The Feasibility of a Wood Pellet Plant Using Alternate Sources of Wood Fibre

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Abstract:

This Thesis will evaluate the feasibility of building and operating a pellet plant in interior British Columbia. This thesis will examine the economic demand for wood pellets in different regions of the world. It will also identify the current Canadian supply and production of wood pellets. The thesis considers the capital costs associated with the building of a pellet plant as well as the machine capital costs. The variable costs associated with a pellet plant are examined in this thesis, with an emphasis on the costs associated with obtaining different wood fibre sources. Transportation and drying costs are also taken into consideration with regards to variable costs. In the analysis of data five different scenarios are calculated to identify the feasibility of using different fibre sources to operate a pellet plant. Recommendations based from these scenarios demonstrate the feasibility of operating and building a pellet plant in interior British Columbia.

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1 Introduction:

1.1 Statement of Problem

This thesis will identify the feasibility of wood pellet production in the interior of British Columbia. This thesis will take into account different types of wood fibre available in the area, including wood fibre available from the recently killed pine trees.

1.2 Biomass Energy

Wood pellet energy is a new and rapidly developing source of biomass energy. Biomass energy is defined as any living and/or recently dead biological material that can be used for fuel or industrial production.

1.3 Environmental Benefits

Wood pellets have been seen as both an environmentally sustainable and an economically feasible fuel source. Wood pellets have been seen to be superior to both conventional cord wood burning and the use of fossil fuels.

Wood pellets are carbon neutral because they do not emit harmful greenhouse gases that produce through the combustion of fossil fuels. Common greenhouse gases emitted by fossil fuels include: arsenic, carbon dioxide, and sulphur dioxide. The burning of wood pellets does emit carbon dioxide into the air but this carbon neutral because if the wood was left to rot instead of being burned the carbon would still be released into the atmosphere therefore the same amount of carbon is released. This makes wood pellets a carbon neutral energy source. Also, when wood decomposes, other toxic gases are also released such as methane; therefore the combustion of wood pellets is even more environmentally friendly then leaving to wood to decompose. Figure 1.1 demonstrates how the burning wood pellets are carbon neutral compared to the wood

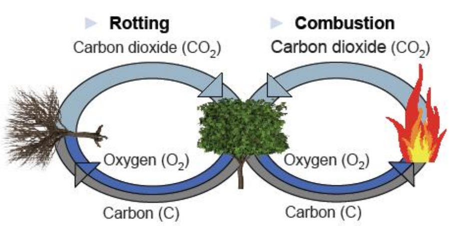

Figure 1.1: Carbon Cycle
Source: Main Energy Systems

decomposing. Because wood pellets are carbon neutral they are popular with environmental groups. Also the effects of climate change could be avoided or reduced with more pellet fuelled energy systems. Since pellet heating systems have been proven to not contribute to the depletion of ozone levels and comply with the United States Environmental Protection Agency (EPA) as well as with the Kyoto Accord Air Emissions. Wood pellet stoves are one of the cleanest burning solid fuel systems available. Another environmentally friendly aspect of wood pellets is that the energy needed to produce wood pellets is much less then the production of other energy sources.

2 The Production of Wood Pellets

2.1 Environmental Fibre Options

Wood pellets are made from the waste products that other mill manufacturing processes. They can be seen as recovery of waste from the manufacturing of other products. Wood waste that would otherwise end up in landfills can be converted to pellets and burned for clean energy. Wood pellets are produced as a 100% natural fuel. There are no additives or binding agents required to produce wood pellets. Wood pellets are dried and then compressed into form. The natural extractives and lignin found within the wood hold the pellets together. Due to the simplistic manner of which wood pellets are produced other biomass products can also be converted into pellets; some of these materials include waste paper, straw, cornstalks, and even animal waste.

2.2 Energy Efficiencies

Wood pellets are viewed to be among the cleanest and have the highest energy heat values. Table 2.1 below shows the amount of heat energy produced by different fuel sources. Wood pellets burn cleaner than cord wood. This is also because the lower moisture content allows for wood pellets to burn at a higher temperature producing less ash and particulate matter in the smoke.

Fuel Type	Efficiency	Units to Produce 1,000,000 BTU	Unit Cost	Cost to produce 1,000,000 BTU
Wood	60%	0.08 cord	$180.00/cord	$14.40
Wood Pellets	80%	0.08 ton	$220.00/ton	$17.60
Natural Gas	80%	12.5 therm	$1.50/therm	$18.75
Propane Gas	80%	13.5 gal	$2.00/gal	$27.00
Coal	75%	0.05 ton	$200.00/ton	$10.00
Fuel Oil	80%	9.0 gal	$2.00/gal	$18.00
Electricity	100%	293.1 kW	$0.10/kW	$29.31

Table 2.1: Energy efficiencies for different fuels
Source: woodpelletsvietnam.com

2.3 Cord Wood

Wood pellets are superior to cord wood because of the lower moisture content of wood pellets. The lower moisture content of the wood pellets gives wood pellets a higher heat energy value than cord wood. Another reason to use wood pellets over cord wood is that they are much easier to transport than cord wood because of their small uniform shape. Wood pellets can be easily used in automated systems feeding systems.

2.4 Fuel Costs

Wood pellets can be viewed as a clean and sustainable from of alternative energy. A British study done in November 2008 (HMSO, 2008) showed that per kilowatt hour the cost of wood pellets was identical to the price of natural gas. The study also showed that burning wood pellets were 15% less expensive than using heating oil, 59% less expensive than liquid petroleum gas, and 70% less expensive than using electrical energy. Wood pellets can be produced at a fraction of the cost of many other non-renewable energy sources such as oil, gas, and coal. Not only are wood pellets more cost effective than fossil fuels, wood pellets are in such high demand because they are carbon neutral, this make the burning of wood pellets for energy to be a sustainable source of energy and with the global reduction in the amount of carbon allowed to be emitted.

2.5 Wood Pellet Production Steps

The production of wood pellets can be broken down into six major steps. These steps include obtaining a wood fibre source, drying the material, grinding the material, conditioning, pelletization, and packaging and shipping.

2.5.1 Wood Fibre

A pellet plant must first obtain a source of wood fibre in which to make wood pellets from. There are several possible sources of wood fibre such as: sawdust and shavings from primary wood product producers, or chipping biomass piles left over from logging operations.

2.5.2 Drying

Once the wood fibre has been acquired by the pellet plant, it needs to be dried to a moisture content of eight to ten percent. Pre-dried wood fibre such as dry sawdust and wood chips do not need to be dried thus reducing the cost of production for these materials. A common process done by pellet plants is to burn some of the wood fibre in their driers to reduce the drying costs.

2.5.3 Grinding

The next step for the production of pellets is to have the material screened with the larger wood particles being sent to a hammer-mill. A hammer mill crushes the larger wood pieces into smaller pieces that are able to be presses.

2.5.4 Conditioning

A common practice done by many pellet producers is to condition the wood fibre before it enters the pellet presses is to conduction the wood fibre. Conditioning consists of spraying the material with super heated steam to heat and soften the wood fibre.

2.5.5 Pelletization

The wood fibre is then pressed through a dye containing holes the equivalent diameter of the pellets. The most common diameter of wood pellets is six millimeters. During the pressing process the wood pellets undergo tremendous pressure. This pressure increases the heat of the pellets causing the natural lignin in the wood to bind the pellets together acting like glue. Automatic blades will break the pellets off at pre-determined lengths though; a blade is not always required. The pellets leave the pressing process at approximately 100°C. As the pellets cool, the lignin hardens forming the natural pellets. The pellets are then screened to ensure proper size requirements are met with the smaller material being reprocessed.

2.5.6 Packaging and Shipping

The pellets are now ready to packaged and/or shipped. Pellets used for residential consumers are packaged into forty pound bags and shipped domestically. However, since ninety percent of the Canadian produced wood pellets are shipped to commercially either to the states or Europe, most packaging is done at a later date.

2.6 Wood Pellet Grades

Wood pellet plants produce two types of wood pellets; Commercial and Premium. Commercial grades, also known as brown pellets, have a higher concentration of bark and other contaminates that restrict them from being used in residential settings. The higher bark content in the commercial pellets allows for higher heating values however, there is also a higher amount of ash produced. The high ash content is not usually a problem for industrial applications; however, it is not generally accepted in residential applications. The other grades of pellets produced are premium wood pellets. Premium wood pellets contain little to no bark and are commonly referred to as white pellets. These clean burning wood pellets produce little ash and are sold residential markets.

3 Economic Demand for Pellets:

3.1 Worldwide Demand

There is a strong demand for wood pellets worldwide. The demand for wood pellets is greater than the supply (Bennett, 2009). In 2005 there was an estimated thirty million tons of demand for wood pellets with only four million tons of wood pellets being produced (Urbanowski 2005). Furthermore the North American demand for wood pellets has been growing a compounded rate at 4.5% with the European market doing even better at a compound rate of 25% since 1995. (Urbanowski 2005)

3.2 European Market Demand

The economic demand for wood pellets has grown over the last few years in European countries. This is due for two main reasons: firstly, because of the high taxation of fossil fuels alternate sources of heat/fuel are being explored for use. Secondly, the combustion of wood pellets is considered carbon neutral by the Kyoto Protocol thus helping countries meet their Kyoto requirements and reduce green house gas emissions. The European market differs from the North American market in that it has a broader range of consumers. Sweden, Europe's largest consumer of wood pellets, consumes wood pellets primarily for the use in large scale power plants. These plants use pellet fuel for both heating and electricity, these plants are referred to as combined heat and power plants (CHP) (Urbanowski, 2005). Whereas in Austria the sale of pellets is similar to that of the North American demand, being that their sales focus primarily on residential sales. (Urbanowski, 2005)

3.3 North American Market Demand

The strong demand in Europe for wood pellets has created many opportunities in the North American exports. The primary North American consumers of wood pellets are residential customers who have small household wood pellet stoves or reconditioned wood burning stoves adapted to burn wood pellets. Wood pellets are much cleaner then wood burning stoves due to the high heating value and automated systems available compared to conventional wood heating stoves. (Bennett, 2009) In 2008 1.1 million tons of pellet fuel was sold in North America (The Pellet Institute, 2009). The target market in the North American pellet marketplace is primarily individuals concerned about environmentally friendly heating methods. Currently the price of wood pellets is 25% higher than the cost of natural gas. (Bennett, 2009) However, natural gas is low compared to previous months and the cost of natural gas is unstable predicted to increase it the following months whereas the cost of wood pellets is predicted to remain at a set rate. In June 2008 when the price of natural gas was much higher, close to 50 cents a cubic meter, the price of wood pellets were 20% lower than natural gas (Torontogasprices.com, 2009). Wood pellets are currently more expensive than fuel oil with fuel oil being only $1.18 per gallon. However, in July 2008 when fuel oil was $4.00 per gallon fuel oil was sixty times more expensive than using premium wood pellets (Torontogasprices.com, 2009).

Even though the Kyoto protocol was not widely adhered to in North America, other systems to reduce climate change are now being put it is place such as the Canadian "Turning the Corner". However, currently natural gas the main heating fuel being used in North America because of the pre-existing natural gas systems already installed and the current low price of natural gas. The less expensive installation costs of natural gas systems makes natural gas a more attractive and economical choice for consumers. Other obstacles facing pellet producers in North America is the high cost of transportation. Canada supplies about one third of the North American pellet supply. (Bennett, 2009) The future of the North American pellet industry is dependent on two key aspects; firstly the price of fossil fuels. Current prices of fossil fuels are low and both oil and natural gas are less expensive then wood pellets. Secondly, the cost of wood fibre that is available for pellet plants to be able to make wood pellets. As the Unites States housing boom turns into a recession, the wood fibre material available from sawmills will disappear and increase significantly in price. The production in North America currently is higher than the consumption and therefore there are large exports to United States and Europe with most of the exports going to Europe. "95% of western Canadian wood pellets are shipped to either the USA or Europe (Bennett, 2009).

3.4 Other Possible Markets

Many other countries and areas are considering different fuels to fossil fuels. One area that shows a lot potential for Canadian exports of wood pellets is Asia. This is due to shipping opportunities. Currently container ships returning back to Asia from Canada are leaving with empty containers on board. This presents an opportunity to ship pellets at a reduced cost. Also as Asian countries try to reduce their greenhouse gas emissions in accordance Kyoto or other climate change protocols the market for clean burning pellets will increase. (Urbanowski, 2005)

4 Canadian Supply and Demand:

4.1 Canadian Production

In Canada production of wood pellets has increased drastically since 2000 and is projected to continue to increases. The following figure shows the increase in Canadian production from 2000 and the projected increase to 2010. It can be seen from the graph below that there is a predicted 30% increase in Canadian production from 2008 to 2010. From 2000 to 2008 there was an approximate 80% increase in Canadian production.

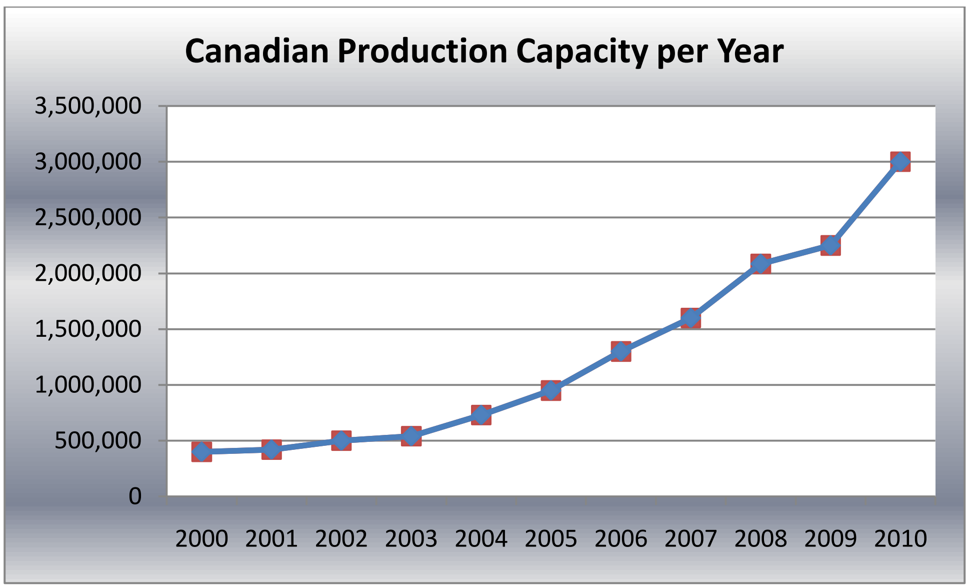

Figure 4.1: Canadian Production from 2002 to 2008, estimated from 2009 to 2010
Source: Author, based on Wood Pellet Association of Canada

4.2 Canadian Sales

Canadian sales for 2008 can be broken up into domestic sales, United States sales, and overseas sales. The following graph shows the 2008 sales for each of these three markets. The graph also demonstrates the total production capable from Canadian pellet plants in contrast with the actual production of Canadian pellet manufacturers. From the graph is it quite clear that the majority of wood pellets produced in Canada are shipped either to the United States or overseas. Europe makes up the vast majority of the overseas sales. From the graph it can also be seen that Canada ships almost 50% more pellets overseas than to the United States.

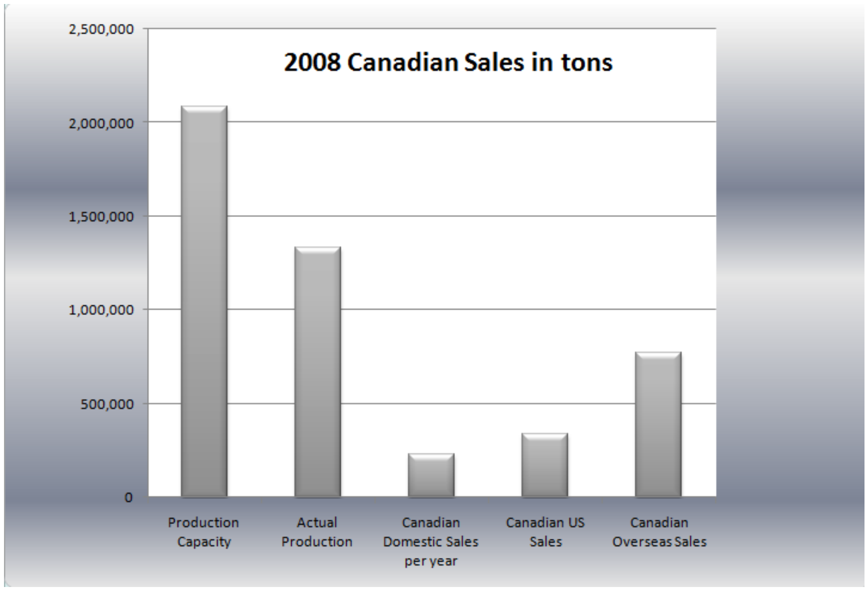

Figure 4.2: Canadian Sales to different markets for 2008
Source: Author, based on Wood Pellet Association of Canada

The next graph shows the predicted trend for pellet sales for 2009 and 2008. As it can be seen in the graph sales of pellets are expected to rise in e market with overseas markets showing the most growth. There is also expected to be a large increase in the Canadian production capacity.

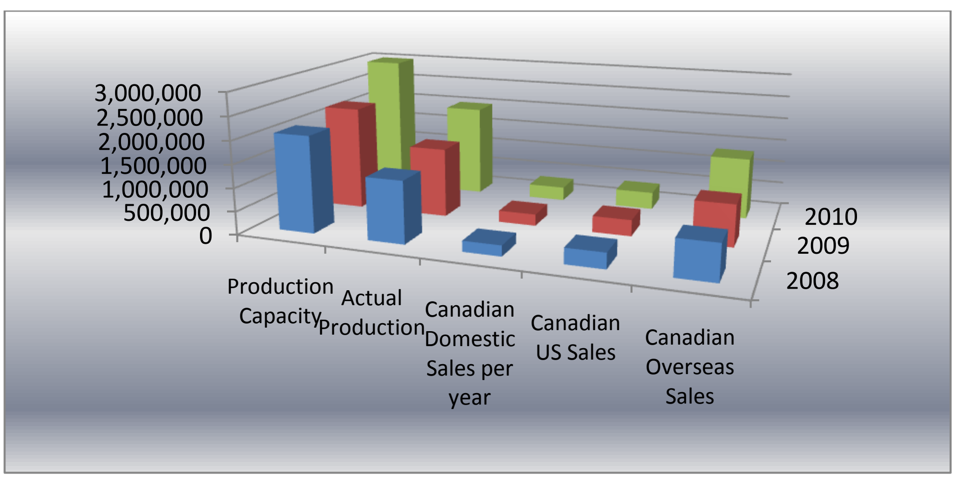

Figure 4.3: Canadian Sales to different markets for 2008 with estimates for 2009 and 2010
Source: Author, based on Wood Pellet Association of Canada

5 Variable Costs:

5.1 Sources of Wood Fibre

The quality of the wood pellets is dependent on the quality of the wood fibre that is used to make them. The wood shavings and wood chips from sawmills are used in the production of wood pellets. These materials are excellent for the production of wood pellets because they do not contain any contaminates such as bark and the pellets produced from the clear wood are called 'white pellets' and are the highest qualities of pellets that can be produced. However, the recent shortage of wood chips and shavings available to pellet mills due to the downturn of the sawmill industry pellet plants are having to rely on other sources of wood fibre (Bennett, 2009). Some examples include using whole log chipping systems in which whole logs are debarked and then chipped for the production of wood pellets. This method will produce high quality pellets however the extra costs associated with debarking and chipping of the logs are a down side to this process. Also having to locate and transport the logs to the plant is an extra cost. Another possible source for wood fibre is by using road side slash piles left over from logging operations. Wood fibre obtained from these piles would include branches with bark and other debris such as foliage. This wood fibre would produce much lower quality wood pellets with increased heat values and higher ash content produced during combustion.

Figure 5.1 shows the North American wood fibre demand for pellet plants. The different colours indicate the amount of tones of raw wood fibre each plant uses per year. Figure 5.1 indicates several large scale pellet plants already in use in central British Columbia as well as one in Northern British Columbia. These plants are surrounded by lodge pole pine and spruce forests.

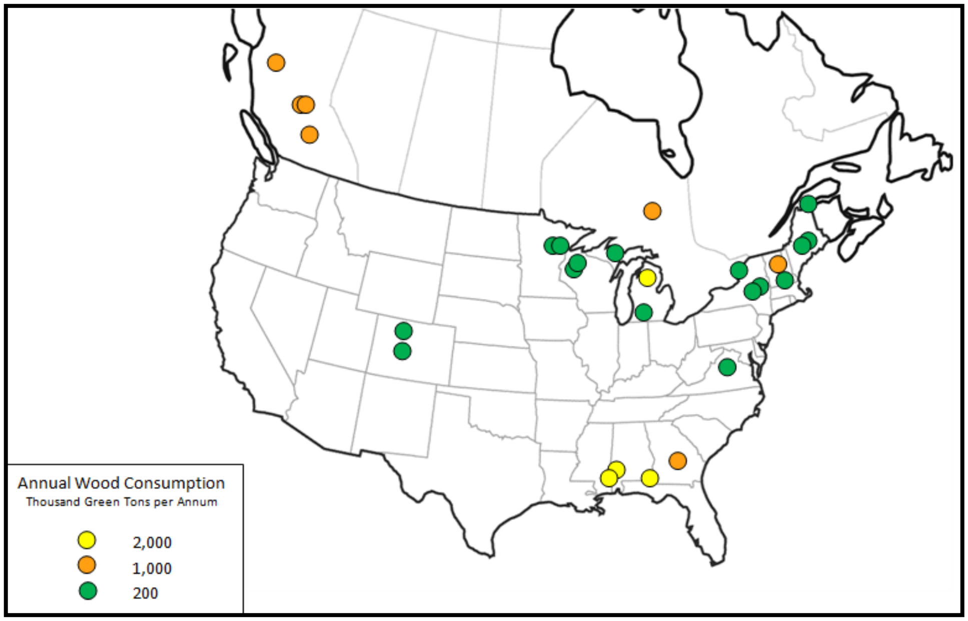

Figure 5.1: Location of major wood fibre consumption plants
Source: Author, based on various sources

The wood fibre that needs to be obtained can be the greatest cost to a pellet plant. The cost associated with obtaining wood fibre will differ depending on what wood fibre is used by the pellet plant and were the pellet plant is obtaining the wood fibre from. The cost per ton of wood fibre can vary from free for wood chips and shavings from an adjacent sawmill to $500 per ton if the chips or shavings could be used for other means. (British Columbia Forest Service, 2009)

5.1.1 Chips and Sawdust from Primary Processing Plants

Chips and sawdust from primary processing plants will be the most variable in cost of the wood fibre sources. The costs associated with wood chips and shavings can vary from being free if there is a deal worked out with a primary processor to remove their waste chippings and sawdust or up to a cost of $500 a ton. These are wood shaving that could be sold as animal bedding and therefore puts a much higher costs on the wood fibre. Another problem associated with getting wood chips and sawdust from primary wood processors is that large producers of wood shavings have pre-existing contracts with pulp producers that need to be met first. This leads to wood fibre from primary wood processors as unpredictable and highly variable in price and supply.

5.1.2 Wood Fibre from Beetle Killed Pine Trees

In late 2000’s an outbreak of pine beetle killed around 620 million cubic meters of pine trees (Holly Pyhtila, IPS) this has left a lot of dead pine in the interior of BC, most of the wood is dead and dry but still standing timber, current logging operations to log the pine killed timber has and still is producing a lot of road side biomass debris. This debris can be chipped in the bush and sent to pellet plants in chip trucks.

Figure 5.2: Image of dead pine trees in the British Columbia interior.
Source: http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/images/Jul1-8_roll1_Williams_Lake_MPB1.jpg

However, since the roadside bio mass is mostly branches and other unwanted tree parts from logging operations getting roadside biomass that is bark free is next to impossible. This means that there will be a lot of unwanted contaminates in the chips used from pine killed trees another issue with using pine killed wood is that the wood is dry, this does not present a problem for the pellet plants or for the chipping operations, the problem is with trying to make lumber from dry wood, when the dry pine hits the gang saws in a lumber mill the logs tend to crack and split because they are not flexible due to the low moisture content. This drastically reduces the yield for a sawmill when using pine killed timbers; this also means that as the quality of pine wood in the forest degrades less lumber mills are going to be willing to log them and the roadside biomass resource will dry up. The first table in the figure below shows the costs associated with collecting roadside biomass used to make chips. The costs come from the British Columbia forest service website and are the prices that must be paid per cubic meter of wood used. The costs include use of the logging roads and the loading of a haul truck to different locations within the interior of British Columbia. The values given in the third column show the costs associated with timber harvesting pine killed trees; this is the cost that would be incurred if the whole log chipping of trees was done in the bush. Since there is a lot more involved in logging whole trees rather than just the roadside biomass the costs associated with timber harvesting are over 2.5 times higher than the costs associated with roadside biomass.

Estimated Average Total Cost ($/m3)		
District	**Roadside Biomass**	**Timber Harvesting**
100 Mile House	$12.90	$36.62
Cascades (Merritt)	$13.15	$37.37
Central Cariboo (Williams Lake)	$14.95	$40.82
Chilcotin (Alexis Creek)	$21.75	$52.33
Okanagan Shuswap (Vernon)	$14.52	$38.50
Quesnel	$14.36	$38.29
Kamloops	$13.44	$36.11
Nadina (Burns Lake)	$15.26	$37.73
Prince George	$11.91	$33.37
Fort St. James	$11.28	$34.58
Vanderhoof	$11.11	$34.59
Average	**$14.06**	**$38.21**

Table 5.1: Costs of beetle killed biomass both standing logs and roadside biomass, hauled to different interior towns

Source: Author, based on
http://www.for.gov.bc.ca/hts/bioenergy/estimates/cost%20estimates.pdf

There is a maximum life expectancy that the pine killed wood will still be usable. Since the approximate maximum life of a standing dead pine tree is ten years, the resource of pine killed wood has a maximum life of also ten years. Once the trees have fallen and are decomposing on the ground they will not be usable.

5.1.4 Standing Green Timber

The price associated with standing green timber is the most expensive source of wood fibre. This is because the standing green timber can be used for a variety of other products such as lumber. The prices associated with standing green timber ranges from $50 - $100 per cubic meter depending on the species and quality of the logs. For example, the three month average in the Interior ending Feb 28 2009 for peelers is $65.33 whereas on the Coastal average cost is $70.14 (Revenue Branch, Ministry of Forests and Range, 2009)

5.2 Transportation

The next major cost associated with pellet plants is the transportation of both the raw wood fibre and the finalized pellet.

The raw fibre is trucked to the plant from a nearby fibre source and the costs associated with trucking the wood from the forest to the British Columbia towns are included in the raw fibre costs calculator earlier. The transportation of raw wood fibre is the second highest cost associated with obtaining the raw wood fibre.

The cost associated with shipping of the finished pellets depends on where the pellet plant is located and where the pellets are being shipped to. This is definitely a major variable that should be taken into account when deciding where to locate a potential pellet plant. Since this paper deals with pellet plants in the British Columbia interior, the main transportation cost should be the shipping of finished pellets using sea ports or rail to the United States and overseas. The transportation of the pellets can easily 50% of the total costs of the good sold (Urbanowski 2005)

Costs incurred with shipping include: storage of goods at the harbor, rail charges; port charges, shipping charges. Currently the port of Vancouver is the only port that will ship pellets to Europe. A cost of $70 per ton shipped to Europe from central British Columbia. This value was calculated based on results from Urbanowski's paper "Strategic analysis of pellet fuel opportunity in northwest British Columbia" (2005) with $50 of the cost being the ocean transportation costs The costs associated with trucking and rail with-in North America is variable depending on the distances that are traveled.

5.3 Drying Costs

All of the wood fibre must be dried to a moisture content of less than 12%. Because most plants use the wood pellets they produce as fuel to dry their raw wood fibre the cost of the wood pellets can be used to calculate the costs of drying the wood fibre. The moisture contents of the different types of wood fibre available can be seen in Table 5.2. One ton of wood pellets produce 13.19 GJ of energy and assuming a cost to the plant of $100 a ton for wood pellets the costs associated with drying the raw wood fibre can be seen below.

Energy need to reduce wood to 10% MC using wood Pellets					
	Moisture Content	% of water removed	Energy Required to Remove Water (GJ)	Cost of wood pellets per (GJ)	Total Cost
Green felled wood	60%	50%	1.68	$7.58	$12.74
Wet saw dust and chips	50%	40%	1.344	$7.58	$10.19
Dead Pine	30%	30%	1.008	$7.58	$7.64

Table 5.2: Drying energy needed to dry wood fibre using wood pellets for fuel

Source: Author, based off various sources

Another option is to use natural gas to dry the raw wood fibre, currently the price of natural gas is $6 a GJ however, the $6 low price is not expected to last long and the price of natural gas is expected increase significantly within the year.

Energy need to reduce wood to 10% MC using natural gas					
	Moisture Content	% of water removed	Energy Required to Remove Water (GJ)	$6 Natural Gas per (GJ)	Total Cost
Green felled wood	60%	50%	1.68	$6.00	$10.08
Wet saw dust and chips	50%	40%	1.344	$6.00	$8.06
Dead Pine	30%	30%	1.008	$6.00	$6.05

Table 5.3: Drying energy needed to dry wood fibre using natural gas for fuel

Source: Author, based off various sources

5.4 Other Operating Costs

Other variable costs of running a pellet plant include: power need to operate machines, people, start up periods, and maintenance. All of these values fluctuate depending on the size of the plant, the location, and the skill set of the employees. Because this thesis deals mainly with viabilities in input costs it will be assumed that these variable costs are constant.

6 Capital Costs:

6.1 Plant Costs

The Table 6.1 looks at the capital costs of four different North American pellet plants; two plants are from Canada and two plants are from the United States. These capital costs take into account, the land, the plant building costs and the machines need to operate the plant. The costs are then broken down to how much each plant costs per the production that each plant can produce annually. The capital costs associated with a pellet plant can be seen from the following table. The average cost of each plant per output can be seen, from the table and an average of $177 per ton of production can be calculated by averaging the capital costs of the four plants.

Company	Plant	Production (ton) per year	Capital Plant Cost (CAD)	Cost per ton of Production
Canadian Bio Pellet Inc	Ingleside, Ontario	450,000	$80,000,000	$178
Green Circle BioEnergy	Schuyler, New York	100,000	$13,560,000	$136
Green Circle BioEnergy	Jackson County, Florida	550,000	$100,000,000	$182
Digby	Nova Scotia	20,000	$4,250,000	$213

Table 6.1: Average Capital Costs of pellet plants
Source: Author, based off various sources

The capital costs also depend on the raw material that is going to be used in the pellet plant, the raw material will determine if there is a need to dry the material fist and how much the material will need to be chipped first; for example whole log chipping.

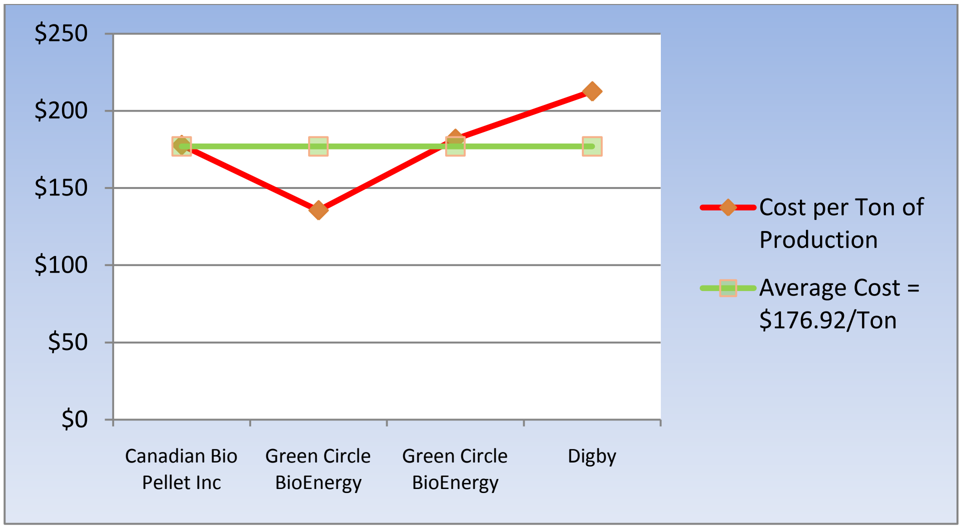

Figure 6.1: Average Capital Costs of pellet plants
Source: Author, based off various sources

6.2 Machines Costs

An example of the capital cost from a Swiss pellet plant is seen in the Table 6.2 below. The plant is capable of producing fifty tons of pellets per annum compared to North American pellet plants this plant is small, However, by multiplying the total cost of the Swedish plant by the output of the North American plant, the capital costs work out to be similar.

Item	Capital Cost $CAD	Useful Life in Years
Dryer	$3,550,000	10
Hammer Mill	$530,000	10
Pellet Machine	$890,000	15
Cooler	$360,000	50
Storage, Conveyers, Separators	$1,290,000	50
Peripheral Equipment	$640,000	50
Building	$1,520,000	50
Total	$8,780,000	

Table 6.2: Capital costs of machines in a wood pellet plant based off a plant capable of 50 ton / year
Source: author based off (Urbanowski 2005)

6.3 Production Costs

The production costs take into consideration all of the fixed and variable costs associated with the production of wood pellets, some of these costs include: labor costs, power need to run equipment and payback on capital costs. This thesis primarily deals with the costs associated with input costs and therefore can be assumed that the production costs for each scenario will be a constant. The production costs for a large pellet plant will also be lower than the production costs of a smaller pellet mill; in this thesis the assumed production cost for all scenarios will be $20 per ton.

7 Analysis of Data:

7.1 Scenarios

In order to evaluate the feasibility of a wood pellet pant using the different sources of wood fibre available, five different scenarios with varying costs of raw fibre will be analyzed. The costs of producing wood pellets with each scenario are seen in Table 7.1 and Figure 7.1.

7.1.1 Scenario 1

The first scenario assumes fibre costs of $0 per ton. This would be an example of a pellet plant with a pre-arranged agreement to receive chips and shavings from a primary processing plant.

7.1.2 Scenario 2

The second scenario also assumes fibre costs of $0 per ton from a primary processing plant, however; in this scenario the fibre is wet and must be dried.

7.1.3 Scenario 3

The third scenario utilizes road side biomass from logging operations of dead pine trees. The values of which are obtained from Table 5.1.

7.1.4 Scenario 4

The fourth scenario deals with whole log chipping of dead pine trees. These values are also obtained from Table 5.1.

7.1.5 Scenario 5

The fifth scenario deals with using green standing timber as a source of raw fibre. An extreme value is assumed here at $100 per ton slightly higher than the value of $70.14 obtained from the British Columbia Forestry Service.

7.2 Equations

Using the Equation:

Pellet Cost per Ton = Fibre Cost + Drying Cost +Processing Costs + Shipping Costs,

The Figure 7.1 can be constructed to demonstrate the input costs associated with each type of wood fibre used.

Costs	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Fibre	$0.00	$0.00	$14.06	$38.20	$100.00
Drying (using pellets)	$0.00	$10.19	$7.64	$7.64	$12.74
Production	$20.00	$20.00	$20.00	$20.00	$20.00
Shipping	$70.00	$70.00	$70.00	$70.00	$70.00
Total	**$90.00**	**$100.19**	**$111.70**	**$135.84**	**$202.74**

Table 7.1: Total Cost to produce one ton of pellets using different fibre sources

Source: Author, based off various sources

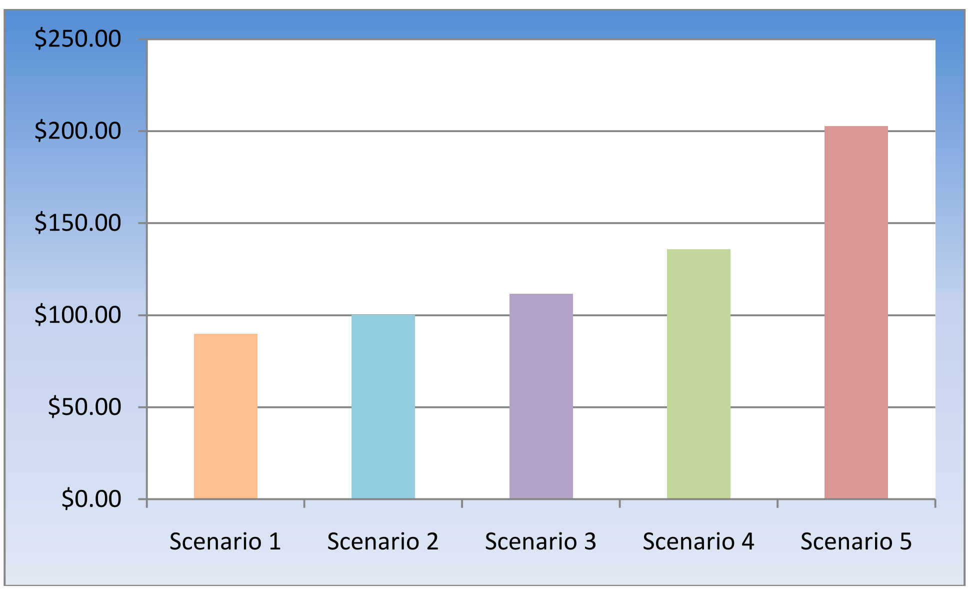

Figure 7.1: Total Cost to produce one ton of pellets using different fibre sources

Source: Author, based off various sources

8 Summary of Results

8.1 Profit Overview

From the analysis of data it can seen that the overall costs of producing wood pellets in the interior of British Columbia is largely dependent on the cost associated with the wood fibre available. Table 7.1 clearly shows the drastic fluctuation in production costs with the different sources of wood fibre available. These costs range from $90 to $220 per ton of wood pellets produced. Since the current selling price of wood pellets ranges from $110 to $160 per ton (Harrison 2006). With these values it can be seen that in order for a plant to make a profit all of the scenarios are feasible except for scenario five, where green standing timber was used as a fibre source.

From an economic point of view a pellet plant’s best option would be to secure a solid contract with a primary wood producer. It is seen in table 7.1 that this scenario offers the lowest production costs of wood pellets by over double that of harvesting green timber.

8.2 Assumptions Made

The values obtained in table 7.1 are rough estimates and make many assumptions with operating costs such as labor costs. The overall costs associated per ton of production would vary depending on the size of the pellet plant, and the location of the plant. A larger pellet plant would most likely have lower costs per ton than that of a smaller pellet plant.

9.0 Recommendations

9.1 Conclusions

This thesis shows that there is enough economic demand and wood fibre available to support the building and operation of a pellet plant in the interior of British Columbia. The pellet plant should first try to obtain a fibre source from a primary producer because it is clearly the most inexpensive source of fibre. However, if that is not feasible the options of roadside biofuel (scenario 3) as well as whole log chipping of dead pine trees (scenario 4) are also economically feasible. These conclusions are all based on current worldwide demand for wood pellets being greater than the supply. If supply is greater than demand the price of wood pellets will drop and these predictions are no longer valid.

9.2 Other Opportunities

It is also recommended that new markets be researched and identified. As mentioned in the thesis utilizing the cheap shipping options to Asia could provide vast and valuable new market opportunities.

References:

Wood Pellets – Wood Pellets Info. (n.d.). Retrieved January 6, 2009, from http://www.woodpelletinfo.com/wood-pellets/

Biomass Energy Centre. (n.d.). *Fuel costs per kWh.* Retrieved March 2, 2009, from http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,59188&_dad=portal&_schema=PORTAL

Wood Pellets Vietnam. (2008). *Renewable Fuels – Firewood & Wood Pellets.* Retrieved February 23, 2009, from http://www.woodpelletsvietnam.com/en/profile.aspx

Pellet Fuels Institute. (n.d.). *Pellet Stoves.* Retrieved February 10, 2009, from http://www.pelletheat.org/2/index/index.html

Maine Energy Systems. (2007). *Wood Pellets – Basic Training.* Retrieved March 9, 2009, from http://www.maineenergysystems.com/userfiles/file/Wood%20the%20renewable%20ener gy%20Source.pdf

Urbanowski, Ernie. (1984). *Strategic Analysis of a Pellet Fuel Opportunity In Northwest British Columbia.* Retrieved January 22, 2009, from http://ir.lib.sfu.ca/retrieve/2213/etd1891.pdf

Energy Shop. (2009). Natural Gas Prices – Historical and Forecast. Retrieved February 25, 2009, from http://www.energyshop.com/es/homes/gas/gaspriceforecast.cfm

Fuel Products Laboratory. (2004). *Fuel Value Calculator.* Retrieved March 30, 2009, from http://www.fpl.fs.fed.us/documnts/techline/fuel-value-calculator.pdf

Home Heating Oil Chart. (2009). Retrieved January 7, 2009, from http://www.torontogasprices.com/homeoil_chart.aspx

Brad Bennett. (Speaker*).* (2009). Kamloops, BC: Pacific BioEnergy.

WoodWeek. (2009, March 11). *Wood Pellets Demand Pushes Prices Up In Europe.* Retrieved March 27, 2009, from http://www.woodweek.com/dsp_newsletter.cfm?id=24#9

Swaan, John. (2009). *European Wood Pellet Conference 2009 Report.* Wood Pellet Association of Canada.

Drewry, R., Wimberly, J., & Costello, T. (n.d.). *Poultry Farm Energy Audits & Alternative Energy Sources.* Retrieved March 18, 2009, from http://www.pelletheat.org/3/institute/2008summerConf/ScottJacobs.pdf

Harrison, Matthew. (2006, January 5). *Pellet Fuel Potential: The Resurgence of Wood as a Heating Source.* Pallet Enterprise. Retrieved March 18, 2009, from http://www.palletenterprise.com/articledatabase/view.asp?articleID=1952

Pellet Fuels Institute. (2003). *Wood Pellet Info.* Retrieved March 18, 2009, from http://www.allbasics.com/wood_pellet_info.htm

Wisconsin Focus on Energy. (2002). *Heating Your Home With Wood Pellets.* Retrieved March 18, 2009, from http://www.focusonenergy.com/data/common/dmsFiles/W_RB_MKFS_Wood%20pellets%20fact%20sheet.pdf

Ministry of Forests and Range – Province of British Columbia. (2008, March). *Bioenergy Opportunities Using Wood Resources: Cost Estimates Based on July 1, 2007 Average Market Price Dataset (Forest Industry Average).* Retrieved on March 18, 2009, from http://www.for.gov.bc.ca/hts/bioenergy/estimates/cost%20estimates.pdf

Revenue Branch, Ministry of Forests and Range – Province of British Columbia. (2009, March). *B.C. Interior Log Market (Report for the 3 month period December 1, 2008 to February 28, 2009).* Retrieved on March 28, 2009, from http://www.for.gov.bc.ca/hva/timberp/llsp/interior/2009/3m_Feb09.pdf