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Input on basic assumptions

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1. Introduction

This report presents a number of recommendations for NSPI's 23 year Integrated Resource Plan (2007 to 2029).

The report examines many of the assumptions raised by NSPI in their "Integrated Resource Plan – Basic Assumptions", presented at a Technical Conference held in Halifax on 22 September 2006.

2. Emissions

2.1. Sulphur dioxide

No costs are associated with emissions in excess of the legal limits or the annual charges levied by the province on SO_2 emissions.

Recommendations:

- These costs should be included in the IRP model, with the expected high, low, and base charges.
- A model run should be performed to determine the costs associated with no SO_2 emissions abatement technology, using, for example, the EPA SO_2 emissions trading scheme.

2.2. Carbon dioxide

Slides 13 and 14 show the assumed high, low, and base reduction targets and assumed high, low, and base offset-costs for CO_2. The two slides are inconsistent, in that reductions end in 2029 and offset-costs end in 2025.

Figure 1 shows the projected annual costs associated with CO_2 emissions offset-costs in U.S. dollars, based upon NSPI's data. A linear growth was assumed between the supplied data points. It is unclear from NSPI's data whether the costs are in constant or chained dollars.

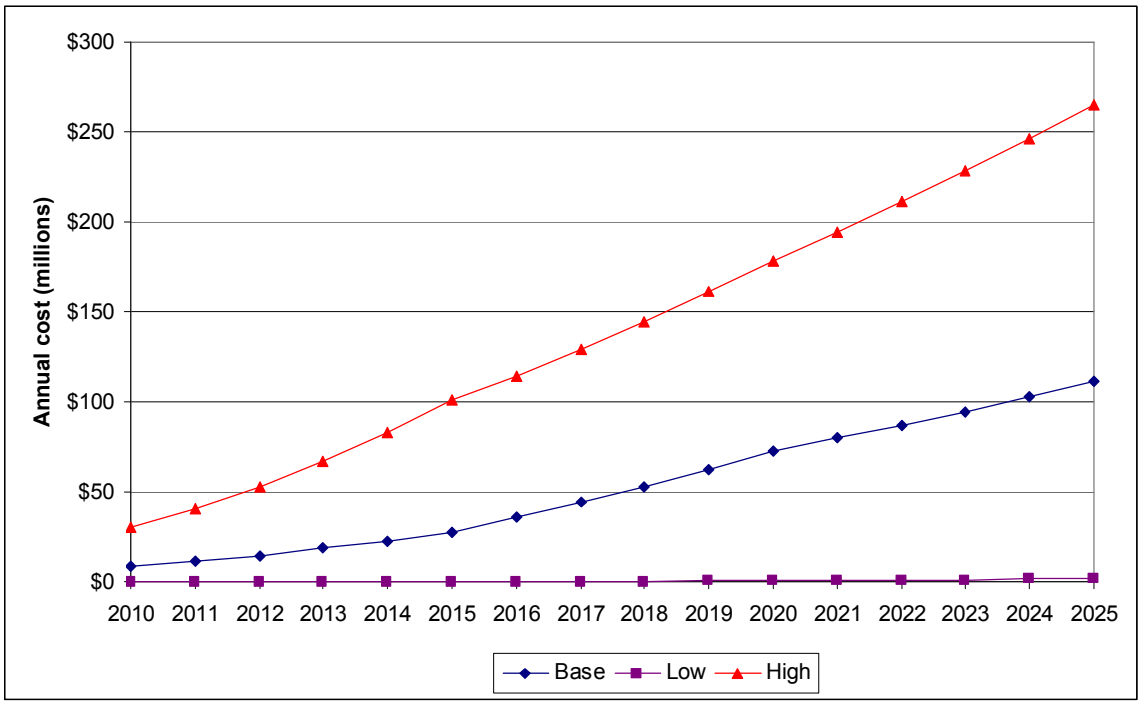

Figure 1: Annual CO_2 offset costs (U.S. dollars)

Table 1 shows the total costs for each case based upon the offset costs in Figure 1. The cost to NSPI's consumers could range from $8 million to over $2 billion, depending upon the required emissions reductions and the associated offset costs. These costs should be taken into account when considering any new technologies.

Table 1: Total costs for all cases between 2010 and 2025

Case	Total cost
Base	$846,150,000
Low	$8,030,000
High	$2,248,370,000

Recommendation: Total CO_2 offset costs must be included in the IRP model.

Note: The revised slide 13 states that NSPI's 1990 CO_2 emissions were 6.85 Mt; in the table on this slide, the Kyoto reduction for 2010 is given as 4.4 Mt. The 4.4 Mt target implies that NSPI's 2010 CO_2 emissions will increase to 10.84 Mt (up from today's level of about 10 Mt). This suggests an 8.4 percent increase in CO_2 emissions between now and 2010.[1]

[1] In the unlikely event that NSPI would be required to comply with Canada's Kyoto commitment, the

2.3. Other greenhouse gases

In addition to CO_2, there are two other greenhouse gases associated with electrical generation: CH_4 (GWP: 23) and N_2O (GWP: 296).

Recommendation: The mass of these gases should be calculated and included in the IRP model.

3. Supply-side

3.1. Renewable Portfolio Standard

The government of Nova Scotia has recently called for a Renewable Portfolio Standard to increase the percentage of electricity generated by renewables in the province to 20 percent (from about 10 percent) by 2013. When this percentage is met, it must be maintained "forever" by NSPI.

Renewables such as wind require backup facilities, supplied by either the renewables generator or NSPI.

Recommendations:

- The backup fuel sources for renewables must be explicitly identified in the IRP model.
- The impact of the interaction between the renewable energy sources and the backup fuel sources should be included in the IRP model.

3.2. Emissions reduction technology

NSPI's basic assumptions include SO_2, NOx, and mercury reduction technologies for existing generating facilities; no consideration is given for retrofitting CO_2 reduction technologies. This is a reasonable request, given that NSPI is funding research into carbon capture and storage technologies.

Recommendation: Include the addition of CO_2 abatement technologies for existing generating facilities into the IRP model.

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company's emission target would be six percent below 1990 emissions levels: 6.85 Mt × 0.94 or 6.44 Mt. NSPI claims that to meet Kyoto in 2010, they would have to decrease CO_2 emissions by 4.4 Mt to 6.44 Mt; meaning that they project their 2010 CO_2 emissions to be 6.44 + 4.4 or 10.84 Mt, an 8.4 percent increase over today's level.

3.3. New generation alternatives

As the costs associated with CO_2 emissions abatement increase (see Table 1), less-carbon intensive generation technologies become more attractive. Despite this, NSPI has ignored a number of potentially promising technologies in favour of coal and natural gas generating facilities.

3.3.1 Nuclear power

Nuclear power is rejected as it is "*prohibited by NS legislation*". The legislation in question is the Nova Scotia Power Privatization Act of 1992, which states:[2]

> *8 (a) a provision that the primary object of the Company is to develop in the Province the use of power on an economic and efficient basis and for this purpose to engage in the Province and elsewhere in the development, generation, production, transmission, distribution, supply and use of electricity, water, sun, wind, steam, gas, oil or other products or things used or useful in the production of power and the Company shall not construct a generating plant that utilizes nuclear energy to produce electricity;*

This Act, like all others passed in the Legislature, can be amended (and has been several times since it was enacted in 1992), meaning that nuclear power could be considered as part of the province's energy mix.

Recommendation: The capital, operating, and fuel costs, as well as the associated greenhouse gas emissions for nuclear generation should be included in the IRP model.

3.3.2 Cogeneration

Cogeneration is dismissed by NSPI because "*opportunities assessed to date (are) not economical.*" This argument can no longer be valid, for a number of reasons, including:

- Most Nova Scotians use light fuel oil for home heating. As world energy costs increase, the need for alternate sources of energy for space heating become paramount. For example, as the population density of peninsula Halifax increases with the construction of multi-story buildings, the "waste" heat from Tufts Cove (the LM 6000 gas turbines and the combustion turbines) could be piped under the harbour to meet

[2] Interestingly, although the Act explicitly lists "*water, sun, wind, steam, gas, and oil*" as means of the production of power, nowhere in the Act is coal mentioned.

space heating needs.

- The cost of CO_2 emission offsets could become prohibitive, as shown in Table 1. By installing district heating/energy systems, CO_2 offset credits could be obtained as the "waste" heat would be replacing light fuel oil.
- As energy costs increase, consumers may turn to NSPI for electric heating to offset the cost of light fuel oil for space heating. This would put pressure on NSPI to increase generation capacity, potentially increasing CO_2 emissions. Cogeneration would help alleviate this problem.

Recommendation: Cogeneration must be included in the IRP model.

3.3.3 Biomass

Biomass is "*desired by NSPI if economical*." Biomass offers a number of interesting possibilities, from direct combustion, to co-firing, to gasification. With rising world energy prices, indigenous biomass offers the potential of helping reduce energy costs and greenhouse gas emissions.

Recommendation: Direct combustion and co-firing of biomass must be part of the IRP model.

3.3.4 Tidal

Tidal energy is dismissed by NSPI because "*stream tidal under review, but not commercially available by 2010.*" This argument implies that NSPI will be installing all its new capacity on or before 2010 and none between 2010 and 2029. Given that NSPI is projecting an increase in peak demand to about 3,100 MW in 2029 (a 50 percent increase), NSPI will clearly be adding new generating capacity after 2010.

Recommendation: Tidal stream must be included in the IRP model.

3.3.5 Shared system operator

One way to address the issue of future resource management is to work in conjunction with operators in neighbouring jurisdictions, such as the New Brunswick System Operator. For example, the province of Nova Scotia has a renewable portfolio standard, and a wind integration study recently completed by NBSO has shown that the costs of

managing renewable energy can be reduced if the system operators of the Maritime provinces consider the entire region as a whole when scheduling generation.

Recommendation: Run the IRP model to include cooperation with the NBSO, determining the associated costs and benefits of such a program.

3.3.6 Accessing the Lower Churchill

The Lower Churchill project consists of generating facilities at Gull Island and Muskrat Falls, with a planned generating capacity of nearly 3,000 MW. The CEO of Emera has mentioned the Lower Churchill on several occasions. Now that Newfoundland and Labrador has indicated that it is considering proceeding with the project, Emera should consider the possibility of participating in it.

Recommendation: Include the Lower Churchill as part of the IRP model.

4. Load forecast

4.1. Annual energy – GWh[3]

The graph on slide 26 shows the projected growth in provincial electricity demand based upon five assumptions made by NSPI: industrial demand, economic growth, heating oil prices, price of electricity, and the number of residential customers. This is a very traditional view of electrical generation and does not take into account changes that are taking place around the world with respect to energy supply and demand.

For example, if light fuel oil prices continue to increase, more consumers may opt to use electricity for space heating. Similarly, as gasoline prices continue to rise, there will be a growing interest in true electric vehicles.

Recommendation: Expand the possible loads to include a larger share of electric heating and the possible increase in demand from electrically powered vehicles.

4.2. Residential customer projections

The residential customer projections (slide 26) are for an increase of 250 customers per

[3] Additional analysis was to have taken place in this section; however, NSPI failed to supply the requested data by 5 October 2006 – the day before this report was to have been submitted.

year (high case) and a decrease of 250 customers per year (low case). Using these projections, the number of residential customers should increase or decrease by 6,000 between 2005 and 2029.

According to Statistics Canada, the high and low population projections for Nova Scotia for 2029 are 1,023,800 and 933,300, respectively. Table 2 shows the customer and population projections using NSPI's and Statistics Canada's customer projections. The table also shows the ratio of customers to population; for the most part, the ratio is nearly constant for the low growth case (about 2.25 ± 0.01). However, in the high growth case, the ratio increases to 2.41.

Table 2: Customer and population projections for Nova Scotia

Year	Low growth			High growth		
	Customers	Population	Ratio	Customers	Population	Ratio
2005	419,000	937,889	2.24	419,000	937,889	2.24
2006	418,750	938,200	2.24	419,250	940,000	2.24
2029	413,000	933,300	2.26	425,000	1,023,800	2.41

Given demographic trends, it would appear that the growth ratio makes little sense. For example, if the low growth ratio for 2029 was used in the high growth case, the number of customers would increase to 453,048.

Recommendation: A more realistic residential customer high growth case should be used in the model.

4.3. Demand side

Requests were made for additional data regarding their proposed demand side management program on 22 September 2006. By 5 October 2006, NSPI had failed to supply the Energy Research Group with the requested information, meaning that it was impossible to make recommendations before the 6 October 2006 deadline.

4.4. System peak

Slide 27 shows system peak demand for the duration of the IRP; however, it does not indicate how this demand is met. An IRP requires not only knowing what demand exists, but detail on how this demand is currently being met and how it will be met in the future. This information will assist in determining the best strategy for meeting future projected

demand growth.

Recommendation: Ensure that the selected analysis tool provides graphs or tables which indicate the sources of electricity supply used to meet peak demand. This should be by generating facility or failing that, a breakdown indicating hydro, thermal base load, thermal peaking, and purchased power.

4.5. Economic model

The limited information supplied regarding the economic model is of concern; for example, the rate of return on rate base is same for the low- and base-cases.

Recommendation: Increase the base case or decrease the value of low case so that they complement other economic assumptions in the IRP model.

5. Fuel

NSPI relies almost exclusively on non-indigenous energy supplies for its fuel generating requirements (see Table 3).

Table 3: NSPI's energy sources for 2004

Fuel	Percentage
Coal (imported)	55.9%
Oil and pet-coke	32.3%
Coal (local)	8.3%
Primary energy	2.7%
Natural gas	0.9%

This overwhelming reliance on non-indigenous energy makes Nova Scotians particularly vulnerable to changes in fuel costs, as stated in slide 6:

> *Assumptions for key areas, for example fuel costs, financial or load assumptions, are highly volatile, and therefore impossible to predict accurately. These assumptions or forecasts may change in the future, perhaps substantially. Therefore, deviations from the assumptions will happen over time. NSPI has used best efforts to provide ranges of realistic values as appropriate, based on current information.*

As the price of crude oil increases, there will be a push for developing liquid fuels (and hydrogen) from coal. This, coupled with the growing demand for coal in China and other nations, will increase the price of coal and potentially lead to supply shortages.

Recommendations:

- IRP model runs should be performed using indigenous fuel supplies, taking into account their costs and availability. These runs should include secure energy supplies such as tidal and coal.
- IRP model runs should also simulate supply shortages caused by supply interruptions.

6. Transmission and Reliability

With the addition and upgrade of generating capacities in place, NSPI will also require upgrading and developing its transmission capacity. Although the upgrade of the 345-kV transmission line between Nova Scotia and New Brunswick and some cost allocation for transmission lines within Nova Scotia have been mentioned, there is no specific plan for upgrading existing or constructing new transmission lines within the province.

Recommendations:

- To achieve system reliability when adding new generation capacity, it is recommended than instead of installing a single (large) generating unit, the IRP model should consider installing several smaller units. For example, rather than installing a single 300 MW unit, six 50 MW units should be used, as this will improve the system's reliability.
- Upgrading substations with new or upgraded switchgear and protective devices is another area that must be evaluated in the IRP since there will be increased generating capacity and upgraded transmission lines. It is not clear whether this is included in the anticipated transmission costs.

7. Modeling tool

The constraints, uncertainties, and objective functions used in NSPI's analytical tool "Strategist" will help to direct important energy decisions in Nova Scotia. To achieve unbiased results from "Strategist", the model must be developed with inputs that evenly and accurately consider all energy and technology options available and decision variables/objectives which support the interests of Nova Scotians.

Renewable energy options must be given greater prominence in the IRP. The grouping

of "Renewables" in "Options to Add New Generation" (slide 24) suggests that "Strategist" will not be developed to consider specific assumptions that would be required to support the development of secure renewables.

Recommendation: Stakeholders cannot verify that the agreed upon basic assumptions will be correctly entered into the model. The concern is that NSPI could use confidentiality to restrict the stakeholders from seeing all the inputs and outputs. If this happens, then the stakeholders must assume that this investor-owned utility is looking out for everybody's best interest. It is recommended that NSPI disclose all inputs, outputs, and the sensitivity analysis of the computer model for stakeholder discussion and interpretation.

8. Concluding Remarks

Two of the greatest energy-related problems facing most governments today are energy security and climate change. With almost 90 percent of its energy supplied by non-indigenous sources of coal and oil, Nova Scotia is not immune to either of these problems.

Addressing these two problems will require a concerted effort from all sectors of the Nova Scotian economy, with leadership from the provincial government. This will involve considering the environmental and economic costs and benefits associated with using different fuels and technologies to address how Nova Scotians heat and feed themselves, move, and work.

Electrical generation cannot be exempt from this. NSPI's reliance on non-indigenous fossil fuels for almost 90 percent of its electrical generation means that in terms of electricity, Nova Scotians have virtually no energy security and produce significant quantities of CO_2.

NSPI has a vested interest in maintaining the status quo when it comes to coal, as most of its generating plants are designed to burn coal. Furthermore, NSPI and its parent company, Emera, have invested in clean coal research projects across Canada.[4]

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[4] NSPI and Emera are members of the Canadian Clean Power Coalition, a consortium of companies and governments funding clean coal research. According to NRCan, the first clean coal demonstration project is to be in place by 2010. NSPI's and Emera's annual financial statements give no obvious indication as to

Meeting Nova Scotia's need for energy security and greenhouse gas abatement will mean that NSPI's past and present reliance on coal cannot be used as an excuse to ignore other generation technologies.

NSPI's proposed "basic assumptions" are built primarily around maintaining the status quo of burning coal. The generation technologies used in the IRP model must be expanded beyond those relying on coal. Whether NSPI has the expertise to examine other technologies appears to be open to question, given the focus of their "basic assumptions". Without this expertise, it is unlikely that NSPI could finish an effective IRP of this magnitude before the planned completion date of December 2006.

Nova Scotia's energy security and climate change responsibilities cannot be addressed in a piecemeal fashion. A provincially funded program is needed to improve provincial energy security and reduce greenhouse gas emissions in a coordinated fashion between all sectors of the economy, including electrical generation.

In conclusion, the IRP as proposed should be shelved and work on a provincial energy security and climate change program should begin immediately.

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