Calaveras CHIPS

Market Feasibility Study

- ❖ Landscaping Materials
- ❖ Pellet and Log Manufacturing
- ❖ Fence Posts
- ❖ Electricity Generation
- ❖ Biodiesel Production

Prepared for:

Mother Lode Job Training
19900 Cedar Road North
Sonora, CA 95370-9231

Study conducted by the CED/SBDC Partnership
California State University, Chico
Chico, California 95929-0765
Phone: 530-898-4598
Fax: 530-898-4734
www.csuchico.edu/cedp/

THE CENTER FOR ECONOMIC DEVELOPMENT AND SMALL BUSINESS DEVELOPMENT CENTER
CED/SBDC PARTNERSHIP

Table of Contents

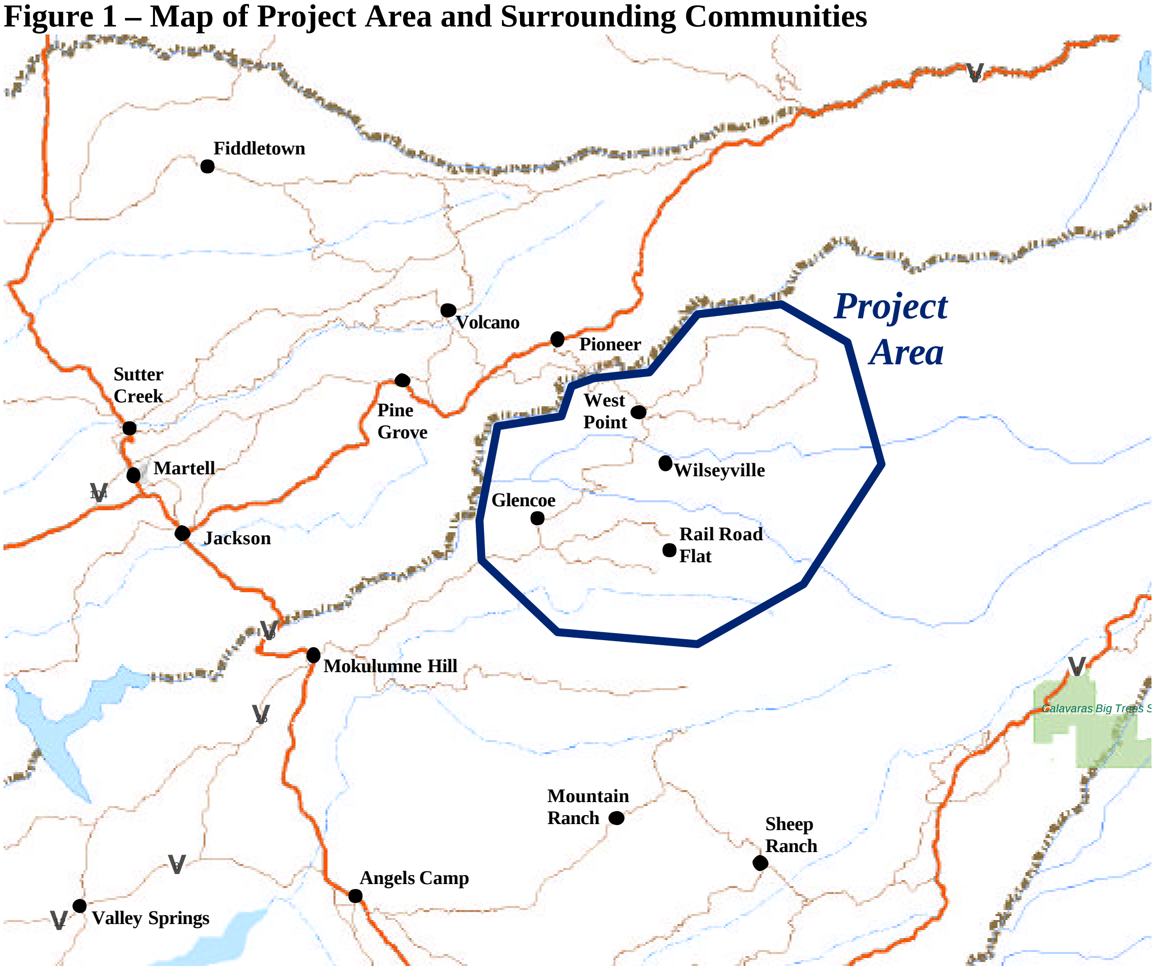
I. Introduction

The Calaveras Healthy Impact Product Solutions (CHIPS) project was conceived as a way to extract brush, small trees, and other forest overgrowth in the lower reaches of the Sierra Nevada in Calaveras County, California, while providing some jobs and income to residents of the project area. The project is intended to address two problems in the area: forest overgrowth that creates a fire hazard in the region and economic depression in the region's communities. The Center for Economic Development (CED) at California State University, Chico was contracted to conduct a market feasibility of producing five products from forest overgrowth: wood chips for landscaping, wood pellets for wood-burning fireplaces and stoves, fence posts, electricity, and biodiesel fuel.

CHIPS Project Area

The project area includes the communities of West Point, Wilseyville, Rail Road Flat, and Glencoe. The area is located 65 miles southeast of Sacramento around the Sierra Nevada's 2,500- to 3,000-foot elevation level. The project area is east of the Mother Lode–State Highway 49 tourism corridor, and therefore separated from where most visitors to Calaveras County travel.

Figure 1 – Map of Project Area and Surrounding Communities

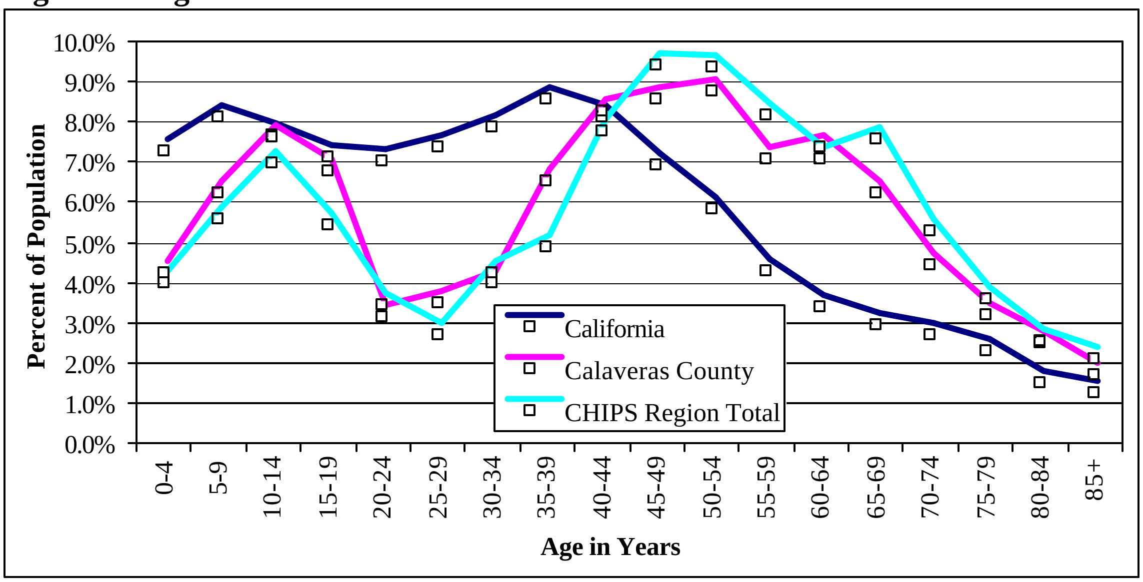


The area can be reached by State Highway 26 traveling east from Mokelumne Hill in the Mother Lode corridor or south from the Carson Pass Highway–State Highway 88 near Pioneer in Amador County. Overall, the region is not located on a throughway–a traffic corridor that people would typically drive through to get from one place to another. This isolates the project area economically and socially from the rest of Central California.

Project Area Economic and Demographic Profile

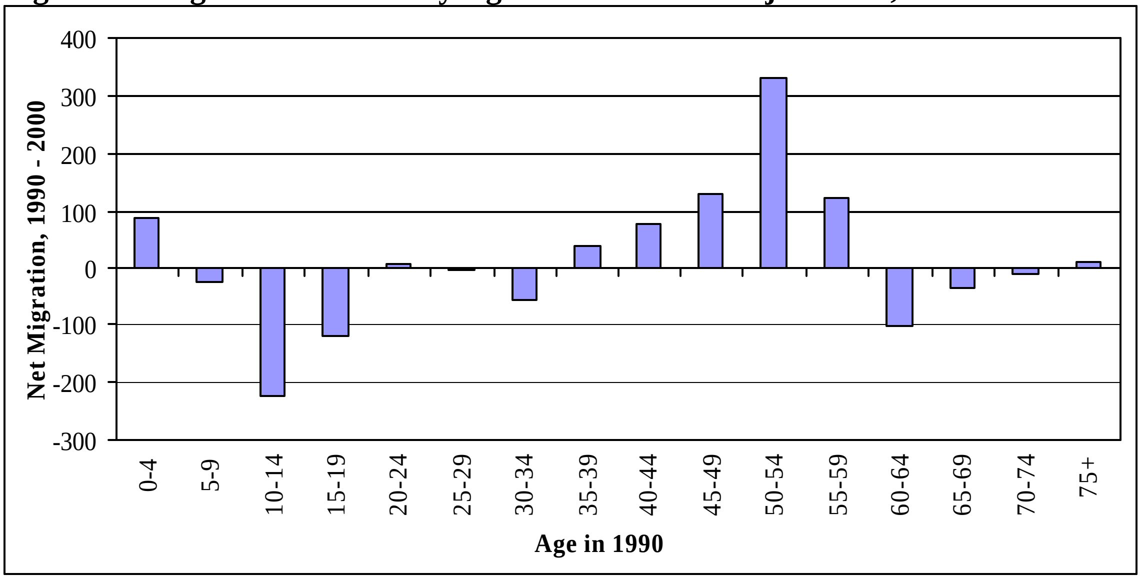
Despite its isolation, four communities exist here with a combined population of over 4,300 permanent residents as of 2000. In addition, more than 20 percent of the area's housing units are only used seasonally as vacation or second homes, whose occupants claim a usual residence elsewhere. Therefore, as many as 5,200 people may be staying in the area during peak summer months. The age distribution of the region shows a proportional lack of young workers up to age 40, and a proportionately high number of older workers and retirees. This pattern, however, is not unique to the project area. It holds countywide.

Figure 2 – Age Distribution in 2000



The net migration pattern by age group shows that hundreds of children leave the area after graduating high school. These people are replaced by young children and middle-aged people between 35 and 60 years old. Retirees over 60 tend to leave the area, likely due to an insufficient amount of services that most seniors need, such as health care.

Figure 3 – Migration Patterns by Age in the CHIPS Project Area, 1990-2000

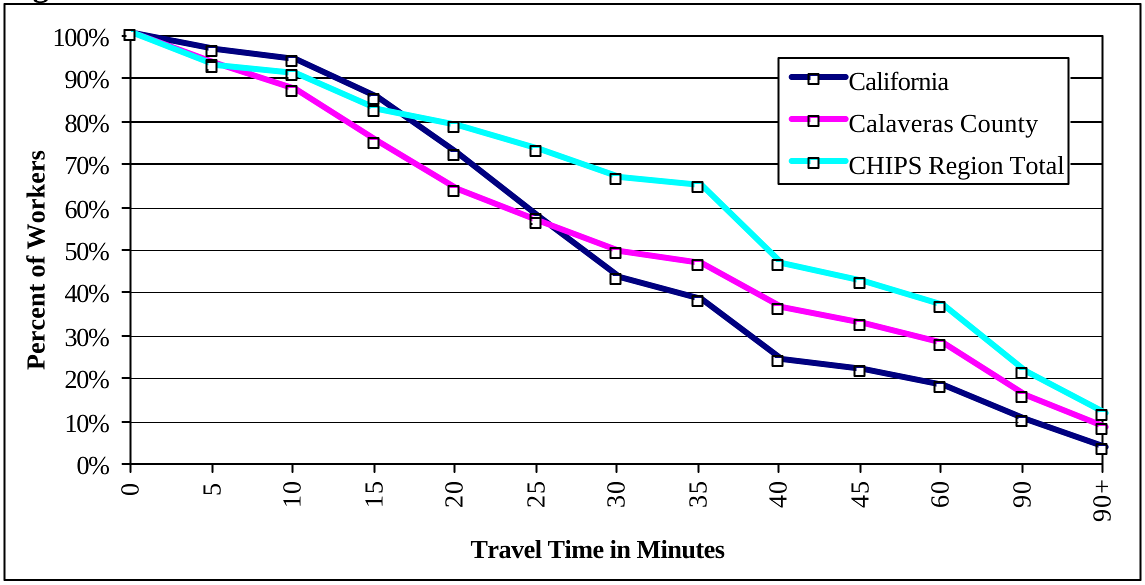


West Point began as a stage stop and gold mining camp, although the region's first significant development occurred in the late 1800s when private timber companies started harvesting the surrounding forest for lumber. These companies claimed much of the land in the project area before the U.S. Forest Service was created, which resulted in much of the land remaining private today. The timber industry started declining around the 1950s, as judged by divestiture of their property beginning around this time.[1] No economic activity came to replace the timber industry in this part of the county and the economy here slowly declined.

Employed people who do live in the region tend to travel farther to work than average in the state or county. The median travel time to work for employed people in the project area is between thirty-five and forty minutes. About 20 percent of the area's employees travel long enough to arrive in Sacramento and Stockton to work. Because it usually takes less than fifteen minutes to travel from one end of the project area to the other, about 80 percent of the area's employees travel outside of the project area to work.

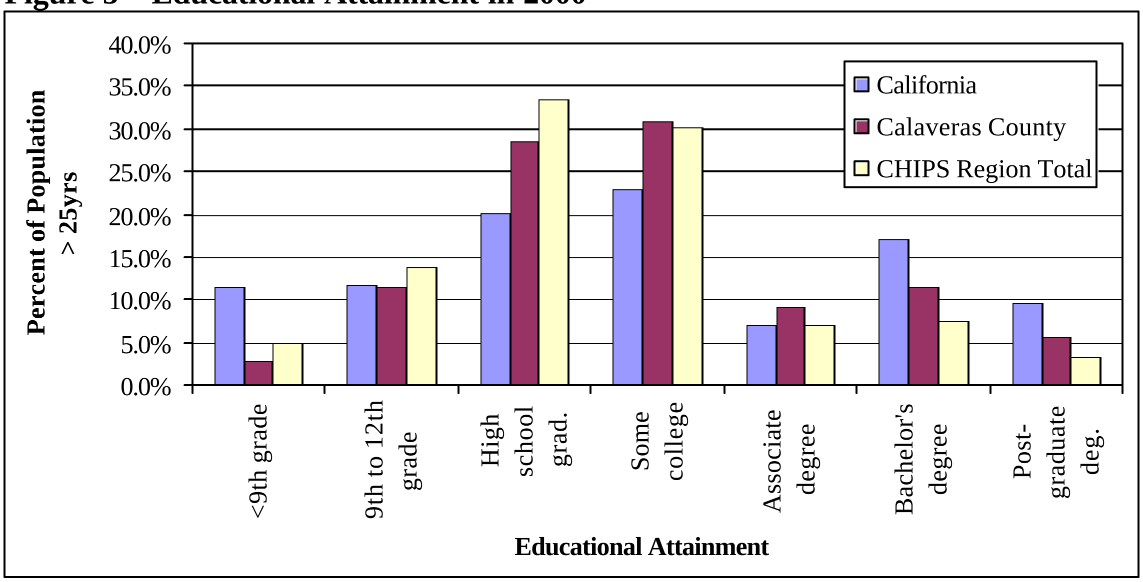
[1] Calaveras County Water District. West Point, Wilseyville, Bummerville Water System -- Background. 2001. <http://www.ccwd.org/documents/Facilities/West Point History.pdf>.

Figure 4 – Travel Time to Work in 2000



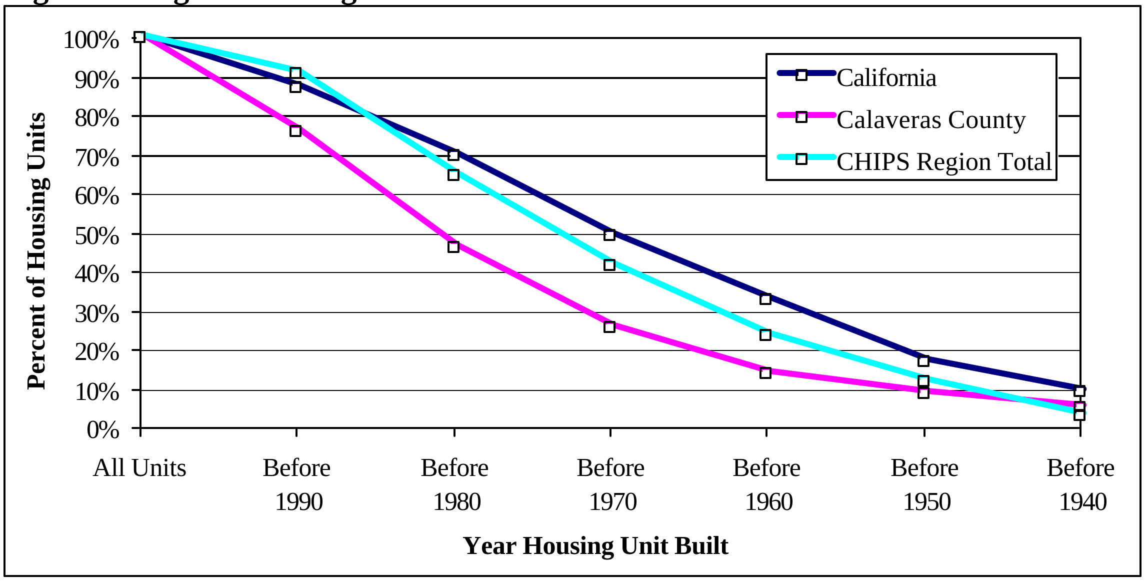
Fewer people living in the project area are college educated, which limits employment opportunities for area residents.

Figure 5 – Educational Attainment in 2000



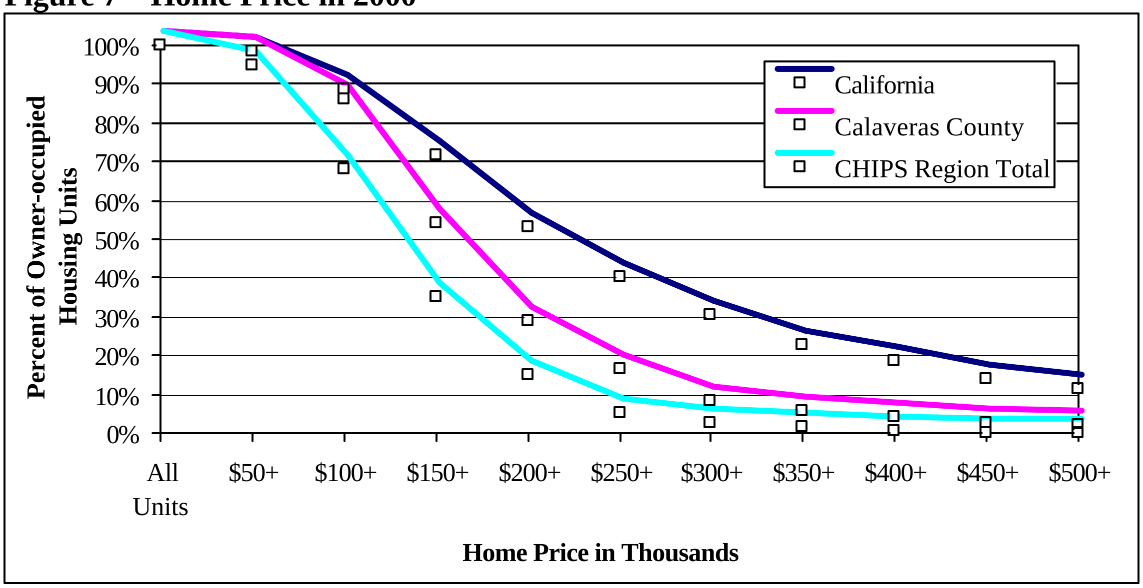
Housing stock in the project area is much older than that in the rest of Calaveras County. More than nine out of ten units were built prior to 1990 and two out of three were built before 1980. It was during the 1980s that the region's timber industry began to decline.

Figure 6 – Age of Housing



While home prices in Calaveras County are much lower than the rest of the state, those in the project area are much lower than Calaveras County. This situation results from the region's isolation and lack of current economic opportunity and limits the ability of capital among local homeowners.

Figure 7 – Home Price in 2000

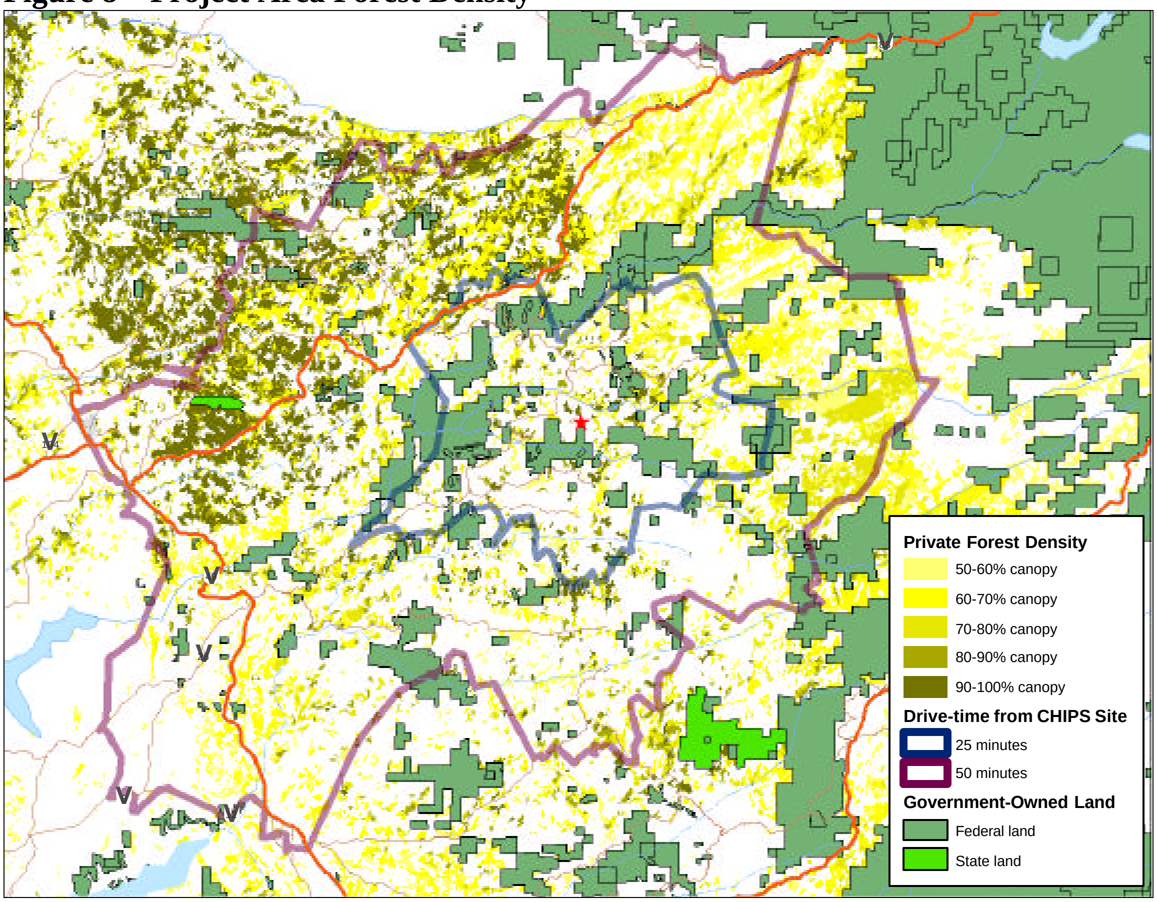


Status of the Project Area Forest

The CED estimates that there are between 2.0 and 2.5 green tons available for processing every year. This assumes cutting on all private property within a twenty-five-minute drive time and half of all property within a fifty-minute drive time from the transfer station in Wilseyville, cutting anything over a 50 percent canopy, including underbrush, and cutting every twenty-five years. This includes private productive timberland not likely to be available to the CHIPS project within the twenty-five to fifty minute drive time areas. The CED was unable to find out how much of this land is productive timberland, although based upon the human landscape, the CED assumes this land to encompass most of the region on the eastern third of the 50-mile drive time radius around Wilseyville.

CHIPS may be able to cut more of the available timber in their first few years of operation because of existing overgrowth, although it will be limited to 2.0-2.5 million green tons per year in the long run, minus those in productive timberlands not available to the CHIPS project.

Figure 8 – Project Area Forest Density



A map showing forest density (Figure 8) indicates that much of the timber available to the CHIPS project is likely to be found outside of the Project Area. It may be economic to transfer wood waste up to fifty miles for processing.[2] The forest map indicates that the greatest forest density in the area is found in Amador County. This is in the portion of the county with few commercial timber tracts, as well.

[2] Forest Products Laboratory. Techline – Wood Biomass for Energy. April 2004. Madison, WI.

The following sections discuss the production process, economics, and market feasibility of each of the five products separately analyzed for this report. Production of landscaping materials, wood pellets and composite logs, and electricity may be feasible, although production of fencing and biodiesel is probably not technically feasible through the CHIPS project.

II. Landscaping Materials

Potential exists to produce landscaping material, including wood chips and mulch for ground cover. Used mobile equipment is available that can be brought to the collection site and set up to produce marketable ground cover without prior storage or transport that could compromise product quality. Mulching equipment is also relatively inexpensive and can convert chips into nutrient-rich soil supplement. Sales will likely be limited to bagged material and most of the demand for this product will be in the San Joaquin Valley, which means that additional transportation costs will need to be covered by income from sales of the product. Lack of demand in Calaveras County and low retail prices in the valley may prohibit sales of bulk material.

Production Process

Three landscaping products were studied for this report: wood chips, bark, and mulch. *Chips* are a thin wafer of wood, split off from a log or tree branch, and cut at a precise angle. *Bark* is the outer protective layer on tree stumps. *Mulch* is a composition of ground wood chips, sawdust, bark, and/or other organic material.

The wood chip production process is simple. Cost-effective storage and transport are the greatest challenges for the producer because of their high volume compared to weight. To produce bark, a log (usually from a large tree) is sent through a machine that strips off the outer bark layer. The bark is then ground or chipped into relatively uniform particles. Bark can be produced from small logs, although to do so requires equipment not needed for either chips or mulch. In addition, the size of bark pieces will be limited, which in turn limits variety of the product. Exclusive production of bark would therefore be less economic than chips or mulch. Mulch requires further grinding than wood chips or bark to produce a finer material. Because it is a finer material, bark from small trees is acceptable.

The core components in the production of wood chips and mulch include: a wood chipper with a large chipping capability, a forwarder (to feed wood into the chipper), and a harvester (for extensive operations). The harvester can be supplemented with or even replaced by chain saws and manual labor, although for large operations, a harvester will be necessary to process the volume needed to increase economic efficiency.[3]

For the business example used in this report, capital definitions include:

Chipper: Bandit 1850 portable chipper with an 18-inch diameter capacity, a 250-horsepower Cummins diesel engine, and 12,000-pound weight.

Forwarder: Fabtek 546B six-wheeled machine with a 22.7-foot loader reach, weighing 32,500 pounds, and with a load capacity of 30,000 pounds.

[3] Bolding, M Chad and Lanford, Bobby L. Wildfire fuel harvesting and resultant biomass utilization using a cut to length/small chipper system. Forest Products Journal. December 2005.

Harvester: Timbco t-415c 200-horsepower tracked harvester with an 18-inch series 2000 four-roller Fabtek head.

Capital and operation costs are represented in the following two tables, respectively. For the example (in market feasibility section), these figures were adjusted to year 2006 dollars.

Table 1 – Capital Costs of a Mobile Chipper (2001)

Machine	Cost
Harvester	$ 193,016
Forwarder	$ 168,000
Chipper	$ 69,500
Total	$ 430,516

Source: Forest Products Journal

Table 2 – Operation Costs of a Mobile Chipper (2001)

	Harvester	Forwarder	Chipper
Fuel and Lubrication (per productive machine hour)	$ 10.44	$ 7.65	$ 11.31
Maintenance and Repair (per scheduled machine hour)	$ 18.23	$ 22.97	$ 6.59
Labor (per scheduled man hour), before taxes	$ 15.00	$ 15.00	$ 0.00

Source: Forest Products Journal

The modeled process includes two people earning $15.00 per hour, each, before taxes, and produces 5.17 green tons per scheduled man hour (70 percent capacity). The harvester is capable of producing more material, up to ten green tons per hour, and can operate on its own as long as there is a clean place to store the product and keep it from drying out before chipping.

Regional Landscape Materials Market

In this section, the three products analyzed, chips, bark, and mulch, are analyzed separately. Bagged product (typically available in 40-pound quantities) is analyzed, as well as bulk sales (typically sold by cubic yard or green ton), if appropriate.

For wood chips, the average pricing for fuel energy typically ranges from $15 to $20 per green ton.[4] The CHIPS project can already sell wood chips to the county for $15 per green ton or to the correctional center in nearly Ione for $18 per green ton. Most wood chips produced commercially are used to generate electricity. For landscaping, relatively few chips are used. Most chips used for landscaping are cedar or redwood because of

[4] Zerbe, John. Primer on Wood Biomass for Energy. USDA Forest Products Laboratory. Madison Wisconsin. 2004.

their durability.[5] There may be potential to produce cedar chips for landscaping if the cedar can be sorted.

Bark is available at home improvement retail stores in Calaveras County and within a 100-mile radius. Bagged cedar and other wood product bark is available. In Calaveras County, pricing for a 2-cubic-foot bag of bark is $4.69. All Home Depots within 100 miles of West Point sell a 2-cubic-foot bag of bark for $3.69. Home Depot indicates that their product is shipped from the east coast.

Wood-based mulch may not command a very high demand in Calaveras County, based on lack of availability.[6] Mulch is more commonly sold in 2-cubic-foot bags in the San Joaquin Valley for an average price of $6.31. In bulk, mulch sells at an average of $34-$38 per cubic yard in the valley. This range in pricing takes into consideration the coarseness of the product – the coarser product is more expensive.

Table 3 – Average Pricing of Wood Products

	Calaveras County	San Joaquin Valley
Bag Chips	n/a	$ 3.75
Bulk Chips	n/a	$ 35.00
Bag Bark	$4.69	$ 3.69
Bulk Bark	$ 34.00	Not surveyed
Bag Mulch	$5.44	$ 6.31
Bulk Mulch	$36.00	Not surveyed

Note: All bags in 2 cubic feet

Source: Telephone interviews conducted February 2006

Market Feasibility for Landscape Materials

The CED constructed a conservative business model with the following assumptions to determine the market feasibility for producing mulch. Production of wood chips would be slightly higher because bark would need to be removed from the product to be free from bark before entering the loader, although the added cost would not be significant.

- Man-hours per day: 8
- Scheduled machine-hours per day: 7
- Productive machine-hours per day: 6
- Days per week: 5
- Weeks per year: 40 (operation may not be possible during inclimate weather)
- Inflation 2001-2006: 13.0% (applied to non-labor costs only)
- Fringe rate: 20.0% (applied to labor costs only)

[5] Telephone interview with Green Masters Landscape Design and Development Company, April 2006

[6] Telephone interviews with Calaveras County gardening supply stores, February and March 2006

Based on these assumptions, a realistic operating budget should be as follows.

Fuel and Lubrication:	$39,866	
Maintenance and Repair:	$75,604	
Labor:	$57,600	
Total operation cost:	$173,070	(w/o repayment of a loan to purchase equipment)
Annual loan repayment:	$45,360	(if a loan is needed to purchase equipment—assumes twenty-year loan at 7 percent interest)
Total operation cost:	$218,430	(w/ repayment of a loan to purchase equipment)

Producing 5.17 green tons per productive machine hour, this operation would produce a total of 6,204 green tons per year. If the CHIPS project can acquire the necessary equipment through grants or donations, which means the organization does not need to repay a loan, the average production cost over the course of a year would be $27.90 per green ton. This may be far enough below the retail price to enable the CHIPS project to sell mulch or wood chips to Project Area consumers at a competitive retail price, and perhaps sell wholesale to other retailers in Calaveras and Amador counties. Transport costs will likely eat much of the profit margin if the product were shipped to the valley.

Unfortunately, the CED was unable to determine total demand in Calaveras and Amador counties, although conversations with garden supply retailers in the area indicate that relatively little of this product is sold here. Lack of demand is likely due to lower-cost alternatives (customers producing chips from brush on their own land) and less use in landscaping because wood chips and mulch are utilized infrequently in Calaveras and Amador counties. While there is a potentially viable product, it is unlikely that there is enough demand to sell the entire 6,204 green tons produced per year in bulk.

Assuming 2 cubic feet of material weighs 40 pounds, a green ton would produce fifty bags of material. In Calaveras County, fifty bags of mulch sell for $272.00. Bag mulch is used in small gardens, which are not relatively common in Calaveras County, but are comparatively numerous in the valley. Also, bag mulch currently sells at a higher retail price in the valley at $6.31 per bag, or $315.50 per green ton. The cost of a bagging and sealing machine was not covered in the operational sample utilized by the CED, although if operations costs for supplies and labor were $50,000 per year (a high estimate based on the operating cost of a harvester, forwarder, and chipper), the average cost to produce one bag would only increase to $48.66 per green ton, or less than $1.00 per bag. Therefore, a possibility exists to provide bag much to retailers in the valley at competitive wholesale prices. A sales person to negotiate a wholesale price and shipping costs would need to study the market more in-depth to determine whether long-distance sales of bag mulch would be possible.

If equipment must be purchased with loaned capital, the average annual production cost of bulk mulch rises to $35.21 per green ton. With the average price of mulch in Calaveras County at $36.00, prices may not be sufficient to cover costs if transportation or any management costs are included. There still may be a possibility of selling bagged mulch to valley retailers at wholesale prices, although the cost of producing each bag would be slightly higher at about $1.12 per bag.

Because the CED was unable to locate a business model that included the cost of bagging landscaping materials, further study is recommended.

The most common wood chips used for landscaping is produced from cedar. If the CHIPS project can separate cedar from other mixed wood, the demand for their product may be higher in the valley.

The total amount of product demanded in Calaveras and other nearby mountain counties, or in the valley, could not be determined without a more in-depth study. Such a study is recommended if a business plan is built around the sale of landscaping materials to ensure that the 6,202 green tons produced each year could be sold.

Conclusion

The research on the production of wood chips and/or bark provides the following conclusions:

- The small-scale production of wood chips is a process that is capital and/or labor intensive.
- A market for the retail sale of wood chips and mulch exists in the Project area and Calaveras County, although most of the material produced may be sold wholesale to retailers in the San Joaquin and Sacramento valleys.
- Most of the market potential is for bagged material because the demand and profit margin may be higher than for bulk sales.
- A market exists for the sale of wood chips used as energy fuel, although the price of chips may not be enough to cover the cost of producing them.
- Wood chipping could be an independent activity or utilize waste product of other production processes.

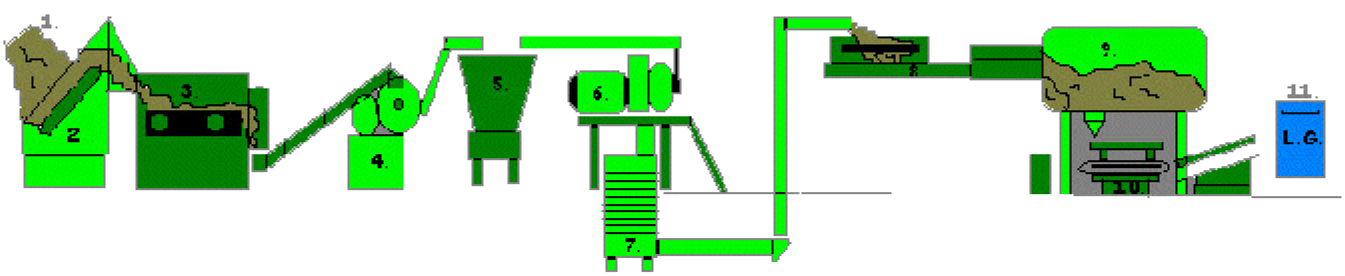
III. Wood Pellet and Log Manufacturing

Potential exists to produce wood pellets and composite logs for burning in wood-fire heating stoves, including pellet stoves. Capital expenditures are higher than those for landscaping for fence post production, but the profit margin for this product may be higher. Sales potential looks favorable in the Project Area, where just more than half of all households rely on wood to heat their homes. Sales to retailers in Amador, Calaveras, and Tuolumne counties is also a potential because of high competitive retail prices. CHIPS may be able to undercut current wholesalers if their transport costs are low enough in these areas. If the supply of wood product is sufficient, CHIPS may also be able to sell pellets wholesale in the Sacramento and Stockton areas.

Production Process

Wood pellets are produced through a process of wood densification. Wood densification is the process of taking wood byproducts such as chips or sawdust and processing them into uniform-sized particles so they can be compressed into a fuel wood product.[7] The product is held together by lignin, a chemical component of wood that bonds the cellulose together. Any wood species can be used to make pellets, including mixed wood, making wood sorting unnecessary. [8] Figure 9 illustrates the production process.

Figure 9 – Pellet Production Process



1. Feeding
2. Storage
3. Dry Kiln
4. Premix
5. Grinding Reserve
6. Scalar
7. Cooler
8. Dust Collector
9. Holding Bin
10. Packaging

Source: Granules L.G. Inc. Wood densification process. 2006
Note: Reference 11 not identified

The process begins with the feeding of raw material (sawdust) by means of a loader mechanism transporting the sawdust and filling the storage bin. The storage bin is where the sawdust is transported to the dry kiln for the primary stage of transformation. The sawdust must be refined to a specific moisture content, so it is conveyed into a kiln where the excess moisture from the sawdust is removed. Upon completion of the drying process, the sawdust is converted into premix by the grinding of the sawdust into very fine particles also known as mulch. Mulch can be stored until needed. The process continues with sawdust mulch being compressed into a solid wood pellet. The pellets

[7] West Virginia University. *Wood Densification*. Publication No. 838. 1988
[8] Pletcher, John. *Wood Residue-Compress for Profit*. Pennsylvania State University. 1998

must then be cooled, sorted from other debris, and stored in a holding bin. Pellets must be packaged and packed onto pallets for transport to market. The pellet can be as small as a cubic millimeter or as large as a tree limb.

Regional Wood Pellet Market

The capital costs associated with a pellet mill are relatively high compared to operational expenses. The CED utilized an illustrative wood pellet processing plant business plan and summary to help illustrate the costs associated with this industry.

Wood pellet processing costs generally, "…depends on several factors, specifically throughput (tons/hour) and moisture content of the residue….Operations set up to handle green residue will have additional pieces of equipment for storage and drying and therefore a higher setup and operating cost as compared to operations designed to utilize kiln dried material from secondary processors. For example, to establish a pellet plant from scratch that will utilize green residue to produce 1 ton of pellets per hour, [you might] expect to invest $650,000. A plant designed to produce 4 tons per hour will cost approximately $1,000,000 and a plant designed to produce 8 tons of pellets per hour will approximately [cost] $1,500,000. Operations that are designed to utilize dry residue will reduce the capital outlay by roughly $200,000 to $300,000." [9]

Further, the CED utilized a handbook published by the Pellet Fuel Institute in 1994 to illustrate the capital costs of a pellet mill based on different output scenarios. This is illustrated in Table 3. Although this data is more than 10 years old, the technology illustrated has not changed.[10] The CED will convert these figures to 2006 dollars in the market feasibility section.

[9] Pletcher, John. Wood Residue for Profit. Pennsylvania State University. 1998

[10] Pletcher, John. Phone conversation. January 11, 2006.

Table 3 – Capital Costs of a Pellet Mill – Output Scenarios (1994 dollars)

	1 Ton per Hour		3-4 Tons per Hour		7-8 Tons per Hour	
Items	**Capital Cost**	**Installation Costs**	**Capital Cost**	**Installation Costs**	**Capital Cost**	**Installation Costs**
Misc. Conveyors	$ 10,000	$ 5,000	$ 14,000	$ 7,000	$ 18,000	$ 9,000
Front-end Loader	$ 15,000		$ 65,000		$ 125,000	
Feed Hopper	$ 5,000	$ 3,000	$ 6,000	$ 3,500	$ 7,500	$ 4,000
Primary Grinder	$ 15,000	$ 10,000	$ 20,000	$ 15,000	$ 30,000	$ 22,000
Dryer Burner and Air System	$ 140,000	$ 75,000	$ 200,000	$ 85,000	$ 250,000	$ 100,000
Secondary Grinder	$ 20,000	$ 15,000	$ 32,000	$ 17,000	$ 45,000	$ 20,000
Live Bottom Bin	$ 12,000	$ 10,000	$ 12,000	$ 10,000	$ 18,000	$ 12,000
Pellet Mill	$ 65,000	$ 55,000	$ 120,000	$ 70,000	$ 240,000	$ 130,000
Pellet Cooler	$ 16,000	$ 12,000	$ 18,000	$ 14,000	$ 24,000	$ 18,000
Pellet Shaker	$ 10,000	$ 8,000	$ 12,000	$ 9,500	$ 18,000	$ 11,000
Boiler/Water Heater	$ 0	$ 1,500	$ 15,000	$ 18,000	$ 18,000	$ 20,000
Bagging Bin	$ 3,000	$ 2,000	$ 4,000	$ 2,500	$ 5,000	$ 3,000
Bagging System	$ 25,000	$ 5,000	$ 25,000	$ 5,000	$ 60,000	$ 7,500
Fork Lift	$ 15,000	-	$ 18,000	-	$ 25,000	
Building	$ 20,000	-	$ 35,000	-	$ 50,000	
Sub Total	$ 371,000	$ 201,500	$ 596,000	$ 256,500	$ 933,500	$ 356,500
Total Cost	$ 572,500		$ 852,500		$ 1,290,000	

Source: Pellets Fuel Institute

Note: Volumes indicate dry tons of product. One dry ton is roughly equivalent to two green tons.

The Pellet Fuel Institute also summarized operating costs of a pellet mill.

Table 4 – Operation Costs of a Pellet Mill per Ton (1994 dollars)

Direct Production	**Cost Range**
Wood Raw Material	$8-40
Labor	$8-12
Electric Power and Motor Fuel	$6-10
Dies and Rollers	$2-6
Maintenance	$6-9
Dryer Fuel	$0-8
Bagging	$13-17
Total Cost	$82-95

Source: Pellet Fuel Institute

According to the 2000 Census, 27 percent of homes in Calaveras County utilize wood as their primary source of heat. In the Project Area, more than half (52 percent) of all homes primarily use wood to heat their homes.[11] Therefore, a tremendous local market exists for wood pellets as long as their price is cheaper than substitutes, such as whole firewood. Based on a phone survey of local retail outlets distributing wood pellets, a 40-pound bag averages $5.22.[12]

The neighboring foothill counties of Amador and Tuolumne also have a high percentage of households that use wood as their primary heat source. Together with Calaveras County, this represents 25 percent of all households, numbering 12,500. There is a possibility of selling wood pellets and processed logs to retailers in the foothill area to serve this population if the CHIPS project can offer a wholesale price that undercuts what local retailers can get currently.

In the valley counties of Sacramento, San Joaquin, Stanislaus, only 1.2 percent of all housing units primarily use wood, although that does represent a potential market of almost 9,500 households.[13] In addition, there are an unknown number of homes that use wood as a secondary or ambient heat source. In the valley, natural gas is the number one source of heat (nearly two out of three households), and electricity is number two (nearly all of the remainder). With the rising price of natural gas and electricity, there might be a possible niche market available for the sale of wood pellets as a cost-effective secondary heat source in this area. Burning wood pellets and processing logs is more environmentally sound that burning whole logs in fireplaces.[14] In this area, corporate home improvement chain stores have captured a majority of market share for wood pellet and related products sales. From a survey of Home Depot stores in a 100-mile radius of Calaveras County, the average price of pellets per 40-pound bag is $4.97. Consumers tend to purchase large quantities at a time and stock up for the winter. Because of the large quantity of pellets consumers from mountainous areas like the Project Area need to last the entire winter, it is worthwhile for most to travel to Stockton or Sacramento to purchase the lower-priced product.

Currently in California, there are no producers of wood pellets.[15] However, the growth in sales of pellets has increased significantly in the last two years. Research provided by the Pellet Fuel Institute shows a 14 percent growth in sales from companies involved in the institute of between 2003-04 and 2004-05. In the U.S. Pacific region, sales grew 10 percent during the same period, although that followed a 10 percent decrease the previous year. Table 5 illustrates the growth in tons per region of sales of pellets in the last four years.

[11] U.S. Census, 2000.
[12] Based upon the survey of five retail outlets in Calaveras County in February 2006.
[13] U.S. Census, 2000.
[14] http://www.pinnaclepellet.com/pinnaclefuel.html
[15] Based on information provided from Pellet Fuel Institute and phone surveys of potential CA producers.

Table 5 – Wood Pellets Shipment Data (Tons)

REGION	2004-2005	2003-2004	2002-2003
U.S. Pacific	266,000	241,000	269,000
Mountain	172,000	131,000	105,000
Central	67,000	76,000	49,000
Great Lakes	71,000	53,000	41,000
Northeast	328,000	272,000	254,000
Southeast	45,000	43,000	43,000
Canada (Marit/Quebec)	26,000	30,000	32,000
Ontario/Sask/Manti	22,000	25,000	24,000
Alberta/B.C.	33,000	32,000	32,000
TOTALS	1,030,000	903,000	849,000

Source: Pellet Fuel Institute, 2006

Note: Figures in this table represent the heating season, April 1st through March 31st.

With no existing wood pellet manufacturers in California and the abundance of small-diameter logs and brush, wood pellets could be a marketable product. Three constraints could be the existence of electricity and gas heating, the high fixed costs of capital, and that the market is seasonal with shifting prices due the change in demand between seasons.

Positives include a large potential market locally (local markets having the advantage of lower transport costs), plus an additional niche market in the use of pellets as a secondary source of heating. The range in price for a 40-pound bag of wood pellets was large: from $3 to $6. If the trend of rising energy prices continues, the wood pellet industry could experience substantial growth.

Additional possibilities include use of a cogeneration facility to dry the wood if electricity production or cogeneration is considered feasible, and the use of small-particle byproducts of other production processes to produce wood pellets. Larger-particle byproducts such as bark and chips could be sold as landscaping material.

Market Feasibility of Wood Pellet Production

In the value of year 2006 dollars, the operating cost of producing wood pellets is between $122 and $142 per ton. For the purpose of this analysis, the higher-cost figure will be used. The CED used the following operational assumptions for the modeled pellet mill.

- Operating hours per day: 8
- Productive machine-hours per day: 8 (no shutdown during lunch breaks)
- Days per week: 5
- Weeks per year: 50 (indoor operation that can operate during inclimate weather)
- Inflation 1994-2006: 48.9%

Table 6 – Cost of Producing Wood Pellets (2006 dollars)

	1 Ton-per-Hour facility	3-4 Tons-per-Hour facility[1]	7-8 Tons-per-Hour facility[1]
Operations cost only	$ 284,000	$ 904,000	$ 2,130,000
Capital repayment[2]	$ 72,630	$ 107,760	$ 163,080
Cost with capital repayment	$ 356,630	$ 1,101,760	$ 2,293,080
Cost per ton with capital repayment	$178	$157	$153

[1] The CED used the average of the indicated volume range.

[2] Assuming the cost of a facility would have to be repaid over twenty years at 7 percent annual interest.

One ton of product will produce fifty 40-pound bags. Each bag will, therefore, cost $2.84 in a facility paid for by a grant or gift that does not have to be repaid. Under this scenario, it may be feasible to produce pellets for both local retail sale, and wholesale to retailers in the Central Valley. Wood pellets cost an average of $5.22 per bag in Calaveras County. At that level, the CHIPS project may be able to offer a very competitive price locally.

The CED was unable to quantify demand without a more in-depth study, although the number of households that use wood as their primary source of heat in the Project Area, and surrounding counties is considerable. If CHIPS can offer a substantial discount to the consumer, there may be an opportunity to significantly increase disposable income in the area if large quantities of wood pellets are demanded. Annual production quantities are roughly 2,000 tons for the 1-ton-per-hour facility, 7,000 tons for the 3-4-tons-per-hour facility, and 15,000 tons for the 7-8-tons-per-hour facility. More in-depth research on the potential demand for wood pellets in a 100-mile radius is recommended to determine which size facility is the most feasible.

The potential of wood pellet production to utilize forest product is greater than that for landscaping materials if one of the two larger facilities are feasible. Because one dry ton of output is roughly equivalent to two green tons of forest product, the 3-4-tons-per-hour facility would utilize 14,000 green tons per year while the 7-8-tons-per-hour facility would use 30,000.

Wood pellets are not available for bulk sale in the Project Area or in the valley. Research also indicates that many households purchasing wood pellets buy them in substantial quantities. These purchasers may be using wood as their primary source of home heat and are stocking up for the cold winter months. There may be additional opportunity providing wood chips for bulk sale to local households, making the bagging process unnecessary and reducing the cost of production even further. Additional study of this possibility is recommended.

If the CHIPS project is required to repay loaned capital to build their facility, production costs per bag of wood pellets would be $3.57 in a 1-ton-per-hour facility, $3.15 in a 3-4-tons-per-hour facility, and $3.06 in a 7-8-tons-per-hour facility. Under this scenario, the

CHIPS project may require that one of the larger facilities be built to preserve its competitive per-unit cost of production, although further study on the demand for pellets is recommended to determine if this is feasible.

Future demand for wood pellets may increase. Marketed properly, this product has the potential to at least partially replace whole logs in wood-burning fireplaces and stoves because pellets do not produce as much air pollution (an issue in the valley), are easier for the consumer to procure, and burn longer per volume than whole logs. If the CHIPS project can offer a competitive price for this product, there may be a good long-term potential to produce wood pellets.

Conclusion

The following conclusions were made about the production of wood pellets in the Project Area:

- The wood pellet production process has a high capital cost, but low operating cost relative to the production of landscaping materials.
- A local market for wood pellets exists, as well as a market in the Central Valley, but faces competition from substitute heating fuels such as natural gas.
- There are no wood pellet manufacturers currently in California.
- If the CHIPS project can build a pellet mill with grants or gifted capital that does not need to be repaid, then the project can offer a competitive price for sale in Calaveras and surrounding counties.
- Consumer awareness of wood pellets for the use of home heating is growing, making future demand projections favorable to a new producer.

IV. Fence Posts

The potential to produce and sell marketable wood fencing material remains unknown. Available tree size will limit the size of fencing material available for sale. Round posts may be feasible, although the capital cost of equipment capable of producing marketable posts may be prohibitive. The CED is continuing to research the market feasibility of fencing materials. Fence post production was thought of as a way to use the large supply of cedar in the area to be removed for fire safety. However, when researching the market, the CED discovered that cedar fencing is rare relative to fencing using other wood products such as fir and pine. Cedar does not demand much of a price premium compared to these other species. Research indicates that cedar is generally too expensive to use for fencing. Therefore, as a courtesy, the CED will include where cedar is primarily used and how CHIPS might be able to take advantage of higher pricing point for its available cedar.

Production Process

The production of wood poles is usually a process of mechanical uniformity created from large diameter trees and milled to exact measurements for greater market consistency. This process requires large-scale machinery capable of computerized standardization. This type of machinery is usually associated with large mills that do not exclusively produce poles and posts.

Smaller-sized fence posts are usually produced from a large diameter tree that has been milled to numerous smaller cuts. This is only possible in large mills capable of efficiently producing many wood products with expensive computerized machinery.[16] Machinery designed specifically to produce fence posts is not commercially available and is probably a component of large-scale mill machinery that can be adjusted to produce other products such as boards, planks, and other cut wood products.

Because the majority of cedar and other wood species available for harvesting in the Project Area is primarily limited to small diameter wood, the options for producing marketable fencing products may be limited. Further, although the technology exists to produce lumber, including fencing, from small-diameter trees, it is usually considered a low-quality product. "The high proportion of juvenile and reaction wood found in small trees is a major cause of warp in this lumber."[17] Overall, these findings mean that it is probably not technically feasible to produce planks, posts, or poles from cedar or any other species available for fencing or any other use.

Conclusion

The following conclusions are made regarding the use of cedar and other timber to produce fence posts, poles, or planks:

[16] Canadian Lumber Industry. Technology Road Map: Lumber and v/a wood products. March 30, 2005.
[17] Sierra Economic Development District. *Northern Sierra Nevada Biomass Study*. June 1996

- The industrial production of lumber has become an industry of narrow competition.
- The market for conventional cedar lumber is limited to a few products.
- The available market outside of Calaveras County is heavily dominated by large lumber companies with access to large-diameter trees and railroads for low-cost transportation.
- The production process includes high fixed costs with an ever-growing shift toward computerized standardization.
- The hindering factor for production is the consistency of diameter in the supply of timber.

V. Electricity Generation

The generation of electricity utilizing wood products, with either a wood fire generator or through wood gasification, is not likely to be feasible in West Point. Capital expenditures for units producing electricity to sell to the grid could cost millions of dollars, an amount that would be difficult for Calaveras County to marshal for West Point. Smaller units with a lower capital cost do not produce enough electricity to make the expense worthwhile compared to buying equipment for other production processes. Cogeneration (producing heat and electricity) is not likely to be feasible because the capital cost of cogeneration, compared to the cost of a wood-fire heater, is also not worthwhile compared to other equipment for other production processes.

Production Process

The generation of electricity using wood products and byproducts is done using combustion to burn the wood fuel and generate heat, which boils water to produce steam, which in turn is used to turn an electricity generating turbine. Much has been written on the use of wood byproducts to generate electricity because it can be a convenient way to dispose of otherwise useless material. However, generation of electricity using biomass, including wood products, is not economically feasible.

This section will address the question of whether or not electricity generation from wood products becomes economic if the initial capital investment does not need to be paid back, that is, the capital cost is paid for by a grant or by the county. However, it must be noted that the capital cost is in the millions of dollars, an amount the county may not be able to generate. Therefore, the CED will also present the option of producing electricity with equipment bought with loaned capital.

Electricity Generation Using Wood Products Market

As of February 28, 2006, the average retail price for electricity is 15.4 cents per kilowatt-hour (kWh) for residences and 15.8 cents per kWh for businesses.[18] The average wholesale price in Northern California over the past year to February 28, 2006, is 5.4 cents per kWh.[19] Therefore, if electricity can be produced for less than 5.4 cents per kWh, then it may be economic to produce electricity and sell it on the open electricity market operated by the California Independent System Operator (Cal ISO). If electricity can be produced for between 5.4 and 15.4 cents per kWh, then it may be economic to produce electricity for local use, either at the facility where electricity is being generated or for direct sale to residences under an independently established local distribution system such as Sacramento Metropolitan Utility District (SMUD) or the Modesto

[18] Pacific Gas & Electric Company (http://www.pge.com/rates/tariffs/electric.shtml).

[19] Figure based upon a sample of 24 hourly prices for 24 days during the past 12 months (1st and 15th of each month) available at the California Independent System Operator (http://oasis.caiso.com/). The confidence interval for the sample is +/- 4 percent, placing the average wholesale price between 5.6 and 5.6 cents per kWh for the 12 months prior to February 28, 2006.

Irrigation District (MID).[20] If electricity cannot be produced for any less than 15.4 cents per KWh, then it is probably not economic to do so because it would cost less to purchase electricity at retail prices.

Table 7 – Cost Comparisons of Thermal, Electric, and Cogeneration Facilities (2004)

	Size (MW)	Fuel use (green ton/yr)	Capital cost (million $)	O&M[a] (million $)	Avg. cost/kwh w/ capital repayment[b]	Avg. cost/kwh w/o capital repayment[c]
Thermal Plant (heat only)						
Utility plant	14.6-29.3	20,000-40,000	10-20	2-4	$ 0.021	$ 0.017
Industrial plant	1.5-22.0	5,000-60,000	1.5-10	1-3	$ 0.024	$ 0.021
School campus	1.5-17.6	2,000-20,000	1.5-8	0.15-3	$ 0.024	$ 0.020
Commercial/institutional	0.3-5.9	200-20,000	0.25-4	0.02-2	$ 0.045	$ 0.040
Electrical Plant (electricity only)						
Utility plant	10-75	100,000-800,000	20-150	2-15	$ 0.048	$ 0.025
Industrial plant	2-25	10,000-150,000	4-50	0.5-5	$ 0.048	$ 0.025
School campus	N/A	N/A	N/A	N/A	N/A	N/A
Commercial/institutional	N/A	N/A	N/A	N/A	N/A	N/A
Combined Heat and Power (Cogen.)						
Utility plant	25 (73)[d]	275,000	50	5-10	$ 0.060[e]	$ 0.037[e]
Industrial plant	0.2-7 (2.9-4.4)	10,000-100,000	2-25	0.5-3	$ 0.104	$ 0.060
School campus	0.5-1 (2.9-4.4)	5,000-10,000	5-7.5	0.5-2	$ 0.303	$ 0.207
Commercial/institutional	0.5-1 (2.9-7.3)	5,000	5	0.5-2	$ 0.234	$ 0.207

[a] Operation and maintenance.

[b] Assuming twenty-year repayment of initial capital cost at 7 percent interest.

[c] Operating cost only.

[d] Sizes for the CHP facilities are a combination of electrical and thermal; the first figure is electrical and the figure in parentheses is thermal. 1MW = 3.413 million Btu/h.

[e] Cost per kwh only calculated for the electricity portion of cogeneration.

Source: USDA Forest Service, Forest Products Lab and CED at CSU, Chico

Note: The Forest Products Laboratory warns that the cost estimates shown in the above table are only meant as a guideline to assist in determining the possibility of installing a wood energy system, and that a cost estimate for installing any facility requires flexibility and technical understanding depending on site and use requirements.

The Forest Products Laboratory (FPL) at the U.S. Forest Service provides the most recent research on the economics of electricity generation using wood products. FPL shows that electricity can be generated for as little as 3.7 cents per kWh, including repayment of capital (2.5 cents per kWh without repayment of capital). This means that the CHIPS project could feasibly produce electricity for the wholesale electricity market using wood products. However, such production would require a large capital investment in the

[20] Pacific Gas and Electric Company, which provides electrical power distribution to the West Point area, would not allow sale of their distribution system. This makes the setting up of a local distribution company unlikely.

millions of dollars and would require more wood product than available in the Project Area, that is, product would have to be harvested from the 50-mile radius rather than just the 25-mile radius shows in Figure 1 (page 1).

Market Feasibility of Electricity Generation Using Wood

The market feasibility of electricity generation using wood products is summarized in Table 7.

The smallest thermal (heat only) plant option is viable to dry product used for wood pellets as documented in that section. A wood dryer is included in the capital expenditures in the wood pellet section of this report. Not enough heat is required for any other potential use to make any larger thermal plant feasible.

An electrical plant may be feasible from a market standpoint. The USDA Forest Products Laboratory indicates that the average operating cost is 2.5 cents per kilowatt hour of generation (plus cost increases since 2004) with a capital cost of at least $4 million and as high as $150 million. If the CHIPS project can find a way to install an electricity generating facility without having to pay back a capital loan, it would be feasible to sell electricity wholesale to PG&E at the average rate of 5.4 cents (a profit of 2.9 cents per kilowatt hour). If, however, a capital expenditure would have to be repaid, then the market feasibility is marginal. The electricity would cost 4.8 cents per kilowatt hour to generate, leaving only 0.6 cents profit on an average annual price of 5.4 cents, minus increases in the cost of generation between 2004 and the current year. Given the unpredictability of the electricity market over the past seven years, it may not be wise to invest in electricity generation with such a small average margin. Long periods of low-cost electricity (such as occurs in the winter and spring), could undermine the financial stability of any organization choosing to do so.

Cogeneration is a less viable option because the smallest plants (industrial, school, and commercial in Table 7) produce more heat energy than needed for the pellet mill and generate electricity that, in some cases, costs more to produce than would if the electricity were purchased on the retail market (15.4 cents per kilowatt hour).

Conclusion

The conclusions regarding the generation of electricity using wood products follows:

- The only economically feasible way to produce electricity using wood chips from the Project Area is to build a large facility with capital that does not have to be paid back (from a grant or government funds). However, the capital expense is large enough (a minimum of $4 million in 2004) that such a gift may not be likely.
- The CHIPS project may break even if they were to repay a loan to purchase the capital equipment necessary to build a large power plant, although in today's volatile electricity market, such a venture may be too risky.
- A cogeneration plant is probably not feasible unless there is a local electricity consumer willing to use the heat and electricity generated – no activity proposed

for the CHIPS project studied in this report requires enough heat to make cogeneration feasible.

VI. Biodiesel Production

Production of biodiesel using wood products is a technology that has yet to be introduced in a marketable form. Literature is available on production of biodiesel from agricultural products and the production of ethanol from wood products. The CED will include research on the production of ethanol using wood if resources from the project remain to do so, although the CED believes additional research on cedar use (above) is more likely to result in a marketable product for CHIPS than fuel production because of the potentially high price point for cedar.

Production Process

Biodiesel is a fuel produced from renewable sources. It is often blended with petroleum diesel to create what is known as a biodiesel blend.[21] Biodiesel can be produced in several different ways, although the majority of biodiesel is produced through a process where; "A fat or oil is reacted with an alcohol, like methanol, in the presence of a catalyst to produce glycerine and methyl esters or biodiesel. The methanol is charged in excess to assist in quick conversion and recovered for reuse. The catalyst is usually sodium or potassium hydroxide which has already been mixed with the methanol."[22]

No studies to date conclusively determine the technical feasibility of producing biodiesel from wood, much less the economic feasibility. David Pimentel from Cornell was contacted by the CED because of his research on ethanol production from wood and biodiesel production from soybeans and sunflower. When asked about the possibility of biodiesel production from wood the only information he gave was to refer back to the original article.[23] The CED found no supplemental information on the technological feasibility of producing biodiesel from wood. Of the fifty-three commercial biodiesel production plants in the United States, not one of them uses wood or wood waste as the primary material.[24]

There are some possibilities of producing ethanol from wood. Producing fuel from biomass may become more financially feasible if government policy changes in ways that encourage fuel from biomass. In President Bush's State of the Union address on January 31, 2006, he stated "We will also fund additional research in cutting-edge methods of producing ethanol, not just from corn but from wood chips and stalks or switch grass."[25] This could provide the possibility of additional funding in the future and might make ethanol or other fuels more economically and technologically feasible. However, at this time, there is not enough available information from which to draw any conclusions.

---

[21] "Biodiesel Basics." Biodiesel. National Biodiesel Board. 22 Mar. 2006 <http://www.biodiesel.org/resources/definitions/default.shtm>.
[22] "Biodiesel Production." Biodiesel. National Biodiesel Board. 22 Mar. 2006 <http://www.biodiesel.org/pdf_files/fuelfactsheets/Production.PDF>.
[23] Pimentel, David, and Tad W. Patzek. "Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower." Natural Resources Research 14.1 (2005): 65-76.
[24] "Commercial Biodiesel Production Plants." Biodiesel. 31 Jan. 2006. National Biodiesel Board. 22 Mar. 2006 <http://www.biodiesel.org/buyingbiodiesel/producers_marketers/ProducersMap-Existing.pdf>.
[25] Bush, George W. "State of the Union Address." Congress, Washington D.C. 31 Jan. 2006. 21 Mar. 2006 <http://www.washingtonpost.com/wp-dyn/content/article/2006/01/31/AR2006013101468.html>.

Conclusion

The CED's research on biodiesel led to the following conclusions:

- Biodiesel can be made from any naturally occurring plant oil or animal fat as long as the resulting product meets certain specifications. Wood products do not meet these specifications.
- Soybean oil is the most commonly used feedstock for biodiesel production in the United States, followed by recycled waste grease.
- Ethanol can made from cellulose, although this product requires a low-cost cellulose product that few have tried to commercially produce using wood.

VII. Additional Considerations

In this section, the CED explores some options that either combine concepts presented in previous sections or otherwise did not fit into any of the previous product analyses.

Combination Pellet Mill and Wood Chips Production

Potential may exist to combine the process of wood pellet production and the resale of wood chips and mulch, including bark. The only wood part unsuitable for producing wood pellets is bark because of its high silica content. If the bark can be separated and remain clean before the core wood is used to produce pellets, then the CHIPS project may be able to grind or chip the bark for retail or wholesale distribution. The project would be limited to small-size bark products, although this product may offer a favorable price because it is already being collected to produce wood pellets. The bark may also be mixed with other small-piece chipped wood to produce marketable mulch.

Operation of a Mini Sawmill

One possibility for collection of wood product is the use of a "mini sawmill." A mini sawmill refers to a mobile machine that has been designed specifically for the purpose of rapidly processing small-diameter logs. Modern multi-blade mini mills can rapidly produce cants and lumber from logs that range from 6 to 30 inches in diameter and from 8 to 16 feet in length.[26] Mini mill systems can be implemented to mock nearly all of the functions of a large capacity lumber mill. Mill extensions can be purchased, such as chippers, planers, and kilns. The CED analyzed the business plan of an urban tree recycler implementing a mini mill system to provide an example of associated costs and processes.

The Iowa Heartland RC&D have shown figures on the production of 800 board feet operating eight hours a day. Table 8 illustrates relative capital costs. Table 9 represents the associated operation costs.

[26] NCDC. Small sawmill feasibility studies. www.ncdcimaging.com/economic.php. 2005

Table 8 – Detailed Budget of a Portable Sawmill

Item	Number	Cost Each	Total
16.5 Acres (Appraised 475,000)[1]	1	$ 250,000	$ 250,000
Band Re-Saw Mill	1	$ 65,000	$ 65,000
Planer	1	$ 6,000	$ 6,000
Firewood Splitter	1	$ 22,500	$ 22,500
Bobcat Loader	1	$ 18,550	$ 18,550
Woodmizer Portable Mill	1	$ 18,000	$ 18,000
Kilns Nyle L300 (8,000 Bd. Ft. Ea.)	2	$ 13,750	$ 27,500
Truck with Grapple	1	$ 11,500	$ 11,500
Edger	1	$ 6,000	$ 6,000
Cutoff Saw	1	$ 1,500	$ 1,500
Wood Moisture Meter	1	$ 1,200	$ 1,200
Metal Detector	1	$ 1,400	$ 1,400
Chainsaw	3	$ 750	$ 2,250
Wood Boiler	1	$ 6,500	$ 6,500
Subtotal for Land and Equipment			$ 437,900

Source: Iowa Heartland RC & D, Business Plan, 2002
[1] Probably not applicable to the CHIPS project.

Table 9 – Operating Costs of a Portable Sawmill

Type	Month	Annual
Electricity	$ 86	$ 1,032
Fuel	$ 100	$ 1,200
Saw Blades	$ 100	$ 1,200
Chipper Knives	$ 100	$ 1,200
Water	$ 300	$ 3,600
Blade Sharpening	$ 100	$ 1,200
Travel	$ 50	$ 600
Repairs and Maintenance	$ 600	$ 7,200
Miscellaneous (trash, etc.)	$ 1,200	$ 14,400
Subtotal for Operating Costs	$ 2,636	$ 31,632

Source: Iowa Heartland RC & D, Business Plan, 2002

With an unknown consistency of diameter in the supply of timber, a compact and portable mill that employs a broad range of capabilities may provide a feasible and economic solution to the removal of small-diameter trees in the Project Area.

With all of the potential extensions, the mini mill could be utilized to make larger wood chips for landscaping or sale to electricity-generating facilities, separate bark for independent sale, chip wood into very small pieces for mulch or, if no bark is present, wood pellets. There may be some economic advantages to purchasing a mini mill to provide products for both landscaping materials and wood pellets, although this should be determined for certain during the development of a business plan for the CHIPS project.

The drawback to a mini sawmill is that it is designed to saw wood into boards, although the boards that could be produced from small-diameter trees may have limited market potential. If a market can be found for boards or posts from small-diameter trees, then a mini sawmill may be feasible.

Legal Organization of CHIPS

While discussing this project with Project Area community members, a request was made to comment on possible legal organizations for the CHIPS project. There are many possible legal organizations available, including

- For-profit corporation
- Proprietorship or partnership
- Native American corporation
- Nonprofit organization
- Special district (quasi-governmental)
- County of Calaveras

The CED is unable to recommend a legal organization for CHIPS without knowledge of who is willing to take a leadership role to start and operate the project. All legal organizations have advantages and disadvantages, and often times these are unique to an individual leader's personality, management/accounting style, and financial risk tolerance. Once a project leader has been identified, the CED recommends working with the Delta Small Business Development Center for information on developing a private organization, the California Association of Nonprofits for information on developing a nonprofit organization, and the California Special Districts Association for information on setting up special districts.

Conclusion

Other options that the CHIPS project should consider include:

- Production of multiple marketable products taking advantage of shared equipment and transportation.
- Consider and research additional marketable products that can be produced independently or using resources shared with the production of other products.
- Choose a project leader willing and able to direct the project as it develops a business plan to produce products utilizing Project Area timber.