



## Electric Vehicle and E-Mobility Research - Spring 2023

### Introduction

reThink Green is dedicated to educating our members and affiliates about the benefits of shifting to a Low carbon future.

The Government of Canada has announced its plans to ban the sale of gas-powered Light Duty Vehicles from 2035, with interim targets also set to gradually increase the uptake of Electric Vehicles (EVs) ahead of that deadline.

As an organization, reThink Green advocates for new and advanced active transportation strategies, plans, and projects which will support our shift towards a more multi-modal approach to Transportation; and which, will lead to more sustainable, accessible, and inter-connected communities here in Northern Ontario.

We also recognize there are factors which may discourage or even prevent some individuals, households, or organizations from making the shift, including:

- The prevailing culture associated with owning and driving a private vehicle.
- The geographical dispersion and population of rural communities.
- The limited availability of alternatives (rail, bus, cycle Lanes and sidewalks, etc.)
- The continued prominence of Highways Infrastructure planning; and
- New proposed investments which will encourage further additional car-based travel.

In this regard, this briefing note is intended to provide further information related to the roll out of Electric Vehicles and e-mobility vehicles more generally; highlighting ways that you and your business or organization can get involved.

### Electric Vehicles

The shift towards the adoption of Electric vehicles is rapidly taking shape in the Province of Ontario, which sees itself as a potential global market leader when it comes to the Design, Manufacture and Sale of EVs.

With these new sales regulations, experts predict Canada can expect to see around 395,000 New Light Duty Zero-Emission Vehicle Sales in 2026, all the way to 2 million Zero-Emission Vehicle Sales in 2035 and **12.4 million** on the road by **2035**. In addition, around 39,000 new Medium and Heavy-Duty Zero-Emission Vehicle Sales can be expected in 2030.

The IEA's Global Electric Vehicle Outlook estimates the number of electric cars, buses, vans, etc. will reach 145 million globally by 2030.

## Understanding the Difference Between Electric and Hybrid Vehicles

Electric and hybrid vehicles perform at around **90 percent** efficiency due to their high-efficiency energy conversion processes. Traditional gas-powered cars use internal combustion engines that are only **20 to 30 percent** efficient.

### Hybrid Electric Vehicles

Hybrid vehicles store energy in both their fuel tank and battery pack. One difference between hybrid vehicles is how the vehicle turns the power into propulsion or movement, which is called the powertrain. The powertrain and its efficiency will affect the vehicle's drivability, fuel economy, and purchasing price. There are three different types of hybrid vehicle classifications that are based on the differences in the powertrain:

- **Series Hybrid System** - These vehicles are like battery-powered vehicles in the sense that the only thing powering the wheels is a battery. The engine works in a narrow optimal range to deliver mechanical energy, which converts to electrical energy - which charges the battery. The battery then feeds energy to the motor, the axle, and the wheels. Additionally, when braking, mechanical energy from this is converted back to electrical energy and stored in the battery. This car's configuration is a better fit for stop-and-go scenarios caused by heavy traffic. Some common examples of the series hybrid vehicle are **BMW i3 extended range and the Fisher Karma**.
- **Parallel Hybrid Vehicles** - These types of hybrid vehicles use both battery and engine power for transmission in tandem. This leads to a smaller battery pack compared to the series hybrid system. The battery relies mostly on braking to regenerate the battery. This car's configuration is more efficient in high-speed driving. Some common examples of a parallel hybrid system are the **Honda Insight, the Land Rover Range Rover P400e, Hyundai Tucson Hybrid, the Hyundai Ioniq, and the BMW X5 530e**.
- **Series-Parallel Hybrid Vehicles** - These vehicles use a combination of both series and parallel configurations. These vehicles are very efficient hybrids that use the advantages of both types of powertrains. The series-parallel hybrid uses both a combustion engine and an electric motor connected to a mechanical transmission. The power use is distributed between both sources so that both run in their optimum operating regions. These cars are more complex, therefore sell at a higher price. Some common vehicles that have series-parallel configurations are the **Toyota Prius, Lexus Ct 200h, Ford Fusion Hybrid, and the Toyota RAV4**.

### Fully Electric Vehicles

Fully electric vehicles do not include a combustion engine and rely solely on energy from a battery pack. These cars must be charged to obtain power from the electrical grid, which is stored in their battery pack. These vehicles usually only have one electric machine as the propulsion source, such as front-wheel-drive or rear-wheel-drive.

Some other electric vehicles include two or three electric machines enabling them to be all-wheel-drive and more efficient energy use. The cars with three electric machines have a process known as **torque vectoring control**, which provides support in handling and braking the vehicle.

These vehicles would be great for those who live near **easily accessible charging stations** and do not drive **long distances** often. Investing in an electric car is a great way to keep pace with Canada's transition to greener vehicles.

The Canadian government supplies funding for electric vehicles such as the [Incentive for Zero-Emission Vehicles](#). The University of McMaster provides an article for buyers interested in electric/hybrid vehicles, which can be viewed [HERE](#).

## Electric Trucks

Creating functional electric commercial trucks is a hard process because of the nature of the vehicle. These vehicles must be able to drive long distances and sustain heavy loads. There are few companies that have tackled these obstacles and produced electrically powered trucks. Some are summarized as follows:

### Volvo Trucks

**Volvo Trucks** recently announced that its **Volvo FH Electric model** has successfully completed an independent energy efficiency test. The test was conducted on the Green Truck Route, which spans **343km** and was tested by German trucking journalist, Jan Burgdorf.

The Volvo FH Electric covered the distance at an average speed of **80km (about 49.71 mi)/h**, while having energy left over. The full range of the Volvo truck is estimated to be **345km (about 214.37 miles)**. Another important note is that the truck consumed about **1.1kWh/km** (or approximately **377 kWh** on this trip). The truck has a combined weight of **40 Tonnes** and includes a three-motor configuration (**390 kW**). The truck can store up to **540kWh**.

Volvo Trucks says that if this truck is charged during a lunch break it will be able to cover **500km** in one day. The charging time of this truck to reach full charge is **9.5h** with an AC (**43kW**) three-phase charger and **2.5h** with a DC (**250kW**) charger.

As a final touch to the truck, Volvo has added a "Ready to Run" feature that can be remotely controlled by an app, which ensures the batteries maintain a temperature of **+25°C** before the driver intends to turn on the vehicle. Volvo is working hard to meet its electrification goals by 2030 when half of its truck sales are predicted to be electric. For more information on the Volvo FH Electric, visit the website [HERE](#).

### Lion Trucks

Next is a relatively new company and producer of Trucks - Lion, which has developed an all-electric commercial truck that uses Lithium batteries and powers a **350kW** motor. The Lion 6 Truck stores up to **252kWh** in the battery and has a range of about **350kms (about 217.48 mi)**. The full charging time from a Level III charger is a minimum of **2 hours**.

Lion claims that switching to an electric commercial truck from diesel can create an **80% energy cost reduction and a 60% maintenance cost reduction**. The company has multiple other trucks on the market including the Lion8 and Lion5 in Tractor Versions. Lion trucks are said to have proven safety records, and lower total costs of ownership. For more information on these commercial trucks, visit the Lion website [HERE](#).

### **Good Food Market Corp**

Finally, there is the electrically powered refrigerated delivery truck from Goodfood Market Corp; also known as **Lightning Electric Class 3 Transit vans**.

In 2021, Lightning eMotors successfully deployed **10 all-electric cargo vans** in Montreal. The Goodfood trucks have an estimated range of **195km**, with an **86-kWh** battery pack. The truck uses regenerative braking for improved efficiency and can hit **120 km (about 74.56 mph)**.

The refrigerated trucks' cooling units have a capacity of **-15°C**.

For more information on these refrigerated electric cargo vans visit this website [here](#).

### **Plug 'n Drive**

[Plug 'n Drive](#) is a non-profit organization committed to accelerating the adoption of Electric Vehicles to maximize their environmental and economic benefits. It aims to provide a trusted and unbiased source of information on electric vehicles, charging stations, and the electricity sector.

Plug 'n Drive's **Electric Vehicle Discovery Centre (EVDC)** was the first facility of its kind in the world and provides an experiential learning environment for electric transportation. The purpose of the Centre is to:

- Help drivers better understand the environmental and economic benefits of electric transportation.
- Provide a one-stop-destination to test drive a wide variety of the latest EV models from leading manufacturers while being supported by Plug'n Drive's EV ambassadors.
- Provide unbiased information about electric cars in a sales-free, no-pressure environment.
- Help drivers make the transition from a gasoline / diesel car to an electric car that suits their lifestyle.
- Increase customer confidence in home and public charging by answering questions and exposing them to home charging solutions, and public charging maps/apps.
- Offer a unique event venue for professional and private events.

The Electric Vehicle Test Drive Zone is home to 9 different makes and models of electric car. **There is no cost to participate in a Test Drive session.**

The EV Test Drive Zone is also home to Four Level 2 Charging Stations provided by Autochargers.ca, and Flo - which are Plug N'Drive's Charging Partners in Canada. The EV Charger Stations are available for public use 24 hours a day, and 7 days a week.

## **EV 'Lunch and Learn' Program - Businesses and Organizations**

Plug 'n Drive also offers an 'EV Lunch and Learn' Session through which it encourages workplace and employee engagement on the uptake of EVs. Plug 'n Drive can send experienced outreach professionals **to your location** to provide an EV presentation, followed by exclusive EV Test Drives!

## **Electric Vehicle Roadshow - Communities**

Plug 'n Drive is also on a mission to increase public awareness of Electric Vehicles, through their participation in Trade Shows, Conferences and Community Events across the Province of Ontario. The [Electric Vehicle Roadshow](#) is an opportunity to bring EVs to a community near you!

## **EV Student Learning Program**

The EV [Student Learning Program](#) is designed to be a fun and informative learning experience which teaches your students about the environmental and economic advantages of electric transportation, and potential career opportunities in the growing EV Industry. The Student Learning Program covers:

- Science Discovery: How electric motors work, and how EV batteries work
- Environment Discovery: How EVs can reduce Greenhouse Gas Emissions
- Math Discovery: Calculating distance, electric range, charging speed, and travel time; and
- History Discovery: The History of Electricity, and the evolution of the Electric Vehicle

This program is delivered in accordance with the Ontario curriculum and is said to be a full and comprehensive introduction to electric vehicles and their benefits.

Further details on Plug 'n Drive can be found on their website [HERE](#).

## **Electric Motorcycles**

Electric Motorcycles appear the same as combustion engine motorcycles; however (like other EVs) electric motorcycles use electric engines powered by rechargeable battery packs to generate power. Buying an electric motorcycle can be beneficial when compared to gas-powered motorcycles. Crossroad Powersports lists some benefits of electric motorcycles over traditional motorbikes, including:

- They are environmentally friendly.
- They are less expensive to maintain.
- You may be able to access financial incentives to offset the cost of purchase.
- They are lightweight and easy to ride.
- They make less noise; and
- Are designed to be fast with more torque for rapid acceleration and easier control.

Visit the [Crossroad Powersports website](#) for more information.

There are also multiple electric motorcycle dealers, meaning it's important to make an informed decision when purchasing a new electric motorcycle. Here are some options for reference:

## Emmo E-Bikes

**Emmo E-Bikes** is a Canadian electrical bike dealership that sells motorcycles, scooters, and e-bikes. Its range of electric motorcycles can be viewed [HERE](#). Its motorcycles typically range from **\$2500 - \$4000** with an average range of **100-200km** range on full charge.

## Zero Motorcycles

Zero Motorcycles is an international motorcycle company based in America, that has been selling e-motorcycles since 2006. Zero Motorcycles has various options for sale, with a battery range between **140 - 301km**, and relatively short charging times from **1 to 4 Hours**. Zero Motorcycles also offers street and dual sport motorcycles. These bikes can reach speeds of **137-200km/h**. Check out Zero Motorcycle's website [HERE](#) for further information.

## Daymak

Daymak is a Toronto-based retailer which sells a fully electric, battery powered, and street-legal motorbike known as the Pithog Max. The model is powered by a **72V 32AH** Lithium-Ion Battery. You can view the product [HERE](#) for further details.

There are also some e-motorcycle dealers in Northern Ontario, including:

- **Sudbury E-Bikes** - which is located on the Kingsway, and sells e-bicycles, e-motorcycles, e-scooters, e-mobility devices, e-ATVs, and more. You can view Sudbury E-Bike's website [HERE](#).

## E-Bikes

E-Bikes are another great way to get around town while reducing your footprint. They are also becoming increasingly popular, with the Canadian Research firm Precedence Research suggesting the global e-bike market was valued at **US \$17.56 billion in 2021** and **projected to reach US \$40.98 billion by 2030**. For more information on these stats visit [this article](#).

E-bikes are also gaining popularity here in Northern Ontario. Last year, **Manitoulin Island Cycling Advocates (MICA)** received a grant to install e-bike charging stations and e-bike rentals, with seven municipalities receiving the stations. [This article](#) provides more information on Manitoulin Island's growing E-bike community. Listed below are some benefits of E-bikes for reference:

- E-bikes can attain high speeds with relatively little effort.
- They can also be used for exercise, and healthy outdoor living.
- E-bikes are easy to use and operate.
- You can go faster and further with an e-bike than a traditional bike - exploring more places within your range - with no parking costs.
- An e-bike can also allow you to bypass traffic.
- Some e-bike riders say they arrive to work or school, etc., more energized, and in a better frame of mind to start their day after a ride.
- E-bikes are an affordable option when in place of a car.
- The selling price is much cheaper, and you won't spend on gas.

- E-bikes can also be accessorized with cup-holders, phone holders, rear packs, rear-view mirrors, and more. Most of the accessories for regular bikes have been adapted for e-bike use.
- Communities of e-bikers are very prevalent on social media, and you can join these communities of like-minded, passionate people.

In addition, E-bikes do not require licensing as long as they still have pedals on them. To operate an e-bike in the Province of Ontario, the bike must have:

- A maximum assisted speed of 32 km/h
- A maximum weight of 120 kg (includes the weight of the bike and battery)
- An electric motor not exceeding 500 Watts.
- No modifications to the motor - which would allow it to exceed a power output greater than 500 watts and an assisted speed greater than 32 km/h.
- The battery and electric motor should be securely fastened to the bicycle frame to prevent them from moving while the e-bike is operating.
- All electrical terminals should be properly insulated.
- A minimum wheel width of 35 mm and a minimum diameter of 350 mm is required.
- Two independent braking systems are also required to apply force to each wheel, helping bring the e-bike to a complete stop while being operated at a speed of 30 km/h within 9 metres on a level asphalt surface, from the point of application.

For further information, check out the Provincial Government's website [HERE](#).

**Daymak** sells a range of E-Bikes which can be viewed [HERE](#).

**Bikeep** is a company that produces smart parking stations for use by your organizations' customers, visitors, and employees. These parking stations can lock E-bikes (controlled by an app) while also charging them. In Canada, TransLink has installed Bikeep's bike parking racks. The bike rack ensures your battery can be charged safely by keeping it in a locked compartment that only your app can lock and unlock. For more information on this innovative bike rack, visit the website [HERE](#).

## Other E-mobility Systems

### Electric Boat Motors

Boats have typically involved the use of gas-powered motors; however electric motors are becoming increasingly popular. A Swedish electric boat manufacturer Candela has released a new electric motor called the C-Pod, which is supposedly the highest-efficiency and most long-lasting motor ever. The C-Pod is designed to have an "almost unlimited lifetime", with a swift torpedo design that contains two electric motors. Each motor is located on the motor, with one on each side, and each drives a counterrotating propeller. The following image demonstrates this technology:



Figure 1: The C-Pod Motor, retrieved from [HERE](#).

C-Pods are 50kW motors that have a hydrofoil design. When a C-Pod is paired with Candela's 12-person P-12 hydrofoil water taxi, the boat can reach 30 knots (or 56km/h). These motors are said to be dependable and designed for both speed and durability. Candela's website can be viewed [HERE](#) and additional information on the C-Pod can be found [HERE](#).

### **Other Electrically Powered Vehicles**

There are many other promising electrically powered vehicles like scooters, stair-climbers, ATVs, skateboards, Vespas, and more. Many of these can be found through popular EV dealers. For example, some of the dealers linked above sell multiple different devices. Also, others like [Rosso Motors](#), and [Action Car and Truck Accessories](#) sell multiple different vehicles, like E-bikes, ATVs and other accessories.

### **Adapting the Workforce to Net Zero Transportation**

As our economy continues to transition to a low carbon future, the sale of electric and hybrid vehicles will continue to increase; and with this, the demand for additional employees to fill new jobs within the transportation sector.

Analysis produced by the Future of Canadian Automotive Labour Force estimates that almost 16,500 powertrain and transmission auto jobs will be created in the next few years. To support this shift, different levels of Government will need to find additional ways to support workers as they transition into these new positions. Upskilling workers for EV-type work is a highly important next step, and new programs and pathways will be required to ensure the readiness of the labour market. For more information on ways to prepare the workforce for EVs visit Electric Autonomy's website [HERE](#).

In addition, here is a micro credential you may want to investigate regarding this new EV Technology. This credential will teach you how to safely diagnose, maintain and service hybrid and electric vehicles. Visit QuickTrain [HERE](#) for further information.

### **Conclusion**

We hope you have found this guide to EVs and other e-mobility systems useful. Please Note: The examples provided are not exclusive, and there are many other examples to be found on the market which may be better suited to your needs.

If you're looking into buying an EV, E-bike, or some other form of e-mobility system, feel free to reach out to a member of Green Economy North for further assistance.