Electric Mobility Canada | Mobilité électrique Canada

DRIVING THE RAPID ADOPTION OF ELECTRIC VEHICLES IN CANADA

A position paper from Electric Mobility Canada, outlining the benefits of plug-in electric vehicles (PEVs), the current status of PEVs in Canada, their benefits, and what is needed to realize Canada's advantage in the green-auto economy

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1. SUMMARY

Canada has an unusually broad range of core competencies in all areas of transportation electrification—from battery development, to electric-vehicle (EV) systems integration, to battery management and power-management systems. Until most recently, the sum of these signalled our country's potential to lead North America in the adoption of plug-in electric vehicles (PEVs) for sustainable green transport. Canada is also uniquely positioned—based on our supply of electricity from renewable sources – to power PEVs from green electrons. This is a challenge for our US neighbours whose electricity is mostly generated from fossil fuels (coal and natural gas).

Canada's potential primacy in PEVs will now be hard to achieve as other jurisdictions—the U.S., among several others—implement the kind of policy and funding commitments that are already enticing i) original equipment manufacturers (OEMs) to develop and manufacture PEVs, and ii) consumers to buy them. Viable PEVs are coming to the marketplace in 2011 and onward. If Canada doesn't support EV-industry growth and consumer adoption, manufacturers have indicated that they will focus their efforts in jurisdictions that are becoming PEV ready. This will have implications for Canadian consumer access to these vehicles, and for home-grown Highly Qualified Personnel (HQP) and prosperity in PEV component technology development (e.g., batteries) and PEV production.

This threat of lost-opportunity cost for Canada and Canadians must be countered by the Government of Canada's commitment to early PEV adoption: made-in-Canada consumer incentives programs, charging-infrastructure funding and incentives programs, and OEM support and loan programs. In addition, Canada has a primary role to play in ensuring harmonization of codes and standards for PEV charging, across jurisdictions in Canada; with the U.S., given our integrated auto sector in North America; and with other countries that are driving an international PEV agenda.

In Canada, the ramped-up level of commitment and collaboration among OEMs and public utilities, demonstrated through work on new electric-code standards and PEV demonstration projects that strive to expand our understanding of PEVs, have resulted in the development of this

position paper. This paper proposes a three-year plan to accelerate the first phase of Canada's electric-transportation sector in the shorter term—through federal public-policy actions and support. Now is the time for the Government of Canada to secure an opportunity-gain for our country.

2. INTRODUCTION

Canada is well positioned to capitalize on the very near-term transformation to electric mobility, as an alternative to traditional transportation energy—a transformation demonstrated by auto-sector PEV launch commitments across a range of jurisdictions. With our significant amounts of clean and renewable energy and a growing PEV industry, the Canadian auto industry is well placed to be a major supplier of PEV components and vehicles, not only for domestic use, but also for export. PEVs will contribute to sustainable-energy development as well as contributing to air quality and climate change improvements. The market for PEVs in Canada will grow as Canadians look for cleaner, more efficient vehicles.

Further, timely and effective commercialization of PEVs demands that Canada link its PEV technical and promotional efforts with those of its primary auto-market partner, the U.S., in our integrated North American automotive industry. For example, the OEMs and component suppliers, including battery designers and developers in Canada, are generally past the research-and-development (R&D) stage and are in the early stages of commercialization. This is a key stage in the adoption of new technology, in which financial support from government agencies is critical to bridge the gap to full- scale commercialization.

These commercialization and promotion efforts overall are prioritized for government support in Section 9 of this document. They include the further development of advanced batteries, a charging infrastructure, , codes and standards and incentives, as well as public education, and fostering the growing consumer acceptance of electric light-duty vehicles.

2.1 Environmental Impact—Market Potential

There are nearly 20 million passenger cars and light-duty trucks in Canada. Annual sales are in the order of 1.5 million vehicles. Virtually all these vehicles operate on fossil fuels as their energy source, except a small number converted to alternate fuels or electric drive.

Electric traction, characterized by plug-in hybrid (PHEVs) and battery-electric vehicles (BEVs), is set to transform the auto industry in the coming years. This transformation has already begun, with the first phase of international PEV launch plans (either PHEVs or BEVs) scheduled for 2011. All G8 nations, except Canada, have adopted aggressive policies and financial incentives (see Section 7 for details) to accelerate the adoption of this disruptive new technology. A new study by a consortium of 30 international organizations has suggested that for the G8 leaders to achieve the overall 80-percent decarbonization goal set for 2050, a portfolio of advanced power trains will be needed, including electric PEVs and fuel-cell vehicles (FCVs).

Light-duty vehicles are currently responsible for 75 percent of vehicle kilometres travelled in Canada. These vehicles contribute roughly 18 percent of all greenhouse gas (GHG) emissions in Canada, with transportation in total contributing 25 percent—an increase of 37.5 percent in emissions since 1990. Converting the light-duty vehicle marketplace to electric traction is, therefore, and currently an important manufacturing priority and activity in the auto sector.

2.2 Building the PEV Infrastructure in Canada

Collaboration between OEMs and Canada's major utilities is essential to the deployment of electric vehicles. This required collaboration is occurring on many levels in all G8 nations and, despite lack of formal national policy on PEV adoption, Canada is no exception. In fact, collaboration between OEMs and Canadian utilities is unprecedented and ongoing, notably through the deployment of electric vehicles in demonstration projects in major urban areas across the country.

This position paper defines where electric-vehicle deployment, policy and adoption stand in Canada at the end of 2010; the productivity gap between policy and a realized Canadian PEV

industry; and the EMC's proposed federal-government actions, phased in over three years, to close the gap.

3. TYPES OF ELECTRIC VEHICLES

The best-known PEVs are vehicles powered from the grid while in motion. Electric trains, street-cars and trolley buses are examples. In another type, the power for the electric vehicle's motor is generated on board (as in the hybrids seen on the roads today), or by a fuel cell.

This document focuses on yet another type, the Plug-in Electric Vehicle (PEV), whereby electricity is generated away from the vehicle through plug-in infrastructure, but stored on the vehicle in a battery or other storage device. This is found in Plug-in Hybrid Vehicles (PHEVs) and Battery Electric Vehicles (BEVs), both included in the term Plug-in Electric Vehicles (PEVs). Data suggests that these PEVs may offer, in the near term, the best opportunity to replace ICE-propelled vehicles on the road today, including many personal automobiles and smaller commercial vehicles. While fuel-cell technology is seen as promising, its general availability in the short term is unlikely because of the lack of distribution infrastructure and other development issues.

The simplest type of PEV is the BEV, which is propelled only by one or more electric motors powered from a battery, charged from the grid when the vehicle is stationary. The second type is a BEV with a range-extender. This BEV is powered like other BEVs; however, the range-extender, a small on-board internal combustion engine (ICE), drives a generator that can drive the electric motor or charge the battery, or both, when the energy in the battery that has been gained from charging from the grid has been depleted. The third type of PEV, the PHEV, is propelled by an electric motor or an ICE, or both. Its battery can be charged from the grid while the vehicle is stationary, or on-board from a generator powered by the vehicle's ICE. PHEVs are similar to hybrid vehicles on the road today, except for one big difference: their larger batteries can be charged from the grid.

The batteries in all three types of PEVs can also be charged by what is known as *regenerative braking*: the energy of motion is transformed into electrical energy, thereby further increasing the efficiency of electric traction.

4. NATIONAL AND INTERNATIONAL BENEFITS OF ELECTRIC VEHICLES

4.1 Why the transition to electric vehicles?

Some decades from now most land transportation will be propelled by electric motors, rather than by ICEs. Currently, ICEs provide almost 100 per cent of the propulsion. The transition and transformation, just beginning in North America and elsewhere, is occurring for a range of compelling reasons. These include:

- **Limited supply and high cost of oil.** Only 15 percent of Canada's population is energy self-sufficient in the petroleum-based transportation sector. There is a growing understanding that the petroleum-based fuels that power ICEs – chiefly gasoline and diesel fuel – are becoming more expensive or in more limited supply, or both. Canada is among a handful of countries that are well endowed with resources for producing these fuels. Nevertheless, the country is exposed to price and scarcity challenges, in a sector that is a primary determinant of Canada's prosperity. Canada buys and sells oil on world markets, which determine prices within our country, a perilous situation exacerbated by a lack of sufficient oil-distribution infrastructure in Eastern Canada. Eastern Canada, therefore, depends on imported oil. Only Alberta, Saskatchewan and Newfoundland are net oil exporters. Transportation electrification presents an opportunity for Canada to become more energy independent and self-sufficient.

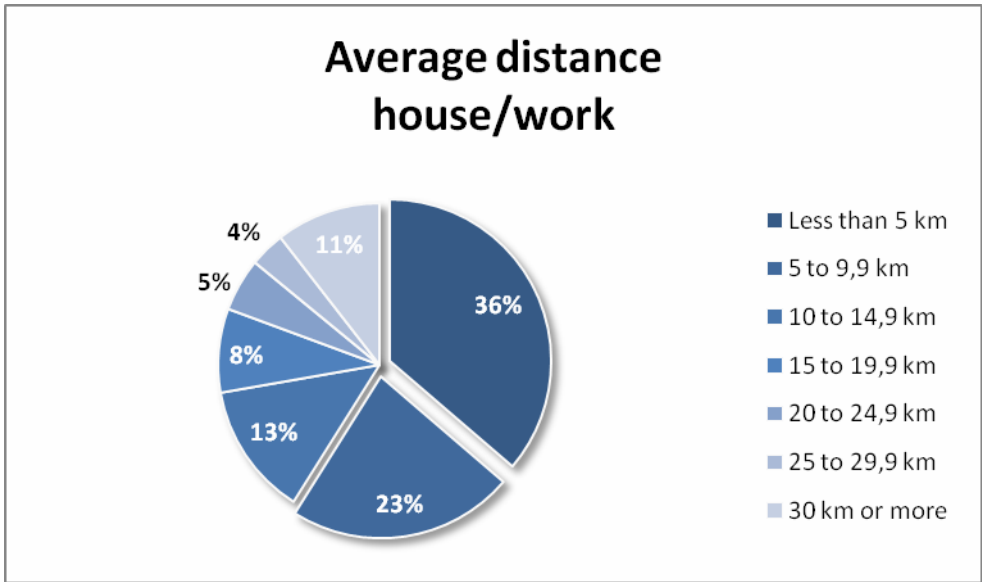
- **Renewable and nuclear generation.** Section 5 defines Canada's distinct advantage in this regard. There is potential almost everywhere to provide significant amounts of additional electricity from renewable or nuclear resources, thereby reducing dependence on coal, oil, and other fossil fuels.. Electricity can be produced renewably, from water, sun, wind, and geothermally. Worldwide, most electricity is now generated from coal and other fossil fuels.

- **Electric vehicles are enormously more efficient.** Electric vehicles use energy much more efficiently than vehicles with ICEs. In ICE vehicles, only 40 percent of the fuel's energy can be extracted to propel the vehicle. The rest is lost heat losses, idling, accessories, drive-train losses, etc. In electric vehicles, electric motors are 90% efficient at converting stored electricity to motion. As the world's energy constraints increasingly press us to alternative action, PEVs' remarkable advantage in energy efficiency will become a critical consideration for Canada. Electric vehicles have other marked efficiency advantages over ICE vehicles. They accelerate rapidly at low speeds and have potentially low maintenance needs, because many PEVs will contain fewer parts, and regenerative braking will extend the life of vehicle brakes, an important signal for consumer convenience. Moreover, the source of electricity can change, e.g., from gas turbine to solar generation, with no change being required to the vehicle's electric power train.

- **Canadians' daily commute is relatively short.** Approximately 60 percent of daily passenger kilometres (kms) travelled in Canada are one-way vehicle trips of 25 kms or less. In larger cities, where the majority of Canadians live, distances are even less: in Toronto, for example, 9.4 kms is the typical daily one-way distance travelled. These kinds of trips are easily done with electric vehicles: PEVs demonstrated and tested, along with those PEVs about to launch, are rated consistently for a range of from 40 to more than 100 kms. See Figure 1, which lists the one-way distances from home to work across Canada.

- **Electricity is the most readily available alternative to oil.** Another alternative, now largely off the radar, is the continued use of ICE vehicles, fueled with liquids not derived from oil, including liquids from coal and biofuels. Producing liquid fuels from coal is a costly and energy-intensive process that can have major negative environmental impacts. Similarly, current production of biofuels is energy intensive, while also competing with the essential use of biofuels' components in food.

Figure 1 – Average distance house to work for Canada – one way – Source Statistics Canada



5. ELECTRIC MOBILITY: ADVANTAGE CANADA

Canada is uniquely positioned among major industrialized nations to realize the potential for dramatic GHG reductions through the adoption of EVs. (See Table 1 and Figure 2 in the following pages.) Our country is also uniquely positioned worldwide in our capacity to generate electricity from clean, renewable resources.

5.1 Canada's Powerhouse of Clean, Renewable Energy

Given that three quarters of Canada's electricity is generated from hydroelectric or nuclear energy, electric traction can be responsible for essentially zero GHGs.

Only about 25 per cent of electricity generated in Canada comes from fossil fuels. On average, 60 percent of Canada's electricity is produced from hydroelectric sources. In four provinces—Newfoundland, Quebec, Manitoba and British Columbia—the proportion is more than 95 per cent. Canada compares favourably to the U.S. in this regard: in the U.S., more than 70 per cent of the country's electricity is generated from fossil fuels. Switching to electric traction, with resulting reduction of GHG emissions, is thus much more feasible from the outset in our country. In fact, Canada compares favourably with most other countries in terms of our clean, renewable resources.

Canada's existing and potential hydropower alone could strongly address any increased domestic electricity demand created by a growing North American PEV fleet. In addition, according to the Canadian Hydropower Association, there is much potential for more electricity to be produced from hydro. The production capacity levels they quote are the following:

- Current installed capacity– 74,000 megawatts – generating approx. 355 terrawatt hours per year
- Planned capacity – 25,000 megawatts
- Potential capacity- 163,000 megawatts

Moreover, Canada has many opportunities to increase its renewable-energy generation, above all through development of more hydroelectric facilities, but also from marine energy near the East and West coasts, geothermal energy in Western Canada, and wind energy in numerous locations.

It is, therefore, feasible to charge EVs from green electrons, and there is every potential for generating even more green electrons in Canada in the future.

5.2 Canada's contribution to reduction of greenhouse gas emissions

Today, Canadians travel 75 percent of their kilometres in light-duty vehicles. As stated earlier, these vehicles contribute roughly 18 percent of all GHG emissions in Canada, while transportation in total contributes 25 percent. Critical to note is the growth in these emissions: 37.5 percent since 1990. The current carbon intensity of the average ICE vehicle in Canada is over 190 grams of Co^2 per kilometre. Generally, light-duty ICE vehicles have significantly lowered their smog forming emissions over the past 40 years. Technical solutions, combined with a mix of public policies and low sulphur fuels have significantly reduced smog emissions from internal combustion engines (ICEs) but there has been little progress in GHG emission reductions.

The transition to electric vehicles allows all emissions to be reduced considerably more, especially GHGT emissions when the electricity used is not generated from fossil fuels, as will be the case for most of the electricity generated for PEV use in Canada. GHG Emission reductions from

the auto sector will pose ever more significant challenges as the population and the economy continue to grow.

Yet transportation is critical to Canada's economy and to Canadian lifestyles. Technical solutions for emission reduction in fossil-fuel vehicles are reaching their maximum potential, unless vehicle weights and power are downsized—whereas consumer sales indicate,a preference for vehicle size and power. Transforming light-duty vehicles to electric drive has the potential to achieve a quantum decreases in greenhouse gas (GHG) emissions from transportation.

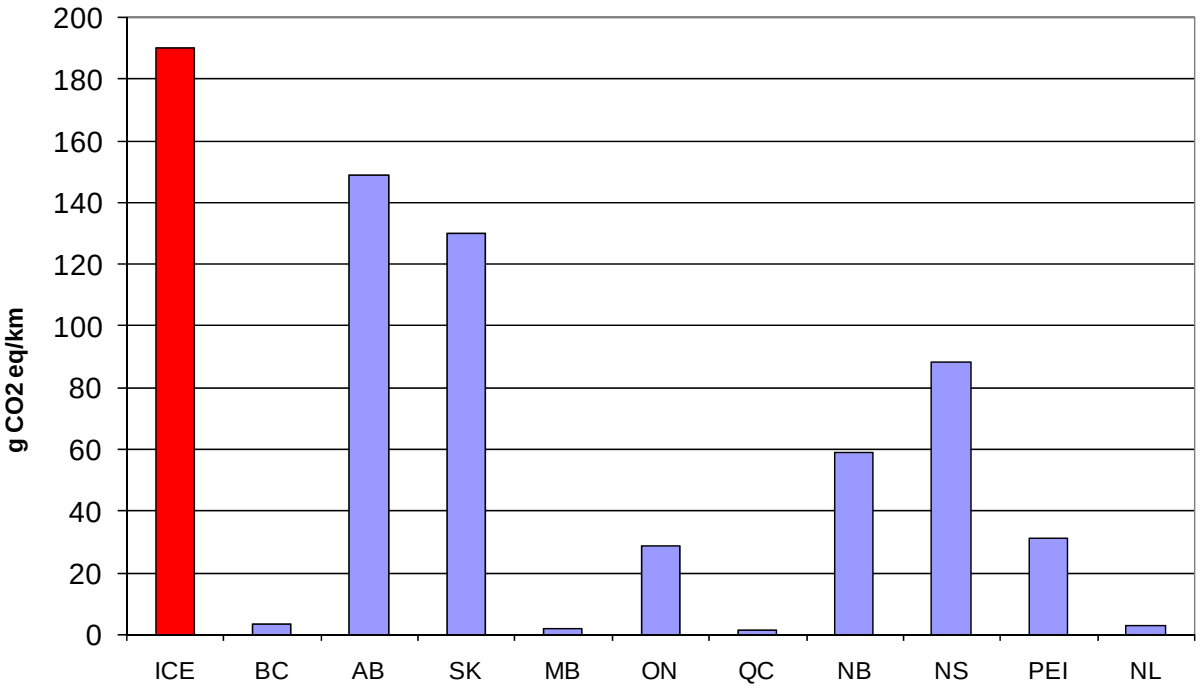
Figure 1 is a general summary of the expected emission reductions from electric traction in passenger cars and light-duty vehicles.

Table 1 – Summary of expected emission reductions from electric traction in passenger cars and light-duty vehicles

Type of electric traction	**Current status**	**Emission reductions (depending on how electricity is generated)**
Hybrid	Established in the marketplace for nearly 10 years	Up to 50%
Plug-In Hybrid Electric	Coming to the marketplace in 2011	Up to 80 %
Battery Electric	In the marketplace since 2009	Up to 100%

Figure 2 describes emission reductions at the vehicle, available through electric traction. GHG Emission reductions of as much as 95 percent are found in provinces in which the electricity is mainly generated from hydro; namely, in Ontario, Quebec, Manitoba and British Columbia. These reductions are available now, since the infrastructure for electric vehicles basically exists, with the exception of charging stations.

Figure 2 - Estimated unit greenhouse gas emissions from a 2006 compact automobile moved by an ICE engine (Canadian average), compared to electric traction (provincial averages for 2006)



To summarize, in Canada near zero emissions are created in generating the power for an electric vehicle, and near zero emissions are produced when the power is consumed by the vehicle.

5.3 Economic benefits of electric vehicle

The auto industry — including the Tier 1 and Tier 2 suppliers, many of which are located in Canada—are gearing up quickly to provide PEVs. The industry is investing heavily in electric vehicles: as much as $500 million is needed to launch a new vehicle for volume production. For example, the Chevy Volt, launching in 2011, uses components supplied by more than 20 Ontario-based companies, and some of its design and engineering was completed in Canada.

Globally, more than 70 percent of OEMs have announced firm plans to bring PEVs to market in the next few years. Canada is also well represented among the Tier 1 and Tier 2 suppliers necessary to these OEMs. A September 2010 publication by Electric Mobility Canada, titled "Canadian EV Industry – October 2010'", found at http://www.emc-mec.ca/en/publications.php, lists

the Canadian companies/entities involved in the following fields, in both design and production capacities:

- Charging infrastructure
- Chargers
- Batteries
- Motors and controllers
- Vehicle manufacturers (not counting major OEMS)
- Testing and R & D Centres

These entities are involved in domestic and export activities for their products and services, and their contribution to the recruitment and training of Highly Qualified Personnel (HQP) is also important. They are mostly located in British Columbia, Manitoba, Ontario and Quebec.

Some of Canada's electricity is sold to U.S. clients at a profit for the Canadian utilities involved. Canada exports an average of 40 terawatt hours per year. Each terawatt hour of hydro exported to the U.S. largely replaces fossil-fuel generation, reducing North American GHG emissions by at least half a million tons and increasing Canada's revenues by up to $100 million per terawatt hour.

Over the next decade, hydropower project development will benefit Canada with through more than $50 billion in investments and more than 150,000 jobs.

As electric vehicles enter the marketplace and as Canadian utilities strive to produce more electricity from their renewable sources, the construction of more hydro capacity should be supported. The development of more hydro-electric sources will not only meet increasing domestic demands from PEVs, but will also create more energy for export purposes.

6 IMPACT OF PEVs ON THE GRID IN CANADA

6.1 Generation capacity

Without additional load from road PEVs, by 2018 the Canadian electric grid would be required to supply a further 99 TWh to meet normal load growth, i.e., 17 per cent more than the 2006 total. If a PEV consumes 3,000 kWh in moving 15,000 kms a year (200 Wh/km for a medium-sized vehicle), the 500,000 EVs targeted by the Electric Vehicle Technology Roadmap to be on Canadian roads by 2018 will use an additional 1.5 TWh of electrical energy. This would be about 0.2 per cent of the projected total energy supply from electricity available in that year, and should not present a challenge with respect to generation.

Night-time charging of an EV battery would not require new generation capacity and would require only very local changes to the distribution system. New generation capacity may not be required, but daytime charging could strain distribution systems to the extent that additions or upgrades could be required. Clusters of EV load could stress certain feeders and the associated local distribution transformers. A smart grid, as well as smart chargers, are expected to alleviate much of this, but eventually replacement or upgrades could be required. Infrastructure for public charging (120–600 V) may have to be added in some locations.

Surveys conducted in the U.S. and Canada indicate that public acceptance and willingness to pay a premium for PEVs is linked to environmental benefits. The fact that PEVs' significantly lower emissions are an important selling point should be part of the business model. This leads to the conclusion that if new generating capacity is required for electric vehicles, it should ideally make use of renewable sources of energy. As stated earlier, this is precisely Canada's situation and a primary advantage to the adoption of electric vehicles here.

6.2 Collaboration between OEMs and utilities

Electric vehicles are the first mobile electrical load to be served by utilities. Unlike electric trains and trolley buses, which are continually connected to the grid, PEVs are occasionally connected and not always at the same location. The interface between the vehicle and the grid needs to be managed in a safe and secure manner as PEV owners connect or disconnect their

vehicles from the grid. This requires a new level of collaboration between OEMs and utilities. This is now occurring to an unprecedented level with several utilities and industry partners in Canada, through cooperation on the development of new electrical- code standards and the deployment of PEVs in demonstration projects in several urban centres across the country, such as Vancouver, Calgary, Winnipeg, Toronto, Montreal and Saint-Jérôme.

7. SHIFTING CANADA BACK TO THE DRIVER'S SEAT IN ELECTRIC VEHICLES

Until a little more than a year ago, Canada was positioned to move to the forefront of the transition to electric traction. It was then possible to say the following:

> "Canada has an unusually broad range of core competencies in all areas of transport electrification. These competences concern batteries, EV systems integration especially for commercial vehicles and low-speed vehicles, and battery management and power management systems. Per capita, at least at the moment, these resources are substantially larger than those in the U.S. ….
>
> Electric Vehicle Technology Roadmap for Canada, Page 21

Much of this statement remains true, but the last sentence becomes increasingly difficult to assert because of the recent, massive expansion of the U.S. programs noted briefly below.

7.1 Canadian public-sector support for the auto industry

PEV technologies are transforming the auto industry. As a major centre of auto manufacturing, Canada needs to ensure that domestic manufacturing capacity does not fall behind. Every effort must be made to entice international OEMs to manufacture PEVs in Canada, just as they currently do with ICE vehicles. Achieving this requires government support for the evolving PEV industry, given the further technology development, manufacturing scale-up and consumer adoption that will sustain this shift in passenger auto travel. Governments in other jurisdictions are providing much-needed support for PEV programs designed to accelerate the adoption of this new technology: Canada lags significantly behind other G8 nations on consumer tax incentives and infrastructure programs to ensure Canada is plug-in vehicle ready.

New-technology investment and adoption in the auto sector is also a core strategy to reverse the downslide in Canadian auto-sector production and to ensure the vitality of the industry. Canada has suffered significant setbacks over the past decade. In 2000, Canada had by far the largest per-capita vehicle production among major auto producers. By 2009, Canada's vehicle production was half of what it was in 2000. Japan, Germany, South Korea, and Spain all had higher per-capita production. The U.S. has suffered a comparable slide to Canada's. But it is taking numerous steps to regain its former dominance in automotive manufacturing. Led by the federal government and some states, many of these steps are focussed on developing, supporting and promoting PEVs.

The Government of Canada has continued to invest significantly in various programs supporting energy efficiency and other improvements in ICEs but has not yet invested specifically in PEVs. It has recently taken a step in the right direction by moving to provide larger greenhouse gas emissions credits for electric vehicles sold in Canada than those available in the U.S. These are part of the new fuel-efficiency regulations for cars and light-duty trucks. This was a recommendation of Electric Mobility Canada and recognizes the much lower share of electricity generation from fossil fuels in Canada.

However, without further action there could be continued erosion of Canadian automotive production and technology development as the manufacture of PEVs expands in other vehicle-producing jurisdictions and displaces Canadian vehicle and component production.

The U.S. Model. U.S. government support is resulting in necessary new components required for PEVs being developed and manufactured in the U.S. OEMs will source these components as they manufacture PEVs. If no such design and development are encouraged in Canada, components from our Tier 1 and Tier 2 suppliers, a major portion of Canada's market share in the auto sector currently, will result in a concomitant loss of high-quality jobs and training opportunities in Canada. Some of this needed R & D activity is occurring in Canada, thanks to occasional support from federal or provincial programs that do not necessarily focus on PEVs

U.S. federal government initiatives to support PEV adoption include:

- Investments of more than $2 billion in facilities for manufacturing advanced batteries and electric-drive components. One public-sector objective is to increase U.S. factories capable of producing advanced vehicle batteries: from two in 2009 to 20 in 2012, raising the U.S. share of world production of these batteries from a negligible proportion to 20 per cent. These investments will also support the construction of 10 additional factories to manufacture electric-drive components. These total 30 factories will produce components for the production of up to 500,000 PEVs each year.

- Loans made, totalling more than $2.4 billion, to support three of the world's first electric-car factories.

- Investments of $400 million underway to support PEV deployment programs, including programs to increase the number of public vehicle charging locations: from 500 in 2010 to more than 20,000 in 2012.

- Consumer and business incentives for home and work charging stations - a tax credit of 50% up to a maximum of $2,000 per installation (one per home and up to 10 per business).

- Research underway and funded on numerous potential "game-changers" in the electrical-vehicle sector, including semi-solid flow batteries, ultra capacitors, and "all-electron" batteries that could go well beyond today's best technologies.

- The moves are complemented by numerous consumer incentives. These include, for example, tax credits for the purchase of PEVs that range from $2,500 to $7,500, according to vehicles' energy storage capacity, to a limit of 200,000 vehicles per manufacturer.

- Investments in charging infrastructure to buttress the above: in clean electricity generation, in upgrading electricity grids, and in the development of national codes and standards related to charging and other matters vital to the development of electric traction.

The Chinese model. In September 2010, Canada's Department of Foreign Affairs and International Trade (DFAIT) issued a report on China's electric-vehicle sector. DFAIT noted that China is

now the world's largest automobile producer and market, that all major Chinese automakers are developing electric vehicles, and that "new energy vehicles" – chiefly PEVs – are expected to comprise at least a quarter of Chinese auto production by 2020. China, for one, is making larger investments than the U.S. to foster domestic production and use of electric vehicles.

Many other countries are seeking to forge or maintain major positions in the transition to electric traction, including Japan, Germany, France, South Korea, the UK, and Spain. (A 50-page table summarizing initiatives in other countries is available at Electric Mobility Canada, at http://www.emc-mec.ca/en/incentives.php.)

Over three years, such programs instituted in Canada would represent relatively modest cost to the government, while providing high visibility in the strategic Canadian urban centres in which OEMs will first introduce their PEV models.

7.2 The EV industry: a high-performance system

Most OEMs are offering PEVs starting in 2011. Most Tier 1 companies and several Tier II companies are involved in supply chain. The commitment and investments from OEMs and the industry have been strong. In addition, the private sector, i.e., battery companies, have invested massively in R & D and production.

Demonstrations of electric vehicles are the surest way to prove their performance and to convince consumers that they can meet their needs. This is particularly true in terms of performance in Canada's cold climate. The EV industry internationally is involved in many demonstrations of vehicles and charging infrastructure. Canada has several PEV demonstrations underway or planned.

However, these industry commitments require a boost from the Canadian government, in the form of investments and loans: to ramp up made-in-Canada PEV innovations through the supply chain; to greatly expand our demonstration projects---particularly critical to gauge performance in Canada's cold climate; and to aid OEMs in manufacturing scale-up of PEVs.

But the topmost priorities for the federal government pertain to incentives passed directly to the consumer to support the feasibility of this new technology; and public infrastructure funding. Please see Section 9 for details of proposed public investments in electric-vehicle adoption.

7.3 The utilities: another competitive advantage for Canada

Utilities worldwide are driving the infrastructure side of the electrification of transportation, with particular emphasis on the installation of charging stations for PEVs. This is in addition to their extensive PEV demonstration projects in collaboration with OEMs.

The Canadian electric-utility sector, unlike its counterpart in the U.S., is much more centralized and is, therefore, better positioned to take a lead role across the country in ensuring that the national grid infrastructure is prepared to meet the PEV load. Our centralized utilities structure is a competitive advantage for Canada: there are fewer utilities with a broader reach, and there is a high degree of cooperation and collaboration across provincial boundaries.

Canadian utilities are significantly engaged in demonstration projects and in the installation of charging stations. They are keen to assess the technical and performance implications of EVs in their jurisdictions and to provide technical information to their customers on how to prepare for EV use, especially the recharging of batteries. These utilities include BC Hydro, EnMax in Calgary, Manitoba Hydro, Ontario Power Generation, Toronto Hydro, Burlington Hydro, EnWin Utilities in Windsor, Veridian Connections in Durham Region, Power Stream in Vaughan, Hydro-Québec and others.

7.4 The provinces: modelling some incentives solutions

British Columbia, Manitoba, Ontario and Quebec are currently leading provincial efforts to encourage the adoption of EVs in Canada. Their efforts in financial incentives are summarized.below. References to public support programs directed solely at hybrid vehicles have been deleted, since this report focuses on plug-in hybrid (PHEVs) and battery electric vehicles (BEVs). In addition to providing financial incentives, these provinces are involved in demonstration projects to support industry and infrastructure deployment.

Table 2 – Provincial Support Programs

Province	Program
British Columbia	▪ 50% PST reduction, up to a maximum of $1,000, on the purchase of electric motorcycles ▪ 50% PST reduction on parts and labour for conversion to hybrid electric drive of shuttle buses (up to a maximum of $5,000) or passenger buses (up to a maximum of $10,000) ▪ The Clean Energy Act allows utilities such as BC Hydro to invest in measures that support reduced greenhouse gas emissions and recover the cost of these investments. Investments listed under Section 18 of the Act include those in plug-in transportation. ▪ The Climate Action and Clean Energy Fund includes a $100-million- fund with clean transportation infrastructure as one of its priorities.
Ontario	▪ Tax rebates of between $5,000 and $8,500 per plug-in electric vehicle. ▪ Green licence plates, that would allow drivers to use less-congested High Occupancy Vehicle (carpool) lanes, even if there is only one person in the vehicle
Quebec	▪ Tax credit that varies according to the year of acquisition of the vehicle and the vehicle's fuel consumption. The maximum credit for HEVs currently on the market is $2,000, while owners of low-speed all-electric vehicles are eligible for a credit of up to $4,000. The program is open to individuals and corporations. ▪ Provincial sales tax rebate of up to $2,000 on the purchase or lease of a HEV or all-electric vehicle by taxi drivers or car sharing services. ▪ Provincial sales tax rebate of up to 50% of the difference between the sale price of a conventional bus and that of a hybrid or electric bus (up to maximum of $500,000) on the purchase of one of the latter. ▪ Provincial sales tax rebate of up to $2,000 on the purchase or lease of a HEV or all-electric vehicle by taxi drivers or car-sharing services. ▪ Provincial sales tax rebate of up to 50% of the difference between the sale price of a conventional bus and that of a hybrid or electric bus (up to maximum of $500,000). ▪ Tax rebates of between $2,000 and $8,000 for plug-in electric vehicles, depending on fuel efficiency of the vehicle.
Saskatchewan	▪ Provincial sales tax rebate of up to $2,000 on the purchase or lease of a HEV or all-electric vehicle by taxi drivers or car-sharing services

7.5 The municipalities: seeking partnerships with the federal government

Major municipalities in Canada are interested in PEVs as a source of transportation GHG reductions in their jurisdictions. They are also supporting PEVs in their fleets as a means of reducing their energy and maintenance costs. Prompted by the Electric Vehicle Technology Roadmap and supported by EMC, 13 municipalities collaborated in 2010 to identify the necessary municipal actions to ensure that the required infrastructure is in place to welcome PEVs. Much consensus was built and emphasis placed on charging infrastructure. The municipalities developed a policy paper including these actions, and EMC has included and will further promote this paper as part of its 2011 Business Plan. The municipal policy paper recommends federal government financial support for charging infrastructure to augment municipal commitments.

Municipalities are also involving OEMs and their utilities in demonstrating EVs in their communities. These include Vancouver, Calgary, Winnipeg, Toronto, Montreal and Saint-Jérôme. More municipalities are at the planning stage for both PEV and infrastructure demonstrations. But these are limited in scope, lack sufficient resources to deploy at scale and require national reach to ensure standardization and interoperability. Municipal, along with regional and provincial stakeholders are seeking funding partnerships with the federal government in order to ensure public charging infrastructure demonstrations are adequately deployed. These are an important means of convincing consumers that EVs are appropriate for use in Canada.

8. DRIVING THE FUTURE OF EVs IN CANADA

8.1 The Electric Vehicle Technology Roadmap for Canada

The *Electric Vehicle Technology Roadmap for Canada* (at http://www.emc-mec.ca/en/roadmap.php) provides a good guide as to where Canada needs to be. An industry-government group with federal government support prepared this document during 2009. It speaks to ensuring that there are at least 500,000 highway-capable PEVs on the road in Canada in 2018. If the number of light-duty vehicles on the road were to remain at the present level of nearly 20 million, PEVs would comprise 2.5 per cent or more of these.

8.2 U.S. benchmarks as a comparator

This goal for Canada may be compared with the more ambitious goal for the U.S., set out in the *Electrification Roadmap*, produced in 2009 by the U.S. Electrification Coalition, an industry group. The group's overarching goal is that by 2040, 75 per cent of the distance travelled by light-duty vehicles in the U.S. will be "electric miles," i.e., miles for "which the vehicle is propelled by an electric motor and not relying on a gasoline engine." As a milestone for this goal, PEVs should comprise five per cent of light-duty vehicles on U.S. roads by 2020, about 12.5 million PEVs in total. Achieving the goal would require that PEVs comprise 25 per cent of sales of light-duty vehicles in the U.S. in 2020 which, according to the *Electrification Roadmap*, could be as many as five million PEV sales annually.

The U.S. government's investments and loans, noted in the previous section, will go far toward meeting the Electrification Coalition's 2020 milestone. The *Electrification Roadmap* suggests that achieving the 2020 milestone of up to five million sales of PEVs a year in the U.S. will require sales of some 800,000 PEVs a year by 2015. The U.S. government's investments will provide for production of up to 500,000 PEVs in 2015. The remaining investments, as may be required, could readily come from the private sector.

No similar federal policy positions and programs exist in Canada. A focused PEV policy is needed if Canada is to remain a force in electric traction and in automotive production generally. Such a policy is a necessary, temporary measure to stimulate Canada's industry and consumer adoption of PEVs during the period when electric vehicles coming to market are more expensive than ICE vehicles, chiefly because of present battery costs.

Canadians will likely embrace such policy leadership. According to a 2009 survey conducted by Environics and Pollution Probe, six out of ten Canadians are interested in purchasing PEVs, more in urban areas Work by Electric Mobility Canada suggests that the interest among fleet owners could be even higher.

8.3 PEV market penetration

Market penetration is predicated on several factors when it comes to a sizeable change in a product offering. OEM's and their supportive industries have invested heavily in PEVs and are ready for sales to willing consumers. Though consumers are disposed toward PEV purchases, they are concerned about the higher costs of PEVS compared to ICEs, which purchase incentives will alleviate. Consumers also need assurance that the necessary infrastructure for electric vehicles will be in place. This has primarily to do with charging facilities, both private and public.

Several market forecasts for PEVs over the next few years range from two percent to five percent. But these figures do not take into account the positive power of financial incentives to consumers from government agencies. PEVs will come to the marketplace according to the manufacturers' plans, and these will be dictated by PEV readiness in the form of charging infrastructure and consumer incentives for early adopters. Without financial incentives and supporting charging infrastructure in Canada, manufacturers will likely focus their sales efforts in jurisdictions that are becoming PEV ready and have PEV incentive policies to accelerate adoption.

Canada will be missing a huge opportunity if it does not get involved in supporting the transformation to electric vehicles. The PEV industrial activity is mainly going to jurisdictions that are offering support to industry and consumers, but It is not too late for Canada to get on board to attract PEV benefits to this country

9. MOVING FORWARD WITH ELECTRIC VEHICLES IN CANADA

The Government of Canada has an opportunity-gain to be seriously considered. Getting involved now in supporting electric vehicles will lead to growth in the industry and market penetrations, with resulting economic growth and environmental benefits. Not getting involved at this stage will likely see the OEMs focus sales in other G8 nation markets that have established programs to support and encourage this transformative green-transportation technology. In North America, OEMs are, in fact, focussing more efforts on sales in the U.S. than in Canada and Canadians may be deprived of the opportunity to acquire the PEVs that would be offered elsewhere.

Compared to other G8 nations' programs, this three-year proposal from EMC to encourage early adoption of PEVs in Canada is modest in cost, aligned with the federal government's practical GHG reduction objectives, and will foster good media coverage of government GHG reduction support in key Canadian urban centres (Victoria, Vancouver, Winnipeg, Toronto, Montreal, Ottawa, Quebec City, as well as Calgary).

9.1 Codes and standards (charging). <$2 million. Helping to ensure harmonization of codes and standards among federal departments, among provinces, and with the U.S. will require leadership on the part of the Government of Canada. It will also require modest support to enable the Canadian Standards Association and partners to develop appropriate Canadian codes and standards.

Although the action above is the one that requires the least funding, it is the most urgent item. Without appropriate codes and standards, PEVs may not be able to be sold in Canada, and installation of necessary charging infrastructure could be delayed.

9.2 Incentives for the provision of home and business charging facilities: $30 million over three years. Individual and business owners of PEVs are likely to do most of their vehicle charging at home or at the business site overnight, making the best use of overnight electricity-supply surpluses and consequent low costs. This charging can be done from regular sockets, known as Level 1 charging, but could take more time than is practical. For example, a BEV with a 24-kWh battery could require more than 21 hours for a full charge at 120 volts form a Level 1 charging socket. A BEV with a range extender and an 8-kWh battery could require eight hours of charging at this voltage. Charging at 240 volts – known as Level 2 charging – can reduce charging time by more than half, compared with Level 1, rendering overnight charging practical. The additional equipment required for Level 2 charging could cost about $2,000 per installation, more in the rare instances that electrical service to a home needs to be upgraded.

EMC believes the federal incentives for installation of charging facilities in Canada should at least equal those in the U.S. The U.S. incentive for home-charging equipment is a tax credit of 50 per cent of the cost up to a maximum credit of $2,000 per home. For a business with multiple

charging stations, the maximum tax credit is $50,000. The Government of Canada should focus on supporting Level 2 charging and should temporarily refund 50 per cent of the cost of providing charging at this level. It would be reasonable to review this incentive program in year three of this proposal to determine if it should be extended. A three-year program aimed at funding 30,000 charging units across Canada is reasonable and would cost the federal government $30 million.

Support for home and business charging installations could be administered through existing federal government programs, such as the ecoEnergy program. This program expires in March 2011, but could be continued to support installation of PEV charging infrastructure.

9.3 Earmarking existing 'green' funding to public charging stations: $50 million over three years. Public charging stations will also be required. Initially, funding will be needed to encourage establishment of public charging stations, to ensure consumer confidence about PEV range on a charge. Public stations will typically provide fast charging—also known as Level 3 charging, at 480 volts or higher— which can provide a significant charge in minutes. These could cost up to $100,000 per station. Public charging stations could also be designed to provide only Level 2 or even Level 1 charging, at much lower cost.

Public charging facilities, as well as home and business charging, discussed in Section 9.2 above, could be funded through a variety of existing programs, with funds earmarked specifically to PEV charging facilities. These include the Infrastructure Fund, the Green Building Fund and the Green Municipal Fund, administered by the Federation of Canadian Municipalities. Close examination of the terms of reference for these existing programs clearly suggests that PEV infrastructure meets government policy objectives.

Over a three-year period, an investment of $50 million would allow for a 50 percent subsidy toward the installation of 100 fast-charging stations in Canada's major urban centres, a reasonable program.

9.4 Investments and loans to support electric-vehicle production: $200 - $500 million over three years.

As noted earlier, the governments of other countries with automotive industries, notably the U.S. and China, are investing heavily in electric-vehicle development and production, including advanced batteries and electric-drive components. To sustain the Canadian automotive industry, the Government of Canada should provide comparable, proportionate investments and loans.

As in the U.S., investments and loans could support achievement of specific targets for industrial development, particularly to companies involved in supplying batteries and other PEV components. Funds required for investment over the next few years would be in the order of $200 million to $500 million, according to whether the proportion factor used will pertain to population size or the size of the automotive industry. Similar amounts could be available for industry loans.

The Electrical Vehicle Roadmap goal of 500,000 PEVs on the road by 2018 may be now be difficult to achieve at this stage of federal policy development. However, the short-term actions summarized for discussion in this document will help establish Canada as a leader in the adoption of this environmentally "game-changing" technology.

9.5 Incentives for the purchase of electric vehicles by individuals and for fleets: $105 M over three years.

Financial incentives are a key factor in the acceleration of PEV sales. This is supported by the literature and sophisticated economic modelling. EMC believes that the incentives provided by the Government of Canada should at least equal those provided by the U.S. government, described earlier. As in the U.S., federal incentives should augment those provided by provinces and municipalities where available. These other incentives to date in Canada include, for example, rebates of between $5,000 and $8,500 per vehicle provided by the Ontario government and up to $8,000 provided by the Quebec government. (See further details in Section 7.)

EMC believes that EV sales in Canada will not occur as quickly as in the U.S., where charging stations are being installed and financial incentives are available now at the national and state lev-

els, but there is still a window of opportunity to build this infrastructure in Canada as sales ramp up.

A reasonable program for the Government of Canada would, therefore, be to provide financial incentives for the first 15,000 electric vehicles. This would likely occur over the next three years, with a small market penetration in year one growing by year three.

- Year one – 2011: 1500 vehicles
- Year two – 2012: 4,500 vehicles
- Year three – 2013: 9,000 vehicles

The cost to the federal government of such a program, assuming $7,000 per vehicle, would be $10.5 million in 2011, $31.5 million in 2012, and $63 million in 2013.

9.6 Federal vehicle procurement

The federal government operates a large fleet of assorted vehicles to meet the needs of various departments and agencies. These vehicles are replaced on a regular basis, and it is EMC's recommendation that extra effort go into identifying those vehicles that could be replaced by new PHEVs or BEVs in order to further reduce GHG emission from the fleet. This can be accomplished at little extra cost, and it would send a strong signal that lower-emitting vehicles are part of an important national policy. Examining the duty cycles of vehicles and defining those that can be replaced by electric- traction vehicles will be required.

ELECTRIC MOBILITY CANADA

Electric Mobility Canada is a national not-for-profit organization dedicated to the promotion of electric mobility as a readily available and important solution to Canada's emerging energy and environmental issues. The membership of EMC-MEC includes companies engaged in the sale or distribution of vehicles or components or the delivery of professional services, representing all modes of surface transportation from bicycles to trains. Membership also includes providers of electric energy at the provincial and local levels; managers of the vehicle fleets of companies, governments, agencies, and others; related associations, societies, research centres and labour organizations; governments and their agencies; and individual supporters.

Members and non-members of Electric Mobility Canada have been involved in the preparation of the present document through a series of meetings and conference calls.

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ABBREVIATIONS USED IN THIS DOCUMENT

EV:	Electric Vehicles as a generic reference
BEV:	Plug-In Electric/Battery Electric Vehicle (vehicle is propelled electrically; battery is charged only from the grid)
ICE:	Internal Combustion Engine (propels almost all vehicles today, fuelled by gasoline or diesel fuel)
PHEV:	Plug-in Hybrid Electric Vehicle (propelled electrically and by an ICE; battery chargeable from the grid and by and ICE-powered generator)
PEV	Plug-in Electric Vehicle (includes BEV and PHEV and also BEV with range-extender, which is an on-board ICE used to charge the battery)