The Emergence of Electric Vehicles on Prince Edward Island and Potential Scenarios to 2030

A Guide for Policy Development
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Working Paper

Written by: Matthew McCarville
Environmental Coalition of Prince Edward Island

Photo Credit: Better Place

Photo Credit: Better Place

Summary of Findings

1) 18,726 electric vehicles could be on PEI by 2030[1].
   a) Assuming the size of PEI's light duty fleet (LDF) remains flat.
   b) Assuming a 24 percent consumer adoption rate, which was a model forecasted for the U.S. to 2030, in a recent study conducted by the UC Berkeley Center for Entrepreneurship and Technology.

2) This could reduce GHG emissions by up to 115 kilotonnes CO_2 annually by 2030 – equal to a 7 percent decrease from current total energy related emissions on PEI.
   a) Assuming certain driving indicators, like vehicle characteristics, total fleet size and kilometres traveled remain stable.
   b) Assuming full utilization of renewable power or renewable energy certificates (RECs), to guarantee that the demand and supply of personal electric transportation is met, with a verifiable account of zero emissions.

3) The annual electricity supply needed to power an all 78,024 cars and light trucks electrically on PEI is estimated at between 200 GWh to 300 GWh.
   a) This range is a rough estimate. More study is needed.

4) This could reduce GHG emissions by up to 479 kilotonnes CO_2 annually – equal to a 31 percent decrease from current total energy related emissions on PEI.
   a) Assuming certain metrics, such as vehicle characteristics, total fleet size and kilometres traveled remained steady overall.
   b) Assuming full utilization of renewable power or renewable energy certificates (RECs), to guarantee that the demand and supply of personal electric transportation is met, with a verifiable account of zero emissions.

5) 26 to 39 large 3 MW turbines could provide power output for all 78,024 electric vehicles on PEI.
   a) Assuming a cost of $2.4 million per MW, the total installed cost of this installed wind capacity is $187.2 to $280.8 million.
   b) This range is a rough estimate. More study is needed.

6) Pricing is critical for consumer adoption. There are indications that some electric vehicles will be priced competitively in the marketplace, and will benefit from lower operating and maintenance costs compared to vehicles with internal combustion engines. Many jurisdictions are offering financial incentives to drive consumer adoption.

[1] http://www.statcan.gc.ca/pub/53-223-x/2008000/t058-eng.pdf Canadian Vehicle Survey in 2008. PEI - 78,024 vehicles, weighing up to 4.5 tonnes, in 2008.

7) Overall, based on the UC Berkeley studies of both the United States and the San Francisco Bay area, given the trends in other jurisdictions, and given the Island's wind energy, the economy could benefit from a change to electric vehicles, even given PEI's currently higher cost of electricity. However, due a limitation in data, including knowledge about future grid investments planned for PEI, including smart metering, this working paper does not attempt to calculate the net economic impact of a detailed scenario.

Summary of Conclusions

1) Electric vehicle adoption is likely to be driven by a combination of proactive local governments, stakeholder engagement and planning, as well as charging infrastructure, fast-charging, perhaps switchable batteries or pay per-kilometre battery contracts to reduce up-front costs, and information flows that enable renewable energy to be effectively utilized or procured.

2) Cost of ownership under a network operator model is expected to be lower than internal combustion engine vehicles.

3) Smart-grid infrastructure investments, including smart meters, enhance the charging processes by allowing vehicle-to-grid electricity flow and ancillary benefits such as smart charging and demand-response capabilities, providing more stable electricity prices to consumers while increasing wind penetration for local use in the Prince Edward Island energy mix. Not expected for up to a decade.

4) Beyond a certain point, smart grid capabilities become absolutely necessary to manage the load duration curve. Fast charging will require innovative technologies are used, such as ultra-capacitors (ie - NaS batteries), in order to maintain reliability.

5) Establishing proactive incentives, such as the $10,000 Ontario incentives for electric vehicles, or incentives from network operators, will a dramatic impact on consumer awareness and consumer adoption rates.

6) A lead time is needed to more effectively prepare the market for this shift. The design of a rollout strategy, in combination with stakeholders in the public and private sector, should include progressive incentives, development and planning considerations to encourage charge points or battery switch stations to be deployed as timely as possible. A major educational component is critical to consumer adoption. This component is also necessary to prepare the automobile sales, maintenance and repairs, parts and supplies sectors to be retrained, retooled, etc.

7) More third-party study is needed to fully model economic/environmental / etc. impacts of consumer adoption and the associated roll-out of infrastructure investments on PEI.

"It took over sixty years and six generations of gasoline engines for the Chevy Corvette to accelerate from zero to sixty miles per hour in under four seconds. The first version of the Tesla Roadster, which is the world's first Lithium-ion battery powered car, achieved that feat immediately. Whereas earlier generations of electric cars were plagued by poor performance, high cost, and short ranges, a new generation of affordable, high-performance electric cars is about to enter the U.S. market."[2]

In 2007, Renault-Nissan signalled plans to begin marketing electric vehicles in places which agree to install charging points and battery switching stations. Switchable batteries offer the best value to consumers, according to a recent study from the University of California, Berkeley[3]. Separating the ownership of the vehicle and the battery reduces the initial cost of an electric car to current vehicle market prices. Electric mobility providers such as a company called Better Place then hold ownership of batteries which are supplied on a pay-per-kilometre contract – similar to the cell phone model. This business model eliminates consumer risk because the constantly improving battery technology will not adversely impact the value of the consumer-owned vehicle. The automated battery switch stations cost roughly $500,000 to $1,000,000 and are able to accommodate multiple batteries for different vehicles. The time it takes to go through a battery switch is less than that needed for a trip to the gas station. It is expected the average consumer will travel to the station no more than once per week as the majority of drivers travel shorter commutes. The Governments of Israel and Denmark were quick to take the lead in adopting this model, announcing bold plans to convert vehicle fleets to electricity powered by solar and wind. Australia was next in line, followed by Calfornia, Hawaii and Ontario. Japan has plans to have half of their cars off oil by 2020 and all of these jurisdictions around the world are supporting the Better Place business model and other plug-in service providers. Additionally, several other state and sub-state actors are engaged in creating and planning the "inevitable" transition to electric vehicles.

The Detroit Auto Show in 2009 featured an all electric and plug-in hybrid line-up from leading manufacturers. The United States, China and other countries are enabling the global auto manufacturing industry, and many support industries, to invest billions of dollars to create and compete in mass-markets derived from more sustainable transportation models. The U.S. government is providing incredible financial supports to stimulate market activities in an effort to scale-up the production and supply of batteries, plug-in vehicles and smart-grid technologies along with support for their renewable energy industry. There is the creation of a changed global marketplace to align and compete within a new paradigm. At the 2009 California Institute of Technology commencement, Nobel Prize winner and current U.S. Secretary of Energy Stephen Chu told the graduating class that they must prepare for "the inevitable transition to electricity as the energy for our personal transportation."

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[2] See "Electric Vehicles in the United States, A New Model with Forecasts to 2030", University of Berkeley, Center for Entrepreneurship & Technology, University of California, Berkely; Technical Brief; July 14, 2009; Thomas A. Becker; pg 1; http://vancouver.ca/ctyclerk/documents/penv3.pdf

[3] See "Electric Vehicles in the United States, A New Model with Forecasts to 2030", University of Berkeley, Center for Entrepreneurship & Technology, University of California, Berkely; Technical Brief; July 14, 2009; Thomas A. Becker

The Canadian ZENN motor company has had some challenges introducing its low speed electric vehicles on Canada's roads – due in some part at least to safety concerns. The lead-acid battery provided consumers with a low price, but the batteries have a high life-cycle impact compared to other battery technologies, and they also suffer from a limited range. The current ZENN cars achieve only speeds up to 40 km/hr, restricting usability to low-speed zones.

ZENN is currently invested in a company which has made bold claims about its EEStor technology, which if validated, could reposition the car company more competitively. Currently, however, there is a question of whether the technology expectations can be demonstrated.

In January of 2009, Government of Ontario announced a partnership with the company Better Place. In mid-July of 2009 Ontario announced incentives of up to $10,000 for people who buy electric cars.[4] This initiative came on the heels of a recent multi-country study conducted by leading global market research company Ipsos. The study took a stratified sample of 1002 Torontonians and found that73% are personally concerned about air pollution or climate change, 81% would like Canada to be a leader in developing renewable energy, the top priority in the purchase in their next car is fuel efficiency, 70% would like to test drive an electric vehicle, 47% would not consider a "gas only" car for their next vehicle and 35% are interested in purchasing an electric vehicle for their next car. Notable is that Toronto is the first Canadian city participating in the demonstration of a network operator model of electric vehicles. Of course, Ontario's investments in smart-metering are expected to become worthwhile, as over time large numbers of cars will be able to charge "intelligently", minimizing peaks on the electricity grid. Vehicle-2-grid technology will someday, perhaps within the decade, allow batteries to sell excess energy back onto the grid in exchange for favourable returns and fewer GHG emissions.

The City of Vancouver has recently established provisions requiring charge points are installed in each new single family dwelling. On July 9, 2009, this was expanded to include requirements for charging infrastructure to be incorporated into the development of all new multi-family dwellings, as well as into its publicly owned parking areas.[5]

[4] See: "Ontario rebates aim to spark electric car sales", Reuters article; July 15, 2009; http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE56E50F20090715

[5] See the Policy Report on Electric Vehicle Charging approved on July 9, 2009; http://vancouver.ca/ctyclerk/documents/penv3.pdf

Prince Edward Island Personal Vehicles Sector in 2008

- The average price for regular gasoline in Charlottetown in 2008 was $1.14 per litre.[6]
- Total gasoline sales on PEI were roughly 200,524,000 litres for a total cost of $228,597,360. Of this total, it is estimated that light-duty vehicle owners on PEI account for the vast majority of sales.[7]
- The total vehicle kilometres traveled by light duty vehicles, weighing up to 4.5 tonnes, was roughly 1,192,800,000 km in 2008.
- Approximately 96.5% of this distance traveled is estimated to be by vehicles which use gasoline as a fuel source.
- A total of 78,024 light duty vehicles were registered in 2008 and the average vehicle traveled 15,288 km in 2008.[8]
- A total of 3,469 vehicles were sold in 2008 and the value of these sales totalled $73,276,000.
- The average vehicle price in 2008 was roughly $21,123.
- Total CO_2 emissions from the light duty fleet in 2008 were estimated to be 479 kilotonnes.

[6] See "Prince Edward Island 35th Annual Statistical Review 2008"; Provincial Treasury, Province of Prince Edward Island; June 2009; pg 93; http://www.gov.pe.ca/photos/original/pt_annualreview.pdf

[7] See "Prince Edward Island 35th Annual Statistical Review 2008"; Provincial Treasury, Province of Prince Edward Island; June 2009; pg 91; http://www.gov.pe.ca/photos/original/pt_annualreview.pdf

[8] See: Canadian Vehicle Survey: Annual – 2008, Statistics Canada; July 2009; http://www.statcan.gc.ca/pub/53-223-x/53-223-x2008000-eng.pdf

Potential Impact of an Electric Vehicle Fleet on Prince Edward Island

The emergence of electric vehicles on Prince Edward Island provides an incredible opportunity to the residents of the province. A battery that can achieve a 160 kilometre range, for a sedan or small crossover platform, must have an energy capacity between 20 and 22 kWh.[9] Using the total vehicle kilometres traveled, the total personal vehicles registered in 2008 and information on battery and electric vehicle performance, one can develop a basic comparison to identify the impact of an all electric personal vehicle fleet on PEI.

One kWh of electricity would enable a vehicle to travel approximately 7.3 km. This figure assumes the vehicle is comparable to a sedan. The annual electricity production required to power an all-electric vehicle fleet on PEI would be 164 million kWh or 164 GWh. The total annual cost of this electricity is $24,601,500. Gasoline sales on PEI totalled $228,597,360 in 2008 [These figures must be adjusted]. Procurement of regionally generated renewable electricity would lead to annual CO_2 reductions of 479 kilotonnes[10]. This figure is reflects a roughly 31% reduction in Prince Edward Island's energy related CO_2 emissions[11].

This unfinished example broadly highlights economic and environmental objectives for both the provincial government and communities to develop a plan that best enables PEI industry and consumers to invest in electric vehicles, thus reducing its dependence on foreign oil imports and increasing its use of renewable energy. As for the 164 GWhs of annual electricity production needed power the total PEI fleet – wind energy could be procured. This would require roughly 63 MW of installed wind capacity, or twenty-one 3 MW turbines, to power all of the personal vehicles on PEI today assuming the wind resources are similar to the current Summerside Wind Farm Project[12] [adjust figures].

This provision to purchase renewable energy to power the fleet would enable deeper integration of wind energy on Prince Edward Island's electricity grid beyond the 30% threshold currently identified.

Beyond 10 percent consumer adoption of electric vehicles, it is estimated that changes to the grid are much more likely to cause serious problems in meeting demand, and it will become critical to coordinate and enhance charging processes, to promote electricity price stability and to capture valued-added benefits. No grid simulations were actually carried out yet for PEI. More study would be beneficial.

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[9] See "Electric Vehicles in the United States, A New Model with Forecasts to 2030", University of Berkeley, Center for Entrepreneurship & Technology, University of California, Berkely; Technical Brief; July 14, 2009; Thomas A. Becker; pg 7

[10] Note: 2.39 kg of CO_2 per litre of gasoline predicts 479 kilotonnes CO_2 in 2008, however latest verifiable data available was 454 kt CO_2 in 2006

[11] Note: Used CO_2 equivalent emissions figures from GHG Emission Summary for Prince Edward Island, 2006

[12] Summerside Wind Farm Project, including four, 3 MW turbines, is projected to have annual energy production of 31 GWh. This is conservative, given stronger resources available in some of PEI. However, there is no consideration of resistance, and some variances such as in extreme low temperatures, etc.

Mass-Adoption of Electric Vehicles on Prince Edward Island – Potential Scenario to 2030

Of course the market transformation of the personal vehicle fleet on PEI will not be immediate. According to a recent study from the University of California, Berkeley, in a baseline forecast electric cars account for 64% of U.S. light-vehicle sales by 2030 and comprise 24% of the U.S. light-vehicle fleet. The rates of adoption are driven by the low purchase price and operating costs of electric cars with switchable batteries. The estimates include the cost of installing charging and battery switching infrastructure to extend the range of electric vehicles.[13]

Under this scenario, assuming vehicle registrations and kilometres travelled on Prince Edward Island remain flat, a total of 18,726 light duty electric vehicles would be registered on Island roads in 2030. This reduces CO_2 emissions by 115 kilotonnes annually, or a 7 percent reduction of total energy based emissions, under a renewable electricity purchasing scenario.

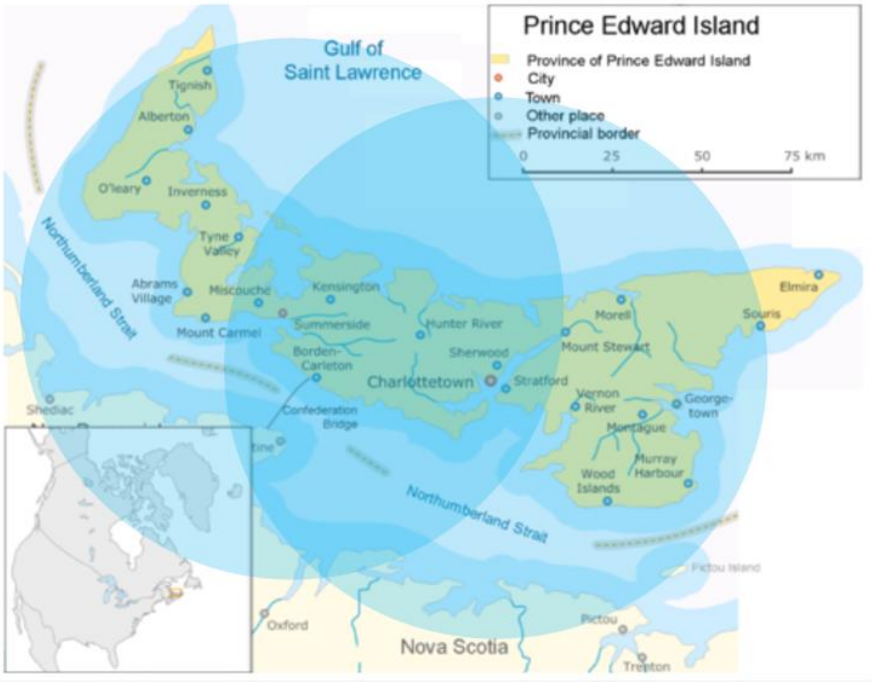
Battery-switch stations, fast-charging and public charge points will be strategically rolled out on PEI and regionally. In the above scenario, a core charging infrastructure of 37,452 charge spots would be required for homes and workplaces – where the majority of charging occurs. Fast-charging would also be helpful.

Consumers "renting" a battery would pay an estimated 5 cents per kilometre traveled. This avoided up-front cost makes purchasing an electric car comparable to a conventional one, but with lower maintenance and operating costs.

Phase 1 - Rollout Strategy

Physical Architecture
'Coverage Driven Deployment Model'

- two charge points per consumer on demand in 2010
- fast charging and/or battery switch stations in 2012



[13] See "Electric Vehicles in the United States, A New Model with Forecasts to 2030", University of Berkeley, Center for Entrepreneurship & Technology, University of California, Berkely; Technical Brief; July 14, 2009; Thomas A. Becker; pg 14

Recommendations

- Conduct a third party assessment of the full impact of electric vehicle adoption on PEI.
- Consider electric vehicle incentive programs.
- Engage communities and the public in consultation, education and outreach.
- Ensure stakeholders that are employed in the automotive, maintenance and repairs, parts and supplies sectors receive the necessary time and support for transition, retraining and retooling.
- Establish provisions in the building code for charging accessibility, such as a right to charge access and mandatory smart metering in new residential starts. Charging can be encouraged overnight using off-peak pricing. When excess wind energy is available, smart charging processes can be deployed, this is possible with smart meters as vehicles will be plugged for 22 hours per day. Smart metering can also lead to future vehicle-2-grid capabilities which become valuable as consumer adoption increases.
- Encourage charging infrastructure parking areas.
- Develop a provincial or jointly-led municipal proposal to the Building Canada Fund for PEI to access the funds currently designated to install electric vehicle charging infrastructure.
- Encourage plug-in vehicles to procure renewable energy, especially from Island owned capacity to maximize economic spinoffs.
- Identify existing knowledge and technology transfer options to assist in the development of a rollout strategy.

Possible Next Steps

- Establish an EV Working Group to carry out a concrete strategic planning directive: http://projectgetready.com/
  - ECO-P.E.I. has already been in contact with the Rocky Mountain Institute (RMI), the organization which is responsible for carrying out Project Get Ready.
  - RMI's Project Get Ready could provide us with a step-by-step framework, support materials, lessons learned and best practices from several other communities, plus technical support.

- Conduct a detailed study to model the impact of electric vehicles adoption on PEI.

- The findings of this group could assist in government, industry and consumers in decision-making. Such an approach facilitates a more detailed, local perspective into plug-in vehicle issues without spending too heavily on public resources or missing out on potential opportunity.

  Depending on the findings of an EV Working Group, there must be a process to take things to the next step. The timing of public information, announcements, etc. would be necessary to educate the public and move forward. A public event could be sequenced with a scheduled Climate Conference on Coastal Communities in the summer of 2010.

Resources
Better Place: http://www.betterplace.com
UC Berkeley Center for Entrepreneurship and Technology: http://cet.berkeley.edu/connect/translational-research
Project Get Ready: http://projectgetready.com/

Matthew McCarville
Energy Policy Coordinator
Environmental Coalition of Prince Edward Island
126 Richmond Street, Charlottetown, PE C1A 1H9
(902) 566-4696
energy@ecopei.ca
http://www.ecopei.ca

ECO-PEI
Plug-in Working Group
The ECO-PEI Plug-in Working Group is seeking interested individuals with diverse backgrounds.

This is a working paper and information contained in this document is subject to change based on further information and analysis.