2014 Technology Assessment Program Grant Report

Foresthill Biomass Utilization Feasibility Study

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Prepared for:
Placer County Air Pollution Control District

Prepared by:
Technical Feasibility Assessment Team led by the Placer County Resource Conservation District

Technical Feasibility Assessment Team

Phoenix Energy: Greg Stangl and Matt Cook
TSS Consultants: Fred Tornatore
Consultant: Steve Eubanks
Placer County Water Agency: Andy Fecko, Ryan Cline and Darin Reintjes
Placer County Planning Services Division: Brett Storey and Gerry Haas
Placer County Air Pollution Control District: Bruce Springsteen
Placer County Resource Conservation District: Elisa Noble

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Special thanks to the Foresthill Bioenergy Steering Committee:

Duane Frink, Chair
Chase Dowling, Vice Chair
Sue Anderson
Neil Cochran
Robin Guthrie
Tyler Harkness
Robyn Husmann
Keith Light
Laura Nelson
Scott Nelson
Michelle Roper
Sherry Wicks

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1.0 Executive Summary

This report describes a preliminary feasibility assessment for a biomass energy facility in the Foresthill, California area. The assessment covered the important elements of feasibility including long-term sustainable biomass feedstock availability, suitable technology to utilize the available biomass feedstock, possible facility locations, environmental considerations, and basic economics.

This report includes the following results:

- Analysis indicates that approximately 20,640 Bone Dry Tons (BDT) of biomass feedstock is available annually on a long-term sustainable basis. Of this total, 16,590 BDT are from sources that are from public and private lands where budgets for projects producing the biomass are relatively reliable. The remaining projected biomass is from other sources where budgets for projects producing biomass are less certain. The amount of biomass feedstock available on a sustainable basis is estimated to be sufficient for a 1 to 2 megawatt energy facility.

- The assessment included comparisons of the most common biomass to energy technologies - direct combustion systems that produce steam to power a turbine generator, and gasification systems that produce synthetic gas to power an internal combustion engine that in-turn powers a generator. Also considered was the option for systems that produce only heat. The technology assessment included factors such as sensitivity to temperature and humidity, water consumption requirements, feedstock consumption/efficiency, air emissions, and labor costs. Also considered was the ability for gasification facilities to produce biochar, a byproduct that can be used for soil nutrient enhancement or water filtration, and may provide an important potential economic benefit. Overall, gasification technology was found to offer the best economic feasibility.

- Several potential locations were analyzed based on criteria including existing zoning, proximity to sensitive receptors, proximity to the existing electrical grid, access for truck traffic, and size of the site. Based on the screening criteria, the most feasible location was determined to be a site just east of central Foresthill and south of Foresthill Road (Figure 7, page 29). The site is only a representation of potential locations for a facility.

- While no formal environmental analysis was completed for this study, the technical team discussed environmental factors such as potential traffic, air emissions, noise from facility operation, and impacts to biological and cultural resources. The discussion was based upon the experience of the team. Included was identification of the various permits that would be necessary if a facility is proposed. Based on experience from other biomass energy projects, the assessment determined that most or all potential impacts for a facility in the Foresthill area can be reduced to less than significant levels through incorporation of mitigation measures and sound project design.

- Assessment of economic feasibility for a biomass energy facility considered factors such as likely price of electricity, ability to contract for biochar at the price and quantity necessary, and the ability to acquire biomass feedstock at the price and quantity necessary. Overall, the economic assessment showed that a biomass facility of the size estimated to be possible for the available supply of biomass feedstock would have marginal economic feasibility. There is potential for using biomass only for heat, particularly in the industrial-zoned west end of Foresthill or if a future industrial park is developed, but this option requires further analysis.

Overall, the feasibility assessment showed that a biomass energy facility in Foresthill is potentially feasible, but marginal economically. This indicates that further analysis is warranted before any firm project proposal can be developed.

Based on the Proposed Decisions (dated August 14th, 2015), which is subject to further modification and approval by the California Public Utilities Commission, we believe the following items will be required to enter a project into the SB1122 Queue:

	Cost		Estimate time in	
Major Tasks to enter the SB1122 Queue	**Low**	**High**	**business days**	**Note:**
PPR Form	0	0	n/a	
Non-refundable application fee:	4,000	4,000	n/a	$2*KW
Completed System Impact Study	15,800	50,000	80	based on Phoenix Energy actual costs incurred, thought PGE now states that $10.8K is the expected value
Electrical one-line diagram	5,000	10,000	10	Needed for SIS application
Geographic Information System file of the project boundry	0	1,000	n/a	
Site control documentation	0	0	n/a	Needed for SIS application
Site plan drawings	5,000	10,000	10	Needed for SIS application
RPS Elligibillity pre-certificate	0	5,000	20-40	Application with CA Energy Commission
Such other information as requested by IOU	unknown	unknown	unknown	
	$ 29,800	$ 80,000	90 business days	

2.0 Assessment Approach

A team of agencies and individuals experienced in completing biomass to energy feasibility plans, as well as in the development and implementation of operating facilities in California, was assembled to explore the feasibility of establishing a biomass energy facility in the Foresthill area. The team analyzed multiple essential issues and synthesized the results into a reliable overview of results and recommendations in a six month period. This approach was intended to be an initial feasibility assessment to ensure that a biomass to energy facility would be viable for this region. Further, more detailed, analyses would need to be performed to determine the specific size and technology that would be economically feasible and sustainable for the Foresthill area.

The study assessed multiple facets, including the potential for sustainable biomass feedstock, facility location, technology, logistics, initial economics, and community support. Specific capabilities for technology integration, transmission potential, energy sales, environmental considerations and economic options are detailed in this final report. Recommendations and possible next steps are also included.

A budget of $30,000 from a Placer County Air Pollution Control District (PCAPCD) Technology Assessment Program (TAP) grant was managed by the Placer RCD for the consultant team's tasks. Additional in-kind funding for personnel (valued at $30,000) was provided from local agencies to provide experience in biomass energy operation, and to ensure conformance with applicable regulations. Finally, a grant amount of $7,460 was provided from Middle Fork Project Fuel Management Program funds (a combination of Placer County and the Placer County Water Agency) to facilitate community involvement.

The full grant proposal entitled "PCAPCD Technology Assessment Program Grant Proposal – Foresthill Biomass Utilization Feasibility Study" can found at www.placercountyrcd.org.

In addition, the information and analyses from this project were utilized by the Placer Resource Conservation District (Placer RCD) to inform a complementary study titled, "Value-Added Forest Material and Uses for an Integrated Product Yard in the Foresthill Area" (Value-Added Product Yard Study). This study, funded with $10,000 from the Sierra Nevada Conservancy, provided information on how feedstock that is not suitable for conventional lumber products might be used for other products besides energy in an economically, socially, and environmentally acceptable program.

3.0 Feasibility Assessment

3.1 Biomass Feedstock Assessment

Introduction

Biomass included in this analysis is woody biomass that is produced by a variety of hazard reduction and forest management projects. There is also the possibility of some biomass from orchard maintenance in the area west of Auburn, though the amount would be minor. For all sources, the woody biomass, commonly referred to as "excess biomass," consists of limbs, tops, brush, stems of small trees, and larger logs that are defective. None of this excess biomass is suitable for lumber, but some might have utility for miscellaneous products like posts, poles and compost.

Specifically, the woody biomass analyzed is generated from the following categories of projects:

- Forest Management: These are projects in forestland that may include a goal of hazard reduction but are intended to meet certain forest management goals such as increasing growth, short and long-term economic return, wildlife habitat maintenance and improvement, and protection of watershed values. Specifically, this category includes commercial thinning, mature forest harvest—both even age and partial cutting—and pre-commercial thinning[1] (PCT) of forest plantations. Trees larger than about 10" in diameter in this category generally have economic value for lumber and other products, while smaller trees do not.
- Hazard Reduction: These are projects in forestland, brush land and oak woodlands with the primary goal of reducing fuels and associated fire hazard. This category includes both large and small ownerships, some of which are located in and around communities. Some hazard reduction projects may include removal of trees larger than 10" in diameter that have economic value for lumber and other products, but that is not a primary objective.
- Power Line Maintenance: Power line maintenance involves removal of brush and trees that encroach on power line rights of way or power lines.
- Orchard Maintenance/Replacement: This category consists of annual orchard pruning material, and whole trees that are removed when they reach maturity and must be replaced.

Biomass Feedstock Supply Area

Feedstock analyses for biomass feasibility assessments usually consider an approximate circular area with the center at the proposed facility location and a radius that is 30 to 40 miles, since that distance is generally considered to be an economically feasible haul distance. However, distance from a potential energy facility is not always the best measure because travel times vary greatly depending on the availability and quality of road access. This is particularly true for a facility in the Foresthill area because

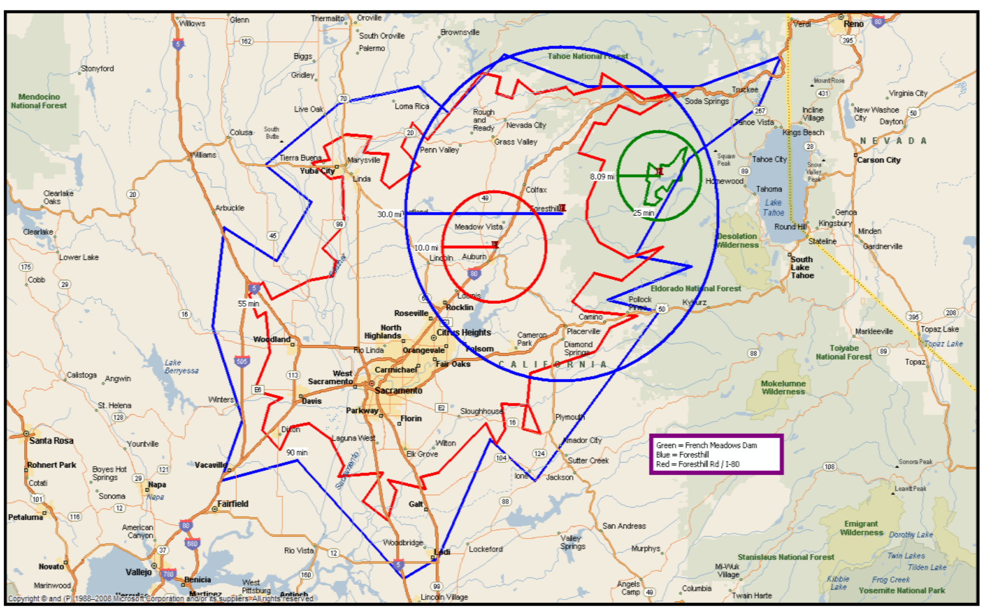
[1] Pre-commercial thinning involves cutting excess trees in areas that are over-stocked. This applies to areas where trees are less than 10 inches in diameter and have no commercial value for lumber products.

travel is constrained by lack of road access to the south and north, and also due to slow travel along the Mosquito Ridge Road to the east.

West of French Meadows, there is no access to areas south of the Middle Fork American River that would normally be well within the feedstock supply area. Truck travel time from French Meadows to Foresthill is about one hour, so some land beyond French Meadows to the east and south is considered to be economically accessible. Iowa Hill and the Iowa Hill Road generally define the northern boundary of the area directly accessible from Foresthill. The feasible haul distance from the west goes well beyond Auburn because of the good access provided by Interstate 80. Some areas west of I-80 between Gold Run and Auburn are also feasible for haul to Foresthill via Foresthill Road. The area between Lincoln and Auburn generally has good accessibility, but much of the area is closer to the Rio Bravo energy facility in Rocklin along highway 65.[2]

An approximate feedstock supply area is shown in Figure 1. In this map, supply areas of 30 miles and 90 minutes from Foresthill are shown in blue, supply areas of 10 miles and 55 minutes from the junction of highway I-80 and Foresthill Road are shown in red and supply areas of 8 miles and 25 minutes from French Meadows dam are shown in green. As discussed above, the portions of supply areas south of the Middle Fork American River can be ignored, with the exception of the areas shown in green. The separate French Meadows mapping is shown because travel time to that location from Foresthill by trucks is approximately one hour. In general, the travel time mapping is more pertinent than the distance mapping, but it is important to note that the travel time mapping is based on cars or light vehicles and not trucks —particularly loaded trucks— so feasible travel distances may be somewhat less than shown.

Figure 1. Approximate Feedstock Supply Area



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[2] Per information from Tad Mason of TSS Consultants, Rio Bravo's current energy price amendment terms out in 2016 and may not be renewed, and their master contract with PG&E terms out in 2020. If Rio Bravo shuts down, this area could provide feedstock to Foresthill.

Feedstock Supply Estimates

Calculations of available feedstock were made based on information about projected program levels on various ownerships within the feedstock supply area. Program levels were obtained for both public and private land where forest management projects are occurring or where projects will focus primarily on hazard reduction. Available biomass feedstock estimates include assessment of the general probability that the feedstock amounts can be relied upon as a stable supply. The probability is related to how projects that will supply the biomass are funded, and whether or not that funding is reasonably assured.

In the case of projects on national forest land (managed by the U.S. Forest Service), long-term project levels are assumed to be stable at current projected levels. For Bureau of Land Management land, funding has been inconsistent due to lack of general funding. That inconsistency is projected to continue. Projects on private industrial forestland have been fairly stable and discussions with major landowners/managers indicate a continuation of current levels of treatments. On private nonindustrial lands, projects are primarily focused on hazard reduction, and are generally dependent on grants. While grant funding is currently available, it cannot be fully relied upon as a long-term, stable funding source. These projects on private nonindustrial forestland are important and valuable, but they do not produce the volume of biomass that is generated by private and public forestland management

In addition to feedstock supply probability, access to feedstock by chip trucks must also be considered. Not all roads to harvest unit landings will accommodate normal chip trucks, which have a long trailer wheelbase and are not as maneuverable as logging trucks that carry their trailers piggyback into landing areas. For lands within 10 miles of Foresthill, it is assumed that smaller trucks would be economically feasible to use on secondary and tertiary roads that would not accommodate normal chip trucks. To account for the lesser accessibility, a factor of 90% is applied to biomass from national forest lands and other lands within 10 miles of Foresthill and a factor of 80% is applied to other biomass. On Mosquito Ridge Road, a major artery that connects Foresthill to French Meadows and beyond, pilot vehicles are required to accompany chip trucks on the winding sections of the road to ensure safety for other vehicles. Use of pilot vehicles can increase costs for some projects, and that may result in shorter economical haul distance for chips.

Description of Feedstock Supply by Source Category

Table 1 below summarizes the approximate woody biomass feedstock available from each of the sources that are subsequently discussed below.

Table 1. Approximate Woody Biomass Feedstock Availability

(Feedstock that is dependent on grant funding is shown in blue)

Land Ownership Category	Biomass Available/Yr.—Gross	Biomass Technically Available/Yr.
USFS American River RD	7,000 BDT	6,300 BDT
USFS Georgetown RD	1,000 BDT[3]	800 BDT*
BLM Mother Load Field Office	700 BDT	630 BDT
Private Forestlands		
Ryan Family	1,600 BDT	1,440 BDT
AT&T Pension Fund	6,800 BDT	5,440 BDT
American River Conservancy	1,600 BDT	1,280 BDT
Other Private Lands		
General Projects	4,500 BDT	4,050 BDT
Middle Fork Funding	1,500 BDT	1,350 BDT
PG&E Power Line Maintenance	150 BDT	150 BDT
Agriculture/Orchard	Minor, Not Included	
TOTAL	24,850 BDT	21,440 BDT

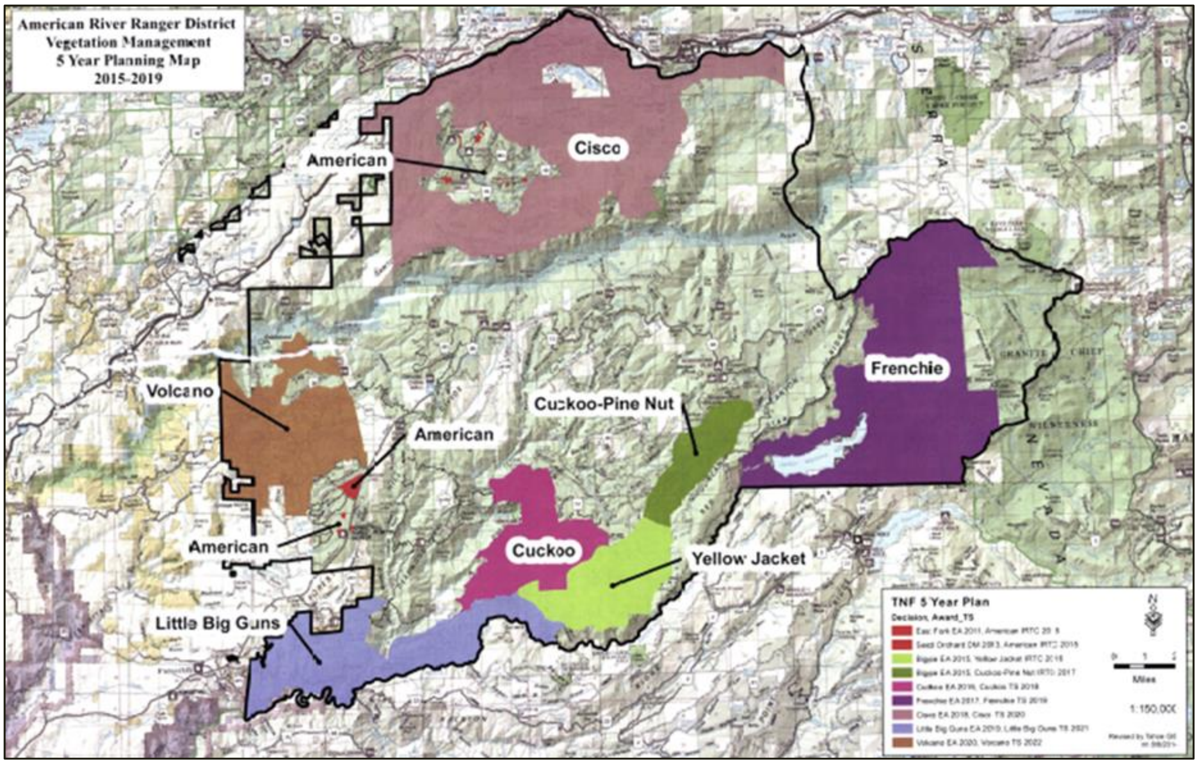
U.S. Forest Service, American River Ranger District, Tahoe National Forest. The American River Ranger District (ARRD) of the Tahoe National Forest (TNF) prepares a planning document each year that shows several years of timber sale and vegetation management projects. The current planning document indicates an average annual program of timber sales of approximately 5.8 million board feet (MMBF). These timber sales will generally consist of thinning forest stands to reduce wildfire hazard. Such thinning involves cutting trees, approximately 60 percent of which are small size (10" to 16" diameter) and 40 percent of which are medium size (18" to 29.9" diameter). In order to reduce the amount of potential hazardous fuel in the timber sale areas, most projects require whole tree yarding which involves pulling cut trees to a central area called a "landing" where the limbs and tops are removed and put in piles. In some cases, trees smaller than 10" and non-merchantable logs not needed for wildlife habitat are also pulled to the landings and placed in the piles. The piled material has no commercial value for wood products and, absent a market for biomass, is usually open-burned. No PCT is separately planned, but is completed within areas where projects are carried out.[4] It is estimated that forest management projects on the ARRD will produce an average of 1200 BDT of biomass for every 1.0 million board feet (MMBF) of estimated forest management project output. This estimated amount accounts

[3] These amounts are a rough estimate of biomass volume from two projects for which initial estimated volume has been impacted by the 2014 King Fire—final volume has not been determined. And the volumes will be created only for 4-5 years starting in 2015.

[4] ARRD information from Tony Rodarte, ARRD Vegetation Management Officer

for the larger amount of excess biomass produced from small tree harvest and from concurrent PCT within harvest units.[5] Figure 2 is a map of the ARRD five year plan for projects within this area.

Figure 2. TNF ARRD Five Year Planning Map



U.S. Forest Service, Georgetown Ranger District, Eldorado National Forest. The Georgetown Ranger District (GRD) of the Eldorado National Forest (EDF) was heavily impacted by the King Fire in 2014. Other than two existing projects just to the east of the King Fire area that were not fully impacted by the fire and may proceed, there is little likelihood of forest management projects tributary to Mosquito Ridge Road for the foreseeable future. The two existing projects may produce as much as 12 MMBF of wood products and about 10,800 BDT[6] of biomass in the next few years, and would decline to zero after that. These projects will also involve whole tree yarding and piling at landings, followed by burning of the piles if no market exists for biomass.[7] There may also be some future PCT projects in the areas impacted by the Star and King Fires but the acreage and biomass are not currently predictable.

Bureau of Land Management, Mother Lode Field Office. The Bureau of Land Management (BLM) manages several thousand acres within the feedstock supply area. However, much of the land is steep and inaccessible, and is comprised of brush and/or oak woodlands. Approximately 2,000 acres are

[5] Conversion estimate from Tad Mason, TSS Consultants

[6] Conversion estimate, 900 BDT/MMBF from Tad Mason, TSS Consultants

[7] GRD information from Pat Ferrell, Timber Management Officer, and Dana Walsh, North Zone Silviculturist

accessible to roads and of that acreage, about 1,500 acres is suitable for commercial thinning. About 500 acres has completed environmental documentation but implementation of a project is awaiting available funding. This project would involve thinning trees less than 8" in diameter followed by mastication of the cut trees and brush and some hand piling and burning. There currently is no projected funding for future projects, though the potential exists. If a market existed within economic haul distance of BLM projects, mastication might be replaced with biomass removal and utilization. Overall, it is estimated that about 100 acres of management will occur on BLM land annually in the Foresthill area, producing about 7 BDT per acre. [8]

Private Forestlands. This category includes forestlands that are or can be managed with projects that have an emphasis on forest products or hazard reduction, and that generate excess biomass. Included are lands owned by the Ryan family, and lands that are owned by the AT&T Pension Fund and managed by Mason, Bruce and Girard on behalf of Forest Investment Associates.

The Ryan family lands, a total of approximately 3,000 acres, are located around Foresthill and currently are being managed primarily with hazard reduction projects with no attempt to produce commercial products. About 200 to 300 acres of treatments are completed each year by mastication (grinding) of brush and smaller trees and removing lower limbs of remaining trees, followed by bulldozer piling and burning of the piles. Much of this treatment is being completed with the objective of hazard reduction and/or providing wildfire protection for the town of Foresthill. It is estimated that an average of 8 BDT of biomass per acre will be generated by these treatments. [9]

AT&T Pension Fund lands, currently managed by Mason, Bruce and Girard (MBG) on behalf of Forest Investment Associates, total approximately 40,000 acres (see Figure 3). About 10,000 acres of this ownership are in escrow for sale to the American River Conservancy. The sale is projected for completion during 2015. Details for management of the 10,000 acres are discussed below. About half of the remaining 30,000 acres are considered to be within an economically feasible biomass haul distance/time of 1.5 hours. These lands are being managed for long-term production of forest products and for reduction of wildfire hazard. Current plans are to harvest mature stands with even-aged management, primarily clearcutting. General plans call for about 400 acres of harvest each year. MBG estimates that harvesting timber stands produces about 6 BDT of biomass per acre. About 300 acres of PCT and about 100 acres of standalone biomass treatment are also projected each year, with each treatment producing about 15 BDT of biomass per acre. [10]

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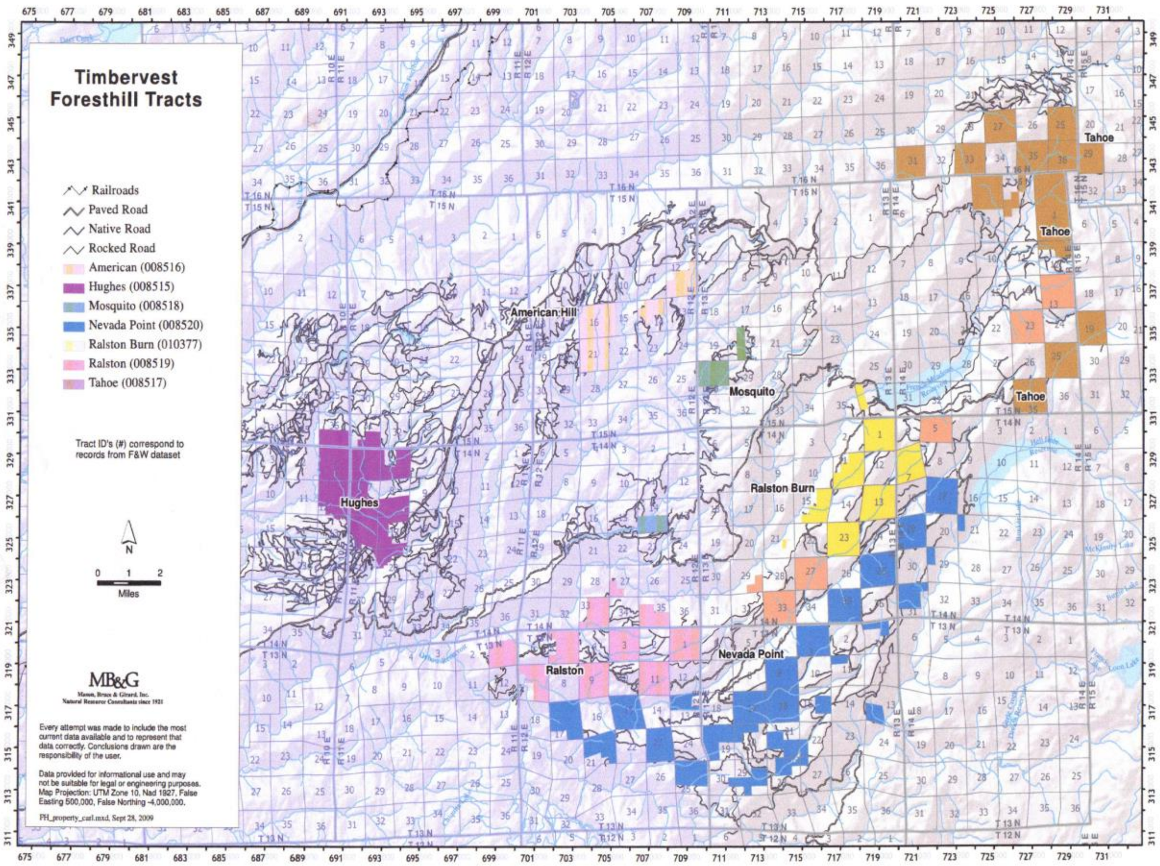
[8] BLM information from Jerry Martinez and Brian Mullhollen; biomass amount based on similar biomass treatment estimate from Robert Galliano for MBG-managed lands

[9] Information and estimate based on discussion with owner, Mike Ryan

[10] Per information from Robert Galliano and Larry Gonzales of MBG, clearcuts produce an average of about 1/3 to 1/2 load of biomass per acre, and other treatments produce an average of about 1 load of biomass per acre.

Figure 3. AT&T Pension Fund Lands Managed by Mason, Bruce and Girard



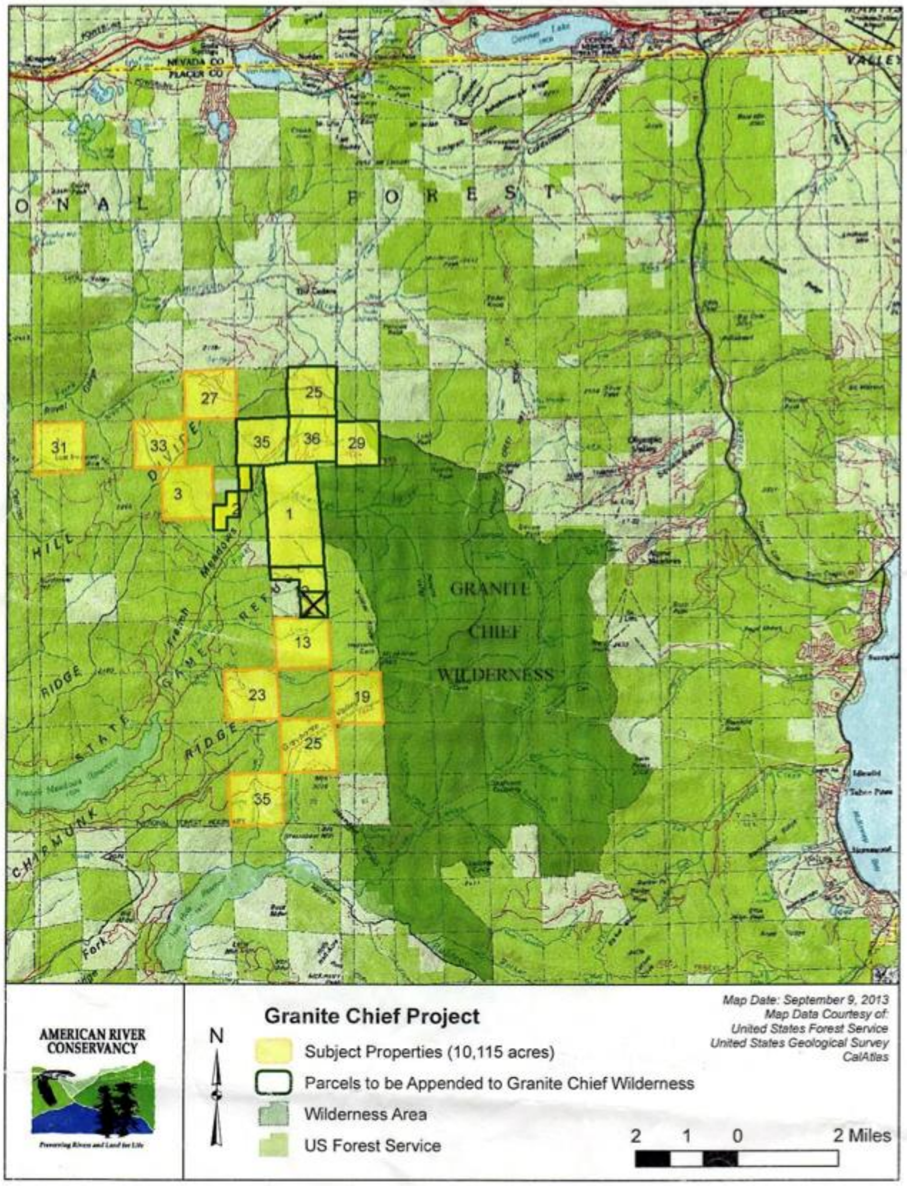
Lands being sold to the American River Conservancy total about 10,000 acres and are located east, northeast and north of the French Meadows reservoir (see Figure 4). [11] No management is currently occurring on these lands, but it is anticipated that projects totaling about 200 acres per year will begin in 2016, with an emphasis on partial cutting to reduce wildfire hazard. This would include some commercial products and associated excess biomass, plus biomass from forest stands where no commercial products exist.[12] It is estimated that an average of 8 BDT of biomass per acre will be produced on these lands. These lands are at the outer limit of an economically feasible commercial haul for biomass, but a biomass market would provide some incentive for utilization of the biomass in lieu of burning.

[11] Sections shown in brown and salmon colors and located in the upper right of Figure 4

[12] Per discussions with Robert Suter, consulting forester who is involved in the pending sale of the property

Figure 4. Land Being Sold to the American River Conservancy (Sections Shown in Yellow)

SUBJECT TOPOGRAPHICAL MAP



<u>Other Private Lands.</u> These are lands that vary in ownership size and are not focused on regular management. Most are not well suited for commercial forest management and projects are mostly for reducing hazard on a specific ownership or in a general overall area. Most projects are either partially or fully funded with grant monies, and are coordinated by the Foresthill/Iowa Hill Fire Safe Council in concert with the Placer County Fire Safe Alliance. These projects implement shaded fuel break standards—cutting and/or mastication of brush and small trees, pruning of some trees, and creating 20-foot spacing for leave trees. No burning is done. The amount of area treated annually varies but based

on historically available funding and professional judgment, it is projected that an average of 400 acres per year - 100 acres of which will be funded by the Placer County Water Agency Middle Fork Project - will occur in the future, producing an average of approximately 15 BDT of biomass per acre. [13]

PG&E Power Line Maintenance. PG&E power line maintenance is done by contractors that cut and chip encroaching brush and trees. Currently, chipping contractors give the chips to interested private parties. Maintenance is ongoing on a regular basis and, for power lines from Auburn up to the Foresthill area, creates an average of about 1,000 cubic yards of biomass per year. [14] This equates to about 10 to 12 chip truck loads and, at 15 BDT per load, this then equates to about 150 to 180 BDT per year. Biomass from power line maintenance beyond Auburn is unlikely to be economically feasible to haul to Foresthill in the smaller trucks used by maintenance crews.

Agriculture/Orchard Biomass. Placer County contains about 1,300 acres of orchards. The largest category, walnuts, comprises about 850 acres and is the most likely source of biomass—from annual pruning and periodic replacement.[15] Other orchards may produce some pruning and replacement biomass, but the amount is minor. Orchards in Placer County are more concentrated in the western part of the county where biomass is much more likely to go to the Rocklin-based Rio Bravo energy facility, but some, located in the foothills near Auburn, may be a minor source of biomass.

Energy Facility Size

Gasification energy facilities require approximately 1 BDT of biomass per megawatt (MW) hour of output, or 24 BDT per day and 8,000 BDT per year for a 1 MW installed capacity facility. However, to allow for fluctuations or changes in supply availability, investors and banks generally like to see availability of at least two times the biomass feedstock needed for actual operation - commonly referred to as a 2:1 "cover ratio" – that basically serves as a "safety factor" to ensure their funding is reasonably protected.[16] Therefore, the 21,440 BDT of biomass that is estimated to be available annually would be sufficient for a 1.3 to 1.5 MW gasification facility.

Feedstock Processing and Transportation

The processing (chipping or grinding) of excess biomass and transportation of the chips or grindings to an energy facility represents a large cost center that often makes energy production infeasible, and is the main factor driving land managers to burn excess biomass in lieu of utilizing it. Due to this situation, the number of companies doing the processing and transporting has declined. There is, however, one new company headquartered in the Foresthill area that is planning to start operations in 2015. This company will do both grinding and transporting of feedstock. Having Foresthill as headquarters may

[13] Per information from Luana Dowling, Fire Safe Council and Placer County Fire Safe Alliance; biomass amount based on biomass treatment estimate from Robert Galliano for similar treatments on MBG-managed lands
[14] Information from Rand Smith, PG&E Vegetation Management Supervisor
[15] Information from Placer County Crop Report and correspondence with Joshua Huntsinger of Placer County Agriculture Department
[16] Per information from TSS Consultants

provide this company with a competitive advantage for providing feedstock to a facility in Foresthill because trucks and drivers would not have to return to another location after the workday is over.

3.2 Facility Capability Range

While gasifiers have a broader capability range, which is the realistic limiting factor in scale, the most important choice for a gasification system is the type of standard internal combustion engine utilized to power the generator. Based on costs per kilowatt (KW) installed and Phoenix Energy's operating experience, building blocks of the following gross power ratings on syngas are the most appropriate sizes: 1172KW, 912KW, and 540KW for General Electric (GE), and J612, J420 and Cat 3516G for Caterpillar. All of these models have individual considerations that must be weighed carefully based on a project's goals. Parts availability and cost, availability of local technicians, and project performance requirements must all form part of a decision matrix. For instance, the CAT 3516 has lower electrical efficiency but rejects (wastes) more heat as a result. If there is a value use for on-site heat, this may be an advantage, which would be factored into a final decision. Some vendors such as GE offer performance guarantees based on use of syngas, while others such as Cummins have yet to do so. While this is a very involved selection process, it is most important to size the gasifier for the engine, not vice versa.

Table 2 below is a very brief example based on Phoenix Energy's operating experience, and is not intended to be an exhaustive list. Other engine vendors, such as Generac, Waukesha, Cummins, Volvo, GM, and Guascor may also be used. Furthermore, technology and commercial terms changes rapidly. The project should consider all options carefully should it move forward.

There is a parasitic energy load - electricity used for pumps, motors and electronics used to operate the plant - on site of between 10 and 15 percent.

Table 2. Estimated Power Output of Engines

VENDOR	MODEL	GROSS POWER OUTPUT ON SYNGAS	ESTIMATED NET POWER OUTPUT
GE	J612	1,172 KW	1,000 KW
GE	J420	970 KW	825 KW
CATERPILLAR	3516G	580 KW	493 KW
CUMMINS	GTA1710	250 KW	212 KW

Since there are reasonable economies of labor on project size - e.g., there is little operating labor cost difference between operating a 1 MW versus a 2 MW plant - it takes the same amount of time to do most maintenance items on two J420 engines as it does two J612 engines. However, gasification does not scale particularly well. While there is insufficient operating performance history for large-scale biomass gasifiers, it is Phoenix Energy's opinion that there are better non-gasification technology options that should be considered for facilities larger than 3 to 5 MW.

Finally, no consideration would be complete without including the commercial terms of the recommended contract, which encourage modular systems due to production and system availability guarantees.

Taking all of these factors into consideration, the optimal facility operational size should be based on the largest suitable engine that could be used in series to move towards the 3 MW limitation of the SB1122 program. The size limit would be imposed by sustainable feedstock availability.

3.3 Energy Sales Potential

Study team members from Placer County, Placer County Water Agency, and Phoenix Energy investigated three potential avenues for electricity sales for a Foresthill bioenergy facility. While there are many ways to sell electric power, the three below offer the clearest path to market, and are likely to provide the highest return with the least contract risk:

1) Renewable Market Adjusting Tariff (ReMAT) (aka "feed-in-tariff")
2) Senate Bill (SB)1122 - Bioenergy Feed-in-Tariff (Bioenergy FIT)
3) Open market sale - Public Utility Regulatory Policies Act (PURPA) or California Independent System Operator (CAISO) through PCWA

It is important to understand the differences between the ReMAT program and the SB1122 program. SB1122, passed in 2012, introduced a variant of ReMAT with a sector focus on bioenergy. Forest-sourced biomass power was given an even greater direct carve-out for higher electricity prices from the three major investor-owned utilities: Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric. PG&E would be the purchasing utility for the Foresthill area.

The contract terms for ReMAT and SB1122 are expected to be essentially identical. In the eighth round of ReMAT, the current pricing for base load projects was 8.9¢ per kilowatt hour (KWh). The auction start price for the first round of SB1122, (anticipated in the second quarter of 2015) is just under 12.8¢ KWh. Since the contract terms are largely similar and only SB1122 has a carve-out that will favor forest-sourced biomass, the ReMAT process is not recommended for a Foresthill facility unless there is some interruption in the SB1122 program.

Consideration was also given to having a Foresthill facility sell power into the open (CAISO) or PURPA markets, and having such sale administered as part of the Middle Fork Project (MFP) Finance Authority future open-market operations. This option would have the advantage of eliminating most of the adverse contract provisions in the investor-owned utility (IOU) contracts; however, power purchase agreements and an interconnection must still be negotiated. This option would also benefit considerably from being included in the management of an existing operation, which would reduce some administration costs and increase overall reliability by inclusion into a large pool of power currently generated by the MFP hydroelectric project that is owned and operated by the Placer County Water Agency. However, selling power as part of the MFP future operation would not benefit from the higher proposed pricing under the SB1122 program. The current daily average spot price for electricity is 3 to 4¢/KWh for all resources transacting through the CAISO marketplace. In addition, a bilateral contract to assign the renewable energy credit to an entity that is required to procure a specific percentage of their portfolio from renewable sources might yield an additional 3 to 4¢/KWh. With current natural gas pricing and the abundance of inexpensive supplies, this pricing paradigm is expected to be stable for the foreseeable future.

After considering the three possible energy sales avenues for a Foresthill facility, the study team members recommend the current Bioenergy Feed-in-Tariff (FIT) under SB1122. This program directed the California Public Utilities Commission (CPUC) to create a Bioenergy FIT, whereby 50 MW of power sourced from sustainable forestry practices[17] must be acquired under more favorable electricity prices. Projects must be 3 MW or less to participate. The CPUC Final Decision on the program itself was issued December 26, 2014, and the utilities were directed to issue Bioenergy FITs within 45 days. On February 2, 2015, the CPUC issued a decision to end the comment period on March 6, 2015. It was anticipated the CPUC would issue a final approval of the Bioenergy FIT program and a subsequent "one-month before the first auction will occur" notice on or about April 19, 2015. Per the approved CPUC Final Decision, the first offer price will take place at 12.772¢/KWh. A total of 6 MW will be placed for auction at that price in the forestry category during each PG&E auction. Depending on the number of bidders and the acceptance of any bids, prices will adjust. In the forest biomass sector, this adjustment is expected to be upward. Auctions will be held every two months.

Assuming a straight upward trajectory, it would take eight months from the Bioenergy FIT auction start date before the price reaches the target for a potential Foresthill bioenergy facility financial model as presented and discussed below. Table 3 below shows the expected auction price change over the eight months. In practice, if generators in the queue accept less than 20 percent of the 6 MW offered (1.2 MW), the price will go up in the subsequent auction. If 100 percent of the 6 MW offered in an auction are accepted, the price will go down in the subsequent auction. Should the contract acceptance in any auction fall between 20 and 100 percent of the offered capacity, prices will remain flat in the succeeding auction period. Prices will rise or fall in accordance with the same metric: the first adjustment will be 0.4¢/KWh, the second adjustment will be 0.8¢/KW, the third or succeeding adjustment will be 1.2¢/KWh.

[17] CPUC Decision 14-12-08, Appendix B, December 2014

Table 3. Bioenergy FIT Auction Price Change Over Eight Months

	¢/KWh
Auction 1	12.772
Auction 2	13.172
Auction 3	13.972
Auction 4	15.172
Auction 5	16.372
Auction 6	17.572
Auction 7	18.772
Auction 8	19.972

It should be remembered that contract risk is an important consideration in any non-traditional source of energy such as biomass. Both the SB1122 and the ReMAT contracts have a number of potential penalty clauses, which must be fully considered. First among these is the Guaranteed Energy Delivery clause; whereby the projected KWh output must be projected for the life of the contract. Since feedstock for the power generation is produced in real time, as opposed to a natural gas plant where a pipeline simply needs to be open, there is more risk of unplanned shutdowns due to feedstock unavailability.

Thus, while a biomass plant is considered "base load" it is - similar to a conventional plant - not planned to operate the full 8,760 hours in a year. It is assumed that there will only be 7,500 operating hours per year for a potential bioenergy facility in Foresthill. This is to allow for scheduled and unscheduled maintenance and downtime of various system components, which translates to approximately 85 percent power production availability. An additional source of concern that has been added to the new renewable contacts is forecasting penalties. Any unplanned outage results in a payment roughly equal to 150 percent of the contract rate for each 10 minutes that a facility has an unscheduled outage or fails to report availability. Obviously, care and attention must be paid to all the text in new renewable contracts. After operations have begun, it is important to plan appropriately for expenses associated with managing the new contracts.

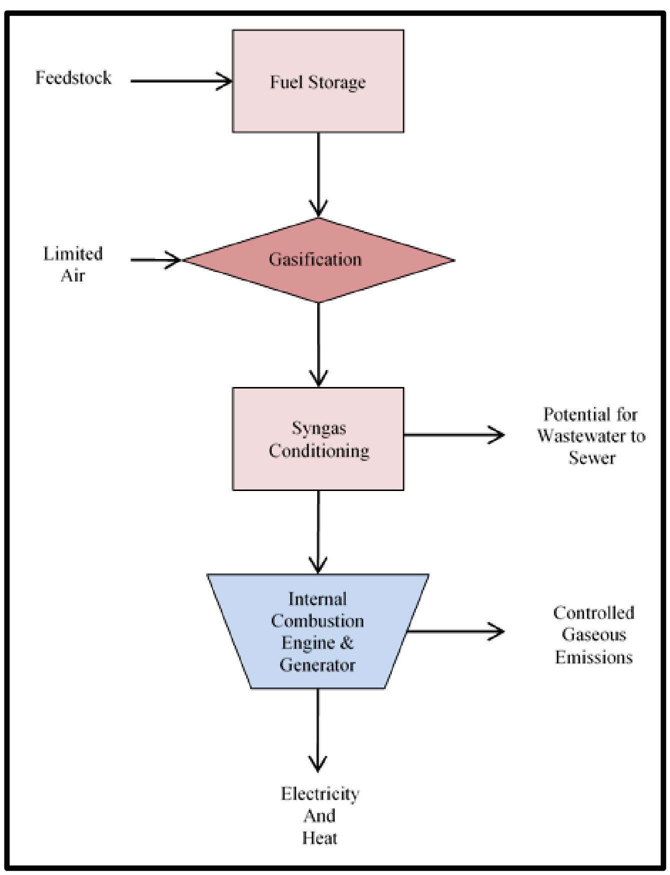
3.4 Technology Preference

Based on experience and current technology development, gasification to electricity and heat is the desired technology for community scale bioenergy facilities. As the current estimated turnkey cost to construct such a system is approximately $5.00 to $5.50 per watt of electricity installed, a 1 MW facility could be permitted, constructed, and interconnected, for approximately $5.0 to $5.5 million dollars. The primary means for electricity generation would be an internal combustion engine, fired by syngas from the gasification of the biomass feedstock that would in turn power a generator. Feasible engines manufactured by GE, Caterpillar or others have relevant emission control equipment as specified by PCAPCD. The successful permitting of a 2 MW gasification facility by Tahoe Regional Power Company at Cabin Creek in eastern Placer County is evidence of the potential ability to permit a similar system in Foresthill.

Gasification is the conversion of a solid (biomass) into an energy-rich gas that can be used to produce electricity, heat, or, in some instances, liquid fuels. The biomass conversion process is a thermochemical occurrence that 'cooks' biomass in an oxygen-limited environment. By depriving the fuel of sufficient oxygen, the biomass does not burn, but rather gives off a hydrogen rich syngas. As the biomass emits the syngas, it is transformed into biochar that amounts to approximately nine percent of the volume of the original biomass feedstock. The syngas is then captured, cleaned and cooled before being sent as fuel to the engine generator (genset). The gensets are provided by a variety of nationally known vendors, such as Cummins, Caterpillar, or GE.

Once it has left the gasifier, syngas must be cooled and cleaned sufficiently before it can be used in a generator, as shown in Figure 5 below. Because biomass contains water, which is released into and then condensed out of the syngas, the process is actually water accretive. This water is normally cleaned and reused but can also be disposed of through sewer or evaporation. Wood also contains tar, which is normally recirculated into the gasifier where its energy content is recovered. If desired, it can also be separated out for use in bio-chemicals. Once the syngas enters the generating unit it normally produces about 75 to 80 percent of the power that a traditional natural gas unit would produce.

Figure 5. Schematic of a Typical Gasification to Electricity System



Alternative Technology Systems

Biochar Production

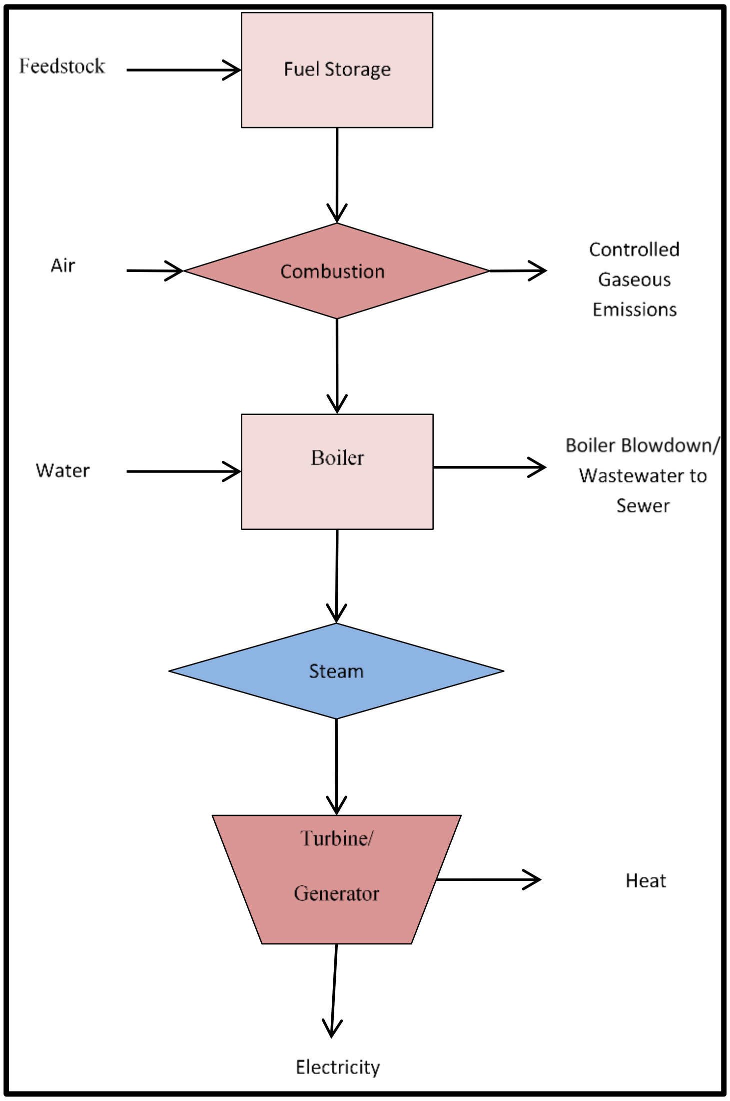
Another potential technology project associated with a forest-sourced biomass feedstock, could be a focused biochar production facility, which is similar to gasification, but much simpler. In essence, a similar process of thermochemical conversion occurs whereby volatile gases are driven off; however, as these gases cannot be sufficiently cleaned to use in an internal combustion engine generator set, they are flared off as opposed to used productively (such as in the generation of electricity). The positive side of this technology is that biochar can be produced in volumes of up to 30 percent of input, compared to 10 percent in a traditional gasification installation, or zero percent in a traditional direct combustion biomass boiler system. The downside risk is that the emissions are more difficult to adequately control since they are flared off, as opposed to controlled combustion in an engine equipped with a catalytic emission reduction device. Furthermore, the tars and other hydrocarbon constituents are not filtered, which results in the flare emission profile being relatively "dirty" compared to the alternative systems. This may lead to permitting difficulties with PCAPCD.

Further complicating the picture is the fact that while commercial finance is available for systems with a Power Purchase Agreement, such as the ones envisioned in an SB1122 contract (see additional discussion below), commercial financing is not yet readily available for biochar-only systems. Being an emerging market, there are few, if any, credit worthy markets for the biochar product. This leads to the current situation where biochar revenues are discounted by financial institutions, leaving only power contracts to underwrite the project. Given these factors, a biochar-only facility does not appear to be a reasonable, or financially viable, option for Foresthill.

Direct Combustion Systems

As opposed to gasification systems, the biomass feedstock in direct-fired combustion systems is directly burned (combusted) in a combustion chamber with access to sufficient oxygen to allow for the total decomposition of the molecular structure of the feedstock during the oxidation process. The heat from the combustion is transferred to a working fluid for distribution as heat - in the form of steam or hot water - or for use in a steam-cycle turbine to produce electricity. Common boilers used for biomass direct-combustion systems include traditional stoker boilers and fluidized bed boilers. A schematic for a direct-fired combustion unit is depicted in Figure 6 below. Notice that Figure 6 is a schematic for an electricity-producing unit. For a thermal-only system (discussed further in the next section), the end product - hot water or steam - is represented in the blue diamond labeled "steam".

Figure 6. Schematic of a Typical Direct-Fired Combustion to Electricity System



Each combustion technology has individualized feedstock specifications that optimize system performance. It is important to consider feedstock requirements as system efficiency may decrease and maintenance costs may increase with deviations from feedstock specifications.

Biomass direct combustion systems are common in California and the United States. Approximately 10,000 MW of electricity generation can be attributed to woody biomass direct combustion in the United States, with over 700 MW currently online in California. However, few of these facilities are community-scale size (1 to 3 MW). Due to the additional costs associated with operating a steam cycle turbine, small-scale electricity production has proven economically challenging as this technology greatly benefits from economies of scale. There are also other challenges with small-scale direct combustion to electricity systems. Table 4 below is a comparison between biomass direct combustion to steam turbine, and gasification to an internal combustion engine generator set.

Table 4. Comparison of Direct Combustion v. Gasification Systems

Attribute	Direct Combustion to Steam Turbine	Gasification to Internal Combustion Engine
Technological Maturity	3	2
Sensitivity to Ambient Conditions	4	3
Water Consumption	1	3
Feedstock Consumption/Efficiency	1	4
Air Emissions Profile	2	3
Labor Costs	1	3
TOTAL	12	18

Technological Maturity:

4: Commercial deployment of the integrated system at scale
3: Commercial deployment of system components, but not the integrated system at scale
2: Limited commercial deployment of the integrated system at scale
1: No Commercial deployment of the integrated system at scale

Sensitivity to Ambient Conditions (e.g., temperature, humidity):

4: No variation in output with fluctuations in ambient conditions
3: Output varies minimally with fluctuation in ambient conditions
2: Output may vary significantly with fluctuations in ambient conditions
1: Operation of the system is limited by ambient conditions

Water Consumption:

4: No water is used for system operations
3: Water use can be mitigated by the use of air cooled radiators
2: Some water use is required for normal operations
1: Significant water use is required for normal operations

Feedstock Consumption / Efficiency:

4: Total system efficiency is, on average, greater than 20 percent
3: Total system efficiency is, on average, between 15 and 20 percent
2: Total system efficiency is, on average, between 10 and 15 percent
1: Total system efficiency is, on average, less than 10 percent

Air Emissions Profile:

4: No emissions treatment necessary to meet local air standards
3: Limited air emissions control devices are necessary to meet local air standards
2: Air emissions control devices are necessary to meet local air standards
1: Cannot meet local air standards with treatment

Table 4 (Continued)

Labor Costs: *4: The system can operate without staff present* *3: The system can operate with two employees per shift without any specific certifications* *2: The system requires more than two employees per shift (without any specific certifications)* *1: The system requires specialty certifications (e.g., high pressure steam boiler operator*)

The comparison discussed above supports the recommendation to utilize a biomass gasification to electricity system.

Thermal Production Only

As an alternative to using forest-sourced woody biomass for electricity generation, there is a potential to establish a large facility, or possibly, district-wide heating system using woody biomass as the energy supplying feedstock.

The market driver for biomass thermal energy is the cost of the alternative fuel. In the Foresthill area, propane is the primary fuel source for heating along with probably some utilization of electricity. To understand the potential annual savings from switching to biomass, the price of these fuel sources are illustrated in Table 5 below, which shows the energy source as a price per unit of energy delivered. These metrics account for different system efficiencies. Electricity pricing is shown at two different price points, as the price paid varies by customer type - such as large commercial users versus residential users.

Table 5. Energy Price Comparison for the Foresthill Area

Energy Type	Current Price		Energy Content		Price per Unit Energy		System Efficiency	Price per Unit Energy	
Propane*	2.50	$/gal	91,500	Btu/gal	27.32	$/MMBtu	0.80	34.16	$/MMBtu
Natural Gas**	0.775	$/therm	100,000	Btu/therm	7.75	$/MMBtu	0.80	9.69	$/MMBtu
Electricity @ 12¢	0.12	$/kWh	3,412	Btu/kWh	35.17	$/MMBtu	0.98	35.89	$/MMBtu
Electricity @ 17¢	0.17	$/kWh	3,412	Btu/kWh	49.82	$/MMBtu	0.98	50.84	$/MMBtu
Woody Biomass Feedstock	25	$/BDT	8,500	Btu/lb	1.47	$/MMBtu	0.70	2.10	$/MMBtu

* - The price of propane has dropped considerably in the last year

**- Natural gas is not available in the Foresthill area

The above table indicates that fuel savings of a factor of 16.3 (biomass v. propane) to 24.2 (biomass v. electricity at $0.17/kWh) are possible by utilizing biomass energy with feedstock priced at $25/BDT.

Even with a higher price of feedstock ($45/BDT) there can still be significant savings factors of 9.1 to 13.45, respectively.

A facility (or facilities) utilizing a 2 MMBtu per hour boiler system at a 15% capacity factor and $25/BDT feedstock could provide between $42,126 per year and $64,044 per year in fuel savings. The system payback therefore is dependent upon the current cost of fuel, the annual heat utilization (capacity factor), the additional cost of a system, and appropriate emissions controls as required by PCAPCD.

3.5 Location Options

Project Siting Needs

The study team considered a number of locations in an effort to identify the most suitable site for a community-scale bioenergy plant in the Foresthill area. The Placer County Planning Services Division assisted in the identification of these sites and supplied the study investigators with zoning and land use designations regarding the sites. Site visits were also conducted to examine the various sites' potential to host a bioenergy facility.

In general terms, a bioenergy facility of 1 to 3 MW in size would require a minimum of three acres of cleared, relatively level land to house the power generating facility, exterior support equipment and accessory biomass feedstock material in-feed equipment (conveyors, elevators, etc.). Utilizing forestry waste feedstock requires more specialized processing equipment than is used for other woody biomass, such as dimensional lumber scraps or sawmill residuals. This extra equipment is required to "polish" incoming feedstock, because operational experience has shown that forestry waste is more likely to be contaminated with undesirable components that must be removed before introduction into the gasification equipment. An ability to remove/reduce excess material such as fine particles, dust, dirt, rocks, pine needles and leaves, as well as oversize material, would be essential to utilizing forest-sourced feedstock and keeping operational costs as low as possible.

In addition to space for the bioenergy facility itself, an ideal site will require a minimum of three and up to seven additional acres for sufficient on-site windrow pile storage of wood chips. This required space is important for several reasons:

- First, woody biomass gasification systems are sensitive to the moisture content of the feedstock. Ideal conditions for gasification occur when the feedstock is between 10 and 15 percent moisture. Operational experience has demonstrated that while gasification can occur at 20 to 25 percent moisture content in the feedstock, this significantly increases operational burdens and places an excessive demand on the filtration equipment. Forestry-sourced feedstock material is generally assumed to have approximately 50 percent moisture content upon delivery to the bioenergy facility. Given the energy input required to evaporate that amount of water, it would be the most cost-effective for the bioenergy facility to air-dry some of the material. This would reduce the energy input required to finish the drying process in a waste heat or direct heat powered dryer. Additionally, since bioenergy sells for a premium price, it would be wasteful to use biomass-produced syngas to dry the feedstock.

- Second, a bioenergy plant in Foresthill would likely receive a special tariff (i.e., electricity price from the utility) for using forestry-sourced feedstock. As such, it would be required to use a minimum of 80 percent of its feedstock input from sustainable forestry sources, as defined by the California Department of Forestry and Fire Protection (CAL FIRE). Since most forest feedstock becomes inaccessible for up to 25 to 30 percent of the year, it would be necessary to stockpile several months of feedstock in advance of the winter season. Under ideal conditions and using standard California Fire Code requirements for pile storage, one acre of storage space would hold 44 days of feedstock for a 2 MW facility.

- Third, the project site must be configured to accommodate wood chip trucks, which would access the site year-round to unload the feedstock. Chip trucks should be able to unload and leave the site within 30 minutes, since a longer wait time typically involves additional cost. The fire department would also require all-weather access around the perimeter of the site and the feedstock piles; thus a fair amount of space at the bioenergy facility site would be needed for feedstock pile access ways.

Once a site has been determined to be suitable for the construction and operation of a bioenergy facility, several additional factors are critical for determining the economically optimal site. Ideally, the facility would be sited at a location with a current electrical and/or thermal demand. In California, the prices for both propane heat and electrical energy are high and likely to be higher than prices offered by wholesale tariffs. Thus, value is maximized to the extent the facility is able to use its energy output on site. The CPUC allows for power to be sold to two properties adjacent to the site (aka “over the fence”). Thus, energy demand load at a neighboring, contiguous facility can also be considered.

The ideal site would be improved with all necessary infrastructure prior to consideration. A biomass energy facility requires convenient delivery truck access, water supply, wastewater connection or treatment, and a minimum 60kv power line connection for electricity conveyance. For these reasons, sites that are remote or difficult to access are not only undesirable, but also infeasible. Sites that are close to major roadways - especially approved truck routes - are preferred, particularly if high-voltage power lines are nearby.

In terms of constraints, the ideal site for a biomass energy facility cannot be located in proximity to schools, residences or other moderately to highly populated areas. Such “sensitive receptors” are susceptible to emissions and truck traffic noise that would be generated by a new facility. Stationary source permitting from PCAPCD would require additional control devices that add significant cost if a facility is proposed for location near sensitive receptors.

Site Review

The Placer County Planning Services Division offered guidance in the site recommendation process. Based on current County zoning ordinances, it was determined that electric power generation facilities could be potentially sited in four zone districts that occur in the immediate Foresthill town area. Each zone district would require, at minimum, that the bioenergy facility acquire a Conditional Use Permit (CUP). These zone districts (and their zoning definition[18]) include:

- FOR – Forestry: Growing and harvesting of forest products, public and commercial recreational uses
- RF – Residential Forest: Single-family residential and agricultural/forestry-type uses; recreational, public uses; and service uses
- IN - Industrial: Manufacturing, assembly, wholesale distribution, and storage
- INP – Industrial Park: Light industrial, manufacturing, assembly, research and development, limited commercial and office uses

Consistent with Section 17.58.130 of the Placer County Zoning Ordinance, any CUP process requires approval by the County Planning Commission. If any decision of the Planning Commission is appealed, then the Board of Supervisors must take action on the appeal and move to approve or deny the CUP. The CUP process is also subject to the California Environmental Quality Act (CEQA). For CEQA compliance, an Initial Study checklist will be prepared following environmental review by the County or its consultant. Based on the conclusion of an Initial Study, a Negative Declaration (no significant environmental impacts are created by the project), Mitigated Negative Declaration (any significant impacts are reduced by the project applicant to less than significant), or a full Environmental Impact Report (EIR) would be prepared. Other community scale forest-sourced bioenergy facilities have received CUPs with either a Mitigated Negative Declaration[19] or a full EIR[20].

Parcels zoned IN and INP are relatively limited in the Foresthill area. Although other zone districts can allow for a biomass energy facility, the approval process in these zones would be more difficult. Bioenergy use is genuinely industrial, and industrial zoning is designated as such on account of existing industrial uses and the presence of public utilities and truck corridors. Thus the focus of this study was on IN and INP zoned areas. These zones occur at the west and east ends of the central business district of Foresthill.

One of the industrial zones is currently the location of Foresthill High School and its neighboring parcels. While a bioenergy facility would likely provide low additional increases in risk at the high school, it would still be extremely difficult to obtain community support and agency approvals. Because of the close location to sensitive receptors at the high school, there would likely be increased scrutiny,

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[18] Placer County zoning definitions per:
http://www.placer.ca.gov/departments/communitydevelopment/planning/zoning%20ordinance/zoningdefs

[19] The proposed 1 MW North Fork bioenergy facility in Madera County received its CUP in 2014

[20] The Placer County Cabin Creek bioenergy facility received its CUP in 2013

increased perceived risk, and objection from some community members. Any project within 1,000 feet of the school will also require a special public notice.

A 1 to 2 MW electrical generating plant using biomass feedstock is anticipated to have air pollutant emissions of fine particulate, products of incomplete combustion, and toxics; however, these will be significantly lower than PCAPCD requirements due to the use of a state of the art biomass gasification-internal combustion engine system. Smaller capacity units (including thermal-only energy projects) will have even lower emissions and lower associated perceived risk and impact to the local community. These types of systems may be an acceptable use for the community and the local agencies.

For these reasons, siting investigations were concentrated on the east end of the Foresthill, principally at three sites that are far-removed from potential sensitive receptors. Of these, the first two sites offered for investigation are owned by the Foresthill Public Utility District (FPUD), and are located northeast of the Foresthill community along the north side of Foresthill Road. These two sites are developed with the FPUD operations facility and wastewater pond. The parcels containing the operations facility total 5.74 acres, and are currently occupied by office buildings, maintenance buildings, water tanks, ponds, and other structures and equipment used by the FPUD. The combination of on-site facilities utilizes nearly all of the developable land on this site, and precludes consideration of a biomass facility.

The other FPUD site is located approximately 1,000 feet further northeast, also along the north side of Foresthill Road. The three parcels that constitute this site total 14.44 acres in area. However, the FPUD wastewater pond system takes up nearly seven of the acres and is located in the middle of the site. While the relatively narrow band of property surrounding the pond may provide sufficient area for a facility in terms of total size, the configuration of the land (as essentially a long, narrow strip) is not conducive to designing a large (100-foot by 100-foot) facility with accessory material and equipment storage, truck delivery and access routes that, by necessity, must all be adjoining and clustered.

An additional consideration is the fact that the two FPUD sites are currently zoned Open Space, which is a zone district that does not allow power generating plants. Although generously offered for use by the FPUD, these two sites lack sufficient land to develop a biomass facility and they would need to be rezoned. This complicates their consideration for development.

The other candidate site is a former sawmill site located adjacent to the south side of Foresthill Road, just east of the Foresthill downtown mixed use area. This site is composed of Assessor Parcel Numbers 007-220-075 (58.9 acres) and 007-220-077 (11.96 acres) and is displayed in Figure 7. Because this area was a working sawmill operation with a large log yard for several decades, it is already a highly disturbed site of relatively flat terrain. At a total of nearly 71 acres, these parcels are much larger than needed for the proposed bioenergy facility, so the most efficient design of the site can be considered without the constraints that exist on smaller parcels. The sites are zoned INP, so no rezone would be necessary, and all utilities are near the site. In addition, the site is relatively close to Foresthill Road, which would facilitate delivery truck and employee access to the site.

Figure 7. Location of Parcel Numbers 007-220-075 (58.9 acres) and 007-220-077 (11.96 acres)

Consideration was also given to co-locating a bioenergy facility with an up-country PCWA power station. A facility at this site would likely benefit from existing electrical interconnection if PG&E were to allow multiple feedstocks on one interconnection. However, the remoteness of the site and the limited potential feedstock storage space render the site difficult to develop and infeasible for the use, hence this site was ruled out. If solutions could be found to assure reliable ease of incoming feedstock truck deliveries and to obtain suitable storage space, the potential benefits of less expensive interconnection could warrant using this site as a back-up location.

Preferred Site for Biomass to Energy Facility

Of the sites with appropriate zoning investigated by Phoenix Energy, parcels 007-220-075 and 007-220-077 stand out as optimal representative sites. As an additional consideration, the Foresthill electric substation appears to have a reasonable amount of available electrical capacity. While this is no guarantee of reduced costs and ability to remain below 15 percent of each major protective device's maximum load, the substation proximity could potentially simplify interconnection considerably. A preliminary investigation revealed that a 1.1 MW unit would be below the 15 percent threshold for line section peak load. While this is no guarantee of pricing, the Foresthill substation has the most excess available capacity in a rural setting seen to date.

Because the representative site is removed from the downtown area, and is not adjacent to significant residential development, the permitting process for the facility, both in terms of land use compatibility and air quality, would be simplified. For ease of design and permitting, convenient access, existing utilities and distance from sensitive receptors, this site has emerged as the preferred option in the preliminary investigation.

Siting a Thermal Biomass Unit in the Foresthill Area
There are several considerations for biomass thermal heating systems that might potentially be sited in Foresthill. These include:

- A boiler system large enough to make necessary emissions control equipment more economically feasible. This would likely require some form of district heating whereby several buildings could utilize the heat.
- Adequate heat loads at existing buildings in Foresthill to economically allow the purchase and operation of a biomass thermal boiler system. In addition, any buildings using the biomass thermal heat must either already have a hot water system, or such a system must be economically installed.
- Distances from identified heat users to the thermal system. Distance, and therefore costs, of heating pipelines (to and from heat users) must be factored into the economics.

A preliminary review of the location of buildings and structures in the town of Foresthill indicates a relatively un-centralized business district that would not be ideal for biomass thermal district heating. However, located on the western edge of the town, and at the former site of a lumber mill, are several large buildings and the Foresthill High School. There are also several large propane tanks at the High School and behind the large building immediately east of the High School, which indicates a potential for alternative heating such as biomass thermal. Additional, detailed review of these buildings, heat loads, and current heating systems is warranted.

3.6 Environmental Considerations (California Environmental Quality Act Clearance)

Installing and operating a biomass energy generating facility in any community in California would require environmental clearance, because such an action would be considered a project subject to CEQA. As mentioned above, CEQA clearance could be achieved in the form of a Mitigated Negative Declaration, which means that all potential environmental impacts can be reduced through proposed mitigation to a less than significant level. However, the suite of environmental impacts and the intense industrial use of the site, in combination with the requisite to adequately address community and special interest concerns, commonly results in the need to prepare a full Environmental Impact Report (EIR).

Regardless of what type of environmental document is prepared, the CEQA Initial Study Checklist provides a framework for analysis of all potential environmental impacts to each resource area. Specific topics to be addressed and issues to be identified and analyzed in each resource chapter include:

Aesthetics: Existing visual character of the site and surrounding; visibility of the site from scenic vistas; potential effect on community character; consistency with local plans/design guidelines; height limits; and mitigation measures.

Air Quality: Applicable local, state, and federal air quality regulatory framework; existing regional and local air quality, including attainment status for criteria pollutants; sensitive receptors, including on-site caretaker residences; short-term construction and long-term operational emissions; assessment against PCAPCD's Significance Thresholds for reactive organic gas, particulate matter (PM_{10} and $PM_{2.5}$), nitrogen oxide, and carbon monoxide emissions; general conformity applicability analysis; air toxics review and analyses; and mitigation measures (including emissions offsets needed to meet PCAPCD thresholds). A comprehensive health risk assessment may also be required.

Biological Resources (Vegetation and Wildlife): Existing biological resources, trees, species, and habitat for sensitive species; post-project effects on biological resources, including facility site and feedstock source areas; identification of significant effects; and mitigation measures. This analysis will also address forestry resource effects.

Cultural Resources: Known cultural resources, if any; potential for disturbance of presently unknown resources; impact significance; and mitigation measures.

Geology and Soils: Descriptions of existing soils and geology; project grading (cut and fill) and topographic alteration; specific soils impacts; erosion potential; identification of significant effects; and mitigation measures.

Hazards and Hazardous Materials: Historical uses of the site based on historical land use maps, aerial photographs, and other public records available through Placer County, Lahontan Regional Water Quality Control Board (RWQCB), and U.S. Environmental Protection Agency (EPA); the potential for hazardous contamination/conditions to exist on or near the project site; short-term construction and long-term operational-related hazardous materials use and health risks; and mitigation measures. This analysis will also address potential fire hazard risks at the site and within the region, as well as effects on fire protection services.

Hydrology and Water Quality: Summary of project plans and drainage study; applicant-proposed BMPs; pre- and post-project onsite hydrologic, runoff, and pre-project drainage and water quality conditions, including depth to groundwater and groundwater quality; potential water quality impacts; and mitigation measures.

Greenhouse Gas (GHG) Emissions and Climate Change: Applicable regulatory framework and relevant guidance; current state of the science discussion; short-term construction-related GHG emissions; long-term operational-related GHG emissions for mobile, stationary, and area source types; applicable quantification methods, emissions factors, and assumptions protocols from, but not limited to, the Western Climate Initiative, Intergovernmental Panel on Climate Change (IPCC), California Climate Action Registry's General Reporting Protocol, and California Air Resources Board (ARB) will be used to estimate long-term operational-related stationary source emissions; though mandatory reporting is not required as part of this analysis, quantification methods typically rely on ARB requirements and default emission factors as stated in the regulation for usability in the future and substantiation of approach for legal defensibility. The environmental document may also address the avoidance of GHG emissions from the alternate fates (e.g., biodegradation, open burning) of the biomass wastes (e.g., forest sourced material) by virtue of the collection of these wastes for use as fuel; qualitatively discuss any potential adverse impacts to the proposed project from adaptation to climate change; increases in GHGs will be compared to applicable thresholds; and mitigation measures.

Land Use: Project site designation and zoning; surrounding land uses; site and community character; development intensity and height; urban infrastructure; consistency with local and regional plans; impacts relative to change of use and character; and mitigation measures.

Noise: Applicable local regulatory framework; existing noise environment at and near the project site based on a combination of short-term and up to one long-term (24-hour) noise measurements and other available data; noise sensitive receptors; short-term construction and long-term noise impacts; and mitigation measures.

Traffic and Transportation: Existing traffic volumes and mix on Foresthill Road and the local roadway network; construction traffic effects; operational effects, including number, size, and routes of incoming (biomass fuel loads) and outgoing (ash) haul trucks; potential impacts to traffic flow, safety, and road wear; and mitigation measures.

Utilities and Service Systems: Existing utility service and use (electricity, natural gas, telecommunications water, wastewater); utility providers; water supply availability and improvements needed to provide water to the site; post-project utility service and use; coordination with utility providers; potential for increased demand and ability to serve, including fire flow requirements; and mitigation measures.

3.7 Air Emissions Permitting

Air pollutant emissions projections are compared to the PCAPCD permitting thresholds - for offsets, use of best available control technology, and environmental impact review - in Table 6 below for the two system options being considered in this report:

Table 6. Air Emissions Compared to Permitting Thresholds

	Electricity producing dryer/gasifier/IC engine, for sizes of 1, 1.25, and 1.5 MW. Emission factors are used for a GE Jenbacher lean burn engine using combustion controls (no add-on SCR).	**Thermal heat-producing combustion boiler, for sizes of 5, 10, and 15 MMBtu/hr. Emission factors are used for a wood-fired boiler with combustion control and cyclone for PM control.**
Offsets	All options fall under the offset requirement for all pollutant types. NOx is the closest to the offset threshold, with the largest system right up against the offset limit.	All options fall under the offset requirement for all pollutant types. For the largest system, NOx and PM levels are about one-half of the offset thresholds.
Best Available Control Technology	All options will require BACT for NOx and VOCs. For gasifier/IC engine systems of this size, the combustion controls for lean burn engines are projected to be considered BACT.	All options will require BACT for NOx. For boilers of this size, combustion controls with a limit of 0.2 lb/MMBtu is projected to be BACT. BACT is not required for any of the other pollutant types.
Environmental Impact Review	CO for the largest system is the only case that exceeds EIR significance – mitigation or additional CO improvements would be required.	CO for the largest system is the only case that exceeds EIR significance – mitigation or additional CO improvements would be required.

The above table also compares the air pollutant emissions from open pile burning that would be avoided because of the energy project alternatives. For all projects and all pollutant types, there is a significant reduction in overall air pollution – that is to say, emissions from the energy project are lower than those from any open pile burning of the material.

It is projected that the emissions are below the EIR trigger threshold for all but one of the energy project alternatives being considered. Thermal systems that rely only on combustion control and cyclone - as opposed to potentially more effective control options such as bag house, scrubber, or electrostatic precipitators - may need special site-specific consideration and scrutiny to comply with opacity, fine particulate and associated air toxic standards

3.8 Gasification Technology Integration

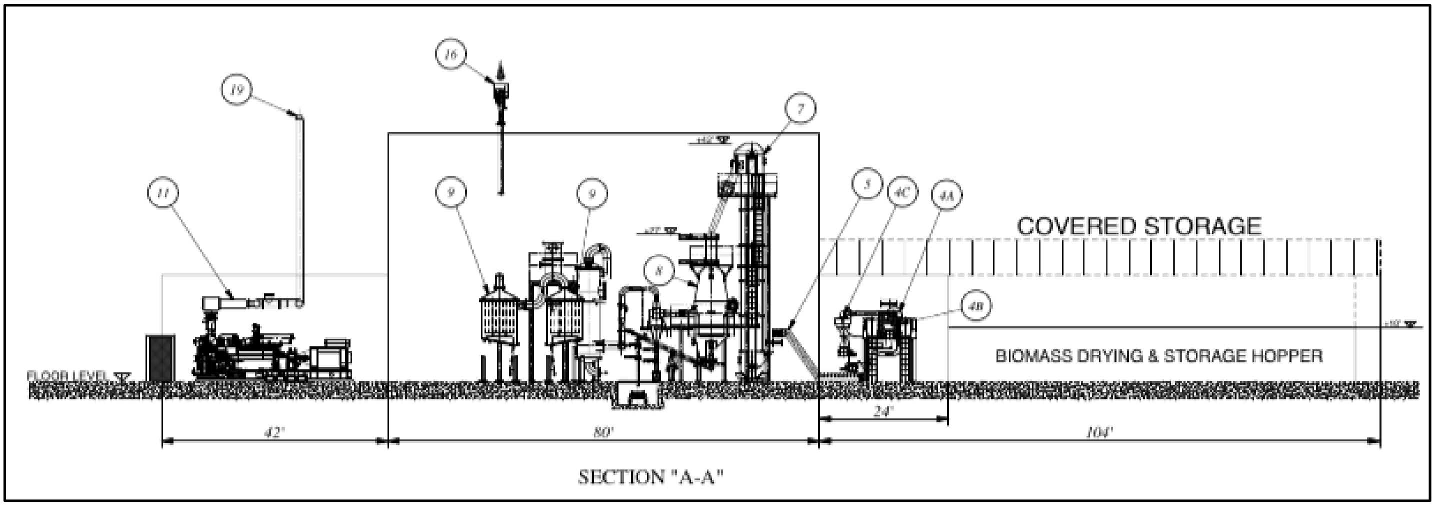
The bioenergy facility key systems are laid out in modular design specifically because the technology is still evolving (see Figure 8 on page 35 below). By utilizing modular design, it is easy to replace or upgrade a section without major renovation to the whole system in the future. In essence, feedstock processing, gas generation, syngas clean up, and power generation are all separated by a reasonable amount of space to allow future improvements or equipment additions to the process. Furthermore, it is necessary to allow sufficient space such that forklifts and reach lifts may reasonably access the equipment for operation, maintenance, and repair. Potential future adjustments that should be kept in mind during the planning stages are the following:

- Addition of liquid transportation fuel generation capability: In the study base case, the prime product is electricity. However, as electricity prices go down or as the subsidies or prices for liquid transportation fuel increase, it may become attractive to change the syngas use from exclusively or primarily electric generation to the conversion of syngas into liquid transportation fuel. If the economics are good, this could be done in the future by adding a Fischer-Tropsch system for syngas conversion to liquid fuels, as well as additional infrastructure for the movement and storage of liquid fuels on site.

- Conversion of syngas to pipeline quality gas: The biomass gasification industry sector pays attention to the potential to add hydro-methanization equipment for conversion of syngas into pipeline quality gas. As more of the U.S. energy mix tilts towards natural gas, it may become more profitable at some future point to introduce syngas into the pipeline. As syngas is mostly H2 and CO, this would likely require a catalytic process to convert gas into a more methane-rich format, which could be further enhanced for injection directly into the existing natural gas pipeline system. While not currently economically superior, this production process has benefits such as the removal of most air quality concerns, and attracting potentially significant government support.

- Addition or replacement of state of the art gas filtration equipment: The most likely scenario are changes to the state of the art syngas filtration. As this is also an evolving gasification technology component, it is recommended that any final layout leave ample space for replacing outdated and/or less efficient equipment with incremental state of the art equipment for improving the quality and cleanliness of syngas, which would improve operational efficiency and economics.

Figure 8. Key Systems of a Bioenergy Facility



POS.	DESCRIPTION
1A	BIOMASS STORAGE HOPPER
1B	BIOMASS DRYING HOPPER
2	HYDRAULIC UNIT
3	BELT CONVEYOR
4A	OVERSIZE BIOMASS MULTIPLE DISC SIEVE
4B	FINE BIOMASS MULTIPLE DISC SIEVE
4C	KINETIC SEPARATOR
5	BELT CONVEYOR
6	REVERSE BELT CONVEYOR
7	BUCKET ELEVATOR
8	GASIFIER
9	SYNGAS COOLING & FILTRATION
10	SYNGAS RESERVOIR (PNEUMATIC COMPENSATOR)
11	GAS ENGINE
12	PLANT CONTROL ROOM
13	LT/MT TRANSFORMER ROOM
14	PROCESS WATER FILTRATION & COOLING
15	DRYING FAN & EXHAUST/AIR MIXER
16	FLARE
17A	SAW DUST HOPPER
17B	OVERSIZE BIOMASS HOPPER
17C	CHAR HOPPER
18	FRONT END LOADER
19	EXHAUST CHIMNEY

3.9 Transmission Factors

Locating a biomass facility in an area with maximum available capacity in the surrounding utility lines and substation is helpful in minimizing the overall cost of interconnection. All of the sites in the Foresthill area had similar characteristics regarding available capacity, and thus this criteria became less relevant for site selection. However, all other factors being equal, it is normally desirable to minimize the physical distance to a substation. This is because each safety device between the power plant and the substation - such as line re-closer, fuse, etc. - may need to be upgraded at significant cost. Interconnection costs are the most difficult factor to establish in the entire project. In each PG&E project Phoenix Energy has completed, written costs estimates from the utility have varied by a factor of 10 times over the 1-2 year duration of the project. Past success at reversing dramatic mid-project cost increases is no guarantee of future success. Close attention should be paid to the other California forestry projects that may be ahead of Foresthill such as North Fork Community Power and Blue Mountain Electric Company (Wilseyville), among others. Previous Phoenix Energy projects have required $220 to $440 per KW installed.

Figure 9 below shows the location of the recommended project site in relation to the PG&E Substation. In the 2MW project modeled here, interconnection costs could be approximately $500,000 - $1,000,000. We have included this estimate in our anticipated cost to construct of $11.1 million. Costs to prepare the System Impact Study, which would provide this estimate including all utility fees and third-party costs, should be approximately $50,000.

Figure 9. Location of Recommended Site and PG&E Substation

3.10 Financial Pro Forma

With the recommendation of utilizing the SB1122 Bioenergy Feed in Tariff (FIT) within the sustainable forestry category, a basic financial pro forma was conducted to determine the relative economic feasibility of operating a biomass facility in the Foresthill area. The principal metric used was whether a biomass facility would potentially generate sufficient returns to enable construction of a facility, although it is a marginal case. Phoenix Energy's experience developing biomass projects in the U.S. and Europe indicates that 12 to 13 percent unlevered internal rate of return (IRR) is the minimum return that will attract private capital at this time. Given the risk profile of the investment and the lack of historical data in the U.S., this rate is not expected to change much in the near term. The total project cost for a 2MW facility is approximately 11.1 million dollars and the relevant critical issues are described below.

Achieving a desirable IRR for a Foresthill bioenergy project requires some significant, yet plausible, assumptions under the new Bioenergy FIT program. This program was established primarily to specifically target forest-sourced power and encourage its development. While there are numerous assumptions that will influence whether a bioenergy facility is built, the three below are the critical ones that require the most explanation and further consideration:

1) The wholesale contract price would be 15¢/KWh
2) 100 percent of biochar would be sold for 35¢/lb
3) Feedstock would be acquired for $25/BDT[21]

<u>Assumption 1 - Wholesale Contract Price:</u> With current ReMAT transactions for solar at 5.7¢/KWh and wind and landfill gas at 8.9¢/KWh, it would be a considerable departure to assume 15¢/KWh under SB1122[22]. However, a Foresthill bioenergy facility would likely be, in large part, specifically designed to encourage forestry projects, such as hazardous forest fuels reductions to mitigate catastrophic wildfires. The Bioenergy FIT takes into account the critical differentiating factor of increased feedstock costs - specifically, that forestry feedstock can be expensive. This report used the Placer County Cabin Creek model that estimates $25/BDT, which is half of the cost of typical forest operations. While this model could work in the region, provided some entity create cost-sharing obligations from public and private operations. A full assessment of future cost estimates should be undertaken. It should be noted that at normal forest operation costs these projects likely would not be economical, and that there are increased interconnection costs.

[21] Biomass feedstock is normally measured in bone dry tons (BDT) to eliminate problems in weight measurement related to differences in moisture content
[22] PG&E ReMAT Program period number 8, prices as of January 2, 2015

The final report on the Bioenergy FIT produced by the CPUC[23] assumes that the prices for forestry contracts will have an average value of 21.6¢/KWh, as shown in Table 7 below. This outcome could be possible since it will be determined at auction with a likely small pool of bidders, due in part to the current lack of forest-sourced bioenergy project developers. However, these price projections strain reason by exceeding retail energy costs. A more likely outcome will be 15-18¢/KWh. While seemingly high, this price range would provide enough revenue to justify a 2 MW facility in Foresthill, in spite of the uncertainty of biochar sales.

Table 7. Forecasted Electricity Prices for Forest-Sourced Bioenergy Project

	Low	Medium	High
Forest $/MWH	148	219	281

Assumption 2 – Biochar Sales: Biochar revenues are also reasonably uncertain. Modeling revenues at 35¢/lb, accounts for a reasonable degree of variability and vulnerability in co-product sales. Current biochar prices at existing Phoenix Energy gasification facilities in California range from 79-99¢/lb for bulk customers and even higher for retail customers. The biggest uncertainty centers on the debt of the biochar market - i.e., how large and rapidly will the expected supply grow?

Bioenergy facilities are in various stages of development in North Fork (Madera County), Cabin Creek (Placer County), Wilseyville (Calaveras County), Camptonville (Yuba County), Nevada County, Humboldt County, Mendocino County, Plumas County, and elsewhere. If all of these facilities come on-line, it would represent a dramatic expansion of the biochar supply and would likely push prices much lower. However, if biochar is successful in entering the activated carbon market for use in such things as wastewater or supply water filtration, prices might rise or hold steady - displacing material that is more expensive and currently imported from Asian coconut producers or West Virginia coal carbon producers.

Activated carbon is a 2 billion dollar market in the U.S., with most customers being municipal governments employing carbon in wastewater and water treatment plants. This, however, is a developing market that is not currently reliable. The vast majority of biochar today is used in agriculture. Because of these and other factors, it is believed that valuing biochar at 35¢/lb in the financial model is a reasonable approach. However, it must be noted that significant uncertainty remains about the ability to convert that biochar into revenue as well as banks' willingness to lend capital on the promise of future, un-contracted biochar sales.

[23] "Small-Scale Bioenergy Resource Potential, Costs, and Feed-In Tariff Implementation Assessment" prepared for the CPUC, April 2013

Assumption 3 – Feedstock Prices: Another factor impacting the financial pro forma is the price at which feedstock can be acquired by a potential bioenergy facility. Discussions with Placer County have indicated that it is possible to achieve a price of $25/BDT for feedstock. This price is based on a model of cost sharing with the feedstock landowners to remove, grind and haul the biomass at an economic price. However, it should be noted that in other areas of the state, prices of between $45-55 per BDT are normal for forest-sourced material. If a project moves forward, feedstock contracts need to be investigated and performed prior to basing any financial conditions for a potential facility.

Also, it should be noted that the Bioenergy FIT allows the use of up to 20% non-forestry biomass,[24] including agricultural and urban derived wood material. It is believed that these feedstocks can be acquired at a relatively lower cost. Materials could also be collected from Fire Safe Councils, utility right of way trimmings, and other sources where the weighted average of the feedstock price could be lowered. This will be of critical importance to any potential forest-sourced bioenergy project.

The total costs for the analysis were based on a 2.0 MW (net output) sized plant for approximately $11,100,000. The costs were based on the use of current bids from contractors for major equipment. The biggest unknown in the total cost to construct is the price the utility charges to interconnect. It is also important to note that this $11.1 figure does not include extensive fuel processing equipment. To the extent a project would do upstream fuel processing as opposed to purchasing ready-to-use fuel additional chipping, grinding and possibly rolling stock would be required. A rough guestimate of this impact would be $500,000 increase to cost, which would presumably be done only to the extent it reduced fuel purchase costs.

Major capital expenditure categories	
Gasification and balance of plant equipment	$ 3,097,218
Power gen equipment, utility interconnect, site electrical	4,672,715
In-feed equipment	225,025
Leashold improvements	1,238,807
Intallation and soft costs	1,866,235
Total cost	**$ 11,100,000**

Internal Rate of Return (IRR): The financial pro forma was conducted to look at the impact of changes in the variables on the unlevered rates of return to see under what conditions the case becomes unattractive. This hopefully will allow any potential development team to make appropriate decisions about the financial risks being undertaken. In an example per Table 8 below, if power rates were to be contracted at the 12.77¢/KWh starting price, and biochar were to remain at the planned case of 35¢/lb, the total project IRR would be 9.4 percent.

Table 8. Effect of Electricity & Biomass Prices Changes on IRR

Project IRR - effect of price changes

		Biochar price per lb			
		$0.25	**$0.35**	$0.50	$0.79
Electricty price per KWh	$0.128	6.3%	9.4%	13.5%	20.2%
	$0.135	7.3%	10.3%	14.3%	20.9%
	$0.150	9.3%	**12.1%**	15.9%	22.3%
	$0.180	13.0%	15.5%	19.0%	25.0%

base case is highlighted

In looking first at the relationship between biochar and price, it can be seen that if biochar prices can be contracted at levels above the 35¢/lb base case price, there is a significant positive impact. For this potential bioenergy project it is proposed that a 12 percent unlevered IRR would be the minimum privately financeable investment case at current market conditions. Of note, Table 8 also demonstrates the importance of getting contracted biochar revenues above 35¢/lb in relieving pressure from requiring relatively high prices for electricity.

Unit Operation: In addition to the three key performance assumptions discussed above, the impact of successful operation of the unit expressed in operating hours (at maximum output) was also examined. Table 9 below shows that with biochar at 35¢/lb the project IRR is marginal, and there is no circumstance of superior performance that will compensate for a decrease in biochar to 25¢/lb. While current vendors are offering liquidated damages for performance below 7,000 hours, we have ignored this impact here as any such guarantees are limited in time. The conclusion here is that operations will have to be professionally managed to ensure that the unit achieves maximum uptime. Regular, preventative and proactive maintenance will need to be performed in order to keep the unit running at such a high uptime factor.

Table 9. Effect of Generator Hours and Fuel Prices on IRR

Project IRR - effect of generator hours and fuel prices

		Fuel prices per ton			
		$15	**$25**	$35	$45
Generating hours per year	6,500	9.9%	8.8%	7.6%	6.4%
	7,000	11.6%	10.5%	9.3%	8.1%
	7,500	13.3%	**12.1%**	11.0%	9.8%
	8,000	14.9%	13.7%	12.5%	11.3%

base case is highlighted

In modeling the feedstock prices with the generation hours, it is evident that this factor has a lesser price impact than biochar prices on overall project IRR. An increase of price of $10 (from $25/BDT to $35/BDT) still results in a return of 11 percent without the effects of leverage. Similarly, lower feedstock prices, perhaps through increased use of free drop-off materials, has less impact than achieving higher prices for the sale of biochar.

<u>Project Leverage:</u> Finally, it is appropriate to consider the effects of leverage on a potential bioenergy facility. Bioenergy project developers such as Phoenix Energy have been successful in establishing a process whereby banks will lend against the assets and contracts involved in a biomass gasification plant. It should be noted that leverage increases both the internal rate of return and the risk of default. As such, any use of project debt must be undertaken only after careful assessment of incremental risk.

Phoenix Energy has seen its current California projects acquire leverage at 75 percent of the capital required. In other words, a $10M plant is likely to get $7.5M in debt and require $2.5M in cash equity to be able to afford to construct. However, the amount of debt reduces significantly in the absence of performance guarantees. Current rates of around 5.5 percent for guaranteed amounts, and 7 to 9 percent for weaker credits, seem to be reasonable for consideration at this time.

The return on a project can be augmented by the use of debt (leverage) in addition to investor cash. The more bank debt that can be used in the project the less investor/community cash is required. This also has a beneficial impact of increasing the percentage return on the community's/investor's money. However, since debt must be repaid and often guaranteed the increased use of debt capital increases the amount of risk that the project takes. It is our experience that the amount of leverage that can reasonably be obtained in project finance of this type is 60-75%, thus a $1,000,000 project would potentially be financed with a $750,000 bank loan and a $250,000 cash investment. That said, given the amount of uncertainty - e.g. biochar prices, operating costs, uptime, etc. - it may be prudent to utilize a lower amount of debt or no debt. Such a decision should be carefully undertaken with a financial advisor once the project is closer to construction.

Table 10 below shows the impact of various levels of debt on project investor (equity) returns: from 12.1 percent using 100 percent cash equity, to 28 percent using 75 percent bank debt. The project returns should normally be presented using both 1) a debt free or "unlevered" scenario, as well as 2) the actual proposed capital structure using debt, which is known as the "levered" return. Given the current market conditions and the fact that this could be a community-owned project (without a personal guarantor), we believe that 60 percent is the maximum reasonable amount of bank debt the project might receive.

Table 10. Effect of Various Levels of Debt on IRR

Project IRR - effect of leverage

	alpha	75%	60%	50%	0%
IRR		28.0%	20.8%	18.2%	12.1%

Table 11 below is a modeled income statement (profit and loss) for a facility for a 10-year period that shows where and how the project would earn money, and where it would spend it. This analysis was done assuming there is no debt (note that the interest expense line item is zero). The IRR is displayed in green; this is a common metric to approximate the average annualized return on the investment of the funds it takes to construct the plant. The payback of 6.1 years is the length of time it would take under these assumptions for the positive cash flow to equal the investment in the plant.

The EBITDA line, highlighted in orange, is a widely used metric for the cash flow that the business would generate - sometimes also called operating profit. It stands for Earnings Before Interest, Taxes, Depreciation and Amortization.

Table 11. Example of 10-Year Profit and Loss Statement
2MW Facility with $11.1 million Construction Cost

				IRR	12.1%					
				payback	6.1 years					
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Project Income Statement										
Sale to Grid	2,250,000	2,250,000	2,250,000	2,250,000	2,250,000	2,250,000	2,250,000	2,250,000	2,250,000	2,250,000
Biochar sales	1,070,669	1,092,082	1,113,924	1,136,203	1,158,927	1,182,105	1,205,747	1,229,862	1,254,459	1,279,549
Carbon Credits	-	-	-	0	-	-	-	-	-	-
Gross Revenue	3,320,669	3,342,082	3,363,924	3,386,203	3,408,927	3,432,105	3,455,747	3,479,862	3,504,459	3,529,549
Fuel purchase	(325,025)	(334,775)	(397,830)	(344,919)	(351,817)	(358,853)	(366,030)	(373,351)	(380,818)	(388,434)
OPEX	(686,660)	(700,393)	(714,401)	(728,689)	(743,263)	(758,128)	(773,290)	(788,756)	(804,531)	(820,622)
Maintenance reserve	(79,825)	(79,825)	(79,825)	(79,825)	(79,825)	(79,825)	(79,825)	(79,825)	(79,825)	(79,825)
Property Tax	(108,000)	(108,000)	(108,000)	(108,000)	(108,000)	(108,000)	(108,000)	(108,000)	(108,000)	(108,000)
Land lease	(20,988)	(20,988)	(20,988)	(20,988)	(20,988)	(22,718)	(23,172)	(23,636)	(24,109)	(24,591)
Insurance	(18,000)	(18,360)	(18,727)	(19,102)	(19,484)	(19,873)	(20,271)	(20,676)	(21,090)	(21,512)
Admin expenses	(58,112)	(58,486)	(58,869)	(59,259)	(59,656)	(60,062)	(60,476)	(60,898)	(61,328)	(61,767)
EBITDA	**2,024,060**	**2,021,254**	**1,965,284**	**2,025,421**	**2,025,894**	**2,024,645**	**2,024,682**	**2,024,720**	**2,024,758**	**2,024,797**
Deprecation	(1,586,190)	(2,718,390)	(1,941,390)	(1,386,390)	(991,230)	(990,120)	(991,230)	(495,060)	-	-
Interest expense	-	-	-	-	-	-	-	-	-	-
Pre tax income	437,870	(697,136)	23,894	639,031	1,034,664	1,034,525	1,033,452	1,529,660	2,024,758	2,024,797
(Tax)/tax rebates	(168,580)	-	-	-	(385,175)	(398,292)	(397,879)	(588,919)	(779,532)	(779,547)
Net income	269,290	(697,136)	23,894	639,031	649,489	636,233	635,573	940,741	1,245,226	1,245,250

4.0 Community Involvement and Feedback

The Foresthill Biomass Utilization Feasibility Study (funded by PCAPCD, and by Placer County with funding from PCWA via the Middle Fork Project) and the Value-Added Forest Material Products and Uses for an Integrated Product Yard in the Foresthill Area Study (funded by Sierra Nevada Conservancy) were carried out by the technical team with coordination between the Placer RCD and the Foresthill community.

This studies were initiated after a community meeting, held in 2013, led to the establishment of a local Foresthill Bioenergy Steering Committee. Community members outlined questions and topics to be explored. During completion of these studies, another community meeting was held to provide preliminary project information to interested community members. In addition, project team members have provided information at various monthly meetings of the Foresthill Bioenergy Steering Committee.

Throughout the development of the two studies, the Foresthill community was encouraged to provide feedback regarding the concept of locating a biomass facility in Foresthill. The technical team appreciated the interest and input of the Foresthill community throughout the process. The team would particularly like to thank the members of the Foresthill Bioenergy Steering Committee for their role in providing local perspective, and for keeping the community informed of the studies' progress.

"Appendix A: Documented Community Involvement and Feedback" outlines the various meetings and process through which the collaborators developed the studies and sought community involvement and feedback. All of the community feedback received is also documented in this appendix.

5.0 Results, Recommendations, and Next Steps

General Overview and Next Steps

The results of this feasibility study have shown that there is a potential to create and sustain some form of use for the forest waste in the Foresthill region. Several alternatives are postulated to allow a future project team to begin the process of identifying and evaluating a possible biomass to energy facility. Below is a summary of the results with recommendations and next steps in each significant category. This report recommends that each of these paths be carefully looked into, as the economics of any proposed biomass to energy facility are challenging.

5.1 Sustainable Feedstock for the Life of a Facility

<u>Results:</u> The Sustainable Feedstock Supply Assessment indicated a likely available supply of approximately 20,640 BDT per year. Of this amount, 16,590 BDT is from national forest, BLM and private lands that are managed for hazard reduction and wood products, and have a relatively firm assurance of future project funding. Another 4,050 BDT is from private lands where biomass is from projects that are typically funded by various grants and programs that are less predictable or assured in the future.

<u>Recommendations:</u> The recommended size of a biomass energy facility for the Foresthill area would depend ultimately on the “cover ratio” (safety factor) required by investors. A general norm for cover ratio is 2:1. A gasification energy facility requires about 8,000 BDT per MW hour of output. The more reliable 15,960 BDT of biomass would, at a 2:1 cover ratio, supply a 1 MW energy facility. If the full 20,010 BDT can be reasonably assured and/or if the cover ratio is less, a 1.5 to 2.0 MW energy facility may be feasible.

<u>Next Steps:</u> For the development of a biomass to energy facility to have a credible funding option, contracts with the public land agencies and private landowners would need to be developed in order to show investors that a reliable, sustainable source of biomass feedstock can be assured. Any project developer with investors will need to see at least 10 years of continuous assured source feedstock at a reasonably stable price. In addition, a long-term contract relationship for biomass processing and transportation would need to be developed. An organization/institution that has the financial acumen to perform these activities would be ideal for reaching necessary agreements, as the ability to negotiate and perform contracts with associated billing and credit services is the key to success. A project developer may wish to complete a more detailed biomass feedstock assessment that would take into account new agreements for future funding, and more detailed discussions with various land ownerships regarding predicted projects that produce feedstock.

5.2 Range of Energy Options and Technology

Results: This report discusses the feasibility of both gasification and direct combustion systems for producing electricity along with the alternatives of producing only biochar or heat.

Recommendations: Based on a number of factors including technology "maturity", sensitivity of the systems to ambient conditions like temperature and humidity, water consumption requirements, feedstock consumption/efficiency, air emissions and labor costs, gasification technology is recommended for a Foresthill energy facility. This technology offers the benefit of also producing biochar as a byproduct to increase economic feasibility. This could be done under an SB1122 contract with PG&E or as a stand-alone contract.

Next Steps: If this is to become a project, a development team must also begin the process of permitting and planning to prepare debt and equity financing as well as potential grants for the project. Once a site has been finalized, the project team should then prepare and pursue necessary permits, which will include an Authority to Construct with PCAPCD, as well as Use Permitting with the Placer County Planning Department. Site conditions and a bid package should also be prepared for future key vendor selection.

5.3 Location Options

Results: Several potential sites were initially identified and then analyzed in detail as possible locations for a biomass energy facility. Screening criteria included zoning district, proximity to sensitive receptors, proximity to the existing electrical grid, and size of the site. The latter criterion included the need to have at least three acres overall for a biomass facility and storage of feedstock.

Recommendations: Based on the screening criteria, a highly feasible location was identified east of the central Foresthill area, and south of Foresthill Road. It is recommended as a representative preferred site for energy facility construction. The parcels are the site of a former sawmill, total nearly 71 acres, have good potential access to the existing electrical grid, and are located near Foresthill road for excellent truck access.

Next Steps: Should some entity decide to move forward with further analyses, obtain rights to a site and create a project, they would need to prepare and submit a Predevelopment Meeting request to Placer County to determine the list of studies and analyses necessary to complete an Environmental Questionnaire (EQ). The EQ will then be submitted and will direct the environmental review process to conclusion. The final step would be a public hearing for consideration of issuance of a Conditional Use Permit.

5.4 Environmental Considerations

Results: For County Conditional Use Permit (CUP) approval, several potential environmental impact topics are likely to be considered significant, and will require mitigation of some form. These consist primarily of traffic, air quality, climate change, noise, and biological and cultural resource impacts. Evaluations of other biomass permitting processes and reviews has determined that most or all of these impact areas can be reduced to less than significant levels through incorporation of appropriate mitigation measures and careful project design. To obtain a PCAPCD Operating Permit for a gasification project, careful consideration will be needed for engine emissions based on the anticipated hours of operation and the level of emissions control equipment. Additionally, fugitive dust emissions and volatile organic compound (VOC) emissions from feedstock processing and drying activities must be considered and assessed. VOC emissions from cooling towers and water handling may also need to be considered. For biomass thermal production and thermal district heating only, environmental considerations must include air emissions (NOx and PM in particular) from the combustion unit, siting near sensitive receptors, and district heating piping routes (both supply and return).

Recommendations: Outline and budget for all necessary studies and analyses that would be required to create an environmental document sufficient for the purposes of CEQA.

Next Steps: If an entity decides to further study a potential facility in the Foresthill region and accomplishes the necessary analyses to create a project that has elements of a design, the next step would be to prepare and submit a Predevelopment Meeting request form to Placer County Environmental Coordination Services. Based on the information provided by County staff at the Predevelopment Meeting, the applicant would begin preparation of the Environmental Questionnaire (EQ). The EQ would then be submitted and would direct the environmental review to conclusion in advance of a public hearing for consideration of a CUP.

5.5 Financial Considerations

Results: The biomass to energy project under the key assumptions of this analysis is marginally economical, representing the minimum likely project that could be financed. The three most important variables are the price of electricity, the ability to contractually sell biochar at the price and quantities projected, and the ability to contractually acquire feedstock at the price and quantity required.

District heating in the Foresthill Central Business District would be very marginal at best given the low density of buildings and intermittent heat load. However, biomass thermal heating could possibly work in the buildings in the industrial zoned west end of Foresthill, and at the high school, as these buildings are currently heated by propane. As discussed above, the use of biomass can be several times more cost effective than using propane.

Recommendations: Any future biomass to energy project team should work to strengthen the business case for pursuing the project. Since the electricity price may be determined at auction and thus cannot reasonably be impacted, the focus should be on the next two most influential variables: biochar and feedstock costs. While the project would be economical with feedstock costs at $25/BDT, it likely would not be at $45/BDT (a price more typical of forest feedstock operations throughout the state). Work should be focused on contractually ensuring both the biomass price at $25/BDT or better, and a sufficient biomass quantity for the project. A minimum 10-year (or equivalent to loan length) supply contract will be required.

Furthermore, biochar is a key component of the revenue and needs to have a secure market. Investigations are needed to identify a reliable, credit-worthy outlet for as much of the biochar as possible. Projected revenue without a confirmed contract will tend to be heavily or entirely discounted by potential financial partners, thus work should focus on seeking possible contracts for biochar sales. Finally, as discussed earlier, prices in the SB1122 auction process will not move until there are three projects in the queue. Currently, there appears to be only two projects eligible for the SB 1122 process.

The high school and other buildings in the west end industrial-zoned area, as well as any proposed industrial park, should be examined further for the feasibility of using biomass thermal heating.

Next Steps: If a gasification-to-energy facility effort moves forward, the next most critical items, including work on feedstock sources detailed above, are those that qualify the project to receive a Power Purchase Agreement under SB1122. In particular, the critical items to qualify a facility to earn revenue will be certification by the California Energy Commission that the project is Renewable Portfolio Standard (RPS) - eligible.

Creation of single line (aka “one-line”) electrical drawings must be completed as well as both the preliminary PG&E interconnection study and the more detailed System Impact Study (SIS). Given the size of the project and the location of the potential site, it is recommended that the project proceed with the SIS under Independent Study Process with PG&E. This type of a project is not eligible for the “fast track” SIS and, given the remote location, a “cluster study” process is unlikely to be allowed in this area. Whichever SIS procedure is selected, the project must acquire control of a selected site first. Currently this could be done as a “right to develop,” and doesn’t necessarily need to be a lease or ownership. This would minimize upfront costs.

It would also be highly beneficial for the project to create preliminary site drawings (which need not specify final equipment selections) and a summary project presentation. To a lesser extent, any project development team would also need to conduct negotiations with potential outlets for the other project by-products, heat and biochar, as soon as practical. Any ability to contract with reputable buyers for these outputs will be greatly beneficial to the project in terms of improving access to finance.

For district heating purposes, any future team should conduct an economic feasibility analysis of replacing the propane with biomass thermal at the high school and other buildings located immediately east of the high school, and/or perform similar feasibility studies on any proposed industrial park.