



MAY 2017

Driving EV Uptake in the Greater Toronto and Hamilton Area

How Driver Perceptions Shape
Electric Vehicle Ownership
in the GTHA



ACKNOWLEDGMENTS

This report is prepared by **Plug'n Drive**, a non-profit organization committed to accelerating the adoption of electric vehicles to maximize their environmental and economic benefits. Plug'n Drive has established itself as a leader in the electric vehicle industry, a trusted source of unbiased information on electric cars, charging stations, and the electricity sector. Plug'n Drive's four key pillars are public education and outreach, charging station infrastructure development, industry research and government policy development.

We gratefully acknowledge research contributions of: Dr. Josipa Petrunic, Executive Director of the Canadian Urban Transit Research & Innovation Consortium (CUTRIC), Research Now, Peter Christie, Science Communication, and Dav Cvitkovic, G3P Consulting for their research, writing and editing contributions.

Special thanks to the Advisory Group members for their guidance throughout the project:

David Adams, Global Auto Makers
Eli Angen, Pembina Institute
Angelo Boschetti, Toronto Hydro
Cecilia Fernandez, City of Toronto
Ian Klesmer, The Atmospheric Fund

Francois Le Favre, Nissan Canada
David Murphy, Mitsubishi Motors Canada
Phil Pestinis, General Motors
Dr. Josipa Petrunic, CUTRIC
Marc Vejgman, Ford of Canada

The market research and report would not have been possible without the generous support of our funders. We thank and acknowledge the following organizations for their contributions:



Report design by **Up Marketing**

© Copyright May 2017 by Plug'n Drive. Permission is granted to the public to reproduce or disseminate this report, in part, or in whole, free of charge, in any format or medium without requiring specific permission. Plug'n Drive takes sole responsibility for the content of this report.

TABLE OF CONTENTS

Executive Summary	4
Market and Policy Overview	6
Survey Methodology	9
Survey Findings	10
Recommendations	12
References	15



EXECUTIVE SUMMARY

Transportation is the largest source of greenhouse gas (GHG) emissions in Ontario, and electrification of Ontario's vehicles is critical to reducing GHGs from this sector and achieving the province's ambitious climate change goals. This report describes findings from the first comprehensive survey of driver attitudes and beliefs regarding electric vehicles (EVs) in the Greater Toronto and Hamilton Area (GTHA), Canada's largest and fastest growing urban region.

Commissioned by Plug'n Drive and conducted by Toronto-based polling company Research Now, our survey of 1,000 gasoline-powered car owners and 192 EV owners across the GTHA clearly supports the premise that widespread adoption of these new and largely unfamiliar vehicles is impeded by multiple barriers, both real and perceived. Strategies are needed to improve:

1. Driver perceptions of the cost of EVs in light of generous purchase incentives;
2. Knowledge of EV travelling range relative to average daily driving distance of GTHA car owners;
3. Awareness of the importance of individual car buying choices in driving down GHG emissions.

Effective implementation of these strategies could help accelerate the uptake of EVs and pave the way to a lower carbon future for the GTHA and beyond.

Key Findings and Recommendations:

1 Get the word out about EV incentives

Finding: Perceived hefty EV prices are the main reason current gasoline-powered car owners say they don't drive electric, but according to our survey, few know about incentive programs that might tip the affordability balance. Ontario's current EV buyer incentives of up to \$14,000 are substantial enough to bridge the gap in spending expectations of many gasoline-powered car owners.

Recommendation: The Ontario government and vehicle manufacturers should collaborate to raise public awareness of available purchase incentives through a coordinated information campaign.

2 Emphasize long-term cost savings from EVs

Finding: EV owners in the GTHA understand that the upfront costs of a new EV are offset by lower fuel and maintenance costs over time. On average, EV owners save \$1,900 per year in operational costs compared to gasoline-powered car owners – or \$17,100 over a typical nine-year car ownership.¹ However, gasoline-powered car owners seem to be unaware of these significant financial benefits.

Recommendation: Awareness campaigns to improve EV knowledge should emphasize the "total cost of ownership" – a figure that includes purchase price, fuel costs and maintenance over the entire ownership period of a vehicle.

3 Tackle the myths behind "range anxiety"

Finding: "Range anxiety" – or the fear that EVs will run out of power during a trip – is frequently cited by gasoline-powered car owners as a reason for not going electric. However, surveyed EV owners reported that they actually travel farther and more frequently than gas car owners. This holds true for both work and leisure car trips.

Recommendation: Consumer-focused education should make gasoline-powered car owners aware that an EV's travel range is more than enough to meet the daily demands of most GTHA drivers – and that one weekly charge is sufficient for the average driver.

4 Connect car choice and climate change

Finding: Almost a third of gasoline-powered car owners in the survey didn't believe that switching to an EV would affect GHG emissions in the GTHA, and almost half don't believe a similar worldwide transportation switch would help to mitigate climate change. On the other hand, EV owners believe their personal choice of vehicle does make a difference.



Recommendation: Awareness campaigns should emphasize that an individual's car-buying choice and car-driving habits can really make a difference in terms of reducing GHG emissions.

5 Make EV infrastructure a priority

Finding: Surveyed EV drivers lamented the lack of public charging stations and EV-designated parking spots. Likewise, few condos and workplaces offer EV charging stations.

Recommendation: All levels of government, developers and Business Improvement Areas should focus on expanding EV charging infrastructure in the GTHA as a priority. EV-only parking space rules also need to be enforced to allow easy access to existing EV charging stations.

6 Recruit EV ambassadors

Finding: Most EV owners in the GTHA bought their first EV after being introduced to one by a trusted colleague, friend or relative. EV owners overwhelmingly tend to be satisfied with their EV experience, and are therefore enthusiastic and effective EV ambassadors.

Recommendation: Manufacturers and dealers should leverage peer-to-peer consultation and information sharing, combined with an incentivized referral program.

CONCLUSION

If implemented effectively, the recommendations flowing from our survey would both highlight and reinforce the value proposition of EVs and create the spark needed to accelerate their wider adoption in the GTHA.

MARKET AND POLICY OVERVIEW

Introduction

To prevent GHGs from pushing global warming beyond 2°C – a threshold of irreversible harm – the International Energy Agency (IEA) estimates that 40% of new vehicle sales worldwide must be plug-in EVs by 2040 (with most remaining vehicles fueled by biofuels).² Ontario still has a long way to go on this path, but early action is critical. The province's transportation sector is responsible for more than one-third of the province's greenhouse gases (GHGs). A 2015 Plug'n Drive report suggests that modestly increasing EVs share of annual new car sales from less than 1% current market share to 5% in 2020 (14,161 EVs in Ontario) would reduce the province's GHG emissions by as much as 222,000 tonnes by 2020.²

CO₂ INCREASING EVS' SHARE OF NEW CAR SALES TO 5% IN 2020 WOULD REDUCE ONTARIO'S GHG EMISSIONS BY 200,000+ TONNES.

EVs—including plug-in hybrid EVs powered by electricity and gasoline (PHEVs) and battery EVs powered solely by electricity (BEVs) – can significantly cut emissions compared to gasoline-powered vehicles (depending on the local electricity grid mix). In Ontario, drivers can slash their vehicle's GHG emissions by up to 90% simply by swapping their compact, full-size or mid-size gasoline-powered car for a comparable EV.³

However, despite their environmental benefits, EVs still made up less than 1% of new Canadian vehicle sales in 2016.⁴ As of December 2016, the total number of EVs in Canada was just shy of the 30,000 mark,⁵ a fraction of a percent of all vehicles on Canadian roads. In Ontario, with almost 14 million residents,⁶ drivers owned 9,179 registered EVs at the end of December 2016.⁷ As a solution to cutting GHGs from traffic, EVs currently remain too few to make a significant difference.⁸

PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV)

A PHEV is a partially electric vehicle that carries two types of fuel on board: (1) a carbon fuel (e.g. gasoline or diesel); (2) electrical energy stored in a battery pack. PHEVs are charged by plugging into the grid through a regular or upgraded electrical outlet and by regenerative braking, which converts the forward motion of the car into electricity on board. A PHEV can operate in "EV mode", meaning the car operates on electricity alone. The EV "range" – in kilometres – achieved by a PHEV depends on the size of the car's battery pack (among other factors). A PHEV can also operate in "hybrid mode", which means the gasoline or diesel engine or generator on board works in tandem with the battery and motor to power the vehicle. Examples of PHEVs include the Chevy Volt, the Toyota Prius Plug-in Hybrid, the Ford CMax and the BMW i3 (range extended model).

BATTERY ELECTRIC VEHICLE (BEV)

A BEV is a 100% electric vehicle. It carries no carbon fuel (e.g. gasoline or diesel) on board. The only "fuel" available on board is electricity stored in a battery pack. BEVs are charged by plugging into the main electrical grid system through a regular or upgraded electrical outlet. BEVs can also be charged by regenerative braking, which converts the forward motion of the car into electricity. Examples of BEVs include the Nissan Leaf, the BMW i3, the Chevy Bolt, the Ford Focus EV and the Tesla Model S.



Barriers to EV Adoption

While many Canadian drivers show interest in EVs,⁹ our research identified various obstacles that keep most car buyers from driving one home.¹⁰ Some of these obstacles—described as **supply-side barriers**¹¹—reflect the difficulty in finding an EV at a new car lot in Canada¹² or the limited availability of different models.¹³ In addition, many car dealers simply appear not to know much about them.¹⁴ Supply-focused government policies—such as zero-emissions vehicle (ZEV) standards or low-carbon fuel standards—can help.¹⁵ Recent federal Corporate Average Fuel Economy (CAFE) standards in the U.S. led to a surge in EV interest and development by U.S. automakers beginning in 2011. They require cars, SUVs, minivans and light trucks to be twice as fuel efficient as 2010 model years (on average) by 2025.¹⁶

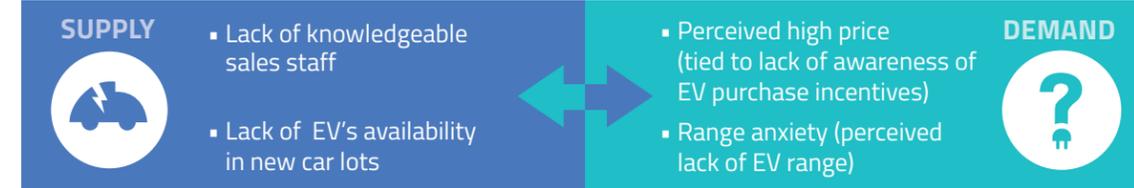
Demand-side barriers to EV uptake are the other important part of the equation. Achieving wide-

spread acceptance of these new and largely unfamiliar vehicles depends mainly on improving consumer perceptions of EVs.¹⁷ For example, concerns regarding cost and insufficient range could help explain why most drivers still steer clear of EVs when buying a new car in Canada.¹⁸ On the other hand, factors that improve driver perceptions of EVs could help pave the way to a lower carbon future for transportation.

Our survey of gasoline-powered car drivers and EV drivers in the GTHA sheds light on these barriers and suggests how they can be overcome.

The widespread introduction of EVs throughout the GTHA will be important in driving down Ontario's transportation-related GHG emissions. The GTHA is currently home to more than 6 million Canadians, and the population is expected to grow to 8.6 million by 2031.¹⁹

COMMON BARRIERS



EV Policies and Incentives in Canada and Ontario

The decisions of car buyers can be affected by public policy. A 2015 study, for example, found that BC's EV purchase rebate strongly influenced the purchase decisions of about half of the province's EV owners.²⁰

As of October 2016, 62 policies were in place to improve EV sales across Canada, and another 26 had been proposed.²¹ Yet according to a 2016 assessment²², the combined effect of these policies is unlikely to push EVs to account for more than 5% of all new vehicle sales in the country by 2040—well below the International Energy Agency's EV target of 40% of the global market. As a result, much more needs to be done to accelerate the uptake of EVs in Canada.

Most Canadian EV policies exist at the provincial level²³ and aim to influence car-buyer choice (i.e., to address demand side barriers).²⁴ Among the most effective demand-side policies are substantial, enduring financial incentives for EV buyers and high gas taxes and/or carbon pricing to deter consumers from purchasing another gasoline-powered car.

Ontario was the first province in Canada to offer purchase incentives to EV buyers beginning in 2010.²⁵ Currently, drivers can receive up to \$14,000 for buying a new EV.²⁶ From 2011 to 2015, Ontario also launched six programs to support new EV chargers in homes and to install more along public roads. In June 2016, Ontario announced its Climate Change Action Plan which aims to ensure 5% of new passenger vehicles sold each year are powered by electricity or low-carbon fuels by 2020.²⁷ The plan calls for new buildings to be EV-ready and proposes free overnight charging for EV drivers, among other EV-friendly measures.²⁸ In January 2017, Ontario also began applying a price on carbon as part of the cap-and-trade program.²⁹ The carbon price is expected to ramp up over time, increasing the cost of gasoline and making EVs more economically attractive.

On the supply side, zero-emissions vehicle mandates such as the one in Quebec encourage carmakers to sell more EVs, and rank among the most effective policies.³⁰



PLUG 'N DRIVE DISCOVERY CENTRE

The Ontario government is supporting Plug'n Drive's new EV Discovery Centre (EVDC) in north Toronto. Opening in May 2017, the EV Discovery Centre is the first facility of its kind in the world focused entirely on providing an experiential learning environment for electric vehicles. At this one-stop-shop, visitors will learn about Ontario's Climate Change Action Plan and the role electric cars play in reducing greenhouse gas (GHG) emissions. Visitors will learn about the environmental and economic benefits of EVs and the electricity system that powers them. Finally, visitors will have the opportunity to test drive EV models from leading manufacturers in a family-friendly sales-free environment, to see first-hand how an EV can fit into their life.

The EVDC is located at Dufferin and Finch in the DUKE Heights area (1126 Finch Ave. W. North York). This location presents several advantages, including easy access to major highways 400, 401 and 407, a diverse business community that includes everything from small independently owned stores to international corporations, subway, bus and GO Train access and visibility to over 34,500 drivers per day.

The EVDC is a public-private partnership between Plug'n Drive, the Government of Ontario, TD Bank, Ontario Power Generation, Power Workers' Union, Toronto Hydro, Bruce Power and the auto and charging station sectors.

SURVEY METHODOLOGY

Plug'n Drive commissioned a survey of GTHA drivers to shed light on their attitudes towards EVs and the most prominent motivators and barriers – whether real or perceived – to further adoption. Respondents included 1,000 people from across the GTHA who own a gasoline-powered car, as well as 192 residents of the region who own an EV.³¹

The survey was conducted via email by the private research firm Research Now³² in October 2016. Non-EV owners were identified through Research Now's network of GTHA survey participants. The vast majority of EV owners were identified by Plug'n Drive directly through its own regional network. The study comprised an anonymous survey to gather quantitative data accompanied by more descriptive "survey queries" for in-depth, qualitative analysis.³³

Among gas car owners, the survey controlled for gender and age distribution to ensure a standard distribution of Non-EV Owners against which a "naturally occurring" – uncontrolled – distribution of EV Owners could be compared. The number of participants in this survey results in general margins of error as follows:

- Entire sample set margin of error 2.9 per cent (19 times out of 20)
- Non-EV Owners cohort margin of error 3.16 per cent (19 times out of 20)
- EV Owners cohort margin of error 7.23 per cent (19 times out of 20)



🔌 SURVEY HIGHLIGHTS



Price: The top reason gas car owners choose not to purchase an EV is price by a wide margin. 31% of respondents believe EVs are too expensive. The second reason, range anxiety, came in a distant second at 13%.



Incentives: Only 5% of gas car owners are knowledgeable about Ontario's incentive program.



Motivation: Concern for the environment is the main reason for EV owners to drive an electric car (36%). Unfortunately, the link between climate change and individual vehicle choice is not understood by roughly 30% of conventional car owners.



Driving Behaviour: EV Owners drive farther and more frequently on a daily basis. On average, EV owners commute approximately 14km more a day than gas car owners - 46km vs 32km. 60% of EV owners drive up to 60km per day. Additionally, more than 25% of EV Owners commute more than 60 km per day and 12% commute more than 100km per day.



Education: While a large share of both groups holds undergraduate degrees, almost 40% of EV owners hold a graduate or professional graduate degree with a concentration in engineering and technology-related fields.



Age: The plurality of EV owners are 30-39 years old (27% of sample), with 40-49 and 50-59 years old age bands each representing 20% equally. This might indicate a higher generational willingness to adopt a new technology.

KEY SURVEY FINDINGS

■ **Price is the main barrier to buying an EV:** When gasoline-powered car drivers in the region were asked why they didn't buy an EV, their high price tag was the most cited reason (almost a third of the time). Concerns about their range (the distance they can travel on a charge) and the inconvenience of charging them were the next most frequently cited reasons for not purchasing an EV (13% and 12%, respectively). Other notable objections included limited choice (8%), being unable to afford any new car (8%), not knowing enough about EVs (7%), and a general sense that EVs are an "immature" or "unproven" technology (5%) and not to be trusted.

■ **Gas car owners know little about EV rebates and incentives:** Among gasoline-powered car owners in the survey, only 5% of respondents said they were "knowledgeable" and 61.6% said they "know nothing" about government incentives to encourage the purchase of an EV. Further, almost 70% said they "know nothing" about incentives to support the purchase of EV charging systems ("electric vehicle supply equipment" or EVSE).



61.6% OF THOSE SURVEYED SAID THEY "KNOW NOTHING" ABOUT GOVERNMENT INCENTIVES TO ENCOURAGE THE PURCHASE OF AN ELECTRIC VEHICLE.

By comparison, more than half of EV owners said they know "a great deal" about EV purchase incentives and more than 40% indicated they know "a great deal" about charging system rebates. More than 70% took advantage of Ontario's EV buyer's rebates, receiving an average of \$7,200 in purchase incentives. Almost half said they also used the provincial rebate for installing EVSE at home. However, the reason that some EV buyers did not take advantage of the rebates was not explored in the survey process and needs to be better understood.

■ **The environment is the main reason EV owners drive electric:** Drivers who currently own EVs in the region cited environmental benefits (36% of the time) most frequently as their top reason for doing so. Almost a quarter of EV owners attributed their decision to the lower cost of charging and maintaining EVs. Other reasons included the desire

for a positive driving experience (12%), wanting to support "advanced technology" (9%), perceived ease of use (8%), and the likelihood of low maintenance responsibility (5%).

■ **EV owners drive farther and more often:** The concept that "range anxiety" – or the fear that a battery electric car will not suffice to accommodate an individual's travel or commuting needs – has often been cited as a challenge to EV ownership. Surprisingly, EV owners drive farther and more frequently across the region than gas car owners – for both work and leisure, according to the survey.



SURPRISINGLY, EV OWNERS DRIVE FARTHER AND MORE FREQUENTLY ACROSS THE REGION THAN GAS CAR OWNERS.

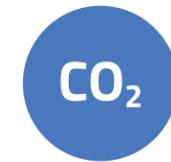
EV owners are about 20% more likely than gas car owners to drive "very frequently" on a daily basis and are more likely to commute farther overall (an average of 46 km/day versus an average of 32 km/day for gasoline-powered car owners). More than a quarter of EV owners commute farther than 60 km/day, whereas only 12.5% of gas-powered car owners commute this distance.

Leisure driving is similar: EV owners, according to the survey, are more likely to drive their cars, and drive farther, than gas car owners on the weekend (an average of 47 km/day versus an average of 36 km/day).

■ **EV owners in the GTHA tend to be well educated, higher-income, tech-savvy and male:** More than two thirds of the EV owners in the region are male. EV owners are more educated—typically with a university education and nearly 40% with a graduate or professional degree—than the generally well-educated population of gas car owners in the GTHA. Many EV owners have professional jobs in business and finance or health, while more than 25% work in engineering and technical sciences. Gas car owners in the survey, meanwhile, tend to work in business and finance, health, education, and sales. A larger proportion of gas car owners are retired. EV owners tend to have a higher disposable income, with average household incomes of \$114,300 compared

to \$83,100 for the gasoline-powered car owners surveyed in our study. EV owners are also more likely than other drivers to live in a house rather than a condo or an apartment, and they have more people living in their home. Meanwhile, most gasoline-powered car owners are more suburban while EV owners are more urban, mainly clustered in Toronto and North York. On average, gas car owners have lived in the GTHA for longer than EV owners.

■ **Most GTHA drivers know burning gas affects the climate; EV owners believe EVs can help:** More than 80% of EV owners and more than 70% of gas car owners in the GTHA believe conventional cars, trucks and other fossil-fuel-burning transportation solutions emit GHGs and contribute to climate change. Yet, gas car owners in the region are much less likely than EV owners to think that vehicle purchasing decisions can have a significant effect on global warming. Barely half of gasoline-powered car owners think switching to EVs worldwide would help mitigate global warming, while more than three-quarters of EV owners believe a widespread shift to electric transportation is an important climate change solution.



BARELY HALF OF GASOLINE-POWERED CAR OWNERS THINK SWITCHING TO EVS WORLDWIDE WOULD HELP MITIGATE GLOBAL WARMING.

■ **Gas car owners are willing to pay less up-front and more on the road:** About two-thirds of gasoline-powered car owners in the GTHA say they intend to pay less than \$30,000 for their vehicle (about \$24,800 on average). More than half of current EV owners, meanwhile, intend to pay \$30,000 or more (\$33,800 on average) for their car. Vehicle prices above \$50,000 are within the spending expectations for more than 15% of current EV owners, but fewer than 5% of gasoline-powered car owners. The story, however, is different on the road: Drivers of EVs expect to pay a lot less in fuel costs. Almost half of current EV owners in the GTHA say if they were to buy a gas-powered car, they would buy one with a fuel economy rating of 6.0L/100km or better. More than a quarter expect their new car to use 4.0L/100km in fuel (which only an EV can achieve

today in Canada). Meanwhile, less than 15% of gasoline-powered car owners are committed to buying a vehicle with a fuel economy rating of 6.0L/100km or better, and more than a quarter weren't sure what fuel economy they expected from their car.

■ **EV buyers are introduced to EVs by others, and they do their homework, too:** More than 40% of interviewed EV owners were introduced to EVs by a friend, a relative or a colleague before owning one. About nine out of ten gas car owners, on the other hand, had never been exposed to an EV before buying their cars. The survey found that more EV owners (80%) than gas car owners (62%) perform online searches to find new vehicle information prior to taking one home from the dealership.

■ **EV owners are happy with their cars and loyal to their choice and brand:** The region's EV owners sampled in this survey reported high levels of satisfaction with all aspects of their vehicles—including range and battery performance, noise levels, driving experience, and maintenance—but were less happy with the availability of charging stations on public roads, at condos, and in parking lots. Almost 70% of drivers currently driving EVs are "very likely" to buy or lease another EV in the future. Conversely, only 33% of gasoline-powered car owners describe themselves as "unlikely" or "very unlikely" to purchase an EV in the future. This suggests a willingness among most GTHA residents to consider an EV down the road even though they do not own one today – assuming that any major concerns they have regarding EVs can be adequately addressed.



RECOMMENDATIONS FOR GOVERNMENT AND INDUSTRY

1 Get the word out about EV incentives

The higher upfront cost of EVs represents the most commonly-cited barrier to buying one, but according to our survey few gas car owners know about incentive programs that might tip the affordability balance. Gasoline-powered car owners say they are prepared to pay (on average) about \$25,000 for a new car. With the average price of an EV currently around \$40,000, EV buyer incentives must be substantial enough to bridge this gap in spending expectations to appeal to EV-hesitant buyers. Today's incentives of \$14,000 in Ontario can essentially close this gap.

The Ontario government should initiate an awareness campaign to make more drivers aware of these incentives. The campaign should emphasize that the rebate programs put EVs firmly within range of a typical car buyer's budget. The Ministry of Transportation (MTO) should promote Ontario's EV incentive program to car owners directly, for example through license renewal mailings, online information, as well as brochures at Service Ontario locations and kiosks throughout the province.

EV manufacturers and dealers must consistently educate consumers about the rebates available and lend expertise in terms of the rebate administration process with MTO. These steps would increase consumer awareness of how cost-competitive EVs have recently become.

2 Emphasize the long-term cost savings from EVs

EV owners in the GTHA do the math; they realize that an EV's upfront costs can be offset through government incentives plus savings on fuel and maintenance down the road. In fact, EV owners in Ontario save approximately \$1,900 per year on these operational costs compared to gasoline-powered cars, which may cost a lot more in the long run.

Recent research suggests that communicating the "total cost of ownership"—a figure that includes the upfront vehicle price as well as fuel and all other costs over the entire ownership period—can increase the likelihood that drivers of small and

mid-sized cars buy a conventional hybrid, plug-in hybrid, or a battery-electric vehicle.³⁴ Government and industry-led awareness-raising efforts that emphasize total cost of ownership figures for popular EV models would help increase interest in purchasing EVs among gas car drivers in the GTHA. To highlight the important fuel savings potential of EVs, government and utilities should reinforce the low costs of charging overnight through mailings, online ads, bill inserts, etc. The advantage of overnight charging is poised to improve further as the provincial government plans to introduce free overnight charging across Ontario³⁵.

3 Tackle the myths behind "range anxiety"

Among the top reasons gas car owners in the GTHA avoid driving EVs is the worry that their cars will run out of power before they reach their destination. However, EV owners in the region actually travel farther and more frequently than gasoline-powered car.



THE AVERAGE CANADIAN DRIVER WOULD ONLY NEED TO CHARGE AT HOME ONCE PER WEEK.

Consumer education could include efforts to make gasoline-powered car owners aware that an EV's range of travel is more than enough for typical GTHA drivers. Gasoline-powered car drivers travel an average of 32 km daily; this distance is well within the capability of all EVs in the marketplace today. In fact, the average Canadian driver would only need to charge at home once per week with a fully charged EV going the distance of 200+km on a single charge. While the existing infrastructure would allow for driving such daily distances, government and industry are investing in more public charging infrastructure to give people the comfort and confidence to drive an EV. Further strategic expansion of public, workplace and street charging stations will help to overcome the psychological barriers associated with range anxiety. Additionally, it will increase the convenience for EV drivers who charge up for everyday use and for special, long-haul trips.

4 Connect car choice and climate change

Almost a third of gas car owners in the survey don't believe that switching to EVs will affect GHG emissions in the GTHA, and almost half don't believe a similar worldwide transportation switch would help mitigate climate change. Furthermore, barely two-thirds of this group believe they have any personal role at all in cutting GHGs or in mitigating climate change. EV owners, on the other hand, say concern for the environment is their number one reason for driving electric. Meanwhile, the scientific link between driving EVs and reducing climate-altering gases is clear (even considering the carbon-intensive manufacturing of these electric cars³⁶).



EVS IN ONTARIO PRODUCE UP TO 90% FEWER GHG EMISSIONS THAN GASOLINE-POWERED CARS.

Awareness campaigns should emphasize the important role of individual car-buying choices and driving habits to reducing GHGs and slowing the rise of atmospheric temperatures that threaten our planet, our lives and livelihoods. Drivers need to know that EVs in Ontario produce up to 90% fewer GHG emissions than gasoline-powered cars. A coordinated effort amongst eNGOs, government, academia, and industry is required to increase awareness of the positive environmental impact of EVs and programs that support EV adoption. Gas car owners believe climate change is real, but they need to internalize their personal role in mitigating climate change through the electrification of transportation. Education and training programs targeted at dealers, consumers and youth about the environmental impacts of EVs will help to close this knowledge gap. Climate change will bring economic and environmental challenges as well as opportunities, and those who have an understanding of climate science and the role of EVs in combating climate change will be better prepared to respond to both. As well, youth who are not yet car owners will be in a position to make enlightened choices without being pre-disposed to a gas car and are more comfortable with new technology. Furthermore, youth may become motivated to pursue advanced

education and/or a career that supports a revolutionary clean economy.

5 EV infrastructure: Make chargers and EV parking spots a priority

Prior research suggests that drivers who are aware of public EV chargers seem no more likely to buy an EV than those who are not.³⁷ Nevertheless, current EV owners in the GTHA from this study think more chargers are needed. Many in this survey said that installing charging stations would help businesses attract EV-driving clientele. Toronto-area condos with chargers could similarly attract EV-owning condo buyers. Owners of EVs also said that EV-only parking spaces should be enforced, and fines levied, against other drivers who block EV charging stations. In addition, universal standards for high visibility signage should be implemented for reserved EV spaces. The MTO must increase awareness and monitoring of standards to ensure EV owners benefit as intended.

The City of Toronto and other municipalities in the GTHA should develop a comprehensive charging strategy that includes charging stations at city-owned lots and a campaign to advertise them. Municipal tax offsets could encourage malls and other large properties to put chargers in place as well.



MUNICIPALITIES IN THE GTHA SHOULD DEVELOP A COMPREHENSIVE CHARGING STRATEGY THAT INCLUDES CHARGING STATIONS AT CITY-OWNED LOTS AND A CAMPAIGN TO ADVERTISE THEM.

The installation of workplace charging stations needs to become a policy priority for government by offering charger installation rebates to companies. While it is a relatively new phenomenon in Canada, it offers significant upside potential for employers. Employers also enjoy multiple benefits from workplace charging infrastructure: it can serve as an employee recruitment and retention tool, enhance a company's environmental and sustainable image, and contribute towards LEED certification. It can also enable conversion of corporate fleets to EVs, leading to operational savings. In addition, employees benefit from convenience and reduced concerns about range.

Regarding multi-residential charging infrastructure, there is recognized value in codes and standards to make it easier to plug in. Changes to the municipal and provincial building codes and the Ontario Condo Act to require “roughing in” for charging infrastructure (as done in Vancouver for example) are an important step. Municipal governments should engage with property management firms and condo boards to prepare their parking garages for EVs. Additionally, Plug’n Drive proposes to host education seminars and best practice sharing at the Electric Vehicle Discovery Centre to engage and educate various stakeholders on multi-residential charging.

6 Recruit EV ambassadors

Most EV owners in the GTHA bought their EV after being introduced to EVs by someone else. Most say they took one for a drive first. These same EV owners are overwhelmingly EV supporters—both committed to buying another EV when they need a new car and loyal to their EV brand. Research suggests people who are open to change are more likely to develop sustainability-oriented values (such as interest in buying an EV) if, among other things, they experience positive social support for these values.³⁸ Efforts to raise awareness and improve perceptions of electric vehicles should consider methods that employ existing EV owners as goodwill ambassadors, promoting low-carbon transportation and its social, economic and environmental benefits. For example, installing workplace charging alone might not entice employees to make the switch to EVs. Education and experiential elements are also needed to allow employees to understand the value and benefits of EVs. Evidence suggests that an employee is six times more likely to buy an EV after learning about the benefits from a workplace colleague³⁹. EV ambassadors, such as those in Plug’n Drive’s EV Owners Club, need to be recruited and leveraged to conduct lunch-and-learn sessions at their workplaces to encourage their peers to switch to EVs. Plug’n Drive proposes to scale up its EV Owners Club by targeting large, high technology and engineering firms with head offices in the GTHA to roll out employee engagement campaigns.

In addition, putting theory into practice at the new Plug’n Drive EV Discovery Centre, members of the EV Owners Club will assist on weekends and evenings, offering peer-to-peer consultation and information sharing. Furthermore, an incentivized referral

program, modelled after Tesla’s, could create the spark needed to push car buyers to the EV tipping point. The structure of the program could take the form of a cash credit or gift in kind (product offering) depending on the type of referral.

CONCLUSION

Our first-of-its-kind study in the GTHA shows that there is tremendous potential for broad EV uptake in the region – if government and industry address a number of barriers and misperceptions. Among the most encouraging finding is the fact that current EV owners are happy with their vehicle choices. As many of them were influenced by peers and first-hand EV experience, they can create a multiplier effect if they are recruited as EV ambassadors.

The number one barrier for increased EV uptake is the perception that EVs are still not affordable for most car owners. This is tied to a lack of awareness around provincial purchase incentives that can effectively close the affordability gap.

EV economics and the long-term cost savings are not well understood. Again, the identified knowledge gap should be addressed to make the business case for EVs clear to Ontario’s drivers.

Unfortunately, a significant portion of gas car drivers don’t seem to grasp the link between their vehicle choice and their impact on climate change. Highlighting the emissions savings from EVs and the link to Ontario’s energy mix will go a long way in overcoming this misperception.

This should go hand-in-hand with prioritizing public charging infrastructure and reserved EV parking spots.

From Ontario’s attractive EV purchase incentives to manufacturers’ increasing EV selection and Plug’n Drive’s newly opened EV Discovery Centre, a number of stakeholders are laying the groundwork for increased EV adoption in the GTHA. But our findings make it clear that additional steps from government and industry are needed to truly accelerate EV uptake in the region.

FOOTNOTES

- Papoff, 2014. *Wheels.ca* <http://www.wheels.ca/news/most-canadians-keep-their-cars-for-nine-years-or-more-desrosiers/>
- International Energy Agency 2015
- Plug’n Drive 2015
- Axsen, Goldberg & Melton 2016
- Fleetcarma 2016
- Statistics Canada 2016
- Fleetcarma 2016
- Rezvani, Jansson & Bodin 2015
- Axsen, Goldberg & Melton 2016
- Egbue & Long 2012
- Axsen, Goldberg & Melton 2016
- Bauman, Hacikyan & Stevens 2015; Cloet et al. 2014
- Matthews et al. 2017
- Consumer Reports 2014
- Axsen et al 2015
- Office of the Press Secretary, The White House 2012
- Krause et al. 2013; Rezvani, Jansson & Bodin 2015; Schuitema et al. 2013
- Axsen et al. 2015
- Metrolinx 2012
- Axsen et al. 2015
- Axsen, Goldberg & Melton 2016

- Axsen, Goldberg & Melton 2016
- The carbon pricing policy of the federal government announced in October 2016, meanwhile, is expected to have only “a modest impact.” The proposed plan insists on a price on carbon pollution starting at a minimum of \$10 per tonne in 2018 and rising by \$10 a year to reach \$50 per tonne in 2022.
- Axsen, Goldberg & Melton 2016
- Axsen, Goldberg & Melton 2016
- Ontario Ministry of Transportation 2016
- Government of Ontario 2016
- Axsen, Goldberg & Melton 2016
- Ontario Ministry of the Environment and Climate Change 2017
- Axsen, Goldberg & Melton, 2016
- The total sample set margin of error for the survey was 2.9% (19 times out of 20), while the gasoline-powered car owners sample margin of error was 3.16% (19 times out of 20) and the EV owners sample margin of error was 7.23% (19 times out of 20).
- Research Now. <https://www.researchnow.com/>
- The qualitative analysis of the survey data used NVivo qualitative data analysis software. QSR International. <http://www.qsrinternational.com/>
- Dumortier et al. 2015
- Ontario Ministry of the Environment and Climate Change, 2016
- Hawkins et al. 2013
- Bailey, Miele & Axsen. 2015
- Axsen & Kurani. 2013
- Oleksak, 2015

REFERENCES

- Axsen, J., Goldberg, S., Bailey, J., Kamiya, G., Langman, B., Cairns, J., Wolinetz, W., & Miele, a.2015. Electrifying Vehicles: Insights from the Canadian Plug-in Electric Vehicle Study. Vancouver: Simon Fraser University. 201 pp. Accessed on January 20, 2017 online at [http://rem-main.rem.sfu.ca/papers/jaxsen/Electrifying_Vehicle_\(Early_Release\)-The_2015_Canadian_Plug-n_Electric_Vehicle_Study.pdf](http://rem-main.rem.sfu.ca/papers/jaxsen/Electrifying_Vehicle_(Early_Release)-The_2015_Canadian_Plug-n_Electric_Vehicle_Study.pdf)
- Axsen, J., Goldberg, S., & Milton, N. 2016. Canada’s Electric Vehicle Policy Report Card. Simon Fraser University: Vancouver, B.C.
- Axsen, J., & Kurani, K. 2013a. Hybrid, plug-in hybrid, or electric—What do car buyers want? *Energy Policy* 61:532-543
- Axsen, J., & Kurani, K. 2013b. Developing sustainability-oriented values: Insights from households in a trial of plug-in hybrid electric vehicles. *Global Environmental Change* 23: 70–80.
- Bailey, J., Miele, A., & Axsen, J. 2015. Is awareness of public charging associated with consumer interest in plug-in electric vehicles? *Transportation Research Part D* 36: 1–9.
- Bauman, J., Hacikyan, S. & Stevens, M. 2015. Ease of Purchasing EVs in Canada: Final Report for Environment Canada. Waterloo: FleetCarma. 44 pp.
- Consumer Reports. 2014. Dealers not always plugged in about electric cards, Consumer Reports’ study reveals. Accessed on January 20, 2017 online at <http://www.consumerreports.org/cro/news/2014/04/dealers-not-always-plugged-in-about-electric-cars-secret-shopper-study-reveals/index.htm>.
- Dumortier, J., Siddiki, S., Carley, S., Cisney, J., Krause, R. M., Lane, B. W., Rupp, J. A., & Graham, J. D. 2015. Effects of providing total cost of ownership information on consumers’ intent to purchase a hybrid or plug-in electric vehicle. *Transportation Research Part A: Policy and Practice* 72: 71-86.
- Egbue, O., & Long, S. 2012. Barriers to widespread adoption of electric vehicles: An analysis of consumer attitudes and perceptions. *Energy Policy* 48: 717–729.
- Fleetcarma. 2016. Electric Vehicle Sales in Canada: Q3 2016 Update. Accessed on January 20, 2017 online at <http://www.fleetcarma.com/ev-sales-canada-2016-q3/>
- Government of Ontario. 2016. Ontario’s Climate Action Plan. Accessed on January 20, 2017 online at <https://www.ontario.ca/page/climate-change-action-plan>.
- Hawkins, T.R., Singh, B., Majeau-Bettez, G., & Strömman, A.H. 2013. Comparative environmental life cycle assessment of conventional and electric vehicles. *Journal of Industrial Ecology* 17: 53–64.
- International Energy Agency. 2015. Energy and Climate Change World Energy Outlook Special Report (OECD/IEA, 2015). Paris: International Energy Agency. 200 pp. Accessed on January 20, 2017 online at <https://www.iea.org/publications/freepublications/publication/WEO2015SpecialReportonEnergyandClimateChange.pdf>.
- Krause, R.M., et al. 2013. Perception and reality: Public knowledge of plug-in electric vehicles in 21 US cities. *Energy Policy* 63: 433-440.
- Matthews, L., Lynes, J., Riemer, M., Del Matto, T., & Cloet, N. 2017. Do we have a car for you? Encouraging the uptake of electric vehicles at point of sale. *Energy Policy* 100: 79–88.
- Metrolinx. 2012. The Big Move. Accessed on January 20, 2017 online at http://www.metrolinx.com/thebigmove/en/introduction/1_2_GTHA.aspx.
- Plug’n Drive. 2015. Electric Vehicles: Reducing Ontario’s Greenhouse Gas Emissions. Accessed on January 20, 2017 online at <https://plugndrive.ca/sites/default/files/Electric%20Vehicles%20-%20Reducing%20Ontario's%20Greenhouse%20Gas%20Emissions%20-%20A%20Plug'n%20Drive%20Report.pdf>.
- Office of the Press Secretary, The White House. 2012. Obama Administration Finalizes Historic 54.5 mpg Fuel Efficiency Standards, in Consumer savings comparable to lowering price of gasoline by \$1 per gallon by 2025. Accessed on January 20, 2017 online at <https://obamawhitehouse.archives.gov/the-press-office/2012/08/28/obama-administration-finalizes-historic-545-mpg-fuel-efficiency-standard>.
- Oleksak, Sarah, U.S. Department of Energy, EV Everywhere Workplace Charging Challenge, Mid-year review 2015. <https://energy.gov/eere/articles/workplace-charging-challenge-mid-program-review-promising-progress-us-employers>
- Ontario Ministry of the Environment and Climate Change. 2017. Cap and trade in Ontario. Accessed on January 20, 2017 online at [http://www.forms.ssb.gov.on.ca/mbs/ssf/forms/ssfforms.nsf/GetFileAttach/023-2096E-3/\\$File/2096E_Guide.pdf](http://www.forms.ssb.gov.on.ca/mbs/ssf/forms/ssfforms.nsf/GetFileAttach/023-2096E-3/$File/2096E_Guide.pdf).
- Ontario Ministry of Transportation. 2016. Electric Vehicle Incentive Program (EVIP) Guide. Accessed on January 20, 2017 online at [http://www.forms.ssb.gov.on.ca/mbs/ssf/forms/ssfforms.nsf/GetFileAttach/023-2096E-3/\\$File/2096E_Guide.pdf](http://www.forms.ssb.gov.on.ca/mbs/ssf/forms/ssfforms.nsf/GetFileAttach/023-2096E-3/$File/2096E_Guide.pdf).
- Rezvani, Z., Jansson, J., & Bodin, J. 2015. Advances in consumer electric vehicle adoption research: A review and research agenda. *Transportation Research Part D* 34: 122–136.
- Statistics Canada. 2016a. Motor vehicle registrations, by province and territory. Accessed on January 20, 2017 online at <http://www.statcan.gc.ca/tables-tableaux/sum-som/I01/cst01/trade14a-eng.htm>
- Statistics Canada. 2016b. Population by year, by province and territory. Accessed on January 20, 2017 online at <http://www.statcan.gc.ca/tables-tableaux/sum-som/I01/cst01/demo02a-eng.htm>



PLUG 'N DRIVE

The Electric Vehicle Discovery Centre

1126 Finch Ave. W., Unit 1, North York, ON M3J 3J6

647.717.6941 • PLUGNDRIVE.CA

