Type



Source: Based on data collected from the online version of the AFLEET Tool 2018, developed by the Argonne National Laboratory, available here: https://afleet-web.es.anl.gov/afleet/.

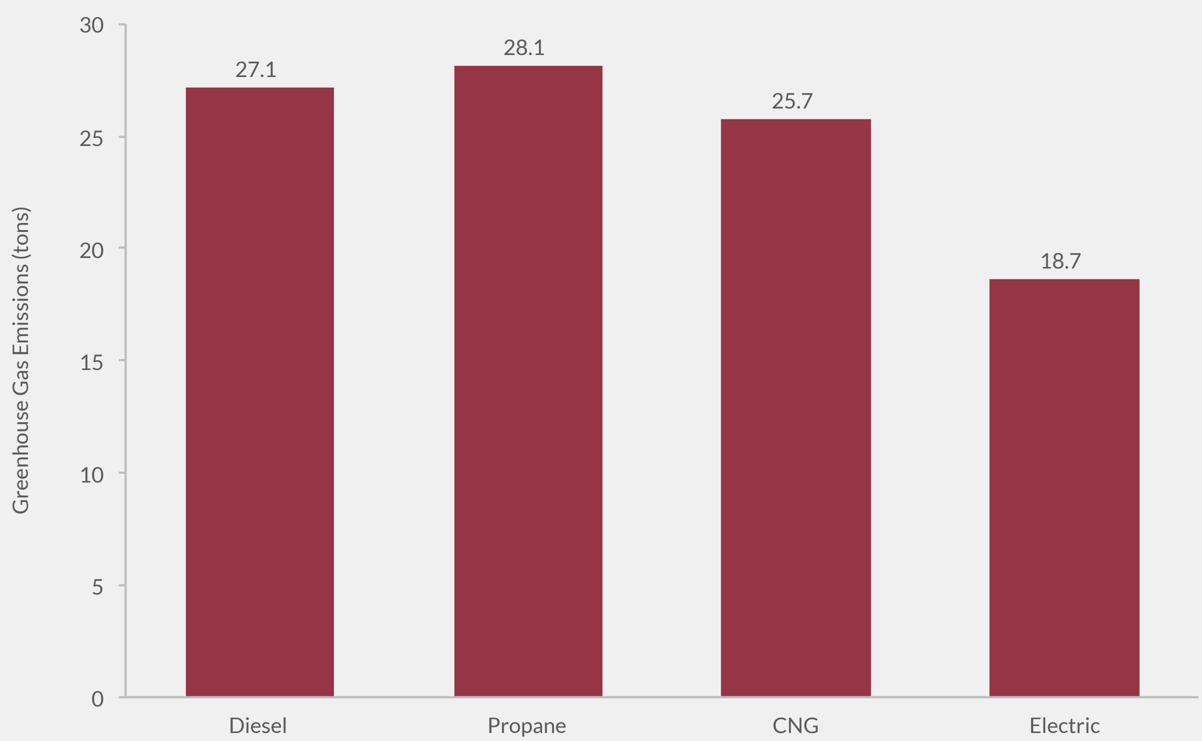
Electric buses, meanwhile, are a much more environmentally friendly option than their diesel, propane, and CNG counterparts.

In addition, propane and CNG buses start more easily in cold weather than diesel buses and do not need to be heated overnight in cold climates,[31] which could increase the potential environmental benefit of these options in some parts of the country. Electric buses, meanwhile, are a much more environmentally friendly option than their diesel, propane, and CNG counterparts.

Making changes to school buses' fuel sources could drastically reduce their effects on the environment. According to data from the Argonne National Laboratory's online AFLEET tool, which provides information on fuel use and emissions for various vehicle and fuel types, new diesel school buses use much more petroleum, on average, than alternatively fueled options.[32]

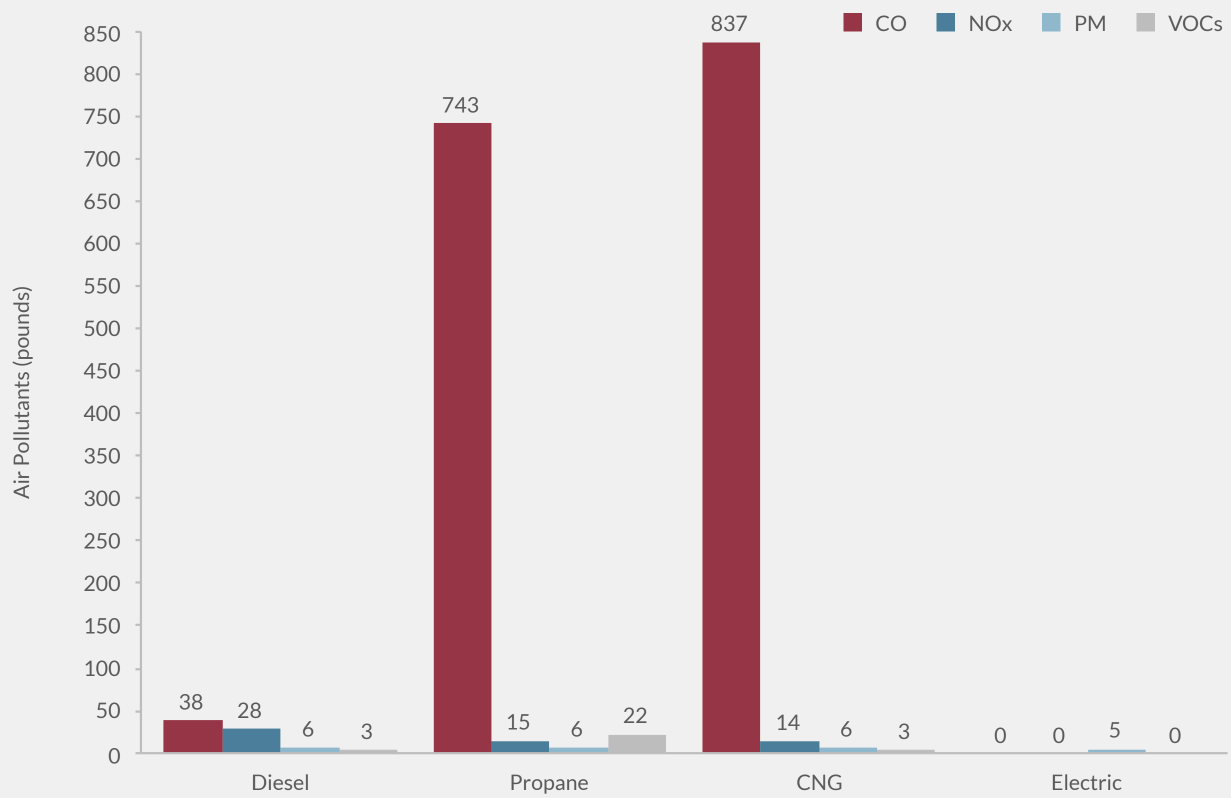
There are important environmental considerations beyond fuel consumption, including GHG emissions. As described above (see: Glossary, page 8), higher concentrations of GHGs in the atmosphere contribute to global warming. Despite their differences in petroleum use, the latest diesel, propane, and CNG school bus models emit similar amounts of GHGs — about 40 to 50% more than electric options.

Figure 3 Average Annual Greenhouse Gas Emissions Per Bus, by School Bus Fuel Type



Source: Based on data collected from the online version of the AFLEET Tool 2018, developed by the Argonne National Laboratory, available here: https://afleet-web.es.anl.gov/afleet/.

Figure 4 Average Annual Air Pollutants Per Bus, by School Bus Fuel Type



Source: Based on data collected from the online version of the AFLEET Tool 2018, developed by the Argonne National Laboratory, available here: https://afleet-web.es.anl.gov/afleet/.

Emissions and fuel use data clearly show that electric school buses are the most environmentally friendly option, as they use less fuel, emit fewer GHGs, and create little pollution.

Different types of school buses also vary in the amount and type of air pollution they create. Propane and CNG buses release particularly high amounts of CO relative to diesel, though they still meet the emissions standards required by the EPA.[33] This disparity is due to diesel engines' use of compression ignition, which ignites fuel using highly compressed air, leading to more complete combustion and less CO.[34] Electric school buses, meanwhile, create little air pollution when compared to other fuel options. (For more information on these pollutants, see: Glossary, page 8.)

Emissions and fuel use data clearly show that electric school buses are the most environmentally friendly option, as they use less fuel, emit fewer GHGs, and create little pollution. However, as we describe below, the high up-front costs associated with electric school buses — including the price of the vehicles themselves and additional charging infrastructure — continue to limit districts' ability to include them in their school transportation operations.

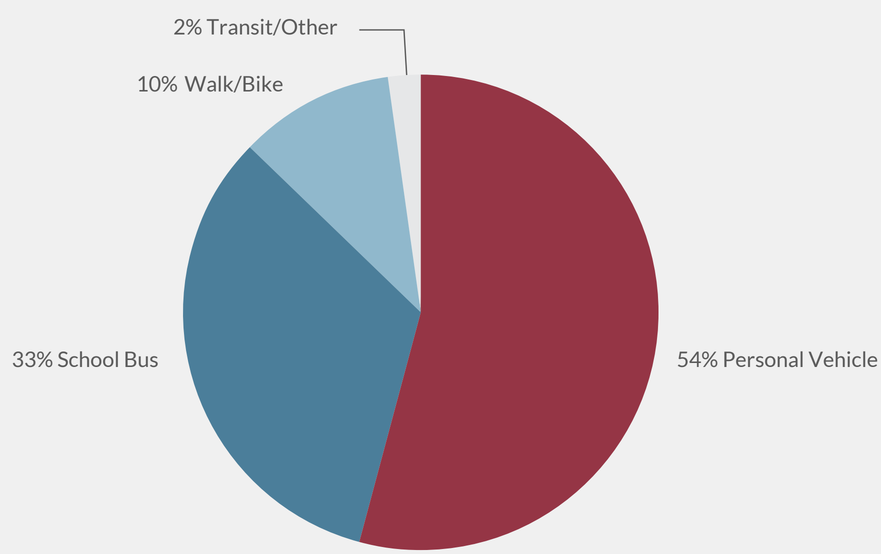
Personal Vehicles

Only about a third of students ages 5–17 travel to school on school buses; more than half travel to school in personal vehicles.

Personal vehicles — like cars, SUVs, and other commercial vehicles — also play a key role in school transportation and its environmental impact. Only about a third of students ages 5–17 travel to school on school buses; more than half travel to school in personal vehicles. The distance between students' homes and schools is the primary factor influencing their mode of transportation. For example, children living within a half mile of school are much less likely to travel in personal vehicles, opting to walk or bike instead.[35] Residents of rural communities are also more likely to rely on personal vehicles rather than public transit options, due in part to the relatively low population density in these areas.[36] (For more information on the shifts in modes of transportation over time, see Bellwether's publication "School Crossing: Student Safety on the Bus and Beyond.")

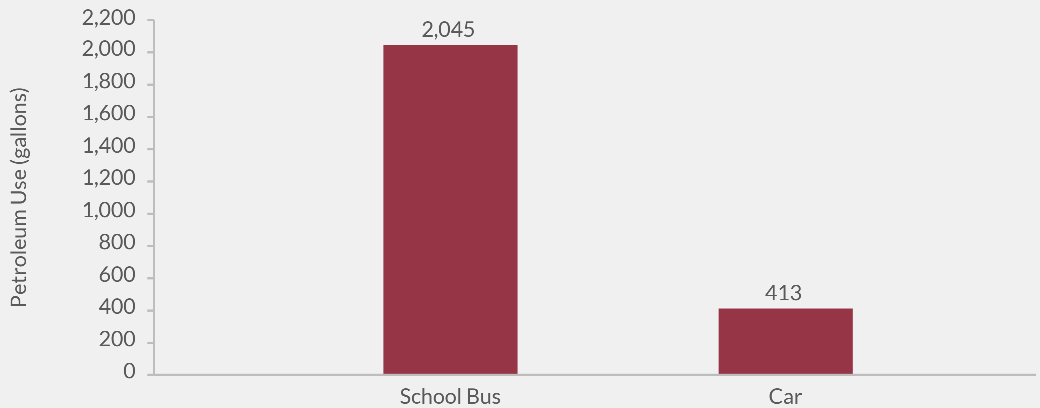
School buses use more fuel and produce more emissions per vehicle than a typical car. For example, a new diesel school bus uses more than 2,000 gallons of petroleum and emits roughly 27 tons of greenhouse gases annually — both equivalent to about five gasoline-powered cars.[37]

Figure 5 Means of Travel from Home to School, Children Ages 5–17, by Transportation Mode, 2017



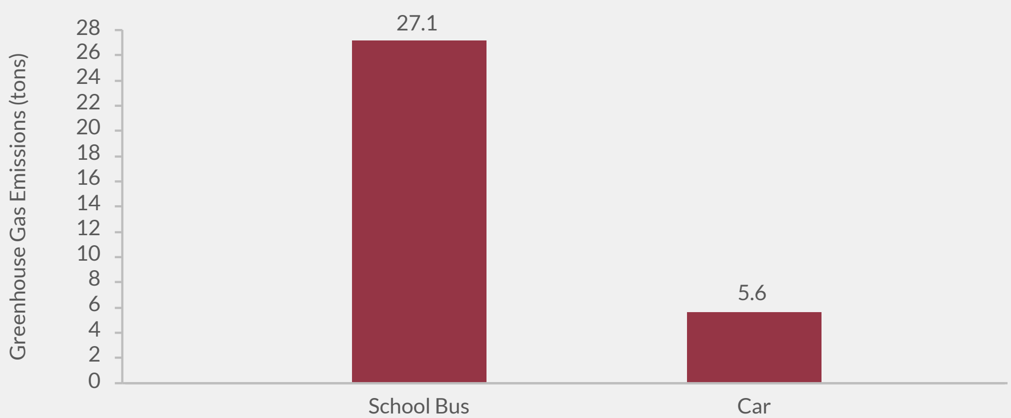
Source: "Children's Travel to School," FHWA NHTS brief, March 2019, p. 1, https://nhts.ornl.gov/assets/FHWA_NHTS_%20Brief_Traveltoschool_032519.pdf.

Figure 6 Average Annual Petroleum Use Per Vehicle, by Diesel School Bus and Gasoline Car



Source: Based on data collected from the online version of the AFLEET Tool 2018, developed by the Argonne National Laboratory, available here: https://afleet-web.es.anl.gov/afleet/.

Figure 7 Average Annual Greenhouse Gas Emissions Per Vehicle, by Diesel School Bus and Gasoline Car



Source: Based on data collected from the online version of the AFLEET Tool 2018, developed by the Argonne National Laboratory, available here: https://afleet-web.es.anl.gov/afleet/.

School buses operating at full capacity can carry as many children as about 36 cars.

However, school buses operating at full capacity can carry as many children as about 36 cars.[38] This means that school buses can transport students more efficiently than cars, which could have a relative environmental advantage. Unfortunately, there is little publicly available data on the average operating capacity of school buses. The size of the environmental benefit associated with using school buses rather than cars also depends on a number of other factors, like the efficiency of the bus route, the extent to which students carpool or share vehicles, and what share of vehicle travel is actually used for school transportation. For example, according to the 2017 National Household Travel Survey, only 2.9% of vehicle miles traveled were dedicated to transportation for school, day care, or religious activity.[39] Regardless, shifting students from smaller vehicles to larger, more efficient school buses is likely to reduce the overall environmental effects of school transportation systems, especially if those buses are equipped with environmental improvements.

Other Transportation Modes

Roughly 10% of students ages 5–17 — primarily those who live within a half mile of their school — travel to school by walking and biking. These modes do not release any emissions or pollutants, though students can still be exposed to them if walking or biking near areas with vehicle traffic.

An additional 2% of students — especially those living in dense urban areas — use public transit or other means, including transit buses or subway systems. Public transit buses are much more likely to be powered by alternative fuels, as many public transit systems have invested in modern fuel technologies to reduce environmental impact. Less than 3% of school buses run on alternative fuels, compared to about 40% of public transit buses.[40] Similar to electric school buses, electric transit buses use less petroleum, emit fewer GHGs, and create fewer air pollutants than diesel, propane, and CNG options.[41]

As the data show, various modes of school transportation affect the environment at different levels and in different ways. These modes also have different up-front costs and infrastructure needs, long-term savings, and implementation challenges, each of which is described in the following section. All of these factors play an important role in states' and districts' decisions about school transportation.

Impact Reduction

There are many strategies that school transportation systems can use to reduce environmentally harmful emissions and pollution.

There are many strategies that school transportation systems can use to reduce environmentally harmful emissions and pollution. Some of these strategies apply to diesel school buses, including reducing how much time they spend running their engines while not in transit — known as idling — as well as retrofitting these buses with technologies that reduce emissions. Others require replacing diesel school buses with buses powered by alternative fuels, like propane, CNG, and electricity. And increasing walking and biking where possible can improve students' health and provide an opportunity to travel to school without using a vehicle at all.

Nearly all of these environmental impact reduction strategies can also save money in the long term by reducing fuel use and maintenance costs. However, cost and implementation challenges in the short term can make taking advantage of these strategies difficult for school districts with limited budgets. As shown in the table below, these strategies vary in their impact on the environment, as well as in their short- and long-term costs to states, districts, or schools.

Table 1 — Impact and Cost of Impact Reduction Strategies

	Environmental Impact	Short-Term Cost	Long-Term Cost
Idling Time Reduction	Medium	Low	Medium
Diesel Retrofits	Medium	Low	Medium
Propane & CNG Buses	Medium	Medium	Low
Electric Buses	Low	High	Low
Walking & Biking	Low	Low	Low

Note: High/Medium/Low designations are based on available data and research, and approximate comparative impact and cost across strategies, explained in greater detail below. Environmental impact refers to the relative environmental harms of each strategy, primarily in terms of emissions. Low environmental impact in this case is positive for the environment and for impact reduction. Short- and long-term costs refer to the additional spending required from schools and districts for each strategy.

Reducing School Bus Idling Time

Environmental Impact: Medium
Short-Term Cost: Low
Long-Term Cost: Medium

Diesel exhaust from school buses can have negative effects on students' health and air quality. Students can be exposed to these fumes — even when not in transit — if school buses run their engines while stopped.[42] School buses typically idle in the morning and afternoon before scheduled bus routes begin, while waiting at schools, maintenance yards, parking lots, and other locations.[43]

School transportation operators can reduce idling time with relatively low-cost approaches that mostly involve training drivers.

School transportation operators can reduce idling time with relatively low-cost approaches that mostly involve training drivers on fuel-saving and idling-reduction procedures. Examples include powering lights without running the engine, minimizing the time spent running the engine to heat or cool the bus, and waiting until all students have loaded onto the bus before starting the engine.[44] Fuel-operated heaters can also be installed on school buses to heat the inside of the bus without running the engine. These small heaters are lightweight and burn fuel from the main engine fuel supply or a separate fuel reserve.[45]

Benefits

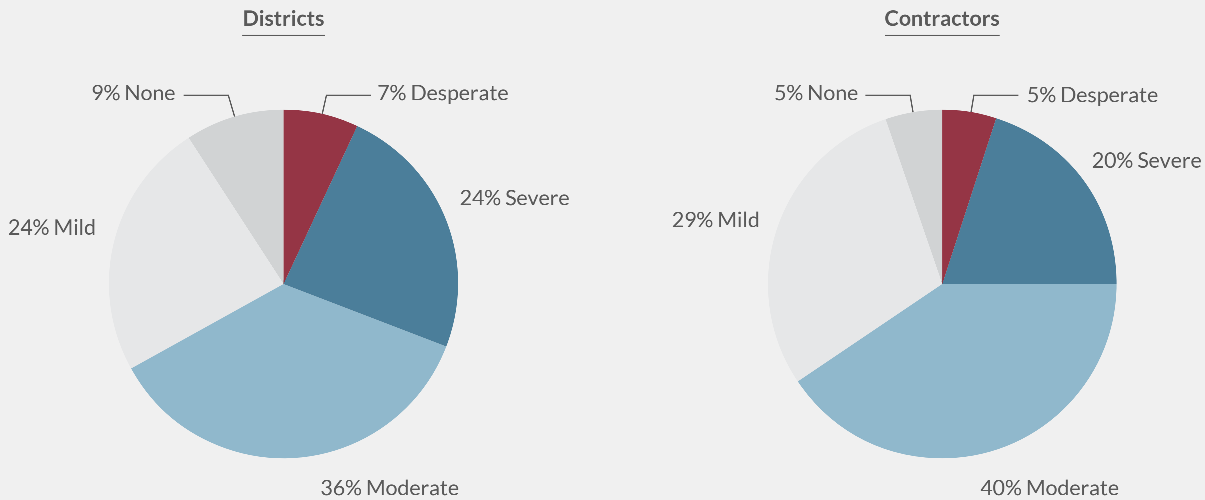
Limiting idling time reduces unnecessary pollution and can save districts money by conserving fuel, reducing maintenance costs, and extending the life of school bus engines. For example, one hour of idling burns approximately half a gallon of fuel, and idling for one hour a day during the school year adds the equivalent of more than 1,000 miles of additional wear and tear on the engine.[46] It is also among the least expensive environmental improvement strategies for school transportation, because it can be done with any existing buses.

Challenges

Because most of the strategies for reducing idling time are reliant on driver behavior, school transportation operators must provide adequate training for their drivers. However, driver shortages and high turnover can present a challenge for districts or contractors who want to implement a specific idling reduction plan.

The vast majority of school districts and school transportation contractors are facing driver shortages, with more than 25% indicating that these shortages are "severe" or "desperate."[47] They must compete for drivers with other professions requiring a commercial driver's license (CDL), which certifies that drivers are trained to operate large trucks and buses, including school buses. This can be difficult because school bus drivers are typically paid less than drivers in other sectors, like public transit and trucking.[48]

Figure 8 Reported Levels of School Bus Driver Shortage, 2018



Source: Thomas McMahon, "School Bus Driver Pay Rises as Shortage Worsens," *School Bus Fleet*, November 2018, p. 2, http://files.schoolbusfleet.com/stats/SBF1118-survey-webpress-lores.pdf; Nicole Schlosser, "Contractors Boosting Fleets, Bumping Up Driver Pay," *School Bus Fleet*, July 2018, p. 3, http://files.schoolbusfleet.com/stats/SBF0718SchoolBusContractorSurvey.pdf.

Figure 9 Mean Hourly Wages of Select Professions Requiring a CDL, 2018

Source: Transportation and Material Moving Occupations, 53-0000, *Occupational Employment Statistics*, Bureau of Labor Statistics, May 2018, https://www.bls.gov/oes/current/oes_stru.htm#53-0000.

Diesel Retrofit Technologies

Environmental Impact: Medium
Short-Term Cost: Low
Long-Term Cost: Medium

Diesel retrofit technologies are products that can be added to existing diesel school buses in order to reduce emissions. These technologies may include installing devices in buses' exhaust systems, upgrading certain engine components, or making other modifications that reduce emissions.[49] The EPA has verified that a number of these technologies significantly reduce various air pollutants.[50]

Benefits

Diesel retrofits are a relatively low-cost strategy to reduce the environmental effects of existing school buses.

Diesel retrofits are a relatively low-cost strategy to reduce the environmental effects of existing school buses. For example, studies in Washington state have found that retrofits reduced pollution, reduced the number of doctor visits for asthma and pneumonia, and had positive effects on students' health.[51] In addition, an analysis of more than 2,500 retrofits in Georgia found that students riding retrofitted buses experienced improved English and math test scores.[52]

Because of these benefits, retrofits can also be cost-efficient. For example, the Georgia study also found that the benefits of retrofits far outweighed the costs. The average retrofit only cost about $8,000 per bus, suggesting that diesel engine retrofits can be at least three times more cost-effective than class-size reductions for improving test scores.[53]

Challenges

Diesel retrofit options are relatively affordable, but prices and effectiveness vary considerably. For example, diesel oxidation catalysts, which reduce the emissions resulting from diesel exhaust, can be installed for as little as $600. These devices can reduce particulate matter by 20 to 40% and carbon monoxide (CO) by 10 to 60%.[54]

Meanwhile, diesel particulate filters, which also limit the impact of exhaust, can cost up to $15,000. They also cut substantially more emissions, reducing particulate matter by 85 to 90% and CO by 70 to 90%.[55]

Propane and CNG School Buses

Environmental Impact: Medium
Short-Term Cost: Medium
Long-Term Cost: Low

Propane and CNG school buses do not significantly improve air quality compared to newer models of diesel buses, and actually emit some forms of pollution at higher levels.

As described above (see: Glossary, page 8), propane and CNG are alternative fuels that can be used to power vehicles instead of diesel. Propane and CNG school buses do not significantly improve air quality compared to newer models of diesel buses, and actually emit some forms of pollution at higher levels. This limits the potential environmental benefit of propane and CNG options, unless they are being used to replace older diesel buses.

Benefits

The primary benefit of propane and CNG school buses is fuel and maintenance cost savings. These buses can save districts thousands of dollars in maintenance per bus and reduce facilities costs.[56] This is because:

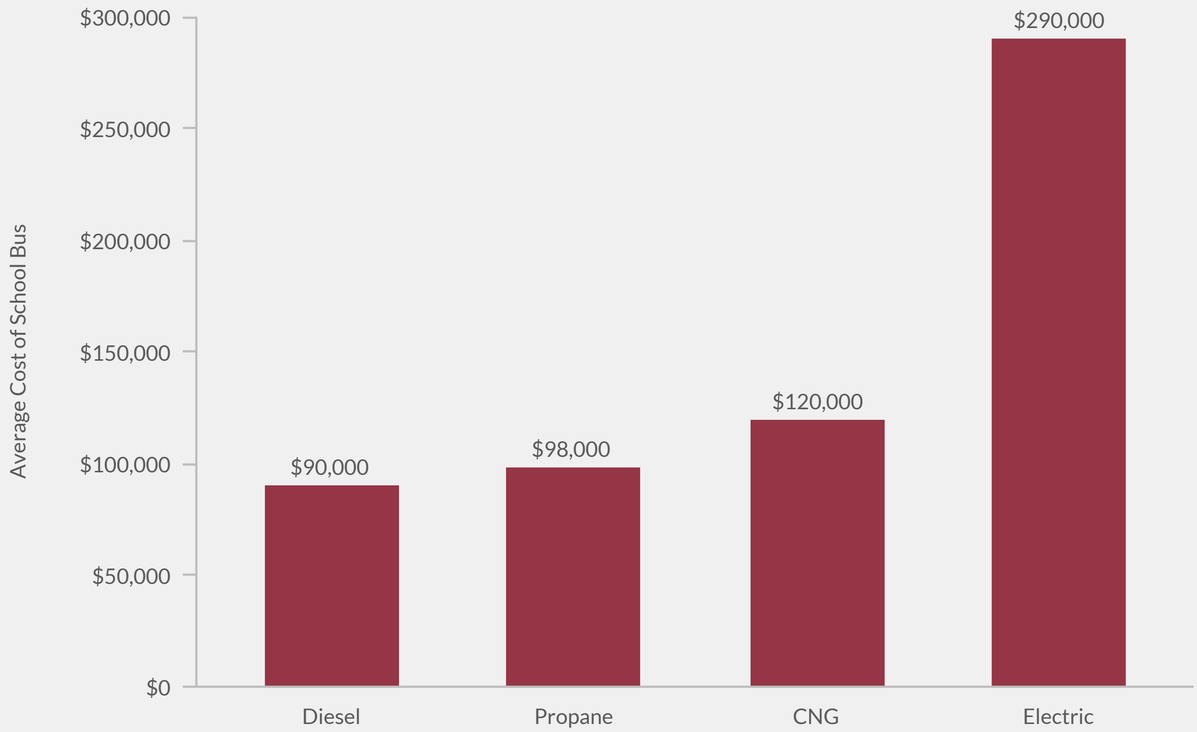
- The price of propane and CNG is lower and more stable than diesel
- Propane and CNG buses require less maintenance and do not require additional treatment to meet federal vehicle emissions standards, unlike many diesel buses
- Propane and CNG buses start more easily in cold weather and do not need to be parked in heated facilities overnight in cold climates

Case studies have shown that districts using propane and CNG buses experience substantial savings — enough to offset the initial additional cost of new buses. For example, a study by the U.S. Department of Energy tracked 110 propane buses in five school districts, all of which replaced diesel buses. All five districts experienced savings — between $400 and $3,000 per bus per year — enough to offset the incremental costs of the buses and related infrastructure over a period of three to eight years.[57]

Challenges

As discussed above, propane and CNG buses do not have substantial environmental benefits over newer diesel buses, and may have some environmental drawbacks. Propane and CNG buses are more expensive than their diesel counterparts. Propane school buses cost about $98,000, 9% more than diesel buses. CNG buses cost approximately $120,000, about 33% more than diesel buses.[58]

Figure 10 Average Cost of School Buses, by Fuel Type



Source: Based on data collected from the online version of the AFLEET Tool 2018, developed by the Argonne National Laboratory, available here: https://afleet-web.es.anl.gov/afleet/.

These types of buses may also require infrastructure investments — primarily fueling stations — as well as additional training for maintenance staff. Case studies from the Department of Energy estimate that installing a propane fueling station costs between $55,000 and $250,000, depending on the station's size and equipment.[59]

However, suppliers and manufacturers regularly provide assistance to lower these costs, like paying some or all of the costs of installing on-site fuel stations,[60] or providing specific maintenance training.[61]

In addition, many public fueling and charging stations for alternative fuels already exist. According to the Department of Energy, as of April 2019, there are nearly 40,000 public alternative fuel stations in the United States, including stations for biodiesel, CNG, electric, ethanol, hydrogen, and propane. Of those, more than 3,000 are propane stations and nearly 1,000 are CNG stations.[62] There are currently public propane stations in all 50 states, and public CNG stations in 45 states.[63]

Despite the potential cost savings of propane and CNG school buses, they are limited in their ability to reduce the environmental impact of school transportation. Districts that want to invest their limited transportation resources in the most environmentally beneficial and cost-effective ways possible should consider other options.

Electric School Buses

Environmental Impact: Low
Short-Term Cost: High
Long-Term Cost: Low

Electric vehicles store energy in rechargeable batteries. In all-electric vehicles, these batteries serve as the primary fuel source, while hybrid electric vehicles use electricity along with other fuels to improve overall efficiency. Electric school buses are far less common than propane and CNG options, in part because they have only been commercially available since 2015.[64] The public transportation sector has been much faster to adopt these options: Though electric options accounted for less than 1% of school bus sales in 2017, more than 17% of transit buses nationwide are fully or hybrid electric vehicles, and these vehicles have been used in public transit fleets for more than a decade.[65]

Though electric options accounted for less than 1% of school bus sales in 2017, more than 17% of transit buses nationwide are fully or hybrid electric vehicles.

To date, most electric school buses have been deployed in California, Massachusetts, Minnesota, and New York. Case studies below give more detail on results from recent electric bus pilots. Because electric buses offer greater environmental and long-term cost-saving benefits than other types of buses,[66] they are likely to become more popular in the future.

Benefits

The most enticing benefit of electric school buses is that they are zero-emission[67] vehicles, meaning they do not release harmful tailpipe emissions like diesel buses and even propane and CNG buses. The emissions-reduction benefit of electric vehicles is tempered by the emissions released in the production of the electricity used to power them. As energy production continues to become cleaner in the future, the net reduction in emissions tied to transitioning to electric vehicles is likely to improve.[68]

Electricity is also less expensive and has more stable prices than any other vehicle fuel, and electric school buses require less maintenance than those powered by diesel, propane, or CNG.[69] Districts could realize further savings and environmental benefits using vehicle-to-grid technology — which enables electric buses to communicate and interact with the overall electrical power grid, rather than just draw a charge from it. Vehicles using this technology can become repositories for overproduction and serve as "prosumers," meaning they actually return energy to the grid.[70]

For example, the energy stored in the batteries of electric school buses could be tapped to release stress on the grid, especially during the summer when fewer school buses are in use.[71] Vehicles can also return energy to school district buildings, which could lower overall energy use and mitigate demand charges, reducing electricity costs for the district. However, the potential benefits of electric school buses' vehicle-to-grid and vehicle-to-building capabilities are still untested. As we discuss further in the case studies that follow on page 27, pilot programs to date have not yet reached the stage where bus batteries can return power to the electrical grid.

Researchers from the University of Delaware have estimated that using an electric school bus with vehicle-to-grid capabilities instead of a diesel bus could save a district $6,000 per seat — or roughly $230,000 per bus — over a 14-year lifespan.[72] Evidence from the public transit sector has also shown that electric transit buses can have a lower total lifecycle cost than options powered by other fuels.[73]

Challenges

There are high up-front costs associated with transitioning to electric buses, as they are more than twice the price of diesel, propane, and CNG buses.

There are high up-front costs associated with transitioning to electric buses, as they are more than twice the price of diesel, propane, and CNG buses. An electric school bus typically costs about $200,000 more than its diesel counterpart.[74] This means that all districts currently using electric buses rely on grants and subsidies to fund initial purchases. The price of electric school bus batteries is a large contributor to the cost of these buses, but recent data shows that electric vehicle batteries are continuing to drop in price due to technological advancements and the expanded use of electric power in multiple sectors. Based on this progress, some experts estimate that electric vehicles could actually be cheaper than their combustion-engine equivalents as soon as 2022.[75]

Districts also need to install their own charging stations for electric buses. There are more than 21,000 public electric charging stations[76] across all 50 states,[77] but electric school buses typically use more powerful, more expensive chargers — up to $50,000 each — than smaller electric vehicles.[78] Using these chargers requires more planning and coordination with local utility companies, and school districts need to closely manage charging plans to maximize the energy and cost savings of electrification. This means that on-site charging stations are a necessity for implementing and operating electric school bus fleets.

In the public transit sector, some cities have also experienced challenges adopting electric school buses, including limited battery ranges due to factors like extreme temperatures and high elevation.[79]

Across several of these challenges, utility companies can be a valuable partner to school districts hoping to successfully shift to electric school buses. However, utility companies may have limited interest in co-sponsoring school bus electrification until deployments of electric school buses reach a certain scale — meaning pursuing electrification may not currently be a realistic option for smaller districts.

Encouraging Walking and Biking

Environmental Impact: Low
Short-Term Cost: Low
Long-Term Cost: Low

Walking and biking to school, also known as active school transportation, is the most environmentally friendly, and healthy, way to get to school.

Walking and biking to school, also known as active school transportation, is the most environmentally friendly, and healthy, way to get to school. If more students walk or bike, communities can reduce emissions, benefit students' health, and potentially save districts money. However, a number of factors limit the reach of these options, including distance to school and parent concerns about traffic safety.[80]

Benefits

Research has shown that walking and biking can improve students' cardiovascular fitness and overall health. It has also been linked to academic benefits, like a higher degree of alertness during school hours and better grades.[81] Replacing motorized travel with walking and biking could also reduce exhaust and greenhouse gas emissions.[82]

Increasing the share of walking and biking trips to and from school can also translate into savings by reducing the overall need for transportation services. Districts can successfully encourage walking and biking through simple investments like well-designed roads and sidewalks, protected bike lanes near schools, and clearly painted crosswalks, which can help prevent student fatalities during pickup and drop-off times. (For more information on designing safe infrastructure for walking and biking, see Bellwether's publication "School Crossing: Student Safety on the Bus and Beyond.") Districts can also offer incentives for students, like hosting "walk and bike to school day" events, offering certificates or prizes for students who frequently walk or bike to school, or creating other contests and activities.[83]

These types of programs have been successful in many places. For example, a three-year analysis of a national sample found that programs supporting walking and biking doubled the share of students who walk and bike to schools.[84] A 2014 evaluation of state-level projects supporting walking and biking in Florida, Mississippi, Washington, and Wisconsin also found that they were associated with significant increases in active school travel.[85]

Challenges

Despite its many benefits, the number of students walking and biking to school has declined substantially over the past 50 years. In 1969, 49% of children ages 5–14 in the United States walked or biked to school. However, by 2009, that figure was 13%.[86] In 2017, the number of children ages 5–17 walking and biking to school fell further to 10%.[87]

One of the major reasons for this decline is the increasing distance that students must travel to reach school. Research has shown that distance to school is the factor most strongly associated with walking and biking,[88] and home-to-school distance has increased over time. While nearly 35% of U.S. students lived within one mile of their school in 1969, fewer than 20% did by 2001. At the same time, the percentage of students living three miles or more away from school increased from 33% to 52%.[89]

The decline in walking and biking has coincided with a sharp increase in the share of students traveling to school in private vehicles, while the share riding school buses has remained about the same.

The decline in walking and biking has coincided with a sharp increase in the share of students traveling to school in private vehicles, while the share riding school buses has remained about the same.[90] This suggests that strategies aimed at increasing walking and biking options might primarily shift students away from driving to school in cars. While this would still substantially reduce emissions, it also limits the potential for walking and biking programs to directly reduce costs from buses.

What Can We Learn From Electric School Bus Pilots?

As explained above, electric school buses have great potential to save money in the long run and substantially reduce environmental impact. Pilot projects in California, New York, and Massachusetts are showing the successes and challenges of electrification efforts, from which other districts can learn. To date, they have shown that:

- Successful electric school bus pilots require an array of partners and funding sources
- Electric school buses can reduce emissions compared to diesel options
- Electrification creates opportunities to provide new educational programming and inspire pride in the community
- Implementation challenges can limit electric school buses' ability to reduce energy use and emissions, but these issues can be resolved with appropriate planning and project monitoring
- Vehicle-to-grid systems using bus batteries to store electricity for the public grid have potential, but are largely untested with school buses
- Electric bus fleets will be very difficult to implement at scale and sustain without subsidies until the cost of buses comes down substantially

Twin Rivers

Starting in 2017, Twin Rivers Unified School District, located north of Sacramento, California, was the first school district in the United States to deploy electric school buses and currently has the largest electric school bus fleet of any district in the country.[91] The district transports nearly 5,000 students — 87% of whom qualify for free and reduced-price lunch — to more than 50 schools each day, using a fleet of 127 buses. Of those, 25 are electric and 37 run on CNG, while the remainder are powered by diesel.

The electric school buses are part of a pilot program involving multiple organizations, including Twin Rivers, the California Air and Resources Board, and the Sacramento Metropolitan Air Quality Management District.[92] A $7.5 million California Climate Investment grant, using proceeds from the state's carbon cap-and-trade program, covered a substantial portion of the cost of the buses and electric charging infrastructure.[93] This infrastructure included a new electric charging station, for which the local utility company contributed nearly $100,000. A local carbon reduction fund and other sources provided additional funding.[94]

Although up-front costs are currently high, Tim Shannon, Twin Rivers' transportation director, believes that the price point of electric school buses will come down in the future. "Multiple bus manufacturers want to work with and support us. There is support to create an electric school bus industry, which will reduce the cost of the vehicles."[95]

So far, the pilot has reduced Twin Rivers' fuel and maintenance costs considerably. Diesel fuel costs the district 82–86 cents per mile, electric costs 15–17 cents per mile.[96] Over a two-month period last year, data on Twin Rivers' electric buses reported that their fuel costs were more than 80% lower than diesel buses of equivalent size.[97] Because electric buses have fewer moving parts requiring regular maintenance, Shannon estimates that the electric buses' maintenance costs are also 60–80% less than his other buses.[98]

"Once a larger share of our fleet is electric, I could see us halving the fuel budget," Shannon says. "And once we are all electric, we wouldn't need much of anything for fuel — those savings could be put back into the classroom."[99]

Shannon also hopes to further reduce the cost of electric buses by taking advantage of the buses' vehicle-to-grid capabilities (explained on pages 23–24). However, that component of the pilot is still in development.[100]

Alignment among the superintendent, district administration, and central budgeting office has also enabled Twin Rivers to use the pilot as an opportunity to engage the community. For example, the district is using its electric buses to create classes focusing on clean energy and environmental topics for high school students. Twin Rivers is also partnering with the local community college to offer career and technical education courses related to electric vehicle maintenance.[101]

Long-term environmental benefits, such as improved air quality and student health outcomes, are still being evaluated. Regardless, Twin Rivers plans to increase its electric fleet to 50 buses over the next three years, and eventually have a fleet composed entirely of electric buses. Even the district's CNG buses are only viewed as a "stopgap" to get to electric buses, according to Shannon.[102]

Shannon recommends that more districts consider using buses run on electric and other alternative fuels. "Look at the numbers. Even though there's sticker shock up front, with the right business model it's more efficient, and less taxing on kids because of cleaner air."[103]

White Plains

White Plains City School District, located north of New York City, enrolls more than 7,000 students, a majority of whom are Hispanic or Latino (57%) and economically disadvantaged (55%).[104] The district works with National Express, a private contractor that provides school transportation services, to transport more than 5,000 students each day.

In 2018, the district began piloting five electric school buses. The pilot program involves multiple organizations, including National Express, which owns, operates, and maintains the fleet of school buses serving White Plains students, and also employs the school bus drivers. National Express operates the five electric buses and pays the related energy costs during the school year. The contractor purchased the buses with the support of a grant from the New York State Energy Research and Development Authority, which offset $120,000 of the cost of each vehicle, as well as another $100,000 per bus from Consolidated Edison (Con Ed), the local utility company.[105]

In return, Con Ed has the right to use the buses' batteries to help power the electrical grid in the summer. During this time, utilities are at peak use due to air conditioning needs. Because the buses sit idle during the summer months when school is out of session, their batteries can store electricity when demand is low and discharge it at peak hours.[106] This aspect of the program began in summer 2019.

According to John Shipman, department manager of demonstration projects at Con Ed, pilots like this can demonstrate the feasibility of alternative revenue streams for fleet operators, but more work is needed to make electrifying school bus fleets an enticing investment.

For example, Con Ed will not actually profit from the savings in electricity costs — those will go to people paying their utility bills. This is because utilities in New York are regulated so that power generation, transmission, and distribution cannot be managed by the same company. This revenue-decoupling means that Con Ed doesn't make more money for distributing more power. Instead, if total revenues increase, that creates downward pressure on utility rates.[107]

However, Con Ed could benefit more directly if a much larger number of electric school buses were able to reduce stress on the electrical grid. Reducing this stress could allow Con Ed to delay building large electrical infrastructure projects, like substations with higher capacity, which can be a billion-dollar investment.[108]

"If state policy is to reduce greenhouse gases, a big chunk needs to come from transportation," says Shipman. "But we need to demonstrate paths to profitability for operators. In the meantime, we'll need creative ways to finance the up-front costs."[109]

If these challenges can be addressed, there is great potential to scale up the pilot. This could include converting a larger share of White Plains' fleet to electric, or expanding to include fleets in other districts, like the 1,000 school buses in Westchester County or the 7,000 in New York City.[110]

Because White Plains contracts for its bus service, the district is removed from the day-to-day operations of the pilot, and gets to participate at no additional cost. According to White Plains Superintendent Dr. Joseph Ricca, "We're the customer — on a day-to-day basis, we're looking at rider satisfaction and vehicle quality."[111] Ricca also underscored the importance of multi-organization partnerships for enabling districts to transition to electric buses. "The initial cost is way more than what a district would be able to do on its own. If we're serious about this, it will require external support, including state and federal funds. There has to be a paradigm shift."[112]

According to both Shipman and Ricca, National Express has been reliable and successfully able to operate the buses. "There has been no difference in terms of services," Ricca said. "And there's no doubt that you don't smell the exhaust. It's a discernible difference."[113]

Ricca also highlighted the opportunity for innovative pilots to engage students and galvanize community support. "Kids and parents have loved them. We have a strong commitment to sustainability in our curriculum, so to have electric buses as part of that has been a neat experience for our students. It shows the community that we are investing in sustainability. It's pretty exciting!"[114]

Massachusetts

The state of Massachusetts enrolls nearly one million public school students,[115] transporting roughly 400,000 students on 9,000 school buses each year.[116] In 2016, the Massachusetts Department of Energy Resources (DOER) began piloting three electric school buses, deploying one bus each to three school districts around the state: Amherst-Pelham Regional Public Schools, Cambridge Public Schools, and Concord Public Schools.[117] These districts range in their shares of students who are economically disadvantaged from as low as 6% to nearly 30%.[118] Cambridge is by far the largest of the districts, enrolling more than 7,000 students.[119]

The Regional Greenhouse Gas Initiative (RGGI) — a multistate cooperative focused on capping and reducing emissions[120] — provided roughly $2 million to help fund the pilot project. DOER selected the Vermont Energy Investment Corporation (VEIC) to support implementation and evaluate the pilot. VEIC tracked the vehicles for approximately one year and evaluated them based on reliability, energy efficiency, and energy consumption.[121]

The evaluation found that districts were able to successfully deploy the electric school buses, but implementation challenges limited their potential impact. For example, energy costs in the pilot were 63% higher than necessary due to inefficient charging practices — like charging buses at high-demand times and charging them for longer than necessary — as well as the use of auxiliary fans and heaters to heat or cool batteries during charging. This excess energy consumption can be avoided through improved management of charging plans, dramatically increasing energy savings.[122]

Similarly, the evaluation found that the electric buses emitted half the greenhouse gases of comparable diesel buses — a substantial reduction, but less than expected. Again, this was due in part to poor charging practices, as well as the use of diesel-powered heaters to heat the inside of the buses in cold weather.[123]

There are many reasons why implementation was a challenge. Managing bus fleets is not a primary function of schools. As a result, districts vary widely in their capacity to manage fleets and to adopt new technology. In addition to managing the different fueling techniques and charging infrastructure used by the electric buses, districts also struggled with smaller components of implementation, like ensuring that the buses were able to be parked in locations with access to chargers. This underscores the importance of assisting districts with planning and implementation of bus electrification projects and providing adequate training for transportation staff.[124]

These implementation challenges threw off plans to test vehicle-to-grid capabilities. “Utilities have growing interest in batteries’ ability to store energy and discharge power back into the grid as needed,” says Jennifer Wallace-Brodeur, director of transportation efficiency at VEIC. “But what we found is that it takes a lot of time and energy to support adoption, and we didn’t get to the demonstration of vehicle-to-grid capabilities.”[125]

Despite these challenges, Wallace-Brodeur is hopeful for the potential of electric school buses. “People are underrating the opportunity. The economics of the bus itself is only half the opportunity — there also substantial benefits for children’s health,” she said. “Purchasers are pioneers. Hopefully they’re helping others systematize adoption to make it easier in the future. We could be in a different place relatively quickly.”[126]

Funding Investments in Green School Transportation

Cost is one of the top barriers for school districts interested in environmentally friendly school transportation, whether they are seeking to improve diesel buses, replace them with alternatively fueled buses, or encourage more walking and biking. Electric school buses, which may offer the most environmentally effective solution with the highest long-term savings, also have the highest up-front costs. This is why all the pilot programs above use a combination of state, federal, philanthropic, and corporate donations to offset initial costs and implementation.

A variety of incentive programs exist at the state and federal level to help school districts and school bus vendors invest in environmental improvements, including:

- Federal grants, like those made under the Diesel Emissions Reduction Act (DERA) and Fixing America's Surface Transportation (FAST) Act
- State-level programs, including grants, loans, rebates, and tax exemptions
- State plans funded by the recent settlement with Volkswagen after the company admitted to cheating on vehicle emissions tests in 2015[127]

If all of this money were allocated towards new electric buses, it would only buy about 86,000 buses, replacing less than 20% of diesel school buses.

These types of programs provide funding to reduce the environmental impact of school transportation, but they are far from sufficient, especially if the goal is to increase the share of electric school buses in America's fleet. For example, districts spend a total of roughly $25 billion each year for school transportation[128] — if all of this money were allocated towards new electric buses, it would only buy about 86,000 buses, replacing less than 20% of diesel school buses at current cost levels.

Diesel Emissions Reduction Act (DERA) grants

Under DERA, the EPA awards grants and rebates to help replace or retrofit older diesel vehicles, including school buses. Roughly $40 million is available in 2019 for projects that significantly reduce diesel emissions, particularly in areas designated as having poor air quality,[129] which include some of the largest counties in the country.[130]

In May, the EPA announced several dozen DERA awards to districts and contractors, providing over $9.3 million in rebates to replace older diesel school buses nationwide. Applicants replacing buses with engines from 2006 or earlier were eligible to receive rebates between $15,000 and $20,000, depending on the size of the bus.[131]

Fixing America's Surface Transportation (FAST) Act

Following its reauthorization in 2015, the FAST Act sets aside more than $800 million per year under the Surface Transportation Block Grant Program to help state and municipal governments fund "transportation alternatives."[132]

Alternatives encompass a variety of smaller-scale transportation projects, including "safe routes to school" projects that improve bicycling and walking conditions near schools and create safe connections for students using these modes of transportation.[133] Funding can be used for a variety of purposes, like paving sidewalks and walkways, painting bike lanes, or building bike and pedestrian bridges and underpasses.[134]

State-level Programs

While state-level programs vary widely, all 50 states and the District of Columbia provide at least some sort of incentive for reducing emissions and using alternative fuels, and many of these programs are explicitly for school buses.[135]

For example, Oregon's Clean School Bus Grants program provides funding for purchasing new school buses or retrofitting older school buses with parts or technology that reduce emissions. Similarly, Illinois has a School Bus Retrofit Reimbursement program, which reimburses school districts for the cost of converting diesel buses to more fuel-efficient engines or to engines using alternative fuels. And Mississippi's Revolving Loan Program provides zero-interest loans to school districts for purchasing alternative fuel school buses, fuel systems, equipment, and fueling stations.[136]

Volkswagen Settlement

In 2015, Volkswagen admitted to outfitting diesel vehicles with software that enabled them to cheat on emissions tests — nearly 600,000 vehicles in the U.S. and over 11 million worldwide — leading to massive recalls in the U.S., Germany, and more than two dozen other countries.[137]

Following legal action, Volkswagen has agreed to pay more than $25 billion in the U.S. for claims from vehicle owners and dealers, environmental regulators, and states, and has also offered to buy back roughly 500,000 heavily polluting U.S. vehicles. The buybacks will continue through the end of 2019.[138]

Of the $25 billion in reported settlements, $2.9 billion will be distributed to states through a mitigation trust that will fund projects designed to reduce harmful emissions from diesel vehicles. Funding can be used to replace or repower older diesel vehicles with new diesel, propane, CNG, or electric — including school buses, transit buses, large trucks, and freight trains.[139]

Before states can spend their share of the funding, they must develop and submit beneficiary mitigation plans. Most states have included school bus replacement projects in these plans. Some are focusing on electric vehicles, while others are also including other alternative fuels or clean diesel.[140]

These funding opportunities play an important role in helping states and districts make their school transportation systems more environmentally friendly — whether they want to opt for well-established solutions like retrofits and active transportation, or serve as leaders in implementing emergent options like electric buses and vehicle-to-grid technology. But much more funding would be needed in order to shift the current fleet of school buses at scale.

Recommendations

School transportation can have a substantial impact on the environment. Most school buses on the road today — particularly older diesel buses — emit GHGs that contribute to global warming and create air pollutants that can harm students' health and academic outcomes. In addition, the majority of students travel to school in personal vehicles, which also release harmful emissions and pollutants. When considering that these smaller vehicles carry many fewer students per vehicle than the typical school bus, their negative effects can be even more pronounced.

However, districts have several options to reduce the environmental impact of their school transportation systems. Some of these strategies — like limiting idling time and implementing retrofit technologies — provide relatively affordable and accessible ways to reduce the effects of existing diesel buses.

Other strategies, like replacing diesel buses with alternatively fueled options, can result in greater environmental benefits. However, these options have higher up-front costs associated with purchasing new buses, building new infrastructure, or providing additional training for maintenance staff.

Electric school buses, which provide the greatest potential environmental benefit, also have the highest up-front costs. These buses cost more than three times as much as a diesel bus, and also require charging stations and close management of charging plans. As our case studies of electric school bus pilot programs show, poor implementation can limit these buses' benefits over diesel options, underscoring the importance of funding adequate training and support for staff.

Encouraging more students to walk and bike to school would also benefit the environment, and shift students away from private vehicle trips. Walking and biking can benefit the environment, and students' individual health. But it may not be feasible where students live far from school, or where safe routes to school are not available.

Beyond environmental benefits, these impact reduction strategies can create savings for districts. Some strategies reduce fuel use, while others lead to fewer maintenance needs and can extend the usable life of buses. Walking and biking options can lower costs by reducing the overall need for school transportation. Electric school buses can even potentially offset utilities costs using vehicle-to-grid and vehicle-to-building capabilities, though this benefit still needs to be demonstrated in the field.

Whether districts opt for low-cost strategies or more expensive, more effective ones, affording additional up-front costs can be difficult for districts with limited budgets that already struggle to provide adequate transportation using their current fleets. There are several steps that states, districts, and other education and transportation leaders can take to reduce these barriers and support strategies that reduce the environmental impact of school transportation.

1 Develop an environmentally friendly transportation vision.

States, school districts, and other local agencies, such as utilities or departments of public works, should develop a shared vision for making their school transportation systems more environmentally friendly.

States, school districts, and other local agencies, such as utilities or departments of public works, should develop a shared vision for making their school transportation systems more environmentally friendly. This vision should consider many factors, including which modes of transportation are available to students. For example, districts located in dense urban areas may have greater access to public transit and more opportunities to encourage walking and biking. In larger, more sprawling districts, vehicle transportation may be the best path for most students.

States and local communities should also consider their transportation infrastructure needs. Some may already have access to the infrastructure needed for transitioning to alternative fuels, like public or shareable fueling and charging stations, which can reduce the up-front costs of adopting alternatives. Similarly, some schools may already have infrastructure in place to support walking and biking — such as well-designed roads and sidewalks, protected bike lanes, and clearly painted crosswalks — while others may need further investment.

A vision for environmentally friendly school transportation systems should also set clear goals based on the resources available for making environmental investments. Some states and communities may want to rely on impact reduction strategies that are more affordable and better established, while others may jump at the opportunity to be leaders in adopting new technologies like electric school buses. Districts that already have a large transportation burden may not be able to dedicate the necessary time and resources to adopt strategies that require more expensive and complicated implementation, which affects how they balance short- and long-term costs with environmental benefits. In addition, districts that contract for transportation services may want to consider contractors that operate more environmentally friendly fleets.

2 Collect the necessary data.

Developing and implementing a vision for school transportation's environmental impact will also require collecting more information on students' transportation needs, the composition of current fleets, and school transportation operations.

Districts need to understand how their students get to school.

Districts need to understand how their students get to school. Are students primarily traveling to schools on school buses, or are they using private vehicles? What share of students live close enough to their schools to walk or bike, and how many are doing so? The answers to these questions are important for determining what impact reduction strategies are likely to be most effective.

Districts also need to consider more extensive data on their current school bus fleets and operations. Factors like the number of school buses being used, how many miles they travel, and what fuel types they use influence the extent to which school transportation operations affect the environment. Similarly, districts need to track other operational data, like ridership, whether buses are operating at or near full capacity, and time spent idling. Some districts and vendors collect data like this already, but they do not often analyze it through an environmental impact lens. All of this information can help districts determine their estimated fuel use, emissions, and pollutants, and also identify opportunities to improve the efficiency and reduce the environmental impact of their transportation systems.

3 Fund environmental investments on multiple levels.

To support the efforts described above, state funding mechanisms should consider the costs and benefits of investments in impact reduction strategies. If states help school districts cover the cost of new buses and infrastructure in the short term, these investments typically reduce fuel and maintenance costs and generate savings in the long term. This means that states can clean up their school transportation systems while ultimately lowering the amount schools spend on transportation.

States can also provide additional funding opportunities to incentivize the adoption of environmental impact reduction strategies.

States can also provide additional funding opportunities to incentivize the adoption of environmental impact reduction strategies. This could include creating new programs or expanding existing ones. Targeted grants, reimbursements, or low- or zero-interest loans that support the adoption of new technologies, fuels, or infrastructure can all help districts make smart, environmentally friendly investments that pay off in the long run.

In addition, the federal government should provide more support for adopting alternatively fueled school buses and other clean air technology for school buses already in operation. As noted above, the level of funding currently available from federal programs pales in comparison to the total need of the school transportation sector. By increasing funding for these programs, the federal government could help spur on investments and improvements at the state and local level.

4 Support innovative partnerships and multi-sector collaboration.

Even with a vision, additional funding, and good data, districts and communities may need additional support to execute ambitious school transportation plans.

Even with a vision, additional funding, and good data, districts and communities may need additional support to execute ambitious school transportation plans. For example, as our case studies show, funding and support from manufacturers, utility companies, and other entities make it possible for districts to put electric school buses on the road. More companies and public utilities should consider opportunities to develop these kinds of innovative partnerships to spur the adoption of new technologies and fuels. Districts pursuing electrification will also need to build capacity, whether internally or externally, to support fleet energy modeling, scoping and procurement, and infrastructure planning that goes well beyond what is typical in most school transportation departments.

Similarly, increased collaboration between the education and transportation sectors can help reduce school transportation's environmental impact across multiple modes of transportation. For example, districts can coordinate with local public transit authorities to maximize students' access to public transit options and reduce the need for school buses. Districts can also work with state departments of transportation to ensure that they are providing safety enhancements that enable students to safely walk and bike to school.

These steps can lead to transportation services that are more affordable, more environmentally friendly, and better for students' health and outcomes.

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Bellwether Education Partners is a national nonprofit focused on dramatically changing education and life outcomes for underserved children. We do this by helping education organizations accelerate their impact and by working to improve policy and practice.

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