



## 23.1 Major Developments in 2017

### 23.1.1 National Developments

#### Pan-Canadian Framework

In December 2017, the Government of Canada along with provincial and territorial governments released the first annual synthesis report on the status of the Pan-Canadian Framework (PCF) on Clean Growth and Climate Change. As part of this work, federal, provincial and territorial governments committed to modernize transportation systems through new emission standards for vehicles, a plan for establishing retrofit requirements for heavy-duty vehicles, and a strategy to put more zero-emission vehicles (ZEVs) on the road. In addition, governments are enhancing investments in lower-emitting public transportation and electric and alternative fuel vehicle charging and refueling infrastructure.<sup>25</sup>

The PCF aims to achieve Canada's international commitments in the Paris Agreement and confirms the commitment of Canada's First Ministers to implement policies in support of meeting or exceeding Canada's 2030 target to reduce greenhouse gas (GHG) emissions by 30 % below 2005 levels while transitioning Canada to a stronger, climate resilient, low carbon economy.

Under the PCF, federal, provincial and territorial governments also committed to work with industry and stakeholders to develop a Canada-wide ZEV strategy, to be released in 2018. The ZEV strategy will build on existing programs and policies to meet 2030 emission reduction targets. A sectoral Advisory Group comprised of government, industry, academia, and other stakeholders was established to develop options for addressing the key barriers that are preventing the broader deployment of ZEV technologies.<sup>26</sup>

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<sup>25</sup> Government of Canada. "Pan-Canadian Framework on Clean Growth and Climate Change: First Annual Synthesis report on the Status of Implementation". December 2017.

<sup>26</sup> Transport Canada. "National Zero Emission Vehicle Strategy". [https://www.canada.ca/en/transport-canada/news/2017/05/government\\_of\\_canadatodevelopanationalzero-emissionsvehiclestrat.html](https://www.canada.ca/en/transport-canada/news/2017/05/government_of_canadatodevelopanationalzero-emissionsvehiclestrat.html) Accessed: January 26, 2018.

Also in 2017 after consultations, the Government of Canada published a regulatory framework on a new clean fuel standard. The clean fuel standard aims to reduce GHG emissions through the increased use of lower carbon fuels, energy sources, and technologies. Consultations will continue in 2018 with the intent of publishing regulations in mid-2019<sup>27</sup>.

Finally, work is underway to ensure carbon pricing applies across Canada. Some jurisdictions have carbon pricing systems in place while others are working to develop and implement pricing systems. In the event that jurisdictions do not have a pricing scheme in place by 2018, a federal backstop system will apply that will ensure that carbon pollution pricing applies in every province to a broad set of emission sources with increasing stringency over time<sup>28</sup>.

### **Investing in Electric Vehicle and Alternative Transportation Fuel Infrastructure**

The 2016 federal budget allocated 48.3 million USD over 2 years to Phase I of the Electric Vehicle and Alternative Transportation Fuels measures in order to support the demonstration of next-generation electric vehicle (EV) charging infrastructure and the deployment of charging infrastructure for EVs, as well as refueling infrastructure for alternative transportation fuels, such as natural gas (NG) and hydrogen (H<sub>2</sub>).

The Demonstration Program supports the use of innovative and next generation EV charging infrastructure technologies in real-world applications such as multi-unit residential buildings (MURBs), workplaces, and public transit, where market failures are preventing the development and commercialization of new charging technologies. Upon the successful completion of projects (some of which have been extended to 2020), the Demonstration Program is expected to result in over 200 next-generation EV charging stations which include Level 2 (240V AC) and DCFC (direct current fast-charge).

The aim of the Deployment Initiative is to increase the number of EV fast charging stations along Canada's highways, NG refueling stations along key freight corridors, and H<sub>2</sub> refueling stations in strategic urban centers. In 2018, upon successful completion, this initial investment will result in the deployment of over 100 new publically accessible EV fast chargers, 7 NG and 3 H<sub>2</sub> refueling stations

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<sup>27</sup> Government of Canada. "Clean Fuel Standard". <https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-standard.html>, Accessed: February 7, 2018.

<sup>28</sup> Government of Canada. "Technical paper: federal carbon pricing backstop". <https://www.canada.ca/en/services/environment/weather/climatechange/technical-paper-federal-carbon-pricing-backstop.html>, Accessed: February 07, 2018.

in 7 provinces. Budget 2017 announced an additional 61 million USD over 4 years (starting in 2018) in support of Phase II of the EV and Alternative Fuel Infrastructure Deployment Initiative, to further deploy NG refueling stations along key freight corridors, establish H<sub>2</sub> stations in key metropolitan areas, and to bolster Canada's coast-to-coast EV fast charging network. An additional 23 million USD was also allocated over 4 years for Phase II of the EV Infrastructure Demonstration Program to support new and innovative EV infrastructure projects. Finally, 7 million USD was allocated to the development of supporting codes and standards for electric and alternative fuel vehicles, as well as charging and refueling infrastructure.

### **Leading by Example, Greening our Government Fleets**

In December 2017, the Government of Canada released an aggressive strategy to reduce emissions from all Government operations, including facilities and fleets. This strategy includes commitments to adopt low-carbon mobility solutions, deploy supporting infrastructure in its facilities, and modernize its fleet. Starting in the 2019-2020 fiscal year, 75 % of new light-duty administrative fleet vehicle purchases will be ZEVs or hybrid, with the objective that the Government's administrative fleet comprises at least 80 % ZEVs by 2030. Priority is to be given to purchasing ZEVs. Also starting in the 2018-2019 fiscal year, all new executive vehicle purchases will be ZEVs or hybrids. To assist all federal departments in succeeding in this commitment, the Government is coordinating across all departments to help collect and analyze the energy usage of vehicles in their fleets, and determine the lowest emitting option that continues to meet their operational needs. This includes identifying options for electrification, fuel switching, fleet right sizing, and fuel-efficient driver training.

### **Encouraging Innovation with the Smart Cities Challenge**

In 2017, the Government of Canada launched the first phase of the Smart Cities Challenge. The challenge will award 60 million USD in 2018 to 4 communities. Eligible recipients include municipalities, regional governments, and indigenous communities. The Challenge encourages communities to improve the quality of life for urban residents through better urban planning, the implementation of clean, digitally connected technology including greener buildings, smart roads and energy systems, and advanced digital connections for homes and businesses.

### 23.1.2 Provincial Policies and Incentives

#### British Columbia<sup>29</sup>

British Columbia (B.C.) has a multitude of policies and programs to accelerate the deployment of low-emission vehicles within the province.

In 2017, the provincial government launched its 30 million USD Specialty-Use Vehicle Incentive program. The funding aims to accelerate the deployment of electric and H<sub>2</sub> vehicles and expand refueling infrastructure. Over 20 million USD will be available for vehicle purchase incentives. In addition to incentives for light-duty and low speed vehicles, rebates are available for medium and heavy-duty vehicles, airport and port specialty vehicles, and forklifts. The goal of the program is to stimulate the sale of clean energy vehicles where by 2020, five percent of new light duty vehicle sales in B.C. will be clean energy vehicles. The remaining funding will enhance charging and H<sub>2</sub> infrastructure across the province by expanding fast charging, workplace charging, and charging at MURBs. The province's first of six public H<sub>2</sub> refueling stations is also expected to open in 2018.

The BC Scrap-It program also provides an incentive of 2,500 USD to vehicle owners that scrap an aging fossil fuel powered vehicle in favor of a more fuel-efficient vehicle. The program was enhanced in 2017 to increase the incentive to 4,500 USD when scrapping an older vehicle and purchasing a new EV, and 2,250 USD when purchasing a used EV. Other financial incentives are available to encourage public transit, active transportation, and ride sharing. The BC Scrap-It Program incentives can be combined with incentives for the purchase of clean energy vehicles up to 8,250 USD.

#### Manitoba

The Government of Manitoba and the City of Winnipeg formed a joint task force to investigate the viability of deploying electric transit buses in the provincial capital. A number of electric buses and overhead chargers are being tested on routes that were typically serviced with diesel buses. Preliminary results of the demonstration reveal that the electric buses reduce operating costs (fuel and maintenance), reduce environmental impacts, and enhance energy security and price predictability. While a number of obstacles exist (high capital cost of electric versus diesel buses), there is a case for larger scale deployments in a transit setting.

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<sup>29</sup> B.C. Government. "CEV for BC". 2017.

<https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/transportation-energies/clean-transportation-policies-programs/clean-energy-vehicle-program/cev-for-bc>, Accessed online: February 20, 2018.

### **Newfoundland**

In 2017-18, the province established an EV working group consisting of representatives from the provincial government, municipalities, Newfoundland Power, Newfoundland and Labrador Hydro, and industry. This group is assisting in the development of the province's policy approach for increasing the market penetration of EVs in Newfoundland and Labrador moving forward.

The provincial government also launched the Vehicle Efficiency and Cost Calculator (VECC) to inform consumers about the costs and benefits associated with purchasing a fuel-efficient and alternatively powered vehicle. The VECC provides calculations for both EVs and those that run on gasoline or diesel. The VECC allows users to compare different vehicles to estimate their costs of ownership and impact on the environment by inputting information such as the vehicle type, purchase price, repayment structure, fuel consumption rating, and annual kilometers driven.

### **Ontario<sup>30</sup>**

On July 11, 2018, the newly elected government of Ontario announced that it was terminating its electric vehicle incentive program that provided up to 10,500 USD on eligible electric and hydrogen vehicles, as well as its electric vehicle infrastructure programs targeted at expanding electric vehicle infrastructure in Ontario.

The government has committed to provide an update on its plan to address climate change in the fall of 2018.

### **Québec<sup>31</sup>**

The Government of Québec aims to have 100,000 PHEVs and EVs on Québec roads by 2020. To support this goal, the province announced a multitude of initiatives in 2017, as described below.

Regulations were published that will provide consumers with more EV and PHEV vehicle choices. Starting with model year 2018, regulations will establish EV/PHEV sales targets for each reporting vehicle manufacturer. The legislation requires manufacturers to sell an increasing percentage of EVs and PHEVs over time. In the event that manufacturers do not comply, they will be able to purchase “credits” from other manufacturers to meet their mandated sales thresholds. With

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<sup>30</sup> Government of Ontario, “Climate Change Action Plan”, 2016. <https://www.ontario.ca/page/climate-change-action-plan>, Accessed online, February 19, 2018.

<sup>31</sup> Government of Québec. “Propelling Québec Forward With Electricity: Transportation Electrification Action Plan 2015>2020”. 2015. ISBN 978-2-550-73274-7.

this new measure, manufacturers will be motivated to offer more models and to use low-carbon technologies.

In addition, new regulations enable eligible EV, PHEV, and hydrogen fuel cell vehicle (HFCV) owners to obtain a green license plate. These vehicle owners will be exempt from paying the additional annual registration fees for luxury vehicles that applies to the portion of a vehicle's value between 30,000 USD and 56,000 USD.

A new outreach program (Electrifying Encounters) was also launched that will allow employers and employees to try a variety of EVs and to learn more about EV technologies from industry experts. Four hundred thousand motorists from across the province are expected to participate in the program.

In addition to these measures, the Government of Québec offers incentives to encourage the uptake of electric and H<sub>2</sub> cars and trucks and electric school buses. Programs and incentives also exist to expand charging infrastructure along major routes, to increase the availability of charging infrastructure at workplaces and for residents of MURBs.

### **23.2 HEVs, PHEVs and EVs on the Road**

Increased consumer awareness, greater availability of charging infrastructure, improvements in vehicle technology, more PHEV and EV choices offered by the vehicle manufacturers, purchase incentives offered by provinces, and infrastructure supports from all levels of government, have all contributed to an increase in plug-in vehicle sales in Canada in 2017.

As Table 1 illustrates, at the end of 2017, Canada had almost 25,000 EVs on the road, 23,000 PHEVs, and over 200,000 HEVs. There are almost 23 million light-duty vehicles on Canadian roads<sup>32</sup> where EVs, PHEVs and HEVs now represent just over 1 % of Canada's total light-duty fleet.

Year over year sales of EVs increased by almost 100 % in 2017 (9,838 versus 5,130), whereas sales of PHEVs increased by almost 50 % (8,730 versus 5,893). The sale of both EVs and PHEVs totaled 18,568 vehicles, representing a 68 % increase over 2016 sales of 11,000 vehicles. Canadian light-duty vehicle sales in

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<sup>32</sup> Statistic Canada, "Annual Vehicle Registrations", <http://www5.statcan.gc.ca/cansim/a267?lang=eng&retrLang=eng&id=4050004&pattern=&stByVal=1&p1=1&p2=37&tabMode=dataTable&csid>, Accessed: February 16, 2018

2017 totaled 2,038,600<sup>33</sup> units where EVs, PHEVs, and HEVs represented over 2 % of new vehicle sales.

Table 1: Distribution and sales of EVs, PHEVs and HEVs in 2017<sup>34</sup>

Fleet Totals on 31 December 2017					
Vehicle Type	EVs	PHEVs	HEVs	FCVs	Total
Passenger Vehicles	24,748	23,040	211,019	n.a.	26,308,468 <sup>1</sup>
Total Sales during 2017					
Vehicle Type	EVs	PHEVs	HEVs	FCVs	Total
Passenger Vehicles	9,838	8,730	24,962	n.a.	2,038,600

<sup>1</sup> Fleet total estimated from 2016 registration data and 2017 vehicle sales  
n.a. = not available

Table 2 illustrates the top selling EVs and PHEVs in Canada in 2017. In both the EV and PHEV categories, Chevrolet led the way with the Bolt and Volt product offerings.

Table 2: 2017 Top Three Selling Plug-in Vehicles in Canada

EV Models	# of EVs sold	PHEV Models	# of PHEVs sold
Chevrolet Bolt	2,107	Chevrolet Volt	4,340
Tesla Model X	1,803	Chrysler Pacifica	838
Tesla Model S	1,675	Toyota Prius Prime	734

In terms of geographic distribution of plug-in vehicle sales in Canada, provinces that offer consumers purchase incentives for low emission vehicles have the highest sales. Over 7,000 EVs and PHEVs were sold in both Ontario and Québec, whereas British Columbia witnessed sales of 3,200 vehicles. Table 3 provides a list of some of the EVs and PHEVs for sale in Canada and their estimated pricing.

<sup>33</sup> DesRosiers Automotive Consultants Inc. "Automotive Reports: Market Snapshot December 2017".

<sup>34</sup> Schmidt, Eric. Fleetcarma: "Electric Vehicle Sales in Canada, 2017". <https://www.fleetcarma.com/electric-vehicle-sales-canada-2017/>, Accessed: February 14, 2018.

Table 3: Available vehicles and prices in Canada (Data source: based on Manufacturers Suggested Retail Price as advertised on manufacturer websites; Note 1 USD=1.25 CAD)

Market-Price Comparison of Selected EVs and PHEVs in Canada	
Available Passenger Vehicles	Untaxed, Unsubsidized Sales Prices (in USD)
Audi A3 e-tron	36,720
BMW i3	40,800
BMW i3 Rex	44,400
BMW i8	122,400
BMW 330e	40,960
BMW X5 xDrive/40e	60,000
Chevrolet Bolt	34,400
Chevrolet Volt	31,200
Chrysler Pacifica Hybrid	31,200
Ford Focus Electric	22,400
Ford C-Max energy	22,000
Ford Fusion energi	28,000
Hyundai Sonata Plug-in	35,200
Karma-Revero	124,800
KIA Soul EV	28,800
KIA Optima Plug-in	28,000
Mercedes GLE-550e 4Matic	67,200
Nissan Leaf	27,200
Smart Fortwo Electric Drive	23,200
Tesla Model S 100 D	97,500
Tesla Model X 100D	105,700
Toyota Prius Prime	26,400
VW e-Golf	29,200

### 23.3 Charging Infrastructure or EVSE

Due to initiatives by the federal, provincial, and municipal governments, as well as, utilities and private firms, public charging infrastructure is continuing to grow in Canada.

As shown in Table 4, there were approximately 5,843 EVSEs in Canada in 2017, of which 5,168 were Level 2 (240V AC), 483 were DCFC, and 190 were Tesla Superchargers. This represents a 38 % increase in public charging infrastructure

installations across Canada compared to 2016. Most of the newly installed charging infrastructure was in British Columbia, Ontario, and Québec, however, there was also a notable increase in other provinces such as in Alberta and New Brunswick.

It is important to note that there are no requirements by respective jurisdictions to register EVSEs as they are installed. As a result, tracking of operational Level 2, Level 3 and Tesla Supercharger stations is performed through the issuance of service contracts to collect the charger information, or through voluntary reporting by charging network owners and managers, as well as end users. Level 1 (120V AC) EVSEs are not reported on since this infrastructure typically relates to charging via a residential wall outlet.

Table 4: Information on charging infrastructure in 2017<sup>35</sup>

Charging Infrastructure on 31 December 2017	
Chargers	Quantity
AC Level 1 Chargers	n.a.
AC Level 2 Chargers	5,168
Fast Chargers	483
Superchargers	190
Inductive Charging	n.a.
<b>Totals</b>	<b>5,843</b>

n.a. = not available

## 23.4 EV Demonstration Projects

### 23.4.1 Enhanced Charging Infrastructure via Vehicle Side Data

Natural Resources Canada is providing 2.6 million USD to CrossChasm Technologies Inc. to demonstrate that the collection and analysis of real-world vehicle charging data, such as battery state and all charge events, will improve the operation and the deployment of EV charging infrastructure. This will be accomplished by monitoring data on the vehicle side through a logging module installed for the project duration.

The results and analytics will be widely disseminated and enable Canadian utilities and policy makers to identify where grid overloading may occur, as well as where grid and charging infrastructure upgrades are required. Research will also provide

<sup>35</sup> Natural Resources Canada, "Electric Charging and Alternative Fuelling Locations"

decision-makers with tools to successfully deploy EV charging infrastructure at workplaces and MURBs.

### **23.4.2 Demonstration of Next Generation Integrated Smart Infrastructures for Charging Electric Vehicles**

Approximately 5.4 million USD will be provided to AddÉnergie Technologies Inc. to develop and demonstrate new and innovative EV charging technologies. Activities include: the development of next generation EV fast charging stations; exploring a monthly subscription based charging business model; and installing street-side charging in five major Canadian cities.

### **23.4.3 EV Charging Stations across Trans-Canada Highway (TCH) – Ontario and Manitoba**

Funding of 6 million USD will be provided to Fast Charge TCH. The objective of this project is to demonstrate an EV fast charging network using battery storage across the Trans-Canada Highway that can serve as an example for rural areas that have low-power grid connections. The network will include 34 locations, connecting northern Ontario to the Manitoba-Saskatchewan border along the inter-provincial national highway.

### **23.4.4 TransLink Electric Bus Demonstration and Integration Trial**

South Coast British Columbia Transportation Authority (TransLink) will receive approximately 1 million USD to install, operate and maintain two high-powered, overhead bus charging systems with one on-route and an in-depot charging solution to support four electric buses.

The project, which is part of a pan-Canadian initiative led by the Canadian Urban Transit Research and Innovation Consortium (CUTRIC), will integrate more than one bus manufacturer and more than one charging system provider, allowing to assess bus and charging station cross-compatibility, as well as to evaluate the performance of electric buses and overhead chargers in a Canadian transit setting. A third party will gather, validate, and share data and intellectual property emanating from the trial regarding charging episodes, powertrain performance, vehicle and charging system ruggedness, and durability. Data will be disseminated to the wider Canadian community of transit and utility systems and will result in improving the performance, charging speed and safety of DCFC systems associated with overhead electric bus hardware.

### 23.4.5 High Voltage Utility Connected Level 2 Electric Vehicle Charging Demonstration

British Columbia Hydro and Power Authority will receive approximately 0.9 million USD for a novel Level 2 EV charger aimed at MURBs, and large commercial and municipal buildings. In this project, the transformer would be integrated into the charger, which will eliminate the need for the designated transformer reducing space requirements in the meter room, reduce the number of conduits and wiring, and improve the EV charger system's performance and reliability, while also reducing costs. The space savings would be especially beneficial for charger installations in older buildings. A smart utility meter will be integrated into the charger to allow for individual metering and billing, as well as remote monitoring.

### 23.4.6 Next Generation EV Charging Infrastructure

British Columbia Institute of Technology (BCIT) will receive approximately 0.8 million USD to demonstrate EV charging solutions destined for the urban environment. The project will demonstrate curbside charging using existing streetlight infrastructure, and provide charging infrastructure in commercial outdoor parking lots by leveraging the existing lighting systems. The project will also demonstrate a load-management system and user interface to emulate a MURB, and an open, non-proprietary communication protocol to improve interoperability between charging technologies from different vendors.



Figure 1: Streetlight integrated, curbside charging in front of a MURB in the City of New Westminster, British Columbia (Source: BCIT)



Figure 2: Simulation of MURB EV charging using a load-management system at the OASIS (Open Access to Sustainable Intermittent Sources) installation at the BCIT campus (Source: BCIT)