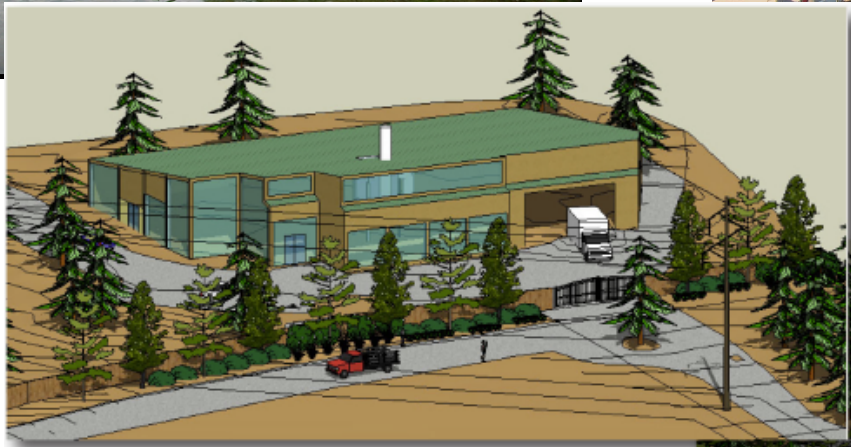


# Biomass Feasibility & Technical Assessment Studies



TSS Consultants

April 4, 2011

# Introduction

- Technology Assessment for Lake Tahoe Basin Biomass Plant
- Feasibility Study for Biomass Thermal System at Sierra at Tahoe Ski Resort
- Feasibility Study for Biomass Power in Yuba County

# **Assessment of Small-Scale Biomass Combined Heat and Power Technologies For Deployment in The Lake Tahoe Basin**

Prepared for:

Placer County Executive Office

High Sierra Resource Conservation and Development Council

U.S. Forest Service



# Project Objectives

- Assessment of small-scale (1 to 3 MW) biomass combined heat and power technologies for deployment in the Lake Tahoe Basin
- Evaluation had strong emphasis on systems with very low emissions
- Needed to be environmentally compatible with the Lake Tahoe Basin while utilizing locally available biomass fuels



# Tasks

- Technology Assessment -Using a systematic approach and methodology to review the benefits, challenges, and tradeoffs of various technologies.
  - Included both gasification and direct-fired combustion
  - Nearly 50 vendors/developers received Solicitation of Interest (SOI), 28 responded, 11 with enough info to evaluate via Technology Matrix.
- Technology Matrix - summarizes potential “fatal flaws” and analyze how these might be overcome. Limited to 3 of the most promising technologies (1 direct-fired combustion steam cycle, 2 gasification with IC engine genset)
- Financial analysis were also conducted on the 3 technologies

<p align="center"><b>Table 6-1</b></p> <p align="center"><b>BIOMASS RENEWABLE ENERGY FACILITY</b></p> <p align="center"><b>EVALUATION MATRIX</b></p> <p align="center">Weighted Value Range: 0 to 10      10 = highest rank   0 = lowest rank</p> <p align="center">Highest four total scores in <b>red</b></p>								
	Vendor and Lead Contact	Proven Technology	Biomass Utilization Experience	Biomass Fuel Flexibility	Air Emissions (Projected)	Capital Costs	User Friendly Operation (Projected)	Total Points
13	Emery Energy Company 157 W. Pierpoint Ave. Salt Lake City, UT 84101 801.364.8283 <a href="mailto:bphillips@emervenergy.com">bphillips@emervenergy.com</a>	5	5	5	7	4	5	31

# Financial Analysis

- To develop a biomass power plant using the leading technology, TSS analyses show that the prices at (\$25/BDT) for the electric output would range from \$0.098/kilowatt hour (kWh) with public financing (zero financing cost to project) to \$0.134/kWh for private financing.
- Different fuel costs and financing arrangements were used. 9 financial analyses were conducted for each of the 3 leading technologies.

# Subsequent Project Follow-on Work

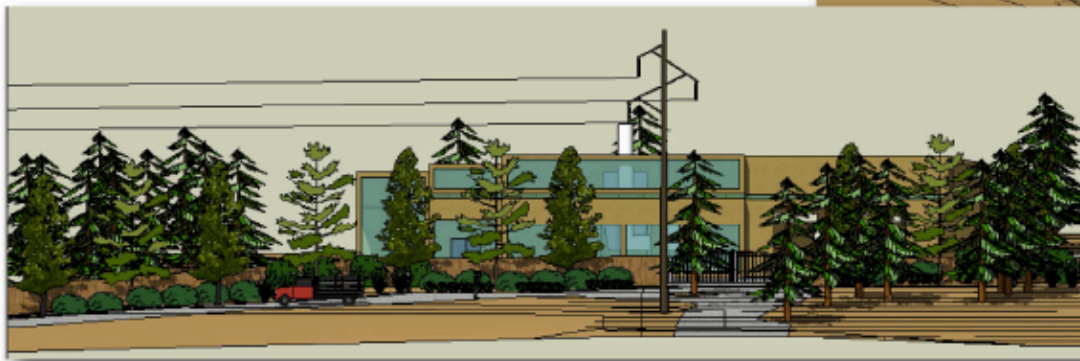
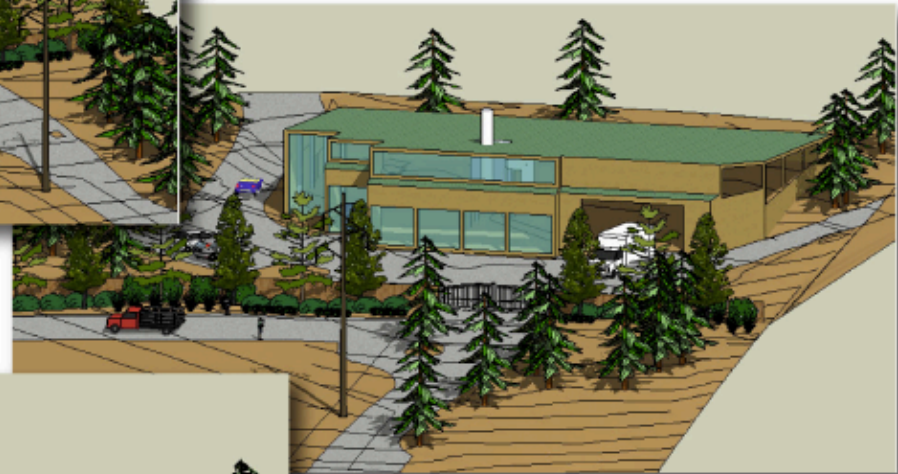
- **2007: \$75K** The U.S Forest Service and Placer County funded a preliminary technical feasibility assessment for a biomass energy facility in the Lake Tahoe Basin - *Report completed*
- **2008: \$500K** Placer County received Congressionally-directed funding to move this facility concept through the development phase - requiring matching funds of \$125k from PC - *Studies nearly complete*
- **2009: \$750k** Placer County received Congressionally-directed funding to move this facility concept through the environmental review, permitting and preliminary design stage - requiring matching funds of \$255k from PC – Stage I *Studies ongoing*
- **2009: \$677,250** Stage II of the 2009 award is for detailed design and construction and will require matching funds of \$677,250 – *awaiting permit decision*
- **2010: \$1M** Placer County was awarded additional funds to assist in the construction of the biomass utilization facility - requiring matching funds of \$1M– *In process*
- **To date: Another \$1M** Placer County is also contributing significant project support

# Continuing the Tech Assessment

- Phase II Technology Assessment – *Report pending*
- 3 promising small scale technologies; Gasification (2), Direct Combustion (1)
  - Nexterra (Gasification) - \$6,000+/Kwh
  - Envio Energi (Direct Combustion) - \$4,500/Kwh
  - Phoenix Energy (Gasification) - \$4,500/Kwh
- Financial analyses conducted on these technologies –  
Installation of electrical generating unit would require an electricity sales of 9.2 cents/Kwhr, based on 2 MW production and \$30 BDT woody biomass
- Total capex estimated at \$10M

# Kings Beach Biomass Facility

## 3-D Conceptual Site Plan



CONCEPTUAL ILLUSTRATIONS  
(REVISED 01/27/2011)



# Feasibility Study for Biomass Heating of Buildings and Snow Melting at the Sierra at Tahoe Mountain Resort



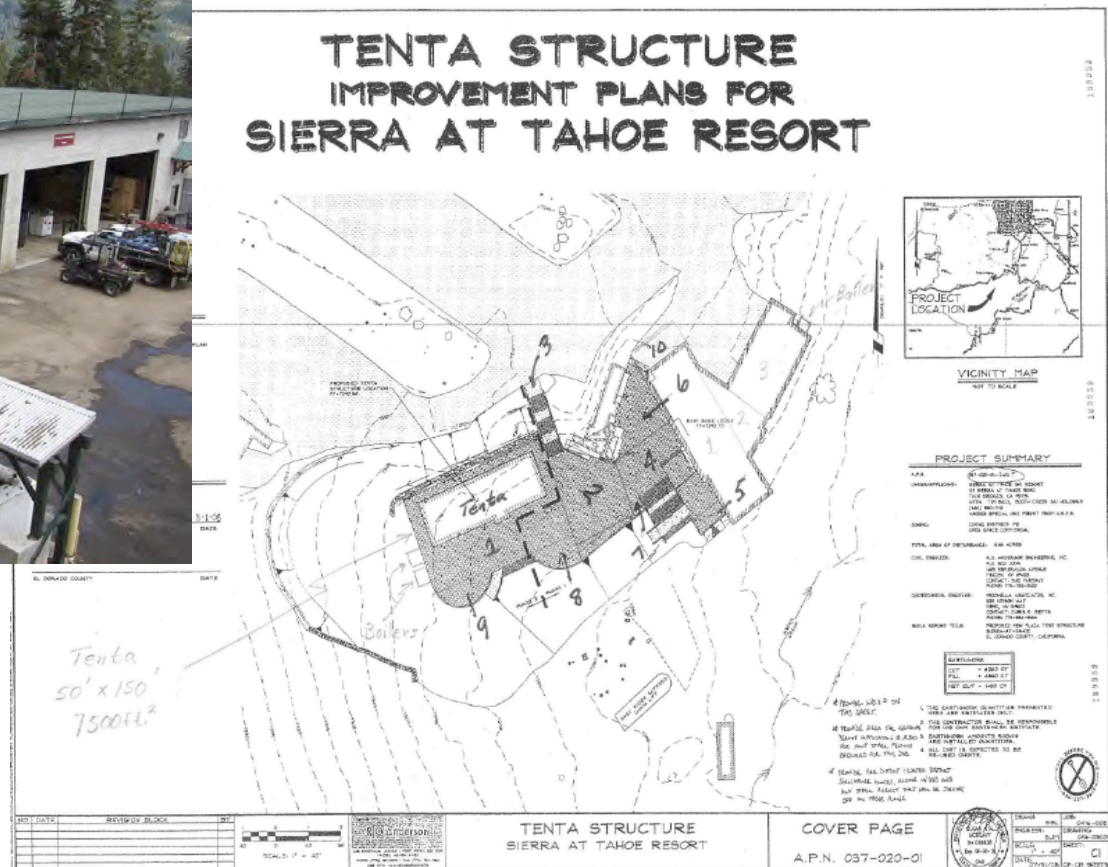
Prepared for:

The High Sierra Conservation and  
Development Council, Inc.  
Auburn, California

# Project Objectives

- Determine amount of woody biomass needed to heat selected existing and proposed structures
- Determine adequacy of economically available woody biomass in area of project
- Estimate price of woody biomass
- Conduct technical and economic feasibility of installing and operating biomass thermal heat systems
- Determine if project can acquire necessary air quality permits

# Existing and Proposed Structures

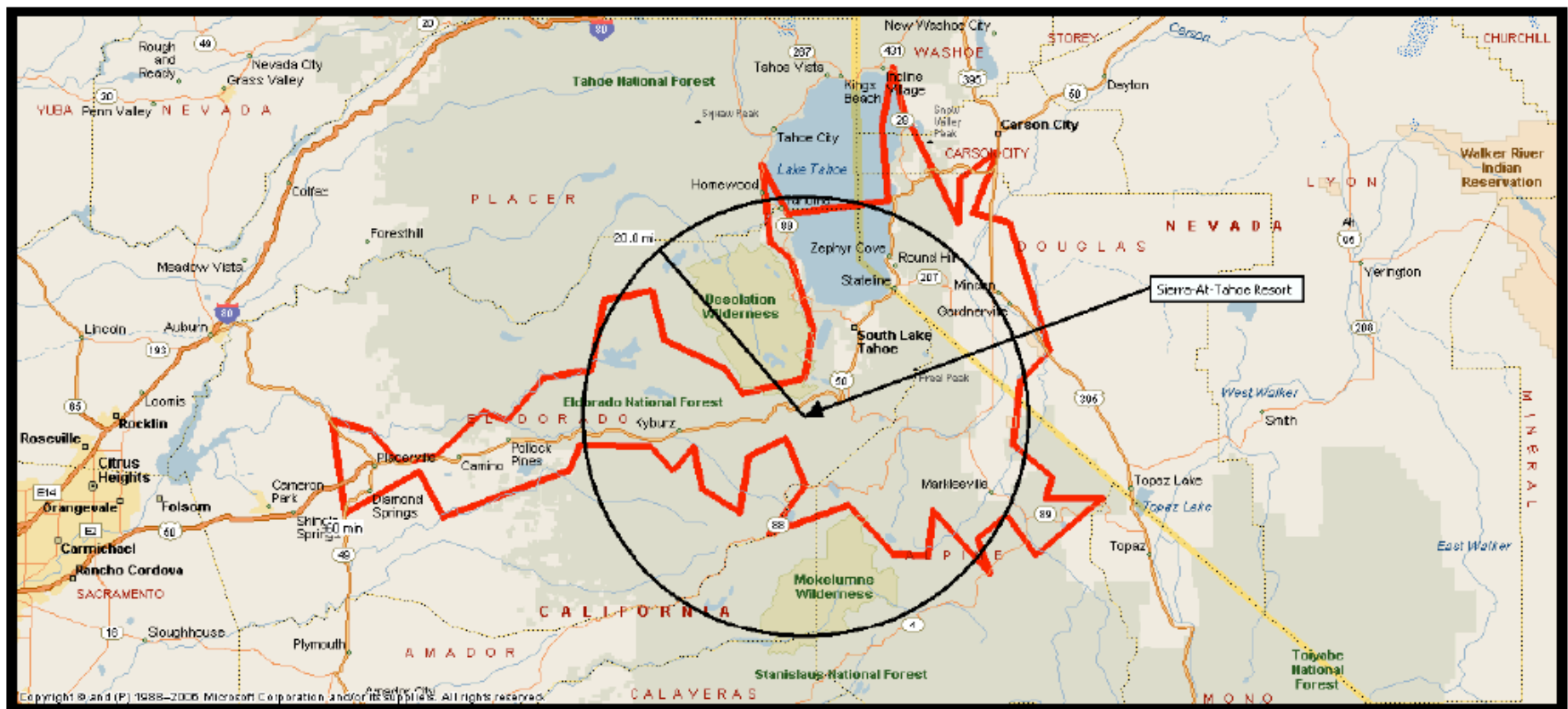


# Estimate Amount of Biomass Needed

**Table 1. Estimated Biomass Required for Sierra At Tahoe Facilities (BDT/Year)**

MONTH	LARGE MAINT. BLDG.	LODGE & ADMIN.	TENTA	SNOWMELT	TOTAL
Jan	16	18	10	11	55
Feb	13	14	8	8	43
Mar	14	15	9	9	47
Apr	10	11	7	7	35
May	8	8	5	5	26
June	0	0	0	0	0
July	0	0	0	0	0
Aug	0	0	0	0	0
Sept	0	0	0	0	0
Oct	5	6	3	4	19
Nov	9	10	6	6	31
Dec	17	19	11	11	58
<b>Total</b>	<b>92</b>	<b>101</b>	<b>59</b>	<b>60</b>	<b>313</b>

# Biomass Fuel Study Area





# Biomass Fuel Availability

FUEL TYPE	AVAILABLE
Hazardous Fuels Reduction Residuals – Inside the Lake Tahoe Basin portion of the TSA	4,330
Hazardous Fuels Reduction Residuals – Outside the Lake Tahoe Basin portion of the TSA	1,200
Forest Thinning and Harvest Residuals – For entire TSA	20,538
<b>PRACTICALLY AVAILABLE TOTAL</b>	<b>26,068</b>
MARKETS	CURRENT & POTENTIAL DEMAND
Operating Biomass Power Generation Facilities	5,000 <sup>1</sup>
Planned Biomass Power Generation Facilities	9,000
Soil Amendment/Soil Restoration	3,000
Firewood	500
Composite Panels	1,000
<b>MARKET DEMAND TOTAL</b>	<b>18,500</b>
<b>MARKET ADJUSTED TOTAL AVAILABLE</b>	<b>7,568</b>



# Technical & Economic Feasibility

- Biomass heating of large maintenance building very cost effective
- Biomass heating of Base Main Lodge, Administration Building, and Tenta Structure very cost effective with manually fed boilers
- Automated systems increase capital costs considerably, but still economically advantageous.
- Snowmelting not economically advantageous in comparison, as propane is not currently used for snowmelting.
- Biomass thermal units examined can be permitted in the El Dorado Air Quality Management District

# Yuba Foothills Biomass Feasibility Study



*Lake of the Springs, Yuba County*

*prepared for:*

**High Sierra Resource Conservation and Development Council  
&  
Yuba County Watershed Protection and Fire Safe Council**

# Project Objectives

- Originally planned as study of small-scale electric systems using Yuba County forest-sourced biomass – 3 MW or so
- Added larger plant (15 to 20 MW) at Teichert Aggregate facility near Marysville
- Determine economically available biomass fuel with 50 miles of Teichert site
- Determine siting and environmental needs of Foothill and Teichert sites
- Conduct financial analyses of 3 MW facility in Yuba County foothills and 20 MW facility at Teichert site

# Phase I

- Reviewed potential sites Identified by Council
- Preliminary fuel analysis of Yuba Foothills
- Estimate cost of forest-sourced fuel
- Estimate size of power facility
- Key partner identification



## Phase II

- Examination of Yuba Foothill and Teichert sites as a biopower facility site
- Biomass resource analysis
- Siting and environmental considerations
- Preliminary financial analysis
- Project planning and development





# Economically Available Biomass

**Table 2-10. 2013 Forecast - Economically Available Biomass Fuel with the FSA**

ESTIMATE	AVAILABLE FUEL (BDT/YEAR)	COMMENTS
Projected Economically Available	<b>999,700</b>	
Current Demand	505,000	Six operating biopower facilities.
Potential Demand	98,500	Five high probability commercial-scale facilities. Includes two re-starts, two coal conversions, and one green field biopower facility.
<b>TOTAL DEMAND</b>	<b>603,500</b>	
<b>BALANCE AVAILABLE</b>	<b>396,200</b>	

With approximately 2.5 coverage ratio =  
160,000 BDT (20 MW)

# Fuel Pricing

**Table 2-14. Optimized Fuel Blend and Pricing Example**

BIOMASS FUEL TYPE	PERCENT BLEND (% TOTAL)	VOLUME PROCURED (BDT/YEAR)	FUEL PRICING (\$/BDT)	
			LOW	HIGH
Urban Wood/Tree Trimmings	28%	45,000	24	32
Timber Harvest Residuals	19%	30,000	45	50
Orchard Removal	19%	30,000	37	40
Orchard Prunings	6%	10,000	35	40
Leached Rice Straw	13%	20,000 <sup>21</sup>	40 <sup>22</sup>	45
Forest Fuels Treatment/Restoration	16%	25,000	45	55
<b>Total</b>	<b>100%</b>	<b>160,000</b>		
<b>Blended Average</b>			<b>\$36.34</b>	<b>\$42.59</b>

# Candidate Sites

**Table 3-2. Candidate Sites Zoning**

SITE	ZONING	LAND USE DESIGNATION	PRINCIPAL PARCEL NUMBERS
Celestial Valley sawmill site	A/RR20	Foothill Agriculture,	064-250-030
Oregon House - Siller sawmill site	A/RR05	Neighborhood Commercial, A/RR05	048-080-018
Teichert	A/RR05	Valley Agriculture	018-150-057

# Air Quality

**Table 3-1. Criteria Air Pollutant Emissions Calculations**

CRITERIA POLLUTANT	EMISSION FACTOR (LBS/MMBTU)	LIKELY CONTROL MEASURE	3 MW <sup>23</sup> (TONS PER YEAR)	20 MW <sup>24</sup> (TONS PER YEAR)	EMISSION OFFSETS THRESHOLDS (TPY) PER FRAQMD <sup>25</sup>
NO <sub>x</sub>	0.09 <sup>26</sup>	Selective non-catalytic reduction	17	95.8	25
PM <sup>10</sup>	0.02	Baghouse	3.8	21.3	25
CO	0.09	Combustion practices	17	95.8	N/A <sup>27</sup>
VOC	0.02	Combustion Practices	3.8	21.3	25
SO <sub>x</sub>	0.04	Low sulfur fuel	7.6	42.6	N/A

# Financial Analysis

**Table 4-1. Input Values for Biomass Cogeneration Model (3 MW Power Plant) Located at Oregon House and Celestial Valley Sites)**

INPUT ITEM	VALUE
Gross Electrical Capacity (MW)	3
Parasitic Electrical Load (MW)	0.3
Capital Cost of Generating Facility (M\$)	13,500
Capacity Factor (%)	90
Net Electrical Efficiency (%)	23
Fuel Cost Beginning Year (\$/BDT)	50
Fuel Heating Value (Btu/lb)	8500
Fuel Ash Concentration (%)	5
Ash Disposal Cost (\$/Ton)	20
Fraction of Heat Recovered & Sold (%)	10
Price/Value of Heat Sold (\$/MMBtu)	7
Labor Cost (M\$/Yr.)	600
Maintenance Cost (M\$/Yr.)	150
Property Tax Rate (%/Yr.)	1
Utilities (M\$/Yr.)	10
Land Lease (M\$/Yr.)	12
Administrative & General (M\$/Yr.)	25
Other Operating Expenses (M\$/Yr.)	20
Federal Income Tax Rate (%)	35
State Income Tax Rate (%)	9
Tax Depreciation Method	MACRS-5
Investment Tax Credit Rate (%)	30
Escalation Rates-All Items (%/Yr.)	2
Debt Ratio (%)	75
Interest Rate on Debt (%)	7
Economic Life of Plant (Yrs.)	20
Return on Equity Required (%)	15

# Financial Analysis

**Table 4-2. Estimated Price That Electricity Must be Sold to Realize a 15% Return on Owner's Invested Capital at the Oregon House Celestial Valley Sites**

CASE	REQUIRED PRICE OF ELECTRICITY (¢/KWHR)
With ITC Realized	10.25
ITC Not Realized	13

**Table 4-4. Estimated Price That Electricity Must be Sold to Realize a 15% Return on Owner's Invested Capital at the Teichert Site**

CASE	REQUIRED PRICE OF ELECTRICITY (¢/KWHR)
With ITC Realized	6.95
ITC Not Realized	9.2



# Follow-on Work

- Meetings and presentations to Teichert management
- Assisted Teichert with WOODYBUG application
- Continue project development work with Teichert