Switching to

Electric School Buses

It's good for our children's health

Conservation Council *of* New Brunswick

Overview

The New Brunswick school bus fleet runs on fossil fuels such as diesel, gasoline, and propane. The tailpipe exhaust from burning diesel and gasoline contains harmful air pollutants such as $PM_{2.5}$, ground level ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, and volatile organic compounds like benzene, a known carcinogen.

Vehicle exhaust exposes children to harmful pollutants from an early age throughout their entire adolescence while they wait at bus stops and ride the bus every day.

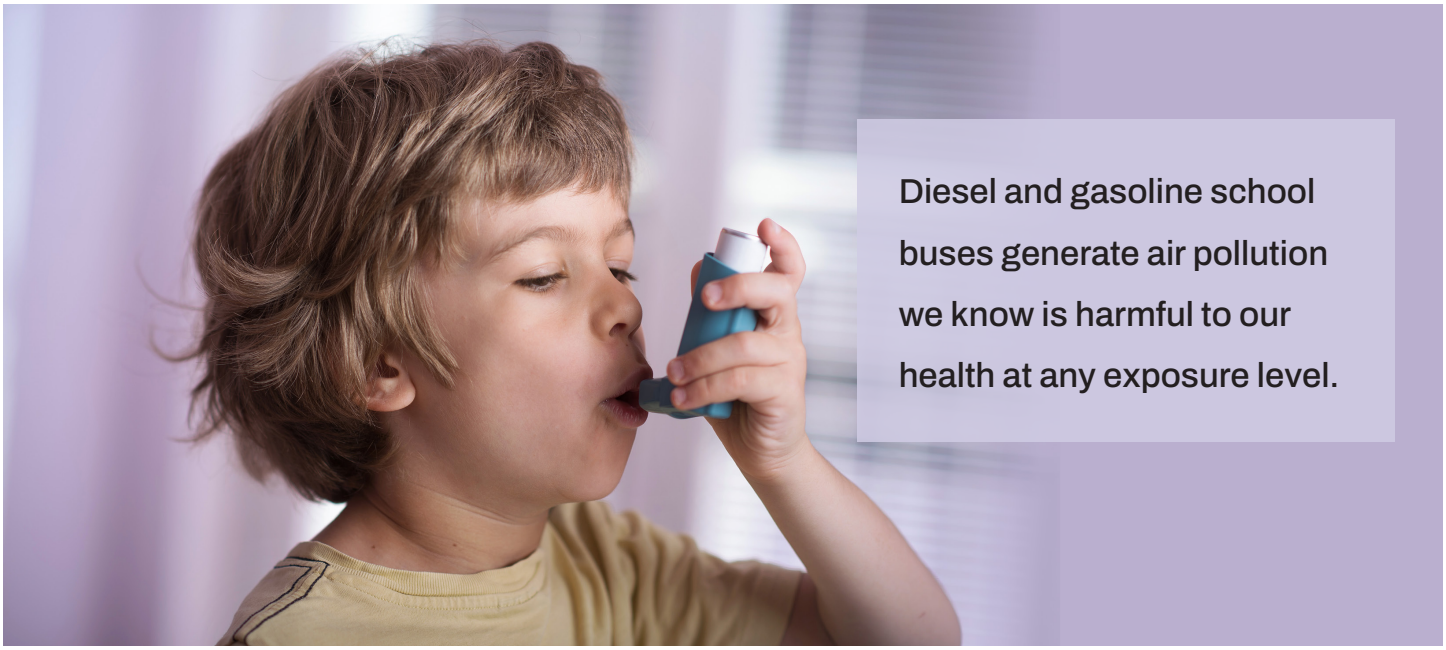
Air pollutants can leak into school buildings if the school bus loading zone is close to the HVAC system.

Children (15 and under) are among the most vulnerable to these air pollutants as their lungs are still developing, they have a higher respiration rate, and have higher exposure to pollution on a weight-to-weight basis, compared to an adult. The tailpipe exhaust from school buses adds to already significant air pollution affecting human health from all other road traffic. Scientific studies increasingly show there is no safe exposure to vehicle air pollution. Switching to electric school buses that have no tail pipe exhaust reduces children's exposure to harmful air pollutants. It's good for our children's health and good for the planet.

Background

In 2017, the Department of Education and Early Childhood Development responded to recommendations in the New Brunswick Climate Change Action Plan to reduce vehicle emissions by conducting an alternative fuels assessment for the province's school bus fleet. The department reviewed the fuel economy and carbon dioxide (CO_2) emissions of gasoline, propane, and, to a lesser extent, electric buses, against a baseline of diesel. The goal of the study was to find a suitable fuel replacement for diesel, while minimizing fuel costs and lowering CO_2 emissions. The study concluded that the best option for New Brunswick was to transition to gasoline for rural areas and propane for urban areas. The Department of Education and Early Childhood Development opted to not pursue electric school buses because of high up-front cost and concerns about range. Since the study, the province has procured 74 gasoline buses, 16 propane, 11 hybrid-electric, and two fully electric buses which were part of an initial pilot project.

The impetus behind the alternative fuels assessment was to study the climate impacts of the different fuel types. What is missing, however, is consideration of how the fuel types contribute to air pollution and how it affects the health of children riding the bus. In the context of our children's health, a primary concern must be how student transportation options affect the health and well-being of students. The only alternative fuel source that does not produce tailpipe emissions is electric. **As such, to protect the health of children, bus drivers and the environment, the Conservation Council of New Brunswick recommends transitioning to a fully electric school bus fleet in New Brunswick.**



Health Impacts 101

In a standard internal combustion engine, the engine burns gasoline to release energy that propels the vehicle forward. The burned fuel emits exhaust that is harmful to human health and the environment. The compounds in vehicle exhaust can affect human health at chronic (long term) and acute (short term) exposure levels. In addition to the negative health effects, vehicle emissions contribute to global heating causing climate change.

Impact of Vehicle Air Pollution

Vehicle emissions contribute to the air pollution Canadians breathe every day. Health Canada estimates overall air pollution contributes to **15,300 premature deaths per year, 2.7 million asthma symptom days, and 35 million acute respiratory symptom days per year.** The economic impact of these negative health effects in 2016 was $120 billion. Unlike a coal plant, which has high levels of localized air pollution, vehicle emissions are a "mobile source." Exposure to these pollutants can happen from inside and outside of vehicles from their own emissions and the other vehicles in traffic.

One study of $PM_{2.5}$ exposure in children from diesel school buses found higher levels in the cabin of the bus than outside. The result is that children, who are particularly vulnerable to toxins, are consistently exposed to harmful pollutants. This also presents a risk for bus drivers, often seniors – another vulnerable population – who have spent their whole career in a diesel bus. The chronic occupational exposure to $PM_{2.5}$ can pose significant health risks for older bus drivers.

The scientific link between vehicle exhaust and health complications is well established. One study found that cars, in particular, are estimated to be responsible for 80 per cent of today's air pollution. Health Canada estimates that traffic-related air pollution (TRAP) was "*associated with 1,200 premature deaths in Canada in 2015.*" Of the premature deaths, they estimate that $PM_{2.5}$ contributed to **800**, nitrogen dioxide (NO_2) contributed to **340** and ozone (O_3) to **85**.

TRAP was associated with 2.7 million acute respiratory symptom days, 1.1 million restricted activity days and 210,000 asthma symptom days per year. The total monetary burden to the health system is estimated at **$9.5 billion in 2015**. In New Brunswick, traffic-related air pollution contributed to six deaths in 2015. TRAP can worsen existing conditions such as asthma. In New Brunswick, 11.8 per cent of residents reported that they have been diagnosed with or treated for asthma.

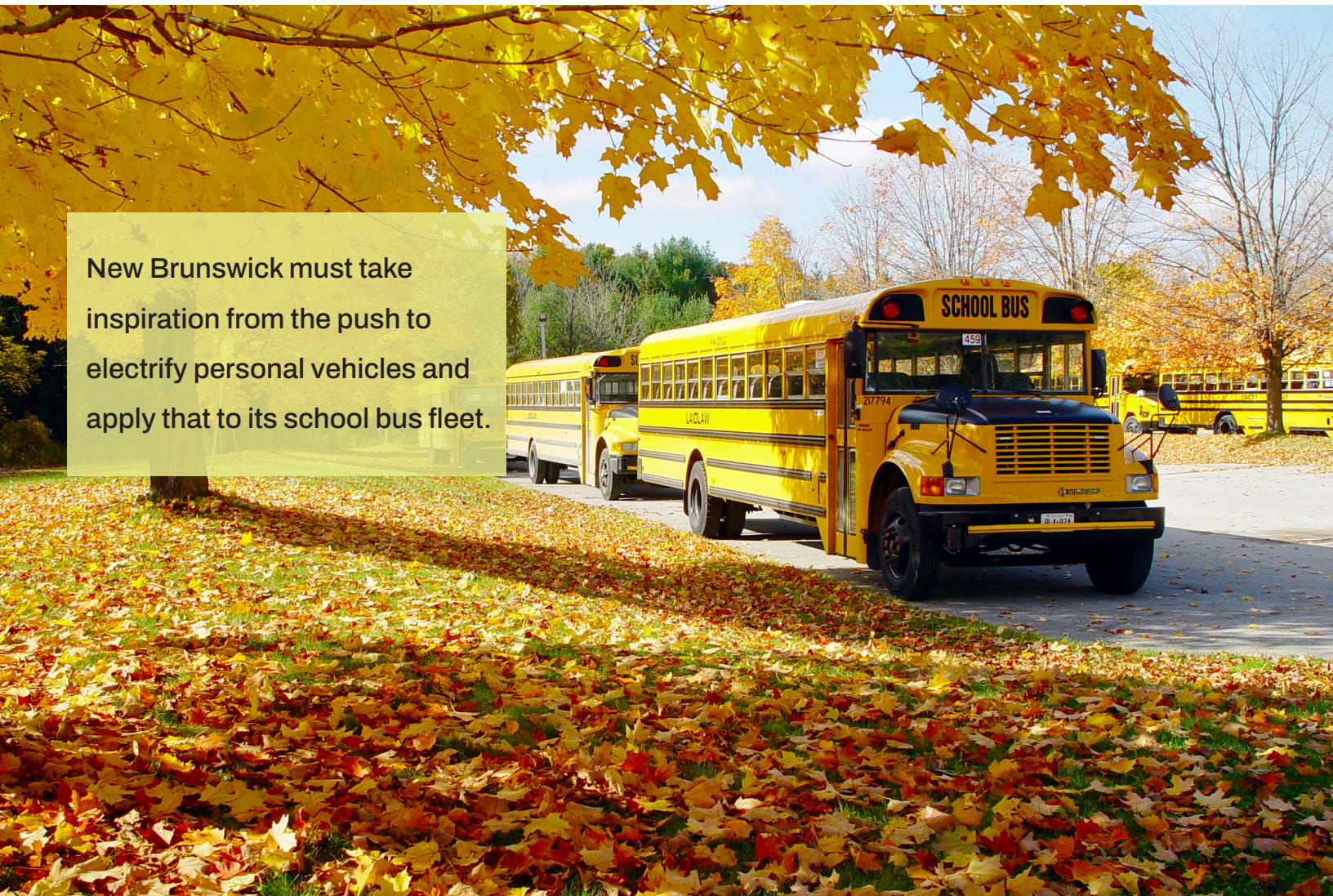
Conclusion

Switching to electric school buses is good for our children's health. School bus electrification will eliminate tailpipe emissions as a mobile source of air pollution, but will have some associated air pollution and greenhouse gases if the electricity grid uses fossil fuels. Despite the fossil fuels still used for electricity generation, electrifying school buses in New Brunswick will lower overall air pollution and carbon emissions. New Brunswick still burns coal, accounting for 14 per cent of total electricity generation. Fossil fuels in general, when including natural gas and oil, represent **30 per cent** of the provincial electricity mix. The good news is that as the province reduces its dependence on fossil fuels to generate electricity, electric school buses will contribute even fewer localized air pollutants and greenhouse gases that cause climate change.

Diesel school buses and the replacement gasoline buses generate air pollution we know is harmful to our health at any exposure level. They are not safe. Propane also produces air pollutants harmful to human health.

A study on air quality in ice hockey arenas, where propane is the primary fuel source for Zambonis, found harmful carbon monoxide and carbon dioxide emissions. Propane is a byproduct of natural gas processing and crude oil refining, fuels we must phase out to solve climate change.

New Brunswick needs to switch to non-polluting options such as electric vehicles. Jurisdictions across Canada and internationally are moving toward electric school buses instead of polluting options such as gas, diesel, and propane. In Canada, Prince Edward Island and Québec have made commitments to purchase electric school buses along with U.S. states such as New York and California. Transitioning to electric buses eliminates significant sources of pollution for children in their day-to-day lives and brings environmental benefits. New Brunswick must take inspiration from the push to electrify personal vehicles and apply that to its school bus fleet.



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Appendix
Exhaust Pollutants and Your Health

$PM_{2.5}$

$PM_{2.5}$ stands for particulate matter that is 2.5 micrometres in size. It is created by a chemical reaction between different pollutants. The particles can become lodged deep in the lungs, causing inflammation and tissue damage. $PM_{2.5}$ is one of the main culprits of negative health effects related to air pollution. Among the serious health impacts associated with exposure to $PM_{2.5}$ are **asthma attacks, chronic bronchitis, and heart attacks**.

Children (15 and under) are an age group who are more vulnerable to the harmful effects of $PM_{2.5}$ exposure. One **study** identified $PM_{2.5}$ and its components as an *"identifiable and preventable risk factor for hospitalization of children,"* while **another study** warned that due to a positive correlation between $PM_{2.5}$ exposure and blood pressure, *"children should not live in areas with high pollution for more than four years."*

Exposure to $PM_{2.5}$ also has adverse effects on cognitive development. One **study** found that peak exposures to daily $PM_{2.5}$ pollution were "*positively associated with the percentage of students with low proficiency in math and English language arts, even after accounting for school disadvantage,*" concluding, *"there is mounting evidence that the negative effects of $PM_{2.5}$ on the human body at even low levels, such that there may be no 'safe' level of exposure."* Elderly individuals, likewise, are a group at risk to negative health effects from exposure to $PM_{2.5}$, particularly **cardiovascular disease**. Long term occupational exposure can pose a significant health risk to older bus drivers.

Ground Level Ozone (O_3)

Ground level ozone (O_3) forms through a chemical reaction between oxides of nitrogen and volatile organic compounds (VOCs) produced when vehicle fuel is burned. It is a major component of smog. Ozone has low **water-solubility** which means it has the capacity to deeply penetrate the lungs when inhaled. Exposure to it has similar health impacts to $PM_{2.5}$, such as throat irritation, coughing, shortness of breath, and reduced lung function. Ozone exposure is associated with premature mortalities.

In two Canadian studies, researchers found *"statistically significant associations between short-term exposure to ozone and circulatory mortality during the warm **season**,"* and *"long-term exposure to ambient ozone is associated with higher risks of deaths from Parkinson's, dementia, stroke, and multiple **sclerosis**."* Ground level ozone poses both chronic and acute health risks.

Nitrogen Dioxide (NO_2)

Nitrogen dioxide is a primary pollutant emitted through the burning of fossil fuels. Approximately 70 to 80 per cent of NO_2 in cities comes from **motorized traffic**. At elevated levels, NO_2 produces a harsh odor and can form a "**brownish haze**" over large cities. Nitrogen dioxide is primarily an irritant of the respiratory system inducing **symptoms** such as coughing, wheezing, dyspnea (shortness of breath), bronchospasm (airway inflammation), and even pulmonary edema (excess fluid in the lungs) at high exposure levels. It can also irritate the eyes, throat, and nose.

A **meta-analysis** on the prevalence of child asthma in relation to chronic exposure to NO_2 levels found that *"there is a small but real association between NO_2 and increased asthmas prevalence in children."* It is difficult to understand the full health effect of NO_2 as its presence is indicative of other pollutants such as $PM_{2.5}$ and ground level ozone. Researchers of another **meta-analysis** found that the *"magnitude of the long-term effects of NO_2 on mortality is at least as important as that of $PM_{2.5}$."*

Sulfur Dioxide

Sulfur dioxide (SO_2) belongs to a group of gases called sulfur oxides. Fossil fuels emit sulfur dioxide when burned. It is a colourless gas that smells like burnt matches. SO_2 is a component of the harmful group of pollutants that make up $PM_{2.5}$ and, when combined with water in the atmosphere, can form sulfuric acid, otherwise known as acid rain. As with other pollutants, children, the elderly and people with lung diseases are most at risk to adverse health effects from sulfur dioxide exposure.

The major health impacts of sulfur dioxide exposure are respiratory irritation, bronchitis, mucus production, and bronchospasm (tightening of airway muscles). It also causes skin redness and damage to the eyes and mucous membranes.

Carbon Monoxide (CO)

Carbon monoxide (CO) is an invisible, odorless pollutant that is produced when combustion is incomplete. It is particularly dangerous in high exposures over an extended period. The symptoms of carbon monoxide poisoning are headaches, dizziness, weakness, nausea, vomiting, and loss of consciousness. You can limit exposure to CO by limiting time in a confined space with a running vehicle.

Volatile Organic Compounds (VOCs)

Volatile organic compounds (VOCs) are a variety of chemicals such as toluene, benzene, ethylbenzene, and xylene that can adversely affect human health for both chronic and acute exposure. In more serious instances, the above compounds are associated with cancer in people. Short term exposure to VOCs can induce symptoms such as eye, nose and throat irritation, headaches, nausea, dizziness, and worsening of asthma. Longterm, chronic exposure can cause more serious adverse health effects such as damage to the liver, kidneys, and central nervous system.

Among the chemicals in volatile organic compounds, benzene stands out as a notable carcinogen and threat to human health. Researchers are now finding that there is no safe exposure level to benzene for humans, especially the more vulnerable such as children. Although research on the health effects benzene has on children is developing, *"findings from currently available studies reveal that benzene exposure is associated with clinical abnormalities in the hematologic, hepatic, respiratory, and pulmonary functions in children."*

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This factsheet answers your questions about the health impacts of diesel, gasoline and propane school buses and the benefits of transitioning New Brunswick's school bus fleet to fully electric.

For more information:

Check out the Conservation Council of New Brunswick's Atlantic Electricity page.

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