



# ***Electric Car Report***

**What are the prospects for an  
Electric Car Industry in Canada  
and is this a Real or False  
Solution for Climate Change?**

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*The Polaris Institute is a public interest research organization based in Canada. Since 1997 Polaris has been dedicated to developing tools and strategies for civic action on major public policy issues, including energy security, water rights, green economy and global trade.*

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# Table of Contents

Introduction	1
I. The Canadian situation	4
II. Challenges	8
III. Real solution for emissions reductions?	12
IV. Impact of powering electric cars	16
V. Individual Car Dependency	20
VI. Conclusion	23

<b>Abbreviations used in this document</b>	
BEV	Battery Electric Vehicle. This is a vehicle that is propelled exclusively by an electric motor and charged from the grid.
ICE	Internal Combustion Engine. An engine fuelled by, diesel fuel, gasoline, biofuel etc.
PHEV	Plug-In Hybrid Electric Vehicle. PHEVs are propelled by an electric motor, which can be recharged by the on-board ICE or by plugging into the grid. The Chevy Volt is a PHEV.
PEV	Plug-in electric vehicle (includes BEV and PHEV)
GHG	Green House Gas Emissions
EMC	Electric Mobility Canada

## **Executive Summary**

The electric car is being positioned as the next big revolution in automobile technology. All of the major car manufacturers have some form of electric vehicle in the pipeline and Nissan and General Motors have already launched their products in the United States. Touted as a key to limiting green house gas emissions and as a step in the right direction for reducing our reliance on fossil fuels, some governments have made large investments geared towards stimulating the emergence of the electric car.

In Canada, however, significant levels of investment by our governments have yet to appear. In many ways the electric car will not emerge in this country unless our governments help to support the industry while at the same time working toward developing the infrastructure that will be required for people to effectively charge and operate these vehicles.

With an entrenched automotive industry that includes a well trained workforce, Canada's car manufacturing infrastructure could make the transition to producing electric vehicles without much difficulty. Dozens of Canadian companies already have the expertise and capacity to produce inputs for the electric car industry, and all 9 automotive plants in the country could transfer production to electric vehicles.

Canada already has many of the elements needed for a national electric car industry, but if public funds are not forthcoming to help stimulate this industry and the nascent market for these products, the widespread adoption of these vehicles and the emergence of a Canadian production base are less likely. However, before recommendations for public investment in this industry can be made, an important debate over whether or not electric cars are a real or false solution to the negative impact of automobiles needs to occur. This report aims to spur this debate by outlining how the country is well positioned to become a major player in the production of electric vehicles, while also asking some serious questions about how much of a 'greening' force electric cars will actually be.

Vehicles powered solely by batteries literally have no tailpipe and will produce zero emissions when in operation. Therefore, this type of vehicle technology is very promising for the prospect of reducing green house gas emissions from tailpipes. What this report shows, however is that even with 500,000 of these zero tailpipe emission vehicles in operation, Canada's overall green house gas emissions would see a very small reduction.

What is the carbon foot print of an electric car? Promotional material for electric vehicles are dominated by 'green' images making these products seem devoid of any kind of negative environmental foot print. This ignores three factors: 1) the reality of the emissions from generating electricity from fossil fuels; 2) the lithium required to produce the present battery technology which is only found in the natural environment, thereby creating a situation where moving from gas powered to electric cars means shifting the reliance on one extractive industry to another and; 3) the resources needed for the lifecycle of the electric car, that is to say the production (e.g., body, interior and engine.), transportation (e.g., moving the vehicles from production plants to the consumers) and disposal. The report will also show that simply 'greening' the automobile will not mitigate the social and environmental impacts associated with automobile production and use such as, congestion, urban sprawl, and land use for roads and parking lots.

Electric cars should therefore be seen as an interim solution to the broader problem of how we get around. Any plan to promote and encourage the use of electric cars should be short term and be combined with increased development and investment in public transportation and inter-city rail programs, as well as a rethink of our present model of urbanization.

The sum of the positive results from electric cars will not be enough to outweigh the overall negative consequences of a car dominated society. Therefore, before recommendations for government funding can occur, a debate needs to take place about how the electric car can fit into a broader national public transportation strategy. Alone they are not a real solution, but as part of a transition strategy the electric car could play a pivotal role in weaning society off of its reliance on fossil fuels.

## Introduction

The vast majority of the 1 billion passenger vehicles worldwide are powered by fuel derived from crude oil. By 2020, this number will have increased to 1.2 billion. Global emissions from gasoline and diesel powered automobiles will only rise. In Canada alone 68.33 billion litres<sup>1</sup> of gasoline and diesel is consumed annually to meet the country's transportation needs not to mention the amount of energy that goes into producing the vehicles, shipping them to market and the impact of the road infrastructure.<sup>2</sup>

Energy derived from fossil fuels is the leading cause of green house gas emissions which are responsible for the rapid changes to our atmosphere; changes that are severely impacting people and ecosystems around the globe. Automobiles are one of the most visual and pervasive symbols of the fossil fuel based economy that is having a devastating impact on the planet's environment.

A critique of automobiles as major contributor to air pollution in general emerged in the 1970s. Since then, automobiles have become a regular focal point in environmental debates and discussions about 'what is to be done' about the environment and climate change. Carbon emissions from automobiles are widely seen as a main driver of climate change and large gas guzzling vehicles, such as the Hummer, have become code words for negative environmental impacts.<sup>3</sup>

The climate change issue and a broader environmental debate has made it into mainstream consciousness and has created a sense of urgency that individuals, institutions and corporations need to take action in order to deal with this problem. A new discourse of sustainability has surfaced that has created a system where material objects are either perceived as friendly to the environment or damaging. One such product is the electric car that, at first glance, could be perceived as one of these 'environmentally friendly' products and a potential solution to vehicular rooted environmental problems.

A buzz has developed around electric cars over the past two years based on the recent high profile release of the Chevrolet Volt and the Nissan Leaf in the United States and the related marketing of these products.<sup>4</sup> Most national newspapers in Canada and the United States have covered electric cars over the past 12 months in reports and editorials. Driven by strong corporate advertising campaigns, the image of the electric

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<sup>1</sup> This figure includes larger vehicles as well as automobiles and light trucks.

<sup>2</sup> "The Supply and Disposition of Refined Petroleum Products in Canada, September 2010", Statistics Canada, December 16, 2010. <http://www.statcan.gc.ca/pub/45-004-x/45-004-x2010009-eng.pdf>

<sup>3</sup> Barkenbus, J., "Our electric automotive future: CO2 savings through a disruptive technology," Policy and Society 27 (2009) 399-410.

<sup>4</sup> Reed, J., Simon, B., "Groups Shift Gear for a Power Revolution," Financial Times, September 19, 2010.

car as a solution to damaging tailpipe emissions is being perpetuated with some success.

All of the world's large automotive manufacturers have picked up on the trend towards electric cars and have launched research and development programs aimed at producing these products. Many will be releasing commercially available plug in electric vehicles (PEV)<sup>5</sup> in the near future.

Based on the optimism shown by the automotive industry it would seem that there is a nascent market for these vehicles in the United States, Japan and Western Europe. In the United States, at least, the confidence shown by the traditional auto manufacturers is driven in part by the Obama administration's financial commitment to developing the industry, part of the President's plan to help build the clean energy economy that he sees as key to the country's competitiveness in the 21<sup>st</sup> century. Only time will tell if the buying public in the U.S. will flock to the local dealership to purchase a Volt or Leaf in 2011.

Meanwhile the Canadian government has yet to earmark significant funds to this industry leaving the country in a chicken and egg situation: without the government funds to foster an electric car industry and stimulate a market this mode of electrified transportation may not emerge in Canada.

Canada is a major vehicle producing country and in the event that electric vehicles come into general use, this sector – a major employer of Canadian workers – could be adversely impacted if not properly prepared. The Canadian government continues to invest significantly in programs supporting the efficiency of internal combustion engines, but has not yet made specific investments in battery and plug-in hybrid electric vehicles. Further action by the Federal government to support this sector will be needed or Canada could be left behind other auto producing centres to the detriment of jobs in the automotive sector.

But should public money be used to stimulate a burgeoning electric car industry or would government funds be more successful in reducing emissions if they went to developing more accessible public transportation or to encourage people to simply walk more often or create more and safer bicycle lanes? This report will explore these questions and posits that a separate debate about the perceived benefits of the electric

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<sup>5</sup> The electric cars referred to in this report include battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV). The acronym PEV (plug-in electric vehicle) encompasses both types and will be used in this report when referring to electric cars. See page iii for further information on abbreviations.

car needs to occur before any serious recommendations on government spending can be made.

As part of a series of reports and position papers dealing with the emerging 'green economy' in Canada, this paper acknowledges that personal vehicles, whether powered by fossil fuels or electricity from renewable resources, are the transportation method of choice for Canadians. Given that this is not likely to change right away, electric cars should be adopted and seen by policy makers as a short term tool to mitigate tailpipe emissions.

The debate about the electric car is complex and is not simply a discussion of zero tailpipe emissions. One of the complexities highlighted in this report is that the electrification of automobiles will not lessen the serious negative social and environmental impacts associated with automobile production and use such as, congestion, urban sprawl and land use for roads and parking lots. Real solutions to the environmental devastation caused by our biggest emitters and guzzlers of oil will have to include a general phase out of personal vehicles in favour of public transportation and sustainable urbanization. Therefore, any plan to promote and encourage the use of electric cars should be short term and be combined with increased development and investment in public transportation and inter-city rail programs.

This report begins by exploring the present electric car landscape in Canada and what kinds of government intervention will be required for this technology to emerge. It then looks at some of the hurdles that could impede this emergence as well as the status of the electric mobility industry in Canada including the prospects for Canadian job creation in this sector. After establishing that a viable electric car industry could indeed surface in Canada, the potential for reductions in emissions achieved through the adoption of electric cars is investigated along with a presentation of the potential negative impact of power generation and battery manufacturing. The report concludes with a general critique of automobiles in the context of the need for an overall public transportation policy. Since this report makes extensive use of acronyms, please make use of the table at the beginning of the Introduction as a reference.

## **I. The Canadian situation**

As we will show below, the hurdles that need to be cleared for plug-in electric vehicles (PEVs) to come into wide usage in Canada are many and profound. But with these products already on U.S. roads and the imminent release of PEVs in Canada there exists a real possibility that the age of electric mobility is upon us. There is a general 'wait and see' mood about how quickly these products will take off, if at all.

One operating assumption, however, is clear: that is if PEVs are going to succeed in Canada, all levels of government need to be involved in stimulating both supply and demand. This section explores some policy recommendations that have been made by the electric car industry in Canada and highlight how this country's industry is presently situated to produce electric cars for the Canadian and North American market.

### **Government Policies action**

In the United States the federal government has provided close to \$5 billion (usd) to stimulate the development and manufacturing of battery technologies, electric drive components, electric car factories, public charging locations and research and development.<sup>6</sup> The U.S. government also has generous incentive programs including tax credits for the purchase of PEVs and home charging infrastructure. Recently adopted vehicle efficiency standards requiring new vehicle fleet fuel consumption to drop by 30 percent from 2012 to 2016 will also encourage automobile companies to develop and produce more fuel efficient cars including PEVs. Actions like these should help PEVs to emerge more broadly throughout the US and, according to a recent report by the Natural Resources Defense Council, the Center for American Progress and United Autoworkers, should create a significant number of new jobs.<sup>7</sup> Numerous other countries, especially in Europe and Asia are pushing to entrench electric mobility through government policy and investment.<sup>8</sup>

The efforts of the Canadian government<sup>9</sup> to stimulate this industry have been surpassed by those in the United States. Canada's electric mobility industry association, Electric

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<sup>6</sup> "Encouraging the Rapid Adoption of Electric Vehicles in Canada," Electric Mobility Canada, October, 2010.

<sup>7</sup> Baum, A., Luria, D., "Driving Growth: How Clean Cars and Climate Policy can Create Jobs," Natural Resources Defense Council, Center for American Progress and United Autoworkers, March 2010.

<sup>8</sup> See EMC's summary of government electric mobility initiatives here: <http://www.emc-mec.ca/files/InternationalIncentives-Dec2010.pdf>

<sup>9</sup> See EMC's overview of Canadian government incentive programs for hybrid and electric vehicles here: <http://www.emc-mec.ca/files/EMC-HybridElectricVehicleIncentivesCDNoverview.pdf>

Mobility Canada's (EMC) position on the role of our governments in the future of PEVs in Canada is that:

“The Government of Canada must encourage the widespread adoption of plug-in electric vehicles by providing incentives for purchasing and manufacturing them, by supporting the installation of home, workplace, and public charging infrastructure, and by helping ensure harmonization of codes and standards for charging electric vehicles among federal departments, among provinces, and with the U.S.”<sup>10</sup>

EMC further notes that “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.”<sup>11</sup>

In 2009, a group of academics, labour leaders and industry members with financial support from the Government of Canada produced an Electric Vehicle Technology Roadmap for Canada that proclaims to be a starting point of a new transport regime where Canadian vehicles are increasingly powered by electric traction.<sup>12</sup> The roadmap presents a comprehensive overview of how Canada can become a serious player in electric mobility. To achieve this, EMC [whose members contributed heavily to the production of the ‘roadmap’] recommends that the government of Canada and the provincial governments invest large amounts of money in Canada’s electric car industry. Based on its goal of 500,000 PEVs on the road by 2018, EMC is recommending that the government of Canada invest between \$1.1 and \$1.4 billion to stimulate the industry. This investment would mainly be used to provide loans to vehicle and parts manufacturers, subsidies for private and public charging infrastructure, plus tax credits as incentives for individual and fleet purchases of PEVs.<sup>13</sup>

Due to the fact that the majority of this money would subsidize private business, a question remains about the collective benefit PEVs could have on Canadian society. The limited GHG emission reductions [explained below] that will be brought about by PEVs in Canada further brings into question the overall benefit of PEVs to Canadians. This problem needs to be seriously debated, not only by the electric mobility industry

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<sup>10</sup> “Encouraging the Rapid Adoption of Electric Vehicles in Canada,” Electric Mobility Canada, October, 2010.

<sup>11</sup> “Encouraging the Rapid Adoption of Electric Vehicles in Canada,” Electric Mobility Canada, October, 2010.

<sup>12</sup> “Electric Vehicle Technology Roadmap for Canada,” Natural Resources Canada, [http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/81891/E-design\\_09\\_0581\\_electric\\_vehicle\\_e.pdf](http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/81891/E-design_09_0581_electric_vehicle_e.pdf)

<sup>13</sup> IBID

that stands to reap financial rewards from the adoption of these vehicles, but within the broader environmental and labour movements in Canada.

## **Canadian industry**

Dozens of companies are involved in Canada's growing electric car industry. They manufacture and distribute electric cars, motors, batteries, parts, charging infrastructure and, in relation to Canada's population, make up a relatively large number of companies involved in this industry.<sup>14</sup> Canada also boasts a large number of skilled workers across a wide range of energy storage, power management and control systems. The Canadian electric mobility industry with help from Natural Resources Canada has prepared a directory of the hundreds of companies operating across the country that are involved in manufacturing electric mobility products.<sup>15</sup>

Clearly a strong industry has emerged in Canada that creates jobs and can only expand if PEVs become popular. Canada's entrenched automotive sector also stands to benefit from this potential shift away from ICE vehicles. However, if this shift takes place, future and present workers in auto manufacturing in Canada will need to be prepared to meet the requirements for electric car production.

Canada boasts 9 auto assembly plants and numerous facilities that supply components and parts to our existing auto production industry. Close to 160,000 workers are employed in both auto production and auto parts manufacturing in Canada today with another 336,000 working in distribution and aftermarket sales and service.<sup>16</sup> Jobs in the auto manufacturing sector are primarily located in Ontario, but companies producing parts for conventional and electric cars are located in most provinces. If indeed PEVs become widespread in Canada and the United States, workers in Canadian auto manufacturing will have to be prepared in advance to meet the demand for specialty labour skills required to produce these products.

The Canadian Auto Workers, Canada's largest autoworker union, is taking action to ensure that if the big three auto companies increase production of PEVs in North America and in turn reduce production of traditional vehicles, that these companies do

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<sup>14</sup> "Electric Vehicle Technology Roadmap for Canada," Natural Resources Canada, [http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/81891/E-design\\_09\\_0581\\_electric\\_vehicle\\_e.pdf](http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/81891/E-design_09_0581_electric_vehicle_e.pdf)

<sup>15</sup> "Directory of Electric Mobility Resources Canada 2008," Electric Mobility Canada, accessed January 12, 2011, <http://www.emc-mec.ca/files/EMC-Directory2008.pdf>

<sup>16</sup> "Cars on the Brain: Canada's Automotive Industry," Industry Canada, 2007, [http://www.ic.gc.ca/eic/site/auto-auto.nsf/vwapj/2007\\_AutoStatisticsFlyer-ENG.pdf/\\$FILE/2007\\_AutoStatisticsFlyer-ENG.pdf](http://www.ic.gc.ca/eic/site/auto-auto.nsf/vwapj/2007_AutoStatisticsFlyer-ENG.pdf/$FILE/2007_AutoStatisticsFlyer-ENG.pdf)

not move their Canadian manufacturing investments [i.e. assembly plants] to other countries.<sup>17</sup> Preparing workers for the production of PEVs will be of utmost importance for the Canadian Auto Workers in order to maintain and increase jobs in Canada. For example, the skills required for the safe handling and installation of high voltage battery packs will need to be taught to automotive workers in order to safely prepare the workforce for the production of this new technology.<sup>18</sup> If this training does not take place there is a risk that more autoworker jobs could be lost to countries with workforces that are ready to take on the more technical aspects of building electric cars.

Ford, General Motors and Chrysler have not announced that PEV production will be coming to Canada. However, when and if they do make this announcement, the Canadian Auto Workers union affirms that existing auto plants in Canada would not require extensive retrofits to accommodate production.<sup>19</sup> This means that if workers have the proper skills, Canada could be well positioned to become a producer of PEVs. In addition, given that some of these vehicles, such as the Chevy Volt [the Volt has both an electric and gas powered motors], will require more parts than ICE vehicles further Canadian jobs could be created in the auto industry.

For these reasons the Canadian Auto Workers union, through its membership on the Board of Directors of Electric Mobility Canada, is calling for the federal government to stimulate investment in the manufacturing of battery electric vehicle, plug-in hybrid electric vehicle and parts manufacturing in the country. Existing jobs will be maintained and new jobs created in this sector with industry stimulation from the federal government.

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<sup>17</sup> Conversation with Ken Bondy, National Coordinator for the Health, Safety and Environment Department, Canadian Auto Workers.

<sup>18</sup> "Electric Vehicle Technology Roadmap for Canada," Natural Resources Canada, [http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/81891/E-design\\_09\\_0581\\_electric\\_vehicle\\_e.pdf](http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/81891/E-design_09_0581_electric_vehicle_e.pdf)

<sup>19</sup> Conversation with Ken Bondy

## **II. Challenges**

This report is advocating for PEVs as an interim measure in a broader shift towards sustainable mobility solutions such as public transportation, bicycling and walking. For PEVs to gain a foothold as an interim solution, however, some serious hurdles need to be cleared in order for the electric car to emerge as a viable option for consumers. This section will explore the challenges that PEVs face in Canada and looks at what our municipal, provincial and federal governments will need to do to foster PEVs.

### **Lack of Infrastructure**

Most PEVs will allow owners to charge their vehicle's battery at home by plugging into a regular 120 volt outlet. The time required for this type of charging could take up to 21 hours depending on the size of the vehicle's battery.<sup>20</sup> Vehicle owners can purchase special 240 volt charging equipment that will cut the charging time in half. Nissan is selling a 'home charging dock' for its BEV, the Leaf. The company lists the price of the charging dock at \$2,000 (usd) per home.<sup>21</sup> There will also be extra costs to the customer for installation and potential electrical upgrades to the home.

Public charging stations will also be needed in order to provide confidence for PEV owners concerned about the range of their vehicle. Stations would offer a 'fast charging' service at 480 volts that would significantly reduce charge times. Some initiatives are underway to provide this type of charging infrastructure in Canada, but it has yet to materialize on a broad scale. Until charging infrastructure is further developed, PEVs will remain a much less attractive option for people who do not live in a home or in buildings where charging stations are installed.

### **Affordability**

At the beginning of 2011, no electric cars were widely available for sale in Canadian dealerships. Two models, the Chevy Volt and the Nissan Leaf, are now available for purchase in the United States and should be in Canadian dealerships in 2011. Based on the U.S. prices for these vehicles – base price of \$40,000 (usd) and \$33,000 (usd) respectively – consumers of PEVs will be paying a premium for these products. Compared with traditional compact vehicles powered by ICEs, a similar sized PEV is

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<sup>20</sup> "Encouraging the Rapid Adoption of Electric Vehicles in Canada," Electric Mobility Canada, October, 2010.

<sup>21</sup> Nissan website, accessed January 10, 2010, <http://www.nissanusa.com/leaf-electric-car/faq/list/charging#/leaf-electric-car/faq/view/113>

priced 50%-100% higher.<sup>22</sup> This price will vary depending on the subsidies the consumer may receive from the government.

The power source represents fifty percent of total vehicle cost for PEVs.<sup>23</sup> Lithium ion batteries that power most contemporary electric cars are priced based on how much electricity can be stored in the vehicle's battery. For example, the Tesla Roadster, a high-end electric sports car, boasts a 53 kWh<sup>24</sup> lithium ion battery that gives the vehicle a range of 394 kilometres.<sup>25</sup> The cost of this battery would be approximately \$53,000 (cnd), or \$1,000 for every kilowatt hour stored in the device.<sup>26</sup> With the price for a Tesla Roadster listed at \$125,000 (usd), the cost of the battery is close to 50 percent of the total cost of the vehicle.<sup>27</sup> One must also take into account that the lifespan of these batteries is still quite short. The Roadster's battery, for instance, has an estimated lifespan of only 7 years.

The Tesla Roadster is a special vehicle with a very big battery and large range. Most electric vehicles in development today have smaller batteries and ranges of only up to 100 kilometres and, hence, the cost of the battery and overall vehicle is lower. Given that lithium batteries for electric vehicles are still considered to be in a prototype stage of development, ranges should increase over time.<sup>28</sup> Costs of batteries should come down through economies of scale and with further development in production practices.<sup>29</sup>

High prices for electric vehicles will deter potential buyers even with generous government subsidies. Prices should drop over time if sales increase, but this is not expected to happen during the next 5 years.<sup>30</sup> On the affordability question, marketing information services firm J.D. Power and Associates concludes: "based on the real and perceived negative financial challenges that alternative-energy vehicles present to consumers – and as long as the price of oil remains relatively stable – it does not seem

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<sup>22</sup> "Drive Green 2020: More Hope than Reality?" published by J.D. Power and Associates, 2010 by J.D. Power and Associates, The McGraw-Hill Companies, Inc. All Rights Reserved.

<sup>23</sup> IBID

<sup>24</sup> "The Tesla Roadster Battery System," Tesla Motors, August 16, 2006, [http://webarchive.teslamotors.com/display\\_data/TeslaRoadsterBatterySystem.pdf](http://webarchive.teslamotors.com/display_data/TeslaRoadsterBatterySystem.pdf) Accessed Dec. 17, 2010.

<sup>25</sup> Tesla Motors website, <http://www.teslamotors.com/roadster/specs> Accessed Dec. 17, 2010

<sup>26</sup> "Demonstrating Electric Vehicles in Canada," Electric Mobility Canada, March 2010.

<sup>27</sup> Tesla Motors website, <https://www.teslamotors.com/own> Accessed Dec. 17, 2010

<sup>28</sup> "Electric Vehicle Technology Roadmap for Canada"

<sup>29</sup> "A cleantech resource crisis? Will rare earth and lithium availability thwart cleantech growth?" Cleantech Insight, January 2010, [http://www.tremcenter.org/index.php?option=com\\_attachments&task=download&id=2](http://www.tremcenter.org/index.php?option=com_attachments&task=download&id=2)

<sup>30</sup> IBID.

likely that the growth rate of such battery-based vehicles as HEVs and BEVs will be significant.”<sup>31</sup>

Regardless of this conclusion, government subsidies to the auto industry along with rebates for customers will be necessary to lower electric car prices in the short term, thereby encouraging more people to purchase these vehicles. However, even with rebates these vehicles will remain accessible to only a few well off buyers for the foreseeable future. The goal would be for economies of scale to lower the price therefore making the electric car more accessible to a greater number of people. Only time will tell if this will happen.

## **Batteries**

Dubbed the ‘Achilles’ heel of electric vehicles,’ battery technology is the key piece of the electric car puzzle. Some have said that “the speed at which the world embraces the electric car rests in its ability to build a better battery.”<sup>32</sup> Electric Mobility Canada says that batteries are the most important ‘element in the viability of the PEV industry.’<sup>33</sup> This is logical given that the vehicle will not be mobile without power, electric or otherwise.

Over the years, different types of batteries have been used to power electric vehicles including lead acid and nickel metal hydrate. The majority of electric vehicles in development, or already in production today, use lithium ion batteries as the main source of power.<sup>34</sup> Lithium – batteries made with lithium are found in most laptops and mobile phones – batteries are widely believed to be the most likely to power electric vehicles between now and 2018.<sup>35</sup> This is due to the higher energy density of lithium based batteries and greater power storage capacity. Even though most manufacturers of battery powered vehicles are using lithium based batteries, the technology is still very much in the developmental phase.

The ‘Electric Vehicle Technology Roadmap for Canada’ produced in 2009 by members of electric mobility industry and Natural Resources Canada, outlines some serious

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<sup>31</sup> IBID.

<sup>32</sup> Burnham, M., “Baltimore Drivers to Test ‘Near-Enough Perfect’ Electric Fleet,” June 24, 2009, New York Times. <http://www.nytimes.com/gwire/2009/06/24/24greenwire-baltimore-drivers-to-test-near-enough-perfect-85613.html>

<sup>33</sup> “Electric Vehicle Technology Roadmap for Canada,” Natural Resources Canada, [http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/81891/E-design\\_09\\_0581\\_electric\\_vehicle\\_e.pdf](http://canmetenergy-canmetenergie.nrcan-rncan.gc.ca/fichier/81891/E-design_09_0581_electric_vehicle_e.pdf)

<sup>34</sup> IBID

<sup>35</sup> IBID

challenges to lithium battery technology. The core concerns around lithium batteries outlined in the 'Roadmap' are cost, energy density and lifetime. Another serious concern [to be discussed below] about batteries is the environmental impact of extracting lithium.

## **Range**

Range issues are one of the biggest challenges for the general adoption of electric mobility. In Canada 59 percent of the population lives within the battery life ranges of most PEVs in development.<sup>36</sup> Many Canadian commuters could therefore switch to electric vehicles and get to and from work without the battery dying. Extended range for driving on weekends will still pose some problems for general adoption until longer lasting batteries or good charging infrastructure are developed.

Plug-in Hybrid Electric Vehicles, such as the Chevy Volt, that have an on-board internal combustion engine that charges the battery on the fly, are designed to deal with the issue of 'range anxiety.' The Volt's electric motor is powered by a lithium battery and has a stated range of 65 kilometres. When the battery runs out of power the ICE is engaged and begins to recharge the battery. Until longer lasting batteries are developed, the plug in hybrid electric vehicle will remain the only battery powered vehicle with an unlimited range.

Another factor to consider in the Canadian context is the impact of cold temperatures on the range of lithium batteries. More power is needed to power all aspects of an automobile when the temperature drops. The range of an electric vehicle will drop with the outside temperature. Conversely, with the use of air conditioning, high temperatures will also impact the operating range of PEVs.

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<sup>36</sup> "Demonstrating Electric Vehicles in Canada," Electric Mobility Canada, March 2010.

### III. Real solution for emissions reductions?

There is no question that PEVs will reduce overall tailpipe emissions. In addition, gasoline and diesel consumption will drop considerably if this technology is widely adopted. Based on these two tangible outcomes, PEVs are routinely touted as an important component in reducing global greenhouse gas emissions and our reliance on oil. Yet, just how much of an overall reduction is achievable through widespread PEV use is an important question.

Some sources say that PEVs will significantly reduce GHGs while other data suggests that this is not the case. One reason for this discrepancy is whether one is calculating GHG reductions from one individual PEV compared to a conventional car, or if one calculates GHG reductions from the widespread adoption of PEVs using overall national level GHG emissions data. The answers also depend on who is calculating the data and how it is broken down.

For example, Electric Mobility Canada (EMC) – an industry association whose members include electric car manufacturers, battery companies and labour unions – states that Canada’s transportation sector is responsible for more than 30 percent of the country’s CO<sub>2</sub> emissions.<sup>37</sup> While this figure is accurate<sup>38</sup> using the emissions data from the entire transportation sector [including domestic aviation, light and heavy duty gasoline and diesel trucks, railways, motorcycles and motor boats, etc.], tends to exaggerate the emissions from individual cars, or the kind of smaller automobiles that could, in the foreseeable future, be replaced with electric vehicles.

By looking at the GHG emissions from the tailpipes of automobiles one can find a more accurate picture of effectiveness of PEVs at reducing overall GHGs. According to Environment Canada’s 2008 Greenhouse Gas Inventory, the country’s overall greenhouse gas emissions (GHGs)<sup>39</sup> totaled 734 megatonnes (734 Mt of CO<sub>2</sub> eq) of carbon dioxide equivalent for the year.<sup>40</sup> The transportation category, according to the report, accounted for 27 percent (198 Mt of CO<sub>2</sub> eq) of this total. Emissions from automobiles

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<sup>37</sup> “Demonstrating Electric Vehicles in Canada,” Electric Mobility Canada, March 2010.

<sup>38</sup> Government of Canada Greenhouse Gas Emission figures vary slightly depending on the department or agency providing the data. For this report data from the Environment Canada publication “Information on Greenhouse Gas Sources and Sinks: Canada’s 2008 Greenhouse Gas Inventory – A Summary of Trends 1990-2008” is employed.

<sup>39</sup> The GHGs referred to in this report include carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, perfluorocarbons and hydrofluorocarbons. Carbon dioxide emissions account for 78.2% of all Canadian GHGs.

<sup>40</sup> “Information on Greenhouse Gas Sources and Sinks: Canada’s 2008 Greenhouse Gas Inventory – A Summary of Trends 1990-2008,” Environment Canada, <http://www.ec.gc.ca/Publications/F62F0CF4-5254-45F2-9365-B01BE0576174%5CCanadas2007GreenhouseGasInventoryASummaryOfTrends.pdf>

and small trucks powered by gasoline and diesel were responsible for 5.6 percent (4.1Mt of CO<sub>2</sub> eq) of Canada's overall GHGs in 2008, or approximately one fifth of carbon emissions generated by the entire transportation sector.<sup>41</sup>

While alternatively powered heavy duty SUVs and trucks exist and have been demonstrated in Canada, most automobile manufacturers that will release PEVs in the next two years are focused on smaller sized cars.<sup>42</sup> Therefore, PEVs will most likely replace some of the automobiles and small trucks that account for approximately 5.6 percent of Canada's overall GHG emissions or one-fifth of the transportation sector's carbon emissions.<sup>43</sup>

*It is important to note that the data provided here refers to GHG emissions from tailpipe emissions only, and does not include the source of the electricity used to power the hypothetical BEVs mentioned in this analysis*

In the hypothetical situation where in 2008 all of the vehicles in this category had been zero tailpipe emission battery electric vehicles, Canada's overall GHG emissions would have totaled 693 Mt of CO<sub>2</sub> eq instead of 734 Mt of CO<sub>2</sub> eq. A drop in emissions of this magnitude (5.6%) would be significant; however the reality is that full battery electric vehicles are projected to make up only 1.85 percent of global personal vehicle sales by 2020.<sup>44</sup> The reduction in overall national GHG emissions in the Canadian context will therefore not be very high.

Using a more concrete example, Electric Mobility Canada has set a modest goal of 500,000 highway capable PEVs on Canadian roads by 2018.<sup>45</sup> This number equals 2.6 percent of the 18,938,839 diesel and gasoline powered light vehicles in Canada.<sup>46</sup> In the hypothetical situation where 500,000 diesel and gasoline powered light vehicles had been replaced by 500,000 zero tailpipe emission BEVs, the light vehicle category's overall annual GHG emissions would have been reduced by 2.6 percent. Based on Canada's 2008 total GHG emissions this hypothetical switch would only result in a .14

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<sup>41</sup> IBID.

<sup>42</sup> "Demonstrating Electric Vehicles in Canada," Electric Mobility Canada, March 2010.

<sup>43</sup> It is important to note that the data provided here refers to GHG emissions from tail pipe emissions only and does not include the source of the electricity used to power the hypothetical BEVs mentioned in this analysis.

<sup>44</sup> "Drive Green 2020: More Hope than Reality?" published by J.D. Power and Associates, 2010 by J.D. Power and Associates, The McGraw-Hill Companies, Inc. All Rights Reserved.

<sup>45</sup> "Encouraging the Rapid Adoption of Electric Vehicles in Canada," Electric Mobility Canada, October, 2010.

<sup>46</sup> "Canadian Vehicle Survey," Natural Resources Development Canada, 2007, p.9

<http://oee.nrcan.gc.ca/Publications/statistics/cvs07/pdf/cvs07.pdf>

percent overall reduction of carbon emitted into the atmosphere by this segment of vehicles.<sup>47</sup>

These calculations explore the potential for overall annual GHG emissions reductions from the adoption of PEVs. The results show that a very small decrease will occur if half a million BEVs replaced gas or diesel fueled vehicles. These figures contrast dramatically with the calculation of reductions for individual automobiles. Compare, for example, the above figures to the Pembina Institute's recent study of the lifecycle analysis of individual automobiles in British Columbia.<sup>48</sup> Pembina calculated that an individual BEV would boast an 80 percent reduction in GHGs when compared to individual ICEs. The study showed that plug-in hybrid electric vehicles would reduce green house gas emissions by 55 percent relative to a traditional gas powered vehicle.

Although these two sets of data – the hypothetical .14 percent reduction versus the 80 percent reduction – are wildly different, they are also both accurate. On the one hand, the individual GHG emissions reductions for the lifecycle of one PEV are significant. Yet, on the other hand, the collective tailpipe emissions reduction from a projected fleet of 500,000 is not at all significant. It is important therefore, that data related to the positive role PEVs could have in reducing emissions, include an individual as well as a collective analysis. Otherwise, an inaccurate and incomplete message about this technology will be perpetuated.

## **Fuel consumption**

In terms of fuel consumption, if EMC's goals are met there would be a significant impact on the amount of liquid fuel refined and consumed in the country. In 2007, the 18,938,839 diesel and gasoline powered light vehicles in Canada consumed 1.29 billion and 31.3 billion litres of diesel and gasoline respectively.<sup>49</sup> In a hypothetical situation where 500,000 PEVs replaced 484,700 gasoline powered vehicles and 15,300 diesel powered vehicles, 825 million litres of gasoline and 34 million litres of diesel fuel would be saved every year. This translates to a savings of approximately 12.13 million barrels

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<sup>47</sup> This figure will be higher if the GHG emissions from the refining of the fuel saved was taken into account. The purpose of excluding the refining process is to highlight the divergent set of data that is available regarding emission reductions that can be attributed to PEVs.

<sup>48</sup> including manufacturing processes, fuel and electricity production and tailpipe emissions

<sup>49</sup> "Canadian Vehicle Survey," Natural Resources Development Canada, 2007, p.9

<http://oee.nrcan.gc.ca/Publications/statistics/cvs07/pdf/cvs07.pdf>

of oil annually or approximately 1.5 percent of the total oil consumed in Canada in 2008 (817.6 million barrels).<sup>50</sup>

The data provided here shows that PEVs will have an encouraging but limited impact on overall tailpipe emissions from automobiles. In addition, demand for oil will drop due to the reduction in demand for gasoline and diesel fuel. These limited environmental gains from fuel and GHG emissions reductions from the potential adoption of electric cars are positive. However, as we will see in the following section the source of the electricity used to power these vehicles could cancel out these positive results.

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<sup>50</sup> United States Energy Information Administration, accessed January 12, 2011, [http://tonto.eia.doe.gov/country/country\\_energy\\_data.cfm?fips=CA](http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=CA)

#### IV. Impact of powering electric cars

A recent industry report notes that “a mass transition to vehicles that depend on electricity might only result in changing where exhaust is emitted, rather than decreasing the amount of exhaust emitted.”<sup>51</sup> This is a major concern when, for example, the government of China – China is the largest consumer of coal in the world – indicates that it plans to convert its national automotive fleet to battery powered technologies. These concerns are also echoed by the United Kingdom’s Royal Society of Chemistry who recently stated that given the present forms of power generation in the U.K. replacing all of Britain’s cars with PEVs would have a negligible impact on the carbon footprint of the country.<sup>52</sup>

In the United States where the Obama administration has invested heavily in stimulating the electric car industry, electricity from coal fired plants currently accounts for close to 50 percent of the total annual electricity generation in the country.<sup>53</sup> Only 10 percent of the U.S. electricity is generated from renewable sources, while the rest comes from extractive industries including nuclear, natural gas, petroleum liquids and petroleum coke and of course coal.<sup>54</sup>

In 2008, the burning of coal for electricity generation accounted for 28 percent of the green house gas emissions in the United States.<sup>55</sup> If the 250 million cars on U.S. roads transformed into Chevy Volts overnight, and each of these cars plugged in to charge every day for 365 days, the amount of electricity consumed would total 1,186,250,000 megawatt hours or approximately one third of the total power generated in the United States in 2009. With close to one-third of the United States’ GHG emissions coming from coal fired power generators, the emissions reductions that could be gained with the widespread adoption of PEVs would be negligible.

This scenario will never transpire of course, but what these figures show is that one cannot simply conclude that electric vehicles will always be ‘green.’ When extractive industries provide the primary input for electricity generation the image of PEVs as

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<sup>51</sup> “Drive Green 2020: More Hope than Reality?” published by J.D. Power and Associates, 2010 by J.D. Power and Associates, The McGraw-Hill Companies, Inc. All Rights Reserved.

<sup>52</sup> “RSC enters debate over R&D funding,” Royal Society of Chemistry press release, August 13, 2010, <http://www.rsc.org/AboutUs/News/PressReleases/2010/RAPLettertoAdrianSmith.asp>

<sup>53</sup> United States Energy Information Administration, [http://www.eia.gov/cneaf/electricity/epm/table1\\_1.html](http://www.eia.gov/cneaf/electricity/epm/table1_1.html)

<sup>54</sup> IBID.

<sup>55</sup> “Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2008,” United States Environmental Protection Agency, April 15, 2010.

sustainable should be challenged.

This contradiction is illustrated well when energy companies like Duke Energy in the United States are also advocating for the electric car.<sup>56</sup> It is of course natural for a corporation that exists to create profit for shareholders to promote merchandise that will be supplied by its own products. In this case, however, the ostensibly 'green' electric cars Duke Energy so desperately wants to fuel with the energy generated from its power plants will, in many cases, be using electricity from coal fired power plants. Not only are emissions from these plants disturbingly high, in many cases the coal that is burned to generate electricity comes from mountain top removal. For example, if one were driving an electric car charged with electricity from coal fired generators in Eastern Kentucky or West Virginia, the electricity powering this vehicle has a huge environmental and social footprint.

Substituting one extractive industry for another is not a solution. This is one of many contradictions that proponents of electric cars need to confront before these products can become generally accepted as 'green' forms of transport.

In Canada, however, in provinces such as British Columbia, Manitoba, Newfoundland and Labrador and Quebec where up to 100 percent of electricity comes from renewable resources (mostly hydro electric dams) electric vehicles will be charged with more sustainable forms of electricity.<sup>57</sup> PEVs could live up to their constructed image as 'green solutions' if they are charged by hydro generated power in these regions. Both upstream and downstream pollution would be very low in these cases [even though there's a tendency to forget that the construction of mega dams caused considerable social and environmental disruption in the 1970s]. By contrast, the Pembina Institute's study found that driving a BEV in the Province of Alberta, where close to all of the electricity is generated from fossil fuels, would only result in a 1.1 percent reduction in emissions relative to a conventional ICE.<sup>58</sup>

Another consideration is the impact of hydroelectric dams on the environment and society. Canada's hydroelectric infrastructure was developed decades ago and the country is now far removed from the social and environmental impacts that these

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<sup>56</sup> Link to Duke Energy United States Government lobbying report, <http://soprweb.senate.gov/index.cfm?event=getFilingDetails&filingID=11DAA3A3-B6E9-41D2-BD05-6204CF8F2A30>

<sup>57</sup> Ontario has substantial amounts of renewable generation

<sup>58</sup> Moorhouse, J., Laufenberg, K., "Electric Vehicles: Powering the Future," Pembina Institute, September, 2010. Accessed January 12, 2011, <http://www.pembina.org/pub/2073>

projects brought to many communities. However, in many developing countries of the Global South hydroelectric dam projects are today having serious impacts on local populations. If PEVs do gain a global reach, the push to generate more electricity from dams could end up causing even more serious social and environmental damage. Other forms of renewable sources of electricity generation such as solar, wind and tidal power seem to be the cleanest sources of energy for PEVs.

In addition, like any consumer product, many of the inputs required for the manufacturing of automobiles, including PEVs, are derived from oil. Production processes are also polluting. For example, regardless of the source of power for propulsion automobiles require huge amounts of water (250,000 litres) to produce one unit.<sup>59</sup> PEVs will therefore always have a sizeable carbon footprint.

### **Resource extraction - lithium**

As we have seen, electric vehicles are not as 'green' as they are made out to be by proponents due in part to the negative impact of the source of electricity used to charge them. Add to this footprint the use of lithium as an essential raw input in the production of batteries.

Over 30 PEVs have been announced to launch in the next few years and global sales are projected to reach 5.2 million units by 2020.<sup>60</sup> Unless a new battery technology emerges in the next 9 years, the lithium based battery will remain the dominant power source for these vehicles. If lithium batteries continue to be the most widely used technology for PEVs, based on sales projections 39,000 metric tons of lithium will be required to meet demand by 2020.<sup>61</sup> Production of lithium is expected to reach 42,000 metric tons by 2015. When the rising demand for lithium from the electronics industry (laptops, mobile phones etc.) is added to this total, a supply problem could potentially arise.

Some experts say that "realistic analysis of the world's lithium deposits and potential sources shows that maximum sustainable production of battery grade lithium will only

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<sup>59</sup> Barlow, M., Clarke, T., "Blue Gold," Stoddard: Toronto, 2002.

<sup>60</sup> "Drive Green 2020: More Hope than Reality?" published by J.D. Power and Associates, 2010 by J.D. Power and Associates, The McGraw-Hill Companies, Inc. All Rights Reserved.

<sup>61</sup> "A Cleantech Resource Crisis? Will Rare Earth and Lithium Availability Thwart Cleantech Growth?" Cleantech Insight, [http://www.tremcenter.org/index.php?option=com\\_attachments&task=download&id=2](http://www.tremcenter.org/index.php?option=com_attachments&task=download&id=2)

be sufficient for very limited numbers of electric vehicles.”<sup>62</sup> Others say that no catastrophic lithium shortage will happen between now and 2015.<sup>63</sup> In spite of this ongoing debate over available lithium, this is a finite resource meaning that PEVs face an uncertain future, similar to fossil fuel powered vehicles.

Seventy percent of the globe’s lithium deposits are situated in the Northern part of Chile and Argentina and in Southern Bolivia. More limited deposits can be found in Australia, Brazil, Canada, China, Portugal and Zimbabwe. Lithium is extracted from brine through an evaporation process, or mined from clays and pegmatite. Like any extractive industry, these processes have an impact on the local environment. The salt flats of Southern Bolivia and Northern Chile and Argentina is where a majority of the brine extraction of lithium occurs. One negative outcome of the extraction process in this part of South America is the heavy use of fresh water. One source estimates that lithium extraction from brines in Chile consumes 2/3 of area’s drinking water.<sup>64</sup>

The impact of lithium extraction has led some to state that ‘green cars’ are not possible when “they have been produced at the expense of some of the world’s last unspoiled and irreplaceable wilderness.”<sup>65</sup> Substituting our reliance on one element (oil) to another (lithium) is illogical. A diversity of power sources need to be developed for electric cars to limit their ecological footprint. Lithium batteries should therefore only be part of a broader transition and not be seen as a ‘silver bullet’ technology for powering electric vehicles.

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<sup>62</sup> “The Trouble With Lithium 2: Under the Microscope,” Meridian International Research, 2008.

<sup>63</sup> “A Cleantech Resource Crisis? Will Rare Earth and Lithium Availability Thwart Cleantech Growth?” Cleantech Insight, [http://www.tremcenter.org/index.php?option=com\\_attachments&task=download&id=2](http://www.tremcenter.org/index.php?option=com_attachments&task=download&id=2)

<sup>64</sup> Abelli, L., Oppenheimer, P., “World Lithium Resource Impact on Electric Vehicles,” <http://action.pluginamerica.org/o/2711/images/World-Lithium-Resource-Impact-on-Electric-Vehicles-v1.pdf>

<sup>65</sup> “The Trouble With Lithium 2: Under the Microscope,”

## V. Individual Car Dependency

Before any recommendations can be made about promoting PEVs, some serious non-propulsion issues with personal vehicles need to be addressed. As we have seen if all of the cars on the world's roads shifted to electrified propulsion tomorrow, emissions from tailpipes and pollution caused by extracting and refining oil would obviously be reduced significantly. Even if a fraction of this shift occurred it would be a great victory for eliminating the pollution caused by fuelling and operating ICEs. In many ways, however, this victory would be hollow if the overall impact of automobiles is not dealt with simultaneously. The argument is that shifting to PEVs, or simply greening the automobile, will only deal with a part of the overall socially and environmentally destructive nature of society's obsession with the automobile.

This section will explain a few of the social, political, economic and environmental problems that have emerged due to the emphasis on individual cars and will recommend that any serious action taken to mitigate or eliminate the impact of ICEs needs to include the issues discussed below.

In his book *Automobile Politics*, Matthew Patterson states that there are dangers to the “weak” approach of simply improving the way that cars are used. Patterson states that a major criticism of this approach is that it focuses purely on changes to the car and the fuels they use and has a “relatively narrow range of the environmental problems with which the car is associated...but it is unlikely to deal with most of the problems of space use – parking, congestion and so on.”<sup>66</sup> His position is that transport as a whole should undergo a fundamental change and that any critique of automobiles needs to move beyond the car to include the associated negative impacts of our car dependant society.

When the number of cars quickly rose in the early twentieth century, more roads needed to be built and road quality had to be improved. Government subsidies for cars through the use of tax money to build roads or to artificially lower the price of gasoline helped secure the dominance of automobiles over other forms of transportation in Canada and the United States. In the United States much of the rapid road expansion that occurred after World War II was spurred through a powerful road or, highway lobby made up of automobile, oil and construction companies. Government bureaucrats and planners worked with the lobby machinery to help create an environment where cars

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<sup>66</sup> Paterson, M. “Automobile Politics: Ecology and Cultural Political Economy.” Cambridge University Press, Cambridge, 2007, PP 200 - 201

and their energy intensive and sprawling infrastructure could develop without impediment and to the exclusion of alternative means of transport.<sup>67</sup>

Added to this were the required parking spaces to meet the ever growing number of personal vehicles. By and large this infrastructure has been financed through public monies to the benefit of individual car users, and largely excluding bicycles, public transport and pedestrians. Roads have also penetrated our large urban centres to, as Paterson says, “compete with/replace trains,” which, until the explosion of the automobile had been the dominant form of travel between cities.<sup>68</sup>

The ever increasing number of cars globally – PEV or ICE – will require more space for them to operate. More land will be expropriated and turned into highways and parking lots with the unchecked growth of individual cars. Blindly pushing for a shift to electric cars will not solve the ongoing destruction of fertile farmland, forests, wetlands, and people’s homes etc. to make way for more roads and parking lots. A recent industry report points out that it took 95 years – from 1900 to 1995 – to get the first 500 million cars on the world’s roads, but it will only take another 20 years from that point for the number to exceed 1 billion.<sup>69</sup>

In Canada, the United States and Western Europe, the rapid growth in the number of cars has leveled and the development of road infrastructure that accompanied this growth has slowed. In emerging markets, however, the quickly expanding middle class will drive the next explosion in passenger vehicle sales and the resulting rise in demand for new road infrastructure will have a serious impact on local environments and ecosystems. In this case, regardless of whether or not the cars on these new roads have zero emissions, the impact of the infrastructure on the population and the local environment cannot be ignored.

This is just one example of the negative overall impacts of a car dominated society. Others impacts include car facilitated urban sprawl, automobile production<sup>70</sup> and hyper individualism.<sup>71</sup> Simply recommending electric vehicles as the answer to car induced environmental degradation cannot be complete without a serious look at how Western society has developed with individual automobiles as the focal point for our economy.

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<sup>67</sup> Paterson, pp 117,118

<sup>68</sup> IBID, p. 117

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<sup>70</sup> E.g. If an automobile plant that has been shown to be destructive to surrounding environment and people were to switch production from ICE cars to EVs without improving production processes, electric vehicles cannot be seen as a sustainable solution.

<sup>71</sup> See Paterson (2007) for a complete critique of automobile politics.

The sum of the positive results from electric cars will not be enough to outweigh the overall negative consequences of a car dominated society.

That being said, cars are not going anywhere soon and therefore should undergo some kind of 'greening' process as an interim stage in the broader societal shift towards truly sustainable mobility solutions, such as public transportation, bicycling, walking and better forms of urbanization. This argument leads to further questions about whether or not public money should be used to stimulate a burgeoning electric car industry or would funds be more effective in reducing emissions if they went to developing more accessible public transportation or other modes of sustainable transportation?

## VII. Conclusion

The question of electric mobility is complex and is littered contradictions. A situation, therefore, is created where expounding a clear position on the issue becomes difficult for those who would advocate for emissions reductions from cars. Take the question of GHG reductions for example; on the one hand an individual electric car charged with electricity from a renewable source emits 80 percent less GHGs than a traditional fuel powered vehicle. However, when examining national GHG emissions from the tailpipes of personal vehicles, replacing 500,000 ICE vehicles with zero emission BEVs would have only reduced tailpipe GHG emissions in this category by .14 percent.

Other elements covered in this report are the footprint of electric vehicles. Can one consider electric vehicles charged from coal fired plants to be 'green' cars? Is it reasonable to promote vehicles that are essentially – in the short term – shifting their reliance on one extractive industry – fossil fuels – to another – lithium? Add to this the fact that pushing for electric cars will do nothing to curb the impact of the ever growing automobile infrastructure of roads, parking lots and traffic congestion.

This report raises these questions in order to stimulate the overall debate around the creation of more sustainable systems of transportation in this country and around the world. Given the unavoidable contradictions that are highlighted here, any discussion of reducing emissions in the transportation sector should include serious consideration of moving away from personal vehicles altogether. Public transportation, other forms of mobility such as cycling or simply walking combined with a rethink of present urban planning trends should be at the forefront of any debate of the benefits of electric cars.

Contradictions are unavoidable, but when terms such as 'green jobs,' 'green society,' and 'green economy' are used whenever a product or trend has the semblance of being sustainable, a comprehensive analysis is required in order to clearly formulate strategies for the future.

That being said, electric vehicles could indeed 'take off' and with an injection of public funds Canada is well positioned to emerge as a significant supplier of electric vehicles to the North American market. However, given the contradictions highlighted above, the hope would be that these products are only seen as interim solutions in a widespread shift away from individual mobility to a more collective and sustainable form of transportation.