Return To Log Values for California's North Coast Region

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CHAPTER 1 – EXECUTIVE SUMMARY

This chapter briefly summarizes the key findings of this study. More detail is available in each chapter.

1.1 INTRODUCTION

Return To Log (RTL) is a methodology for estimating the economic value a manufacturing technology[1] confers to the wood fiber used as the raw material. In the simplest terms, RTL analysis involves subtracting the cost of manufacturing from the value of the products produced. The remaining amount, if greater than zero, is the price the manufacturing process can afford to pay for raw material (delivered to the plant site) and break even.

1.2 PURPOSE OF THE STUDY

This report investigates various wood-based manufacturing technology scenarios selected by the North Coast Resource Partnership team and The Beck Group as appropriate for development in Northern California. For each selected technology an RTL analysis was completed to evaluate the economic return on raw materials. Unique to this study is that all units of measurement for raw materials and finished products (e.g., board feet, green tons, cords, cubic feet, square feet, etc.) were converted to a common basis – bone dry tons. Converting to a common unit of measurement allows for direct comparisons of each technology's ability to generate economic value. This in turn can help policymakers and entrepreneurs focus efforts on businesses and technologies that have the strongest economic performance. BECK has provided North Coast Resource Partnership an Excel spreadsheet to accompany this report. It contains more detail about the RTL analysis.

1.3 KEY FINDINGS

Delivered RTL Values: The following are the top-performing manufacturing technologies. Please note that the RTL values reported for each business are what that particular business could afford to pay for raw material, on a dollars per bone dry ton basis, delivered to their operation and break even financially. This means that higher RTL values indicate stronger economic performance. Also, to the extent that a business can procure raw material at delivered costs lower than the break-even RTL values, the more profitable the business will be.

- Wood Wool Cement Large Wall Elements had the highest EBITDA[2] RTL at $416/BDT. This business is promising due to lightweight, fire-resistant, durable construction panels which are well accepted overseas. However, U.S. building codes pose a challenge for market acceptance.
- Post & Pole Manufacturing had an EBITDA RTL of $226/BDT. It's strong performance is due to durable and versatile markets like fencing and small utility poles and relatively low costs of production. Also, the market and technology are well-established.
- Sawmilling (Base Case) yielded an EBITDA RTL of $119/BDT. The mill modeled in this scenario used relatively small diameter logs to produce lumber, but faces challenges from higher labor costs and lower economies of scale compared to larger mills.

The following businesses are potential add-ons to the Base Case Sawmill operations:

- Sawmill Base Case plus Thermally Modified Decking (TMT): Enhanced lumber durability and aesthetics provide potential higher-value products. It's EBITDA RTL was $138/BDT.

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[1] Throughout this report the words *technology* and *business* are used interchangeably

[2] EBITDA refers to Earnings Before Interest, Taxes, Depreciation, and Amortization. It is a financial metric used to measure a company's profitability and operational performance by focusing on core business operations, excluding the effects of financial and accounting decisions. A related term that appears in this report and the accompanying spreadsheet is EBIT, which refers to Earnings Before Interest and Taxes. This is a financial metric that measures a company's profitability from its core operations, excluding the effects of financing (interest) and tax expenses. EBIT is also known as Operating Income or Operating Profit, although minor differences may exist depending on accounting practices.

- Sawmill Base Case plus Lumber Treating: Increased value through chemical treatments for outdoor applications. It's EBITDA RTL was $132/BDT.
- Sawmill Base Case plus Pallet Manufacturing: Viable due to demand for low-grade lumber utilization. It's EBITDA RTL was $129/BDT.

Several renewable energy businesses were also evaluated:

- BioMAT Cogeneration yielded an EBITDA RTL of $117/BDT. This business generates electricity and heat from wood biomass, benefiting from California's incentives for renewable energy projects. The economics of this business were modeled as a standalone operation, but siting at a sawmill has many benefits to both the sawmill and the cogeneration operation.
- Fuel Briquettes had an EBITDA RTL of $76/BDT. This business converts wood waste into compressed, eco-friendly energy alternatives. Briquettes may have wider market acceptance since they can be burned in existing fireplaces and wood stoves. In contrast, wood pellets require a homeowner to purchase a special pellet burning appliance.

Several niche and emerging technologies were included in the analysis:

- Wood Wool for Packaging had an EBITDA RTL of $107/BDT. Wood wool, also known as excelsior, is an alternative to synthetic packaging materials.
- Wood Fiber Growing Media had an EBITDA RTL of $61/BDT. Wood Fiber Growing Media provides sustainable horticultural substrates as a peat alternative. Keys to success in this business are low power cost, and proximity to market since the material is bulky per unit of volume and therefore costly to ship long distances.

Stumpage RTL Values: The RTL values can also be expressed on a stumpage basis; in other words, the value a technology returns to the raw material after accounting for the costs of logging and hauling, or the value "at the stump." In Northern California, it is estimated that logging and hauling costs combined average about $98 per bone dry ton. This means that the RTLs listed above must be reduced by that amount in order to determine stumpage values. On an EBITDA basis all of the technologies yield a positive value. In other words, the landowner can receive some value for selling their standing timber. However, when expressed on an EBIT basis (i.e., when the cost of capital is included), most of the RTL values become negative. This means that businesses cannot afford to pay the landowners any value for their standing trees. See additional details in Chapter 4.

1.4 CONCLUSIONS

Economic Viability: Wood Wool Cement Large Wall Elements show the highest return potential, but there are uncertainties about the value of the material in the marketplace and acceptance into US building codes presents an obstacle. For all technologies, co-locating several businesses on one site can significantly increase viability because it can reduce costs while allowing sales values to be enhanced by selling products to co-located businesses. Additionally, add-ons like TMT decking, lumber treating, pallet manufacturing, and cogeneration provide strong diversification opportunities for sawmills. In all cases, it is critical to reduce the capital cost for establishing the business to the greatest extent possible. Strategies for reducing capital cost include: using existing mill sites and buildings, opting for used equipment over new, and co-locating with existing business, or other newly developed businesses. Also, several of the technologies evaluated do not create products with high value on a dollar per bone dry ton basis. Examples included fuel briquettes, cogeneration, and sawmilling. For these types of businesses , strict management focus on controlling operating costs is critical to financial viability.

Market Challenges: Regulatory hurdles, lack of established markets for newer products, and high power costs limit some opportunities. These issues can potentially be overcome by starting with small, pilot-scale operations that allow for proving the technology, refining operational processes, and proving and developing market acceptance.

Raw Material Sources: All of the technologies considered here can utilize roundwood sourced directly from the forest. However, for technologies such as cogeneration and wood briquettes other raw materials such as mill by-products are available at a lower cost and in a form that is more readily useable. In those cases, the business will almost certainly need to buy raw materials from the lowest cost source in order to compete in the marketplace. See Chapter 3 for additional information and discussion on this topic.

Strategic Recommendations: Investments in technologies with proven demand, such as post and pole manufacturing or cogeneration, combined with diversification into emerging markets like TMT decking or packaging, can maximize resource use and profitability. There may be opportunities for existing forest product manufacturing operations to diversify their operations into one or more of these businesses. This strategy would fit well with keys to success such as reducing capital and operating costs.

CHAPTER 2 – RETURN TO LOG ANALYSIS OVERVIEW & METHODOLOGY

This chapter provides an explanation of RTL analysis and the key assumptions to apply it in this study.

2.1 AN INTRODUCTION TO RTL ANALYSIS

Return To Log (RTL) is a methodology for estimating the economic value a given manufacturing technology returns to the wood fiber used as the raw material. In the simplest terms, the process involves subtracting the cost of manufacturing from the value of the products produced. If greater than zero, the returned amount is the price the manufacturing process can afford to pay for raw material (on a delivered basis) and break-even.

RTL values are determined at sawmills and veneer/plywood plants to help managers understand which log types are most valuable for their operations. Mills sort logs by length, diameter, species, and grade, then process them to track the value and volume of products produced.

It is just as important for mills to monitor costs. These include the time to process a batch of logs, in particular:

- Labor cost and fixed costs incurred during that time
- Power and other utilities consumed
- The cost of supplies consumed

Sophisticated RTL tests will also include tallies of the number of pieces passing through each machine center to better understand how machine center loadings ebb and flow as factors such as log size, species, and product mix vary. For example, log of certain sizes might cause a sawmill's edger to become the mill's bottleneck, while the trimmer/sorter line or primary breakdown could be the bottleneck when cutting logs of other sizes.

2.2 UNITS OF MEASUREMENT

All of the preceding is fairly common practice. However, in this report the RTL tool has been used in a different way. Rather than calculating RTL values across different types and sizes of logs, the analysis compares the RTL values across different manufacturing processes. BECK is not aware of any other similar analysis.

Perhaps the reason for this is that in order to compare RTL values across different manufacturing processes, the units of measurement for each must be the same. This is rarely the case. For example, suppose one wanted to know whether a sawmill or a post-and-pole manufacturing operation returns a higher value to its raw material. Sawmills commonly buy logs using a board foot log rule as the basis of measurement. Thus, RTL tests at a sawmill result in a calculation of the dollars per board foot (log scale basis) that the mill returns to the log raw material. A post-and-pole plant typically buys logs by the ton, which means that their RTL values will be expressed on a dollars-per-ton basis. This means that the RTL value of the sawmill cannot be easily compared to that of the post-and-pole operation.

Table 2.1 illustrates this issue by showing how the units of measurement for both finished products and raw materials vary across different manufacturing technologies.

Table 2.1—Units of Measurement Comparison Across Selected Forest Products Manufacturing Technologies

RTL Process	Lumber	Plywood	Post & Pole	Firewood
start with Sales Realization	$/MBM	$/MSF	$/ton	$/Bundle
less Manufacturing Cost	$/MBM	$/MSF	$/ton	$/Bundle
times Yield factor	2.2	3.2	0.5	285
equals RTL on roundwood basis	$/MBF	$/MBF	$/ton	$/ton

2.3 HOW RTL METHODOLOGY IS APPLIED IN THIS STUDY

In addition to converting the units of measurement for all finished products and raw materials to bone dry tons, a number of other conventions were adopted as part of this process to assure that the results would result in "apples to apples" comparisons to the fullest extent possible across the various technologies. These include:

Hourly Labor Costs: For all businesses it was assumed that there are three basic levels of skill with each having the hourly wage rates shown in **Table 2.2**. Also, for all businesses and wage rate levels it was assumed that the fringe benefits loading factor was 35%. In other words, fringe benefit costs (medical insurance, pensions, vacation and holiday pay, etc.) equal 35% of the hourly wage rate. Finally, the number of hourly employees at each skill level for each technology was estimated based on the specific circumstances and needs for each business.

Table 2.2—Assumed Skill Level Categories and the Associated Hourly Wage Rates

Skill Level	Basic Hourly Wage Rate ($/Hour)	Loaded Hourly Wage Rate ($/Hour Including Fringe)
Low	25.00	33.75
Medium	30.00	40.50
High	40.00	54.00

Salaries: For all businesses it was assumed that the general manager's annual salary was $125,000 per year with 35% fringe loading added to that cost for a total salaried cost of $168,750. Some of the businesses also included salespeople, with a salary of $115,000/salesperson/year plus fringe loading at 35%.

Power: In all cases it was assumed that power cost was $0.25 per kilowatt hour. This is likely a conservative assumption. In other words, for most industrial operations, power costs are typically considerably lower. However, in this case, given the relatively small scale of each operation, it was assumed that the facilities might not readily qualify for lower rates. Changes to the power cost assumptions are site- and situation-specific, but would likely have the effect of lowering costs and giving a relatively minor boost to the RTL values.

Depreciation: In all cases it was assumed that the annual depreciation cost is equal to the all-in capital cost divided by 15 years.

Moisture Content: When converting wood volumes to bone dry tons, it was assumed that all wood fiber starts as a live, green tree with 62% moisture content. In other words, of the total weight of a given cubic volume of wood, when first harvested, 62% is water. This value is slightly higher than normal, but was considered reasonable for the species mix in California's North Coast region.

Scale: The smallest of the businesses consumed just over 1,000 bone dry tons of raw material per year. The large consumed about 45,000 bone dry tons per year. These are all modestly sized in comparison to a sawmill, veneer/plywood mill, OSB plant, or pulp/paper mill—all of which typically have annual consumption volumes well into the hundreds of thousands of bone dry tons per year, and even in excess of a million bone dry tons per year at some of the largest pulp/paper mills.

Interpreting the RTL Values: For all the businesses, the RTL values calculated represent the break-even dollar cost per bone dry ton of raw material delivered to the manufacturing site, or the estimated stumpage value for standing timber as calculated from the break-even delivered to the manufacturing site value. These values are reported in Chapter 3. The term break-even is used here since in a more typical RTL analysis, a mill would commonly apply a profit and risk allowance factor. This has the effect of lowering the RTL values by a certain amount depending on each mill's view on the profit and risk associated with business operations.

CHAPTER 3 – PROFILE OF EACH TECHNOLOGY

This chapter provides a brief profile about each business considered and the key underlying assumptions.

3.1 INTRODUCTION

Note that the businesses appear in ranked order by RTL value from highest to lowest on an EBITDA basis. Importantly, the RTL values shown represent the break-even value of the raw material delivered to the manufacturing site. Chapter 4 provides detail about the estimated RTL stumpage values as calculated from the break-even RTL prices presented here.

3.1.1 Wood Wool Cement Large Wall Elements

Overview: This technology involves converting small diameter roundwood into wood wool strands, mixing those strands with Portland cement, and then placing the mix into a mold. While most manufacturers of this material use thin molds that result in panels 1” or less in thickness, a new (to North America) version of this technology is to place the mixture into molds that are more than 1’ thick by up to 10’ feet wide and 20’ long. After curing, the resulting panel is essentially a wall that can be used in residential and commercial construction.

The advantages of these panels are that the material is relatively lightweight, but also very strong—and much more resistant to fire than traditionally built wooden homes, since the wood fibers are encased in cement. The panels are also very durable with good resistance to decay, insects, pests, and moisture. They also absorb sound very well and have good thermal insulation properties.

A major obstacle for this technology is that it is not currently accepted for use in the construction of buildings in the US. However, it has been in use in structural building applications for well over 50 years in Europe and South America. There are several firms currently working on developing this type of business in the Western US and part of their efforts include removing the code-related obstacles.

Modeling Specifics: This business was modeled as a stand-alone facility operating three shifts per day, five days per week, 50 weeks per year. The assumed feedstock is small diameter roundwood. A turnkey manufacturing facility is available from a European vendor (Eltomation) at an estimated cost of $45 million. It was also assumed that 25% of the input fiber is lost in the form of bark (which cannot be used as wood wool) and the inability of the stranding machines to fully utilize each piece of feedstock.

A critical factor for modeling the financial performance of this technology is the sales value of the finished panels. Since the material is not currently accepted for use in buildings in the US, there are no price comparisons, much less an industry-wide price reporting service. Therefore, the project team estimated the cost of erecting fully constructed walls using stick-built home construction (i.e., the cost of framing, sheathing, vapor barrier, insulation, siding, etc.). The cost of those walls on a dollars per cubic foot basis was used to derive the sales price for walls made from Wood Wool Cement Large Wall Elements.

The preceding modeling assumptions and others are summarized in **Table 3.1**, which shows an EBITDA RTL value of $415/BDT.

Table 3.1—Wood Wool Cement Large Wall Element Manufacturing Modeling Assumption Summary

Metric	Units of Measurement	Wood Wool Cement
Raw Material In	Bone dry tons/year	26,009
Finished Product Out	Cubic Feet/year	4,414,000
Yield	% in vs % out as main finished product	75%
Capital Cost	Dollars	45,000,000
Depreciation Cost	Dollars/Year (15-year straight line)	3,000,000
Revenue	Dollars/Year	25,000,000
less Manufacturing Cost	Dollars/Year	14,212,755
= EBITDA	Dollars/Year	7,787,245
less Depreciation	Dollars/Year	3,000,000
= EBIT	Dollars/Year	10,787,245
Revenue	Dollars/BDT	961
less Manufacturing Cost	Dollars/BDT	546
= EBITDA RTL	**Dollars/BDT**	**415**
less Depreciation	Dollars/BDT	115
= EBIT RTL	**Dollars/BDT**	**299**

Similarly, **Table 3.2** summarizes the key assumptions associated with the wood wool cement large wall element RTL modeling.

Table 3.2—Summary of Wood Wool Cement Large Wall Element (WWC-LWE) Modeling Characteristics

Key Assumptions	Wood Wool Cement Large Wall Elements
Siting	Stand-alone
Raw Material Type	Small diameter roundwood
Approximate Truckloads/Year of Raw Material	2,100
Concept/Scale	Sales of WWC - LWE only, no acoustic panels. Sized to match Eltomation standard plant.
Product Mix/Sales Value	No published sales prices. Sales realization of $5.66/FT3 FOB plant is likely conservative as it is very low on a $/FT3 basis compared to other structural supports for vertical and horizontal loads. Market will take time to develop.
Proven Technology/Market	Technology yes; market no

3.1.3 Post & Pole Manufacturing

Overview: Wood post and pole manufacturing involves a series of processes that transform small diameter logs into durable and functional products such as fence posts and rails, hop poles, small utility poles, furniture, and balusters. Small diameter logs are typically delivered to a mill in tree length form. In other words, an entire small diameter tree is delivered to the manufacturing facility regardless of its length. The stems are then bucked (cut to length) for the desired post, pole, and rail products. Next, specialized equipment is used to peel the logs, which means removing the bark but leaving the stem's natural taper intact. Alternatively, they are doweled; this also means removing the bark, but with equipment that results in a post, pole, or rail with a consistent diameter along its entire length. Both peeled or doweled posts, poles, and rails are then sorted into groups of like diameter, length, and quality. Once enough of each sort is accumulated, they are bundled and packaged for sale.

Posts, poles, and rails often expose wood to weather and soil. Therefore, most posts/poles/rails are treated with preservative chemicals to enhance their resistance to weathering, decay, and insect damage. Species is an important consideration in post and pole manufacturing because it affects taper rate, with less taper more desirable because it improves yield. Species also affects bark thickness, with thinner-barked species also having a better yield. Finally, species affects the ease with which preservative chemicals are absorbed. Lodgepole pine is the clear favorite in the Western US because it has thin bark, little taper, grows with a straight bole, and easily absorbs preservative chemicals. Still, a variety of species are used to produce posts and poles.

Modeling Specifics: The operation was assumed to operate 8 hours/day and 5 days/week with a staff of four hourly operators and one general manager. The hourly laborers were assumed to have general maintenance skills, but the facility would also utilize an outside contractor to perform regular maintenance. The general manager was also assumed to handle purchasing raw material and supplies and selling the products. The operation was assumed to use doweling technology.

It was also assumed that a processor would be located in the log yard to process the tree length stems into shorter lengths and sort the resulting stems into groups of like length and diameter. This system is an alternative to a bucking merchandising line. The average value of finished products was assumed to be $225 per green ton and $5 per green ton for by-products. The preceding modeling assumptions and others are summarized in **Table 3.3**, which shows an EBITDA RTL of $226/BDT**.**

Table 3.3—Post & Pole Manufacturing Modeling Assumption Summary

Metric	Units of Measurement	Post & Pole
Raw Material In	Bone dry tons/year	9,500
Finished Product Out	Bone dry tons/year	4,940
Yield	% in vs % out as main finished product	52%
Capital Cost	Dollars	2,000,000
Depreciation Cost	Dollars/Year (15-year straight line)	133,333
Revenue	Dollars/Year	2,955,000
less Manufacturing Cost	Dollars/Year	804,940
= EBITDA	Dollars/Year	2,016,727
less Depreciation	Dollars/Year	133,333
= EBIT	Dollars/Year	2,150,060
Revenue	Dollars/BDT	311
less Manufacturing Cost	Dollars/BDT	85
= EBITDA RTL	**Dollars/BDT**	**226**
less Depreciation	Dollars/BDT	14
= EBIT RTL	**Dollars/BDT**	**212**

Similarly, **Table 3.4** summarizes the key assumptions associated with the Post & Pole RTL modeling.

Table 3.4—Summary of Post & Pole Modeling Characteristics

Key Assumptions	Post & Pole
Siting	Stand-alone
Raw Material Type	Small diameter roundwood
Approximate Truckloads/Year of raw material	800
Concept/Scale	This business is listed as stand-alone, but could also be an adder to the sawmill. Merchandising line could buck sawlogs out of P&P logs.
Product Mix/Sales Value	Produces mix of posts and poles for ag and ranch/fencing applications. Sales average is comparable to that of other P&P operations around the West. May be opportunity for upside in California given proximity to treaters and large ag market.
Proven Technology/Market	Yes to both

3.1.4 Sawmill – Base Case[3]

Overview: Sawmilling is the process of converting logs into lumber, which is a fundamental step in the timber industry. This operation typically begins with harvesting logs and selecting those best suited to a given sawmill. The selected logs are then transported to a sawmill where they undergo various cutting techniques. Most softwood logs are delivered to the mill in "long log" form (i.e., typically 30' to 40' long). The logs are then debarked and cut into the desired shorter lengths, typically between 8' and 16', but some mills specialize in producing longer lengths of lumber. The cut-to-length logs, often called mill length blocks, are then processed into lumber.

A variety of processes are used, but a common setup for larger logs involves a primary breakdown saw, which makes the first cuts on the log. The resulting pieces are then sent to downstream machines such as edgers, resaws, and gang saws. Some of the lumber is also trimmed to length to remove defects and wane. After all of these processes the lumber is sorted to similar widths and lengths and stacked into units for kiln drying. Drying reduces moisture to minimize warping after the lumber is placed into use. After drying, the lumber is planed and graded. Some pieces are further trimmed in length to improve grade/value. After planing, the pieces are sorted into like grade/length groups and packaged for shipment.

Modeling Specifics: Modern industrial sawmills employ high levels of technology to automate processes and optimize yield and value. The cost of those technologies necessitates processing large volumes of material. In the sawmill scenarios modeled in this study, the scale is roughly an order of magnitude smaller than a typical softwood sawmill producing stud and dimension lumber in the Western US. This necessitates taking a lower-tech and more labor-intensive approach. This results in higher per-unit manufacturing costs for the mill modeled here than seen at large-scale mills.

To offset the higher cost, the mill modeled here was assumed to produce a mix of higher-value specialty lumber products (to the greatest extent possible given the size and species of logs assumed to be available). Additionally, it was assumed that several of the major equipment items in the sawmill would comprise used equipment purchased from recently closed mills. The assumed product mix at the mill is 4x4 and 4x6 small timbers as well

[3] This scenario is out of order in the ranking by EBITDA RTL. This is because the Base Case forms the platform that the other sawmill scenarios build on.

as 2x4, 2x6, and 2x8 dimension lumber from a species mix that was assumed to be 45% ponderosa pine, 35% white fir, and 20% Douglas-fir. The assumed sales price was based on Forest Economic Advisors' average forecasted price for the period 2025 to 2026. The mill's production was assumed at 8,000 board feet per hour and operating 120 hours per month. It was also assumed that log-to-lumber yield is 4.5 green tons of logs input per thousand board feet of lumber produced, with an average small-end mill block diameter of 8.5". Staffing at the mill totaled 27 hourly laborers of which 9 were low skill level, 12 were medium, and 6 were high.

It was further assumed that the crew would shift back and forth between the sawmill and planer mill to adjust staffing to the assumed mill output, with a general manager to supervise the operation. The annual lumber output is estimated at about 11.5 million board feet. The preceding modeling assumptions and others are summarized in **Table 3.5.** As the results indicate, the EBITDA RTL value is estimated at $128/BDT. Each of the subsequent sawmill scenarios illustrate ways in which the sawmill can add value to the lumber produced, and thereby raise the RTL values.

Table 3.5—Sawmill - Base Case Manufacturing Modeling Assumption Summary

Metric	Units of Measurement	Sawmill -Base Case
Raw Material In	Bone dry tons/year	20,044
Finished Product Out	Board feet/year	11,520,000
Yield	% in vs % out as main finished product	50%
Capital Cost	Dollars	25,554,750
Depreciation Cost	Dollars/Year (15-year straight line)	1,703,650
Revenue	Dollars/Year	8,431,942
less Manufacturing Cost	Dollars/Year	5,861,328
= EBITDA	Dollars/Year	866,964
less Depreciation	Dollars/Year	1,703,650
= EBIT	Dollars/Year	2,570,614
Revenue	Dollars/BDT	421
less Manufacturing Cost	Dollars/BDT	292
= EBITDA RTL	**Dollars/BDT**	**128**
less Depreciation	Dollars/BDT	85
= EBIT RTL	**Dollars/BDT**	**43**

Similarly, **Table 3.6** summarizes the key assumptions associated with the Sawmill – Base Case RTL modeling.

Table 3.6—Summary of Sawmill - Base Case Modeling Characteristics

Key Assumptions	Sawmill + Pallets
Siting	Stand-alone
Raw Material Type	Small Sawlogs (6”-12” small end diameter)
Approximate Truckloads/Year of raw material	1,600
Concept/Scale	Small sawmill. One-shift operation is about 20,000 BDT/year log consumption, which means this size should be relatively easy to supply if carefully sited.
Product Mix/Sales Value	Mix of timbers, dimension and small timbers. Sales realizations based on November 2024 Random Lengths.
Proven Technology/Market	Yes to both

3.1.5 Sawmill + TMT Decking

Overview: Thermal Modification Treatment (TMT) of lumber is a process that involves heating wood to high temperatures, typically above 320°F, in specially designed kilns where there is little oxygen. This treatment permanently alters the wood's chemical and physical properties, enhancing its durability, stability, and resistance to decay and insects. The process reduces the wood's moisture content, which minimizes the risk of warping and cracking. Additionally, thermal modification can improve the wood's color, giving it a richer, darker appearance. This process is a small but growing market because it offers an environmentally friendly (non-chemical) method of increasing wood’s decay resistance and dimensional stability properties. The most common applications are lumber used in outdoor decks and siding.

Modeling Specifics: The TMT Decking operation modeled here is assumed to be an add-on to the Base Case sawmill. This means no separate administrative offices, crew, etc. Also assumed is that the operation is housed inside an existing 10,000 square foot building that is leased (i.e., no capital cost for constructing a building). It is also assumed that all 2x6 premium grade lumber produced at the mill would go through the TMT process since 6” wide lumber is the most common width for deck boards. The kiln assumed for the operation is a smaller-scale kiln manufactured by Mespell in Italy.

These assumptions are based on a similar, existing operation called Composite Recycling Technology Center in Port Angeles, Washington. The kiln’s capacity is 3,500 board feet per charge and three days of treatment per charge, which translates into 408,000 board feet of lumber treated annually. The installed capital cost for the kiln system was assumed to be $1,000,000. Like the Sawmill + Treating scenario, this scenario assumes a sales manager (but no logistics assistant) with a $30,000 travel/marketing budget. The treatment cost is assumed to total $209 per thousand board feet.

There are no published prices available for TMT lumber products. Therefore, it was assumed that the TMT material sold by the mill would be priced equal to a premium product it would replace, namely 2x6 Western red cedar architectural decking. The preceding modeling assumptions and others are summarized in **Table 3.7.** As the results indicate, the RTL value on an EBITDA basis is about $138/BDT.

Table 3.7—Sawmill + TMT Decking Manufacturing Modeling Assumption Summary

Metric	Units of Measurement	Sawmill + TMT Decking
Raw Material In	Bone dry tons/year	20,044
Finished Product Out	Board feet/year	11,520,000
Yield	% in vs % out as main finished product	50%
Capital Cost	Dollars	25,454,750
Depreciation Cost	Dollars/Year (15-year straight line)	1,696,600
Revenue	Dollars/Year	6,399,182
less Manufacturing Cost	Dollars/Year	3,623,605
= EBITDA	Dollars/Year	1,078,977
less Depreciation	Dollars/Year	1,696,600
= EBIT	Dollars/Year	2,775,577
Revenue	Dollars/BDT	319
less Manufacturing Cost	Dollars/BDT	181
= EBITDA RTL	**Dollars/BDT**	**138**
less Depreciation	Dollars/BDT	85
= EBIT RTL	**Dollars/BDT**	**54**

Similarly, **Table 3.8** summarizes the key assumptions associated with the Sawmill + TMT Decking RTL modeling.

Table 3.8—Summary of Sawmill + TMT Decking Modeling Characteristics

Key Assumptions	Sawmill + TMT Decking
Siting	Assumes this is built as an add-on at the base case sawmill
Raw Material Type	Small Sawlogs (6”-12” small end diameter)
Approximate Truckloads/Year of raw material	1,600
Concept/Scale	This business is an add-on to the sawmill. Assumes premium quality 6" width material produced at sawmill becomes decking via thermal modification.
Product Mix/Sales Value	No published sales values exist for thermally modified wood, so the price of the product it would substitute for (cedar decking) was used.
Proven Technology/Market	Technology yes; market no

3.1.6 Sawmill + Treating

Overview: The sawmill modeled in this scenario would operate no differently than the Base Case sawmill. However, in this scenario it is assumed that all upper-grade ponderosa pine and hem-fir 2” thick and 4” thick products are treated with preservative chemicals so that the lumber is suited for use in applications exposed to the elements and/or soil. Note that hem-fir refers to a common practice in the lumber industry of grouping certain species into a larger, mixed species category. Thus, the hem-fir lumber category can contain a mix of various hemlock and true fir species common to the Western US. For example, it may contain a mix of grand fir, white fir, and hemlock. This scenario models an opportunity to add value to its lumber products.

Modeling Specifics: Importantly, the modeling assumes no additional capital cost for treating equipment. Rather it is assumed that an existing treater (for example, All Weather Wood in Ukiah) would be contracted to treat the lumber produced at the mill. It is further assumed that the treated lumber would be marketed locally and regionally through smaller lumber yards, building supply stores, and large building contractors. Since this would require additional marketing and sales effort, this scenario assumes an additional sales manager with a base salary of $115,000 per year plus 35% fringe loading, plus a logistics assistant with a base salary of $62,400 per year and 35% fringe loading. Finally, it is assumed that the sales/logistics team would have a $30,000 per year budget for travel and marketing.

The preceding modeling assumptions and others are summarized in **Table 3.9.** As the results indicate, this scenario increases total revenue by about $534,000 (net of treating costs) and increases cost by about $270,000 for increased sales and marketing efforts.

Table 3.9—Sawmill + Treating Manufacturing Modeling Assumption Summary

Metric	Units of Measurement	Sawmill + Treating
Raw Material In	Bone dry tons/year	20,044
Finished Product Out	Board feet/year	11,520,000
Yield	% in vs % out as main finished product	50%
Capital Cost	Dollars	24,454,750
Depreciation Cost	Dollars/Year (15-year straight line)	1,630,317
Revenue	Dollars/Year	6,434,922
less Manufacturing Cost	Dollars/Year	3,777,848
= EBITDA	Dollars/Year	1,026,757
less Depreciation	Dollars/Year	1,630,317
= EBIT	Dollars/Year	2,657,074
Revenue	Dollars/BDT	321
less Manufacturing Cost	Dollars/BDT	188
= EBITDA RTL	**Dollars/BDT**	**133**
less Depreciation	Dollars/BDT	81
= EBIT RTL	**Dollars/BDT**	**51**

Similarly, **Table 3.10** summarizes the key assumptions associated with the Sawmill + Treating RTL modeling.

Table 3.10—Summary of Sawmill + Treating Modeling Characteristics

Key Assumptions	Sawmill + Treating
Siting	Assumes this is built as an add-on at the base case sawmill
Raw Material Type	Small Sawlogs (6"-12" small end diameter)
Approximate Truckloads/Year of raw material	1,600
Concept/Scale	This business is an add-on to the sawmill. Treating added as a way to increase sales revenue. No capital expense included because treating provided by others.
Product Mix/Sales Value	Mix of timbers, dimension and small timbers. Sales realizations based on November 2024 Random Lengths plus $75 adder for treated material (net of trucking cost).
Proven Technology/Market	Yes to both.

3.1.7 Sawmill + Pallets

Overview: This scenario is based on a small pallet manufacturing facility co-locating at the sawmill. The pallet plant would operate one shift per day and produce an average of 1,000 pallets per shift. Like the other Sawmill + Scenarios, this would be an add-on to the Base Case sawmill; thus no additional administrative offices, crew facilities, etc. An extensive review of the pallet market was beyond the scope of the study, but a preliminary analysis indicated that there are not many existing pallet manufacturers in Northern California.

Modeling Specifics: The estimated capital cost for the pallet manufacturing operation is $1.1 million. This assumes that there is an existing 10,000 square foot building that can be leased to house the operation. It also assumes that there is adequate space for outdoor storage of lumber used to make the pallets. The analysis also assumes that all trim ends and other downfall material from the pallet manufacturing operation are collected and sent to the sawmill for chipping/hogging. The pallet operation will consume about 7 million board feet of lumber per year. It is also assumed that all the low-grade (#3 and Economy) lumber from the sawmill will be sold to the pallet operation.

Importantly, the volume of low-grade lumber produced at the sawmill is only enough for about 35% of the pallet operation's needs. Therefore, the balance of the lumber supply would have to be purchased from other regional sawmills. Using higher lumber grades is not cost-effective for pallet manufacturers because the increased yield from higher grades does not offset the significantly higher cost of purchasing the lumber. This scenario would require eight hourly laborers in addition to the sawmill staff. Of those, two are at the low skill level, five at the medium level, and one at the high level. Finished pallets were valued at $14.25 per pallet FOB the mill.

The preceding modeling assumptions and others are summarized in **Table 3.11.** As the results indicate, this scenario provides an RTL value of $128/BDT.

Table 3.11—Sawmill + Pallets Manufacturing Modeling Assumption Summary

Metric	Units of Measurement	Sawmill + Pallets
Raw Material In	Bone dry tons/year	20,044
Finished Product Out	Board feet/year	11,520,000
Yield	% in vs % out as main finished product	50%
Capital Cost	Dollars	25,554,750
Depreciation Cost	Dollars/Year (15-year straight line)	1,703,650
Revenue	Dollars/Year	8,431,942
less Manufacturing Cost	Dollars/Year	5,861,328
= EBITDA	Dollars/Year	866,964
less Depreciation	Dollars/Year	1,703,650
= EBIT	Dollars/Year	2,570,614
Revenue	Dollars/BDT	421
less Manufacturing Cost	Dollars/BDT	292
= EBITDA RTL	**Dollars/BDT**	**128**
less Depreciation	Dollars/BDT	85
= EBIT RTL	**Dollars/BDT**	**43**

Similarly, **Table 3.12** summarizes the key assumptions associated with the Sawmill + Pallets RTL modeling.

Table 3.12—Summary of Sawmill + Pallets Modeling Characteristics

Key Assumptions	Sawmill + Pallets
Siting	Assumes this is built as an add-on at the base case sawmill.
Raw Material Type	Small Sawlogs (6”-12” small end diameter)
Approximate Truckloads/Year of raw material	1,600
Concept/Scale	This business is an add-on to the sawmill. Assumes all low-grade lumber from the mill is used to make pallets. That only makes up about 35% of supply for pallet making if mill runs one shift. Thus, additional lumber is needed from other sources.
Product Mix/Sales Value	This business is an add-on to the sawmill. Preliminary indication is that there are few pallet manufacturers in Nor Cal.
Proven Technology/Market	Yes to both

3.1.8 BioMAT Cogeneration

Overview: Biomass cogeneration, also known as combined heat and power (CHP) from biomass, is a renewable energy source that simultaneously produces electricity and useful thermal energy from woody biomass, or in some cases agricultural by-products (organic materials). This process involves the combustion or gasification of biomass to generate steam or hot gases. The steam drives a turbine to produce electricity, while the excess heat is captured and utilized for heating purposes, such as lumber dry kilns or district heating systems. The dual-use approach enhances the overall energy output, making it more viable and a renewable, firm, and dispatchable power generation source.

Modeling Specifics: The biomass power business modeled here is based on California's Bioenergy Market Adjusting Tariff (BioMAT) program. It is a California Public Utilities Commission (CPUC) program that encourages the development of small bioenergy projects. The program offers long-term contracts to eligible projects to export electricity to California's investor-owned utilities. Key aspects of the program are that eligible projects must have 5 MW or less in generating capacity. However, only 3 MW of power can be sold to the grid at the above-market rate, which is nearly $200 per megawatt hour. The balance must be consumed internally. Biogas, dairy and agricultural waste, or forest waste are all eligible fuel sources. For forest waste, the material must be sourced from sustainably managed sources, or from areas designated as high hazard zones. Power purchase agreements through this program for projects using forest-derived biomass are typically 20-year agreements.

For this analysis it was assumed the facility would be co-located at the Base Case sawmill. Such an arrangement has multiple benefits including options for utilizing mill residues such as bark, sawdust, chips, and shavings during periods when other markets for those materials are weak or non-existent. Additionally, since most lumber is kiln-dried and since kilns typically operate 24/7/365 there is a steady demand for thermal energy. Finally, sawmills typically use a lot of electrical power. Thus, the sawmill can use some of the power generated by the power plant, if the economics warrant that approach, and there is generally a robust electrical service to the site, which might reduce the cost of interconnecting the project to the power grid.

More specifically it was assumed that, after internal parasitic load, the net generation of the plant is 4.6 MW. Of that 3 MW are sold to the grid at a value of $200/MWH and 1.6 MW are consumed internally at the sawmill with the sawmill paying the same $200/MWH price. Note that to model the sawmill as a stand-alone facility, the power cost in all the sawmill scenarios was $250/MWH. It was also assumed that the plant would sell the sawmill 4,500 pounds of steam per hour at a rate of $8 per thousand pounds. Fuel usage was estimated at 1.15 bone dry tons consumed per megawatt hour of power produced. The plant was assumed to operate 7,812 hours per year. This translates into gross power generation of 39,060 megawatt hours per year and annual fuel consumption of nearly 45,000 bone dry tons. The estimated all-in capital cost is $37.5 million.

The preceding modeling assumptions and others are summarized in **Table 3.13.** As the results indicate, this business generates an EBITDA RTL value of $117/BDT.

Table 3.13—BioMAT Cogeneration Modeling Assumption Summary

Metric	Units of Measurement	BioMAT Cogeneration
Raw Material In	Bone dry tons/year	44,919
Finished Product Out	Megawatt hours/year	39,060
Yield	% in vs % out as main finished product	100%
Capital Cost	Dollars	37,500,000
Depreciation Cost	Dollars/Year (15-year straight line)	2,500,000
Revenue	Dollars/Year	7,429,212
less Manufacturing Cost	Dollars/Year	2,182,000
= EBITDA	Dollars/Year	2,747,212
less Depreciation	Dollars/Year	2,500,000
= EBIT	Dollars/Year	5,247,212
Revenue	Dollars/BDT	165
less Manufacturing Cost	Dollars/BDT	49
= EBITDA RTL	**Dollars/BDT**	**117**
less Depreciation	Dollars/BDT	56
= EBIT RTL	**Dollars/BDT**	**61**

Similarly, **Table 3.14** summarizes the key assumptions associated with the BioMAT Cogeneration RTL modeling.

Table 3.14—Summary of BioMAT Cogeneration Modeling Characteristics

Key Assumptions	BioMAT Cogeneration
Siting	Assumes this is built as an add-on at the base case sawmill, but the economic analysis is only for the cogeneration operation only.
Raw Material Type	Hogged/ground fuel from either mill residues or forest-sourced material such as logging slash and small diameter biomass.
Approximate Truckloads/Year of raw material	3,600
Concept/Scale	Designed for California BioMAT rule. Would need about 75% of its fuel from outside sources if sited at Base Case sawmill.
Product Mix/Sales Value	Assumes approximate BioMAT power sales price of $200/MWH and rules about how much of the power can be sold versus consumed internally.
Proven Technology/Market	Yes to both

3.1.9 Wood Wool for Packaging

Overview: Wood wool, also known as excelsior, is a versatile packaging material derived from wood fibers. The manufacturing process begins with selecting suitable wood species—typically softwoods like pine, fir, or other common Western softwood species. The first step in wood wool production involves debarking the logs, which are then cut into small sections typically 16-20” long and less than 12” in diameter. These sections are then fed into a wood wool machine, which shreds the wood into long, thin strands. Most machines involve passing the wood fiber over a series of knives that yield strands of the desired thickness and width. The result is a lightweight and flexible material.

Once the wood wool is produced, it undergoes a drying process to reduce moisture content, ensuring durability and preventing mold growth. The dried wood wool is then sorted and graded based on fiber length and quality. To enhance its appeal and functionality, wood wool can be treated with non-toxic dyes or coatings, making it suitable for various applications including gift packaging, cushioning for fragile items, and decorative purposes. Many view wood wool as an environmentally friendly alternative to synthetic packaging materials because it is biodegradable and made from renewable resources. Its natural properties provide excellent shock absorption and protection for products during transportation, making it popular among manufacturers and consumers alike.

Modeling Specifics: This business was modeled as a stand-alone operation. However, the wood wool machine is the same as that which is used for manufacturing Wood Wool Cement Large Wall Elements. Thus, it could be a precursor operation to a wood wool cement facility. With wood wool cement manufacturing as the ultimate goal, this arrangement would allow cash generation much earlier in the business development process—and if approval for WWC-LWE takes longer than anticipated or even fails to materialize, will assure that an outlet for that material is not necessarily dependent upon the general adoption of WWC-LWE.

There are no published prices for this material, therefore, the FOB value of the material was back calculated from retail prices. More specifically, it was assumed that the FOB value is 50% of the retail price, which was estimated at $1.35 per pound and for material that contains 5% moisture. The plant was assumed to have five wood wool machines, which operate three shifts per day five days per week at 85% uptime.

Normally such an operation would need debarking equipment. However, this operation was assumed to use veneer log peeler cores and/or lumber trim ends. This approach avoids the capital expense of a debarker and the operational expense of debarking. Importantly, it also allows for procuring a lower cost raw material. This is because the costs of harvesting, processing, and trucking small diameter roundwood are greater than the market value of veneer peeler cores. For example, small diameter stems sourced from the forest may cost well over $100 per bone dry ton to produce and deliver to a site. Veneer peeler cores are a by-product of another operation and typically do not have a cost assigned to them. Therefore, they can be purchased at whatever their market value is plus the cost of transportation. While market prices can vary, generally peeler cores are valued well below $100 per bone dry ton. Thus, the businesses' economics are improved by opting for the lower cost raw material. In such circumstances, the operator must compare the break-even RTL value to different types of raw material available.

Full-time staffing was assumed at 3.33 per shift. In a three-shift configuration this totals 10 hourly employees. Nine of them were assumed to be paid at the middle skill level, with the tenth being a maintenance person who would work the day shift and is assumed to be paid at a high skill level rate. The operation was assumed to have one salaried employee: a general manager who handles purchasing, sales, and other administrative tasks. The all-in capital expense is estimated at $750,000.

The preceding modeling assumptions and others are summarized in **Table 3.15.** As the results indicate, the wood wool for packaging business is estimated to provide an EBITDA RTL of $107/BDT.

Table 3.15—Wood Wool for Packaging Modeling Assumption Summary

Metric	Units of Measurement	Wood Wool for Packaging
Raw Material In	Bone dry tons/year	1,215
Finished Product Out	Bone dry tons/year	1,033
Yield	% in vs % out as main finished product	90%
Capital Cost	Dollars	750,000
Depreciation Cost	Dollars/Year (15-year straight line)	50,000
Revenue	Dollars/Year	1,466,646
less Manufacturing Cost	Dollars/Year	1,336,845
= EBITDA	Dollars/Year	79,801
less Depreciation	Dollars/Year	50,000
= EBIT	Dollars/Year	129,801
Revenue	Dollars/BDT	1,207
less Manufacturing Cost	Dollars/BDT	1,100
= EBITDA RTL	**Dollars/BDT**	**107**
less Depreciation	Dollars/BDT	41
= EBIT RTL	**Dollars/BDT**	**66**

Similarly, **Table 3.16** summarizes the key assumptions associated with the Wood Wool for Packaging RTL modeling.

Table 3.16—Summary of Wood Wool for Packaging Modeling Characteristics

Key Assumptions	Wood Wool for Packaging
Siting	Stand-alone
Raw Material Type	Veneer peeler cores
Approximate Truckloads/Year of raw material	100
Concept/Scale	Small volume that is matched to output of a wood wool machine. This business could be a precursor to the startup of WWC-LWE.
Product Mix/Sales Value	No published sales prices so sales realization is an estimate.
Proven Technology/Market	Technology yes; market no.

3.1.10 Fuel Briquettes

Overview: Wood briquettes are a renewable energy source made from compressed sawdust and wood shavings, offering an alternative to fossil fuel energy sources. The manufacturing process begins with the collection of wood waste, which is then dried to reduce moisture content. Once dried, the wood is ground into fine particles, ensuring uniformity for optimal compression. The next step involves the use of a briquette press, which applies high pressure to the wood particles. The pressure essentially liquefies the wood's lignin component, which is the agent that binds the wood particles together without the need for additional adhesives. This process not only creates a dense and compact product but also enhances the energy density of the briquettes. Note that this is another business where roundwood is a higher cost raw material than other options (mill by-products) available.

The resulting briquettes are then cooled and cut into various sizes, depending on market requirements. Quality control is essential throughout the manufacturing process, with tests conducted to measure moisture content, density, and calorific value. Properly manufactured wood briquettes are characterized by their high energy output, low ash content, and minimal emissions when burned. An advantage of this material over wood pellets is that briquettes can be burned in fireplaces and wood stoves, while wood pellets require the purchase of a specialized wood burning pellet appliance. Thus, it is an energy source offering many homeowners a lower barrier to entry than wood pellets.

Modeling Specifics: Since the most cost-effective raw materials for briquetting are sawdust and planer shavings, it was assumed that this business would be co-located at the Base Case sawmill. The operation was assumed to operate on a one-shift basis. The assumed raw material input is 7,500 bone dry tons per year. Of that amount 98% was assumed to be manufactured into saleable material. The assumed sales value FOB the manufacturer's site was $222 per bone dry ton. It was assumed that one person would operate the equipment at the mid-skill level wage rate. Total capital cost was estimated at $2.5 million for a machine capable of producing more than 3 tons of material per hour.

The preceding modeling assumptions and others are summarized in **Table 3.17.** As the results indicate, the Fuel Briquette business generates an EBITDA RTL of $76 per BDT.

Table 3.17—Fuel Briquettes Modeling Assumption Summary

Metric	Units of Measurement	Fuel Briquettes
Raw Material In	Bone dry tons/year	7,500
Finished Product Out	Green tons/year	7,903
Yield	% in vs % out as main finished product	98%
Capital Cost	Dollars	2,500,000
Depreciation Cost	Dollars/Year (15-year straight line)	166,667
Revenue	Dollars/Year	1,634,594
less Manufacturing Cost	Dollars/Year	1,061,195
= EBITDA	Dollars/Year	406,732
less Depreciation	Dollars/Year	166,667
= EBIT	Dollars/Year	573,399
Revenue	Dollars/BDT	218
less Manufacturing Cost	Dollars/BDT	141
= EBITDA RTL	**Dollars/BDT**	**76**
less Depreciation	Dollars/BDT	22
= EBIT RTL	**Dollars/BDT**	**54**

Similarly, **Table 3.18** summarizes the key assumptions associated with the Fuel Briquettes RTL modeling.

Table 3.18—Summary of Fuel Briquettes Modeling Characteristics

Key Assumptions	Fuel Briquettes
Siting	Assumes this is built as an add-on at the base case sawmill
Raw Material Type	Chips, sawdust, and shavings
Approximate Truckloads/Year of raw material	600
Concept/Scale	Sells fire logs as a replacement for firewood.
Product Mix/Sales Value	No published prices, so the FOB mill price was back calculated from retail values. It would likely take time for market to develop to match full scale of sawmill output.
Proven Technology/Market	Yes to both

3.1.11 Wood Fiber Growing Media

Overview: Wood fiber growing media manufacturing involves the production of wood-based substrate used in horticulture and agriculture. The process begins with sourcing wood raw materials, primarily wood chips, from either mill by-products or chips produced from small diameter whole logs. The wood material provides a suitable growing substrate because wood's fibrous properties contribute to aeration, drainage, and moisture retention in growing media. The key steps in manufacturing include gathering and/or processing material into wood chip form: smaller pieces of wood typically about 1/4" thick, 1" to 1.5" wide, and about 2-3" long. The chips are then fed into either an extrusion machine or a disc refiner, both of which transform the chips into a fluffy fibrous form.

The treated wood fibers are then mixed with other organic materials such as peat, coconut coir, or compost to create a balanced growing medium.

This formulation is tailored to meet specific horticultural needs, ensuring optimal pH, nutrient levels, and moisture retention. To eliminate pathogens and weed seeds, the growing media may undergo sterilization through heat treatment or chemical processes. In some circumstances this step is important for ensuring the health of plants grown in the media. Finally, the wood fiber growing media is packaged into bags or bulk containers for distribution to nurseries, garden centers, and agricultural producers. Wood fiber growing media is gaining popularity due to its renewable nature, lightweight properties, and ability to improve soil structure. It offers an alternative to traditional peat-based substrates, which have fallen out of favor because they release carbon into the atmosphere.

Modeling Specifics: The plant was assumed to operate on a three-shift basis, which translates into consuming just over 8,000 bone dry tons of raw material per year. Generally, wood chips in the form of mill by-products cost less than wood chips sourced from chipping small diameter trees. Therefore, it was assumed that this facility would be co-located at the Base Case sawmill. When the wood fiber growing media plant is operated on a three-shift basis and the sawmill on a one-shift basis, the mill only produces about 80% of the chips that would be needed by the wood fiber growing media operation. Thus, about 20% of the chip supply would need to come from another source.

The financial performance of this business is sensitive to the assumed sales value of finished bundles of the growing media, which are typically compressed into 3 cubic foot bags. There are no published prices for wood fiber growing media. Therefore, the price was estimated by comparing it to competing materials. This resulted in an assumed sales price of $20 per cubic yard FOB the manufacturing site, or $455 per bone dry ton.

Another key factor in this business is the cost of power. The manufacturing process is power-intensive, which translates into high power costs. The business would have much better financial performance and higher RTL values if the actual power costs were much lower than the assumed rate of $0.25 per kilowatt hour. Another factor that was not modeled—but which is important in feasibility—is that the material is bulky (i.e., low weight per unit of volume). This means it is costly to transport because trucks run out of space before they reach their weight limit.

This in turn means that while siting at a sawmill is important from an operating cost standpoint, it is also important for the sawmill to be relatively close to greenhouses, nurseries, and other agricultural operations that would be the markets for the materials. The preceding modeling assumptions and others are summarized in **Table 3.19.** As the results indicate, the wood fiber growing media business is estimated to generate an EBITDA RTL value of $61/BDT.

Table 3.19—Wood Fiber Growing Media Modeling Assumption Summary

Metric	Units of Measurement	Wood Fiber Growing Media
Raw Material In	Bone dry tons/year	8,011
Finished Product Out	Cubic yards/year	182,400
Yield	% in vs % out as main finished product	100%
Capital Cost	Dollars	3,650,000
Depreciation Cost	Dollars/Year (15-year straight line)	243,333
Revenue	Dollars/Year	3,648,000
less Manufacturing Cost	Dollars/Year	3,162,768
= EBITDA	Dollars/Year	241,899
less Depreciation	Dollars/Year	243,333
= EBIT	Dollars/Year	485,232
Revenue	Dollars/BDT	455
less Manufacturing Cost	Dollars/BDT	395
= EBITDA RTL	**Dollars/BDT**	**61**
less Depreciation	Dollars/BDT	30
= EBIT RTL	**Dollars/BDT**	**30**

Similarly, **Table 3.20** summarizes the key assumptions associated with the Wood Fiber Growing Media RTL modeling.

Table 3.20—Summary of Wood Fiber Growing Media Modeling Characteristics

Key Assumptions	Wood Fiber Growing Media
Siting	Assumes this is built as an add-on at the base case sawmill
Raw Material Type	Chips
Approximate Truckloads/Year of raw material	600
Concept/Scale	Convert wood to growing media for nurseries/greenhouses. At the scale modeled for this business and the sawmill, the operation would need about 15 to 20% of its raw material (chips) from outside sources.
Product Mix/Sales Value	100% of growing media sold to nurseries/greenhouses in Central Valley. No published sales value. $20.00 per CY might be optimistic. Also, uncertain if market could absorb full volume produced.
Proven Technology/Market	Technology yes, market no

CHAPTER 4 – STUMPAGE RTL VALUES

This chapter provides an estimate of average logging and trucking costs so that RTL values can be calculated for stumpage[4].

4.1 LOGGING COSTS

The logging costs included in the analysis are the costs of harvesting trees, yarding them to a centralized location (log landing), and processing them into logs (delimbing, cutting to length, defect removal, etc.). In Northern California both ground-based and skyline logging systems are used. As the names imply, ground-based refers to equipment configurations using various wheeled and tracked machines that move all the material on the ground between the harvest site and the landing. In contrast, skyline systems are used when the ground is too steep for wheeled/tracked vehicles; rather, a system of towers and elevated steel cables is used to move harvested trees from the harvest site to the landing. Ground-based systems tend to be less costly than skyline systems. Additionally, factors such as average tree size and trees to be harvested per acre affect productivity, and in turn cost. Given these circumstances, the table below is an estimate of the average logging cost in Northern California given the high and low range for each type of logging system and the estimated proportion of logging that is completed using each type of system. As the data show, the estimated average logging cost is $64 per bone dry ton.

Table 4.1—Estimated Average Logging Cost for Northern California

Method	Low ($/GT)	High ($/GT)	Average ($/GT)	Proportion	Weighting ($/GT)	Weighting ($/BDT)
Ground-Based	28.00	40.00	30.00	90%	27.00	54.00
Skyline	35.00	70.00	50.00	10%	5.00	10.00
Weighted Average					**32.00**	**64.00**

4.2 HAULING COSTS

Hauling cost is a function of the cost per hour for operating a log truck, the round trip time per load, and the payload per truckload. For this analysis it is estimated that current log truck costs in Northern California average $142 per hour. It was also assumed that each truck averages 25 green tons per load, and that on average, each load has a 3-hour round trip time for loading, transport, unloading, and return trip. Given all of the preceding, the estimated average trucking cost is calculated at $17.04 per green ton, or $34 per bone dry ton.

4.3 STUMPAGE VALUES

As previously described, stumpage is the value paid to a landowner for the right to harvest trees. In this case, the costs of logging and hauling are subtracted from the EBITDA and EBIT RTL values to estimate the stumpage value that each processing technology returns to the timber owner. The results are shown in **Table 4.2**. As the data show, on an EBITDA basis the technologies generate a positive RTL value on a stumpage basis as shown in the upper portion of the table. However, most of the technologies generate negative values when the stumpage RTL is expressed on an EBIT basis as shown in the lower portion of the table. Since several technologies generally use mill by-products or logging slash, no RTL values are shown for those technologies since the source of the material is not direct from the forest.

[4] Stumpage is the amount paid to a landowner for an entity (sawmill, logger, etc.) to harvest timber.

Table 4.2—Estimated Stumpage RTL Values ($/BDT)

Metric	Wood Wool Cement	Wood Wool for Packaging	BioMAT Cogen	Wood Fiber Growing Media	Sawmill - Base Case	Sawmill + Treating	Sawmill + TMT Decking	Sawmill + Pallets	Post & Pole	Fuel Briquettes
Revenue	962	1,207	166	456	294	321	319	421	311	218
minus Manufacturing Cost	546	1,100	50	395	175	188	181	292	85	141
= EBITDA RTL at mill gate	**416**	**107**	**116**	**61**	**119**	**132**	**138**	**129**	**226**	**76**
minus Logging Cost	64	64	n/a	n/a	64	64	64	64	64	n/a
minus Hauling Cost	34	34	n/a	n/a	34	34	34	34	34	n/a
= EBITDA RTL standing timber	**318**	**8**	**n/a**	**n/a**	**21**	**34**	**40**	**31**	**128**	**n/a**
= EBITDA RTL at mill gate	416	107	116	61	119	132	138	129	226	76
minus Depreciation	115	41	56	30	81	81	85	85	14	22
= EBITDA RTL at mill gate	301	65	61	31	38	51	54	44	212	54
minus Logging Cost	64	64	n/a	n/a	64	64	64	64	64	n/a
minus Hauling Cost	34	34	n/a	n/a	34	34	34	34	34	n/a
= EBITDA RTL standing timber	202	(33)	n/a	n/a	(60)	(47)	(44)	(54)	114	n/a