Response to Electricity Review Report Draft – 18 February 2015

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1 Introduction

Over the past 20 years, individuals and organizations have successfully pressured both the provincial government and Nova Scotia Power to address some of the social and environmental issues associated with electricity supply in Nova Scotia. From a predominantly thermal-coal based electricity supplier, Nova Scotia Power, although still heavily reliant on coal, is on the path to significantly reducing a variety of its emissions by generating electricity from a more diverse mix of energy sources.

The current provincial government, having campaigned on reforming the province's electricity system, passed the Electricity Reform (2013) Act, requiring the government to conduct a "comprehensive review of the province's electricity system, including a public consultation". Central to the government's plan is the requirement that renewable electricity generators be able to sell directly to the retail market.

One of the first outcomes of the public consultations was the *Electricity Review Report Draft – 18 February 2015* (hereafter referred to as the Review). This draft was made public in mid-February 2015 with the objective of gaining public input on the draft of the review of the public's original input.

This is a response to the request for input on the draft of the review of the public's original input. It presents background information not discussed in depth in the draft of the review, an examination of possible electric futures, and considers the serious shortcomings and possible long-term impacts of Nova Scotia's existing energy strategy from 2001.

1.1 Notes regarding the *Electricity Review Report Draft – 18 February 2015*

Nova Scotia consumed about 11,000 GWh (gigawatt-hours) of electricity in 2014, not 11 GWh as stated on page 1 of the Review. Moreover, it is unlikely that the experts contracted to the writers of the Review that "our predicted demand over the next 25 years" will be "between 8 and 13 gigawatt-hours" (despite the best efforts of Efficiency Nova Scotia), also on page 1. It is more likely that the demand will be between 8,000 and 13,000 GWh.

The Review repeatedly refers to renewables such as wind, tidal, and solar as *intermittent*. It is generally agreed that these sources are not intermittent but *variable*.

Page 20 of the Review states "Note that tidal is not included in the chart below because the expected cost-reduction time frame is only beginning to become clear". There is no chart "below".

2 Background

2.1 Factors affecting energy consumption in Nova Scotia

Future energy consumption in Nova Scotia will be affected by a number of issues, including an ageing population (Statistics Canada, 2014a), the prospects of limited population growth over the next 20 years (see Figure 1 and (The Daily, 2014)), and the prospects of a gradual increase in the number of households due, in part, to the ageing population (Statistics Canada, 2014a; Milan, Bohnert, LeVasseur, & Pagé, 2014).

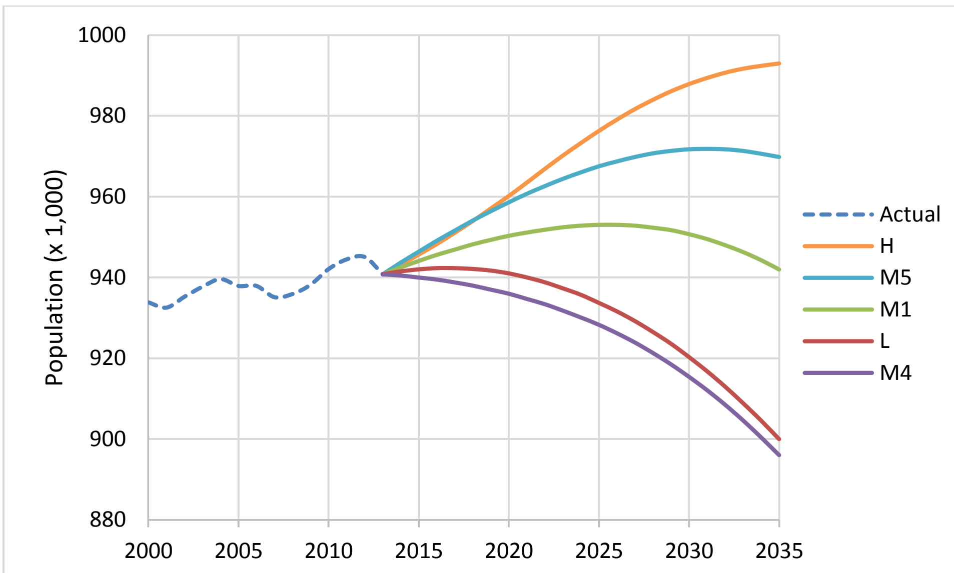

Figure 1: Nova Scotia's population projections from 2013 to 2035 (2000 to 2012 – actual) (Data from (Bohnert, Chagnon, & Dion, 2014))[1]

In addition to demographics, energy consumption will be affected by family income as energy costs can affect the amount of income available for other activities. In 2012, Nova Scotia had the third lowest median income ($67,910) of any province or territory in Canada, after New Brunswick ($65,910) and Nunavut ($65,530); the national median income was $74,540 (Statistics Canada, 2014b).

Despite the importance of these issues to both electricity supply and demand, the Review fails to address them in any meaningful way. They will be discussed at length in subsequent sections.

2.2 Electricity consumption

Over the past decade electricity consumption in Nova Scotia has reached a peak and appears to be entering a period of stagnation (see Figure 2). Nova Scotia's electricity consumption peaked in 2007 and has declined since then; in 2012, several paper mills closed, causing consumption to drop below 10,000 GWh per year for the first time since 1998. By 2014, industrial consumption was 40% less than it was at its peak in 2005, while residential and commercial had grown by 9.3% and 2.9%, respectively over this period. Although residential demand was essentially flat

[1] L – Low growth; H – High growth; M1, M4, and M5 – medium growth.

between 2013 and 2014, its growth has been attributed in large part to Nova Scotia Power's push for electric heating in the province. Other possible reasons for the growth in residential electricity consumption include the increased use of electrical appliances such as computers as well as appliances that are a permanently "on" when attached to the electrical network.

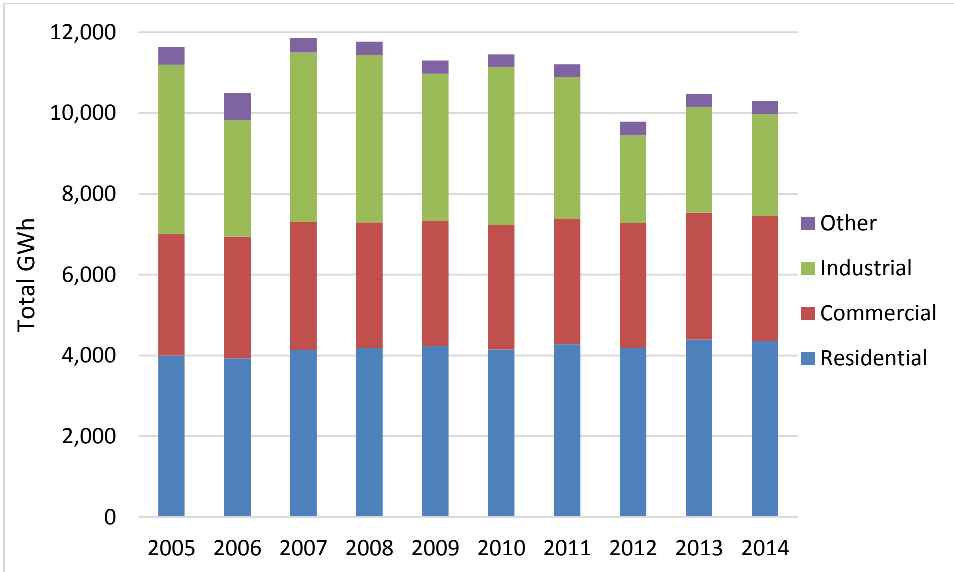

Figure 2: Nova Scotia Power's electricity consumption by sector 2005 to 2014 2014, (Data from (Emera, 2015))

While the Review does suggest that Nova Scotia's future electricity consumption is expected to fall somewhere between 8,000 GWh and 13,000 GWh over the next 25 years, it does not discuss how these numbers were obtained, nor does it present an analysis of the implications of these projections to the province.

2.3 Future electricity mix

Although the Review is ostensibly dealing with electricity production to 2030 and 2040, the only numbers presented refer to 2013 and 2020; in fact, the 2020 numbers reflect what was published in the Dalton report in 2013 by the previous provincial government (see Figure 3).

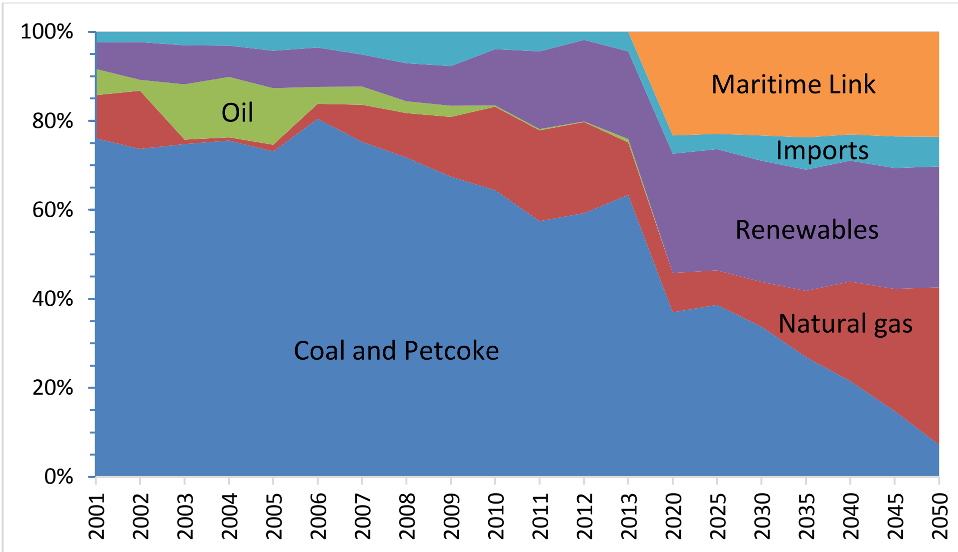

Figure 3: Percentage production volumes by fuel source for Nova Scotia Power (2001-2013 – Actual; 2020 through 2050 – Dalton projections)

The Dalton report showed a plausible future electricity mix for Nova Scotia based on the environmental and to a lesser extent, social, legislation of the two previous governments (both PC and NDP).

The Review describes the benefits to Nova Scotia of the apparently soon-to-be-developed Atlantic Energy Gateway – it will make Nova Scotia more connected to the North American grid and allow exports of "surplus renewable electricity" from Nova Scotia. The Review fails to mention the fact that Nova Scotia was not affected by the blackout that hit eastern North America in August 2003 for the simple reason that Nova Scotia had a weak connection to the North American grid. The Review does not explain what is meant by "surplus renewable electricity", nor does it explain whether Nova Scotians will benefit from the sale of this electricity, much of which will have been subsidized through feed-in tariffs.

Similarly, the government's proposed Renewables-to-Retail program is open to abuse in that renewable energy producers could export non-surplus renewable electricity by selling to a Nova Scotia-based energy broker acting as an exporter.

3 An electric future?

The following section discusses a number of topics mentioned in passing in the Review.

3.1 Metering and billing in Nova Scotia

For the majority of Nova Scotia Power's residential and small commercial-institutional customers, electricity consumption is metered using an induction meter which records consumption from the start to the end of each billing period. The cost per month depends upon the billing method (tariff):

Domestic Service Tariff: A flat per-kilowatt-hour rate consisting of two components, the Electricity consumption charge and the Fuel Adjustment Mechanism charge (NSP, 2013a). The total energy cost is a product of the rate and the total consumption during the billing-period.

The Domestic Service Tariff is applied to the majority of Nova Scotia Power's residential customers.

Small General Tariff: This tariff is a declining block rate and is applied to small commercial and institutional customers; it consists of three components: Electricity consumption charge for the first 200 kWh, Electricity consumption charge for any additional kWh (i.e., more than 200 kWh), and Fuel Adjustment Mechanism charge (NSP, 2013c). The price per kWh for the first 200 kWh is about 13% more than the price per kWh for each additional kWh. As electricity consumption increases with the Small General Tariff, the average cost per kilowatt-hour declines.

3.1.1 Limitations of Nova Scotia Power's Domestic and Small General Tariffs

Electricity consumption varies throughout the day. In Nova Scotia, it is typically at its lowest point during the overnight hours, increasing in the morning (breakfast time), reaching a higher point during the daytime (work hours), and climbing to the system peak during the early evening (dinner or supper time). To meet the demand, the energy mix used throughout the day varies as does its cost: typically a low-cost energy source is used continuously (to meet the base load), with moderately more expensive sources that can be brought on-line during the daytime (intermediate load), and expensive sources, used for short periods during the evening hours (peak load).

Without the ability to record when a customer uses electricity during the billing period, Nova Scotia Power estimates the cost of electricity for its Domestic and Small General Tariff customers, based upon the cost of production over the billing period (undercharging peak consumption and overcharging non-peak consumption). Since electricity costs more to produce during the system peak, this means that (Hughes, 2005):

- Customers with a large portion of their demand that is not coincident with the system peak are overcharged for the price of a unit of energy.
- Customers with a large portion of their demand that is coincident with the system peak are undercharged for the price of a unit of energy.

In other words, the Domestic and Small General Tariffs do not reflect the cost of generation at a given time and can result in cross-subsidies; this is due to both the tariff and the underlying metering technology.

3.1.2 An alternative to Nova Scotia Power's Domestic and Small General Tariffs

At present, Nova Scotians have no control over the price they pay for electricity, regardless of the cost of fuel used to produce the electricity. By changing the metering technology (from induction meters to interval meters), it is possible to measure a customer's load at a given time (typically an hour; however, some meters can be programmed to measure intervals as short as a few minutes or less). This information, coupled with the cost of the energy mix used for that interval's production volume, can determine the cost of consumption for that time period. This is referred to as time-of-use (or time-of-day) billing.

Time-of-use billing reflects the cost of production more accurately as it charges the customer for the electricity consumed at a given time, unlike flat-rate billing that does not take into account when the electricity is consumed. Depending upon the length of the interval, time-of-use billing:

- Reduces the effect of cross-subsidies.
- Identifies the type of energy used during the interval.

Time-of-use billing is not new to Nova Scotia: Nova Scotia Power's second residential rate, the Domestic Time-of-Day Tariff, uses time-of-use billing and interval meters (NSP, 2013b). However, it is only applicable to those customers who use electric-heating systems that utilize Electric Thermal Storage (ETS) and electric in-floor radiant heating.

The Time-of-Day rate is divided into four electricity charge components, depending upon the time-of-day (NSP, 2013b). The customer is charged more during the on-peak hours (7am to noon and 4pm to 11pm) than the mid-peak hours (noon to 4pm – the same rate as the Domestic Tariff) and off-peak hours (11pm to 7am – about half the Domestic Tariff rate).[2] NSPI's mid-peak is almost twice as expensive as the off-peak, while the on-peak is about two-and-a-half times as expensive as the off-peak and about 30% more expensive than the mid-peak.

3.2 Interval meters and a smart-transition strategy

An increasing number of jurisdictions are requiring their electricity suppliers to install interval meters and introduce time-of-use billing for many of their customers (typically residential and commercial-institutional); Figure 4 shows the time-of-use rate periods for four jurisdictions:

PG&E (Pacific Gas and Electric): PG&E has three time-of-use rates. The time-of-use rates shown in the figure are for the summer (PG&E has an afternoon system peak due to air conditioning) (PG&E, 2013).

CT (Connecticut): Connecticut's public utility board has a year-round time-of-use tariff, with an eight-hour peak starting at noon (CT Energy Info, 2013).

ON (Ontario): Ontario's three-time-of-use rates for the winter months are shown in the figure; during the summer, the on-peak and mid-peak rates are reversed to discourage the use of air conditioning (Ontario Hydro, 2013) .

NS (Nova Scotia Power): Nova Scotia Power has three time-of-use rates with an evening peak which is considerably longer than that associated with the other jurisdictions (NSP, 2013b).

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[2] Nova Scotia Power has a non-winter Time-of-Day rate as well: the 7am to 11pm rate is the same as the Domestic Tariff and the 11pm to 7am rate is the same as the winter off-peak.

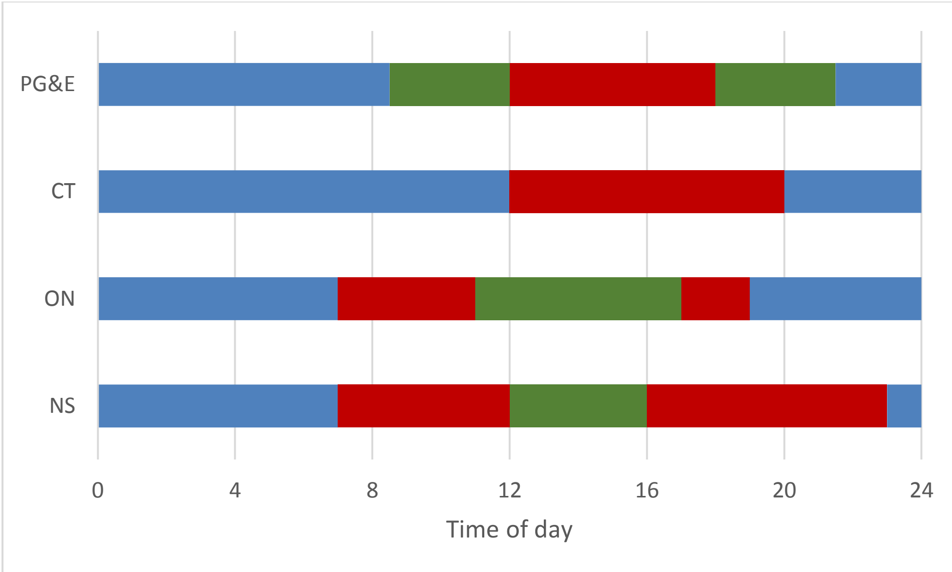

Figure 4: Examples of time-of-use rate periods
(off-peak, on-peak, mid-peak)

The transition to interval meters and time-of-use billing is seen by many as the first step to a more diversified electric future, often referred to as the smart grid. Although many of the more advanced concepts are still in their embryonic stages, a smart grid is seen as a means to:

- Integrate variable sources of renewable electricity into the energy mix, reducing the need for electricity from backup energy sources such as natural gas or hydroelectricity.
- Reduce electricity costs to customers with smart-appliances (i.e., appliances that are enabled to schedule themselves to operate during periods of less costly electricity). For example, Connecticut's Energy Information Center explains how using less electricity during the peak hours of noon until 8pm is a financial incentive and that to take advantage of it, customers can (CT Energy Info, 2013):
  - "Wait Til 8" to run high use devices like pool pumps, clothes washers and dryers, water heater and dehumidifiers;
  - Purchase efficient equipment for the use of electricity that can't be shifted to off-peak;
  - Install solar systems to produce their own electricity during peak hours or solar thermal equipment to offset peak consumption for heating water and other needs;
  - Learn about the benefits of net metering;
  - Conserve by simply becoming more aware of their use of electricity during these times.
- Encourage the use of electricity for services other than appliances or lighting (e.g., heating and transportation) that recharge during periods of low-cost electricity (traditionally during the base-load overnight hours, although with two-way communications and real-time pricing, this could occur at any time, for example, during the overproduction of electricity by a wind-farm).

An immediate, wholesale transition to a smart grid is both unlikely and probably ill-advised; however, once the interval meters are installed, an evolution to a smart grid is possible. Consider the following scenario:

1. Re-meter the province, replacing induction meters with interval meters equipped to operate as smart meters. This could be done over a number of years, leading up to the completion of the Maritime Link. The costs of the meters could be covered by, for example, the (now-removed) Demand Side Management tax or simply rolled into the rate class's Customer Charge.
2. With interval meters in place, consumers could be offered a choice of billing method:
   - Customers not wanting to take advantage of time-of-use rates could still be billed using the flat-rate tariffs (i.e., the different rates could be ignored). In this case, smart appliances could not take advantage time-of-use rates.
   - Time-of-use billing is possible for those consumers wanting it. Smart appliances can operate in conjunction with the smart grid; customers without smart appliances could take advantage of time-of-use rates by manually scheduling activities to, for example, mid- and off-peak hours.
   - Eventually, those consumers opting for real-time pricing could take advantage of the features of the smart grid in which prices are announced and smart appliances vie for the supply.
   - Over time, all customers with interval meters would be given the opportunity to migrate to the smart grid.

There are other benefits of the transition to interval meters, time-of-use billing, and, eventually, a smart grid. For example, the former Demand Side Management tax levied on all electricity consumed in the residential and commercial-institutional sectors made no distinction between the types of generation, regardless of its environmental impact; similarly, the Small General Tariff does little to encourage the reduction of electricity consumption as it is a declining rate (in Ontario, customers without smart meters are subject to an inverted block rate of $0.078/kWh for the first 600 kilowatt-hours and $0.091/kWh for any additional kilowatt-hours consumed (Ontario Hydro, 2013)). However, with the time-of-use and type of generation known, electricity prices could be changed to reflect the effect of the different energy sources used; as an example, electricity from coal could have a Demand Side Management tax applied, whereas that from a renewable source might not.

3.3 Electric vehicles

Electric vehicles (or EVs) are, as the name suggests, vehicles that derive some or all of their motive power from electricity and are typically discussed in terms of (PlugInCars, 2015; Hughes & Sundaram, 2011):[3]

[3] A third category, HEVs or hybrid electric vehicles, derive all of their motive power from an on-board gasoline or diesel generator; energy is stored in batteries and a fuel tank. The Prius is an example of a HEV. Although widespread

PEV: A plug-in electric vehicle is one which derives all of its motive power from mains electricity, with the energy stored in batteries. The Nissan Leaf and BMW i3 are examples of PEVs.

PHEV: A plug-in hybrid electric vehicle derives a portion of its motive power from mains electricity, the remainder comes from a gasoline or diesel generator. Energy is stored in both batteries and a fuel tank. The Chevy Volt and Ford C-Max Energi are examples of PHEVs.

The increase in electricity demand will depend on the number of grid-connected EVs in Nova Scotia, their fuel (i.e., electricity) consumption, and usage.[4] For example, in Figure 5, five PEV electricity demand scenarios are considered based on the following assumptions:[5]

1. A city-highway driving split of 55:45 (NRCan, 2014a).
2. The average vehicle driving distance in 2012 in Nova Scotia of 22,102 km (NRCan, 2015b).
3. The average fuel consumption of five PEVs of 17.3 kWh/100km (city) and 21.4 kWh/100km (highway) (NRCan, 2014a).

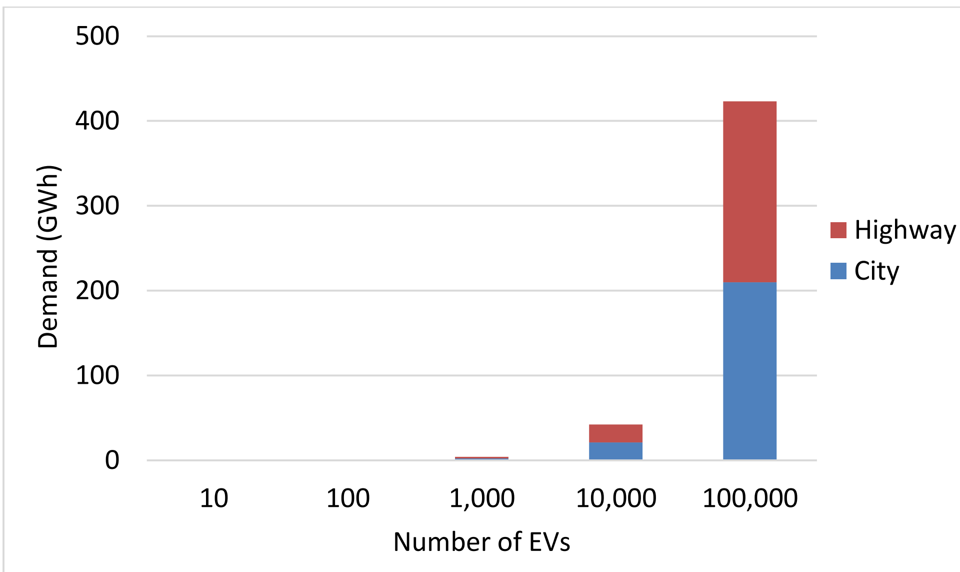

Figure 5: Range of annual PEV electricity demands

If all PEVs in the province were to charge at the same time, the effect on the grid would depend on the charge rate, the number vehicles being charged, and when the charging took place. The charging rate for the PEVs considered in the above discussion range from 3.3 kW to 6.6 kW (PlugInCars, 2015), meaning that the maximum demand would range between 33 kW to 660 MW (see Table 1). Adding an additional 660 MW to the grid during the evening peak would be a challenge; less so during the overnight hours.

adoption of HEVs would reduce the volume of oil products used for motive fuels in the province, which in itself may be a good thing, they would not affect the production and consumption of electricity.

[4] This discussion ignores the impact of tourist vehicles and EVs not considered in NRCan's efficiency ratings.

[5] The five are Spark EV, Focus Electric, i-MiEV, Smart Cabr, and Smart Coupe.

Table 1: Peak additional demands caused by the introduction of EVs

Number of vehicles	Hourly demand (MW)	
	3.3 kW charge rate	6.6 kW charge rate
10	0.033	0.066
100	0.33	0.66
1,000	3.3	6.6
10,000	33	66
100,000	330	660

If Nova Scotia's 355,000 cars were to become EVs, there would be an estimated 1,500 GWh of additional electricity consumption in the province. However, such a penetration of EVs is unlikely, given continued concerns over vehicle range, both under normal conditions and during the winter when in-car heaters reduce range still further. Moreover, a significant cost-savings advantage of electricity compared to that of liquid fueled vehicles would be needed to encourage the adoption of PEVs (for example, see (Anderson, 2014)).

Given the limited range of existing plug-in electric vehicles, it would be necessary to ensure the availability of a sufficient number of charging stations throughout the province (Dimitrova & Marécha, 2014; Cardwell, 2015). There are the additional questions of who pays for the charging stations and who pays for the grid upgrades to meet the additional demand placed on the system by the charging stations.

Realistically, no Nova Scotia government should subsidize the purchase of private-use PEVs:

1. There is no PEV industry in Nova Scotia (and there is little likelihood of any such industry appearing, given the size of the regional market); consider New Brunswick's experience with the Bricklin in the mid-1970s.
2. The beneficiaries of such a subsidy are typically those who can already afford such a vehicle; consider the demographics of those purchasing electrical appliances and heat pumps subsidized by Efficiency Nova Scotia.

The mass adoption of PEVs raises other issues that will be of concern to the provincial government:

1. Road improvements and maintenance are funded in large part from the provincial Motive Fuel tax collected from the sale of gasoline and diesel fuel. Since electricity is not subject to this tax, PEV owners would be using provincial roads without paying their share.
2. Toll roads could be introduced to address this problem; however, past experience with toll roads in this province has been problematic, although usually accepted over the long term (e.g., Wentworth toll road).

Although there are a number of impediments to the widespread adoption of EVs, their associated emissions can be less than an equivalent conventional vehicle; this is something worth considering.

Finally, other vehicles (for example, service vehicles and public transport) can be electrified.

4 The problem isn't electricity – it's the lack of an energy strategy

Like its two predecessors, the present provincial government's major energy policy focuses on electricity; however, unlike its predecessors, policies are driven by loosely-defined economic promises rather than social and environmental objectives associated with the production, transmission, and sale of electricity.

The justification for the Review is stated in its opening paragraphs:

> *The second part of the* [Electricity Reform (2013)] *act committed government to conducting a comprehensive review of the province's electricity system, including a public consultation process. The review was to take no more than one year. For the first time in over a decade, all aspects of the system were to be studied.*

(The last attempt at reviewing the province's electricity system was conducted by the EMGC, or Electricity Marketplace Governance Committee, in the mid-2000s).

If the length of time since the last review of the province's electricity system is seen as being a justification for the review, then, by the same argument, there is an even stronger justification for a review of the province's *entire* energy system to develop a new energy strategy, since the last energy strategy was written 15 years ago. In that review, *Seizing the Opportunity*, Nova Scotia was apparently flush with natural gas, thereby justifying its export to the United States (NSDOE, 2001). Since then, major changes have taken place in the energy marketplace, directly and indirectly affecting Nova Scotians – oftentimes in the pocketbook.

As some of the issues discussed in the following sections show, Nova Scotia needs an energy strategy that addresses the province's long-term energy needs.

4.1 Meeting the energy demand of Nova Scotia's energy services[6]

At present, the energy demand of Nova Scotia's energy services (notably transportation, heating and cooling, and electrical) is met from four secondary energy sources: refined petroleum such as gasoline, heating oil, and diesel; electricity; biomass; and natural gas. The breakdown of this demand in 2013 is shown in Figure 6. Although successive provincial governments have focused their attention on electricity, refined petroleum is the single most important secondary energy source to the province.

[6] Parts of this and the following section have been adapted from *Moving western Canadian crude oil to eastern Canada: An analysis of its potential to improve Canadian energy security* by Larry Hughes, March 2015. Copies are available from http://lh.ece.dal.ca/enen.

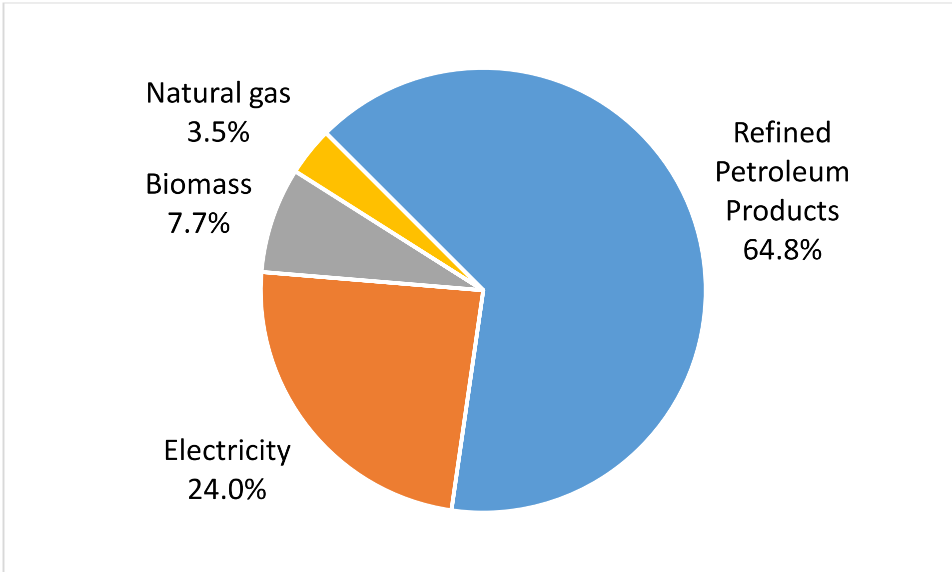

Figure 6: Nova Scotia's secondary energy sources in 2013
(from (Statistics Canada, 2014d); biomass is for residential only (NRCan, 2015a))

Refined products such as gasoline, diesel, light-fuel oil, and aviation fuel are seen as necessities in the developed world, including Canada, to meet final energy demand for energy services such as transportation and heating. As Table 2 shows, demand for these products varies within Canada, in large part because of the availability and, in some cases, the cost of alternatives.

Table 2: Refined petroleum product demand in Canada and Nova Scotia in 2013
(Statistics Canada, 2014c; Bohnert, Chagnon, & Dion, 2014)

Region	Total volume (MMbbl)	Litres per person
Canada	550.3	2468.4
Nova Scotia	17.1	2875.2

In 2013, about 93% of Canada's refined petroleum products are for transportation, specifically gasoline, diesel, and aviation fuel. However, as shown in Table 3, this is not the case in Nova Scotia, where less than 73% of the refined products are for transportation.

Table 3: Transportation fuel demand in Canada and Nova Scotia in 2013
(Statistics Canada, 2014c; Bohnert, Chagnon, & Dion, 2014)

Region	Percent of total volume	Gasoline litres/person	Diesel litres/person	Aviation litres/person
Canada	93.0%	1,247.2	843.0	206.1
Nova Scotia	72.5%	1,196.5	732.8	155.0

After transportation, the next major use of refined petroleum products in Canada is for heating in the industrial, residential, and commercial and institutional sectors. The products consumed range from light to heavy fuel-oils and include kerosene and stove oil. Nationally, slightly over

6% of petroleum products met heating demand; whereas in Nova Scotia, over one-quarter of the available fuel was used for heating purposes (see Table 4).

Table 4: Heating fuel demand in Canada and Nova Scotia in 2013 (Statistics Canada, 2014c; Bohnert, Chagnon, & Dion, 2014)

Region	Percent of total volume	Kerosene, stove oil litres/person	Light fuel oil litres/person	Heavy fuel oil litres/person
Canada	6.3%	78.7	6.7	70.1
Nova Scotia	27.4%	665.7	7.4	114.6

Nova Scotia's reliance on refined petroleum for transportation is understandable, given the limited number of alternatives to the private automobile; however, the continued reliance on petroleum products for space and water heating is costing an estimated $750 million each year, most of which leaves the province.[7]

Until recently, most of the crude oil used to meet Nova Scotia's refined petroleum product needs was imported from the Middle East, North Africa, and the North Sea. With the closure of the Dartmouth refinery, Nova Scotia's petroleum products are now coming from refineries in Saint John, New Brunswick (Irving) and Levis, Quebec (Valero). Over the past year, increasing volumes of crude oil are being shipped to these refineries by rail, primarily from the shale oil fields in North Dakota and the tar-sands in northern Alberta. Just how acceptable these transportation methods and crude oil sources are to Nova Scotians is not clear, given the seriousness of the rail accidents associated with transporting these goods and the environmental impacts of their extraction methods.

4.2 Residential heating costs

Although a survey conducted for the Review highlighted the fact that about 41% of all Nova Scotian homes relied on fuel oil for heating, little was made of this information. However, the cost of energy in general and that used for heating is an important issue for all Nova Scotians as this section shows.

With the exception of the run-up to the crude oil price spike in the summer of 2008, when a variety of factors caused world energy-prices to rise significantly, there has been a steady increase in the price of light fuel oil in Nova Scotia (and across Canada); whereas the price of natural gas, the principal heating fuel used in Canada, has seen a decline. The effect on affordability is illustrated in Figure 7, which shows the relative changes to the average prices of light fuel oil in Halifax and natural gas in Alberta's two largest cities since January 2007. Not only was the cost-per-unit-energy of light fuel oil almost three-times higher than the cost of natural gas in January 2007, by the end of 2014, light fuel oil prices were almost 40% higher than they were in January 2007, while natural gas prices were over 40% lower (Government of Alberta, 2014; NRCan, 2014b). The energy prices in this graph are for urban as opposed to rural

[7] Nova Scotia consumed about 747 megalitres or 4.7 MMbbl of light and heavy fuel oil and kerosene in 2013. At $1.00 per litre, or $160 per barrel, the total cost is about $750 million.

communities (salaries are often higher and light fuel oil prices are typically lower in urban centers, adding to the cost of these products for rural consumers).

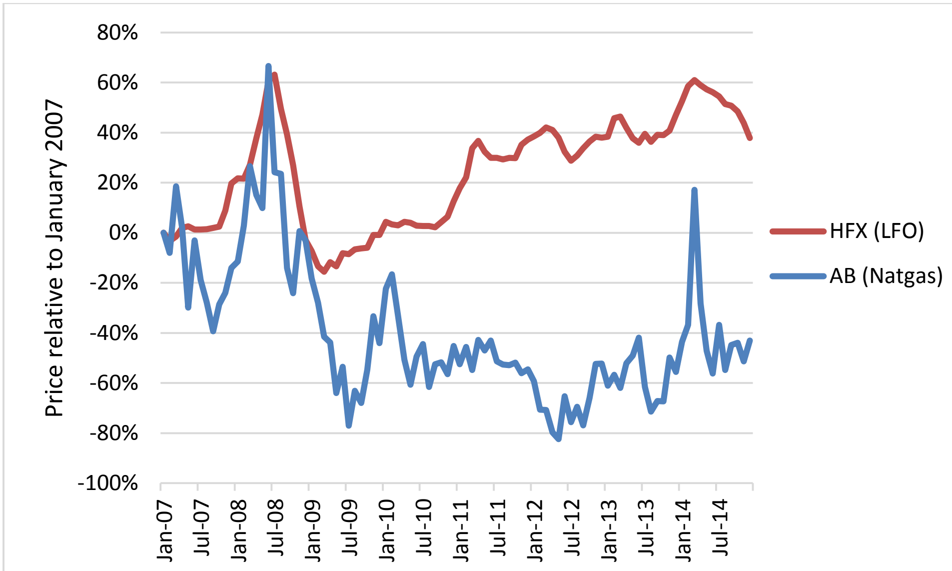

Figure 7: Changes in average monthly light fuel-oil prices in Halifax (HFX) and natural gas prices in Alberta (AB) (Government of Alberta, 2014; NRCan, 2014b)

High energy prices can also be examined in terms of the end-user's ability to pay for an energy service. Table 5 is a comparison of median household-energy costs for Nova Scotia and Canada in 2011. The reliance on light fuel-oil for heating, the cost of electricity, and the lack of natural gas means that energy takes a larger percentage of shelter costs in Nova Scotia (20.2%) compared to the Canadian average (13.3%).

Table 5: Median household-energy costs in Canada and Nova Scotia for 2011 (annual) (Statistics Canada, 2013; Statistics Canada, 2014e)

	Nova Scotia	Canada
Total shelter costs	$12,519	$15,198
Total shelter-related energy costs	$2,528	$2,014
Percent of shelter costs for energy	20.2%	13.3%
Household after-tax income	$46,100	$50,700
Percent after-tax income for energy	5.5%	4.0%

Research conducted in 2009 shows that low family incomes and higher energy costs in Nova Scotia are putting some households at risk of falling into energy poverty, if they are not there already (Boardman, 2009; Hughes & Ron, 2009).

5 Recommendations

Nova Scotia has a dubious record with its energy projects – most of which involve the export of energy resources, which could have helped improve the lives of Nova Scotians: the natural gas exported to New England over the past 15 years, the export of wood chips and pellets to Europe, and the burning of hardwood for electricity are but three examples. Even attempts at reducing the province's electricity demand have proven to be expensive, often benefitting a limited number of people.

In light of this track-record, it is essential that the proposed legislation include a requirement that any energy-related project produce measurable, evidence-based research to demonstrate to Nova Scotians how it will maintain or, ideally, improve the province's energy security. This should be done by considering each in terms of its effects on the availability, affordability, and social acceptability of electricity in the province (Hughes & Ranjan, 2013; Ranjan & Hughes, 2014).

Given the importance of energy to the province's social and economic wellbeing, the provincial government should develop a new energy strategy. The strategy should be in two parts, first, an analysis of the current state of Nova Scotia's existing energy system and second, to put in place a transition to a new energy system that ensures the province's long-term energy security.

References

Anderson, E. (2014, November). Real-Time Pricing for Charging Electric Vehicles. *The Electricity Journal, 27*(9), pp. 105-111.

Boardman, B. (2009). *Fixing Fuel Poverty - Challenges and Solutions.* London: Earthscan.

Bohnert, N., Chagnon, J., & Dion, P. (2014). *Population Projections for Canada (2013 to 2063), Provinces and Territories (2013 to 2038).* Retrieved February 20, 2015, from Statistics Canada - Publications - 91-520-X: http://www.statcan.gc.ca/pub/91-520-x/91-520-x2014001-eng.htm

Cardwell, D. (2015, February 19). *Utilities Push Into Fuel Stations for Electric Cars.* Retrieved February 28, 2015, from New York Times: http://www.nytimes.com/2015/02/20/business/utilities-push-into-fuel-stations-for-electric-cars.html?ref=energy-environment&_r=0

CT Energy Info. (2013). *Time-of-Day Rates in Connecticut.* Retrieved June 9, 2013, from CT Energy Info: http://www.ctenergyinfo.com/dpuc_time_of_day_rates.htm

Dimitrova, Z., & Marécha, F. (2014, November). Environomic design of vehicle energy systems for optimal mobility service. *Energy, 76*, pp. 1019-1028.

Emera. (2015, February). *Management Discussion & Analysis.* Retrieved February 10, 2015, from Emera - Investors - Financial Reports and Filings - Financials & MD&A: http://www.snl.com/irweblinkx/QuarterlyResults.aspx?iid=4072693

Government of Alberta. (2014). *Historic Rates.* Retrieved May 8, 2012, from Utilities Consumer Advocate: http://ucahelps.alberta.ca/historic-rates.aspx

Hughes, L. (2005, October 17). *An Application by Nova Scotia Power Incorporated for Approval of Certain Revisions to its Rates, Charges and Regulations.* Retrieved June 11, 2013, from http://dclh.electricalandcomputerengineering.dal.ca/enen/hfx2005/Hughes_support.pdf

Hughes, L., & Ranjan, A. (2013). Event-related stresses in energy systems and their effects on energy security. *Energy, 59*, pp. 413-421. doi:10.1016/j.energy.2013.06.070

Hughes, L., & Ron, D. (2009, March). *Energy security in the residential sector: Rapid responses to heating emergencues - Part 2: Nova Scotia.* Retrieved from Canadian Centre for Policy Alternatives: www.policyalternatives.ca/~ASSETS/DOCUMENT/Nova_Scotia_Pubs/2009/Energy_Security_Part_1_Final.pdf

Hughes, L., & Sundaram, S. (2011). *Do Electric Vehicles Make Carbon-Sense in Nova Scotia? A Well-toWheels Analysis Using Nova Scotia Power's Electricity-Fuel Mix.* Halifax: Nova Scotia Power.

Milan, A., Bohnert, N., LeVasseur, S., & Pagé, F. (2014). *Living arrangements of seniors - Families, households and marital status - Structural type of dwelling and collectives, 2011 Census of Population.* Statistics Canada.

NRCan. (2014a). *2014 Fuel Consumption Guide.* Retrieved February 25, 2015, from NRCan - Office of Energy Efficiency: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/pdf/transportation/tools/fuelratings/FCG2014print_e.pdf

NRCan. (2014b, January 22). *Petroleum Products and Crude Oil Prices.* Retrieved February 17, 2014, from Natural Resources Canada: http://www.nrcan.gc.ca/energy/fuel-prices/4593

NRCan. (2015a, February 5). *Comprehensive Energy Use Database Tables - Residential Sector – Nova Scotia - Secondary Energy Use and GHG Emissions Summary Tables.* Retrieved March 14, 2015, from NRCan Office of Energy Efficiency - Comprehensive Energy Use Database Tables: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&rn=1&page=0

NRCan. (2015b, February 5). *Transportation Sector Nova Scotia Table 21: Car Explanatory Variables.* Retrieved February 27, 2015, from NRCan - Office of Energy Efficiency - Comprehensive Energy Use Database: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=tran&juris=ns&rn=21&page=0

NSDOE. (2001). *Seizing the Opportunity - Nova Scotia's Energy Strategy* (Vol. 1). Halifax, Nova Scotia, Canada: Nova Scotia Department of Energy.

NSP. (2013a). *Domestic Service Tariff.* Retrieved June 10, 2013, from Nova Scotia Power: http://www.nspower.ca/en/home/aboutnspower/ratesandregulations/electricityrates/domesticservicetariff.aspx

NSP. (2013b). *Domestic Service Time-Of-Day Tariff.* Retrieved June 11, 2013, from Nova Scotia Power: http://www.nspower.ca/en/home/aboutnspower/ratesandregulations/electricityrates/domesticservicetimeofdaytarriffoptional.aspx

NSP. (2013c). *Small General Tariff.* Retrieved June 10, 2013, from Nova Scotia Power: http://www.nspower.ca/en/home/aboutnspower/ratesandregulations/electricityrates/smallgeneraltariff.aspx

Ontario Hydro. (2013, May 1). *Ontario Hydro Rates.* Retrieved June 9, 2013, from Ontario Hydro: http://www.ontario-hydro.com/index.php?page=current_rates

PG&E. (2013). *Time of use pricing.* Retrieved June 10, 2013, from Pacific Gas & Electric: http://www.pge.com/mybusiness/energysavingsrebates/timevaryingpricing/timeofusepricing/

PlugInCars. (2015). *Cars.* Retrieved February 24, 2015, from plugincars: http://www.plugincars.com/cars

Ranjan, A., & Hughes, L. (2014, July). Energy security and the diversity of energy flows in an energy system. *Energy, 73*, pp. 137-144. doi:10.1016/j.energy.2014.05.108

Statistics Canada. (2013, June 27). *Table 202-0605 - Median after-tax income, by economic family type, 2011 constant dollars, annually (dollars).* Retrieved February 18, 2014, from Statistics Canada, CANSIM(database): http://statcan.gc.ca/cansim

Statistics Canada. (2014a, April 17). *Focus on Geography Series, 2011 Census - Province of Nova Scotia.* Retrieved March 15, 2015, from Statistics Canada - Census - Analytical products - Focus on Geography Series: http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-pr-eng.cfm?Lang=Eng&GC=12

Statistics Canada. (2014b, July 23). *Median total income, by family type, by province and territory (All census families) - CANSIM table 111-0009.* Retrieved March 15, 2015, from Statistics Canada: http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/famil108a-eng.htm

Statistics Canada. (2014c, December 12). *Table 128-0017 - Supply and demand of primary and secondary energy in natural units, annual (megalitres unless otherwise noted),.* Retrieved March 16, 2015, from Statistics Canada - CANSIM (database): http://www.statcan.gc.ca/cansim

Statistics Canada. (2014d, December 12). *Table 128-0016 - Supply and demand of primary and secondary energy in terajoules - annual.* Retrieved March 15, 2015, from Statistics Canada, CANSIM(database): http://www.statcan.gc.ca/cansim

Statistics Canada. (2014e, January 29). *Table 203-0021 - Survey of household spending (SHS), household spending, Canada, regions and provinces, annually (dollars)*. Retrieved February 18, 2014, from Statistics Canada: http://estat.statcan.gc.ca/cgi-win/cnsmcgi.exe?Lang=E&EST-Fi=EStat/English/CII_1-eng.htm

The Daily. (2014, September 17). *Population projections: Canada, the provinces and territories, 2013 to 2063.* Retrieved February 26, 2015, from Statistics Canada: http://www.statcan.gc.ca/daily-quotidien/140917/dq140917a-eng.htm