Response to:
Notice of Application Maritime Link Proposal (M05419)

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1 Introduction

Over the next decade, Nova Scotia's principal electricity supplier, Nova Scotia Power, will undergo a major transformation: from a generation mix relying almost exclusively on coal and petcoke to a more diversified one, employing natural gas, renewables (primarily hydroelectricity, biomass, and wind), and coal and petcoke. This transformation is being driven by government legislation that requires Nova Scotia Power to reduce a variety of atmospheric emissions by meeting an ever-increasing percentage of its electricity supply from renewables, from about 10% in 2000 to 40% in 2020.

A key component in this transformation will be electricity imported from outside the province. Nova Scotia Power's choice, supported by all parties in the provincial legislature, is to obtain electricity from the 800 MW Muskrat Falls hydroelectric project in southern Labrador via a yet-to-be-built subsea cable referred to as the Maritime Link.

The Maritime Link is to have a capacity of 300 MW and carry up to three TWh of electricity per year. Nova Scotia Power has contracted to purchase one TWh, although estimates from the government's consultant imply that all three will be needed to meet the 40% renewables target (Nova Scotia, 2013a). The Maritime Link is seen as important to Nova Scotia Power because it is both a renewable energy source allowing the company to meet the 40% target and a form of dispatchable generation which can be used to meet peak demand.

Nova Scotia Power is promoting the Maritime Link as the "lowest cost energy solution for our province" and the provincial government as offering Nova Scotians the "lowest and fairest" possible electricity rates (Emera, 2013b; Nova Scotia, 2013b). Despite the concerns of many Nova Scotians over both the Maritime Link and the lack of consideration of alternatives, the Utility and Review Board has been asked to determine whether the Maritime Link "represents the lowest long-term cost alternative for electricity for ratepayers in Nova Scotia".

Unless the legislation and associated regulations requiring Nova Scotia Power to supply 40% of its electricity from renewable sources are repealed or amended, by 2020, Nova Scotia Power will have undergone a radical transformation in the way it produces electricity. However, without an equally radical transformation in the way Nova Scotia Power's customers are charged for electricity, Nova Scotians will miss out on an important opportunity brought about by the 40% renewables target.

To this end, this submission recommends that should the Utility and Review Board approve the Maritime Link, the following rider be attached, requiring Nova Scotia Power to:

1. Replace existing induction-type meters in the residential and commercial-institutional sectors with interval meters that support two-way communications (sometimes referred to as Advanced Metering Infrastructure or more commonly, "smart meters").

2. Offer its residential and commercial-institutional customers a choice of billing methods (maintain the existing flat-rate or migrating to time-of-use as both methods can utilize interval meters).
3. Develop a plan to transform the present grid to a "smart grid" which allows customers to take advantage of real-time electricity pricing based upon the production volume at a given time of day. In this environment, customers' use of electricity can be driven by, for example, cost of electricity or type of generation.

In its legislation requiring Nova Scotia Power to transform itself, the Nova Scotia government considered the generating side of the equation only – it overlooked how Nova Scotians could change their consumption habits and reduce their electricity costs by changing the way in which electricity is metered and billed. The Utility and Review Board's decision on the Maritime Link is an opportunity to correct this fundamental oversight.

2 Nova Scotia Power's past and future production volumes[1]

Until the late 1990s, Nova Scotia Power relied almost exclusively on coal from Cape Breton in its thermal generating stations for the production of electricity; with the closure of these mines, it was forced to use imported coal. Over the past decade, the consumption of coal has declined significantly with an ever-increasing penetration of natural gas into the energy mix; from 2001 until 2011, Nova Scotia Power's volume of electricity from coal declined from over 75% to less than 55%, almost entirely because of the increased use of natural gas.

Future production volumes are hard to predict; however, the provincial government is of the opinion that the recently released Dalton Report is an accurate estimate of Nova Scotia Power's expected annual production volume of about 10.9 TWh between 2020 and 2050 (Power Advisory LLC, 2013).[2] The Report suggests that electricity production will evolve from one dominated by coal and petcoke to one relying on a variety of energy sources.

Figure 1 shows Nova Scotia Power's annual production volumes in percentage terms between 2001 and 2050 (2001 to 2012 are actual production volumes from Nova Scotia Power, while the percentages from 2020 until 2050 are the projected annual volumes from the Dalton Report).

[1] Production volumes refers to the volume (i.e., amount) of electricity produced from a given energy source. It does not take costs or efficiencies into account.

[2] Nova Scotia Power believes that its total production volume will increase to meet increased demand over this period.

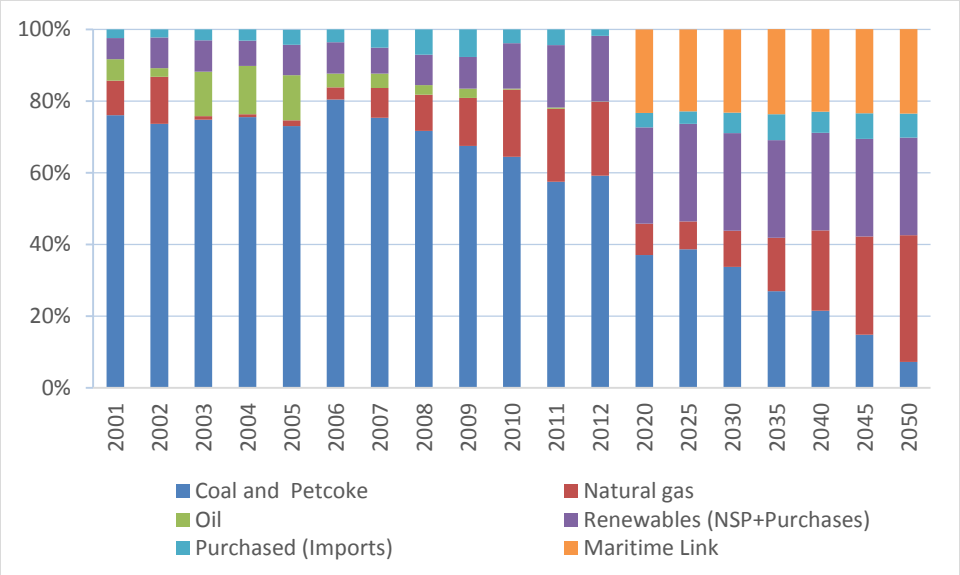

Figure 1: Percentage production volumes by fuel source for Nova Scotia Power (2001-2012 – Actual; 2020 through 2050 – Dalton projections)

Table 1 shows the actual and projected volumes of electricity produced by different fuel sources between 2001 and 2050.

Table 1: Actual and projected volumes of electricity by fuel source for Nova Scotia Power (2001, 2010 – Actual; 2020 through 2050 – Dalton projections)

Energy source	2001	2010	2020	2030	2040	2050
Coal and Petcoke	8.86	7.84	4.03	3.67	2.34	0.78
Natural gas	1.13	2.28	0.96	1.09	2.43	3.85
Oil	0.69	0.04	0.00	0.00	0.00	0.00
Renewable production (Provincial and NSP)	0.69	1.54	2.92	2.96	2.96	2.96
Imports (via New Brunswick)	0.28	0.47	0.44	0.62	0.64	0.72
Maritime Link	0.00	0.00	2.54	2.53	2.51	2.57
Total production volume	11.65	12.16	10.89	10.87	10.88	10.88

The Dalton Report's projections for 2020 to 2050 suggest that:

- Nova Scotia Power's production volume will stabilize around 10.9 GWh.
- All three TWh (closer to 2.5 TWh after losses are taken into account) will be available to Nova Scotia Power.
- Electricity from outside the province (i.e., via the Maritime Link and imports from New Brunswick) and provincial renewables will remain relatively constant at about 3 TWh per year.
- Electricity from coal and natural gas will essentially reverse their production volumes.

3 Nova Scotia's changing electricity demand

Between 2001 and 2012, the total demand for electricity in Nova Scotia fell by 10.2%, due almost entirely to the collapse of industrial demand (a 43.4% decline) with the closure of a number of pulp and paper mills. However, the decline in total demand is misleading since over this same period, residential and commercial demand has increased by 11.4% and 13.7%, respectively (see Figure 2).

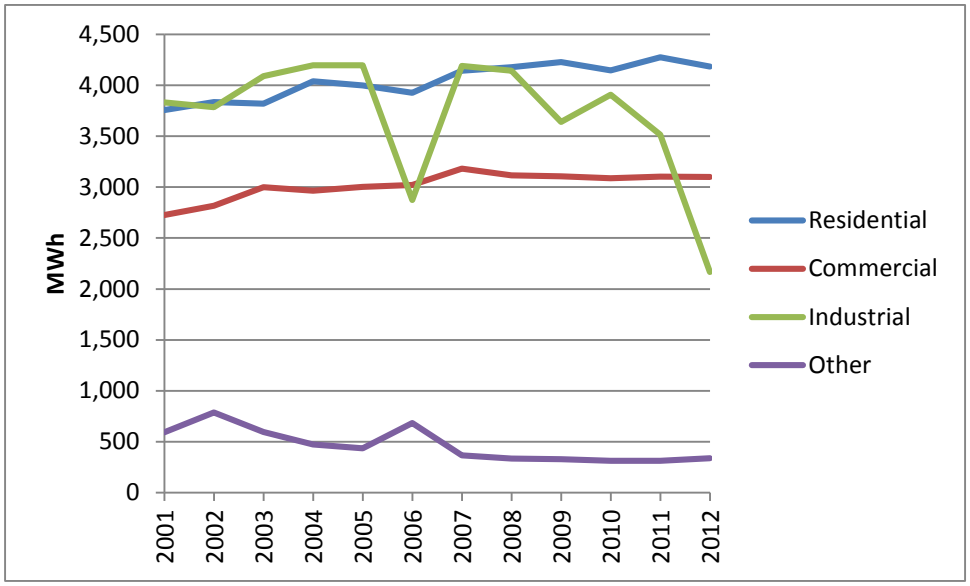

Figure 2: Changes in Nova Scotia's electricity demand 2001-2012 (Quarterly data from (Emera, 2013a))

Statistics Canada data suggests that between 2001 and 2011 there was a decline in the demand for heating oil and a slight increase in demand for electricity in the residential, public administration, and commercial-institutional sectors (Statistics Canada, 2013). Some of this might be attributable to a shift from oil-heating to electric-heating because of incentives from Efficiency Nova Scotia that encourage the use of heat pumps. In addition to electric heating, other electricity demand drivers include the increased use of electrical appliances (such as computers and other devices that are a permanently "on" when attached to the electrical network) and a gradual switch to electric vehicles. Should these trends continue and industrial demand stabilize, there could be an increase in electricity demand in the province.

4 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 three components: Electricity consumption charge, Fuel Adjustment Mechanism charge, and the Demand Side Management tax, as shown in Table 2. The Domestic Service Tariff is applied to the majority of Nova Scotia Power's residential customers.

Table 2: Domestic Service Tariff (NSP, 2013a)

Component	Rate (per kWh)
Electricity consumption charge	$0.13497
Fuel Adjustment Mechanism charge	$0.00293
Demand Side Management Tax	$0.00573

Small General Tariff: This tariff is a declining block rate and is applied to small commercial and institutional customers; it consists of four components: Electricity consumption charge for the first 200 kWh, Electricity consumption charge for additional kWh (i.e., more than 200 kwh), Fuel Adjustment Mechanism charge, and the Demand Side Management tax, as shown in Table 3.

Table 3: Small General Tariff (NSP, 2013c)

Component	Rate (per kWh)
Electricity consumption charge (first 200 kWh)	$0.14276
Additional electricity consumption charge (remaining kWh)	$0.12560
Fuel Adjustment Mechanism charge	$0.00291
Demand Side Management Tax	$0.01231

As electricity consumption increases with the Small General Tariff, the average cost per kilowatt-hour declines.

4.1 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.

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

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). With this information, coupled with the cost of the energy mix used for that interval's production volume, the cost of consumption for that time period can be determined. This is referred to as time-of-use (or time-of-day) billing.

Time-of-use billing charges the customer for the electricity consumed at a given time, whereas flat-rate billing does not take into account when the electricity was 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, as shown in Table 4. 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).[3]

[3] 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.

Table 4: Domestic Time-of-Day Tariff (December to February) (NSP, 2013b)

Component	Rate (per kWh)
Electricity consumption charge 7am to noon (on-peak)	$0.17585
Electricity consumption charge Noon to 4pm (mid-peak)	$0.13497
Electricity consumption charge 4pm to 11pm (on-peak)	$0.17585
Electricity consumption charge 11pm to 7am (off-peak)	$0.06920
Fuel Adjustment Mechanism charge	$0.00293
Demand Side Management Tax	$0.00573

5 What does this have to do with Nova Scotia Power and the Maritime Link?

In previous Utility and Review Board hearings in which interval meters and time-of-use billing have been suggested (for example, see (Hughes, 2005; Hughes & Dhaliwal, 2007; Hughes, 2008)), Nova Scotia Power has rejected them, arguing that the energy mix is dominated by one source (coal and petcoke), making interval meters and time-of-use billing superfluous. In each case, the Utility and Review Board has sided with Nova Scotia Power.

However, in light of the provincial government's 40% renewables target and the Dalton Report's long-term projections, Nova Scotia Power's post-2020 fuel mix will mean that, unlike in the past, electricity will be supplied from a wide variety of energy sources, each with different costs.[4]

One of the principal arguments for the Maritime Link is that it will allow Nova Scotia Power to have dispatchable electricity available during times of peak demand. This will be especially important given the prospect of large volumes of electricity generated by variable production from renewable sources, notably wind.

There is another way to address the system peak: rather than simply adding more dispatchable generation to the system to meet the system peak, Nova Scotia Power could discourage consumption during the peak using price signals. This is not possible with the existing Domestic and Small General Tariffs since they do not differentiate between times of consumption. However, it could be done if residential and commercial-institutional customers had interval meters and were subject to a time-of-use tariff. This allow Nova Scotia Power to balance its loads by reducing the peak or "peak shaving" (i.e., shifting the load to a time with a less expensive or more favourable energy mix).

[4] Nova Scotia Power's argument against time-of-use (time-of-day) rings hollow given its projected energy mix as other jurisdictions of varying sizes and energy mixes have adopted interval meters and time-of-use billing. For example, Ontario (52% nuclear, 22% hydro and other renewables, 16% coal, and 8% natural gas and other sources), Italy (65% coal, oil, and natural gas, 18% hydroelectric, 16% other renewables, and 1% other), United Kingdom (52% natural gas, 32% coal, 6% nuclear, 5% renewables, and 4% other), and Summerside, PE (50% from NB Power and 50% from wind).

Without a change in the way Nova Scotians are billed for their electricity consumption, the Maritime Link cannot be considered the lowest long-term cost alternative for electricity for ratepayers in Nova Scotia. This can be done by transitioning from induction meters to interval meters, time-of-use billing, and, eventually, the smart grid.

6 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 3 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).

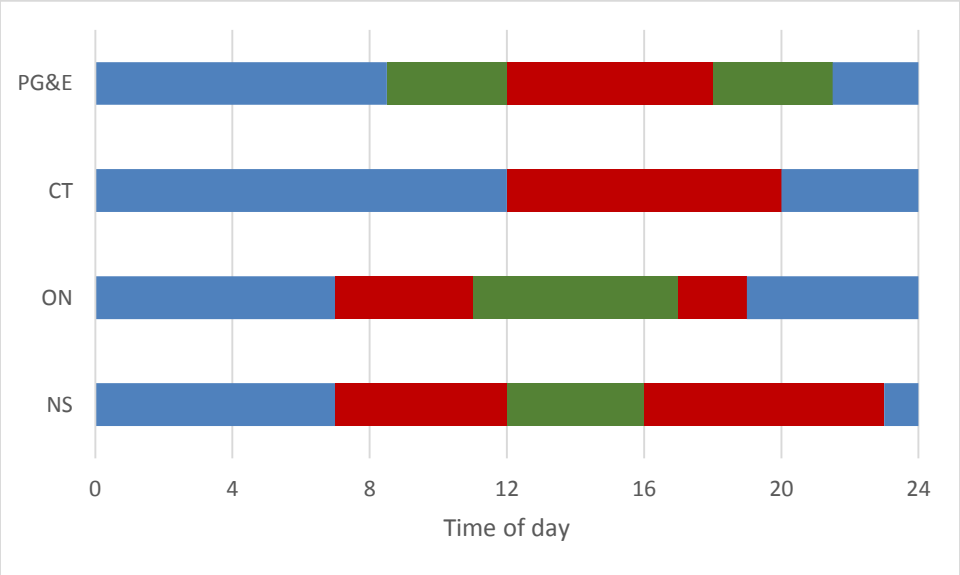

Figure 3: Examples of time-of-use periods
(off-peak, on-peak, mid-peak)

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).

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 Demand Side Management tax.
2. With interval meters in place, consumers could be offered a choice of billing method:
   a) 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.
   b) 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.
   c) 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.
3. 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 present Demand Side Management tax levied on all electricity consumed in the residential and commercial-institutional sectors ($0.00573 and $0.01231 per kilowatt-hour, respectively) makes 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 solar might not.

7 Summary and recommendations

Short of repealing or amending the legislation that requires Nova Scotia Power to meet 40% of its electrical generation from renewable sources by 2020, Nova Scotia Power's energy mix and corresponding production volumes will undergo a significant transformation over this decade.[5] This means that by 2020, Nova Scotia Power will be obtaining electricity from a variety of energy sources, none of which have a production volume in excess of 38% of NSPI's total production volume.

If the province's electricity customers are to benefit from the changes underway in Nova Scotia Power's energy mix, they should be given the choice to decide when and how they will consume electricity in order to, for example, reduce their cost of electricity or reduce the environmental impact of their electricity usage. Changing the way electricity is metered and billed will be one of the few ways in which Nova Scotians will see electricity rates which can be truly be considered the "lowest and fairest".

If the past decade is any indication, residential and commercial-institutional demand for electricity can be expected to continue to increase as new electrical services are introduced, the use of electricity for space and water heating becomes more commonplace, and there is a gradual increase in the use of electricity for transportation.

To achieve these goals and maximize the benefits of the 40% renewables target, this submission recommends that, in addition to obtaining electricity from the Maritime Link, Nova Scotia Power be instructed to undertake the following actions:

1. Replace existing induction-type meters with smart meters (i.e., interval meters that support two-way communications with the electricity supplier).
2. Offer its residential and commercial-institutional customers a choice of billing methods (the existing flat-rate or a time-of-use; either method can utilize interval meters).
3. Develop a transition to a smart grid to allow customers to take advantage of real-time electricity pricing based upon the generation-mix at a given time of day. In this environment, customers use of electricity can be driven by, for example, cost of electricity or type of generation.

[5] Should the Maritime Link not come to fruition and the legislation remain in effect, Nova Scotia Power will still be required to change its energy mix and find other supplies of electricity from sources such as electricity from Hydro Quebec or natural gas from the United States.

The focus of both the provincial government and Nova Scotia Power has been on the generation of electricity. It is time to rethink this strategy and ask ourselves how best to use the electricity that is generated.

These hearings may be the last chance for the foreseeable future to give Nova Scotians the opportunity to take advantage of interval meters, time-of-use billing, and, eventually, the smart grid.

If this isn't done now, when will it be?

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