

Energy Research and Development Division  
FINAL PROJECT REPORT

**PLUMAS ENERGY EFFICIENCY AND  
RENEWABLES MANAGEMENT  
ACTION PLAN (PEER MAP)**

Prepared for: California Energy Commission  
Prepared by: Sierra Institute for Community and Environment



**Sierra Institute**  
for Community and Environment

NOVEMBER 2016  
CEC-500-2016-067

**PREPARED BY:**

***Primary Author(s):***

Jonathan Kusel  
Mik McKee

Sierra Institute for Community and Environment  
PO Box 11  
Taylorsville, CA 95983  
Phone: 530-284-1022 | Fax: 530-284-1023  
<http://www.sierrainstitute.us>

***Contract Number: PIR-12-003***

***Prepared for:***

**California Energy Commission**

Rizaldo E. Aldas, Ph.D.  
***Project Manager***

Aleecia Gutierrez  
***Office Manager***  
***Energy Generation Research Office***

Laurie ten Hope  
***Deputy Director***  
***ENERGY RESEARCH AND DEVELOPMENT DIVISION***

Robert P. Oglesby  
***Executive Director***

**DISCLAIMER**

This report was prepared as the result of work sponsored by the California Energy Commission. It does not necessarily represent the views of the Energy Commission, its employees or the State of California. The Energy Commission, the State of California, its employees, contractors and subcontractors make no warranty, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the California Energy Commission nor has the California Energy Commission passed upon the accuracy or adequacy of the information in this report.

## ACKNOWLEDGEMENTS

The Sierra Institute for Community and Environment would like to thank the members of the Plumas Energy Efficiency and Renewable Energy Management Action Plan Advisory Body for their help in developing a robust plan and bringing it to efficient closure. It would not have been possible to create the PEER MAP plan, which lies at the heart of this project, without their guidance and input.

**Danielle Banchio**, Registered Professional Forester #2808

**Nick Boyd**, Feather River College Director of Facilities

**David Keller**, Plumas County Community Development Commission

**Charles Plopper**, Professor Emeritus, UC Davis

**Dony Sawchuk**, Plumas County Director of Facility Services

**John Sheehan**, former Executive Director of Plumas Corporation

**Lori Simpson**, Plumas County Supervisor District Four

**Elaine Vercruyse**, Logging Systems Planner with the Plumas National Forest

**Randy Wilson**, Plumas County Planning Director

The Sierra Institute for Community and Environment would also like to thank Andrew Haden and the staff at Wisewood, Inc. for providing their expert technical assistance and helping develop a fully integrated biomass utilization project and many of the components of the PEER MAP project.

We appreciate the time and energy as well of the following partners for their interest and work to advance biomass utilization in Plumas County: Tom Hayes and staff at Eastern Plumas Health Care District, Dr. Derek Lerch and staff at Feather River College, Nils Lunder, Plumas County Fire Safe Council Coordinator, and Gretchen Bennitt and her staff at the Northern Sierra Air Quality Management District. The sincere interest in seeing increased utilization of biomass and general support by the Plumas County Board of Supervisors is also appreciated.

The commitment to increased utilization of biomass by the Plumas National Forest and Region 5 has also helped advance this project. The Biomass Working Group, comprised of members from across California, has been vital source of new ideas and provided a knowledgeable, thoughtful and diverse group of which to bounce ideas off.

Finally, the Sierra Institute for Community and Environment would like to acknowledge the California Energy Commission, which made this project possible. The work to develop a renewable energy plan for Plumas County has been generously funded by a California Energy Commission Public Interest Energy Research (PIER) grant.

## PREFACE

The California Energy Commission Energy Research and Development Division supports public interest energy research and development that will help improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

The Energy Research and Development Division conducts public interest research, development, and demonstration (RD&D) projects to benefit California.

The Energy Research and Development Division strives to conduct the most promising public interest energy research by partnering with RD&D entities, including individuals, businesses, utilities, and public or private research institutions.

Energy Research and Development Division funding efforts are focused on the following RD&D program areas:

- Buildings End-Use Energy Efficiency
- Energy Innovations Small Grants
- Energy-Related Environmental Research
- Energy Systems Integration
- Environmentally Preferred Advanced Generation
- Industrial/Agricultural/Water End-Use Energy Efficiency
- Transportation

*Plumas Energy Efficiency and Renewables Management Action Plan* is the final report for the PEER MAP project, contract number PIR-12-003, conducted by Sierra Institute for Community and Environment. The information from this project contributes to Energy Research and Development Division's Renewable Energy Technologies Program.

When the source of a table, figure or photo is not otherwise credited, it is the work of the author of the report.

For more information about the Energy Research and Development Division, please visit the Energy Commission's website at [www.energy.ca.gov/research/](http://www.energy.ca.gov/research/) or contact the Energy Commission at 916-327-1551.

## ABSTRACT

In 2012, Governor Brown signed Senate Bill 1122 calling for the generation of 50 megawatts of electricity from sustainably harvested forest biomass. To support this mandate, the Sierra Institute for Community and Environment researched, developed, and initiated implementation of a renewable energy plan in Plumas County, California as part of their Plumas Energy Efficiency and Renewables Management Action Plan.

Plumas County residents lack access to natural gas due to small population size and remote location in the high Sierras, causing them to be dependent on expensive and volatile fossil fuels (propane and heating oil) for heating. However, the region's need to reduce fuel loading in forests and abundance of sunshine make it an ideal location to develop a forest biomass-powered combined heat and power facility and a photovoltaic infrastructure to support local needs for thermal and electrical energy.

Sierra Institute staff focused primarily on advancing sustainably harvested forest biomass use. They developed an understanding of the economic, environmental, and community benefits to be gained from implementing the plan. They used this understanding to create the Plumas Energy Efficiency and Renewables Management Action Plan Energy Vision, which outlines the need for strategies rural forested communities can use to 1) develop and implement energy plans that meet economic, environmental, and community health benefits and 2) increase the use of local renewable resources, all while meeting California's statutory energy goals and reducing the consumption of fossilized carbon.

If the action plan is fully implemented, the county will benefit from savings of \$200,000, a reduction of over 175,000 gallons of fossil fuel annually, and the creation of numerous new short- and long-term employment opportunities.

**Keywords:** Forest biomass, solar PV, renewable energy, wildfire threat reduction, community benefit

Please use the following citation for this report:

Kusel, Jonathan; Mik McKee. 2016. Sierra Institute for Community and Environment. *Plumas Energy Efficiency and Renewables Management Action Plan (PEER MAP)*. California Energy Commission, Publication number: CEC-500-2016-067.

# TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>7</b>
Introduction .....	7
Project Purpose.....	7
Project Results.....	8
Project Benefits .....	9
<b>CHAPTER 1: Project Context.....</b>	<b>11</b>
1.1 Partnership with Wisewood.....	12
1.2 Understanding Plumas County .....	12
1.3 Opportunities to Utilize Forest Biomass.....	16
<b>CHAPTER 2: Developing PEER MAP.....</b>	<b>19</b>
2.1 Stakeholder Outreach and Advisory Body .....	19
2.2 Site Selection .....	20
2.3 Understanding Relevant Policy and Recommendations.....	21
<b>CHAPTER 3: Financing PEER MAP.....</b>	<b>25</b>
3.1 Biomass Boilers.....	25
3.2 Combined Heat and Power Facility .....	26
<b>CHAPTER 4: Implementation Barriers.....</b>	<b>28</b>
4.1 Biomass Boilers.....	28
4.2 Combined Heat and Power .....	29
4.3 Solar PV .....	30
<b>CHAPTER 5: Moving PEER MAP Forward.....</b>	<b>31</b>
5.1 Biomass Boilers at PHHS .....	32
5.2 Biomass Boilers at EPHC .....	32
5.3 Additional Biomass Boilers .....	33
5.4 Combined Heat and Power Facility .....	33
5.5 Solar PV .....	34
<b>CHAPTER 6: Conclusion.....</b>	<b>35</b>

<b>Glossary of Terms and Abbreviations</b> .....	<b>37</b>
<b>References</b> .....	<b>39</b>
<b>APPENDIX A: Feasibility Study for Biomass Heat at Eastern Plumas Health Care</b> .....	<b>A-1</b>
<b>APPENDIX B: Feasibility Study of Biomass Heat for Portola Jr/Sr High School</b> .....	<b>B-1</b>
<b>APPENDIX C: Feasibility of Biomass District Energy for Portola, California</b> .....	<b>C-1</b>
<b>APPENDIX D: Feasibility Study for Biomass Heat at the Plumas National Forest Supervisors Office and Mount Hough Ranger District</b> .....	<b>D-1</b>
<b>APPENDIX E: Site Specific Engineering and Architectural Plan for Eastern Plumas Health Care</b> .....	<b>E-1</b>
<b>APPENDIX F: Crescent Mills Site Aerial Image + Plan</b> .....	<b>F-1</b>

## **LIST OF FIGURES**

Figure 1: Plumas Energy Efficiency and Renewables Management Action Plan (PEER MAP) Energy Vision.....	11
Figure 2: Forested Landscape in Plumas County After the Moonlight Fire.....	13
Figure 3: Weekly Residential Propane Prices.....	18
Figure 4: Weekly Residential Heating Oil Prices.....	18
Figure 5: Eastern Plumas Health Care Site.....	20
Figure 6: Crescent Mills Wood Processing Site.....	21
Figure 7: Sierra Institute and Wisewood Staff Discuss Master Site Planning and Development at the Crescent Mills Site.....	31

## **LIST OF TABLES**

Table 1: Critical Facilities Identification and Assessment.....	15
Table 2: Available Biomass in Upper Feather River Watershed.....	16





# EXECUTIVE SUMMARY

## Introduction

The goal of the Plumas Energy Efficiency and Renewable Energy Management Action Plan (PEER MAP) is to identify, develop, and begin implementation of a renewable energy plan for Plumas County, California. The plan involves strategizing methods to harness the county's two main sources of renewable energy, forest biomass and solar energy, to meet residents' energy needs.

The plan's primary focus is using forest biomass, a locally abundant, renewable natural resource, as an alternative source of heat at public institutions in Plumas County. When sourced from timber harvest residuals and combined with sustainable forest management techniques, forest biomass is a carbon neutral source of fuel. Forest biomass can be harvested, refined, and delivered to institutions with biomass-fired boilers at costs substantially lower than those associated with fossil fuels. Technological advances in biomass-fired boilers, largely driven by European research and development, have led to modern heating systems that are significantly cleaner and more efficient than their predecessors.

The opportunity to use biomass as a renewable source of heat and electric energy generation is gaining attention from state legislators. Senate Bill 1122 requires investor-owned utilities (Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric) to purchase 50 megawatts (MW) of electricity from small-scale (3 MW or smaller) bioenergy projects using sustainably harvested forest biomass as a primary fuel source. To make biomass-fueled electricity generation economically feasible on the small scale, SB 1122 establishes an artificially high price floor and a price auction mechanism to govern power purchase agreements. The California Department of Forestry and Fire Protection and the California Public Utilities Commission are tasked with overseeing and implementing this program as part of the California Renewables Portfolio Standard.

Regional climatic and geographic conditions are such that solar energy potential in Plumas County is rated at 520 watt hours per square foot per day, making it one of the best locations to generate solar electricity in the United States. The abundant sunshine and high altitude combined with the attractive state and federal tax incentives available to homeowners and private businesses have allowed for significant solar PV technology development throughout the county.

## Project Purpose

The purpose of PEER MAP is to work with local stakeholders, county officials and other organizations in Plumas County to collaboratively identify and develop a renewable energy plan for the county. The decision to focus primarily on sustainably harvested forest biomass, and secondarily on solar PV technology stems from the fact that these are the most abundant renewable resources in the immediate geographic region. Additionally, increased use of biomass, and to a lesser extent solar PV, will provide local residents with additional economic, environmental, and community benefits.

During the PEER MAP planning process, Sierra Institute and Wisewood staff investigated the financial savings available to large public institutions willing to switch from fossil fuel-generated heat to biomass generated heat. Wisewood staff developed several feasibility studies demonstrating that savings will vary depending on the fossil fuel replaced and the overall heat demand of the facility.

Like many other rural communities in California, Plumas County is plagued by relatively high risk of catastrophic wildfire. A central component to PEER MAP is to demonstrate how a stronger demand for forest biomass could lead to thinning of additional acres and reduction in the risk of catastrophic wildfire. Though forest fire risk was not a focus of this work, increased use of biomass will reduce black carbon and greenhouse gas contribution because biomass would be burned in confined boilers as opposed to open-pile burning and wildfires. By quantifying the amount of acres that could be treated if new markets for biomass are developed, PEER MAP may help mitigate the risk of catastrophic wildfires by helping local land managers and groups focused on fire safety develop strategies to increase the number of acres thinned in the Wildland Urban Interface; as well as other forests as needed, including national forest lands where many acres are at high risk for catastrophic wildfire.

Sierra Institute staff also used PEERMAP to explore how stimulating demand for biomass by constructing boilers and combined heat and power facilities can reduce the amount of fossil fuels consumed across the county. They explored boilers at a variety of public facilities with in-depth work at Eastern Plumas Health Care and Portola High School. They also explored a community thermal system for City of Portola facilities. PEER MAP was also used to evaluate the development of new long- and short-term employment opportunities, as well as bolster existing economic sectors. Plumas County had once been dependent on a vibrant timber industry, but employment is now far lower than it has been in previous years.

Finally, the PEERMAP project was designed not only to make a difference in Plumas County, but also to serve as a prototype for biomass use in northern California and other rural regions abundant with forest biomass. The Sierra Insitute has regularly shared its work, and now is working with a variety of rural communities to advance biomass energy production in rural forested communities throughout California.

## Project Results

PEER MAP has been successful by:

1. Improving understanding among residents and state and county officials of the economic, environmental, and community benefits available through increased use of biomass.
2. Informing how careful use can simultaneously improve forest conditions, reduce risk of catastrophic wildfire, and improve air quality by reducing long-term CO<sub>2</sub>, black carbon, and other forest open pile burning pollutants.
3. Saving money through replacement of non-renewable petrochemical fuels with woody renewable material.

#### 4. Reducing use of “fossil” carbon with renewable woody material.

Increased understanding has led to widespread support for increased biomass use. PEER MAP helped identify avenues and support for local utilization, including development of combined heat and power (CHP) facilities and woody-renewable thermal boilers that can replace the many aging—including dirty diesel—boilers throughout the county.

PEER MAP identified key metrics necessary for developing financially viable biomass thermal projects by working with local hospital districts, the countywide school district, Plumas County, Feather River College, and the U.S. Forest Service, among others. By project end, impoverished and risk-averse districts that initially resisted adoption of the technology were interested in further exploration of the financial implications and options available for biomass-powered boiler construction. Extensive planning and pre-engineering work has been completed on the Eastern Plumas Health Care District site, where a viable biomass boiler can be developed. The staff proposal to build a boiler that will provide heat to both the Plumas County’s Health and Human Services Building and the Feather River College dorms was awarded funding by the California Energy Commission. This is a combined heat and power (CHP) boiler that will produce a small amount of electricity along with heat. Despite initially rejecting a boiler for Portola High School, Plumas Unified School District has expressed renewed interest in biomass boiler installation at its facilities.

Working with Wisewood, the Sierra Institute has identified key metrics for developing a 3 megawatt biomass-fired CHP plant that will be eligible for the SB 1122 Feed in Tariff program in Crescent Mills. Funding for in-depth engineering and site preparation work on the Crescent Mills site has been secured from the U.S. Forest Service through a Woody Biomass Utilization Grant and a Wood Innovations grant. Extensive work continues on exploring the technology and how it will be financed.

#### **Project Benefits**

Research conducted during the PEER MAP process has helped influence policy on biomass use on a statewide level. Efforts to develop a 3 MW CHP plant have resulted in an increased understanding of how SB 1122 needs to be modified to be successful. Additionally, the Sierra Institute is using lessons learned from pioneering the pre-development phase of the CHP project to help organizations save time and resources as they develop similar projects. Based on PEER MAP and related work, the Sierra Institute secured a USDA Rural Community Development Initiative grant that allows the Institute to share results of this project and create a peer network for rural communities that advance SB 1122 and wood utilization projects together.

On a local level, if the full PEER MAP Energy Vision is realized, Plumas County residents will gain multiple economic, environmental and community benefits. The county will save roughly \$200,000 dollars per year in heating costs and will save approximately 175,000 gallons of fossil fuel on an annual basis.

Full implementation of PEER MAP, including a biomass use campus in Crescent Mills, will create roughly 20 long-term and many more short-term employment opportunities, injecting

more than \$40 million into the local economy. Additionally, an increased demand for forest biomass will help bolster the existing forest products industry by developing additional revenue streams for in-woods contracts.

At full build out, PEER MAP Energy Vision can create a demand for approximately 35,000 bone dry tons of forest biomass annually. In Plumas County, this will enable land managers to thin roughly 3,500 acres of land each year, which is about ten times more than what Plumas County Fire Safe Council currently thins. Should a heat user be secured for an SB1122 CHP project—an effort that is needed to help make a CHP economically sound—total demand could be tripled and remain under the low-end estimate of sustainable biomass production in the county. In short, a stronger demand for forest biomass will reduce the risk of catastrophic wildfire in Plumas County and support existing forest management projects, enabling more land to be restored than would otherwise be possible.

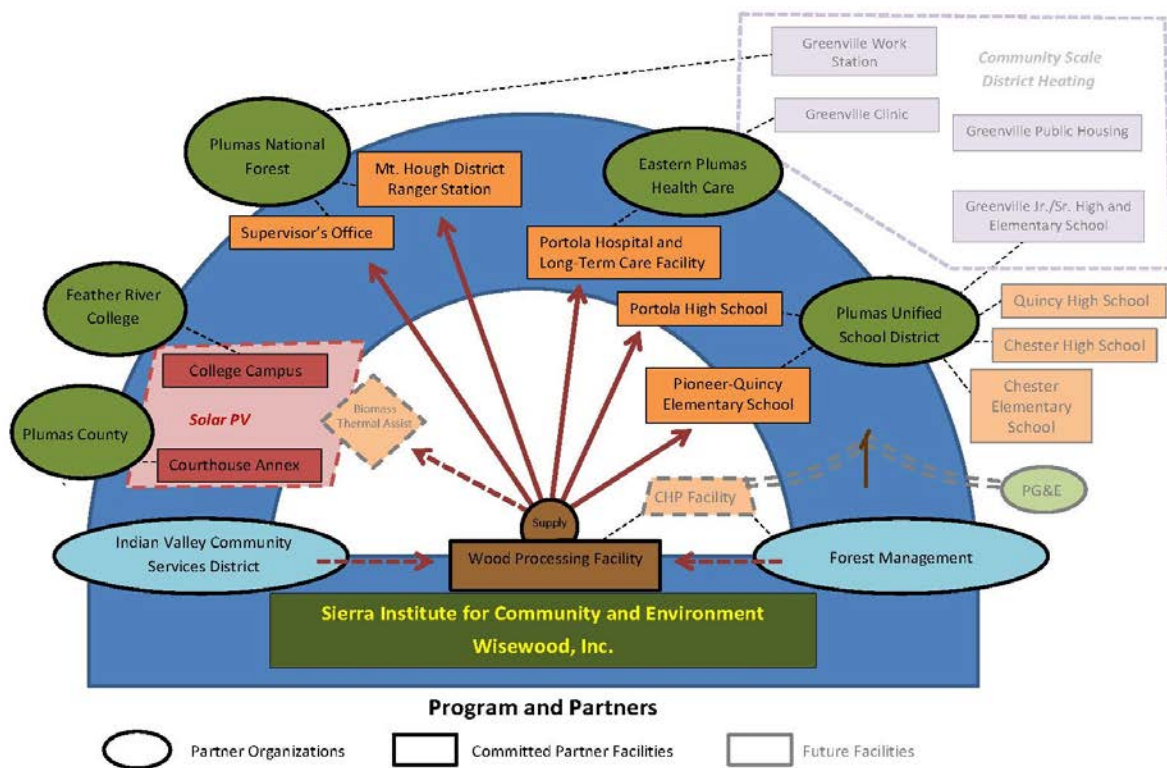
Lastly, PEER MAP has paved the way for development of a truly integrated biomass use program that directly benefits local communities while meeting many of the state's statutory energy goals. If the Sierra Institute and partnering agencies like the U.S. Forest Service and the CEC are able to successfully implement the PEER MAP Energy Vision to its full extent, this project will serve as the prototype for biomass use in California and rural areas elsewhere.

# CHAPTER 1: Project Context

The need for increasing biomass utilization in the Sierra and throughout the Western United States is growing, and one of the overarching goals of PEER MAP is to develop a road map for other organizations and communities that wish to advance similar projects. While every community will have its own set of challenges and barriers to overcome, advancing and explaining the process and context that has shaped the PEER MAP Energy Vision will inform and potentially benefit others.

PEER MAP was launched with a vision of players and opportunities. The following is a schematic of the players and potential users of biomass and solar photovoltaic energy that was part of the original PEER MAP proposal.

**Figure 1: Plumas Energy Efficiency and Renewables Management Action Plan (PEER MAP) Energy Vision**



The ovals represent partner organizations and users of biomass or solar PV energy, and the rectangles the specific sites at which energy projects might be located. At the center of the diagram is a wood processing facility that will provide conditioned wood chips to users and where a combined heat and power facility that will produce electricity for the grid is located. PEER MAP allowed the Sierra Institute and Wisewood, Inc., to develop this vision and explore feasibility of building it out.

## **1.1 Partnership With Wisewood**

A critical component of the Sierra Institute's ability to develop a comprehensive energy plan that truly addresses the triple bottom line (economic viability, environmental integrity, and community benefits) has been a successful partnership with Wisewood, Inc. Wisewood is a development firm with experience advancing state-of-the-art biomass facilities throughout the Pacific Northwest. Sierra Institute and Wisewood staff worked in tandem on this project, and the combination of expertise created a dynamic team capable of addressing the technical, ecological, and social components of PEER MAP.

Wisewood brought a wealth of technical experience to PEER MAP, and their council has been invaluable to the development of the PEER MAP Energy Vision. Specifically, Wisewood staff created detailed feasibility studies for a number of public institutions in the county. These studies focused on selecting appropriately sized technology as well as producing detailed assessments of energy use and heat demands at various facilities. As a result of these studies, Sierra Institute staff were able to present detailed analysis of the respective costs of each project, as well as the savings afforded by switching from fossil fuel-power boiler to biomass-fired boilers, to partner organizations.

## **1.2 Understanding Plumas County**

With 20,000 residents and a land base of over 2,600 square miles, Plumas County is one of the more rural counties in California. With densely forested mountains and several wide fertile valleys, Plumas County has a long history tied to natural resource management. Tourism, the forest products sector, agriculture and the associated service industries remain the primary economic drivers in the county.

The abundance of forest biomass and existing timber infrastructure are part of what makes Plumas County a particularly fitting location to develop a prototype biomass utilization project. With two sawmills located in the county, Sierra Pacific Industries' Quincy Mill and Collins Pine Company's Chester Mill, residents not only have a strong relationship with forests, but many are directly or indirectly employed by the timber industry. As such, there is an abundance of institutional knowledge and existing mechanical equipment available to develop the biomass utilization component of PEER MAP.

This infrastructure includes a landmass that totals more than 1.2 million acres, 80 percent of which is forested, and a relatively dense network of forest roads on both public and private lands. Taken together, these factors make Plumas County an ideal location to capitalize on the energy available in sustainably harvested forest biomass.

There is also a growing understanding about the need to develop viable, long-term markets for forest biomass. Residents of forested communities are familiar with the risk of catastrophic wildfire, and with recent events like the 2015 Butte and Valley Fires, 2014 King Fire, and 2013 Rim Fire and, locally, the 2012 Chips Fire and 2007 Moonlight Fire. Downstream communities are also now beginning to understand the economic and ecological impacts associated with the severity of new disturbance regimes. Accordingly, public appreciation for the need to thin

forests in and around rural, forested communities and vital public infrastructure like reservoirs is gaining momentum.

**Figure 2: Forested Landscape in Plumas County After the Moonlight Fire**



Photo credit: Sierra Institute for Community and Environment

In many ways PEER MAP is the catalyst linking the local institutional knowledge and workforce with the economic, environmental, and social benefits derived through stronger biomass markets. In Plumas County, one of the most critical aspects of this linkage involved identifying locations where biomass technology could be deployed on an appropriate scale, and introducing the idea of wood-powered biomass boilers exclusively for heating purposes.

While many Plumas County residents heat their homes with wood, installing industrial-scale biomass boilers is a capital-intensive undertaking. As is the case with other capital development expenditures, demonstrating a reasonable payback period is necessary to justify investment in new, expensive technology. Wisewood's feasibility studies were able to show that switching to biomass thermal technology at large public and private facilities with significant heat demands can provide fast payback periods and be cost effective. In Plumas County payback periods ranged from 8 to 20 years depending on the overall heat demand at a facility, the type of fossil fuel being replaced, the air pollution technology included in the project, and other variables.

The following is a description of the facilities examined during the PEER MAP planning process:

#### **Eastern Plumas Health Care (EPHC)**

EPHC is a small rural critical access hospital located in Portola, California serving roughly 10,000 local residents and summer tourists. Currently, the EPHC campus is heated by two industrial boilers powered by heating oil. In 2012, EPHC consumed 35,000 gallon of heating oil

at a cost of \$145,000 (see Table 1). A feasibility study showing the cost savings of switching to biomass-fired boilers is included in Appendix A.

### **Portola High School (PHS)**

The Portola Junior/Senior High School consists of a one-story campus with multiple buildings located at 155 Sixth Avenue, Portola, California, serving approximately 250 students in grades 7-12. The majority of heat for the campus is generated centrally in oil-fired boilers and distributed throughout the school via a hydronic (water-based) heat distribution system. See Appendix B of this report for full feasibility study.

### **Cluster of Buildings at Portola City Center**

Three small public buildings located at the center of Portola, consisting of the Portola City Hall, the US Post Office building in Portola and a county library building, were examined as part of a larger districting heating feasibility that included the hospital and high school (above). See Appendix C of this report for this district heating feasibility study.

### **New Jail Facility**

Plumas County officials are planning a new County Corrections facility. This facility will have both a significant heat demand for heating purposes and to meet hot water needs. Sierra Institute staff are working with officials to incorporate biomass boilers in the design of this facility.

### **Quincy Courthouse**

Plumas County Superior Court is the visual centerpiece of Quincy. This facility, completed in 1921, is 33,000 square feet and consumes approximately 10,000 gallons of heating oil annually. The Plumas County Director of Facilities reports spikes in electricity consumption during peak cold snaps in winter months due to increased use of electric space heaters by county staff.

### **Plumas District Hospital**

Plumas District Hospital serves residents of Quincy, the most heavily populated town in Plumas County. This facility is in need of boiler replacement and uses considerable energy.

### **Plumas Health and Human Services Facility (PHHS)**

PHHS is a 53,000 square foot building that houses many vital county services. This facility is relatively new and is currently heated and cooled with a geothermal loop. However, the current loop is undersized and the fluid medium in the pipes is pre-heated by two industrial electric hot water heaters.

### **Plumas National Forest Supervisors Office and Mt. Hough Ranger Station**

Plumas National Forest officials have expressed great interest in heating and possibly even cooling their local facilities with biomass technology. Despite the fact that the heat demand at these facilities is small, resulting in a small or even negligible return on investment, especially for the Mt. Hough Ranger Station, Forest Service officials continue to press forward with efforts to install boilers at these sites. See Appendix D of this report for the feasibility study for these facilities.



## Quincy High School (QHS)

QHS currently heats with heating oil consuming more than 25,000 gallons per year at an average cost of approximately \$106,000. The 1045 feet between the school and the Plumas National Forest Supervisors Office makes a shared system between these two facilities financially feasible though institutionally challenging.

**Table 1: Critical Facilities Identification and Assessment**

Biomass Thermal Opportunities	Current Heating Costs	Fuel Type	Gallons Used	Est. Biomass Used	Est. Savings
Portola District Heating Facility					
<i>Eastern Plumas Health Care</i>	\$ 147,500.00	diesel fuel	37,000	400 bdt	\$ 97,500.00
<i>Portola High School</i>	\$ 79,500.00	heating oil	22,640	210 bdt	\$ 53,250.00
<i>Portola City Hall</i>	\$ 4,700.00	propane	2,582	15 bdt	\$ 2,825.00
<i>Portola Library</i>	\$ 5,500.00	propane	2,750	15 bdt	\$ 3,625.00
<i>Portola USPS Building</i>	\$ 4,000.00	propane	2,300	15 bdt	\$ 2,125.00
County HHS/FRC	\$ 135,000.00	electric/Prop.	17,000	800 bdt	\$ 45,000.00
USFS Supervisors Office	\$ 37,000.00	prop/fuel oil	11,500/3,260	100 bdt	\$ 24,500.00
USFS Mt. Hough RD	\$ 35,000.00	propane	14,340	115 bdt	\$ 20,625.00
Greenville K-12 School	\$ 112,500.00	diesel fuel	30,646	275 bdt	\$ 78,125.00
Plumas Co. Court House	\$ 42,500.00	diesel fuel	10,000	150 bdt	\$ 23,750.00
Quincy High School	\$ 106,250.00	diesel fuel	25,000	220 bdt	\$ 78,750.00
Chester Heating Facility					
<i>Wildwood Asst. Living Fclty</i>	\$ 60,000.00	propane	26,000	175 bdt	\$ 38,125.00
<i>Seneca Hospital</i>	\$ 35,000.00	diesel fuel	11,000	100 bdt	\$ 22,500.00

Green Tons/Acre	10 to 15
Bone Dry Tons/Acre	8 to 12
Avg. price of chips (raw mtrl).	\$ 60.00
Retail chips/bdt (thermal)	\$ 125.00
Price of heat	83%
<b>Thermal Network</b>	
Total biomass needed	2,590 bdt
Acres treated	220 - 325
<b>3 MW CHP</b>	
Total biomass needed	25,000 bdt
Acres treated	2,100 - 3,200

Increased biomass utilization in Plumas Co. will have the following estimated annual results:	
County wide savings:	\$490,700
Fossil fuel gallons offset:	216,000
Homes powered:	3000
Bone dry tons of biomass used:	27,000
Acres treated:	2,250 - 3,500

**KEY**

bdt: bone dry ton  
 CHP combined heat and power

## Greenville

California Department of Transportation is planning a major infrastructure upgrade in the town of Greenville during the summer of 2015 and 2016. This presents an excellent opportunity to develop a biomass-fired district heat system for downtown Greenville. This system would be anchored by Greenville High School, which in 2012 consumed over 30,000 gallons of heating oil at a cost of more than \$112,000.

## Seneca Hospital

Seneca Hospital is a small critical access hospital that serves residents of the town of Chester. Seneca currently heats with heating oil, and due to the facility's relative small size and the heat produced by hospital equipment, the hospital does not have a high heat demand. However, the hospital is required to undergo significant structural upgrades in order to meet new statewide seismic requirements and this presents an opportunity to retrofit the current heating system.

## Wildwood Assisted Living Facility

Wildwood Assisted Living Facility is located Chester. Currently Wildwood consumes approximately 26,000 gallons of propane annually. Current use suggests the site would be ideal for siting a biomass boiler, but multiple independent heating units may make this an economically difficult site to justify a central heating system.

### 1.3 Opportunities to Utilize Forest Biomass

In 2012 the Sierra Institute worked with TSS Consultants to produce a report titled “Forest Biomass Transport and Value-Added Market Optimization Assessment for the Upper Feather River Watershed.”<sup>1</sup> This report assessed the transportation costs and logistics of removing biomass from the forest as well as the overall amount of biomass available in the Upper Feather River Watershed. A key component of this report is identification of the low and high annual sustainable supply of biomass in the watershed.

**Table 2: Available Biomass in Upper Feather River Watershed**

<b>BIOMASS MATERIAL SOURCE</b>	<b>BDT PER YEAR</b>	
	<b>LOW RANGE</b>	<b>HIGH RANGE</b>
Timber Harvest Residuals	81,120	109,750
Fuels Treatment/Restoration/Timber Stand Improvement Activities	51,250	96,250
Fuels Treatment Activities – Fire Safe Councils	550	1,150
<b>TOTAL</b>	<b>132,920</b>	<b>207,150</b>

Source: *Forest Biomass Transport and Value-Added Market Optimization Assessment for the Upper Feather River Watershed*

As Table 2 indicates, there is just under 133,000 bone dry tons (bdt) of biomass available annually in the Upper Feather River Watershed. This total is based on forest harvest and thinning operations conducted on US Forest Service land, private timber land, as well as fire threat reduction activities conducted by Plumas County Fire Safe Council and U.S. Forest Service projects. What this study makes clear is that even conservative estimates of available biomass in the Upper Feather River Watershed are significantly greater than the projected demand created by PEER MAP.

While some of the available biomass is used by local mills to power their own combined heat and power plants, much is simply piled and burned in the woods. This is not only a waste of available energy but, worse, a major contributor to air quality and public health concerns.

---

<sup>1</sup><http://sierrainstitute.us/wp-content/uploads/2015/02/Transport-Assess-Value-Added-Study-Report-TSS-FINAL.pdf>

The low economic value of forest biomass has long limited the options available for the end use of this material in California. However, for communities located primarily within Pacific Gas & Electric territory, Senate Bill 1122 may help create new alternatives for efficient and clean utilization of forest biomass.

Senate Bill 1122 requires Investor Owned Utilities (Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric) to purchase 50 megawatts of electricity from small-scale (3 MW or smaller) bioenergy projects utilizing sustainably harvested forest biomass as a primary fuel source.<sup>2</sup> The SB 1122 process establishes an artificially high price floor as well as a price auction mechanism governing power purchase agreements whereby it becomes economically feasible to generate electricity from biomass at such a small scale. California Department of Forestry and Fire Protection and the California Public Utilities Commission are the public agencies tasked with overseeing and implementing this program as part of Investor Owned Utilities renewables portfolio standard. After a couple of years of determining the specifics associated with implementation of the law, it appears that SB 1122 auction will finally be launched in the first quarter of 2016.

Advances in biomass boiler technology can facilitate new markets for forest biomass. Driven largely by innovation in Europe, modern biomass boilers are capable of achieving levels of efficiency and cleanliness on par with propane and natural gas. Compared with traditional open pile burning, utilizing biomass to generate heat and electricity can reduce particulate emissions by 98%, NO<sub>x</sub> by 54%, nonmethane organics (NMOCs) by 97%, CO by 97%, and carbon dioxide equivalents (CO<sub>2e</sub>) by 17%.<sup>3</sup> This efficiency and reliability should lead to more widespread adoption of this technology, particularly in communities lacking access to natural gas.

Also contributing to new markets for biomass boilers is the aging infrastructure common in many rural areas. Plumas County is no exception. Many of the boilers at schools and other public facilities have been operated well beyond their expected lives. As a result, agencies are exploring ways to replace boilers.

Compared to fossil fuel boilers, biomass boilers have the advantage over fossil fuel boilers when historic fuel costs are factored in. Figures 2 and 3 show the 15-year cost of fuel oil and propane, from 1990 to 2014. Beginning in roughly 2000, the price of both has on average steadily increased.

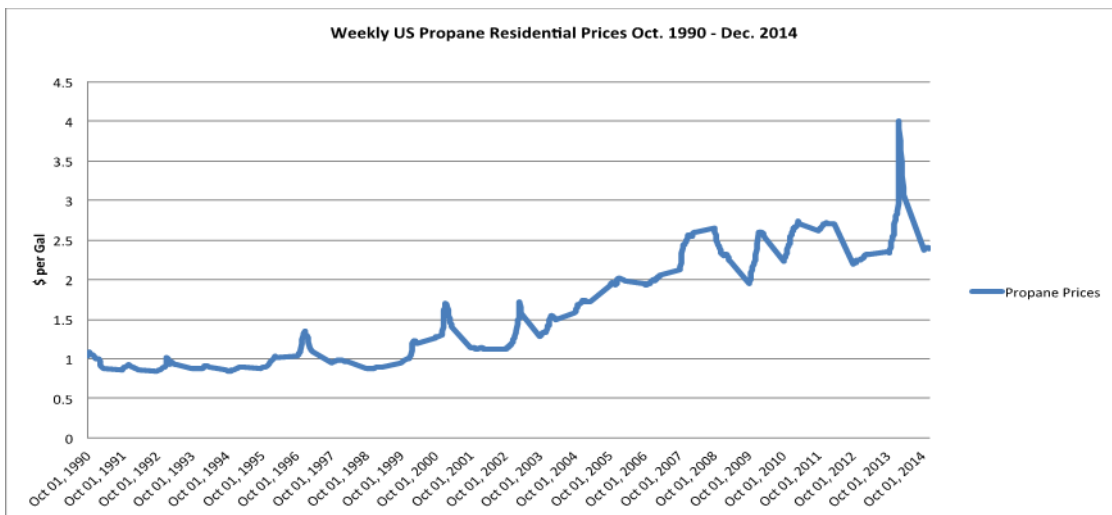
Finally, state and federal mandates have increased, leading to further examination of the technology.

---

<sup>2</sup> [http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/SB\\_1122\\_Bioenergy\\_Feed-in\\_Tariff.htm](http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/SB_1122_Bioenergy_Feed-in_Tariff.htm) (last accessed 2/21/14).

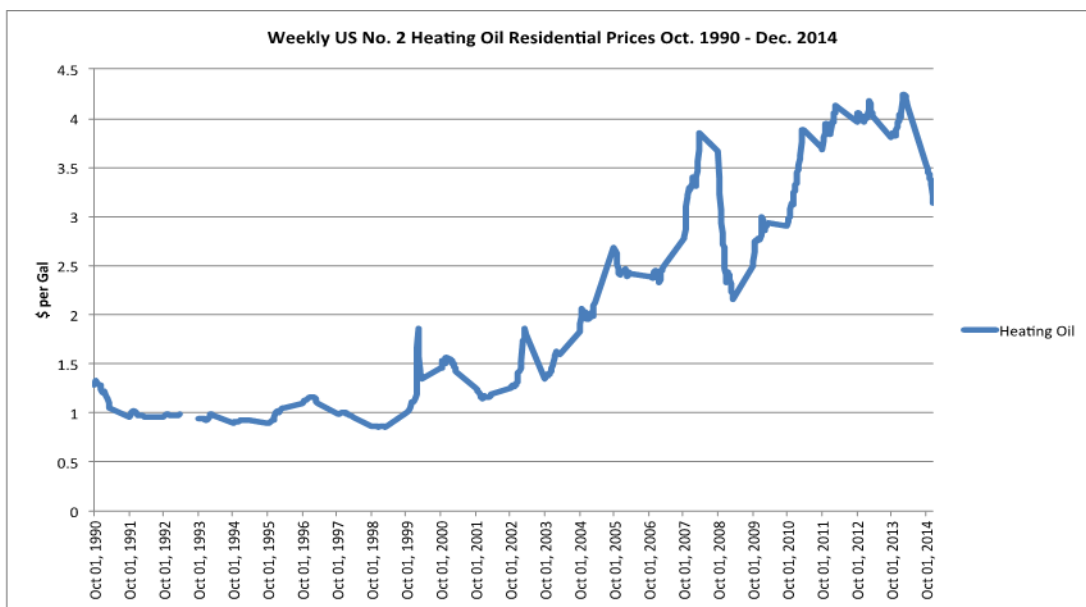
<sup>3</sup> Springsteen, B., Christofk, T., Eubanks, S., Mason, T., and Storey, B. 2011. *Emission Reductions from Woody Biomass Waste for Energy as an Alternative to Open Burning*. Air & Waste Management Association vol. 61: 63-68.

**Figure 3: Weekly Residential Propane Prices**



Source: US Energy Information Administration

**Figure 4: Weekly Residential Heating Oil Prices**



Source: US Energy Information Administration

## **CHAPTER 2: Developing PEER MAP**

PEER MAP from the start was considered a countywide planning project. The need to utilize material from the forest to reduce risk of catastrophic wildfire and its general availability, coupled with the long history of the presence of timber industry in the county suggest a readiness and willingness of the public to support the project. But biomass utilization in thermal boilers at public facilities in California is unproven. Failed attempts to implement similar projects in the early 1970s in Plumas County, along with the high capital cost of boilers coupled with the fact that public districts are risk-averse and generally cash starved, mitigated against advancing interests in biomass boilers.

### **2.1 Stakeholder Outreach and Advisory Body**

The first part of this project involved interviewing key informants in Plumas County to learn about their perspectives regarding interest and barriers in renewable energy with a primary focus on solar PV and biomass. It also served as an excellent way to inform them of the project that they could help shape with their perspectives and local knowledge. Informants included county supervisors, agency leads, individuals who attempted to advance biomass utilization previously, foresters and forest industry leaders, and others. From these interviews, others were identified to interview and explore ideas with. All in all, a wide range of Plumas County residents and perspectives were included in the initial interviews and focused conversations.

Local agency representatives with whom Sierra Institute staff met included (but were not limited to): Plumas County Board of Supervisors, Plumas County department leads, Plumas Unified School District Board, hospital administrators and hospital board members, Feather River College leaders, Plumas County Community Development Department, and U.S. Forest Service.

From the many interviews, conversations, and board meetings, the Sierra Institute organized an advisory body for the project. It included: Danielle Banchio, Registered Professional Forester; Nick Boyd, Feather River College Director of Facilities; David Keller, Plumas County Community Development Commission; Charles Plopper, Professor Emeritus, UC Davis and a member of the Lake Almanor Watershed Group; Dony Sawchuk, Plumas County Director of Facility Services; John Sheehan, former Executive Director of Plumas Corporation and one who had studied biomass utilization in the late 1990s and early 2000s in hopes of advancing it locally; Lori Simpson, Plumas County Supervisor District Four; Elaine Vercruysse, Logging Systems Planner with the Plumas National Forest who was tasked for advisory body participation by the Supervisor of the Plumas National Forest; and Randy Wilson, Plumas County Planning Director.

This group met approximately once every three months to discuss project findings, review documents, and make recommendations on next steps and what they felt were the most productive avenues to pursue. In this way, the project remained anchored in the perspectives of

those living, working, and committed to the area, and informed by what they perceived as possible based on their long-standing residency and institutional knowledge.

## 2.2 Site Selection

Thermal use of biomass in the county is not new. Biomass-burning boilers were installed in the early 1970s at two high schools, and many homes are heated with wood. But following the failure of biomass heating units—boilers were pulled from two high schools within a year of installation—no attempts had been made since. Many public facilities, however, were operating boilers that were beyond their useable lifespan; new boilers were needed. Because the area lacks access to natural gas, only fuel oil or propane-fired boilers were considered. This offered opportunity to compare capital costs of biomass-powered to fossil fuel fired boilers.

**Figure 5: Eastern Plumas Health Care Site**



Hospitals, such as Eastern Plumas Health Care in Portola, with a high heat demand will have a quick payback period after installation of a biomass boiler.

Photo credit: Aspen Street Architects

Preliminary feasibility studies were conducted on Portola Junior/Senior High School, Eastern Plumas Health Care (EPHC) District, Plumas National Forest Supervisor’s Headquarters and the Mt. Hough District Ranger Station, and Plumas County’s Health and Human Services Building along with Feather River College’s needs for heating dorms. The proximity of Portola High School and EPHC to one another led to more detailed analysis of a community heat system that would also involve providing heat to City of Portola buildings. For a community system, researchers referred to the highest heat boiler as the “anchor system.”

Very preliminary examination of heat needs were conducted at a number of other facilities including: Greenville Junior/Senior High School and adjacent Indian Valley Elementary, Seneca Hospital in Chester, Quincy Junior/Senior High School, and the old historic Courthouse in Quincy. One key finding relating to heat needs and economics of biomass boilers stood out:

*The higher the heat load for a building the quicker the payback period and the more appropriate to install a biomass boiler.*

Variability in boiler configuration (e.g., is an electrostatic precipitator to be included, amount of trenching and heat piping installation, and the like) and values of the agencies and their



willingness to accept a longer payback period makes it impossible to state a minimum heat load requirement for biomass boiler viability. For example, the financial analysis for the Forest Service Supervisors Office in Quincy included chiller technology so the boiler could provide summer cooling and piping for a number of outbuildings, which were operating on small, independent boilers, in the boiler replacement costs. As a result, return on investment for replacement of boilers at Forest Service facilities reached a point at which it was deemed marginal by Department of Energy analysts.

**Figure 6: Crescent Mills Wood Processing Site**



The Sierra Institute also examined the feasibility for constructing a combined heat and power plant on an old lumber mill site in Crescent Mills. This is one of the few sites in Plumas County zoned heavy industrial and with an adjacent electrical substation operated by Pacific Gas & Electric. In 2012, SB 1122 was passed which called for the IOUs to purchase electricity generated from woody biomass in their territory from a new generation facility of 3 MW or smaller under the Feed in Tariff program. A total of 47 MW of electricity generated from sustainably harvested forest biomass can be developed in the PG&E service area. Because of the abundant wood supply in nearby forests, the Crescent Mills site (Figure 5) was one of the top three sites identified in an assessment the Sierra Institute supported prior to the launch of this project.

### **2.3 Understanding Relevant Policy and Recommendations**

The Sierra Institute helped launch the California Forest Biomass Working Group (BWG) prior to receiving funding for this project. PEER MAP support allowed Sierra Institute to continue to work with this group, along with the California State Wood Energy Team, to learn about key

policies and to offer recommendations to state and federal agencies and community groups. As part of its Regulatory, Policy and Institutional Innovation work (Task 5 in the CEC grant agreement), Sierra Institute has directly worked with a variety of local, state, and federal agencies to advance policies and explore regulations in order to advance biomass powered boilers and CHP projects.

One of first questions from those interested in a biomass boiler is: Where will the fuel supply come from? In response to this question, the Sierra Institute has worked directly with the U.S. Forest Service, which manages the majority of forested land in Plumas County. Discussions with the agency focused on examination of existing timber sales, including thinning and service contracts, and establishment of a stewardship contracting tool, which involves a ten-year contract and guaranteed long-term supply of woody material; stewardship contracts are an underutilized agency tool. The Plumas National Forest indicated that they are capable of treating 2,500 to 3,500 acres per year. A key component of their capability is their ability to complete National Environmental Policy Act (NEPA) mandated analysis. Sierra Institute also held discussions with one of the largest private industrial landowners as well to assure woody biomass would be available in supplies needed for a built-out PEER MAP project. Sierra Institute was assured by this landowner that biomass could be made available in amounts vastly exceeding what would be needed by PEER MAP projects in the near future.

Sierra Institute engaged the local Fire Safe Council about how wood-fired boilers can contribute to creating a market for biomass from thinning in the wildland urban interface (WUI) and elsewhere. Researchers learned that purchase of biomass from Fire Safe Council activities would enable the Council to treat 33% more land as dollars gained from selling chips were invested in thinning more acres. Sierra Institute partnered with the Fire Safe Council coordinator and Feather River Resource Conservation District on a proposal to thin local WUI areas and develop a site that will process woody material for fuel and county green waste as part of the State's expenditure of greenhouse gas funds. This proposal remains in process at the conclusion of PEER MAP.

In addition to regularly participating in BWG meetings in Sacramento, Sierra Institute staff have commented on documents and presented at field gathering with the leaders from California Department of Forestry and Fire Protection, U.S. Forest Service, and the California Public Utilities Commission to discuss the need for joint work and assuring sustainable wood supply and practices that advance utilization of biomass and improve forest restoration.

The Sierra Institute has also dedicated considerable time to working with permitting agencies to determine which agencies have California Environmental Quality Act and linked requirements associated with air, water, and building permits. Because changing federal regulations and the fact that biomass-powered boilers are new in California, responsibility is not always clear. For example, installation of a biomass boiler at a public facility involves Plumas County Planning Department, the Building Department, along with the Northern Sierra Air Quality Management District, all of which have project responsibilities. Sierra Institute has consulted with these agencies throughout the project, as much to keep them informed as to learn from them and be ready to obtain permits for boiler construction. A key finding from this work is:



*Early and continuous work with permitting agencies is important to learn about permits required for projects and to assure necessary permits are understood and secured, and surprises and lengthy delays are avoided.*

If a biomass-powered boiler is constructed at a hospital or school, additional agencies must be included. For the schools, the Division of the State Architect is the oversight agency. For hospitals, it is the Office of Statewide Health Planning and Development (OSHPD). Sierra Institute and Wisewood consulted with architects and engineers regarding construction of a biomass boiler at Eastern Plumas Health Care (EPHC). In October of 2014, researchers held a face-to-face meeting in Sacramento with OSHPD officials to share plans and discuss ways to most effectively work with the agency for the installation of a boiler at EPHC. Local agencies are concerned over the time and work it takes to secure permits from these oversight agencies.

In addition to regulatory barriers, building biomass-boilers is challenged by capital costs, which are higher than that of standard boilers, and require subsidy through grants and low interest loans to overcome perceived risks and lack of successful examples in California. This represented another key finding of this work:

*Community or institutional support did not immediately translate into support for construction of a biomass boiler if it involved relying on loans to install equipment, even when such decisions can be shown to be economically sound. Proof of technology and proof of finance are needed.*

Impoverished rural areas are risk averse and their willingness to adopt new technology is limited. This is discussed further below.

A similar challenge exists with development of a CHP. High capital costs, even with SB 1122, require identification and development of grant and loan mechanisms that will support construction of these facilities. The 3 MW total is small for traditional boilers, and for the production of electricity alone is generally uneconomical. For example, the labor costs associated with direct combustion boiler operation of a 3 MW facility differ little from those of a CHP six or seven times larger. Gasification/syngas technology is also unproven at the 3 MW scale.

Sierra Institute has explored options with a variety of state and federal agencies, including exploration of novel ways of blending programs to support development of biomass boilers and CHPs. Discussions have been held with the U.S. Rural Council, officials in the Brown Administration, and leaders of individual federal and state agencies. Individual agencies included are: USDA Rural Development, U.S. Economic Development Administration, USDA Rural Utilities Service, U.S. Forest Service, California Public Utilities Commission, California Department of Forestry and Fire Protection (CAL FIRE), California Energy Commission, among others. These and other funding sources, such as New Market Tax Credits and avenues of private capital, are discussed in the chapters that follow.

Finally, PEER MAP was a planning project focused on renewables, primarily biomass and secondarily solar. While geographically appropriate, tax credits have dwindled making increased solar development difficult if not impossible. As a result, PEER MAP focused

primarily on biomass boiler and CHP development. Several local agencies expressed interest in pursuing solar development, but only Indian Valley Community Services District made progress during the PEER MAP process, yet, as of the writing of this report this project had not been developed due to limited line capacity and organizational challenges.

## CHAPTER 3: Financing PEER MAP

Because of the high capital cost of biomass boilers, whether for heating or for producing heat and power, financing PEER MAP development first requires determination of both an ownership model and where boilers or a CHP will be located. Grants and loans are needed to finance boilers, and the ownership structure typically determines the grants and loans for which an entity is eligible. This section reviews ownership models and financing options.

### 3.1 Biomass Boilers

Like many rural counties in Northern California, Plumas County is resource rich and cash poor. Many organizations expressed interest in obtaining a biomass boiler, but the difference between interest and commitment to build is large. A primary constraint to building a boiler is that cash-limited districts are appropriately concerned about taking on additional debt, particularly when capital costs for a biomass boiler are significantly higher than those for a propane or diesel boiler. Risk-averse districts also often express concern about adopting new and unproven technology and a concern that there is no reliable supply of fuel.

The Sierra Institute secured assurances from a private forestland owner and the U.S. Forest Service that needed material would be available, and also secured a grant to purchase equipment to make refined wood chips for boilers. The Institute conducted financial analyses for a public hospital and high school, showing that for both it was cost effective to install a biomass boiler. Limited institutional liquidity and aversion to risk, however, led both entities to back away from biomass-based solutions. The school district replaced an aging diesel boiler with a new propane boiler. The payback period for this boiler was nine years when fuel savings were factored in. Another fear of districts was that biomass powered boilers would require more labor than other boilers. Biomass powered boilers, however, require no more labor than standard propane or diesel boilers, and considerably less than many of the older, finicky boilers that are being nursed along until a new boiler replaces it.

The hospital district that is working hard to keep old, inefficient diesel boilers running appeared ready to install a biomass powered boiler but, despite the likelihood of grant and loan funding to purchase the boiler, decided regulatory concerns, length of time to resolve these concerns, along with loan obligations outweighed the potential opportunity.

*From an economic standpoint, the best ownership model for biomass boiler installation is for an institution—be it a school district, a hospital, the county—to purchase, own, and operate its own boiler.*

The payback period for the school district boiler was calculated without grants. There are numerous grant and loan programs available from Economic Development Administration, USDA Rural Development, California Energy Commission, and more, that support public infrastructure improvements, especially when energy savings at public institutions are the result. These can dramatically reduce payback periods. The hospital district payback period

would have been less, possibly far less, than the nine years associated with the high school boiler as a result of grant dollars available for non-profit public districts.

Because of the reticence of institutions to take ownership of a boiler, the Sierra Institute explored “third-party” ownership models for public districts boiler ownership: two examples include the non-profit Sierra Institute or some other non-profit or public district constructing and owning a boiler, or a for-profit entity owning it. Another entity may be eligible for grants, loans, and possibly tax writeoffs in the case of a for-profit entity; the advantage of this model is the “derisking” of the boiler for the public institution and the elimination of the capital costs of the boiler. Whether profit or non-profit, when an entity other than a user builds and owns a boiler, that heat-using entity will buy heat from the owner for at least the payoff period for the boiler. This will protect the building/owner investment. The savings from biomass heat compared to propane or diesel fuel are the funds that can be used to pay off the capital costs of the biomass boiler.

Based on feasibility studies conducted at potential sites for biomass boilers, another key finding from this project work is:

*The fastest payback period results when institutions purchase, own, and operate their own boilers. Reluctance to assume debt and perceived risk that comes with biomass boilers, however, required exploration of alternative ownership models to “derisk” biomass boiler construction and investment for public institutions.*

In the case of one hospital district, fear of a lengthy process to secure approval from the state regulatory body, Office of Statewide Health Planning and Development, forced the Sierra Institute to pursue offsite boiler location. Interestingly, the Office of Statewide Health Planning and Development supported this approach. Third-party construction of a boiler on property adjacent to the hospital requires establishment of a long-term heat contract with the hospital to protect investment in boiler construction. Work continues to identify pathways for biomass boiler ownership and installation.

### **3.2 Combined Heat and Power Facility**

In addition to smaller boilers throughout the county, Sierra Institute proposed development of a biomass-powered 3 MW combined heat and power (CHP) facility located on an abandoned 28-acre mill site in the community of Crescent Mills. A CHP facility at this location will sell power to Pacific Gas & Electric, pursuant to Senate Bill 1122. Results of master planning of a state of the art facility, however, indicated that the project is a massively expensive project, costing \$20 to 25 million to build. Due to the high costs of development, this CHP will likely only be feasible through a combination of grant funds, renewable energy tax credits, and private capital investment.

Thus far, two U.S. Forest Service grants have been granted to the Sierra Institute to be applied toward master planning and engineering of the CHP facility: the Woody Biomass Utilization Grant (2013) and Wood Innovations (2015). Sierra Nevada Conservancy granted the Sierra

Institute \$350,000 through Proposition 84 funds for development of a wood processing yard to develop the fuel supply needed for boilers in the county.

Other potential sources of funding include the California Energy Commission's Electrical Program Investment Charge, California Assembly Bill 32 dollars, and USDA's Wood to Energy Initiative.

New Market Tax Credits (NMTC) increase the flow of capital to businesses and low income communities by providing a modest tax incentive to private investors. NMTCs are made to Community Development Entities (CDEs); hundreds of CDEs compete annually for a limited supply. When awarded a NMTC, a CDE sells it to an investor who then makes a loan to the project. Project eligibility is based on the poverty rate, median family income, unemployment rate, and other criteria such as food deserts, native areas, HUB zones, brownfields, and more based on Census data. Given the low socioeconomic condition of Plumas County, NMTC could well be an appropriate financing option for this project, though they are complex.

The Northern California Community Loan Fund (NCCLF) is among the awarded CDE's and Sierra Institute has partnered with the NCCLF to develop a model for NMTC financing of the project. This effort was launched as a result of the PEER MAP project along with the Woody Biomass Utilization grant.

## **CHAPTER 4:**

# **Implementation Barriers**

Plumas County is a natural resource dependent area with a long history of forest harvesting and wood products manufacturing and two operating co-generation facilities at two mills in the county. For these reasons, along with the over-abundance of biomass and high risk of catastrophic wildfire, it is a logical place to launch biomass thermal and electricity producing boilers. Despite these reasons, risk aversion of public districts, generally poor public districts, and the failure of biomass burning boilers in the early 1970s have challenged development of biomass boilers and community thermal networks.

### **4.1 Biomass Boilers**

Sierra Institute initially anticipated that a number of biomass-powered boilers would be constructed once institutions were shown the cost savings over time resulting from using biomass-produced heat. Later it was learned that support for a biomass boiler does not immediately translate into commitment to finance and build one. The Sierra Institute has also learned that unless it takes responsibility to fundraise and build a boiler and—as it now appears—and an entity other than the public institution takes at least initial ownership responsibility, risk-averse institutions will not support them.

Capital costs for biomass boilers are significantly higher than those for propane and diesel boilers, and cash-limited entities seek to avoid taking on debt. Additionally, there is concern about adopting new and what is considered unproven technology, along with a concern that there is no reliable fuel supply of fuel. A functional boiler actively proving benefits to Plumas County will help overcome these barriers. Sierra Institute hopes to demonstrate the potential for financial savings and the dependability of technology through the development of a biomass boiler that is currently underway at the Health and Human Services building in Quincy (see Section 5.1). In the mean time, high capital costs of boilers and associated equipment combined with a lack of a currently operating examples clearly deter entities from pursuing biomass boilers.

The fear of no reliable fuel supply stems largely from issues associated with diminished timber harvests for lumber production and environmental challenges to timber sales, and a related lack of confidence in the U.S. Forest Service, which manages two-thirds of the forestland in the county. It is important to note that the initial scale of biomass needed for thermal boilers is far less than timber supply needed for local mills. Even if full build out of all thermal boilers takes place along with construction of a co-generation plant at Crescent Mills, the biomass needed totals less than 30,000 bone dry tons, far less than the low annual production estimate of 133,000 bone dry ton in the Feather River Watershed that covers much of the county.<sup>4</sup> Sierra Institute staff have discussed and received supply assurances from both federal and private land managers.

---

<sup>4</sup> TSS Consultants 2012

## 4.2 Combined Heat and Power

While re-developing a 28-acre industrial site in Crescent Mills for operation of biomass facilities presents an excellent opportunity for revitalizing a brownfield and abandoned land, various barriers to implementation exist and necessary due diligence needs to be conducted.

As Sierra Institute launched into the project, it was soon realized that solely completing design and engineering of a 3 MW facility was a far cry from successful development of a funded and constructed project. Improved understanding of demand, supply opportunities and constraints, and the economics of both, along with site and engineering issues are needed to ensure success. Sierra Institute worked with local entities to determine chip demand, along with county and larger regional players to understand market opportunities and to determine the kind of facility needed to meet heat demand and 3 MW production.

Numerous delays by the California Public Utilities Commission and the Administrative Law Judge resulted in final rules for Senate Bill 1122 implementation being released in September 2015. There has been considerable confusion among groups moving towards implementation of the complexities of the interconnection process, and the degree of work required to move a project from the design and engineering phase to readiness for the Feed in Tariff (FiT) queue.

PG&E requires a System Impact Study of interconnection to the grid. For the Plumas project as well as other projects, this process is a source of significant concern. Costs of System Impact Studies are often ambiguous and PG&E has provided little clarity on the process. Estimated costs for the Crescent Mills site study range from \$10,000 to \$50,000, and could be higher.

A critical component of any biomass project, especially a CHP facility, is identifying long-term fuel supplies and executing contracts to assure supply. Sierra Institute staff consulted with private industrial landowners along with the U.S. Forest Service. No contracts have been put in place because it remains unclear when a power purchase agreement may be needed. Private industry typically has more flexibility to establish long-term contracts but discussions have been held with the U.S. Forest Service that has expressed interest in supporting the project.

Obtaining site control of a brownfield site comes with risks and complications. Sierra Institute staff have worked with the Sierra Business Council and the Northern Sierra Partnership, and USDA Rural Development to raise funds to purchase the Crescent Mills property. A mix of private and federal grant funds have been secured for property purchase. The funds will be disbursed upon completion of the Phase II Environmental Site Assessment (ESA) and remediation, should the latter be needed. The Environmental Protection Agency funded a Phase I and Phase II ESAs through the Targeted Brownfields Assessment program; in addition, an Analysis of Brownfield Cleanup Alternative (ABCA) report is expected to be completed by January 2016. The ABCA will help determine cleanup and redevelopment opportunities for the site.

Master site planning efforts thus far have indicated that the project will be very expensive. Preliminary costs suggest capital expenditures between 20 and 25 million dollars for a 3 MW facility. Environmental considerations coupled with a vision of more small plants operating in a

number of areas led to selection of the 3 MW, but it is an uneconomical size. The labor costs, for example, are roughly the same as those for a 20 MW facility. Due to the high costs of development and construction, this will likely only prove feasible through a combination of grant funds, renewable energy tax credits, and private capital investments.

Because of the high cost of development, another key finding of this project is:

*Stand alone direct combustion CHPs using traditional boilers will be far more cost effective as well as energy efficient if a co-located heat user can be secured.*

The Sierra Institute and partners have discussed and explored a variety of heat uses ranging from pellet production to greenhouses though none have been selected. The demand for the outputs of a co-located heat user needs further analysis and investment. Nonetheless, building a CHP requires considerable technical knowhow, but determining the co-located heat user may prove to be even more challenging.

### **4.3 Solar PV**

Opportunities for continuing to install solar PV in Plumas County are currently limited due to high capital costs and lack of incentives available for public institutions. The California Solar Initiative earmarked \$2.167 billion for solar PV development between 2007 and 2016 with the goal of installing 1,940 MW of new generation within this time period.<sup>5</sup> Allocation of incentives vary by utility provider and customer type, but it is notable that the combination of this aggressive policy and federal and state tax incentives resulted in California meeting this target in an extremely short time. Plumas County is largely served by PG&E, and there are no longer any incentives available to private residences, businesses, or non-profit entities, and this has significantly curtailed solar development. As a result of this, Sierra Institute dedicated far less time than was originally anticipated on advancing this renewable.

---

<sup>5</sup> <http://www.gosolarcalifornia.ca.gov/about/csi/php>



## CHAPTER 5: Moving PEER MAP Forward

The PEER MAP process was efficient and effective in that much of the vision that was developed for the project proposal was advanced successfully. Pre-feasibility studies were completed as planned, the advisory committee established for the project adapted, improved and ratified the vision, and proposals were developed for implementation of the vision.

The school district proved a disappointment with acceptance of pre-feasibility study and public embrace of a biomass boiler at a local high school. The district, however, subsequently decided without discussion or consultation to install a new propane boiler. As of this final report, and with new leadership, the school district has invited the Sierra Institute to present at an upcoming board meeting about opportunities for the district to take advantage of biomass boilers at district sites.

**Figure 7: Sierra Institute and Wisewood Staff Discuss Master Site Planning and Development at the Crescent Mills Site**



Photo credit: Sierra Institute for Community and Environment

One of the hospitals identified at the outset of the project as a candidate for a biomass boiler embraced the preliminary engineering that was completed as a part of PEER MAP, and work with this facility continues along with state regulatory body that oversees hospital facilities. In addition, with a change in leadership, another local hospital has expressed interest in obtaining a pre-feasibility study for a biomass boiler. This study will be supported by a Wood Innovations grant from the U.S. Forest Service that is supporting further network development that is based on the PEER MAP work.

## 5.1 Biomass Boilers at PHHS

The Plumas County Health and Human Services building (PHHS) in Quincy has relied on an inefficient geo-field loop to supply water to water source heat pumps, an additional electric fired boiler to pre-heat the water for the geo-loop, and localized electric space heater use by occupants to keep warm. The heaters at Feather River College dormitories are also in dire need of an upgrade as the dorms are currently heated by forty-year-old propane-fired wall heaters. Planners at Feather River College (FRC) have intended to upgrade to water-source heat pumps for several years.

As a response, Sierra Institute and Wisewood submitted a proposal to the California Energy Commission to fund the development of a small-scale biomass powered combined heat and power boiler, and was awarded funding in the spring of 2015. The boiler will be located at PHHS, and will provide heat to both PHHS and the dormitories at Feather River College. It will also product 65 kW of electricity to PHHS. Heat will be generated in the form of hot water, and will flow to water source heat pumps at PHHS and FRC through a district energy system.

This unique model will be the first of its kind in California, and is funded through the CEC's Electrical Program Investment Charge (EPIC). The system will offset up to \$45,000 in annual electrical and fuel costs, and will also reduce demand on the electric grid at both peak and non-peak times by generating renewable electrical and thermal energy on site. Project planning began in July 2015, and the facility is anticipated to be operating at capacity by Fall 2016 or Winter 2017.

## 5.2 Biomass Boilers at EPHC

A stand alone-system at Eastern Plumas Health Care (EPHC) is also being explored, and Sierra Institute staff anticipates submitting a grant request to the US Economic Development Administration (EDA) and USDA Rural Development to fund purchase and installation of equipment. A biomass boiler at EPHC will offset approximately \$145,000 of annual heating bills for the hospital. As a part of this project Wisewood completed pre-engineering work for this system (Appendix E).

The hospital generally embraced the concept, but the hospital architect in charge of new hospital campus planning resisted and encouraged EPHC to do the same. EPHC decided to postpone boiler installation in the spring of 2015 pending completion of site planning being done by an architect/planner. A key lesson from this work is:

*Even when the economics make clear the value of a biomass boiler relative to fossil fuels, fear of new technology and fear of lengthy permitting delays may scare institutions away from adopting new biomass-boiler technology.*

To be fair, the Office of Statewide Health Planning and Development's (OSHPD) regulatory process is time consuming. Additionally, there was concern expressed by EPHC administrators that a new boiler would require seismic testing. In fact, only a boiler control panel will require testing, but this could prove expensive and time consuming. Discussion with OSHPD led to the recommendation that a boiler be constructed just off site, on property the hospital district

owned but that was not part of the hospital site. This has resulted in exploration of a new ownership model for the proposed boiler at EPHC as well as for other interested institutions. Sierra Institute continues to work with EPHC to advance boiler development for the district. Work with EPHC and others have led to another key finding:

*New ownership models may be needed to build and initially operate boilers to work around permitting challenges, fear of the technology, fear that staff may not be able to manage the new technology, and to reduce other perceived risks associated with boiler development.*

The Sierra Institute and Wisewood are exploring development of a third-party model to build and operate boilers for EPHC, Plumas County and possibly the school district to advance biomass-boiler development and acceptance.

### **5.3 Additional Biomass Boilers**

Sierra Institute staff continues to communicate with school, hospital, and county officials to discuss the potential for biomass boilers to provide affordable heating at their facilities. Through a U.S. Forest Service Wood Innovations grant, funding has been secured to conduct boiler feasibility analyses for Plumas District Hospital in Quincy and for a Plumas Unified School District high school in either Greenville or Quincy. Funds for engineering and design of a boiler at the Plumas County Courthouse in Quincy are included in the same grant. Sierra Institute anticipates that the boiler currently in development at the Health and Human Services building in Quincy will be a model for the county; this boiler will demonstrate the technology and financial savings and thereby helping interested users overcome aversion to risk and general reticence to adoption of the technology.

### **5.4 Combined Heat and Power Facility**

Sierra Institute is continuing work to advance planning and development of a 3 MW CHP facility to be located in Crescent Mills. Staff is working with Wisewood and Angel Energy, LLC on the master site planning, engineering specs, financial feasibility assessments, and to develop an “investor ready package.”

The project is being prepared to apply for participation in PG&E’s distributed generation program, and for it to be eligible under SB 1122 criteria. In order for a project to be SB 1122 “ready,” it needs: 1) supplemental reviews and interconnection impact studies; 2) clear site control; and 3) selection of an approved project developer.<sup>6</sup> The 28-acre property is a former Louisiana Pacific lumber mill. Sierra Institute has raised funds needed to purchase the property. An 11-year lease was signed in September 2015 with the current owner until the necessary environmental assessments can be completed, at which time the property will be purchased.

Sierra Institute has also partnered with the Northern California Community Loan Fund, Cutting Edge Capital, and Angel Energy to develop a financial model utilizing cost data from this project. Cutting Edge Capital is spearheading strategy discussions on new financing vehicles to

---

<sup>6</sup> This means with demonstrated experience and successful project implementation of a like facility.

assist stewardship funding and the businesses that will utilize biomass, specifically through Direct Public Offerings. Northern California Community Loan Fund is a recipient of New Market Tax Credits and a provider of debt, and is focusing on modeling the project for NMTC financing.

## **5.5 Solar PV**

Indian Valley Community Services District completed the initial stages of work with a project developer, North State Solar Energy (NSSE), to install a 140 kW system at its wastewater treatment ponds outside of Greenville. This system was scaled to provide power to IVCSD's treatment plant, sewer pond pumps, and the water/sewer office facility. The proposal NSSE presented to IVCSD required no money down and a cash stream that is based on payments to the project developer equal to current electrical bills. Because the IVCSD is a public governing body, NSSE proposed to create a Special Purpose Entity in order to capitalize on the federal Investment Tax Credit and annual deductions for depreciation of the system.<sup>7</sup>

Sierra Institute anticipates that if this project model were successful in Indian Valley, then Portola and Quincy would be able to follow a similar development model. The major variables that remain to be determined include the exact capital costs of the IVCSD project, the likelihood of an investor purchasing the Special Purpose Entity created by NSSE, and the current electrical rate that IVCSD is paying PG&E. The Indian Valley Community Service district ultimately abandoned the project for reasons that remain unclear. Part of it is the disorganization of the district, but acceptance of a Special Purpose Entity. There have been no further discussions or efforts by other districts.

---

<sup>7</sup> <http://www.indianvalleycsd.com/solar-energy.htm>

## CHAPTER 6: Conclusion

After months of collaborative work with local, county, state, and federal agencies to identify opportunities for community scale renewable energy development, the Plumas Energy Efficiency and Renewables Management Action Plan is ready to move from planning to implementation. PEER MAP sought to identify, develop, and begin implementation of a renewable energy plan for Plumas County, focusing primarily on forest biomass and secondarily on solar photovoltaic (PV) technology. Biomass became the primary focus early in the project because of limitations associated with local solar PV. Nonetheless, PEER MAP represents an excellent opportunity for addressing economic, environmental, and social challenges that Plumas County faces associated with aging boilers and utilization of biomass.

If implemented, PEER MAP will provide the county with numerous benefits. Replacing old, inefficient fossil fuel-fired boilers with state of the art biomass boilers can reduce open pile burning and thus help improve air quality. Increased demand for biomass will strengthen the forest products sector, improve forest health, and reduce the risk of catastrophic wildfire. Offsetting fossil fuel consumption at critical public facilities and developing a 3 MW distributed generation facility will help California reduce GHG emissions while also increasing energy security.

Implementation of PEER MAP is a multi-phase process. For the biomass boiler network, it is critical that early stages of development demonstrate positive financial returns to the community and the dependability of biomass boiler technology. Initially, greater assistance from public funds will be necessary to prove benefits and financial returns to surrounding communities. Sierra Institute staff believes that once a few demonstration projects are functioning and proving themselves, other institutions will adopt the technology.

The future of the 3 MW CHP system is more difficult to determine. The fate of this facility rests largely on the ability of the project to be cost-effectively constructed and connected to the grid, and the ability of the project to truly become a combined heat and power facility rather than just a biomass-to-electricity project. This is perhaps one of the most important findings that applies not only to the 3 MW CHP at Crescent Mills but for CHPs elsewhere:

*The traditional model of burning biomass to make electricity is economically infeasible at the 3 MW scale. Instead of developing facilities that simply burn biomass to make electricity, communities and developers need to explore co-product development that can use waste heat for alternative product development and offset facility costs.*

Utilizing both heat and power is critical for ensuring economic success and energy efficiency purposes. Sierra Institute staff and partners are working to identify potential heat users. This represents less a technology challenge and more a marketing challenge involving sale of the co-product(s).

Solar PV development will happen as electricity prices increase, efficiency of PV technology improves, and research and development costs decrease. It will also require local districts and institutions to commit property to developers and development of favorable contracts for the technology to be utilized.

Communities of Plumas County with a long history of wood product development, experience with large, community-threatening wildfires and smoky summer days, and long-running cogeneration plants at two large mill sites in the county, understand the benefits and importance of biomass utilization. Support from the community ranges from those who see the need to harvest biomass as an ecological imperative, to those who see the financial benefits biomass provides in comparison to more expensive and private-volatile fossil fuels. It is widely recognized that biomass is one of Plumas County's most abundant natural resources and that increased utilization will yield numerous benefits.

With successful implementation, PEER MAP provides the basis for development of a replicable model that can be used by other rural counties in California and across the West with an abundance of biomass. Indeed, Sierra Institute has secured two Rural Community Development Initiative grants that support organizational and technical capacity building work with communities across northern California and extending to the southern Sierra. Sierra Institute looks forward to moving PEER MAP to full implementation and helping develop and advance projects in Plumas and communities and counties elsewhere.

## GLOSSARY

<b>Term</b>	<b>Definition</b>
ABCA	Analysis of Brownfield Cleanup Alternatives
bdt	Bone dry ton: 2,000 lbs of woody material at 20% or less moisture content
Biomass	Locally abundant, renewable natural resource. Includes small-diameter trees that need to be thinned out from overstocked forests, and forestry residue leftover from timber operations. When sourced from timber harvest residuals and combined with sustainable forest management techniques, forest biomass is a carbon neutral source of fuel.
BWG	California Forest Biomass Working Group. The BWG is composed of a variety of wood energy interests across California. They meet to discuss wood energy policy, project opportunities and barriers, technology progress, funding opportunities and other relevant topics.
CDE	Community Development Entity – recipient of New Market Tax Credits
CEC	California Energy Commission
CHP	Combined heat and power
EPHC	Eastern Plumas Health Care
EPIC	Electric Program Investment Charge, a program administrated by the California Energy Commission, Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric
FiT	Feed-in Tariff: financial incentive to encourage uptake of renewable energy-generating technologies
FRC	Feather River College (Quincy, CA)
IVCSD	Indian Valley Community Services District (Greenville, CA)
NCCLF	Northern California Community Loan Fund, promotes economic justice and alleviates poverty by increasing the financial resilience and sustainability of community-based nonprofits and enterprises. Based in San Francisco, CA
NMTC	New Market Tax Credits: designed to increase the flow of capital to businesses and low income communities by providing a modest tax incentive to private investors.
OSHPD	Office of Statewide Health Planning and Development
PG&E	Pacific Gas & Electric

PHHS	Plumas Health and Human Services building, located in Quincy
SB 1122	California Senate Bill 1122: requires California’s three large investor owned utilities (PG&E, SCE, SDG&E) to procure up to 250 MW of renewable electrical generation from small-scale facilities that use biomass feedstocks, including up to 50 MW from sustainable forest management byproducts.
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric
SWET	State Wood Energy Team
Triple bottom line	Economy, environment, and community
WUI	Wildland Urban Interface – space where homes and wildlands meet or intermingle



## REFERENCES

- About the California Solar Initiative (CSI). Go Solar California.[http://www.gosolarcalifornia.ca.gov/about/csi/php\\_](http://www.gosolarcalifornia.ca.gov/about/csi/php_)(last accessed 7/21/2014).
- Indian Valley Community Services District Solar Energy.  
<http://www.indianvalleycsd.com/solar-energy.htm>
- McKechnie, J., Colombo, S., Chen, J., Mabee, W., & Maclean, H. 2011. Forest Bioenergy or Forest Carbon? Assessing Trade-offs in Green house Gas Mitigation with Wood-Based Fuels. *Environmental Science & Technology*. Vol. 25:2 pp. 789-795.
- McKee, M. Kusel, J. 2014. Plumas Energy Efficiency and Renewables Management Action Plan (PEER MAP), PIR-12-003. Sierra Institute for Community and Environment.  
[http://www.sierrainstitute.us/documents/Research\\_Reports/PEER\\_MAP\\_ENERGY\\_VISION\\_FINAL.pdf](http://www.sierrainstitute.us/documents/Research_Reports/PEER_MAP_ENERGY_VISION_FINAL.pdf)
- SB 1122: Bioenergy Feed-in Tariff. California Public Utilities Commission, State of California.  
[http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/SB\\_1122\\_Bioenergy\\_Feed-in\\_Tariff.htm](http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/SB_1122_Bioenergy_Feed-in_Tariff.htm) (last accessed 2/21/14).
- Sedjo, R., & Tian, X. 2012. What is the Carbon Footprint of Wood Biomass Energy? *Journal of Forestry*, Vol. 110:6 pp. 304-311.
- Springsteen, B., Christofk, T., Eubanks, S., Mason, T., and Storey, B. 2011. Emission Reductions from Woody Biomass Waste for Energy as an Alternative to Open *Burning*. *Air & Waste Management Association* vol. 61: 63-68.
- TSS Consultants 2012. Forest Biomass Transport and Value-Added Market Optimization Assessment for the Upper Feather River Watershed. Prepared for Sierra Institute for Community and Environment. <http://sierrainstitute.us/wp-content/uploads/2015/02/Transport-Assess-Value-Added-Study-Report-TSS-FINAL.pdf>

# **APPENDIX A: Feasibility Study for Biomass Heat at Eastern Plumas Health Care**

This appendix is available as a separate volume,  
publication number CEC-500-2016-067-APA.

(Financial pro forma included)

# **APPENDIX B: Feasibility Study of Biomass Heat for Portola Jr/Sr High School**

This appendix is available as a separate volume,  
publication number CEC-500-2016-067-APB.

(Financial pro forma included)

# **APPENDIX C: Feasibility of Biomass District Energy for Portola, California**

This appendix is available as a separate volume,  
publication number CEC-500-2016-067-APC.

(Financial pro forma included)

**APPENDIX D:  
Feasibility Study for Biomass Heat at the Plumas  
National Forest Supervisors Office and Mount Hough  
Ranger District**

This appendix is available as a separate volume,  
publication number CEC-500-2016-067-APD.

# **APPENDIX E: Site Specific Engineering and Architectural Plan for Eastern Plumas Health Care**

This appendix is available as a separate volume,  
publication number CEC-500-2016-067-APE.

# **APPENDIX F: Crescent Mills Site Aerial Image + Plan**

This appendix is available as a separate volume,  
publication number CEC-500-2016-067-APF.