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Summary Report

GHG Reductions from Enhanced Electrification of Potential New Industrial Demand in British Columbia

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At a Glance

In 2007, B.C. made a legislated commitment to reduce its greenhouse gas (GHG) emissions to 33% below 2007 levels by 2020 and is aiming for 80% or greater reductions by 2050. In other words, B.C. has targets to produce not more than 45 million tonnes (MT) of GHGs in 2020 and 13.5 MT of GHGs in 2050.

A number of new industrial developments have been proposed in recent years, including several developments in northeastern B.C. with large energy demands. If these proposed developments proceed and were to be powered by fossil fuels, the resulting GHG emissions would make it harder for B.C. to meet its targets.

The Canadian Wind Energy Association (CanWEA) commissioned the Pembina Institute to review projected developments in six industrial sectors and estimate the potential of clean electricity, such as wind energy, to limit the upward pressure that the developments place on the province's GHG emissions.

Summary of results. Clean energy supplied by grid-based electricity can limit the increases in GHG emissions by approximately 3.13 MT CO_2e/year in 2017 and by 8.86 MT CO_2e/year in 2025, compared to using fossil fuels. The reductions in 2025 are significant, equivalent to the energy-based GHG emissions from all fossil fuel industries (including oil and gas extraction) and mining in B.C. in 2009. Clean electricity provides a strong opportunity to reduce the environmental impact of large industrial developments, such as those included in the *BC Jobs Plan*. However, any industrial development needs careful consideration in terms of both the appropriate pace and scale of the development and the opportunities for clean technology to mitigate negative impacts.

Caveats

- This analysis has not assessed the assumptions or calculations that were used to produce the industrial energy demands projected in CanWEA's analysis.
- This analysis is an assessment of the potential greenhouse gas emissions associated from one set of assumptions on the choice and pace of new industrial development in B.C.: those assumptions provided in CanWEA's BC WindVision analysis. This Pembina analysis should not be interpreted as an endorsement of the CanWEA assumptions or as a rejection of other possible assumptions for industrial development.
- This analysis focuses entirely on GHGs from energy use that could be supplied by grid-based electricity. Other environmental impacts of this development are not assessed here but are very important to consider.

Context and background

B.C. has a legislated commitment to reduce its greenhouse gas (GHG) emissions to 33% below 2007 levels by 2020. Beyond this, the province has promised continued cuts in the following decades as it aims for 80% or greater reductions by 2050. Meeting these commitments will be a challenge and will require significant changes in the way energy is produced and used in all sectors of the economy.

In 2008, the province produced its Climate Action Plan, which compiled a number of enacted and promised policies that were intended to help the province meet its commitments. The policies in the Plan included the provincial carbon tax, the low carbon fuel standard, LiveSmart BC grants for energy efficient renovations, and a cap-and-trade system.

B.C. had predicted in the Climate Action Plan that without any climate action policies its emissions would grow from 64 million tonnes in 2009 to 78 million tonnes in 2020. Modelling completed as part of the plan estimated that enacting all of those policies in the plan would enable B.C. to get the 2020 number down to 55 million tonnes, or 73% of the way to the province's commitment. Many of these reductions will need to come from transportation and natural gas, which account for roughly 40% and 20% of the province's emissions respectively.[1]

Since the completion of the plan, there have been several notable developments that suggest that the gap between the emissions B.C. is likely to have in 2020 and the levels it has committed to reach will be bigger than anticipated:

- Some of the policies anticipated in the plan are behind schedule and may not achieve the emissions reductions anticipated. Cap-and-trade is probably the most important example in this category.
- Current projections of new industrial development (such as those informing the CanWEA's WindVision for British Columbia) exceed what was anticipated in 2007/2008. If these developments are powered by fossil fuels, they would make it much harder for B.C. to meet its targets.[2] The largest of these potential pressures are likely increased shale gas development and liquefied natural gas (LNG) export plants.

This project focuses on this projected new industrial development and the potential to limit the upward pressure that new projects in these sectors place on the province's greenhouse gas emissions.

Analysis scope and boundaries

This analysis focuses on projected development within six industrial sectors in B.C. (shale gas from Montney, Horn River and Cordova/Liard; LNG exports; new mines, and alternative fuel plants), building on the results of a previously published study, *Additional Industrial Electricity Load Growth in B.C. to 2025*, released by CanWEA in October 2011.

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[1] Government of British Columbia. 2008. *Climate Action Plan.* Accessed online Nov 2011 at http://www.gov.bc.ca/premier/attachments/climate_action_plan.pdf

[2] See *Shale gas in B.C.: Risks to B.C.'s Climate Action Objectives*, (The Pembina Institute, 2011)

Within these six sectors, this analysis focused specifically on energy uses that are typically provided by fossil fuels based on standard industry practice today, but could potentially be provided by grid-based electricity. Examples of these energy uses include compression of natural gas and electricity generation at remote locations (typically provided through diesel generation). Some energy uses, such as heavy-duty road transportation, are unlikely to be provided by electricity.

Within this scope, the analysis compares the GHG emissions of two possible scenarios. One scenario assumes that the energy for the six industrial activities can be supplied by grid-delivered electricity. The other scenario assumes that fossil fuels will be used, as is standard practice in these industries today. GHG emissions from formation gas, fugitives, vehicle combustion, process gases etc. were excluded from the scope of this analysis. Similarly, life cycle GHG emissions from the construction, maintenance or decommissioning of an extended grid or from land use change were not considered.

It should be noted that the scope of this study overlaps with some of the specific commitments in the *BC Jobs Plan* released by the BC Government in September 2011. The *BC Jobs Plan* has a strong focus on growth in the natural resource sectors – forestry, mining, natural gas and agri-food exports. For mining, the *BC Jobs Plan* includes "ensuring that we have will have eight new mines in operation by 2015."[3] For natural gas, the plan "commits the government to working with LNG export proponents to bring at least one LNG pipeline and terminal online by 2015 and have three in operation by 2020, assuming all environmental and permitting applications are granted."[4] While the *BC Jobs Plan* does not put specific commitments on shale gas development or alternative fuel plants, it appears that the projections used in this analysis are broadly consistent with the goals of the *BC Jobs Plan*.

Methodology

In May 2011, CanWEA contracted Steve Davis & Associates Ltd. (SDA) to research and publish an electrical load forecast analysis entitled *Additional Industrial Electricity Load Growth in B.C. to 2025*.[5] The SDA analysis outlined the electricity demand forecast of new industrial development in six B.C. sectors and compared their projection against the most recent BC Hydro load forecast for these sectors (completed in December 2010). The total electrical demand of these sectors as calculated by SDA is shown in Table 1 below in GWH/yr. The SDA electrical demand figures include considerations of the probability of projects being implemented (termed "discounting for attrition" in original report) and the percentage of each project that is realistically able to be electrified by an extended grid (termed "discounting for potential electrification" in original report). These adjustments result in an estimate of electrical demand that can be satisfied by connecting these projects to the provincial grid (SDA Demand Forecast). Table 1 also shows the BC Hydro forecast and the difference between the SDA and BC Hydro forecasts: that is, potentially electrifiable energy demand over and above that identified in the BC Hydro load growth projection of December 2010.

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[3] Government of British Columbia. 2011. *Canada Starts Here: The BC Jobs Plan.* Accessed on-line November 2011. http://www.bcjobsplan.ca/wp-content/uploads/2011/11/CSH_BCJobsPlan_web.pdf

[4] Ibid.

[5] Steve Davis & Associates Consulting Ltd, 2011. *Additional Industrial Electricity Load Growth in BC to 2025*. Accessed online Nov 2011 at http://www.aeoliswind.ca/resources/bfe_load_growth_BC_2025.pdf.

The analysis performed here by the Pembina team calculates the GHG gas emissions that would be produced by this amount of potentially electrifiable energy demand over and above the BC Hydro forecast under two different scenarios. The first scenario assumes this energy is provided by fossil fuels and fossil-fuel generated electricity, while the second scenario assumes this energy is provided with electricity having the same GHG emission intensity as BC Hydro's current 93% "clean or renewable" electricity supply.

Table 1. Electrical demand forecast – SDA versus BC Hydro

Sector:	SDA Demand Forecast GWH/yr		BC Hydro Demand Forecast GWH/yr		Demand Increase over BC Hydro GWH/yr	
	2017	2025	2017	2025	2017	2025
1 Montney Basin Gas	2,997	3,483	1,939	2,359	1,058	1,124
2 Horn River Basin Gas	2,659	4,027	892	1,092	1,767	2,935
3 Cordova/Liard Gas	0	1,334	0	0	0	1,334
4 LNG Terminals & Pipelines	3,956	7,559	1,100	1,100	2,856	6,459
5 New Mines	2,331	3,140	1,900	1,900	431	1,240
6 Alternative Fuel Plants	0	4,200	0	0	0	4,200
Total	11,943	23,743	5,831	6,451	6,112	17,292

Assumptions for the fossil fuel scenario

The fossil fuel scenario is based on assuming that industrial development follows typical industry practice. In particular, in the three shale gas basins (Montney, Horn River and Cordova/Liard in Table 2 below), the energy that is required to transport newly acquired and processed natural gas through a pipeline is provided by natural gas fired compressors. The mine sites use on-site electrical generation provided by diesel generators as the sites are generally remote from provincial pipeline or grid infrastructure. LNG terminals and alternative fuel plants are assumed to generate on-site electricity by using a portion of the natural gas pipeline feed.

Table 2. Assumptions on fossil fuel used in fossil fuel scenario

Project	**Fossil fuel used if development is not grid connected**
Montney Basin Gas	NG in 30% efficient compressors
Horn River Basin Gas	NG in 30% efficient compressors
Cordova/Liard Basin Gas	NG in 30% efficient compressors
LNG Terminals & Pipelines	NG in 35% efficient on-site generators
New Mines	Diesel in 35% efficient on-site generators
Alternative Fuel Plants	NG in 35% efficient on-site generators

Assumptions for the electric grid scenario

This scenario assumes that

- The electricity grid will be expanded sufficiently to provide electricity to the projected developments within these six industrial sectors.
- The new power generation satisfying this new load will not change the present GHG emission intensity of BC Hydro's electricity supply. BC Hydro is developing plans that will comply with 93% clean energy requirement.
- Pipeline compressors that use electricity operate with 85% efficiency.

Factors

The natural gas emission factor used throughout this analysis represents pipeline-grade natural gas that has been processed. Natural gas combustion results in different GHG emissions depending on where it is combusted (i.e. before or after the natural gas has been processed). Combusting natural gas upstream of processing facilities will have a higher emission factor than that combusted downstream. This is because the unprocessed natural gas will contain other hydrocarbons that are removed during the processing stage. The most likely ratio of processed to unprocessed natural gas that would be used in the industrial developments in this analysis was not readily available. The simplifying assumption that all natural gas combusted in these developments would be processed is a conservative approach and could somewhat understate the GHG emission reductions from using grid power over fossil fuels.

Factors are derived from the following sources:

- Environment Canada. 2011. National Inventory Report 1990-2009 — Emission factors assume marketable natural gas produced in B.C. that is combusted in either pipeline or industrial applications.
- Statistics Canada. 2005. Report on Energy Supply and Demand in Canada — Natural gas energy content.

Caveats

This analysis has the following caveats:

- As a starting point, the Pembina Institute uses CanWEA's BC WindVision which is based on work performed by SDA. Pembina has not assessed the assumptions or calculations that were used to produce the electricity demand forecast by CanWEA or SDA.
- This analysis quantifies the GHG emissions from electrifying industrial activity in northeastern B.C. by extending the provincial grid to these areas and projects. This analysis does not consider the GHG emissions from non-electrifiable project activities (e.g. transportation activities using diesel or gasoline fuel) nor process or fugitive GHG emissions (e.g. GHG emissions from venting solution gas at natural gas processing plants). As such, while this analysis estimates the emission reductions achievable through aggressive electrification, the study should not be referenced to estimate the remaining GHG emissions from the projected developments in these six industrial sectors.

While this analysis focused on quantifying one type of benefit (decreased GHG emissions) from using B.C. grid power, several important questions were out of scope:

- What are the greenhouse gas emissions associated with the industrial development that are not suitable for electrification (e.g. formation carbon dioxide vented from gas processing plants)?
- What are the other environmental impacts of the industrial development projected in CanWEA's BC WindVision (e.g. water use and contamination from shale gas development)[6]?
- Looking beyond electrification and GHG emissions, what are other economic, social and environmental costs and benefits of the projected activities in these six industrial sectors? How do these costs and benefits compare to alternative scenarios, including different paces and scales of development for the six industrial sectors considered in this report?

The Pembina Institute has quantified these figures as a service to CanWEA. The results should not be taken as Pembina's endorsement or approval of any of these industrial activities.

Results

In their analysis, SDA forecasted the electricity demand from industrial development in B.C. and compared their forecast with BC Hydro's. This analysis quantifies the GHG emissions of meeting the electrifiable portion of the energy needs of the specified industrial developments, based on using either fossil fuels or grid electricity. The results are shown in Table 3 below.

Table 3. Comparison of GHG emissions using fossil fuels and grid electricity

Sector:	Demand Increase over BC Hydro GWH/yr		GHG emissions fossil fuel scenario (MT CO2e/yr)		GHG emissions electric grid scenario (MT CO2e/yr)		GHG emissions difference (MT CO2e/yr)	
	2017	2025	2017	2025	2017	2025	2017	2025
1 Montney Basin Gas	1,058	1,124	0.56	0.59	0.03	0.04	0.52	0.55
2 Horn River Basin Gas	1,767	2,935	0.93	1.54	0.06	0.09	0.87	1.45
3 Cordova/Liard Gas	0	1,334	0.00	0.70	0.00	0.04	0.00	0.66
4 LNG Terminals & Pipelines	2,856	6,459	1.51	3.42	0.09	0.21	1.42	3.22
5 New Mines	431	1,240	0.32	0.93	0.01	0.04	0.31	0.89
6 Alternative Fuel Plants	0	4,200	0.00	2.23	0.00	0.13	0.00	2.09
Total	6,112	17,292	3.32	9.41	0.20	0.55	3.13	8.86

GHG emissions will be reduced by approximately 3.13 MT CO_2e/year in 2017 and by 8.86 MT CO_2e/year in 2025 if the incremental energy demand that can be electrified is supplied using clean-energy-based grid power rather than fossil fuels. The reductions in 2025 are very significant,

[6] See for example: *Shale Gas in British Columbia: Risks to B.C.'s climate action objectives* http://www.pembina.org/pub/2264 and *Shale Gas in British Columbia: Risks to B.C.'s water resources* http://www.pembina.org/pub/2263.

equivalent to the energy-based GHG emissions from all fossil fuel industries (mining plus oil and gas extraction activities combined) in B.C. in 2009.

Clean electricity provides a strong opportunity to reduce the environmental impact of large industrial developments, such as those included in the *BC Jobs Plan*. However, any industrial development needs careful consideration in terms of both the appropriate pace and scale of the development and the opportunities for clean technology to mitigate negative impacts.