An Inventory of Mill Wood Residue and Preliminary Assessment of Alternative Uses in the West Kootenay

Submitted To:
Ministry of Water, Land, and Air Protection, Kootenay Region,
Kootenay Association of Science and Technology,
and the Renewable Resources Department, Selkirk College

Submitted By:
Colin Hamilton
Integrated Environmental Planning Student
With the Renewable Resources Department,
Selkirk College

February 15, 2003

ACKNOWLEDGEMENTS

I wish to thank Maureen Grainger from the Ministry of Water, Land, and Air Protection and Claudia Trudeau from the Kootenay Association of Science and Technology for their generous support.

Thank you also to the faculty of the Renewable Resources Department at Selkirk College for their time and encouragement over the length of the project. Special thanks to my supervisors Rhys Andrews and Barry Janzen for their patience and guidance for which this report would not have been possible. I also wish to acknowledge the support from colleagues who worked on the Residential and Commercial Waste Studies.

My appreciation also goes to Chris Bullock of WesternBio Resources Ltd.

EXECUTIVE SUMMARY

Wood residues from timber processors in the West Kootenay are currently under-utilized and are commonly disposed of by open burning. This report inventories wood residue from timber processors and identifies alternative technologies that may be applied to make better use of this available energy source.

The inventory data used in this report was obtained in surveys completed by 15 of 22 timber processors in the West Kootenay area. Based on the information reported during this survey, 1,204,748 m^3 of wood residue is produced annually by these processors. Of this total, 913,600 m^3 or 76% is currently allocated for the production of pulp, particleboard, or electricity. The remaining 291,148 m^3 or 24% is unallocated and could serve as a potential energy source for new initiatives. Data obtained from the questionnaires was unaudited but reflects feedback provided by the survey respondents.

This report investigates the feasibility of using current unallocated wood residue reported by the timber processors in the West Kootenay area. Alternative wood residue technologies examined in this report include; wood pellet production, heat recovery, cogeneration, bio-energy, composting and bio-diesel.

This report provides a general discussion of factors related to the development of these alternative uses. These factors are common to all listed alternatives and include inventory type, transportation, and delivery models.

The utilization of the current unallocated wood residue in the West Kootenay area will require the cooperation and coordination of the various government levels, timber processors and business partnering for new initiatives. This report recommends the following strategies be implemented to help achieve total allocation of wood residue.

1. Inventory and database for wood residue in the West Kootenay area.
2. Annual reporting of wood residue by timber processors.
3. Provide recommendations for appropriate storage and handling of wood residue.
4. Develop grading and sorting standard for wood residue.
5. Develop a cooperative relationship between governments, timber processors, and other interested parties.
6. Develop a detailed analysis of transportation and delivery models for new technologies.
7. Inventory other sources of wood residue in the West Kootenay.

TABLE OF CONTENTS

1 INTRODUCTION

The Ministry of Water, Land and Air Protection (MWLAP), Kootenay Region, has commissioned Selkirk College to conduct a study for wood residue use from timber processors in the West Kootenay. This study encompassed the area from the US border north to Nakusp including Meadow Creek, and from Nancy Greene Lake to Creston. The current practice of burning wood residue is common locally. Alternatives to open burning as a means of wood residue disposal may result in a healthier environment, growth of new business in the West Kootenay and cost savings to current wood residue producers. Current and emerging technologies can be developed to utilize unused and low value residue from timber processors.

Wood residue is the by-product of the primary wood processing activity. This residue may be in the form of bark, sawdust, shavings, hog (a combination of bark, sawdust, and shavings), chips, slabs, or trim ends (Samis and others 1999). The fate of wood residue can range from disposal by open burning to uses such as fibre in the pulping process and others.

People in BC have expressed concern about the smoke produced by various wood-burning activities, including prescribed (slash) burning and the disposal of sawmill wood residue in beehive burners. In many communities in BC, beehive burners have been identified as major sources of particulate emissions (British Columbia 2001). These fine particulates are considered one of the worst kinds of air pollution problem in BC. Within British Columbia, fine particulates in the air have been linked with numerous health problems, such as bronchitis, emphysema, asthma and even death. They have also been the cause of additional provincial emergency room visits and hospitalizations (British Columbia 2001).

Fine particulates in the air can also affect visibility by reflecting light to the eye, making it difficult for residents and tourists to enjoy the scenery (British Columbia[1] 2002).

The Ministry of Water, Land and Air Protection has moved to control the sources of smoke in BC and is encouraging the use of wood and leafy residue as a resource. New regulations will require wood residue (beehive and silo) burners in populated areas to be shut down by the end of 2004 (British Columbia[3] 2002). Eliminating these inefficient burners, will lead to cleaner air in many regions (British Columbia 2001).

Timber processors also face the increased costs associated with open burning. When costs are fully considered ie. Permits, extra personnel, fire-fighting equipment and machinery, open burning is not an inexpensive solution.

Given these considerations, industry and government are looking for alternative solutions of disposal. Current wood residue markets are available to local timber processors. Examples of these include: Canpar Industries in Grand Forks that uses sawdust and shavings for particleboard, Celgar Pulp in Castlegar that uses chips for pulping, and

Avista in Kettle Falls, Washington that uses hog for co-generation. However, residue requirements of these facilities place restrictions on the types of material accepted. As well, the timber processing businesses need to consider new approaches in sorting and storing wood residue, in an effort to ensure its highest value. Thus, additional viable alternatives for wood residue solutions need to be fostered from government and industry.

This report provides an assessment and inventory of the wood residue from timber processors, reviews alternative uses of wood residue, provides a general analysis of these technologies and makes recommendations that can facilitate these emerging alternatives.

2 LITERATURE REVIEW

During the development of this assessment, other wood residue reports were identified and researched. The report titled Scrap Wood Availability in the Triangle J Region (Buehlmann and Kincaid[2], 2002) utilized a survey as its data collection method to identify the types of wood residue, the volume of wood residue, and its availability to potential end users.

A report from the Clean Washington Center entitled Identifying Generations Streams of Wood Waste Materials (CWC[2] 1997) recognized the opportunity in distinguishing wood residue generators and the types of wood residue they produced. New wood residue processors were able to use this data to secure their supply paths (CWC[2] 1997). By conducting focused telephone interviews, a current date wood-waste generation and economic database was developed. The report found that a single wood-waste supply source would not necessarily support a reuse-recovery system. The report also found that a detailed profile from a larger geographic region would help potential wood residue processors arrange supply sources. In addition, the report outlined the need for processors to focus their discussions directly with wood residue generators. The report concludes that this information is necessary to justify the viability of an operation in a business plan, develop an understanding of the competition, secure supply accounts, and satisfy investors (CWC[2] 1997).

Two reports that promote a bridge between the wood residue generator and the post use consumer are Prioritizing Generator Sources and Developing Close Relationships Between Processor and End-User (CWC[1] and CWC[3] 1997). In the report Prioritizing Generator Sources, the technical and economic needs of the wood residue processors are outlined as they try to establish a business relationships with wood residue generators. The report suggests developing a regional network of supply sources that are diversified enough to enable the processor to its needs regardless of any individual source problems. It underlines the need for processors to consider volume, material quality and feedstock reliability issues (CWC[3] 1997).

The report entitled Developing Close Relationships Between Processor and End-User considers the need to develop a closer relationship between wood residue processor and end-user. The benefits include minimizing feedstock returns or rejections, maximizing feedstock value, and strengthening the long-term viability of the supplier or market. The report emphasizes the importance of both parties understanding and appreciating each other's facility and business (CWC[1] 1997).

Other reports of wood residue volumes are recorded in the Oregon Wood Waste Profile and state wood residue figures (State of Oregon 1998) though it does not include industrial wood waste from the wood products industry. The document stressed the importance of contaminant free material from such things as rocks, dirt, glass and garbage.

Another source of wood waste audits was found in the Central Okanagan Regional District Wood Residue Survey. This report identified different sources, volumes, and end uses for wood residue and their current end use (Bullock 2000).

An examination of wood markets for unallocated wood residue can be found in the report Markets for Scrap Wood in the Triangle J Region (Buehlmann and Kincaid[1], 2002). This report outlines the markets available for several types of scrap wood currently sent to landfills including dimensional lumber, cutoffs, and pallets. The report suggested ways local governments could ban or impose a significant surcharge on wood residue at their landfills and transfer stations without creating a hardship for the generators of these materials. The report also proposed plans whereby public decision-makers could support enterprises using wood residue by dedicating some public land to public-private partnerships involving scrap wood reuse. An example included a composting operation that could divert organics from the landfill and create a demand for scrap wood as a bulking agent (Buehlmann and Kincaid[1], 2002).

Effects of wood residue contamination are outlined in a report entitled Visually . Identifying Common Wood Waste Contaminants (CWC[4] 1997). The report suggests that minimizing the presence of contaminants in their wood residue will increase the materials marketability. The procedure outlined was to inspect wood residue for particular contaminants to meet end-user quality specifications. This basic knowledge would lead to improved decisions concerning raw material sourcing, wood-waste processing, and end-product marketing (CWC[4] 1997).

3 METHODOLOGY

The procedure used in preparing this report involved a multistage process. Initially, wood residue producers were identified and a survey was developed. Producers were then sent the survey and the information collected formed the basis of a wood residue inventory. Alternative technologies were investigated and assessed to determine their respective feasibility. Finally, this report was produced to present the results and provide recommendations related to the management of wood residue within the study area.

Identification of Wood Residue Producers

An initial list was compiled of 17 wood manufacturers issued burning permits within the last year from MWLAP. Added to this list were timber processors who did not carry out open burning as part of their operation. Within the defined project area, a total of 22 operations were identified and surveyed.

This study did not survey other potential sources of wood residue that are currently underutilized locally. Some of these other sources would include the following:

- Municipal wood residue
- Orchard trimmings
- Land clearing debris
- Construction and demolition wood residue.
- Wood residue directly associated with logging activities.

Information Collection and Database Development

Critical to the study was an inventory of wood residue in the region. The objectives of the survey was to gather the following information:

- Type of processing facility
- Annual wood consumption and species composition
- Volume of wood residue per year
- Type of wood residue
- Current uses and disposal methods
- Costs associated with wood residue disposal

To evaluate requirements of potential technologies, specific milling machinery at the mill was identify as well as a review of existing mill infrastructure such as storage facilities, available machinery, and road restrictions. This information was used to determine the compatibility of existing operations to accommodate wood residue demand by new technologies.

The survey was mailed out on June 20, 2002 with a three-week turn around time limit. Many of these businesses were phoned to clarify any omitted information on the returned surveys. Also, in discussing the project, businesses provided additional suggestions and information.

A database was constructed to assist with the volume of information. Survey information was entered into the database and queried to determine wood residue volumes. The software used was Microsoft's Access 2000. Volumes were reported in m^3 of solid wood. This database will be included as part of a larger project being undertaken by the Kootenay Association of Science and Technology (KAST). The project is titled By-Product Synergy and is being developed by a Royal Roads Masters candidate (KAST February 2002).

The survey used in this project provides a starting point for further investigations of wood residue inventories and was intended to provide base information. A more comprehensive survey and analysis will be required as part of a business plan or to support investment, including an assessment of other wood residue producers.

The timber processors surveyed were asked whether or not they wished to be anonymous, with the majority answering yes. Therefore the data presented does not indicate which timber processors completed the survey and which data comes from which source. However, it was clear that more surveys were completed because the sources of data were kept confidential. Terminology and definitions of the types of wood residue varied between participants. This report attempts to clarify and group the variety of responses. However, future audits of inventories may require more developed standards and specifications for data analysis.

Identifying and Assessing Feasibility

The alternative uses of wood residue included in this report have been selected based on: consultation with people in the industry of new and emerging technologies, a literature and library search, and on-line research of wood residue.

The initial assessment of these new technologies relied on the following factors:

- The minimum amount of wood residue required to support the wood residue technology.
- The type of wood residue required to support the wood residue technology.

- The total volume of unallocated wood residue within the study area.
- Consideration of shipping wood residue from the producers to potential new facilities.

4 RESULTS

A total of 22 surveys were mailed out and 17 surveys were returned. Of the returned surveys, one operation was issued a burning permit but does not produce wood residue because it is a field operation and one operation did not wish to participate in the survey. The data presented is the results from 15 completed surveys. As the majority of respondents indicated their desire to remain anonymous, text, tables, and figures do not include company or employee names.

Survey summaries for total wood consumption (see Table 1) and total wood residue (see Table 2) are given below.

Table 1: *Summary of Total Volumes*

	Total (m3)	Percentage (%) of Total Volume
Total Wood Consumption By Processors	2,122,500	-
Total Wood Residue	1,204,748	57

Table 2: *Summary of Total Wood Residue*

	Total (m3)	Percentage (%) of Total Wood Residue
Total Allocated Wood Residue	913,600	76
Total Unallocated Wood Residue	291,148	24

Wood consumption refers to the wood that enters the processing facility, primarily in the form of logs. The results of the survey indicate an annual wood consumption of 2,122,500 m^3/year, made up entirely of softwood species (see Table 3).

Table 3: *Total Annual Wood Consumption by Species (m^3/year)*

Douglas Fir	Pine	Cedar	Spruce	Western Hemlock	Other Softwoods	Total
614,050	412,750	375,450	336,000	327,500	56,750	2,122,500

The survey participants did not identify any hardwood species consumed. Of the total of softwood species consumed, Douglas fir was the most dominant wood species with 614,050 m^3/year or 29% of the total volume (see Figure 1). Pine, Hemlock, Spruce, and Cedar were the remaining species evenly distributed between 15-19% of the total volume. Other softwoods totaled 56,750 m^3/year or 3% of the total volume.

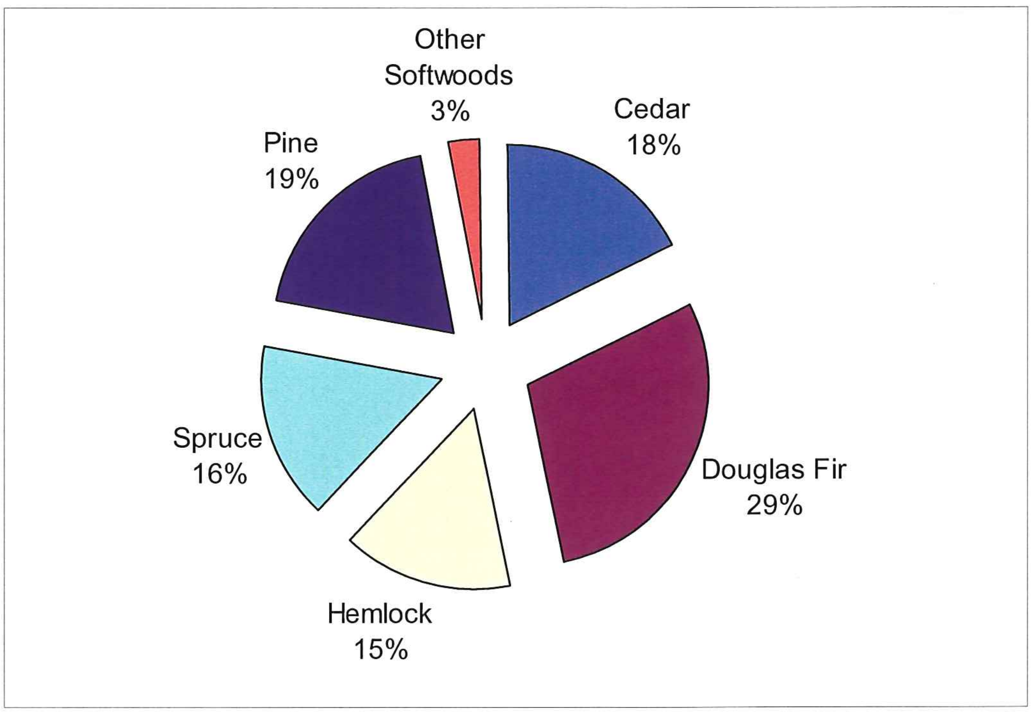

Figure 1: *Softwood Species Consumption (%)*

Wood residue refers to all the wood fibre by-products that result as part of the timber manufacturing process. Wood residue includes: bark, sawdust/shavings, trim ends, hog fuel (a mixture of bark and sawdust), chips, slabs, and other. Conversions were made to express volumes in m^3 of solid wood. From the 15 timber processors surveyed, the total wood residue volume was determined to be 1,204,756 m^3/year (see Table 4).

Table 4: *Total Wood Residue Volumes (m^3/year)*

Bark	Sawdust/Shavings	Trim Ends	Hog	Chips	Slabs	Other Wood	Total
262,503	299,392	8,970	156,292	422,070	3,297	52,224	1,204,748

Chips made up the largest type of wood residue with 422,070 m^3/year or 35% of the total volume (see Figure 2). Sawdust/Shavings and bark have comparable volumes at 299,392m^3/year and 262,503 m^3/year respectively. Hog was at 156,292 m^3/year and Trim ends at 8,970 m^3/year. The Other Wood category totaling 52,224 m^3/year was identified as shavings at 46,424 m^3/year, fines at 3,000 m^3/year, and log yard residue (bark, sawdust, and trim ends mixed with dirt) at 1,300 m^3/year and hog at 1,500 m^3/year.

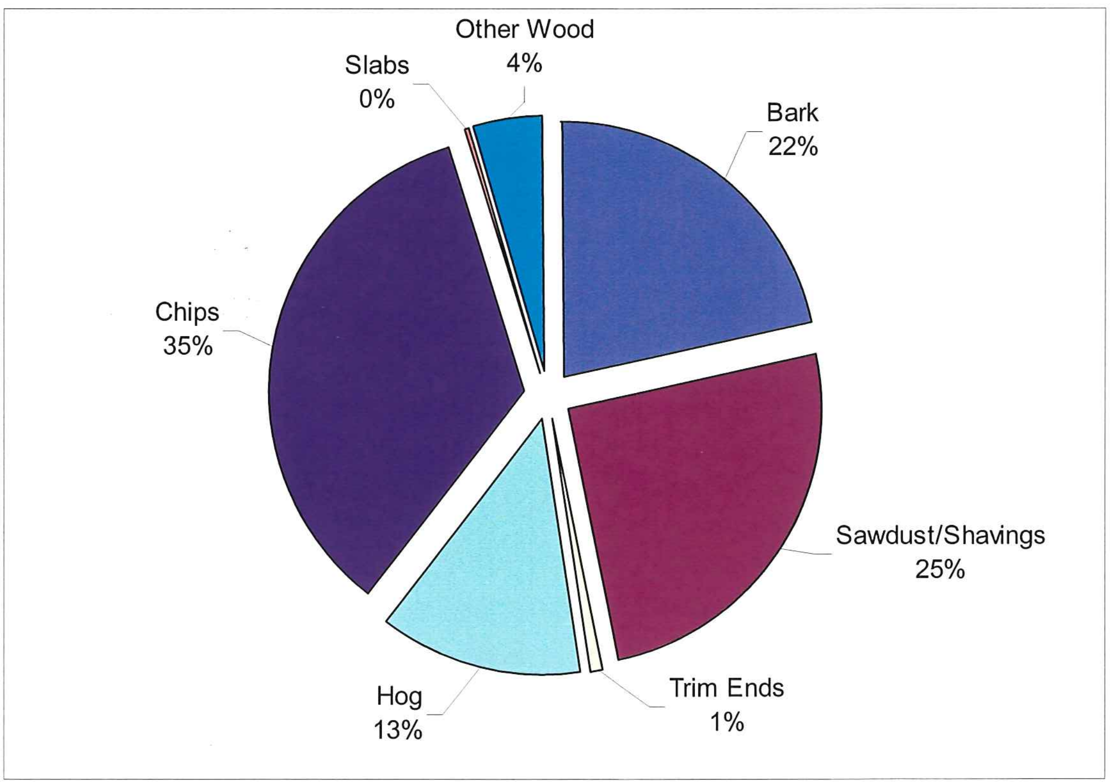

Figure 2: *Types of Wood Residue (%)*

Of the 1,204,756 m^3/year of wood residue currently produced, much of it is allocated for use. To determine the amount of unallocated wood residue, volumes were determined for landfilling, burning, site storage, and other uses (incineration). From the database the total volume of unallocated material was determined to be 291,148 m^3/year (see Table 5).

Table 5: *Unallocated Wood Residue in m^3/year*

Bark	Sawdust/Shavings	Trim Ends	Hog	Chips	Slabs	Other Wood	Total
104,026	100,532	775	66,000	0	3,032	16,782	291,148

Bark and Sawdust/Shavings constituted 70% of this total at 204,558 m^3/year. The remaining material was hog at 6,600 m^3/year with slabs and trim ends at 3,032 m^3/year and 775 m^3/year respectively. Other Wood was 16,782 m^3/year (see Figure 3). The unallocated wood residue total is 24% of the total wood residue produced.

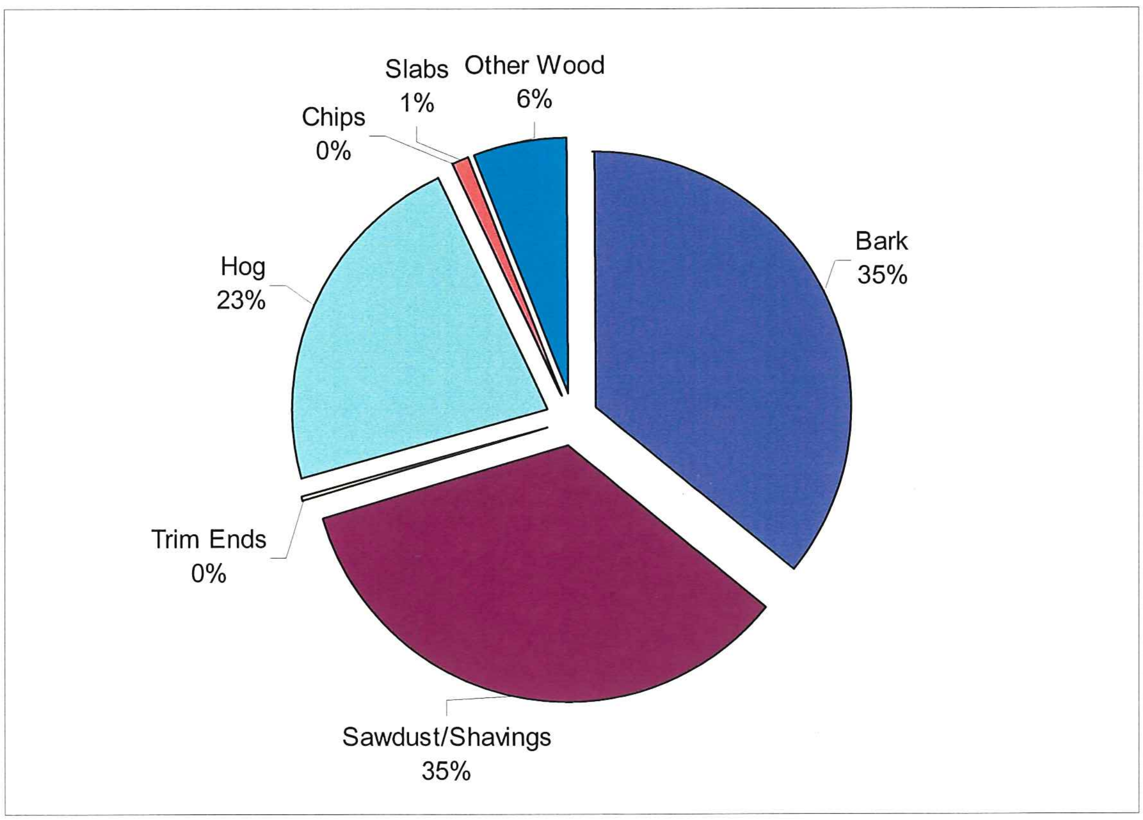

Figure 3: *Unallocated Wood Residue (%)*

The majority (59%), of the timber processors surveyed, were sawmill operations (see Table 6). However, it was possible that more than one type of operation was located at the same site. An example of this may be a sawmill that may also have a remanufacturing facility adjoined to it. Each type of location was recorded independent of location.

Table 6: *Types of operations*

Sawmill	Plywood	Remanufacturing	Shakes	Poles	Log Sort	Poles & Rails	Pulp Mill	Training Facility
10	1	5	3	1	1	2	1	1

Current infrastructure of the surveyed operations indicated the majority (80%) with loading machinery available, 53% with storage facilities such as specified areas of containment or holding bins, and 27% with no transportation restrictions to the mill site such as weight load or seasonal road hauling restrictions (see Table 7).

Table 7: *Current Infrastructure*

	Total (/15)	%
Paved Landings	6	40
Onsite Storage	8	53
Wood Waste Separation	6	40
Loading Machinery Available	12	80
Poor Road Access/Trucking Restrictions	4	27
Drying Facility	7	47

Specific milling machinery inventoried from the 15 surveyed operations included: 53% of the operations with hogs, 60% with chippers, 60% with debarkers, and 47% with kilns. Of the remaining operations, the milling machinery included planers and splitters (see Table 8).

Table 8: *Specific Milling Machinery of 15 Operations*

	Hog	Chipper	Debarker	Kiln	Other
Total (/15)	8	9	9	7	3
%	53	60	60	47	20

Timber processors surveyed also indicated the cost of removing wood residue from their site by either truck or open burning. This information was recorded through telephone conversation throughout the study period. Three participants indicated costs associated with open burning to be $20,000, $5,000 and $4,000 per year respectively. Other participants indicated that their costs were nil or were equivalent to costs associated with the transport of wood residues to markets.

Surveyed mills were given the opportunity to list issues that most concerned them. A total of 93% responded and indicated concerns including: the value received related to wood residue, government regulations, problems with current disposal methods, the need for ideas/innovations, and the development of a wood residue processing facility (see Table 9).

Table 9: *Current concerns*

	Total /15	%
Value received for wood residue	4	27
Government regulations	1	7
Problems with residue disposal	4	27
Ideas/Innovations	4	27
Development of processing facility	1	7

5 DISCUSSION

For the purposes of this report, the discussion has been divided into two parts. In 5.1 the report provides discussion of the key factors that influence the utilization of unallocated wood residue. In 5.2 the report reviews and assesses some of the current alternative wood technologies.

5.1 General Discussion

Three key issues are central to the utilization of existing unallocated wood residue and the development of new wood business ventures. These include a clean and sorted supply of wood residue, an effective transportation strategy, and an effective delivery model (Buehlmann and Kincaid[2] 2001).

Condition of Wood Residue

The survey indicates that approximately 291,148 m^3/year (24%) of wood residue is unallocated in the West Kootenay region. The unallocated material includes bark, sawdust, shavings, trim ends, and slabs. Currently the majority of this material ends up being burned or disposed in landfills. Current practices for managing this material at the mill site include piling with little to no sorting. Many of the storage areas are dirt and gravel surfaces. As the loading machinery scoops up the wood and builds the pile, the wood residue is often mixed with dirt and some rocks. This contamination significantly reduces the value and options for utilization (CWC[4] 1997). Other contaminants that are to be considered are particleboard, pressure treated wood, as well as creosote contaminated and varnish contaminated wood.

Wood residue technologies require dirt free and sorted material. Wood residue that has value is typically sorted into residue types and stored separately at the mill site. This allows the residue to be marketed and transported as clean material (CWC[2] 1997). From the manufacturing process, conveyor belts or vacuums pile residue separately. These piles may be open or contained within outdoor bins. Usually this material is taken off site within a few weeks so it is not subject to the effects of adverse weather conditions eg. wet from rain, frozen from cold (CWC[3] 1997).

It is the author's opinion that the requirements for basic wood residue storage consist of a minimum of a paved landing, preferably with a roofed structure. This would minimize the presence of contaminants in the wood residue and increase its marketability (CWC[4] 1997).

Transportation

Transportation, and the costs associated with it, is another major factor that affects the feasibility of wood residue utilization. Generally, transportation costs in the West Kootenay are high due to winding roads, adverse grades, and winter conditions (Sutco pers. comm., 2002).

The cost of transportation using the current industry standards is approximately $1.45/km (Peterson pers. comm., 2002,Sutco pers. comm., 2002). This rate applies to both straight trailers and walking floor trailers. These rates include an estimated load and unload time of half an hour at each end of the trip. These rates can be made more economical if there was the opportunity to back haul as part of a round trip (Sutco pers. comm., 2002).

Consideration of transport costs and locations of wood residue suppliers and potential site selection would need to be carefully considered by any new business. To be cost effective, new or existing users require an adequate supply of material located within cost effective hauling distances.

Delivery Models

A delivery model is a relationship design of how a new initiative is likely to be implemented. New initiatives may come from the private sector, municipalities, regional districts, crown corporations, or others. It is likely that solutions will require the involvement of several of these groups in partnership. Benefits of partnerships are well known but may include shared start up capital and operating costs, reduced disposal costs, increased market exposure, positive public relations, and a healthier environment.

The West Kootenay region can support new opportunities for utilizing wood residue. Policy initiatives, investment, partnerships, and a greater willingness to utilize the resource would help achieve these ends. Future research and work is necessary to uncover these opportunities.

5.2 Alternative Wood Residue Technologies

This section reviews and examines six alternative technologies, which could help reduce or eliminate current open burning and landfill practices and improve the economic return from the resource.

Wood Pellets

Review

Wood pellets are pellets manufactured from wood residue that are sold as a fuel for heat or electrical generation. This fuel is typically burnt in a stove or furnace using an electric fan to maximize combustion efficiency. The pellets are formed when feedstock, the material put into the machinery to manufacture the product, is forced through a pelletizer, or extruder, under extreme pressure. Naturally occurring wood resins and binding compounds called lignin hold the pellet together (Pellet Fuels 2002).

Wood pellets are commonly made from sawdust and ground wood chips. The mixture of wood species is important to the quality of the pellet. Pellets with a higher Douglas-fir component relative to spruce and pine are most favourable because they burn longer with less ash after combustion (Stirling 2002). Cedar, particularly for a residential fuel, is less favourable in the feedstock because it burns too quickly. Bark is also a problem and must be limited in the feedstock mixture due to higher ash content following combustion (Pellet Fuels 2002). Wood pellets may also be manufactured from hog. This is sold for the international market in Eastern Europe (MacTara 2002).

Additional important requirements for wood pellet feedstock are its moisture content and cleanliness. Moisture content requirements are achieved by blending wet (green) and dry wood residue, resulting in a material with moisture content of approximately 10%-15% (BC Pellet Fuel Manufacturers Association 1999). Dry wood residue comes from either wood that has been through a kiln as part of the wood manufacturing process or part of the wood pellet facility (Stirling 2002). Also important for quality pellet manufacturing is clean and uncontaminated feedstock.

Implications

It is common for wood residue used as pellet feedstock to contain moisture at a rate of 50% by weight. Therefore, approximately 20 tons of wood residue will equal approximately 10 tons of pellets. Pellet plant size can be rated by the hourly production of pellets. A small pellet plant operation produces about 3 tons per hour of finished pellets (Best 2002). Capital costs for this type of plant is about 1 million dollars. These small plants normally require an additional 500 000 dollars for a dryer. During this study, a higher production plant was identified that has capacity of 6 tons per hour at a capital cost of 7 million dollars (Johnston per. Comm., 2002).

In Salmo, a company is in the latter stages of developing a business plan for a low volume pellet mill. This proposed 90 ton per day operation would incorporate new technology by using sound waves and kinetic energy to dry and break up the wood residue to desired wood pellet processing specifications (First American Scientific Corporation 2002). This operation is expected to cost approximately $1.75 million dollars (Best 2002).

The ability for this region to support a pellet mill is positive. A small pellet mill would require approximately 21,600 tones per year (Best 2002). The surveys indicate, the amount of unallocated wood residue minus unallocated bark would equal approximately 42,250 tones per year.

Incineration

Incineration is a term used to describe a closed burning or oxidation system. The use of a commercial incinerator utilizes the energy released by burning wood residue. These closed systems provide greater efficiency and environmental control. Additionally, an incinerator can have the ability to utilize the heat generated for secondary use such as a heat recovery system or cogeneration.

Heat Recovery

Review

Most heat recovery systems are designed to capture the residual heat from incineration and utilize it. Usually these systems are found in conjunction with industrial operations.

The feedstock, or material for disposal, is augured into a combustion chamber were it is burnt. Oxygen is controlled in the combustion chamber for maximum efficiency (Del-tech 2002). Typically, thermal oil is piped through the combustion chamber where it is heated and pumped elsewhere in the plant. An example of its use is to heat a kiln for drying lumber.

Materials that are not to be used for incinerated includes:

- Pressure treated wood
- Creosote contamination wood
- Varnish contamination wood
- Particleboard.

Incinerators are sized by the throughput rate of tons/day. A small size unit for incineration only, will use about 10 tons/day. Incineration units that incorporate a heat recovery system are more cost effective and normally utilize 50-100 tons/day. Turnkey operations are also available depending on the type of wood residue. If the mixture has less than 15% moisture content, it would be considered dry. If the residue mix has 40%-50% moisture content, it would be considered wet and would need additional drying capability (Lindsey pers.commm., 2002).

Dry incineration plants utilize wood that has already undergone moisture reduction. An example of this is planner shavings, which come from lumber that has been air dried or processed through a kiln. The feedstock for a wet fuel incineration unit may be bark, sawdust/shavings or hog with moisture content greater than 40%. Ash from these from these oxidization processes may be marketed or sent to landfill sites (Lindsey pers.commm., 2002).

Implications

An incineration unit, without a heat recovery system, will cost approximately $100,000 - $200,000 (Lucus pers. comm., 2002). The costs for these incinerators with recovery systems are approximately $3-4 million dollars. To build additional cogeneration turbines, an additional cost of approximately 30% would be added on to the incinerator cost. The cost for a dry incineration unit is approximately $1.3 million dollars. A wet incinerator unit will cost approximately $7 million dollars. Existing kilns at a facility may be converted so that the incinerator heats the kiln. Such conversions cost approximately $135,000 per kiln. Based on the incinerators examined, the rate of throughput for the dry incineration system is 17 tons/day compared to 15 tons/day for the wet system (Lindsey pers.commm., 2002).

The ability for this region to support a dry or wet incineration plant is positive. These plants would require approximately 4080 tons/year and 3600tons/year respectively. From the results, the amount of unallocated wood residue would equal approximately 145,500 ton/year (Lindsey pers.commm., 2002).

Some of the larger mills already utilize this technology because their feedstock is close at hand. Unfortunately, their operation does not typically allow for off site wood residue to be trucked in. Elimination of wood residue from smaller timber processors may be optimized if an independent company set up an incinerator to heat another facility or operation

An important factor for this technology is the moisture content of the wood. The lower the moisture content the more efficient the burn. This reflects the importance of having wood residue protected from the elements from timber processor to residue consumer. Another consideration is the distance the wood residue must be transported. Distances greater then 100kms quickly lose their cost effectiveness.

Cogeneration

Review

Cogeneration is the process by which the heat from the burning of wood residue is used to produce steam. This in turn runs a turbine to produce electricity. Such cogeneration facilities exist with local examples in Castlegar, Kettle Falls and Kelowna. With electricity prices currently low at this time, the cogeneration plant in Kettle Falls has been closed for 5 months due to the current unfavourable economic conditions to run the plant (Scarlett pers. comm., 2002)

An available turnkey incineration unit that is able to produce 300kW on a continual basis requires 1.7 green tons/hour. Another turnkey operation is available with a throughput of 150,000 Bone Dry Tons (BDT)/year. Such a system would be able to produce 20-23 MW of power continually (Kelly pers. comm., 2002).

Implications

The small cogeneration plant (300kW) costs approximately $2.5 million. The large plant would cost approximately $30-40 million dollars (Lucus pers. comm., 2002)

To sustain a large cogeneration plant in the West Kootenay area, it would need to be geographically central to operations that produce wood residue.

Bio-energy

Bio-energy refers to technologies that utilize solid fuel such as wood residue or agricultural waste as an energy source. The two technologies investigated were bio-oil and ethanol production.

Ethanol Production

Review

Ethanol is a by-product of the fermentation of sugars. In this case, the sugars have originated from cellulose that makes up tough walls of plant cells within the wood. Lignin is also a major component of plant cells and must be separated from the cellulose before fermentation may begin (Arato 2002).

Until recently, an acid base agent was used to dissolve the lignin from the cellulose before fermentation. The resulting product was not of high value because the lignin was not reused. Recent technology now uses ethanol as the dissolving solvent of lignin (McCloy pers. comm., 2002, Palm pers. comm., 2002). Once the lignin is separated and the production of ethanol complete, a small portion of the ethanol is recycled back as the dissolving agent. This enables the process to have a continuous supply of solvent (Arato 2002).

As well as the production of ethanol, the lignin is also reusable, which was not the case with the acid dissolving process. The ethanol/lignin solution is flushed with water and the lignin becomes an activated lignin. This is used as organic glue in the manufacturing of wood products such as particleboard and the production of industrial ethanol (Arato 2002).

Implications

The feedstock desired for an ethanol production facility should be bark free because of barks low quantity of cellulose. The volume of feedstock, or throughput, per day for a commercial size plant is 100 BDT. This equates to approximately 60,000 m^3 per year of wood residue. The ability for this region to support an ethanol plant is positive. From the survey results, the amount of unallocated wood residue minus unallocated bark would equal approximately 291,000 m^3/year. Capital cost estimates for an ethanol facility are approximately $37-$39 million dollars (Arato per comm., 2002).

Bio-Oil

Review

Bio-oil is an end product of a process called fast pryolysis. Pryolysis is the rapid heating of biomass (wood residue, agricultural waste) to high temperatures without the presence of oxygen. This results in the feedstock, or biomass used, to decompose to a combination of solids and gases, called volatiles. When these are cooled quickly, some of the volatile gasses condense to form a liquid called bio-oil. The other products produced are char and non-condensable gases (DynaMotive 2002).

Bio-oil is sold as a fuel product that is used to run diesel engines and natural gas boilers and turbines. These engines are used for heat and power generation. Solid char is formed into charcoal bricks or charcoal briquettes that are commercially sold as a fuel source (JFBioEnergy Inc[1] 2002). Many of the non-condensable gases are used as a source of fuel for the pryolysis reaction thus enabling the system to become almost self powered (JFBioEnergy Inc[2] 2002).

Implications

This technology may be manufactured in a modular form. For this technology, a minimum of six burning chambers, or retorts, are stacked upon each other to form a working unit. For commercial production, 18 retorts are required. The modular form of this technology enables the unit to be portable. The cost of a small bio-oil plant with six retorts is approximately $700,000. A larger commercial plant consisting of 18 retorts is approximately $1.5 million dollars (Flottvik pers.comm., 2002).

The material necessary for bio-oil technology is wood residue feedstock that includes bark, sawdust, and shavings. The quantity of this material is 120 green tons (wet) or 60 bone-dry tones (dry) per day (Flottvik pers.comm., 2002).

The ability for this region to support a bio-oil plant is positive. From the results, the amount of unallocated wood residue would equal approximately 291,000 m^3/year. A commercial sized bio-oil plant requires approximately 28,800 m^3/year of wood residue (Flottvik pers.comm., 2002).

Composting

Review

Composting is the process of mixing biosolids with wood residue to obtain a soil augment. The biosolids come from two sources. They may come from either the product of organically stabilized waste from sewage treatment facilities or a by-product of the pulp and paper industry. A mixing of biosolids and wood residue is needed to achieve the minimum nutrient level for productive soils (BIO-WISE 2001).

The sewage and the pulp and paper industries have costs associated with disposing of their biosolids. Therefore a complementary solution for biosolid and wood residue producers is needed (Cavers pers. comm., 2002). An example of where this arrangement is working is the City of Kelowna and Riverside Forest Products Ltd. The end-composted product is called ‘Ogogrow’. Biosolids from Kelowna’s water treatment facility are mixed with wood residue from Riverside and composted for approximately 2 months before being sold (Cavers and Light 2000).

Composting is regulated by the Organic Material Recycling Regulation, which came into affect in January 2002. The new regulation classifies biosolids and compost into two categories; Class A and Class B compost. Class A compost requires more stringent composting and stabilization but has less restrictions on where it can be used. Class B compost is less stringent, but does require a land management plan for its use (Bullock 2002).

Implications

Within the West Kootenay region there is not enough biosolids from municipal sewage produced annually to provide a feasible, large scale composting operation that would utilize the wood residue. The other option is to use the biosolids from the pulping process from the pulp and paper industry. Currently, Celgar has a market for all of the biosolids that it produces.

The ratio of biosolids to wood residue is about 1:3. There are enough wood residues in the West Kootenay for composting. A composting facility capital cost is approximately $100,000 (Cavers pers. comm., 2002). Most municipalities have the necessary equipment including loaders and dump trucks. More specialized machinery will dramatically increase the capital costs. Public education is a large factor in the development of solid waste composting (BIO-WISE 2001). Also, partnerships are needed to allow this process to succeed (Cavers pers. comm., 2002). This activity does have the potential to produce a value added product from these two industries.

Revenue may be collected from the sale of the end product as is the case in Kelowna, or be given away for free after qualified inspection and approval (Cavers and Light 2000).

Other Solutions

Biodiesel

Biodiesel is a fuel that is added to diesel, which results in more efficient combustion and a reduction in the amount of diesel being burnt It is more commonly made from the by-products of the rendering community, restaurants and seed oil producers. Biodiesel may also be produced using tall oil. Tall oil is a product of the initial pulping process of wood. During this process, the lignin is separated and forms two elements. One is turpentine; a volatile element and the other is tall oil. Tall oil is currently being used in northern BC as biodegradable oil to apply on gravel roads for dust control (Arato pers. comm., 2002).

Industrial facilities built to produce biodiesel would require at least 10,000 – 30,000 tons/day of tall oil (Norton pers. comm., 2002). It is possible to supplement this tall oil with seed oil and residue from the rendering community, but locally there are not significant sources at this time (Norton pers. comm., 2002).

6 RECOMMENDATIONS

The solution to the use of unallocated wood residue in the West Kootenay will likely involve a mix of alternatives and the cooperation and coordination of governments, timber processors and business initiating new ventures.

These include first steps in a process. The recommendations included are designed to make these first steps successful.

1. **Inventory and database wood residue.**

   An annual regional inventory of allocated and unallocated wood residue should be developed. This database would serve a critical role in the development of alternative uses for wood residue. This will involve the cooperation of timber processors in the region. The MWLAP or other organisations in the West Kootenay region could maintain this database. For example, the Kootenay Association of Science and Technology (KAST) is currently developing a By-Product Synergy program that will track and market reusable materials from industry and residential waste.

2. **Annual reporting of wood residue by timber processors.**

   Identification is the first stage to increase the value of wood residue. For emerging wood residue technologies to become viable, business must know the volume of material within a target area. Under Section 3, Monitoring and Reporting Requirements of the burning permits issued by MWLAP, there is prevision to permittees to keep an inventory of wood residue. Reporting is currently only required if requested by the Regional Waste Manager. Such reporting should either be made an annual requirement of all timber processors or be performed by ministry staff prior to disposal.

3. **Provide recommendations for appropriate storage and handling of wood residue.**

   To mitigate wood residue contamination, minimum requirements such as paved landings, containment bins, and roofed structures are recommended for timber processors. These practices would lead to wood residue marketing and improving residue processor quality specifications (CWC[4] 1997).

4. **Develop grading and sorting standards for wood residue.**

   The next eventuality is to have wood residue graded for business opportunities. Graded wood residue will again increase its value. This would require wood residue to be sorted at the front end, or immediately after the timber is processed. This would also require more elaborate storage of wood residue. This grading and storing may lead to business opportunities or at least minimize the costs of wood residue disposal. Basic grading standards would be required by the industry too. An example of how business is shaping the wood residue grade is from a co-generation plant in Kettle Falls, Idaho. Processors ship sorted residue determined by optimal industry standards. The wood residue is then sorted against these standards and the grade is determined.

5. Meeting with Mills, Government, and other interested parties

A formal meeting with representatives from the timber processors, local, regional, and provincial governments, and interested business groups could serve to inform, consult, and develop a cooperative environment that would facilitate the development of new initiatives.

6. More detailed analysis of transportation and delivery models.

It dose not include an economic feasibility of selected technologies should be completed. An economic analysis would look in greater detail at capital and operation costs, markets, transportation, and residue requirements specific to the target technology.

7. Inventory other forms of wood residue

A more comprehensive analysis will identify all sources of wood residue within the region. Other sources of underutilized wood residue could help support new initiatives. Other sources to expand the scope of the study would include municipal wood residue, orchard trimmings, land clearing debris, construction and demolition waste, and wood residue directly associated with logging activities.

7 REFERENCES

Arato, Claudio. May 2002. Biorefining: Back to the future. Innovation. May 2002. p13-15.

Arato, Claudio. 2002. Telephone interview regarding ethanol. Castlegar. August 28, 2002.

BC Pellet Fuel Manufacturers Association. 1999. Home page. [online] Available from: http://www.pellet.org/index.html Accessed July 20, 2002.

Best, Mark. June 19, 2002. Wood pellets. [e-mail to R. Andrews],[online] Available from: randrews@selkirk.bc.ca .

BIO-WISE, June 2001.Industrial Solid Waste Management: A review of composting technology. AEA Technology, Oxon, England. June 2001.

British Columbia.2001. Air quality in British Columbia. Ministry of Water, Land, And Air Protection. 2001. [online] Available from: http://wlapwww.gov.bc.ca/soerpt/992airquality/particulates.html Accessed: July 1, 2002.

British Columbia[1]. 2002. Environmental indicator: air quality impacts from inhalable particulates and ozone. Ministry of Water, Land, And Air Protection. 2001. [online] Available from: http://wlapwww.gov.bc.ca/soerpt/pdf/992airquality/Airquality_2002.pdf Accessed January 5, 2003.

British Columbia[2]. 2002. Fine particulates: what they are and how they affect us. Ministry of Water, Land, And Air Protection. February 2002. [online] Available from: http://wlapwww.gov.bc.ca/air/particulates/fpwtaaht.html#top Accessed January 5, 2003.

British Columbia[3]. 2002. Wood residue burner and incinerator regulation. Ministry of Water, Land, And Air Protection. February 2002. [online] Available from: Get address Accessed July 15, 2002.

Buehlmann, Urs and Judy Kincaid[1]. April 2001. Markets for scrap wood in the Triangle J Region. North Carolina State University. Raleigh NC. April 2001. [online] Available from: ftp://mail.tjcog.org/pub/webftp/finlmkts.pdf Accessed: June15, 2002.

Buehlmann, Urs and Judy Kincaid[2]. April 2001. Scrap wood availability in the Triangle J Region. North Carolina State University. Raleigh NC. April 2001. [online] Available from: ftp://mail.tjcog.org/pub/webftp/finlavai.pdf Accessed: June15, 2002.

Bullock, Chris, February 2000. Central Okanagan Regional District Wood Residue Survey. Western BioResources Consulting Ltd., Trail. February 2000.

Bullock, Chris, August 2002. Hog fuel composting. Western BioResources Consulting Ltd., Castlegar. August 2002.

Cavers, Beth. August 2002. Telephone interview regarding Ogogrow. Castlegar. August 12, 2002.

Cavers, Beth, and Gordon Light. 2000. Marketing tips from eight years of successful biosolids composting. City of Kelowna. Kelowna, BC. 2000.

Sutco Trucking. 2002. Telephone interview regarding transportation. Contact, Chris. Castlegar. July 12, 2002.

Clean Washington Center (CWC[1]), March 1997. Developing close relationships between processor and end-user. Best Practices in Wood Waste Recycling. Clean Washington Center, March 1997. [online] Available from: http://www.cwc.org/wd_bp/wd_bp_pdf/2-07-01.pdf Accessed: June 15, 2002.

Clean Washington Center (CWC[2]), March 1997. Identifying generations streams of wood waste materials. Best Practices in Wood Waste Recycling. Clean Washington Center, March 1997. [online] Available from: http://www.cwc.org/wd_bp/wbp0101.htm Accessed: June 15, 2002.

Clean Washington Center (CWC[3]), March 1997. Prioritizing generator sources. Best Practices in Wood Waste Recycling. Clean Washington Center, March 1997.

[online] Available from: http://www.cwc.org/wd_bp/wd_bp_pdf/1-01-02.pdf June 15, 2002.

Clean Washington Center (CWC[4]), March 1997. Visually identifying common wood waste contaminants. Best Practices in Wood Waste Recycling. Clean Washington Center, March 1997. [online] Available from: http://www.cwc.org/wd_bp/wbp0301.htm Accessed: June 15, 2002.

Del-tech Industries Inc. 2002. Home Page. [online] Available from: http://www.deltech.ca Access: July 15, 2002.

DynaMotive Energy Systems Corporation. 2002. Home page. [online] Available from: http://www.dynamotive.com/profile/aboutus.html Accessed: July 15, 2002.

First American Scientific Corporation. 2002. Home page. [online] Available from: http://www.fasc.net/main.html Accessed: July 17, 2002.

Flottvik, John. 2002. Telephone interview regarding bio-oil. Castlegar. July 4, 2002.

Greenbaum, Perry. 2001. Fuelling progress. Pulp and Paper Canada. 102(9):13-14,17.

JFBioEnergy Inc[1]. 2002. Home page. [online] Available from: http://www.jfbioenergy.biz/frames.html Accessed: July 15, 2002.

JFBioEnergy Inc[2]. June 2002. Information package for bioenergy solution, organic waste refinery. JFBioEnergy Inc. Abbotsford, June 14, 2002.

Johnston, Gary. 2002. Telephone interview regarding wood pellets. Castlegar. July 9, 2002.

KAST, February 2002. By-product synergy in the West Kootenay Boundary application for funding. Kootenay Association of Science and Technology. Rossland. February 1, 2002.

Kelly, Mark. 2002. Telephone interview regarding cogeneration. Castlegar. July 29, 2002.

Lindsey, Grant. 2002. Telephone interview regarding cogeneration. Castlegar. July 31, 2002.

Lucus, Jean. 2002. Telephone interview regarding cogeneration. Castlegar. June 6, 2002.

Lui, S.D., Nassichuck M.D., Samis, S.C. March 1996. Guidelines on storage, use, and disposal of wood residue for the protection of fich and fish habitat inBritish Columbia. Environment Canada and Fisheries and Oceans Report 95-18. March 1996.

MacTara Limited. 2002. Home page. [online] Available from: http://www.mactara.com/home.html Accessed: July15, 2002.

McCloy, Brian. 2002. Telephone interview regarding ethanol. Castlegar. August 12, 2002.

Norton, Kevin. 2002. Telephone interview regarding biodiesel. Castlegar. August 1, 2002.

Palm, Bill. 2002. Telephone interview regarding ethanol. Castlegar. July 30, 2002.

Pellet Fuels Institute. 2002. Home page. [online] Available from: http://www.pelletheat.org/index.html Accessed July 16, 2002.

Peterson, Dwayne. 2002. Telephone interview regarding transportation. Castlegar. July 8, 2002.

Samis, S.C., Liu, S.D., Wernick, B.G., Nassichuck, M.D. 1999. Mitigation of fisheries impacts from the use and disposal of wood residue in British Columbia and the Yukon. Can. Tech. Rep. Aquat. Sci. 2296: viii and 91p.

Scarlett, Don. 2002. Telephone interview regarding cogeneration. Castlegar. July 17, 2002.

State of Oregon. October 1998. Oregon wood waste profile. Oregon Department of Environmental Quality. October 15, 1998. [online] Available from: http://www.deq.state.or.us/wmc/solwaste/woodwaste.html Accessed: June 15.2002.

Stirling, Jim. June 2002. Value-added pellet product. Logging and Sawmilling Journal. June 2002. p30-31.

APPENDIX A

Covering Letter

625 Columbia Ave.
Castlegar, BC
V1N 1G9

June 20, 2002

To: West Kootenay Timber Processors

The BC Ministry of Water Land and Air Protection (WLAP) and the Kootenay Association for Science and Technology (KAST) are trying to find alternative uses for wood waste and other wastes of industrial activity.

They have since commissioned Selkirk College and a Royal Roads University Master's student to conduct two studies that will explore alternative uses for wood waste and other industrial wastes. In order to explore these alternatives, more accurate information about the types and volume of waste is required. The enclosed survey will provide us with information about your waste.

The questions in this survey will be used for two studies and one academic thesis:

1. ***West Kootenay Woodwaste Study***, for WLAP, Kootenay Region. For all information regarding this study contact: Colin Hamilton by phone at 250 – 365 – 2028 Ext. 26, by fax at 250 – 365 – 2088, or by e-mail at colin.hamilton@westernbioresources.com . Please find enclosed the **green** survey.

2. ***Application of By-Product Synergy in the West Kootenay Boundary Region***, for KAST and, a thesis by a Royal Roads University Master's Student that will be developed from the results of the study for KAST. For all information regarding this study and thesis contact: Scott Bailey by phone at 250-414-0151 or e-mail at scott.bailey@royalroads.ca . Please find enclosed the **white** survey.

The results of these studies are intended to facilitate the development of cooperative relationships among businesses in the Kootenay Region, to share inputs and outputs of industrial activity. This could help reduce your disposal costs or provide new revenue streams for you by finding uses for your waste.

All information in this study will be made public in reports for KAST and WLAP as well as in the thesis. While we do not anticipate that any information in the survey is commercially sensitive, the survey form has the option for anonymity.

We would be most grateful if you would take the time to complete the attached survey. We will be calling you to help you fill it out and to ask to meet with you. **We would appreciate having the survey returned by July 16, 2002.**

THANK YOU VERY MUCH FOR PARTICIPATING IN THIS SURVEY.

Sincerely,

Colin Hamilton
Wood Waste Technologist

Scott Bailey
Master of Science Candidate

APPENDIX B

Wood Residue Survey

Purpose of This Wood Waste Survey

This survey is being conducted to establish an inventory of wood waste generated in the West Kootenay region by timber processors. The data gathered will assist in a feasibility study of alternative wood waste uses other than periodic burning or landfill use. This information could help minimize your disposal costs or increase the value of your wood waste.

This feasibility study is being conducted by Selkirk College for the Ministry of Water, Land, and Air Protection, Kootenay Region. If you have any questions, please contact Colin Hamilton by phone at 250 - 365 - 2028 Ext. 26, by fax at 250 - 365 - 2088, or by e-mail at colin.hamilton@westernbioresources.com .

PLEASE FILL OUT THESE FORMS AND RETURN THEM BY MAIL, OR FAX THEM BACK TO COLIN HAMILTON AT (250) - 365 - 2088, BY JULY 16, 2002. If we do not receive your survey form by then, we will give you a call to ask if you would be willing to provide this information.
Please indicate if you would like a copy of the final report. Yes____No_____
THANK YOU VERY MUCH FOR YOUR PARTICIPATION.

COMPANY INFORMATION

Company Name____________________
Street Address____________________
Mailing Address____________________
City____________________Postal Code____________________
Contact Person____________________Title____________________
Phone____________________Fax____________________E-mail____________________
Years in Operation_____Days/Year of Operation______Days/Week of Operation____________

<u>Existing Infrastructure:</u> Description/Comments

Paved landings ____________________
On-site storage
(Eg. covered bays, etc.) ____________________
Wood waste separation
(Eg. Specific bins etc.) ____________________
Loading machinery available ____________________
Road access/trucking restrictions____________________
Drying facility ____________________

Identify the issues most concerning your company regarding this issue of wood waste? (For example; government regulations, the value currently received for wood waste, the potential uses for wood waste....)

____
____
____

WEST KOOTENAY WOODWASTE SURVEY
File No.: 031-01-01 Timber Processor Survey

A. Type of operation (✓)

Sawmill	Veneer/Plywood	Remanufacturing	Shake/Shingles	Poles	Log Sort	Other

B. Specific Milling Machinery (✓)

Hog	Chipper	Debarker	Kiln	Other

C. Annual Wood Consumption in m^3/year

Softwood	
Cedar	
Douglas Fir	
Hemlock	
Spruce	
Pine	
Other	

Hardwood	
Cottonwood	
Paper Birch	
Aspen	
Other	

D. Total Volume of Wood Waste in m^3/year (if using a different unit, please indicate)

____

E. What volume (m^3) or percentage (%) of total wood waste per year is currently being used for which market?

	Types of Wood Waste						
Current End Uses	Bark	Sawdust/ Shavings	Trim Ends	Hog Fuel	Chips	Slabs	Other
a) Co-generation							
b) Pulping							
c) Remanufacturing							
d) Value-added							
e) Livestock bedding							
f) Composting							
g) Agricultural Co-generation							
h) Landscaping							
i) Horse track/Roadbed							
j) Horticultural application							
k) Firewood							
l) Landfill							
m) Burning							
n) On-site Storage							
o) Other							

F. Who and where are your current wood waste markets?____________________________

____

G. What are your costs to export your wood waste?____________________________