Collaborative Program for Testing Alternative Treatment and Utilization of Excess Forest Biomass

Lake Tahoe Basin Management Unit, Placer County
and Placer County Air Pollution Control District

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Executive Summary

Background—Developing a Collaborative Relationship

The Lake Tahoe Basin Management Unit (LTBMU) is implementing forest management projects to reduce the effects of wildfire and improve long-term forest health. Placer County is interested in helping reduce the effects of wildfires on communities and forest resources. The Placer County Air Pollution Control District (PCAPCD) is interested in reducing emissions and green house gases associated with wildfires and open burning of excess biomass generated by forest management projects.

With common goals and willingness to seek more effective and efficient ways to reduce the risk of catastrophic wildfire in the Lake Tahoe Basin (LTB), restore the forest health and reduce the amount of open burning of woody biomass materials, the LTBMU, Placer County and the PCAPCD have begun collaboration on forest management and biomass utilization projects. Together, these three governmental organizations planned and funded projects that exceeded initial goals and laid the foundation for sustained operations within the LTB.

This report details what this partnership did to develop alternative ways to remove and utilize biomass waste and to analyze the costs and benefits utilizing the biomass to create electricity rather than burning on-site.

Program Description

Forest management projects designed to reduce wildfire hazard, improve forest health, and increase protection of communities and forest resources usually create excess woody biomass waste in the form

of brush, limbs, tops, and small stems. This excess biomass is normally piled and burned on-site for a variety of factors including limited access and having a cost to collect, remove, process and transport the biomass, that is higher than the biomass value as fuel or wood products. Although burning is carried out only when air quality consideration and prescription parameters for factors such as fuel moisture, air temperature and wind speed can be met; such burning still produces more emissions than if the biomass was burned under controlled conditions in a biomass energy facility.

In order to explore the feasibility of utilizing excess biomass for production of energy in a local facility, a participating agreement was developed between Placer County and the LTBMU to complete biomass removal and fuel reduction on two national forest projects totaling approximately 100 acres. Placer County was required to follow all conditions of a Participating Agreement for each of the two projects and to hire contractors that could meet all U.S. Forest Service (USFS) and PCAPCD regulations, including onsite inspections of all completed activities. This agreement was finalized in January of 2009. Two separate projects—CRAG and Rubicon--were completed, with significantly different upfront environmental restrictions and economical outcomes.

Results of Projects

Biomass Removal

The two projects were able to remove 2300 bone-dry tons (BDT) or approximately 4,000 green tons (GT) of excess woody biomass that was scheduled to be open burned.

Economics

Each project had economic factors that made them unique. For example, based on the environmental analyses (NEPA), use of mechanical equipment was restricted in one project while the other project, with typical constraints and mitigation requirements, did not have such restrictions. Having to haul the material 60 miles or more to existing biomass energy facilities at either Loyalton or Quincy made both projects economically infeasible.

Alternative Economic Outcomes

Both projects included analysis of the economic effects of utilizing the excess biomass in energy facilities at potential alternative sites (Kings Beach or other locations). Analysis indicated that cost sharing among various agencies and increased efficiency of biomass handling could make biomass utilization economically feasible.

Air Quality Improvements of Program

These two projects resulted in significant reductions in air emissions and deposition into Lake Tahoe:

* PM-10 (particulate matter, diameter less than 10 microns); 15.8 tons
* NOx (nitrogen oxide); 3.1 tons
* CO (carbon monoxide); 124 tons
* NMOC (non-methane organic hydrocarbons); 10.8 tons
* GHGs (greenhouse gases); 794 tons

Conclusions and Recommendations

Continuation and perhaps expansion of this collaborative pilot program seems warranted. Consideration should be given to including other government organizations and also private lands and businesses. The results of this collaborative program show great promise for decreasing the overall cost of forest management and hazardous fuel treatment projects, thereby allowing more acres to be treated to improve forest health and reduce the effects of wildfires in the LTB.

This program also shows that longer-term economic sustainability of biomass removal and utilization requires certain important elements.

- First, efficient removal of biomass from forest management projects is essential for keeping initial project costs low. This can be done with appropriate equipment that provides essential protection for soil and water quality while reducing biomass handling costs. Further testing of possible types of such equipment would be worthwhile.

- Second, cost sharing and collaborating among agencies and organizations can produce a synergy that reduces overall project cost.

- Third, given that transportation of biomass is a major cost center, having a biomass energy facility closer to forest management projects could significantly lower costs.

This program and similar programs initiated by Placer County and the PCAPCD have shown there is great potential for reducing greenhouse gases by increasing utilization of excess biomass generated from forest management and hazard reduction projects for energy production. Greenhouse gas reductions and the related fossil fuel-reduction benefits from using renewable woody biomass for energy production could ultimately create an opportunity to qualify for carbon credits. Such credits, when applied to the forest management projects producing excess biomass, can further contribute to the overall economic sustainability of a biomass energy program.

Pilot Projects

Rubicon/McKinney Trail Forest Fuel Treatment Pilot Project

Introduction

The Rubicon/McKinney Trail Forest Fuel Treatment Pilot Project (Rubicon Project) was the first of two projects under the broad collaborative partnership with the LTBMU, Placer County and the PCAPCD. These projects were intended to help determine feasible approaches for processing excess woody biomass from forest management projects and utilizing that biomass for energy generation—in lieu of disposing of the biomass through open burning. Although costs experienced with the Rubicon Project were higher than is feasible for regular operational implementation, valuable information was collected to help guide future approaches.

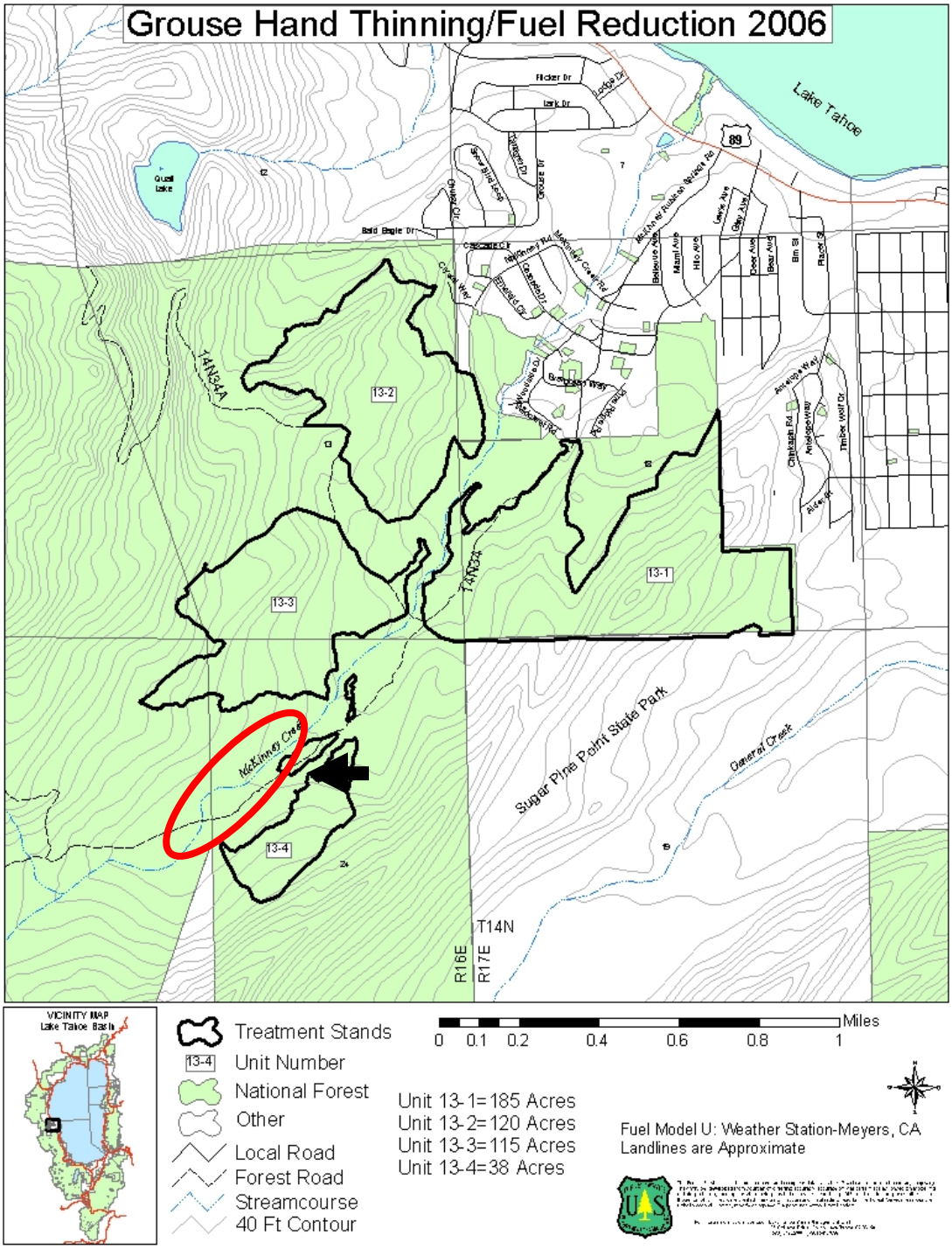
Background

In the Rubicon area, the LTBMU planned to thin the forest and to lower fuel loading to create more open, healthy stands that were more prevalent historically and lower the risk of catastrophic wildfire to protect forest resource values.

Project Description

The Rubicon Project was located near the beginning of the Rubicon/McKinney trail. This project was a high priority for the LTBMU because there was woody slash left behind from a previous, defaulted contract that created a high wildfire risk in an area receiving high volumes of public visitors including motorized vehicles.

Figure 1: Location of the Rubicon Project—Red Circled Area.



Originally (2006), the Hand Thinning contract was awarded to complete forest thinning while retaining high quality scenery in this popular public use area. Under that contract, small trees, limbs and tops were piled for later disposal by burning. Later (2009), C.T.L. Forest Management Inc. (CTL) was contracted as part of this Rubicon Project to remove the piled slash in order to use it for energy production in lieu of burning piles in the forest.

No mechanical equipment was allowed to be used off of the existing road. Therefore a substantial alternative operation was needed to remove the material.

A hand crew was hired by the project contractor to collect the already-cut and piled biomass material within the hand thinning areas (between 50 and 150 feet of each side of the road) and carry it out to the nearest road where it was stacked for later removal. The carrying and stacking operation took 12 days and involved two crews of 23 personnel for over 650 person-hours.

Roadside piles were loaded into large dump trucks with a grapple loader. The biomass was then hauled to a grinding site located in the parking lot of the Homewood Ski Resort. The biomass was first dumped into piles and then loaded into the Rotochopper horizontal grinder using a Caterpillar front-end loader. The grinder had the capability of grinding approximately 60 green tons (GT) per hour. Chips were conveyed directly from the grinder into chip vans having a loaded capacity of approximately 25 GT. The chip vans moved the processed biomass from the chipping site to the Sierra Pacific Industries (SPI) power generation operation at Loyalton, California, a distance of approximately 60 miles, one way.

Equipment specifications are shown in Table 1, below:

Table 1: Equipment Used to Process and Transport Biomass Fuel

Equipment	Vendor / Model / Year	Engine
Horizontal Grinder	Rotochopper, MC 266, 2005	Caterpillar C-15, 2005, 450 HP
Grapple Loader	John Deere, 200CLC, 2006	John Deere, 6068HT059, 2006, 140 HP
Front End Loader	Caterpillar, 950B, 1985	Caterpillar 3304DI, 1985, 155 HP
Chip Van	Kenworth, 1997	Caterpillar C13, 1998, 380 HP

Diesel engine fuel usage for biomass processing and transport equipment included:

- Chip van: 3.8 miles/gal
- Horizontal grinder: 14 gal/chip van load
- Front end loader and grapple loader: 6.5 gal/chip van load

Exhibit 1: Slash Piles Scheduled for Burning

An example of the hand crew piling is show below. Piles were located so the biomass could be collected efficiently with a grapple loader.

Exhibit 2: Hand Crew Collected and Stacked Biomass along the Road

As shown below the contractor was required to collect the woody biomass material with a grapple loader from roadside.

Exhibit 3: Grapple Loader Picks up Biomass

Loading the material alongside this road was sometimes difficult (as shown in Exhibit 4 below) because the road was lined with existing trees and brush. All operations were conducted to minimize any on-site impacts.

Exhibit 4: Biomass Loaded Into Trucks

The contract for this project required transporting the biomass to an alternate site for grinding. This additional material handling contributed to the high costs of this project.

Exhibit 5: Biomass Material Transported to Grinding Site

The project benefited from Homewood Ski Resort (JMA Ventures Inc.) allowing grinding operations at their facility. This location was nearby and minimized the additional time and expense of transporting and chipping the biomass outside the project area. Placer County wants to acknowledge and thank the owners of the resort for allowing use of their site and their support of Placer County in biomass removal operations in alternative ways, including energy production and slope stabilization at their resorts.

Exhibit 6: Biomass Arriving at Grinding Site

Exhibit 7: Biomass Slash Dumped Into Pile

Biomass was taken from the piles and placed in the grinder with a large front-end loader.

Exhibit 8: Biomass Material Loaded into Grinder

Ground-up biomass material was loaded into chip vans that have a capacity of about 25 GT of ground biomass.

Exhibit 9: Horizontal Grinder

Exhibit 10: Ground-Up Biomass Material Being Loaded into a Chip Van

The biomass chips were transported to the SPI Loyalton biomass energy facility. Chip vans were weighed at the biomass facility. Price paid for the chips was $50 per bone dry ton (BDT). Payment for the chips was factored into the cost of the project.

Exhibit 11: Ground-Up Biomass Material Being Trucked to the SPI Biomass Energy Facility

The SPI biomass energy facility uses a wood-fired Riley spreader-stoker boiler, rated at 336 MMBtu/hr, driving a 20 MW steam turbine generator. It uses an electrostatic precipitator (ESP) for particulate matter control and selective non-catalytic reduction (SNCR) for NOx control.

Exhibit 12: SPI Biomass Energy Facility at Loyalton, Ca

Results

Production

Biomass operations were conducted between July 8 and August 8, 2009. Project accomplishments, including chip van loads, total biomass processing, energy content, and SPI boiler electricity production from the Rubicon Project biomass, are shown in Table 2.

Table 2: Rubicon Biomass Project Production

Biomass Energy Plant	Chip Van Loads	Biomass (Bone Dry Tons[1])	Biomass Energy (MMBtu)	Electricity Production (MWh)
Loyalton	12	220.8	1.8	239.5

Project Economics

The total project cost for CTL, Inc. to process and transport the biomass was $57,769and the project revenue (biomass value) was $11,039 (a net loss of $46,729), resulting in a net cost for delivering biomass to the energy facility, on average, of $212/bone dry ton (BDT) well over the current market value.

The cost per acre of forestland treated for this project was approximately $4600. Typically this cost should be around +/- $2500 per acre. Again the constraint against using any equipment off roads contributed significantly to the high project cost, because of hand- carrying slash to the roadside and hauling the material twice. The additional cost of this project was covered by a grant from the PCAPCD and funding from the LTBMU.

The overall biomass removal process utilized on this project was not ideal. The original environmental assessment completed for the project included mitigation requirements that confined mechanized equipment to roads. This necessitated use of more expensive manual labor to move biomass material to the roadside where it was loaded into trucks. Equipment constraints identified in the environmental assessment also prevented the use of a grinder on-site. These restrictions resulted in high biomass treatment costs that would not be feasible for operational scale implementation.

Future Project Economics

To determine how biomass delivery from this project related to a proposed Placer County Biomass Facility (at Kings Beach or other regional site), economic calculations were made for alternative grinding and utilization locations. One alternative considered transporting the biomass to the Cabin Creek facility where a grinder is already located. This approach would not have reduced the cost of hand carrying the biomass to the roads for pickup and would have resulted in essentially same cost for hauling the biomass to the grinder, grinding, and hauling the chips to Loyalton. Overall, this alternative would have resulted in approximately the same cost as the pilot operation. A second alternative considered trucking the chips from the Homewood grinding location to the proposed Kings Beach biomass facility location instead of to Loyalton. This would have reduced the cost of hauling the chips but would not

[1] Note: One green ton (GT) of freshly cut biomass normally produces approximately 0.5 bone dry ton (BDT), so a chip van with a full, 25 GT load will normally produce 12-14 BDT. However, biomass included in this project experienced longer-than-normal drying in the field resulting in chip vans being able to transport more BDT.

have reduced the cost of handling the biomass prior to grinding. The costs would have been $4300 per acre or $194/BDT, which would still be too costly for providing biomass to the proposed biomass facility.

Options for Improving the Economics of Collecting and Processing Biomass

In order for excess biomass to be utilized for energy production, this pilot project clearly demonstrates that using extensive manual treatment and removal is not economically feasible.

If thinning projects can be planned to allow on site use of mechanical equipment, it is estimated that the overall cost of similar operations would be approximately $1100 per acre. This would result in a delivered cost for biomass at the energy facility of approximately $51/BDT, an amount that would make biomass removal economically feasible. Mechanical equipment exists that produces low ground impacts. In addition, these impacts can be further minimized using best management practices. Given the environmental benefits of thinning and utilizing the biomass for energy production, allowing such equipment would be appropriate where feasible.

Air Quality Impacts

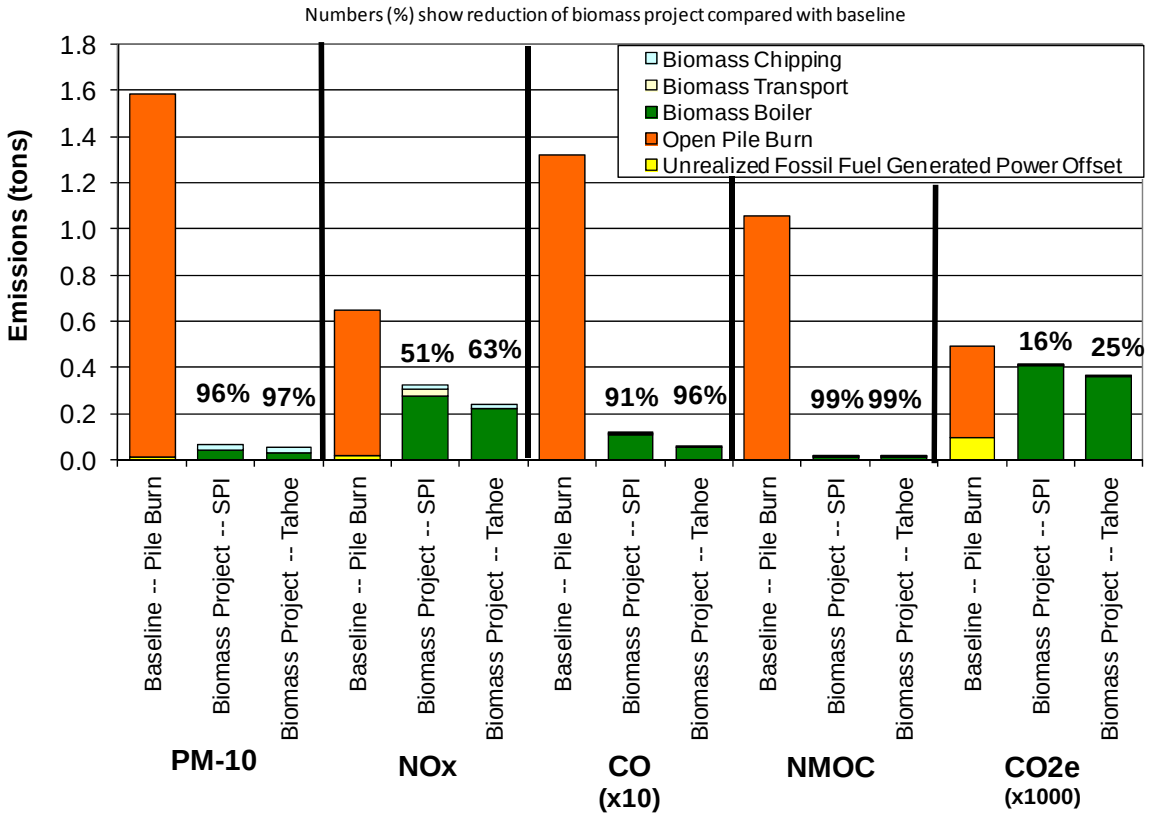
The air emissions comparison for the alternative waste biomass treatments, as shown in Table 3 and figure 2, indicates a dramatic overall reduction of pollutants if excess forest biomass is utilized for the production of energy instead of being pile burned on-site. The results are shown for the baseline condition of open pile burning compared with both current facilities and the proposed Tahoe Project facility:

- PM_{10} (particulate matter, diameter less than 10 microns); Reduced by 96% (1.5 tons)
- NOx (nitrogen oxides); Reduced by 47% (0.3 tons)
- CO (carbon monoxide); Reduced by 91% (12 tons)
- NMOC (non-methane organic hydrocarbons); Reduced by 99% (1.0 tons)
- CO_2e (carbon dioxide + methane*21); Reduced by 78.6 tons

Table 3: Criteria Air Pollutant and Greenhouse Gas Emissions – Summary Comparison of Biomass Energy Project with Open Pile Burn Alternative.
Emission factors used for the analysis are provided in an attachment to the report.

	Air Emissions (tons)				
	NOx	PM10	NMOC	CO	CO2e
Biomass Utilization for Energy Project -- SPI Biomass Energy Facility					
SPI Biomass Boiler	0.28	0.038	0.011	1.03	404.8
Biomass Processing and Transport					
Tub Grinder, Loader	0.02	0.024	0.001	0.02	4.4
Chip Van Transport	0.03	0.001	0.001	0.06	3.5
TOTAL	0.32	0.062	0.013	1.12	412.7
Biomass Utilization for Energy Project -- Tahoe Biomass Facility					
Tahoe Biomass Facility	0.24	0.050	0.013	0.52	364.0
Baseline -- Without Biomass Utilization for Energy Project					
Open Pile Burning	0.63	1.573	1.049	13.11	397.8
Unrealized, Fossil Fuel Generated, Power Offset	0.02	0.010	0.002	0.03	93.5
TOTAL	0.65	1.583	1.051	13.14	491.3
Emission Reductions (Biomass - Baseline)	0.33	1.520	1.038	12.03	78.6
% Reduction	51%	96%	99%	91%	16%

Figure 2: Comparison of air emissions from open pile burning and biomass to energy alternative.



Conclusions

While this project may have cost more than is practical and economically sustainable, the results from analyzing costs and benefits did provide valuable information for determining the economics for a proposed Placer County Biomass Facility, valuable mitigation of high-risk fire on National Forest System lands adjacent to communities in the LTB, sound information that will help inform future decisions about forest management and hazardous fuel reduction projects, and information for designing treatments to use excess biomass generated by such projects.

An important lesson learned from the project is that hand thinning and carrying biomass material to the roadside dramatically increases costs. In the case of biomass that is suitable for use in an energy facility, handling cost is particularly affected by how such material is moved to a road and whether extra loading and hauling are required for converting the biomass to chips off-site. While it is essential that on-site soil protection be maintained in order to prevent unnatural levels of erosion and compaction, it is important to consider three important facts: 1) There are many types of equipment that can be used to gather and transport biomass without unacceptable soil impacts; 2) With fixed budgets, the high cost associated with using hand labor to accomplish forest management work reduces the amount of overall forest management work that can be done (resulting in less fire hazard reduction work being accomplished in an area of high wildfire risk); and, 3) Wildfire inevitably causes more soil and water quality impacts than modern forest management activities and equipment. All these factors lead to the desirability of considering expanding the use of mechanical equipment on-site where possible. This would provide improved economic feasibility, enhanced protection of forest resources, and enhanced protection of human infrastructure in the Lake Tahoe Basin.

Lake Tahoe Basin CRAG Forest Fuel Treatment Pilot Project

Introduction

The CRAG Forest Fuel Treatment Pilot Project (CRAG Project) was the second of two projects intended to determine feasible approaches for processing excess woody biomass from forest management projects and utilizing that biomass for energy generation—in lieu of disposing of the biomass through open pile burning. As was the case with the earlier Rubicon Project, costs involved in this CRAG project were higher than is feasible for regular operational implementation. However, the project provided valuable information to help guide future approaches and included analysis of other potentially feasible alternatives.

Background

The CRAG project was located on approximately 120 acres North of Tahoe City on National Forest System lands managed by the LTBMU. The original project involved thinning live trees to reduce fuel ladders and improve forest health, reduce surface fuel to lower fuel loading, and reduce risk of catastrophic fire. These treatments generated six large landing piles that were planned for burning. Placer County and the PCAPCD sponsored an evaluation of the economics and environmental air quality benefits of utilizing the CRAG waste woody biomass for energy. The removal of biomass from the landing piles was conducted in partnership with the LTBMU and SPI.

Project Description

Landing piles on the CRAG project, each consisting of approximately 1,000 green tons (GT) of biomass, were processed into chips, transported, and utilized for fuel at SPI biomass energy facilities located in Loyalton (56 miles one way) and Quincy (85 miles one way). The Loyalton facility was the preferred destination for the processed biomass, but was shut down during part of the project, necessitating delivery to Quincy. CTL, Inc. was contracted by Placer County to conduct the biomass operations. Biomass was ground into chips at the landing pile sites. Pile sorting and grinder loading were performed using a John Deere loader. Processing into chips was done with a Rotochopper horizontal grinder having a capacity of approximately 60 GT per hour. Chips were conveyed directly from the grinder into chip vans that had a loaded net capacity of approximately 25 GT. When chip vans were not present, chips were piled for later loading with a front-end loader—this allowed more efficient, non-stop operation of the grinder. A water truck and bulldozer were used for dust abatement and to maintain the access roads. Equipment specifications are shown in Table 1. Chip vans transported the processed biomass from the CRAG project landings to the SPI power generation facilities.

The SPI Loyalton biomass energy facility is a wood-fired Riley spreader-stoker boiler, rated at 336 MMBtu/hr, driving a 20 MW steam turbine generator. It uses an electrostatic precipitator (ESP) for particulate matter control and selective non-catalytic reduction (SNCR) for NOx control. The SPI Quincy facility is a co-generation unit, comprised of two wood-fired boilers – a Riley fixed grate, and a Zurn traveling grate – with total rated capacity of approximately 300 MMBtu/hr. Together they provide steam to on-site mill lumber drying kilns, and additionally run a 20 MW steam turbine generator. They also utilize an ESP and SNCR for air pollution control.

Figure 3: Location of the CRAG Project

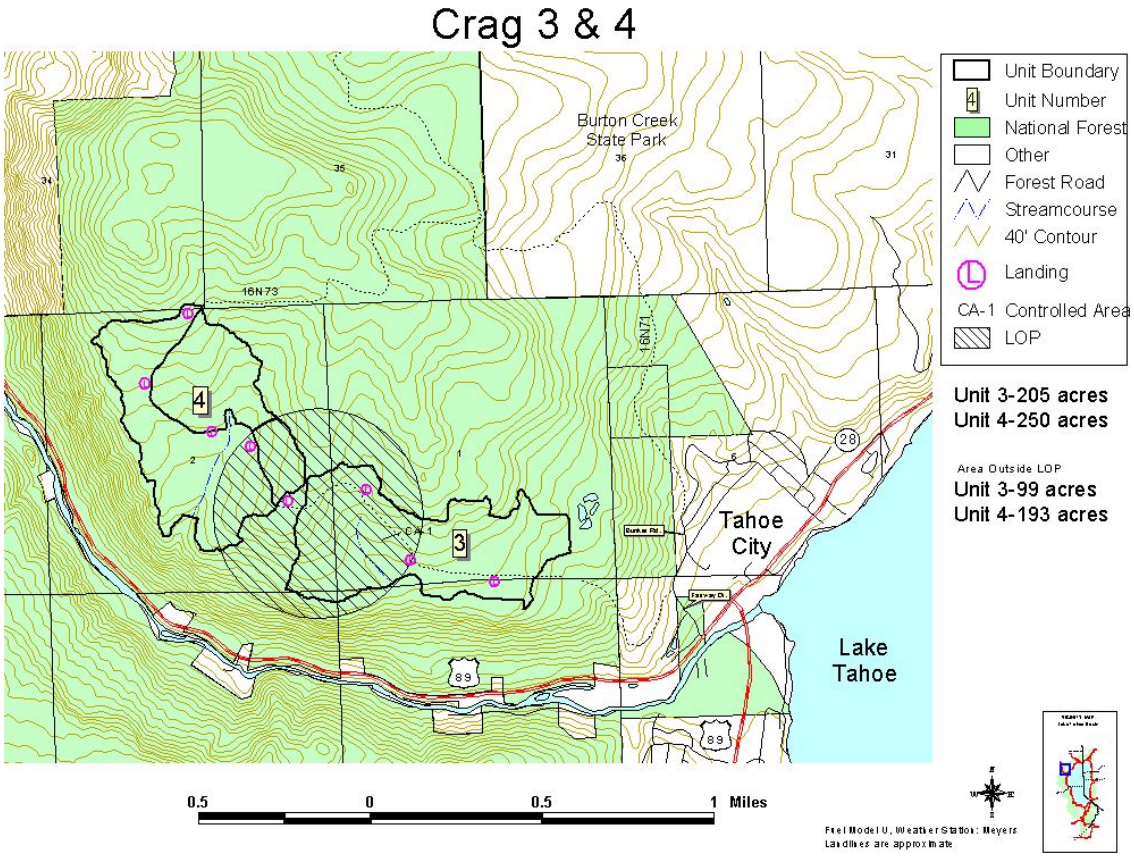


Exhibit 13: Slash Piles Scheduled for Burning

Exhibit 14: Grapple Loader Picks Up Biomass

Exhibit 15: Biomass ground into piles

Exhibit 16: Roads sprayed with water to keep dust down

Exhibit 17: Site cleaned up and ready for USFS restoration

Equipment specifications are shown in Table 4 below:

Table 4: Equipment Used to Process and Transport Biomass Fuel

Equipment	Vendor / Model / Year	Engine
Horizontal Grinder	Rotochopper, MC 266, 2005	Caterpillar C-15, 2005, 450 HP
Excavator	John Deere, 200CLC, 2006	John Deere, 6068HT059, 2006, 140 HP
Water Truck	Freightliner 4000	Detroit Series 60
Dozer	John Deere, 850-B, 1989	John Deere, 6466TF-00, 1989, 180 HP
Chip Van	Kenworth, 1997	Caterpillar C13, 1998, 380 HP

Results

Production

Biomass operations were conducted between September 16 and October 16, 2009. Project accomplishments, including chip van loads, total biomass processing, energy content, and SPI boiler electricity production from the CRAG biomass, are shown in Table 5.

Table 5: CRAG Biomass Project Production[2]

Biomass Energy Plant	Chip Van Loads	Biomass (Bone Dry Tons)	Biomass Energy (MMBtu)	Electricity Production (MWh)
Loyalton	22	315.1	2.7	341.8
Quincy	102	1,764.3	15.0	1,914.5
TOTAL	124	2,079.4	17.7	2,255.3

Diesel engine fuel usage for biomass processing and transport equipment included:

- Chip van: 3.8 miles/gal
- Horizontal grinder: 14 gal/chip van load
- Loader: 6.5 gal/chip van load
- Water truck: 5.5 gal/hr
- Dozer: 8.0 gal/hr

Project Economics

The total cost for CTL, Inc. to process and transport the biomass was $179,009, including $15,765 for road work using the water truck and dozer. This resulted in a cost, on average, of $86/BDT to deliver chips to the energy facilities. This was higher than the prevailing market value of $50/BDT for forest residual biomass. The project had a net loss of $75,039 ($36/BDT), based on the difference between the project cost of $179,009 and the project revenue (biomass value paid by Loyalton and Quincy of $50/BDT) of $103,970. Some of the loss can be directly attributed to the extra cost of transporting chip to Quincy, 28 miles further than Loyalton (about ¾ of the biomass material). The cost per acre of forestland treated for this project was approximately $1490. Typically this cost should be around $1,200 per acre. The entire cost of this project was covered by a Supplemental Environmental Project (SEP) from the Placer County Air Pollution Control District, SPI, and the LTBMU.

Future Project Economics

To determine how costs for delivering biomass from this project could relate to a proposed biomass facility located nearer to the LTB, costs were calculated using alternative locations for grinding and utilization. One alternative considered transporting the biomass to the Cabin Creek facility where a grinder is already located. This approach would have produced essentially same costs (due to the tipping fee) for hauling the biomass to the grinder, grinding, and hauling the chips to Loyalton and Quincy. Therefore, this alternative would have had the same overall results as the pilot operation. A second

[2] Note: One green ton (GT) of freshly cut biomass normally produces approximately 0.5 bone dry ton (BDT), so a chip van with a full, 25 GT load will normally produce 12-14 BDT. However, biomass included in this project experienced longer-than-normal drying in the field resulting in chip vans being able to transport more BDT.

alternative considered trucking the chips from the CRAG project to a potential biomass facility location (Kings Beach or other location) instead of to Loyalton and Quincy. This would have reduced the cost of hauling the chips. Chip van transportation costs are about $0.20/BDT/mile. Trucking to a location in the Kings Beach area or another location nearer to the project site, as opposed to Quincy or Loyalton, would reduce the transportation distance by a weighted average of 81 miles one way per chip van trip (162 miles total per chip van trip). This would reduce delivered biomass cost $32.40/BDT. On average the biomass gate cost would then be $53.60/BDT ($86 - $32.40), which is near the market price. This indicates that utilizing chips at a biomass facility at Kings Beach or other sites nearer to LTB projects could be economically viable. Note that this does not include the USFS cost of creating the landing piles.

Air Quality Impacts

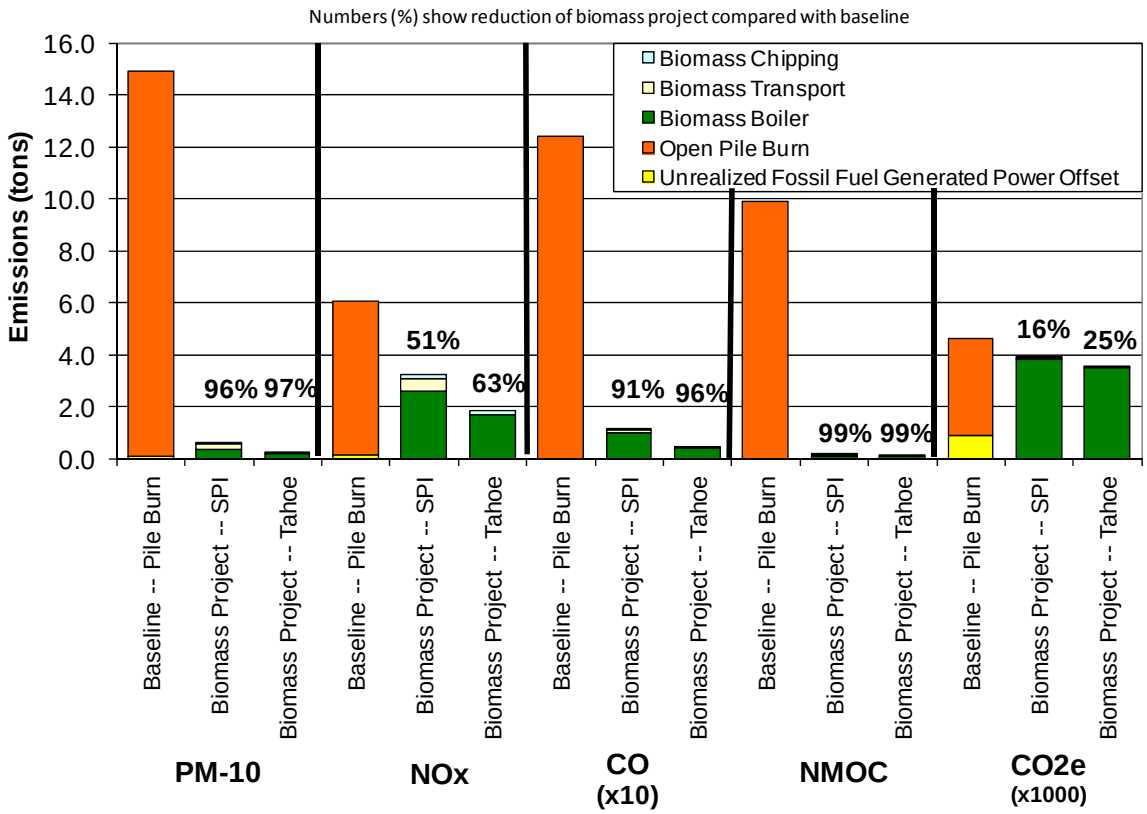
The air emissions comparison for the alternative waste biomass treatments, as shown in Table 6 and figure 4, indicates a dramatic overall reduction of pollutants if excess forest biomass is utilized for the production of energy instead of being pile burned onsite. The results are shown for the baseline condition of open pile burning compared with both current facilities and possible energy facilities nearer to LTB projects:

- PM_{10} (particulate matter, diameter less than 10 microns); Reduced by 96% (over 14 tons).
- NOx (nitrogen oxide); Reduced by 47% (2.9 tons)
- CO (carbon monoxide); Reduced by 91% (112 tons)
- NMOC (non-methane organic compounds); Reduced by 99% (10 tons)
- CO_2e (carbon dioxide + methane*21); Reduced by 712 tons

Table 6: Criteria Air Pollutant and Greenhouse Gas Emissions – Summary Comparison of Biomass Energy Project with Open Pile Burn Alternative. Emission factors used for the analysis are provided in an attachment to the report.

	Air Emissions (tons)				
	NOx	PM10	NMOC	CO	CO2e
Biomass Utilization for Energy Project -- SPI Biomass Energy Facility					
SPI Biomass Boiler	2.60	0.358	0.104	9.73	3812.6
Biomass Processing and Transport					
Tub Grinder, Loader	0.15	0.224	0.008	1.92	41.2
Chip Van Transport	0.46	0.011	0.014	10.93	60.7
TOTAL	3.21	0.593	0.125	11.02	3914.5
Biomass Utilization for Energy Project -- Tahoe Biomass Energy Facility					
Tahoe Biomass Facility	1.85	0.210	0.112	4.20	3541.0
Baseline -- Without Biomass Utilization for Energy Project					
Open Pile Burning	5.93	14.816	9.877	123.46	3746.4
Unrealized, Fossil Fuel Generated, Power Offset	0.15	0.090	0.020	0.32	880.6
TOTAL	6.08	14.906	9.897	123.78	4627.0
Emission Reductions (Biomass - Baseline)	2.87	14.313	9.772	112.76	712.5
% Reduction	47%	96%	99%	91%	15%

Figure 4: Comparison of air emissions from open pile burning and biomass to energy alternative



Conclusions

Transportation of biomass is typically a large cost center in biomass energy operations. The additional handling of biomass that was required in the Rubicon project—moving biomass to another site for grinding—adds significant cost. Analysis of the CRAG Project indicate that reducing transportation distances together with processing chips on-site offer the opportunity for a local biomass facility to operate economically with biomass from forest health and hazardous fuel reduction projects within the LTB. Good upfront planning and permitting on the CRAG Project provided the basis for a successful outcome. Efficient operations benefited from large piles located along existing roads, landings large enough to allow equipment operation, and grinding of biomass on-site.

This project provided valuable information for the determination of economics for the proposed Placer County Biomass facility in the area of Lake Tahoe. The removal of biomass took the place of having to open-burn landing piles. As ideas for innovation continue, further study and analysis will be needed to determine if biomass utilization will become a viable option for the management of forestlands within the LTB.

Placer County and the LTBMU have entered into a Master Stewardship Agreement since completing these projects. This will allow further partnership opportunities to reduce hazardous fuels, improve forest health, and divert biomass from pile burning in the forest to an energy generation facility.

Program Documentation:

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