Estimated Production, Consumption and Surplus Mill Wood Residues in Canada - 2004

A National Report

Natural Resources Canada
Canadian Forest Service
Policy, Economics and Industry Branch

Forest Products Association of Canada

Forest Products Association of Canada fpac.ca
Association des produits forestiers du Canada fpac.ca

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CLIMATE CHANGE SOLUTIONS
"CONSULTING IN STRATEGY, ISSUES, MECHANISMS"

Executive Summary

The forest products industry has long been using mill residues as feedstock to process wood products and as a source of energy. With the development of new wood products, increasing energy prices and the implementation of the Kyoto Protocol, the demand for mill residues has grown to the point where there is little surplus left in several Canadian provinces while other provinces still have considerable residue surplus available.

In order to understand the potential of forest biomass in the manufacturing of wood products and the production of bioenergy, we need an accurate estimation of residue availability across Canada. While data is available to determine the volume of biomass used for energy generation in the wood products and pulp and paper sectors, up-to-date information on quantities of biomass residue produced and disposed of at wood products manufacturing sites is lacking. The following is an assessment of the amount of wood waste residues (bark, sawdust and planer shavings) that are produced, consumed and disposed of by the Canadian forest industry in 2004.

The mill residue inventory is a joint Canadian Forest Service (NRCan/CFS) – Forest Products Association of Canada (FPAC) project. The purpose of the study is to determine the surplus mill residues that may be available for others uses including the offset of fossil fuels and potential greenhouse gas (GHG) reduction. Existing bark/hog fuel piles were also estimated in the study.

This report is a roll-up of two studies covering the East (Ontario, Quebec, and the Atlantic provinces) and the West (British Columbia, Alberta, Saskatchewan, and Manitoba). The West, in particular British Columbia, is typified by large sawmills, many in excess of 300 MMfbm (million board feet) and as high as 500 MMfbm. Numerous smaller mills typify the East (where a mill producing 175 MMfbm would be considered large, and where many small mills exist that produce less than one million board feet annually).

Where feasible, the studies (East and West) make use of existing information to build an inventory estimate. Unfortunately, existing data are incomplete. A telephone survey was undertaken to determine production and availability of mill residues, beginning with large companies, followed by a random sample of lumber remanufacturers and of medium and small sawmills. For the western provinces (i.e. British Columbia, Alberta, Saskatchewan and Manitoba) sawmills representing 96 percent of 2004 lumber production were contacted. In the East (Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland & Labrador), due to a higher number of smaller sawmills, this proportion is lower, at 71 percent.

Summary of residue production and surplus

Canadian sawmills are responsible for the majority of forest mill residues produced. In 2004, lumber production in Canada was 35,510 MMfbm. Over 71 percent of this production occurred in British Columbia (47%) and Quebec (24%). Alberta and Ontario accounted for approximately 10% each. The coastal region of British Columbia was not

considered in this analysis because there are very little residues available in this region, if any. Therefore, the numbers shown in the following tables do not include the B.C. coast.

As shown in Table E1 and Figure E1, the 2004 annual Canadian production (excluding coastal B.C. and the Territories) of wood residues is estimated at 21.2 million bone-dry tonnes (BDt). The unused portion is estimated at 2.7 million BDt. This is less than half of the quantity determined by Brian McCloy in 1999 (5.9 million BDt). Most of the surplus is located in western Canada and particularly in B.C., the latter of which accounts for 66 percent of the Canadian estimated surplus (Table E2). While 11.5 million BDt of sawdust, shavings and bark is produced annually in eastern Canada, the unused surplus is estimated at 265,000 BDt.

Table E1- Canadian and Regional Estimated Residue Surplus – in 2004 (BDt)

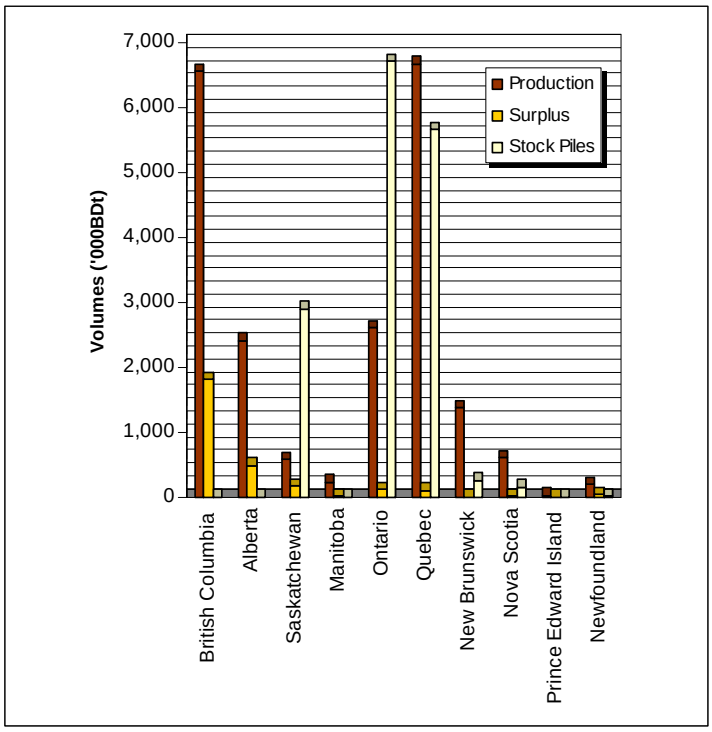
	Bark	Sawdust	Shavings	Total
Canada				
Production	11,553,549	5,355,054	4,319,934	21,228,536
Consumption				17,821,286
Exports				669,445
Surplus				2,737,805
Western Canada				
Production	5,169,983	2,632,900	1,960,886	9,763,769
Consumption				6,940,872
Exports				349,905
Surplus				2,472,992
Eastern Canada				
Production	6,383,566	2,722,154	2,359,048	11,464,767
Consumption				10,880,414
Exports				319,540
Surplus				264,813

As shown in Table E2, bark/hog fuel piles usable for energy production are estimated with less accuracy at 15.7 million BDt.

Table E2- Provincial Estimated Residue Surplus – in 2004

Province	Lumber production		Residue			
	MMfbm	Share of total	Production ('000 BDt)	Surplus ('000 BDt)	Share of total surplus	Estimated usable Bark Piles ('000 BDt)
British Columbia (Interior)	13,994	43%	6,554	1,815	66%	N.A.
Alberta	3,413	10%	2,406	481	18%	N.A.
Saskatchewan	501	2%	580	164	6%	2,900
Manitoba	270	1%	225	13	<1%	0
Ontario	3,698	11%	2,602	121	4%	6,712
Quebec	8,246	25%	6,669	100	4%	5,652
New Brunswick	1,712	5%	1,373	0	0%	257
Nova Scotia	756	2%	601	13	<1%	148
Prince Edward Island	45	<1%	24	1	0%	0
Newfoundland	120	<1%	195	30	1%	19
Canada (total)	**32,755**	**100%**	**21,229**	**2,738**	**100%**	**15,688**

Figure E1- Provincial Estimated Residue Surplus and Stock Piles – in 2004



Provinces

British Columbia

British Columbia has traditionally been the largest lumber-producing region of Canada. Surplus mill residues are produced primarily from large B.C. interior sawmills, which are responsible for more than 84 percent of B.C.'s annual lumber production in 2004. The coastal region does not produce any significant surplus residues and recently, it has been forced to import residues from the B.C. interior.

While the demand for wood residues has grown significantly in recent years in B.C., this demand has been offset by the increase in the AAC resulting from the mountain pine beetle (MPB) infestation and the concomitant increase in lumber production from mills located in this region. The MPB is still spreading and we should expect growth in wood residue production in the coming years with planned expansion of sawmills in the region. The estimated surplus in B.C. (1,814,955 BDt) is virtually all disposed in wood residue incinerators with small portion going into managed wood residue landfills. The region also exported over 350,000 BDt of residue to the United States and another 300,000 BDt of wood pellets to Europe in 2004.

Possible future energy projects to utilize the surplus wood residue include the conversion of sawmills from natural gas to hog fuel energy systems, wood pellet, board and panel manufacturing and stand-alone power generation. These projects could decrease the surplus available to virtually zero in some parts of the B.C. interior.

Alberta

The Alberta forest industry is concentrated in the western foothills and north central regions of the province while the residue surplus is primarily located in the north central region. Surplus residues in this province have declined in recent years. The estimated surplus residues in 2004 are estimated at 481,137 BDt; most of this volume is incinerated. Possible future projects for the residues include the conversion of lumber dry kilns to biomass.

Saskatchewan

The Saskatchewan forest industry is located in the northern half of the province. The provincial mill residue surplus is estimated at 579,500 BDt. In addition, there are a number of historical wood residue (bark/hog fuel) piles that have accumulated over the past two decades. These storage piles, estimated at 2,900,000 BDt, continue to grow and are a significant potential source of energy. A significant number of mills in the province are still using natural gas for heating purposes and could be converted to biomass-fuelled heat generation.

Manitoba

The Manitoba sawmilling industry is the smallest amongst the four western provinces. The volume of surplus residue, estimated at 13,000 BDt, is disposed of in wood residue incinerators.

Ontario

The Ontario lumber production in 2004 represented 10% of total production in Canada. Of the 2,601,773 BDt of residue produced in Ontario, only 120,937 BDt (< 5%) is surplus; over 95% of provincial residue production is used. This entire surplus is located in the Northwest region; no residue surplus has been identified in Ontario Northeast and South regions. The province has a sizeable amount of bark/hog fuel in existing piles, the bulk of it located in the Northwest region.

There is considerable competition for mill waste in Ontario as producers are increasingly able to find customers that will pay premium prices, forcing traditional users to pay higher rates for fibre. The spruce-pine-fir wood supply is predicted to fall below demand in 5 to 10 years and take 80 years to recover. The wood supply situation is threatening to close sawmills, which would further reduce the residue surplus; however, poor-quality wood may then become available for bioenergy.

With a minimum of surplus residue production in the province and an impetus to reduce energy production from fossil fuels such as coal, strategies are being reviewed to find more fibre for energy. Alternative sources of forest fibres, such as forest-floor residues, are being investigated in the province.

Quebec

Lumber production in Quebec was 8,426 MMfbm in 2004, almost 24 percent of Canadian production (second only to B.C.). Provincial residue production is estimated at 6,669,146 BDt. Of this total, only 100,000 BDt (1.5%) has been identified as surplus while 169,000 BDt (2.5%) is exported to the US.

The surplus in Quebec is likely to drop to zero in the next year or two, thanks to pending 20 percent reductions in AAC (translating to a reduction in harvest of 15-16 percent across all regions). An AAC reduction of this magnitude could result in sawmill and pulpmill closures and a decline in the production of mill residues.

Data in Table E2 show residue production level in Quebec comparable to production in B.C. even if B.C. produces over 60% more lumber. This can possibly be explained by a lower lumber recovery factor in Quebec because the province companies' primary investment has been in the pulp and paper sectors. The sawmill industry in Quebec produces more woodchips since companies have high interest in chip production to feed pulp mills. The opposite scenario prevails in the West; the primary driver is lumber production and not pulp and paper.

New Brunswick

New Brunswick sawmills produced 1,712 MMfbm in 2004, a little less than 5 percent of Canadian production. Provincial residue production is estimated at 1,373,418 BDt. The survey does not identify any residue surplus; the survey estimates exports to the US at 11 percent (150,000 BDt) of production. Reduction of exports could make available residue volumes for new forest bioenergy projects in the province.

Nova Scotia

Nova Scotia produced 756 MMfbm in 2004, just over 2 percent of Canadian production. The province produced an estimated 601,015 BDt of residue in 2004. Although word of mouth suggests that there is no surplus available and has not been for some time, the study estimated that 13,000 BDt was available. Two of the four bark/hog fuel piles in the province are being mined.

Prince Edward Island

With only three sawmills, lumber production in Prince Edward Island is very small. Residue production in PEI is estimated at 24,000 BDt with a surplus of 1,000 BDt.

Newfoundland

Newfoundland produced 120 MMfbm in 2004. Approximately 195,000 BDt of residue is produced annually in the province. Consumption is estimated at 165,000 BDt leaving a surplus of just under 30,000 BDt, which is landfilled.

Discussion

There is significant potential in non-traditional sources of residue. Many large piles of bark/hog fuel at sawmills and pulp mills have been ignored as too old or contaminated, but are drawing keen interest. Until five years ago, bark/hog fuel piles were considered an environmental problem, not a revenue source. With annual residue production almost completely committed, companies are looking at hog fuel piles with renewed interest. This is particularly the case in eastern provinces where bark/hog fuel piles are now being mined for energy production.

Although much of the mill residue can be purchased at a relatively low price in most regions in Canada, transportation costs are sometimes prohibitive, making the residue uneconomical to distant users. The economic radius of wood residue is greatly dependent

on the value of residue and the end product. For example, in western Canada, transportation of wood residues for power generation generally becomes prohibitive beyond a 200-km radius of a power generator while sawdust destined for a pulp digester is hauled over 500 km.

Ontario is looking closely at forest-floor biomass as a potential supply. With declining surplus in Quebec, interest may grow there also. A second source of residue for energy is chipper debris. Separate studies are needed to determine the potential of forest-floor and chipper debris.

Traditionally, producing bioenergy meant using residues to produce heat and power at sawmills, pulp mills and power stations. A fair share of the actual residue surplus in western Canada could be used in dry kilns to replace natural gas. A recent option is to develop pyrolysis bio-oil that can be transported easily at lower cost than raw residue. No steam host is needed, and plants can be built at a fraction of the cost of a large cogeneration plant. This option awaits success of the world's largest bio-oil plant, started up in West Lorne, Ontario in February 2005.

Large volumes of residue are exported to the US. A better domestic incentive system may keep residues in Canada to address our GHG emissions. Farmers use a significant proportion of sawdust and shavings for animal bedding. Alternative products may make available residue for energy.

Bioenergy development zones assessment of potential

When considering surplus annual mill residues and usable hog fuel from existing piles (but without regard to forest floor residue), the following may be considered zones for bioenergy development. Table E-3 list the potential zones of bioenergy development based on the estimated residue surplus and existing bark/hog fuel piles[1]. The zones listed are areas with abundant residue that can be access with relatively small transportation distances.

While Alberta and British Columbia have a number of zones with identified mill residue surplus, most of Saskatchewan, Ontario, Quebec, New Brunswick and Nova Scotia potential development zones are centred around bark/hog fuel piles.

[1] For British Columbia, Alberta, Saskatchewan and Manitoba, the consultant did not provide specific zones of surplus. For these provinces the information presented in the table is limited to regional surpluses.

Table E3- Potential zone of bioenergy development

Area	Surplus Residue Production (BDt per year)	Bark/hog fuel piles (BDt)
British Columbia:		
Cariboo region	206,483	
Kamploops region	204,905	
Nelson region	45,728	
Prince George region	1,073,839	
Prince Rupert region	284,000	
Alberta	481,137	
Saskatchewan	163,900	
Hudson Bay		400,000
Prince Albert		1.2 million- 2 piles
Glaslyn		700,000
Meadow Lake		150,000
LaRonge		500,000
Manitoba	13,000	
Ontario		
Dryden area	68,000	2.7 million- 3 piles
Thunder Bay area	40,000	Capped piles of unknown size
North of Superior	10,000	2.8 million- 4 piles
Hearst to Kirkland Lake	None identified	1.3 million- 9 piles
Pembroke area	None identified	360,000- 3 piles
Quebec		
Abitibi-Temiscaming	None identified	690,000- 9 piles
La Tuque	30,000	540,000- 4 piles
Chibougamau/Opitciwan	15,000	550,000- 2 piles
Lac St. Jean	10,000	None identified
Baie Comeau area	45,000	200,000- 2 piles
Gaspe	None identified	80,000- 2 piles
New Brunswick		
Edmunston	Reduce exports?	85,000- 3 piles
Moncton area	Reduce exports?	120,000- one pile
Nova Scotia		
New Glasgow	None identified	120,000- 2 piles
Prince Edward Island:	1,000	30,000
Newfoundland & Labrador		
Central region	15,000	75,000
Eastern region	15,000	75,000

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Introduction

The forest products industry has long been using mill residues as feedstock to produce wood products and as a source of renewable energy. Fully 55% of the energy consumed by the pulp and paper sector is biomass derived. The wood products manufacturing industry also uses a significant amount of biomass energy as a share of its overall energy consumption.

The environmental and economic implications of forest bioenergy reach further than the forest sector – biomass is Canada's largest non-hydro renewable source for electricity generation. The primary environmental benefits are lower greenhouse gas (GHG) emissions and better air quality. Biomass use provides more sustainable economic vitality to the operations and the local communities said operations support. As well, distributed renewable power generation displaces fossil fuel utility generation – providing a more sustainable and secure electricity supply.

With increasing energy prices and the implementation of the Kyoto Protocol, the demand for mill residues in the production of bioenergy has increase to the point where some regions are faced with mill residue shortages. The foundation for understanding the use and potential of biomass for bioenergy is an accurate estimation of its availability. The focus of this study is on the amount of wood waste residues (bark, sawdust and planer shavings) that are being generated, used or disposed of by forest products companies in Canada, and the resulting surplus in 2004.

Existing wood biomass inventory studies in Canada are becoming dated. Biomass supply-demand balances have changed as mills continue to fuel-switch away from high-cost fossil fuels to biomass. New wood products have provided a market alternative for residues, reducing surpluses further. Consequently, some volumes formerly available and surplus have found economic uses. In many areas of eastern Canada, demand for residues exceeds supply so that old bark/hog fuel piles are now being mined.

Although not considered in this study, forest-floor biomass is being looked at seriously as a source for energy. This trend is likely to continue into the foreseeable future. Rising world energy prices and the coming into force of the Kyoto Protocol are driving a renewed interest in the economics of forest biomass supply and bioenergy in Canada and abroad.

There is broad-based interest in bioenergy within governments and industry across Canada, and a number of multi-stakeholder research and/or consultation processes are gearing up to assess bioenergy potential from a number of perspectives. This analysis provides an important building block for further work in the area that will be carried out by a number of different organizations. While data is available to determine the volume of biomass used for energy generation in the wood products and pulp and paper sectors, up-to-date information on quantities of biomass residue produced and disposed of at wood products manufacturing sites is lacking.

This study is a joint Canadian Forest Service (CFS) – Forest Products Association of Canada (FPAC) effort. CFS and FPAC commissioned studies to assess forest mill

residues in Canada in 2004. Two consultants prepared the assessment, one covering eastern provinces (Ontario, Quebec, and the Atlantic provinces) and the other looking at western provinces (B.C., Alberta, Saskatchewan, and Manitoba). The B.C. coastal region and the territories (Yukon, NWT and Nunavut) were excluded from this study because there are very little surplus mill residues available in these regions.

This report is a roll-up of the two studies. Even though efforts have been made to standardize the analysis, difference still exists between the works of the two consultants. The report first presents the methodology and approaches used to gather the mill residue information. A quick overview of provincial lumber production in 2004 follows in Section two. Next, the report presents the provincial summary of forest mill residue production, consumption, exports and surpluses as well as estimates of the piles of residue (hog fuel). Due to their size and the importance of the forest sector in their economies, B.C., Ontario and Quebec were divided into sub-regions.

Section five highlights major trends and caveats. This section covers timber supply issues in B.C., Ontario and Quebec as well as potential for forest-floor biomass, types of bioenergy projects, alternative products and potential bioenergy development zones. The last section briefly discusses mill residue disposal costs, i.e. stock pilling, landfilling, incineration and associated transportation costs. A short conclusion follows. Four appendices are included in the report. They include: a list of questions asked in the mill residue survey, a list of mills surveyed, a map depicting the regional division of Quebec, and some background information on confidence-limit calculation.

1 Methodology

The purpose of this study is to determine the surplus mill residues that may be available for other uses including the offset of fossil fuels and potential GHG reduction. Where feasible, this report makes use of several existing studies in order to build a comprehensive inventory estimate. For example, Ontario, Quebec, New Brunswick and Newfoundland have studies of residues that were helpful in building a more up-to-date and complete estimate.

Unfortunately, Statistics Canada does not provide a survey of mill residues other than pulp chip production and shipments. Volumes of bark, sawdust, planer shavings and chip fines are not surveyed even though there is a market in some instances for these mill residual products. While massive sawmills typify B.C., often with capacities larger than 300 million board feet measure (MMfbm) and as high as 500 MMfbm, the East is typified by hundreds of small mills which together comprise a meaningful proportion of a province's production. As such, it is more difficult to get a complete picture of residues in the East. A telephone survey was undertaken to determine production and availability of mill residues, beginning with large multi-mill companies, i.e. primary sawmills, plywood mills, pulp mills with wood rooms and a sampling of lumber remanufacturers. For the eastern provinces, a random sample of medium and small sawmills was also surveyed, to achieve an effective representation of the whole population. A data template was often emailed to companies; however, emailed reports often are returned with missing or questionable data. By telephoning, one tends to get a better feel for the quality of data. Table 1 summarizes the extent of this survey by province.

Table 1: Summary of Wood Residue Survey Information Compared to Actual Mill Production by Province

Province	2004 Lumber Production		Share surveyed (%)
	Actual MMfbm	Surveyed MMfbm	
Western provinces	**18,169**	**17,375**	**96%**
B.C. (excludes coastal B.C. mills)	13,994	13,411	96%
Alberta	3,404	3,259	96%
Saskatchewan	501	465	93%
Manitoba	270	240	89%
Eastern provinces	**14,757**	**10,424**	**71%**
Ontario	3,698	2,964	80%
Quebec	8,426	5,339	63%
New Brunswick	1,712	1,292	75%
Nova Scotia	756	676	89%
Newfoundland	45	45	100%
Prince Edward Island	120	108	90%
Total	**32,926**	**27,799**	**84%**

Where available, total mill residues were divided into bark, sawdust and planer shavings components. In the survey, some companies had data readily available for bark, sawdust and shavings. Other companies had only a vague notion of volumes, and often could not

distinguish proportions of bark, sawdust and shavings. Where mills were unable to determine this split, if agreed by the company, appropriate factors were applied to determine the breakdown of total mill residues. In some instances mills were unable to determine their total mill residues, especially the portion going to an incinerator or landfill, as typically these residues are not weighed. In many regions of western Canada, there is no market for mill residuals and they are simply incinerated as waste or landfilled. In these instances regional average residue factors were applied to estimate total mill residues.

For pulp mill residues, the 2002 FPAC Energy Monitoring Report was used, corroborated by data provided by companies with pulp mills. The study also surveyed major residue consumers in regions to gain an understanding of the major users (not to achieve a residue balance, which is outside the survey terms of reference).

In addition to the sawmilling industry, all pulp mills, plywood mills and OSB mills in the surveyed region were contacted to determine their production as well as their consumption of wood residues. Most pulp mills with wood rooms typically purchase additional amounts of hog fuel to supplement their own hog fuel generation. OSB and plywood mills tend to self-generate sufficient wood residues to satisfy their thermal heat requirements. A number of plywood mills also generate power in addition to their steam heat requirements. Other purchasers of wood residues including, MDF, particle board, sawdust pulp digesters, wood pellet manufacturers and independent wood residue power generators were also contacted as a cross-check against sawmill reported sales of wood residues.

Actual mill residue information was obtained from sawmills representing 96 percent of western Canadian[2] and 71 percent of eastern Canadian 2004 lumber production. Although share of production surveyed in eastern Canada is lower than western Canada, the study produced accurate estimates. For Ontario and Nova Scotia, with companies totalling 80 and 89 percent respectively of provincial lumber production supplying data for the survey, an accurate estimate of residue production and surplus within 3-5 percent is possible based on the survey alone. In Quebec, there are 1,200 sawmills, yet telephoning every mill is unnecessary to achieve accurate estimates. Data from 72 sawmills, including all of the largest and a random sample of smaller mills, was corroborated with a 2002 bark study of all Quebec mills, sufficient to produce an accurate estimate of residues within 3-4 percent. New Brunswick forests have a greater conformity than the larger provinces, so that a survey of 21 mills encompassing 75 percent of production is sufficient to develop an accurate estimate of residues. In Newfoundland & Labrador a study has just been conducted for the Ministry of Forestry, and though not public, sufficient data has been acquired to estimate residues within 1-2 percent.

Primary treatment pulp sludge estimates are included for B.C. pulp mills. Pulp sludge is a high moisture content fuel (lower than 60%) and therefore has a low heat value (below 12GJ/t). Pulp sludge is typically land filled at mills with aerated stabilization basins. In high rate systems, that must be regularly cleaned, sludge is typically mixed with drier hog fuel and fed to pulp mill power boilers.

[2] This survey excludes B.C. coastal sawmills as there is very little surplus mill residues available.

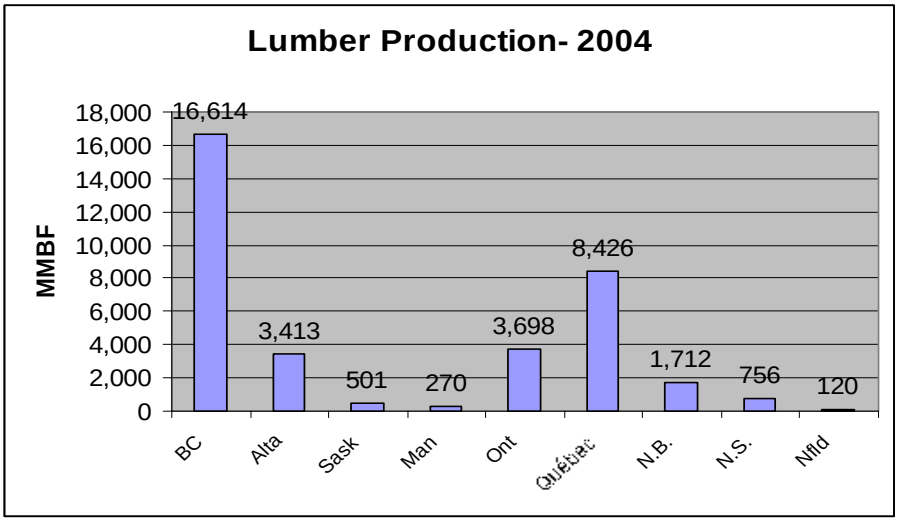
Hog fuel piles are difficult to determine both size and quality, and thus estimates are general. Some have been tested and determined to be entirely usable for energy, except for the top metre.

Summaries are provided for provinces and where applicable provincial sub-regions. In some instances there are residue volumes imported and exported between provinces and between regions within a province. Due to the amount of residue crossing into different regions and provinces, exports are shown only as exports to the US. Moreover, there were sometimes discrepancies between consumption estimates and shipments from producing sawmills. Consequently, the regional consumption estimates may not always agree with the listing of major consumers due to this factor.

2 Overview of lumber production

In 2004 lumber production in Canada was 35,510 MMfbm[3]. Fully 81 percent of Canada's lumber production was from three provinces, i.e. B.C., Ontario and Quebec. As shown in Figure 1, almost half (16,614 MMfbm), was produced in B.C., 8,426 MMfbm (24%) was produced in Quebec, 3,698 MMfbm (10%) in Ontario and 3,413 MMfbm (9.6%) in Alberta. The Maritimes was responsible for 7.3 percent of the Canadian lumber production.

Figure 1: Lumber Production- Canada, 2004



Canadian sawmills are responsible for the majority of mills residues produced in Canada. Plywood mills, pulp mills with wood rooms and oriented strand board mills also generate significant residues but these mills generally consume all of their residues for heat and power generation. Surplus mill residues are almost exclusively the domain of the sawmilling sector and to a much lesser degree, the sawmill remanufacturing industry.

In the period 2002-04, lumber production in Ontario, Quebec and Nova Scotia has been declining partially due to wood shortages and partially as an outcome to the Canada-US lumber dispute, which effectively limits US imports due to duties. New Brunswick has increased production over the period. B.C. and Alberta have increased production substantially, B.C. to utilize fibre that may otherwise be lost as a result of the mountain pine beetle infestation. PEI is not on this Statistics Canada database, but has production of approximately 45 MMfbm.

[3] Statistics Canada- Catalogue 35-002 and 35-003

Table 2: Provincial Lumber Production (MMfbm)

Province	2000	2001	2002	2003	2004	Change 2002-04
British Columbia	13,267	13,818	15,044	15,012	16,614	10%
Quebec	7,475	8,111	8,641	8,200	8,426	(2%)
Ontario	3,002	3,615	3,983	3,770	3,698	(7%)
Alberta	2,671	2,899	3,025	3,204	3,413	13%
New Brunswick	1,434	1,522	1,658	1,607	1,712	3%
Nova Scotia	732	626	793	712	756	(5%)

The following section presents an analysis of forest mill residue production, consumption and surplus, including a brief description of the provinces wood processing industry. It also provides volume estimates of usable the bark/hog fuel piles in each province.

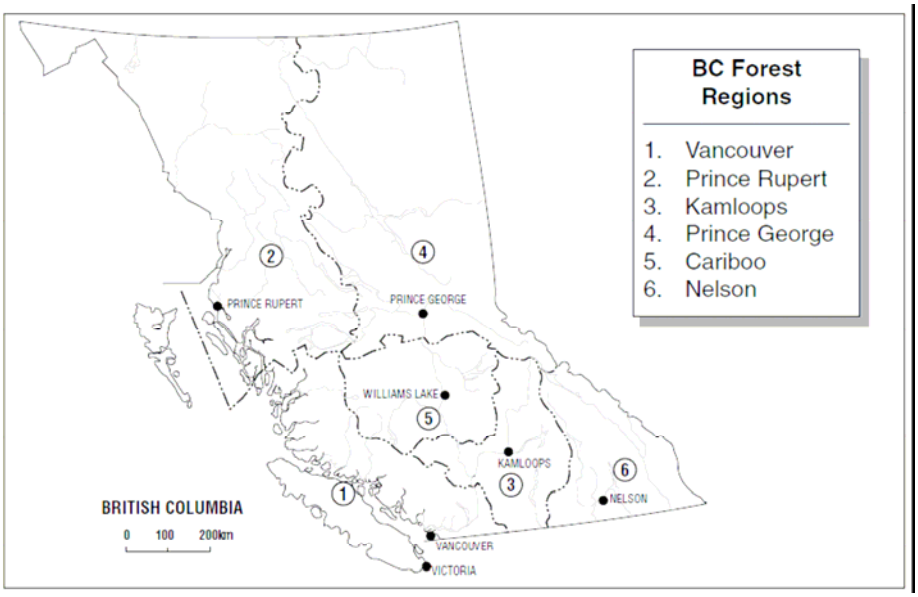
3 Provincial analysis

3.1 British Columbia

British Columbia has traditionally been the largest lumber producing Region of Canada. It is also Canada's largest producer of softwood plywood and softwood kraft pulp. Surplus mill residues are produced primarily from large primary B.C. interior sawmills that produced more than 84 percent of B.C.'s annual lumber production in 2004. The coastal region, unlike the interior region, does not produce any significant surplus residues. This is a result of the evolution of the coastal industry where pulp mill consumption of wood residues has traditionally been in balance with sawmill production of wood residues. In recent years this became a negative balance and companies such as Norske Canada have been forced to import sawdust from the B.C. interior for their pulp digester at Campbell River. For this reason, the coastal region was not included in this study of surplus wood residue availability.

The province of British Columbia is divided in six forest regions: Prince Rupert, Prince George, Cariboo, Kamloops, Nelson and Coast (see Figure 2). On Figure 2 the coastal region is the same as the Vancouver region.

Figure 2: British Columbia Forest Regions



While the demand for wood residues has grown significantly in recent years, this demand has been offset in the Cariboo, Prince George and Prince Rupert Regions by the increase in the AAC resulting from the mountain pine beetle epidemic and the concomitant increase in lumber production from mills located in these three regions. As a result, the world's largest sawmill (500 MMfbm annually) is now located at Houston, B.C. However, planned expansion of Canfor's nearby Plateau mill will surpass the production of their Houston mill.

Total B.C. interior production of wood residues is estimated at 6,553,754 BDt in 2004.

Table 3: B.C. Interior Summary of Mill Residue Production, Consumption, Exports and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	2,981,633	2,057,163	1,514,958	6,553,754
Consumption				4,388,894
Export				349,905
Surplus				1,814,955

Consumption is estimated at 4,388,894 BDt and exports at 349,905 BDt leaving an estimated surplus of 1,814,955 BDt that is virtually all disposed of in wood residue incinerators[4]. The surplus availability has not changed appreciably since a 2003 update prepared for NRCan despite an almost 1.0 million BDt increase in residue consumption since the last update. The primary reason for this situation is the increase in lumber production and residue availability as a result of mill expansions attributable to the mountain pine beetle epidemic.

The export of unprocessed mill residues from the Nelson and Kamloops regions to the United States has also grown significantly in recent years and is now estimated at almost 350,000 BDt. In addition, there is an estimated 400,000 BDt of processed wood pellets produced in B.C. in 2004 with an estimated 300,000 tonnes shipped to Europe.

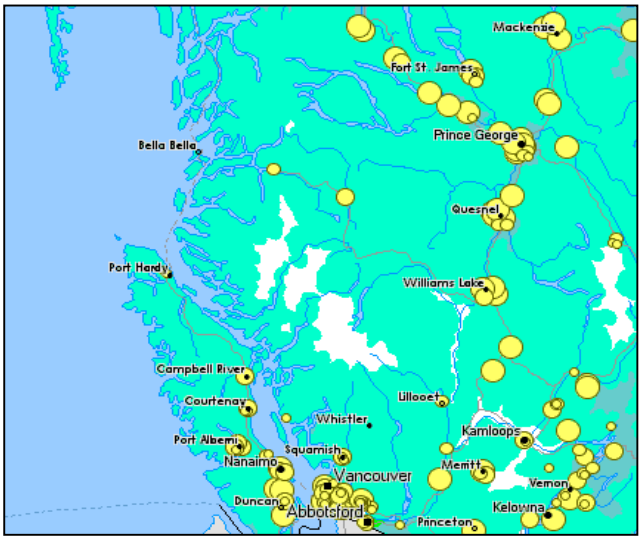
The following sections present British Columbia forest region residue analysis.

3.1.1 Cariboo Region

The Cariboo Region is centred in Williams Lake and stretches west to the Coast Mountain range, east to Quesnel Lake, south to Clinton and north to Quesnel.

[4] There are a few managed wood residue landfills in B.C. but most are contaminated with soil and other over burden and are therefore of questionable use for energy purposes.

Figure 3: Location of Sawmills in the Cariboo Region[5]



Mills in the Region generated 1,186,600 Bdt of combined hog fuel in 2004, including 627,500 Bdt of whitewood sawdust and shavings and 559,100 Bdt of bark. The two area pulp mills produced an estimated 14,000 Bdt of primary sludge.

Table 4: Cariboo Region Summary Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	559,100	351,000	276,500	1,186,600
Consumption				980,117
Surplus				206,483

Major consumers of wood residue include:

- NW Energy's 65 MW power generation plant in Williams Lake that utilizes 380,000 Bdt of hog fuel annually;
- West Pine MDF in Quesnel that consumes 210,000 BDt of primarily sawdust and shavings for heat and product production;
- Regional wood pellet producers that annually consume approximately 120,000 BDt of primarily planer shavings;
- Cariboo Pulp in Quesnel that utilized 109,000 BDt of hog fuel in its power boiler in 2004 and
- Sawmill wood energy systems for kiln drying lumber that consumed 228,000 BDt of planer shavings.

The net surplus in the Cariboo Region is 206,483 BDt that is primarily bark in origin and disposed of in wood residue incinerators. Virtually all of the Region's residues are

[5] Map inserts are the product of Natural Resources Canada. The circles show sawmill locations whose production exceeds 10 000 cubic metres of lumber per year. The circles further indicate the relative size of the mill. http://atlas.gc.ca/site/english/maps/environment/forest/useforest/sawmills

produced from 12 sawmills with an average annual production of 250 MMfbm. The region also supports two plywood mills that consume most of their residues in mill steam energy systems.

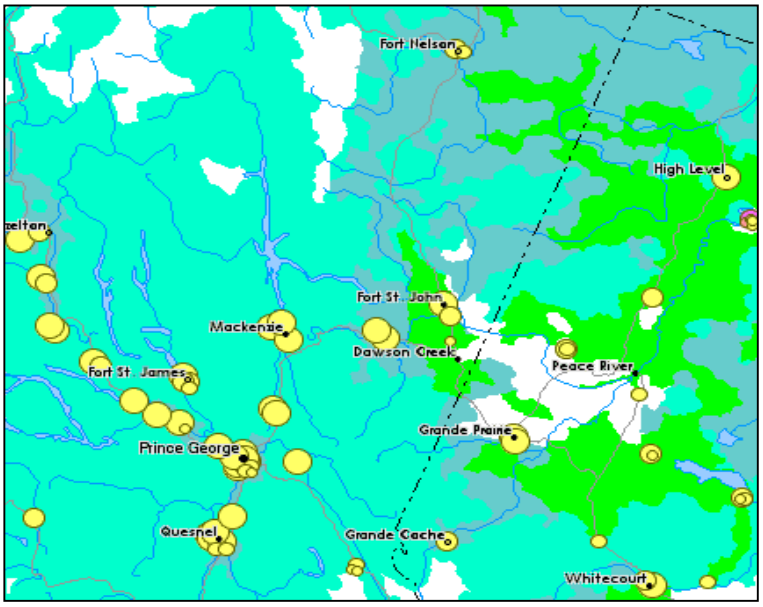
Possible future energy projects include the conversion of 6 sawmills from natural gas to hog fuel energy systems. This would utilize approximately half of the remaining surplus.

Some growth of available wood residue is expected in future years as a result of sawmill expansions that are underway to deal with increases in the AAC resulting from the mountain pine beetle attack that is still rampant throughout the Region. In this regard, West Fraser has recently announced the construction of a new mill in Quesnel that will produce over 500 MMfbm annually.

3.1.2 Prince George Region

The Prince George Region is the largest in the Province, stretching from Quesnel to the Yukon border and from Burns Lake in the west to the Alberta border in the east.

Figure 4: Location of Sawmills in the Prince George Region



The Region mills generate 2,670,839 BDt of combined hog fuel annually, including 1,464,126 BDt of whitewood sawdust, shavings and pulp mill fines and 1,162,713 BDt of bark. The six area pulp mills also produce approximately 50,000 BDt of primary sludge from wastewater treatment facilities annually.

Table 5: Prince George Region Summary Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	1,206,713	859,331	604,795	2,670,839
Consumption				1,597,000
Surplus				1,073,839

Major consumers of this wood residue include:

- Pope and Talbot's Mackenzie pulp mill sawdust digester that consumes 260,000 BDt of sawdust;
- Regional pulp mills which annually consume 769,000 BDt of combined hog fuel and chip fines in their power boilers for combined heat and power production;
- Regional sawmills, OSB and plywood mills that annually consume 329,000 BDt of sawdust and shavings in mill thermal energy systems;
- Prince George region wood-pellet manufacturers that consumed 240,000 BDt of sawdust and shavings in 2004.

Despite the significant increase in residue consumption in recent years, the net available surplus wood residues in the Prince George Region have increased to 1,073,839 BDt, more than half of which is bark. However in the Ft. St. James, Chetwynd and Ft. St. John areas, there are still an estimated 200,000 BDt of surplus sawdust and shavings.

The surplus wood residues are produced by 23 large primary sawmills located in the Region. Due to the demand for wood residues by pulp mills in the city of Prince George, most of this surplus is located west of Prince George and in the Chetwynd/Ft. St. John area. Surplus mill residues are disposed of in on-site wood residue incinerators. Sawmills in the Prince George region are among the largest in the world with most large mills now producing in excess of 300 MMbfm annually. Further expansions of sawmilling capacity are now underway driven by increases in the AAC resulting from the mountain pine beetle epidemic and the industry's desire to consolidate lumber production. A planned expansion of Canfor's Plateau sawmill, for example, will increase the size of this mill to more than 600 MMfbm – making it the largest sawmill in the world.

The mountain pine beetle epidemic is still spreading in the western portions of the Prince George Region. The provincial Ministry of Forests has recently awarded two 700,000 cubic metre per annum Timber Sales to Ainsworth Industries. Ainsworth operate an OSB facility in 100 Mile House based primarily on pine furnish. Ainsworth will likely build one or more new OSB plants in the Prince George area in response to these awards. New OSB mills are designed to be thermal energy self-sufficient based on the consumption of self-generated residues. Therefore, the impact of these mills on surplus residue supply should be neutral.

Canfor's Prince George Pulp facility is currently completing a 48 MW cogeneration project. It is expected that this project will consume an additional 200,000 BDt of hog fuel from mills within a 200 km radius of Prince George. Consequently, available wood residue for future projects within this radius will be limited.

There are several possible opportunities to utilize the surplus wood residues in this region:

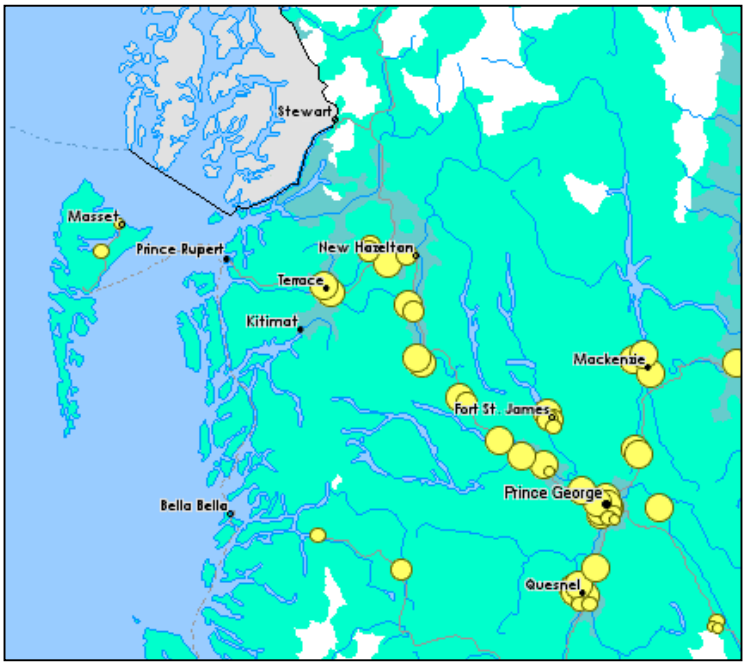
- Seven of the 23 large primary sawmills still use natural gas rather than their own wood residues for lumber drying. Converting these mills to wood residue would reduce surplus wood residue by an estimated 150,000 BDt annually.

- There is likely sufficient surplus residue to conservatively support an additional 60 MW of power production in the Region.
- Wood pellet manufacturers are considering new pellet mills within the region. Some manufacturers are also considering the marketability of hog fuel wood pellets. Should this prove feasible, all of the remaining bark in the Region could potentially be made into wood pellets and sold into the burgeoning European market.

3.1.3 Prince Rupert Region

The Prince Rupert Region covers the Northwest corner of the Province and includes the North Coast, inland east to Burns Lake and north to the Alaska-Yukon border.

Figure 5: Location of Sawmills in the Prince Rupert Region



The Regional mills generate 625,000 BDt of wood residue including 363,000 BDt of sawdust and shavings and 262,000 BDt of bark. The one regional pulp mill produces approximately 10,000 BDt of primary sludge annually.

Table 6: Prince Rupert Region Summary Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	262,000	195,000	168,000	625,000
Consumption				341,000
Surplus				284,000

Major consumers of this wood residue include:

- West Fraser's Eurocan pulp mill which consumes 93,000 BDt of sawdust in its sawdust digester and 67,000 BDt of combined hog fuel in its power boiler;
- A regional particleboard mill in Smithers that annually consumes 75,000 BDt of sawdust and shavings and;
- Regional sawmills that consume 106,000 BDt in mill energy systems.

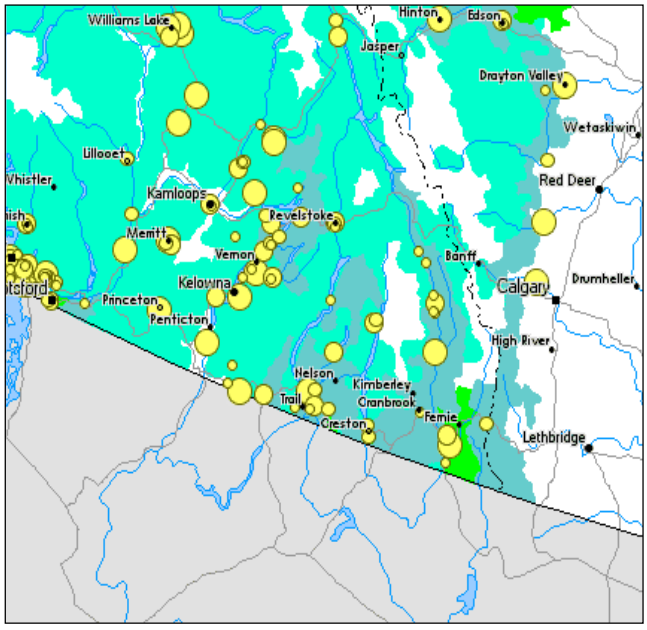
The current net available surplus in the Prince Rupert Region is 284,000 BDt that is currently being disposed of in wood residue incinerators. This surplus is expected to increase in coming years due to significant increases in the milling capacity of regional sawmills in reaction to the mountain pine beetle epidemic that has its epicentre within the region. Wood residue production comes from five large regional sawmills that now produce an average 300 MMfbm annually. Canfor's Houston mill produces in excess of 500 MMfbm. In addition to the annual surpluses generated by regional sawmills, there is a large pile of hog fuel located at the former Skeena Cellulose pulp mill in Prince Rupert that accumulated for a number of years. Further investigation will be required to determine the quantity and quality of this resource.

Future wood residue projects will likely include the construction of a pellet mill as well as planned expansion of West Fraser's cogeneration facility at their Eurocan pulp mill. The Eurocan project is not expected to significantly increase hog fuel consumption as the increased power is primarily the result of efficiency improvements to the boiler. Over the past decade there have been several proposals that considered cogeneration at Houston. The project proponents in most instances were independent power producers that eventually withdrew from the projects for a number of reasons including the lack of guarantee of a long term fibre supply.

3.1.4 Kamloops

The Kamloops Region extends from Lytton-Lilloett in the west to the Okanagan-Kettle Valley in the east and from Clearwater in the north, south to the US border.

Figure 6: Location of Sawmills in the Kamloops Region



Regional mills generated approximately 1,395,405 BDt of wood residues in 2004. This total includes 721,805 BDt of sawdust and shavings and 637,600 BDt of bark. In addition the Kamloops pulp mill generates 11,000 BDt of primary sludge annually.

Table 7: Kamloops Region Summary Mill Residue Production, Consumption, Exports and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	637,600	437,005	284,800	1,359,405
Consumption				1,094,500
Exports				60,000
Surplus				204,905

Major consumers of residues in the Region include:

- Weyerhaeuser's pulp mill in Kamloops that consumes 537,000 BDt of sawdust and hog fuel annually.
- Tolko's Armstrong plywood and sawmill complexes at Kelowna and Armstrong that consume an estimated 343,000 BDt to produce heat and power.
- Three wood-pellet plants consume 114,000 BDt of sawdust and shavings.

The current net available surplus in the Kamloops Region is estimated at 204,905 BDt that is currently being disposed of in wood residue incinerators. Sawmill capacity is expected to increase in coming years due to the presence of the mountain pine beetle in the Region but to a lesser degree than the Prince George and Prince Rupert Regions that will increase residue production. In 2003, the Provincial Chief Forester announced a temporary three year increase in the Kamloops Timber Supply Area for the salvage of fire-damaged timber - up to 670,000 cubic metres a year for the next three years and a

further 1 million cubic metres a year increase in the AAC for the next three years for the control and salvage of mountain pine beetle infestations.

There is also likely to be some consolidation of the sawmilling industry (closure of small mills and additions to larger mills) but this should not significantly impact on surplus wood residue availability. Unlike other B.C. Interior Regions, few sawmills in the Kamloops region have wood energy systems to dry their lumber. There is a significant opportunity within this region to convert sawmills from natural gas to wood energy systems that could decrease the surplus to virtually zero and potentially decrease the current volume available to consumers such as the Weyerhaeuser pulp mill and wood pellet producers.

Like the Nelson Region, part to the Kamloops Region borders the US border. At least one mill in the Region is shipping hog fuel to a Washington State based power generator.

3.1.5 Nelson

The Nelson Region is located in the southeast corner of the Province stretching from Midway in the west to the Alberta border in the east and from the US border north to Revelstoke and Golden.

Mills in the Region generated 711,910 BDt of wood residues including 531,047 BDt of sawdust and shavings and 316,220 BDt of bark in 2004. The two area pulp mills produce 7,000 BDt of primary sludge.

Figure 7: Location of Sawmills in the Nelson Region

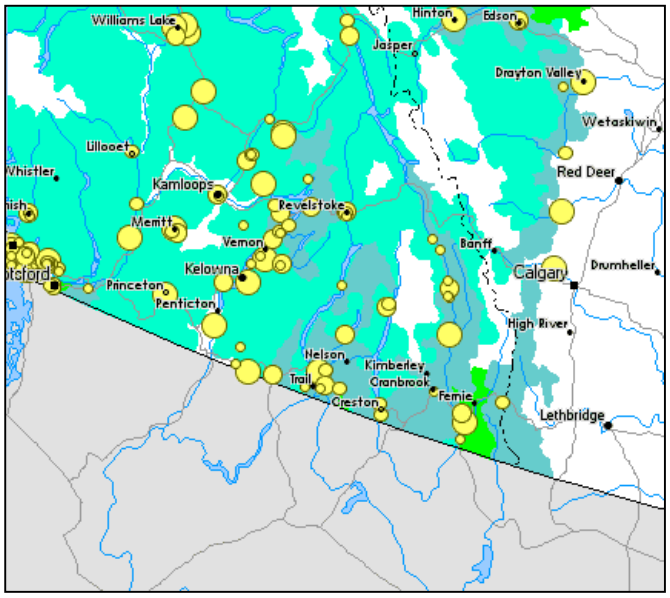


Table 8: Nelson Region Summary Mill Residue Production, Consumption, Exports and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	316,220	214,827	180,863	711,910
Consumption				376,277
Export				289,905
Surplus				45,728

Major consumers of wood residue in the Region include:

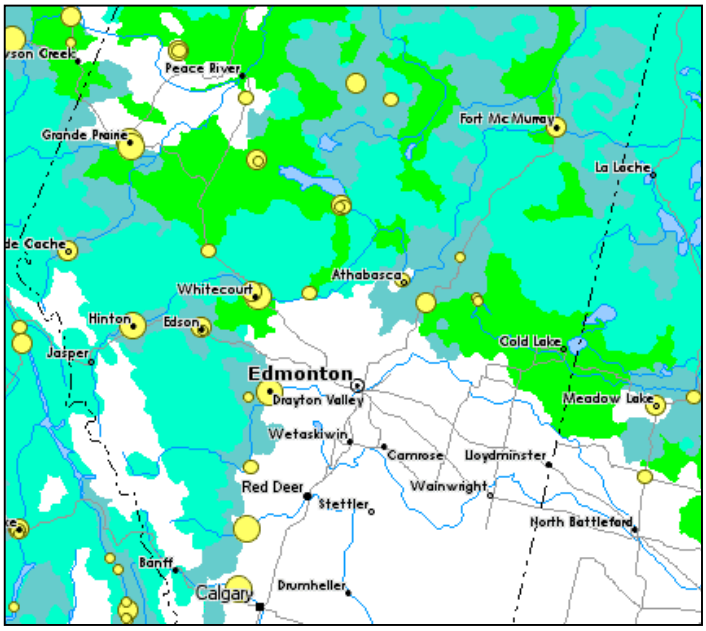
- Canpar's particleboard plant at Grand Forks that consumes 127,000 BDt of shavings and chip fines annually;
- Evans Products wood residue co-generation facility at their Golden plywood mill that consumes an estimated 17,000 BDt for heat and power production.
- Tembec's Skookomchuck pulp mill that consumes an estimated 160,000 BDt annually for heat and power production.
- Regional sawmills that consume 72,000 BDt in wood energy systems for lumber kiln drying.

In addition to Regional consumption of wood residues, there is an estimated 290,000 BDt of residues exported to a combination of US power plants, sawdust pulp and MDF manufacturers. The net available surplus in the Nelson Region is estimated at 45,728 BDt of primarily bark residue that is currently being disposed of in wood residue incinerators. Given the relatively small surplus residue availability, the only regional opportunities are likely to be further conversion of sawmill kilns from natural gas to wood residues.

3.2 Alberta

The Alberta forest industry is concentrated in the western foothills and north central regions of the Province. Alberta is the fourth largest primary lumber producer in Canada and one of the largest producers of oriented strand board.

Figure 8: Location of Sawmills in Alberta



The Province's mills produced 2,405,615 BDt of residue in 2004.

Table 9: Alberta Summary of Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	1,566,549	472,238	366,828	2,405,615
Consumption				1,924,478
Surplus				481,137

Major consumers of wood residue include:

- Three provincial independent power generators that consume a combined 358,000 BDt.
- Four kraft pulp mills that consume 761,000 BDt for heat and power generation.
- An MDF facility that consumes 216,000 BDt for product production.
- OSB and sawmill energy systems that consume an estimated 453,000 BDt.
- Two wood pellet producers that consume 31,000 BDt.

Surplus residues have declined significantly since the last survey conducted by the Alberta Forest Products Association (AFPA) in 1998 and now consist primarily of bark residues with the exceptions of High Level and Ft. McMurray where the full spectrum of mills residues is still available. At that time of the AFPA report, estimated surplus residues were approximately 889,000 BDt. The surplus residues in 2004 are estimated at 481,137 BDt and located primarily in the north central portion of the Province that is currently being disposed of in wood residue incinerators. More than half the Provincial

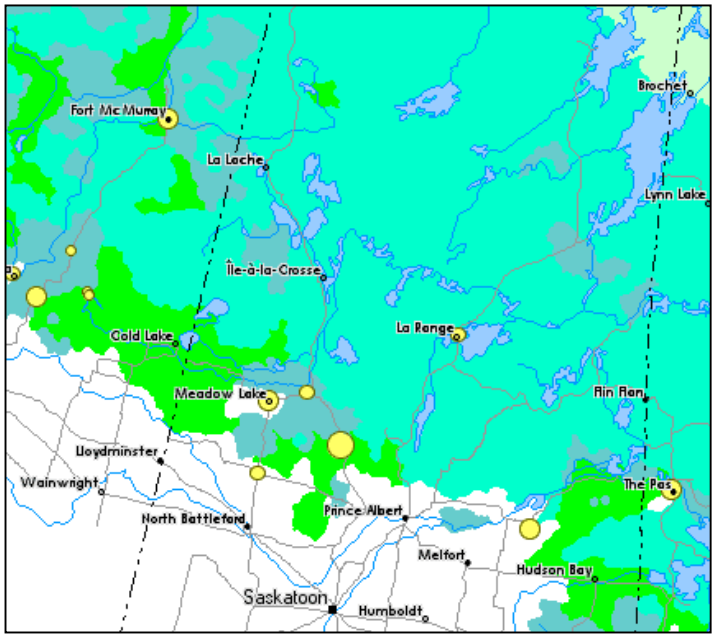
surplus residues are located in the northern portion of the Province in the communities of Slave Lake, High Level and Fort McMurray.

Because of the relatively inexpensive natural gas supply, most lumber dry kilns at sawmills in Alberta were designed to use natural gas rather than their own wood residues. At today's gas prices, the conversion of mills to wood energy systems is an obvious potential use for surplus wood residues. There is also some interest in a possible cogeneration facility in High Level but the available residue may not support an economically viable project. Conversion of sawmills to natural gas would utilize the available surplus residue at many Alberta sawmills. However, at High Level and Ft. McMurray, kiln conversion would only utilize approximately 45,000 BDt of the available surplus residues.

3.3 Saskatchewan

The Saskatchewan forest industry is located in the northern half of the Province. Major producing and consumption centres include Prince Albert, Meadow Lake and Hudson's Bay.

Figure 9: Location of Sawmills in Saskatchewan



The Province's mills produced an estimated 579,500 BDt of residues in 2004.

Table 10: Saskatchewan Summary of Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	465,000	64,500	50,000	579,500
Consumption				415,600
Surplus				163,900

Major consumers include:

- Weyerhaeuser's Prince Albert pulp mill that consumes 202,000 BDt annually.
- Mill wood energy systems that consume an estimated 200,000 BDt annually.

In addition to the annual surplus mill residues there are a number of historical wood residue piles that have accumulated over the past two decades. Unlike other Provinces, wood residue incinerators were not common in earlier years. Rather, mills decided to store residues adjacent to mills, as land for storage was readily available. The following table indicates the size of some of the larger storage piles.

Table 11: Saskatchewan Summary of Historical Residue Piles (est. 2004)

Storage Pile	Location	Bdt
Weyerhaeuser	Hudson Bay Wood Residuals	400,000
Weyerhaeuser	Prince Albert Pulp & Paper	1,000,000
L&M Wood	Glaslyn	700,000
Clearwater FP	Meadow Lake	150,000
Provincial FP	Prince Albert	150,000
Zelensky Bros	LaRonge	500,000
Total		**2,900,000**

These storage piles continue to grow and are a significant untapped source of future energy that could potentially be mined for energy purposes[6]. A 2001 analysis indicated that two of the more significant fuel piles had an average heat value of 15 GJ/t compared to fresh wood residue @ 20 GJ/BDt. The potential heat value of 2.9 million tonnes in storage is therefore 43.5 million GJ. If all of this energy were used to offset natural gas, GHG emissions would be reduced by 2.1 Mt.[7]

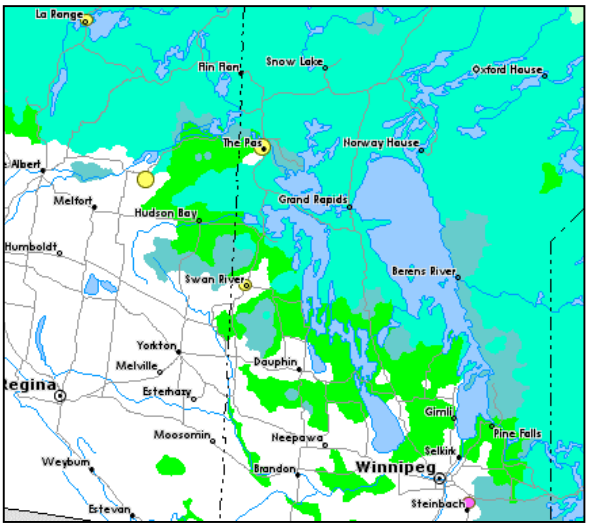
In addition to potential energy projects focused on the storage piles, there are several Saskatchewan mills still using natural gas rather than their own wood residues for heating purposes. Conversion of these mills to self-generated wood residues is an obvious priority that could reduce current annual surplus residues by approximately one-third.

3.4 Manitoba

The Manitoba sawmilling industry is the smallest amongst the four western Provinces. Total lumber production in 2004 was 270 MMfbm. More than half of the total lumber production comes from Tolko's sawmill at The Pas. The remaining production comes from mills nearby The Pas as well as smaller mills in Swan River and the southeast corner of the Province adjacent to the Ontario border.

[6] The current annual rate of growth of the residue piles is difficult to estimate as a number of mills have installed wood residue incinerators and no longer landfill their residues.
[7] http://www.saskforestcentre.ca/index.php?f=news&item=6&from=26

Figure 10: Location of Sawmills in Manitoba



The Province's mills produced an estimated 224,900 BDt of residues in 2004.

Table 12: Manitoba Summary of Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	156,800	39,000	29,100	224,900
Consumption				211,900
Surplus				13,000

Major consumers include:

- Tolko's The Pas pulp mill that consumes 104,000 BDt annually.
- Mill wood energy systems that consume an estimated 94,000 BDt annually.

Surplus wood residues are disposed of in wood residue incinerators.

3.5 Ontario

In Forestry studies the province often considers three regions (see Figure 11), so this study does also:

- Northwest, encompassing the areas surrounding Kenora and Dryden to Atikokan-Thunder Bay, and north of Lake Superior to Marathon
- Northeast, encompassing that area from Wawa on Lake Superior Shore east to the Quebec border, south to Lake Huron and north to Hearst-Kapuskasing
- South, Ontario south and east of Sudbury

Figure 11: Ontario Forest Regions

Ontario lumber production in 2004 was 3,698 MMfbm, 10.4 percent of the Canadian total. Three companies dominate lumber production: Buchanan, Tembec and Domtar. Combined they produce 60 percent of the province's lumber production.

As shown in Table 13, the Northwest and Northeast boreal regions are dominated by large softwood sawmills (over 50,000 m^3 of wood), while the south is dominated by small (<5,000 m^3) and medium sized (5,000-50,000 m^3) sawmills, often hardwood. There are 11 veneer operations and 13 panel/board mills.

Table 13: Ontario Sawmills, Veneer, Panel & Board Mills

	Northwest	Northeast	South	**Ontario**
Sawmills				
Large (>50,000 m³)	12	23	7	**42**
Medium (5-50,000 m³)	5	12	49	**66**
Small (<5,000 m³)	4	9	21	**34**
Total	**21**	**44**	**77**	**142**
Veneer	2	6	3	**11**
Board mills	5	6	2	**13**

To estimate regional lumber production and residue volumes, four main sources are used:

- The Ontario Ministry of Natural Resources Electronic Facilities Annual Return8.
- The FPAC Energy Monitoring Report- 20039.
- FPAC Environmental Resurvey- 2003
- Telephone and email survey of mills in the province

[8] The OMNR database is developed from a survey of mills, but is incomplete. Data from 2002 and 2003 is undergoing verification, and it is not known what data is missing. There is no data on internal usage of residue or exports.

[9] The FPAC report covers pulp mills and contains hog fuel usage, and hog fuel purchased, but has no indication of exports or detail on type of residue.

Estimated regional lumber production is shown in Table 14. Approximately 40 percent of production is from the Northwest region, 40 percent from the Northeast, and 20 percent from the South.

Table 14: Estimated Regional Lumber Production ('000 fbm)

	Northwest	Northeast	South	**Ontario**
Large (>50,000 m³)	1,489,187	1,462,871	396,309	**3,348,367**
Medium (5-50,000 m³)	25,427	61,024	249,180	**335,630**
Small (<5,000 m³)	1,695	3,814	8,899	**14,408**
Total	**1,516,309**	**1,527,709**	**654,388**	**3,698,405**

For the survey, 45 sawmills provided data, which comprises 2,964 MMfbm or 80 percent of the provinces lumber production. Most mills provided residue production as well as lumber production. Some smaller mills agreed to use provincial averages to estimate production of bark, sawdust and shavings. For one large company, residue production was developed from publicly known data, and residue uses were developed from consumer data. Six sawmills totalling less than 150 MMfbm were surveyed or called but did not provide information in time for this report.

Table 15: Ontario Summary of Mill Residue Production, Consumption, Exports and Surplus – 2004 (BDt)

	Bark	**Sawdust**	**Shavings**	**Total**
Production	1,630,235	620,601	350,937	2,601,773
Consumption				2,480,296
Exports				540
Surplus				120,937

For Ontario, residue production is estimated at 2.6 million BDt, of which 1.6 million BDt is bark. Exports are estimated at almost 540 BDt[10], and the surplus at 121 million BDt.

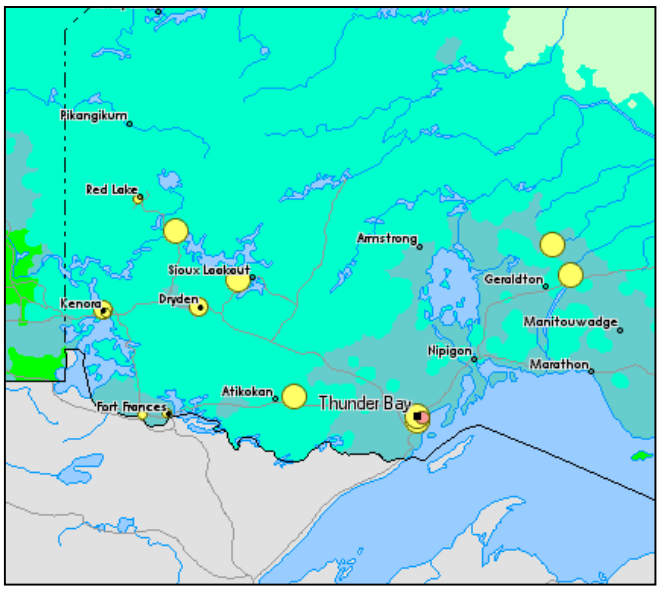
3.5.1 Northwest Region

There are several pulp mills in the Northwest region; Weyerhaeuser (Dryden), Abitibi-Consolidated (Fort Frances, Thunder Bay, Kenora), Bowater (Thunder Bay), Neenah (formerly KC, Terrace Bay) and Marathon Pulp (Marathon). Bowater shut its Thunder Bay groundwood pulp mill in August 2004. The Abitibi-Consolidated pulp mill at Kenora is undergoing strategic review. There are no surplus residues at any of these pulp mills. All of these mills use their own bark and that of nearby sawmills for energy.

There are 12 sawmills that use in excess of 50,000 m^3 wood. Seven are in the Buchanan group, including four in Thunder Bay, and single mills in each of Atikokan, Hudson, and Long Lake. Bowater has large mills in Ignace and Thunder Bay. Large independents include Kenora Forest Products in Kenora, and Olav Haalvaldsrud in Wawa, and LKGH in Red Lake. There is a panel operation in Longlac and a plywood operation in Nipigon. Figure 12 shows the location of regional sawmills as circles, with the size of the circle indicating relative size.

[10] 89,000 BDt was identified as exports in 2004, almost all bark to a US pulp mill, however this bark is now utilized domestically.

Figure 12: Location of Sawmills in Ontario- Northwest Region



As shown in Table 16 residual production in the region is estimated at 1,088,000 BDt, of which 738,000 BDt is bark, and the remainder sawdust and shavings. Approximately 369,000 BDt bark is produced at sawmills and a similar amount at pulp mills.

Table 16: Ontario Northwest Summary of Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	738,145	221,828	128,269	1,088,242
Consumption				967,305
Surplus				120,937

Residue consumption, estimated at 967,000 BDt, is calculated as a residual. The key users of residues in the region are:

- Regional pulp mills, which use over 600,000 BDt to produce 54 MW of heat and power, about half of the residue being produced onsite and the remainder purchased from surrounding sawmills.
- 35 MW power plant operated by TransCanada Power in Calstock, near Hearst, in the Northeast region but partially supplied from the Northwest region.
- Board and panel mills, which utilize virtually all the sawdust and shavings, except for 29,000 BDt, which is surplus.

89,000 BDt was identified as exports in 2004, almost all bark to a US pulp mill, however this bark is now utilized domestically. While a 2003 Ontario study still undergoing revision indicated a potential surplus of over 300,000 BDt in the region in 2002-03, only 120,000 BDt was identified as surplus in the 2004 survey, of which 35,000 BDt was incinerated and the remainder landfilled. The surpluses are in five separate centres, and three are approximately 30-50,000 BDt each. Mill residues currently are being shipped over 200 km economically.

There is a sizable amount of bark/hog fuel in existing piles. As shown in Table 17, 9,400,000 BDt (in ten locations) was identified. Some piles were judged to be contaminated and unusable, for example if mixed with rock, gravel and soil, or if they lie in wet low-lying areas. 5,900,000 BDt of that identified is considered usable for energy. Piles totalling 1,333,000 BDt are being mined now, leaving 4,600,000 BDt available. Escalating to account for mills not in the survey would add perhaps 400,000 BDt and total 5,000,000 BDt. 2.7 million BDt are in the Kenora/Dryden area, 0.4 million in the Thunder Bay area, and 2.8 million BDt are north of Superior. Mining over 10 years would yield 500,000 BDt p.a.

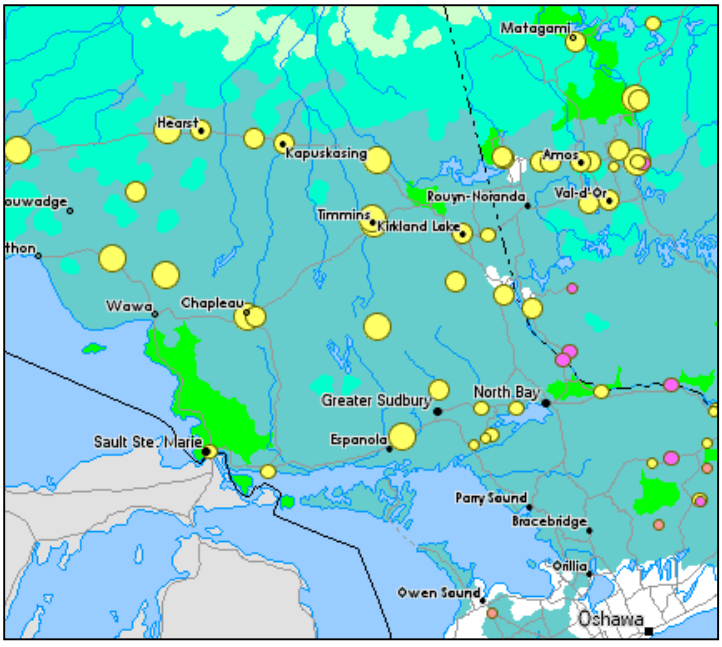
Table 17: Ontario Northwest Region – Bark/Hog Fuel Piles ('000 BDt)

	Identified	Estimated	Annual (10 yrs)
Existing	9,411	10,000	1,000
Usable	5,943	6,300	630
Available	4,609	5,000	500

3.5.2 Northeast Region

Pulp and paper mills are situated at Iroquois Falls (Abitibi-Consolidated), Smooth Rock Falls (Tembec), Kapuskasing (Spruce Falls Inc), Espanola (Domtar) and Sault St. Marie (St. Mary's Paper). There are 23 large (>50,000m^3) sawmills in the region, with key lumber centres at Chapleau, Timmins, Hearst and Kirkland Lake. There are also 21 small to medium sawmills. Locations are illustrated on Figure 13.

Figure 13: Location of Forest Mills in Ontario- Northeast Region



As shown in Table 18, an estimated 924,000 BDt residue are produced in the region, of which 613,000 BDt is bark, and 311,000 BDt is sawdust and shavings. An estimated 432,000 BDt bark is produced at sawmills, and 181,000 BDt produced at pulp mills.

Table 18: Ontario Northeast Summary of Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	612,575	166,563	144,576	923,714
Consumption				923,714
Surplus				0

Major consumers of residue in Northeast Ontario are:

- Regional pulp mills, which consume 180,000 BDt of onsite residues and 101,000 BDt of purchased residues to generate 64 MW of heat and power.
- Northland Power 40 MW Generating Station in Cochrane, which consumes 200,000 green tonnes (Gt) (107,000 BDt) of residue annually (95% bark). 13 MW is generated from wood and 27 MW from natural gas.
- A 106 MW generating station operated by Kirkland Lake Power, which consumes 200,000 Gt (107,000 BDt) of residue annually, mostly bark from 12 area sawmills. 20 MW is generated from wood and the remainder from natural gas.
- 35 MW biomass generation station at Calstock, operated by Transcanada Power.
- G-P Flakeboard MDF plant in Sault St. Marie, which uses approximately 16,000 BDt sawdust

Although the 2003 Ontario government survey showed a possibility of 128,000 BDt surplus residues in 2002-03, no surplus residues were identified in the current survey. As such, none can be assumed. Also, no exports of residues were identified.

As shown in Table 19, although there is no apparent annual residue surplus, there are several large bark piles. 11 piles near 7 centres totalling 1,385,000 BDt have been identified. Approximately 1.3 million BDt are at centres on Highway #11 from Hearst to Kirkland Lake (including Timmins), and 50,000 BDt are north of Georgian Bay. Some mills have indicated only half may be usable for energy, others up to 90 percent, yielding 1,176,000 BDt identified and usable. Adjusting for mills not in the survey increases the total to 1,350,000 BDt, equivalent to 135,000 BDt p.a. if mined over 10 years.

Table 19: Ontario Northeast Region – Bark/Hog Fuel Piles ('000 BDt)

	Identified	Estimated	Annual (10 yrs)
Existing	1,385	1,600	160
Usable	1,176	1,350	135
Available	1,176	1,350	135

3.5.3 South Region

Southern Ontario has more sawmills than the two Northern regions combined, but only seven are considered large compared with 35 large mills in the North. There are 49

medium-sized sawmills (5,000-50,000 m^3 wood) and 21 small sawmills. Of three regional pulp mills, Domtar announced the closing of the Cornwall pulp mill in December 2004, and two others do not have wood rooms and produce no wood residue.

As shown on Table 20, residue production is approximately 590,000 BDt, of which 280,000 BDt is bark and 310,000 BDt are sawdust and shavings.

Table 20: Ontario South Summary of Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	279,516	232,209	78,092	589,817
Consumption				589,277
Exports				540
Surplus				0

Almost all the residue is consumed domestically. The largest users are:

- Temple Pembroke 130 million square food MDF mill that consumes approximately 150,000 BDt residues from 50 surrounding sawmills, including from Quebec and the US.
- Panolam, a manufacturer of thermo-fused panels in Huntsville, which utilizes 160,000 BDt of whitewood residues: 135,000 BDt are sawdust and shavings.
- (The G-P Flakeboard MDF mill in Bancroft suspended operations in May 2003 and was permanently closed Jan 2005, largely due to lack of low-cost fibre.)
- The landscaping market. Much of the bark in Southern Ontario is sold at premium prices to landscaping companies for mulch.

No surplus residues were identified. There is now considerable competition for mill waste as producers find customers that will pay premium prices, forcing traditional users to go further and further to find fibre. Only 540 BDt were identified as being exported.

Many of the mills in the Upper Ottawa valley have hog fuel piles. They are not growing, since all current residual production is utilized. 234,000 BDt have been identified in close proximity on the upper Ottawa River, none have been identified in Southwest Ontario. Extrapolating for mills that did not supply data for the survey might conservatively raise the total to over 360,000 BDt, or 36,000 BDt p.a. over 10 years.

Table 21: Ontario South Region – Bark/Hog Fuel Piles ('000 BDt)

	Identified	Estimated	Annual (10 yrs)
Existing	234	400	40
Usable	211	362	36
Available	211	362	36

3.6 Quebec

Quebec is commonly divided into 16 districts, listed in Appendix 2. Since this number is unwieldy for a residue study, the districts have been combined into four regions:

- Nord-Saguenay, essentially northern Quebec including Lac-Saint-Jean region
- Abitibi-Outaouais, Ottawa River, bordering Ontario
- Rive Nord, north shore of the St. Lawrence, including Montreal to Quebec City
- Rive Sud, south shore of the St. Lawrence, bordering Maine and New Brunswick

Figure 14: Quebec Regions

Lumber production was 8,426 MMfbm in 2004, almost 24 percent of Canadian production, second only to B.C. The largest producer is Abitibi-Consolidated, but the province also has several multi-mill companies including Domtar, Tembec, Kruger and Bowater. Major independents include Temrex, Gérard Crête, Barrette-Chapais, G.D.S. and Cedrico. There are 38 pulp and paper mills that consume roundwood, chips, sawdust or shavings[11].

To estimate 2004 lumber production and residue volumes, four main sources were used:

- A report on Bark Production and Use by Region from the ministère des Ressources naturelles et de la Faune12.
- The FPAC Energy Monitoring Report- 2003
- Telephone and email survey of mills in the province
- A confidential (unnamed) report used as a cross reference

Although there are over 1,200 sawmills in Quebec, as shown in Table 22, only 288 mills had production greater than 10,000 m^3. For this report, sawmills totalling 75 percent of Quebec production were surveyed, and 62 mills totalling 63 percent of production provided data. As shown in Table 23, Nord-Saguenay has the highest production of the four regions, estimated at 3,484 MMfbm, though from a relatively smaller number of

[11] Ministère des ressources naturelles. Data 2002, Website June 2003
[12] This report is updated annually with the last update being 2002, however it does not differentiate between bark exports to the US vs simply out of province, and does not encompass sawdust or shavings.

large sawmills. Contrastingly, Rive Sud region has three times as many mills and half of the production.

Table 22: Quebec Sawmills – 2003

	Nord-Saguenay	Abitibi-Outaouais	Rive-Nord	Rive-Sud	Quebec
Over 10,000 m³	51	57	71	109	**288**
Below 10,000 m³	109	214	196	395	**914**
Total	**160**	**271**	**267**	504	**1,202**

Source: Quebec Forest Industry Council - 2003

Table 23: Estimated Quebec Regional Lumber Production in 2004[13]

	Nord-Saguenay	Abitibi-Outaouais	Rive-Nord	Rive-Sud	Quebec Total
Production (MMfbm)	3,484	1,754	1,200	1,989	4,426

A provincial bark survey undertaken for 2002 determined production (& imports) of 3,544,000 BDt bark. 2,931,000 BDt was utilized in Quebec and 392,000 BDt left the province. The bark surplus was estimated at only 222,000 BDt. Planned projects were to utilize 242,000 BDt bark, leaving a deficit of 21,000 BDt for the province. As shown on Table 24 below, the 2004 survey indicates production of 6,669,000 BDt residues, of which 3,473,000 BDt is bark and 3,197,000 BDt is sawdust and shavings.

Table 24: Quebec Summary of Mill Residue Production, Consumption, Exports and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	3,472,645	1,655,862	1,540,640	6,669,146
Consumption				6,400,146
Exports				169,000
Surplus				100,000

In 2002, of 392,000 BDt of bark leaving Quebec; approximately 88,000 BDt went to Ontario, 135,000 BDt to New Brunswick, and 169,000 BDt to the US. The 2004 survey identified exports of 66,000 BDt bark and 5,000 BDt of sawdust, but many mills did not answer the question of exports. It is assumed that exports are about the same as 2002. Some exports to the US are annual contracts only, but many are longstanding business relationships of many years.

The residue surplus is estimated at 100,000 BDt, of which 82,000 BDt has been specifically identified, and 18,000 BDt has been estimated for mills that were not surveyed.

Following the recommendations of the Coulombe Commission on resource protection, the Quebec government announced on March 18, 2005, that it would reduce the AAC of provincial softwoods by 20 percent (see section 4.3). This reduction is estimated by the

[13] Regional lumber production 2003 is from the Quebec Forest Industry Council website (sources are QFIC data and MNRFP). 2003 proportions are applied to the 2004 lumber production, Statistics Canada, Fig 3-1.

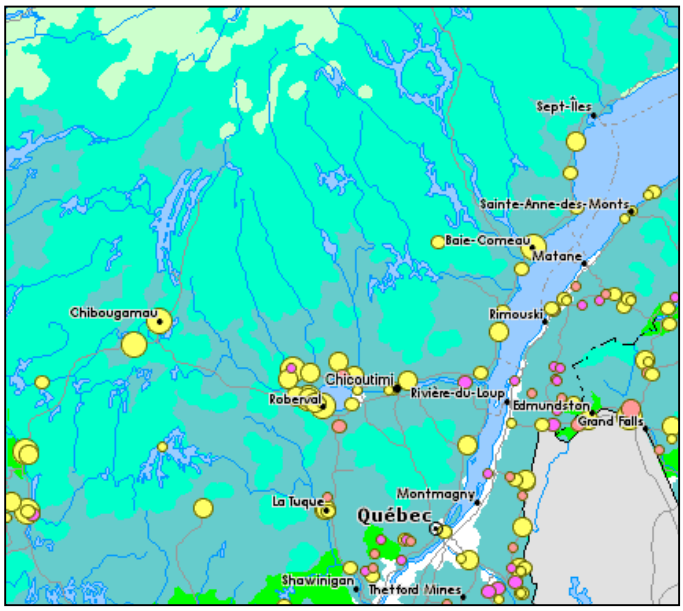
Québec Forest Industry Council (QFIC) to translate to a reduction in harvest of 15-16 percent across all regions. While industry and government will work to reducing the impact by finding additional fibre, for example from deadwood, an AAC reduction of this magnitude will result in sawmill and pulp mill closures and a decline in the production of bark, sawdust and shavings. There will be no surplus, unless they are small pockets of residue in remote regions. At least one large independent energy producer has inquired about availability of forest floor biomass.

3.6.1 Nord- Saguenay

The Nord-Saguenay region comprises three administrative districts as shown in Appendix 2: Nord-du-Québec district (far northwest), Saguenay – Lac-Saint-Jean, and Côte Nord (north shore of the St. Lawrence above Quebec City). Most lumber production occurs in the populated area surrounding Lac-Saint-Jean and the Saguenay River.

The area is dominated by Abitibi-Consolidated which has 12 sawmills, though Domtar, Kruger, Bowater and many independent mills have significant production. Lumber production in the region is estimated at 3,484 MMfbm.

Figure 15: Location of Sawmills in Quebec- Nord-Saguenay Region



As outlined in Table 25, residue production is estimated at 1,952,000 BDt, of which 1,017,000 BDt is bark and 970,000 BDt is sawdust and shavings. While some residue leaves the region, none has been identified as leaving the province. The residue surplus is estimated at 72,000 BDt, of which 58,000 BDt has been identified (mostly in remote areas) and 14,000 BDt extrapolated.

Table 25: Quebec Nord-Saguenay Summary of Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	1,016,683	484,785	451,051	1,952,519
Consumption				1,880,519
Surplus				72,000

Approximately 1,880,000 BDt bark is consumed in local mills. Major consumers of wood residue in the region include:

- 6 regional pulp mills, which burn 730,000 BDt, primarily bark
- Regional sawmills for drykilns
- 28 MW wood residue thermal and cogeneration power plant at Dolbeau (Boralex) which utilizes 250,000 BDt residue
- 27 MW wood residue power plant at Chapais (Probyn Group-Clean Power Trust) which uses approximately 200,000 BDt residue.
- 138 MMSF MDF plant (Uniboard) at La Baie, which utilizes approximately 175,000 BDt of sawdust[14].

As shown in Table 26, 2.7 million BDt bark in existing piles was identified and usable for energy. Extrapolating for mills not surveyed increases the estimate to 4.2 million BDt, equivalent to 424,000 BDt annually if mined over 10 years. 0.5 million BDt is in the Chibougamau region, and 2 million BDt is near Lac-Saint-Jean. Since usable volumes were conservatively estimated at 50 percent of the total, volumes could be higher.

Table 26: Quebec Nord-Saguenay – Bark/Hog Fuel Piles ('000 BDt)

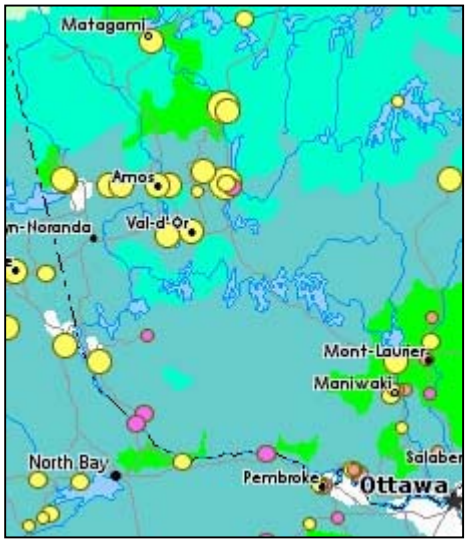
	Identified	Estimated	Annual (10 yrs)
Existing	4,471	9,720	972
Usable	2,714	4,241	424
Available	2,714	4,241	424

3.6.2 Abitibi-Outaouais

The Abitibi-Outaouais region encompasses the Ottawa Valley bordering on Ontario, and comprises the Abitibi-Temiscaming district on the upper Ottawa River, and the Outaouais and Laurentides districts, as illustrated in Appendix 2. The main production area is in the Val-d'Or and Rouyn-Noranda region of Abitibi-Temiscaming. Lumber production in Abitibi-Outaouais is approximately 1,754 MMfbm, over 20 percent of the province's production (twice as much as New Brunswick). Key lumber companies in the region include Domtar, Tembec and Abitibi-Consolidated.

[14] Actual number from Uniboard is confidential. This number was published in March 2002 Logging & Sawmilling Journal.

Figure 16: Location of Forest Mills in Quebec- Abitibi-Outaouais Region



As shown in Table 27, residue production is estimated at 1,823,000 BDt p.a. of which 949,000 BDt is bark and 874,000 BDt is sawdust and shavings. Approximately 1,819,000 BDt is consumed domestically of which 1,760,000 BDt is local. An estimated 59,000 BDt is sent to Ontario and 4,000 BDt to the US. There is no known regional surplus.

Table 27: Quebec Abitibi-Outaouais Summary of Mill Residue Production, Consumption, Exports and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	949,115	452,567	421,075	1,822,757
Consumption				1,818,757
Exports				4,000
Surplus				0

Major users of regional residues include:

- 5 local pulp mills which consume 335,000 BDt annually
- Sawmills, which the survey identified use 150,000 BDt for drying
- Boralex 35 MW wood residue power station at Senneterre that utilizes approximately 200,000 BDt annually.
- Two Uniboard MDF plants at Val-d'Or and at Mont Laurier that use a considerable amount of sawdust, shavings and bark. (Amount is confidential but is between 250,000 and 500,000 BDt.)

Bark piles usable for energy totalling 624,000 BDt have been identified and the estimated total including mills not surveyed is 657,000 BDt. Mining over 10 years would yield 66,000 BDt p.a.

Table 28: Quebec Abitibi-Outaouais Region – Bark/Hog Fuel Piles ('000 BDt)

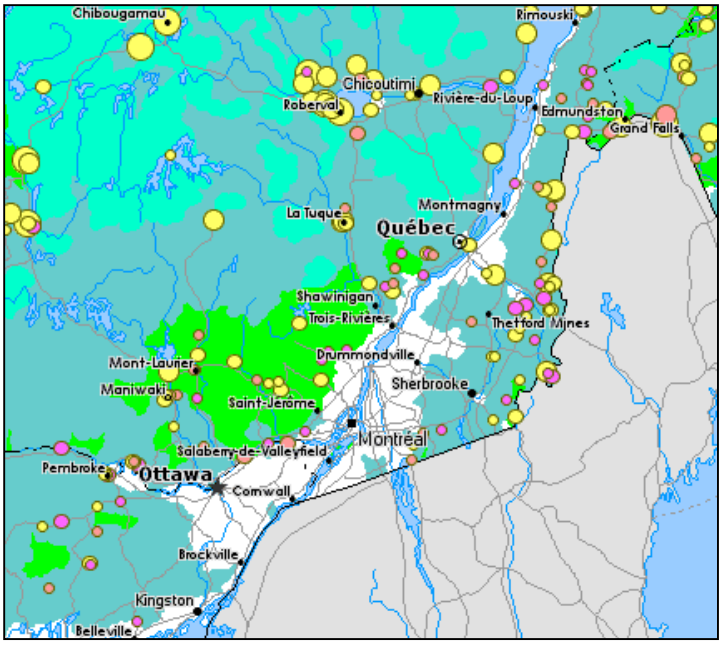
	Identified	Estimated	Annual (10 yrs)
Existing	693	730	73
Usable	624	657	66
Available	624	657	66

3.6.3 Rive-Nord

Rive-Nord comprises the north shore of the St. Lawrence from Montreal up to and including Quebec City and includes the following administrative districts: Montreal, Capitale Nationale (Quebec City), Lanaudière and Mauricie.

2004 lumber production in this region is estimated at 1,200 MMfbm. There are six pulp mills, two are owned by Abitibi-Consolidated and two by Kruger. While Abitibi and Kruger have three sawmills combined, most sawmills are operated by independents.

Figure 17: Location of forest mills in Quebec- Rive-Nord Region



As shown in Table 29, residue production is estimated at 1,433,000 BDt, of which 746,000 BDt is bark and 687,000 BDt sawdust and shavings.

Table 29: Quebec Rive-Nord Summary of Mill Residue Production, Consumption, Exports and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	746,358	355,886	331,122	1,433,366
Consumption				1,317,366
Exports				88,000
Surplus				28,000

Domestic consumption is estimated at 1,317,000 BDt, of which 33,000 BDt goes to Ontario. Major users in this region are:

- Pulp mills, which utilize an estimated 337,000 BDt for energy
- Local sawmills, which utilize at least 70,000 BDt for dry kilns.

An estimated 88,000 BDt is exported to the US. Due to the lack of response data on exports, the provincial 2002 bark study is used as a basis. The identified surplus is 24,000 BDt in two locations, all bark, and mostly in the remotest areas of the region. The total has been inflated to reflect mills not in the survey.

Shown in Table 30, existing hog fuel piles estimated at 375,000 BDt (usable) have been identified. They are spread geographically: 250,000 BDt in one pile in the south, 70,000 BDt in one pile in the north and the rest in several central piles. Taking into account mills not surveyed, hog fuel piles can reach 543,000 BDt, or 54,000 BDt annually over 10 years.

Table 30: Quebec Rive-Nord Region – Bark/Hog Fuel Piles ('000 BDt)

	Identified	Estimated	Annual (10 yrs)
Existing	680	986	99
Usable	375	543	54
Available	375	543	54

3.6.4 Rive-Sud

Rive-Sud comprises the entire south shore, from Montreal through the Gaspésie and bordering on Maine and New Brunswick. Districts include: Montérégies, Centre-du-Québec, Estrie, Chaudière-Appalache, Bas St-Laurent and Gaspésie-Iles-de-la-Madeleine, illustrated in Appendix 2. Sawmill concentrations are shown in Figure 18.

There are over 500 sawmills in the region, 109 of which utilize more than 10,000 m^3 wood. Lumber production is estimated at 1,989 MMfbm. While the major firms such as Bowater and Domtar are represented, there are many multi-mill independents such as Cederico, G.D.S. Inc and Maibec with significant production.

As shown in Table 31, bark production is estimated at 760,000 BDt and total residues at 1,461,000 BDt. Approximately 212,000 BDt of residue leaves the region, primarily bark. An estimated 135,000 BDt is destined for New Brunswick cogeneration plants, and 77,000 BDt are exported to Maine. No residual surplus was identified.

Figure 18: Location of Forest Mills in Quebec- Rive-Sud Region

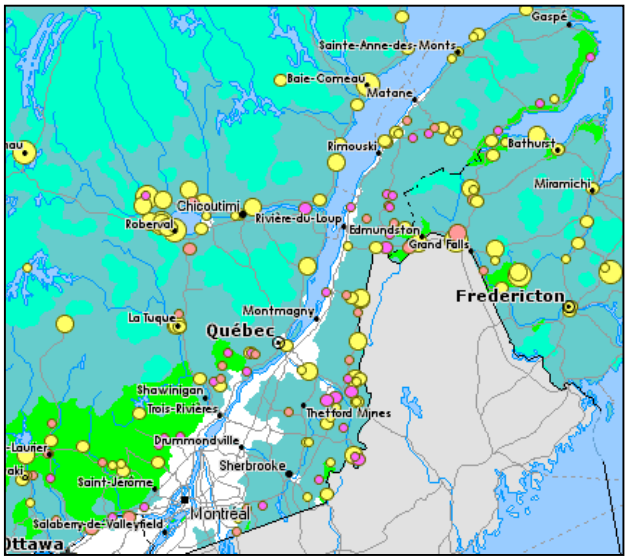


Table 31: Quebec Rive-Sud Summary of Mill Residue Production, Consumption, Exports and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	760,489	362,624	337,391	1,460,504
Consumption				1,383,504
Exports				77,000
Surplus				0

Major residue users to the region are:

- Smurfit−Stone containerboard mill in New Richmond which consumes over 175,000 BDt (est.) of whitewood residues (chips, sawdust and shavings) from lumber mills in the Baie−des−Chaleurs area
- Fraser 45 MW cogeneration plant in Edmunston, New Brunswick, which draws over 70,000 BDt residues from Quebec
- Boralex cogeneration facilities in the US including: a 25 MW unit in Chateaugay-NY, which requires 120,000 BDt residue, and four facilities totaling 166 MW in Maine, which require 880,000 BDt, of which 133,000 BDt of which is imported.
- Local farmers, which use a significant amount of shavings for animal bedding.

Owing to the proximity to many cogeneration facilities in New Brunswick, Maine and New York, which have drawn on bark supplies for some time, only 107,000 BDt of hog fuel in existing piles has been identified. The usable amount can potentially reach 210,000 BDt if extrapolated for non-surveyed mills, however there could be a large margin for error in this estimate.

Table 32: Quebec Rive-Sud – Bark/Hog Fuel Piles ('000 BDt)

	Identified	Estimated	Annual (10 yrs)
Existing	107	274	27
Usable	82	210	21
Available	82	210	21

3.7 New Brunswick

New Brunswick sawmills produced 1,712 MMfbm of lumber in 2004, 4.8 percent of Canada's total. The major producer is JD Irving with 7 mills. Other large companies include Fraser Papers, Bowater, and UPM Kymmene. As expected, mills tend to be smaller than counterparts in B.C., with only one mill in excess of 200 MMfbm lumber production, and three in excess of 100 MMfbm.

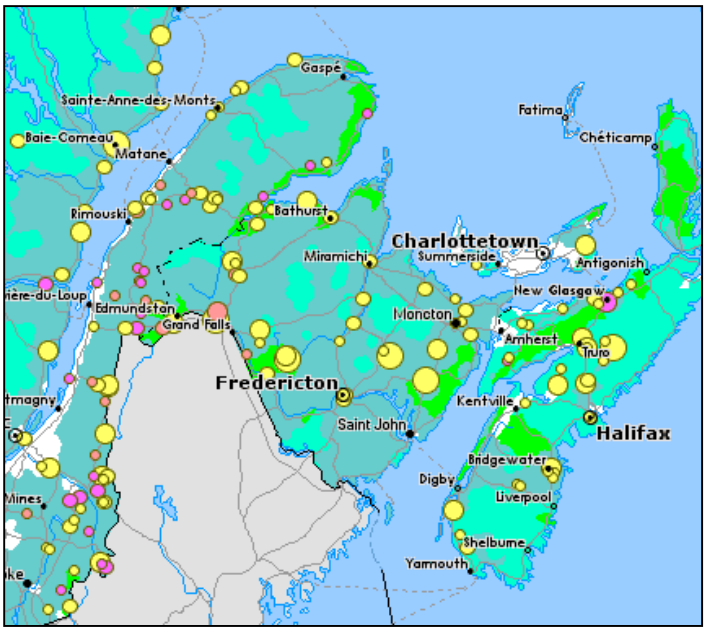
A total of 21 mills responded to the survey, including all of the major mills and a random sample of medium sized mills, encompassing 1,292 MMfbm or over 75 percent of provincial lumber production. Major sources of data for this study include:

- New Brunswick Timber Utilization Survey- 2002
- New Brunswick Residue Inventory Study- 1994[15]
- The FPAC Energy Monitoring Report- 2003
- Telephone survey of provincial sawmills

The areas where sawmills are concentrated are shown in Figure 19.

[15] For the 1994 study 545 companies were interviewed through mail-out questionnaire. Though some companies reported bark, sawdust and shavings separately, others reported only hog fuel. Estimates of hog fuel makeup result in estimated yields of BDt/000BF lumber of 0.29 for sawdust, 0.20 for shavings and 0.29 for bark. The proportions for sawdust and shavings will decline due to increased equipment efficiency.

Figure 19: Location of Sawmills in New Brunswick



As shown in Table 33 below, New Brunswick sawmills and pulp mills produce annually approximately 783,000 BDt bark, 268,000 BDt sawdust, and 321,000 BDt shavings. No surplus was identified. All production is used internally or exported.

Table 33: New Brunswick Summary of Mill Residue Production, Consumption, Exports and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	783,548	268,039	321,831	1,373,418
Consumption				1,223,418
Exports				150,000
Surplus				0

Major consumers of wood residue include:

- Fraser Papers 45-MW cogeneration facility in Edmunston that utilizes 366,000 BDt residues annually from a 75-mile radius, primarily bark, of which over 290,000 BDt is sourced in New Brunswick and the rest from Quebec.
- Flakeboard Co. Ltd plant in St. Stephen that utilizes approximately 110,000 BDt residues on the particleboard side of the mill.
- Smurfit-Stone containerboard mill in Bathurst which consumes over 175,000 BDt (est.) of whitewood residues (chips, sawdust and shavings).
- Area pulp mills, which use approximately 350,000 BDt residues p.a. (112,000 BDt purchased). (NB St. Anne Nackawic was shut down in 2004 but since the Province on April 1 2005 announced its reopening, its data is included).
- Sawmills, which use 100,000 BDt on site for energy
- A significant but unknown amount to farmers for animal bedding

New Brunswick shares a long border with Maine, which is also a major forest products producer. 125,000 BDt of residue has been identified as being exported to Maine, including sawdust and bark, much of it to biomass power plants. Major crossover points are Edmunston, and St. Stephen. To reflect mills not surveyed, exports are estimated at 150,000 BDt.

286,000 BDt in hog fuel has been identified in existing piles, of which 245,000 BDt may be usable for energy. Two piles are in excess of 70,000 BDt. Some is being mined now. Extrapolating for mills not surveyed increases the estimated hog fuel inventory to 257,000 BDt, or 26,000 BDt annually over 10 years.

Table 34: New Brunswick – Bark/Hog Fuel Piles ('000 BDt)

	Identified	Estimated	Annual (10 yrs)
Existing	286	300	30
Usable	245	257	26
Available	245	257	26

With respect to trends, one facility that uses residues is considering a major expansion that would result in the need for 50-100,000 BDt additional residue. As there is no excess residue in New Brunswick, strategies are being devised as to where to get it, including proposing fibre allocation methods in the Provincial residue market.

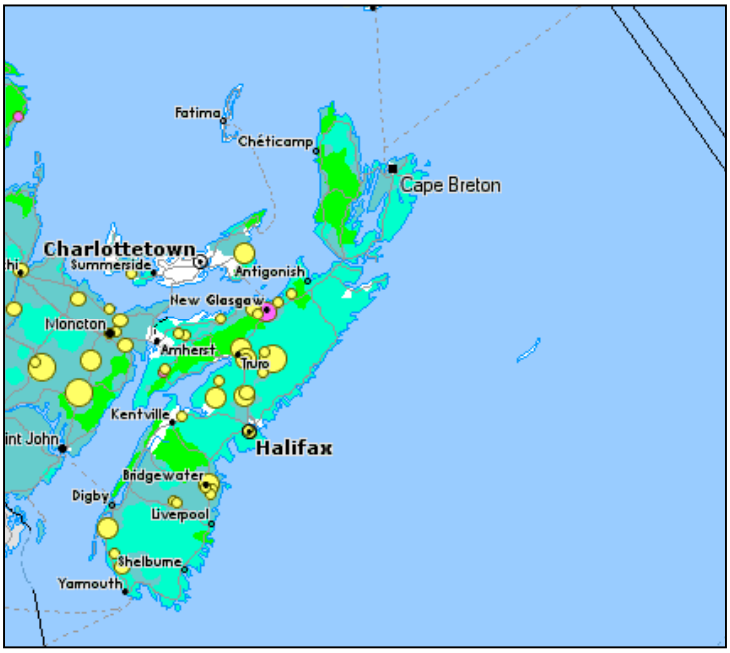
3.8 Nova Scotia

Nova Scotia produced 756 MMfbm in 2004, just over 2 percent of Canada's production.

There are almost 200 active sawmills in the province, but only four utilize more than 200,000 m^3 wood p.a.: Bowater Mersey Paper Co- Oakhill, Ledwidge Lumber, MacTara, and Truro Lumber. Four other sawmills use 70,000-200,000 m^3 p.a., including a JD Irving mill at Weymouth. 44 mills use 1,000-70,000 m^3 wood p.a., and fully 147 use less than 1,000 m^3 wood annually. Figure 20 illustrates the concentrations of sawmill production.

Of three pulp & paper companies, only Stora Enso (Port Hawksbury) produces hog fuel. Neenah Paper (Pictou, formerly Kimberly Clark) and Bowater Mersey Paper use only chips and produce no hog fuel. Stora uses all of its hog fuel and purchases some from surrounding sawmills.

Figure 20: Location of Sawmills in Nova Scotia



Main data sources for the province include:

- Government of Nova Scotia forestry registry-2004
- The FPAC Energy Monitoring Report- 2003.
- Telephone survey of provincial mills

The survey included the eight largest sawmills encompassing over 84 percent of provincial production, and a random sample of six of the remaining mills encompassing another 6 percent, for a total of more than 89.5 percent of Nova Scotia lumber production.

As shown in Table 35, annual production of residue is estimated at 601,000 BDt, of which 310,000 BDt is bark, 158,000 BDt is sawdust, and 132,000 BDt is shavings. An estimated 253,000 BDt bark are produced at sawmills, 58,000 BDt at pulp mills. Although word of mouth suggests that there are no surpluses of residue and have not been for some time, 12,500 BDt was determined to be in surplus and available (11,500 BDt in one centre). Adjusting for mills not surveyed might yield 13,000 BDt total surplus residues.

Table 35: Nova Scotia Summary of Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	310,922	157,853	132,240	601,015
Consumption				588,015
Surplus				13,000

Four major operations use 95 percent of the biomass residue produced in the province

- Brooklyn Power runs a 28 MW biomass power plant that consumes 233,000 BDt of mixed residues purchased from sawmills. 50 percent are under long-term contract.
- McTara Pellet Plant utilizes 119,000 BDt in the production of pellets, 82,000 BDt from the adjacent sawmill.
- Province pulp and paper mills (Stora-Enso, Bowater Mersey Paper and Neenah Paper) utilize over 200,000 BDt.
- Farmers use about 5 percent of sawdust and shavings for animal bedding.

The residue sold to farmers for animal bedding is usually at premium prices. This is an important business partnership since farmers are also wood lot owners. If farmers can't get residues from sawmills, they won't supply the mills with wood. Some bark is sold to landscapers.

As shown in Table 36, approximately 213,000 BDt of hog fuel has been identified, which are in four existing piles. Two are being mined already and one will be gone by the end of 2005. 148,000 BDt is considered available, almost entirely in one location. The annual potential of 30,000 BDt is spread over five years because of the high demand for residues in Nova Scotia.

Table 36: Nova Scotia – Bark/Hog Fuel Piles ('000 BDt)

	Identified	Estimated	Annual (5 years)
Existing	213	213	43
Usable	206	206	41
Available	148	148	30

3.9 Prince Edward Island

PEI has only three sawmills. To maintain confidentiality of mill data, no tables will be shown and data will be approximate only, on the request of two of the three mills.

Approximately 24,000 BDt residues are produced. Even though Charlottetown has a district heating plant that uses municipal solid waste and wood waste, there is still a residue surplus in PEI estimated at 1,000 BDt p.a. There is not enough demand for residue in the province. Farmers use sawdust from the mills, but not shavings. Bark from one of the small mills is landfilled. A significant amount is exported to New Brunswick. Forest floor and poor quality timber are being explored as possible bioenergy fuel sources.

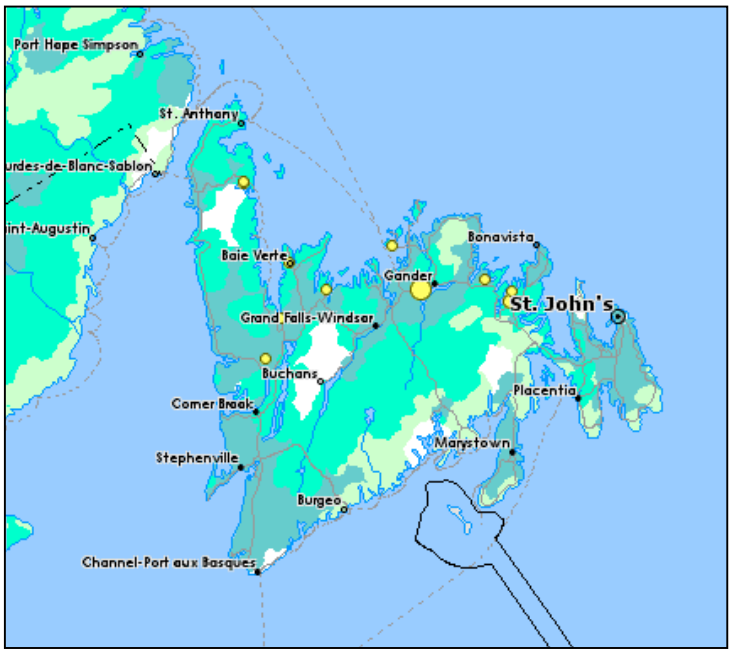
Identified hog fuel piles total over 30,000 BDt. One is currently being mined.

3.10 Newfoundland & Labrador

Newfoundland produced 120 MMfbm of lumber in 2004. Of 65 mills, only two sawmills are considered large even by Newfoundland standards, with production in the 25-30 MMfbm range: North Atlantic Lumber and Sexton (Bloomfield). There are a handful

of mills in the 7-8 MMfbm range and most of the rest are considerably smaller. Figure 21 shows the location of sawmills in the province.

Figure 21: Location of Sawmills in Newfoundland



A mill residue study is currently being prepared for the Ministry of Natural Resources, however most of the data is confidential for the time being. Not being final, data may be altered slightly. The study undertook a survey that covers 90 percent of Newfoundland lumber production. Rather than call mills a second time, this survey takes preliminary data from the MNR study.

Approximately 195,000 BDt of residue is produced each year. Pulp mills produce 132,000 BDt and 63,000 BDt is from sawmills, of which 30,000 BDt is bark (including green slabs) and 33,000 BDt is sawdust and shavings. Some of the sawmill sawdust and shavings are used, but little of the bark, which is landfilled. Consumption is estimated at 166,000 BDt leaving a surplus of just under 30,000 BDt.

Table 37: Newfoundland and Labrador Summary of Mill Residue Production, Consumption and Surplus – 2004 (BDt)

	Bark	Sawdust	Shavings	Total
Production	162,216	19,799	13,400	195,415
Consumption				165,539
Surplus				29,875

Key users of residue are:

- Area pulp mills, which use approximately 149,000 BDt sawdust and shavings
- Farmers, for animal bedding

Bark from old bark piles is not used in Newfoundland. The size of each pile is determined by the age of the sawmill, most of which have been in operation less than 10 years. Much of the provincial bark inventory is concentrated near the two largest mills, and may be on the order of 75,000 BDt each.

Table 38: Newfoundland and Labrador – Bark/Hog Fuel Piles ('000 BDt)

	Identified	Estimated	Annual (10 yrs)
Existing	-	235	24
Usable	-	188	19
Available	-	188	19

When asked about surplus biomass for energy, a Newfoundland Lumber Association member noted that Labrador had 400,000 m^3 annually of wood that is not being utilized. It could be used for pulp and paper, providing a residue source, or it could be used for energy directly.

4 Trends and Caveats

4.1 British Columbia

Forest residue surplus is abundant in all British Columbia regions excepting the coast. The surplus will likely increase in the next few years with the increase in the AAC resulting from the mountain pine beetle infestation in the Cariboo, Prince George and Prince Rupert regions. Several projects are underway to increase sawmilling capacity in these regions. The abundant supply is favouring the development of industries specialized in residue processing. Wood pellet production and panel & board manufacturing are increasing. Bioenergy production is also benefiting from the situation. Forest companies are converting to bioenergy and independent power producers are also investigating the feasibility of new forest bioenergy projects.

It is expected that the AAC will decrease significantly in 10 to 15 years once the MPB epidemic is over and all the economical MPB-killed trees have been harvested. At that time, the forest industry will downsize its operations. This will certainly have an impact on the residue-consuming industry, including power production.

4.2 Ontario

With a minimum of surplus residue production in the province and an impetus to reduce energy production from fossil fuels such as coal, strategies are being reviewed to find more fibre for energy.

A Provincial Wood Supply Strategy, linked to the Ontario Forest Accord, was developed in 2004 to identify strategies to sustain a continuous long-term wood supply for wood processing facilities. The SPF (spruce-pine-fir) wood supply is predicted to fall below industrial demand in 5-10 years and take 80 years to recover. Failure to find fibre would mean closure of mills or operation below capacity, which in turn would mean less residue produced by mills. Some sawmills are already operating significantly below capacity due to lack of wood. The Ontario Forest Industries Association indicated 12 forest-product-related mills in Northern Ontario are in jeopardy[16]. Reasons include wood supply, wood quality, the Canadian dollar, etc. One positive outcome is that mill closures may free up poor-quality wood for energy.

Because the supply of hog fuel is diminishing, there is an increasing interest in using other forest-derived biomass including: roadside residues left from full-tree harvesting systems (see Section 4.5 Forest-floor biomass), cull, low-value trees allocated but not harvested, and stands impacted by fire, insects or disease. An Ontario Ministry of Natural Resources forest biomass project is underway to develop models for biomass harvesting systems and for assessing the economic feasibility of forest biomass use in the province. It is targeted for completion in 2006. The project is not intended to provide a biomass inventory.

[16] Kenora Daily Miner and News- May 17, 2005

4.3 Quebec

Residue production is projected to drop considerably in the next 2-3 years. In October 2003 a commission was set up to examine the management of public forests and make recommendations in response to the needs of the population of Quebec. The final report was released in December 2004. The Commission examined resource protection and recommended that government protect 8 percent of the forest territory by 2006 and 12 percent of the boreal forest in each of several jurisdictions by 2010. While the report recommended an intensive silvicultural strategy aimed at increasing timber yield, it also recommended not automatically anticipating the yield effect when determining the AAC. It was anticipated that there will be a "northern limit" above which no allocation will be given. All new Sustainable Forest Licenses will have to conform to the new limits.

The implications on the forest industry are huge, and they will differ by region. While industry is working with the Quebec government to find additional fibre, Quebec does not have the flexibility to free up fibre sources as did Ontario after the Lands for Life program. It is estimated that a 20% cut across the board in AAC in Quebec may result in a 15-percent reduction in harvest. Some mills and regions may experience only a five-percent decline; others will experience a more severe impact. There will certainly be a reduction in lumber production, and several mills will have to close. The impact on residue is obvious; there will be less.

4.4 Bark/hog fuel piles

Until five years ago, bark/hog fuel piles were considered an environmental problem, not a revenue source. Many piles were considered too contaminated, or moisture contents were considered too high for energy use. With annual residue production almost completely committed, companies are looking at hog fuel piles with renewed interest. Companies are experimenting with methods to remove contaminants, and some are mixing wet hog fuel with drier residues to produce a fuel with a lower average moisture content.

In Canada, the identified bark/hog fuel piles are estimated at 20.4 million BDt with estimated usable volume of 15.9 million BDt (see Table 39). Hog fuel piles identified in eastern Canada are estimated at 17.5 million BDt. The usable portion has been estimated at 13 million BDt. With the exception of Saskatchewan, the common practice in western Canadian provinces is to incinerate mill residue surplus. Bark/hog fuel piles in Saskatchewan are estimated at 2.9 million BDt.

Table 39: Identified and Estimated Usable Volume of Bark/Hog Fuel Piles ('000 BDt)

	Identified	Estimated Usable
British Columbia*	-	
Alberta*	-	
Saskatchewan	2,900	2,900
Manitoba*	-	-
Ontario	11,030	6,712
Québec	5,951	5,651
New Brunswick	286	257
Nova Scotia	213	148
Prince Edward Island	30	30
Newfoundland	-	188
Canada	**20,410**	**15,886**

*: Residues are incinerated

In the survey, some companies assessed the usable portion of bark piles at 90-100 percent. In mining tests it has been determined that all but the top metre was usable for energy. Other companies estimated that only 50 percent was usable for energy, either due to the level of deterioration, or simply to be conservative. It is quite possible that much more is recoverable.

4.5 Forest-floor biomass

Lacking domestic oil and gas supplies and experiencing high energy prices, Finland and Sweden have effectively used policy to build thriving biomass industries. Virtually all mill residues are being utilized and now harvesting systems have been developed to economically acquire forest-floor biomass (slash), all at the stump. A 2004 study in Finland to compare costs of harvesting systems showed that bundling systems, such as the Timberjack Harvester, are more cost-effective at getting forest residues to a bioenergy facility than traditional methods such as in-bush chipping and transport. In 2004, a Timberjack harvester underwent testing in several locations in Canada and the U.S. Measured costs were not out of line for bioenergy. It is expected that costs will fall as efficiencies are learned. Incentives should be considered to make this source more economic.

A second source of residue for energy is chipper debris. In an effort to reduce costs and stay competitive, the trend with Canadian pulp mills has been to eliminate wood rooms and supply chips only to pulp mills. Sometimes chips are supplied from centralized chipping operations, which may truck residues to cogeneration sites. Often chipping is by way of mobile chippers, where residues are left in the bush. This is a sizable supply and a topic of a separate study.

In Ontario, 95 percent of harvesting is full-tree harvesting, which involves delimbing and deposit of slash at roadside. Ninety percent of this residue is burned, both to prevent uncontrolled forest fire and also to free up more land for forest renewal. Slash is a huge potential source for bioenergy. For slash at roadside, forest nutrients are a non-issue.

To stress the potential in forest-floor residues, a recent study determined that the Atikokan-Thunder Bay area had over 400,000 BDt of conifer slash burned at roadside annually, and almost 100,000 BDt chipping debris left onsite annually. Over 400,000 BDt of forest-floor residue is within a 150 km trucking distance. (Measuring forest floor potential is beyond the scope of this survey and should be the topic of a separate study.)

In the past, Quebec employed primarily full-tree harvesting as in Ontario; however, in the last five years, methods have gradually changed. Forty percent of harvesting is now cut-to-length, whereby delimbing occurs at the stump. Reasons include increased efficiency, reduced losses from skidding, and less damage to the forest floor including soils. However, the decisions to change harvest methods do not reflect today's market for residue. There are very few surplus residues, and they are projected to fall with the pending reductions AAC in Quebec. A viable source thus becomes the forest floor. Gathering of residues should be integrated with harvest operations to minimize costs.

No study of potential in biomass development should be undertaken without considering the potential addition to supply from wasted forest residues.

4.6 Types of bioenergy projects

Bioenergy has traditionally meant utilizing mill residues for heat (such as in sawmill dry kilns), or heat and power (in pulp mills or other operations requiring a steam host). Many cogeneration proposals do not get off the ground because of high capital costs, marginal projected returns, or a 2-year payback requirement on energy projects. One stumbling block has been the need, prior to financing, to ensure long-term biomass supply contracts, now rare. In the recent federal budget, the development of bioenergy facilities was given a needed boost by way of a 1¢/kWh production incentive, formerly only accorded to wind power.

Lately an option is to develop bio-oil from fast-pyrolysis, which does not require a steam host, and which results in a liquid fuel that does not have to be used on the site of production but can be transported easily to markets at low cost. In addition, the by-product *char* can be used to co-fire in coal-burning power plants to reduce GHG emissions. The world's largest bio-oil plant (100 tpd) started up in West Lorne, Ontario in February, and is undergoing normal startup procedures and testing. A second plant (200 tpd) has been announced. Plants can be economically sized to use only 35,000 BDt annually of residues, ten times less than the Fraser 45MW cogeneration plant, for example. Capital costs are in the $7-13 million range, compared to several times that for cogeneration plants. In addition, plants are designed to be moveable at minimum cost. If the plant runs low on fibre, it can be moved to a new fibre source. The biofuel application is one that will fit in many northern communities, in particular First Nations communities.

Since Quebec will be undergoing a reduction in AAC and subsequently residue production, it is anticipated that any existing residue surplus will first try to find its way economically to existing cogeneration facilities. Where not economic, possibly in Baie-Comeau, Chibougamau/Opitciwan and La Tuque, small bio-oil plants may be considered to utilize annual surplus. It is unknown whether the old hog fuel piles are appropriate for

bio-oil. Northwest Ontario has large enough surpluses, including old hog fuel piles, to warrant new cogeneration capacity, especially with the 1¢/kWh incentive. Where large investments are still not economic, bio-oil plants should be considered. In Northeast Ontario, hog fuel piles can fuel minor expansions to existing cogeneration units. In New Brunswick, additional cogeneration capacity is possible using residue diverted from US plants, hog fuel piles and forest-floor residue, if steam hosts are available. Newfoundland may be a good location for a 100-tonne per day bio-oil plant. In all cases, projects should consider a portion of forest-floor biomass, which may provide sufficient volumes to make a project of economic size.

4.7 Bioenergy development zones: Assessment of potential

Clearly the conditions are different in eastern Canada and western Canada, and different policy approaches will be needed for each region. In the West, large residue surpluses are being incinerated in beehive burners. AAC's are increasing to take advantage of mortality due to mountain pine beetle, which will inflate the surplus even more. Also, some stands affected by the mountain pine beetle may be harvested directly for energy, increasing residue supply. In the East, pulp mills, saw mills and private energy companies have been taking advantage of residues for a long time, so that now surpluses have diminished to almost zero. The surplus of annual residue production is now measured at a mere 265,000 BDt for the entire East. All of it is considered usable.

When considering surplus annual mill residues and usable hog fuel from existing piles (but without regard to forest floor residue), Table 40 lists zones that may be considered for bioenergy development.

4.8 Alternative products

Farmers utilize a significant amount of sawdust and shavings as animal bedding. They do so because it suits their purpose and is available. If alternative products could be found with similar properties of absorbency and softness, farmers may be motivated to use them, freeing up residues for energy. An example is paper mill sludge, which in the past has undergone experimentation as kitty litter.

Table 40: Potential zones of bioenergy development

Area	Surplus Residue Production (BDt per year)	Bark/hog fuel piles (BDt)
British Columbia:		
Cariboo region	206,483	
Kamploops region	204,905	
Nelson region	45,728	
Prince George region	1,073,839	
Prince Rupert region	284,000	
Alberta	481,137	
Saskatchewan	163,900	
Hudson Bay		400,000
Prince Albert		1.2 million- 2 piles?
Glaslyn		700,000
Meadow Lake		150,000
LaRonge		500,000
Manitoba	13,000	
Ontario		
Dryden area	68,000	2.7 million- 3 piles
Thunder Bay area	40,000	Capped piles of unknown size
North of Superior	10,000	2.8 million- 4 piles
Hearst to Kirkland Lake	None identified	1.3 million- 9 piles
Pembroke area	None identified	360,000- 3 piles
Quebec:		
Abitibi-Temiscaming	None identified	690,000- 9 piles
La Tuque	30,000	540,000- 4 piles
Chibougamau/Opitciwan	15,000	550,000- 2 piles
Lac Saint-Jean	10,000	None identified
Baie Comeau area	45,000	200,000- 2 piles
Gaspe	None identified	80,000- 2 piles
New Brunswick:		
Edmunston	Reduce exports?	85,000- 3 piles
Moncton area	Reduce exports?	120,000- one pile
Nova Scotia:		
New Glasgow	None identified	120,000- 2 piles
Prince Edward Island:	1,000	30,000
Newfoundland & Labrador:		
Central region	15,000	75,000
Eastern region	15,000	75,000

5 Disposal costs

Surplus wood residues are currently disposed in wood residue incinerators throughout western Canada. The only exception to this practice is in Saskatchewan where several mills have historically stored their residues in piles adjacent to their mills.

The cost of on-site mill residue incineration varies between $5 and $10/BDt. In a few instances mills in populated areas are spending additional money to truck residues to incinerators that are located away from populated areas. In other instances, mills have banded together to form incinerator cooperatives where the costs of operating the incinerators are shared amongst the cooperative members.

In B.C. a significant cost of operating an incinerator are burner permit fees payable to the provincial government. In B.C. these fees vary, dependent on whether the incinerator is located in a populated area. Mills in populated areas pay an additional $2.80/BDt for incinerator permit fees[17]. In unpopulated areas permit fees are $0.33/BDt. For a large sawmill in a populated area, permit fees can range up to $300,000 annually. In Alberta, Saskatchewan and Manitoba permit fees are negligible.

In the East, disposal is predominantly by landfill. In many cases, disposal is merely at the side of the sawmill, although landfilling rules and regulations must be followed. In other cases residue must be transported to a regulated landfill site. For onsite landfills, costs have been quoted at $8-10/BDt. In the case of transporting to a landfill site, costs may be in the $25-30/BDt range.

The cost of piling wood residues is relatively small compared to incineration ($1-$2/BDt), assuming there is land available for storage. However, wood residue piles nearby sawmills pose a significant fire risk and potential environmental risk due to run-off. Minor costs are incurred to keep piles from igniting. Generally permits are required and rules are to be followed on management of the pile. In some populated or environmentally sensitive areas, such as on the Ottawa River in southern Ontario, there is government pressure to deal with the landfill sites and B.C. and Alberta environment ministries discourage this practice.

Transporting wood residues is an expensive undertaking. Transportation is a function of fixed costs for loading and unloading and variable costs that are a function of distance traveled. Until recently, mills have addressed the issue as one of cost reduction, and have let the bark go at a net zero transportation cost, instead of incurring the cost and headache of landfillling. Costs typically start at $5/Bdt for short hauls of 1-2 km. For local transportation of a few kilometres, costs are around $10/BDt. They escalate upward as distance increases and transportation distances can be large. In Northern Ontario for example, one mill transports bark up to 140 km for internal use at a cost of $38/BDt. Another transports bark almost 240 km at a cost of $33/BDt. Costs depend on type of road and truck, and demand for trucking in the region.

[17] Permit fees are scheduled to increase by 46.5% in 2005.

In western Canada transport of wood residues for power generation generally becomes prohibitive beyond a 200 km radius of a power generator. This economic radius is greatly dependent on the value of the residue. Sawdust, destined for sawdust pulp digester, is routinely hauled from the southern Cariboo region to Vancouver Island by Norske Canada, a distance of more than 500 km. In this instance the value of the end product (sawdust pulp) justifies the added transportation costs.

Conclusions

The residue situation in the East is very different to the situation experienced in western Canada. In 2004 in eastern Canada, there was almost no residue available in many regions. The regional surplus is estimated at 264,812 BDt, which represents less than two percent of total production, equal to 11,332,817 BDt. Unlike eastern Canada, there is still significant mill wood residue surplus available for potential use in western Canada. Mills in the four western provinces produce an estimated 9,763,769 BDt of mill residues. Consumption and exports account for 7,290,777 BDt leaving an annual surplus of 2,472,992 BDt. This is equivalent to over 49,460 TJ of energy.

Table 41: Eastern and western Canada summary of mill residues (BDt)

	Bark	Sawdust	Shavings	Total
Canada				
Production	11,421,599	5,355,054	4,319,934	21,096,586
Consumption				17,689,336
Exports				669,445
Surplus				2,737,806
Western Canada				
Production	5,169,983	2,632,900	1,960,886	9,763,769
Consumption				6,940,872
Exports				349,905
Surplus				2,472,992
Eastern Canada				
Production	6,251,616	2,722,154	2,359,048	11,332,817
Consumption				10,748,464
Exports				319,540
Surplus				264,812

Of the estimated 2,472,992BDt annual surplus, B.C. is responsible for 1,814,955 BDt or more than 69 percent of the total annual surplus residues in western Canada. Alberta is responsible for 481,137 BDt or 19 percent.

In addition to this annual surplus in western Canada, there are an estimated 15,264,000 BDt of surplus piles mainly in Ontario, Quebec and Saskatchewan that could potentially be utilized for heat and power production. .

The mountain pine beetle epidemic is causing a significant increase in the AAC in the Prince George, Cariboo, Prince Rupert and Kamloops Regions of British Columbia. In turn forest companies are adding shifts and increasing their sawmilling capacity to deal with this increase in AAC. As a result, the production of mill residues is expected to increase in coming years in all four Regions. Offsetting this increase in residue production is the significant expansion of the wood pellet industry in western Canada. As well, there is interest in further combined heat and power projects as well as the conversion of sawmill from natural gas kilns to wood energy systems.

Different policies are required to effectively encourage bioenergy in each region. The amount of unused residue is sizable, and incentives should be considered to encourage development.

Due to an early focus on cogeneration, New England acquires a considerable amount of Quebec and New Brunswick residues. A review of New England incentives is advised so that equal incentives can be applied in the Maritimes and Quebec to keep residue for domestic use. The same applies for exports of residue from Ontario.

A study should be undertaken to assess the potential for residue from the forest floor, particularly in eastern Canada. This study should include fibre from chipping operations as well as slash from harvest.

Appendix 1: Questions asked

Each of the mills was asked the following list of questions:

- 2004 lumber **capacity and production** for each sawmill (MMfbm)
- Total residue production (BDt) broken down into **sawdust, shavings and bark**
- For each sawmill, the **fate** of the sawdust, shavings and bark (i.e. How much is used onsite? For energy or products? How much is sold? For energy or products? Are the sales under long-term contract? How much is landfilled? How much is incinerated? How much is exported to the USA? How much is surplus?) Estimate of usage on site for energy production, of off-site sales and of surplus residues production and disposal method
- Savings achieved per BDt by NOT having to landfill residues.
- For each sawmill or pulp mill, are there any **older existing hog fuel/bark/sawdust piles**? What is the volume? Is it totally contaminated, or potentially usable for energy?

Not all questions were answered. There was often discomfort in discussing related to prices, so the issue was dropped.

Appendix 2: Surveyed sawmills

The survey first contacted the largest companies and mills, and then a random sample of small-medium mills. Coverage was extensive in terms of proportion of provincial lumber production. For example, in Ontario, surveying 45 mills resulted in residue data for 80% of provincial lumber production.

Table A2-1: Mill Surveyed

	Lumber production in 2004 (MMBF)		Share	Mills Surveyed
	Actual	Surveyed		
Ontario	3,698	2,964	80 %	45
Quebec	8,426	5,339	63 %	62
New Brunswick	1,712	1,292	75 %	21
Nova Scotia	756	676	89 %	14
Prince Edward Island	45	45	100 %	3
Nfld & Labrador	120	108	90 %	?
Total	14,757	10,425		

Most mills provided data directly, but not for all categories. Smaller companies tended to approximate volumes, not knowing volume in annual BDt but in other measures such as "truck loads every other week". In cases where breakdowns between bark, sawdust and shavings were not known or readily available by a company, companies agreed that the survey use regional factors to estimate them. Some companies provided little or no data directly, but some data was available from other sources.

Mills listed in Table A2-2 were contacted directly or indirectly as part of this residue study. For the mills highlighted, appropriate factors were used to estimate residue production.

Table A2-2: List of Surveyed Mills (Western Canada)

British Columbia			
Cariboo			
Mill	**Location**	**Mill**	**Location**
Ainsworth Lumber Co. Ltd.	100 Mile House	Tolko Industries Ltd.	Quesnel
C & C Wood Products Ltd	Quesnel	Weldwood of Canada Ltd.	100 Mile House
Jack Pine Forest Products	Williams Lake	Weldwood of Canada Ltd.	Quesnel
Lignum Ltd.	Williams Lake	Weldwood of Canada Ltd.	Quesnel
Tolko Industries Ltd.	Williams Lake	Weldwood of Canada Ltd.	Williams Lake
Tolko Industries Ltd.	Williams Lake	West Chilcotin Forest Product Ltd.	Nimpo Lake
East Fraser Fibre Co Ltd	Williams Lake	West Fraser Mills Ltd.	Quesnel
Canfor	Quesnel	West Fraser Mills Ltd.	Williams Lake
Pal Lumber	Williams Lake	West Fraser Mills Ltd.	Clinton
Sigurdson	Williams Lake		
Prince Rupert			
Mill	**Location**	**Mill**	**Location**
Babine	Burns Lake	Kyahwood Forest products	Smithers
Cheslatta Forest products	Burns Lake	West Fraser	Houston
West Fraser	Decker Lk.	West Fraser	Smithers
Canfor	Houston	West Fraser	Terrace
Kispiox F.P.	New Hazelton	Pleasant Valley FP	
Kitwanga Lumber	Kitwanga		

Prince George

Mill	Location
Canadian Forest Products Ltd.	Bear Lake
Winton Global	Prince George
Winton Global	Bear Lake
Canadian Forest Products Ltd.	Chetwynd
Chetwynd Forest Industries	Chetwynd
Redekopp Custom Sawmilling Ltd.	Chetwynd
Vern's Ventures Ltd.	Chetwynd
Tembec	Chetwynd
Louisiana Pacific Canada Ltd.	Dawson Creek
Canfor	Engen
Jones and Linklater Enterprises Ltd	Farmington
Canfor	Fort Nelson
Canfor	Fort Nelson
Canfor	Fort Nelson
Apollo Forest Products Ltd.	Fort St James
Canadian Forest Products Ltd.	Fort St James
T'loh ForestbProducts Ltd.	Fort St James
Stuart Lake Lumber Co. Ltd.	Fort St James
Canadian Forest Products Ltd.	Fort St John
Canadian Forest Products Ltd.	Isle Pierre
West Fraser Mills Ltd	LeJac
East Fraser Fibre Co Ltd	Mackenzie
Abitibi-Consolidated Inc	Mackenzie
Canfor	Mackenzie
Corwood Timber Products Ltd.	McBride
Gibbs Custom Sawmill Ltd.	McBride
Marsh Bros Lumber and Supply Ltd	McBride
McBride Forest Ind. Ltd.	McBride
Smith Custom Sawing Ltd.	McBride
Walter Jervis Sawmills Ltd	McBride
Canadian Forest Products Ltd.	Prince George
Canadian Forest Products Ltd.	Prince George
Canadian Forest Products Ltd.	Prince George
Carrier Lumber Ltd.	Prince George
Lakeland Mills Ltd.	Prince George
Woodland Lumber Ltd.	Prince George
Stella-Jones Inc.	Prince George
Canadian Forest Products Ltd.	Prince George
Dunkley Lumber Ltd.	Strathnaver
Canfor Fibreco Pulp Inc.	Taylor
Hauer Bros. Lumber Ltd.	Tete Jaune Cch
AZ - Tech Forest Products Ltd	Valemount
Bent Hammer Timberframes Ltd	Valemount
Griffin Sawmills Ltd.	Valemount
Canfor	Valemount
Nechako L & M Lumber Ltd.	Vanderhoof
Brink's	Prince George
Vanderhoof Specialty	Vanderhoof
Rahn Forest Products Ltd.	Prince George

Kamloops

Mill	Location
Tolko Industries Ltd.	Cache Creek
Tolko Industries Ltd.	Bear Creek
A.R. Lifely	Clearwater
AIA Lumbermill	Little Fort
Ardew Wood Products Ltd.	Merritt
Aspen Planers Ltd.	Merritt
Condale Industries Ltd	Lumby
Darfield Building Products Ltd	Darfiled
Delibo Enterprises Ltd	Clearwater
Ewashina & Son Logging Ltd.	Barriere
Gilbert Smith For Prod Ltd	Barriere
Gorman Bros Lumber Ltd.	Westbank
International Forest Products Ltd	Adams Lake
Kamloops Firewood Ltd.	Kamloops
L. Russo Sawmills Ltd.	Kelowna
Lakeside Timber Ltd.	Tappen
Larry Buff Sawmills Ltd.	Westwold
Lytton Lumber Ltd.	Lytton
Schapol Logging Ltd.	Enderby
Seaward Mechanical Ltd.	Albas Falls
Simpcw Development Co Ltd	Barriere
Canfor	Vavenby
T.L. Timber Ltd.	Cawston
Tolko Industries Ltd. Lavington	Lavington
Tolko Industries Ltd.	Merritt
Wadlegger Log & Constr. Co.	Raft River
Weyerhaeuser Company Ltd.	Mission Flats
Weyerhaeuser Company Ltd.	Okanagan Falls
Weyerhaeuser Company Ltd.	Princeton
Tolko Industries Ltd.	Kelowna
Tolko Industries Ltd.	Armstrong
Federated Co-op Ltd.	Canoe
Ainsworth Lumber Co. Ltd.	Savona
Tolko Industries Ltd.	Heffley Creek
Princeton Wood Preservers Ltd	Princeton
Ainsworth Lumber Co. Ltd.	Lillooet

Munson Equipment Ltd.,	Chase	Kootenay Hardwoods Ltd.	Kamloops
North Enderby Timber Ltd	Enderby	M. V. P. Veneer Inc.	Kamloops
Notch Hill Forest Products Ltd	Sorrento	Kamloops Forest Products	Kamloops
Oyama Forest Products	Oyama	Tolko Industries Ltd.	Lumby
Paragon Ventures Ltd.	Lumby	Bridgeside	Lillooet
R & T Zieske Sawmills Ltd.	Falkland	Meeker	
Tolko Industries Ltd.	Armstrong	Nicola Post and Rail	Merritt
Rouck Brothers Sawmill Ltd	Lumby		

Nelson

Mill	Location	Mill	Location
Bear Lumber Ltd.	Cranbrook	Meadow Creek Cedar Ltd.	Cooper Creek
Clarence Palumbo Sawmill Ltd.	Parson	Moberly Wood Products Ltd.	Golden
Downie Timber Ltd.	Revelstoke	Pope & Talbot Ltd.	Castlegar
Galloway Lumber Co. Ltd.	Galloway	Pope & Talbot Ltd.	Midway
Garry Brock & Son Logging	Harrogate	Pope & Talbot Ltd.	Grand Forks
Herridge Trucking and Sawmilling Ltd	Nakusp	Porcupine Wood Products Ltd	Salmo
Hilmoe Forets Producst Ltd	Rock Creek	S & O Sawmills Ltd.	Rhone
J H Huscroft Ltd.	Erickson	Seel Forest Products Ltd.	Edgewater
J. D. Mills Ltd.	Revelstoke	Canfor	Radium Hot Sprgs
Joe Kozek Sawmills Ltd.	Revelstoke	Canfor	Slocan
Jones Ties and Poles (1978) Ltd.	Rossland	Tembec Industries Ltd.	Elko
Kalesnikoff Lumber Co. Ltd.	Thrums	Tembec Industries Ltd.	Canal Flats
Karl Beattie Cont Ltd	Revelstoke	Ukass Logging Ltd.	Wilmer Creek
McDonald Ranch & Lumber Ltd.	Grasmere	Wynndel Box & Lumber Co. Ltd.	Wynndel

Alberta

Mill	Location	Mill	Location
Canfor	Grande Prairie	Boucher	
Canfor	Hines Creek	Buchanan Lmbr.	High Prairie
Tolko	High Level	Crestview	
Tolko	High Prairie OSB	Daishowa	
Tolko	Slave Lake OSB	Bobocel Lmbr	
West Fraser	Blue Ridge	Evergreen Lmbr	
West Fraser	Alberta Plywood	Hansen	
West Fraser	Ranger Board MDF	La Crete	
West Fraser	Seetha	Manning	Manning
West Fraser	Slave Lake Veneer	Millar Western	Boyle
West Fraser	Hiatha	Millar Western	Whitecourt
West Fraser	Hinton	Mostowich Lmbr	Fox Creek
Weyerhaeuser	Grande Prairie	Northland FP	Ft mcmurray
C&C	Grande Cache	Rocky WP	
Weyerhaeuser	Drayton Valley	Shadow creek	
Weyerhaeuser	Drayton Valley OSB	Slave Lake CTMP	Slave lake
Weyerhaeuser	Edson OSB	Spray Lake	
Weyerhaeuser	Claresholm	St. Jean	
Weyerhaeuser	Gr. Prairie Kraft Pulp	West Fraser LVL	Strrachan
AlPac	Boyle	Sundance Forest Industries	Edson
Ainsworth	Grande Prairie OSB	West Fraser Sunpine	Sundre
ANC		Tall Pine	
Footner	High Level OSB	Vanderwell Cont.	Slave Lake
Atlas Lumber		Zavisha	

Saskatchewan

Mill	Location	Mill	Location
Weyerhaeuser	Hudson Bay Plywood Plant	NorSask FP	Meadow Lake
Weyerhaeuser	Hudson Bay OSB Plant	Clearwater FP	Meadow Lake
Weyerhaeuser	Carrot River Sawmill	Green Lake Metis	Green Lake
Weyerhaeuser	Wapawekka Lumber	Aallcann Wood	Prince Albert
Weyerhaeuser	Big River	Zelensky Bros	LaRonge
Weyerhaeuser	Prince Albert Pulp & Paper	Provincial FP	Prince Albert
L&M Wood	Glaslyn	Carrier Lumber	Prince Albert
Mistik Management	Meadow Lake	Ewen Lumber	McKague
Millar Western Pulp	Meadow Lake	Tolko	Meadow Lake

Manitoba			
Mill	**Location**	**Mill**	**Location**
Tolko	The Pas	Palliser Furniture Ltd	Winnipeg
Tembec	Pine Falls	South East Forest Products Ltd.	Blumenort
Spruce products Ltd.	Swan River	Waugh's wood	The Pas
Prairie Forest Products Ltd.	Neepawa	Kotyk Sawmill	The Pas
Lousiana Pacific OSB	Minitonas		

Appendix 3: Quebec regions-districts

Nord-Saguenay
Nord-du-Quebec
Saguenay- Lac-St Jean
Côte-Nord

Abitibi-Outaouais
Abitibi-Témiscaming
Outaouais
Laurentides

Rive Nord
Lanaudières
Capitale Nationale
Maurice
Estrie
Montréal

Rive Sud
Montérégies
Centre-du-Quebec
Chaudières-Appalaches
Bas-St. Laurent
Gaspésie-Iles-de-la-Madelaine

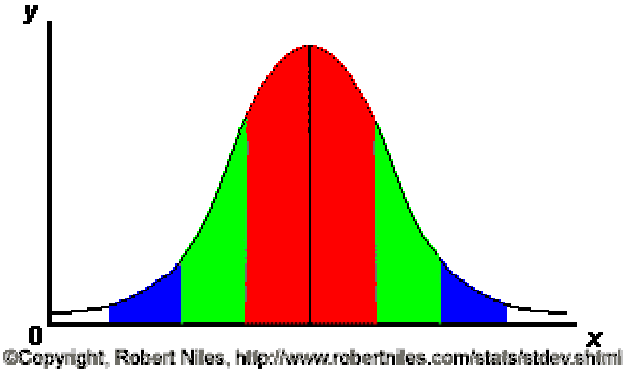
Appendix 4: Confidence limits

Standard deviations are used to illustrate the confidence surrounding an estimate. If a number such as "residue production" is estimated, one can normally calculate the standard deviation "σ" for that estimate. It is calculated as follows:

Std dev = σ = square root [sum$(x_i-u)^2/(n-1)$],
x_i = each mill residue production identified
u = average of x_i
= number of mills surveyed

One can say with 68% confidence that the actual surplus will be within one standard deviation of the estimate, 95% confidence that the actual surplus will be within 2σ of the estimate, and 99.7% confidence that the actual surplus will be within 3σ of the estimate.

Fig 1- Standard Deviations surrounding a mean



The intention was that telephone survey would provide data for both residue production and surplus for each mill surveyed, that this data would be used to estimate residue production and surplus for the mills not surveyed, and that a standard deviation would be calculated. For example, in the case of Ontario, 80% of lumber production in the province was surveyed. Actual residue data for the surveyed mills is a very good indicator for estimating the production and surplus of the unknown 20%.

However, idiosyncrasies with the data prevent a reliable estimate of standard deviation. Some companies provided data for the whole company, not by mill. To assume the company standard deviation for each mill would underestimate of sample standard deviation. To assume the company as one mill would either under or over estimate sample σ. One multi-mill company reported 2004 residue production as a percent of lumber production but did not supply lumber production (confidential). 2002-03 lumber production data from the company website was used to calculate 2004 residue production. While this would give a fair estimate of production, the σ would be inaccurate. Some companies reported lumber production accurately, but asked to apply provincial factors for residue production. Thus, while the amount of data acquired through survey will give a very accurate estimate of both actual residue production and actual surplus, a calculated standard deviation calculation would be meaningless. A notional confidence measure becomes necessary.

With the survey covering 80 percent of lumber production for Ontario, 89 percent for Nova Scotia, 90 percent for Newfoundland and 100 percent for PEI, total residue production and residue surplus are probably accurate within 3-5 percent. In Ontario for example, 1550 BDt was estimated directly from the survey, but since some mills did not provide all data, it is possible that even the surveyed estimate could be out as much as 3 percent. As shown in Table A3-1 below, even if the estimate for Ontario mills not surveyed were out by 10 percent, the Ontario total would only be out by 4.7 percent. Notionally, 5 percent might represent a good error range for Ontario encompassing pulp mills and sawmills. Nova Scotia, Newfoundland and PEI would be less than that, owing to a higher proportion of surveyed mills.

Table A3-1

Example: Ontario Confidence Limits

	Pulp	Sawmills	Error Range (+/-)	Error
	Bdt	Bdt		Bdt
Surveyed		1550	3.0%	47
Not Surveyed		502	10.0%	50.2
Total	550	2052	4.7%	97

For Quebec over 63 percent of production was surveyed, however the 2004 survey and a QFIC 2002 bark survey undertaken over all mills combine to produce a very accurate picture of bark production, probably with 3 percent. Projections for sawdust, shavings and surplus based on surveyed mills are probably accurate within 4-5 percent.

As many companies did not report exports, they are estimated with less certainty but are probably fairly accurate. The 2002 Quebec bark survey encompassing all mills estimated al bark leaving the province, including to Ontario and New Brunswick. Bark directed to other provinces shows up in the 2004 survey. Also, exports to Maine and New York are limited by geography. Only those mills in the Rive Sud and certain portions of Rive Nord will export to the US. These factors act to limit the error of estimate.

Existing bark piles are difficult to accurately assess, as described in each of the regional sections. Some piles have been tested and have determined that the pile is 90% usable for energy. Many have not been tested. Some have been capped and contain layers of sand and gravel. But even these, previously judged usable, are now being tested for ways of removing contaminants.