California Assessment of Wood Business Innovation Opportunities and Markets (CAWBIOM)

Phase II Project Summary Report: Feasibility Assessment of Potential Business Opportunities

Completed for:

The National Forest Foundation

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1.1 INTRODUCTION

The National Forest Foundation (NFF) issued a Request for Proposal to assess the status of California's forest products industry, identify forest products business opportunities that will help the U.S. Forest Service increase the pace and scale of forest ecosystem restoration, identify gaps and weaknesses in policy, and prepare business plans with actionable items for the most promising business opportunities.

The Beck Group (BECK), a Portland, Oregon based forest products planning and consulting firm, was selected to complete the project. Funding for this project was provided by the U.S. Forest Service, State & Private Forestry, California Region. A multi-agency, public/private Steering Committee provided direction, contacts, references and insights.

BECK formed a multidisciplinary project team with expertise in forest inventory and timber supply (Mason Bruce & Girard), forest products technology and biomass steam & power technology (BECK, Carlson Small Power Consultants), and business feasibility and planning (BECK, CSPC, FIDO Management). BECK and its team appreciate the opportunity to complete this important work and thank the CAWBIOM steering committee for the guidance provided during the course of the study.

The project scope was divided into two phases. In the first phase, BECK developed a list of nearly 50 technologies for converting wood fiber into products. BECK also developed a screening tool to identify the technologies judged to provide the best chance of being developed into viable businesses in California. The results of Phase I were summarized in a report that was completed in June of 2015. That report is available on the National Forest Foundation website.

This document provides the results of Phase II. It includes more detailed technical, market and financial feasibility assessments and describes where additional analysis is needed for the four technologies In addition, policy recommendations for technology and more generally for increased utilization of forest products are included.

As previously described, BECK enlisted the services of FIDO Management, a group very experienced in the evaluating the attractiveness of various types of new business investments. FIDO developed simplified financial models for the four potential forest products businesses identified by BECK in Phase I of the study. The models developed by FIDO focus on the early project development stage metrics most important to potential investors. BECK has used the output of these financial models in the narrative for each business and in the development of the sensitivity analyses. The models developed by FIDO are part of the work product of this study and they are available for use by readers of this study. Potential developers or investors should go to the NFF website to access the models. The models allow users to input details of a specific project.

The following sections of the executive summary describe the key findings associated with the feasibility assessment for each technology.

1.2 ORIENTED STRAND BOARD

BECK assessed the feasibility of developing an OSB plant at an industrial site in Anderson, California. OSB was selected because California is a large market for this product and because an OSB plant uses hundreds of thousands of tons of small diameter timber annually. The plant considered would be capable of producing 475 million square feet (3/8" thickness basis) of OSB annually. As modeled in this analysis, the plant would produce a mix of underlayment (about 1/3) and sheathing (about 2/3). The output of the plant would be sold into the California market, which would allow the plant to capitalize on the significant finished product transportation cost advantage it would enjoy over the nearest OSB producers, which are located in British Columbia and east Texas. The plant would require an estimated 670,000 green tons of raw material per year. The following sections describe the key findings associated with BECK's feasibility assessment.

1.2.1 Raw Material Supply and Cost

Based on the average delivered cost of wood fiber in California and for other currently operating OSB plants, BECK assumed that the average delivered cost of material to the plant would be $35 per green ton. Given that parameter, BECK found that an estimated 233,000 green tons of sawmill by-products and 425,000 tons of topwood from existing sawlog harvests would be available. Combined, these two sources would provide an estimated 658,000 of the 670,000 green tons of raw material needed annually. No raw material from forest thinning operations was judged to be available for less than or equal to $35 per green ton. However, some thinning material could be used so long as its higher costs were offset by topwood or mill residue material that can be delivered for less than the average price of $35 per green ton.

Under more optimistic assumptions (i.e., no stumpage payment to landowners for topwood, utilization of sawlogs to an 8" top instead of the current practice of 6" top utilization, and full adoption among sawmills to converting to stranding of by-products rather than chipping), an estimated 1.373 million green tons of raw material is estimated to be available annually at an average delivered price of $35 per green ton. Based on these findings, BECK concludes that adequate raw material would be available to supply the facility.

1.2.2 OSB Markets

To assess the California OSB market BECK used historic (2007 to 2014) OSB market data from APA – The Engineered Wood Association. That analysis indicated that an average of 1.4 billion square feet (3/8" basis) of OSB was consumed annually in California. However, the time period for which the data was available included historically low levels of OSB demand because of the downturn in the economy during the Great Recession. Therefore, BECK also used forecasted housing starts, repair and remodeling, and industrial demand to estimate the size of the California OSB market during more robust economic conditions. That analysis indicated an OSB market in California of an estimated 2.158 billion square feet per year (3/8" basis). In both cases, the size of the market is significantly larger than the 475 million square foot annual output of the plant modeled in this study. In addition, the plant would enjoy a finished product transportation cost advantage of $30 to nearly $60 per MSF. Based on these findings, BECK

concludes the plant's location and the size of the nearby market would provide it with significant competitive advantages.

1.2.3 OSB Economic Feasibility

BECK assessed the economic feasibility of the OSB plant using the following key parameters:

- The delivered cost of raw material was $35 per green ton
- The all-in capital expense for the plant would be $166.2 million
- The f.o.b. plant sales price for OSB would be $210/MSF 3/8" basis
- The manufacturing cost, including raw material, would be about $160/MSF 3/8" basis

Based on the preceding parameters the plant would have an operating margin of nearly $50/MSF 3/8" basis, which is roughly 24 percent of the product sales value. This translates into an estimated $23.57 million of operating cash flow annually. This, in turn, translates into a simple payback period of 9.6 years (assuming a 27 month period during which the plant is under planning and development). The preceding set of economics would provide an annual return on capital of 14 percent (assuming 100 percent equity in the project).

1.2.4 Conclusions and Recommendations

Based on these results, BECK recommends additional analysis on the feasibility of OSB manufacturing in California. The key items for further development of this concept include:

- *Identification of a Potential Developer* – Given the large capital investment required, the complexity of the manufacturing process, and the sophistication of competing producers, BECK believes the most likely path to a California OSB plant is for an existing OSB manufacturer to pursue development.
- *Raw Material Supply* – Because the markets for sawmill byproducts are limited, sawmills near an OSB plant are likely to invest in equipment to convert sawmill waste (edgings, slabs, trim ends, etc.) into OSB strands. Additional research is needed to validate this concept.
- Relocating an Idled Plant – There are a number of idled OSB plants that could be relocated to California. BECK estimates relocating a plant would reduce the capital expense by $18.4 million relative to the estimate of $166.2 million for all new equipment. However, additional analysis is needed to identify a plant that could be dismantled and to more precisely estimate the associated costs and benefits.
- Environmental and Permitting – Numerous parties suggested that obtaining an air quality permit in California for an OSB plant would be very difficult. Additional analysis is needed to understand a plant's emission profile relative to California air regulations.

1.3 SMALL SCALE BIOMASS

Senate Bill 1122 (Rubio, 2012) created a unique opportunity to develop 50 MW of small (less than or equal to 3 MW) biomass power facilities in California fueled by the products of sustainable forest management. The price adjusting mechanism of SB 1122[1] allows these small facilities, which use expensive fuels, to be developed, though they would otherwise be far too expensive for the renewable power marketplace. Ironically, this legislation is being implemented February 2016 at the same time as large scale biomass plants producing ten times as many megawatts of power are systematically being shuttered when their contract amendments expire and because price levels that will sustain the operations are not being renewed. Unless changes are made to address the decline in large scale biomass plants California will end up with dramatically less capacity to utilize forest waste despite the potential success of SB 1122. Section 1.6 includes policy recommendations addressing preservation of large scale biomass plants.

1.3.1 Fuel Availability and Cost

For a 3 MW facility, 25,000 to 30,000 bone dry tons of forest fuel will be required annually. The range is determined by whether the facility has a thermal customer and the size of that customer. The fuel must come from one of four categories of sustainable forest management activities specified by the California Public Utilities Commission (CPUC) in their implementation of SB 1122.

Consequently, fueling a single 3 MW project for a year will require access to the biomass material derived from an estimated 2,000 to 3,000 acres of sustainable forest activity. If a co-located business can be developed that would use the small stems from thinning projects instead of treating them as fuel, that annual acreage requirement could rise to 4,000 to 6,000 acres.

It is imperative, for financing purposes, that the facility have contractual access to the required acres (and the associated fuel) on a long-term basis. Lenders consider a 10 year fuel supply arrangement a minimum. This can take the form of an access to logging slash from a private landowner to a long-term stewardship contract with a public entity.

The types of forest fuels required by SB 1122 are all expensive to gather, process, and haul. All work must be done with diesel powered equipment at the forest site. BECK has made the assumption that fuel for the projects would be obtained from active thinning/logging operations, and so the cost of gathering trees to a central landing can be assigned to the party utilizing the tree stems. With this assumption, BECK estimates an average delivered fuel cost of $45 per bone dry ton, which represents an average haul distance of 30 miles.

[1] Initially the term “SB 1122” was used to refer to this program. More recently, however, the term BioMAT has been used as its name. The term ReMAT has also been used to describe the program. Throughout this report the terms SB 1122, ReMAT, and BioMAT are used interchangeably.

The fuels will be mixed forest waste containing tops, limbs, needles and bark. Average moisture content is expected to be 40 percent with a range of 25 – 55 percent. Fuel heating value will average 8,600 BTU per dry pound.

1.3.2 Choice of Technology

BECK analyzed two technology options for application to an SB 1122 project: 1) gasification/internal combustion engine; and 2) direct combustion/steam turbine technology. Despite advantages of gasification in producing other potential high value by-products, BECK recommends and has modeled the direct combustion/steam turbine technology for this study.

Most of the reasons for choosing direct combustion/steam turbine as the preferred technology choice revolve around the specific requirements of the SB 1122 program. By SB 1122 rules, the fuel will be mixed forest waste, which is characterized by wide variations in piece size, moisture content, ash content, species, and heating value. All of these variations can occur within a single truckload of fuel. It has not been demonstrated commercially that gasification technology can produce a consistent gas quality and quantity from fuel with such variations.

The SB 1122 program Power Purchase Agreement (PPA) requires that a biomass project produce 180 percent of its annual contractual commitment every two year period. Again, there is insufficient evidence that gasification technologies using mixed forest waste can meet such a standard.

Another technology issue involves the inability to obtain “full-wrap” warranties for completion, performance and environmental compliance from a creditworthy entity for emerging gasification technologies. Availability of these warranties is essential in obtaining commercial financing for any SB 1122 project.

Conversely, hundreds of biomass projects using direct combustion technology have been constructed and operated using forest waste as a fuel source. They have demonstrated high annual capacity factors over long periods, and several vendors can offer the “full-wrap” types of warranties required.

Note that this same evaluation performed 3-5 years in the future may reach a different conclusion about the preferred technology. By that time, perhaps a publicly funded project will have demonstrated the ability to comply with SB 1122 requirements, and California's carbon markets may be placing consistently high values on other biomass byproducts. However, that is not the case in late 2015.

1.3.3 Stand-alone Versus Cogeneration Operation

A 3 MW project can be configured to produce electricity only or a combination of electricity and thermal energy to a co-located business or institution. BECK has chosen to model in detail a cogeneration (also known as Combined Heat & Power or CHP) project and then contrast that with the stand-alone project. The key reasons for this choice involves CHP projects having higher overall thermal efficiency, a second revenue stream, enhanced public acceptance, and potentially lower fuel cost.

An extraction/condensing steam turbine generator can discharge exactly the amount and pressure of thermal energy required by the thermal user at all times while maintaining a consistent 3 MW of electrical sales. Most thermal users use hot water or low pressure steam. This means that much of the energy in the high pressure boiler steam is converted to electricity prior to being sent to the thermal customer, thus boosting overall efficiency.

Sales of thermal energy typically occur at price levels based on the equivalent energy produced from natural gas. At these levels, the small increase in capital and fuel costs associated with serving a thermal customer are returned several-fold in thermal sales.

It is BECK's experience that a CHP project is inherently easier to permit than a stand-alone project, which could be a significant advantage in California. The public intuitively embraces the concepts of higher thermal efficiency and displacement of fossil fuel with renewables. The thermal customer also anchors the CHP facility in the chosen location by answering the "great idea - but why don't you build it elsewhere?" question.

If the thermal customer is a co-located forest products business, lower overall fuel costs are the likely result. Since the two businesses are using the same forest activity, any extra value added to the tree stem by the co-located business means the fuel fraction can carry a lower overall percentage of the cost of forest operations.

As will be demonstrated in the following sections, the value of a substantial thermal customer is very significant within the context of a SB 1122 project.

1.3.4 Co-Located Businesses

Because of the potential value to the SB 1122 project and since it would ultimately result in more forest acres being treated, BECK completed a high level analysis of seven potential forest products co-located businesses. The businesses were: Small log sawmill; Bagged shavings operation; Post and pole production; Fuel briquette manufacturing; Pellet production; Firewood production; and Fuel chip production.

These seven businesses were analyzed on residual value basis (i.e., either a Return-To-Log or Return-To-Fiber basis) in terms of the "break-even" raw material value delivered to the plant. The results were that the small log sawmill had the highest return potential, nearly twice that of other businesses. A second tier was occupied by shavings and post and pole operations, with a reasonable return of over $50/BDT. A third tier, with returns in the $35 to $40 per BDT, were briquettes, pellets and firewood. Fuel chips had virtually no return.

Most of these technologies could be supported thermally for their drying needs by the prototype plant except for the small log sawmill, which would require a substantially larger boiler. The pellet plant would require hot flue gas from the boiler as well.

1.3.5 Prototype Plant

The prototype plant for the SB 1122 program sells a net of 3 MW to the utility while supplying a co-located thermal customer with 10 million BTU per hour of low pressure process steam. The boiler is a single combustion chamber with a moveable grate and a rating of 40,000 pounds per

hour of steam at 600 psig/750 degrees Fahrenheit. Pollution control is provided by a multi-cone collector and 3 field electrostatic precipitator for particulate control, multiple levels of staged heat overfire air for CO and VOC control, and a Selective Non-Catalytic Removal (SNCR) system for NO_x control.

The turbine-generator has double automatic extractions and is rated at 3,000 KW @ 0.8 power factor, meaning that the generator can produce 3,750 KW at unity power factor. The generator is driven at 1,800 RPM through a gear reduction unit with the turbine rotating at 8,000 RPM. Steam not needed for process is condensed in a two pass surface condenser with cooling water supplied from a single cell wet mechanical draft cooling tower. The 42 gallons per minute of makeup water is treated with sand and charcoal filters and the boiler makeup is further treated in a reverse osmosis unit.

The unit is connected to the utility grid through a 3,500 KVA 4160/12KV step up transformer and a circuit breaker controlled by a bank of utility required relays. All major boiler and turbine equipment is housed in a metal sided building.

The total capital cost of the above plant, including all hard and soft costs, using the EPC method of contracting is $24.1 million. A slightly smaller version (35,000 pound per hour steam) could be constructed for $22.8 million for a 3 MW stand-alone operation.

1.3.6 Financial Analysis

The prototype plant was analyzed to determine a fixed power selling price that would result in a 12 percent after tax equity return over 20 years. The key assumptions in the analysis were: 60/40 debt to equity ratio; New Market Tax Credit financing resulting in $3,850,000 in lender equity; A total of $1,000,000 in state and federal grant funds; Debt interest rate range of 3.5 – 7 percent annually; 10,000 pound per hour of steam sales at $10.70 per thousand pounds (i.e., the estimated natural gas equivalent price); Staff of 8 full time employees; First year delivered fuel cost of $45/BDT; Escalation of expenses and steam sales of 2.5 percent annually; Escalation of power sales price of 0 percent annually (in accordance with SB 1122); and 3 MW of power sales for 8,200 hours annually. The above analysis produced a required power sales price range of $190 – $200/MWH for the range of debt interest rates.

A companion stand-alone project with lower capital, fuel and operating costs, but with no thermal energy sales was also analyzed. The result was a required power selling price of $215 – $225/MWH over the same interest rate range.

1.3.7 Conclusions and Recommendations

Based on the preceding results BECK concludes that the full implementation of SB 1122 through the development of small scale biomass heat and power projects is likely the only near term opportunity to feasibly develop small scale biomass projects, and in the process, expand biomass utilization from forest derived fuels in California.

This finding comes at a time when, ironically, low wholesale electric prices and contract expirations are causing the shuttering of numerous larger biomass power facilities, several in

forested areas that are at the end of their existing PPA's. However, with only a 50 MW limit, the new facilities will not come close to replacing those being lost in terms of forest biomass processing capability; they will be more targeted geographically and may be configured to produce other high valued by-products. In other words, CA will end up with less markets for the products of forest restoration, despite the success of the SB 1122 program, unless policies are changed to assure the future of the fleet of existing larger biomass power facilities (see policy recommendation in Section 7).

These small projects could not hope to compete economically in the California wholesale power market without a program such as SB 1122. These will be, essentially, community scale projects designed to support local efforts to lower fire risk and restore the local forests to health and vitality. They will be small enough that they will not require guaranteed access to large swaths of federal forests over extended periods, something very difficult for federal land managers to provide.

Although sponsoring groups may have hoped to base their projects on the production of newer biofuels or biochar, it will be the standard production of electricity from biomass that allows a long term assured revenue stream so that financing can be obtained. If California "doubles down" on a long term commitment to greenhouse gas reduction, the facilities can later transition to other uses, but will likely begin life as electric power producers with perhaps small quantities of other by-products or an onsite thermal user.

The bottom line is that SB 1122 is without a doubt the only contracting vehicle that would lead to a viable small scale biomass heat and/or power project in the foreseeable future. The accepted ReMAT contract price will likely be at least 3 times current wholesale renewable power prices. Even with this price multiplier, it does not appear to BECK that there will be a large number of projects proposed.

Given the preceding analysis and results, BECK concludes that a small scale biomass project developed in accordance with the SB 1122 program specifications would be feasible. BECK suggests that prospective developers carefully consider the following recommendations.

- *Secure Fuel Supply* – It is imperative, for financing purposes, that the facility has contractual access to the required amount of acres/fuel on a long-term basis. Lenders consider a 10 year fuel supply arrangement a minimum. The contracts could be with private landowners or a long-term stewardship contract with a public entity. In either case, BECK recommends that developers engage landowners in discussions.
- *Fuel Source Verification* – BECK has assumed that the logging slash produced from sustainable forest management activities qualifies as an allowable fuel under BioMAT. BECK recommends that project developers verify this interpretation of the program's rules since a differing interpretation could substantially increase the delivered cost of fuel and, in turn, significantly increase the required power sales price.
- *Project Qualification* – BioMAT allows the price at which a utility will buy power to increase until a developer finds the price acceptable. However, this process only occurs when there are at least three projects in the queue. Therefore, BECK urges prospective

project developers to quickly qualify projects for the queue, which is currently forming ahead of a first auction to be held on February 1, 2016. The qualification process and associated costs are described in Chapter 4, Section 4.6.

- *Identify Potential Steam Hosts* – BECK recommends project developers partner with entrepreneurs or existing businesses that utilize thermal energy. Selling thermal energy improves project economics by up to an estimated $25/MWH and could allow a project to begin construction ahead of non-CHP projects and before a BioMAT price review.
- *Technology Selection* – BECK concludes that direct combustion technology will allow developers to meet BioMAT power delivery requirements. In BECK's judgment, gasification technology using forest-derived fuels is not reliable enough at this point. However, gasification technology could provide additional revenue streams. Therefore, BECK recommends that developers monitor advances in gasification technology.

1.4 CROSS LAMINATED TIMBER

BECK assessed the feasibility of developing a cross laminated timber (CLT) plant in Northern California. The plant considered would be capable of producing 1.1 million cubic feet of CLT panels annually assuming a single manufacturing line operating two shifts (80 hours) per week. The following sections describe the key findings associated with BECK's feasibility assessment.

1.4.1 Raw Material Supply and Cost

The primary raw material for CLT is structural (dimension) lumber, and the prototypical plant considered in this study will consume 24 million board feet annually (when operated at capacity). While other lumber sizes and species could potentially be used, the primary lumber supply will be Douglas Fir and White Fir, 2" x 6" and 2" x 8" material.

BECK identified sawmills in Northern California that produce primarily dimension lumber. Their total annual production is nearly 1.5 billion board feet. Of that amount, more than 260 million board feet is estimated to be the appropriate size, grade, and species. Thus, BECK estimates the prospective CLT plant would require less than 10 percent of the regional supply.

Based on long term historical lumber prices, BECK has assumed that the average delivered price of lumber at the prototypical plant will be $330 per thousand board feet.

Most dimension lumber is kiln-dried to a moisture content of 19 percent. CLT requires lumber dried to 12 percent moisture. Therefore, BECK assumed that the prospective plant would pay lumber suppliers a premium of $25 per thousand board feet to provide lumber dried to this lower moisture level.

1.4.2 CLT Markets

CLT is an innovative building material that has been in commercial production in Europe since the 1990s and in North America for less than five years. It is therefore in its infancy in terms of market development. North American markets are relatively small but expanding rapidly, with the greatest potential in large multistory buildings where it replaces concrete and steel building systems. Key advantages for CLT relative to concrete and steel construction include: reduced

construction time, excellent strength-to-weight ratio, good seismic performance, reduced jobsite labor requirements, good thermal performance and energy efficiency, superior environmental performance.

Because CLT is a relatively new product, adoption into building codes is a work in progress. The 2015 International Building Code allows use of CLT in buildings up to 85 feet in height. State and local authorities are expected to incorporate this standard over the next 2-3 years. Future possibilities for code adoption include CLT use in even taller buildings.

Determining the total historical or current market for CLT is difficult because there are not yet any North American trade associations to track its production and sale. FP Innovations developed estimates of future U.S. market potential, projecting the equivalent of between 0.9 billion and 2.7 billion board feet for 5% and 15% market penetration respectively for large multistory buildings, including apartments, commercial, industrial, and institutional categories. While the prospective CLT plant would supply only a tiny fraction of this volume, it is unclear how long it will take for this market to reach its potential. With four existing North American CLT suppliers (in Quebec, British Columbia, Montana, and Oregon) and more likely in the planning stages, it is possible that the market could become oversupplied in the short term.

Unlike many wood products, CLT panels are not generally sold as commodity products, but custom designed products for specific applications. Specifiers and users of CLT are looking for a complete building system solution, so CLT producers need to have design and engineering staff, and complementary building products available.

There is no publicly available pricing information for CLT products. Based on a cost-plus-margin analysis performed by FP Innovations, BECK has assumed an average market price of $21 per cubic foot.

1.4.3 CLT Economic Feasibility

BECK assessed the economic feasibility of the CLT plant with the following key assumptions: capital cost of $16.7 million, annual production of 1.1 million cubic feet, annual lumber consumption of 24 million board feet; delivered lumber price (including custom drying) of $355 per thousand board feet, and a CLT average panel sales price of $21 per cubic foot. With these assumptions, the total estimated cash cost (lumber, glue, manufacturing) is $13.17 per cubic foot, resulting in an operating cash flow of $7.84 per cubic foot, or $8.6 million per year. Assuming a 12 month construction period and 100 percent equity investment, the simple payback period is 3.3 years.

Evaluating this business on the basis of payback period or operating margin as a percentage of sales, CLT is by far the most attractive technology analyzed by BECK.

1.4.4 Conclusions and Recommendations

Based on these results, CLT appears to be the most attractive of the four major businesses evaluated as part of the CAWBIOM project. Recommended next steps for planning and continued analysis include:

- *Confirm CLT Sales Values* – CLT is a relatively new product in North America. Therefore, published pricing for the material is not available. BECK recommends additional price analysis through a combination of surveys of developers of recently completed North American CLT projects and analysis of pricing for competing materials such as concrete and steel, which would allow a more informed estimation of CLT sales price.
- *Raw Material Supply* – BECK found that an adequate volume of lumber is produced in California to supply a CLT plant. However, additional research and analysis is suggested to verify whether the mix of species, grades, and sizes produced is aligned with what is allowed for use in CLT manufacturing. Additionally, BECK recommends assessing the business case for producing CLT from currently underutilized species such as small diameter ponderosa pine.
- *Validate the Lumber Drying Premium* – BECK assumed that existing sawmills would be able and willing to supply lumber that meets the moisture content specifications of CLT manufacturing. This assumption, however, needs verification through additional research and discussion with existing lumber producers in the region.
- *Assess the Impact of Foreign Currency Exchange Rates on CLT Pricing* – A very recent trend in the lumber industry is that the increase in the strength of the U.S. dollar relative to other currencies such as the Euro allows manufacturers in other countries to supply lumber to the U.S. market at prices that are very competitive against U.S. manufacturers. Research is needed to see if the same is true among CLT manufacturers, especially since most of the existing manufacturers are in European countries.
- *Building Code Adoption* – CLT use has been adopted into U.S. and international building codes, but is facing opposition from other building material suppliers. The rate at which adoption filters down to California's local and regional municipalities is evolving rapidly. BECK recommends that prospective CLT developers monitor this situation closely.

1.5 VENEER MANUFACTURING

BECK examined the feasibility of developing a green (i.e., undried) veneer manufacturing plant in North Coast Region of California. The prospective plant would be capable of producing 170 million square feet of veneer from 50 million board feet of logs. After initially considering the additional processing steps, such as drying, grading, and layup, to manufacture composite wood products, green veneer was selected as the preferred business because of adequate green veneer markets, lower capital costs, and easier environmental permitting requirements.

1.5.1 Raw Material Supply and Cost

Mason Bruce & Girard (MB&G) examined three major timber resource regions in Northern California and found that the North Coast region is the area most likely to be able to supply an additional 50 million board feet of logs to supply the prospective plant. Although a significant portion of the surplus growth in this region is likely to be redwood, which is not suitable for sales into the prospective plant's target markets in Southern Oregon, there appears to be sufficient surplus growth of Douglas Fir and White Wood species on privately owned timberland to supply the prospective operation.

The average delivered cost of Douglas Fir logs from the North Coast region was assumed to be $444 per thousand board feet (Scribner short log scale), while the cost of White Wood logs was assumed to be $373 per thousand board feet.

1.5.2 Veneer Markets

The target market for the prospective green veneer plant would be plywood and laminated veneer lumber (LVL) producers located in Southern Oregon. At present, the region produces about 2 billion square feet (3/8" basis) of veneer while using 3 billion square feet – a deficit of 1 billion square feet. Two existing Northern Californian veneer plants supply approximately 500 million square feet or one half of the deficit, but the balance is brought in from Washington State and British Columbia. The prospective plant should have a transportation cost advantage relative to these distant veneer suppliers.

Based on historical pricing and an average mix of 75 percent 54", 10 percent 27", 10 percent Strip, and 5 percent Fish Tails, BECK assumed average veneer sales values of $185 per thousand square feet (3/8" basis) for Douglas Fir and $170 per thousand square feet for White Woods.

One market related risk factor is that additional supply of Fish Tails (the lowest value veneer product) would likely be too much for regional markets to absorb.

1.5.3 Green Veneer Economic Feasibility

BECK evaluated the economic feasibility of the prospective green veneer plant with the following key assumptions: capital cost of $30 million, annual production of 170 million square feet (3/8" basis) using 50 million board feet of logs, hourly staffing of 48, total staffing of 62, veneer sales of $185 per thousand square feet for Douglas Fir and $170 per thousand square feet for White Woods, byproduct sales of $22.57 per thousand square feet (for peeler cores, veneer chips, and bark/hog fuel).

With these basic assumptions, the plant would generate $203.82 per thousand square feet in sales with log costs of $125 per thousand square feet and cash manufacturing costs of $50.41 per thousand square feet, resulting in an operating cash flow of $28.41 per thousand square feet or $4.8 million per year. Assuming a construction period of 18 months, the expected simple payback period is 7.8 years.

1.5.4 North Interior Scenario

Because the North Coast region is a relatively low risk area in terms of forest fire, and is not a high priority for increasing the pace and scale of National Forest ecosystem restoration activities, BECK also analyzed the feasibility of locating the prospective veneer facility in the North Interior region. Because private lands are unlikely to provide adequate supplies of logs, and in the interest of increasing the pace and scale of forest ecosystem restoration activities, BECK assumed that 20 million board feet of logs would be provided from National Forest lands, including approximately 10 million board feet of small diameter logs.

Because small diameter logs negatively impact veneer recovery and peeling productivity, the North Interior scenario would generate approximately $2 million per year less cash flow than the Base Case scenario, but the plant would utilize 10 million board feet of small diameter logs.

1.5.5 Conclusions and Recommendations

Given the finding of an adequate supply of raw material, the presence of nearby markets for green veneer, a strong market forecast for the products produced from green veneer, and the financial analysis completed for this study BECK concludes that development of a veneer plant in Northern California is feasible. BECK recommends the potential developers complete the following actions for further development of this concept:

- *Investigation of Fish Tail Veneer Markets* – BECK found that markets for fish tail veneer (a low grade of veneer) in the Northern California Region are likely oversupplied. Research is needed on ways to mitigate this issue.
- *Identification of a Potential Developer* – Given that there are several existing manufacturing operations in the region that are sourcing significant quantities of green veneer from outside suppliers in distant locations, the logical developer would be an existing veneer, plywood, or LVL manufacturer in the region.
- *Security of Supply* – The most critical aspect of this business is a secure supply of the required log volume. BECK recommends that potential developers engage the U.S. Forest Service in discussions for providing a long term stewardship contract in the North Interior region.
- *Supply Mix* – The raw material supply analysis for this project was completed at a relatively high level. BECK recommends additional analysis to confirm that the size and species mix of the log supply is appropriate for producing veneer used in products such as LVL and for plywood produced in the region.

1.6 POLICY RECOMMENDATIONS

Identifying gaps and weaknesses in policy, environmental, and social concerns was a secondary objective of this study. Accordingly, the following report sections identify and describe those types of issues discovered by BECK during the course of the study. In addition, where appropriate, BECK has made specific recommendations about actions that can be taken to address the gaps and weaknesses.

1.6.1 Developers Must Obtain Long-Term Supply Contracts to be Successful

Any lender financing the initial capital investment of a forest products business will require the business owner to demonstrate that an adequate supply of raw material is available and that the supply is in the developer's control. The specific requirements will vary from lender to lender, but, based on BECK's experience, the owner typically needs to have an independent third party complete a supply study showing that a minimum of 1.5 times the plant's annual raw material requirement is available and that the business owner has a substantial portion of the plant's annual raw material supply requirement contractually secured for the duration of the loan.

In much of the Western U.S. as much as 70 to 80 percent of the forest land is publicly owned. This means that business owners holding traditional timber sale contracts (that might have a maximum duration of 3 years) have difficulty showing a contractually secure supply to lenders. Fortunately, with regard to federal lands, long-term stewardship contracting is a tool that has been increasingly used over the last 10 to 15 years. The length of stewardship contracting terms could allow business developers to secure longer term supply.

One example of the long-term approach is the 4 Forest Restoration Initiative (4FRI) currently underway in Arizona. The project spans four national forests (Kaibab, Coconino, Apache-Sitgreaves, and Tonto) and aims to use a 10 year contract to carry out forest restoration efforts on more than 300,000 acres of forestland. Contracts with that type of long-term duration and large-scale volume are preferred by lenders. While the contractors awarded the 4FRI contract have experienced difficulty carrying out the prescribed treatments, BECK believes the long-term, landscape-wide model could be employed in California. Unlike Arizona, there is sufficient forest products industry remaining in California to successfully process the material harvested during restoration treatments. Development of one or more businesses analyzed in this report would even further enhance the viability of carrying out restoration treatments.

BECK recommends that any entrepreneur pursuing development of a business based on the technologies considered in this report work closely with the U.S. Forest Service to explore opportunities for developing long-term, landscape-scale stewardship contracts.

1.6.2 CPUC and Carb Should Explore Protocols for Large Biomass Power Facilities

Small biomass combined heat and power facilities were identified and analyzed as having one of the highest potentials for additions to California's forest products infrastructure. This ranking is wholly dependent on the existence of BioMAT, which provides for contracts for 50 MW of 3 MW and smaller projects.

At the same time as BioMAT is in development at the CPUC and the IOUs, older larger biomass projects, with similar technology, are closing across California as their Power Purchase Agreement amendments expire and are not renewed by the IOUs. The closures dwarf the size of the BioMAT program, with several hundred additional MW likely to close over the next 24 months.

Given the dire need to utilize the products of accelerated forest thinning and restoration and California's program to dramatically reduce statewide greenhouse gas emissions, the closure of larger biomass power facilities is a perverse outcome that should not be allowed to happen.

California’s Governor, who recently proclaimed a State of Emergency due to drought conditions, recognized the need to extend contracts for existing bioenergy facilities so they remain a tool for dealing with drought killed trees and overstressed forests. As a result, the governor directed the CPUC to utilize its authority for such purpose. This study recommends that the CPUC move aggressively to assist the IOUs and biomass power industry in crafting replacement contract amendments that will allow existing plants to cost effectively run at a high annual capacity factor and allow recently closed plants to restart. Such amendments should extend to the end of the existing PPAs or 2020, whichever is later.

Longer term, the value of the biomass power facilities, both existing and new, in greenhouse gas reduction efforts in California should be analyzed and reported by the California Air Resources Board (CARB) so that a Biomass Power Protocol can be developed and facilities can be allowed to produce carbon credits for sale. The quantity of credits awarded would be based on the demonstrated greenhouse gas reductions versus the alternative fates of the biomass fuels. Displacement of fossil carbon emissions would continue to be captured in the Environmental Attributes that are the property of the purchasing utility. Development of a new revenue stream for biomass power facilities can remove some of the pressure from electric ratepayers who, in the short term, will shoulder the burden of keeping plants open through above market power purchases.

Alternatively, the CPUC's expected redraft of procurement policy for the Renewable Portfolio Standard (RPS) program could mandate levels of biomass power participation in the program and assign carbon credits earned from the Biomass Power Protocol application to the purchasing utility to offset fossil carbon emissions.

1.6.3 CPUC Should Explore Changing BioMAT Price Adjusting Protocol

Currently, the bidding protocol for the SB 1122 program requires 3 pre-approved parties in the bidding queue before programmed price changes can begin. It is widely expected that prices must increase substantially from the $127.72/MWH starting price before parties can accept the price. Once a producer of 1MW of capacity or more accepts the price, the queue requirement for further price changes expands to 5 parties in the queue. Beck's analysis of existing development efforts found that it may not be possible to have 5 parties simultaneously seeking contracts, so the queue size requirement should stay at 3 parties.

1.6.4 CARB Should QuanTIfy Benefits of Controlled Forest Waste Burning

California's strict air quality regulations, when aggressively applied, can greatly increase a forest products conversion facility’s capital and operating cost and threaten the economic viability of small biomass power or combined heat and power facilities. However, if such facilities were to be installed, regional air quality might actually be improved as it could lead to less open burning of forest wastes and a lower chance of forest wild fires, which have staggering emission levels of pollutants. For example, controlled combustion of forest wastes in a boiler versus open burning typically results in a 95 percent or more reduction in the criteria pollutants of concern in California (PM, CO, VOC's, NO_x).

BECK recommends that the California Air Resources Board (CARB) recognize the air quality benefits of forest waste combustion under controlled conditions versus open burning of the same materials. CARB should petition EPA to allow consideration of regional air quality benefits and avoided open burning cost in the permitting process for biomass power and CHP facilities. Once approved, CARB should distribute such authority to local permitting agencies in California.

The goal is protection of air quality in the vicinity of the project without overburdening the plant with Lowest Achievable Emission Rate (LAER) technology or operating protocols that would cause the project to be abandoned with the attendant loss of potential regional air quality improvements.

1.6.5 CARB Should Expand Forest and Biomass Protocols for Forest Restoration

Under AB 32 implementation, the California Air Resources Board is tasked with developing Protocols under which various GHG reduction efforts can be evaluated and offset credits assigned. The work of CARB in this arena should be expanded to include Protocols for forest activities and infrastructure expansions designed to address the need for large scale forest restoration in California, including the need to develop uses for small timber, dead and burned trees, and the byproducts of forest thinning.

The need to limit future wildfires, restore forest health and function, and prevent open burning or decay of forest byproducts have quantifiable GHG reduction benefits that can be analyzed by CARB. The recovery and use of traditional non-merchantable material is very expensive, however, and so the long term sequestration of the carbon in products or the use of the material to offset fossil fuel use should be encouraged by Protocol through the granting of scientifically determined saleable offset credits.

1.6.6 U.S. Forest Service Should Continue Support for CLT Market Development

During the summer of 2015 the International Code Council considered a request from the American Wood Council for the development of an International Code Council Tall Wood Ad-Hoc Committee. The purpose of the committee will be to identify appropriate opportunities to expand the current building standards to recognize use of mass timber construction in taller buildings and craft the accompanying requirements. BECK recommends that the USDA continue their ongoing efforts to support this and other initiatives aimed at conducting the required research toward advancing the appropriate use of wood products such as CLT.

1.6.7 State Should Study Opportunities for Enhancing Wood Pellet Feasibility

Global demand for wood pellets is expected to rise to over 50 million metric tons by 2025. The forecasted growth is primarily driven by global carbon policies that encourage the substitution of pellets for a portion of the coal currently burned to generate electricity. The vast majority of the growth in pellet demand is expected to come from Europe, Japan, and Korea.

California could potentially capitalize on the expected growth in the pellet market in Asia as there are many sawmills in the state that currently have limited markets for their sawmill byproducts. If a pellet industry were present in the region it would provide markets for those sawmill byproducts. According to the Western Wood Products Association, softwood sawmills in California produced just over 1.9 billion board feet of lumber in 2014. BECK estimates that level of lumber manufacturing translates into the production of about 1.3 million bone dry tons of “clean” mill byproducts (i.e., 900,000 BDTs of chips, 220,000 BDTs of sawdust, 180,000 BDTs of shavings).

There are no pulp mills operating in California to purchase the chips, and there is only one particleboard plant operating in the state to purchase sawdust and shavings. Thus, the clean fiber (non-bark) portion of the mill byproduct production would appear to represent a stable, relatively low cost fiber resource that could be utilized for manufacturing wood pellets.

BECK estimates that nearly 70 percent of the total cost of the delivered pellet can be attributed to the cost of fiber and transportation and logistics. As described previously, California appears to have a supply of low cost fiber. However, California does not currently have port infrastructure to efficiently and cost effectively handle bulk pellet exports. This fact precluded pellets from being considered for detailed financial analysis.

BECK has identified only two ports along the entire North American West Coast with infrastructure specifically designed for efficient and cost effect pellet handling; both are in British Columbia and both ship pellets primarily to Europe through the Panama Canal with much smaller amounts being shipped to Asia. These ports have the following features that are required for pellet handling: rail/truck access, covered receiving area, automated discharge from trucks/rail, receiving systems designed to limit breakage and dust, fire protection, covered/enclosed storage, storage areas with dust control, aeration systems, fire detection and fire control, special loading and unloading equipment designed to minimize breakage, and specially designed loaders to minimize ship repositioning.

In addition, pellet exports are happening on increasingly larger ships, which typically have a loaded draft of about 39 feet. The water depth at the port facility must be capable of handling such ships. According to information published about the two ports equipped for pellets in British Columbia, investments in infrastructure range between $25 million and $50 million per port. The State of California should investigate use of public funds to bring a port in the state up to the standards described above. BECK recommends follow-up analysis to:

1. Survey sawmill firms in the state to gather data about the market values of their mill residues and gauge their interest in either supplying a pellet manufacturing operation or possibly developing a pellet manufacturing operation
2. Identify a port that is best suited for pellet export infrastructure development

1.6.8 Carbon

A policy issue overarching all of these potential businesses is California's substantial commitment to future reduction of net carbon emissions through the passage of Assembly Bill 32 and several pieces of follow-on legislation.

California's forests have historically played a major role in maintaining the carbon balance by absorbing a substantial percentage of California's total carbon emissions. With the ongoing drought, a changing climate, and increasing forest wildfire, continuation of the forest's traditional role is in doubt. It has been speculated that if current trends continue, California's forests may soon become net carbon emitters, which would be a disaster for California's carbon reduction efforts.

The Governor has recognized this potential and recently issued an Emergency Order regarding the effects of drought on California's forests. The order calls for various State agencies to take actions to reverse this trend. A key goal of this study is to identify businesses that, if initiated, could assist with increasing the pace and scale of forest restoration in California. Forest restoration, done correctly and at scale, could remove drought killed trees and lower stand

densities to the current carrying capacity of the land. The goal is to restore health and net growth to the forest, as well as to change and interrupt fire behavior.

Another aspect of developing forest products businesses is that the carbon stored in the wood fiber and then placed into service in products such as OSB, Veneer, and CLT continues to sequester carbon. In addition, biomass material not suitable for forest products can be used for energy production instead of being openly burned in the forest. Utilizing the material in this way displaces carbon emissions from both fossil fuel energy production and from open burning. Assessing the carbon impact (environmental and financial) of these businesses was beyond the scope of this study. However, BECK recommends this topic as an area for potential follow up research. As part of their ongoing efforts to implement AB32, the California Air Resources Board is tasked with developing protocols for various carbon reduction efforts. BECK urges them to include forest product carbon sequestration and open burning reductions in their protocol efforts.