


Will Canada Miss the Bus?



For a country that's home to leading electric bus makers, Canada is slow to adopt them—it's a missed opportunity in more ways than one

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Missing the bus

Buses. They're the veins of our cities, transporting billions of people around their daily lives. Whether it's a morning commute, a lift home from school, or a trip to the hockey game, buses have been a stalwart part of Canadian life for decades.

But most Canadian buses also pollute. Yes, they're better than cars because they move more people, but they are nonetheless a sizable source of emissions. The good news is there's a solution, and it's a big opportunity for Canada.

Enter electric buses (or e-buses), powered by emission-free electric motors, making them healthier for both people and the planet. What's more, **many are manufactured here in Canada, and that's good for business. Yet despite their appeal, most Canadian transit operators are acquiring few e-buses compared to other cities globally.**

This timid approach could mean Canadian e-bus companies choose to open manufacturing plants in the U.S. rather than in Canada, which is already the case for some of these companies. And Canadian businesses are losing valuable contracts to manufacturers from countries with more enthusiastic e-bus markets, namely China.

One need only look at Shenzhen. The Chinese city has undergone a complete e-bus transformation, growing its fleet from 1,000 to over 16,000 in just five years. Not only is it the first fleet in the world to go totally electric, it's the largest bus fleet of any kind on the planet—over eight times bigger than Toronto's. In fact, thanks mostly to China, by the end of this year 270,000 barrels a day of diesel demand will have been displaced as a result of e-buses.¹

As cities across Canada set targets to substantially cut emissions in the next two decades, the country's transit authorities need to make decisions now to ensure they remain on track. Montreal is showing good leadership with a plan to transition to zero-emission transit by 2040, but other Canadian cities are moving too slowly.

Many global cities have even more ambitious targets, procuring hundreds of e-buses and investing in the associated infrastructure. But without a strong market at home, our Canadian e-bus companies—such the Lion Electric Company and GreenPower Motor Company—

may find it more difficult to keep prices low, making local products less internationally appealing.

E-buses aren't necessarily an expensive option either. With battery prices falling 79% between 2010 and 2017, e-buses are becoming increasingly competitive with diesel buses. **According to Bloomberg New Energy Finance, transit providers will be able to drive away an e-bus for the same price as a diesel bus by 2030, while also saving hundreds of thousands on fuel costs over the bus's lifetime.²**

Vancouver's TransLink estimates that lifecycle cost parity—which factors in the upfront purchase cost plus operating and maintenance costs—will be achieved by 2023.³ When the associated cost to public health is added to the equation, some studies argue e-buses are already cheaper.

Although many look to e-buses as the transit of our future, they're also the transit of our past. Canada welcomed electric trolley buses back in 1922, replacing old gasoline buses in Toronto's growing suburbs. The buses were so popular that the transit commission of the day upgraded them to larger electric vehicles—the forerunners of today's street car.

The choice to adopt a new and innovative technology paved the way for a transit system so successful it's still transporting millions of Canadians almost a century later. Let's hope that future generations can look back on this period and remark how Canada showed global leadership in the universal shift toward electric transportation.



A stylized, handwritten signature in black ink, consisting of a large, flowing 'M' and 'S'.

Merran Smith
Executive Director
Clean Energy Canada

“Canada’s transit industry is working towards a more sustainable future. We are transitioning to greener propulsion systems, including electrification, to do our part in reducing greenhouse gas emissions and supporting our country’s international climate commitments.”

—Marco D’Angelo, Canadian Urban Transit Association
CEO and President

A city comparison

WE KNOW THAT ELECTRIC BUSES ARE CLEAN, SAFE, and improve rider experience. We also know that 25% of Canada’s emissions come from transportation⁴ and that electrifying transit is one way to reduce this—by both increasing ridership and reducing emissions from buses. Several Canadian cities have developed timelines for zero-emission transit, but achieving them will require a

substantial—and immediate—overhaul in the way fleets are procured. Buses have an average lifespan of 12 to 20 years, meaning decisions being made now will have implications for achieving these zero-emission goals. So how many electric buses are actually on Canada’s streets today? And where are they? Here are four Canadian cities that have introduced electric buses to their transit fleets.



Montreal, Quebec



TARGET: Société de transport de Montréal has committed to 100% zero-emission transit by 2040⁵



TOTAL RIDERS: 429.5 million in 2017⁶



BUS FLEET SIZE: 1,837 in 2017⁶

When it comes to zero-emission transit, Montreal has one of Canada's most forward-thinking strategies. Not only does Société de transport de Montréal have zero-emission ambitions for 2040, but it has a clear plan for how it will get there. Between now and 2025, all new acquisitions will be hybrid or electric, becoming 100% electric after 2040. The wheels are already in motion, with the transit authority in the process of acquiring six rapid-charge buses, 30 slow-charge buses, and six other electric buses and para-transport vans from Canadian manufacturers.⁷ The move follows a successful test of three rapid-charge buses over an 18-month period in 2017 and 2018. During the trial, the buses were charged 11,000 times with an average charge time of three minutes, travelled more than 100,000 kilometres, and saved well over 100 tonnes of CO₂.⁸

Toronto, Ontario

The Toronto Transit Commission, which operates 140 bus routes across the Greater Toronto Area, is maneuvering its way toward a 100% zero-emission fleet by 2042. Toronto's transit fleet, which is the third most heavily used in North America, has already begun the electric transition by acquiring 10 new 40-foot battery-electric buses from a Canadian supplier¹¹ in 2018 as part of its Green Bus Technology Plan.¹² These buses will soon be joined by additional electric buses, bringing Toronto's e-bus total to 60 by the end of 2019⁹—increasing to 907 zero-emission buses by 2027. The transit authority will purchase only zero-emission buses starting in 2025.



TARGET: The Toronto Transit Commission has committed to 100% zero-emission transit by 2038-2042⁹



TOTAL RIDERS: 533.2 million in 2017¹⁰



BUS FLEET SIZE: 1,920 in 2017¹⁰

Edmonton, Alberta



Edmonton is also set to join the electric bus party, recently ordering 25 overnight-charging buses to operate on the city's routes from 2020.¹⁵ Before committing, Edmonton commissioned one of the most in-depth feasibility studies of electric bus operation in North America. When faced with Edmonton's steep river valleys and plummeting winter temperatures, the buses fared well, with the study concluding battery-electric buses could operate efficiently and cost-effectively even during a deep freeze.¹⁶ When plugged into Edmonton's grid, a battery-electric bus is expected to emit 38% to 44% less CO₂ than a diesel equivalent—and as the electricity gets cleaner, so will the buses.¹⁶



TARGET: The Edmonton Transit Service currently has no zero-emission targets but intends to implement a “phased strategy”¹³



TOTAL RIDERS: 87 million in 2017¹⁴



BUS FLEET SIZE: 1,032 in 2018¹⁴

Vancouver, British Columbia

While battery-electric buses are making their debut elsewhere in Canada, Vancouver has been successfully operating electric buses of a different kind for more than 70 years. Vancouver is home to 262 operational electric trolley buses—the third-largest such system in North America.¹⁸ This year, Vancouver is diversifying its electric fleet with the addition of four new on-the-go charging battery-electric buses purchased from Canadian manufacturers as part of a partnership between TransLink, Natural Resource Canada, Metro Vancouver, and BC Hydro. The pilot project is part of a pan-Canadian initiative led by the Canadian Urban Transit Research and Innovation Consortium (CUTRIC).¹⁹



Photo: Magnus Larsson



TARGET: TransLink has committed to reducing carbon pollution by 80% by 2050 and to powering its entire fleet by renewable energy by 2050¹⁷



TOTAL RIDERS: 407 million in 2017¹⁸



BUS FLEET SIZE: 1,075 in 2016¹⁸

Canadian e-buses



Photo: New Flyer

WHEN IT COMES TO CLEANTECH, Canada can rightly call itself a world leader. With 12 Canadian companies making this year's CleanTech 100 list of top global cleantech innovators, Canada is in a good place to reap the rewards of a growing clean economy. Electric bus manufacturing is no exception. Canada is home to

multiple North-America-leading e-bus manufacturers that, as the world moves to electrify transit, are well-positioned to capitalize—provided transit authorities and policy makers seize the opportunity. Here are four companies in Canada driving the battery e-bus transition.

Lion Electric Company

Quebec-based Lion Electric Company is North America's largest supplier of electric school buses, employing 135 people and manufacturing all of its buses in Canada. Lion has around 200 e-buses on roads across the continent, with around 80 in Canada. Lion's electric school bus, the LionC, can be found on school runs across North America, with the most in California.

And the number of Canadian kids enjoying an all-electric commute will soon rise, with Lion recently agreeing to supply transit provider Keolis with 12 LionCs for its fleet of school buses in Montreal. The company is also taking orders for two additional electric bus models: the LionA, a 26-seat mini-school bus with a 306-kilometre range, and the LionM, a mini-bus designed specifically for the paratransit market with a number of accessibility features.²⁰



"School buses hadn't evolved for at least 40 years. I didn't want to produce the same thing as other manufacturers."

—Marc Bédard, founder of the Lion Electric Company



New Flyer Industries

New Flyer was founded in Winnipeg in 1930 with just five employees and is now the largest bus manufacturer in North America. The company has a manufacturing plant in Winnipeg as well as four others in the U.S. A report by Bloomberg New Energy Finance suggested New Flyer is one of the biggest competitors for Chinese e-bus manufacturers BYD and Yutong in the U.S. market.²

New Flyer makes hybrid, trolley-electric, battery-electric, and fuel-cell electric buses including its “next generation” Xcelsior Charge battery-powered bus with a 420-kilometre range. Of the 41,000 buses serviced by New Flyer, 18% are powered in some capacity by batteries or electric motors (such as plug-in hybrids), while 4% are entirely zero-emission.²¹

Photo: New Flyer

Nova Bus

Nova Bus is a Quebec-based bus manufacturer with two manufacturing plants in Canada and one in the U.S. In 2011, the Volvo-owned company decided it was time to go electric, developing the battery-powered model ‘LFSe’ to join its range of diesel, hybrid, and natural-gas-powered buses.²²

An 18-month trial of Nova’s battery-electric buses in 2017 and 2018 by Montreal’s transit authority saw the delivery of North America’s first on-the-go charging technology. The trial resulted in the order of four additional buses, which



Photo: Jason Vogel

will join its fleet this year. B.C. transit provider TransLink has also decided to follow in Montreal’s tire tracks, piloting two 40-foot Nova buses in its Vancouver fleet over the first few months of 2019.



SO WHAT'S AN E-BUS LIKE TO RIDE?

It turns out they're pretty great. Recent studies found that **70% of riders say their experience is improved by e-buses**²³ compared to old buses, with 64% even saying they would pay more for the privilege.¹⁶ The drivers are happier too, as e-buses reduce their daily exposure to toxic diesel fumes.

"It drives just like a regular bus, except it's more powerful. They're very good buses."

—Daniel Girard, Montreal e-bus driver²⁴

GreenPower Motor Company

Vancouver-based GreenPower is the only Canadian company to exclusively produce electric buses. The company sells a range of buses, which are manufactured in California and come in eight different models, including a school bus and 45-foot double-decker, two of which are in use at Victoria's cruise ship terminal on Vancouver Island.

With an expanding order book of over 120 buses, GreenPower intends to triple its production capacity over the next few years after leasing a new manufacturing facility in California. The company plans to focus its expansion on its mini-buses and school buses.²⁵



Photo: GreenPower Motor Company



There are four ways electric buses can get their power. The top two are used by **Battery Electric Buses**, which are the focus of this report.

1. SLOW-CHARGING

These buses charge slowly while not in use, usually overnight. The buses then operate all day on a single charge.

2. ON-THE-GO RAPID-CHARGING

These charge (sometimes wirelessly) while passengers are getting on and off, usually at a central bus station or strategic stops along the route. The buses usually charge for five or six minutes every hour and, as a result, can operate continuously.

3. TROLLEY BUSES

They draw power continuously from overhead wires, rather than onboard batteries. Trolley buses can only operate where wires are installed over the entire route.

4. HYDROGEN FUEL CELLS

With the same electric power train as a battery bus, hydrogen fuel cell electric buses have a hydrogen fuel cell generator that produces power. Notably, Canada is home to several leaders in hydrogen fuel cell technology for buses, including Ballard Power Systems and Hydrogenics.

The global view

ELECTRIC BUSES ARE NOT A NEW OR NOVEL

CONCEPT. Hundreds of thousands of them (365,000, to be precise) are currently transporting millions of passengers around cities all over the world. Over 13% of the world's bus fleet is already electric² and, globally, transit fleets are being electrified at a rapid pace—sales of battery-electric buses increased by 40% between 2016 and 2017.²⁶ The biggest player by far is China, home to

99% of the world's e-buses. The electrification of buses is also helping cut pollution in a meaningful way: **for every 1,000 e-buses introduced, global demand for fuel drops by over 180,000 barrels per year.**²⁷ So what can Canada learn from other international cities that have been quicker to embrace the change? Here we profile four cities that are miles ahead on the e-bus journey.

Los Angeles, California



100% zero-emission buses by 2030²⁸



132 electric buses in September 2018²⁹



Approximately 6% of total fleet³⁰

The Los Angeles Metropolitan Transportation Authority's emissions plan is motoring ahead of many other international cities. Since retiring its last diesel bus in 2011, Metro has operated compressed natural gas buses in combination with e-buses and is aiming for total bus electrification by 2030. The move is not only good for Californian emissions, but also for Canadian business, with Metro ordering up to 100 electric buses from Canadian company New Flyer³¹ as well another 60 from Chinese manufacturer BYD.

"This purchase of 100 electric buses is a down payment on a more sustainable future—and a big step toward our goal of having a fully electric bus fleet by 2030."

—Los Angeles Mayor Eric Garcetti, chair of the Metro board



CALIFORNIA'S ZERO-EMISSION TRANSIT POLICY

The government of California recently introduced one of the most ambitious clean transport initiatives in the world. The California Air Resources Board now requires all newly acquired buses to be **zero-emission by 2029 and aims to completely phase out all fossil-fuelled transit by 2040.**

The move comes after three years of planning and discussions and is supported by utility companies that are heavily invested in electric vehicle infrastructure—having set aside hundreds of millions of dollars for their electrification programs.



Amsterdam, the Netherlands

- 🎯 **100% zero-emission buses by 2025³²**
- 🚌 **100 e-buses in 2018³²**

Amsterdam is also aiming high, with plans for 100% emission-free traffic by 2025. This has been put into motion through the acquisition of 100 articulated battery-electric buses in 2018 to service Amsterdam's Schiphol airport and other city routes, making it the largest electric bus fleet in Europe.³² The plans don't stop at e-buses either. The city, in collaboration with its 15 different municipalities, is building innovative e-hubs that allow charging for buses and cars as well as bike storage and e-car sharing.³³

Shenzhen, China

- 🎯 **Already achieved 99.5% zero-emission buses**
- 🚌 **16,359 e-buses³⁴**

When it comes to e-bus uptake, no city can beat Shenzhen. The city has undergone a complete e-bus transformation, growing its e-bus fleet from 1,000 to over 16,000 in just five years. Not only is it the first bus fleet in the world to go totally electric, it's the largest bus fleet of any kind on the planet—over eight times bigger than Toronto's. The electrification was achieved through a combination of e-bus leases, national and local purchasing subsidies, and the development of a high-density network of charging infrastructure, which can also be used for personal vehicles.³⁴



Electric Bus

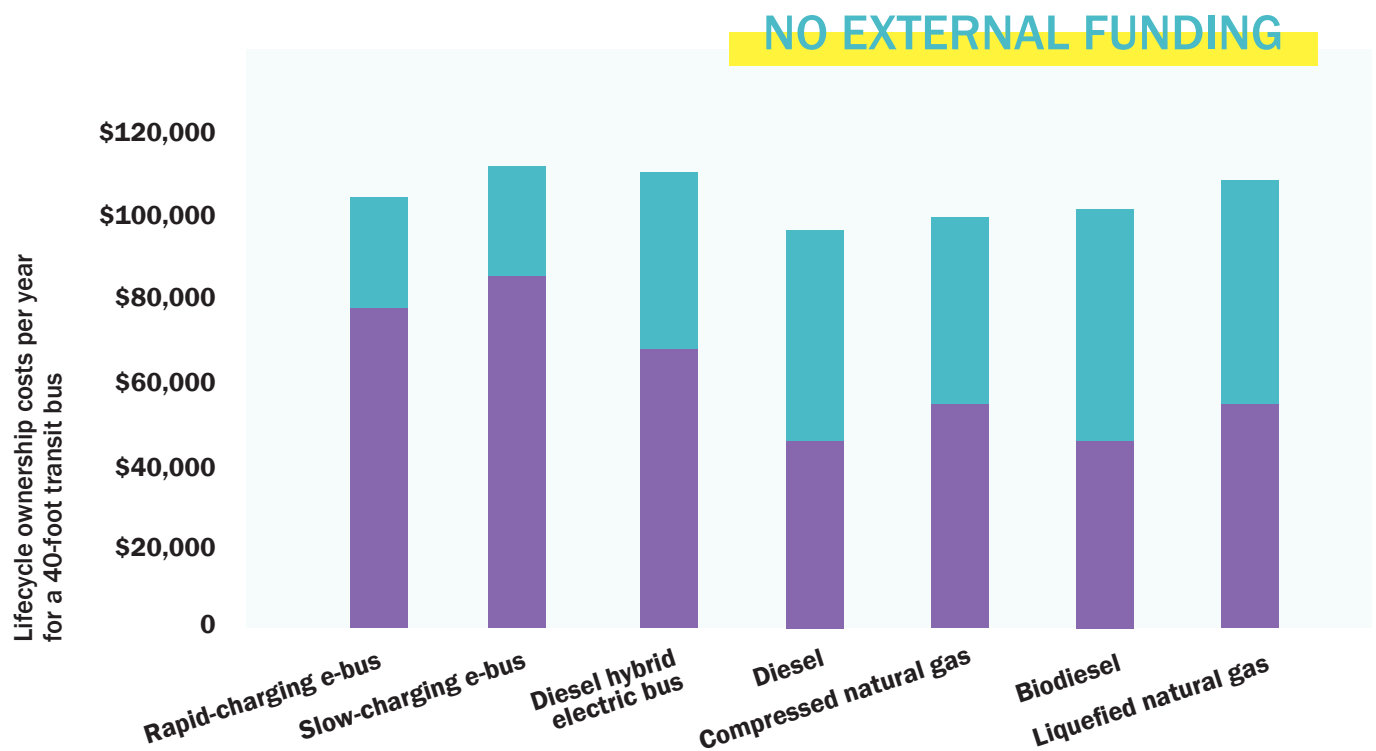
Dollars and good sense

AS E-BUS MOMENTUM GROWS, so does the business case. In the past, upfront purchase costs were the biggest barrier for e-buses, but with advancements in battery and charging technology, the economic argument against them is crumbling. While the upfront cost of an e-bus is currently two- to four-times higher than a diesel bus, a study by Bloomberg New Energy Finance suggests that increased demand will reduce costs rapidly, and **e-buses will reach upfront cost parity with diesel buses by 2030.**²

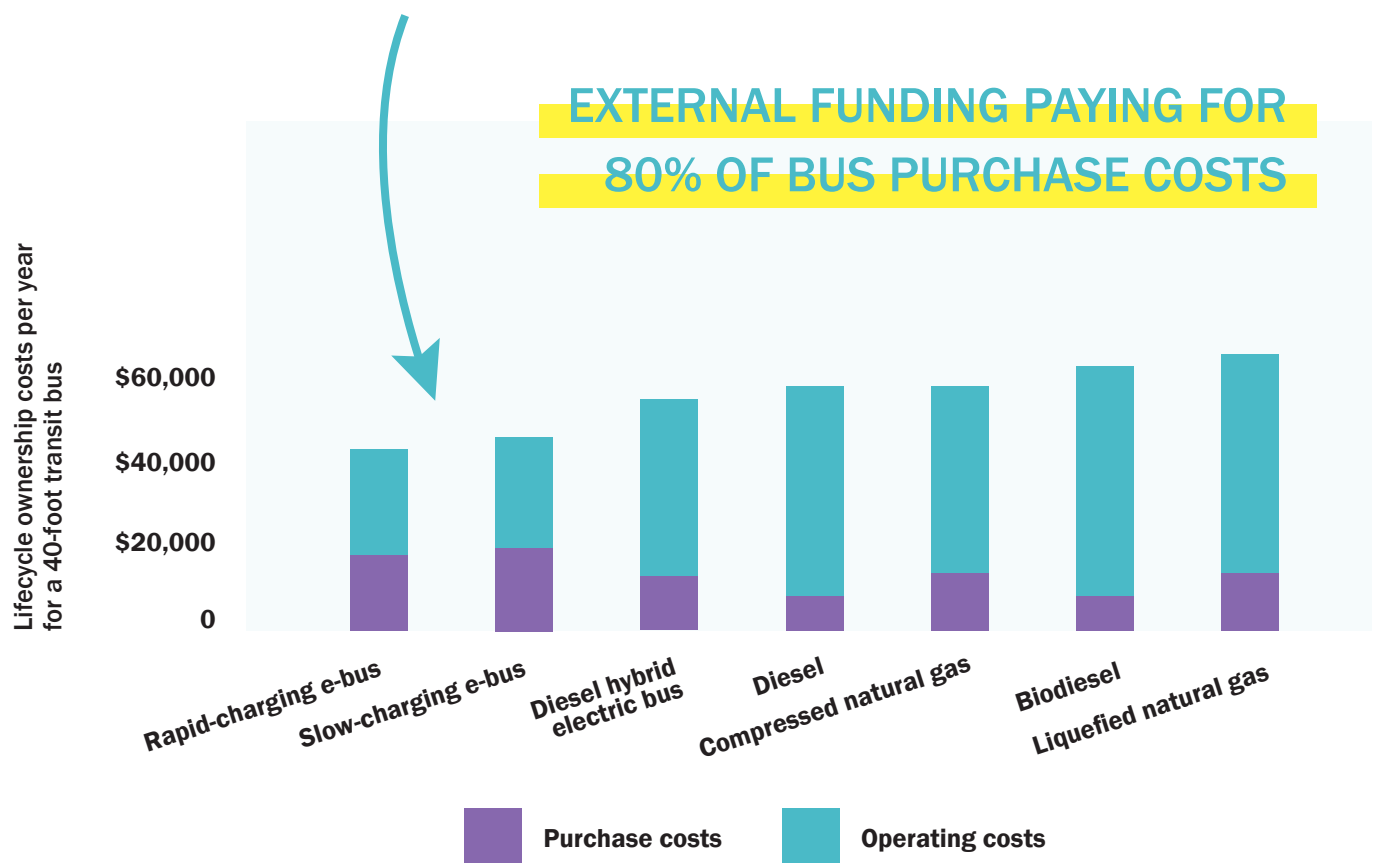
On top of that, there are the massive fuel savings. Transport providers have estimated **e-buses are responsible for lifespan savings between C\$85,000 and C\$290,000**³⁶ with a study in Edmonton finding e-buses' operational expenses to be between 41% to 44% cheaper than their diesel counterparts.¹⁶ Modelling by Vancouver transport operator TransLink suggests that, **by 2023, e-buses will be cheaper over their lifespan—even including the purchase cost.**³

What's more, when the additional costs spawned by the use of diesel vehicles are included—such as poor air quality and carbon emissions—e-buses already outprice diesel.³⁵ Consider a study by the City of Chicago, which put a price tag of US\$55,000 annually on the health impact of emissions from a diesel bus, which accumulates to US\$660,000 over a 12-year lifespan.³⁶ When government funding is available to cover the purchase costs of e-buses, the business case becomes even clearer, driving the lifecycle costs well below that of a diesel bus, making e-buses a fundamentally cheap option for transit providers (see chart).³⁵ There are even e-bus leasing schemes, which have been successful in China, available to Canadian transit authorities to assist with the upfront purchase cost.³⁷

If transit providers and governments consider the issue at a societal level, incorporating the costs of health impacts and climate inaction, the case for e-buses is even clearer.



E-buses become the clear winner once external funding helps to pay upfront purchase costs



SOURCE: "Lifecycle ownership cost and environmental externality of alternative fuel options for transit buses."
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Looking to the future

WITH THE GLOBAL SHIFT TO ELECTRIC TRANSIT already well underway, policy decisions made now will have lasting implications for Canada's future in the e-bus industry. The sector is already large: in 2018, the global e-bus industry was estimated to be worth C\$46 billion.³⁸ **With the market dominated by Chinese manufacturers, Canada must act to ensure it can keep, or even grow, its share in this rapidly accelerating space.** The good news is we have four expanding Canadian manufacturers already in place.

While cities like Montreal are already showing leadership by setting a date by which it will procure only e-buses, others should do the same. Manufacturers are prepped and ready—they just need policies to release the handbrake so they can gather some real momentum. As Patrick Gervais from the Lion Electric Company said, “Our business is no longer diesel buses.” Transit authorities could very well say the same.

As we look to the future of Canada's transit, let's remember the century-old e-buses that once trundled down Toronto's streets, and whose descendants are still doing so today. Let's learn from the past and make the right choices for now and for generations to come. The global e-bus is on its way, and it's up to Canada's transit providers, cities, and governments to make the necessary policy changes to be part of it. The benefits are abundant. Will Canada get on board—or will we be left behind at the stop?



How can we accelerate the uptake of e-buses in Canada?



Create a roadmap for 100% zero-emission bus fleets

Working with willing provincial and municipal governments, transit authorities, and businesses, the federal government should lead the development of a roadmap for increasing the production and use of zero-emission medium- and heavy-duty vehicles across Canada—including a specific focus on buses.



Establish zero-emission fleet targets

Canadian transit authorities face unique considerations and will therefore need to undertake their own analyses of how they can integrate e-buses into their fleets. Governments should support transit authorities in developing plans to achieve 100% zero-emission fleets, including incremental targets along the way. If these targets aren't achieved, governments could consider tying financial contributions to emissions performance or legislating the targets.



Support the accelerated adoption of e-buses

Increased and expanded public transit can improve Canadians' quality of life, enhance affordability, and cut carbon pollution. The federal government has invested \$3.4 billion in transit since 2016, and has committed another \$20 billion over the next decade, which will be invested through bilateral agreements with provinces and territories. To ensure this next generation of investment maximizes long-term pollution reduction and cost-savings, it should include a focus on zero-emission transit fleets and associated fuelling infrastructure, complemented by innovative financing that bridges the higher capital cost of e-buses with the long-term cost-savings they deliver.

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