The Corporation of the
Town of Cobourg

Resolution

Moved By	**Councillor Brian Darling**	**Resolution No.:**
Last Name Printed	**Darling**	323-22
Seconded By	**Councillor Aaron Burchat**	**Council Date:**
Last Name Printed	**Burchat**	October 3, 2022

WHEREAS at the Regular Council Meeting on October 3, 2022, Council considered a delegation from Randy Curtis, Chair, Zero Emissions Advisory Committee, regarding the Zero Emission Ad Hoc Report for the Town of Cobourg;

NOW THEREFORE BE IT RESOLVED THAT Council the report be forwarded to the Chief Administrative Officer and staff for consideration

2022

Zero Emission Vehicle Sub Committee Report

SUB COMMITTEE OF THE TRANSPORATION ADVISORY COMMITTEE
CURTIS, RANDY

Cobourg
"Ontario's Feel Good Town"

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1. Summary

Based on the work that the committee performed over the last 8 weeks it has concluded that the best available option for implementation of a Zero emission vehicles (ZEV) strategy, is to pursue Battery Electric Vehicles (BEVs). This provides complete emission elimination and provides, in most cases, a positive payback over the life of the vehicles. It is also concluded that implementation in advance of the existing fleet being kept until end of life is not the best way to or the most economical method of implementing a zero-emission vehicle strategy because the resale values of partially capitalized vehicles would be a higher return to the town of Cobourg than waiting for end of life of the Internal Combustion Engines (ICE) vehicles.

Although there are some alternate technologies such as hydrogen and hybrid vehicles, none of these alternatives provide the same financial payback to the Town of Cobourg based on the analysis completed by the committee.

It is also evident that there are numerous alternatives to Internal Combustion Engine (ICE) vehicles for nontraditional applications such as heavy-duty trucks, street sweepers and tractors.

2. Types of Technologies

A) Battery Electric Vehicles (BEVs)

Battery Electric Vehicles (BEVs) or Electric Vehicles (EVs) use only electricity to propel the car and do not burn any combustible fuels. They run solely on the battery and do not have a gasoline engine, unlike hybrid and plug-in hybrid vehicles which rely on gas engines. The wheels of a BEV are driven by one or more electric motors. Just like gasoline cars, BEVs can come in front-wheel drive, rear-wheel drive or all-wheel drive configurations. BEVs have much larger battery packs than hybrid vehicles, allowing the car to travel up to several hundred kilometers before needing to be recharged. BEVs produce no emissions as they do not have a combustion engine and they are more efficient as almost all of the energy from the battery is converted to energy for the motor, whereas gasoline and diesel cars can only convert up to 60 or 70% of the energy in the fuel into motion, the rest is lost as heat. BEVs also do not consume power when stopped as the motors can start on their own, unlike internal combustion engines which must be cranked by an electric motor to start.

Because of the lack of combustion engine, BEVs require far less maintenance than combustion engine and hybrid vehicles. BEVs have no spark plugs, exhaust systems, belts, do not require oil changes nor many other fluid changes that are part of regular maintenance for combustion engine vehicles. ICE cars, including hybrids, have 2000+ parts whereas BEVs have around 200, which means far less chance of mechanical failure[1].

BEVs must be recharged to run, however the main advantage of BEVs is that most homes and buildings have their own fuel source (electricity). BEVs can be charged with anywhere from a 120 volt standard outlet for trickle charging to a DC fast charger which can provide a full charge in as little as 10-15 minutes. Level 1 chargers typically provide a maximum of 1.5 kilowatts (the same as a space heater

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[1] Plug and Drive. http://plugndrive.ca/wp-content/uploads/2019/05/Lead-the-Charge-EV-101-Brochure.pdf Accessed on July 31, 2022

or coffee maker). At minimum a Level 2 charger is recommended. Level 2 chargers use 240 volts and can deliver energy much more quickly, providing up to 10 kilowatts similar to a clothes dryer. A typical BEV can be charged using a Level 2 charger in a few hours. Level 3 chargers or DC Fast Chargers can provide anywhere from 100 kilowatts to 350 kilowatts or more and can add several hundred kilometers of range in as little as 10-15 minutes. DC Fast Chargers are typically used to recharge on the road for long trips, while most BEV drivers charge their cars at home overnight, taking advantage of off-peak rates, using Level 2. This way, the car is always fully charged and visiting public charging stations is rarely required.

The range of BEVs is constantly improving. Many BEVs have a range of at least 200km and some models have 4-500km of range.

Examples of BEV vehicles include: Tesla Model S, 3, X and Y, Hyundai Kona EV, Hyundai IONIQ 5, Chevrolet Bolt, Audi e-Tron, BMW i4, Ford Mustang Mach-E, Ford F-150 Lightning, Kia Niro EV, Kia Soul EV, Jaguar i-PACE, Nissan Leaf, Polestar 2, Porsche Taycan, Volkswagen e-Golf, Volkswagen ID-4, Volvo XC 40 Recharge and Volvo C40 Recharge.

B) Hybrid Vehicles

There are two types of hybrid vehicles: a standard hybrid or plug-in hybrid. Both use a gasoline or diesel-powered engine in conjunction with an electric motor to propel the wheels. The difference is plug-in hybrids can be recharged for additional electric-only range. In both standard and plug-in hybrids, the electric motor is powered by a small battery pack which is recharged using a combination of the gas engine turning a generator and the regenerative braking system, which captures the motion of the car’s wheels to turn a generator. This not only recharges the battery but slows down the car, like a dynamo on a bicycle, also minimizing wear on the brakes. In a standard hybrid, the electric motor is used to provide more power to the combustion engine under heavy load such as moderate to hard acceleration or to propel the car very short distances (usually 1-3km) without the gas engine. This is known as electric-only mode. In electric-only mode, the car emits no CO_2 or other emissions because the combustion engine is not operating. Plug-in hybrids offer much longer distances in electric-only mode (up to 75km), but they must be plugged in to achieve this.

Standard Hybrid Vehicles

Standard hybrid vehicles, which are different from plug-in hybrid vehicles in that they have a smaller battery that provides very limited electric-only driving, primarily use a gasoline engine along with an electric motor for supplemental power. Some standard hybrids have no electric-only range, depending on the model.

Standard hybrid vehicles are best suited for city driving. Low speed driving (less than 60 km/h) doesn't require as much energy and doesn't deplete the battery pack as quickly as highway driving. This is more effective at saving fuel and more frequent braking and slowing down helps to recapture energy by regenerative braking that would otherwise be lost as frictional heat through the brake pads and rotors.

Examples of standard hybrid vehicles include Toyota Prius, Honda Accord Hybrid, Honda Insight, Toyota Camry Hybrid, and Ford Fusion Hybrid.

Plug-in Hybrid Vehicles

Plug-in hybrid vehicles are essentially the same as standard hybrid vehicles except the battery pack is larger and can be plugged in, unlike standards hybrids, to charge for additional electric-only range. This allows the car to travel much further using only the electric motor than a standard hybrid. Plug-in hybrids can drive anywhere from 25-80km using only the electric motor, depending on the model. After the battery has been depleted, the combustion engine switches on, and the car operates as a regular hybrid. Plug-in hybrids do not need to be plugged in to work – if they are never plugged in, they will still run, however they will simply work like a standard hybrid (as described above). However, if they are plugged in and re-charged, they will run longer in electric-only mode, reducing emissions and lowering fuel costs.

Plug-in hybrid cars are best suited for commuting as many typical commuting distances can be accomplished using only electricity. Should more range be required, the combustion engine allows the car to travel further until it requires re-fueling often referred to as a “range extender”.

Examples of plug-in Hybrid vehicles include: Toyota Prius Prime, Honda Clarity, Ford Fusion Plug-in Hybrid, Mitsubishi Outlander Plug-in, and Chevrolet Volt.

C) BEV & Alternative Fuel Medium and Large On-road Vehicles

In addition to passenger vehicles, battery-electric powertrains are available for larger commercial and municipal vehicles. Familiar brands like Freightliner, Kenworth, Peterbilt, General Motors and Ford offer all electric cargo vans, trucks, and chassis cabs. There are also many other manufacturers that offer additional all electric vehicle types such as buses and refuse collection vehicles.

As of July 2022, the federal government is offering financial incentives of up to $150,000 for the purchase or lease of these vehicles.

Many municipalities are switching their vehicles to electric, including heavy duty and large vehicles. This is outlined further in Section 7: Specialty Vehicles Available in BEV below.

D) Hydrogen

Because of the many uses of hydrogen, and because it can be produced using renewable or other zero/low carbon energy, it is seen as one of many energy sources required to help transition the world to low and eventually zero carbon emissions in the 2050 timeframe. In the context of the Town of Cobourg, hydrogen may be potentially used as a low greenhouse gas option for vehicle operation. This is discussed below. Although hydrogen may be used in industrial and other processes as well, the Zero Emission Vehicle Ad Hoc Committee only explores in depth the vehicle related opportunities. As of summer 2022, hydrogen’s use as a mass scale vehicle energy source is not secured, there is competition from Battery Electric Vehicles (BEVs) and whether both technologies will coexist in mass deployment or one will dominate the other is not certain. At the moment, in the light duty vehicle sector (pickups, SUVs, crossovers, sedans) the BEV is clearly dominating with many models available locally and electric vehicle charging available at many convenient locations. At the time of writing, there is only one place in Ontario to purchase hydrogen for a vehicle.

For the Town of Cobourg's immediate future vehicle purchases, say to year 2025, there are few to no options depending on the vehicle type and no fueling infrastructure to make hydrogen powered vehicles a practical choice. It is also at present not economically attractive to use hydrogen as a road going vehicle fuel when compared to the much lower energy cost for battery electric vehicles.

Status of commercially available hydrogen powered passenger vehicles and operating costs

Hydrogen powered vehicles use a "Fuel Cell" using hydrogen as a fuel to produce electricity. Hydrogen vehicles produce no exhaust, only emissions of liquid water and water vapor. The hydrogen itself must be produced at a specialized facility and may or may not have greenhouse gas and other emissions associated with its production. Hydrogen powered passenger vehicles are referred to as "Fuel Cell Electric Vehicles", or FCEVs. The promise of hydrogen as a fuel is that if it is produced in a manner which does not emit greenhouse gases to the atmosphere, then hydrogen fueled vehicles can be part of overall greenhouse gas reductions, see the section below for more about hydrogen production and greenhouse gas emissions.

In Canada as of summer 2022 there are about 200 FCEVs and five hydrogen refueling stations, four in British Columbia and one in Quebec, while in the state of California, there are about 14,000 FCEVs and 56 hydrogen fueling stations. Presently, there are only two FCEVS available for fleet and direct consumer purchase in specific regions of Canada and the USA, the Toyota Mirai, a 5-seat passenger car, and the Hyundai Nexo, a five passenger SUV.

In comparison to the 200 FCEVs in Canada, as of summer 2022, there are several hundred thousand Battery-Electric Vehicles (BEVs) and tens of thousands of Plugin Hybrid Electric Vehicles (PHEV) . The large numbers of BEVs sold relative to FCEVs is due to many factors. These include: hydrogen availability, FCEV cost and availability and the widespread availability of charging stations for BEVs relative to a FCEV refueled with hydrogen. In addition, fully commercialized BEVs have now been in the Canadian market for just over ten years while fully commercialized passenger FCEVs are a relatively recent entry and available in only two models in two provinces.

At the moment, hydrogen is not as low cost a fuel as electricity, therefore the economics of a hydrogen powered car are not as attractive as a BEV charged at home or a place of work. As of summer 2022, the price of hydrogen at hydrogen refueling stations in British Columbia is $12.75/kg. The Toyota Mirai FCEV can travel about 500 km on 5 kg of hydrogen, therefore a cost of about $64 for that distance. This is about the same cost per km as a gasoline hybrid engine car that will use about 30 liters of gasoline to go the same distance. An EV, charged at home on electricity at $0.15/kWh will travel the same 500 km for about $10-$15 depending on the time of day it is charged. At the present time, the BEV has a very significant operating cost advantage over hydrogen or gasoline powered passenger vehicles.

Note that although the economics of passenger vehicles favors the BEV over hydrogen fueled FCEVs, for large commercial trucks and various large service vehicles that require large amounts of energy to operate, the use of hydrogen as an alternative to gasoline may be attractive. This is due to the very large batteries that would be necessary to allow these large vehicles to have the same daily duty cycles. In such cases, the possibility of equal cost of operation using hydrogen as compared to gasoline (or more likely diesel), while eliminating tailpipe greenhouse gas emissions may create a compelling business case for large fuel cell electric vehicles. As yet however, large FCEVs such as commercial heavy trucks are in the pilot or demonstration phase of development.

For more information on hydrogen as a fuel, see Appendix A.

3. Life Cycle Analysis of Greenhouse Gas Emissions (GHGs) of Gas vs Electric Vehicles

Introduction

"Life Cycle" terminology can be used in the context of "Life Cycle Costs" and "Life Cycle GHG Emissions". In this report we use the terminology of "Total Cost of Ownership" rather than "Life Cycle Costs" to discuss the relative economics of gasoline/diesel vehicles to those of electric vehicles. We use the term "Life Cycle GHG Emissions" in discussing the GHG emissions that a vehicle is responsible for due to manufacturing energy use and actual operating life cycle energy use.

Manufacturing and Vehicle Use GHG Emissions

GHG emissions during manufacturing are a combination of those resulting from the production of electricity to run the factory and direct emissions during manufacturing such as those from natural gas or oil heating and chemical processes. These energy mixes and processes vary regionally depending on the energy sources in the province, state or country. Therefore, comparisons of GHG emissions from manufacturing must be set in the context of the region in which a vehicle is manufactured. In the context of EVs that are, or will be made in Ontario, the energy mix is primarily that of Ontario's relatively low GHG emissions electricity and natural gas. What is harder to assess are the GHG emissions associated with manufacturing of vehicle components in other countries. We are not aware of studies specific to Ontario produced vehicles, so we will reference other studies. These studies show that the Life Cycle GHG emissions associated with EVs are much lower than those associated with gasoline vehicle use, even when accounting for EV battery production and electricity generation in jurisdictions that have higher GHG intensity electricity generation than Ontario.

A gasoline/diesel powered car/SUV/Pickup vehicle produces GHG from the fuel burned during use. What is found in all reputable studies is that the GHGs emitted from operating Internal combustion engine (ICE, gasoline or diesel) vehicles far exceed the manufacturing related GHG emissions. Over a typical 300,000 km life of an ICE vehicle these direct tailpipe emissions will be in the order of 50 to 200 tonnes of GHGs due to the many thousands of litres of fuel burned. This is an order of magnitude greater than the manufacturing GHG emissions of either an ICE vehicle or an EV.

Reports on Life Cycle GHG Emissions

There are many studies examining vehicle Life Cycle GHG emissions. The chart reproduced below is from the July 2021 International Council on Clean Transportation (ICCT)[2] Fact Sheet and clearly illustrates the GHG emissions over life cycle usage of various vehicles in various countries. This study uses data that has car/SUVs (not pickups) having lifetime km use of 200,000 km to 270,000 km depending on vehicle type.

In the chart below, one can see that in the USA an EV produces less than half the GHG emissions per km than an ICE vehicle. The chart also shows that EV battery production is not a major GHG contributor in life cycle GHG emissions, but rather, in the context of the USA, electricity generation to charge the EV is the major contributor of GHG emissions during the life of the vehicle. In Ontario, with our very low Carbon electricity production, an EV would have lower Life Cycle GHG emissions than shown in the chart. Around the world, if we accept the scenario that in addressing climate change, electricity generation will trend towards lower GHG/kWh intensity, then with a proliferation of EVs, the GHG emissions associated with EV use will actually be decreasing over time.

[2] https://theicct.org/wp-content/uploads/2021/12/Global-LCA-passenger-cars-jul2021_0.pdf

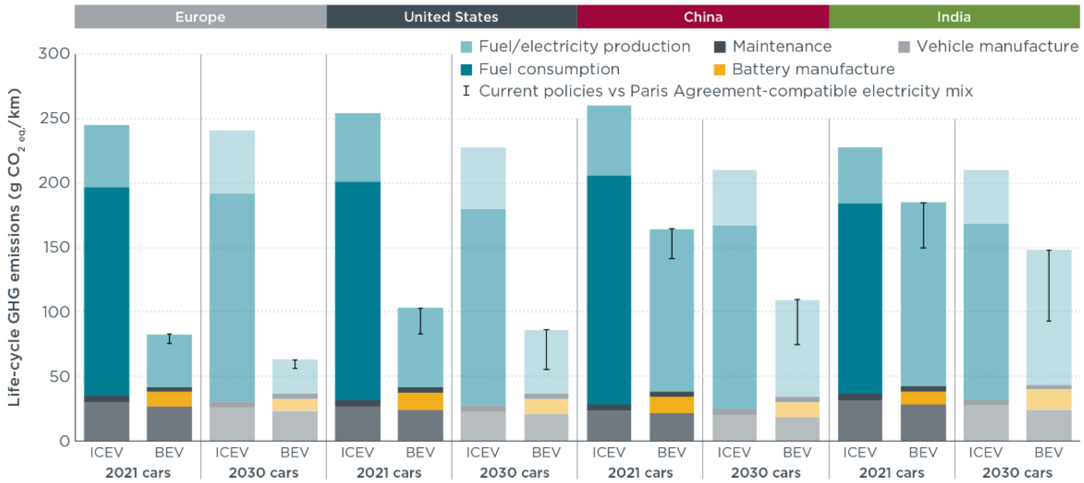

Figure ES.1. Life-cycle GHG emissions of average medium-size gasoline internal combustion engine (ICEVs) and battery electric vehicles (BEVs) registered in Europe, the United States, China, and India in 2021 and projected to be registered in 2030. The error bars indicate the difference between the development of the electricity mix according to stated policies (the higher values) and what is required to align with the Paris Agreement.

Figure 1-Life Cycle GHG Emissions on a per km basis

Another USA based study[3] also found under the vast majority of locations and vehicles types in the USA, that BEVs have fewer life cycle GHG emissions than similarly sized ICE vehicles. A particularly useful chart from this study shows the cumulative GHG emissions as vehicle mileage accumulates. In the chart, at zero miles, the original manufacturing emissions are apparent, then, as the vehicles are used, further GHG emissions accumulate. At the end of vehicle life the ICE vehicles have a cumulative 70 to 120 tonnes of GHG emissions depending on vehicle type. The BEV total life cycle GHG emissions range from 23 to 40 tonnes. Note that these numbers are based on American electrical grids with substantial coal fired electricity generation. BEV life cycle emissions in Ontario will be much lower due to our relatively low carbon intensity electricity, while the ICE vehicles remain the same.

[3] https://iopscience.iop.org/article/10.1088/1748-9326/ac5142/pdf

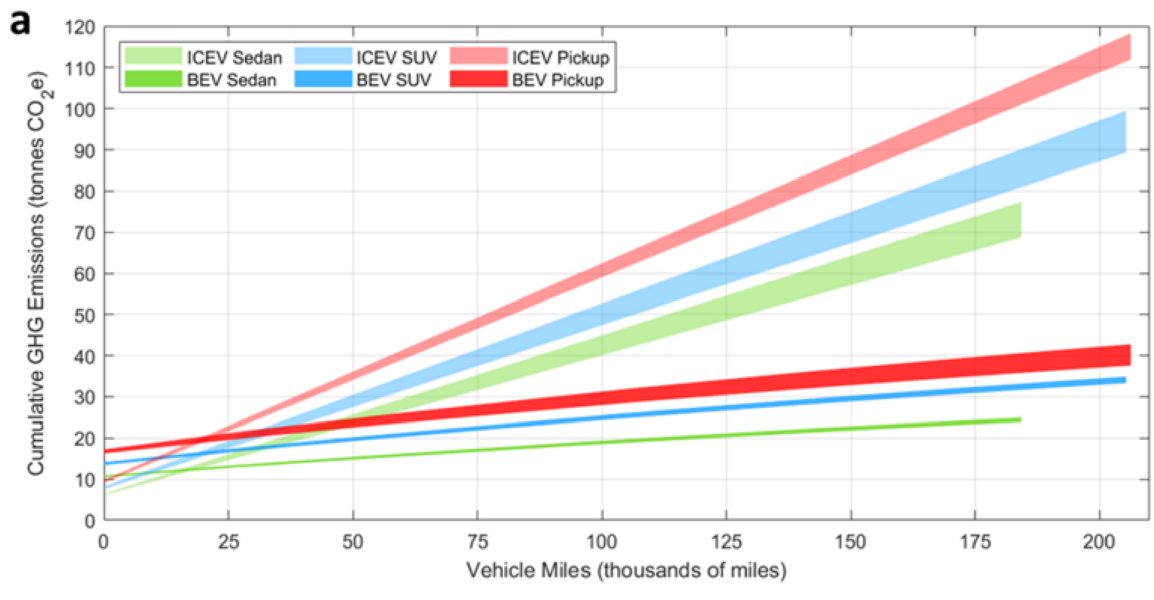

Figure 2 – Life cycle tonnes of GHG emissions

Summary

It is apparent that reputable studies support a clear conclusion. That is, over the complete manufacturing and usage life cycle of any battery electric vehicles purchased by the town of Cobourg and used in the range of 20,000 kilometers per year of travel, the battery electric vehicle will have much lower total GHG emissions. The graph above shows the GHG emissions reduction will be in the range of 40 to 70 tonnes for the USA, reductions in Ontario will be even greater due to our low carbon electricity.

4. Myths vs. Reality

Question: Do we have sufficient mineral supplies for EV batteries?

It is often stated that it's impossible to find enough minerals to make all the batteries that a global fleet of electric vehicles (EVs) will need. Paraphrasing Lovins[4], these concerns are often exaggerated. Generally, within a relatively short period of time, the economics of scarcity comes into play and the market responds by improving battery efficiency, reusing, recycling, substitution, innovation and exploration.

More Efficient Batteries

Since 2010, lithium-ion battery cells have nearly tripled their energy storage per kilogram… Further major gains are expected in this decade. Silicon anodes are said to raise lithium-ion batteries' energy density by 20 percent…technologies collectively doubling lithium-ion batteries' energy density could enter production by 2025. Projections based on old energy densities substantially overstate needed mining.

Substitution of Expensive EV Battery Chemicals

Several firms have demonstrated chemistries, like manganese-zinc or manganese-aluminum, that need no materials that are scarce, costly, toxic, or flammable. They could displace lithium and nickel and cobalt, putting producers of lithium-ion batteries (notably in China) at a disadvantage. Some battery metals, like iron and aluminum, are among the most abundant elements in the Earth's crust.The most effective substitute, in both motors and batteries, is smarter car design that makes motors and batteries smaller.

[4] 1] Six Solutions to Battery Mineral Storage Amory B. Lovins, Rocky Mountain Institute 2022 https://rmi.org/insight/six-solutions-to-battery-mineral-challenges/

Innovative Vehicle Design and Materials

A major variable overlooked is the efficiency of the vehicle that's being electrified. Reductions in mass, aerodynamic drag, and rolling resistance—in other words, improvements in the *physics* of the vehicle rather than the efficiency of its electric powertrain—can cut required battery capacity for the same distance two to three times over. BMW's 2013–22 i3, used ultralight strong carbon-fibre for the auto body. Far fewer batteries were needed to move the car because it had less mass. Molding carbon fibre to form the frame of the car takes just one-third the normal investment and water and half the normal energy, space, and time to manufacture.

A further two to four times efficiency gain is being demonstrated by innovative solar-electric vehicles, entering the market in 2022. They are so efficient that they can power a normal commuting cycle just by solar cells on their upper surface. Solar power reduces the need for as much battery capacity.

https://lightyear.one/configure

Question: Don't EV batteries pose a waste storage problem?

When a battery pack deteriorates to the point where it cannot provide sufficient range, it can be repurposed into valuable stationary storage that provides backup storage to the electricity grid for intermittent wind and solar power. While a battery pack that has reached the end of its life in an EV may no longer provide sufficient range, it still has plenty of capacity for grid energy storage. The batteries could be used either in large scale grid applications or home use. For large scale grid applications, many batteries are connected to achieve the scale required to provide backup power for the grid. For home use, a single battery could be used for backup power, much the same as a Tesla Powerwall would work. One advantage of an end-of-life EV battery is that they typically have much greater capacity than individual Tesla batteries. For example, a Tesla Powerwall battery can store 13.5 kWh of energy whereas a typical EV battery can store 60-70 kWh when new. Even when an EV battery has lost half of its capacity and is no longer practical for use in a vehicle, it can still provide just over twice the storage of a

Tesla Powerwall.
https://www.greencarreports.com/news/1136434_thousands-tesla-powerwalls-back-up-grid-virtual-power-plant

https://electricautonomy.ca/tag/vehicle-to-grid/

Ontario needs to begin updating its grid program to accept EV battery storage both from removed and in-use mobile batteries which will become more available over the next 10 years.

EV batteries are difficult to store because they are heavy and cannot be stacked in more than one layer. It will pose a problem for waste sites if a plan is not in place for their reuse and ultimate recycling.

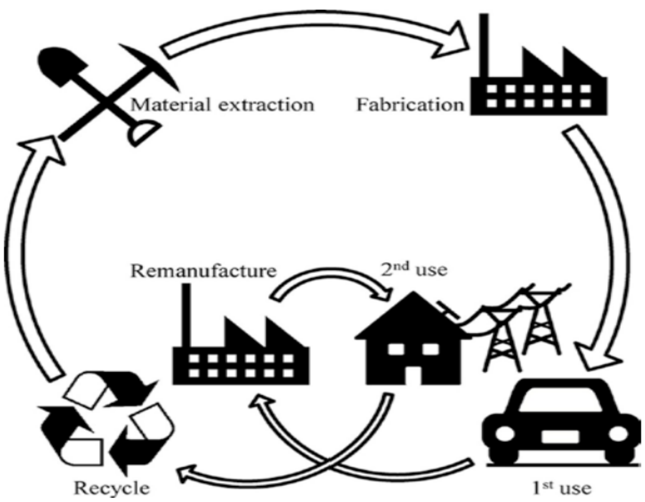

Fig. End of Life Options for EV Batteries[5]

Question:What About Recycling EV Batteries? Is it possible?

"Recycled lithium batteries contain seventeen times more nickel, four times more lithium, and ten times more cobalt than their respective natural ores.

[5]Research Report on Reuse and Recycling of Ev Batteries for the American Petroleum Industry by Kelleher Environmental, Gracestone Inc., Millette Environmental, Nov. 2020. https://www.api.org/-/media/Files/Oil-and-Natural-Gas/Fuels/EV%20Battery%20Reuse%20Recyc%20API%20Summary%20Report%2024Nov2020.pdf

“Mining” that recycling resource is underway in Canada and the U.S. There are three recycling plants in Canada and that number will keep growing. In the U.S. recycling operations can already supply on the order of a tenth of the materials needed for the global EV fleet. In time, recycling can ultimately scale to eliminate further mining. Ford Motors for example announced an alliance to develop a closed-loop North American battery supply chain.

Ford Motor Co. is investing $50 million in an upstart electric vehicle battery recycling company as the automaker moves to shore up its U.S. battery supply chain. The Dearborn, Michigan, automaker will invest in Redwood Materials, a Nevada-based company founded by former Tesla executive JB Straubel.

And in Windsor ON.: Stellantis (formerly Chrysler etc.) and LG Energy Solution to Invest Over $5 Billion CAD in Joint Venture for First Large Scale Lithium-Ion Battery Production Plant in Canada [6]

In Kingston ON: Li-cycle provides a full lithium -ion battery recycling service[7]
In Montreal PQ: Lithion Recycling partners with GM in Detroit to pursue a circular battery ecosystem[8]

A proof-of-concept is the lead-acid automobile battery that uses about two-thirds of the world’s neurotoxic lead. Ninety-nine percent of battery lead is recycled, and lead is rarely mined. Though it won’t be quite as easy - the re-smelting stage can be eliminated from the process by using an ion replacement process underdevelopment. [9]

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[6] https://www.stellantis.com/en/news/press-releases/2022/march/stellantis-and-lg-energy-solution-to-invest-over-5-billion-cad-in-joint-venture-for-first-large-scale-lithium-Ion-battery-production-plant-in-canada March 2022

[7] https://li-cycle.com/about/

[8] https://www.lithionrecycling.com/gm-and-lithion-announce-an-investment-and-strategic-partnership-agreement-to-pursue-a-circular-ev-battery-ecosystem/

[9] Maria Kelleher paper on recycling EV batteries

Battery recyclers plan to “mine” roughly a billion used batteries sitting unused in US homes’ old laptops, cellphones, etc.—(batteries are often rich in cobalt.) While Tesla, among others, plans to eliminate cobalt use altogether. Makers who still need cobalt will be able to get it from old smartphones.

Question: Range Anxiety Will we run out of fuel?

Fleet vehicles in Cobourg will not likely run out of fuel due to short distances traveled within the Town limits and by setting up ‘smart charging’ so that the battery is recharged nightly.

Question: Charging Anxiety, will it take too long to charge the fleet?

As electric vehicles come close to matching the range of internal combustion vehicles, range anxiety is being replaced by ‘charging anxiety’. Although it is unlikely that Cobourg’s vehicle fleet will need to be charged off site, there are over 6,000 DC fast chargers in Canada that can provide a full charge in 30 to 60 minutes depending on the size of the truck. In Cobourg there are over 20 commercial, mainly Level 2 chargers located around the town and more going in at Canadian Tire and at the Tim Horton’s Gas Bar on King St. E. and several DC chargers in Town or nearby on HWY 401.

Smart Charging

Smart charging is already available and it can be used to prioritize which vehicles get charged first and when. Time-of-use rates and fleet schedules are incorporated to ensure least-cost fill-ups without the need for staff on hand and on-time departures. Data gathered by a charging app such as Ampcontrol https://www.ampcontrol.io/ is also useful for administrative purposes or for government bodies that may have granted funding. Smart charging software allows fleet operators to track and monetize carbon credits. With the long-anticipated federal Clean Fuel Standard in December 2022 this opportunity will soon be available.

Fleet managers can also distribute the available energy capacity proportionally across active EV chargers on their site. Since available power at each site is limited, charging an entire fleet at a high capacity could require expensive upgrades to your site or result in high energy costs. Dynamic load management helps to avoid this.

Energy savings: The current cost of gas and the increased gas price under the Clean Fuel Standard means that fuelling an EV is far cheaper Since fleet vehicles are normally left idle at night while energy prices are lower, overnight charging represents a significant savings opportunity.

The Future of Battery Charging

A new way to charge batteries can make 'filling up' equivalent to a ten-minute gas station service call. Using Artificial Intelligence [AI] and machine learning, scientists led by Eric Dufek Ph.D. from the Idaho National Laboratory [INL] describe hooking up computers to many different battery models to find out what happened in each case to cause battery failure. The experiment was run through again this time with the objective of speed but avoiding the unique problems using machine learning. Batteries charge to over 90% in 10 minutes without lithium plating or cathode cracking.

Eventually your vehicle battery, in whatever state it is in, will tell the charger the best protocol for fast charging without causing damage. The Washington Post reported that this fast-charging innovation could be in place by 2025. It means that you won't necessarily need bigger batteries to go longer distances if you can recharge faster and easier. Thus, the roadblock of keeping up with demand for minerals to build bigger and bigger batteries will be lessened.

Question: Are Electric Vehicles too expensive for the Town?

Cost of ownership over time is cheaper due to low maintenance and fuel costs offsetting the higher acquisition cost actually, making the total cost of ownership lower.

The Reality is - A *whole-system perspective to net zero fleet vehicle conversion that emphasizes demand levers as much as supply expansions* will yield better choices, actions, and impacts, and help to avoid asset bubbles, overbuilt supply, needless interventions, and unnecessary risks. That's why discussions of battery materials, or any other supposedly scarce resource, must consider not just simplistic supply projections but fully engage with the efficiency of batteries, battery co-benefits, improvements in vehicle bodies, innovation in both vehicles and batteries and the full cost of ownership not just the upfront cost.

5. Impact on the Grid

What would happen if everybody switched to EVs. Would the province have enough electricity?

Overall, the ZEV Ad Hoc committee did not find any indication that the adoption of a fleet of BEVs by the Town of Cobourg or mass BEV adoption by the public would have any significant effect on the grid.

Our electricity grid was 95% carbon free in 2017 three years after completing the elimination of coal -fired electricity in 2014. Gradually fossil fuels are being reintroduced in the form of gas-fired electricity such that about 15% of supply will be fossil-based until at least 2030. The Town of Cobourg signed a petition along with the County of Northumberland and over thirty other municipalities asking the provincial government to use renewable energy and connect the provincial electricity grid to Hydro Quebec to allow for storage of intermittent renewable power, in lieu of adding fossil fuels in again. Tripling the GHG emissions of the electricity grid will affect the Climate Action Plans of all municipalities in the province. In September 2022, the province decided to heed some of this advice and they will not increase the GHG emissions of the electricity grid by adding more gas-fired generation. Instead, the old and expensive Pickering nuclear plant will be extended for another two years.

The Ontario Power Generation [OPG] system does not have an electricity shortage problem. The Ontario Society of Professional Engineers has charted significant excess electricity capacity during the night [10]which can accommodate BEV charging[11]. Curtailed surplus is GHG emission-free hydro-electric power while the

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[10]Ontario Society of Professional Engineers [OSPE}
https://ospe.on.ca/wp-content/uploads/2022/02/17-02-22-Ontario-Investigating-Options-for-New-Ultra-Low-Overnight-Electricity-Rates-1.pdf

[11] Tyler Seed, PowerON Fri July 21 https://poweronenergy.ca

total surplus includes excess contracted gas plant generation which can not be curtailed. (See Table below)[12]

Table 1

Amount of Surplus Emission-Free Electricity in Ontario

Year	Curtailed Surplus Amount TWh	Number of Homes Equivalent for Curtailed Surplus	Total Surplus Amount TWh	Number of Homes Equivalent for Total Surplus
2014	3.6	380,000	10.0	1,040,000
2015	4.8	500,000	13.3	1,390,000
2016	7.6	840,000	15.9	1,770,000
2017	10.2	1,130,000	23.9	2,520,000
2018	5.8	644,000	13.5	1,500,000
2019	6.5	720,000	17.3	1,920,000
2020	7.0	780,000	19.6	2,180,000

"It is frustrating for Ontario domestic consumers, who pay the fixed costs to build the electricity system, to watch as surplus electricity is sold to adjoining power systems at very low prices, (recently at 1.5 cents) and even worse, to see surplus electricity that can't be exported, curtailed (wasted)."[13]

There are many municipalities planning to reduce Greenhouse Gas (GHG) emissions and to achieve carbon neutrality by 2050 through renewable resources, energy efficiency and/or electrification of heating and transportation. Hydro One plans to replace 2 of the 4 transformers at the local Pt. Hope Transformer Station that after 60 years of operation have reached their End of Life (EoL) and associated 44 kv switchyard assets with current standard equipment. The current load rating is adequate to serve the forecast load for the next 20 years. The transformers will be replaced with similar size equipment and is expected be completed in 2023[14].

[12] OSPE *ibid pg.3*

[13] *ibid pg.3*

[14] **Provincial Grid** - Review of Hydro One document "Needs assessment report Peterborough to Kingston region: Feb 10, 2020". Document available for reference. *https://www.hydroone.com/abouthydroone/CorporateInformation/regionalplans/peterboroughtokingston/Documents/Peterboroug%20to%20Kingston_2nd%20cycle%20NA%20report.pdf*

Lakefront Utilities (LUSI) provided input to the ZEV Ad Hoc Committee on the effects that BEVs would have on the local electricity infrastructure. Currently the Lakefront transformer loading is typically half the installed capacity which will allow LUSI to add EV chargers, and if this were to cause the loading to double LUSI has the transformer capacity.

As a contingency these transformers can be upgraded from the current typical 50KVA to 100KVA or ultimately to 167KVA. The capacity restraint will not be at the municipality distribution level in Cobourg or Colborne, it will be at the Hydro One transmission level.

For the Town charging locations, LUSI is happy to discuss future locations when the Town has determined the electric vehicle location requirements and LUSI and the Town have coordinated a mutually beneficial solution for electrical servicing.

Michael Davison, Operations Director of Engineering at LUSI, told the committee: "I look forward to working with this forward-thinking group in the coming months and years."[15]

Fleet Setup and Next Steps

As LUSI does not have any in-house capacity to install chargers, a third party would have to be retained. There are service providers that can assist municipalities with the electrification of their fleet. The ZEV Ad Hoc Committee spoke to one service provider, PowerON, a subsidiary of OPG, who outlined how it would go about providing assistance and guidance for fleet electrification. First, PowerON would need information on all vehicles including ages, models, distance per day, etc. to determine which vehicles would be good candidates for replacement with BEVs. PowerON would then visit the sites, give an initial estimate and discuss next steps.

[15] ***Local Distribution****- Email from Michael Davison, Lakefront Utilities (LUSI) Fri July 21*

PowerON suggested that initially, starting small with 4-8 chargers in 1 place would be a good start for an electrification pilot. PowerON will provide the charging infrastructure. Solar & stationary battery storage for the current application may be considered depending on the current situation.

Should a fleet of EVs be adopted, LUSI would continue to maintain the local electrical grid and would provide power to the site where the chargers are located.

Co-benefits

Besides the noise reduction, lack of pollution and reduction in the heat island effect (fossil fueled vehicles give off over 95% of the energy from gasoline and diesel as waste heat while only 2% ends up providing motive power), there are associated advantages to having electric fleet vehicles including no need for on-board generators.

Bi-Directional charging

Parked approximately 95 percent of the time, electric vehicles are emerging as a major and lucrative power source to utilities and when still in use for mobility the EV owner will soon be able to sell some of the energy stored in the vehicle battery during times of peak electricity demand[16]. With bi-directional charging some current EVs such as the Ford 150 Lighting can power a typical household from 3 to 10 days during a power outage or supply power during a municipal emergency. Using EV batteries as generators also reduces the need for back- up *fossil fuel* generators by municipalities.

16 https://www.thestar.com/autos/2021/11/25/electric-vehicle-owners-can-get-paid-to-sell-electricity-back-to-the-grid.html

6. Business Case for early adoption of BEV

The Sub Committee was unable to secure the current Fleet Data from the Town so assumptions in the case below were based on Fleet data from 2018. This data shows that there are approximately 100 vehicles in the Town of Cobourg's fleet, 60% on-road, 40% off-road.

Electric Pickup Truck versus Gasoline Pickup Truck Background

As of 2022 there are several electric pickup trucks available in the North American marketplace. As of September 2022 only one model, the Ford F150 Lightning, is available and being delivered in Canada. Other manufacturers will introduce products soon; most likely Chevrolet, Rivian, Stellantis (Chrysler and Dodge) and Tesla. For the purposes of a Total Cost of Ownership (TCO) analysis for the Town of Cobourg, an F150 Lightning 100% electric pickup has been compared to a similarly equipped gasoline F150. For the gasoline model, the Ford F150 Lariat option with quad crew cab and four-wheel drive has been evaluated.

The Ford F150 Lightning EV pickup has several features which make it an improvement on the gasoline model. The EV version has much more power, much lower operating costs, reduced maintenance intervals and a 9.2 kW AC power output option and the capacity to be used as an AC "generator" for everyday work requirements such as power tools and in power outage emergencies. The EPA rated range of the base F150 Lightning is 370 km, with an available larger battery offering an EPA range of 510 km. For town of Cobourg usage, the AC power capability of the EV pickup itself is an estimated $4000 savings, this being the approximate cost of two basic 2000 watt generators or gasoline powered water pumps over eight years of truck usage.

Various studies to date show EV maintenance costs are about half that of gasoline vehicles. Most EV pickups will have similar reduced maintenance cost advantages.

EV Pickup Cost Savings

The spreadsheet below shows the TCO for an EV F150 Lightning pickup and an F150 gasoline pickup. (No quad cab 4WD PHEV pickup is available). Note that over an eight-year truck usage schedule of about 20,000 km/year, the Ford EV pickup has an estimated $42,000 lower annual cost. This savings is primarily due to reduced gasoline usage at about $5k/year per truck. If annual costs are applied with a 5% discount factor, the Net Present Value of the savings is estimated at $35,000 over eight years. Because EV pickups consume very little energy while stopped but still running, they will also have greatly reduced idle time energy costs, but that has not been factored into the estimates.

Cost of chargers

EV pickups will require chargers at the town maintenance building parking at an estimated cost of $2000-3000, including installation, each for a Level 2 charger capable of charging the vehicle overnight.

Scenario of 20 Quad cab 4WD EV Pickups for the Town of Cobourg

The TCO savings for 20 electric pickups is estimated to be about 20 X $42k/truck over eight years for a total of about $840,000. The capital cost of installing 20 chargers so as to ensure every vehicle has a full charge each morning is estimated at 20 X $3k or about $60,000. If it is assumed that half the gasoline trucks require a pump or generator, that is an estimated cost of 10 X $4,000, or $40,000 additional cost for the gasoline vehicles.

The bottom line is that **a fleet of twenty EV pickups** has the potential to **save in the order of $800,000** using an eight year procurement cycle.

Detailed Total Cost of Ownership for Ford F150 Lightning versus a gasoline powered equivalent vehicle

Using September 2022 gasoline and electricity prices and vehicle MSRPs, the following table illustrates the potential savings of an EV pickup operated over an eight-year life cycle. The red text represents variable data used in the analysis and the blue numbers show the results.

The following general usage and cost data is used in the TCO analysis:

General Input Data		
Gasoline or Diesel Cost	**1.55**	$/litre
Electricity Cost	**0.14**	$/kWh
Fuel/Elec inflation cost	**4.0**	%/year
General inflation	**2.0**	%/year
Annual driving	**25,000**	km/year
ICE annual maintenance	**1000**	$/year
PHEV annual maint. = ICE Vehicle maint.	**1000**	$/year
Ontario 2020 electricity emissions factor	**0.04**	kg CO_2/kWh
Gasoline GHG Emissions Factor	**2.32**	kg GHG/Litre
HST	**13**	%
Annual Insurance Cost as percentage of MSRP	**3**	%
Resale Value at End of Year 8	**20**	%
Discount Factor for NPV	**5**	%

Below is a cost analysis which compares a gasoline and electric version of the F150 pickup:

Vehicle Specific Cost and Electricity or Fuel Efficiency Input Data

	Gasoline or Diesel Vehicle	Plug-In hybrid Vehicle	100% BEV Electric Vehicle
Make	Ford Gasoline Pickup	XXX	Ford Electric Pickup
Model	Lariat 4 x 4, Quad Cab, 2.7l stop/start	XXX	Loest Cost Retail F150 Lightning
Efficiency			
Gasoline or diesel Efficiency (l/100km)	11.7	0	n/a
Electricity Efficiency (kWh/100 km)	n/a	0	30
PHEV % EV/Gasoline Split % driven km	n/a	0	n/a
Capital Cost			
Vehicle MSRP before taxes	$67,745	$0	$68,000
AC Tax	$100	$0	$100
Delivery Charge	$2,095	$0	$2,095
Total before taxes	$69,940	$0	$70,195
HST	$9,092	$0	$9,125
Total before rebate including HST	$79,032	$0	$79,320
Federal EV Rebate	$0	$0	$0
Total Capital Cost	$79,032	$0	$79,320
Insurance			
% of Total Capital Cost			
3%	$2,371	$0	$2,380
Maintenance			
EVs shown to be 50% of ICE Vehicle	$1,000	$1,000	$500
Discount for Generator Feature			
Onboard AC 2 kW Power Source	n/a	n/a	$0

Total Cost of Ownership

				Totals				Totals				Totals
Capital Cost				$79,032				0				$ 79,320
	Insurance	Maint.	Fuel		Insurance	Maint.	Gas + Elec.		Insurance	Maint.	Electricity	
Year 1 O & M	$2,371	$1,000	$4,534	$7,905	$0	$1,000	$0	$1,000	$2,380	$500	$1,050	$3,930
Year 2 O & M	$2,418	$1,020	$4,715	$8,153	$0	$1,020	$0	$1,020	$2,427	$510	$1,092	$4,029
Year 3 O & M	$2,467	$1,040	$4,904	$8,411	$0	$1,040	$0	$1,040	$2,476	$520	$1,136	$4,132
Year 4 O & M	$2,516	$1,061	$5,100	$8,677	$0	$1,061	$0	$1,061	$2,525	$531	$1,181	$4,237
Year 5 O & M	$2,566	$1,082	$5,304	$8,953	$0	$1,082	$0	$1,082	$2,576	$541	$1,228	$4,345
Year 6 O & M	$2,618	$1,104	$5,516	$9,238	$0	$1,104	$0	$1,104	$2,627	$552	$1,277	$4,457
Year 7 O & M	$2,670	$1,126	$5,737	$9,533	$0	$1,126	$0	$1,126	$2,680	$563	$1,329	$4,571
Year 8 O & M	$2,723	$1,149	$5,966	$9,838	$0	$1,149	$0	$1,149	$2,733	$574	$1,382	$4,689
End year 8 resale value				-$13,549				$0				-$13,600
8 YearTotal Cost				$136,191				$8,583				$100,111
NPV 8 Year Total Cost				$126,532				$6,899				$97,721
Annual Tonnes of Greenhouse Gas Emissions (Tailpipe or Upstream Electricity)				6.79				0.00				0.30

Electric versus Gasoline Equivalent Police Appropriate Vehicle Total Cost of Ownership Comparison

For the purposes of this analysis, a $75,000 estimate is used for a policing specification Ford Interceptor (based on Ford Explorer) gasoline powered vehicle and is compared to what an electric vehicle equivalent would need to cost for the TCO over eight years to be about the same. Ford has announced a Ford F150 Lightning police type vehicle, but pricing is not yet available. What we have done is estimate the price that the EV police version F150 Lightning would need to be to produce an equivalent eight-year TCO as a $75k capital cost Ford Interceptor.

The TCO for the Ford Interceptor over eight years is estimated at $125,000, of which about $48,000 represents the cost of gasoline. The cost of electricity over the same period for an electric police interceptor version of the F150 Lightning is estimated at about $10,000. The analysis below shows that if an F150 Lightning EV police version was about $118,000 or less, it would have a lower TCO than the $75,000 gasoline powered Interceptor.

Although Ford has released a police version of the F150 Lightning model named the "SSV", it is not clear whether it will meet the same specifications required for policing purposes as the present Ford Interceptors. Below are the data used in this analysis:

General Input Data		
Gasoline or Diesel Cost	1.55	$/litre
Electricity Cost	0.14	$/kWh
Fuel/Elec inflation cost	4.0	%/year
General inflation	2.0	%/year
Annual driving	25,000	km/year
ICE annual maintenance	1000	$/year
PHEV annual maint. = ICE Vehicle maint.	1000	$/year
Ontario 2020 electricity emissions factor	0.04	kg CO_2/kWh
Gasoline GHG Emissions Factor	2.32	kg GHG/Litre
HST	13	%
Annual Insurance Cost as percentage of MSRP	3	%
Resale Value at End of Year 8	20	%
Discount Factor for NPV	5	%

Below is the vehicle model specific cost analysis:

Vehicle Specific Cost and Electricity or Fuel Efficiency Input Data

	Gasoline or Diesel Vehicle	Plug-In hybrid Vehicle	100% BEV Electric Vehicle
Make	Ford Interceptor (Exploroer)	XXX	Ford Electric Pickup
Model	Police Version	XXX	Loest Cost Retail F150 Lightning
Efficiency			
Gasoline or diesel Efficiency (l/100km)	13	0	n/a
Electricity Efficiency (kWh/100 km)	n/a	0	33
PHEV % EV/Gasoline Split % driven km	n/a	0	n/a
Capital Cost			
Vehicle MSRP before taxes	$75,000	$0	$118,000
AC Tax	$0	$0	$0
Delivery Charge	$0	$0	$0
Total before taxes	$75,000	$0	$118,000
HST	$9,750	$0	$15,340
Total before rebate including HST	$84,750	$0	$133,340
Federal EV Rebate	$0	$0	$0
Total Capital Cost	$84,750	$0	$133,340
Insurance			
% of Total Capital Cost			
3%	$0	$0	$0
Maintenance			
EVs shown to be 50% of ICE Vehicle	$1,000	$1,000	$500
Discount for Generator Feature			
Onboard AC 2 kW Power Source	n/a	n/a	$0

Total Cost of Ownership

	Insurance	Maint.	Fuel	Totals	Insurance	Maint.	Gas + Elec.	Totals	Insurance	Maint.	Electricity	Totals
Capital Cost				$84,750				0				$ 133,340
Year 1 O & M	$0	$1,000	$5,038	$6,038	$0	$1,000	$0	$1,000	$0	$500	$1,155	$1,655
Year 2 O & M	$0	$1,020	$5,239	$6,259	$0	$1,020	$0	$1,020	$0	$510	$1,201	$1,711
Year 3 O & M	$0	$1,040	$5,449	$6,489	$0	$1,040	$0	$1,040	$0	$520	$1,249	$1,769
Year 4 O & M	$0	$1,061	$5,667	$6,728	$0	$1,061	$0	$1,061	$0	$531	$1,299	$1,830
Year 5 O & M	$0	$1,082	$5,893	$6,976	$0	$1,082	$0	$1,082	$0	$541	$1,351	$1,892
Year 6 O & M	$0	$1,104	$6,129	$7,233	$0	$1,104	$0	$1,104	$0	$552	$1,405	$1,957
Year 7 O & M	$0	$1,126	$6,374	$7,500	$0	$1,126	$0	$1,126	$0	$563	$1,461	$2,025
Year 8 O & M	$0	$1,149	$6,629	$7,778	$0	$1,149	$0	$1,149	$0	$574	$1,520	$2,094
End year 8 resale value				-$15,000				$0				-$23,600
8 YearTotal Cost				$124,750				$8,583				$124,674
NPV 8 Year Total Cost				$118,622				$6,899				$129,328
Annual Tonnes of Greenhouse Gas Emissions (Tailpipe or Upstream Electricity)				7.54				0.00				0.33

Using the spreadsheet developed by the Ad-Hoc EV Committee, the detailed analysis of the TCO for an EV pickup versus a similar gasoline model is shown below. This spreadsheet has been made available to the town staff to perform their own analysis and to be used in future EV comparisons.

Vehicle Specific Cost and Electricity or Fuel Efficiency Input Data

	Gasoline or Diesel Vehicle	Plug-In hybrid Vehicle	100% BEV Electric Vehicle
Make	Ford Gasoline Pickup	XXX	Ford Electric Pickup
Model	Lariat 4 x 4, Quad Cab, 2.7l stop/start	XXX	Loest Cost Retail F150 Lightning
Efficiency			
Gasoline or diesel Efficiency (l/100km)	11.7	0	n/a
Electricity Efficiency (kWh/100 km)	n/a	0	30
PHEV % EV/Gasoline Split % driven km	n/a	0	n/a
Capital Cost			
Vehicle MSRP before taxes	$67,745	$0	$68,000
AC Tax	$100	$0	$100
Delivery Charge	$2,095	$0	$2,095
Total before taxes	$69,940	$0	$70,195
HST	$9,092	$0	$9,125
Total before rebate including HST	$79,032	$0	$79,320
Federal EV Rebate	$0	$0	$5,000
Total Capital Cost	$79,032	$0	$74,320
Insurance			
% of Total Capital Cost			
3%	$2,371	$0	$2,230
Maintenance			
EVs shown to be 50% of ICE Vehicle	$1,000	$1,000	$500
Discount for Generator Feature			
Onboard AC 2 kW Power Source	n/a	n/a	$0

Total Cost of Ownership

				Totals				Totals				Totals
Capital Cost				$79,032				0				$ 74,320
	Insurance	Maint.	Fuel		Insurance	Maint.	Gas + Elec.		Insurance	Maint.	Electricity	
Year 1 O & M	$2,371	$1,000	$4,534	$7,905	$0	$1,000	$0	$1,000	$2,230	$500	$1,050	$3,780
Year 2 O & M	$2,418	$1,020	$4,715	$8,153	$0	$1,020	$0	$1,020	$2,274	$510	$1,092	$3,876
Year 3 O & M	$2,467	$1,040	$4,904	$8,411	$0	$1,040	$0	$1,040	$2,320	$520	$1,136	$3,976
Year 4 O & M	$2,516	$1,061	$5,100	$8,677	$0	$1,061	$0	$1,061	$2,366	$531	$1,181	$4,078
Year 5 O & M	$2,566	$1,082	$5,304	$8,953	$0	$1,082	$0	$1,082	$2,413	$541	$1,228	$4,183
Year 6 O & M	$2,618	$1,104	$5,516	$9,238	$0	$1,104	$0	$1,104	$2,462	$552	$1,277	$4,291
Year 7 O & M	$2,670	$1,126	$5,737	$9,533	$0	$1,126	$0	$1,126	$2,511	$563	$1,329	$4,403
Year 8 O & M	$2,723	$1,149	$5,966	$9,838	$0	$1,149	$0	$1,149	$2,561	$574	$1,382	$4,517
End year 8 resale value				-$13,549				$0				-$13,600
8 YearTotal Cost				$136,191				$8,583				$93,823
NPV 8 Year Total Cost				$126,532				$6,899				$91,686

	Gasoline or Diesel Vehicle	Plug-In hybrid Vehicle	100% BEV Electric Vehicle
Annual Tonnes of Greenhouse Gas Emissions (Tailpipe or Upstream Electricity)	6.79	0.00	0.30

7. Specialty Vehicles Available in BEV

Fire trucks

As municipalities across Canada look to lower their transportation emissions, several local fire departments are taking the crucial first steps to transition some of their fire trucks to electric. Toronto Fire Service has placed an order for 2 electric pumpers. The vendor of the pumpers says the trucks will be able to meet the needs of Toronto Fire Services 99% of the time, saying: "We believe that 99 per cent of all the emergency responses that an urban or suburban truck needs to tackle can be done on electric only with our product."[17]

The City of Brampton also ordered an electric fire truck, the first in Ontario. The truck was ordered from Austria-based manufacturer Rosenbauer.[18]

Ice resurfacing

Across Canada, dozens of municipalities have switched their ice resurfacers to electric, including a dozen municipalities in Alberta. This necessary municipal maintenance can be one of the costliest line items in a city's budget as well as a source of considerable local emissions. [19]

Snow plows

The town of Innisfail, Ontario purchased automated electric snowplows. The snow-bots went into service over the 2021-2022 winter. To navigate and clear sidewalks, they were equipped with snowplows, salt, GPS and depth-sensing cameras that can detect objects in front of them. For safety reasons, the vehicles had human chaperones accompanying them as they removed snow. The latest snow-clearing robots can push around 2,000 pounds of snow.[20]

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[17] Electric Autonomy. Fire departments in Toronto, Greater Montreal embrace electric trucks for safety and performance.
https://electricautonomy.ca/2022/08/30/toronto-and-greater-montreal-embrace-electric-firetrucks/

[18] Electric Autonomy. City of Brampton orders electric fire truck, in Ontario first
https://electricautonomy.ca/2021/06/21/brampton-electric-firetruck/

[19] Electric Autonomy. Municipalities look to electrify niche public works vehicles to achieve zero-emission city fleets.
https://electricautonomy.ca/2022/05/17/canada-municipal-vehicles-electrify-zev/. Accessed on July 20, 2022.

[20] Ibid.

Police Pursuit Vehicles

Cobourg Police Services does not currently believe pursuit vehicles can be BEV, while other municipalities are aggressively pursuing this strategy.

Police in Bridgewater, NS purchased an electric police cruiser in February 2022. Although the car cost $14,000 more than the gas-powered alternative, the mayor of Bridgewater expects the town to save around $5,000 per year every year. This equates to roughly a 3-year payback. Performance has been better than expected as well. The car can operate for two shifts before needing to be recharged. The main purpose of the vehicle is traffic enforcement. The town plans to eventually replace all their gas police cars with electric vehicles.[21]

General Motors unveiled the price, specs and features of its Chevrolet Blazer electric vehicle this week and the SUV is now ready for pre-order across Canada. Starting at $51,998 for the base 1LT model, the five-seater SUV-sized Blazer offers three additional trim levels: 2LT, RS and SS, and an additional version designed for police units called the Police Pursuit Vehicle (PPV).[22]

Below are some links with additional information on electric police vehicles:

CarBuzz – The Rise of the New Electric Cop Car

Chevrolet Bolt SSV (police) package

Chevrolet Blazer PPV

Ford Mustang Mach e GT

Ford F150 Lightning Pro SSV

Construction equipment

Aecon, one of Canada's leading construction firms, is partnering with Volvo Construction Equipment to launch its second pilot of electric heavy machinery on

[21] CBC News. Bridgewater police say new electric cruiser 'performing better' than expected https://www.cbc.ca/news/canada/nova-scotia/bridgewater-police-say-new-electric-cruiser-performing-better-than-expected-1.6549637

[22] Electric Autonomy. Chevrolet Blazer EV reservations open in Canada with $51,998 starting price tag, up to 515 km range. https://electricautonomy.ca/2022/07/19/chevrolet-blazer-canada-price/

worksites in Ontario, a sign of growing industry interest in zero-emission equipment.[23]

Transit Mobility Substitution

Substituting single vehicle use with buses

New business models such as shareable services like Okototoks' award-winning On Demand Micro Transit carry more people more miles in less time with fewer vehicles at much lower cost. When electrified it could move more people out of their gas vehicles and into public transit, especially if a curb-to-curb transit service like Okotoks, Alberta is used.

The Town of Cobourg adopted on-demand micro transit in June 2022 to replace the larger diesel buses that run on fixed routes after a year-long pilot. The on-demand micro transit service requires smaller, more flexible vehicles that can travel on all of Cobourg's streets. The on-demand transit service reduced average travel time from one hour to ten minutes.[24] The next steps are to reduce the greenhouse gas (GHG) emissions of the transit fleet itself once acceptable EV shuttle vehicles become available and to reduce *community wide* GHG emissions by making the service so convenient that local residents select it over using their own vehicles. This is achieved by curb-to-curb service rather than the current

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[23] Electric Autonomy. Aecon unveils a new electric construction machinery pilot, sees prospect of an industry-wide transition.
https://electricautonomy.ca/2022/02/28/aecon-volvo-electric-vehicle-pilot/

[24] https://www.thepeterboroughexaminer.com/local-northumberland/news/2022/06/18/on-demand-transit-in-cobourg-here-to-stay-council-also-approves-new-transit-hours.html

virtual bus stop service. An example of curb-to-curb service is Okotoks AB, population 28,800, which has a ridership of 52,000 annually during the pandemic and expects to increase to 60,000 trips in 2022.[25] This award-winning On Demand Micro Transit can carry more people more miles in less time with fewer vehicles at much lower cost. When electrified it could move more people out of their gas vehicles and into public transit, especially if a curb-to-curb transit service like Okotoks, Alberta is used.

A key part of the Town of Cobourg's Climate Action Plan is to reach net zero GHG emissions by shifting to public transportation, Since 32% of Cobourg's GHG emissions occur as a result of local, *private* transportation, making *public* transit as successful and user-friendly as possible, leverages the reduction in GHG emissions from the community as a whole.

Transit Vehicle Requirements

- Transit vehicles should not be larger than 10 seaters to keep the on-demand service meeting the time requirements of its passengers.
- The transit vehicles should be able to serve all of its ridership equally.
- Full Battery Electric Vehicles (BEV's) are preferred over hybrid vehicles due to a limited improvement in fuel efficiency with hybrids in municipal fleets experienced by other municipalities - Okotoks and Ottawa[26] and the Original Equipment Manufacturer (OEM) will be coming to the market soon with fully electric versions.

Vehicles Available

There is a long wait time for BEV shuttle vehicles, so it is important to apply as soon as possible to assure service in the next year or two for BEV shuttles.

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[25] To see a 2 minute video about Okotoks curb to curb service click on this Youtube link: *https://www.youtube.com/watch?v=9QGX5j411ws*

[26] Okotoks Transit Specialist, David Gardiner's zoom interview with the Ad Hoc Net Zero Fleets Advisory Committee Sept.1st 2022 and Ottawa Green Fleets Presentation to Clean Air Partnership Workshop November 2021

Ford Transit

Currently there are no passenger versions of the eTransit on the market. Therefore, It requires a retrofit of the vehicle to meet Cobourg's transit requirements. This can be achieved faster by combining the Transit undercarriage and battery[chassis] with a body or shell built to meet Cobourg's requirements.

2023 Ford E-Transit Chassis Cab

https://www.ford.com/commercial-trucks/e-transit/models/chassis-cab/

Potential sources for other bus body (aka transit shell) builders on a supplied chassis are:

Overland Custom Coach
Head Office: R.R. #2, 21051 Nissouri Rd., Thorndale, ON N0M 2P0
https://www.overlandcustomcoach.com/electric-bus-options
regarding their upcoming smaller ebus program [27]

Crestline Coach Ltd. Head Office
126 Wheeler Street, Saskatoon, SK S7P 0A9 **phone:** 1-306-934-8844 **| Toll-free phone in**
Fax: 1-306-242-5838 **| Email:** info@crestlinecoach.com
https://crestlinebuses.com/electric-bus-solutions/

ARBOC (carried by Crestline Coach above)
https://arbocsv.com/models/equess-charge/
Zero emissions, smart mobility, lower operating costs, compatible charging systems - the Equess CHARGE™ is a low-floor shuttle/transit bus on an ARBOC Specialty Vehicles, LLC chassis, that easily accommodates up to 33 seated passengers and six wheelchair passengers.
Middlebury, NJ and Creative Carriage Ltd. 6 Ridgeview St Saint George, ON N0E 1N0
519-740-4801 creativecarriage.com (South of Cambridge)

Examples of electric buses for on-demand transit:

Ten seater electric on-demand shuttle bus

The **Volkswagen ID.Buzz** is a seven seater 17 ft. electric microbus[28,29] which has a longer wheelbase than the European model shown here and a range of about 435km [270mi]. Volkswagen is taking orders in 2023 for Fall 2024 delivery in Canada. Register at https://www.vw.ca/en/shopping-tools/volksklick.html to order.

[27] Contact Bart Dries, Sales Dept, 519-461-1140 ext 115 Bart@overlandcustomcoach.com at Overland Custom Coach (as of Sept 27.22)

[28] https://www.motortrend.com/news/2024-volkswagen-id-buzz-first-look-review/
[29]https://www.kbb.com/volkswagen/idbuzz/#:~:text=Buzz%20pricing%20to%20start%20at,The%202024%20Volkswagen%20ID.

New Flyer Bus (Winnipeg) Their Xcelsior battery electric bus starts at 35 ft (32 seats), which may be too large for Cobourg's requirements.[30]

Karsan eJEST (St. John, NB) leases 6 20 ft E-buses for an on-demand pilot and they aim to have a fully electric fleet by 2040.[31]

[30] https://www.newflyer.com/bus/xcelsior-charge-ng/

[31] Electric Autonomy. City of Saint John leases six electric buses to launch on-demand transit service. https://electricautonomy.ca/2022/07/05/saint-john-electric-buses-on-demand-transit/

Metrolinx Transit Procurement Initiative (TPI) of which Cobourg is a member. https://blog.metrolinx.com/2022/04/26/moving-towards-a-future-with-battery-electric-bus-transit-fleets-across-ontario/. If Cobourg were to move ahead with ZEBus program, it would make sense to use Metrolinx's TPI program, assuming they could provide Cobourg with a bus that meets our requirements; that is a smaller version (e.g. shuttle bus size) suitable for our on-demand program.

Incentives and Funding Available

Investigate the possibility of requesting funding from Infrastructure's **Zero Emission Transit Fund (ZETF)** https://www.infrastructure.gc.ca/zero-emissions-trans-zero-emissions/index-eng.html

Join with other municipalities to share knowledge on net zero fleet adoption.

Besides the Metrolinx connection that Cobourg has joined, there is also a network of municipalities small and large working together in southern Ontario. Municipalities in the Golden Horseshoe and environs have banded together into an organization called the **Clean Air Council [CAC].** **https://cleanairpartnership.org/cac/**

Locally, the County of Northumberland is a member. The Secretariat for the CAC, the **Clean Air Partnership [CAP]** provides workshops and research materials for municipalities to share their experiences working on environmental initiatives specifically GHG reduction measures and climate change adaptation. Membership is based on population and for the County of Northumberland (population 85,500)it was $1,400.

Appendix B contains a policy document from the Clean Air Partnership on Green Fleets that provides a net zero fleets model for adoption by municipalities on how to implement a Net-Zero or 'Green' Fleet in their municipality that covers procurement policy and roles and responsibilities.

8. Recommendations

1. Join the Clean Air Council. https://cleanairpartnership.org/cac/ The Clean Air Council's secretariat, the Clean Air Partnership has worked to provide information from experts in numerous seminars and in research reports for over 20 years. The cost to join is less than $1,000/yr. The Clean Air Partnership is a wealth of knowledge for staff on all topics of municipal energy management and community sustainability. It has a high record of responding to the needs of individual municipalities upon request. The Clean Air Council is a forum for local Council members to inform upper levels of government of concerns on environmental and energy issues and finding funds for municipal pilot projects.

2. Begin a pilot project(referenced above) to start electrifying the Town of Cobourg fleet vehicles beginning with the vehicles most easily replaced such as passenger sedans, SUVs and pick up trucks.

3. Pursue all funding programs for BEVs and Charging options for municipal fleet electrification See Alberta (as an example) https://mccac.ca/programs/electric-vehicles-for-municipalities-program/

4. Direct staff to develop an aggressive policy plan supported and led by the new procurement department to deploy BEVs across the Town's fleets. **See Model Green Fleets Policy template below - Appendix B .**[32]

5. Place orders in advance for BEVs after detailed analysis is completed in order to have vehicles in the pipeline.

[32] https://www.cleanairpartnership.org/caps-releases-green-fleets-support-package/

Appendix A

Hydrogen as a fuel for powering road vehicles has two possible paths in how it is used to propel the vehicle:

- fuel cell to electricity, or;
- direct combustion in a conventional piston engine.

In a FCEV, hydrogen is consumed in a fuel cell to generate electricity. By combining the high energy density of hydrogen with the reasonably good efficiency of a fuel cell, the economics of using hydrogen are potentially cost competitive with conventional gasoline or diesel fuels. Fuel cell technologies have seen significant technical development over the last 50 years and are presently available in a few types of commercially produced vehicles, such as cars, buses and forklifts. Due to the very different duties required of them, FCEVs for private passenger vehicles and hydrogen powered larger vehicles such as buses and commercial trucks have very different market status in terms of products available.

Hydrogen can also be used directly as a combustible fuel in a piston engine or gas turbine. Although this is technically feasible and has been previously demonstrated, the efficiency of the hydrogen fueled engines and the cost of hydrogen make it commercially unviable. At this time, there are no commercially available vehicles that use hydrogen as a fuel with a conventional piston engine.

Properties of Hydrogen as a Fuel

The property of hydrogen that makes it useful as a fuel for vehicles is it's relatively high energy density when stored as a high pressure gas. Hydrogen can also be stored as a cryogenic (extremely cold) liquid, but that is not possible in vehicles applications due to the necessary continuous venting of hydrogen vapors with cryogenic storage.

What are the sources of and environmental impacts of hydrogen?

There is no natural source of H_2, all hydrogen must be produced. Any greenhouse gas emissions associated with hydrogen come from its production:

- All methods to produce hydrogen require an input of energy, either electricity or heat – there is no freely available hydrogen on earth.
- Hydrogen can be refined from several sources:
- Hydrogen refined from natural gas (CH_4), coal or oil creates CO_2, the main greenhouse gas. This CO_2 if not sequestered, contributes to global warming and therefore this method does not resolve the climate change challenge unless the CO_2 is sequestered somewhere, usually underground.
- Hydrogen produced from the electrolysis of water (H_2O) involves applying an electric current to water to separate the hydrogen and oxygen molecules. This process does not create any direct CO_2 emissions as long as the energy to power the electrolysis comes from a zero greenhouse gas energy source such as wind, solar, hydro or nuclear power. If the electricity used for electrolysis is from fossil fuel based electricity generation, then the hydrogen production has greenhouse gas emissions associated with it, and thus does not contribute to reducing or eliminating greenhouse gas emissions.

Current production of hydrogen:

World Hydrogen Production by method:

- 48% steam reformation of Natural Gas (CH_4)
- 30% petroleum fraction
- 18% coal gasification
- 4% electrolysis (only this method may have zero greenhouse emissions)

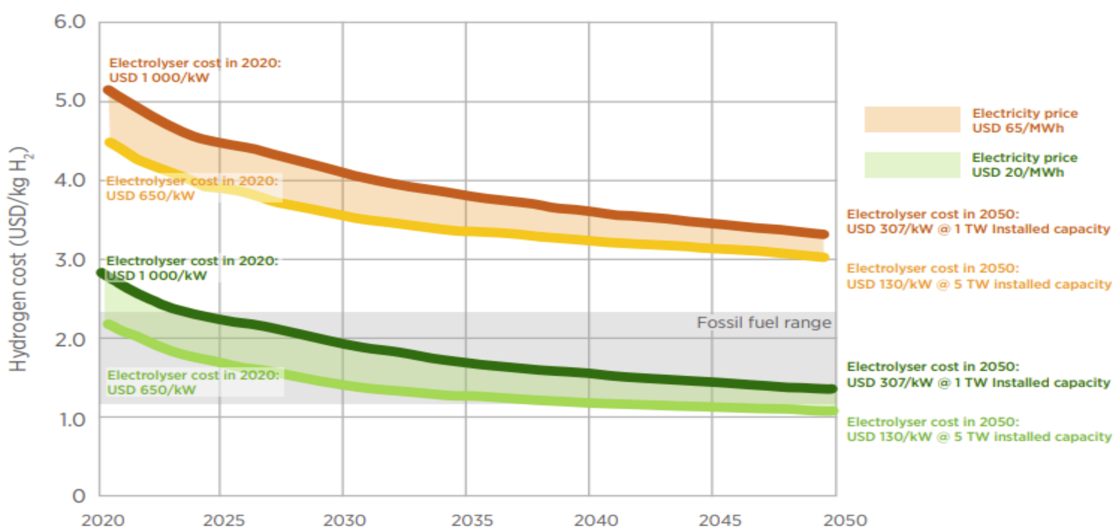
Worldwide total production:

- 115 million Tons / year (2020)
- Worldwide hydrogen production is responsible for emissions of 830 MT of GHG/year

The above shows that although hydrogen as a fuel has the promise of being a low to zero greenhouse gas energy source, at present, most of the hydrogen is made from fossil fuels.

Hydrogen is referred to by various “colours”, with each colour reflecting the process by which the hydrogen is produced. “Green” hydrogen is produced form electrical energy sources that do not have associated greenhouse gas emissions, such as renewable energy sources and nuclear generated electricity. Only “Green” hydrogen is free from greenhouse gas contributions. “Blue”, “Brown” and “Black” hydrogen refers to hydrogen produced from fossil fuels, but in the case of “Blue” hydrogen, the CO_2 emissions are sequestered in some manner such as underground, undersea or chemical conversion storage. Blue hydrogen can be part of a zero carbon economy, but the sequestration of the CO_2 emissions has a cost and this method of hydrogen production will be competing with Green hydrogen made form zero carbon sources.

Figure ES2. Cost of green hydrogen production as a function of electrolyser deployment, using an average (USD 65/MWh) and a low (USD 20/MWh) electricity price, constant over the period 2020-2050.



Note: Efficiency at nominal capacity is 65%, with a LHV of 51.2 kilowatt hour/kilogramme of hydrogen (kWh/kg H2) in 2020 and 76% (at an LHV of 43.8 kWh/kg H2) in 2050, a discount rate of 8% and a stack lifetime of 80 000 hours. The electrolyser investment cost for 2020 is USD 650-1000/kW. Electrolyser costs reach USD 130-307/kW as a result of 1-5 TW of capacity deployed by 2050.

- Grey and Black hydrogen is roughly comparable in cost to gasoline and diesel fuels for powering passenger and commercial vehicles.
- As reported by the Commissioner of the Environment and Sustainable Development to the Parliament of Canada, Green hydrogen is very expensive compared to other energy sources.

- Carbon taxes and/or other carbon-based costs could improve cost competitiveness of low carbon Green hydrogen, these have yet to be realized.
- Significant cost reductions are projected as electrolyze costs decline if they are deployed at high volumes and electricity prices can be lowered.

Properties of hydrogen as a fuel:

Density – hydrogen as a gas

- At normal atmospheric pressure and temperature, it is an extremely low-density gas
- 0.09 kg/m^3 (gas)
- Compare this to air density of 1.2 kg/m^3
- Water at 1000 kg/m^3
- The lightest gas. Extremely buoyant, fast to disperse.

Pressurized Storage:

- To store useful amounts of hydrogen to power a vehicle, hydrogen needs to be in pressure vessels with a capacity of 5,000 psi to 10,000 psi rating (350 to 700 Bar).
- At 10,000 psi (700 Bar) hydrogen has a density of 40 kg/m^3
- For large volume (1,000's of liters) storage in stationary applications, highly insulated tanks are used with liquid hydrogen, or the pressure would be too high to cost effectively manage.

Energy density as a high-pressure gas in vehicle applications:

- 120 MJ/kg, approx. three times as much energy per kg as gasoline or diesel
- BUT – high pressure hydrogen (5000 psi) has an energy density of 5 MJ/L whereas gasoline has a density of 32 MJ/L, as a result, hydrogen as a high-pressure gas requires a 6 times larger storage vessel for the same energy.

7/ Other uses of Hydrogen:

Hydrogen has many uses, only one of which is as a fuel to power vehicles.

As a Fuel:

- Combustion or heat
- Spark ignition engines
- Gas turbines
- Fuel cells to electricity – to power electric vehicles
- Rockets

As a feedstock:

- Fertilizer
- Non oxidizing atmosphere
- Plastics production
- Metallurgy

Because of the many uses of hydrogen, and because it can be produced using renewable or other zero carbon energy, it is seen as one of many energy sources as the world transitions to low and eventually zero carbon emissions.

https://www.cpr.ca/en/search?k=hydrogen CP Rail with H2 0EL (DK)

https://electricautonomy.ca/2022/03/02/cp-cn-zero-emission-locomotives/ CP with hydrogen; CN with battery elec. locomotive (DK)

Appendix B

The Complete Green Fleet Policy Model Template [33]

1. **STATEMENT**

[A statement of what this policy seeks to achieve.]

The City/Town of _______________ is committed to continuously improve the social and environmental impacts of its procurement of Goods and Services in a transparent and accountable way that balances fiscal responsibility, social equity and environmental stewardship.

Or

The City/Town of _______________is committed to advance the protection of the environment and support sustainable development by integrating environmental performance considerations into the procurement decision-making process.

2. **PURPOSE**

[Set up a goal that is aligned with Climate Municipal GHG emissions reductions and Action/Mitigation/Adaptation/Resilient Plans]

The purpose of this policy is to document the process for purchasing and managing the City's diverse vehicle fleet, which includes both vehicles and heavy equipment, in a manner that minimizes greenhouse gas emissions and considers life-cycle economics.

The municipality is committed to greenhouse gas reduction initiatives and has a stated numeric goal of an ____ _ % reduction in greenhouse gas emissions by the year _____.

3. **SCOPE**

[Define the boundaries of the policy and the alignment with existing Procurement Policy]

This policy applies to the procurement of all Goods and Services required by the City.

This policy supplements the ____________________ Bylaw and __________________ Policy/Principals.

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[33] Green Fleets Policy support. Clean Air Partnership Jan.14,2021
https://www.cleanairpartnership.org/caps-releases-green-fleets-support-package/

4. DEFINITIONS

- Employee: An individual who is employed (full-time, part-time, temporary, permanent) by the City/Town
- Buyer: The individual designated by City's/Town's Revenue & Materiel Management Division to undertake all activities necessary for the procurement of goods, works, or services
- Contract Manager: A City/Town employee who has been authorized and assigned the

responsibility of overseeing a particular bid or contract

- Environmental Specialist: City staff with environmental expertise who monitor the impact of the municipality on the environment and the community, identifying environmental issues and recommending solutions
- Goods: Tangible and intangible items, including but not limited to supplies, materials, equipment and licenses
- Services: Actions that support work done, including but not limited to labour, construction, maintenance and professional and consulting services
- Sustainable Procurement: The acquisition of products and services with the lowest environmental impact and most positive social results. It captures the full cycle from manufacturing, supply chain, distribution, retailer, to customer. It considers total costs (e.g. purchase, operating/maintenance, disposal or recycling costs) and supports 'Best Value' procurement)
- Low Emission Vehicle and Zero Emission Vehicle: Electric and hydrogen-fuel-cell vehicles that have zero harmful tailpipe emissions

5. ROLES AND RESPONSIBILITIES

a) Division Finance/Corporate Services Management

- Ensure the maintenance and administration of the policy by:
    - Amending forms and templates for proposals, quotations and tenders to reference the Green Procurement Policy

- o Ensuring all applicable managers/supervisors are aware of this policy and any subsequent revisions
- o Program performance, including managing program planning and resourcing
- o Ensuring that precise specifications are provided for the procurement process

· Monitoring and evaluating performance metrics

· Reporting to Council and the public on Sustainable Procurement progress annually for three years from the effective date of this policy and regularly after that

b) Purchasing and Materials Management Division

· Executing this policy and supporting procedures

· Assisting client departments to incorporate life cycle costing factors within the specification requirements for the good or service being procured

· Ensuring applicable staff are aware of this policy and any subsequent revisions

· Providing training, as requested

· Recommending resourcing

· Coordinating implementation of Sustainable Procurement activities

c) Managers/Supervisors

· Ensuring staff comply with this policy

d) Buyers

· Complying with this policy and supporting procedures

· Coordinating market analysis and research

· Applying best practice procurement tools

e) Departamental/ All Employees

· All departments and all staff are required to comply with the Green Procurement Policy when making all procurement decisions

- All departments and all staff are encouraged to identifying opportunities and risks for sustainability procurement, recommending specifications, and engaging in the total cost of ownership analysis

f) Contract Managers

- Monitoring supplier performance and ensuring sustainability compliance

g) Environmental Specialists

- Communicate and recommending specifications with applicable environmental legislative requirements in the procurement of goods and services

- Engaging in risk and opportunity analysis

6. FLEET PROCUREMENT PRINCIPLES

a) Transparency

- Increase consistency and transparency in green procurement reporting requirements for all departments by publicly reporting on implementation progress

- Inform suppliers and other impacted stakeholders about sustainable fleet procurement methods and decision making

b) Education and Training

- Ensuring staff have the resources needed, including training and funding, to support the implementation and ongoing application of this policy

c) Consider Whole-of- life-costing

Whole-life cost is the total cost of ownership over an asset's life and the life-cycle benefits and impacts on society, the environment and the economy resulting from procurement activities. Including, but not limited to:

- Ownership costs
- Vehicle administration costs
- Fuel costs
- Maintenance costs

· Total cost of ownership

· GHG reductions – Life-cycle assessment

· Charging/Fuel infrastructure costs

d) Sustainability partnerships

· Mobilizing regional approach to Sustainable Procurement in shared supply chains

· Actively participating with the existing coalitions, collaborations, partners to stay abreast of new innovative ideas and be willing to utilize City vehicles to demonstrate promising technologies

· Encourage and support suppliers to continually improve their sustainability practices and outcomes, and the sustainability impacts of their Goods and Services and supply chain, where possible and appropriate

· Integrate knowledge from other leading organizations and share best practices broadly

7. **FLEET PROCUREMENT PRACTICES**

a) Low Emission and Zero Emission Vehicle (ZEV) acquisitions

· Purchase vehicles based on the actual type of use and need of a particular position classification based upon an established vehicle standard with an emphasis on purchasing units offering the greatest fuel economy and lowest GHG emissions in its respective class, as well as alternative fuels and ZEV's

· Increasing ZEVs in the City's fleet across all vehicle and equipment categories as follows:

- o A minimum commitment for ____% of annual light-duty Fleet purchases to be ZEV by ____ year and __% of annual light-duty Fleet purchases to be ZEV by ____ year
- o A commitment to test, evaluate, and, where feasible, acquire ZEVs for medium- and heavy-duty vehicle and equipment categories

· Establishing a "ZEV First" commitment for vehicles and equipment, requiring the procurement of battery-electric, hydrogen fuel-cell, or other ZEV types that emit no tailpipe emissions from the onboard source of power, as follows:

- o Procurement: Fleet Services is authorized to procure ZEVs for vehicle replacements when a suitable ZEV option is identified with equivalent operational capacity. ZEV purchases shall be prioritized over comparable vehicles powered by internal combustion engines utilizing fossil fuels and flex-fuel or bi-fuel vehicles powered by petroleum-based fuels and other alternative fuels, such as ethanol

- o Continue to expand the use of vehicles using Compressed Natural Gas (CNG), Biodiesel or other available clean fuel sources for trucks and heavy equipment where ZEV's are not yet a viable option

b) Environmental, Social, and Ethical aspects of purchasing

· Seeking suppliers that have leading sustainability practices in their governance, supply

· chain or operations

· Seeking suppliers that use reduced materials and waste, maximizing energy efficiency, and reduce GHG emissions

· Seeking suppliers that demonstrate best practices in workplace diversity, inclusion and accessibility

· Seeking suppliers that exhibit fair labour practices and respect human rights

8. **PROCUREMENT ALTERNATIVES**

· Reduce fleet size by removing under-utilized units, reviewing annually, from the fleet or through reassignment in place of additional units

· Consider possible alternatives to buying new Goods, including reuse, sharing between divisions, refurbishing, appropriate order quantity, leasing rather than buying

· Actively seek grants, rebates, and other financial incentives and funding opportunities to use in implementing new technology into the Fleet

· Identify opportunities and the financial resources needed to replace older fleet equipment with certified low emission equipment

· Enhance Fleet Management systems and implement new technology to reduce fossil fuel consumption and "right-sizing" the City fleet

9. MONITORING AND REPORTING

[The ideal sustainable/green procurement policy should evolve and develop over time. Once the green fleet procurement policy is created, evaluate it annually and measure your progress against planned milestones. Then, revise as needed.]

a) Measure and track when the policy is being applied and the outcomes and impacts of Sustainable Procurement

b) Publicly report on implementation progress

c) Each fiscal year Fleet Management shall:

· Prepare an annual replacement budget, including the cost of ZEVs suitable for replacing existing gas vehicles

· Include a report of any other actions taken to support or enhance the City's Fleet Sustainability Procurement

10. APPENDIX

A. Green/Sustainable Procurement Examples and Guidelines

- Town of Oakville - Sustainable Purchasing Procedure
- City of Mississauga - Sustainable Procurement
- The University of Vermont – Fleet Vehicle Procurement Procedure
- Australian Government, Environment and Energy - Sustainable Procurement Guide
- Government of Ireland – Green Procurement: Guidance for the Public Sector