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DRIVING TOWARDS A HEALTHIER FUTURE

Protecting Children's Health by Switching to Electric School Buses

Project Team

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Introduction

For nearly a century, the iconic yellow-orange school bus has been a familiar symbol of education across Canada. Since their debut in the 1930s, school buses have revolutionized student transportation, providing a safe and reliable means of travel. As a community, we've long been reassured that school buses are the safest vehicles on the road, so safe they don't even require standardized seat belts.

However, the significant health risk posed by the exhaust from diesel, gasoline, and propane-fueled school buses is often overlooked. Every day, roughly 215,000 children in Atlantic Canada—Prince Edward Island, New Brunswick, Nova Scotia, and Newfoundland and Labrador—depend on these buses to get to and from school. Each day those kids are put in harm's way on their daily school commute.

This report will delve into the adverse health effects of fuel-powered school-bus emissions on children. It will present findings from a recent study and make the case for transitioning to electric school buses, to truly ensure our children's safety. The report is coupled with a toolkit component, which will guide readers on how to take action. Our goal is to educate the public and equip people with the tools and resources necessary to advocate for a healthier school-transportation system.

Collaborating Organizations

Ecology Action Centre

The Ecology Action Centre (EAC) is a Nova Scotia -based environmental organization dedicated to promoting sustainable and ecologically responsible practices. EAC works toward climate-change mitigation, environmental conservation, and advocating for sustainable transportation and food systems.

NB LUNG POUMON NB

NB Lung is a charity that, since 1933, has been dedicated to improving and protecting lung health in New Brunswick through education, advocacy, and support programs. NB Lung is focused on protecting air quality, preventing lung disease, promoting respiratory health, and supporting those affected by lung conditions.

Conservation Council *of* New Brunswick
Conseil de conservation *du* Nouveau-Brunswick

The Conservation Council of New Brunswick (CCNB) is an environmental organization focused on protecting the province's natural resources and promoting sustainable practices. CCNB is engaged in advocacy, education, and research to address issues such as climate change, pollution, and conservation.

Emissions

Air Quality and Pollution

Air is 78% nitrogen, 21% oxygen, and contains small amounts of other gases. Keeping this balance is crucial for a healthy planet. Disruption of this balance causes air pollution and poor air quality. There is a lot of focus on air pollution and its damages to the natural environment. That is a significant impact of air pollution, but we hope to draw more attention to another impact of air pollution: on human health.

In Canada, the Air Quality Health Index (AQHI) is a communication tool that presents common air pollutants (NO^2, particle pollution from fine particulates, and ground level ozone) on a scale of 1 – 10+. An AQHI of 1-3 is considered low risk, 4-6 is considered moderate risk, and 7+ is considered high risk or very high risk or discomfort and possible lung damage. Like checking the weather, the AQHI helps you decide how safe it is to be outside, especially for those who are more sensitive to poor air quality, such as children, seniors, or those with asthma and other lung conditions. Air pollution occurs when harmful substances accumulate in the air, posing risks to health and the environment.

Fuel-powered School buses in Atlantic Canada

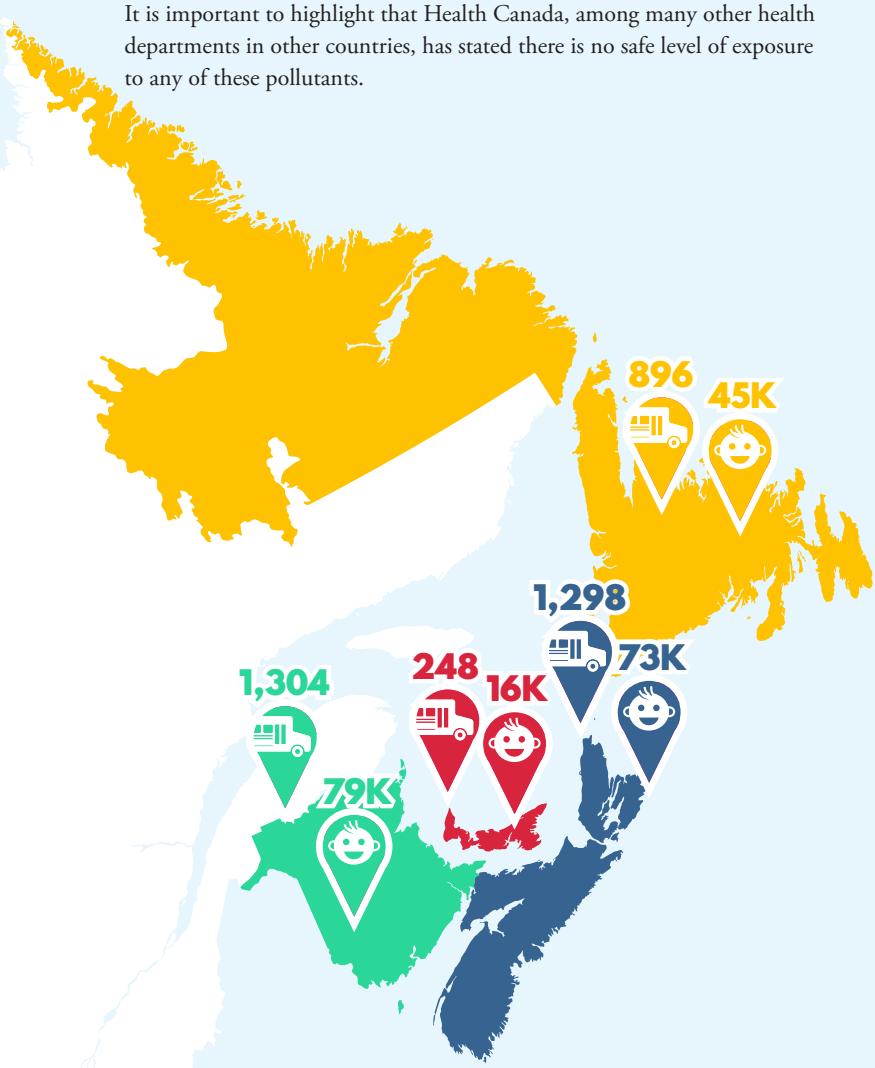
There are currently about 3,900 school buses in operation across the region. These buses are a mix of diesel, propane, gasoline, and electric. Of these categories, electric has by far the smallest share of buses. There are only 129 electric school buses in Atlantic Canada. Notably, 107 of those are in Prince Edward Island. PEI is leading the way in pursuing an electric fleet of school buses. The other 22 electric school buses are in New Brunswick, which has no commitment to pursuing a fully electric fleet. There are currently no electric school buses in Nova Scotia or Newfoundland and Labrador.

Chemicals and Pollutants

According to the Government of Canada, air pollution is the fifth leading cause of death worldwide, which is concerning as Canadians are regularly exposed to traffic-related air pollution (TRAP). TRAP stems from vehicle exhaust, tire and brake wear, road dust, and evaporation of fuels from engine components. It is a complex mixture of air contaminants, including these particulates and gases:

- black carbon (BC)
- carbon monoxide (CO)
- nitrogen dioxide (NO^2)
- sulfur dioxide (SO^2)
- fine particulate matter ($PM^{2.5}$)
- ultrafine particles (UFP)
- polycyclic aromatic hydrocarbons (PAHs)
- benzene and other volatile organic compounds (VOCs)

It is important to highlight that Health Canada, among many other health departments in other countries, has stated there is no safe level of exposure to any of these pollutants.



Traffic Emissions and Health Risks

Removing diesel, gasoline, and propane buses from the road removes a large source of health risk to our students, bus drivers, and community members.

LUNG AND HEART

Short-term exposure, such as occurs when spending time around a fuel-powered school bus, to ozone, sulfur dioxide, nitrogen dioxide, and $PM^{2.5}$ in vehicle exhaust can cause throat irritation or shortness of breath. Long-term exposure to vehicle exhaust can cause serious lung conditions such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD). Exposure is also connected to increased heart disease and hypertension.

Short-term exposure to these emissions can also aggravate and increase the symptoms of these and other lung and heart conditions. In New Brunswick, approximately 1 in 5 children live with an asthma diagnosis. In Canada that is equivalent to roughly 850,000 children under the age of 14 who have been diagnosed with asthma, marking it as a common chronic disease among children.

IMMUNE SYSTEM

Exposure to tailpipe emissions has been shown to impact immune systems, increasing allergy sensitivity. Long-term exposure is connected to higher risk of type-2 diabetes, while short-term exposure can worsen symptoms in any existing diabetes conditions.

Studies have also connected traffic-related pollution to increases in lung cancer, leukemia, and breast cancer cases, among others.

CENTRAL NERVOUS SYSTEM

Ground-level ozone and nitrogen dioxide in vehicle exhaust have been connected to higher risks of death from Parkinson's, dementia, stroke, multiple sclerosis (MS), and ALS. When exposure starts young, the connection is even stronger.

Studies have shown that $PM^{2.5}$ also negatively impacts cognitive development, with measured impacts on proficiency in math and English. This, in addition to the brain fog and memory deficits also caused by exhaust exposure, is a poor way to set up students as they begin each day of learning.

MENTAL HEALTH

Sound exposure from the diesel bus ride also increases rates of anxiety and depression in young people. At this important and already challenging life stage, we should be seeking avenues to decrease mental distress on students.

Children are at a higher risk

Children under 16 are more susceptible to health risks from poor air quality compared to adults. Children's lungs are small, still developing, and have a higher respiration rate, creating a higher exposure to pollution than adults, accounting for their size difference. This means that when a child inhales, a larger percentage of their small lungs is exposed to the particles in the air.

Health risks for Bus Drivers

While the group most significantly impacted by diesel fuel exhaust is the 215,000 students in Atlantic Canada riding the buses, we must remember the hundreds of bus drivers who transport our children to and from school each day. Bus drivers are exposed to exhaust fumes inside the bus for a longer time than students each day. Several symptoms unique to bus drivers and other adults are:

- Hearing loss
- Diabetes
- Heart conditions
- When pregnant: complications with pregnancy, birth, and newborn health

Consideration for these health effects is important for employers as well, in order to be compliant with Occupational Health and Safety regulations.

Carbon Dioxide on a School Bus Commute

Study conducted by NB Lung, EAC, and CCNB

In August of 2024, our teams collaborated to measure the concentration of carbon dioxide (CO2) in the air of a 2022 gasoline-fueled school bus while simulating real school routes and idling experiences. Health Canada recommends an average CO2 daily-exposure limit of 1000ppm.

Results

IDLING

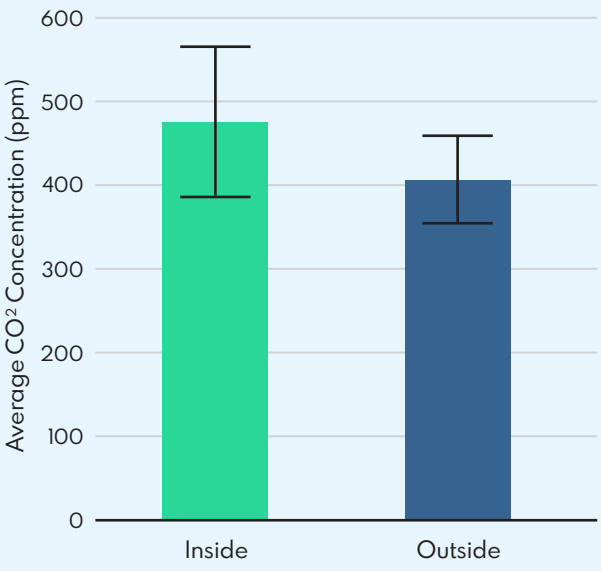
We measured carbon dioxide inside and outside an idling school bus for 30-minute intervals. The average concentration of CO^2 while idling was 476ppm inside the bus and 406ppm outside the bus. The difference between these data sets was found to be statistically significant. The data we collected confirmed what others have discovered before. Counterintuitively, the concentrations of CO^2 are higher inside the bus than outside the bus while idling.

EN ROUTE

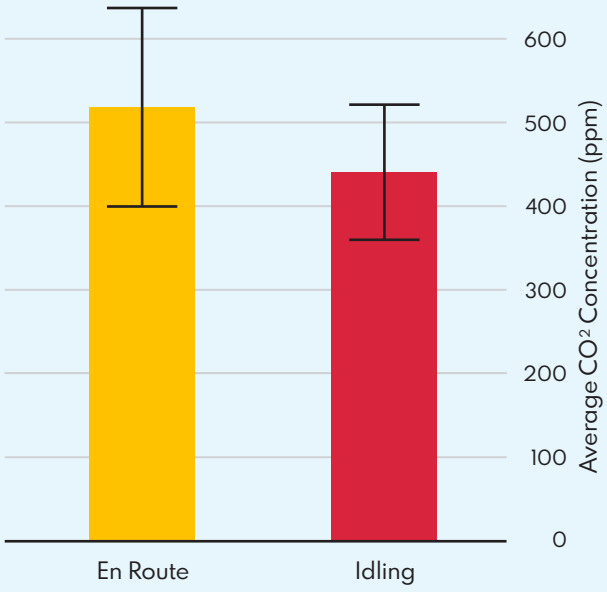
The air in the school bus was monitored while traveling through two real bus routes in Fredericton, NB, including stops simulating student pick-ups. These routes were driven one after the other, as buses often run two different routes each morning. The concentration of CO^2 during these routes was quite consistent, averaging 518ppm.

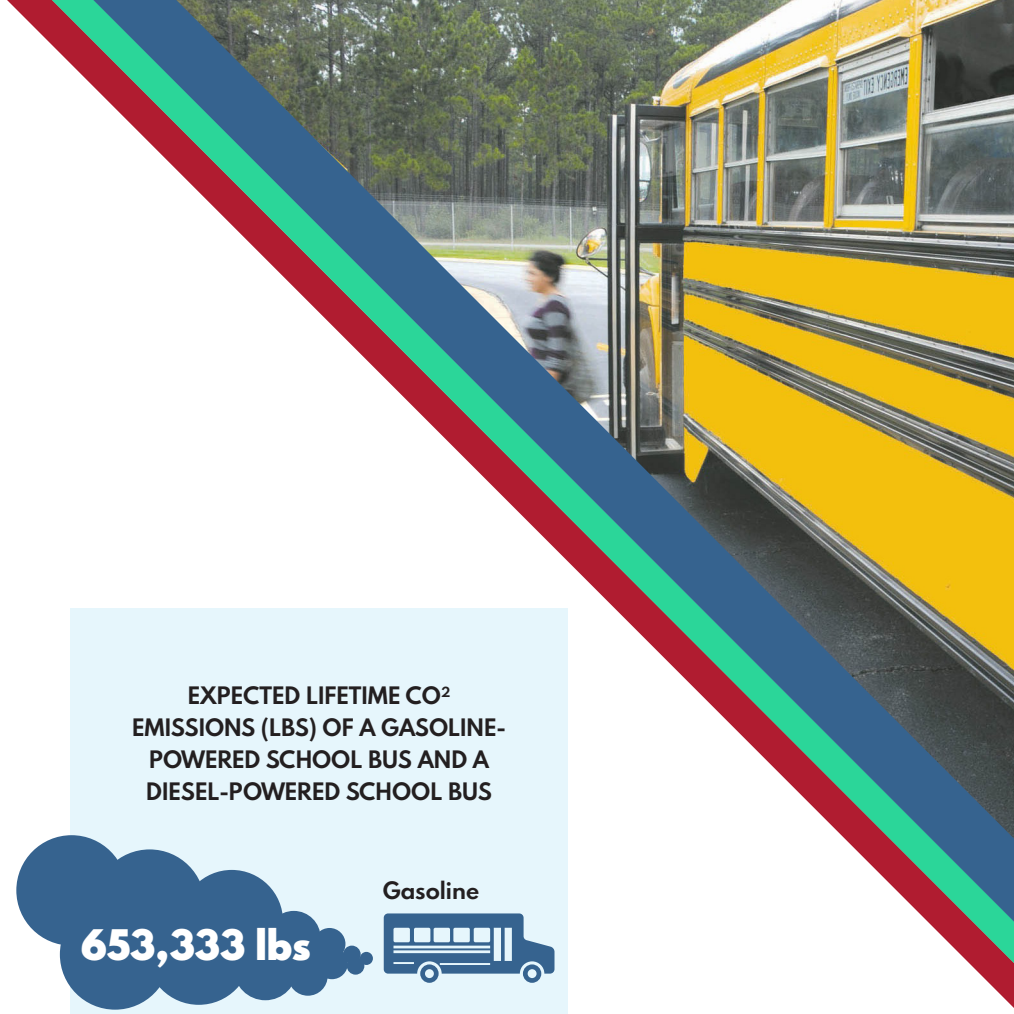
We were able to determine that the concentration of CO2 inside the bus while on the school routes (518ppm) was significantly higher than when the bus was idling (441ppm).

AVERAGE CO^2 CONCENTRATION (PPM) MEASURED INSIDE AND OUTSIDE A GAS-POWERED SCHOOL BUS WHILE IDLING



AVERAGE CO2 CONCENTRATION (PPM) MEASURED WHILE DRIVING SCHOOL BUS ROUTES AND WHILE IDLING BUS





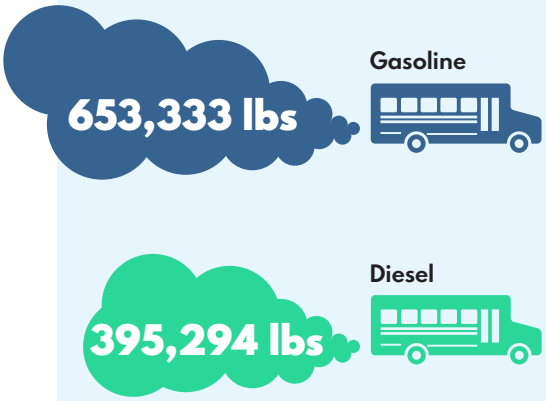
Conclusions

Through this experiment, we confirmed that levels of CO^2 are higher inside the bus than outside, whether stationary or moving. While many schools, districts, and bus drivers limit idling through policy or legislation, carbon dioxide levels are actually highest while moving. Students who take the bus will always be exposed to the highest level of pollution, as they are always inside the bus during commutes.

Our measurements were taken on a warm day with four adults inside the bus. Other studies have shown that buses emit more pollutants during cold weather, which overlaps with our school year in the northern hemisphere. Because humans produce CO^2 when breathing, when inside a small space like a vehicle, levels can increase dramatically. Typical school buses can accommodate up to 85 students and one bus driver. This likely makes average levels of carbon dioxide during school-year commutes higher than during our experiment.

These data and conclusions are all about the concentration of CO^2 related to school buses. As mentioned in above sections, CO^2 is just one of many harmful pollutants from vehicle exhaust that cause health and environmental issues. Other studies have shown that gas-powered school buses emit 65% more CO^2 than diesel buses, while diesel buses produce more particulate matter (PM) in their exhaust. The various other pollutants make up the rest of the exhaust fumes we are exposed to. Electric school buses have zero tailpipe emissions and thus do not expose children to air pollution.

EXPECTED LIFETIME CO^2 EMISSIONS (LBS) OF A GASOLINE-POWERED SCHOOL BUS AND A DIESEL-POWERED SCHOOL BUS



Health Canada recommends an average daily exposure limit to CO^2 of 1000ppm, to avoid symptoms such as eye irritation, headaches, and tiredness, and decreased performance on tasks and tests. This limit is set for the general population, not specific to children, who are more vulnerable to the risks of air pollution. A 2021 study in New Brunswick tested classrooms in 24 schools with inadequate ventilation in the province and found that the average CO^2 concentration was above 1500ppm. Once other indoor spaces are accounted for, including their home, a student may be exposed to average CO^2 concentrations reaching 1000ppm or higher. Our hope is to lower and limit exposure to harmful air pollution at every opportunity.

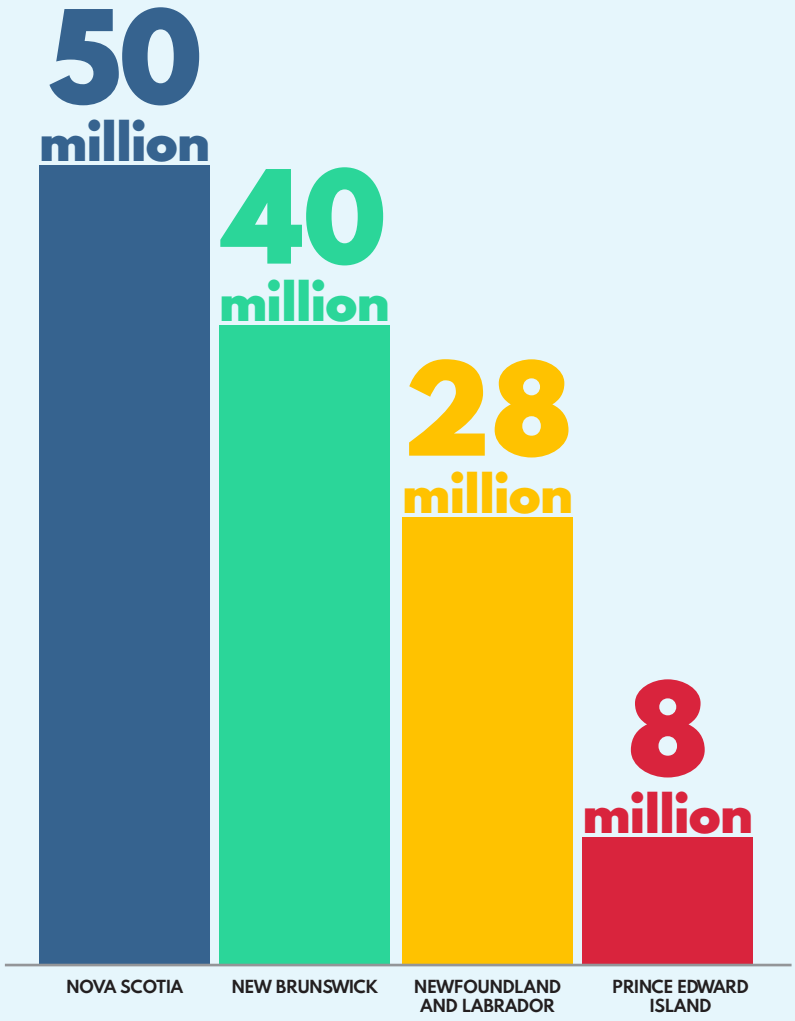
A High Pollution Future

Future economies

Fuel buses emit fumes that have significant health impacts, particularly on children. From 2021 to 2022, Canada experienced a 7.8% increase in traffic emissions. Without a reduction in these emissions, the associated health risks are likely to worsen. Despite the growing interest in vehicle electrification, progress has been slow. In April-June 2024, 13.4% of new light-duty vehicles registered in Canada were electric. In the same time period in 2022, only 7.6% of light duty registrations were electric. While this growth is encouraging, there is still much work to be done. We need to continue pushing for greater electrification to sustain this positive trend and further improve health outcomes.

Currently, it is estimated roughly CAD 126 million is spent in Atlantic Canada on health issues related to traffic emissions each year (CAD 50 million in Nova Scotia; CAD 40 million in New Brunswick; CAD 8 million in Prince Edward Island; CAD 28 million in Newfoundland and Labrador). These costs are projected to rise if traffic emissions continue to increase, highlighting the urgent need for accelerated adoption of electric vehicles to mitigate these impacts.

Not only will there be rising costs for medical facilities but also rising costs for cleanup. Governments and municipalities may face significant expenses on air-quality management and measures to address the impacts of pollution. Pollutants from diesel emissions can contribute to the deterioration of infrastructure as acidic compounds in emissions can corrode buildings and other structures. Poor air quality can also affect worker productivity due to health issues and reduced cognitive function, which could affect productivity due to increased health-related absenteeism.



MONEY SPENT IN EACH PROVINCE ON TRAFFIC EMISSION RELATED HEALTH

Future communities

Communities with high emissions often face poor air quality, which can severely diminish residents' quality of life, leading to discomfort, reduced outdoor activity, and a generally less pleasant living environment, negatively impacting mental and physical well-being. Children in these areas, particularly those exposed to diesel emissions, may suffer from health issues that affect their school attendance, academic performance, and long-term success.

Persistent pollution can also depress property values, potentially forcing residents to relocate to less polluted but often less affordable areas, disrupting community cohesion. This is incredibly challenging for low-income and vulnerable communities, who may lack the financial means to move to cleaner regions and often have limited access to healthcare, further deepening social inequalities and contributing to disparities in health and economic outcomes.

Introducing electric school buses in these historically polluted areas offers a promising solution by reducing diesel pollution, improving community health, and supporting equitable energy distribution, ultimately benefiting these communities.

The Impact of Electric School Buses

Human Health

The health risks from traffic related pollution laid out in the above sections are caused by exposure to tailpipe emissions. The range of mild to severe respiratory, cardiovascular, and cognitive impacts are significant and serious.

The risk of exposure from school-bus commuting and drop off can be all but eliminated by transitioning the bus fleets to electric. Notably there is significant noise pollution in areas with school-bus traffic and even the risk of hearing loss to bus drivers is removed because of the quiet ride that electric buses provide.

Healthier Environment

Transitioning school buses to electric mitigates the effects of a future where diesel severely impacts our lives. A gas-powered bus produces roughly six tonnes of CO_2 per year. If we committed to switching all 50,000 gas, diesel, and propane buses in Canada, we would be eliminating upwards of 300,000 tonnes of CO_2 per year from entering our atmosphere. Thus, setting our children and their communities up for success in a better future.

Public Appeal

In 2023, Abacus Data and the Canadian Lung Association released a poll asking Canadians how they felt about various topics related to lung health, climate change, and vehicle emissions. Notably, 78% of Canadians are concerned about the health impacts of school bus emissions on children, and therefore support for policy actions is high.

Furthermore, 83% of people support accelerating the plan to electrify school buses with a commitment to 100% electric new school buses by 2040. Similarly, 82% support the introduction of interim 5-year targets to meet this goal. Lastly, 77% of respondents support the introduction of a sales mandate requiring a minimum percentage of school-bus fleets sold to be electric.

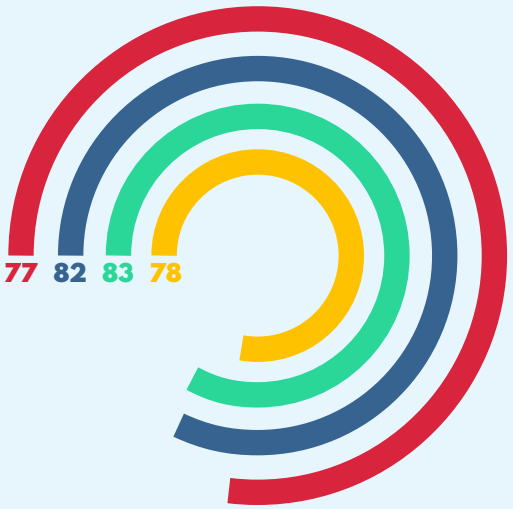
It's not only the everyday adult Canadian that supports electric school buses, but the kiddos want them too! Many articles have surfaced highlighting communities that have received an electric school bus where the students have been nothing but excited. Bus-driver satisfaction is notably higher with the quieter and smoother-driving electric bus.

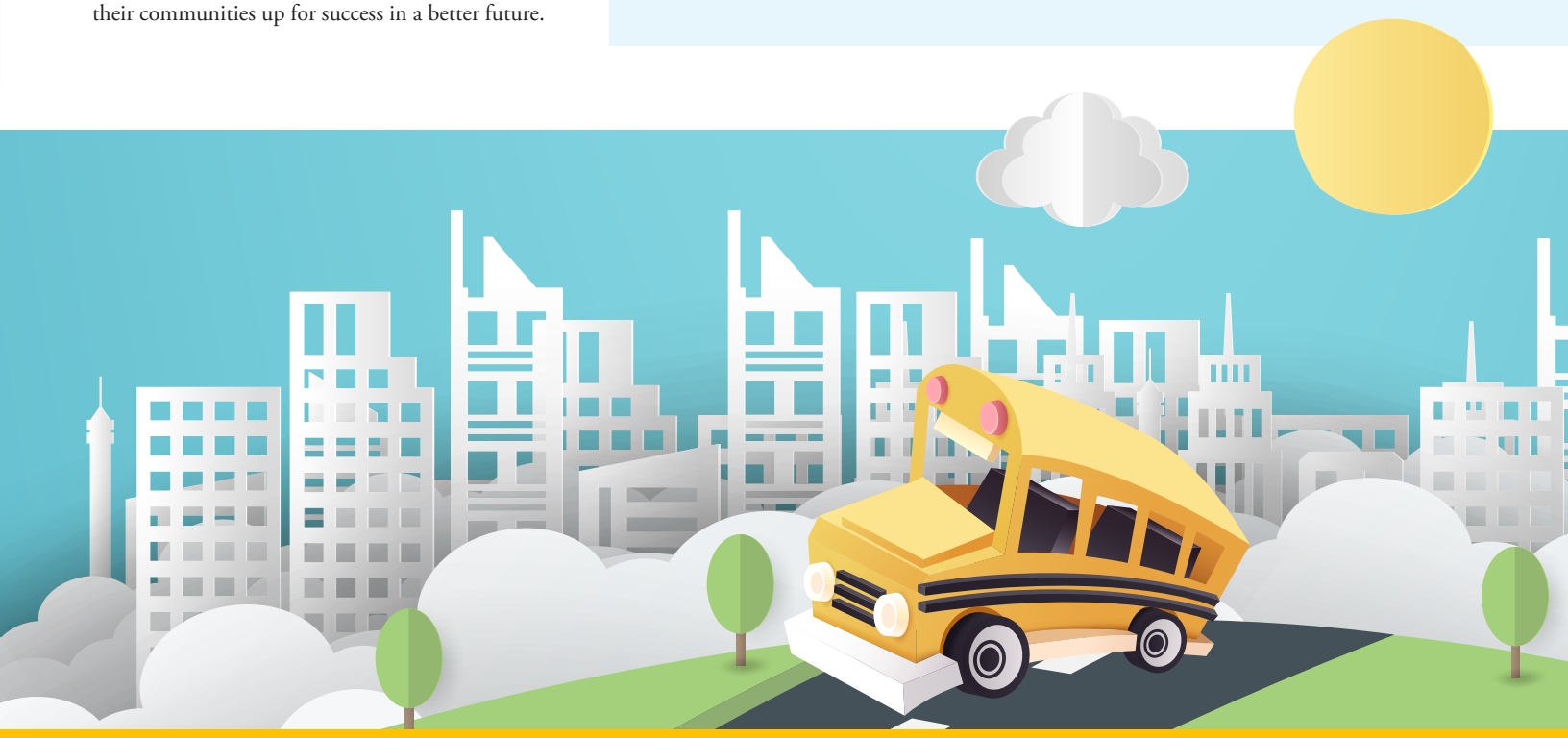
78% **Canadians concerned with health impacts** of school bus emissions on children.

83% **Support accelerating the plan** to electrify school buses 100% by 2040

82% **Support interim 5-year targets** to meet electrifying goals

77% **Support sales mandates** for minimum of sales must be electric





Child Satisfaction

SENSORY ISSUES

Electric school buses offer significant benefits for children with sensory issues by creating a more comfortable and less stressful travel environment. Roughly 5-16% of kids are diagnosed with sensory issues (SDP), 5-7% of kids are diagnosed with ADHD, and 1 in every 50 kids is diagnosed with Autism (ASD). These and other health conditions make overstimulation a struggle for many young people.

Electric school buses, with their quieter operation, reduce auditory overload and make the ride more pleasant for those sensitive to loud sounds. Additionally, the smooth, vibration-free performance of electric buses helps minimize discomfort for children who are sensitive to motion.

Electric buses eliminate the odors associated with diesel engines, making the environment more tolerable for those who are sensitive to smells. Overall, these improvements in noise, vibration, and odor contribute to a more predictable and calming commuting experience for children with sensory sensitivities.

ECO-ANXIETY

Getting an electric school bus significantly mitigates eco-anxiety among students. Eco-anxiety, which includes feelings of worry and stress about climate change, is increasingly common among young people. In Canada, about 40% of young people report feeling anxious about the future due to environmental issues.

The visible commitment of seeing schools take proactive steps towards a more sustainable future, like adopting electric school buses, helps reassure students that their community and school are committed to protecting their health and their future.

Larger Possibilities with Electric School Buses

School buses run the same routes daily, have two long periods to recharge (once during the day while children are in school, and again during the evening and overnight before school the next day). Electric school buses can come with advanced features like Vehicle-to-Grid (V2G) and Vehicle-to-Building (V2B) that offer significant benefits for children's safety and well-being, especially during storms or power outages.

V2G allows electric school buses to send electricity stored in their batteries back to the power grid. V2B enables buses to provide power directly to buildings, such as schools or community centres. During extreme weather or unexpected power cuts, these features turn electric school buses into mobile power sources. They can keep essential systems operational, ensuring that schools remain safe and comfortable places for children. While V2G and V2B are still emerging technologies, they hold great promise for resilience in the future

Prioritizing Vulnerable Communities

To ensure the transition to electric school buses benefits low-income, Indigenous, and vulnerable communities, it is essential to adopt an equitable and inclusive approach. This involves engaging these communities in decision-making, conducting needs assessments, and allocating targeted funding and incentives to support deployment and infrastructure in underserved areas.

Developing supportive infrastructure such as accessible charging stations and providing community education and engagement are crucial for fostering understanding and participation. Additionally, creating local job opportunities and training programs can empower residents and ensure they benefit from new roles created by the transition.

Monitoring health and environmental impacts will help demonstrate the benefits and address any issues, while collaboration with local organizations and transparent communication will ensure the process is culturally sensitive and accountable. By prioritizing these steps, the transition can be managed in a way that maximizes benefits and minimizes disparities.

Conclusion

The transition to electric school buses represents a critical step toward improving both environmental and public health. For nearly a century, school buses have been a staple of student transportation, offering a safe and reliable means of getting children to and from school. However, the hidden dangers of diesel, gasoline, and propane emissions from these buses pose significant health risks to students, bus drivers, and the wider community. The pollutants emitted by these vehicles—including particulate matter and carbon dioxide—have been linked to severe health issues such as respiratory diseases, cardiovascular problems, and cognitive impairments.

Our findings reveal that despite some improvements from diesel buses to gasoline, these alternatives still fall short in mitigating health risks when compared to electric buses. Gasoline-powered buses, while presenting lower levels of particulate matter than diesel, produce higher carbon dioxide emissions and still contribute to overall pollution. In contrast, electric buses offer a cleaner, more sustainable solution with no tailpipe emissions, significantly reducing the risk of health problems associated with diesel and gasoline fumes.

The urgency of adopting electric school buses is underscored by the increasing costs of healthcare associated with traffic emissions and the growing public concern about environmental and health impacts. With a significant portion of Canadians supporting the transition to electric buses and recognizing their benefits, there is a clear mandate for action. Electric school buses not only promise a healthier environment but also support mental well-being by reducing anxiety and sensory overload among children.

Transitioning to electric school buses is not just an environmental necessity but a public health imperative. By accelerating the adoption of these vehicles, we can protect our children's health, improve air quality, and reduce healthcare costs.

This transition aligns with community values. It has the potential to transform student transportation into a model of sustainability and health. The future of school transportation is electric, and it is time to make that future a reality for the benefit of our children, our communities, and our planet.

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