ChargeIt

City of Sault Ste. Marie Community Electric Vehicle Charging Infrastructure Plan

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List of Acronyms

BEV – Battery Electric Vehicle

CAP – Clean Air Partnership

ChargeIt - Community Charging Infrastructure Plan

CCR – Capital Cost Recovery

EV – Electric Vehicle

EVAFIDI – Electric Vehicle and Alternative Fuel Infrastructure Deployment Initiative

EVCS - Electric Vehicle Charging Systems

FCEV - Hydrogen fuel cell electric vehicles

FSA – Forward Sortation Area

GHG – Greenhouse Gas

GDS – Green Development Standard

ICEV – Internal Combustion Engine Vehicle

iZEV - Incentives for Zero-Emission Vehicles

LDC – Local Distribution Company

MRSP – Manufacturer Suggested Retail Price

MRSP – Manufacturers Suggested Retail Price

MTO – Ministry of Transportation of Ontario

MURB - Multi-Unit Residential Building

NRCan – Natural Resources Canada

OBC – Ontario Building Code

OEB – Ontario Energy Board

OPG – Ontario Power Generation

PHEV – Plug-In Hybrid Electric Vehicle

SUV – Sports Utility Vehicle

TCO – Total Cost of Ownership

ZEV – Zero Emission Vehicle

ZEVIP - Zero Emission Infrastructure Program

Executive Summary

At the June 13, 2022, Council meeting, Sault Ste. Marie City Council passed a resolution (see Appendix 1) directing staff to develop a community electric vehicle (EV) charging infrastructure plan to be presented to Council for consideration to support the advancement of local policies to accelerate the deployment of charging infrastructure in the community. The resolution also directed staff to include possible changes to local building codes to ensure EV readiness/inclusion in future commercial, industrial, and residential development within the municipality of Sault Ste. Marie. The resolution aligns with the *Sault Ste. Marie Community Greenhouse Gas (GHG) Reduction Plan: 2020 – 2030* (GHG Reduction Plan) that targets net zero emissions by 2050. Transportation accounted for 38% of community GHGs in 2017, making this the highest source of community emissions, excluding industry (Future SSM, 2020). Increasing opportunities to encourage the adoption of EVs is one of many steps that the City of Sault Ste. Marie (the City) must consider to meet its goal of net zero emissions by 2050.

The *Sault Ste. Marie Community Charging Infrastructure Plan* (ChargeIt) focuses on actions to increase opportunities for passenger light duty vehicle charging infrastructure for personal vehicles[1]. The plan offers an overview of municipal best practices to enable and accelerate deployment of public EV charging infrastructure. It is important to note that this plan does not address specific actions for corporate fleet electrification or transit, which are being addressed already by the City.

ChargeIt identifies thirteen (13) actions, which are broken down into three (3) objectives including: 1. Charging Availability, 2. Education & Advocacy and 3. Municipal Leadership & Governance to help the City accelerate the deployment of public EV charging infrastructure in the community. Nine (9) actions identified in this plan are already underway, and this report will serve as a roadmap to ensure that their implementation is prioritized. ChargeIt addresses a variety of elements including zoning, planning, and building codes. It also includes information on funding programs (Provincial and Federal) that are available and that are being pursued by the City and the PUC to increase charging infrastructure availability in Sault Ste. Marie. The ChargeeIt is one of many initiatives that will be used to inform and guide the City's approach to sustainable transportation. The City has a wide range of other transportation and land use policies, programs and infrastructure initiatives that are either in use or in the planning stage to increase the use of more sustainable transportation modes (e.g., walking, cycling, or public transit). The City recognizes that active transportation and public transit must also continue to be prioritized through the development of the *Active Transportation Master Plan,* and transit electrification. The Sault Ste. Marie Parking Review Project is also considering EV parking infrastructure. These tools, in addition to supporting electric mobility, are part of the holistic approach required to reduce the community transportation carbon footprint.

In order to be successful, efforts to advance charging infrastructure availability must become an integral part of the planning process for new developments in the City. This can be facilitated through methods such as ensuring that new developments are equipped with the necessary panel and conduit to accommodate charging infrastructure. As well, establishing a green development standard to be applied to new development and redevelopment is strongly encouraged. A united approach across all City departments and community stakeholders will be required to ensure that this plan is implemented. This plan should be viewed as a living document and will evolve over time as technologies, funding and regulation regarding public charging infrastructure changes.

[1] Light duty personal vehicles include cars, vans, trucks, and for personal and shared use.

Background

Transportation is the largest contributor to Ontario's GHG emissions, accounting for 36% in 2019 (Government of Ontario, 2022a). This aligns with emissions from transportation in Sault Ste. Marie that accounted for 38% of community emissions (less industrial) in 2017 (Future SSM, 2020). Most Sault Ste. Marie transportation emissions come from the mobile combustion of gasoline and diesel fuel due to heavy reliance on personal vehicles with combustion engines. Despite this heavy dependance on fossil fuels, the global market for EVs is growing. There are more options available for purchase than ever before, incentives and increasing availability of charging infrastructure. When it comes to increasing opportunities associated with zero-emission vehicles (ZEV), there are two important elements that need to be considered for increasing adoption. First is the vehicle itself, and second is the charging infrastructure (Transport Canada, 2020). There are three types of ZEVs available on the market in Canada. They are:

1. **Battery electric vehicles (BEVs):** which are powered by electric motors that draw electricity from on-board storage batteries and are charged by plugging the vehicle into a plug-in to charge;
2. **Plug-in-hybrid electric vehicles (PHEV):** which use both an on-board motor and a small internal combustion engine; and,
3. **Hydrogen fuel cell electric vehicles (FCEV):** which use a fuel cell to create on-board electricity, generally using compressed hydrogen and oxygen from the air to power the vehicle[2].

Please note that addressing opportunities for increasing public charging infrastructure for FCEVs is outside the scope of this plan. For PHEVs and BEVs there are three common types of charging infrastructure that can be used. They are outlined in more detail below, along with the estimated cost, range per hour, power usage and typical use locations.

Table 1: EV Charging Infrastructure Types[3]

	Level 1 (AC)	Level 2 (AC)	Level 3 or Direct Current Fast Charger (DCFC)
Typical Output	1.5 kW (120 Volts)	7.2 kW (240 Volts)	50 kW – 350 kW (400 – 800 Volts)
Range Added per Hour (approximate)	8 km	40 km	300 + km
Equipment and installation costs	$150 - $1,500	$5,000 - $10,000	$50,000 - $200,000
Typical use locations	Some homes, workplaces, public spaces	Homes, workplaces, public spaces	Major corridors, public spaces
Used by	BEV and PHEV	BEV and PHEV	Primarily BEVs

As of September 2023, there were 135,000 EVs registered in Ontario, and over 2,900 public charging stations with over 7,900 charging ports, including 6,600 Level 2 ports and 1,300 Level 3 fast charging ports (Government of Ontario, 2023a). By 2030, one out of every three

[2] EVgo Fast Charging. *Types of Ev Vehicles.* Retrieved from: https://www.evgo.com/ev-drivers/types-of-evs/
[3] E.B. Horsman & Son. *What's the Difference Between Level 1, 2 and 3 EV Chargers in Canada?* Retrieved from https://ebhorsman.com/industry-trends/ev-chargers-levels/

automobiles sold will be electric and there are expected to be over one million EVs on the road in Ontario (Government of Ontario, 2022a). This growth in EVs aligns with the Government of Canada announcement in 2021 to require 100% of car and passenger truck sales be zero-emission by 2035 in Canada (Government of Canada, 2021).

EVs can be incorporated into urban environments in ways that internal combustion engine vehicles (ICEVs) cannot. They can be charged at home, at work, or even while running errands. EV infrastructure can also be strategically located so that it ensures a continued shift to walking, cycling and using public transit, aligning it to active transportation objectives. The next section of this report will provide an overview on the EV and charger landscape in Sault Ste. Marie

Sault Ste. Marie Public EV Charger Landscape Assessment

To properly plan for increased charging infrastructure, it is important to understand uptake of EVs in Sault Ste. Marie. Through an agreement with the Ontario Ministry of Transportation (MTO), the Clean Air Partnership (CAP) secured vehicle registration data for all registered vehicles in Ontario from 2016 to 2020. This allows municipalities to examine the market penetration of Evs and PHEVs vehicles in their communities. The dataset provides the actual number of vehicle registrations in a given year and includes all on-road vehicles (both passenger and freight). Off-road and farm vehicles are not included. Fuel types have been categorized based on the make and model of the vehicle into six categories (gas, diesel, compressed natural gas, propane, plugin hybrid, and electric). Non-plugin hybrid vehicles are counted based on the primary fuel source (gas or diesel). The details for vehicles in Sault Ste. Marie from 2016 to 2020 are noted below.

Table 2: Total Registered Vehicles in Sault Ste. Marie 2016 - 2020[4]

Fuel Type	2016	2017	2018	2019	2020
Compressed Natural Gas	3	3	3	3	2
Diesel	2,048	1,987	1,991	20,88	2,069
Electric	5	6	15	19	23
Gas	52,176	51,729	51,930	51,874	52,036
Plugin Hybrid	5	12	17	16	19
Propane	13	11	10	9	12

In addition to the above, in Sault Ste. Marie, as of October 23, 2023, there were 187 electric vehicles registered in the community (per the Ontario Government Open Data Catalogue which lists total EVs by forward sortation area (FSA) (the first three characters of the postal code of the vehicles registered address). 103 are BEVs, and 84 were PHEVs vehicles (Government of Ontario, 2023). In comparison to the 52,036 registered ICEVs in 2020, BEVs equate to approximately 0.2% of the Sault Ste. Marie personal vehicle market.

Registration for EVs is slowly increasing; however, gasoline vehicles still make up most registrations. That being said, given government incentives for EVs, greater market availability and the 2035 federal government mandate for all new light duty vehicles sales to be zero

[4] Clean Air Partnership. (2023). *Registered vehicles by municipality dataset – Ontario – 2016-2020.* Retrieved from: https://www.cleanairpartnership.org/projects/electric-vehicle-proliferation-by-municipality-2016-2020-data-now-available/

emission, more infrastructure will support the need for greater EV adoption in Sault Ste. Marie and the community's net zero emission reduction goals.

From a public charging infrastructure standpoint, as of October 2023, there were thirteen (13) EV charging stations in Sault Ste. Marie. Most chargers are located at gas stations, hotels and car dealers. The location of the station, number of plugs and type are listed below.

Table 3: Sault Ste. Marie Public Charging Stations (as of October 23, 2023)

Line No	Site	Address	Charger Type
1	Maitland Ford Lincoln Sales	1124 Great Northern Road, Sault Ste. Marie, ON, P6A 5K7	1 plug J-1772
2	Prouse Chevrolet Buick GMC Cadillac	851 Great Northern Rd, Sault Ste. Marie, ON, P6A 5K7 (2 plugs:	1 wall, 1 J-1772
3	Northside Volkswagen,	878 Great Northern Road, Sault Ste. Marie, ON, P6B 0B7	2 plugs J-1772
4	Northside Volkswagen	851 Great Northern Road, Sault Ste. Marie, ON, P6A 5K7	3 plugs: 2 J-1772, 1 CCS/SAE
5	Sault Ste. Marie Supercharger	360 Great Northern Rd, P6B 4Z7	6 Tesla Supercharger Plugs
6	Shell Sault Ste. Marie Shell	386 Great Northern Rd., P6B 4ZY	4 plugs: 2 CHAdeMO, 2 CCS/SAE
7	Highland Ford	68 Great Northern Rd, Sault Ste. Marie, On, P6B 4Y8	1 plug J-1772
8	Superior Nissan	460 Pim St, Sault Ste. Marie, On, P6B 2V2	1 plug J-1772
9	Great Lakes Honda	423 Pim St, Sault Ste. Marie, ON, P6B 2T9	1 plug J-1772
10	Holiday Inn Express	320 Bay St, Sault Ste. Marie, ON, P6A 1X1	1 plug CCS/SAE
11	Delta Hotel	208 St. Mary's River Drive, Sault Ste. Marie, ON, P6A 5V4	1 plug J-1772
12	Sault Ste. Marie Canal National Historic Site	1 Canal Drive, Sault Ste. Marie, ON, P6A 6W4	4 plugs: 2 Tesla, 2 J-1772
13	Petro-Canada Sault Ste. Marie	713 Trunk Rd, Sault Ste. Marie, ON, P6A 3T2	4 plugs: 2 CCS/SAE, 2 CHAdeMO

This is a good start; however, greater accessibility to key community assets (e.g., community centres, gathering places), and connecting nodes (e.g., Downtown) are recommended as seen in other communities that are further along in their EV charging infrastructure journey.

The next section of this report will highlight some of the key opportunities and challenges for EV charging infrastructure adoption in the municipal space in Ontario.

Analysis

The energy humans use to transport themselves and the goods and services they consume generate GHG emissions. Anthropogenic (human caused) emissions from the burning of fossil fuels are the primary cause of climate change. The effects of climate change are “impacting both human natural systems” (Government of Canada, 2018).

GHGs come from a variety of sectors, but as this report previously mentions, transportation accounts for an increasing portion. All levels of government are critical in ensuring more resources are allocated to the most sustainable transportation opportunities within communities. Local governments with their influence over land use, new developments and transportation services and decisions are particularly critical in helping to ensure local communities advance EV charging infrastructure (Clean Air Partnership, 2021a). The next section of this report outlines the opportunities and challenges associated to advancing community charging infrastructure.

Opportunities for Municipalities to Encourage EV Charging Infrastructure

This section of the report outlines four (4) key opportunities associated to the deployment of more EV charging infrastructure, including reducing GHGs, municipality authority, economic and equity.

1. Reducing GHGs

EVs produce less GHGs than ICEV equivalents because they run off either just electricity or a combination of electricity and fossil fuels (e.g. PHEVs). Electricity produces lower emissions than gasoline or diesel. Ontario’s electricity grid is relatively clean with 89.8% of energy supplied by nuclear, hydropower, wind and renewables (Ontario Energy Board, 2022). In addition, when you evaluate the lifecycle emissions, meaning the total amount of GHGs emitted through a products existence, including its production, use and disposal, BEVs have the lowest life cycle emissions in comparison to both PHEV and ICE vehicles (Oğuz, 2023). Many municipalities have adopted net zero by 2050 emission reduction targets, including the City of Sault Ste. Marie. Encouraging the adoption and use of EVs through increased infrastructure will help the City in meeting this target.

2. Municipal Authority

Municipal governments are created under provincial statute, which allows them to govern over matters of local jurisdiction. In Ontario, municipalities can make by-laws under the *Municipal Act* (s 11(2)) relating to matters of health, safety, and environmental well-being, including respecting climate change. There are a few mechanisms that municipalities can leverage in advancing EV Ready requirements, including:

- Planning Act and Site Plan Authorities (with EV Ready being advanced via Green Standards);
- Parking Requirements/Zoning By-laws; and
- Climate Change By-law Authorities (Clean Air Partnership, 2021a).

The Sault Ste. Marie *GHG Reduction Plan* recommends the City develop a *Green Building Policy* to incentivize new developments go above and beyond the Ontario Building Code (OBC). Having a green building policy or standard can help advance EV ready requirements. In addition

to this there is a growing trend towards municipalities eliminating or reducing parking minimums, and often times as part of zoning amendments municipalities will require a certain percent of parking spaces to be EV ready. The Sault Ste. Marie Parking Review Project is considering EV parking infrastructure as part of its scope. Though Ontario has no provincial EV-ready bylaws, many municipalities are looking at creating regulations or by-laws to encourage EVs. A few examples are listed below:

1. **City of Cambridge:** On April 11, 2023, the City of Cambridge voted to look at creating a new regulation that would require all new development, retail locations and city parking lots to have a designated number (or percentage) of EV charging stations (City of Cambridge, 2023).

2. **City of Hamilton:** City staff have been asked by the city council to examine how to incorporate requirements for EV charging stations through the parking requirement by-laws in new developments (Electric Autonomy, n.d.)

3. **City of Kitchener:** Zoning bylaw 2019-051 was amended on March 21, 2022. It requires a minimum of 20% of parking spaces required for multiple dwellings to be EV-ready. Additionally, for non-residential buildings and care facilities, 17.5% of parking spaces must be EV-ready (City of Kitchener, n.d.)

4. **City of Mississauga:** A corporate report to amend Mississauga's Zoning By-law 0225-2007 was presented on March 2022 by the City's commissioner of planning and building to the chair and members of the planning and development committee. The report includes recommendations that would introduce EV-ready parking requirements to the city (Electric Autonomy, n.d.)

5. **City of Toronto:** According to the Zoning Bylaw 569-2013, which was amended in December 2021 and the Toronto Green Standard version 4 performance standards for EV Infrastructure, which came into effect in May 2022, all residential parking spaces provided for dwelling units located in an apartment building, mixed-use building, and multiple dwelling unit building, but excluding visitor parking, must include an energized outlet capable of providing Level 2 charging or higher to the parking space (City of Toronto, n.d.)

6. **City of Waterloo:** Zoning bylaw 2018-050 was amended on September 21, 2020. It requires all structured parking spaces for apartments, multi-unit residential buildings (MURBs), mixed-use and non-residential buildings built after January 1, 2021, to be EV-ready (Electric Autonomy, n.d)

7. **Town of Ajax:** In April 2022, Ajax approved a sustainable building framework, the Green Development and Environmental Design Guidelines (GDEDG). It applies to new development and redevelopment. As part of the GDEDG, all mid- to high-density residential and non-residential buildings with over 20 parking spots must ensure half of their parking spaces have EV charging stations or are EV-ready. If a building has less than 20 parking spaces, 10% of the total spots must be EV-ready (Town of Ajax, 2022).

8. **Town of Whitby:** In 2020, Whitby developed "Green Standard" guidelines to encourage sustainability in new developments. While the guidelines are not mandatory building standards, as they exceed requirements under the Ontario Building Code and Provincial Planning Act, they suggest that residential and non-residential buildings that are four storeys or taller should make 20% of their parking stalls EV-ready (Electric Autonomy, n.d.).

3. Economic

There are a variety of economic opportunities associated to the adoption of EVs. Firstly, EVs present lifecycle cost saving opportunities. The fuel cost to charge an EV at home in Ontario is equivalent to roughly $0.20 per litre gasoline and maintenance costs are about half of gasoline vehicles (Clean Air Partnership, 2021a). In addition, they don't idle, are quieter and accelerate faster. As well, retrofitting existing buildings to allow for charging infrastructure can be costly and time consuming. As such, it is the most cost-effective to advance EV infrastructure at the time of construction.

Installation of an EV charging network can also bring additional benefits to a region including increasing economic development opportunities for local businesses, and enhancing tourism experiences. Municipalities have opportunities to encourage EV adoption through initiatives such as creating EV charging standards in areas such as permitting for new commercial and residential developments, rethinking transit fleets, investing in the electricity infrastructure and approving design changes to retrofit existing facilities (Clean Air Partnership, 2021a).

4. Equity

As EV adoption continues to grow, so will the need for charging infrastructure. The provision of publicly available EV charging infrastructure will offset the cost of EV ownership by increasing access for households with limited ability to install on-site charging or who have less access to on-site dedicated parking opportunities, which will help with affordability (Clean Air Partnership, 2021a).

Challenges

This section of the report outlines four (4) key challenges associated to the deployment of more EV charging infrastructure including access, cost, electricity load management and utility deposit concerns and awareness.

1. Access to Charging Infrastructure

As previously mentioned, Sault Ste. Marie currently has thirteen (13) public charging stations. This is a start, but more are needed to serve future EV needs of the community. Simliarly to lack of chargers, low visibility of charging stations is also an issue. It is important to consider adequate signage for future infrastructure to help EV owners. Also, though many organizations and spaces are open to the idea of incorporating public charging stations, it can be challenging to retrofit existing assets (e.g., parking lots) to accommodate public charging stations. Issues could include space, power supply issues and of course cost. Planning for new buildings to include or at least be able to accommodate charging stations will be a critical element of this plan.

2. Cost

Up Front Cost

It is a common understanding that EVs are more expensive than ICEs, and this can often act as a deterrent to consumers. As part of this report, a comparative analysis was conducted between a sample of six BEVs compared to six ICE vehicle counterparts, or best available similar models (see Appendix B for details on analysis, methodology, assumptions, and notes). The sample analyzed in this report determined that the average manufacturer retail sale price (MRSP) of BEVs in 2023 was estimated to be approximately 71% more expensive up front than ICE vehicle counterparts. Despite this being significantly higher than an ICE vehicle, it is important to note that in 2020 a BEV was 106% more expensive than an ICE vehicle, so prices are coming down. As well, as of May 8, 2023, there were 93 battery electric vehicles (BEVs) for sale in Canada (see Appendix 3). Many are eligible for the Federal Government Incentive for Zero-Emission Vehicles (iZEV) program which offers a rebate of $5,000 on specific zero-emission vehicles, which can support the higher upfront cost.

Total Cost of Ownership

Though the upfront cost of EVs is higher than ICEVs, it is important to understand the total cost of ownership (TCO) of a vehicle over its lifetime (in this report it is estimated at 10 years). The sample analyzed in this report determined that the TCO of an ICE vehicle is 2% more than an BEV, predominantly due to higher fuel maintenance and cost. BEVs require less maintenance than traditional ICE vehicles, as some maintenance tasks (e.g., oil changes) are no longer required. A summary of the key findings in Appendix B are outlined below:

1. Manufacturers Suggested Retail Price (MRSP): MRSP: ICE vehicles MRSP cost is 71% less than BEVs
    - Average BEV MRSP was $44,428.50
    - Average ICE MRSP was $26,047,17

2. Annual Insurance Costs: ICE vehicle annual insurance costs on average 1% less than BEVs
    - Average BEV annual insurance cost is $1,700.95
    - Average ICE annual insurance cost is $1,679.30

3. Annual Maintenance Costs: ICE vehicle average maintenance cost 9% more than BEVs
    - Average BEV annual maintenance cost is $1,302.60
    - Average ICE annual maintenance cost is $1,432.68

4. Annual Fuel Costs: ICE vehicle average annual fuel costs are 82% more than BEVs
    - Average BEV annual fuel cost is $446.82
    - Average ICE annual fuel cost is $2,444.23

5. Emissions: BEVs produce approximately 97% less operational emissions than ICE vehicles

6. TCO: TCO ownership of ICE was 2% more than their BEV vehicle counterparts, predominantly due to less fuel and maintenance cost. BEVs require less maintenance than traditional ICE vehicles, as some maintenance tasks (e.g., oil changes) are no longer required

This summary provides a general comparison of BEVs with ICE vehicles; however, financial feasibility should be considered on a vehicle-by-vehicle basis.

Interest Rates

Despite the greater availability of models and an increase in EV ownership, high interest rates are impacting automaker EV production in 2023 and are expected to continue well into 2024. To deal with this, automakers must balance profitability of their EV portfolios and adjust manufacturing growth accordingly. Despite this, EV sales are growing. Sales "topped 300,000 units in the United States for the first time in the third quarter [of 2023] and rose 14.3% in September in the European Union and 22% in China, the world's largest EV market (Klayman, 2023).

3. Electricity Load Management and Utility Deposit Concerns

A 2021 study by the Clean Air Partnership (CAP) noted concerns from developers about the "cost implications associated with electricity allocation requirements", for new developments as it pertains to energy sharing. Energy sharing for EV chargers involves the capability for multiple EVs to share and distribute electrical power among themselves dynamically. This is particularly relevant in scenarios where multiple charging stations are installed in a common location, such as a parking lot (Pollution Probe and The Delphi Group, 2020). Energy sharing has recently been addressed in the Canadian Electrical Safety Code and is an important component about planning for electricity allocation for EV readiness in future developments (Clean Air Partnership, 2021a).

The same 2021 CAP study also noted potential cost implications that EV ready requirements could pose to the electrical utility infrastructure deposit system (also called the Capital Cost Recovery (CCR) process). The CCR process is enacted when there are infrastructure investments that an electrical utility needs to make to provide the electricity allocation needed for a specific development. The deposit system covers a 5-year time horizon, whereby if the electricity demand requested by the development materializes, more of the deposit is returned to the developer. But if the electricity demand does not materialize, then part of the deposit is retained by the utility to cover the infrastructure costs that were required to provide the electricity allocation for that development. The CCR or electricity deposit system structure is not managed by the utility, but is governed by the Ontario Energy Board's Distribution System Code. It is recommended that learning more about the regulations as well as looked towards other jurisdictions such as British Columbia, where municipalities have been implementing EV Ready requirements within new developments for several years for leading practices and lessons learned.

4. Information & Awareness

As previously mentioned, despite an increase in availability in EVs on the Canadian market, there is still a lack of thorough understanding about EVs. Key areas of misunderstanding often have to do with the full lifecycle costs in comparison to ICE vehicles, as well as how charging works and what type of chargers are available, and range anxiety. Misinformation can negatively impact consumers and their understanding of the cost and benefits. In October 2023, the City partnered with the PUC and the Sault Climate Hub to host the Sault's first EV Showcase. Local EV owners were invited to park at the PUC parking lot on Saturday October 14, 2023, from 11:00 AM – 2:00 PM. The come and go event had approximately 50 people come and go, and the partners are already planning to make it an annual occurrence.

The next part of this report will highlight attributes that should be considered for siting (meaning the location) of public charging infrastructure.

Public Charging Deployment

Ensuring sufficient public charging infrastructure availability is a key part of Sault Ste. Marie's energy transition. Equally as important is ensuring that there is enough charging capacity to support a growing EV population (The International Council on Clean Transportation, 2017). While a significant portion of charging is typically done at home overnight, public charging infrastructure provides additional flexibility for EV drivers covering longer distances, such as tourists, and provides an alternative for those without access to charging at home. Numerous studies have emphasized the importance of public charging infrastructure and assessed the overall need for charging infrastructure as a function of the size of the EV population (National Renewable Energy Lab, 2017). Review of best practices by other municipalities indicates two paths to pursue for public charging deployment, including: 1. Attributes that should be considered, and 2. Locations. A set of five key considerations for charging infrastructure siting deployment are listed below.

Table 4: Charging Infrastructure Siting Deployment Key Attributes

Attribute	Reasoning
1. Equitable Accessibility	Ensure fair distribution based on population density.
2. Amenities and Convenience	Consider access to amenities, especially for fast-charging stations.
3. Proximity to Services	Locate charging stations near businesses, transit routes, and essential services.
4. Residential Factors	Prioritize areas with multi-unit residential buildings (MURBs) to accommodate EV owners who may not have private charging options.
5. Community and Infrastructure Support	Consider destinations for longer trips, community input, and ensure sufficient electrical grid capacity, especially for fast-charging stations.

Similarly, to the siting criteria noted above for charging infrastructure deployment, a prioritization for charging is encouraged in the following types of locations.

Table 5: Charging Infrastructure Siting Deployment Key Locations

Location	Criteria
1. High-Traffic Areas	Install charging stations in areas with high foot traffic and commercial activity, such as shopping and community centers, downtown areas, and including tourist spots and key attractions.
2. Workplaces	Encourage businesses and employers to install EV charging stations at workplaces to support employees who drive electric vehicles.

3. Public Institutions	Install charging stations at government offices, libraries, museums, parks, public buildings, schools, and universities to promote EV adoption and sustainability.
4. Future Development Areas	Anticipate future growth and development in the city and plan for charging infrastructure accordingly.
5. Public Parking Facilities	Install charging stations in public parking lots and garages to encourage EV use in urban areas.

The next section of this report highlights the opportunities for municipalities to consider as it relates to their authority for building codes and zoning.

Building Codes

The City of Sault Ste. Marie Building Division is responsible for administration and enforcement of the Ontario Building Code (OBC), the municipality's Building and Property Standards By-laws, and various other statutes and regulations. The OBC provides a set of minimum standards for construction and is followed by the City when issuing building permits. Municipalities have some flexibility to establish certain standards that are specific to their local needs, as long as they do not conflict with the OBC. For example, introducing requirements or incentives in their local planning policies or zoning by-laws to encourage or mandate the incorporation of EV infrastructure in new developments. In fact, advancing EV readiness of new developments has emerged as a leading action within municipal EV Strategies. EV Ready requirements that are advanced at the time of construction reduce the need for future costly retrofits. This is particularly important in the case of MURBs and townhomes. Planning for adequate electrical capacity within electrical panels to accommodate EV charger infrastructure as well as laying the necessary conduit running from the panel to the parking space and/or proposed development location is imperative.

Having policies that require new buildings to be EV ready can help a municipality better prepare for this. One such way is through the establishment of Green Development Standards (GDS), which are voluntary or mandatory measures created by municipalities to encourage environmentally, socially, and economically sustainable design. GDS are comprehensive principles to guide development at a level of planning and design that focuses on the community (Clean Air Partnership, 2021b). GDS can address more actions than EV charging infrastructure such as maintaining existing tree canopy, energy efficiency requirements for buildings, protecting and integrating green space, renewable energy generation and storage, bird-friendly design, material re-use and recycling and more (Clean Air Partnership, 2021b).

The Ontario Building Code (OBC) is a regulation made under the *Building Code Act*. It focuses primarily on ensuring public safety in newly constructed buildings, but also supports the government's commitments to energy conservation, barrier-free accessibility, and economic development. In 2018, the OBC brought in EV charging requirements via Regulation O.Reg. 139/17, that were repealed by the current Provincial Government in 2019. Despite the cancellation of EV readiness parameters, the 2018 OBC offered some good insights on what municipalities could consider in their EV infrastructure plans. Please see Appendix 4 for an overview of the repealed 2018 OBC EV readiness details.

While the current OBC may not have explicit EV requirements, municipalities can incorporate provisions and incentives within their local building by-laws that align with EV infrastructure

objectives. This may include encouraging or mandating the installation of electrical infrastructure conducive to EV charging in new developments or major renovations. Municipalities can also collaborate with developers to implement EV-friendly parking structures and ensure adequate electrical capacity to support charging stations. City staff can work at aligning local regulations with EV readiness goals to contribute to the growth of sustainable transportation options and to help meet net zero emission reduction targets. Regular reviews and updates of local bylaws can help ensure that they remain current with advancements in EV technology and changing community needs.

It's important to note that regulations and policies can change, and dialogue with the City's Planning and Building departments about plans for electric vehicle readiness is encouraged. Consultations with both departments were conducted by the author of this report and confirmed that at present, there are no policies relating to EV readiness per the OBC. It is important that City staff stay up to date on any changes made by the provincial government to the *Building Code Act* or the OBC, as they could impact the authority of municipalities in this regard.

Governmental Support / Policies

In this section of the report, an overview of key policies established by the Canadian Ontario, and City government and PUC will be elaborated upon. The integration of electric mobility into the City's current and planned infrastructure projects will be a multifaceted process that is already well supported by existing initiatives from various orders of government and organizations.

Federal

The Government of Canada's climate targets are to reduce GHG emissions by 40% to 45% below 2005 levels by 2030 and to achieve net zero emissions by 2050 (Government of Canada, 2022). To support this the Federal Government has launched a variety of policies and initiatives, including but not limited to:

1. **Greenhouse Gas Pollution Pricing Act (GGPPA):** enacted in 2018, provides the legislative framework for the federal carbon pricing backstop which includes the Fuel Charge and Output-Based Pricing System (OBPS). Ontario is subject to the federal government's carbon pricing backstop. The OBPS applies to large industrial facilities and is not relevant to this plan. The Fuel charge is a carbon pricing mechanism applied to the purchase of fossil fuels and is intended to incentivize organizations, businesses, and individuals to reduce their carbon emissions by using cleaner energy sources (Government of Canada, 2023a)

2. **Canadian Net-Zero Emissions Accountability Act:** a framework for achieving net-zero greenhouse gas emissions by 2050. While not specifically focused on electric vehicles, this overarching legislation sets the stage for broader initiatives to reduce emissions, including those related to the transportation sector (Government of Canada, 2023)

3. The Government of Canada announcement in 2021 to require 100% of car and passenger truck sales be zero-emission by 2035 in Canada (Government of Canada, 2021).

4. The **Electric Vehicle and alternative Fuel Infrastructure Deployment Initiative (EVAFIDI)** and Zero Emission Infrastructure Program (ZEVIP) programs provide funding for fast charging infrastructure along highway corridors, and for charging infrastructure in multi-unit residential buildings (MURB), workplaces, public charging including curbside charging) and for fleet vehicles. Under both programs, Natural Resources Canada (NRCan) provides up to 50% of eligible project costs. This program is eligible to be matched with the ChargeON program which will be elaborated on in the next section of this report, and the City is supporting the PUC with an application to this.

5. Incentives for **Zero-Emission Vehicles (iZEV) Program** and tax write-offs for businesses are helping to make it more affordable. The Federal Government is providing point of sale incentives of up to $5,000 for consumers who buy or lease eligible EVs. Eligible vehicles include those with six seats or less where the base model is less than $45,000, or those with seven or more seats where the base model is less than $55,000.

Provincial

Similarly to the Federal government, the Province of Ontario has a variety of initiatives and programs designed to advance the adoption and integration of EVs in Ontario.

1. Government Climate Plan
The Government of Ontario has committed to reducing emissions by 30% below 2005 levels by 2030, a target that aligns with the Federal Government's Paris commitments (Government of Ontario, 2022c).

2. Ivy
Recently the Ivy Charging Network, a joint venture of Ontario Power Generation (OPG) and Hydro One, the province's largest local distribution company (LDC) was announced, with a goal of launching 160 Level 3 (DC Fast Charger) at 73 locations. Stations will be on average 1000 km apart (Syed, 2021).

3. Condominiums
On May 1, 2018, changes to the regulations under the Condominium Act, 1998, established a new process for obtaining approval to install electric vehicle charging systems (EVCSs) in condominium buildings. The Condominium Authority of Ontario has a step-by-step guide for installing EV charging stations. More specifically, these new provisions set out the process for condominium corporations to obtain approval to install EVCSs and set out the process for an owner to obtain approval to install an EVCS (Condominium Authority of Ontario, 2022).
The Condominium Authority of Ontario has a step-by-step guide for installing EV charging stations in condominiums. The Plug'n Drive website (opens in new window) provides information on EV charging in condos as well as information on EVs and EV charging more generally.

Municipal / Local

There are a series of initiatives and plans that are aimed at facilitating the growth of EV adoption in Sault Ste. Marie.

1. Sault Ste. Marie Community Greenhouse Gas Reduction Plan: 2020 – 2030

The Transportation pillar of the GHG Reduction Plan, highlights actions to support transportation electrification infrastructure opportunities (e.g. electric vehicles and charging stations).

2. Public Chargers Currently Available in Sault Ste. Marie

The City of Sault Ste. Marie has a webpage where you can see where all public EV chargers are located in Saul Ste. Marie. This is based on the website PlugShare which may be updated more regularly.

3. PUC EV Home Charger Rental Program

In Ontario, the vast majority of EV charging occurs at home, and access to at home charging is one of the most important factors determining whether a household will purchase an EV. In 2022, Sault Ste. Marie's local distribution company (LDC), the PUC launched their EV Home Charger Rental Program which is a great addition to growing EV readiness in Sault Ste. Marie. Opportunities for the City also exist to develop, design and implement EV Ready parking within new developments to avoid expensive and complex EV charging retrofits in the future. For $35.00 / month, you can enjoy the convenience of charging worry free at home. PUC Services Inc. will conduct the installation as well as technical support, and the charger is fully warrantied through them. To learn more about the program click here.

4. Municipal Fleet Electrification

Electric vehicles (EVs) can benefit Canadian municipalities. By electrifying municipal fleets, local governments benefit from:

- Reduced fuel expenses and maintenance costs
- Reduction of community transportation emissions.

A resolution was passed in February 2021 mandating all new light duty fleet be electric. The City has established a plan and with budget monies plans to go to RFP for a plan to electricity its full fleet in early 2024, pending budget approval.

The following section of this report is the charging infrastructure action plan.

Sault Ste. Marie Community Charging Infrastructure Plan

Increasing the availability of charging infrastructure in Sault Ste. Marie is a multi-sectoral endeavour, involving several City Departments, the PUC and other community groups, working in collaboration with each other. ChargeIt focuses on actions to be completed within a 6-year timeframe: 2024 to 2030.

The following vision will guide the implementation of ChargeIt.

Vision: Creating a landscape that is conducive to the increased adoption of electric vehicles in Sault Ste. Marie

The plan recommends 13 actions (9 of which are already in progress) and is broken down into three key sectors, including:

1. Charging Availability
2. Education & Advocacy
3. Municipal Leadership & Governance

An overview for each sector of the action plan is furthered below.

Charging Availability
Access to charging infrastructure is a key barrier to EV adoption. Some charging can occur in single detached homes; however, not all residents have access to driveways or garages. In addition to deployment, maintenance and operation of infrastructure is essential and EV designated parking spots should be made very visible to further the transition. To support the achievement of this strategy the City must enable the deployment of public charging infrastructure. Pilot projects, new construction design requirements, and government funding programs are currently being pursued to improve charging availability.

Education and Advocacy
EV adoption can be inhibited by a lack of information as well as misinformation (e.g., knowledge of charging availability, knowledge of home charging options, range anxiety, lifecycle costs, model availability, and model features). Residents and businesses may not have enough awareness, confidence, or understanding of EVs to be comfortable deciding to switch. Addressing these knowledge gaps can reduce the barrier to EV adoption, and is already being pursued by the city and community groups.

Municipal Leadership & Governance
Demand for charging infrastructure will increase as residents move towards EV ownership. If new buildings continue to be designed without charging in mind, a gap between availability and demand will continue to grow. Retrofitting existing structures presents challenges, including high costs, lack of adequate space and/or electrical infrastructure. Setting up infrastructure during the initial design can mitigate these barriers and reduce costs.

Timelines for Action

Actions within the plan have been broken down into separate timeframes. The timing and length of actions can be adapted to respond to changes in policy, technology and funding. The following legend illustrates the different times for each action:

Immediate: action to begin right away	
Short Term (1-2 Years)	
Ongoing: action has been initiated and will continue throughout the life of the plan	

These actions were developed based on outreach to other municipalities and research regarding municipal charging infrastructure best practices in the Province of Ontario. Actions should be viewed as a starting point and are expected to change over time. The following section of this report is the action plan.

Action Plan

. Objective	Action	Responsibility	Timeline	Performance Measures
1. Charging Availability	a. Identify high-priority areas for public charging infrastructure	Leads • City – Sustainability Coordinator • PUC		• COMPLETE – noted in the Public Charging Deployment section of ChargeIt
	b. Leverage and explore funding opportunities to expand public charging infrastructure	Leads • City – Sustainability Coordinator • PUC		• Number of grants applied to • Number of public chargers installed per year with funding
2. Education & Advocacy	a. Engage and partner with local organizations to share EV information and best practices	Lead • City – Sustainability Coordinator Partners • PUC • Sault Climate Hub		• Number of events / activities that take place a year that increase EV education and awareness
	b. Stay up to date on regulatory changes, funding and pilots to reduce congestion and promote EV adoption	Lead • Various City Departments Partners • PUC		• Number of funding applications submitted and EV pilots applied for and/or participated in by the City per year
	c. Advocate for policies that support a transition to EVs	Lead • Various City Departments, including Sustainability Coordinator Partners • Environmental Sustainability Committee		• Incorporation of EV readiness language in City policies and plans (e.g. Zoning, Parking Reform)

Objective	Action	Responsibility	Timeline	Performance Measures
3. Municipal Leadership & Governance	a. Develop a municipal EV readiness policy	Lead • City Planning and Building Departments Support • City Sustainability Coordinator		• Creation of a policy
	b. Collaborate with stakeholders such as developers, the PUC, Algoma University, and Sault College to incorporate EV infrastructure in their long-term planning strategies	Lead • City Sustainability Coordinator • PUC		• Number of charging infrastructure projects that take place per year
	c. Develop a Green Development Standard that encourages EV readiness in new builds	Lead • City Planning and Building Departments • City Sustainability Coordinator		• Development of a Sault Ste. Marie Green Development Standard
	d. Update the City Zoning By-law to include requirements for EV charging infrastructure in new multi residential and large commercial buildings to help meet EV charging needs in the future as residents and businesses switch to electric vehicles	Lead • City Planning and Building Departments Partners City Sustainability Coordinator		• Amendment of zoning by-law to include EV readiness particulars including requiring electrical capacity within electrical panels to accommodate EV charger infrastructure as well as the necessary conduit running from the panel to the parking space and/or location

Objective	Action	Responsibility	Timeline	Performance Measures
3. **Municipal Leadership & Governance**	e. Lead by example – incorporate EVs in the City's corporate fleet and ensure high visibility signage and branding.	Lead • City – Sustainability Coordinator • Various City Departments		• Number of EVs incorporated into the City's fleet per year
	f. Budget for the installation of public chargers on key City facilities to lead charging infrastructure deployment in the community	Lead • City Council Partners • Finance, Procurement, • City – Sustainability Coordinator		• Number of chargers installed per year
	g. Create an EV Charging Infrastructure working group with a goal to oversee and progress plan implementation with members of City Staff (Parking and Transit, Engineering, By-law, Sustainability) and PUC Services	Lead • City – Sustainability Coordinator		• Creation of the working group
	h. Support efforts to host EV industry events in Sault Ste. Marie and help attract EV related industries and business	Lead • City Economic Development Partner • City Tourism Department		• Number of events held in SSM per year • Number of EV related business that relocate or are established per year in Sault Ste. Marie

Funding

Cities, like other governmental organizations, can access and utilize various financing options for charging infrastructure projects. The following section of this report highlights various funding and grant options researched and available as of the end of October 2023.

Electric Vehicle ChargeON Program

The EV ChargeON program provides funding for the installation of public electric vehicle (EV) chargers in Ontario communities outside of major cities with populations less than or equal to 170,000 people and any indigenous community in Ontario. The Program is administered by the Ministry of Transportation (MTO) and aims to improve network coverage of EV fast chargers to reduce range anxiety by filling existing gaps and support long-distance travel. EV ChargeON is a competitive, application-based grant program offering up to 50-75% of capital funding through post-construction rebates. Level 2 and Level 3 public Charging Stations are eligible for funding in amounts that are proportional to Charger's power output. For more information about this funding program, please visit: https://forms.mgcs.gov.on.ca/en/dataset/on00567

Zero Emission Vehicle Infrastructure Program

The Zero Emission Vehicle Infrastructure Program (ZEVIP) provides funding towards the deployment of electric vehicle (EV) chargers and hydrogen refueling stations across Canada. ZEVIP will be opening up funding in Spring 2024 towards projects focusing on EV charger deployment in public places, on-street, in multi-unit residential buildings, at workplaces, and for vehicle fleets. NRCan's contribution will be limited to fifty percent (50%) of Total Project Costs up to a maximum of 10 million dollars per project. To learn more about this funding, please visit: https://natural-resources.canada.ca/energy-efficiency/transportation-alternative-fuels/zero-emission-vehicle-infrastructure-program/21876

It is important to note that the City and the PUC intend to apply for both of these above mentioned funding streams. The following section of this report highlights opportunities to monitor plan implementation and progress.

Implementation

The development of ChargeIt is a positive step for the City in its goal of net zero emissions by 2050. In order for the plan to move forward the City must follow through on implementation and monitor results. Implementation and overseeing the action plan will require staff time from several City departments and tracking and reporting will be included in the City's annual sustainability report.

As mentioned in the action plan section of this report, most of the actions of this plan are already underway. Immediate actions that the City should continue to prioritize are listed below.

1. Seek Council approval and adoption of the plan
2. Budget for the installation of public chargers on key City facilities to lead charging infrastructure
3. Continue to seek out funding opportunities to increase availability of charging infrastructure in the community
4. Create an EV Charging Infrastructure working group with a goal to oversee and progress plan implementation with members of City Staff (Parking and Transit, Engineering, By-law, Sustainability) and PUC Services

Conclusion

Moving forward with ChargeIt involves a strategic implementation approach to ensure the integration of EV readiness and charging stations throughout the community. Collaboration with key stakeholders, including local businesses, government agencies, and the PUC, will be essential in fostering a comprehensive network of charging infrastructure. Engaging in partnerships will not only facilitate the installation of public charging stations but also enhance the visibility of EVs as a sustainable transportation option in Sault Ste. Marie.

Additionally, community outreach and education programs will be essential to encouraging EV adoption and maximizing the benefits of the ChargeIt. Continuing to partner with organizations such as the PUC and the Sault Climate Hub on awareness campaigns and informational sessions will inform residents and businesses about the advantages of electric vehicles, dispel myths, and address any concerns. Through these efforts, the community can actively participate in the transition to cleaner transportation alternatives. Ongoing monitoring and evaluation will be crucial. Allowing for adjustments to the plan based on local EV usage patterns, technological advancements, and evolving needs, will ensure that Sault Ste. Marie stays up to date on the EV transition.

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Appendix 1: Council Community Charging Infrastructure Plan Resolution

June 13, 2022

Mover Councillor C. Gardi
Seconder Councillor L. Vezeau-Allen

Whereas the climate crisis has forced countries, regions and municipalities around the world to re-evaluate and implement certain measures to help mitigate the existential and catastrophic impacts that will be caused by the changing climate; and

Whereas one of the most recognized ways for society to battle the climate crisis is to transition away from fossil fuels, to eliminate as best as possible, the emission of greenhouse gases (GHG); and

Whereas according to Natural Resources Canada, transportation accounts for 25% of Canada's GHG emissions, and almost half of that comes from light duty trucks and cars; and

Whereas Canada has set a mandatory target for all passenger cars and light duty trucks to be zero-emission by 2035; and

Whereas communities in Canada should be deliberately planning for the transition to predominantly electric passenger vehicles over the next decade;

Now Therefore Be It Resolved that Council request that staff develop a charging infrastructure plan to be presented to Council for consideration that will advance local policies to accelerate charging infrastructure in the community, and to include possible changes to local building codes to ensure electric vehicle readiness/inclusion in future commercial, industrial and residential development within the municipality of Sault Ste. Marie.

Appendix 2: Cost Analysis of Purchasing Electric Vehicles

As of May 8, 2023, there were 93 battery electric vehicles (BEVs) for sale in Canada (see Appendix 3 for full list). Many are eligible for the Federal Government Incentive for Zero-Emission Vehicles (iZEV) program which offers a rebate of $5,000 on specific zero-emission vehicles[5]. For the purpose of this analysis, a sample of six (6) BEVs and six (6) of their internal combustion engine (ICE) vehicle counterparts were selected to determine what the upfront cost increase of EVs. The vehicles were selected based on whether they qualified for the iZEV subsidy and also 2023 availability with standard features. The table below highlights the BEV and ICE sample vehicles used in this analysis.

Table 6: Analysis Vehicles Sample List

EV	ICE
2023 Hyundai IONIQ 5 (EV)	2023 Hyundai Elantra Essential (ICE)
2023 Hyundai Kona (EV)	2023 Hyundai Kona Essential (ICE)
2023 Chevy Bolt EUV	2022 Chevy Trax (ICE)
2023 Kia Soul (EV)	2023 Kia Sou EX (ICE)
2022 Nissan Leaf Plus (EV)	2023 Nissan Sentra S (ICE)
2023 VW ID.4 (EV)	2023 VW Golf R (ICE)

The following six tables (Table 2 to Table 7) summarize the data sets of 6 case studies that compared costs and emissions associated to BEVs to their ICE vehicle equivalent. Comparative variables include: manufacturer retail sales price (MRSP), insurance costs, maintenance costs, fuel costs, grams of carbon dioxide per kilometer (CO_2/km) and Total cost of Ownership (TCO).

Data Assumptions

The analysis in the six case studies below is based on a worksheet provided to author of this report by ChargePoint, an EV charging infrastructure company[6]. Data input assumptions and methodology details are outlined in the bullets below.

1. Vehicle MRSP pricing information was obtained from each company's website. Local dealers may provide alternate pricing for single or multiple vehicle purchases and cold impact the results of this analysis.
2. Assumed City would own the vehicle forever (10 years or more), so zero was entered for the resale price
3. BEV cost 3 to 4 cent/km (at 15 cent / kWh), compared to a typical 4-cylinder gasoline vehicle at 11 to 12 cent/km (at $1.50/L). Retrieved from: https://fcr-ccc.nrcan-rncan.gc.ca/
4. Assumed annual driving distance of 20,000 (multiplied times 10 for life of vehicle
5. Insurance cost obtained from CAA Car Costs Calculator. Annual insurance cost multiplied times 10
6. Maintenance costs obtained from CAA Car Costs Calculator. Annual cost multiplied by 10

[5] https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles/light-duty-zero-emission-vehicles/eligible-vehicles

[6] Electric Vehicle Total Cost of Ownership Analysis Worksheet - (c) Dr. Tom Lombardo.
Licensed for non-commercial use by Creative Commons BY-NC-SA license
https://creativecommons.org/licenses/by-nc-sa/3.0/ Based on Jens Hagman, Sofia Ritzén, Jenny Janhager Stier, Yusak Susilo, Total cost of ownership and its potential implications for battery electric vehicle diffusion,
In Research in Transportation Business & Management, Volume 18, 2016, Pages 11-17, ISSN 2210-5395,
https://doi.org/10.1016/j.rtbm.2016.01.003.
(http://www.sciencedirect.com/science/article/pii/S2210539516000043)

7. Sales Tax (13% multiplied by purchase price)
8. Subsidy for EVs under NRCans iZEV incentive
9. Fuel cost is total distance driven times cost
10. Total Cost of ownership is Depreciation plus total fuel cost, plus insurance cost, plus maintenance cost, plus sales tax minus subsidy
11. KG of CO2 obtained from CAA Car Costs calculator and multiplied times 2 as tool provided 5 years of kg of co2e. Converted to tonnes by dividing it by 1000
12. Average energy consumption of 0.20 kWh per kilometre: https://evbox.com/en/ev-home-charger-electricity-usage#:~:text=Using%20the%20average%20EV's%20energy,and%204%2C310.65%20kWh%20per%20year.
13. If a car drives an average of 20,000 kms a year that equates to approximately 4,000 kWh. When you plug this into the PCP tool that equates to 0.1 tCO2e

Table 7: BEV and ICE Vehicle MRSP[7] Comparison

EV	MRSP	ICE	MRSP
2023 Hyundai IONIQ 5 (EV)	$48,999.00	2023 Hyundai Elantra Essential (ICE)	$22,956.00
2023 Hyundai Kona (EV)	$44,599.00	2023 Hyundai Kona Essential (ICE)	$22,649.00
2023 Chevy Bolt EUV	$43,147.00	2022 Chevy Trax (ICE)	$21,898.00
2023 Kia Soul (EV)	$43,095.00	2023 Kia Sou EX (ICE)	$19,790.00
2022 Nissan Leaf Plus (EV)	$37,498.00	2023 Nissan Sentra S (ICE)	$20,548.00
2023 VW ID.4 (EV)	$49,233.00	2023 VW Golf R (ICE)	$48,495.00
Average	$44,428.50		$26,056.00

Insight: ICE vehicles cost 71% less than BEVs based on average MRSP used in this sample.

Table 8: BEV and ICE Vehicle Lifetime Insurance[8] Cost Comparison

EV	Annual Insurance Cost	ICE	Annual Insurance Cost
2023 Hyundai IONIQ 5 (EV)	$17,487.30	2023 Hyundai Elantra Essential (ICE)	$17,384.40
2023 Hyundai Kona (EV)	$16,611.10	2023 Hyundai Kona Essential (ICE)	$16,080.44
2023 Chevy Bolt EUV	$17,014.20	2022 Chevy Trax (ICE)	$16,278.90
2023 Kia Soul (EV)	$16,551.60	2023 Kia Sou EX (ICE)	$16,550.50
2022 Nissan Leaf Plus (EV)	$16,744.60	2023 Nissan Sentra S (ICE)	$17,052.10
2023 VW ID.4 (EV)	$17,647.90	2023 VW Golf R (ICE)	$17,052.10
Average	$17,009.45		$16,733.07

Insight: ICE vehicle insurance costs on average 2% less than BEV insurance based on the vehicles used in this sample.

[7] Vehicle MRSP pricing information was obtained from each company's website in May and October 2023. Local dealers may provide alternate pricing for single or multiple vehicles purchases and could impact the results of this analysis. https://carcosts.caa.ca/.

[8] Lifetime insurance cost estimate obtained from CAA Car Costs Calculator:

Table 9: BEV and ICE Vehicle Lifetime Maintenance Cost[9] Comparison

EV	Annual Maintenance Costs	ICE	Annual Maintenance Costs
2023 Hyundai IONIQ 5 (EV)	$13,383.70	2023 Hyundai Elantra Essential (ICE)	$14,833.40
2023 Hyundai Kona (EV)	$12,613.60	2023 Hyundai Kona Essential (ICE)	$16,080.44
2023 Chevy Bolt EUV	$14,706.80	2022 Chevy Trax (ICE)	$16,507.30
2023 Kia Soul (EV)	$11,468.30	2023 Kia Sou EX (ICE)	$14,686.70
2022 Nissan Leaf Plus (EV)	$12,585.70	2023 Nissan Sentra S (ICE)	$12,068.90
2023 VW ID.4 (EV)	$13,398.10	2023 VW Golf R (ICE)	$13,044.40
Average	$13,026.03		$14,536.86

Insight: ICE vehicle average maintenance cost 9% more than BEVs based on the vehicles in this sample.

Table 10: BEV and ICE Lifetime Fuel Cost[10] Comparison

EV	Lifetime Fuel Costs	ICE	Lifetime Fuel Costs
2023 Hyundai IONIQ 5 (EV)	$8,000.00	2023 Hyundai Elantra Essential (ICE)	$24,000.00
2023 Hyundai Kona (EV)	$8,000.00	2023 Hyundai Kona Essential (ICE)	$24,000.00
2023 Chevy Bolt EUV	$8,000.00	2022 Chevy Trax (ICE)	$24,000.00
2023 Kia Soul (EV)	$8,000.00	2023 Kia Sou EX (ICE)	$24,000.00
2022 Nissan Leaf Plus (EV)	$8,000.00	2023 Nissan Sentra S (ICE)	$24,000.00
2023 VW ID.4 (EV)	$8,000.00	2023 VW Golf R (ICE)	$24,000.00
Average	$8,000.00		$24,000.00

Insight: ICE vehicle average annual fuel costs are 82% more than BEVs based on this vehicles in this sample.

[9] Annual maintenance cost estimate obtained from CAA Car Costs Calculator: https://carcosts.caa.ca/.
[10] BEV cost 2 to 3 cent/km (at 13 cent / kWh), compared to a typical 4-cylinder gasoline vehicle at 7 to 8 cent/km (at $1.00/L). Retrieved from: https://www.nrcan.gc.ca/energy/efficiency/energy-efficiency-transportation-and-alternative-fuels/choosing-right-vehicle/buying-electric-vehicle/21034

Table 6: Generic Average Annual Fuel Cost

BEV Annual Fuel Cost Average		**ICE Fuel Cost Average**	
Kms (avg / yr)	20,000.00	Kms	20,000.00
Cost / Km	$0.04	Cost / km	$0.12
	$800.00		$1,747.20
Insight: Based on an average rate of $0.04 / km for EVs and $0.12 for ICE and 20,000 km / year - average annual ICE fuel costs are 54% more than BEVs.			

Table 7: BEV and ICE Annual tCO2e[11]Comparison

EV	**Annual tCO2e**	**ICE**	**Annual tCO2e**
2023 Hyundai IONIQ 5 (EV)	0.1	2023 Hyundai Elantra Essential (ICE)	2.9
2023 Hyundai Kona (EV)	0.1	2023 Hyundai Kona Essential (ICE)	3.6
2023 Chevy Bolt EUV	0.1	2022 Chevy Trax (ICE)	4.1
2023 Kia Soul (EV)	0.1	2023 Kia Sou EX (ICE)	3.5
2022 Nissan Leaf Plus (EV)	0.1	2023 Nissan Sentra S (ICE)	3.5
2023 VW ID.4 (EV)	0.1	2023 VW Golf R (ICE)	-
Average	0.10		2.92

Insight: BEVs produce approximately 97% less emissions than ICE vehicles[12]

Table 8: BEV and ICE Total Cost of Ownership Comparison

EV	**TCO**	**ICE**	**TCO**	**Δ**
2023 Hyundai IONIQ 5 (EV)	$89,239.87	2023 Hyundai Elantra Essential (ICE)	$82,158.08	-8%
2023 Hyundai Kona (EV)	$82,621.57	2023 Hyundai Kona Essential (ICE)	$80,493.71	-3%
2023 Chevy Bolt EUV	$83,477.11	2022 Chevy Trax (ICE)	$81,530.94	-2%
2023 Kia Soul (EV)	$79,717.25	2023 Kia Sou EX (ICE)	$77,599.90	-3%
2022 Nissan Leaf Plus (EV)	$74,703.04	2023 Nissan Sentra S (ICE)	$76,340.24	2%
2023 VW ID.4 (EV)	$89,679.29	2023 VW Golf R (ICE)	$109,255.25	22%
Average	$83,239.69		$84,563.02	2%

Insight: Based on the vehicles selected for this analysis, the TCO of ICE vehicles is 2% more than BEVs.

[11] Government of Canada. (2020). *Fuel consumption ratings search tool.* Retrieved from: https://fcr-ccc.nrcan-rncan.gc.ca/en

[12] Average energy consumption of 0.20 kWh per kilometre: https://evbox.com/en/ev-home-charger-electricity-usage#:~:text=Using%20the%20average%20EV's%20energy,and%204%2C310.65%20kWh%20per%20year. If a car drives an average of 20,000 kms a year that equates to approximately 4,000 kWh. When you plug this into the PCP tool that equates to 0.1 tCO2e

Case Studies

Case Study 1: Hyundai IONIQ Electric vs. Hyundai Elantra

	Hyundai IONIQ Electronic	**Hyundai Elantra (ICE)**
Inputs		
Purchase Price (MRSP)	$48,999	$22.956
Resale Price	$0.00	$0.00
Fuel Cost per unit of distance	$0.04	$0.12
Total distance driven (km)	200,000 km	200,000 km
Insurance Cost	$17,487.30	$17,384.40
Maintenance and Repair Costs	$13,383.70	$14,833.40
Sales Tax	$6,369.87	$2,984.28
Subsidies	$5,000	$0
Calculations		
Depreciation	$48,99900	$22,956
Total Fuel Cost	$8,000	$24,0000
Total Cost of Ownership (TCO)	**$89,239.87**	**$82,158.08**
Insight		
The TCO of a Hyundai Elantra is 8% less than a Hyundai IONIQ EV.		-8%
GHG Emissions		
KG CO_2 / km (10-year lifecycle)	0	28,610
Annual tCO_2e / yr	0	2.86

Case Study 2: Hyundai Kona Electric vs. Hyundai Kona ICE

	Hyundai Kona Electronic	**Hyundai Kona (ICE)**
Inputs		
Purchase Price (MRSP)	$44,599.00	$22,649
Resale Price	$0.00	$0.00
Fuel Cost per unit of distance	$0.04	$0.12
Total distance driven (km)	200,000 km	200,000 km
Insurance Cost	$16,611.10	$16,080.44
Maintenance and Repair Costs	$12,61360	$14,819.90
Sales Tax	$5,797.87	$2,944.37
Subsidies	$5,000	$0.00
Calculations		
Depreciation	$44,599.00	$22,649
Total Fuel Cost	$8,000	$24,000
Total Cost of Ownership (TCO)	**$82,621.57**	**$80,493.71**
Insight		

The TCO of a Hyundai Kona ICE is 3% less than a Hyundai iKona EV.		-3%
GHG Emissions		
KG CO_2 / km (10-year lifecycle)	0	35,808
Annual tCO_2e / km	0	3.58

Case Study 3: Chevrolet Bolt EV vs. Chevrolet Trax ICE

	Chevrolet Bolt EV	**Chevrolet Trax ICE**
Inputs		
Purchase Price (MRSP)	$43,147	$21,898.00
Resale Price	$0.00	$0.00
Fuel Cost per unit of distance	$0.04	$0.12
Total distance driven (km)	200,000 km	200,000 km
Insurance Cost	$17,014.20	$16,278.90
Maintenance and Repair Costs	$14,706.80	$16,507.30
Sales Tax	$5,609.11	$2,846.74
Subsidies	$5,000	$0
Calculations		
Depreciation	$43,147	$21,898.00
Total Fuel Cost	$8,000.00	$24,000.00
Total Cost of Ownership (TCO)	$83,477.11	$81,530.94
Insight		
The TCO of a Chevrolet Trax is 3% less than a Chevrolet Bolt EV		-3%
GHG Emissions		
KG CO_2 / km (10-year lifecycle)	-	40,592
Annual tCO_2e	-	4.06

Case Study 4: Kia Soul EV vs. Kia Soul ICE

	Kia Soul EV	**Kia Soul (ICE)**
Inputs		
Purchase Price (MRSP)	$43,095	$19,790
Resale Price	$0.00	$0.00
Fuel Cost per unit of distance	$0.04	$0.12
Total distance driven (km)	200,000 km	200,000 km
Insurance Cost	$16,551.60	$16,550.50
Maintenance and Repair Costs	$11,468.30	$14,686.70
Sales Tax	$5,602.35	$2,572.70
Subsidies	$5,000	$0
Calculations		
Depreciation	$43,095	$19,790
Total Fuel Cost	$8,000.00	$24,000

Total Cost of Ownership (TCO)	$79,717.25	$77,599.90
Insights		
The TCO of a Kia Soul ICE is 3% less than a Kia Soul EV.		-3%
GHG Emissions		
KG CO_2 / km (10-year lifecycle)	-	35,302
tCO_2e annual	-	3.53

Case Study 5: Nissan Leaf EV vs Nissan Sentra

	Nissan Leaf (EV)	**Nissan Sentra**
Inputs		
Purchase Price (MRSP)	$37,498	$20,548
Resale Price	$0.00	$0.00
Fuel Cost per unit of distance	$0.04	$0.12
Total distance driven	200,000	200,000
Insurance Cost	$16,744.60	$17,052.10
Maintenance and Repair Costs	$12,585.74	$12,068.90
Sales Tax	$4,874.74	$2,671.24
Subsidies	$5,000	$0
Calculations		
Depreciation	$37,498	$20,548
Total Fuel Cost	$8,000	$24,000
Total Cost of Ownership (TCO)	$74,703.04	$76,340.24
Insight		
The TCO of a Nissan Santra is 2% more than a Nissan Leaf EV.		2%
GHG Emissions		
KG CO_2 / km (10-year lifecycle)	-	34,728
Annual tCO_2e	-	3.47

Case Study 6: Volkswagen ID.4 vs. Volkswagen Golf R

	Volkswagen E-Golf EV	**Volkswagen Golf R ICE**
Inputs		
Purchase Price (MRSP)	$49,233	$48,495
Resale Price	$0.00	$0.00
Fuel Cost per unit of distance	$0.04	$0.12
Total distance driven (km)	200,000 km	200,000 km
Insurance Cost	$17,647.90	$17,411.50
Maintenance and Repair Costs	$13,398.10	$13,044.40
Sales Tax	$6,400.29	$6,304.35
Subsidies	$5,000	$0
Calculations		

Depreciation	$49,233	$48,495
Total Fuel Cost	$8,000	$24,000
Total Cost of Ownership (TCO)	$89,679.29	$109,255.25
Insight		
The TCO of a Volkswagen Golf R (ICE) is 22% more than a Volkswagen E-Golf (EV).		22%
GHG Emissions		
KG CO_2 / km (10-year lifecycle)	-	39,556
Annual Grams of CO2/km	-	3,955.60

Appendix 3: EVs Currently Available for Purchase in Canada

Note: This list is based on available up to May 8, 2023.

Line No.	Model	Make	Year	Seats	Price	Drive Type
1	2 Long range Dual Motor	Polestar	2023	5	$58,950	AWD
2	2 Long range Single Motor	Polestar	2023	5	$53,950	FWD
3	3 Long Range Dual Motor	Polestar	2023	5	$99,900	AWD
4	3 Long Range Dual Motor with Performance pack	Polestar	2023	5	$106,900	AWD
5	Air	Lucid	2022	-	$105,000	RWD
6	Air Grand Touring	Lucid	2022	-	$189,000	AWD
7	Ariya Engage FWD	Nissan	2023	5	$52,998	FWD
8	Ariya Evolve e-4ORCE AWD	Nissan	2023	5	$60,598	AWD
9	Ariya Evolve+ FWD	Nissan	2023	5	$64,998	FWD
10	Ariya Platinum+ e-4ORCE AWD	Nissan	2023	5	$69,198	AWD
11	Ariya Premiere e-4ORCE AWD	Nissan	2023	5	$69,998	AWD
12	Ariya Venture+ FWD	Nissan	2023	5	$59,498	FWD
13	Bolt EUV LT	Chevrolet	2022	5	$42,797	FWD
14	Bolt EUV LT	Chevrolet	2023	5	$43,147	FWD
15	Bolt EV LT	Chevrolet	2022	5	$40,797	FWD
16	Bolt EV LT	Chevrolet	2023	5	$41,147	FWD
17	bZ4X L	Toyota	2023	5	$44,990	FWD
18	C40 Recharge Core	Volvo	2023	5	$59,950	AWD
19	Cooper SE 3 Door EV Premier Line	MINI	2023	5	$45,590	FWD
20	E-Transit	Ford	2023	2	$70,450	RWD
21	e-tron 55 quattro	Audi	2023	5	$87,342	AWD
22	e-tron GT	Audi	2023	5	$133,950	AWD
23	e-tron Sportback 55 quattro Progressiv	Audi	2023	5	$89,842	AWD
24	Electrified G80 Prestige AWD	Genesis	2023	5	$105,150	AWD
25	EQB 350 4MATIC	Mercedes-Benz	2022	5	$75,700	AWD
26	EQS 450 4MATIC	Mercedes-Benz	2023	5	$136,000	AWD
27	EQS 580 4MATIC	Mercedes-Benz	2022	5	$146,500	AWD
28	EV6 AWD Long Range	Kia	2023	5	$57,495	AWD
29	EV6 RWD Standard Range	Kia	2023	5	$46,995	RWD
30	F-150 Lightning XLT Extended Range	Ford	2022	5	$81,380	AWD

31	F-150 Lightning XLT Standard Range	Ford	2022	5	$68,000	AWD
32	GV60	Genesis	2023	5	$71,150	AWD
33	I-Pace	Jaguar	2023	5	$99,800	AWD
34	i4 eDrive35	BMW	2023	5	$58,245	RWD
35	i4 eDrive40	BMW	2023	5	$64,645	RWD
36	i4 M50 xDrive	BMW	2023	5	$79,245	AWD
37	i7 xDrive60	BMW	2023	5	$147,000	AWD
38	ID.4	Volkswagen	2023	5	$46,632	RWD
39	ID.4 Pro AWD	Volkswagen	2023	5	$55,632	AWD
40	ID.4 Pro RWD	Volkswagen	2023	5	$50,632	RWD
41	Ioniq 5 Essential	Hyundai	2022	5	$44,999	RWD
42	Ioniq 5 Preferred	Hyundai	2023	5	$48,999	RWD
43	Ioniq 5 Preferred AWD Long Range	Hyundai	2022	5	$54,999	AWD
44	Ioniq 5 Preferred AWD Long Range	Hyundai	2023	5	$54,999	AWD
45	Ioniq 5 Preferred Long Range	Hyundai	2023	5	$52,999	RWD
46	Ioniq 5 Preferred Long Range	Hyundai	2022	5	$51,999	RWD
47	iX M60	BMW	2023	5	$124,620	AWD
48	iX xDrive40	BMW	2023	5	$82,860	AWD
49	iX xDrive50	BMW	2023	5	$95,870	AWD
50	Kona Electric	Hyundai	2023	5	$44,599	FWD
51	Kona Electric Preferred	Hyundai	2022	5	$43,899	FWD
52	Leaf	Nissan	2023	5	$39,498	FWD
53	Lyriq	Cadillac	2023	-	$70,597	RWD
54	Model 3 Performance Dual Motor AWD	Tesla	2023	5	$72,990	AWD
55	Model 3 RWD	Tesla	2023	5	$54,990	RWD
56	Model S	Tesla	2023	5	$122,990	AWD
57	Model S Plaid	Tesla	2023	5	$149,990	AWD
58	Model X	Tesla	2023	7	$147,590	AWD
59	Model X	Tesla	2023	6	$151,490	AWD
60	Model X	Tesla	2023	5	$142,990	AWD
61	Model X Plaid	Tesla	2023	6	$156,990	AWD
62	Model Y Long Range	Tesla	2023	5	$69,990	AWD
63	Model Y Performance	Tesla	2023	5	$75,990	AWD
64	Model Y Performance	Tesla	2022	5	$90,000	AWD
65	Mustang Mach-E California Route 1	Ford	2023	5	$79,120	RWD
66	Mustang Mach-E California Route 1	Ford	2022	5	$65,245	RWD

67	Mustang Mach-E GT Performance Edition	Ford	2023	5	$92,745	RWD
68	Mustang Mach-E Premium	Ford	2023	5	$64,995	RWD
69	Mustang Mach-E Premium	Ford	2022	5	$60,245	RWD
70	Mustang Mach-E Select	Ford	2023	5	$56,995	RWD
71	Mustang Mach-E Select	Ford	2022	5	$51,495	RWD
72	MX-30	Mazda	2023	5	$42,650	FWD
73	Niro EV Premium	Kia	2023	5	$44,995	FWD
74	Q4 50 e-tron quattro	Audi	2023	5	$59,950	AWD
75	Q4 Sportback e-tron	Audi	2023	5	$71,300	AWD
76	R1S Adventure Dual-Motor AWD Large Pack	Rivian	2023	7	$113,500	AWD
77	R1S Adventure Dual-Motor AWD Standard Pack	Rivian	2023	7	$105,250	AWD
78	R1S Adventure Quad-Motor AWD Standard Pack	Rivian	2023	7	$124,500	AWD
79	R1T Adventure Dual-Motor AWD Large Pack	Rivian	2023	5	$106,750	AWD
80	R1T Adventure Dual-Motor AWD Max Pack	Rivian	2023	5	$120,250	AWD
81	R1T Adventure Dual-Motor AWD Standard Pack	Rivian	2023	5	$98,500	AWD
82	R1T Adventure Quad-Motor AWD Large Pack	Rivian	2023	5	$117,750	AWD
83	R1T Adventure Quad-Motor AWD Max Pack	Rivian	2023	5	$131,250	AWD
84	RZ 450E Signature	Lexus	2023	5	$68,225	AWD
85	Solterra	Subaru	2023	5	$54,295	AWD
86	Soul EV Premium	Kia	2022	5	$42,995	FWD
87	Soul EV Premium	Kia	2023	5	$43,095	FWD
88	Taycan 4 Cross Turismo	Porsche	2022	5	$119,900	AWD
89	Taycan 4S Performance Battery	Porsche	2022	5	$130,200	AWD
90	Taycan 4S Performance Battery Plus	Porsche	2022	5	$136,560	AWD
91	VF8 Eco Enhanced Range	VinFast	2023	5	$54,990	AWD
92	VF9 Eco Enhanced Range	VinFast	2023	7	$79,990	AWD
93	XC40 Recharge Core	Volvo	2023	5	$59,950	AWD

Appendix 4: 2018 Repealed Ontario Building Code EV Readiness Details

In 2018, the OBC brought in EV charging requirements via Regulation O.Reg. 139/17 that required every new single detached, semi-detached and row townhouse to be provided with a rough in for the installation of future charging stations[13]. This program was repealed by the current Provincial government in 2019. That said, it offered some good insights on what municipalities could consider in their own GDS plans. For example, the 2018 repealed EV requirements in the OBC required buildings that are three stories or less to require electric vehicle charging in commercial workplace buildings with parking spaces in the buildings (this did not apply to MURB developments such as condominiums and apartment buildings). It was also required that not less than 20% of parking spaces be provided with charging stations and the remaining 80% of parking spaces be provided with rough ins for future installation of chargers. In addition to the EV charging requirements in new buildings, the Government of Ontario also provided incentives for the purchase of EV and PHEVs and financial support for EV charger installations in Ontario workplaces. This was also cancelled with the current government in 2018. The existing buyer incentive program, which provided up to $14,000 on the purchase of an EV. Other provinces (8) have buyer incentives. The government also removed a $2.5 million incentive program that helped homeowners install their own charging equipment. The government also removed EV charging station requirements in Ontario's building code (Syed, 2021).

[13] The rough-in was required to include: a minimum 200 amp panel board, a conduit that is not less than 1-1/16" (27mm) trade size; and a square 4-11/16" (119 mm) trade size electrical box.