Response to:
An Application by NSPI, NewPage Port Hawkesbury Corp. and Strait Bio-Gen Ltd. – Review and Approval of a Proposed 60 MW Biomass Project (UARB P-172)

Larry Hughes
Energy Research Group
Department of Electrical and Computer Engineering
Dalhousie University

email: larry.hughes@dal.ca

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Department of Electrical and Computer Engineering
Dalhousie University
Halifax, Nova Scotia, Canada

1 Introduction

Nova Scotia imports over 80 percent of its primary energy, much of which comes from regions that are politically unstable or from suppliers whose production is in decline (Hughes 2007). Most of the energy supply for one of the province's most important energy services—space heating—is met by fuel oil or electricity, neither of which can be considered secure given the volatility in world energy markets (EIA 2009).

Despite the importance of energy security to any developed country or jurisdiction (IEA 2001), for most of this decade the Nova Scotia Department of Energy has focused its attention on exporting natural gas to New England (NS Energy 2009) and encouraging Nova Scotia Power (NSP) to reduce its greenhouse gas emissions (NS Environment 2009). Provincial legislation supported by all political parties set greenhouse gas emissions targets for NSP (EGSPA 2007).

In response, NSP has proceeded with calls for wind energy and is a partner in the province's search for tidal energy (Emera 2009b). Most recently, NSP announced its intention to purchase electricity from a 60 MW biomass facility near Point Tupper operated by NewPage and Strait Bio-Gen (NSP 2009). When fully operational in 2013, the facility is to expected burn between 600,000 and 700,000 tonnes of biomass annually (Renewable Energy Conference 2009). In fact, NSP's plans for biomass extend well beyond the 60 MW biomass facility and include co-firing biomass with coal (Myrden 2009).

However, biomass has other uses. In many countries, it is a secure and environmentally benign source of energy for space heating. Assuming that the planned quantity of biomass to be burnt in the 60 MW biomass facility can be harvested in a sustainable manner, this report considers the benefits of using the biomass for space heating rather than for electrical generation.

2 The proposed system

NewPage and Strait Bio-Gen are proposing to build and operate a 60 MW biomass facility that is expected to produce 406,000 MWh of electricity annually when fully operational by 2013 (NSP 2009). NSP has announced that it will purchase the electricity.

According to NSP spokesperson Jennifer Parker, the biomass project will "produce enough energy to power about 50,000 homes" (Renewable Energy Conference 2009) or about 8.1 MWh per home.[i] Since NSP's average residential customer consumes about 10.2 MWh per year, this overestimates the number of homes that could benefit from the biomass facility—rather than 50,000—the number is less than 40,000.[ii]

2.1 The biomass

Russ Waycott, NewPage's vice-president of woodlands, has stated that the 60 MW biomass facility will require 600,000 to 700,000 tonnes of biomass a year (Renewable Energy Conference 2009). Sources of the biomass include bark from NewPage's wood room, waste material from sawmills and wood not usable for other purposes, such as low-grade hardwood purchased from private landowners and harvested from the lands NewPage manages (Renewable Energy Conference 2009).

Between 2002 and 2006, Nova Scotia's annual harvest of both hardwood and softwood averaged about 6.1 million m^3 (Nova Scotia Finance 2007). At 1.1 m^3 per tonne (NSDNR 2008), the proposed facility will use between 10.8 and 12.6 percent of the province's average annual harvest.[iii]

The available energy will depend upon the water content of the biomass. The heat content of a tonne of dry biomass is about 15 GJ/tonne.[iv] Assuming that approximately half of the biomass is water, the total available energy from the dry biomass will range between 1,250 GWh and 1,458 GWh.[v]

2.2 Biomass-to-electricity

The overall capacity factor of the proposed facility, obtained from the anticipated annual production (406,000 MWh) and the available energy in the biomass (1,250 to 1,458 GWh) is estimated to be between 27.8 and 32.5 percent.[vi] This is within the range of most thermal generation systems using biomass. This does not include the losses associated with the transmission and distribution of the biomass-generated electricity.

3 Residential heating requirements

Space heating is essential to living in Nova Scotia. Depending upon type of structure, residential space heating is responsible for between half and two-thirds of all the energy consumed in a typical Nova Scotian home. When combined with the need for domestic hot water, the total exceeds 75 percent of the energy consumed. The average heating demand for a household (HH) depends upon its building type, as shown in Table 1.

Table 1: Heating requirements by household (HH) and building type in Nova Scotia (OEE 2007)

Building type	Total GJ/HH	Space heating	Space heating GJ/HH	Domestic hot water	Domestic hot water GJ/HH	Heating total GJ/HH
Single detached	132.3	64.2%	85.0	16.8%	22.2	107.2
Single attached	120.4	63.8%	76.8	18.0%	21.7	98.5
Apartment	62.3	49.7%	31.0	25.7%	16.0	47.0
Mobile home	128.0	68.7%	88.0	15.5%	19.8	107.8

For example, in 2003, the total energy demand for all energy services (space heating, domestic hot water, appliances, lighting, and space cooling) for a single detached house in Nova Scotia was 132.3 GJ. Of this, 64.2 percent was for space heating (85 GJ) and 16.8 percent was for domestic hot water (22.2 GJ). The total energy requirement for space and water heating was 107.2 GJ.

In Nova Scotia, the energy requirements for heating services (space and domestic water heating) is met predominantly from fuel oil and electricity—neither of which can be considered secure (Hughes 2007). One solution would be to generate electricity for residential space and water heating from secure sources of biomass.

3.1 Heating with electricity

Most residential electric heating in Nova Scotia uses electric baseboards; during times of peak electrical demand, the electricity consumption for space heating of a typical Nova Scotian home is about 10kW. If the electrical output of the 60 MW biomass facility were to be devoted to meeting the space heating needs during the peak space heating hours, about 6,000 homes would be heated. During non-peak hours, the biomass output could meet the space and water heating needs of additional homes.

Alternatively, assuming that the electricity could be supplied to homes with electric thermal storage units requiring about 30 kW for both heating and charging between 23h00 and 7h00, about 2,000 homes could be heated (Steffes n.d.). Outside these hours, the electricity could be used to meet other electricity needs.

3.2 Heating with biomass

Turning biomass into electricity for heating is an inefficient use of biomass because of the capacity factor and transmission losses (section 2.2). If the biomass is to be used for heating, it could be turned into pellets for pellet furnaces that operate at efficiencies as high as 80 to 85 percent (PelletStoveFires.com 2009a, PelletStoveFires.com 2009b).

If the 600,000 to 700,000 tonnes of biomass for the bioenergy facility were to be turned into pellets, the number of homes that could be heated would greatly exceed the 2,000 to 6,000 homes heated electrically (section 3.1). The estimated number of households of different building types that can be heated by biomass is shown in Table 2.

Table 2: Number of households (HH) that can be heated by biomass[vii]

Building type	Number of HH (600,000 t/yr)			Number of HH (700,000 t/yr)		
	Space heating only	Domestic hot water only	Heating total	Space heating only	Domestic hot water only	Heating total
Single detached	39,728	151,817	31,488	46,349	177,119	36,736
Single attached	43,930	155,621	34,259	51,252	181,558	39,969
Apartment	109,041	210,869	71,874	127,214	246,014	83,854
Mobile home	38,374	170,083	31,310	44,770	198,430	36,528

For example, the number of single attached households that could meet their space heating needs is about 43,930 if 600,000 tonnes of biomass were to be made available for space heating only and 51,252 households if 700,000 tonnes were used. Since many pellet furnaces can supply energy for both space and water heating, about 31,488 single detached households could meet these services if 700,000 tonnes of biomass were turned into pellets each year or 36,736 single detached households if 700,000 tonnes were used.

Sustainably produced bioenergy from local biomass sources is both a secure and environmentally benign energy source. Households that replace fuel oil or electricity with biomass would improve their energy security (Hughes and Ron 2009).

4 Greenhouse gas emissions

Replacing coal or oil with sustainably produced bioenergy improves security and can reduce greenhouse gas emissions. Coal is more carbon intensive than fuel oil, meaning that a greater reduction in carbon dioxide emissions are achieved by replacing a GJ of coal with a GJ of biomass than replacing a GJ of oil with a GJ of biomass.

However, with electricity consumption continuing to rise, there is nothing to suggest that the proposed 60 MW biomass generation facility will actually result in NSP reducing its consumption of coal. If NSP purchases electricity from biomass but does not reduce its use of coal, its carbon intensity (CO_2 per kWh) will fall but the actual volume of CO_2 emitted will remain unchanged.

5 Other sources of biomass

When asked about other possible sources of biomass for co-firing with coal, NSP's CEO Rob Bennett responded, "A great deal of farmland in this province is not being farmed today. Land would be leased to people to plant and grow and harvest the biofuel crop" (Myrden 2009).

Although it may appear that farmland isn't being farmed in Nova Scotia, it is worth considering what is taking place on what little farmland is available in the province. Table 3 shows the uses of farmland in Nova Scotia in 2006.

Table 3: Farmland uses in Nova Scotia (Nova Scotia Finance 2007)

Usage	Hectares	Percent
Land in crops	116,699	28.9%
Summerfallow land	1,083	0.3%
Tame or seeded pasture	23,399	5.8%
Natural land for pasture	31,733	7.9%
Christmas tree area, woodlands, and wetlands	197,593	49.0%
All other land	32,850	8.1%
Total farmland	403,357	

Nova Scotia's total landmass is 52,840 km^2 (Nova Scotia Finance 2007) or 5.2 million hectares. Of this, about seven percent is considered farmland, while over half of the farmland has uses other than crops or pasture. Undoubtedly some of the remaining crop and pasture land could be used for growing biomass; however, it is generally agreed that with both transportation and food costs rising, there will be a need for more local food production (Select Nova Scotia 2007).

6 Summary

Nova Scotia is in the unenviable position of having to import over 80 percent of its energy—much of which comes from sources that are either in decline or are facing political turmoil. One of Nova Scotia's principal energy services—space heating—relies almost entirely on fuel oil and electricity, neither of which can be considered particularly secure or environmentally benign.

The planned burning of 600,000 to 700,000 tonnes of biomass in a 60 MW biomass facility may help Nova Scotia Power reduce its carbon intensity or perhaps even its greenhouse gas emissions, but it will do little to help Nova Scotians improve their energy security. One way in which this biomass can improve energy security for Nova Scotians is to use it for space heating.

With increasing volatility in energy markets and the prospect of supply failing to meet demand, it is necessary to use every unit of energy as efficiently and effectively as possible. High efficiency pellet furnaces are an example of a technology that extracts almost all of the energy from the biomass—the same cannot be said for biomass being burned for electrical generation.

6.1 Recommendations

In light of the above, this report recommends that:

- A detailed review and analysis of Nova Scotia's biomass resource be conducted before any large-scale biomass-to-energy is permitted in the province. Given the province's reliance on insecure sources of fuel oil for space heating, part of this review must decide whether biomass should be used for electrical generation or high-efficiency space heating.

If the review establishes that the large-scale use of biomass-for-energy is feasible, this report recommends that the province should not permit the use of biomass for electrical generation, rather it should require:

- The establishment of a stringent silviculture regime that ensures the long-term viability of a provincial biomass-for-energy program.
- The creation of local biomass pellet and chip production facilities to meet local and provincial bioenergy needs.
- The replacement of existing oil furnaces with pellet furnaces in residential and commercial and institutional sectors where other renewable sources, notably wind, solar, and earth energy are not viable.
- The restriction of new space and water heating demand in both the residential and commercial and institutional sectors to renewable sources, including wind, solar, earth energy, and biomass.

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[i] 406,000 MWh ÷ 50,000 homes or 8.1 MWh/home.

[ii] NSP has about 410,000 residential consumers who consumed 4,179 GWh in 2008 (Emera 2009a), meaning that the average consumption was 4,179 GWh ÷ 410,000 or about 10.2 MWh per residential consumer (home). If the biomass facility produces 406 GWh per year, the total number of homes that the facility could provide electricity for about 406 GWh ÷ 10.2 MWh/home or 39,832 homes.

[iii] Between 2002 and 2006, the average annual cut in Nova Scotia was 6.1 million m^3 of biomass (hardwood and softwood). The conversion factor varies by species, from 0.963 m^3/tonne for hardwood saw logs to 1.167 m^3/tonne for softwood saw logs (NSDNR 2008). Given the range and variety of species cut in Nova Scotia, the report assumes a value of 1.1 m^3/tonne. The following table shows the results of the conversion and the percentage of the total harvest:

Tonnes	**Conversion to m^3**	**Total harvest**
600,000	660,000	10.8%
700,000	770,000	12.6%

[iv] A GJ is a giga-joule or one billion joules. A GJ is the energy found in about 26 litres of gasoline.

[v] The biomass-to-energy calculations assume that "dry" biomass will require removal of half the water in order to achieve a heat content of 15 GJ/t. The calculations are shown in the following table:

Wet biomass (t)	600,000	700,000
Dry biomass (t)	300,000	350,000
Energy content (GJ/t)	15	15
Total energy (GJ)	4,500,000	5,250,000
Total energy (GWh)	1,250	1,458

[vi] The capacity factor is determined by dividing the total output (406,000 MWh or 406 GWh) by the energy content of the biomass (1,250 and 1,458 GWh).

[vii] As shown above in endnote v, the available energy depends upon the total quantity of biomass (600,000 or 700,000 t) and ranges between 4,500,000 GJ and 5,250,000 GJ. Although pellet furnaces can achieve efficiencies over 80 percent, an efficiency of 75 percent was chosen for this example. The number of households is obtained by multiplying the available energy by the furnace efficiency and dividing this by the energy required for the service. For example, the number of single-detached households meeting their space heating needs (85 GJ) from 600,000 t of biomass is (4,500,000 GJ × 75 percent) ÷ 85 GJ/HH or 39,728.

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