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An alternative to the proposed Demand Side Management program for Nova Scotia Power[1]

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Introduction

For over 100 years, electricity has been central to the growth and development of many countries. However, since electricity is a secondary energy source, it is typically created from primary energy sources, including fossil fuels (coal, oil, and natural gas), moving water (hydroelectric and tidal), nuclear, as well as some renewables (including biomass, geothermal, solar, and wind). From acid rain to climate change, electricity generation from primary sources of energy has, perhaps not surprisingly, environmental impacts that can reach far beyond where the electricity is consumed (Environment Canada, 2007).

Broadly speaking, the environmental impacts associated with electricity generation can be addressed at the supply-side (with cleaner generation technologies or using technologies that reduce harmful by-products) or the demand-side (by encouraging consumers to change their electricity consumption habits). Utilities such as Nova Scotia Power have, in some cases for more than 30 years, attempted to address these impacts from both the supply- and demand-side with varying degrees of success.

Throughout the 1990s, the cost of most forms of energy remained relatively constant. However, since the turn of the century, it has become abundantly clear that the world is entering an era of rising energy prices, growing competition for energy sources, and decreasing fossil fuel supplies. This is due to a variety of reasons, from the arrival of "new players" such as China and India, which are demanding an increasing share of the world's energy resources, notably coal and oil, to the rise of state-controlled NOCs (National Oil Companies) that are restricting the export of energy products, primarily crude oil, to world markets (IEA, 2007; NPC, 2007).

The volatility in world energy markets is causing many utilities that rely heavily on energy imports to shift away from multi-year rate agreements with their consumers to rates that can be adjusted at regular intervals (typically every six months or so). These regular adjustments

are sometimes referred to as the Fuel Adjustment Mechanism (FAM) and are designed to protect utilities from carrying too high a debt load if fuel prices increase and electricity rates do not. NSPI has successfully negotiated an FAM with Nova Scotia's Utility and Review Board (UARB).

Utilities that rely on world markets for their energy supplies are not the only ones concerned with rising energy costs and possible supply shortages—a growing number of governments around the world are being confronted with the need to ensure the energy security of their citizens by giving them access to reliable supplies of affordable energy. As energy prices continue to escalate and supplies become tighter, managing the use of energy is becoming of paramount importance. Many governments and energy suppliers are searching for secure, preferably low-carbon, sources of energy to maintain energy security. Figure 1 shows a security-emissions graph for NSPI—insecure, high-carbon energy sources are in the lower-left, while secure, low-carbon energy sources are in the upper-right.

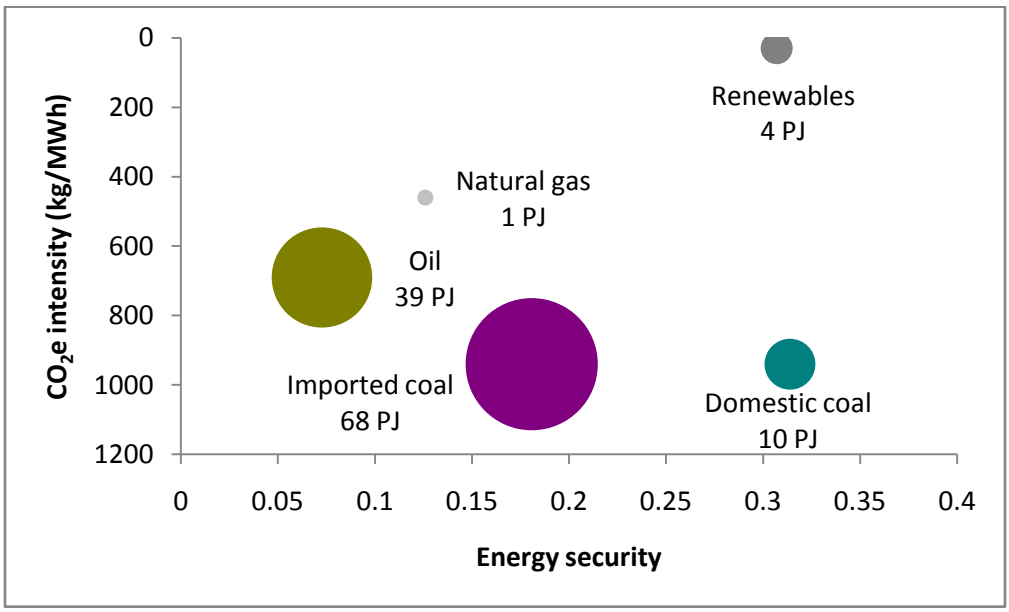

Figure 1: A security-emissions graph for NSPI (Energy units are in petajoules)

This Energy Research Group report presents a brief review of the proposed demand side management (DSM) program for NSPI being discussed at the UARB. It argues that the program will do little to address either emissions or security. Three recommendations are then presented; the first two give the consumer the choice of how and when they use their

electricity, while the third argues that all forms of energy should be included in the funding of any future conservation program. The purpose of these recommendations is to both reduce emissions and improve energy security in Nova Scotia.

Background

In 2004, NSPI released their demand side management (DSM) report, "DSM program Summary of 2003 Projections by Nova Scotia Power Inc.", which included the Electric Power Research Institute's (EPRI) definition of DSM:

> *"DSM is the planning, implementation, and monitoring of those utility activities designed to influence customer use of electricity in ways that will produce desired changes in the utility's load shape, i.e. changes in the time pattern and magnitude of a utility's load."*

Implicit in NSPI's 2003 summary report was the use of this definition to guide the implementation of its DSM program. Since then, NSPI has been under growing pressure to create a much broader DSM program that will reduce greenhouse gas emissions and help those in need (Summit Blue, 2006). Although NSPI may benefits from reduced generation costs, the costs of the program will be born by its consumers in the form of a system benefit charge or SBC.

Observations and comments

The proposed SBC is a tax on electrical consumption imposed on NSPI's consumers by NSPI and approved by the UARB. As such, it raises a number of issues, two of which are:

- This is a tax on a single form of energy.

  Although electricity is an important secondary energy source in Nova Scotia, meeting about 20 percent of the province's needs, it is not the only form of energy consumed. There is no clear justification for taxing electricity and not taxing other secondary energy sources such as gasoline and home heating fuel. Rather than this piecemeal approach to addressing greenhouse gas emissions, the province should be responsible for the setting and distribution of energy taxes. However, if a tax is to be applied, it should be more than a

simple flat tax offering no incentive for consumers to change their consumption habits or for NSPI to change the way it generates electricity.

- The proposed tax treats all electricity equally.

  Since the proposed tax is on consumption rather than production, consumers have no incentive to demand that NSPI generate electricity from secure, preferably low-carbon sources. The tax penalizes all forms of generation, regardless of the source: electricity from coal and oil is treated the same as electricity from hydro and wind.

Simply increasing the cost of electricity through the proposed tax may result in a decline in consumption; however, for many Nova Scotians, the cost will simply be absorbed and habits will not change. Part of the problem lies in the fact that the DSM proposal has no mechanism to change NSPI's existing flat-rate and declining-block rate structures and, as a result, consumers are given no incentive to change their consumption habits (Hughes, 2004).

Recommendations

In an era of rising energy prices, growing competition for energy sources, and decreasing fossil fuel supplies, Nova Scotia's overwhelming reliance on imported energy for the generation of electricity makes the province particularly insecure in terms of its energy needs (Hughes, 2007). If the province is to change this situation, it must institute policies that **reduce** the consumption of electricity and **replace** insecure sources of energy for generation with those that are secure.[2] The proposed demand side management program being discussed by NSPI and its stakeholders will not achieve this.

The following two recommendations are intended to help NSPI meet its original definition of DSM and help improve energy security and reduce greenhouse gases in the province.

[2] Actually, the need to reduce and replace is not restricted to electricity—if the province is to improve its energy security, all forms of energy end-use must reduce their consumption and replace existing insecure sources with ones that are secure.

R1. That NSPI charge its consumers the actual cost of generation of the electricity they consume.

The cost of generation varies hourly throughout the year, depending upon the generation mix used to meet the system load, which also varies. Existing flat-rate or declining-block rate structures offer NSPI's consumers no incentive to reduce their electricity costs by shifting their loads to periods of less expensive generation because the costs remain unchanged, regardless of usage.[3] Furthermore, since these rate structures have no concept of time, they do not allow NSPI to charge its consumers for the cost of generation when it occurs. Experience has shown that varying the cost of electricity to reflect the cost of generation influences the consumer's use of electricity—the expressed objective of EPRI's definition of demand side management.

Offering this capability to NSPI's consumers will require:

i) NSPI's hourly fuel consumption data. The UARB's decision to let NSPI adopt a fuel adjustment mechanism (FAM) means that hourly fuel consumption data should be maintained by NSPI.

ii) Time-of-use metering. Since NSPI's existing induction meters do not record the times at which consumption occurs, it will be necessary to re-meter the province with multiple-register, time-of-use energy and demand meters (sometimes called "smart meters").

iii) Time-of-use billing. With the information available from i) and ii), above, it is a simple matter of matching NSPI's hourly fuel consumption data with each consumer's time-of-use electricity consumption.

There are technologies now available that will allow consumers to take advantage of time-of-use metering and billing. For example, most modern white-goods such as dishwashers, clothes washing machines, and clothes dryers, are programmable to operate during periods of less expensive electricity. Lower-cost electric heating can be achieved using Electric Thermal Storage (ETS) units that are charged during off-peak hours (11pm to 7am), rather than electric baseboard heaters that consume electricity throughout the day.

[3] Electricity costs for consumers with declining-block rate structures do experience a price change, typically from a high-cost block to a low-cost block. Within the blocks, the price of electricity does not change.

In addition to load-shifting, time-of-use metering and billing offers other benefits:

- In some demand side management programs, the utility can remotely control (i.e., turn on and off) major electricity loads, such as hot-water heaters, during periods of high demand. With time-of-use billing, unlike existing flat-rate structures, consumers have an incentive to let the utility control major loads as it will reduce their overall cost of electricity.
- It allows the introduction of novel technologies that take advantage of intermittent sources of electricity, notably wind. Intelligent loads can be designed to operate only when there is electricity available from an intermittent source—time-of-use billing allows the consumer to be charged for electrical consumption during these periods.
- Consumers using electric baseboard heaters can be encouraged to shift to Electric Thermal Storage.
- Independent power producers can be more easily accommodated, as the time of their production can be compared with the time of their consumers' consumption.
- It eliminates the cross-subsidization that occurs in flat-rate systems, in which low-consumption consumers pay for the cost of additional generation incurred by high-consumption, peak-hour consumers.

Time-of-use metering and billing is not new—in fact, NSPI's time-of-use residential rate uses it in about 3,000 homes with Electric Thermal Storage units. Worldwide, time-of-use metering and billing is gaining acceptance (see Table 1).

Table 1: Examples of energy suppliers that are using time-of-use metering

Energy Supplier	Location	Total units	Date
Duke Energy	USA	57,500	2008
E.ON Sverige AB	Sweden	370,000	2008
Vattenfall AB	Sweden	700,000	2006
Enel	Italy	27 million	2005
Nuon	Netherlands	25,000	2007

The cost of a time-of-use meter is quoted in the range of $100 to $200, installed. The total cost of re-metering all of NSPI's residential and commercial customers would be in the range of $40 to $80 million. According to Hydro One, these meters can be installed in a few minutes. The

Ontario government plans to have all residential consumers on time-of-use meters by 2010. The cost of the meters can be recouped through electricity rates, or by the province, if the provincial government considers energy security and greenhouse gas emissions to be of interest to the future well-being of Nova Scotia.

R2. That electricity taxes be based upon the energy security and emissions intensity associated with the fuel.

The first recommendation proposes that NSPI re-meter its consumers with time-of-use meters to allow billing based upon the actual cost of energy used to generate the electricity. The second recommendation proposes that electricity taxes be based upon how secure the fuel source is deemed to be and the emissions intensity of the fuel.

The most obvious form of energy consumption tax is a carbon tax, based upon the carbon emissions associated with a particular fuel source. One could argue that such a tax is appropriate for Nova Scotia, given the province's target of reducing greenhouse gas emissions by 10 percent below 1990 levels by 2020 (Environment Act, 2007).

Reducing greenhouse gas emissions is an important, but by no means the only energy issue facing Nova Scotia—the province's overwhelming reliance on imported energy for electrical generation, contributes to the province's energy insecurity (Hughes, 2007). Any energy consumption tax should be designed to reflect both the emissions and the security associated with a particular fuel source, with the expressed aim of shifting consumption from insecure, high-carbon sources of energy to secure, low-carbon sources.

The information available from the first recommendation (i.e., time and type of generation and time and volume of consumption), coupled with information on the sources of the different fuels allows the second recommendation to be implemented.

The Energy Research Group has developed a technique for determining the energy security and greenhouse gas intensity of any energy source for a given jurisdiction. For example, the security-emissions graph in Figure 1 was produced by this technique (the data for the figure is shown in Table 2).

Table 2: NSPI's security-emissions

Energy source	Security (unit-less)	CO_2 intensity (kg/MWh)	Consumption (PJ)
Oil	0.07	690	39
Imported coal	0.18	940	68
Domestic coal	0.31	940	10
Natural gas	0.13	460	1
Renewables	0.31	30	4

This information can be used in developing a security tax and an emissions tax for the different fuels NSPI uses to generate electricity—ideally, this tax should be applied to all fuels in the province, not just those for generating electricity.

This is a novel approach to taxing energy consumption as it taxes fuels upon their level of security and carbon-intensity. Consumers, aware of these taxes can change their consumption habits if they are informed when different fuels are in use. As importantly, consumers can put pressure on the utility to change the way it generates electricity, from less secure sources to more secure sources.

R3. All forms of energy, not just electricity should incur a consumption tax.

One of the decisions before the UARB is to decide who will oversee the allocation of funds collected from the DSM tax to be imposed on all NSPI consumers. Several groups are calling for an independent organization, essentially an ESCO (or energy services company), to be responsible. From what has been proposed to the UARB, it would appear that the ESCO is to fund projects other than those relating to electricity or DSM.

If this form of ESCO is accepted, it will mean that electricity consumption is penalized in favour of other energy sources. Such a proposal makes little sense—if one form of energy is to be taxed to fund conservation programs, all forms should be taxed.

In order to avoid cross-subsidization, revenues from any such taxes should be applied to projects that are intended to reduce energy consumption. These projects should be designed to reduce consumption for the type of energy from which they were collected.

Summary

This report's principal recommendation is for the UARB to require NSPI to change how it bills its consumers, from flat- or declining-block rates to time-of-use rates. In order to do this, NSPI's consumers will have to be re-metered with time-of-use meters. There are numerous benefits associated with time-of-use metering, including:

- Consumption has been shown to decrease with time-of-use meters
- Billing is based upon the actual cost of generation, not a collective average
- Energy consumption taxes can be targeted towards reducing greenhouse emissions and improving energy security

The second recommendation is that if an energy consumption tax is to be introduced as part of NSPI's DSM program, it should be designed to encourage both an improvement in energy security and a reduction in greenhouse gas emissions. This can best be done in conjunction with the first recommendation. The consumption tax should target all fuels, but vary by fuel, depending upon its security and emissions.

It has been argued that there is little point in introducing time-of-use metering into Nova Scotia because almost all of NSPI's generation is from a single source—coal. However, the two recommendations propose a novel use of time-of-use metering that can help improve the province's energy security and decrease greenhouse gas emissions—something NSPI's proposed DSM tax is unable to do. Furthermore, the two recommendations allow NSPI's consumers to change their consumption habits and put pressure on the utility to change the way it generates electricity, from less secure sources to more secure sources.

The third recommendation is that if the province is to introduce an energy consumption tax, it should be designed to encourage both a reduction in greenhouse gases and an improvement in energy security. The consumption tax should target all fuels, but vary by fuel, depending upon its security and emissions. The most appropriate use of the tax would be to help reduce energy consumption in the sector from which it was obtained. Although the final decision of what energy sources can be taxed by the ESCO may be in the hands of the provincial government

rather than the UARB, if the ESCO is to be funded by a tax on electricity consumption, the funds should be directed to electricity-related projects only.

From different grades of gasoline to airline tickets, consumers are given a choice between the level of service they want and the cost of the service. NSPI's consumers should also be given the right to choose, so that the price they pay for the electricity they consume reflects to cost, security, and emissions associated with producing the electricity.

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