

## Notice of Intervention

Order UE20940

ECO-PEI Energy Project

<http://www.ecopei.ca>

May 31, 2010

Attn: Island Regulatory and Appeals Commission

PO Box 577

Charlottetown PE, C1A 7L1

Dear Commissioners:

This is to advise that I shall intervene at the above named hearing.

Please see the attached document as submitted by the Environmental Coalition of PEI as written evidence.

Regards,

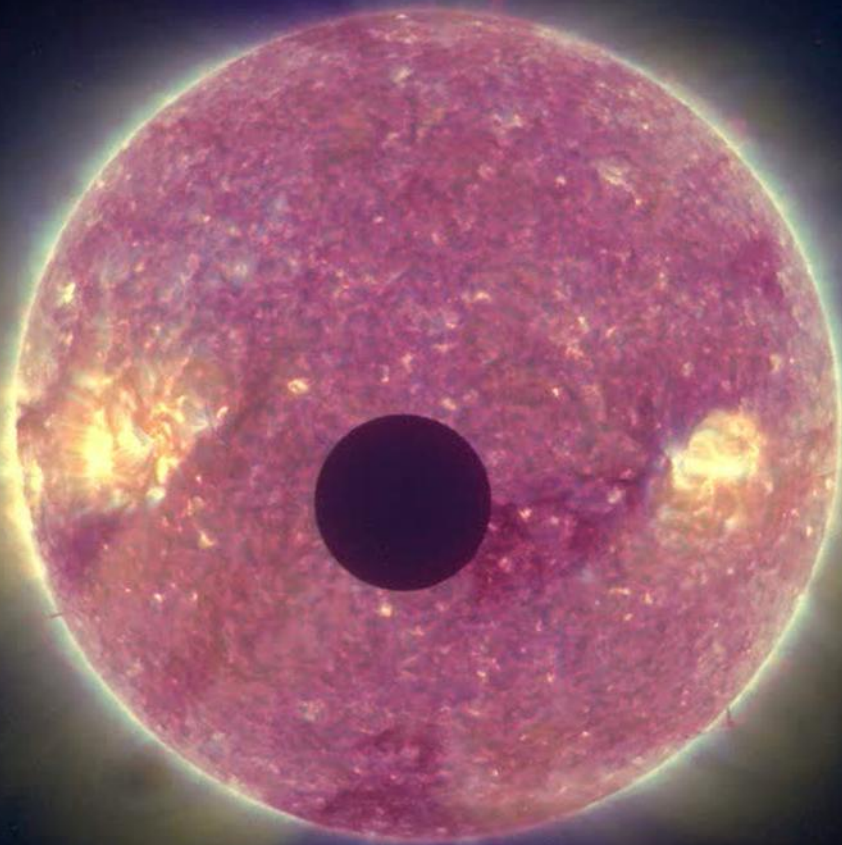
Matthew McCarville

Policy Coordinator, ECO-PEI Energy

[Reducing unnecessary ventilation](#)

2010

# Prince Edward Island Energy Systems & Regulation



Matthew McCarville  
Environmental Coalition of PEI  
5/31/2010



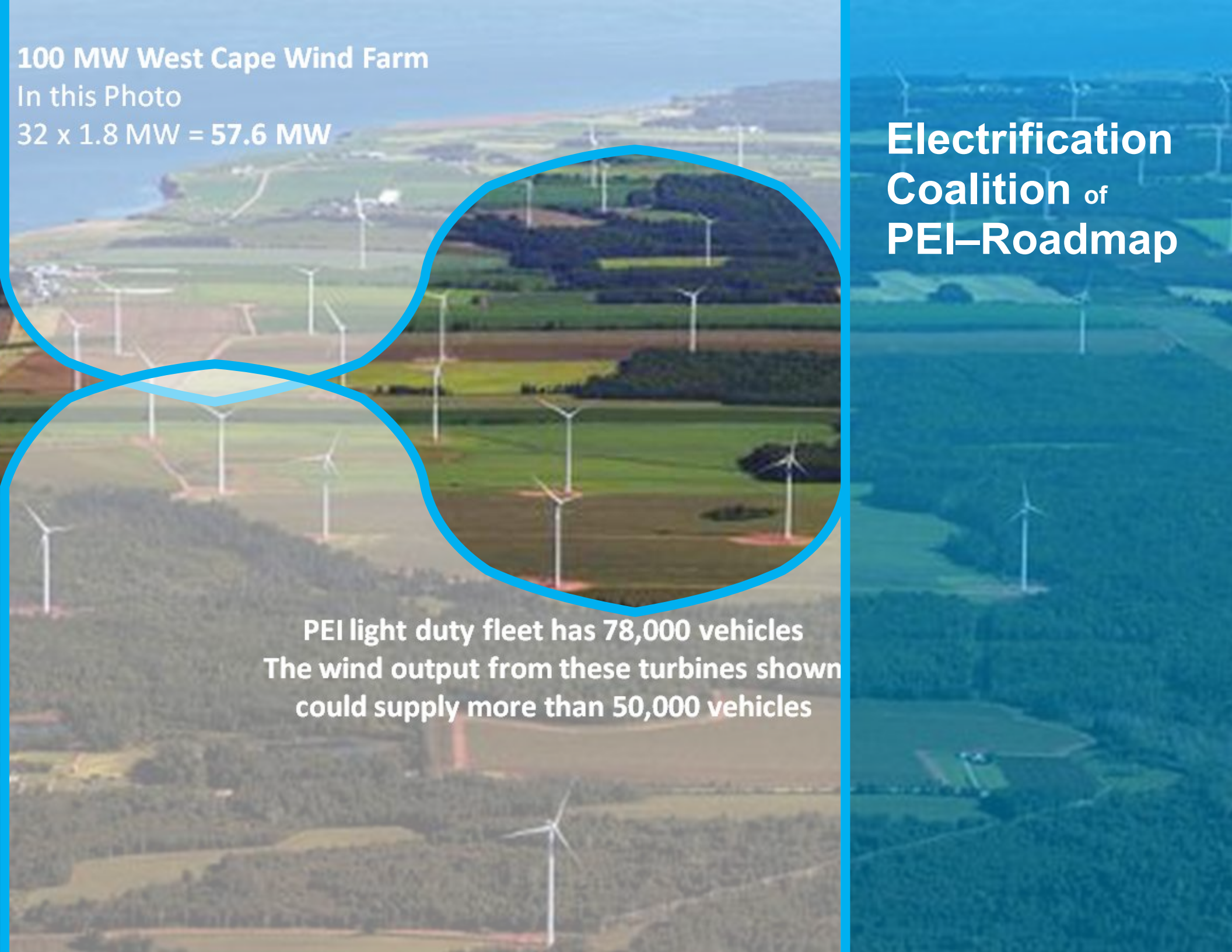
# 100 MW West Cape Wind Farm

In this Photo

32 x 1.8 MW = 57.6 MW

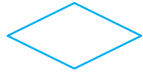
# Electrification Coalition of PEI-Roadmap

PEI light duty fleet has 78,000 vehicles  
The wind output from these turbines shown  
could supply more than 50,000 vehicles





RENEWABLE ENERGY



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# Part One—The Case for Electrification

## ABSTRACT

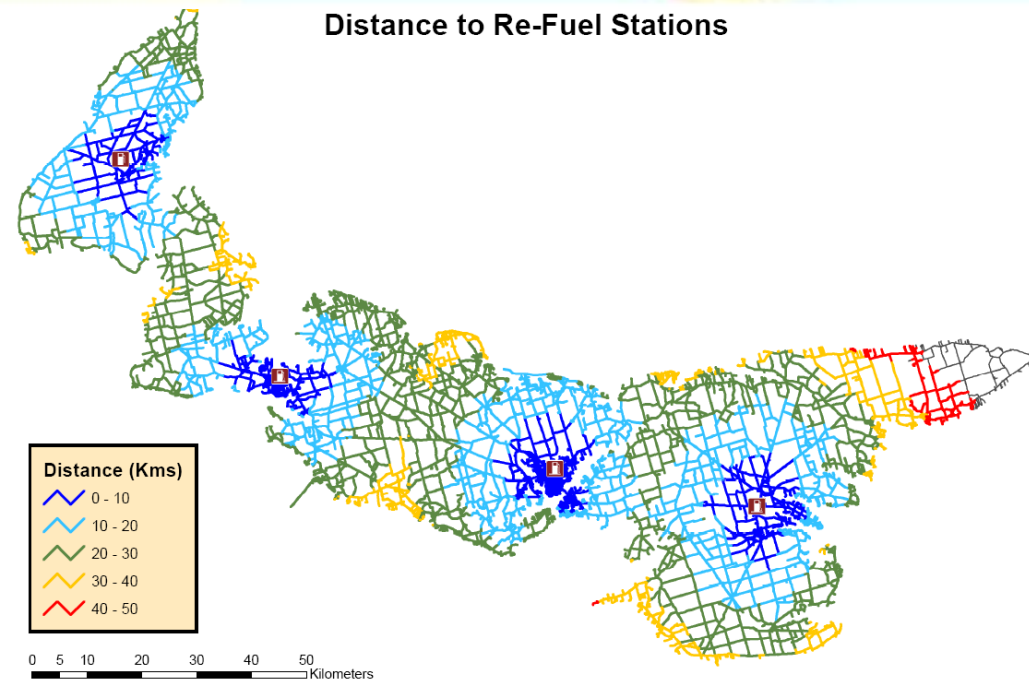
Prince Edward Island (PEI) is dangerously exposed to a global oil market whose fundamental characteristics all but guarantee increasing volatility and instability. Oil dependence weakens our provincial security, threatens our economy, and degrades the environment. PEI oil dependence stems largely from the transportation sector, which relies on petroleum 95 percent of its delivered energy.

Beyond conservation and energy efficiency, wind electricity for heat and transport—powering our homes, cars or bikes with wind electricity—is the best solution available for reducing PEI oil dependence. Wind electricity is produced from diverse areas that are overwhelmingly domestic and oil needs virtually no role in future power generation. Today's installed wind capacity is already 156 MW. It could increase by up to 130 MW based on the current RFP process underway. The Island Wind Strategy calls for 500 MW of wind by 2013 – enough excess wind power is available to meet 100% of PEI household space, water and transport needs.



Creating readiness for plug-in transportation.

Distance to Re-Fuel Stations

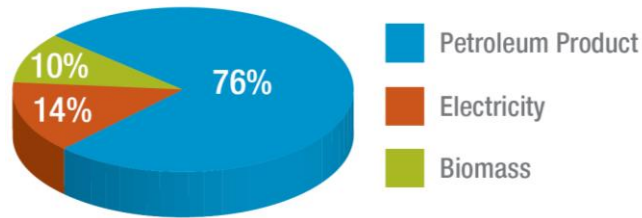




## 1.1 Overview

Modern Island life is premised on the assumption that inexpensive oil will always be available to fuel our transportation system. Our vehicles, our jobs, and even the structure of our communities all depend on reliable supplies of affordable oil. Yet growing worldwide demand for oil and tightening supplies strongly suggest that the days of cheap, plentiful oil are over.

Figure 1:  
Prince Edward Island Current Energy Mix



### Canada's Electric Vehicle Technology Roadmap

*A strategic vision for highway-capable battery-electric, plug-in and other hybrid-electric vehicles*

*By 2018, there will be at least 500,000 highway-capable plug-in electric-drive vehicles on Canadian roads, as well as what may be a larger number of hybrid-electric vehicles. All these vehicles will have more Canadian content in parts and manufacture than vehicles on the road in Canada in 2008.*

[Download a PDF version of the Canadian Electric Vehicle Technology Roadmap](#)

### THE GROWING GAP Regular Conventional Oil

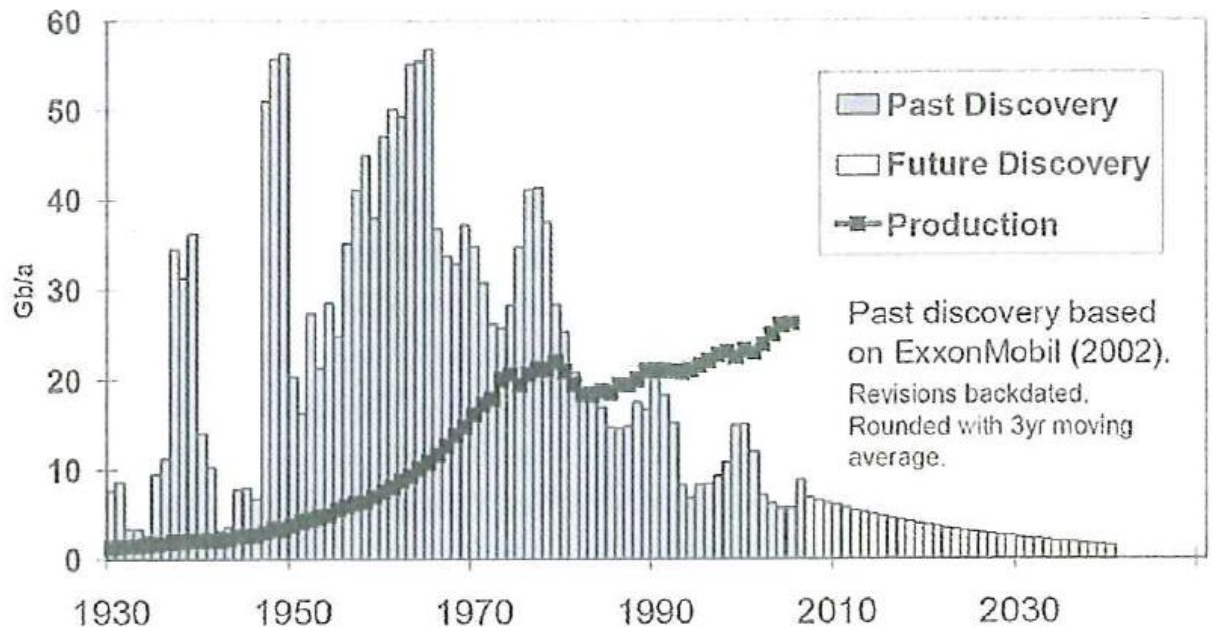
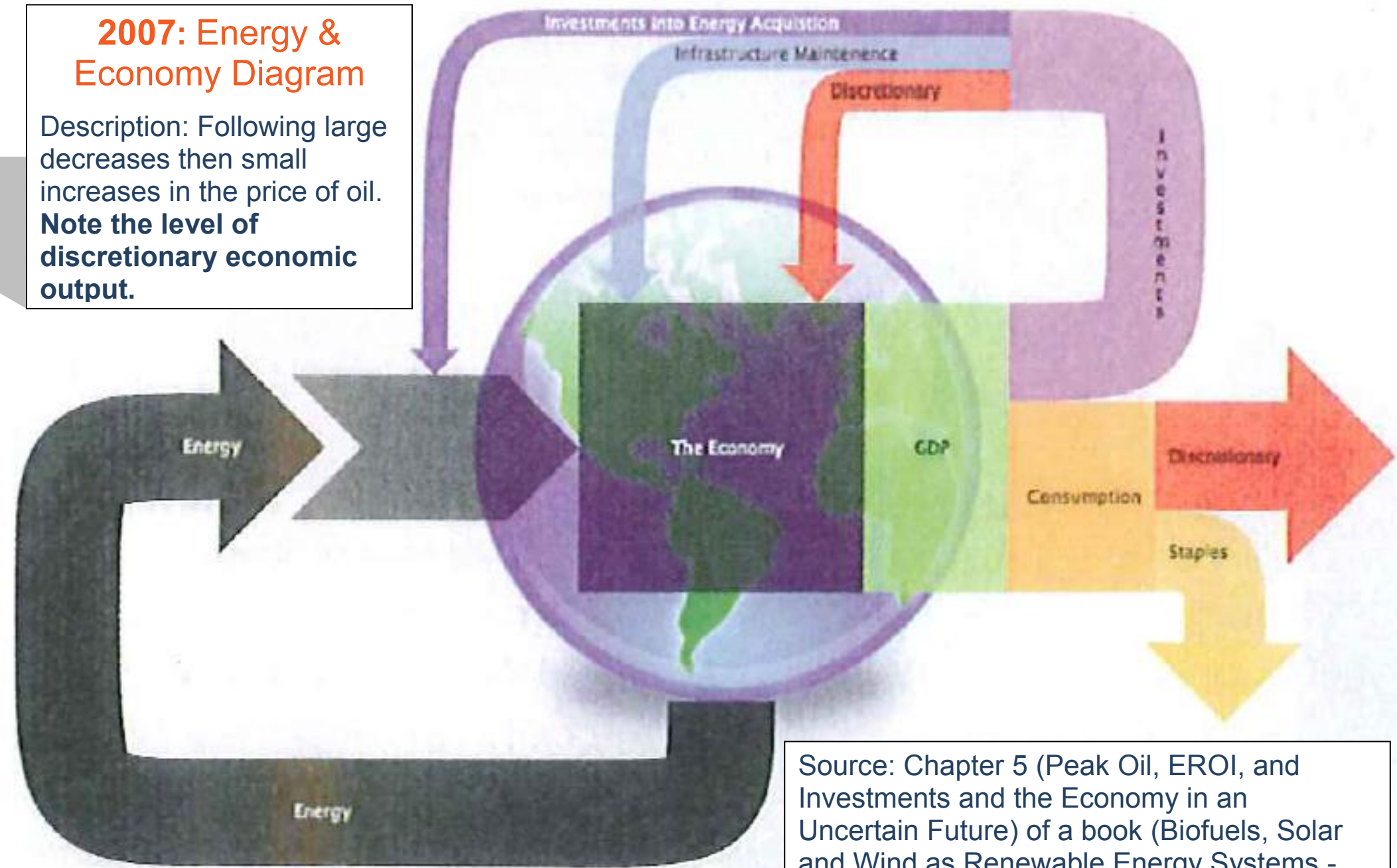


Fig. 5.2 Rate of the finding of oil (where revisions and extensions have been added into the year of initial strike) and of consumption (Source ASPO website)

## 2007: Energy & Economy Diagram

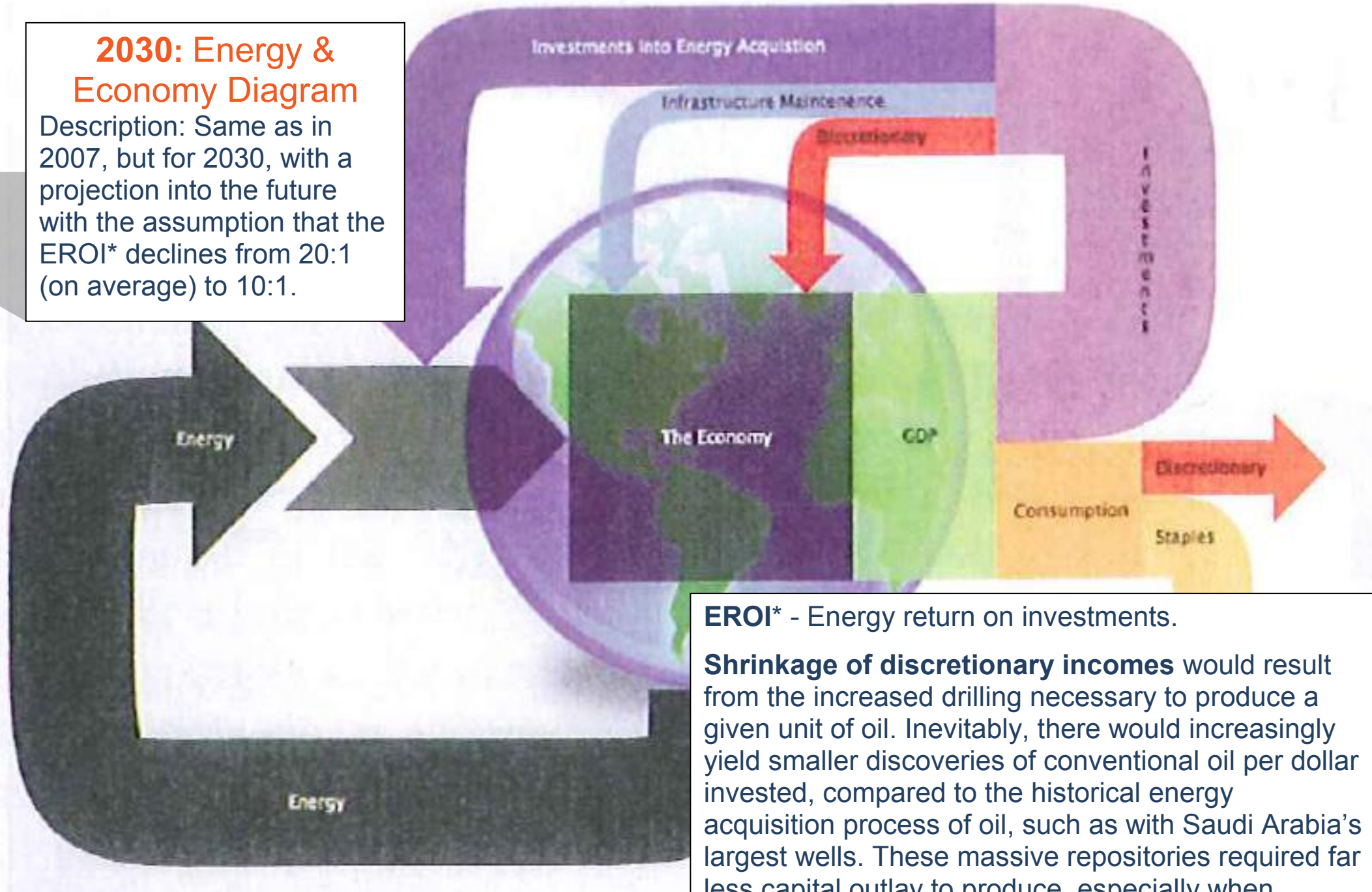
Description: Following large decreases then small increases in the price of oil. **Note the level of discretionary economic output.**



Source: Chapter 5 (Peak Oil, EROI, and Investments and the Economy in an Uncertain Future) of a book (Biofuels, Solar and Wind as Renewable Energy Systems - Benefits and Risks)

## 2030: Energy & Economy Diagram

Description: Same as in 2007, but for 2030, with a projection into the future with the assumption that the EROI\* declines from 20:1 (on average) to 10:1.



**EROI\*** - Energy return on investments.

**Shrinkage of discretionary incomes** would result from the increased drilling necessary to produce a given unit of oil. Inevitably, there would increasingly yield smaller discoveries of conventional oil per dollar invested, compared to the historical energy acquisition process of oil, such as with Saudi Arabia's largest wells. These massive repositories required far less capital outlay to produce, especially when compared to the sources emergent with today's unconventional expansion, such as Canada's oil sands. These oil sources increasingly demand inputs for more energy & GHG abatement on a global basis.

Source: Chapter 5 (Peak Oil, EROI, and Investments and the Economy in an Uncertain Future) of a book (Biofuels, Solar and Wind as Renewable Energy Systems - Benefits and Risks)



## 1.2 The Problem

The PEI economy is heavily dependent on oil, particularly in our massive heating and transportation sectors. Oil price volatility, primarily driven by geopolitical events beyond our control, has made our current level of consumption unsustainable.

### 1.2.1 A Decade of Instability and Rising Oil Prices

Since 2003, rising oil demand in emerging markets, slow expansion of global production capacity, and persistent geopolitical volatility have combined to generate significant oil price volatility.

### 1.2.2 No Free Market Solution

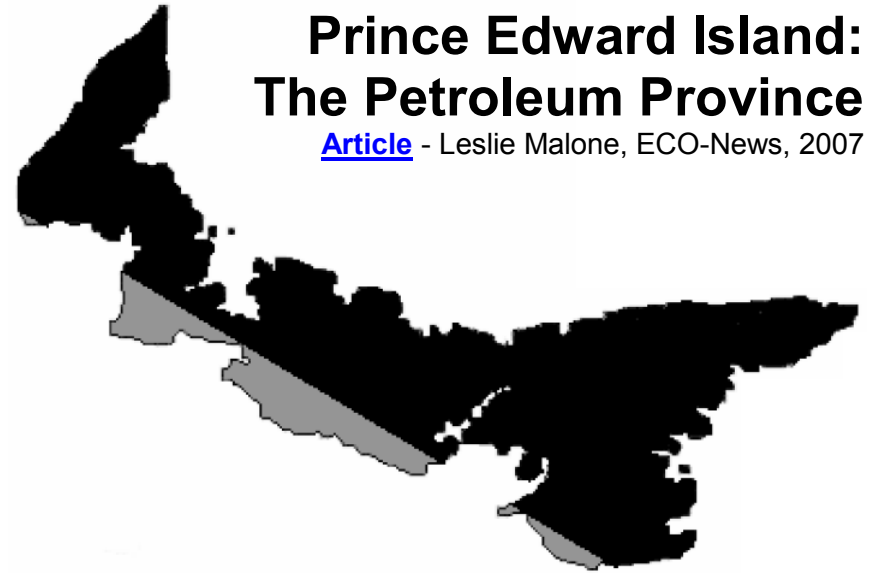
Today's global oil market is far removed from the free-market ideal. Resource nationalism in key oil-producing regions of the world has stunted investment and stalled supply growth.

### 1.2.3 National Security Costs of Oil Dependence

Oil dependence undermines Canada's foreign policy goals. In 2009, the U.S. established a central command response for Africa. What could be Canada's fallout? This activates a military response capacity to secure the reliable supply of energy to the world from Africa – similar to the one that has existed for decades to secure energy supplies from the Middle East. This is a new

## Prince Edward Island: The Petroleum Province

[Article](#) - Leslie Malone, ECO-News, 2007



geopolitical development. There could be increased market pressures and resource competition for oil in this region – especially given China’s and India’s continued increase in demand for energy resources. China is soon expected to have a world-class navy to deal with. The burden of securing the global free flow of oil severely burdens the Canadian and global military forces, especially for the U.S. – Canada’s largest trading partner. It was estimated that the per capita cost of military expenditures to secure the supply of oil for the U.S., is presently between \$500 and \$1,000 per year, depending on whether or not you include the Iraq war<sup>1</sup>. There are also other tragedies associated with the securing of a nation’s energy through militarized activity.



A soldier keeps watch from a checkpoint in Iraq.

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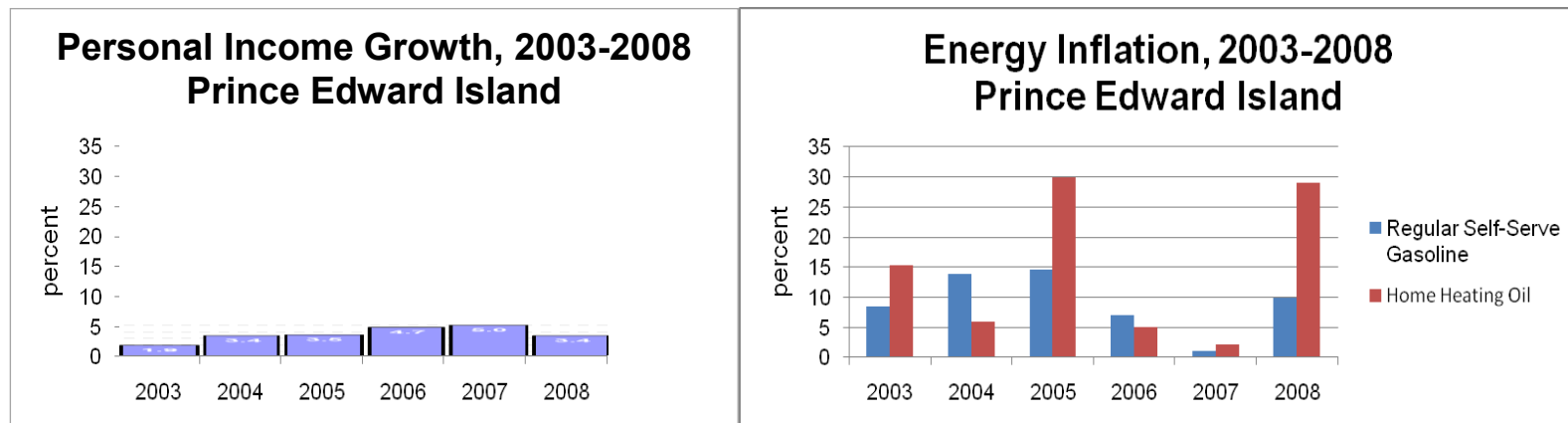
<sup>1</sup> The New Geopolitics of Energy: Stanford University Energy Seminar. See: <http://www.youtube.com/mattville1>

## 1.2.4 Economic Costs of Oil Dependence

PEI's trade deficit in crude oil and refined products reached \$440 million in 2007 – and increased in 2008, despite the collapse of market prices by the fall. Moreover, every recession since 1970 has been preceded by an oil price spike.

Gasoline and home heating oil prices have increased dramatically compared to personal incomes on P.E.I. The price of gasoline fuel and heating oil rose by an average of 9.1% and 14.6% respectively, on a yearly basis from 2003-2008. In the same period, annual income growth was only 3.7%. These trends of increasing oil costs beyond the rate of personal income growth are already shrinking the discretionary incomes of Islanders today.

## Shrinkage of PEI's discretionary incomes from oil dependence



Source: Annual Statistical Review 2008,  
PEI Department of Finance and Municipal Affairs

## 1.2.5 Environmental Sustainability

Post-industrially, global temperatures have increased by 0.9 degrees Celsius due to human activity. However, it is thought that if human-induced global GHGs were virtually eliminated today, the world would still warm a further 0.7 degrees Celsius. At least about a 1.6 degrees Celsius increase is thought to be on the way due to present levels of GHG in the atmosphere.<sup>2</sup>

In the U.S. more than 10,000 people die per year due to air quality from road transportation emissions. The number of these deaths would likely increase if the U.S. switched to E85.<sup>3</sup>

### Gulf Oil Photo Essay

PBSNewsHour 356 videos



[Watch Video](#) (4m: 32s)

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<sup>2</sup> Global Climate Architectural Policy, Stanford University Energy Seminar. See: <http://www.youtube.com/mattville1>

<sup>3</sup> Mark Z. Jacobson, Civil/Environmental Engineer/Atmospheric Modeling: <http://www.stanford.edu/group/efmh/jacobson/>

## 1.3 PEI's Greenhouse Gas Inventory Report 2010

<b>Emissions, Economy and Energy</b>	1990	2004	2005	2006	2007	2008
Total GHG (Mt)	<b>1.980</b>	<b>2.290</b>	<b>2.230</b>	<b>2.110</b>	<b>2.070</b>	<b>1.970</b>
Change Since 1990 (%)	<i>NA</i>	<i>15.9</i>	<i>12.5</i>	<i>6.6</i>	<i>4.5</i>	<i>-0.7</i>
Annual Change (%)	<i>NA</i>	<i>NA</i>	<i>-2.9</i>	<i>-5.3</i>	<i>-1.9</i>	<i>-5.0</i>
GDP (millions)	<b>2 687</b>	<b>3 877</b>	<b>3 955</b>	<b>4 026</b>	<b>4 126</b>	<b>4 148</b>
Change Since 1990 (%)	<i>NA</i>	<i>44.3</i>	<i>47.2</i>	<i>49.8</i>	<i>53.6</i>	<i>54.4</i>
GHG Intensity (Mt/\$B GDP)	<b>0.74</b>	<b>0.59</b>	<b>0.56</b>	<b>0.52</b>	<b>0.50</b>	<b>0.47</b>
GHG Efficiency (\$B GDP/ Mt)	<b>1.36</b>	<b>1.69</b>	<b>1.77</b>	<b>1.91</b>	<b>1.99</b>	<b>2.11</b>
Population (000s)	<b>130</b>	<b>138</b>	<b>138</b>	<b>138</b>	<b>138</b>	<b>140</b>
Change Since 1990 (%)	<i>NA</i>	<i>5.6</i>	<i>5.9</i>	<i>5.8</i>	<i>5.9</i>	<i>7.2</i>
GHG Per Capita (tonnes/person)	<b>15.2</b>	<b>16.7</b>	<b>16.1</b>	<b>15.3</b>	<b>15.0</b>	<b>14.1</b>
Energy Production (Primary only) (TJ)	<b>0</b>	<b>125</b>	<b>144</b>	<b>130</b>	<b>143</b>	<b>510</b>
Change Since 1990 (%)	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>	<i>NA</i>
Net Supply (Primary & Secondary) (TJ)	<b>21 541</b>	<b>26 066</b>	<b>26 137</b>	<b>25 342</b>	<b>25 278</b>	<b>23 796</b>
Change Since 1990 (%)	<i>NA</i>	<i>21.0</i>	<i>21.3</i>	<i>17.6</i>	<i>17.3</i>	<i>10.5</i>
Energy Use - Final Demand (Primary & Secondary) (TJ)	<b>20 598</b>	<b>25 526</b>	<b>25 060</b>	<b>24 492</b>	<b>24 652</b>	<b>23 283</b>
Change Since 1990 (%)	<i>NA</i>	<i>23.9</i>	<i>21.7</i>	<i>18.9</i>	<i>19.7</i>	<i>13.0</i>
<b>Climate</b>						
Heating Degree-Days	<b>4 583</b>	<b>4 650</b>	<b>4 407</b>	<b>3 949</b>	<b>4 647</b>	<b>4 427</b>

Notes: GDP, expenditure-based, chained 2002 dollars. NA = Not applicable.

### 1.3.1 PEI Emissions, Economy, and Energy

Geographically, Prince Edward Island (P.E.I.) is Canada's smallest province. In 2008, P.E.I. was home to 0.4% of the population while contributing 0.3% to Canada's total GDP. The provincial GHG emissions were estimated at 2.0 Mt CO<sub>2</sub> eq, or 14.1 tonnes per person. P.E.I. ranked the second lowest in terms of per capita emissions for 2008, reflecting its service-based economy

and external electricity sources. The key contributors in 2008 to the provincial emissions were the Road Transportation (0.6 Mt) Sector, Commercial/Institutional/Residential (0.4 Mt) Sector, and Agriculture (0.5 Mt) Sector.

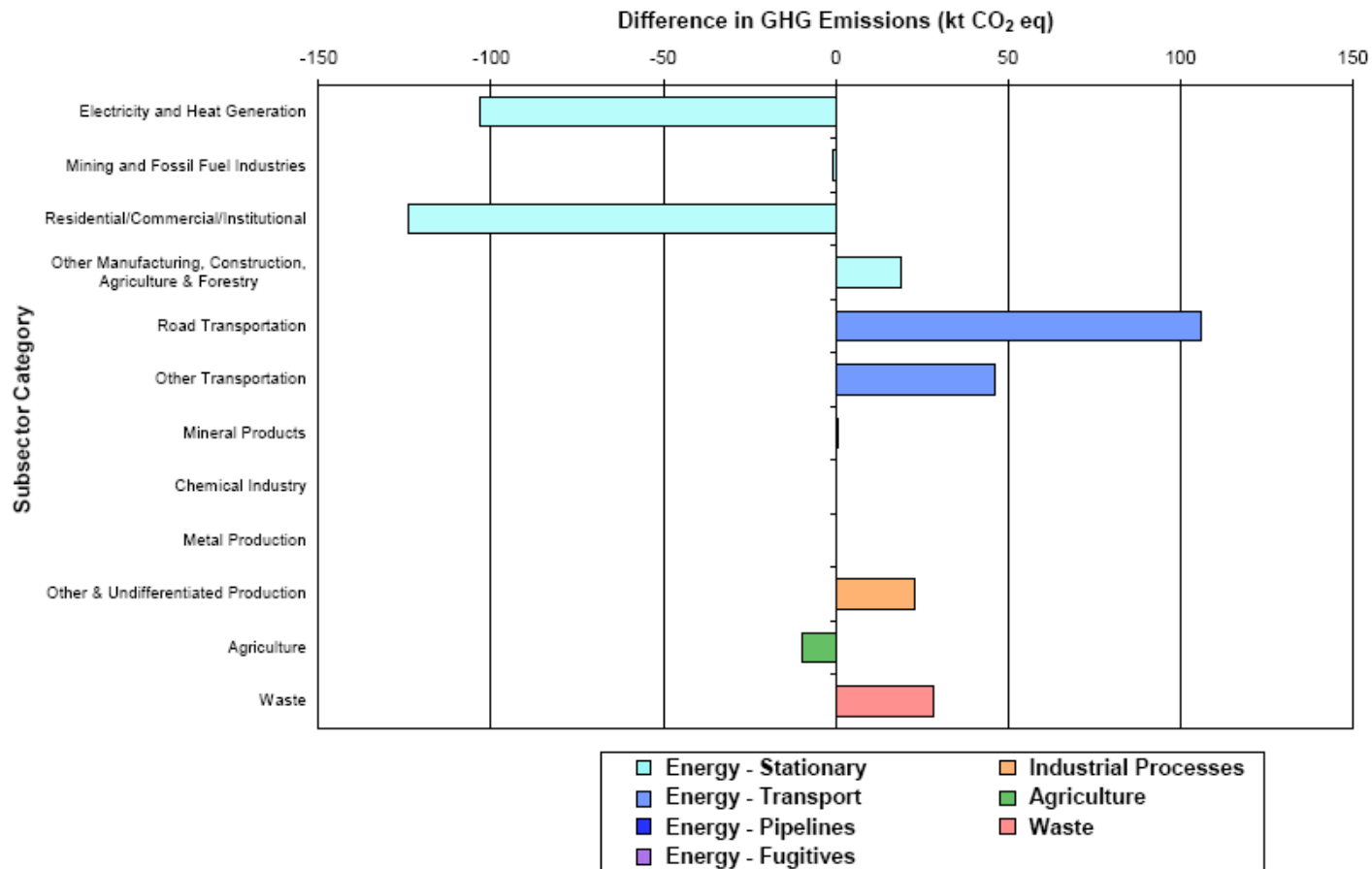
The provincial economy has important service and manufacturing activities with the highest job count appearing under Sales and Service with 17 000 jobs in 2008, down slightly from 17 500 jobs reported in 2007. The service providing industries contribute nearly 74% of the provinces GDP with good producing industries making up the final 26% (Prince Edward Island Department of the Provincial Treasury 2009).

The majority of the electricity consumed in P.E.I. is provided by New Brunswick via underwater transmission cables. There are two thermal generating stations on the island; however, these are kept in standby mode in case of transmission problems from the mainland and to supply electricity during peak times. The Atlantic Wind Test Site was established on the island in the 1980s, and a 13.56-MW wind farm was established by the P.E.I. Energy Corporation (PEIEC) between 2001 and 2004.

In 2008, the province increased its proportion of wind energy use to 15%, up from 3% in 2006 (Maritime Electric 2010). This is echoed in the Residential subsector as heating degree days 57 (HDD) were up 12% over 2006 levels; however, emissions increased by only 7%, reflecting the shift in clean energy consumption. Since there were no new wind farms installed in 2008, the province's wind capacity remains at 72 MW (CanWEA 2010).

### 1.3.2 Long-Term Trends (1990–2008)

Provincial emissions decreased by 14 kt (0.7%) between 1990 and 2008. The increase was due to an overall increase in transport-related emissions, specifically a 106 kt (20%) increase in the Road Transportation Sector and a 46 kt (29%) increase from the Other Transportation Sector (civil aviation, railways, etc). Most of these increases were offset by decreases in the Residential/Commercial/Institutional (124 kt or 23%) and the Electricity and Heat Generation sectors (103 kt or 100%). Long-term emission trends in PEI are illustrated below.



Original source: [National Inventory Report](#), 15 April 2010.

Environment Canada, submitted for the United Nations Framework Convention on Climate Change.

### *Electricity and Heat Generation (100% decrease)*

The installation and operation of wind farms on the island, combined with enhanced interconnections with the New Brunswick power grid, have helped to reduce GHGs from the province's Electricity and Heat Generation Sector. Lower usage of the generating stations on the island has been the main reason for lower GHG emissions over the long term. The impact of new wind farm installations has made a noticeable impact on generation statistics.

### *Residential/Commercial/Institutional (23% decrease)*

The long-term decrease in GHG emissions was mainly reflected in residential emissions. Between 1990 and 2008, residential emissions decreased by 34%, while HDDs only decreased by 3.4%. This may be a result of increased efficiency and a change in consumer behaviour as heating oil is the dominant fuel source in the province and average home heating oil prices increased by 29% from 2007 to 2008 (PEI Department of Provincial Treasury 2009).

### *Road Transportation (20% increase)*

The long-term emission growth observed in the Road Transportation Sector can be attributed to the 32% overall increase in the provincial vehicle fleet. Moreover, the general shift from LDGVs to LDGTs has also contributed to this long-term trend. In 1990, LDGVs accounted for 67% of the provincial on-road vehicle population, decreasing to 52% in 2008. In comparison, LDGTs experienced significant growth, increasing from 22% of the total provincial population in 1990 to 36% in 2008. Since, on average, LDGTs emit approximately 40% more GHGs per kilometre than LDGVs, the increase in road transportation emissions reflects the increasing preference towards LDGTs for passenger transport.<sup>4</sup>

### *Other Transportation (29% increase)*

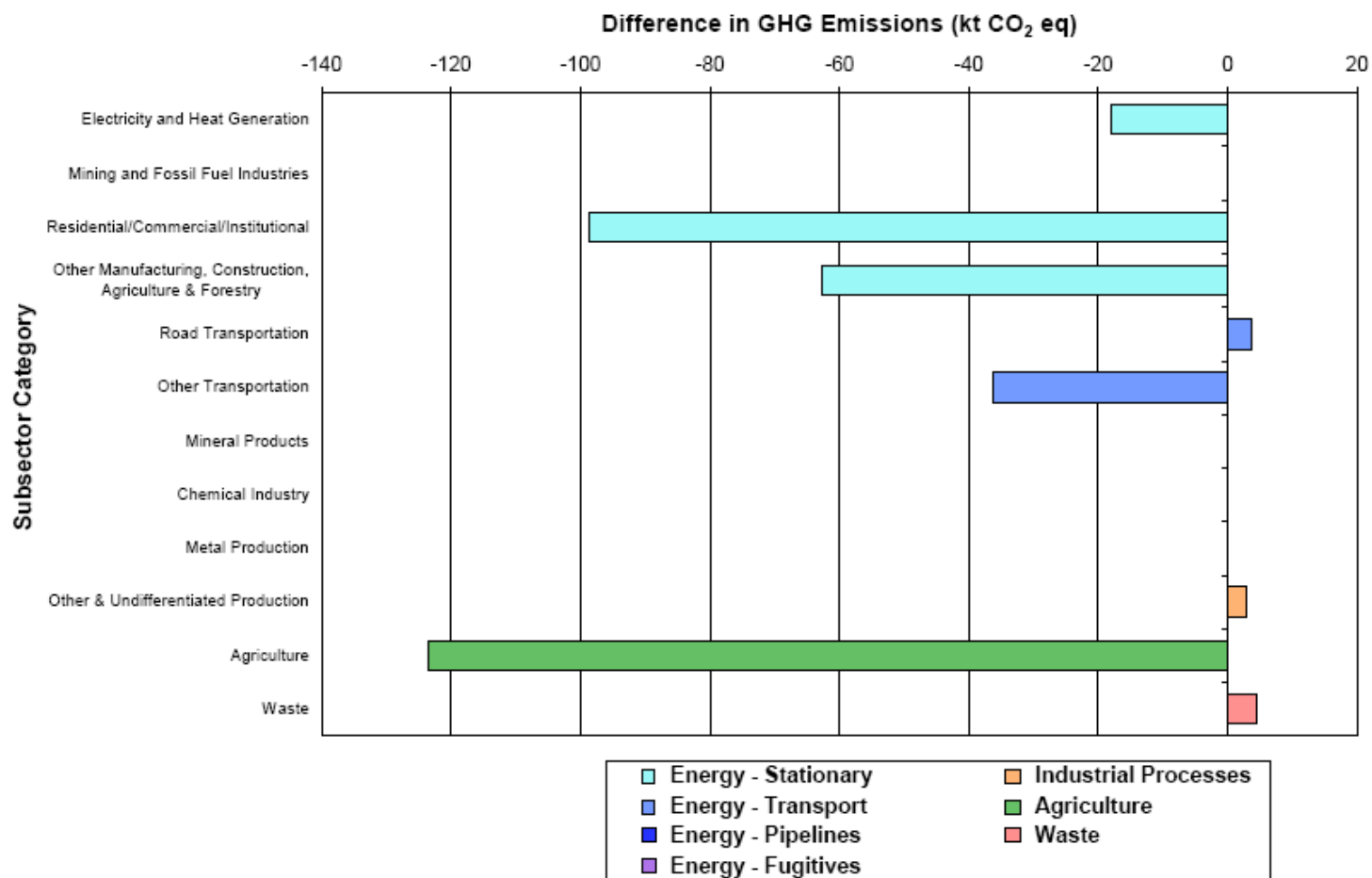
The long-term increase is attributable to the rise in off-road gasoline and diesel consumption, which is most likely related to heightened use of recreational vehicles and equipment in construction/manufacturing.

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<sup>4</sup> For more details on this nationally occurring trend, please refer to Chapter 2, Section 2.3.1.1 or to the Executive Summary of the [NIR](#).

### 1.3.3 Short-Term Changes (2004–2008)

Overall, GHG emissions in P.E.I. decreased by 14% between 2004 and 2008. This decrease was primarily due to the decreases in the Agriculture (124 kt), and Residential/Commercial/Institutional (99 kt) and Other Manufacturing Construction, Agriculture and Forestry (63 kt) Sectors. Short-term emission changes in Prince Edward Island are illustrated below.



### *Residential/Commercial/Institutional (19% decrease)*

The overall 19% (99 kt) short-term decrease is due to a significant 69 kt decrease (29%) in emissions from the Commercial and Institutional subsector, and a 30 kt decrease (10%) in emissions from the Residential subsector.

### *Other Manufacturing, Construction, Agriculture and Forestry (38% decrease)*

Between 2004 and 2008, emissions from the Other Manufacturing subsector decreased by 55 kt, making up the majority of the decrease from this Sector.

### *Other Transportation (15% decrease)*

The short-term decrease in GHG emissions results from a fall in agricultural activity due to reduced crop acreage and poor harvesting conditions, particularly in 2007 and 2008 (Statistics Canada 2009c). Consequently, off-road gasoline and diesel consumption also declined.

### *Agriculture (21% decrease)*

Lower emissions from agricultural soils are attributed to a lower consumption of synthetic N fertilizers (36%), which was due to a lower seeded area of potatoes as a result of low market prices. Furthermore, virtually all categories of livestock populations have decreased, the largest of which being a 52% decrease in swine populations, and this has also contributed to the decrease in GHG emissions.



#### **Useful Acronyms/Terms**

DSM – demand-side management

E85 – high blend ethanol mix

ETS – electric thermal storage (2009 storage price/kWh = \$100 room- \$30/kWh household)

EV – electric vehicles & BEV – battery electric vehicles (2009 storage price/kWh = 600/kWh lithium ion)

GEV – grid-enabled vehicles

HEV – hybrid electric vehicles

kW – kilowatt; 1,000 watts

kWh – kilowatt hour; 1,000 watts for an hour

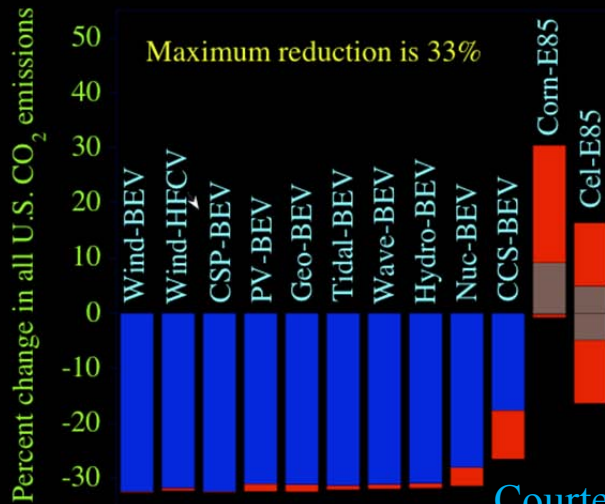
MW – megawatt; 1,000 kilowatts

MWh – megawatt hour; 1,000 kilowatts for an hour

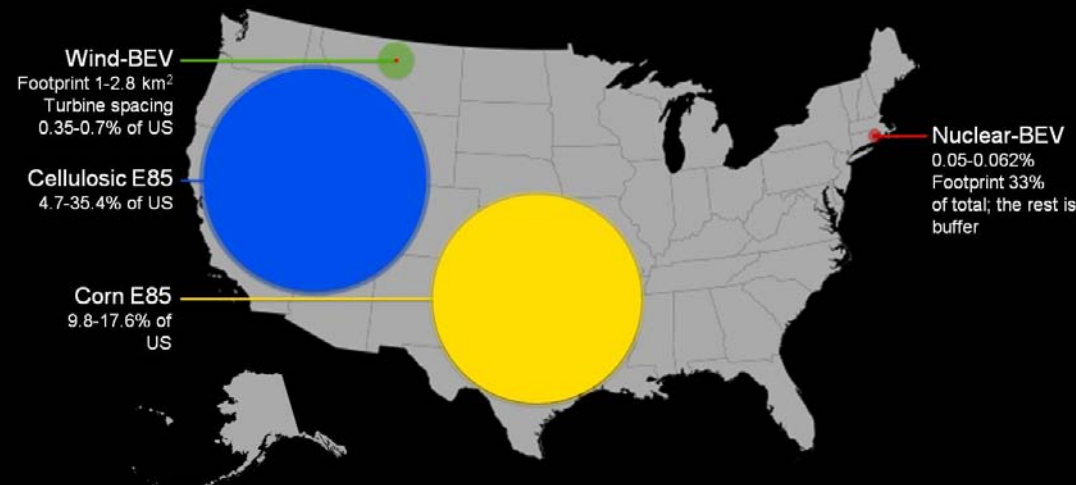
PEV – plug-in electric vehicles (pure or plug-in EVs)

PHEV- plug-in hybrid electric vehicles

# Percent Change in U.S. CO<sub>2</sub> From Converting to BEVs, HFCVs, or E85



## Area to Power 100% of U.S. Onroad Vehicles



Courtesy Mark Z. Jacobson: <http://www.stanford.edu/group/efmh/jacobson/>

## 1.4 The Solution

PEI's [Island Wind Strategy](#) calls for the development of 500 MW of wind by 2013. Conservation, efficiency, the electrification of personal transport and home heating using storage devices at the transmission and distribution levels and matching the excess supply of wind available, along with the optimization of the solar resources, is an ideal way for PEI to use domestically abundant natural resources to dramatically reduce PEI's oil dependence.

Wind energy has substantial advantages over the current petroleum-based fuel systems for heat/transport. Vehicles fueled by wind electricity are far more efficient and up to 98% less GHG emitting than the conventional vehicles we drive today. Wind-stored heat & transport can each technically provide all of PEI's household energy needs by using much of the excess/exported electricity in a 500 MW wind scenario locally.

This approach improves from the baseline energy strategy, further allowing wind integration on PEI's grid, shifting us away from unnecessary combustion, lowering emissions and unlocking stable wind/solar prices for key home services by allowing incomes to grow faster (3.7% annual growth) than energy bills (2% annual utility price escalation) for heat/transport. An energy efficiency tax in NS of 3 – 7 % being run the government of Nova Scotia Energy Efficiency Corporation as of November 2009, should be replicated for PEI and adopted immediately. Capitalizing on this overall theme is only to PEI's advantage, especially for the long-term economic growth and the resulting carbon reductions.

### *Pioneering Green Lifestyles – A closer look at Island Energy*



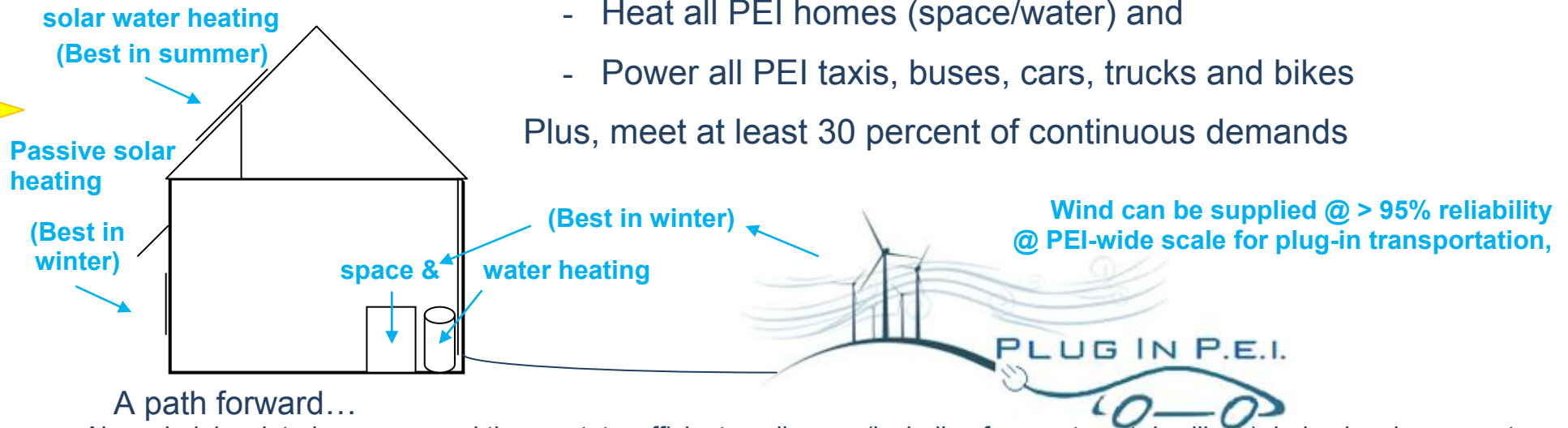
#### 1.4.1 The Power of Wind

PEI's wind resource is a scalable source of energy based on an existing infrastructure. The wind is basically domestic and wind electricity prices exhibit long-term stability.

500 MW... Enough wind for PEI to

- Heat all PEI homes (space/water) and
- Power all PEI taxis, buses, cars, trucks and bikes

Plus, meet at least 30 percent of continuous demands



A path forward...

Air sealed, insulated, programmed thermostats, efficient appliances (including for apartment dwellings), behavior changes, etc... are all highly cost-effective strategies to help PEI achieve energy security.

Then, space heat (using solar air + [off peak wind + ceramic bricks + forced air/hydronic systems]) & water heat (solar water + off peak wind) are logical next steps to maximize energy security for Islanders, due to the price stability, especially during periods of unprecedented global development such as PEI experienced between 2003-2008 (see the economic costs of oil dependence).

### 1.4.2 Smarter — Networked” Grid Systems

Our smart grid outlook in 2009 shows how to increase the capture rate energy efficiency, to free up existing T&D line capacity to integrate/secure wind locally for heat and transport.

*ECO-PEI Energy collaborated with the University of Illinois in 2009 to share*

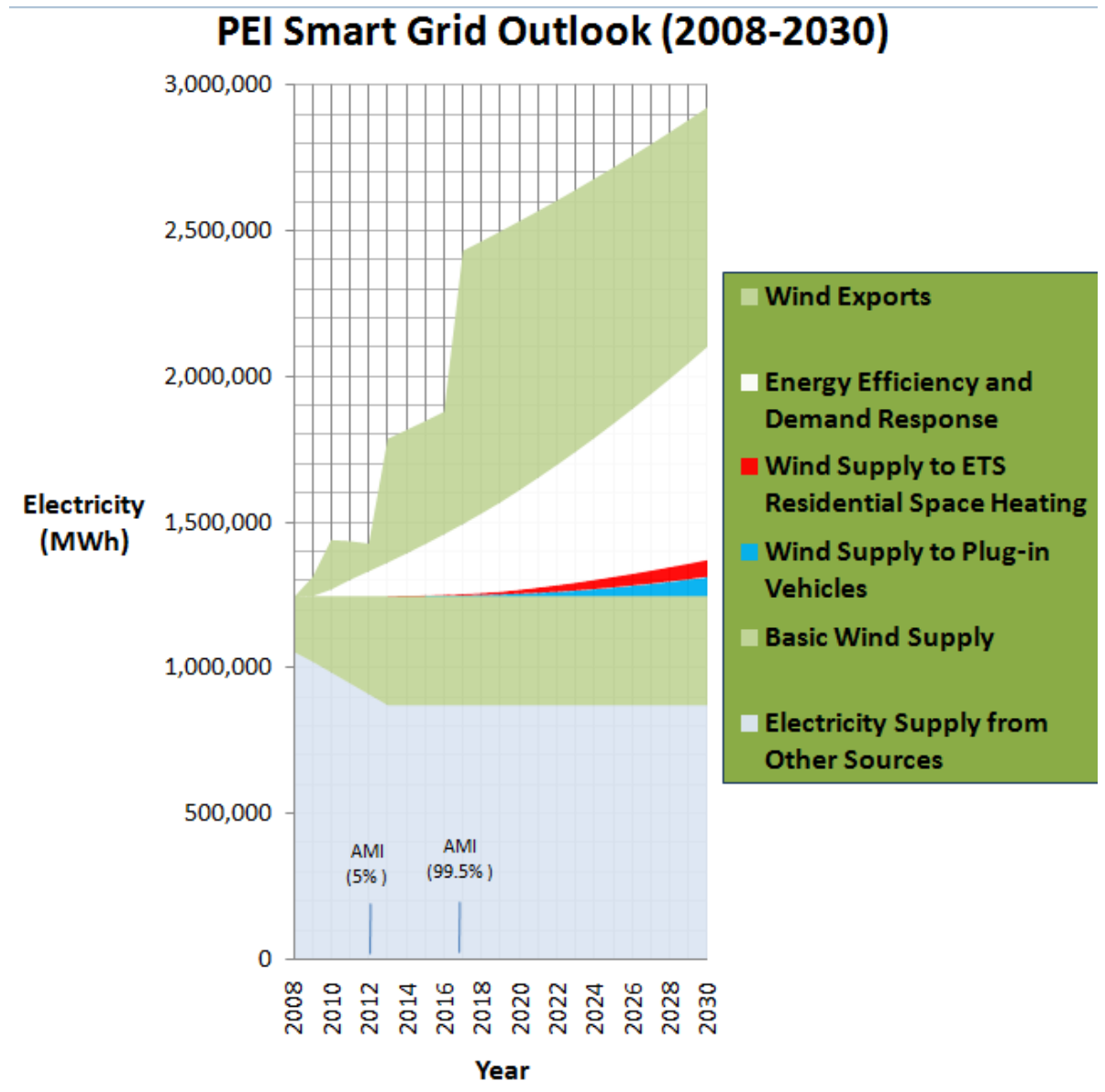


*interactive [Wind and Storage](#) lessons*



The next page shows us PEI’s smart grid in one possible outlook to 2030.

2% annual reduction in demand assuming 2% annual load growth is offset through efficiency (ie - one could regulate to do automatic insulation upgrades if home heat uses baseboard electric, wind-ETS, etc.). Also simulated, is the consumer adoption of wind integration for 3,250 ETS home heating systems and 18,250 plug-in electric vehicles on PEI in 2030. Note that the storage devices help increase the amount of wind used domestically. If 2% efficiency gains annually cause negative load growth to occur, then the reductions of capacity on the lines allows PEI to heat more homes or power more vehicles with wind – while deferring the need to invest in energy infrastructure – extending more wind energy security to Islanders at cheaper prices than otherwise.





The Guardian | [Making efficiency the cornerstone](#)

## Regional Renewable Energy Funding Available



Matthew Sherwood/Telegraph-Journal

P.E.I. Energy Minister Richard Brown made comments about the federal fund in the context of a speech on the need for regional co-operation on energy, which, he said, means capitalizing on the diverse energy mix in the area, supplying clean energy and employing innovative technologies. Source: <http://nbbusinessjournal.canadaeast.com/front/article/1048958>

- **Nova Scotia's Demand Side Management (DSM) program: Concerns and recommendations** ([PDF](#))

*Larry Hughes*

Text and slides of a presentation given to the Nova Scotia Utility and Review Board regarding the province's Demand Side Management program, 19 April 2010.

- **PEI's approach to DSM**  
CBC Radio Series  
| [Part 1](#) | [Part 2](#) | [Part 3](#) |



Can PEI benefit in a regional collaboration on energy efficiency with Nova Scotia – in demand-side management (DSM otherwise known as conservation/efficiency) programming/activities?

[See](#) Nova Scotia's legislation, enacted in November 2009.

# Community Case Study

## Wind Electric Thermal Storage

Monthly heat demand (MWh) of Island house



Monthly output (MWh) of 5.15 MW North Cape Wind Farm



Space heat using  
wind-storage options

Room units  
(ceramic)



Forced air  
(ceramic)



hydronic  
(water)



### 1.4.3 The technical potential for off-peak electricity to serve as backup in wind-electric thermal storage systems [Download \(PDF\)](#)

*Larry Hughes*

*Accepted to International Journal of Green Energy*

Despite its potential as a secure and environmentally benign source of electricity, wind's intermittency is proving to be a challenge for many electricity suppliers. One approach to overcoming this intermittency is to match it with a load that can be made to follow the wind, such as electric thermal storage systems for space heating. In such configurations, wind-generated electricity can be used for space heating and, if sufficient surplus remains, recharging the thermal storage system. When there is a demand for heat but no wind available, the thermal storage system can discharge, meeting the space heating requirements. In extreme cases, when the thermal storage system is fully discharged and there is no wind, some form of backup energy source is required.

This paper examines the technical potential of off-peak electricity to ensure that wind-charged thermal storage systems are able to bridge periods of insufficient wind. The simulations show that wind-heating with off-peak backup can reduce surplus electricity generated from the wind and greenhouse gas emissions. The benefits as well as the limitations of the approach are discussed.

## 1.4.4 Meeting residential space heating demand with wind-generated electricity [Download \(PDF\)](#)

*Larry Hughes*

*Accepted to Renewable Energy*

Worldwide, many electricity suppliers are faced with the challenge of trying to integrate intermittent renewables, notably wind, into their energy mix to meet the needs of those services that require a continuous supply of electricity. Solutions to intermittency include the use of rapid-response backup generation and chemical or mechanical storage of electricity. Meanwhile, in many jurisdictions with lengthy heating seasons, finding secure and preferably environmentally benign supplies of energy for space heating is also becoming a significant challenge because of volatile energy markets.

Most, if not all, electricity suppliers treat these twin challenges as separate issues: supply (integrating intermittent renewables) and demand (electric space heating). However, if space heating demand can be met from an intermittent supply of electricity, then both of these issues can be addressed simultaneously. One such approach is to use off-the-shelf electric thermal storage systems.

This paper examines the potential of this approach by applying the output from a 5.15 MW wind farm to the residential heating demands of detached households in the Canadian province of Prince Edward Island. The paper shows that for the heating season considered, up to 500 households could have over 95 percent of their space heating demand met from the wind farm in question. The benefits as well as the limitations of the approach are discussed in detail.

## 1.4.5 Integrating wind generated electricity with space heating and storage batteries [Download \(PDF\)](#)

*Anirudh Muralidhar and Larry Hughes*

*To be presented at International Green Energy Conference, Waterloo, Ontario, June 2010.*

Renewable energy sources, such as wind, solar, and wave, are often seen as possible replacements for fossil fuels; however, electricity generated from these sources is intermittent, meaning that electricity providers cannot use them as dispatchable sources of electricity. This shortcoming can be overcome by matching intermittent supplies of electricity with energy services that do not require a continuous, uninterrupted supply of electricity.

It has been shown that wind-generated electricity, an intermittent source, can meet most of the space heating requirements of a typical household by storing electricity from the wind in electric-thermal storage (ETS) units. Despite this, the intermittent nature of wind still means that there are periods during which there can be either insufficient wind to meet demand or a surplus of wind that cannot be used. In Canada, many proponents of wind-generated electricity call for the export of excess electricity to U.S. markets where a premium is placed on renewable electricity. In a time of volatile energy markets, typified by problems in accessibility and affordability, the best energy security policy is to utilize domestic energy to its fullest before considering exports.

This paper examines how wind-generated electricity can be applied to two fundamental energy services: space heating (for electric-thermal storage) and transportation (for plug-in electric vehicles, or PEVs, such as the Tesla Roadster). The paper presents two charging algorithms, ETS-first and PEV-first, and discusses their advantages and limitations of each.

## 1.4.6 Strawberry Hill's residential property developers build toward sustainable development

ECO-PEI Energy Project has been collaborating with the Strawberry Hill developers since the summer of 2009. The goal of the collaboration is to focus on ways to improve the performance of the homes and overall sustainability of the community.

One option is for new homes to use wind electric thermal storage (ETS) for heating and plug-in electric vehicles. These options are becoming available today for homebuyers interested in affordable, customizable homes with a low carbon footprint.

The first duplex has been constructed to use an air-to-air source heat pump and propane heating system. Kevin Coulson, engineer responsible for preconstruction energy modeling for the duplex, has completed energy modeling for the duplex again. This time however, by including a wind-ETS and an air-to-air source heat pump. Coulson believes the 2,600 ft<sup>2</sup> spaces can be heated with wind using less than \$1,000/year.

[The Guardian: Business | Right from the start](#)

April 26, 2010

For more information contact Gordon MacPherson at  
Strawberry Hill Development, Focused on Sustainability  
<http://www.strawberryhilldevelopment.ca/index.html>



Overcome efficiency & wind-ETS (heat)/plug-in EV policy issues for next steps on PEI  
Ron Leblanc, Manager, Production and Energy Supply for Maritime Electric, says wind ETS and plug-in electric vehicles pose new challenges in terms of making the transition but says these challenges can be overcome, the price of the wind produced by the PEI Energy Corporation turbines for example, are both reasonable and stable prices, and the production from these turbines could be supplied to Islanders for both ETS and PEVs if there are people that are interested in doing this.

Maritime Electric, PEI Government and IRAC should work to improve grid communications, enabling distribution level storage systems for heat/transport to charge/discharge based on the excess availability of wind. Stable rate/cost structures are beneficial. One option is to allow Islanders using wind-ETS to purchase power from the PEI Energy Corporation's assets – this power is sold to MECL for 7.75 cents/kWh. If inflation is then pegged at 2% annually to the rate structure, it would give consumers the price stability needed to switch to clean, affordable heat/transport. This approach would create new domestic markets to boost wind production/local integration.

Households planning to upgrade oil furnaces could use wind-ETS. The price stability makes this attractive from an energy security perspective and the wind power is an environmentally benign source. PEI Government should replace \$1,000 oil furnace rebates with wind-ETS rebates.

TD Bank is purchasing wind attributes from the PEI Energy Corporation in order to green its operations. Ron Estabrooks at the PEI Energy Corporation believes this trend will only become more commonplace in the future. PEI is already receiving \$90,000 over an 18 month period for the TD deal. This could fund wind-ETS piloting initiatives. Strawberry Hill in the Town of Stratford, the City of Summerside, and other areas are candidates and could be interested to move forward.

## 1.4.7 The Immense Potential of Electric Propulsion

In order to harness the strategic advantages of the electric power sector in the light-duty vehicle fleet, vehicles that can be propelled by electricity must be available to consumers. In fact, the technology for such vehicles has advanced rapidly in recent years. Though important challenges remain, the global automotive industry has invested heavily in highly-efficient electric drive vehicles that use reduced quantities of petroleum in order to meet consumer demand in an era of high fuel prices, and to comply with increasingly stringent regulations that restrict tailpipe CO2 emissions.

A variety of technologies employing electric drive are on the cusp of commercial availability, and an even larger number are currently in the final stages of development. In general, grid-enabled vehicles can be either pure electric vehicles (EVs) or plug-in hybrid electric (PHEVs). Both EVs and PHEVs store energy from the grid in onboard batteries. Energy from the battery powers a highly-efficient electric motor that propels the vehicle. EVs substitute an electric drivetrain for all conventional drivetrain components. PHEVs retain the use of a down-sized internal combustion engine that supplements battery power. At a basic level, both EVs and PHEVs provide consumers with clear advantages compared to gasoline powered conventional vehicles of today.

## BionX Cycles featured prominently in FOX5 Money Report

April 28, 2010



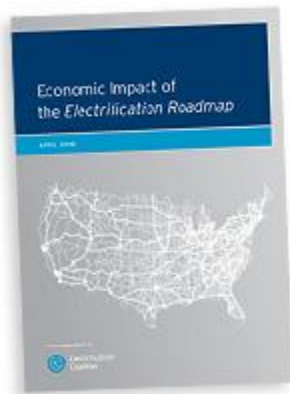
A recent video segment and news article featured on Fox News brings attention to the growing popularity of electric bikes. These news items highlight the benefits of electric bikes for commuting, and provide the perfect opportunity for you to see the BionX system in action.

[BionX Cycles](#) is based in Quebec. In 2008, MacQueens Bike Shop in Charlottetown began supplying/servicing the e-bike systems.

[view video and article online](#)

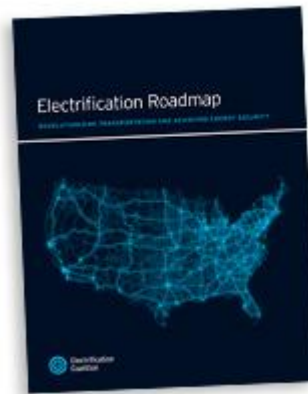


The Environmental Coalition of PEI has developed the Electrification Coalition of PEI Roadmap for grid-enabled vehicles and electric thermal storage for home heating based on information available from many sources. Below are two useful plug-in transportation documents, among many others. The information from these sources allowed us to draw upon/simulate PEI-based scenarios.



**Economic Impact of the  
*Electrification Roadmap***

**Click to download a PDF of the  
Economic Impact Report**



***Electrification Roadmap***

**Revolutionizing Transportation  
and Achieving Energy Security**

**Click to download a PDF of the  
*Electrification Roadmap***

OnPoint -- Thu., May 27, 2010  
-- Go to [www.eenews.tv](http://www.eenews.tv)

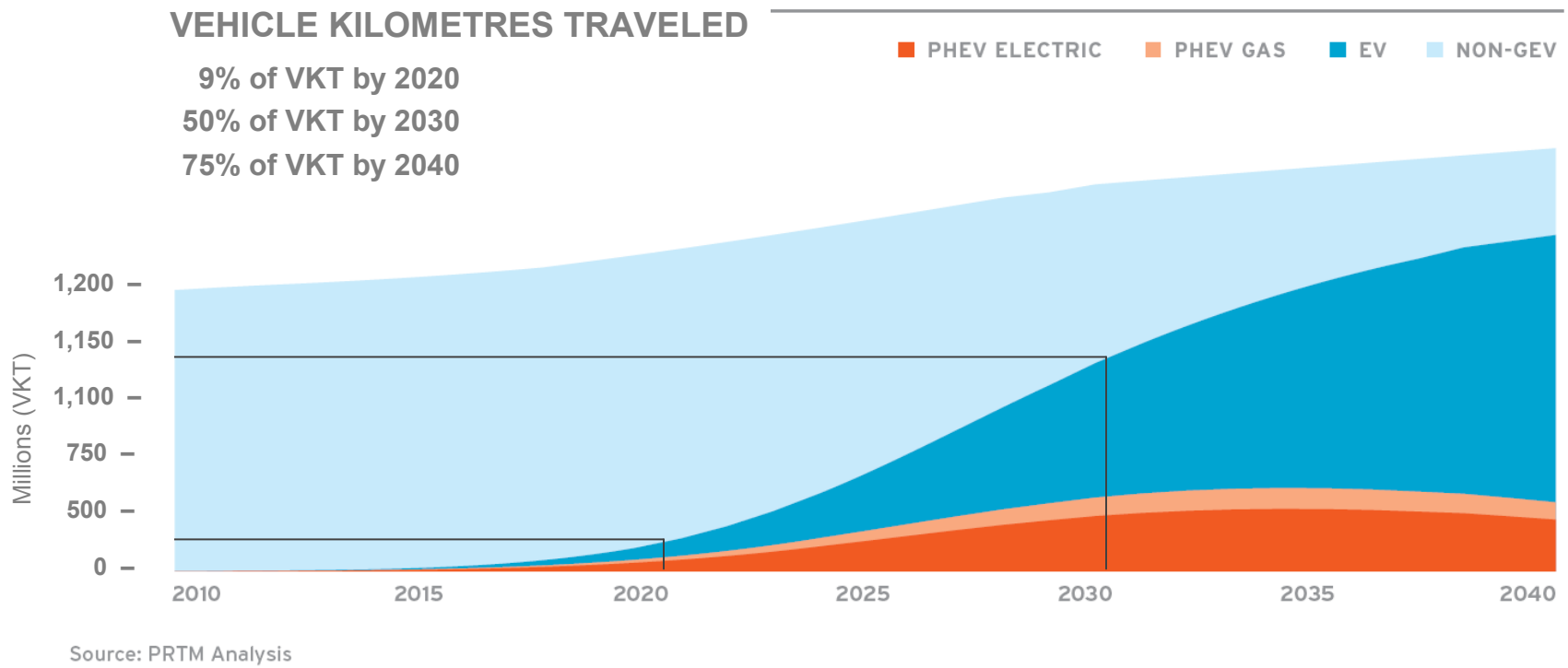
Transportation:

**Electrification  
Coalition's  
Ori discusses new  
bills promoting  
infrastructure, electric  
vehicles**

[watch video](#) [read transcript](#)

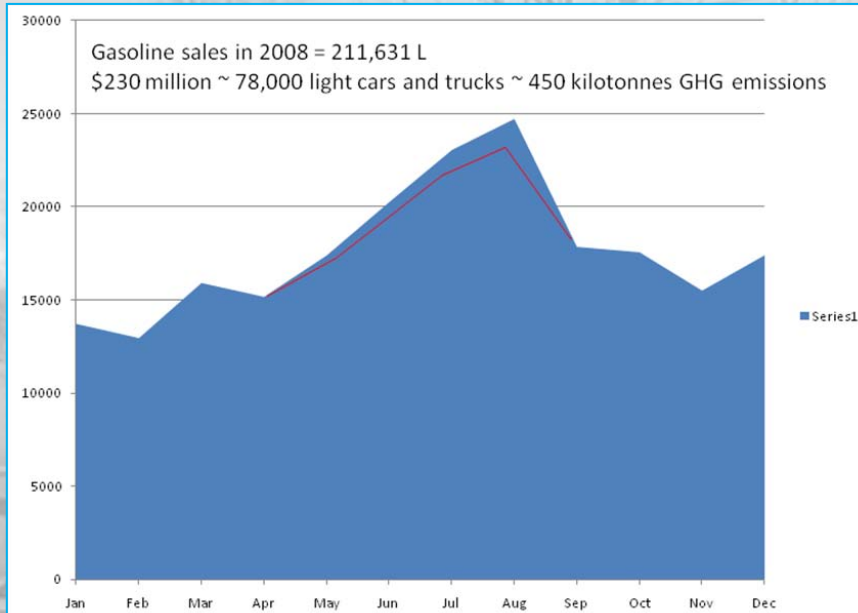


Goal: By 2040, 75% of the light-duty vehicle kilometres traveled in PEI should be electric kilometres.



PEI should integrate measures to reduce unnecessary vehicle kilometers travelled.

## PEI Gasoline Fuel Demand



### An Electric Boost for Bicyclists

It began in China, where an estimated 120 million electric bicycles now hum along the roads, up from a few thousand in the 1990s. They are replacing traditional bikes and motorcycles at a rapid clip and, in many cases, allowing people to put off the switch to cars.

In turn, the booming Chinese electric-bike industry is spurring worldwide interest and impressive sales in India, Europe and the United States. China is exporting many bikes, and Western manufacturers are also copying the Chinese trend to produce models of their own. From virtually nothing a decade ago, electric bikes have become an \$11 billion global industry.



**PEI could stimulate many innovative, sustainable transport models by introducing financial incentives for automotive grade lithium-ion batteries. Yuneec International, a Chinese manufacturer, has introduced the E430 – the world’s first commercially produced ‘Electric Aircraft’.**

**The E430 is a twin seat, single engine, LSA class aircraft designed to be simple to use, easy to fly and with virtually zero vibration, it’s very smooth. Low noise, no emissions, no fuel, extremely low maintenance and best of all. . . . it’s environmentally friendly.**

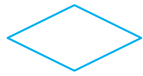
**Electric flight, once seen as futuristic, has arrived and with E430’s flight times of between 1.5 and 3 hours (depending on configuration) electric flight now becomes a realistic power source for sport aviation. Charging times of 3 hours for as little as \$5 make electric a really low cost way to fly and with only 2 main moving parts in the motor (the bearings) the reliability and maintenance are like nothing seen before.**

**Add to that the delight of smooth, quiet powered flight or silent using its 25:1 glide ratio - the E430 is in a class of its own.**



Electric powered aircraft are highly efficient and can be powered by the wind.

This approach could enhance P.E.I.'s reputation and brand image, while allowing people to enjoy in the breathtaking experience of zero emissions flight.



## 1.5 The Target

Prince Edward Island should set a specific and measurable goal for the widespread deployment of grid-enabled vehicles. Such a target will provide Islanders with a clear definition of success and help lawmakers to focus policy efforts over the coming decades. The target should be ambitious but achievable with the right mix of consumer incentives and regulatory stability.

### 1.5.1 A Provincial Goal for Electrification

The Province of P.E.I. has set ambitious goals in order to advance the provincial interest in the past. Today, to safeguard provincial security, the province must commit to a transformed transport sector.

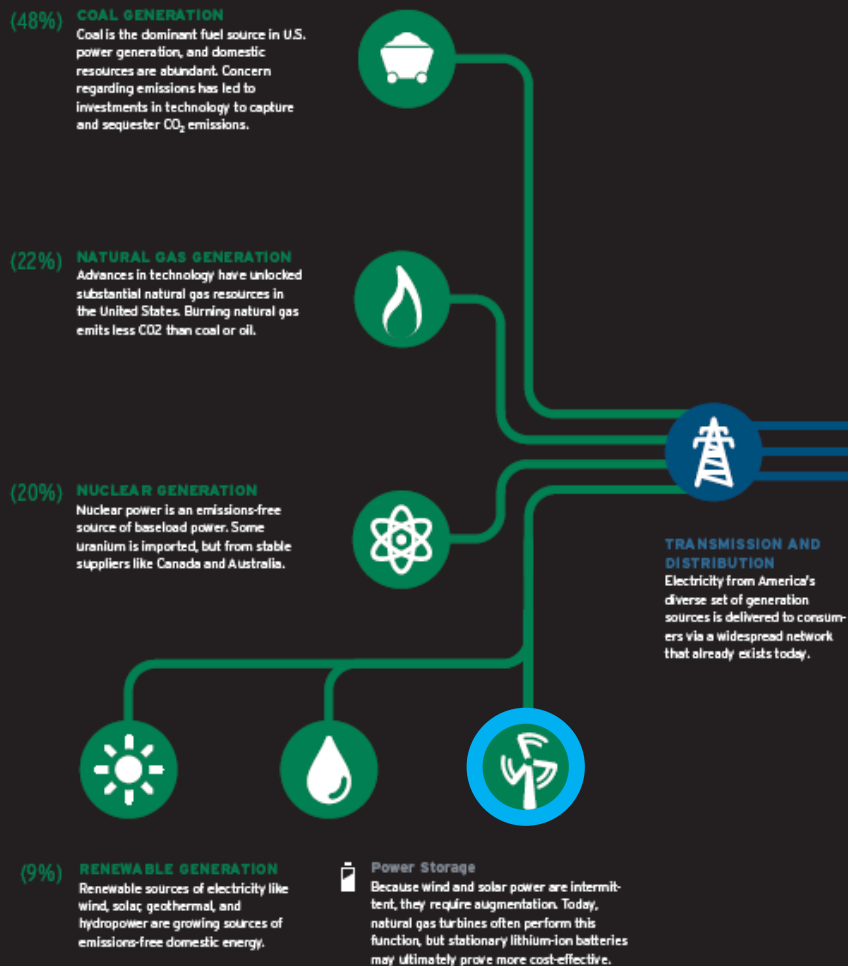
### 1.5.2 Critical Milestones

Specific milestones will assist lawmakers in measuring progress toward widespread electrification. Milestones should take into consideration the number of grid-enabled vehicles sold and on the road in order to assess the competitiveness of the technology.

### 1.5.3 Assessing the Goal's Feasibility

Achieving the rate of GEV deployment targeted by the provincial goal would substantially improve PEI's economic and provincial security. However, it is important to be clear-eyed about the steps required to accomplish such a goal.

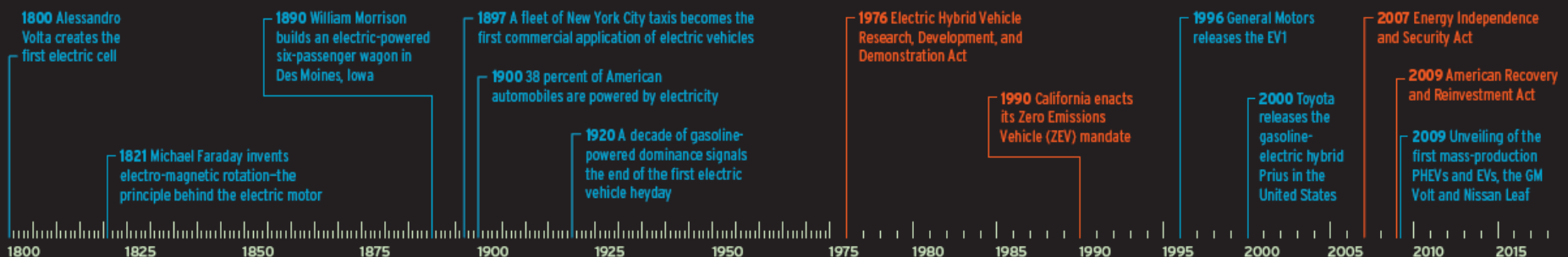
# FIGURE 1P Electrification Architecture

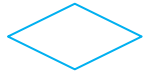


The U.S. transportation system and the electric power sector are completely separate today. The emergence of grid-enabled vehicles offers the possibility to synergize these two systems for the first time. In doing so, the transportation system would access the fuel diversity and price stability of the electric power sector, thus substantially improving U.S. energy security.



FIGURE 1V U.S. ELECTRIC VEHICLE TIMELINE





## 1.6 Provincial Imperative

For electrification to deliver on its full promise, PEI must commit to GEVs as the tactical core of a comprehensive oil abatement strategy. This may raise issues of government intervention in the marketplace. However, the total costs of oil dependence are so overwhelmingly damaging to our provincial interest that an alternative pathway is urgently needed.

### 1.6.1 Electrification is Superior to Alternatives

Meeting PEI's energy needs in the future will require a balanced portfolio of fuels and technologies across all sectors of the economy. Electrification can transform the light-duty fleet and sharply reduce oil dependence.



**Scale and Impact:** By using existing technology and infrastructure, GEVs promise greater scale and impact than alternative fuels.

### 1.6.2 Infrastructure as a Provincial Priority

Grid-enabled vehicles will require access to public charging equipment and will frequently interface with the electric power sector. These requirements present Prince Edward Island with an opportunity to invest in a 21st century transportation infrastructure.

### 1.6.3 Opportunity Costs

Stringent CO<sub>2</sub> emissions standards and high fuel prices have contributed to rapid developments in the global GEV industry. P.E.I. faces the very real risk of being left behind using electric vehicle adoption as part of strategy for energy security to be Canada's green province.



**Batteries:** The global market for large format lithium-ion batteries could reach \$10 to \$15 billion by 2015.



## 1.7 Electrification Policy

Prince Edward Island has a history of intermittent public policy support regarding energy security dating back to the 1970s. The province has generally lacked a regulatory and fiscal commitment for electric drive vehicles however since 2004 the PEI Government has offered \$3,500 rebates for hybrid vehicles. Today, energy security, climate change mitigation and economic pressures have brought electric vehicle policy to the top of many government agendas.



**Policy Impact:** Through public policy, P.E.I. was able to reduce the oil intensity of its electricity supply mix by increasing wind power to 15% from 2001–2008. Today there is 156 MW installed wind capacity – up from 72 MW in 2008. The current [Request for Proposals](#) could add 130 MW more.

## Part Two – Challenges & Opportunities

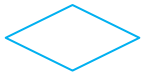


## **ABSTRACT**

### **Core Challenges**

The successful deployment of GEVs faces a range of challenges. Early GEV batteries will have limited range, may take hours to charge, and will add significantly to vehicle cost. Vehicle charging infrastructure is non-existent, and consumers may hesitate to accept new technology.

Yet, each of these challenges can be overcome to achieve widespread, large-scale deployment of grid-enabled vehicles in the near future. Policy support and innovative business models will drive down battery costs and work to deploy adequate charging infrastructure. The electrical grid reaches most corners of the nation, and only upgrades to the last few feet of wire are required to deploy vehicle chargers in mass. The electric power industry has the capacity to generate and transmit most of the power that will be needed to charge GEVs, certainly in the early to middle stages of deployment. Over the long term, smart-grid technology will manage vehicle-to-grid interface while enhancing the overall consumer experience.



## 2.1 Overview

Despite the progress currently being made in the global electric vehicle market, substantial barriers to widespread vehicle adoption still exist. Overcoming these barriers will require innovative business models and the support of effective public policy. Wind electric thermal storage poses a different challenges including unfamiliarity with the systems.

### Prince Edward Island

Demand Distribution by Residential Energy Service (NRCan 2008)

Service	Percent	kWh
Space Heating	68.4%	18,539
Water Heating	21.7%	5,879
Appliances	7.3%	1,969
Lighting	2.5%	673
Space Cooling	0.1%	16

### Wind Electric Thermal Storage (Four Days of Limited Wind Supply)

Hughes: Meeting residential space heating demand with wind-generated electricity

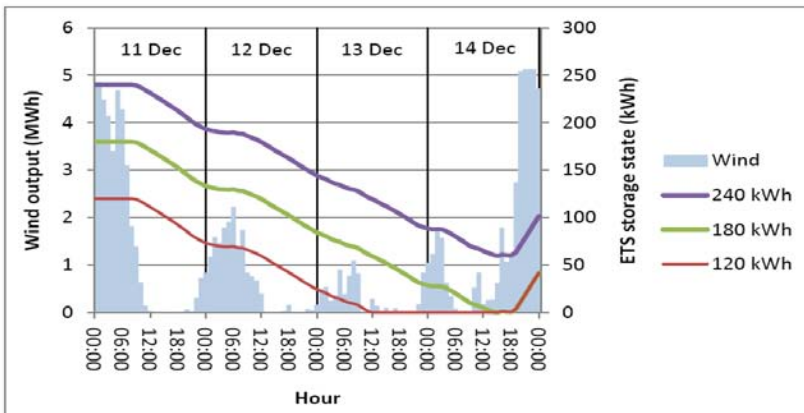


Figure 5: Changes in ETS state during four days of limited wind supply

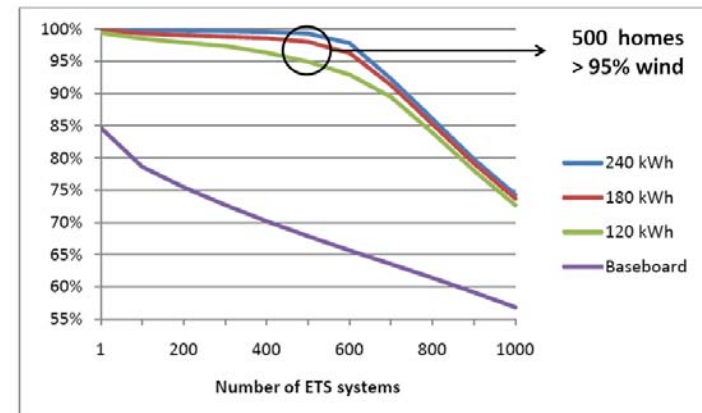


Figure 7: Percentage of heat from wind for different ETS capacities and number of systems

## PEI Smart Grid Case Study: Wind Electric Thermal Storage

Prince Edward Island has set a target of 500 MW installed wind capacity by 2013. Given this, PEI should have enough excess production available during wintertime to use wind-ETS systems to provide reliable, clean and affordable space heating to all homes on PEI.

Islands off Maine's coast are using community wind to test wind-ETS heating for homes and businesses. This project will allow Islanders in Maine to use their "excess" renewable power locally, rather than thinking about how it can be transported out of state. Given these developments, what does the wind-ETS opportunity mean for PEI?

### Wind-ETS with Heat Pumps

Given PEI's climate, both new home constructions and existing homes which already use forced air systems can easily use heat pumps to improve the seasonal efficiency of wind-ETS systems to approximately 175% (Al Takle, Steffes Corporation). This reduces average annual space heating demands from 18,539 kWh per year to 10,594 kWh per year. Furthermore, efficient new home constructions can help reduce average heating demands much further with little or no-added costs using integrated sustainable design features such as optimization for passive solar gain.

**Space heat demand for wind-ETS + air heat pump system is 10,594 kWh/yr**



## Replacing Oil Heat with Wind

For many existing households on PEI, oil is the primary resource used for space heat. In these cases, households typically rely on baseboard hydronic heating to distribute the heat throughout the home in order to maintain comfort.

As long as there is enough space available, it is possible to replace an oil furnace by installing a hydronic wind-ETS system. A 6'x6' space is required to install the hydronic wind-ETS systems to replace oil and heat PEI homes.

## Room Units

Another option is to use one or two room heaters, such as in apartment buildings that conventionally are dependent on oil. Room units are available in five different sizes ranging from 13 kWh to 40 kWh in size. These smaller systems only draw between 3 kW to 9 kW of power from the grid, which means electrical services in most cases will be sufficient without upgrades. The price range for these smaller systems is \$1,300 to \$2,300 meaning that the pricing is more expensive than larger systems, and the price improves based on the capacity (kWh) of the system. A small 13 kWh room unit has a cost of \$100/kWh of storage, compared to a 180 kWh household unit, which has a cost of \$30/kWh.

Room units can be used for the majority of the wintertime to heat apartments. Oil furnaces can then still be used to supply back-up.

## Water Units

The power company in Iowa is installing a control module from Steffes Corporation that enables water heaters to use wind. In Iowa, a 200 home pilot is underway that will use Internet-based communications for the signal to match with excess wind.

## Using wind farms for heating being tested on islands off Maine

The futuristic idea of heating buildings and powering cars with electricity from wind farms off the Maine coast is being tested on a small scale on two islands that are home to a community-run wind project and have some of the highest energy bills in the state.

Over the next year or so, up to 50 homes and businesses on Vinalhaven and North Haven will be installing electric thermal storage heaters. These units, which can absorb a day's worth of heat inside dense, ceramic bricks, will be charged with electricity from the Fox Islands Wind Project.

Source: [http://www.kjonline.com/news/using-wind-farms-for-heating-bing-tested-on-islands-off-maine\\_2010-04-03.html?searchterm=vinalhaven](http://www.kjonline.com/news/using-wind-farms-for-heating-bing-tested-on-islands-off-maine_2010-04-03.html?searchterm=vinalhaven)

### 2.1.1 Batteries & Vehicles

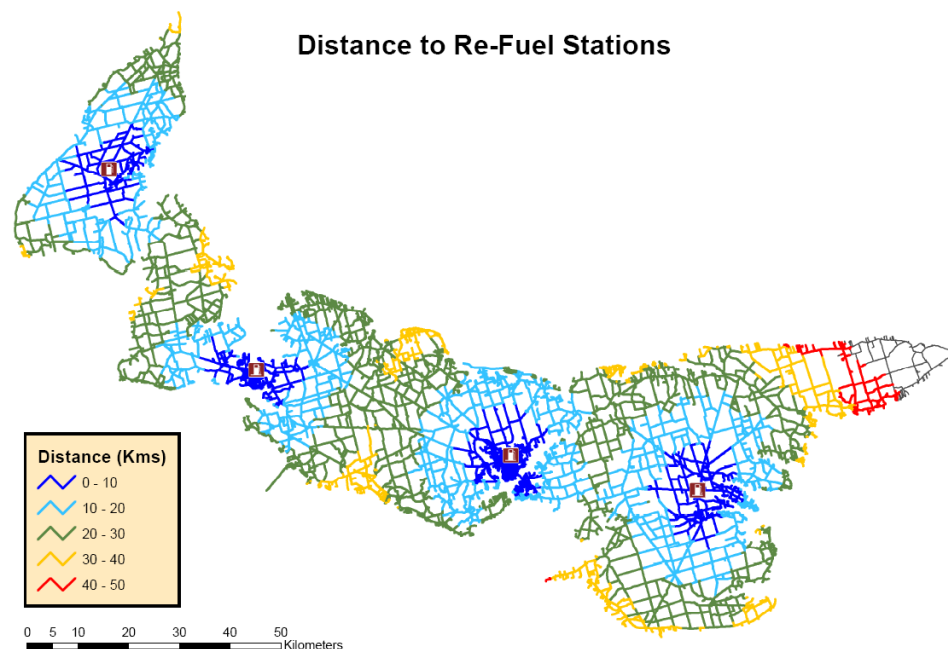
Ongoing battery research is concentrated on developing new chemistries and assessing the performance of batteries under different usage conditions. The focus of much of the battery industry is on producing batteries with high energy and power at a cost most consumers will find compelling. A range of generic estimates for current battery costs centers on \$600 per kWh.

The long-term goal for most market participants is closer to \$200 per kWh. The primary drivers of battery cost are high material costs and lack of scale. Battery performance is significantly impacted by the charge cycle and temperature, among other factors.

## 2.1.2 Charging Infrastructure

Deploying electric vehicles at scale will require the construction of a network of charging infrastructure, both public and private (home). The costs for public Level II electric vehicle supply equipment (EVSE) are highly dependent upon location, but currently range up to \$5,000 per unit; Level III chargers will be less prevalent, as they will be used for fast charging, but are significantly more expensive, up to \$60,000 per unit (installed). According to Doug Houseman, consultant to the Canadian Electricity Association regarding asset management for smart grid, also points out that the efficiency of fast chargers can range from 50% to 90%. It will be important to look at these factors in addition to the unit costs.

The ability for EVSE and charger owners to recoup these costs will depend on utilization rates and whether vendors are allowed to charge a premium for charging. Entrepreneurship and innovation will surely develop models for profitable operation, however it is difficult to imagine a scenario in which substantial government investment would not be required to assist in laying the backbone of the GEV charging network.



### 2.1.3 Electric Power Sector

Managing the interface between the grid—power generation, transmission, and distribution—and the vehicles presents additional complexities. In moving from oil to electricity, we must be deliberate in ensuring the reliability of the Island and maritime power system. Failure to do so would simply trade one economic vulnerability for another. The current regulatory framework may be inadequate to support widespread GEV adoption, and a set of standards for everything from plugs to outlets to charging stations will be required to ensure uniform operability. These are already being developed internationally and integrated into electrification ecosystems.

### 2.1.4 Consumer Acceptance

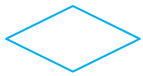
There remains the question of whether enough consumers will ever be willing to accept the demise of the internal combustion engine and the transition to electricity. The payback periods for GEV ownership will need to be dramatically—and permanently—reduced. And yet, policies designed to discourage oil consumption via price incentives are controversial and politically charged. Will Islanders choose to end oil dependence and switch wind-based home heating?

### Maine tests energy storage technology for heating homes



Vinalhaven is one of the Fox Islands off Maine.

Source: [Maine tests energy storage technology for heating homes](#)



## 2.2 Batteries & vehicles

GEVs trace their roots to today's familiar hybrids, but represent a significant advancement in efficiency. Therefore, a great deal of current attention is focused on developing grid-enabled vehicles that meet consumer needs. Most such efforts are dedicated to commercializing advanced batteries that provide the power and range expected by drivers.

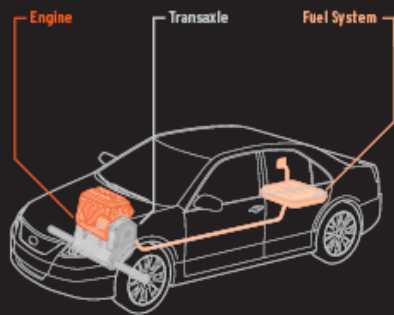
### 2.2.1 The Battery

The battery is a core component in a GEV. Lithium-ion batteries provide requisite energy and power, but add significantly to vehicle cost. Raw materials like lithium are abundant, especially if recycled. Improvements in battery performance are still needed.

## 2.2.2 Electric Motors

The efficiency of the electric motor as compared to an IC engine is the primary reason that GEVs are more efficient than traditional vehicles. Advances in electric motors will continue to improve the cost effectiveness of GEVs.

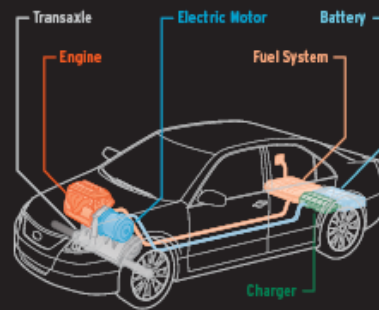
### INTERNAL COMBUSTION ENGINE VEHICLE



#### KEY FEATURES

Traditional IC engine vehicles store liquid fuel—typically gasoline or diesel—onboard in a fuel tank. Fuel is combusted in the engine, which delivers mechanical energy to the axle to propel the vehicle. The high energy density of gasoline and the ability to store significant volumes of fuel onboard allow IC engine vehicles to travel several hundred miles without refueling. Today's internal combustion engines, however, are highly inefficient. IC engine automobiles turn less than 20 percent of the energy in gasoline into power that propels the vehicle. The rest of the energy is lost to engine and driveline inefficiencies and idling.

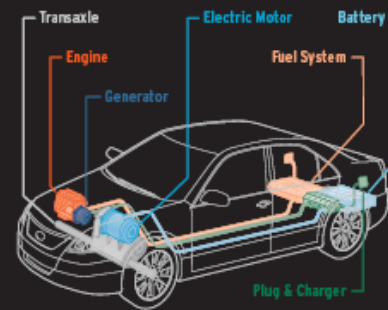
### HYBRID-ELECTRIC VEHICLE (HEV)



#### KEY FEATURES

HEVs retain the use of an IC engine, and therefore require a liquid fuel tank. A additional energy is stored in a battery, from which electricity flows to an electric motor. The motor transforms electrical energy into mechanical energy, which provides some measure of torque to the wheels. In a typical parallel hybrid system, both the engine and the motor provide torque to the wheels. In a series hybrid system, only the electric motor provides torque to the wheels, and the battery is charged via an onboard generator. Power split systems utilize two electric motors and an IC engine. Both the engine and the larger electric motor can provide torque to the wheels—jointly or independently.

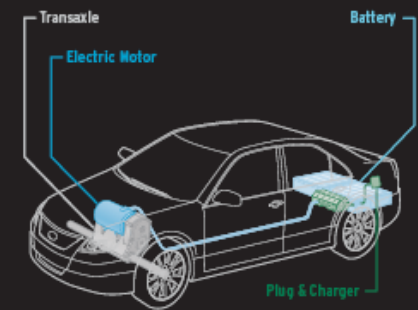
### PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV)



#### KEY FEATURES

Like traditional hybrids, PHEVs retain the use of an internal combustion engine and fuel tank while adding a battery and electric motor. However, PHEVs utilize much larger batteries, which can be charged and recharged by plugging into the electric grid. PHEV batteries are capable of powering the vehicle purely on electricity at a normal speeds over significant distances (approximately 40 miles) without any assistance from the IC engine. When the battery is depleted, PHEVs use the IC engine as a generator to power the electric motor and extend their range by several hundred miles. PHEVs can be configured as a series hybrid system or a power split system.

### ELECTRIC VEHICLE (EV)



#### KEY FEATURES

EVs do not incorporate an IC engine or conventional fuel system. Electric vehicles rely on one or more electric motors that receive power from an onboard battery to provide the vehicle's propulsion and operation of its accessories. EV batteries, which are typically larger than batteries in HEVs or PHEVs to support vehicle range, are charged by plugging the car into a device (electric vehicle service equipment) that receives electrical power from the grid.

### HYBRID ELECTRIC VEHICLE SYSTEMS

#### MILD HYBRID (PARALLEL SYSTEM)

- Still relies heavily on IC engine
- Efficiency gains of 15 to 20 percent
- Battery provides additional power during acceleration; powers the A/C and other systems during idling
- Regenerative braking charges battery

#### FULL HYBRID (POWER-SPLIT SYSTEM)

- Still relies on IC engine, but less than mild hybrid
- Efficiency gains of 25 to 40 percent
- Larger battery provides enough power for autonomous driving at low speeds
- Smaller motor acts as generator to charge the battery

### PLUG-IN HYBRID ELECTRIC VEHICLE SYSTEMS

#### PHEV (SERIES HYBRID SYSTEM)

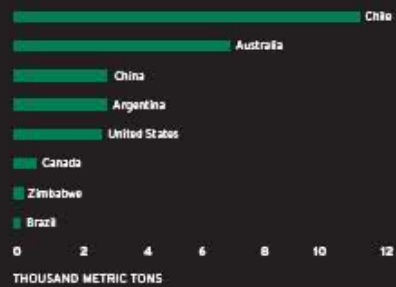
- Only electric motor provides torque to wheels
- IC engine serves only to augment the battery after depletion
- Uses no gasoline while battery is sufficiently charged
- Charges battery through grid connection and regenerative braking

#### PHEV (POWER-SPLIT SYSTEM)

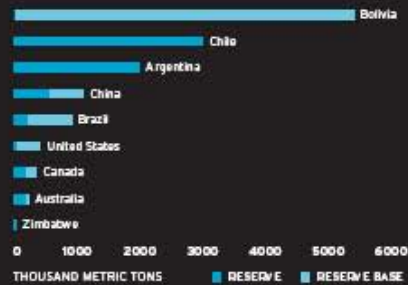
- Both the motor and IC engine can provide torque to the wheels
- IC engine provides torque when required (blended mode)
- Charges battery through grid connection and regenerative braking

**FIGURE 2G**  
**Lithium: Global State of Play**

**MAJOR LITHIUM PRODUCERS**



**MAJOR LITHIUM RESERVE HOLDERS**



Total identified world lithium resources stand at around 13.4 million tons, according to USGS. Reserve estimates must be understood in the context of demand, which has thus far required only the cheapest and most accessible lithium to be developed. Further, unlike oil, lithium is recyclable. Though not currently economical, once the vehicle fleet is electrified it may be economical to reuse 100% of the lithium and other metals in batteries.

Tour “first look” at the lithium flats of Bolivia.  
*Scientific American slideshow, etc.*

Source: USGS



## 2.3 Charging Infrastructure

Electric vehicle supply equipment will be needed to charge the battery in grid-enabled vehicles once depleted. While a substantial portion of charging can be done overnight at home, public charging options will provide drivers with added confidence and flexibility. With limited exceptions, public charging infrastructure does not exist today.



GEVs will move beyond the current petroleum-based refueling system. This will enhance energy security, but will also require thoughtful investment in charging infrastructure.

### 2.3.1 Understanding Charging

The vehicle charger is the device that connects the vehicle to the electrical grid and through which the vehicle's battery is charged. Efforts to standardize chargers, already underway, will be important to ensure network interoperability.

### 2.3.2 Charging at Home

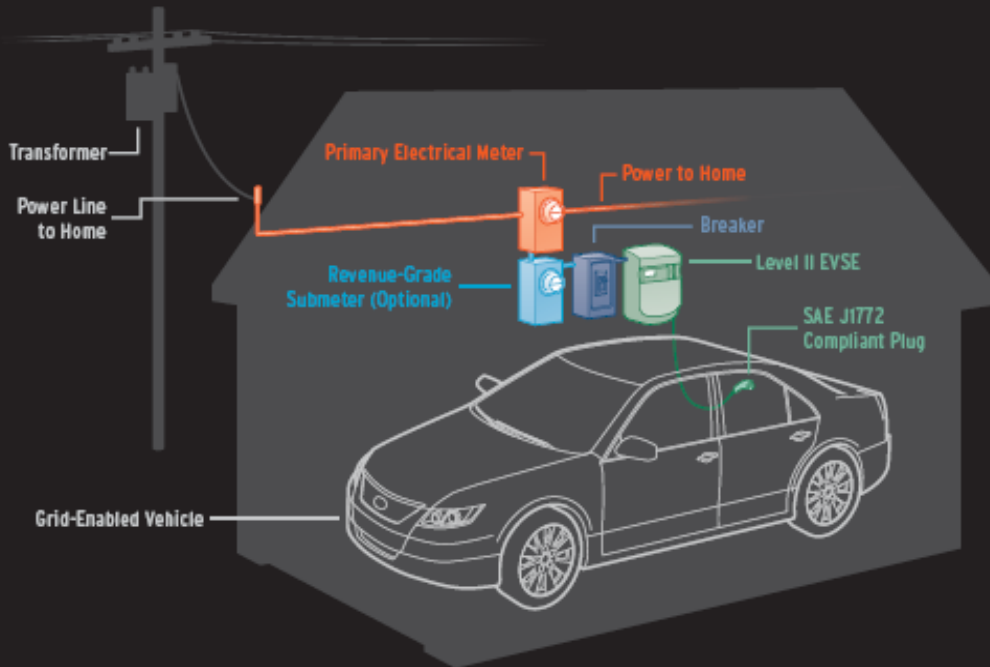
For drivers with access to a dedicated outlet, the most convenient time to charge their GEV will be overnight at home. This will place minimal strain on the grid and offer other important benefits as well.

FIGURE 2J

## Home Charging Configuration

GEV owners will typically install an EVSE device in their garage, carport, or near their dedicated overnight parking spot. A Level II charger, operating at 220 volts, can be mounted on the wall of a garage, plugged into an existing 220 volt outlet or wired directly into a home's electrical panel.

The EVSE may be submetered so that electricity used to charge a vehicle may be subject to different rates. A submeter could also be integrated into an EVSE or even the vehicle. The cord will run from the EVSE to a J1772 standard plug, allowing any vehicle to charge at any Level I or II charger.



### 2.3.3 Public Charging

Reliable access to a network of public charging equipment will provide GEV owners with confidence and flexibility. Especially in the early stages of GEVs and batteries, consumers will likely demand the ability to recharge frequently.

### 2.3.4 Public Charging: Who Will Pay?

Financing public charging infrastructure is a challenge. In the absence of access fees, which make GEVs less cost effective for the user, it is unclear how the charging infrastructure can be built.

Charging: Building an efficient public charging network will require careful planning.



The greater the number of public chargers deployed, the less each of them might be used. Determining how many are needed to meet drivers' needs will be critical in making the system work.



## 2.4 Electric Power Sector

The deployment of GEVs represents an enormous opportunity for the electric power sector to establish an entirely new category of customers. While much of the infrastructure is in place to meet GEV needs, utilities will have to upgrade their information technology, replace some transformers, and seek innovative regulatory treatment so that they can serve this new business.

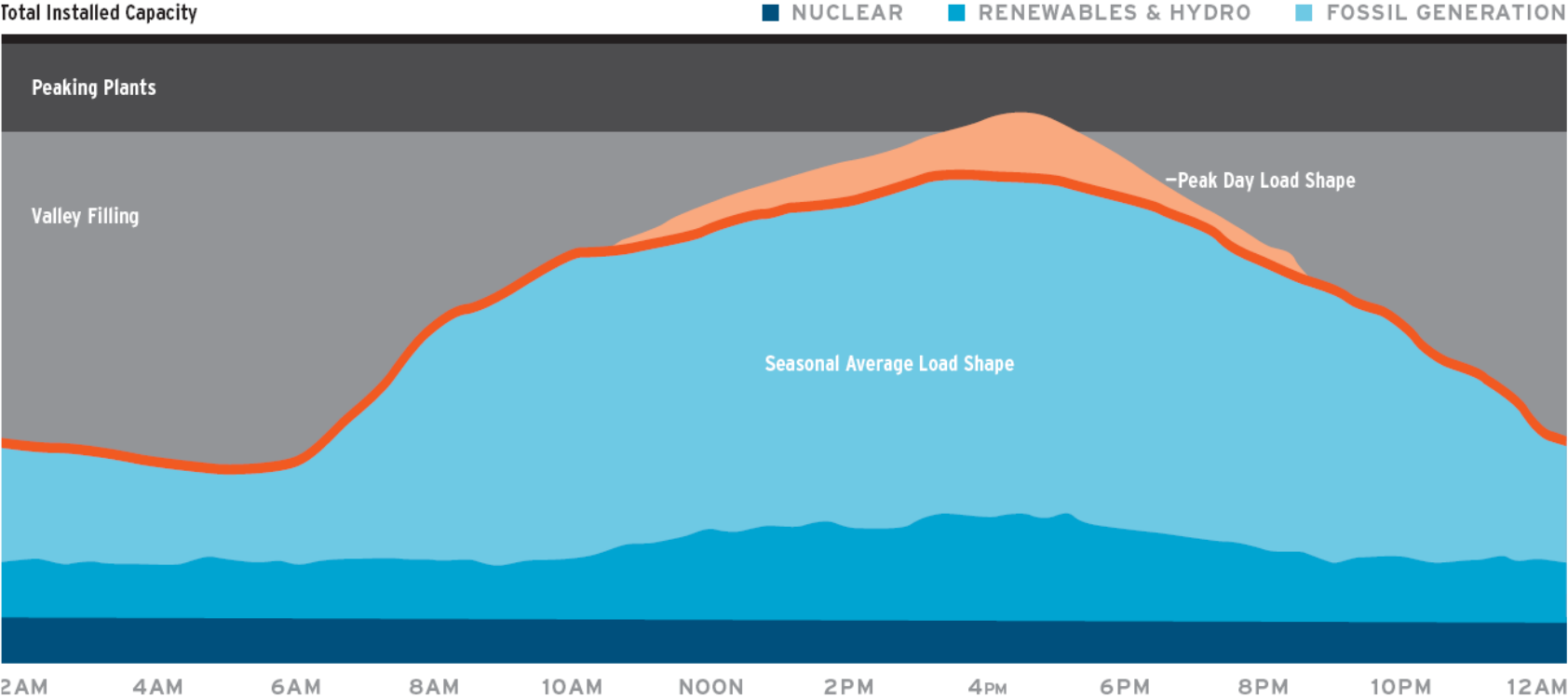
### 2.4.1 Hardware

While charging, GEV power demand can rival that of an average P.E.I. home. To reliably serve large GEV volumes in the short to medium term, the electric industry may need to upgrade neighborhood transformers.



In many cases, utilities will need to upgrade transformers to support GEVs.

**FIGURE 2P** STYLIZED LOAD SHAPE FOR ONE DAY DURING PEAK SEASON, GENERATION DISPATCH, AND INSTALLED CAPACITY|Generic



Source: Pacific Northwest National Laboratory



Prince Edward Island could take advantage of time of use rates in the order of 10 – 15%.

## 2.4.2 Software

In order to manage demand for electricity and take full advantage of the energy storage capabilities of GEVs, utilities will need to upgrade their IT infrastructure.

## 2.4.3 GEVs and the Smart Grid

The eventual deployment of smart grid technology is a key milestone in the ability of utilities to manage GEV interface with the power sector. A responsive and intelligent grid will also serve to enhance the GEV experience.

## 2.4.4 PEI and the Smart Grid

- The Wind Energy Institute of Canada in North Cape is getting an infusion of approximately \$12 million for a green energy research project directed at enhancing storage capacity for wind production.
- The proposal will see additional windmills erected at North Cape to produce nine megawatts at the Wind Technology Research and Development Park. The energy will be used in efforts to increase storage capacity.
- The wind park will be the first wind/storage combination in Prince Edward Island.
- A second project involves a regional —smart grid.” The project has New Brunswick Power Corporation as the lead proponent but involves all three Maritime provinces.
- This project will see more than \$10 million in funding from Natural Resources Canada. Both the Island government and Maritime Electric are involved in the smart grid concept.<sup>5</sup> Summerside is also planning to install smart meters.

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<sup>5</sup> CBC news article

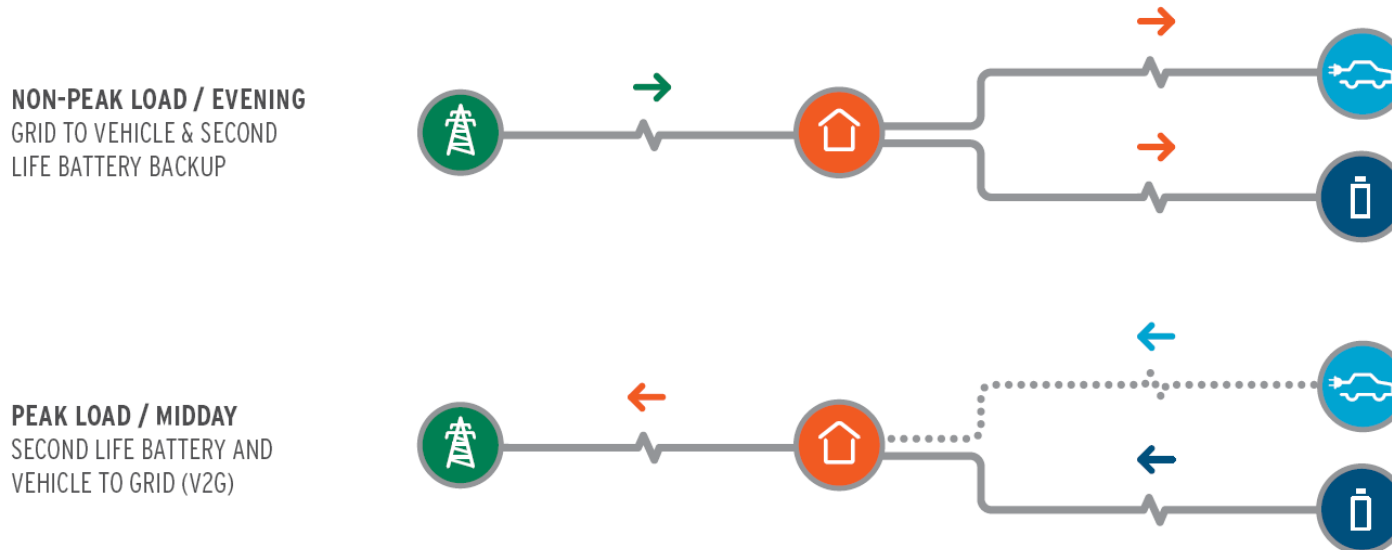
## 2.4.4 Regulatory Reform

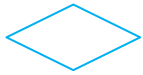
Deploying grid-enabled vehicles at scale will place some additional burden on utilities. While much of this can be managed with investment in new grid hardware and smart grid technology, key regulatory barriers will need to be minimized.

## 2.4.5 Vehicle to Home and Grid

Vehicle-to-home and vehicle-to-grid technologies promise much for the future, but are likely several generations away from mass deployment. Issues more central to deploying GEVs must first be addressed.

FIGURE 2Q PEAK VS. NON-PEAK CHARGING





## 2.5 Consumer Acceptance

Almost a decade since their introduction, penetration rates for gasoline-electric hybrid vehicles are still less than 3 percent of vehicles on the road. More technologically advanced grid-enabled vehicles will need to overcome a number of consumer hurdles in order to reach much higher penetration rates.

### 2.5.1 Identifying the Pitfalls of GEV Acceptance

As with any new technology, expanding consumer adoption alongside the incumbent is a critical and difficult challenge. Investment payback and vehicle range are particularly important issues for GEV consumers.



Battery financing models could drive down upfront battery costs for consumers.

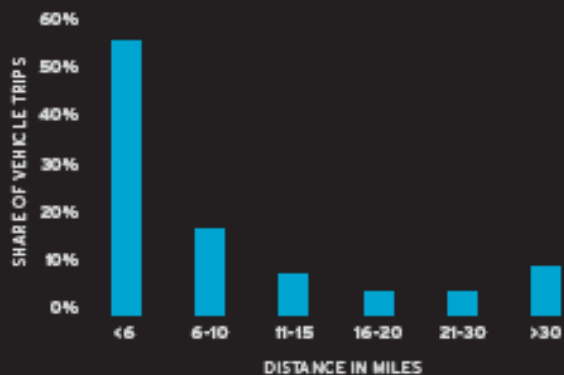
### 2.5.2 Consumer Preferences for Vehicle Utility

Divergence from the traditional model of automobile ownership and established consumer preferences for vehicle range, refueling, characteristics and performance have the capacity to affect the rate of GEV penetration.

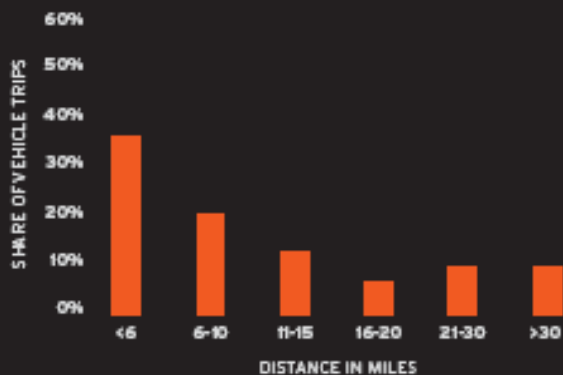


Today, there are well over 100 gasoline stations in Prince Edward Island, each with multiple pumps, but there are almost no electric charge points.

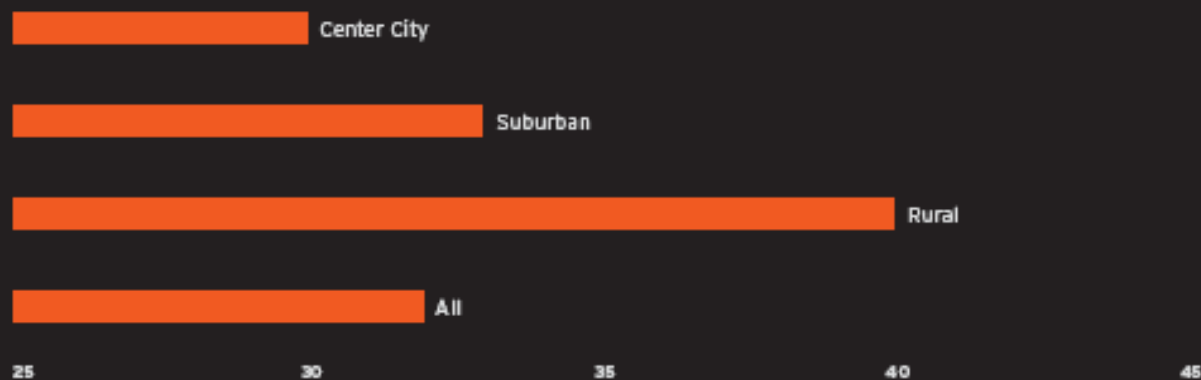
**FIGURE 2R SHARE OF VEHICLE TRIPS BY TRIP DISTANCE**



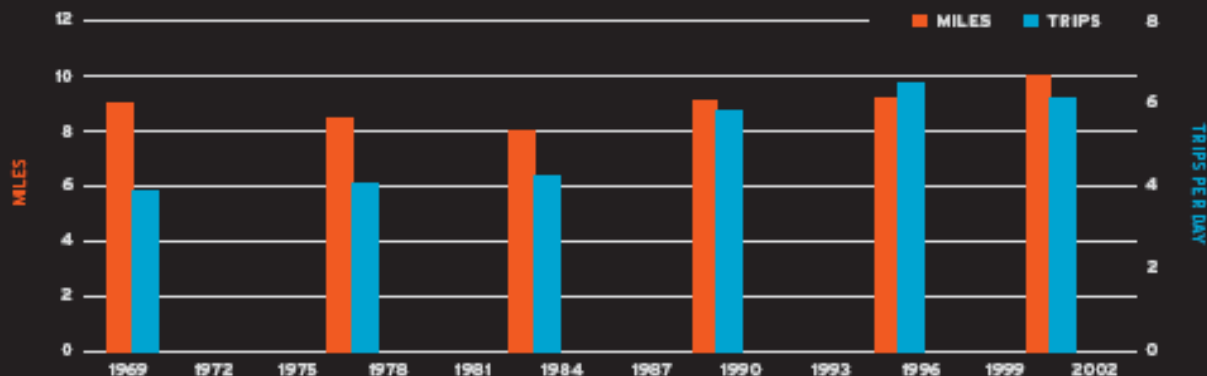
**FIGURE 2S SHARE OF VEHICLE TRIPS TO WORK BY TRIP DISTANCE**



**FIGURE 2T AVERAGE DAILY MILES DRIVEN (U.S.)**

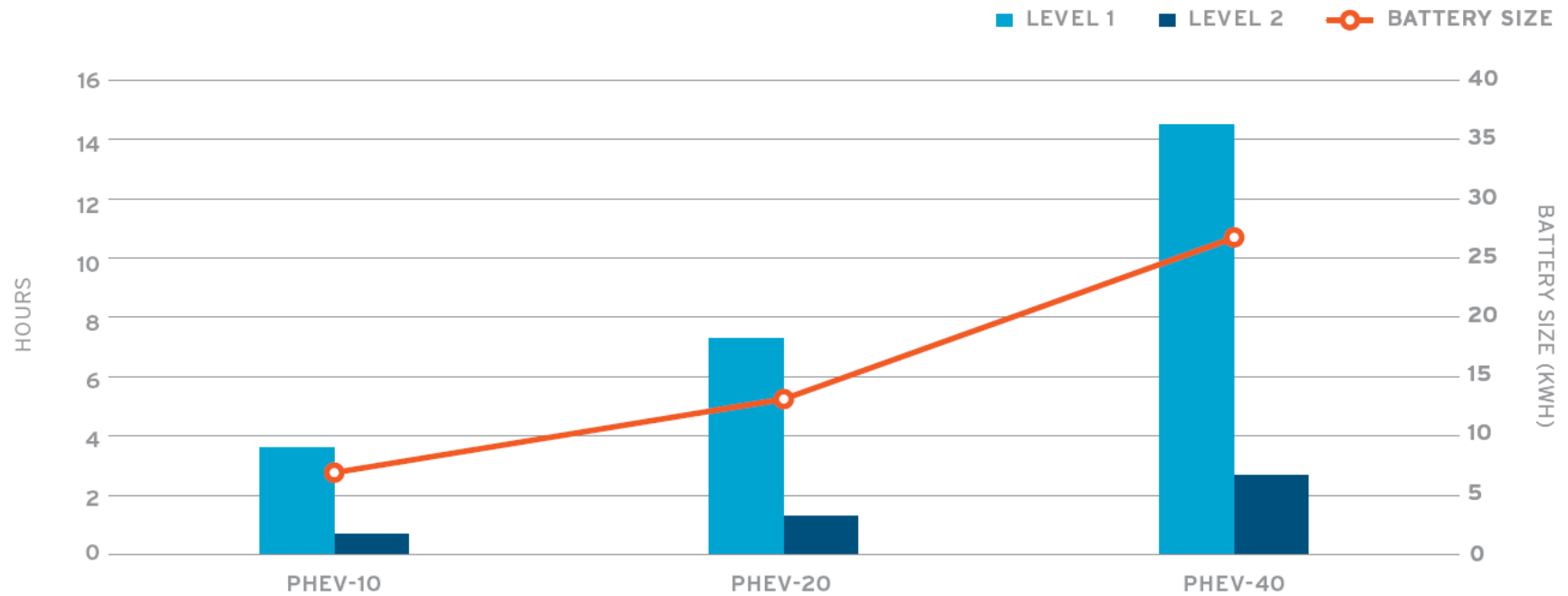


**FIGURE 2U AVERAGE NUMBER OF HOUSEHOLD TRIPS PER DAY AND AVERAGE VEHICLE TRIP LENGTH**



Source: DOE, EERE, Transportation Energy Data Book (2009)

**FIGURE 2V** HOME CHARGING TIMES FOR MID-SIZE PHEVS



Source: Idaho National Laboratory



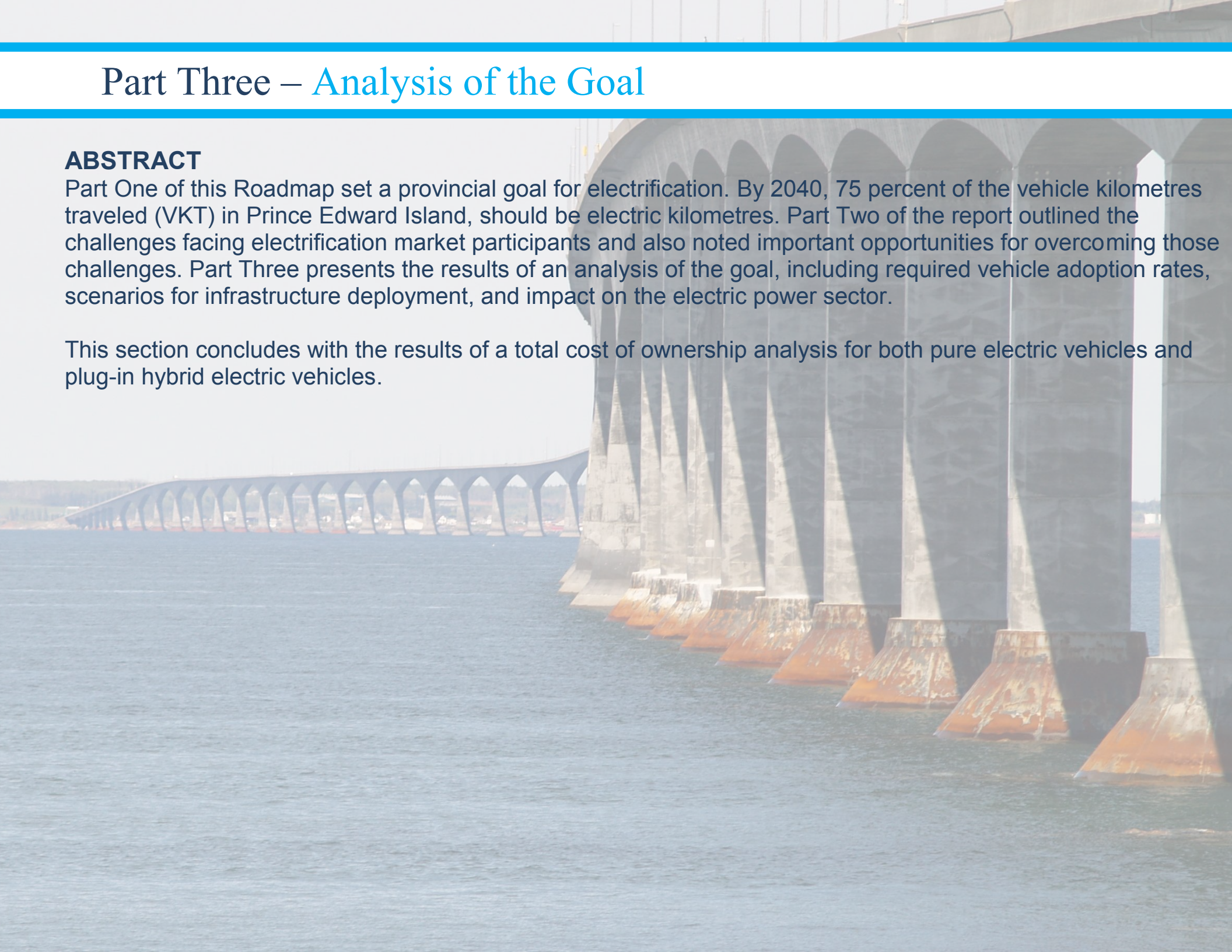
GEV features must meet or surpass the features that traditional IC engine vehicles provide if they are to succeed in the marketplace.

# Part Three – Analysis of the Goal

## **ABSTRACT**

Part One of this Roadmap set a provincial goal for electrification. By 2040, 75 percent of the vehicle kilometres traveled (VKT) in Prince Edward Island, should be electric kilometres. Part Two of the report outlined the challenges facing electrification market participants and also noted important opportunities for overcoming those challenges. Part Three presents the results of an analysis of the goal, including required vehicle adoption rates, scenarios for infrastructure deployment, and impact on the electric power sector.

This section concludes with the results of a total cost of ownership analysis for both pure electric vehicles and plug-in hybrid electric vehicles.





## 3.1 Assessing the Target

A specific and measurable target is a vital precursor to a successful implementation strategy. By setting and committing to a goal of electrifying 75 percent of the vehicle miles traveled in the light-duty fleet by 2040, the government will put the United States in a strong position to significantly reduce its dependence on oil.



## 3.2 Total Cost of Ownership

While upfront costs for GEVs are currently high, battery costs will fall as technology advances, as more vehicles are produced, and as economies of scale are achieved. Over time, the use of electricity as a propulsion fuel will reduce the cost of owning, operating, and maintaining a GEV so that it is more cost effective than a conventional vehicle.



### A gas tax could speed GEV adoption in PEI and Canada

The primary challenge that GEVs will need to overcome if they are to penetrate the market significantly and not be relegated to a niche market is their high upfront cost, much of which is attributable to the cost of the battery. This challenge is exacerbated by relatively low gasoline prices in P.E.I. and Canada. As of April 2009, the federal Gas Tax Fund increased to \$2 billion per year. Prince Edward Island will receive \$88.5 million in gas tax funding between 2007 and 2014. The Government of Canada has announced that the Gas Tax Fund would become a permanent measure at \$2 billion per year after 2014. Fuel taxes in many other developed countries are significantly higher. Because the price of gasoline is much higher in most other developed countries, GEVs are much more cost competitive as compared to traditional IC engine powered vehicles. In most other developed countries,

GEVs will have a lower total cost of ownership than IC engine powered vehicles almost from the moment they hit the market.

Fuel price volatility also acts as a disincentive for Island drivers to switch to more fuel efficient vehicles because experience suggests that high prices are unsustainable.

Consider the volatility in 2008, when average gasoline prices reached more than \$1.41 per litre in mid-summer. Before the end of the year were 72 cents per litre —a drop almost 50 percent in less than 6 months.

In countries where gasoline taxes are higher, however, volatility was considerably less as prices tended to fluctuate in excess of \$2 and \$2.50 per litre. The expectation of Island drivers that high prices are unsustainable reduces the economic incentive to invest in efficiency, wind and solar systems. Therefore, even in periods of rising or high prices, P.E.I. drivers may be uninterested in moving into more efficient vehicles.

Economists and political observers from Thomas Friedman on the left to N. Gregory Mankiw and Charles Krauthammer on the right have argued that a higher gasoline tax would help the United States to accomplish a number of national goals, including reducing oil dependence and lowering carbon emissions. Whereas 25 percent of U.S. oil demand is still met with domestic supply, P.E.I. has no oil sources.

A higher, equitable and sustained gas tax is arguably the most transparent and direct policy path to assist GEV market penetration, which would under a range of scenarios provide benefits to taxpayers far in excess of the cost. However, the substantial likelihood of a rapid repeal of such taxes in the early years after enactment for political reasons, as well as the political difficulties of enacting a gas tax increase at a level that would have a dramatic impact, argue for a GEV deployment plan that assumes gas taxes at the current level.

## Part Four – Strategic Deployment



## ABSTRACT

# Strategic Deployment

Early adopters will eagerly purchase the first grid-enabled vehicles once they hit the market. The primary challenge will be in expanding the market beyond these narrow groups to the general population of drivers. This will ensure that GEVs have a meaningful impact on P.E.I.'s energy security and that they do not become niche products.

To facilitate that process, the provincial government should launch an electrification ecosystem—in which resources are concentrated in order to promote the deployment of GEVs. In doing so, a range of market participants can work together to demonstrate that GEVs meet drivers' needs.

Ecosystems elsewhere are already being established and will allow participants to learn which business models work for supplying, selling, and servicing GEVs and help to create economies of scale. By getting ready to go electric now, P.E.I. can take advantage of the lessons learned in the other electrification ecosystems, thereby lowering the cost of deployment and accelerating provincial deployment rates.



## 4.1 Overview

Concentrating government resources in a small number of communities to serve as electrification ecosystems provides the Canada the best opportunity to deploy a large number of GEVs as quickly as possible and achieve the strategic vision of placing at least 500,000 plug-in electric-drive vehicles on Canadian roads by 2018. P.E.I. can become one of these places—at reduced costs.



## 4.2 Demonstration Projects

Investing in an electrification ecosystem for P.E.I. will allow us to work together with the first wave of ecosystem communities, such as in B.C., Ontario and Quebec, by leveraging their lessons learned and best practices. As these initial ecosystems are already being established, and they will be able demonstrate the viability of GEVs and identify business models that will allow each portion of the GEV supply chain to operate profitably. This can help to reduce the cost of deployment and accelerate consumer adoption for P.E.I.



Establish tax credits for installing automotive grade batteries in stationary applications to help drive scale

Discussion: To enable the purchase of automotive grade lithium-ion batteries, the provincial government should establish a tax credit for the purchase of automotive grade batteries for stationary uses. Lithium-ion batteries are technologically suitable for use in stationary applications, including residential backup power and power storage for intermittent electricity sources like wind and solar power. However, because of the extremely high levels of durability

and production quality required for automotive use, automotive grade batteries are likely to be too expensive for stationary uses.

Still, the lack of scale in vehicle battery production is a primary impediment to driving down costs throughout the industry, and incremental demand from the electric power sector and other stationary applications could help expand battery supply chains across a number of inputs. By expanding the existing vehicle tax credit to include incremental kWh of battery capacity installed, the provincial government would significantly expand the market for automotive grade lithium-ion batteries and help develop the scale of production needed to reduce the cost of GEVs.



## Establish federal loan guarantees for retooling automotive assembly lines

Discussion: In order to reach the goals put forward in this report, GEVs will need to become an increasingly significant portion of new Canadian vehicle sales over the next 10 years. Even as battery technology advances, infrastructure is deployed, and consumer attitudes shift, the demands on automotive original equipment manufacturers (OEMs) to retool facilities will be daunting.

Currently, the cost to retool an automotive assembly line with an annual capacity of 100,000 vehicles is estimated at approximately \$500,000,000. These are non-trivial costs, especially in a time of economic instability. In order to enable the industry to reach the scale required to deploy electric vehicles in large numbers, additional federal assistance for retooling and other capital outlays will be necessary. Any automotive OEM with Canadian facilities should be eligible.

Offering loan guarantees is the most cost effective way to leverage federal dollars. Provincial Governments should encourage the Federal Government to provide Natural Resources or Transport Canada with \$1 billion to support loans up to \$10 billion for automotive retooling to manufacture GEVs, including electric drivetrain components and final assembly. This amount is a sufficient volume of loans to support the eventual development of capacity to manufacture approximately 1.3 million GEVs annually by 2020.



## Modify building codes to promote GEV adoption

Discussion: Data indicates that the average vehicle spends 75 percent of its time parked at home, including all overnight hours. For that reason, there is near universal agreement that each GEV will need a charging device at home for overnight charging. In many instances, homeowners do not have a 220 volt outlet in their garage or accessible to their driveways; a professional electrician would be required to install a 220 volt line and recharging equipment. Doing so could be costly, depending on the difficulty of running a wire from a home's electrical panel to the garage.

To simplify this process, homebuilders could place lines in new garages and carports when homes are first built (or perhaps during certain renovations), significantly lowering the cost of adding EVSE later. Building codes should be modified to require that newly constructed homes and multi-family units have 220 volt outlets installed in garages or, at a minimum, have conduits installed that will facilitate the later installation of 220 volt lines.

Building codes and energy standards are being developed by the Government of Canada and independent standards are being implemented by provinces and cities. Provinces are in the process of implementing certain provisions into their building codes. In this instance, Canada may limit the applicability of future tax credits for GEVs to cars registered in provinces (or localities) that have incorporated the wiring requirements discussed above into their building codes. This approach has been suggested for the U.S. Such a requirement will facilitate the eventual deployment of GEVs by lowering the cost of installing GEV charging infrastructure.



## Promote the inclusion of GEV-related investment in the utility rate base

Discussion: As a result of their experience, utilities may be skittish about significant investments to support the deployment of GEVs which may or may not ever be deployed. Utilities may be concerned that if they make such investments and GEVs are not deployed in sufficient numbers, utility regulators may later determine that the investments were not prudent and disallow those costs.

If the province is to treat oil dependence as a provincial problem, its resolution cannot be left in the hands of provincial utility regulators. In the event that the provincial government and regulators do not move to allow incorporation of the technology needed to support GEV deployment in utilities' rate bases, the federal government should establish a minimum level of utility investment in GEV-related technology upgrades that provincial regulators must approve, and that once approved cannot later be disallowed on the grounds that the investments were imprudent.



## Adjust utility rate structures to facilitate GEV deployment

Discussion: Where necessary, public policy and regulations should be adjusted to support development of separate rate structures and billing options for service providers to develop new business models that maximize benefits for GEV owners. Utilities will need to establish time-of-day pricing for power used to charge vehicles to encourage off-peak charging or create other innovative tariffs for the sale of power to charge GEVs to help manage load. Provincial utility regulators should encourage utilities to experiment with such rate structures in order to improve utility operations and offer service providers, network operators and consumers a greater value.



## Establish a guaranteed residual value for used large-format automotive batteries

Discussion: The lifecycle characteristics of lithium-ion batteries remain a subject of intense research. However, most current analyses suggest that even as automotive batteries reach the end of their useful life in a GEV, substantial opportunities exist for secondary applications. Enabling consumers to capture the residual value of automotive battery purchases could significantly offset the higher upfront cost of purchasing a grid-enabled vehicle.

Unfortunately, the monetary value of automotive batteries for secondary applications is highly uncertain today. In general, this is because markets simply have not developed any experience with the performance of batteries in these applications. Over time, as the first generation of GEV batteries enters the market, a value will surely be derived. If nothing else, the recycling of battery raw materials alone will generate a notional return on investment for consumers. More likely, battery values will be well in excess of the recycling value as their use in the electric power sector

and secondary vehicle markets drive demand. In the meantime, however, markets are likely to undervalue lithium-ion batteries due to their inability to assess the risk of an unknown technology.

This problem will be particularly challenging for promoters of battery leasing, because understanding the residual value of the leased item is critical in establishing the cost of a lease. Therefore, the provincial government should authorize the DOE to establish a program to guarantee residual value for large format automotive batteries. Compared to the uncertainty of battery research and development, establishing a minimum residual value would effectively buy down the cost of batteries immediately. Moreover, while the ultimate cost of such a program is dependent on the actual residual value of batteries, it holds out the possibility of not imposing any meaningful costs on the government, assuming the actual residual value is higher than the minimum guarantee. In the absence of provincial action, Islanders would be forced to wait on federal leadership. The ecoENERGY Homes Program has ended. The U.S. is outspending Canada at a rate of 8.6 to 1 in green energy programs. Provincial delay may risk inaction.



## Review existing regulations on vehicle warranties

Discussion: Consumers and policymakers may need to consider a new approach to vehicle warranties as they relate to grid-enabled vehicles. Business models like battery financing can help de-risk the value proposition of GEVs for consumers, but they also raise important questions about the ultimate responsibility for guaranteeing performance over the life of the battery. Current regulations that require manufacturers to warranty components for the expected life of the vehicle may hinder the earliest efforts to develop cost-effective batteries by forcing manufacturers to over-specify battery capacity.

Further, the anticipated acceleration of technological innovations in the battery industry could make each iteration of batteries obsolete within several years. Traditional warranty rules could slow the pace of technological diffusion.

The National Academies should review existing regulations on vehicle warranties and make policy recommendations with regard to GEVs.



### 4.3 Phase One: 2010—2013

Between 2010 and 2013, the provincial government, along with municipalities, can help lay the groundwork for the deployment of 250 GEVs in P.E.I.'s ecosystem. The effort will require a combination of focused government subsidies for consumers and utilities, in addition to the installation of a public charging network and other measures of support.

#### City of Summerside Budget, 2010-2011

—In support of post secondary education we are providing two \$1,500 scholarships to assist Summerside students entering a program with Holland College. As further support for their Learning for Life Capital Campaign, we have allocated \$20,000 to work with them to convert two city vehicles from gas to electric which will also be the City's first steps towards using our own wind power to operate our fleet.”



## Create a field office for Electric Transportation with linkage to the PEI Department of Energy

Discussion: The province should create a position and field office for Electric Transportation. It would be the Office of Electric Transportation's responsibility to promote the deployment of GEVs. He or she also would be responsible for managing the ecosystem demonstration projects, coordinating across government agencies where necessary, and preparing annual reports on the progress of the ecosystems and other elements of a province-wide electrification process.

To assist the office manager in the meeting of his or her responsibilities, the Office of Electric Transportation should have linkages in each city or area that is participating within an electrification ecosystem (as described below) to serve as a central point of coordination between the community and the government and, if appropriate, within the community. The local office would also be responsible for collecting all of the data generated by the deployment of the GEV fleet and infrastructure in the ecosystems and making it available for research. Finally, the local office would be responsible for working with other stakeholders to undertake a public education program to explain and promote GEVs within the region.



## Modify plug-in electric drive vehicle tax credits by significantly increasing them for vehicles purchased and registered in phase one ecosystems

Discussion: The U.S. tax code currently offers a tax credit of between \$2,917 and \$7,500 for vehicles with batteries with a capacity of at least 5 kWh. Vehicles with batteries with a capacity of 5 kWh are eligible for the minimum \$2,917 tax credit. The credit increases by \$417 for each additional kWh of battery capacity. With the 2009 industry average for lithium-ion battery prices at about \$600 per kWh, the tax credit subsidizes at least two thirds of the cost of the battery. The tax credit begins to phase out for vehicles sold by a manufacturer after the manufacturer has sold 200,000 eligible vehicles.

Based on existing U.S. federal tax credits and an assumed battery price of \$600 per kWh, a 16 kWh PHEV-40 currently has a lower total cost of ownership than an internal combustion engine vehicle. Meanwhile, a 30 kWh pure EV will be cost competitive by 2012. Because of the higher upfront cost of the battery, however, the payback period for these vehicles is still beyond the point at which most consumers view the value proposition as compelling.

To facilitate deployment of GEVs in P.E.I.'s electrification ecosystem, the government could adapt these consumer tax incentives enacted from the American Recovery and Reinvestment Act. The revised tax credit should fully eliminate the premium for the cost of a GEV over the cost of a conventional IC engine vehicle for vehicles registered in electrification ecosystems. The credit should be limited to no more than 50 percent of the cost of the vehicle including the battery. It should also decline over time, both to reward early adopters and to reflect the expectation that battery costs will fall as technology progresses. A declining credit could also provide an incentive for drivers who might not have been in the market for a new car in order to accelerate their purchase of a new electric vehicle.

**FIGURE 4A** REVISED GEV TAX CREDIT FOR LDVs REGISTERED IN ELECTRIFICATION ECOSYSTEMS

		EV	PHEV
<b>Base Tax Credit</b>		–	\$1,750
Additional per kWh Tax Credit	2011	\$587	\$607
	2012	560	548
	2013	536	500
	2014	513	460
	2015	491	424
	2016	465	388
	2017	434	350
	2018	394	305

The credit should be available to an unlimited number of qualified vehicles sold and entered into service in the electrification ecosystem over the life of the tax credit. In order to ensure that all GEVs are capable of communicating with utilities with respect to vehicle charging, the Department of Energy should define a minimum standard for grid communications and the tax credit should only be available to GEVs that meet that standard, assuming that a standard is adopted in ample time to meet an auto manufacturer's production schedule. Any federal tax credit should not be adjusted for GEVs registered outside of the GEV electrification ecosystems.

The law should be further modified to allow the consumer to receive the value of the tax credit as an instant rebate at the time of vehicle purchase, as was the case for rebates that the U.S.

government offered in the Cash for Clunkers program in the summer of 2008. Making the subsidy available as a rebate instead of a tax credit lowers out-of-pocket costs, ensures that consumers do not have to finance the value of the tax credit, simplifies the process by eliminating any need to alter tax returns, and ensures that all consumers can obtain the full value of the subsidy, even if they do not pay sufficient taxes to take full advantage of the tax credit. Making GEVs significantly more cost effective in the electrification ecosystems would promote ecosystem development by concentrating resources.



## Establish tax credits equal to 75 percent of the cost to construct public charging infrastructure in phase one ecosystem

Discussion: Next to the battery, one of the most significant costs in developing GEV ecosystems will be the cost of the public charging infrastructure. As discussed earlier, it is widely assumed that public chargers will be necessary in order to support a GEV ecosystem. Moreover, in order to facilitate public acceptance of GEVs, public charging facilities must be ubiquitous, at least at first. (Even PHEVs have a limited range of operation in charge-depleting mode.)

In order to address range anxiety and meet drivers' needs, public charging infrastructure should be deployed widely in electrification ecosystems. With the development of the P.E.I. ecosystem, policy planners will be able to better understand driver charging patterns and the needs in a given area for public charging infrastructure-based on the early results in the other ecosystems. That information may show where and what type of public chargers are most widely used and where they should be deployed; it may even show that less public charging infrastructure is needed than

was initially believed. Either way, wide-scale deployment of the infrastructure in P.E.I. can be informed by the earlier deployment of infrastructure elsewhere.

Because of the initial importance of such infrastructure, in particular, within the electrification ecosystems, the government should be prepared to pay for up to 75 percent of the cost of deployment. The Building Canada Fund has had some funds available. This would enable the effective deployment of Level II and Level III public chargers, both to ease driver concerns about range anxiety and in order to generate data about how chargers in different places are used.

Second, government funding of the infrastructure can help overcome the chicken and egg problem that drivers and private companies cannot realistically be expected to resolve themselves.

It is expected that 80 percent of charging will take place at home, during overnight periods. However, for GEVs to meet the customer's needs, Level II charging systems will also need to be deployed at workplaces and in public areas, such as the airport, shopping malls, grocery stores, movie theatres, recreation facilities, theatres, parking garages, etc.

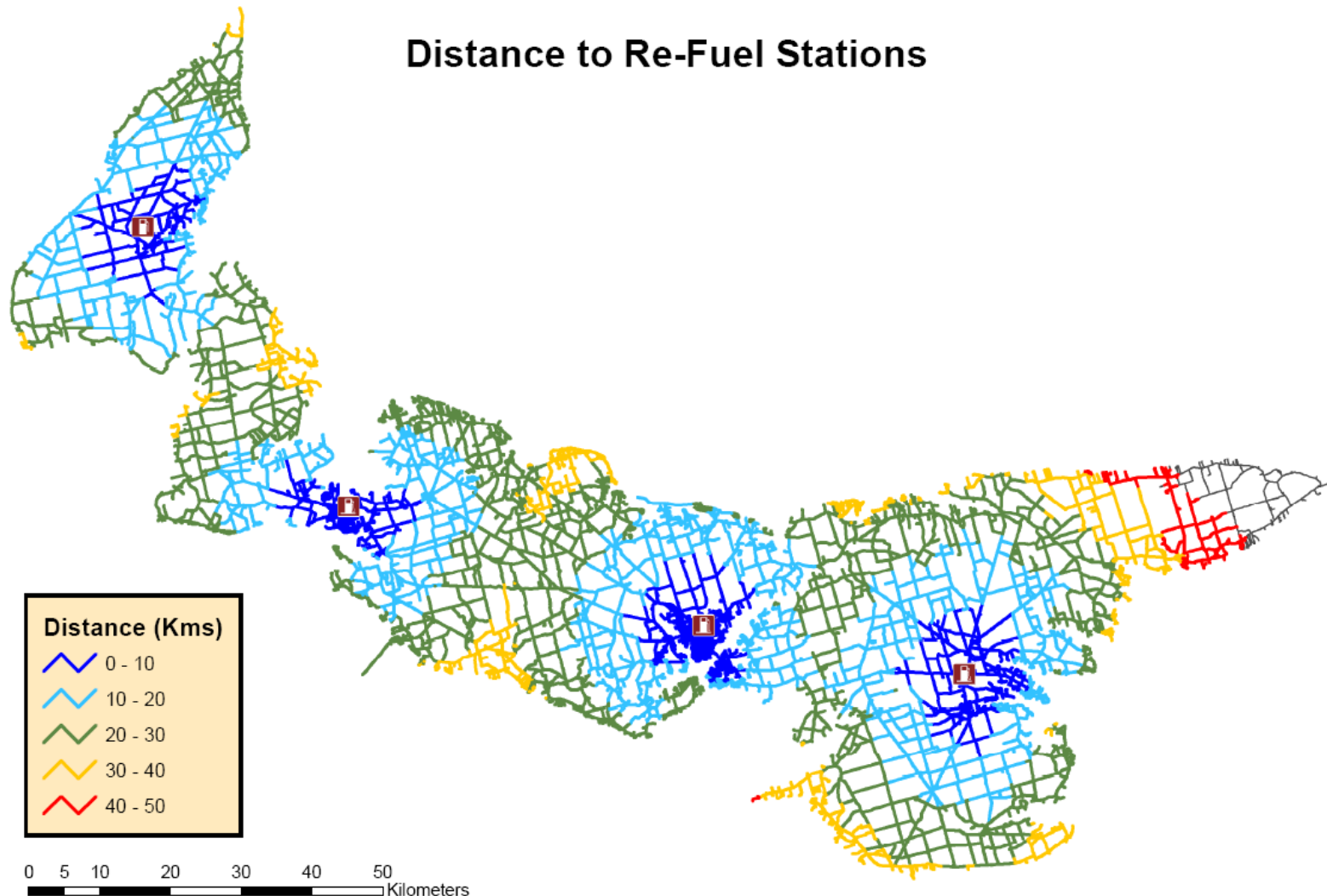
Level III charging systems that will be vital to successful province-wide marketing of electric vehicles are beginning to make an appearance. Coulomb Technologies and Aker Wade have combined forces to develop a stand-alone EV fast-charging "pump" that will be sold to gas stations operators and other entrepreneurs who want to get in on the ground floor of the electric filling station business.



*Level III charging system efficiencies range from 50% - 90%. The right investments can be made.*

The stations cost about \$40,000 for the charger and \$20,000 for the installation. These Level III charging stations, which look a lot like gas pumps in order to keep things as familiar as possible as people switch to the new technology, will feed power to depleted batteries from dedicated 480-volt, 125-amp circuits via a fast-charge connector developed by the Tokyo Power Co. in Japan and now in use in a test program there.

### Distance to Re-Fuel Stations



## 4.4 Phase Two: 2014–2018

By 2014, the P.E.I.'s electrification ecosystem program should continue being installed. Province-wide, target deployment should be 2,220 plug-in electric vehicles by 2018. By this time, it will be important to start using smart charging—ideally using wind storage to maximize energy security and GHG reductions. This level of consumer adoption rate would lag slightly behind the some targeted adoption rates being sought by initial electrification ecosystems. This is less than the number of new cars sold on P.E.I. in an average year. By employing lessons learned in phase one eco-systems, in places such as Boucherville Quebec, PEI's phase two eco-system can achieve greater scale at reduced cost.

See the Electrification of Transportation happening in collaboration with Hydro Quebec

### Transportation Electrification



END.