WOOD PELLETS IN BC

WOODY BIOMASS USED IN THE INDUSTRY

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Executive Summary

The wood pellet industry in British Columbia is a relative newcomer to the forest sector. Despite its comparatively small size, it has managed to garner a great deal of negative and misleading attention in the media. This has often led to confusion in public discourse on the nature of the industry, how it operates, the type of fibre or feedstock it uses, and the sustainability of those feedstocks for wood pellet production.

To address the confusion, this report was commissioned by the Wood Pellet Association of Canada to review the relationship between the wood pellet industry and the rest of the forest sector, and to assess relevant data and information to conduct an independent assessment of the use of fibre by the sector.

Our goal is to analyze the role and impact of pellet manufacturing and specifically its place in the forest products value chain. We achieve this by:

- providing a **brief history of the BC forest industry** to provide context as to how the pellet industry complements the larger industry;
- describing the **main wood products produced by the forest industry** to show how forest-derived pellet feedstocks fit into the larger spectrum of forest-derived fibre and feedstocks manufactured and used by the forest industry at large;
- describing specific **wood fibre feedstocks used by the pellet industry**, including residual material generated as a by-product of other forest product manufacturing processes and fibre sourced directly from the forest; and
- presenting and addressing questions relating to the **impacts and issues related to the sourcing and consumption of forest-derived feedstocks** by the BC pellet industry and related counterfactuals.

We used a combination of government and industry databases and personal interviews with individual pellet plant operators. We then compared the results of our analysis with the Sustainable Biomass Program (SBP) Audit Reports required by SBP certification. We found that the audit reports are consistent with our analysis.

It is important to note that the critical company-specific data used in our assessment is confidential due to the competitive nature of the information. In our approach, we reviewed the data for virtually every truckload of fibre for each pellet mill in the province and we also were able to source forest-based residuals down to the forest harvesting block for each mill. We found that the information used by government and industry is very reliable.

Our key finding is that the pellet industry sources an estimated 85% of its fibre from the by-products of the sawmills and allied industries. Of the remaining 15%, 11% is from low quality logs in the forest. We provide evidence that low quality logs only end up in the pellet facilities when there is no other option for those logs.

In many cases, transportation distance is a key determinant of where low-quality log fibre flows. If the logs originate near a pulp mill and meet the mill quality specifications, they will flow to that pulp mill facility. Otherwise, a pellet mill may purchase those logs. The use of low-quality fibre by the pellet industry is also beneficial to the forest since it will reduce the use of slash burning.

In summary, the evidence collected for this report demonstrates that despite its small size, the biomass industry plays a critical role in the long-term success of the forest sector. Specifically, it:

1. Utilizes and creates value from the mill residuals that are surplus to the existing energy requirements of the traditional forest products sector;
2. Creates an additional revenue stream for sawmills and other facilities that pellet manufacturers purchase residuals from;
3. Eliminates CO2 emissions associated with traditional practices by using the residuals that formerly went into beehive burners or were landfilled;
4. Helps meet one of the greatest challenges of our time: utilizing low quality biomass that comes from natural disturbances;
5. Creates more viable economic opportunities and employment, especially in remote communities that are too far to supply fibre to pulp mills;
6. Contributes to managing wildfire risks by utilizing low quality biomass material, rather than burning it on forest sites or leaving it there in piles;
7. Increases the substitution of renewable energy (biomass) for fossil fuel (coal); and
8. Works with Indigenous communities and other communities to improve forest health, support local economies, and strengthen community resiliency.

Finally, we suggest a number of other important and related issues that should be explored for the biomass industry and key policy makers in British Columbia. These include:

- Confirming that the wood pellet industry is not harvesting primary, ancient or old-growth forests for pellet production;
- Analyzing the GHG implications of using wood biomass through Life Cycle Analysis (LCA) methodology to track the carbon implications of forest and mill residue use in wood pellets;
- Statistically describing the importance of wood as a source of energy in the bioeconomy. Unlike competing jurisdictions, BC has not completed our work in this area; and
- Improving the feedstock report system requirements so that all stakeholders and First Nations have more information on the sector, while protecting the confidentially of the private sector producers.

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1. Introduction

The wood pellet sector in British Columbia (BC) is a relative newcomer to the forest sector. Despite its comparatively small size, it has managed to garner a great deal of negative and misleading attention in the media. As a result, there is often confusion in public discourse on the nature of the industry, how it operates, and the type of fibre or feedstock it uses to make wood pellets. This report was commissioned by WPAC to undertake an independent review of the wood pellet sector to review the data and facts, and address this confusion.

The goal of this report is to analyze the role and impact of pellet manufacturing in the BC forest sector and specifically their place in the forest products value chain. To do this we focussed on four key objectives:

1. Provide a brief history and overview of some key elements of the BC forest industry to provide context of how the pellet industry relates to and depends on the larger industry.
2. Describe the main wood products produced by the forest industry. This gives context of how forest-derived pellet feedstocks fit into the larger spectrum of forest-derived fibre and feedstocks manufactured and used by the forest industry at large.
3. Describe the specific wood fibre feedstocks used by the pellet industry, including residual material generated as a by-product of other forest product manufacturing processes and fibre sourced directly from the forest.
4. Present and address questions relating to the impacts and issues related to the sourcing and consumption of forest-derived feedstocks to the BC pellet industry and related counterfactuals.

To do this we relied on a combination of publicly available information, personal interviews, and commercially confidential data due to competitive concerns within the forest sector.

We've structured our report by:

1. Examining the forest sector as whole;
2. Explaining the role of the pellet sector and the relevant provincial forest policies and regulations;
3. Providing a detailed overview of the industry structure and the nature of the mill and forest feedstock used by the pellet industry;
4. Exploring three case studies focusing on the unique challenges and nature of pellet mill operations in BC; and
5. Highlighting the critical role of wood pellet certification in the production of "good" biomass.

The geographic scope of this report is the interior of BC. This is where all 12 wood pellet facilities are located in the province.[1] In this paper, we report statistics on fibre sources to the industry based on the seven Pinnacle Renewable Energy (now DRAX) plants. Those plants account for almost three-quarters of the total pellet production in the province. The other plants, for which we did not have data, are similar to the Pinnacle (now DRAX) operations, thus we expect that our statistics represent the consumption profile of all plants.

Prices for logs and other wood fibre products are mentioned throughout this report. These prices fluctuate continually and reflect our understanding of prices at the time of writing this report (January 2022); however, relative pricing among these products is more stable over time.

Reference to prices are Canadian dollars as of January, 2022, unless otherwise noted. Units of trade in the forest industry in BC (and Canada) are a mix of imperial and metric units. For clarity, we give units in the generally accepted units in BC with an accompanying conversion where appropriate. Most numbers given in this report are rounded.

[1] There were 13 wood pellet facilities in BC in 2021. Pacific Bioenergy announced in December 2021 that it would close its only plant, located in Prince George.

2. BC Forest Sector

2.1 Forest sector overview

This section provides a high-level summary of some key elements of the BC forest industry to provide context of where wood pellet manufacturing fits into the larger industry[2].

Gross Domestic Product

The 2021 COFI report gives the 2019 GDP of the BC forest industry as $13.3 billion ($4.8 billion from forestry, and logging and support; $5.5 from wood products manufacturing; and $3.0 from pulp and paper). The provincial GDP in 2019 was about $247 billion, thus the forest industry accounted for about 5% of provincial GDP. COFI reports that in 2020, forest products were the number one export category at about 29% of all exports. For 2018, the BC Government reports the real GDP of the forestry sector at about 7% below the 2012 benchmark.

Employment

The COFI report estimates direct employment in the forestry sector at about 48,000 jobs in 2019. The report also estimates the indirect and induced jobs at 53,000 with the most impacted sector being transportation at about 8,500 jobs.

Forest Product Sales

In 2020, the forest industry sold $14.5 billion of goods. About $10.5 billion (72%) was from manufactured wood products and $4.0 from pulp and paper. Sawmills accounted for about $5.6 billion (53%) of total sales, which includes lumber, chips, and all residuals. Veneer sales were $2.0 billion and other minor wood products about $2.9 billion.

In 2020, the forest industry exported about $11.5 billion in products - 56% to the US, 24% to China, 7% to Japan, and 12% to other countries. Lumber accounted for 47% of

[2] The economic and production data reported in this section were taken from published reports and data sources including:

2021 BC Council of Forest Industries (COFI) report on the economic impact of the industry: https://www.cofi.org/wp-content/uploads/TECHNICAL-REPORT_COFI-2019-FOREST-INDUSTRY-ECONOMIC-IMPACT-STUDY-FINAL.pdf/

2020 BC Government report on the economic state of the forest sector: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-industry-economics/economic-state/2020_economic_state_of_the_bc_forest_sector.pdf/

2019 BC Government report on major timber processing facilities: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/fibre-mills/2019_mill_list_report_final.pdf/

Statistics Canada data for BC provincial GDP: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3610040201/

BC Government GDP statistics: https://www2.gov.bc.ca/gov/content/data/statistics/economy/

sales, pulp for 25%, paper 5%, logs 3%, and about 20% for other products. Lumber exports were about $5.4 billion in 2020 with 72% going to the US, 16% to China, 7% to Japan, and 5% to other countries.

Timber Harvest

The BC Government 2020 report gives the timber harvest from public lands in 2020 at about 47 million m^3 with about 4.9 million m^3 from Private and Federal lands.

The total 2020 interior harvest was about 38 million m^3 (73%) and 13 million m^3 (26%) from the coast.

The 2020 interior harvest was about 32% spruce, 26% lodgepole pine, 16% Douglas-fir, and 26% other species.

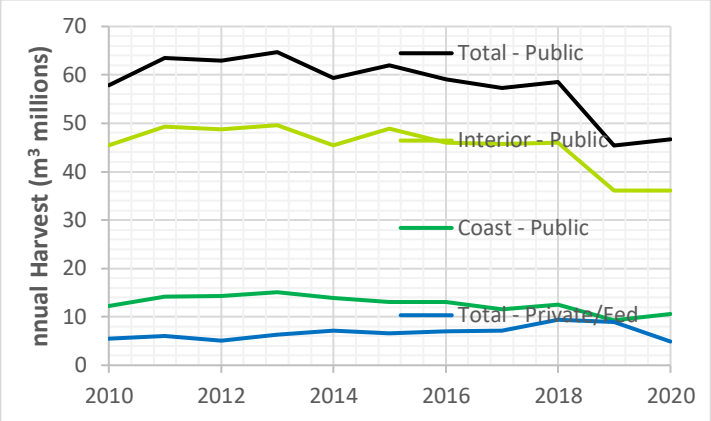

Figure 1. BC annual timber harvest by source 2010 – 2020.

From the coast this was about 34% hemlock, 29% Douglas-fir, 19% cedar, and 18% other species.

The 2020 Provincial harvest from public land was down about 27% in the interior and 30% on the coast from the 10-year peak harvest in 2013 (Figure 1). With several new Government initiatives and the impacts of fire and insect attack, the Provincial Allowable Annual Cut (AAC) is expected to continue to decline in future years. This is discussed later in this report.

2.2 Wood processing facilities

The 2019 Government report gives the log volume consumption by manufacturing plant type as: 68% lumber mills, 11% veneer and oriented strand board (OSB) plants, 10% chip mills (whole log chip plants and wood rooms in pulp mills), 8% log exports, and 3% shake and shingle mills and other small operations (Figure 2). Following are more details on the manufacturing facilities.

Sawmills

In 2020, sawmills in BC produced about 8.9 billion board feet (bdft) of lumber (about 14.8 m^3 of lumber using a 1.66 conversion). This was about 39% of total Canadian production. Sawmills in the interior produced about 90% of that lumber. The US consumed about 51 billion bdft of lumber that year. BC supplied the US with about 5.6 billion bdft - about 11% of US consumption.

Although BC supplies a relatively small proportion of overall US lumber, supply issues in BC have historically had a large influence on commodity lumber prices in the US. For example, the recent floods in BC in November 2021 that impacted log supply and lumber production are credited by some as causing a new increase in North American lumber prices (https://www.bnnbloomberg.ca/lumber-is-soaring-again-thanks-to-supply-snags-from-b-c-floods-1.1704129/).

The 2019 BC Government report noted there were 121 operating mills in the province. Sixty-nine (57%) were considered "large" for the purpose of their reporting—mills with production capacities exceeding 40 million bdft/year (66,400 m^3). Of the 69 large mills, 52 (75%) were in the interior and 17 (25%) on the coast. The interior mills had a production capacity of 10.2 billion bdft (16.9 million m^3) and coastal mills 1.9 billion bdft (3.2 million m^3).

The reported also noted that in 2000 there were 113 large sawmills in the province 76 in the interior and 37 on the coast) with production capacity of 10.7 billion bdft (17.8 million m^3) in the interior and 4.1 billion bdft (6.8 million m^3) on the coast. The production capacity in 2019 has decreased by 18% since 2000. The coast had the largest decrease at 54% and only 5% in the interior. Thus, although the number of mills has been decreasing, lumber production capacity in the interior has remained relatively stable over the last 20 years.

In 2019, the average production capacity of the large 69 mills was 196 million bdft/year (325,000 m^3). The largest capacity sawmill in the interior is Dunkley Lumber at Strathnaver (between Quesnel and Prince George) with a reported annual production capacity of 528 million bdft (876,000 m^3). Those 69 mills operated at 89% of capacity in 2019 producing 9.1 billion bdft/year of lumber (15.1 million m^3), consuming about 32 million m^3 of logs.

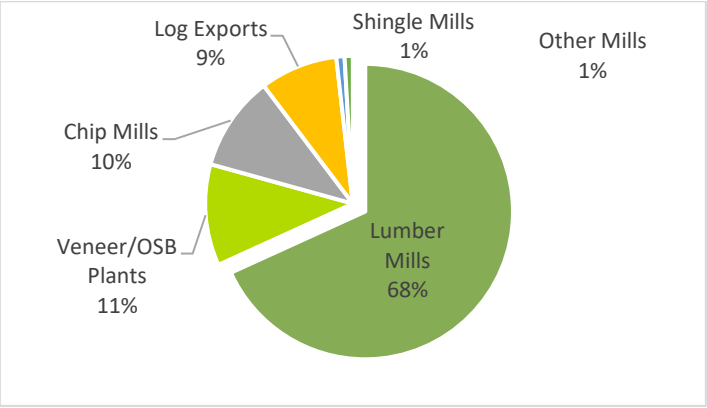

Figure 2. Log consumption by process facility type in 2019. Differences from statistics reported in the text are from rounding.

In 2019, the Government estimated product recovery in sawmills as:

46% lumber, 35% chips, 17% sawdust and shavings, and 2% shrinkage. This estimate is consistent with other sources and can vary by sawmill type, targeted lumber dimensions, and timber type profile of the mill log diet.

Veneer/Plywood Plants

In 2019, there were 12 operating veneer plants in the province, seven having integrated plywood production capability. Nine of those plants were in the interior and three on the coast. Those 12 plants consumed about 4.6 million m^3 of logs.

Pulp Mills

There are currently (Feb. 2022) 13 operating pulp mills in the province, four on the coast and nine in the interior. Three of those pulp mills include paper production and one is a small stand-alone paper mill. The combined production capacity of those mills (from 2019 statistics) is 5.6 million tonnes.

The number of BC pulp mills and associated capacity has also been declining. In 2000, there were 23 pulp mills and 11 paper mills with combined capacity of 11 million tonnes. In 2019, there were 15 pulp mills and five paper mills with combined capacity of 6.4 million tonnes, a reduction of 42%.

The 15 operating pulp mills in 2019 consumed about 8.0 million Oven Dry Tonnes (ODTs) of chips (20.8 million m^3 Softwood Equivalent (SWE)). About 72% of that fibre was residual chips from sawmills (5.8 million ODTs, 15.0 million m^3 SWE) and 28% (2.3 million ODTs, 6.0 million m^3 SWE) was chips from whole log chippers (includes smaller remote portable log chippers and larger stationary whole log chippers at pulp mills).

The total chip consumption of those mills was higher than provincial production and 1.1 million ODTs (15% of consumption) were imported to make up the shortfall (2.9 million m^3 SWE). Those pulp mills consumed about 4.7 million m^3 SWE (2.1 million ODTs) of hog fuel (noted in the 2019 Government report as likely a low estimate).

Pellet Mills

The pellet industry was introduced to BC in the early 1990s. This coincided with a global surge in demand for wood pellets as an environmentally sustainable alternative energy source to fossil fuels. The first industrial scale wood pellet facility in BC was built in 1989 by the founders of what is now Pinnacle Renewable Energy on the family farm south of Quesnel, BC. That plant exclusively used planer shavings from local area sawmills.

The industry saw modest growth in the 1990s with construction of the Pellet Flame facility in Prince George (the predecessor of Pacific Bioenergy) and Eagle Valley Pellets in southern BC. Those early facilities focused on the domestic heating (consumer bag) market that was gaining popularity at the time.

In 1995, the BC Government introduced legislation to phase out the on-site burning of wood waste at wood processing facilities such as sawmills and plywood plants. This was implemented through the late 1990's putting pressure on those operations to find alternative methods to dispose of residual waste wood fibre (mostly sawdust, planer shavings, tree bark, slabs, and lumber trim ends). This created a significant growth opportunity for the wood pellet industry to absorb that material.

The first bulk offshore shipment of wood pellets was made by Pellet Flame in 1998 to supply the rapidly growing market in Sweden. Pellet Flame used grain rail cars and a repurposed port terminal in North Vancouver to provide transportation, storage, and shipping capability. As European demand increased throughout the early 2000's, a dedicated bulk ship loading facility was completed in 2005 at the Fibreco Export Inc. operation in North Vancouver. This provided the platform for rapid growth of the industry with the construction of several new pellet manufacturing operations targeting the growing European power generation market. A second purpose-built ship loading facility was built in 2014 in Prince Rupert by Pinnacle Renewable Energy coinciding with the rapid shift to supplying the Japanese and Korean energy markets.

The global economic recession of 2008 and associated collapse of the US housing market resulted in temporary and permanent closures of several BC sawmills. This resulted in a sharp decline in available conventional raw material for the wood pellet sector. To help fill the gap, the sector started using forest-derived residual fibre that was considered waste. That fibre source was – and still is – abundantly available as a by-product of timber harvesting. Forest-derived waste residual fibre is left after primary timber harvesting where it is piled and burned as required by the BC Government to abate forest fire hazard.

As of January 2022, there were 12 operating pellet plants in BC with a capacity of about 2.0 million ODTs. This does not include the 0.35 million ODTs production of the Pacific Bioenergy (PacBio) plant in Prince George that in December 2021 was announced to be closed. In 2005 there were five operating pellet plants in the province with capacity of about 0.36 million ODTs. That is a capacity increase of about five times over the last 17 years.

The wood pellet industry in BC has created about 2,500 direct and indirect jobs throughout the province. The industry provides about $750 million in economic activity and has made more than $500 million in capital investments over the last decade (WPAC February 2021).[3]

[3] These statistics include the contributions of PacBio, which was recently announced to be closed.

2.3 Pellet industry economic zones

The flow of logs and residual material in BC is highly complex. Log flow is impacted primarily by the location of timber source (determined by tenure conditions) relative to the tenure owner's processing facilities, nuances and quirks of the Government stumpage system (that to a large degree subsidizes inefficiencies of log hauling), and the actual cost of transporting and hauling logs. Log flow within a given forest company is highly optimized – but there is almost no coordination among companies. This results in the continual traffic of log trucks going past each other in different directions to different processing facilities (mostly sawmills).

The economic zones within which "residual material" moves are also very complex, but – because the material is not tied to timber harvesting tenures and the stumpage system – it is more logical and is largely determined by actual transportation economics. For this report, we define four economic zones in the BC interior to describe the movement of residual material among plants (pellet plants, pulp mills, and biomass energy plants). These zones are the Central, Northwest, Northeast, and Southeast (Figure 3).

Central Zone

This is the largest and most active economic zone in the province. It is characterized by a relatively large number of buyers and sellers of residual material that have overlapping economics reaches. Thus, there is high degree of competition for residual material in this zone. This zone includes six of the 10 pulp mills in the interior and many large sawmills.

This zone has seven of the 12 operating pellet plants in the province accounting for about 70% of total pellet production. The supply and demand of residual material in this zone is high. The pellet plants in this zone have a capacity of about 1.4 million ODTs and with internal energy demands this is likely about 1.6 million ODTs.

Six of the nine operating pulp mills in the interior are in the Central Zone. These have a production capacity of about 2.4 million ODTs of kraft pulp which is about 72% of total production in the interior. All of these pulp mills have some form of biomass electrical generating capability that consumes hog fuel and other pulp mill by-products. We do not have an estimate of the volume of that consumption, but for example the pulp mill in Kamloops (Domtar) consumes about 0.38 million ODTs of hog fuel, which is about 20% forest-derived.

This zone includes all three stand-alone biomass electrical generating facilities in the interior. Atlantic Power in Williams Lake consumes about 0.4 million ODTs/year of hog fuel, Merritt Green Energy in Merritt about 0.2 million ODTs/year, and BioNorth Energy

plant in Ft. St. James about 0.2 million ODTs/year.[4] We estimate that at least one-third of the demand of those plants comes from forest-derived residuals, primarily in the form of bush-grind.

Figure 3. Economic zones and location of pellet plants (green circles), pulp mills (grey), and stand-alone biomass plants (orange). Circle size is proportional to ODT input.

[4] The *Merritt Green Energy* plant in Merritt and the *BioNorth Energy* plant in Ft. St. James were built as sister facilities by Veolia Canada group. Both experienced financial difficulty and were sold. The Merritt plant was purchased by Aspen Planers sawmills of Merritt, BC and the Ft. St. James plant was purchased by Arrow Transport of Vancouver, BC.

Northwest Zone

The Northwest economic zone is characterized by low population density, long distances between towns, concentrated transportation infrastructure, and largely old coastal and transition forests. There is little forestry activity, largely because of the relatively high cost and low recovery of harvesting in the primarily old (in historical forest operations terms often called “over-mature” or “decadent”) stands of mixed hemlock and balsam (hembal) of the coastal and interior transition areas that characterize this zone.

Generally, the old hembal forests of this area are considered to contain about 50% pulpwood grade timber. There is only a small local market for this wood, thus when harvesting occurs, most timber (sawlog and pulplogs) are generally barged on the ocean to processing facilities on the south coastal area of the province. This also has a special order in council (OIC) from the BC Government that allows exporting wood to other countries, generally to China. That improves the economics of harvesting for some of the higher quality timber in this zone. That OIC has been in place for at least two decades and was originally implemented to help improve the otherwise poor economics of forest activities in the area. It has only been marginally successful.

Most forestry activity in this zone is in the southeast portion along Highway 16 in the towns of Houston and Smithers adjacent to the Central Zone. There is also some forestry activity in Terrace, located more towards the coast portion of this zone. Houston and Smithers have relatively large sawmills that operate in more interior forest types that have lower operating costs and better recovery of merchantable timber that the older hembal stands on the coast.

There are pellet plants in both towns associated with the local sawmills to consume the residual fibre. Terrace has a small sawmill and associated small pellet plant. The combined capacity of the three pellet plants in this zone is about 0.39 million ODTs (about 20% of provincial production capacity).

There is no pulp mill in this zone and no other biomass users. The pellet loading facility recently constructed by Pinnacle Renewable Resources is located in this zone on tidewater at Prince Rupert. Pellets are delivered to that facility by rail.

Northeast Zone

The Northeast Zone is also characterized by relatively little forestry activity. This area is also characterized by long distances to transport goods and only concentrated infrastructure. The largest impediment to increased forestry activity in this zone is the long distances and thus high costs to transport finished product to market. There is some forestry activity in the southern portion of this zone, again adjacent to the Central Zone.

This zone includes a pulp mill at Taylor (near Ft. St. John) and sawmill and associated small pellet plant in Chetwynd and in Ft. St. John both of which are integrated into the local sawmills operations There is a proposal to develop a large-scale pellet facility in the

very northern part of the zone using standing hardwood as a primary feedstock. Despite the project being well funded, rail distances, overall fibre costs, and customer product acceptability puts the project in question.

Southeast Zone

The Southeast Zone is more developed than the Northwest or Northeast zones but is also characterized by transportation limitations. In this case, the limitation is no direct rail link to the main BC port at Vancouver, and long and challenging highway hauls to access the port. US-bound export lumber has a direct rail link south, but overseas-bound export lumber is shipped by truck to Vancouver, which adds considerable cost to the product.

There is substantial forestry activity in this zone, including two large pulp mills and several mid-sized sawmills. Most of the residual fibre from the sawmills is trucked to nearby facilities in the US; however, some does move to the Central Zone where transportation economics are favorable. The lack of a convenient rail link has, at least to date, resulted in no pellet plants being established in this zone.

2.4 BC Government policies and regulations

Current BC government policies and regulations that affect the removal of forest-derived residuals discussed in this section include:

1. Harvest level determination
2. Tenures and licensing
3. Scaling and volume estimation
4. Stumpage
5. Residue and waste assessment
6. Forest fire hazard abatement

Anticipated policies and regulations that may affect the wood pellet sector discussed in this section include:

1. Fibre supply.
2. Tenures and licensing
3. Residue and waste
4. Policy review

Current regulations and policies

HARVEST LEVEL DETERMINATION

To determine harvest levels and the administration of forest tenures, the province is separated into forest management units that range in size from hundreds of thousands to millions of hectares. Each unit has some historical reference to a transportation/wood supply catchment that supports a forest products manufacturing hub. Most units were defined in the late 1970s and are mostly unchanged.

The two main types of management unit are Tree Farm Licences (TFLs) and Timber Supply Areas (TSAs). The TFL (which also is a tenure type) is a defined area of land allocated to a single licence holder. Within a TSA, a number of licence holders each have a specific volume allocation. In recent years, several smaller area-based tenures have been established within TSAs to support tenure diversity goals of the Government. These include Woodlot Licences, Community Forest Licences, and First Nations Woodland Licences.

The Provincial Chief Forester is required to complete a review of the harvest levels and set an allowable harvest for each management unit at least every 10 years. This complex process involves assessing the timbered land base, land area withdrawals, constraints, and a wide range of environmental considerations. The harvest level review includes a public consultation process which gives all stakeholders the ability to provide technical and socio-economic input.

Recent trends are for continued decline in harvest levels in many management units. Three primary contributors to this trend are removal of area from the timber harvesting land base, environmental restrictions on harvest rates, and reduction in the mature timber inventory from insect and fire damage. The continuation of this trend will result in less residual material being generated from sawmills, which could result in some wood pellet facilities closing or moving to a higher proportion of “forest-derived” residuals.

To date, the AAC has been based on the historical definition of sawlogs and veneer peeler logs. Forest-derived residuals are considered off quota (i.e., are not included in AAC accounting). To facilitate salvage of dead trees from the Mountain Pine Beetle epidemic, provincial policies were created to incent the use of more off quota volume. Primary licence holders were given partial harvest credits to harvest additional sawlog and veneer log volumes when off-quota volume was shipped to a non-sawmill or non-veneer plant facility. This policy is still in effect but is targeted by the Government to be phased out.

TENURES AND LICENSING

As the BC forest sector has evolved, the Province has used various forms of short- and long-term licence tenures to allocate timber harvesting rights on public lands. In early years, these licences were used to develop the timber resource and create employment in rural areas. In exchange for long-term harvesting rights, a company would construct

and operate various forms of wood products facilities (e.g., sawmills, plywood plants, and even pulp mills). This policy was highly successful and attracted large investments to allow the industry to grow into a significant component of the Provincial economy.

These early licences were issued in two forms. Area-based tenures provided exclusive harvesting rights to licence holder on a specific parcel of land. Volume-based tenures provided rights to a specific volume of timber within a common land base shared by a number of licence holders.

In the 1970s, Provincial forest policy shifted, and the allocation of large tenures was no longer used as an incentive for economic development. At that time, most of the economically viable timber had been allocated and the industry had reached its maximum capacity.

Since these early developmental years, the Province has diversified policies to recapture tenures and provide new allocations to non-facility owners. The main thrust has been to satisfy commitments of various US-Canada softwood lumber agreements or provide tenure opportunities for First Nations and rural communities.

Forest licence holders must acquire *cutting permits* to allow the harvest of timber. These permits describe the area where the timber will be harvested, the rate of stumpage payable to the Government, and many other terms and conditions. Those permits grant the right to all timber fibre on the site regardless of size or quality, and whether or not the volume is included in the AAC. Some of this fibre is below the standard used by sawmill or plywood/veneer facilities and is referred to as *off quota* volume – because it is not accounted in the licensee's AAC. This off quota fibre is typically suitable for pulplogs or forest-derived residuals, although in isolated cases where a licensee targets pulpwood grade timber for consumption in a sawmill, that volume is considered *on-quota* and is accounted for in the AAC.

Timber volume harvested from "problem forest types" is also often off quota. A problem forest type is a term used by the Government to describe stands of trees that are typically not considered merchantable, for one reason or another, to the lumber and related industries. This includes stands of deciduous trees, stands of small trees growing on poor sites, or stands with a large degree of decay. Those problem forest types are not included in the timber harvesting landbase that is used to determine the AAC for the area. There are however targeted licences that have been issued to support pulp facilities, OSB plants, and biomass power facilities that are timber-type specific and include typically off-grade material.

As the wood pellet industry began to use forest-derived residuals, the sector engaged Government to acquire similar levels of security afforded the conventional forest products sector. This was difficult with the Province having fully allocated all available sustainably and economically viable timber. In areas of the province with high proportions of pulplogs or forest-derived residuals, the timber is either unallocated or the licences are inactive. In these cases, the collective value of the timber is insufficient

to cover the full cost of developing and harvesting these areas. The Province's solution was to encourage the conventional solid wood and wood pellet sectors to enter into commercial contractual agreements for the incremental generally off quota component of harvest areas.

This initiative had limited success. As a result, the Province introduced two new tenures to provide the wood pellet sector with access to abandoned post-harvest residual fibre. These tenures also transfer the environmental and safety liabilities to the wood pellet producer while providing some form of fibre security over a geographic area. The tenures are a *Fibre Forestry Licence to Cut* (FLTC) and a *Fibre Supply Licence to Cut* (FSLTC). The FLTC is a short-term tenure generally for small areas allowing a primary tenure holder to transfer environmental and safety liabilities to a wood pellet producer to enable them to utilize forest-derived residuals. The FLTC has been moderately successful. In many cases, the FLTC is not needed as the primary licence holder has an on-going business arrangement with the secondary user, and fibre access is provided through direct contractual arrangements.

The FSLTC is designed as a longer-term licence of up to 10 years. This gives the licence holder secondary rights to any post-harvest waste fibre within a generally larger geographic area. Only a limited number of these licences have been awarded and they have been generally unsuccessful. Under this tenure, the primary licence holder has the first rights to the material, and it is available to the FSLTC holder only after deemed surrendered by the primary tenure holder. Both tenures have been administratively cumbersome and costly in light of the low value of the material being acquired.

The Province continues to grapple with how to create tenure and pricing policies that are consistent with other policies and incent growth in the wood pellet sector. The Province has recently made fibre utilization and the reduction of slash burning a focus of its future forest policy initiative.

SCALING AND VOLUME ESTIMATION

The scaling – or measurement – of logs in the Interior is based on a historical weight to volume measurement system. Like many systems of this nature, the origin of the system was based on the measurement of primarily sawlog and peeler grade logs and has been incrementally adapted over time to lower quality grades of logs. The basic concept is the net payload of each truck is weighed and randomly generated samples are physically hand measured for volume, species, and government defined log grades. A scaling plan is generated each year that defines various sampling "stratums" determined by grouping of timber types and log grades. The plan is approved by government scaling officials and the sampling mechanics are uploaded at each scale sites computer. Each aspect of the scaling and weight measuring system is monitored by government scalers with appropriate penalties/suspensions if the prescribed procedures are not strictly followed.

The volume generated from the scale will be classified into various government defined log grades which will ultimately be used to determine stumpage payments and the volume charged to the specific licence against its allocated harvest volume.

STUMPAGE

Stumpage is the fee charged by the Province for the use of timber harvested from public lands. Since 2006, the Province has used a Market Pricing System (MPS) where stumpage rates are linked to the prices of open market logs. Specifically, a complex regression is developed annually with the input data being sealed tendered bid prices as collected by the Province's auction-based timber sales program, commonly referred to as BC Timber Sales (BCTS). The BCTS program represents approximately 20% of the Provincial harvest and is distributed widely across the province to provide a market source of logs to regional facilities and representative data points to support that annual MPS regression. Some elements of the regression include species composition, distance to lumber manufacturing facility, timber defect, and lumber prices. The system was developed to satisfy on-going trade issues with the US over log price subsidies to ensure stumpage rates are reflective of open market transactions for logs.

Stumpage rates are established to set a "fair market price" for the government defined sawlog grade timber. In addition to sawlog defined grades, over the years the Province has introduced log grades that reflect timber not typically used for lumber or veneer production. These grades encompass logs with poor form, excessive knots, significant defect, or undersize. These are logs that are more typically used for pulplogs and more recently biomass.

To date these non-sawlog grades are priced on a flat statutory rate of $\$.025/m^3$ ($0.55/ODT). The various grade categories are also used to account for the volume charged to a licensee's AAC or harvest allocation.

RESIDUE AND WASTE ASSESSMENT

The BC Government recently updated and revised the policy on how the amount of post-harvest forest "residue and waste" material is estimated, reported, charged stumpage, and accounted for against the allowable timber harvest. The policy requires a forest licensee to estimate the amount of waste material left after timber harvesting using the specified sampling process. This must be done within a relatively short time after harvest is complete and prior to disposing of (generally burning) the waste material. The estimated amount of unavoidable and (theoretically) merchantable material remaining is billed to the licensee. This is done by applying the applicable stumpage rate to the estimated volume by log grade and tree species. That volume is also deducted from the allowable annual volume of that licence. This is known in the Province as the "Take-or-Pay" policy.

A new element of the revised policy is that low-grade solid wood fibre (termed "sawlog reject") is now charged against the allowable volume harvest of the licence. Although the

stumpage rate for this low-grade wood is correspondingly low ($0.25/$m^3$), the volume is charged against the allowable cut and is thus lost to the licensee.

This new sampling process and policy generally results in higher estimated amounts of waste material left after harvesting. Because stumpage is charged for much of that material and billed to the licensee, and the volume counted against the AAC, this creates a clear incentive to minimize the amount of this material left after harvesting.

One way to reduce the impact of these changes is to recover as much of this material as possible. If removed in solid form, the material is subject to the same weight-scaling process as all logs (i.e., sawlogs, peeler logs, and pulplogs). The material still attracts stumpage and harvest level accounting according to how it is sampled in the process; however, in some cases this can result in less impact (i.e., lower stumpage charges and less volume removed from allowable harvest) by removing it than leaving it behind for burning. At current prices for pulplogs, bio-logs, and bush grind, this can only be done where the material is physically located near the point of delivery (i.e., where the cost to transport the material is minimal). If the Government institutes some form of a *smoke tax* on burning this material, it will provide an additional incentive to recover and remove this material.

The incentive to remove this material in non-solid form as bush grind can be different from the incentive to remove it in solid form. The reason is in how it is scaled and accounted for by the Government. If the material is removed before a waste survey is done, the material is scaled under a Government program based on a fixed conversion from load weight to the amount and value of solid-wood equivalent volume that is applied to the primary licensee's AAC. If removed after a waste survey is done, the full impact of the waste survey results is applied to the primary licensee, plus an additional (but small) charge to remove the remaining fibre. This option can be more punitive than if the waste survey of the material is avoided by removing it earlier.

In 2018, the Government introduced "fibre recovery zones" in the coastal area of the province. The intent was to increase utilization of residue and waste material for pulplogs. These zones were designed to encompass the economic catchment area of pulpwood around pulp mills. Within these zones, the stumpage payable for waste material was tripled as a further penalty/incentive to reduce waste and increase the

recovery of pulp wood and other forest-derived residuals. Based on efforts of the coastal pulp mill sector, one was put in place in the southern coastal area within what was deemed an economic radius of a number of regional pulp facilities. The initial coastal fibre recovery zone was plagued with implementation problems. A number of geographic adjustments were made to the initial area as a result. Government is currently reviewing the impacts of introducing fibre recovery zones to other areas.

Figure 4. Burning small debris piles after timber harvesting.

FOREST FIRE HAZARD ABATEMENT

Forestry laws and regulations in BC require forest licence holders to "abate" the fire hazard created by residual material remaining in the forest after primary timber harvesting is complete. The objective of legislation is to ensure that fire hazards are identified and abated in an appropriate time and manner and to a level that ensures fuel hazards do not increase the potential fire behaviour and suppression effort associated with a fire start. The specifics of the requirements are laid out in the *Wildfire Act* and associated regulation.

The regulation requires a forest professional to carry out a fire hazard assessment after the completion of harvesting activity and to prescribe an appropriate mitigation strategy. The time frame to complete the assessment and abatement activity is nine months in areas close to community infrastructure and 18 months in most other areas.

The most common method to abate the hazard is to incinerate (burn) the piled slash and debris material in the first fall season after harvest. A less common method is to mechanically spread the debris over the harvest area. In recent years, some of this material has been mechanically ground in the forest and removed as a forest-derived residual (most often as hog and rarely as pulp chips). In the wetter ecological zones of the BC interior or where harvest accumulations are widely dispersed, fire hazard abatement is not required. Despite the almost exclusive burning of harvesting debris, we are not aware of any information regarding the efficacy of this treatment to abate hazard, and many forest professionals in BC question the usefulness of practice.

Weather conditions in which debris pile burning is permitted have become increasingly constrained. There is less acceptance of smoke near communities. In addition, regulations regarding suitable environmental (venting) conditions are increasingly

stringent. This has resulted in a more restrictive burning regulatory regime and more severe implications for non-compliance.

This policy impacts the removal of forest-derived residuals primarily in how it restricts the timing of when the material is potentially available to remove (in solid or ground form). Forest licensees generally abate the fire hazard within one year of completing the timber harvest. When debris is burned, which is almost always the case, this is done in the fall or early winter season. That timing reduces the chance of fires spreading beyond the piles as the ground and nearby timber conditions are wet or covered in snow. This burning can be as soon as six or seven months after harvest is complete. This is a short time to plan the removal of this material as a forest-derived residual as it must be coordinated with the primary licensees' requirement to complete a waste survey, undertake reforestation activities, abate the fire hazard, and complete road deactivation.

Primary licensees are reluctant to delay or jeopardize the completion of any of these activities. Exemptions can be obtained from Government to extend the period for which post-harvest debris can be left prior to burning. In this situation, the onus is on the forest-derived residual consumer to take on the hazard abatement and fire risk liability. This is done through a contractual commitment or acquiring a short-term tenure to transfer the rights and liability of the post-harvest waste.

Anticipated regulations and policies

FIBRE SUPPLY CHANGES

Harvest levels for conventional sawlog/veneer logs in the province are projected by the Government to continue to decline over the next decade (**Error! Reference source not found.**5). However, more land withdrawals and environmental constraints could accelerate this decline. The most significant factors could be land area withdrawals to accommodate Mountain Caribou habitat, preservation of "old growth" forest stand areas, and land area withdrawals and harvest reductions to support First Nations' cultural and traditional uses of forest lands.

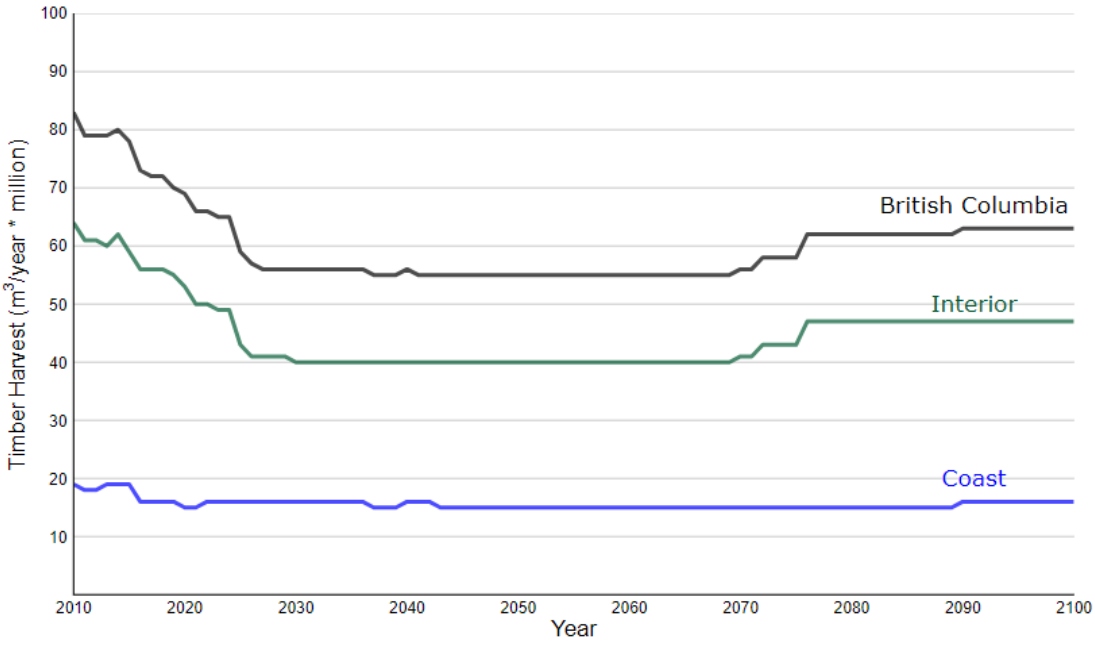

Figure 5. Past and projected future timber volume harvest in BC. Source: BC Ministry of Forests, Lands, Natural Resource Operations, and Rural Development

Caribou

The potential impact of the Mountain Caribou on harvest levels is currently not quantified. What is known is that the species requires habitat of large land areas without road access. Under Federal legislation, conservation plans are required to curb the current downward population trend. These conservation plans are currently being developed. Unverified estimates suggest the impact in the interior could be a 5-15% reduction in harvest levels.

Old Growth

The Province recently announced a harvest deferral on 2.6 million ha estimated by the Government to be stands of old growth timber. BC considers old-growth to be forests greater than 250 years of age on the coast and 140 years old in the interior. The Provincial public forest lands are 55.4 million ha of which 11.4 million ha (20%) are considered old growth. Of the remaining old growth, about 8.5 million ha are either currently protected or not part of the timber harvesting land base (timber deemed uneconomic) (Forsite/COFI November 2021).

Industry estimates suggest that the Government's old growth deferral will result in the closure of 12-18 sawmills and two pulp mills with the loss of 12,000-18,000 jobs. The timber sector, First Nations, and associated reliant communities are aggressively lobbying to set aside the deferrals and engage in a more widespread consultation and impact assessment process. Due to the nature and location of old growth timber, these impacts will be more prominent on the coast where more of the potentially merchantable timber is considered (by the Government's definition) to be old growth.

This reduction in area available for timber harvest will have a significant downstream impact on the supply of residuals from solid wood processing available as conventional wood pellet feedstock.

WILDFIRE

With the number of significant wildfires and remaining under-stocked MPB salvage areas in the province, a comprehensive program to rehabilitate many of these conventionally uneconomic stands has yet to be developed by the Government. The Province is exploring new tenures with fewer obligations (i.e., less cost to licensees) to allow third parties to harvest these areas which then can be rehabilitated. The harvesting of these areas could provide a significant new source of fibre to the pulp and wood pellet sectors. In the first of these pilot tenures, the cost of post-harvest reforestation is born by the Government and the licence holder is only required to develop and harvest the specific areas allocated to the tenure. Several First Nations are exploring the role carbon crediting could play to assist in financing forest rehabilitation projects.

With several record wildfire seasons in the last decade, the Province is looking to develop a more comprehensive program to help reduce wildfire hazard and risk around communities. These programs will target the removal of understory and woody biomass. That material could provide a further source of wood pellet feedstock.

TENURES AND LICENSING

The Province has recently begun a process to review all aspects of forest policy with the intent of "modernizing" forest management and tenure systems. A large aspect of this process is to create broader tenure ownership diversity and add new obligations to existing licences. The Province is targeting to have First Nations manage 20% of the available timber harvest. A second major theme is for existing licence holders to provide more external public interest commitments. These commitments include enhanced silviculture, partnerships with First Nations, supply commitments to value-added wood processors, and practices to offset climate change. Discussions on policy mechanics are in flux but the wood pellet sector is well positioned to partner with primary tenure holders to fulfill these additional licence requirements. This could include a more concerted effort to make economic forest-derived residuals available under long-term contractual arrangements. Historically, when Government implements a primary licence take-back and redistribution, the primary licence holders strategically consolidate their manufacturing capacity. Despite there being no change in the overall licence allocation, this could lead to the closure of a manufacturing facility and a potential reduction in conventional residuals.

As a strategy to create jobs with harvest levels declining, the Province has committed to providing primary licences to the wood products value-added sector. This would occur through a process of a volume allocation "take-back" from existing licence holders with associated financial compensation to create the new tenures. The wood pellet sector has lobbied successfully that the conversion of post-harvest and conventional wood waste to a carbon friendly renewal product should be defined as value-added and thus be

eligible for this program. These policy changes are expected to unfold over the next one to three years.

Residue and Waste

Over the last decade the Province has been on an initiative to reduce the amount of waste and increase the utilization associated with primary harvesting for sawlog/peeler grade logs. The policy pressure has come from the public who see large piles of logging debris being burnt and the pulp and emerging wood pellet sectors who are utilizing a higher percentage of pulplogs and forest-derived residuals. The historical accounting of waste material was estimate based, difficult to monitor and poorly enforced. Adding to the policy friction between primary licence holders and the pulplog and forest-derived residual consumer was the perceived additional costs associated with removing non-sawlog/peeler grade logs. The historical practise of underestimating the level of waste and burning harvesting waste was logistically simple, inexpensive, and did not negatively impact licensees AAC.

More recently the Province has introduced new waste and residue measurement requirements designed to reflect actual waste levels and create a more auditable and enforceable system. This system has had a number implementation struggles but is becoming a mainstream component of the Province's policy enforcement regime.

As part of the Government's current policy review process, a number of initiatives appear to be gaining political support. These initiatives include a carbon tax on debris pile burning, reduction or elimination of "waste benchmarks", and further expansion of the fibre recovery zone policy.

Waste benchmarks are the amount of merchantable timber that is allowed to be left on-site after harvesting (i.e., unrecovered material) without the licensee being billed stumpage. These were introduced over 20 years ago as a transition strategy to accommodate on-site biodiversity requirements and as a transition measure from earlier waste policies. These allowable levels of "waste" have proven to have limited biodiversity value and are creating a cost disincentive to remove the material to a scale site where they would be charged for both stumpage and harvest allocation (i.e., the amount of waste charged to the licensees AAC).

Fibre recovery zones are being trialed on the coast as a catchment zone around pulp facilities where the economics of removing pulplogs was deemed economic. To offset the waste benchmarks and other cost barriers, the Province charges triple stumpage for any waste material left after primary harvesting. The implementation of this initiative was plagued with implementation issues but appears to be gaining some traction and could be implemented in other areas of the Province around both pulp and pellet facilities.

Policy Review Underway

The current Provincial government has made the overhaul of forest policy a key program initiative. Some elements are expected to have a profound impact on the conventional forest products sector and those that rely on conventional and forest-derived residuals.

Some areas that will impact the wood pellet sector include reducing the amount of old growth forests that can be harvested, diversifying licence allocations, and creating further incentives to reduce slash burning.

Historically, when Government redistributes tenure, primary licence holders with reduced volume allocations accelerate their consolidation plans and close facilities. Compounding the problems is those parties that are awarded a new tenure require a period to operationally ramp-up business and harvest activities. In many cases, without the requirements to service the raw material needs of a facility, this ramp-up can take several years or fail to achieve pre-redistribution activity levels.

Government has experimented with minor policy items to increase the use of forest-derived residuals and ultimately reduce slash burning. These include a more stringent measurement system to determine waste levels, streamlined weight conversions to measure forest-derived residuals, and trial of fibre recovery zones in the coastal region of the province. The outcome of these changes is on-going with several informational sessions occurring with the wide range of stakeholders. It is expected that several profound policy elements will result from this process. This could include a smoke or slash burning carbon tax, further incentives to avoid stumpage penalties, and the loss of harvest allocation. The result could be an offset to the loss of conventional residuals expected from other initiatives.

The Government is committed to putting additional social licence obligations on those that hold tenures on a public resource. More specifically, licence holders are going to be looked upon to demonstrate commitments to communities, First Nations, and implement strategies to off-set climate change. Commercial partnerships and direct involvement with the wood pellet sector as either a producer or forest-derived feedstock provider would be seen as a positive element in the evaluation process. The forest management plan is part of an assessment towards these objectives at the time of licence replacement, which occurs every 5 years with most licences.

Currently, the policy overhaul is on-going with some elements being introduced into legislation while others will follow over the next one-to-three years. The results are still to be determined but will have significant implications for BC's forest sector.

3. Industry structure and forest product cascading

3.1 BC forest product industries

The wood products industry in the BC interior sources essentially all its raw material from interior forests. The exceptions are a few solid-wood processing facilities near the border with Province of Alberta or the United States, where it may be less expensive to source raw material. The BC forest products industry includes a wide range of wood-based products finished to final form for end use – and products that feed other processes (e.g., plants that remanufacture lumber into other final products).

Essentially all wood fibre sourced from interior forests is delivered to the point of processing (e.g., sawmills, pulp mills, etc.) in log form (i.e., solid wood). In recent years, some wood fibre residual to harvesting operations has been processed (ground) into hog fuel in the forest for delivery to biomass power plants and wood pellet plants in what is considered "non-solid" form. Less frequently, low grade logs may be processed in the forest and delivered to a pulp mill as "chips", also considered a non-solid form of wood fibre (it is really just a matter of physical size of the particles).

The main wood products sourced from interior forests are listed below and ordered by value ($/unit of trade). Each is described in the following subsections, as well as quality specifications, the quantity used in BC, pricing, and alternate uses. Quality specs are normally quoted in Imperial units and equivalent metric units are also provided. In-bush chipping to supply pulp mills is not discussed here because it rarely occurs and is a very minor proportion of wood fibre removed from the forest.

1. Poles, pilings and house logs (for utility poles, construction/marine pilings, and log homes).
2. Peeler logs (used to produce veneer for manufacturing plywood).
3. Sawlogs (processed in sawmills into lumber).
4. Pulplogs (processed in whole-log chippers to supply chips for pulp production).
5. Bio-logs (used for grinding into hog fuel at biomass-based power plants and pellet plants).
6. Bush grind hog (used in biomass power plants and pellet plants).

Other solid wood material is also derived from the forest for fence posts and rails, bolts for shakes and shingles, and firewood. This is a very small proportion of the material derived from the forest in the BC interior which is used by very small specialty mills or procured by individuals for personal use. Mechanically bundled slash from timber harvesting has also been removed from the forest for power plant feedstock in the BC interior. This was an experimental trial of a very small volume and thus also is not discussed in this report.

Poles, Pilings and House Logs

Figure 6. Top: Example of utility poles after the logs have been peeled (rounded) and pressure treated (www.americanpoleandtimber.com). **Bottom**: Example of red cedar logs used in log home construction (www.pioneerloghomesofbc.com).

Description: This group of solid wood products is focused on high quality and large dimension individual trees from which poles, pilings, and house logs are cut and processed. Trees of the appropriate size and quality to meet the specifications of these products are generally uncommon in most interior forest types and thus command the highest prices.

Log house builders generally prefer western red cedar or Douglas-fir. Plants that produce poles and pilings can take tree species that have good strength and can be pressure treated. Common size specifications for these products are lengths from about 40' to 80' (12.2-24.4 m) with top diameters of 6" to 12" (15-30 cm). Trees and logs must have little to no defect to meet the grade specifications of these products.

Source: There are few forest stands in the BC interior that contain trees of this size and quality – at least within an economic haul distance of a pole plant or house log builder. The logs used to make these products are generally harvested and sorted separately as part of standard timber harvesting operations that focus on sawlogs and peeler logs.

Market: In 2019, the BC Government listed seven utility pole plants in the BC interior with an estimated production capacity of 213,000 poles. There are several log house

builders in the interior; however, their use of these logs is very small relative to the large users such as sawmills and veneer plants.[5]

Consumption: If poles are on average 2.0 m^3 in size (60' long, 9" top and 18" butt; 18.3 m, 22.5 and 45 cm) that would be a consumption of about 425,000 m^3 annually. We do have statistics on the amount of volume used by log house builders, but it is a small proportion of total wood use in the interior.

Pricing: Prices for these products have historically been double or triple the price of sawlogs. Current prices for these products can be in the range of \$250-300/m^3 (\$550-\$660/ODT)

Alternate Use: Trees that can meet the large size and higher quality specification of poles, pilings, and house logs are suitable for any other use of solid wood (logs). However, the market premium for these logs essentially ensures that they will be sold at the higher price where a local market exists. The high value of these logs allows them to be transported longer distances and achieve a higher net profit than selling to a closer destination at a lower price.

Peeler/Veneer Logs

Description: Peeler logs are used to make veneer for the manufacture of plywood. These logs are generally larger than sawlogs and generally have tops 8" or larger (20.3 cm). The larger top size is needed to mount these logs on a lathe to "peel" the veneer from the log. These logs cannot have any rot or checks and only limited amounts of other defects such as large knots and excessive sweep.

Figure 7. A deck of Douglas-fir peeler logs. These are 17' long with top diameters of 8" or greater.

Log lengths are in multiples of 8' (2.44 m) (plus trim allowance) with most peeler plants taking a 16' (plus trim allowance) as the shortest log. Some plants are now taking an 8' log (plus trim allowance) in efforts to improve recovery of this larger and higher valued log product.

[5] In 2002, there were an estimated 200 companies employing 1,500 people, using 200,000 m^3 of wood to generate \$140 million in sales (Thony et al. 2006). By 2011, there were 127 active companies employing 1,200 people (Westcoast CED Consulting 2012).

Source: Most mature forest stands in the interior contain some component of peeler grade and size logs. Where there is a veneer plant within an economic distance for hauling, harvesting operations will manufacture these logs and sort them from sawlogs as they almost always attract a higher value.

Market: There is an active market for peeler logs in most of the BC interior. For 2019, the BC Government reported 10 veneer plants in the interior and four on the coast. The interior plants are well distributed geographically to avoid local competition for the appropriate wood supply. This results in a market for peeler grade logs in most areas of the interior.

Consumption: The BC Government 2091 report noted a consumption of 4.6 million m^3 of logs in peeler and veneer plants.

Pricing: Prices for peeler logs are generally about 20-25% higher than sawlogs. Current prices for peeler logs in the BC interior typically range between \$160-170/m^3 (\$416-\$442/ODT) (using a 1.6 conversion to pulp chips).

Alternate Use: Logs that meet specification for peelers can be used for sawlogs. This is generally only done where there is no peeler plant within economic transportation distance of the log source, as this would result in lower net profit to the log owner. Large forest licence holders that do not have a peeler or plywood plant will often sort these logs from their sawlogs and trade the higher value peeler logs for smaller (and possibly lower quality) sawlogs with other licence holders that have a peeler plant.

Sawlogs

Description: Sawlogs are any log of sufficient size and quality to be converted into lumber in a sawmill. Where a peeler log market exists, sawlogs are generally smaller and lower quality than the logs meeting peeler specifications. Sawlogs are generally manufactured in timber harvesting operations in lengths of 2' multiples (0.61 m) (plus trim allowance) with 16' and 20' logs (4.9-6.1 m) preferred in most interior mills. In ongoing efforts to maximize recovery of solid wood products, many sawmills also use shorter logs such as 14', 12', and 10' lengths (4.3, 3.7, and 3.0 m).

Figure 8. Douglas-fir sawlogs on the left and spruce on the right. Douglas-fir peeler logs were sorted and sold separately. Spruce peeler logs were not sorted as the purchaser paid a higher price for them to be included as premium sawlogs.

All sawmills have an acceptable diameter range. The minimum log top diameter is generally 4" (10.1 cm). That relates to lumber recovery for the dimension lumber market that is based on 2" (5.1 cm) nominal (1.5" or 3.8 cm actual) lumber widths. All sawmills have an "over-size" limit for log diameter. This relates to maximum physical size that can be processed in each mill. Over-size limits vary among interior mills but generally range from 20-24" (50.8 – 61 cm) butt diameter.

Sawlogs generally can tolerate more defect than peeler logs, but do have allowable limits for rot, knot size, sweep, etc.

Source: Sawlogs are the mainstay of the forest industry in the BC interior. All forest stands harvested in the interior contain sawlogs – and possibly other higher valued log products (e.g., peelers, poles, etc.).

Market: The forest industry is the main economic driver in the BC interior and sawmills are located in all but the most remote geographic areas. Consequently, there is a very large and active market for sawlogs in the interior. The exception is some remote areas – such as the northwest and northeast of the province – that may not have any sawmills within a large geographic area.

Consumption: In 2019, the BC Government reported 52 large[6] sawmills in the BC interior and 17 on the coast. There are many more smaller mills that produce speciality sawn-wood products such as posts and beams for house construction, bridge decking, and rig-mat boards for road construction. However, their combined output is only a fraction of the larger sawmills reported here that produce commodity dimension lumber largely for export to the US and overseas.

For the 2015-2019 period, the Government reported that the interior mills produced about 10.8 billion nominal bdft/year on average - and consumed about 38 million m^3/year of roundwood. That is about 286 nominal bdft of lumber per m^3 of roundwood input, or about 3.50 m^3 of roundwood needed to produce 1,000 bdft of lumber (nominal). This is an average lumber recovery of about 46% over the period.

Pricing: Sawlog prices over the last few years (say 2019-2021) have averaged about \$130-140/m^3 (\$338-\$364/ODT). Current sawlog prices in the BC interior are about \$140-155/m^3 (\$364-\$403/ODT) depending on species and quality. Prices spiked in 2020 to as high as \$170/m^3 (\$442/ODT) in some local markets. That was caused by a severe and unusual supply and demand imbalance in the US lumber market that resulted from North American sawmills curbing production because of the COVID-19 pandemic –

[6] Sawmill with a capacity of more than 40 million board feet/year.

while at the same time, lumber demand was increasing primarily from the renovation and repair market.

Alternate Use: Trees that contain fibre of sufficient quality to make peeler grade can also be used for sawlogs; however, this is generally not done unless there is no local peeler log market or opportunity to trade for sawlogs. There are peeler plants located throughout the BC interior, thus it is standard practice for large forest licence holders to sell or trade peelers for sawlogs at an equivalent value. Thus, a given volume of peeler logs would trade for a higher volume of sawlogs.

Technically, sawlogs can be used for pulplogs; however, there are two main market and pricing drivers preventing this from happening (at least on a large scale). First, sawlogs command a price generally two to three times higher than pulplogs. Thus, an operator would experience serious revenue loss by selling sawlogs as pulplogs. Second, the BC Government charges much higher stumpage for sawlog fibre – regardless of where it is used. The stumpage differential results in a much higher cost for the sawlog to be consumed as a low value product.

Pulplogs

Description: Pulplogs are generally defined as those that do not meet a sufficient size or grade to be utilized as a sawlog (Figure 8). Buyers of pulplogs have quality specifications but they are much lower than for sawlogs. For example, log sweep and crook are generally permitted if not overly severe as to clog up the infeed systems at the chip plant. There are size restrictions for pulplogs that are related to the physical sizing and type of processing machinery (debarking and chipping) in the plant where the logs will be processed.

Figure 9. A deck of pulplogs. Generally, these logs are too small or too rotten for use as sawlog.

Source: All stands harvested in the BC interior contain at least some trees, logs, and fibre that is below sawlog grade and quality. The amount of "pulp grade" fibre in a stand harvested for sawlogs varies tremendously. In most interior stands 10-15% of the fibre harvested does not make sawlog specification. That fibre is almost always recovered where there is a local pulplog market within an economic haul distance to deliver the material to a chip plant.
Some areas of the northwest interior of the province that transition to the coastal

climate are considered to have up to 50% or more of pulp-grade fibre in many forest stands.

Market: There is a healthy market for pulplogs in many areas of the BC interior. Every pulp mill in BC buys pulplogs directly for chipping at the mill or buys chips from remote chipping operations. Coniferous tree species pulplogs are also used in oriented strand board (OSB) plants; however, there are only two plants remaining in BC, located in the northeast of the province, and they consume almost exclusively aspen (a deciduous tree species).

Consumption: There are no consolidated statistics on the consumption of pulplogs by pulp mills in the BC interior; however, the 2019 Government report lists total provincial consumption at about 8.0 million ODTs of chips with about 5.8 million from sawmill residual chips and the remaining 2.2 million from whole log chips (from pulplogs). That is about 5.7 million m^3 SWE of pulplogs.

Pricing: The market pricing for pulplogs varies with distance from the pulp mill and degree of local competition for that grade of log. Prices over the last few have been in the range of \$45-50/m^3 (\$117-\$130/ODT) delivered to the pulp mill. Therefore, the value of pulplogs at source is the delivered price less transportation cost.

At greater distances from the mill, the cost of producing pulplogs as part of standard harvesting operations and transporting to a pulp mill exceeds the price paid at the mill. In that case, pulplogs are generally not recovered and are burned in the forest with wood debris generated from timber harvesting operations. We do not know the proportion of the total volume of pulplog-grade fibre that is generated from traditional harvesting operations but expect it could be in the range of only 25%.

Alternate Use: The only real alternate use for pulplogs is feedstock to a grinding operation to produce hog fuel for biomass electrical generating plants or pellet plants. This is sometimes done where the transportation cost to a pulp mill is prohibitive and there is a closer market for hog fuel. Hog has a much lower value in the interior fibre market thus pulp grade fibre can be transported longer distances than hog.

There are possible future alternate uses for this fibre that include producing biofuels (e.g., methane, diesel, and gasoline) and as feedstock to chemical processing to extract and use cellulose in a variety of other chemical and manufacturing processes. However, none of these types of plants are operating in BC today.

Bio-Logs

Description: “Bio-log” is a new term in the vernacular of wood fibre supply in the BC interior. It is used to differentiate the small logs, tree chunks, and other miscellaneous pieces of wood fibre that are too small or poor quality to make pulp grade - but that can be ground into biomass (hog fuel) (Figure 9, Figure **1**10). The *hog* (biomass) is produced

from this material by mechanically grinding it into small pieces for use in biomass power plants or pellet plant feedstock.

Source: Bio-logs are sourced as a by-product of standard timber harvesting operations where stems containing sufficient sawlog/peeler grade are felled and forwarded to a stem processing and loading location. Stems containing exclusively bio-log material or in many cases pulplogs are typically not harvested and are either left or knocked over in the falling process. The value of bio-logs is generally insufficient to cover the full incremental cost of harvesting and transportation and typically are a residual log generated in the processing of full stems into sawlog, peeler, or pulplog grade material. This material is currently rarely recovered as it is low value and must be very close to the final destination to be economic to remove.

Harvesting prescriptions typically have a targeted level of larger biomass to be left after harvesting to accommodate forest floor level biodiversity requirements. These requirements are generally not an issue to achieve as the level of breakage in the falling and forwarding phase generates sufficient levels to achieve the desired outcome. The removal of bio-logs has no negative consequences to the harvested site, reduces the level of on-site fire hazard abatement, and creates a minor but positive economic return to the overall harvesting operation.

Market: There is currently a limited market for this material in the BC interior. This is still a relatively low value product and it is expensive to handle and haul the small pieces. There is a trend of using more of this material where it is hauled to a power plant or pellet plant and ground for consumption at the plant; however, the economics generally are not favourable.

Figure 10. A deck of bio-logs destined for grinding for feedstock for a pellet plant or biomass-based power plant.

Consumption: We are not aware of statistics on the amount of this material that is recovered from the forests of the BC Interior. However, this solid wood product has only been used in the last few years and most biomass power plants and pellet plants are not consuming this material.

We can, however, estimate the volume of this material using the 18% proportion of reported solid wood fibre used by Pinnacle (described in Section 3.2). With the 2.0 million ODT (5.2 million m^3 SWE) production of BC pellet plants, that is 0.9 million m^3 consumption of bio-logs or bush grind hog.

Pricing: The price paid for this material generally only covers the cost of loading onto a truck and hauling it to destination (biomass power plant or pellet plant). This is generally about $30-35/$m^3$ ($78-$91/ODT) and can be higher to meet short-term demands.

Alternate Use: This material currently has no immediate alternate use. However, this is cellulose based material and has the same potential alternate future uses for biofuels and feedstock to extract and use the raw cellulose in other manufacturing and chemical processes.

Bush Grind (Hog)

Description: Bush grind hog (or "hog fuel") as a forest-derived wood product is produced in the form of wood debris that is mechanically ground in the forest and delivered to an end-user in ground form (Figure 1). This contrasts with wood fibre delivered in solid form to a pellet plant or biomass power plant (e.g., bio-logs) where it is ground into hog at the destination before being consumed in the plant. The term hog (or bark hog) is also used to describe the bark removed from logs at sawmills, which is generally processed further (ground with a hammer mill) and delivered to a pellet or power plant in ground form. That is considered a residual fibre product.

Figure 11. **Top**: Typical post-harvest debris pile containing wood fibre that is not recoverable for traditional solid wood products. There was no pulp log market within an economic radius of this site, but piles at this site were ground as hog fuel for a nearby biomass power plant. **Middle**: Portable diesel-powered grinder being fed harvesting debris with a log loader and the ground material (hog) loaded directly into a truck with a 53' live-floor trailer. **Bottom**: Bush grind to a 4" minus hog fuel product for consumption in a biomass

The general specification for bush grind is a 2” and 4” minus (5.1-10.2 cm) product if destined for a pellet plant and a 4” minus product when destined for a biomass power plant.

Hog that is ground in the forest is considered a “non-solid, forest-derived” wood material whereas bio-logs (ground at the destination site) are considered a “solid-wood, forest-derived” product. That is because bio-logs leave the forest and are delivered to the destination in some degree of solid pieces where it is ground into hog before being consumed. Bush grind results in more complete utilization of harvest debris because it includes all forms of tree stem material such as branches, twigs, foliage, log trim ends, etc. Typically, only material with a high level of silica contamination (dirt) are left on site – which is subsequently burned to abate fire hazard.

It is uncommon to produce both bio-logs and bush grind hog from the same site. The decision to choose one form or the other typically depends on availability of markets for each product, transportation distance (haul cost), and the capability of facilities to receive the material in log form. Typically trucks transporting bush grind are only capable of payloads of 16-18 ODTs where trucks transporting bio-logs can achieve loads closer to 20 ODTs.

Source: The source of this fibre product is generally debris piles generated as waste material from standard timber harvesting operations. These piles typically contain branches, twigs, foliage, broken logs, tree ends, tree tops, and other wood fibre pieces that are too small, rotten, or otherwise not suitable for other products.

Market: The market for forest-derived hog fuel is in its infancy in the BC interior. The primary reason is that residual material from sawmills has been abundantly available. With recent sawmill closures, that residual material is in increasingly short supply and consumers are now accessing this newly available, abundant, but more expensive supply of forest-derived feedstocks (bush grind and bio-logs).

Consumption: The BC Government 2019 report estimated that pulp mills used 4.7 million m^3 SWE of hog fuel (2.1 million ODTs). If we assume that 10% of that is sourced as bush grind, that is 0.47 million m^3 SWE (0.21 million ODTs). We don’t know the volume of hog fuel used by power plants in BC but estimate it at least 1.0 million ODTS (2.2 million m^3 SWE). If we assume that 30% of that is bush grind, that is 0.3 million ODTs (0.66 million m^3 SWE). That is an estimated total consumption of bush grind of 0.5 million ODTs (1.1 million m^3 SWE).

Pricing: The price for bush grind varies tremendously, and like other wood fibre products, is heavily impacted by local supply and demand. Delivered price for forest-derived bush grind hog is often in the range of $65-75/ODT ($30-34/m^3 SWE) and can reach $80-85/ODT ($36-$39/$m^3$) to meet short-term demand as pellet feedstock.

Alternate Use: Current alternate uses for hog in pellet or power plants is for agricultural applications such as animal bedding, soil amelioration, landscaping, and other uses.

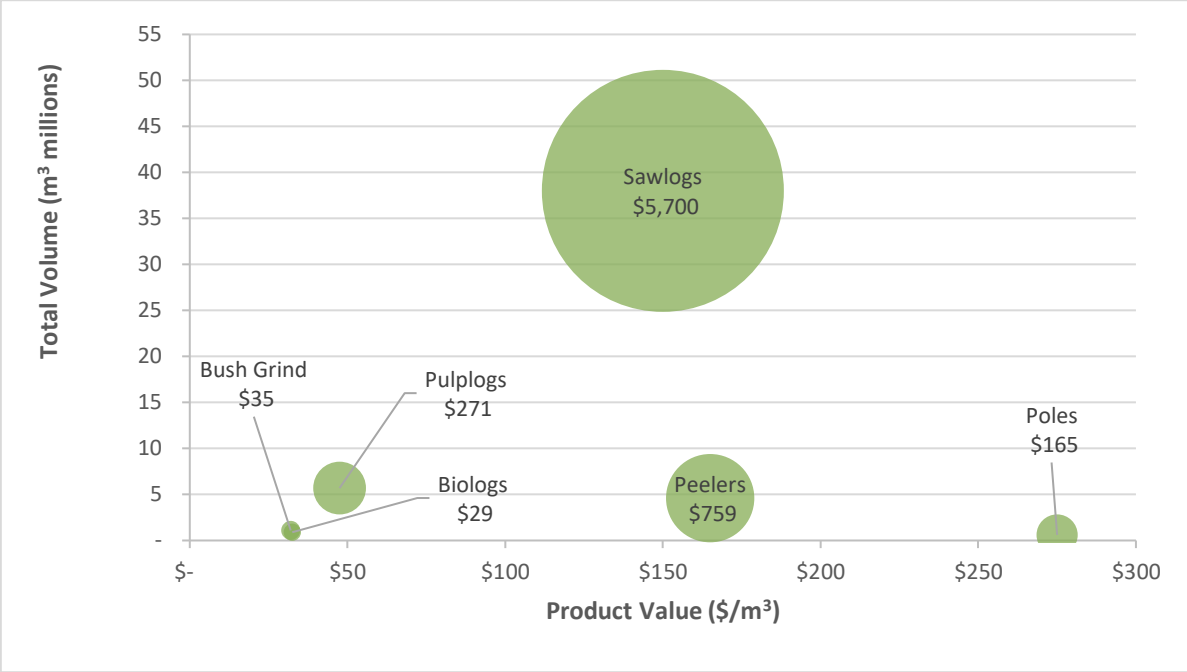

Figure 12. Annual volume consumption of forest-derived wood products by product value. Bubble size is proportional to total value (million $) of annual consumption.

Potential future uses include those previously mentioned based on the many possible applications for cellulose-based products.

Summary of Pricing & Volume

Using the reported and estimated volume consumption data in this section, and the average current prices, we estimate the total value of forest-derived wood products in the BC interior is about $7.0 billion. About 82% of that value is sawlogs, 11% peelers, 4% pulplogs, 2% poles, and 0.5% for bush grind and the same for bio-logs (Figure 11).

3.2 Mill derived feedstock

Alternate use of mill residuals

The use of wood fibre for wood pellets is a relatively new use for fibre in BC. This section considers the alternate fates of the mill residuals, which is the primary feedstock to pellet mills in BC.

Chips produced as by-products of lumber production often flow to pulp mills but sawdust, shavings, and bark, as well as trim ends and the like had few other uses. As mentioned above, most pulp mills in BC have internal electrical power generation systems fueled with by-products from the pulping process, and they will also compete

for sawdust, shavings, and bark hog as additional fuel. Large integrated sawmills that have planers and drying kilns often use these by-products to heat their kilns. Lastly, there is a small number of stand-alone power generation plants that use wood fibre as fuel – these facilities can often compete for sawmill by-products and bark hog. However, since sawdust, shavings and bark hog are low-valued products, they cannot be transported very far economically, so the zones where there is competition among users for low-grade material are quite small. Sawmills tend not to purchase additional residual or bark hog, since their energy systems are generally matched to the capacity of the sawmill to provide fuel. As a result, where pellet mills compete for fibre, it is generally with pulp mills and stand-alone energy plants.

With its high moisture content, sawdust is relatively unattractive to other users, giving pellet producers a strong hand. Shavings are also very desirable for pellet production, as described above, giving them the ability to pay more than pulp mills or wood-waste generators are willing to pay. On the other hand, bark hog is often used by pellet facilities in limited amounts, owing to the high silica content, which limits the interest of pellet mills above a certain threshold.

While there is demand in some parts of the BC Interior for sawmill by-products (e.g., near Prince George), many sawmills lack kilns and if they are located far from pulp mills or wood-waste generators, would typically burn the by-products in the absence of pellet mills providing a market. Occasionally, sawdust and shavings can find a local market as animal bedding, but these opportunities were generally small. So, where pellet mills take mill residuals that would otherwise have been burned at the sawmill, there is generally speaking little net carbon impact associated with the combustion of the wood waste. If it wasn't being burned as a pellet, it would have been burned at the sawmill.

It may be that in the absence of pellet mills, some sawmills that don't produce energy from waste would have added this capacity. In 2013, BC Hydro (Government power utility). ran a competition for clean energy suppliers and the four winning projects were to create energy from waste wood produced by sawmills and sold onto the provincial electricity grid under a 30-year purchasing agreement. These two facilities each produce 13 MW of power and have been operational since 2015. Two of the projects were at sawmills in Chetwynd and Fraser Lake owned by West Fraser, and two were at mills in mills in Merritt and Fort St. James, using wood residuals and sawdust.

The Merritt plant, planned to produce 40 MW, was delayed for a variety of reasons, finally coming on stream in 2019. The Fort St. James plant, also 40 MW capacity, began operations in mid-2017, shut in June 2021, and was purchased in October 2021 by a partnership of the Arrow Group of companies, the Nak'azdli Development Corporation (NDC, the economic development arm of Nak'azdli Whut'en), and low-carbon infrastructure developer, Nexus Program Management Group, LLC (Nexus PMG). It is conceivable that there could have been more projects like this, however, BC Hydro has not issue subsequent calls for proposals, suggesting a limited interest on the part of the enterprise to add more biomass energy suppliers.

Summary of feedstock sourcing in BC

About 75-80% of all feedstocks consumed by pellet plants in BC are classified as "residual" fibre – a residual (waste) product from some other wood fibre manufacturing process. In the early days of pellet manufacturing in BC, 100% of the feedstock was residual fibre from sawmills. The remaining 15-20% of current pellet mill feedstock comes directly from the forest – termed "forest-derived" fibre or feedstock (Figure 12). The expected trend is toward increasing use of forest-derived fibre in pellet and bioenergy plants as timber harvest levels in the province are forecast to decline over the next decade and more sawmills close as a result. These two feedstock categories are described in more detail in this section.

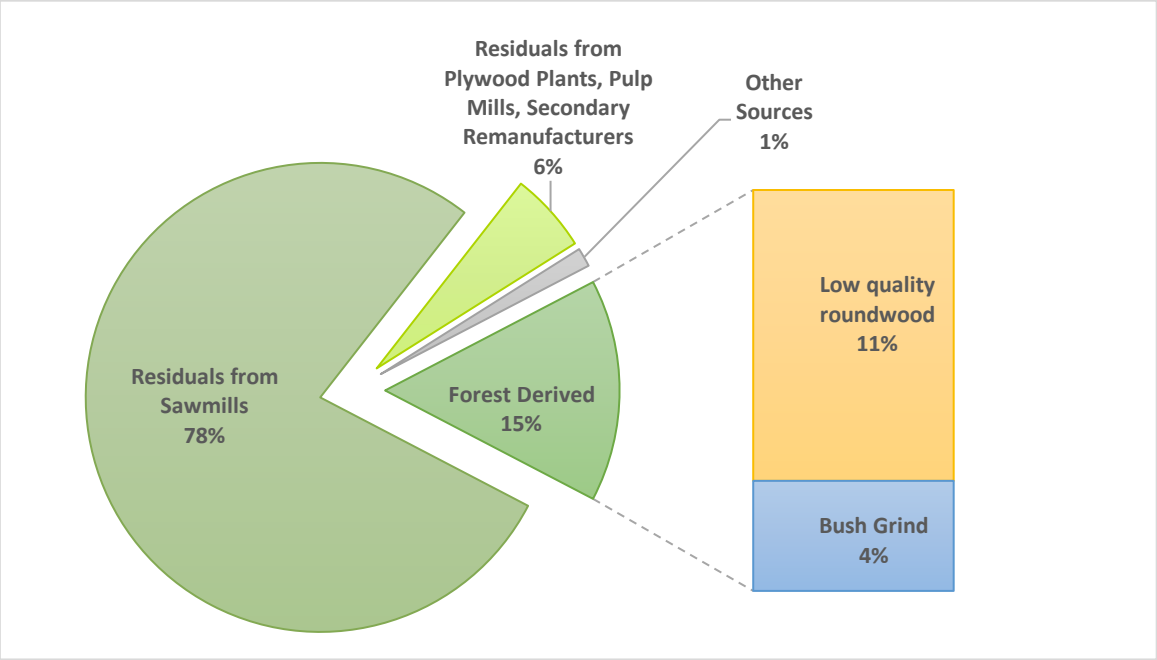

Figure 13. Feedstock for all pellet plants in BC 2017-2021

As a result of our analysis of relevant government and industry databases, about 78% of current residual feedstock used in BC pellet plants is sourced from sawmills. Most of that material is sawdust (40%), planer shavings (35%), bark hog (15%), pulp chips[7] (6%), and other miscellaneous waste wood fibre (1%) generated in sawmills. An additional 6% of current residual feedstock is waste veneer strips from plywood plants, fines from screening wood chips at pulp mills, and trim ends from remanufacturing plants (facilities that remanufacture finished lumber into other products). The remaining 1% is waste wood fibre from whole log chipping operations and clean-up of log yards at various

[7] Pulp chips contaminated with some other wood fibre material that is not acceptable to pulp mills.

wood processing plants throughout the interior. Following is a more detailed description of these feed stock sources.

Sawdust

Source: Sawmills (saws)

Figure 14. Sawdust.

Description: Sawdust is generated as a residual from the sawing process in lumber manufacturing facilities. Sawdust is the dominant sawmill residual product that supports the wood pellet sector and represents approximately 7% of the overall wood fibre volume output of a typical sawmill. With modern sawmilling equipment, sawdust varies little in particle size but can vary in moisture content between facilities depending on tree species and whether water is used in the sawing process (as a lubricant for saws).

Specifications: There are typically no formal sawdust specifications. Most sawdust fibre contracts limit the level of contamination and moisture content.

Pellet Facility Use: Extensively used by wood pellet facilities using conventional size reduction and drying systems. We estimate that sawdust is about 30% of all feedstock consumption by pellet plants in the BC interior. This is about 40% of residual feedstock consumption.

Fibre Competition: Competition for sawdust comes from internal use by sawmills in their thermal energy systems, pulp mills in their recovery and power boilers, and biomass power generation facilities. With a relatively high moisture content, sawdust is comparatively less attractive to these other users compared to sawmill hog (bark hog) and forest-derived residuals. Decisions on the use of various forms of feedstock by alternative users are typically made based on transportation costs and feedstock moisture content. In many cases, alternative users will use short-haul sawdust versus more costly and distant bark hog sources.

Pricing: The price for sawdust varies among regions depending on the level of competition between wood pellet facilities and other potential users of this material. In some areas with limited competition, prices can be $10-40/ODT ($5-18/m^3 SWE) at the source. In areas with significant competition, prices have reached $80/ODT ($36/m^3 SWE) at source. Final delivered prices are often $50-110/ODT ($23-50/m^3 SWE) where

price comparisons are made to forest-derived feedstocks as an alternative supply. Relative pricing decisions between forest-derived feedstock and sawdust are based on silica levels, moisture content, and further processing requirements.

Processing: Typical hammermill and wood pellet facility drying systems.

Transportation: Sawdust is transported with conventional truck and fibre transportation systems. Truck capacity ranges from about 16-21 ODTs/load, depending on the moisture content of the sawdust.

Regulatory Issues: Open-air incineration of wood by-product waste was curtailed by the BC Government in the late 1990s. Prior to that, sawdust (and other sawmill residues) was incinerated in beehive burners at the mill sites. Regulatory compliance was achieved by the early 2000's for most facilities. A limited number of isolated operations could apply for limited term exemption up until 2016.

Planer Shavings

Source: Sawmills (surface planers)

Description: Due to its characteristic low moisture content and small particle size, planer shavings are the most attractive feedstock for wood pellet facilities. Planer shavings are produced with high-speed rotating knife heads in the planer machine in the final sizing and finishing of rough kiln dried lumber. Typically, planer shavings represent 8% of the overall volume output of a conventional sawmill producing kiln dried surfaced lumber.

Figure 15. Planer shavings.

Specifications: There are typically no formal planer shavings specifications. Most planer shavings fibre contracts limit the level of contamination, maximum particle size, and moisture content of the feedstock.

Pellet Facility Use: Extensive use with conventional wood pellet facility size reduction and drying systems. Smaller scale operations use planer shavings without drying systems and rely on pellet die friction to achieve moisture content requirements.

We estimate that planer shavings are about 26% of all feedstock consumption by pellet plants in the BC interior. This is about 35% of residual feedstock consumption.

Fibre Competition: Due to the relatively attractive particle size and low moisture content of planer shavings, the wood pellet sector can out-compete other potential buyers that could use planer shavings in place of bark hog in thermal energy systems. A few small-scale independent operations package planer shavings as a commercial animal bedding product. Some older sawmill thermal energy systems use planer shavings exclusively.

Pricing: Delivered prices for shavings is typically about $60-120/ODT ($27-55/m^3 SWE). In areas with high competition between pellet facilities in logistically advantageous locations, planer shavings typically attract $100/ODT ($45/m^3 SWE) at source. In areas with limited competition, prices at source range from about $30-45/ODT ($14-20/m^3 SWE) with typical delivered prices of $60-70/ODT ($27-32/m^3 SWE). Where pellet facilities are limited by drying capacity, a minimum percentage of the lower moisture content shavings feedstock is needed to operate at full capacity. This further accentuates competition between pellet facilities for the limited supply of planer shavings.

Processing: Smaller scale operations that use planer shavings exclusively can produce wood pellets without a drying system. In larger scale facilities, the drying system is designed to a maximum overall feedstock moisture content. Typically, the feedstock profile requires a certain percentage of planer shavings to achieve a blended moisture content that is below the overall dryer capacity limit.

Transportation: Planer shavings have a relatively low bulk density that limits the capacity of most conventional bulk material handling equipment. Typically, truck load sizes are limited to 10-16 ODTs. This makes planer shavings expensive to transport long distances.

Regulatory Issues: Open-air incineration of wood by-product waste was curtailed by the BC Government in the late 1990s. Regulatory compliance was achieved by the early 2000's for most facilities. A limited number of remote operations could apply for limited term exemption up until 2016.

Bark Hog

Source: Log debarkers (in sawmills, plywood plants, and whole log chippers)

Description: Bark hog is typically identified as tree bark that has been removed in the debarking process during the primary break down of logs in a sawmill, plywood plant, or whole log chipping operation. The material is highly variable in particle size, moisture content, and levels of silica contamination. Bark hog generally represents 5-15% of the total biomass of a log depending on species and debarking technology.

Specifications: The specifications for bark hog typically set a range of acceptable particle sizes, contamination, and moisture content.

Pellet Facility Use: Limited use by wood pellet facilities due to the high levels of silica contamination. The higher levels of silica (sand and grit) significantly accelerate facility component wear and overall maintenance costs. Bark hog is selectively used by wood pellet facilities when mixed with a mixture of cleaner feedstock. Some larger pellet facilities in western Canada have incorporated various fibre cleaning systems that can reduce the level of silica in bark hog feedstock. A small number of wood pellet facilities that are integrated into a sawmill complex, utilize heat from the facilities bark hog thermal energy system to dry the wood pellet furnish. Thermal energy systems are typically not used in stand-alone wood pellet facilities in B.C. because of relatively high capital costs.

Figure 16. Bark hog.

We estimate that bark hog is about 11% of all feedstock consumption by pellet plants in the BC interior. This is about 15% of residual feedstock consumption.

Fibre Competition: Competition for bark hog is typically from pulp mills and biomass power generation facilities. Bark hog is incinerated in pulp facilities recovery and electrical power boilers. Many pulp mills now have electrical power generation systems and sell excess electrical power to BC Hydro. Several sawmills and plywood facilities in BC have dedicated thermal energy systems that generate heat for internal use (for lumber dry kilns, veneer drying, etc.) that use bark hog. A small number of this facilities have an integrated wood pellet facilities that utilizes heat from the sawmill thermal energy system to dry the wood pellet furnish.

Pricing: Price is typically set by competition between regional pulp mills and biomass power generation facilities and typically range from $5-20/ODT ($2-9/m^3 SWE) at source. Delivered prices typically do not exceed the cost of forest-derived bush grind hog which is rarely below $65/ODT ($30/m^3 SWE).

Processing: Typically, piece size is reduced with normal hammer mill processing. Some facilities use pre-hammermill hogging equipment to enhance particle size reduction capacity. Some operations have used cleaning systems to reduce the amount of silica in the feedstock and reduce facility component wear. Higher levels of silica can infringe on the upper limits of the final product “ash” content specifications.

Transportation: Transported with conventional truck and bulk container fibre transportation systems. Truck capacity typically ranges from about 18-22 ODTs/load.

Regulatory Issues: Open-air incineration of wood by-product waste was curtailed by the BC Government in the late 1990s. And as with other sawmill residuals, bark was incinerated at source prior to this regulatory change. Regulatory compliance was achieved by the early 2000's for most facilities. A limited number of isolated operations could apply for limited term exemption up until 2016.

Plywood Plants, Pulp Mills, & Other Secondary Manufacturers

Source: Plywood facilities, pulp mills, and secondary manufacturers.

Description: Wood pellet facilities will take advantage of attractively priced fibre with suitable particle size and moisture content. In the case of plywood plants, waste products come in the form of bark hog from log processing, pulp chips from green veneer, peeler cores, and dry waste veneer. Pulp chips from veneer tend to be less attractive to a pulp mill and can, in an oversupply situation, be made available to a wood pellet plant. Dry veneer that is not contaminated with phenolic resin can be used for wood pellets where logistically practical. Occasionally, pulp mills can have an oversupply of chips and make them available to wood pellet facilities. Secondary manufacturing generates a host of by-products including planer shavings, sawdust, trim ends, and pulp chips that are not in suitable condition for a pulp mill (other than possibly as a bark hog substitute).

Specifications: Wide range of specifications with generally some limits on contamination levels and maximum particle size.

Pellet Facility Use: The use of pulp chips depends on the regional supply-demand situation and configuration of the wood pellet facilities hog/hammermill size reduction capacity. For products produced by secondary manufactures, most use depends on local availability, configuration of the material, and transportation logistics to deliver the material. Long-term localized arrangements between secondary manufacturers and wood pellet facilities are common.

We estimate that this material is about 8% of all feedstock consumption by pellet plants in the BC interior and about 10% of residual feedstock consumption.

Fibre Competition: It is difficult for wood pellet facilities to compete directly with regional pulp mills for pulp chips. In most cases the material is made available by the pulp mills in a localized over supply situation. In the case of secondary manufacturers, arrangements are common when a wood pellet operator can provide a price higher than bark hog. Operational limitations often restrict a secondary manufacture's ability to provide a by-product as a pure planer shavings or pulp chip.

Pricing: Delivered prices for this material range widely from $30-110/ODT ($14-50/m^3 SWE) depending on type of material and regional demand. Generally, prices are higher than bark hog, and depending on material quality, are higher than forest-derived bush grind. For pulp chips, at source pricing can be $80-120/ODT ($31-46/m^3 SWE) and are

generally committed under long-term contracts to pulp mills. Secondary manufacturer's by-products have a wide range of pricing depending on suitability of the material to manufacture pellets.

Processing: Highly variable depending on material configuration. Most wood pellet facilities that operate on feedstock that is not exclusively sawdust or planer shavings have some level of pre-hammermill hogging equipment.

Transportation: Highly variable. In many cases secondary manufacturers have limited on-site storage and deliveries are made in smaller trucks (±5 ODTs). In most cases, the normal spectrum of bulk handling truck configurations is used with load sizes from 16-24 ODTs. In many cases, off-loading equipment at the wood pellet facility can be a limiting factor in the selection of truck configuration.

Regulatory Issues: Open-air incineration of wood by-product waste at processing facilities was curtailed by the BC Government in the late 1990s.X

Other Miscellaneous Sources

Source: Wood pellet operations have acquired various forms of waste wood that are financially and operationally feasible to manufacture into wood pellets. These include waste material from log home manufacturers, post and rail plant waste wood, pole shavings, trim blocks, whole log chipper pulp chip fines, and a variety of localized and typically opportunistic/time sensitive sources. There are some restrictions to product specifications that include demolition waste and material that would contaminate the final product.

Description: Wide range of material generally restricted by the operational logistics of accumulating/transporting material and the type and level of non-wood contamination.

Specifications: Restrictions are typically related to maximum particle size and the type and level of contamination.

Pellet Facility Use: Typically, a minor component of the overall facilities' input and restricted by the capacity of pre-hammermill size reduction and fibre cleaning.

Fibre Competition: Generally, competition is limited because of the relatively small scale of the sources and logistical challenges. Most competition would be as an alternative to forest-derived bush grind hog.

Pricing: This product has a wide range of delivered prices from about $30-80/ODT ($14-36/m^3 SWE) depending on type of material. Prices are generally higher than bark hog prices and for more attractive material may be higher than forest-derived bush grind.

Pricing typically depends on material quality, ease of manufacturing, and transportation logistics. Prices are typically compared to more conventional feedstock alternatives. For

example, whole log chipper pulp chip fines are similar to sawdust and would be priced accordingly. Material that requires some level of additional size reduction would be compared to forest-derived bush grind.

Processing: Typically, most of the opportunistic small volume miscellaneous sources require some level of pre-hammermill size reduction or fibre cleaning.

Transportation: Highly variable depending on loading equipment and storage capacity at the source. Often limiting deliveries to smaller truck configurations (±5 ODTs). In most cases, the normal spectrum of bulk handling truck configurations is used with load sizes about 18-24 ODTs. In many cases, the off-loading equipment at the wood pellet facility can be a limiting factor.

Regulatory Issues: Open-air incineration of wood by-product waste was curtailed by the BC Government in the late 1990s. In many cases, however, disposal of small volumes of wood waste through open burning remains the typical practice. Local environmental regulations are increasingly limiting this practice.

3.3 Forest-derived feedstock

Prior to the world-wide economic crisis of 2009, BC's wood pellet sector exclusively consumed sawdust and shavings from sawmills. With the economic crisis of that period came a sharp decline in US housing starts and an associated widespread production curtailment in the BC wood products sector. This resulted in a significant decline in available raw material for the emerging wood pellet sector in the initial stages of supplying European markets. Consequently, the industry explored other raw material sources to maintain production. This was the catalyst to start using forest-derived residuals from salvage of timber (mostly lodgepole pine) killed by the Mountain Pine Beetle (MPB). At that time, salvage of the dead pine stands was widespread, and the material was plentiful and in proximity to the wood pellet facilities.

Initially, forest-derived residuals were delivered to wood pellet facilities as bush grind (hog) which could be readily consumed by existing facilities. As the industry grew and sawmill capacity declined, the use of forest-derived residuals became more mainstream. The use of forest-derived residuals further evolved to include solid wood residuals as the MPB salvage harvest accelerated. Today, most large pellet facilities are equipped with a fibre cleaning system, pre-hammermill hogging equipment, and log handling equipment that allows them to process a wide range of forest-derived residuals – including hog and solid-wood components.

We estimate that about 25% of all feedstock delivered to pellet plants in the BC interior today is considered forest-derived. For this 25% forest derived feedstock, about 75% from solid wood sources and 25% bush grind hog material. The solid wood component is generally low-grade logs, broken pieces of trees, small tree tops, etc. That material is ground into hog fuel at the pellet plant. The bush grind component is processed at waste

sites in the forest with the fibre delivered to the pellet plant as ground material. This material is debris generated from standard timber harvesting operations that is otherwise normally piled and burned in the forest. The bush grind hog includes a broader array of post-harvest waste material than solid wood forms such as bio-logs. This additional material includes branches, log trim ends, and foliage.

Bio-logs (solid wood)

Source: Solid wood pellet feedstock sourced directly from the forest typically consists of portions of trees that are of a size, quality and form that is below the standards commonly utilized for sawlogs and pulplogs. The material is sorted as part of the harvesting process and delivered with conventional log haul trucks. The level of solid wood feedstock available from a stand of timber ranges between 5-40%, depending on specification and stand quality. The exact specification for solid wood forest- derived feedstock is typical material of a standard that is of a species, length, form, and piece size that cannot be processed by the regionally available whole log chipping facilities. This typically includes small stems and tops, larger logs with extremely adverse form, and non-coniferous species.

Description: Specifications can vary among regions depending on demand for pulplogs and the local manufacturing capability to convert logs to pulp chips. In areas with high demand for pulp chips, wood pellet facilities are typically targeting fibre that is not used by pulp mills, such as hardwood tree species, tree tops, and logs too small to be sawn into dimension lumber or chipped. In areas with limited or no pulplog demand, the solid wood material available to wood pellet facilities could include all logs below the local sawlog size and grade quality specification. In other words, bio-logs do not have an alternative market to the pellet market. The bio-log forest-derived wood product described in Section 0 is a subset of this material destined for pellet plants.

Specifications: Specifications limit contamination and there is a minimum log length that can be safely loaded onto conventional log haul trucks.

Pellet Facility Use: This feedstock type is typically used by larger pellet plants that have the capability to unload logging trucks and have pre-hammermill size reduction capability (generally done with a portable mechanical grinder). Currently, most pellet plants in western Canada require some form of off-line, on-site equipment to convert logs to forest-derived hog prior to manufacturing. This is typically completed by diesel or electric powered, portable grinding equipment.

Based on the industries' own databases developed for both internal reporting and reporting to the Government's Harvest Billing System, estimates are that the bio-logs (solid wood) are about 19% of all pellet plant feedstock and this represents about 75% of forest-derived feedstock consumption.

Fibre Competition: Solid wood feedstock users and pulp log consumers will compete directly for the same log profile under some market conditions.

Pricing: Delivered price for this material is typically $30-35/m^3 ($66-77/ODT) and can be higher to meet short-term demand. The delivered price is heavily impacted by the cost of transportation from the log harvest site. If prices for solid wood pellet feedstock are insufficient to offset the incremental cost of processing trees to a log form, loading, and transportation, the material will be left on site and burned to meet fire hazard abatement Government regulations.

Processing: This material requires little processing on site. Much of this material is short and cannot be loaded onto conventional logging trucks. Sometimes this material is cradled in between longer pieces (i.e., logs), which improves recovery, but increases handling cost. This material is typically processed at destination using a portable horizontal grinder before it enters the normal fibre stream at the plant.

Transportation: Conventional short log truck configurations (20-24 ODT/load). Transportation costs are more attractive when compared to forest-derived bush grind hog where on-site grinding typically produces loads of 14-17 ODTs when transported in 53' live floor vans.

Regulatory Issues: Regulations require the licence holder to abate the fire hazard from any remaining logs, chunks, tree tops, and branches left after primary harvesting. This is typically done by incinerating the material within a year of harvesting completion. Any material left after harvesting is measured and waste levels over certain thresholds are billed for both stumpage and unused harvest level allocation.

Bush Grind (aka Hog)

Source: Bush grind hog is produced from post-harvesting logging debris that is left after primary harvesting of peeler, pulp, and sawlogs. In most cases, harvest locations are near the wood pellet facilities and in-forest grinding is a more economic and logistically attractive compared to shipping solid wood material to be ground later as pellet feedstock.

Description: The ground material is converted with a diesel-powered portable grinder from assorted chunks and pieces of wood and bark and is loaded directly on specialized trucks and trailers (Figure 1). The industry standard is to utilize a screen on the grinder that results in material that is generally less the 4" in size (10.2 cm). This typically represents 10-40% of the overall biomass of the site depending on species, higher value log specifications, and stand quality. Bush grind hog and bio-logs are typically not produced on the same site since there is significant overlap in the material being used from the harvest waste. In the case of bush grind, since there is no requirement to ship material in a log form, a wider range of material inclusive of branches, log trim and foliage are used. This results in a generally lower quality feedstock but a higher level of on-site material utilization.

Specifications: Feedstock limitations typically limit particle size distribution, moisture content and contamination.

Pellet Facility Use: Limited use by facilities that are not equipped with some form of pre-hammermill hogging or size reduction equipment. Facilities that have a fibre cleaning system can consume a higher percentage of brush grind (hog) without inordinately high levels of processing equipment wear.

We estimate that the bush grind hog is about 6% of all pellet plant feedstock and about 25% of forest-derived feedstock consumption.

Fibre Competition: Competition for material is from pulp mills or biomass power generation facilities which use the material as bark hog. The supply of material is ample, however there is competition for material on harvest locations with higher levels of accumulation and favourable transportation distances.

Pricing: Typical delivered prices for bush grind as a pellet feedstock is about $65-75/ODT ($30-$34/$m^3$ SWE). One-half or more of this cost is transportation, thus delivered costs can be significantly higher where the material is located far from the destination.

There is a trade-off between delivering material in log or solid form which is driven by the significant variation in truck capacity between the two feedstocks. The pellet facility must have log handling and grinding (hogging) equipment if the material is delivered in log form.

Processing: Requires some on site hogging capability prior to hammermill processing. Bush grind (hog) is handled with conventional bucket loader handling equipment. Some facilities that use high percentages of this material have installed fibre cleaning systems to remove silica contamination.

Transportation: Bush grind (hog) is transported with off highway 53' (16.2 m) purpose-built bulk transportation vans with load sizes between 14-19 ODTs (depending largely on moisture content).

Regulatory Issues: Regulations within the Province require the licence holder to abate the fire hazard with any remaining logs, chunks, tree tops, and branches left after primary harvesting. This is typically done by incinerating the material on a site within a year of the completion of harvesting activity. Any material left after harvesting is measured and the licensee is charge by the Government for the volume and value of that material.

Summary of pricing and volume

Pellet mills are users of the lowest quality wood fibre material harvested from BC interior forests. About 75% of that fibre is produced as a residual product at processing facilities (primarily sawmills) and the remainder as fibre sourced directly from the forest (bush grind and bio-logs).

This result was obtained through an analysis of feedstock sourcing data provided by pellet manufacturers, data in the provincial harvest billing system, and data reported to SBP in each facility's annual report. In the BC forest sector, there are strong incentives for wood fibre to move to its most valuable (highest and best) end use, i.e., the highest quality logs go into making solid wood products while the lowest quality and residuals go to pulpmills and pellet plants. In most areas, this fibre flows through free-market transactions with several sellers and several buyers competing for the fibre.

The ranking of delivered cost for pellet mill furnish is shavings and sawdust as highest - followed by residual material from other processing plants such as plywood, pulp mills, etc. - then bio-logs, bush grind and bark hog (Figure 14). This cascading of costs comes directly from industry sources.

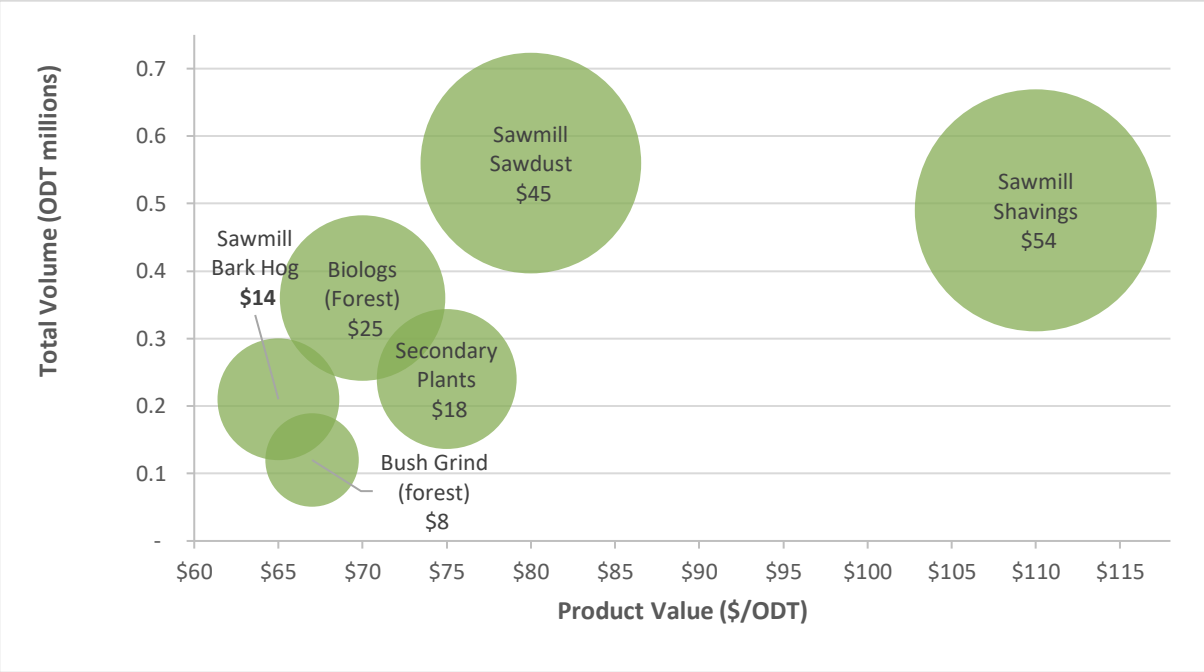

Figure 17. Annual volume consumption of feedstocks by product value. Bubble size is proportional to total value (million $) of annual consumption.

4. Case Studies

As the wood pellet sector of British Columbia has expanded significantly over the last decade, the industry has come under increasing scrutiny over the use of low quality roundwood (forest-based) feedstock. The industry has been accused by authors in Narwhal, Walrus, the Canadian Centre of Policy Alternatives of using forest-based material that could otherwise be used for higher value forest products such as lumber or pulp. Additional claims have been made that the wood pellet industry has been harvesting forest for the sole purpose of creating wood pellets and have tried to make a link to logging in the inland temperate rainforest of British Columbia.

The notion of harvesting whole stands of timber or displacing higher value forest products for the purpose of producing wood pellets to off-set the burning of fossil fuels in overseas markets is counter to the overall economic and environmental objectives of using wood pellets. By assessing specific mills and forest areas surrounding those mills, we hope to illuminate to the reader, what is really happening at the local level in the wood pellet sector.

Outlined below is a detailed look at the feedstock strategy of three wood pellet operations in British Columbia and how they are integrated into the overall forest sector in the region. The three operations were chosen to represent a diversity of situations and conditions; their stories are not unique. They also demonstrate that at the operational level we find further support for the thesis that biomass for bioenergy use is a sustainable response to both the challenges of climate change and forest landscape management where natural disturbances are driving many of the decisions.

Skeena BioEnergy

The Skeena BioEnergy facility was started in 2020, and currently has a capacity of 70,000 ODT/year. It is located in Terrace B.C. Skeena BioEnergy is an integral part of the Skeena Sawmill operation and plays a vital role in the overall business strategy of the sawmilling operation. Simply put, without the pellet plant the sawmill would not be able to operate.

Skeena Sawmills was purchased from West Fraser mills in 2010 by ROC Holdings after West Fraser curtailed the operation in 2007. Prior to the restart of the Skeena sawmill the vast majority of the higher quality logs were exported to Asian markets with a component of the lower quality logs sporadically transported to pulp mills in the southern part of the province but more often piled and burnt. In addition, prior to the sale of the operation to ROC Holdings, West Fraser had shuttered its Eurocan pulp mill in the adjacent community of Kitimat, also in 2010. With the closure of the last regional pulp mill, the Skeena sawmill (when purchased by ROC Holdings) had limited or no markets for its residual fibre of chips, sawdust, shavings and bark hog. This material accumulated at the sawmill site and became a fire hazard.

The forest, which supplies the fibre to the mills, in the Northwest region of BC is dominated by lower quality stands of hemlock and balsam (true firs). Approximately 40% of the logs from these stands have so much defect or rot that they are unsuitable for lumber production.

To ensure the success of the operation, Skeena needed to develop a strategy to extract as much value out of the forest and sawmill residual material to be economically viable. The practices of land filling excess sawmill residuals and burning significant volumes of harvest waste (over 100 m3/hectare) was neither socially, environmentally, or economically sustainable. The concept of "highest and best use" clearly indicates that to make the local operation viable, given the lack of a regional pulp mill to provide value to the non-sawlog fibre and low-quality characteristics of the timber, a wood pellet operation was necessary.

Finding a use for the high proportion of low-quality logs is essential to support harvesting costs, and all the material suitable is safely transported on a logging truck to the sawmill. This greatly reduces that amount of residual material left on the forest sites after harvesting for post-harvest burning of forest residue. Low quality logs that are not suitable for lumber production are chipped and combined with the sawmill residual chips, which are then sold to Nanaimo Forest Products pulp mill and transported by barge through Prince Rupert. The operation at Skeena supports 15% of the chip supply requirements of the pulp mill and is a critical component of extracting the maximum value for all the material harvested from the logging site.

However, this is still a great deal of forest and wood residue that cannot be chipped or used by the sawmill; hence the need for a wood pellet facility. The wood pellet facility was constructed to help ensure that all the wood material was utilized. Prior to the start of the local pellet facility, the sawmill's sawdust, shavings, and bark hog would be transported to the nearest wood pellet facility (over three hours away) at a financial loss – or the material was landfilled. Neither of these options was economically sustainable.

Currently the new wood pellet facility consumes all of the sawmill's residuals inclusive of a small component (<10%) of higher value pulp chips to ensure the product meets maximum ash content standards. The addition of the wood pellet facility has added 22 direct jobs to the operation and is a key economic piece of stabilizing the employment of the sawmill and harvesting jobs. Roger Keery President of Skeena Sawmills said:

> "Without the pellet facility the entire operation would not be viable both economically and socially. Leaving vast amounts of waste on site, as was done in the past to be burnt, is frankly unacceptable to the public."

The wood pellets produced by the plant are sold locally to over 150 users, including a local school and a number of First Nations communities. The remainder of the product is sold to Drax and incorporated into their wood pellet supply.

Skeena is an active participant with the local First Nation communities inclusive of working protocol agreements regarding forestry activities, log supply agreements and a wood pellet handling contract with the local Kitsumkalum community. Regionally the Skeena operation has stabilized employment and contractor activity, that in the past relied on the cyclic markets of both pulp logs and Asian log exports. Keery says:

> "First Nations appreciate the overall stabilizing effect the Skeena operations have brought to the region, both as a customer for their logs, but as a stable employer for their members."

In this case study, we see a region that had large industries leave, putting the long-term viability of the Skeena sawmill in question. Local entrepreneurs stepped up to find a solution that has supported the sawmill, improved utilization of the trees that are harvested, and benefitted local First Nations and non-First Nations communities. The reduction in the amount of slash burned at the harvest block is another benefit. We also see significant efforts to ensure the right log is going to the right product, with a sawmill, pulp mill, and local wood pellet mill all working to ensure the highest and best use of the timber.

Drax Burns Lake

The Drax Burns Lake facility is the largest wood pellet facility in the province. It was built in 2011 with a design capacity to produce up to 400,000 ODT pellets/year. The original feedstock fibre strategy for the facility was to use local/regional sawmill residuals that became available when the beehive sawmill waste burners were shuttered as well as the feedstock that had been used in the energy system of the Kitimat Eurocan pulp mill.

An additional feedstock strategy was necessary since the long-term view was that the Mountain Pine Beetle epidemic would generate large volumes of low quality roundwood and forest residues. Extracting these would mitigate the risk of wildfire and make it more financially attractive to access the higher quality sawlogs, that were damaged, but nonetheless useful for sawmills in the area. The nearest pulp mills were located over three hours away in Prince George, too far from the Burns Lake timber supply area to haul low quality roundwood. Without the pellet plant, there was no use for the flood of low quality roundwood and forest residues.

The Burns Lake Drax facility, like all of the other company's plants, is located in close proximity to area sawmills. They are not a competitor, but a value-added complement to both sawmilling and primary harvesting operations. The Burns Lake pellet facility purchases sawdust, shavings, and bark hog from a number of large regional sawmills, in addition to providing an outlet for a number of smaller operations who lack the ability to produce pulp chips.

For example, Tatsa Timber owned by local entrepreneur Klaus Pouselt has been able to successfully operate three small scale sawmills that consume low-quality dry balsam and pine that would otherwise be wasted or, because of its chip qualities, potentially be

trucked to Prince George as pulp logs. This means a local person is extracting more value from the low quality roundwood, generating more local economic benefits. In turn the Burns Lake wood pellet facility has provided Tatsa with a buyer for an unsorted mix of sawdust, chips, slabs, and bark. Asked what would happen if the Drax facility didn't exist, Pouselt said:

> "This operation would not be viable and the 70 direct manufacturing and harvesting jobs would be lost."

The original idea for the small-scale mills came after Drax asked for proposals from local contractors to utilize waste piles after sawlog harvest. Pouselt explained:

> "The original concept was to grind up the slash piles and deliver them as bush grind."

Working with Drax and the local major licence holders, Tatsa was able to secure the necessary timber commitments to extract low grade lumber from low-quality pulp logs while providing Drax a cost-effective residual feedstock. The value realized by Tatsa wouldn't be realized otherwise – all of the wood used by Tatsa would either be used as pellet feedstock or left in the bush. The Tatsa facilities currently consumes 150,000 m3 per year of which less that 1% conforms to the local standard industrial sawlog standard.

Another key actor in the area is the Burns Lake Community Forest, since they are licensee and a critical and regular log supplier to the Drax Burns Lake facility. The Community Forest is owned by the Village of Burns Lake which equally shares its revenue with the Tsi'lKazKoh and Wet'suwet'en First Nations communities. The Community Forest is 92,000 hectares of FSC certified forest with an Annual Allowable Cut (AAC) of 118,000 m3/year. Their business is to sell logs to the local manufacturing facilities while maximizing social and financial benefits as a community forest. Currently, 25% of their annual harvest is selective logging of dead Mountain Pine Beetle material from "green" stands, the remainder is a more conventional non-salvage harvest. General Manager Frank Varga explains:

> "The timber is sorted four different ways in the field, green sawlogs to the Hampton mill, dry sawlogs to Decker Lake mill, a low-quality cant log to the Tatsa facility, and the rest – roughly 5% – to Drax Burns Lake in a round wood form to a rattail."

Varga explains:

> "As a community forest that surrounds much of the community's recreational playground, if we didn't practice complete utilization we would hear about it in town from the public. Without the Burns Lake Drax facility, we wouldn't have a home for a significant component of our low-grade harvesting profile and the level of waste would not be socially acceptable."

The Drax Burns Lake facility currently utilizes 15% forest-derived feed stock, split equally between bush grind and round wood. The remaining 85% is mill residue. Despite an expected reduction in AAC, Drax Vice-President Andrew Meyer doesn't expect significant increases in forest-based feedstock. Meyer explains:

> "We expect to re-tool our fibre drying systems to consume bark hog versus the current dust burning system that consumes processed pellet feed stock. This way we further optimize the fibre in the manufacturing process and avoid the internal consumption of material that can be used directly to make wood pellets.
>
> If, as expected, one of the Prince George pulp mills shuts down due to a lack of residual sawmill chips, this could have a ripple expect throughout northern part of the Province that would again shift the availability of residual fibre.
>
> Drax Burns Lake does no harvesting of their own and purchases the last bit of round wood or logging waste left on the harvest site by licence holders targeting sawlog timber."

In this case study, a pellet mill was constructed to make use of sawmill residuals that had previously been disposed of by burning. The pellet mill created a market for this waste and at the same time provided an additional revenue stream to the sawmills. When the mountain pine beetle killed swathes of lodgepole pine in the region, the increased sawmill production supported an expansion of the pellet plant. Again, by providing a market for what had been waste, the pellet mill facilitated the salvage of the dead pine. Moreover, the volume of material being processed through the area was sufficient to support a specialty mill that extracts higher quality components from the low-grade stream. The existence of a wood pellet facility is critical to the economics of the region's forest economy, which is trying to optimize the value of the feedstock from the forest.

The case study also describes FSC certified material from a community forest that generates local benefits to First Nations and non-First Nations, by making the highest and best use of the forest that nature has provided. The other plants in BC use SFI/PEFC certified wood.

Drax Meadowbank

The Drax Meadowbank facility is located 60 kilometres south of Prince George and was commissioned in 2008. It has a current capacity of 280,000 ODT/year. The facility was built adjacent to the large 560 million bdft Dunkley sawmill, one of the largest facilities in North America.

Dunkley Lumber is also one of the largest open competitive market buyers of timber in the region. The addition of the Drax facility adjacent to its facility has allowed the operation to extract more value from the log through the usage of its sawmill residuals. This provides a competitive advantage over a number of its competitors.

The Meadowbank facility is close to five active pulp mills in Quesnel and Prince George. Despite the demand for pulp logs in the region, the wood pellet facility utilizes 40% forest-derived residuals. Drax's Vice-President Andrew Meyers explains:

> "The facility cannot compete with the pulp mills in the region for pulp logs. Our operation focuses on low-quality hardwood and other roundwood that is not used by the pulp mills.
>
> Two- thirds of the forest-derived feedstock utilized is in the form of bush-grind, which is leftover landing debris left when all other sawlog and pulpwood is removed.
>
> Drax utilizes low quality roundwood inventories at its sites as a surge or back-up supply when there is an interruption in the supply of sawmill-based residuals. This has been extremely important lately with the fluctuations in the lumber market. When the supply of sawmill residuals are strong the round wood inventories remain fundamentally stable versus sawmill residuals and bush grind that will under-go significant moisture content fluctuation and even combust when stored for a period of time. The end result is roundwood inventories may remain untouched for a period of time when the flow of sawmill residuals and bush grind logging waste is strong.

In this case study we see that the wood pellet facility is again complementary to the overall strategies of a large local sawmill. Any material that is in the form of wood chips is going to a pulp mill because they can pay a much higher price for the pulp chips than a pellet plant (roughly 3 times as much). However, there is a substantial volume of lower quality residual material for which there is no market other than the pellet mill and the pellet mill also enables increased utilization of fibre that would otherwise be left at the landing. Again, we see every indication that the fibre from the forest is going to its highest and best use.

5. Sustainable Biomass Program

The Sustainable Biomass Program (SBP) is a certification system designed for woody biomass, mostly in the form of wood pellets and woodchips, used in industrial, large-scale energy production. It was originally an initiative of seven major European energy producers that use biomass in their power plants.

The SBP was founded in 2013 as a not-for-profit organisation, owned and fully funded by its members, all of which have an interest in the use of woody biomass. Efforts are underway to transform SBP into a multi-stakeholder governed organisation (Preferred by Nature 2022)

The SBP has developed a certification system to provide assurance that woody biomass is sourced from legal and sustainable sources allowing companies in the biomass sector to demonstrate compliance with regulatory requirements. The certification system is designed as a clear statement of principles, standards and processes necessary to demonstrate such compliance.

SBP seeks to avoid duplication and to be consistent with standards that have overlapping scopes, while not limiting innovation and improvement. To that end, SBP certification system draws heavily on well-proven forest-level certification systems, such as, the Forest Stewardship Council (FSC), the Programme for Endorsement of Forest Certification (PEFC), and the Sustainable Forestry Initiative (SFI) – all of which are used in British Columbia. (SBP 2022)

In Europe, SBP product now represents, in 2021, 82.5% of the industry wood pellet market, up from 76.8% in 2020. There are now over 350 certificate holders, an increase of 12% since 2020 (SBP 2021). The market demand for SBP fibre is expected to grow, which speaks to the fact that all pellet operations in BC are certified to the SBP standard, providing added assurance of 'good biomass'.

6. Conclusions

The evidence provided in this report consistently points to the wood pellet sector as a manufacturer and a contributor to sustainable forest management, playing an important role in the forest products value chain of British Columbia. We see in the statistics and other qualitative evidence presented in this report that the industry already plays a critical role in forest maintenance and renewal and there is potential for the role to increase as we seek to address the complex forest management issues we face in British Columbia, indeed in all of Canada. The case studies reinforce the complementarity of the pellet industry with the rest of the forest sector.

We have demonstrated in this report that within BC as a whole, over 85% of the fibre used in wood pellet production is a direct by-product of the sawmill and allied industries. The remaining 15% comes from the forest and the provincial statistics clearly show that just 11% is from low quality logs. The remaining 4% is ground up fibre obtained from roadside piles of what is otherwise waste that would have been burned to reduce wildfire risk. This proportion of fibre by source varies at each wood pellet facility and is largely a response to local conditions, such as insect attack or wildfire management.

We are also convinced by the interviews we conducted, by the experience of the consulting team, and the logic of the market, that low quality logs will not end up in wood pellet facilities if they have a higher valued use in, for example, pulp mill processing. Pellet producers cannot afford to outbid other manufacturers for feedstock. This means that local pellet plants are utilizing the lowest quality logs which would otherwise be burned on site, creating highly polluting emissions, or left to become a fire hazard for the area.

In summary, the evidence collected for this report demonstrates that the biomass industry is a key component of the BC forest sector. It enables the sector to:

1. Utilize and create value from the mill residuals that are surplus to the existing energy requirements of the traditional forest products sector.
2. Create an additional revenue stream for sawmills and other facilities that pellet manufacturers purchase residuals from.
3. Eliminate CO2 emissions associated with traditional practices by using the residuals that formerly went into beehive burners or were landfilled.
4. Help meet one of the greatest challenges of our time: utilizing low quality biomass that comes from natural disturbances.
5. Create more viable economic opportunities and employment, especially in remote communities that are too far to supply fibre to pulp mills.
6. Contribute to managing wildfire risks by utilizing low quality biomass material, rather than burning it on forest sites or leaving it there in piles.

7. Increase the substitution of renewable energy (biomass) for fossil fuel (coal).
8. Work with Indigenous communities and other communities to improve forest health, support local economies, and strengthen community resiliency.

Finally, we suggest a number of other important and related issues that should be developed for British Columbia. First, it will be helpful to test the hypothesis that the wood pellet industry is not harvesting primary, ancient or old-growth forests for pellet production. Second, to analyze the GHG implications of using wood biomass we need to use a Life Cycle Analysis methodology to track the carbon implications of forest and mill residue use in wood pellets. Third, we need to statistically describe the importance of wood as a source of energy in the bioeconomy. Unlike competing jurisdictions, we have not completed our work in this area. Fourth, and finally, we think it would be very helpful to improve the feedstock report system requirements so that all stakeholders and First Nations have more information on the sector and while protecting the confidentially of the private sector.

7. Appendix I - Project Consultants

Jim Thrower, PhD, RPF (BC)

Jim has over 30 years' experience in the forest industry in BC, other Canadian Provinces, the US, and overseas. His primary area of expertise is quantitative systems applied to strategic and operational planning and valuation, fibre supply, growth and yield, inventory, statistical analysis, timber valuation, cruising, and scaling. Jim has a technical diploma in Forestry, BScF and MScF from Lakehead University, and a PhD in Forest Biometrics from the University of BC. Jim is also a Registered Professional Forester in BC.

Jim is part of the professional team at Westwood Fibre Resources Ltd. in Kamloops, BC that specializes in operational aspects of fibre supply, planning, and management. Westwood sources and manages all aspects of fibre supply to sawmills, pulp mills, chip plants, peeler plants, and biomass plants from public and private lands in BC and elsewhere. Westwood manages the forestry assets of some of the largest private land holders in BC including many of the largest cattle ranches. Services include inventory of timber assets, timber valuation for acquisitions and dispositions, strategic planning, harvesting operations, log and fibre sales, accounting, and general management. Westwood also provides strategic planning services relating to fibre supply and valuations for private and public operations. Westwood staff often provide expert opinions and expert witness services to law firms.

Brad Bennett, BScF, RPF (BC)

Brad has over 30 years of experience in BC forestry. His career includes 13 years at Ainsworth Lumber as Chief Forester, General Manager, and Divisional Forester. His most recent position was Woodlands Manager Interfor's large, modern sawmill in the BC Interior.

Earlier in his career, Brad worked as an operational Forester in northern BC. Before his most recent position with Interfor, Brad was Vice President of Operations at Pacific BioEnergy in Prince George, one of the largest pellet plants in BC. There he was responsible for fibre procurement, manufacturing, and logistics. Brad is also a past president of the Wood Pellet Association of Canada (WPAC). He has a BScF from the University of BC and is a Registered Professional Forester in BC.

Jeremy Williams, PhD, RPF (Ontario)

Jeremy has extensive forest economics experience including reviews of timber markets, timber pricing including stumpage rates, timber product production costs, and rates charged by the Crown for property leases. Recent relevant experience includes reviewing forest management and timber markets in Nova Scotia, rental rates for Crown land in Ontario, preparing a Regional Risk Assessment for BC against the SBP standard (in draft) and assessing forest carbon offset protocols for the Ontario government.

In addition to these projects, Jeremy has completed numerous business cases, economic evaluations, and reviews. He is also very knowledgeable and experienced with respect to forest carbon pricing and accounting and has extensive experience working with and advising Indigenous communities and organizations.

Jeremy earned a BScF from the University of Toronto's Faculty of Forestry (1979) and a PhD from the same Faculty with a specialization in Forest Economics (1986). He is a principal of ArborVitae Environmental Services Ltd. and a Registered Professional Forester with the Ontario Professional Foresters Association.

Gary Bull, PhD

Gary has a background in commerce as well as three degrees in forestry, specializing in economics and policy. He has an interest in global forestry policy issues and is an expert on forest and timber markets in Asia and ecosystem services markets. In BC, he has focused his efforts on working on sustainable business development with First Nations communities and sustainable fibre supply.

Gary worked for the Food and Agriculture Organization of the United Nations before moving back to Vancouver and joining the Faculty of Forestry at the University of British Columbia. Gary is currently a full professor and former head of the Forest Resources Management Department at the Faculty. Gary's specialities include Aboriginal forestry, forest carbon finance, economics, and international trade.

Gary has been associated with SBP for several years and was selected to be a member on SBP's Standards Committee and Working Group on Carbon. He recently sat on the External Review Panel of SFI and is a Director of Ostrom Climate and sit on the independent advisory board of Climate Impact X.