NORTH COAST RESOURCE PARTNERSHIP

BIOMASS ENERGY IN THE NORTH COAST REGION

An Assessment and Strategy for Ecologically and Socially Compatible Development

THE WATERSHED CENTER
HAYFORK, CALIFORNIA

Prepared by Jeff Morris, with Nick Goulette, and Lynn Jungwirth
Updated by Angela Lottes with Rebecca Cashero and Claudia Voigt

With funding from North Coast Resources Partnership
Through West Coast Watershed

February 2017

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PROPOSED STRATEGIES

Strategy 1. **Work regionally**

The Counties and partners of the North Coast Region should pool their energy through the NCIRWMP or other regional collaboration processes to develop shared strategies that will result in project build out:

- attract new and existing businesses to sites across the region,
- affect policy to reflect opportunities and challenges unique to North Coast, such as existing infrastructure and shipping barriers,
- understand transmission requirements to improve grid access,
- funding for investments in R&D,
- demonstration and project development for commercial technologies going forward.

The world of energy development and policy is complex and competitive, and regional Counties and businesses will compete more effectively at the state-level if they act as a regional unit. Engaging with US Forest Service Region 5, Cal Fire, California Public Utilities Commission, Governor's Office of Business, and other state agency offices as a group with a recognizable name and able comment on statewide plans is essential.

Strategy 2. **Increase regional energy knowledge and capacity for engagement**

Energy development and policy is highly complex and political. There is a need for the development of educational materials, regular discussions, access to technical assistance, and programming for local decision makers, county staffs, and development partners to increase their familiarity with CA energy policy, the logistics and economics of biomass energy development, transmission and interconnection, and the ecological and social dimensions of biomass energy. This will facilitate regional participation and success in the emerging field of opportunity for biomass energy as well as development of a biomass energy industry that reflects local values.

Strategy 3. **Engage urban and suburban power customers**

Forge new partnerships with end-of-line power customers (local urban / suburban / rural utilities) and state and federal agencies to facilitate equitable project financing. Explore linkages with Community Choice Aggregations (CCAs), Joint Power Authorities (JPAs) and other partnership structures to leverage resources.

Strategy 4. **Leverage available funding to develop demonstration projects and technology commercialization of "scale-appropriate" emerging technologies**

State and federal assistance programs such as the US Forest Service Wood Innovations grant program, California Energy Commission EPIC grant program, USDA Rural Energy for America Program grant and loan guarantees, and New Market Tax Credits are all applicable and useful for supporting project construction and commercialization of appropriately scaled conversion technologies and projects but have been awarded in limited amounts across our region.

Strategy 5. **Work on project development through partnerships and collaboration**

Practice collaboration and build partnerships to forge long-term and environmentally sustainable feedstock supply contracts and balance ecological and social values with project economics.

Strategy 6. **Strategically target new facility locations and work with partners to strategically avoid overpaying for grid upgrades**

Site reviews have traditionally included information like road and utility access, zoning, proximity to feedstock, potential for hazardous material or environmental impact, and cost of site control. Projects should add to that consideration of the electric grid and opportunity for sharing the cost of interconnection with entities motivated to upgrade the system for other reasons.

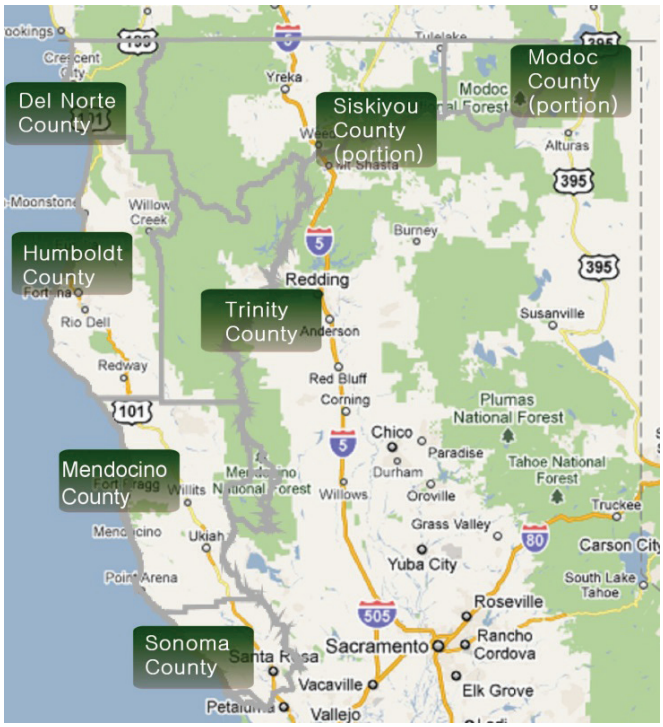
Strategy 7. **Advocate for biomass energy pricing equity**

Biomass plants can provide baseload power, which is different from other renewable power sources like wind or solar. This can be a benefit to the grid but is not reflected in pricing regulation. We need to advocate for fair-accounting energy pricing and feed-in tariffs that acknowledge the many ancillary benefits of biomass energy. This includes engaging other baseload advocacy groups and a push for the reauthorization of the BioMAT program and continued support through the Electric Program Investment Charge. Pilot and demonstration projects, supported by the Public Utilities Commission, may serve as a first step for more systemic policy direction.

INTRODUCTION

THE NORTH COAST CONTEXT: ENVIRONMENT AND ECONOMY LINKED ACROSS INDUSTRIES

The seven-county region in Northern California that is included in the sphere of influence for the North Coast Integrated Regional Water Management Plan is a unique area of California and recognized globally as an important eco-region. Its combination of coastal, forested mountain and high plateau territory is home to diverse forest and aquatic ecosystems, large tracts of federally managed land, minimal areas of urban development and significant economic, demographic and infrastructure challenges.



Although diverse and blanketing a large geographic territory, one commonality of this region is that natural resource utilization has made, and continues to make, a significant contribution to development and economic growth throughout the urban and agricultural regions of California. During the historic housing booms in the state's history, lumber harvested and milled in the area supplied housing and industrial development demands. Water from the lakes and rivers has provided potable water to urban areas and agricultural water to farms. These in turn provided drinking water, water for micro-chip production in the Silicon Valley and the food supply for a growing population. Finally, and perhaps most significantly, energy in the form of electricity was delivered to the rest of the state and other parts of the Western U.S. through the Central Valley Project, dams on the Klamath River, a myriad of small hydro-electric plants and a number of larger biomass to energy facilities. Generated electricity, developed from the natural resources of these rural areas, has supported the economic growth of the state and continues to support the overall stability of the electric grid and energy reliability across the state.

Historic extraction and utilization rates of many of these natural resource sectors has impacted ecologic health and long term sustainability of those resources. Consequently, extraction has been significantly reduced and a number of restoration efforts have been established to begin to restore integrity and resilience to damaged ecosystems. The drastic drop in harvest, consistent with the historical large-scale, sector specific resource utilization boom-and-bust cycle, has damaged local economies and impacted the expansion and sustainability of restoration efforts. Although tourism and service industry economies have emerged as supplemental economic drivers, these sectors are also heavily dependent on ecosystems which have only begun to be restored. Additionally, those economic sectors offer few family-wage jobs and have not amounted to full economic replacement for the losses in the natural resource and manufacturing sectors, leaving remaining resources vulnerable to exploitation by non- and under-employed workers accessing illegal markets.

The potential for successful development in the North Coast Region is better with investments in environmental and economic restoration work. Consider recent success with this strategy in the fisheries and fishing industries, which is one sector of economic stability in the region *(NOAA, 2015)*[1]. Watershed and fisheries management and restoration have emerged as an economic niche resulting in improved habitat and reduced risks from erosion for the environment and healthier fish populations for harvest. The collaborative effort required for the establishment of Marine Protected Areas in the state also ensured that a variety of interests were addressed and multiple benefits resulting. Natural resources employment in the region can also be found in small-scale forest restoration and stewardship contracting projects following this model.

Significant growth in the cultivation of medical and recreational marijuana has been emerging across the area. Recent legalization of recreational use and subsequent regulation may stabilize demand on natural resources and environmental values resulting from this cultivation. New local or state regulatory involvement may help avoid the boom and bust economic cycle that this

1 *The Economic Impact of the Recreational Fisheries on Local County Economies in California National Marine Sanctuaries, 2010, 2011 and 2012.* <sanctuaries.noaa.gov/science/socioeconomic/pdfs/california_rec_sanctuaries.pdf>

region has historically experienced, and place marijuana cultivation as a supporting industry to the region along with fishing, tourism, and wood product manufacturing.

Somewhat of an anomaly in the region is Sonoma County's wine industry, which has been a part of the larger regional industry cluster that includes the Napa Valley. California produced 85% of all wine produced in the United States[2] and California wine is a product that can only be made in the California because of quality climate, topography, and soil for wine grapes. Although certainly subject to market fluctuations and the weather conditions of any given year, the wine industry, as an agricultural sector, has historically been less chaotic than other natural resource based industries in the region. Although the majority of the wine industry activity occurs outside of the North Coast IRWMP boundary, it can serve as a reference for some of the bio-energy strategy described in this document, specifically the benefits of industry clusters and regional messaging/branding. Additionally, a significant amount of biomass waste material generated from the wine industry that could be utilized for biomass energy and/or sequestered back into the soil as an additive through compost and/or biochar production and application.

BIOMASS AS A TOOL FOR ECONOMIC AND ECOLOGICAL HEALTH AND RESILIENCE

Learning from past mistakes of over reliance on singular sources of resource extraction and economic stability, appropriately scaled biomass to energy facilities have the potential to be a part of a larger economic and environmental recovery and stability for the area. This document will present a strategy for how the region might advance biomass utilization strategies, with particular focus on biomass-to-energy projects, that are compatible with protecting and enhancing water resources, terrestrial habitat conditions, forest health and resilience and climate objectives while also improving the economic stability of the region and advancing the overall environmental and energy supply goals of California as a whole.

Political disagreement regarding the appropriateness, impacts, and sustainability of using forest and agricultural feedstocks to produce renewable energy from biomass have driven change in the biomass energy sector in California since 2012. Much of the disagreement and unanswered questions focuses on net greenhouse gas emissions benefits and impacts of biomass power, collectively known as "life cycle" impacts. Such concern has directed state-sponsored research and development in biomass power systems away from direct combustion technology. Direction has also affected the scale of biomass facilities relative to biomass power plants built in California 30 years ago. The intent with smaller scale plants is to mitigate feedstock demands over time to ensure that forest ecosystems can provide an ecologically sustainable supply while also providing adequate nutrient cycling and habitat conditions for species of concern. Scrutiny is also given to the effects bioenergy on food markets when agricultural land is dedicated to biomass energy development, and state support for biomass power has focused on waste material as feedstock rather than purpose grown fiber.

Biomass energy development could have net environmental, social and economic costs, where profit maximization is placed ahead of ecological and social considerations. At the same time, current and future management activities as part of ongoing efforts to restore fire resiliency and overall forest health will provide a significant stream of biomass material as will ongoing agricultural activity like vineyards that produce a focused amount of biomass in a given area. This points to the fact that there is no black and white, one size fits all, answer to the question of under which circumstances biomass energy production is sustainable and compatible with air quality, climate, watershed, fisheries, ecosystem and forest fuels reduction goals. Forest ecosystems and farm systems have diverse productivity, structure, and functions. Avoided impacts from alternative energy sources through displacement of fossil fuels, alternative disposal methods such as open burning of slash piles v. controlled combustion at biomass plants, and potential alternative resource outcomes like high severity stand-replacing wildfire as opposed to low severity fire after fuel reduction and biomass harvest vary across the region and weigh heavily in determining the appropriateness and sustainability of biomass harvest and utilization from agricultural and forestry sources.

The regional strategy that we propose, along with local and individual project development efforts throughout the region, must recognize these uncertainties, and recognize the real risks of developing unsustainable demand and undesirable impacts on the environment and society. Planning for any individual biomass project, if it is to be successful and sustainable, must include both a process of engagement with local stakeholders to consider impacts and design for maximum benefits, but also a process of planning, analysis and permitting that prioritizes minimizing negative impacts on natural resources, the environment, and human health.

The potential social and ecologic benefits from appropriately sited and scaled biomass facilities can include the following:

2 *The Economic Impact of the California Wine and Winegrape Industry, 2015*. The Wine Institute. <http://www.wineinstitute.org/files/Wine_Institute_2015_Economic_Impact_Highlights.pdf>

1. *Protection of water quality*. Natural disturbances that cause significant or complete mortality of forest stands and remove vegetation across large areas pose major sediment risks to aquatic habitats and human water systems. It is well-documented that thinning overly dense forest-stands by removing and utilizing biomass can reduce susceptibility to insect, disease and especially wildfire impacts which result in poor water quality.

2. *Improved forest health*. Thinning dense stands, both in the wet coastal forests and in dryer interior forest ecosystems, improves stand vigor and resilience to natural disturbances such as insect and disease outbreaks and fire. In private forest-lands this amounts to improved stand resilience and accelerates growth to improve stand values for subsequent harvest. Across the public lands that dominate the dry forests, thinning will especially reduce impacts from wildfire.

3. *Increased carbon sequestration*. While the extent of this benefit can vary widely across forest ecosystems and the debate about it is especially strong around wet-temperate ecosystems, avoided emissions from wildfires in fire adapted forests generally means that biomass energy can increase and secure carbon sequestration over time.

4. *Decreased carbon emissions compared to fossil fuels and soil amendments.* The displacement of alternative fossil fuel energy sources or chemical fertilizers and soil amendments with energy or amendments produced by biochar, or "biogenic" carbon, reduces the net emissions of carbon into the atmosphere.

5. *Decreased particulate matter emissions over existing waste disposal and avoided open burning.* Controlled combustion with emissions control technologies like scrubbers, bag houses, and electro-static precipitators, or gasification of biomass in the case of soil amendments, significantly decreases the emission of dangerous particulate matter into human airsheds when compared with the alternative disposal method of open slash and agricultural burning, prescribed fire, or wildfire.

6. *Reduction of the threat of catastrophic wildfire to the Wildland Urban Interface (WUI.)* Many of the communities in this region have been listed as California "Communities At Risk" to Wildfire. Reduction in the level of fuels in overly dense forests has been demonstrated to have a significant effect on the intensity, severity and scope of wildfire, reducing the threat to communities in the WUI. Economic utilization of the removed fuels can somewhat defray the costs of treatment.

The goal of this document is to assist the seven county North Coast region develop sustainable, environmentally compatible, appropriately scaled biomass energy systems that give the rural communities in the region the ability to promote power generation for the greatest local benefit now and in the future.

This document will provide an approach to biomass energy capable of addressing watershed and ecosystem function paired with local economic development accomplished through collective actions and energy from the member counties and partners.

ASSESSMENT PROCESS

Document Review

In developing this strategy document, we conducted a literature review of biomass energy works including policy/legislation, technical issues, financial considerations and the existing regulatory framework. In addition, documents and resources pertaining to watershed health, water quality/quantity, ecosystem health, disadvantaged communities and economic development were reviewed with the intent of exploring the nexus between these disciplines and biomass energy.

Personal Interviews

To help us gain a clearer understanding of the social context, the capacity of local communities, governments and business, social values and political realities, interviews were conducted with local, regional, state and national experts, elected officials, regulatory agency staff members, industry professionals and environmental advocates. These interviews provided key social and political perspectives about the level of awareness of biomass energy, opinions regarding its use and implementation and views in both directions of the region and the governmental and regulatory players in both Sacramento, CA and Washington D.C

Report Compilation

This combined process of both fact finding and perspective compilation provided the information and views that are included within this strategy document. We are hopeful that this document will fulfill its purpose as a regional strategy to facilitate biomass energy and utilization.

USES OF WOODY BIOMASS

Woody biomass can be used for a wide variety of products ranging from durable value-added wood products such as post and poles, to pulp for paper products, to feedstock for energy production. Following is a brief discussion of the array of processes and associated products that yield economic value from woody biomass feedstocks. Biomass feedstocks vary widely in their

quality and characteristics, and not all biomass can be used for all products and processes. As a basic principle, those products that demand the highest market values per biomass volume generally provide the greatest socio-economic benefits and return the most value to landowners to support forest management. Therefore, a diversified and competitive suite of biomass users is desirable for the interest of both land management, landowners, and for communities across the region.

VALUE-ADDED PRODUCTS

Value-added products are byproducts of other higher-value products, like merchantable timber. An inconclusive list of value-added woody biomass products includes post and poles, tree stakes, trellis poles, rustic furniture, spindles for roundwood and log-home construction and decoration, stairway steps and arches, character wood, landscape chips and bark mulch, garden mulch, compost, animal bedding, biochar, biofuels, polymer precursors, thermal energy for heat or heated products such as greenhouse produce and mushrooms, and erosion controls (USFS Biomass Deskguide, 2008; Forest biomass diversion in the Sierra Nevada, 2015; California Assessment of Wood Biomass and Markets, 2015). Although value-added products are usually a result of larger forest management operations, current trends indicate that non-traditional forest management activities (i.e. restoration, sustainable harvest, fuels reduction) will be a continuously growing contributor to this specific feedstock sector.

Many value-added products can be sold into niche markets at relatively high value and low volumes. This supports higher profit margins than low value, high volume business plans which increases business stability and economic benefit in rural areas. Many value-added products can be economically manufactured at small scales, especially relative to products such as lumber or electricity. Product values often range between $20–40 per green ton (gt) of biomass delivered to a processing facility.

Still, consistent feedstock procurement and achieving reasonable economies of scale in manufacturing can be significant barriers to establishing successful value-added biomass businesses.

Species preferences in the marketplace, such as lodgepole pine in the case of post and poles, further limit value-added manufacturing opportunities within the North Coast region as it is only locally abundant in a limited area of Siskiyou County and largely absent elsewhere. Unique opportunities exist with hardwoods, particularly on the coast with tanoak, pacific madrone, *alnus sp.*, big leaf maple, and other locally abundant and/or intermittently available hardwoods. A number of businesses work with these species to produce value-added furniture and housing accent products, which they tend to sell into local and regional niche markets. While post and pole plants have operated successfully in the region, as of 2017 they had moved out of the region to closer transport they do not represent a significant portion of the current value added production in the region.

Cross Laminated Timber (CLT), Oriented Strand Board (OSB), Particle Board, and Composites

OSB chips and composites represent biomass products of intermediate to relatively high-value. The North Coast Region has had two plants owned by Hambro that produce panelboard (flakeboard) and there may be other opportunities with pine species in a few specific locations if market demand, feedstock supply and capitalization become apparent. OSB, particle board and composites tend to focus on species of lower value for lumber production, such as true firs and pine species that are not locally abundant across much of the North Coast region, there are specific places where these species are available. Because all of these products compete in the global commodities marketplace, they tend to require large-scale manufacturing facilities to reach economies of scale. Global market fluctuations can also significantly affect demand and pricing over time. For instance, pulp markets can climb above $60/gt and range below $20/gt. A unique value-added byproduct of pulp manufacturing, black liquor is increasingly being used as a biofuel created through a secondary refining process.

The town of Samoa, on Humboldt Bay, long supported a pulp mill that created market demand for woody biomass from across the region. Unfortunately, market conditions throughout the last decade caused a series of ownership transitions and curtailments that has now left the site permanently closed to pulp production.

The Beck Group has been looking at the California wood products market for the US Forest Service and the California Natural Resources Agency. OSB is one of the top most likely to be profitable wood products businesses in the state, and this may hold true for the North Coast region.

Biomass Energy

In addition to wood products, biomass can be converted to chemical, thermal, or electric energy. Various forms of waste biomass and energy-specific products can be used as fuel, and both chemical and thermal energy can then be used to produce electricity. The production of heat energy through thermal conversion is the most efficient use and cheapest method of woody biomass for energy production. Electricity can also be generated through a number of thermal conversion

processes with excess heat produced as a byproduct of the conversion process. Systems that harness both forms of energy are called combined heat and power (CHP) or co-generation systems, a highly efficient use of biomass for energy generation. It is also possible to produce liquid or gaseous fuels for transport fuel, electric fuel, or heat from woody biomass. Liquid fuel commercial plants operated in both the US and Europe through the early 20th century but were not economically competitive with the emergence of fossil fuels. Today, developers and scientists are working with different technologies to produce what is known as lingo-cellulosic ethanol (cellulosis), biodiesel, and aviation biofuel.

Thermal

Woody biomass, in the form of firewood, has been used to produce thermal energy for heating and cooking for almost 2 million years. Firewood is a cost-effective and sustainable heat source in much of our region, is both renewable and locally procured, and it often supports small business and informal supply chains that retain wealth in local and rural communities. Air quality issues can be considerable when no emissions controls are applied, but EPA approved woodstoves include devices such as catalytic converters that provide significant improvements over emissions from old stoves. Commercial firewood production is relatively common and there are several small producers in our region, making it a key market to expand upon in the development of biomass markets in the region. Businesses and entrepreneurs use firewood processors to rapidly split volumes of wood to be sold in bulk, palletized, and/or wrapped for sale in remote retail outlets for summer campers and winter vacationers. Commercial firewood operations can often pay $15–30/gt, depending upon species, dryness and other factors, which makes firewood a relatively high value use. Firewood sourced in counties that have Sudden Oak Death (Humboldt, Mendocino, Sonoma, and Trinity Counties in the North Coast Region) must heat-treat the product to kill any pathogens that would otherwise be transmitted when selling across county lines. Firewood conversion systems are most often scaled to fit single family homes, but can also service government and commercial buildings, such as the one at Almquist Lumber, a hardwood retailer in Humboldt County. The boiler is surrounded by a water jacket which absorbs heat from the fire in the boiler, and hot water is circulated through the floor of the building to heat it.

Wood chip or "hog-fuel" boilers are another form of direct thermal conversion through combustion. Predominately used as a heat source for larger buildings like elementary schools, dry kilns associated with sawmills, and other medium to large scale applications, these types of boilers have historically been a common use of biomass in our region. States across the northeast and west have been pushing to convert heating oil, propane and kerosene boiler systems in schools and other public facilities to woody biomass boiler systems in an effort to reduce costs, reduce fossil fuel consumption, and to add value to local woody biomass. Nationwide efforts like the Statewide Wood Energy Teams (www.na.fs.fed.us/werc/swet) and the Fuels for Schools (www.fuelsforschools.com) programs support this work. A number of schools and public facilities from the North Coast region have been evaluated for feasibility, but no new conversions have been made do to the relatively fewer heating days in the region compared to more northern states and lower prices of propane over the past 5 years.

Finally, densification is a process by which small particles of woody biomass are , dried to approximately 10% moisture content, and then pressed t to form wood pellets, bricks, briquettes, or logs with higher energy content than firewood or wood chips. Pellet boilers are another alternative, along with wood chip boilers, for new heating retrofits for residential and public facilities, and even district heating systems and can save costs over heating oil, propane and kerosene systems in some instances. District heating systems have one or a series of boilers heating multiple buildings. The quality of the quality of densified products relies on feedstock quality. Premium pellets are higher value and industrial densified products are a low-cost produced to offer an alternative to fossil fuels in the firing of power plants and industrial plants such as cement factories. While there have been small pellet manufacturers in the North Coast region in the past, that producer no longer exists, and the region lacks a commercial densification facility. However, with our confluence of wood supply and proximity to California markets that are currently serviced by manufacturers as distant as the Washington-Oregon border and Montana, real opportunities should emerge for densified fuel manufacturing.

Electricity and Combined Heat and Power (CHP)

Woody biomass can also be used as fuel for electricity production, or for electricity and heat production.

Direct combustion is the primary conversion process for woody biomass to electricity across California and on the North Coast. It has been used to create renewable, distributed generation power in California since the 1980s, and many of the plants built then are still in use today. One of the main benefits of direct combustion power plants is the ability to extract excess heat from the process to serve a local heat load as well as power load, or combined heat and power (CHP). Electricity and heat are created through complete oxidation and the steam cycle in which water is heated to steam and used

to turn a turbine connected to a generator producing electricity. Excess steam and heat is generated in the process and can account for a high percentage of the total energy. Stand-alone plants that produce just electricity are often less than 25% thermally efficient while CHP plants can reach greater than 70% efficiency. State of the art emissions controls technologies are effective at helping meet air quality standards, but they are generally considered prohibitively expensive for smaller installations below approximately 10 MW. Stand-alone and CHP biomass combustion plants can generally pay around $30–$40/GT (Green Ton) for woody biomass and can usually use an extremely wide array of feedstocks, although 3" diameter and less is the standard size. Additionally some types of feedstocks, like redwood, can be difficult to burn. Several are operating in the North Coast region associated with sawmills In addition to a number of other projects being considered. Water, wood supply and airshed issues all limit feasibility.

Gasification is a thermochemical conversion process used to produce electricity in California. Gasification to electricity has been undergoing a new phase of research and development to achieve commercially viable systems with lower emissions and more scalable systems than traditional combustion systems, while rivaling the efficiency of high performing combustion systems. All types of gasification use heat and limited oxygen or steam in "limited oxidation", resulting in a product gas which can be cleaned to synthetic gas (syngas) which is used to power a natural gas engine or turbine to produce electricity or CHP. Biochar is often a co-product of gasification to electricity systems, though amounts of gas and biochar production vary by gasifier brand. Biochar can be used as a soil amendment that increases soil water retention and increases carbon sequestration. Biochar is emerging as an environmental mitigation strategy across California. A number of systems and vendors are in the demonstration phase, including at-least one unit in the North Coast region. The scalability, low water usage, and lower emissions are all factors that make gasification an attractive opportunity for the region.

Alternative Fuels

Biomass can be transformed into liquid or gaseous renewable fuel, termed "biofuels" or "biogas". Examples of biofuels include biodiesel and biomass jet fuel. Examples of biogas are biomethane or biohydrogen.

Pyrolisis and variations of pyrolysis is used to produce biofuel. Gasification can be used to produce biogas and can also be combined with other processes, such as Fischer Tropsch to produce biofuels. California is even beginning to regulate the amount of renewable natural gas (biomethane) in the natural gas pipeline, which could give a boost to biogas production. .

Pyrolysis for biofuels is currently being demonstrated at the pilot scale by a number of companies and may hold promise for commercialization in the coming decade. In pyrolysis, woody biomass is heated in the complete absence of oxygen, driving off volatile gases, which are then condensed into liquid bio-oil and char. Pyrolysis processes can be conducted at different temperatures ("fast" and "slow") to produce different amounts of bio-oil and char. The liquid bio-oil may be refined through a separate complex process and used to run boilers or engines to produce heat, electricity, or motion. It can also be transported to remote markets and has a relatively high energy density, though most small- to medium-scale operations have not proved to produce a shelf-stable. While significant technological limitations remain, pyrolysis has the potential to be highly scalable, has low emissions, and produces a potentially valuable co-product in the form of char as a soil amendment (Roos, 2010). It also addresses a need to replace fossil fuel used for transportation, which is a sector with few other replacement fuels. Pyrolysis could be particularly applicable in the agricultural areas of the North Coast region, such as the vineyards of Sonoma County where biochar projects are beginning to take hold, and in Modoc County, where Juniper would be a fine feedstock while promising few other uses.

BENEFITS, COSTS AND UNIQUE CHALLENGES OF BIOMASS ENERGY PRODUCTION

A complicated and contentious debate is occurring in California, across the U.S., and even worldwide, about the environmental and economic benefits and costs of using biomass feedstocks for the purpose of energy production. The utilization of dedicated agricultural crops, crop residues, and byproducts or waste from forest management practices for biomass energy involve a wide array of cost-benefit tradeoffs heavily affected by upstream management decisions. This becomes especially apparent when considering the diversity of social, economic and ecological implications associated with the myriad pathways of biomass harvest and conversion, and with the complexity of valuing cost-avoidance from alternative disposal pathways, potential loss of the resource to catastrophic fire, and the replacement of fossil energy sources.

Studies conducted throughout the last decade have only further fueled the debate. For instance, while it is broadly acknowledged that thinning and removing small trees from fire prone forests can reduce the risk of ecologically

damaging stand-replacing wildfires (Skinner, 2005) it is unclear whether utilizing those small trees for biomass energy always results in net economic, air quality, and climate benefits (Washington Post, 2017). Furthermore, harvesting and utilizing biomass from differing forest and agricultural systems have different socio-economic, ecological and climate implications. The following sections explore the implications for various socio-economic, ecological and climate values associated with biomass utilization for energy in the North Coast region.

Water Resources

Activities in the biomass energy production life-cycle affect water supply and quality in four primary ways.

First, the harvest of biomass feedstocks, primarily through forestry operations for timber harvest or restoration, has the potential to protect water quality. Thinning dense, fire prone forests or overstocked forest stands can protect water quality through increasing the overall resilience of watersheds to disturbance events such as stand-replacing wildfire and insect infestations. Loss of forest cover associated with high stand densities and severe disturbance events is known to cause significant erosion and sedimentation leading to high ecological and socio-economic costs (McDonald, N.D.) Given the current departure of the region's fire adapted forest ecosystems from their historically resilient conditions, and with disease such as Sudden Oak Death affecting coastal forest systems, the risks to watershed resilience are clear and present. Thinned stands also pull less water from soil reserves during the summer (Deboodt, n.d.) and allow more snow fall to the ground which preserves snow pack during the winter. . While this has been clearly demonstrated in western juniper ecosystems such as those in Siskiyou and Modoc Counties, considerable uncertainty remains as to the implications for other forest ecosystems in the region and whether these effects can be demonstrated at the scale of large watersheds such as the Klamath Basin (Khun, 2007).

Second, biomass harvest can negatively affect water quality where Best Management Practices (BMPs) are not followed. Chronic sedimentation and mass wasting result from poorly built road and skid systems, as has been shown with commercial timber harvest. State and federal laws and regulations largely protect against this risk factor.

Third, a significant volume of water can be consumed in wood biomass electricity plants. Direct combustion biomass boiler systems use water make steam to run turbines, and to condense that steam through cooling. Standard closed-loop systems in place today have cooling towers or ponds and recycle water, rather than discharging hot water. These plants typically use 300–600 gallons per MWh (megawatt hour). Much of that water leaves the "closed loop system" through evaporation, while some can be recycled. Such volumes could significantly affect stream flows. Depending on the type of technology used and the location of any given biomass-to-energy facility, there can be varying levels of need that may impact water resources. Even in the more efficient biomass systems, water needs can still range from 10–15 gallons per minute for each megawatt of power being generated. Taken over the course of a 24/7 30-day cycle this can quickly add up to 21,600 gallons per megawatt per day. This can be a significant impact, especially in areas with already challenged water supplies. *(Office of Indian Energy and Economic Development, 2010)*. Waste heat utilization, such as heating dry kilns, can reduce the amount of water consumption by using the waste heat process as a partial condenser. While much of the North Coast region is endowed with reasonably rich water availability, competing and often higher value uses limit the potential for developing new steam driven biomass boiler systems.

Thermal applications such as home and institutional cordwood and pellet heating, advanced industrial conversion technologies such as gasification or pyrolysis, waste-water reuse, and cogeneration systems all offer promise for reducing water demands from biomass energy production.

Finally, forest and agricultural biomass can be the source material for biochar production. When used as an agricultural amendment such as in vineyards, biochar can reduce watering needs by up to 15%. Biochar can be a byproduct of bioenergy generated through gasification or pyrolysis.

There is also a need for additional study to be done on how improved forest management practices, funded in part by scale appropriate biomass-to-energy projects, can improve overall water quality and improve the stability of overall water quantity. The upcoming "California Biopower Impacts" study to be completed by Humboldt State University with funds from the California Energy Commission, while focused on greenhouse gas emissions that result from fuel harvest for bioenergy, should address this question in part.

Forest Ecology and Management

As with watersheds, the relative resilience of forest ecosystems is significantly affected by stand density, a measure of the size and number of trees per area. Past management practices such as fire exclusion, prohibition on thinning of plantations, and, at the other end of the pendulum over aggressive timber harvest practices, have dramatically altered forest ecosystems across the

region, generally increasing the density of small trees (Skinner, 2005). This means that coastal and interior private industrial timberlands, along with most federal lands, are at-risk of large-scale disturbances such as wildfire, insects and disease that can have profound impacts on ecosystem values such as functioning terrestrial and aquatic habitat for native species, landscape-scale habitat diversity and connectivity, carbon sequestration, and water filtration and metering.

Biomass harvest can be a valuable tool for reducing stand-density while providing a range of ancillary benefits not realized from alternative disposal methods (Morris, 1999). In commercial timber harvest operations and hazardous fuels reductions, as well as with agricultural waste disposal, open-air pile burning is the most common method of disposal. Air quality implications will be discussed later in this section, but there are also direct costs and logistical and regulatory challenges that arise from pile burning. The other primary biomass disposal option utilized in the North Coast region is leaving slash and cut hazardous fuels onsite to decompose. While some amount of biomass retention is appropriate and even desirable, especially on wet sites with higher rates of decomposition, logging slash and hazardous fuels reduction residuals can accumulate and exacerbate fire hazard on dry forest sites where decomposition can be extremely slow and where fire formerly served as a primary nutrient cycling agent. On-site decomposition can also lead to methane generation, a highly potent greenhouse gas.

Due to the complexity of these issues, "sustainability standards" for biomass harvest from forest ecosystems has become a hot-button political issue over the past few years. In 2012 and 2016, the California legislature passed bills requiring forest biomass power generation with restrictions on the type of forest biomass that can be used as fuel for the facilities. While California addresses biomass retention standards through its Forest Practice Act, the interactions with emerging climate and energy legislation and regulatory rulemaking surrounding California's cap and trade program may have significant implications for forest ecosystems and forest management in the state.

Economic and Social Implications

Biomass energy holds significant promise for enhancing both the current condition and long-term resilience and stability of local rural community economies, along with the broader regional economy. This is particularly important in the North Coast Region, where many rural communities that were historically dependent upon logging and sawmilling and have seen continued decline over the past two decades. This has been accompanied by demographic shifts such as aging populations that will further affect county tax revenues, medical services, and potential economic growth.

Biomass energy has higher, longer-lasting, and more localized economic impacts than most other renewables in that it is labor intensive to collect, process, and convert to power. Its relatively low energy density and sometimes odd physical shape leads to high transportation costs, limiting the range of economic haul distances and keeping economic impacts local (Domac, J., Segon, V. 2005). Economic contributions from biomass energy generation are realized in a number of ways including; direct and indirect job retention and creation, increased tax revenues, increased revenues (or reduced costs) for forest and agricultural landowners, energy cost savings to local institutions, local utility generation and transmission revenues, and potentially long-term income from power sales for local and regional equity holders.

Direct job creation from the collection and transportation of biomass feedstocks can help to diversify and bolster the existing forestry, sawmilling and agricultural sectors. While estimates of job creation and associated multipliers vary, a recent study from Oregon estimated that collection, processing (chipping or grinding) and transportation amounts to 3.6 jobs per MW of generation capacity (McNeil Technologies, 2003). Direct employment in operations at standard direct combustion facilities is estimated at around 2 jobs per MW (Allstone and Shepard, 2010). Combined, these numbers agree with the estimates of the California Biomass Energy Alliance for existing plants in CA, which employ approximately 6 direct jobs per MW (California Biomass Energy Alliance, 2010). Even more jobs and economic activity are realized where co-generation is practiced, where sawmills are able to heat dry-kilns for lumber drying, or where heat is drawn off for greenhouses, controlled climate aquaculture, or other industrial processes.

Grebner et.al.(2009) compiled Table 1 from a number of independent regional studies to show multipliers associated with each dollar expended towards the following biomass energy related activities. While additional service sector multipliers and tax revenue implications are difficult to estimate and locally sensitive, their contributions would be particularly important across the rural counties.

While the costs of harvesting and transporting biomass to generating facilities can easily exceed revenues generated through power sales, individual landowners stand to benefit from viable markets for what is otherwise a waste disposal cost. Timber stand improvements, hazardous fuel reductions, slash and agricultural waste disposal are all essential land management practices carried out by landowners and managers large and small, public and private, across the region. With delivered

biomass fuel values of approximately $40 per green ton to existing plants and potentially higher for other uses such as wood pellets or cordwood, landowners could at least offset a portion of their management costs. Proximity to a biomass market is the most critical factor in determining the benefit to land owners and land management.

TABLE 1. ECONOMIC IMPACTS OF BIOENERGY IN DIFFERENT AREAS OF THE U.S.

Group	Region	Multipliers		
		Output ($)	Value Added ($)	Employment (# of jobs)
Recovery of logging residues	East TX, MS	1.67 1.86	2.00 2.62	2.15 2.92
Procurement of small-diameter trees (thinning)	AZ, NM, CO	1.30–1.60	NR	1.45
Electricity generation	East TX, MS	1.35 1.60	1.32 2.33	5.20 2.25

Energy cost savings for local institutions can be significant when existing fossil fuel heating systems are replaced with biomass heating systems. Such systems, whether fueled by cordwood, pellets or hog fuel, can pay for themselves and result in annual cost savings when replacing high cost fuels such as diesel or propane, as has been demonstrated around the country through popular programs like "Fuels for Schools" in MT, ID, and CO, and in other longstanding installations like the district biomass heating systems at the University of Idaho, the Burns and Harney County Hospitals in OR, and in dozens of public facilities across the northeastern US. For example, the Enterprise Elementary School in Northeastern OR is saving $112, 889/year in heating costs (University of Oregon, Wood Heat Solutions). In Grant County, OR, a local pellet facility associated with a sawmill is now serving a regional cluster of new institutional pellet boilers. Associated energy savings can be used to pay down capital costs, reinvested in other critical services or improved revenues, and energy dollars are spent and cycled locally. In California, Cal Fire and the Department of Corrections have recently determined that replacing the space and water heating systems at Conservation Camps in Trinity and Modoc Counties will save heating costs, and are proceeding with final engineering and construction planning as of early 2017.

With the adoption of AB 32 (2006) and SB 350 (2015), both public and investor-owned utilities and Community Choice Aggregation entities are required to expand their portfolios to include 50% renewable power. Many publicly owned utilities (POUs) are currently purchasing this renewable energy on "spot markets" that are expensive and variable. To the extent that the POUs, CCAs, or other local entities, such as private investors, local banks and credit unions, or county governments, are able to invest equity in and/or own new biomass power projects or transmission capacity, revenues will inherently be reinvested in local communities. This may be realized through reduced costs to ratepayers, profit-sharing and dividends, or through direct reinvestment of revenues in economic development activities and other municipal utility improvements.

Local ownership and equity arrangements hold significant promise for returning sustained economic benefits to local communities over time, especially compared with more common absentee ownership models that export profits and wealth. These are more typical in rural resource-rich areas and often result in cycles of boom and bust (Yellowwood, n.d.) Local ownership arrangements may also enhance the social acceptability of new biomass projects, where the benefits are more apparent and equitable to local communities of origin. The Northern California Community Loan Fund and Cutting Edge Capital recently investigated the use of New Market Tax Credits and Direct Public Offerings to increase access to financing and equity retention for community-scale biomass projects with positive results.

Biomass as Base Load Power

Biomass power, like hydro-electric and geothermal power, contributes what is known as "base load" power to the electric grid. This means that it can provide power consistently throughout the day , and is different from wind and solar, which provides power in. While wind and solar can often provide valuable resources during peak demand times, "they are not controllable resources that can be used to meet peak loads and are often remotely located from the source of the demand. As a result, renewable energy producers are often faced with complex and often risky power purchase agreements that may contain penalties for failure to deliver during peak energy user periods." (Booz Allen Hamilton, 2007).

Wood and wood waste energy amount to 2.00% of California's total electrical generation capacity, 1.00% of renewable energy capacity, and 1.70% of California's total renewable energy generation. Examples of non-base load categories include wind power which comprises 3.70% / 2.60% and solar which comprises .60% / .30%, as a comparison. A combination of base load power and available peaking power is necessary for grid stability, and biomass's contribution to base load grid stability could be significant. (US EIA, 2010)

Air Quality

One of the primary environmental concerns associated with electrical generation from woody biomass is the emission of both criteria (regulated) air pollutants (CAPs) and greenhouse gasses (GHGs). While the controlled combustion of biomass produces air pollutants, they can be controlled through emissions control technology, and most of the air districts in the North Coast region

are not out of compliance for CAPs. Additionally, the more recently developed small-scale gasification to electricity systems produce significantly less CAPs than direct combustion systems. Additionally, it can be argued that both systems are considerably cleaner than some non-renewable fossil fuel alternatives, and are orders of magnitude cleaner than the other alternative sources of wood combustion including open-burning and wildfire (Springsteen 2015).

Biomass Emission Control Technologies

Technologies in biomass power generation continuously reduce emissions at power production facilities. CAPs like nitrogen oxide, hydrocarbons, and carbon monoxide are controlled by technologies such as fluidized-bed combustors, staged combustion, flue-gas recirculation, and ammonia injection to control NO_x. Cyclones are used to remove large particulates, and electrostatic precipitators remove fine particulates. Modern biomass plants are generally required to achieve zero visible emissions and use Best Available Control Technologies (BACT). Smaller plants and boilers are able to further reduce emissions through the use of selective catalytic converters and new technologies such as gasifier/combustion combinations.

Biomass vs. Wildland Fire

Controlled combustion through biomass power generation provides considerable air quality benefits when compared with wildland fire. Figure 1 compares two forms of wildland fire, prescribed/pile and wildfire, with two small biomass power systems.

As Figure 1 illustrates, controlled biomass combustion significantly reduces emissions of both CAP particulates and carbon monoxide compared to wildfire. Well designed and controlled biomass energy plants can reduce particulate emissions in a region up to 99%.

Given this information, conducting fuel reduction and restoration projects that utilize woody biomass from forest systems for energy generation can provide a number of valuable benefits. Along with reducing the threat of catastrophic wildfire and eliminating the need for prescribed and/or pile burning, biomass removal and energy generation provides significant air quality benefits when compared to wildland fire. This has been proven in the field through the Blacks Mountain Experimental Forest managed by the USFS Pacific Southwest Research Station and more recently at the UC Berkley Center for Forestry Blodgett Forest Research Station.

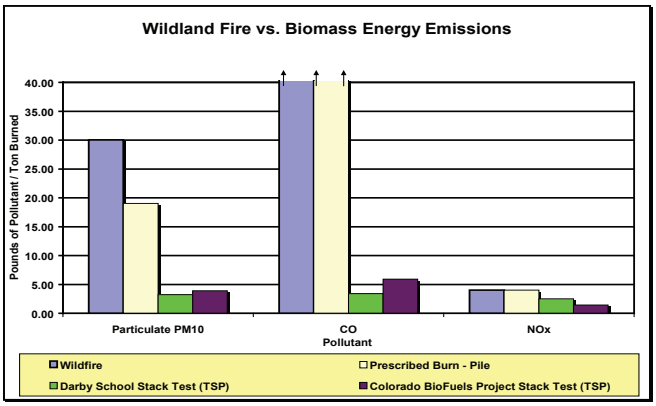


FIGURE 1. COMPARISON OF WILDLAND FIRE VS. BIOMASS ENERGY EMISSIONS

Climate Change Mitigation and Adaptation

Understanding climate change effects is an increasingly important part of forest and agricultural bioenergy planning and development. Impacts of biomass are positioned on top of impacts of land management decisions, which are usually decoupled from power plant management decisions.

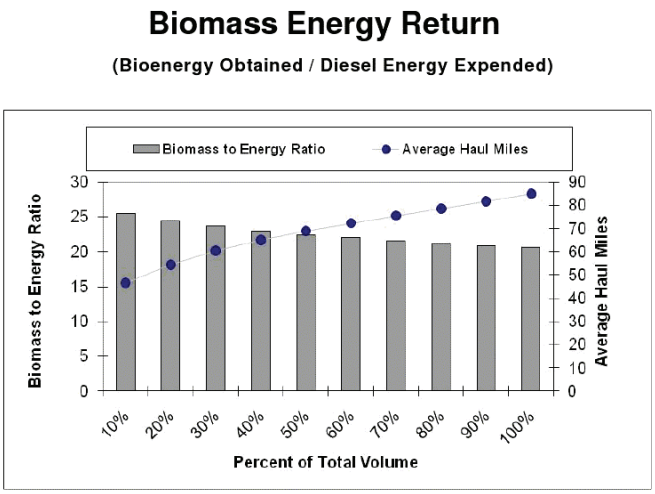
Concerns about whole log or "old log" removal for biomass feedstock purposes in terms of both landscape health and carbon sequestration persist across California and can be more important with regards to private land management. Some critics also equate GHG emissions from biomass-to-energy projects, which is carbon that already exists in the ecosystem, with use of fossil fuels, which "removes carbon from permanent geologic storage and adds it as net new carbon to the carbon already in the atmospheric and biospheric circulation system" (Green, 2104; Walker, 2010; Pacific Institute, 2008).

While these are valid concerns they are also, in large part, associated with utility scale biomass energy projects, generally conceived to have generation capacities of 25 megawatts and higher. Additionally, the most prominent of these analyses, Biomass Sustainability and Carbon Policy Study, prepared by the Manomet Center for Conservation Science, states "The absolute magnitude and timing of the carbon debts and dividends, however, is sensitive to how landowners decide to manage their forests." This is truly where scale appropriate planning and design comes into play.

If, as part of a more sustainable management process, smaller amounts of biomass are removed within a given geographic area, the minimum operational capacity of any proposed biomass- to-energy facility must be sized to accommodate that minimum volume of material. Additionally, profit margins can be challenging in biomass to energy facilities with minimal capital available for feedstock purchase, thereby

emphasizing the benefits of facility design based on existing feedstock supply, which may be limited.

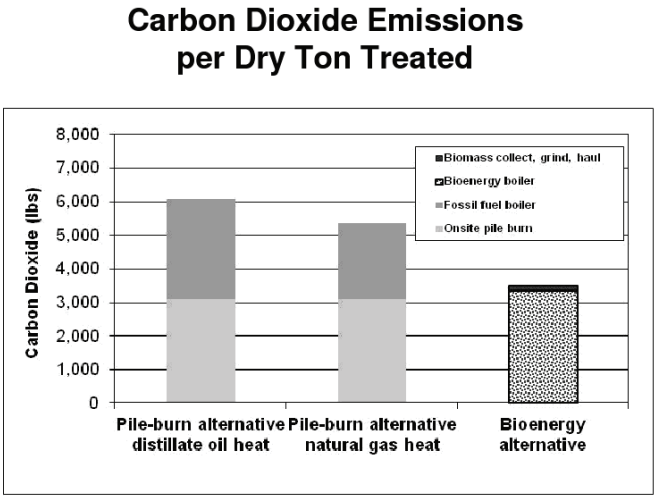
FIGURE 2. BIOMASS ENERGY RETURN, USFS ROCKY MOUNTAIN RESEARCH STATION



Many forested communities, including those in the North Coast Region, are already removing significant biomass from forested areas on both public and privately owned lands. Some of this removal is part of current timber harvest activity and a large part is also fuels reduction to assist in limiting the occurrence of regional scale catastrophic wildfires.

In a study conducted by the USFS Rocky Mountain Research Station, a comparison of CO_2 emissions of pile burning, natural gas and bioenergy concluded that biomass energy projects, with defined implementation, can result in over-all reduced emissions. However, the complete reductions including transportation emissions involved with feedstock transport limited the haul distance that made this feasible.

FIGURE 3. CARBON DIOXIDE EMISSIONS PER DRY TON TREATED, USFS ROCKY MOUNTAIN RESEARCH STATION



When haul distance was analyzed as part of the equation, it was found that the average haul mile distance vs. the amount of total energy expended reached a threshold of diminishing returns at around 60 miles. To meet the goal of both reducing emissions and lowering energy use overall, a smaller "sphere of influence" should be considered when looking at forest biomass needed to maintain minimum operational levels as part of any ongoing business concern.

This particular analysis was also conducted with a maximum feedstock material diameter size of 7" and smaller. Although greater sizes of material are currently being removed from forest landscapes in the North Coast Region as part of fuels reduction projects, this re-emphasizes the need for "below utility scale" biomass energy facilities since the long-term operational sustainability of the facility should be based on the impact to the local ecosystem. This information is also supported by data comparing wildland fire and biomass energy emissions and how biomass energy, when implemented at the appropriate scale and combined with a strategic forest fuels reduction prescription, can also assist in reducing emissions from catastrophic wildfire, even when adding in the net emissions from feedstock collection operations (Huteau, 2009).

The opportunity presented by investment in community scale biomass energy facilities (i.e. 0.5 -10 megawatt) minimizes potential impacts on both landscape and atmospheric systems and, within certain parameters, contributes to an overall reduction in greenhouse gas emissions through fossil fuels energy replacement and reduction in catastrophic forest fires.

Transmission

Transmission and distribution barriers are likely the least considered by a community when considering the need for a biomass project. The North Coast Region is faced with a number of transmission challenges that range from limited transmission capacity to an overall lack of awareness of what the local and regional capacity thresholds are for any given transmission line at any given time.

Over the last few years there have been programs and processes through the Federal Energy Commission in conjunction with the Western Governors Association, the California Energy Commission and others to analyze the opportunities and needs for expanded transmission facilities in the Western United States to address incoming renewable energy to the western power grid. In their review of previous studies, the California Energy Commission, as part of its Renewable Energy Transmission Initiative (RETI) process identified a number of resources, including biomass, geothermal,

wind and solar that could be utilized to produce roughly 1000mw of renewable energy. The transmission analysis, and lack of transmission availability, in a separate section of the RETI report, led to the conclusion that the northern CREZ would not be a source of exportable renewable energy but only distributed power.

This speaks the significant need for additional transmission analysis and infrastructure investment if these resources are to be utilized outside of the local and regional areas. Previously, the CEC had commissioned a transmission study conducted by PG&E, which concluded that few existing transmission lines could stand 1000 MW or more of additional load during peak. However, it did not identify specifically how much additional load these same 52 transmission lines could carry if that number was below 1000mW. This information would be crucial in determining the feasibility and the location of renewable energy projects within the Northern CREZ. Although the North Coast Region, has not been able to take advantage of recent processes and programming such as the California Renewable Energy Zone process, there still might be an opportunity to become both politically and organizationally engaged through a number of different strategies.

The challenge of developing new transmission capacity is exacerbated by the standard approach of proscribing major 500 kV lines, generally costing approximately $1.8 million per mile, $50 million for a sub-station and taking 10 or more years to develop. In the emerging dynamic energy environment an internet type "small hub and node" approach may well be warranted.

In the meantime, well placed community- and industry-scaled bioenergy plants, which can connect to distribution grid or provide power directly to a business as opposed to exporting power to the grid, will avoid transmission upgrade costs and bottlenecks.

The Electric Program Investment Charge (EPIC) is a fee that is charged to electrical ratepayers and used by the CEC to fund a number of different programs, including renewable energy research and demonstration. It currently includes funds for research on upgrading the transmission and distribution system be resilient and without capacity constraint. The third triennial investment plan for EPIC funds is currently under development by the CEC and Public Utilities Commission. We should work to ensure that the way future offerings are structured benefit opportunities on the North Coast.

Transportation

Delivery of feedstock to the facility is a major challenge, mentioned several times in interview responses and discussed in some of the literature that we reviewed, including addressing emissions from the haul as a contributor to greenhouse gas emissions.

Local equity also becomes a concern when factoring in haul distances because greater haul distance increases potential for the extracted resource to leave the local economy without the full economic potential being realized.

Although it is impossible to foresee every combination of transportation cost, topography, revenue from energy sales and all other components of a profitable venture, we can make a rough estimate of a sphere of influence that any facility should be using as a rule of thumb when considering haul distances from the field as part of their analysis. Both during our interviews and in our associated documentation there was a rough estimate of 30–45 miles in terms of insuring profitability within an entire operation. Haul subsidy through programs like the USDA's Biomass Crop Assistance Program or as could be structured using Cap and Trade funds, can expand the sphere of influence.

Cost of transportation is always a limiting factor in the feasibility of biomass-to-energy projects. Present industry standard calls for increasing the capacity of the plant, using economies of scale to drive down per MW capital cost. Increasing the resulting volume of feedstock forces an expansion of the "haul circle," increasing the average transportation distance—and cost—per delivered ton.

Recognizing that transportation adds to the emissions profile of bioenergy production does not mean that emissions benefits overall are not realized. If material transported would have otherwise been pile burned in the field, there is a distance threshold under which GHG reductions would occur as a result of more controlled combustion conditions (USFS, Using Forest Residues for Thermal Energy, 2010). This threshold, generally, falls well above the 45-mile boundary that is recommended here.

Some of the more sophisticated biomass availability studies go beyond drawing a simple haul circle and actually analyze the speed allowed on major roads, thus converting a distance to "haul time," a more accurate transportation cost assessment. One interview completed revealed that beyond fuel costs for distance traveled, time spent sending a truck in one direction would dictate cost of hauling fuel. Approximately one hour of driving per direction is the ideal haul time, allowing one truck to complete four trips per day. Fuel that is further from main roads, requiring trucks to drive slowly, will therefore cost more to move than fuel closer to main roads, even if the road miles are the same. A regional strategy should involve the following process to determine potential facility locations in terms of transportation:

1. A comprehensive analysis of feedstock available by watershed where adequate road infrastructure exists and taking into account speeds allowed into a "haul time analysis"
2. Match up these feedstock sources with potential site locations where transmission exists or improvements can be made at a minimal cost
3. Develop map of targeted territories and variables that can be continually adjusted with rising fuel costs

New Facility Capitalization

With biomass energy facilities in particular, there is a decreasing scale of cost per MW for plant construction, making it easier to finance a large plant than a small one. The table below demonstrates a rough scale based on recent average estimates.

TABLE 2. FACILITY CONSTRUCTION COST AS A PERCENTAGE OF ENERGY GENERATED

Plant Production Capacity Size	Per MW Cost for Construction	Total Cost of Construction	% cost of dollars/MW
2 MW	8 million	16 million	0.50
5 MW	6 million	30 million	0.83
10 MW	4 million	40 million	2.5
30 MW	3 million	90 million	10.0

Although simplee, the above table demonstrates how investment in small-scale biomass is prohibitive in terms of traditional economic models and return on investment. The amount of energy that can be created (MW) in relationship to the investment (millions of dollars) made increases by a factor of 5, as a percentage of investment between the 2MW and 30MW plants. This means that 5 times as much revenue can be made per MW for a large plant relative to a small plant. In order for small-scale biomass facilities to be capitalized, other benefits (social, environmental, emissions) will likely need to be monetized, or at the very least, accounted for, as public and private investment is considered. Without these considerations, even at the 10MW size, power plants relying on forest feedstocks are rarely feasible without a significant waste heat customer to provide an additional income stream.

In 2012, California passed Senate Bill 1122 (Rubio), a requirement that investor owned utilities purchase 250 MW of bioenergy fueled with waste material. Three categories of waste are included, and separate pricing tracks for each category will allow contract offerings for the price of power produced through plants participating in the program to move up and down according to market forces. This will allow innovative facilities to access the price they need to capitalize the plant, without over subsidizing the industry. The program, called the Bioenergy Market Adjusting Tariff (BioMAT) allows urban, agricultural, and sustainable forestry waste to fuel plants exporting 3 MW or less to the grid. Total plant size can be 5 MW if 2 MW are used behind the meter. Price offerings per MW start at $127 and can go as high as $190 before programmatic review is triggered. The BioMAT program began in 2016 and sunsets in 2021. As of January 2017, no projects had executed a Power Purchase Agreement.

Market Uncertainty

The BioMAT program significantly increases market certainty for small scale biomass projects, and as a result, we have seen over a dozen projects pop up across the state since the SB 1122 legislation was passed. However, the program will only provide up to 50 MW of biomass power across the whole state, and will be insufficient for meeting forest health goals in the North Coast. Additionally, since the program limits plant capacity to 5 MW or less, the market is still unstable for existing power plants, which support the current land management structure of our area. Additional facilities will need to be built and addressing uncertainty will be a key part of financing.

Investing in biomass energy projects before a power purchase agreement is executed carries significant financial risk. As stated earlier in this document, feedstock supply, transmission infrastructure, regulatory requirements and local political opinions can all have dramatic effects on any project's viability. However, community engagement, feedstock availability studies, electrical system impact studies, and other work that can total hundreds of thousands of dollars in cost, has to occur before a power purchase agreement is executed. This work can only comfortably be completed with stable power or heat markets.

There is little certainty for those taking a traditional project development approach. Distributing the financial risk into a diversified selection of sources and minimizing the environmental and local political impacts of any given projects will be required for new projects to move forward. Co-location of facilities is still a valid strategy as is a long range strategy to support smaller diversified projects through multiple revenue mechanisms. Some densified wood products mills (pellets, bio-bricks) prefer to be co-located with biomass operations that can sell them their heat byproduct. The availability of low cost heat reduces the expense of drying the densified wood product.

Community Choice Aggregation entities may also stabilize the power market for facility developers. If the project goals and development strategies are in line with community values, the CCA can negotiate in good faith with facility developers and indicate a measure of willingness to buy

the power. Humboldt, Sonoma, and Mendocino counties have or participate in a CCA currently.

Outside of the BioMAT and CCA, market conditions are dynamic and conflicting with the legislated market demand for increased use of renewable energy. Especially for existing large scale power plants, price offerings are too low to maintain operation. Except for where legislation has required renewed contracts for consuming dead and dying biomass material resulting from drought, or where CCA has been able to offer new contracts, existing power plants are routinely shuttering when existing contracts expire, rather than executing new ones. Re-assessing the value that biomass power offers with regard to baseload power and co-benefits in the Renewable Portfolio Standard least-cost best-fit analysis would address this issue, but may take too long to retain certain plants in the North Coast region.

Local Political Environment

Locally, regionally, and nationally there are still significant perceptions and values that will challenge the viability of biomass energy projects. In our interview process, the local political challenges and areas of concern identified could be represented in four categories:

Issues of Scale and Ecologic Impacts

As demonstrated through the historic impacts of boom and bust cycle natural resource extraction, the ecologic impacts of unencumbered large scale projects can have a negative impact on both local ecologies and economies. Fear of a new specter of large resource extraction is a reality in many sectors of the communities in the North Coast.

Transmission Expansion Opposition

As recently as 2009, there was controversy in Northern California, though outside of the North Coast Region regarding the expansion of transmission lines that would assist in distribution of renewable energy resources to urban markets. Stop TANC, http://stoptanc.com/, was a grassroots movement that was effective at stopping part of the transmission expansion identified in California's Renewable Energy Transmission Initiative (RETI). The communities within the pathway of the proposed project were poorly engaged or not engaged at all, became well organized very quickly and were successful in delaying the project, if not stopping it altogether. In addition, there can also be opposition to the location of transmission lines across public lands where residential impacts could be minimized.

Education

There is a low level of knowledge regarding the real impacts, ecologic and economic, of biomass energy within the general populace within the region. Misinformation or application of information from activities in other parts of the country to our region will be large political challenge if not addressed effectively. This began to emerge recently in Humboldt County when the Community Choice Aggregation entity began to advertise biomass power retention. There is also a lack of empirical knowledge about the current level of fuels build up in regional forests and the role that biomass removal has in the restoration of fire adapted ecosystems to levels capable of carrying fire without catastrophic consequences that impact both wildlife and human habitats and resources. Formation of a regional group capable of tracking current science and implications of findings within our region, and communication and engagement within the community, would help address the issue and further the conversation of the place of biomass use and biomass energy in our sustainable futures.

Local Planning to drive Industry and Agencies Development

There is a both a historic record and perception that in certain situations industry and public agencies have moved forward on projects prior to proper analysis and public outreach regarding potential impacts and local needs. Conversely, there is a perception by some that certain interest groups and individuals are systematically appealing projects based on ideology, failing to weigh not only practical costs and benefits to local communities but also impacts to local ecosystems. Establishing trust and backing it up with results will be a key factor to success within the North Coast Region.

There have been a number of projects within the North Coast Region that have set the stage for future potential for biomass energy in a number of different sectors. Humboldt County is one of the first entities within the region to pursue a RESCO (Renewable Energy Secure Community) project with a goal of achieving local energy security through renewable sources. That paved the road for a research project in Blue Lake and development the County's CCA entity, and may still further new biomass projects in the area. In Trinity County, the Weaverville Community Forest, a stewardship area comprised of federal land under the jurisdiction of both the United States Forest Service (USFS) and Bureau of Land Management (BLM) has been an example of local partnership with federal forest land managers in pursuit of sustainable timber harvest and community equity. Through its initial agreement with BLM, the community, through their local Trinity County Resource Conservation District, leveraged the early "win" and projects examples

to parlay the existing 1,000 acres of BLM territory to include an additional 12,000 acres of USFS ground.

These examples speak loudly to the need for individual localities, and preferably regions, to establish themselves as thought leaders early on in any given trend/process in order to leverage future benefits and credibility.

Outside of Region Market Visibility/Credibility

The North Coast California region is traditionally underrepresented in Sacramento and in Washington, D.C. Especially when compared with the Sierra Nevada region, the North Coast is harder to visit and receive visitors from, has less natural resources and conservation representation within state agencies, and receives lower media coverage than other forested parts of the state.

Contacts relayed through the interview process that their overall perception of the North Coast Region generally, and not of any single entity per se, is that it is a disorganized territory and historically one of minimal sophistication when it comes to: : (1) the intricacies of renewable energy production and the market specifically; and (2) low messaging ability more generally. Our engagement during these discussions, in addition to the obvious vanguard entities from Sonoma and Humboldt Counties, are assisting in turning around some of those perceptions.

Aggressive pursuit of a regional voice and message promoting the North Coast as a source for renewable energy production, research, and development and innovation — including biomass energy and other renewable energy and sustainability projects — can assist in gaining additional credibility in with government entities. This does not mean that new "on the ground" efforts are needed, although those will likely continue to develop. Rather, current ongoing activity can be organized and re-branded to demonstrate a commitment to the legislative, regulatory and funding decision makers, both in the public and private sector.

An Introduction to Regional Industry Cluster Analysis, as presented by Edward J. Feser, Professor of City & Regional Planning at the University of North Carolina at Chapel Hill, notes that framing "the policy problem first" is crucial "i.e., KNOW WHAT YOU WANT".

Does the region want to be known for economic success based on renewable energy? Does the region want to move forward in a single sector (biomass energy), multiple sectors of renewable energy (biomass, hydro, solar, wind) or does it want to be known as an example of a completely integrated region of economic strength based on all aspects of natural resource utilization and management? Although these are questions that should be answered by locally elected decision makers, they will need to be answered if a cohesive long-term strategy is to be put in place.

Continued industry cluster analysis, either with a formal region wide approach, or a less formal organic accumulation of contacts and examples as was done informally with this document is one of the recommendations of our proposed strategy. Unified messaging that, "we're in this together, we're innovative, we're organized, we care about the environment AND the economy and we mean business" is a strong and viable position to be able to present. This is also a message that decision makers in Sacramento and D.C. may be surprised to hear from this region of California and will likely welcome its receipt.

Realistic View

Although during our interviews we found that most of the advocates of biomass energy projects talk about it with the realistic view that it won't be a "silver bullet" for the economic challenges of the region, there were some respondents who advocated biomass energy as an economic or a forest restoration panacea.

This is not realistic and also does not support trust building if this message is delivered to local communities.

It should be acknowledged that biomass energy, while a key underutilized resource for the North Coast Region, will fail to address many economic challenges facing counties and communities, and will address even fewer forest health risks. Without adequate attention paid to other institutional factors (i.e. demographic changes, education levels, local governance capacity, technology, infrastructure, etc) even if biomass energy projects move forward, they will only solve a piece of the much larger challenge for these rural underserved forested areas.

With that in mind, biomass energy is a key part of the complex of changes that can address economic and environmental challenges of our region, and is a unique, intersectional tool. Success with biomass can impact the overall momentum of the region.

Conclusions

With historic reduction in the timber-based economies of the North Coast Region, biomass energy and other integrated "payment for ecosystem services" opportunities and mechanisms present a platform for systemic economic and cultural adaptation. With the additional energy supply demands of California's Renewable Portfolio Standards, the BioMAT program, and the threat of significantly increased dead and dying biomass material throughout the region, in addition to waste diversion and distributed generation goals, there is increasing potential for renewable energy to become

a viable economic driver for the North Coast region. Combine this with projected climate impacts of drier winters, higher risk of catastrophic wildfire, a potential reduction in ground and surface water supplies and snowpack, the adaptation challenges start to add up.

Adapting existing systems and organizations in the North Coast Region to these shifts will require a combination of restructuring the institutional policies and agreements in addition to working with the public at large in developing broad based support for the new economic and adaptive management models that should result.

Along with developing specific strategies for implementation of biomass energy and other renewable energy sources, a conversational shift within local communities is needed. When a biomass energy, small hydro electric, solar or wind farm is implemented on the North Coast a process of economic adaptation is taking place and public engagement at the local level will be key. The consideration of ecological costs and benefits, and the discussion of adaptation to environmental and economic factors will need to be presented to the public through a number of processes, including those of stakeholder assessment, public education and outreach, and local governmental support. One simplistic example of changing perceptions would be forest based stewardship and restoration crews starting to consider themselves "renewable energy workers".

Although renewable energy production, and its associated economic spin offs, will never replace the economic drivers generated by the timber industry at its peak, it can be a valuable piece of the economic picture in rural areas and is unlikely to contribute to historic cycles of "boom and bust". When renewable energy production takes hold in these communities the integration, and self-identification, of that fact in daily life will be one of the keys to long-term success.

CHARACTERIZATION OF REGIONAL BIOMASS FEEDSTOCK RESOURCES

The North Coast Region has been endowed with both a wide variety and high volume of potential biomass feedstocks. The USDA defines biomass as "Renewable plant materials such as, feed grains, other agricultural commodities, other plants and trees, and algae; and waste material, including crop residue, other vegetative waste material, including wood waste and wood residues..." For the purposes of this report "woody biomass" is characterized in five categories 1) Forest thinnings 2) Forest slash 3) Shrubs 4) Sawmill residue and 5) Agricultural waste (non-forest) 6) Ag and tree trimmings from "urbanized" rural areas 7) Construction and demolition waste. Note that California policy often separates agricultural waste from urban waste.

Nature and Availability of Biomass Feedstocks

1) **Forest thinnings:** Non-merchantable items removed from harvest activities. Such items are small diameter trees (live or dead), shrubs, and any other material removed from the forest that the mill cannot use to produce saw-logs.

2) **Forest slash**: Materials that are left in the forest after timber harvesting activities. These materials consist of branches and tree tops. Forest slash is every part of the tree excluding the bole from a 4" top down to a one foot stump on the ground.

3) **Shrubs (or chaparral)**: Materials comprised mostly of shrubby evergreen plants adapted to a semi-arid climate. In Northern California, this definition is true for shrubs growing at lower elevations. In higher elevations, shrubs can be found in forested environments and can be evergreen or deciduous.

4) **Sawmill residues:** Materials that are usually a by-product of softwood saw logs (i.e. logs that are greater than 6" in diameter at the small end and/or greater than 10" in diameter at breast height). These products consist of bark, sawdust, planer shavings and trim end pieces. In general, sawmill residue weighs about one-half the weight of the saw log prior to processing.

5) **Agricultural residues:** Materials that are typically byproducts of annually harvested crops such as husks and shells, and trimmings from orchards and vineyards.

Table 3 shows the quantities of woody biomass in Northern California counties, taken from a biomass availability study completed in 2010 (Williams, 2010). The paper breaks out these numbers into categories listed above. Such products are available in potentially economically viable quantities in Sonoma, Mendocino, and Humboldt counties.

TABLE 3. AVAILABLE BIOMASS SUPPLY, IN BONE DRY TONS, FROM THE NORTH COAST COUNTIES OF CALIFORNIA.

County	Forest Thinning	Forest Slash	Shrub	Mill Residue	Ag Waste (non-forest)	Total
Humboldt	1,347,700	871,100	10,800	583,300		2,812,800
Mendocino	1,393,700	797,200	59,000	515,700		2,765,700
Siskiyou	631,100	786,200	89,000	781,700		2,288,000
Trinity	559,600	670,100	19,100	586,700		1,835,500
Sonoma	359,700	199,700	24,800	100,000		684,200
Del Norte	138,700	207,700	7,500	170,100		524,000
Modoc	95,300	155,900	123,800	120,600		495,600

The data set above was produced by the California Biomass Collaborative in order for the California Energy Commission to determine the potential amounts of renewable biomass energy sources. This is meant to be updated by research awarded in 2017. The forest biomass pool, as seen in Table 3, was calculated by the California Department of Forestry and Fire Protection. While these data sets document a broad view of "available" biomass feedstock, there are a number of filters that should be engaged in interpreting the data including physical access, appropriate extraction levels and intensity of removal, costs, and others that should be identified by local communities. These qualifications will reduce the overall totals listed above and reinforce the need for location-by-location scale and site-specific assessment needed.

Purely based on this information, the annual supply of biomass for the region equates to 2,337 MWs of operating capacity, assuming a 90% capacity factor. Given today's energy pricing that translates to annual revenues of $ 1.84 billion. There is certainly a significant level of local economic potential available from biomass energy that is also environmentally sustainable. One of our key recommendations is for interested parties to allocate additional resources to confirm those thresholds, and overlay analysis of spatial feedstock availability with transmission and distribution constraints.

That analysis should also include the potential energy generation, by county, by megawatt, based on sustainable feedstock supply available within a given area. A full analysis of these factors would provide local, state and federal governments, and potential private sector partners, with some of the information needed to leverage adequate financing for the needed facilities and infrastructure needed. We hope that the document that we are presenting here could assist in strategies to fund and complete this much needed analysis.

Characterization of County-level Biomass Resources

Humboldt and Mendocino counties have the highest amounts of forest biomass. This is due mainly to the forest types and management practices. Both counties lay in the heart of the redwood belt, which is among the fastest-growing forests in the world. The majority of the land ownership in both of these counties rests with by private companies, such as Green Diamond Resources, Mendocino Redwood Company, Humboldt Redwood Company, and Sierra Pacific Industries. A handful of mills operate in the area and some sell their mill residues to biomass energy facilities in the area. Public lands are found in these counties, but do not comprise much of the acreage. Forest management on public lands differs from private lands due to varying public interests. Most public lands in these counties, such as the Redwood National Park, the Six Rivers National Forest, the Mendocino National Forest, Humboldt Redwood State Parks, and the BLM Headwaters Reserve manage for resource conservation purposes, rather than for timber management. Limited agricultural residues are available from viticulture, dairies and niche food crop production.

Siskiyou and Trinity counties also have high amounts of woody biomass available. However, in these counties the forest ecology differs due to various geological and climatic characteristics. East of the redwood belt are mixed conifer forests at mid- and higher-level elevations that are dominated by Douglas fir, ponderosa pine, true firs, and cedar. The Klamath Mountain bioregion dominates much of these counties, where very large wilderness areas exist. The Trinity Alps is the largest wilderness in California. It encompasses portions of the Shasta-Trinity, Six Rivers, and Klamath National Forests. Other wilderness areas in these counties include the Marble Mountains, the Russian, and the Siskiyou wildernesses. Forest management activities are very limited in wilderness areas, and no commercial timber harvesting is allowed. However, timber harvesting does occur on public and private lands in these counties. In central and eastern Siskiyou County there is considerable timber harvesting from both public and private lands. This is mainly due to the gentle topography and lack of timber harvesting constraints such as watercourses, steep terrain, lack of accessibility and endangered species listing of salmon.

The coastal regions of Sonoma County lie in the dwindling southern reaches of the redwood belt, which has very high timber productivity. However, most of the private lands in this region are smaller in ownership size and are managed for purposes other than timber harvesting. The Russian River valley dominates a large part of Sonoma County where vineyards are prevalent. Trimmings from vineyards can potentially be a significant source of biomass for Sonoma County. East of the valley, the topography changes into rolling hills that are covered with mainly Douglas-fir and ponderosa pine. Much of the harvesting that occurs in Sonoma County is from fuels reduction treatments, lot clearing for development, and from small timber harvests on private lands.

Del Norte County lies in the northern most portion of the redwood belt. Growth productivity is extremely high, but most of the lands in the county are public lands used for preservation or recreation purposes. The Redwood National Park extends into old growth stands in Del Norte County where the forest ecosystem is protected from any harvest. East of the redwood belt is the Smith River National Recreation Area, which encompasses most of the remainder of the county. The forest types in the Smith River area consist mainly of Douglas-fir, ponderosa pine,

fir, and mixed hardwoods such as tanoak, madrone, and oak. Most of the biomass available from Del Norte County comes from forest management activities such as fuels reduction treatments and hazard tree removals.

Modoc County offers a unique opportunity to utilize a significant amount of biomass. The Modoc Plateau historically consisted of sage grouse habitat, with a landscape dominated by sage and grass, and few scattered conifers. However, past fire suppression activities and historical overgrazing has resulted in a massive encroachment of western juniper into the sage lands. The Modoc National Forest and BLM Alturas Field Office completed a Programmatic Environmental Impact Review to remove over 400,000 acres of juniper to restore the sage grouse habitat. Further, there is nearly 1 million acres of private land on the Modoc where juniper is found. Private landowners mainly consist of ranchers who support the removal of encroaching juniper. Most of Modoc County lies in the sage grouse habitat, while the eastern portions rise to the Warner Mountains. These mountains consist of mixed conifer forests that are dominated by ponderosa pine, fir, and cedar. Most of the Warner Mountains are within the boundaries of the Modoc National Forest and the BLM Alturas Field Office, so timber management is limited, but some biomass supply is available from dry mixed conifer and pine management. Most recently, managers worked with a biomass plant in Big Valley (Shasta County) to make supply available from mixed conifer and juniper thinnings from the southwestern portion of the county. However, that plant, known as Big Valley Power, is currently mothballed and for sale.

Securing Feedstock Supply

Procurement of affordable and consistent biomass feedstocks is often the most challenging aspect of both securing initial capital financing for biomass project development and for economically operating biomass-to-energy facilities over time.

Challenges are numerous and even the most savvy current operations are working "on the margin" when it comes to securing affordable feedstock supply, as one of our interview subjects succinctly described. Our forest health partners indicate that this is not because material does not need to be removed, but that funds for removing the material do not exist. Another obvious challenge is obtaining feedstock supply from public lands, where a sustainable supply for a small-scale operation certainly exists but funds to do the work must be provided by taxpayers and allocated by Congress. Both the U.S. Department of Agriculture via the U.S. Forest Service and the U.S. Department of Interior, to a lesser extent, via the U.S. Bureau of Land Management, have the potential to create opportunities to assist in feedstock supply.

In particular, use of 10-year Stewardship Contracts on US Forest Service lands would allow community-scale facilities to obtain the long term contract needed to obtain capital cost financing and then incentivize further restoration work on those lands. Such contracts have been use in Washington and Oregon, but not yet in California. Support from the Region 5 office will be required before such contracts can move forward.

In looking at future facility siting, an analysis of the historic ability of any local agency office to interact and reach productive supply solutions with all local stakeholders and businesses is essential to success. Procuring consistent supply from private sources is often seen as simpler and less risky, but many private sources, such as industrial timberland owners, are averse to entering into long-term contracts, which are generally a requisite for securing financing.

EXISTING BIOMASS ENERGY FACILITIES IN THE REGION

Four facilities exist within the North Coast Region, with the majority of these being located in Humboldt County. In the past 2 years, two of them have stopped operations and a third is operating at partial capacity. These plants compete with natural gas power plants for pricing structure, and were not able to gain contracts for power production at rates high enough to cover operational costs.

TABLE 4. BIOMASS FACILITIES IN NORTH COAST REGION, VARIOUS SOURCES

	Fairhaven	Scotia	Blue Lake	Weed
County	Humboldt	Humboldt	Humboldt	Siskiyou
Plant Type	Biomass to Energy	Combined Heat and Power	Biomass to Energy	Combined Heat and Power
Nameplate Capacity (Mw)	19 Mw	34 Mw	14 Mw	12 MW
Operational Mw	18 Mw	28 Mw	12.5 Mw	?
Main Power Customer	PG&E	Mill and town of Scotia	San Diego Gas & Electric	Proposed PPA is cancelled and/ or in dispute
Owner	DG Fairhaven Power	Greenleaf Power, LLC	Blue Lake Power, LLC	Roseburg Forest Products
Address	97 Bay Street Samoa, CA 95564	Sacramento, CA	200 Taylor Way Blue Lake, CA	Weed, CA
Phone	(707) 445-5434	**(916)-259-0930**		(530) 938-2721
Fax	(707) 445-2551			
Contact	Bob Marino, General Manager	**Rob Crummet, Fuel Buyer**	Glenn Zane	Arne Hultgren, Manager

	Fairhaven	Scotia	Blue Lake	Weed
Feedstock Source	The plant uses over 250,000 tons of various forms of wood waste from local sawmills annually.	The plant uses mill residuals and other available biomass to provide heat and power to the Town of Scotia and the adjacent saw mill.	This plant uses mill residuals and non-merchantable hardwoods and other waste from timber stand improvement and other timber operations	Veneer plant. Waste material from plant and additional feedstock The plant is an expansion of current cogeneration capacity at the Weed facility

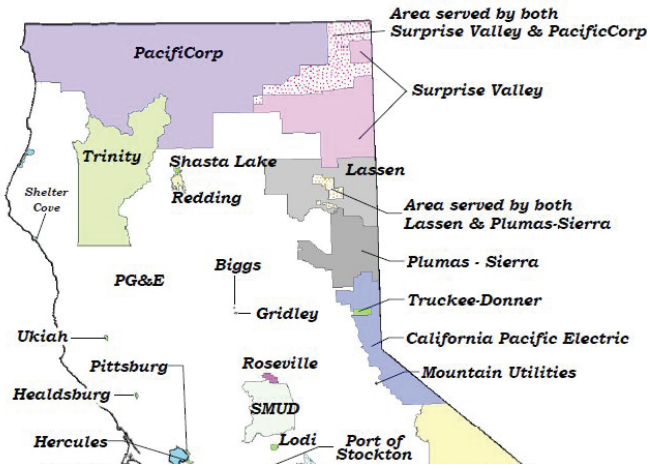
RELEVANT INSTITUTIONS, LAW AND POLICY

The creation, marketing, sales, and distribution of electric power within California, especially in regards to renewable energy, are complex endeavors that involve numerous regulatory agencies, distribution and transmission facilities, and potential utility customers.

Without delving too far into the specifics of any given potential project, we have outlined some of the basic pieces of the puzzle below as an outline of possible influences that any one of these organizations could have on a biomass energy project in the North Coast Region.

Energy Producers, Customers, and Infrastructure

The region currently presents a wide mix of energy producers, customers and infrastructure.



MAP 2. UTILITY SERVICE AREAS WITHIN NORTH COAST REGION

Power generators in the region represent a range of sizes, including very small, personal generation in the form of solar panels or micro hydro-electric systems, mid-size, hydro facilities that are designated renewable under the California RPS, and large "utility scale" facilities of 10MW or more, including biomass, natural gas, geothermal and large hydro electric facilities, some of which are part of the Central Valley Project.

Ownership of facilities is also diverse with local resident ownership of small hydro-electric projects selling into the grid, and significant private, county, state and federally owned biomass, natural gas and hydro-electric projects. Organized utilities present in the region include a mix of Investor Owned Utilities (IOUs), Publicly Owned Utilities (POUs), and CCAs. Infrastructure is similarly made up of various regulatory levels, ownership and transmission systems.

UTILITIES OPERATING WITHIN THE NORTH COAST REGION

It should be understood that many, but not all, electric power utilities play multiple roles within their jurisdictions including: power generation (producer), power purchasing (customer of other generators), power delivery (transmission and distribution) and general power utility (power sales and delivery to end of line customer). These roles vary from utility to utility and being aware of the options available within any given jurisdiction is crucial to understanding the constraints or opportunities with biomass energy generation within any given territory. The role of electric utilities both at the statewide

and local levels has changed dramatically in recent years.

California's utility players and their respective roles are quickly evolving from the traditionally investor owned utilities (IOUs) to publicly owned utilities (POUs) to a number of other consortiums of power purchasing, wielding and marketing entities. A full description of these entities is listed in an addendum to this document.

Traditionally power producers, a biomass to energy facility for example, would be working directly with a single utility that would purchase, transmit and deliver the power produced, all combined into a single agreement. With today's dynamic organizational and pricing environments and the given sphere of influence of any given utility there may be a number of entities involved the production, transmission and delivery of any given power resource. Analysis of the unique conditions surrounding any proposed project is crucial to understanding the options available and the costs incumbent on the sales and delivery of power.

The operational relationship between these entities, their end user power customers and their power providers also becomes more and more dynamic as the regulatory and legal options expand. With additional organizational options for ratepayers, those empowering power source purchasing decisions, we

predict that the markets and relationships will continue to adapt to an increasingly diverse set of conditions.

STATE AND FEDERAL AGENCIES AND REGULATORY ENVIRONMENT

A number of regulatory agencies affect biomass-to-energy projects. As noted previously in this document, not all of these agencies will be involved in any given biomass energy project. However, they all have a potential influence over any proposed strategy for the North Coast Region and should be acknowledged in that capacity. See the attached Agency and Regulatory Addendum for specific listings of each entity. Below is a "thumbnail sketch" of how these agencies could interact with a biomass energy project. Interactions may be required for construction and operation or only during one of those phases of development.

FACILITY OPERATIONS / AIR QUALITY / ENVIRONMENTAL PROTECTION

Air, water, and general environmental quality issues are also of paramount concern both for health and safety and for public perception. Engagement with the California Air Resources Board through the local Air Quality Management District as early as possible is a key to establishing clear communication of expected goals and outcomes as any project moves forward. Cal EPA is the other significant agency within this sector and should be consulted directly in the same fashion as with the Air District.

Energy Generation / Transmission

Agencies involved in this part of permitting and operation depending on the type, size and location of the facility. Becoming familiar with the electrical system operator for a given area, which also may be your local utility service, and their available networks is a good first step for any project manager. Interconnection work will require following Electric Generation Rule 21, governed by the California Public Utilities Commission, or Wholesale Distribution Open Access Tariff, governed by the Federal Energy Regulatory Commission.

Urban / rural connections through energy sales are becoming more commonplace with urban utilities financing and purchasing power from rural providers and projects. Information on urban centered utilities is available from the California Energy Commission (CEC).

The Federal Energy Regulatory Commission (FERC) and the U.S. Department of Energy (U.S. DOE), along with the CEC and the California Independent System Operator, have all been involved in establishing California's Renewable Energy Transmission Initiative 2.0, Western Renewable Energy Zones, and potential upgrades to the California-Oregon intertie.

The CEC also established California Renewable Energy Zones, described in more below, and participated in the Western Renewable Energy Zone (WREZ) development. Actively educating the CEC board and staff regarding levels of interest and region potential, and insuring a seat at the table when financing of additional transmission infrastructure is discussed are all important activities. Distributing draft plans and submitting comments on those plans with a regional voice is also an important part of shaping future investment. Currently, Modoc County and a small corner of Siskiyou County are the only areas in Northern California identified as hubs on the Phase I WREZ maps.

Pricing and Market Regulation

The CEC, California Public Utilities Commission (CPUC), the DOE and the Federal Energy Regulatory Commission (FERC), Cal Fire, and Cal EPA, as well as the California state legislature, all have a certain level of influence over market regulation and pricing that are important for local policy makers to become familiar with. Opportunities for the North Coast as a region to influence the viability of biomass energy and other renewable energy production will pivot on relationships with these agencies in these sectors.

The legislature and CPUC have the highest potential, among those listed, to have a direct effect on the price paid and incentives for biomass energy projects. With a strategic approach and ongoing communication, North Coast local decision makers could take advantage of opportunities and changing conditions in this sector.

Current and Ongoing Infrastructure and Market Activities

Renewable Energy Transmission Initiative 2.0 (RETI 2.0) — http://www.energy.ca.gov/reti/index.html

The Renewable Energy Transmission Initiative (RETI) was a statewide initiative that has identified the transmission projects needed to accommodate California's renewable energy goals, support future energy policy, and facilitate transmission corridor designation and transmission and generation siting and permitting. RETI 2.0 continues this work with renewable energy goals at 50% rather than 30%.

This work identified competitive renewable energy zones in California and possibly also in neighboring states that could provide significant electricity to California consumers by the year 2020. RETI also identified those zones that can be developed in the most cost effective and environmentally benign manner and prepared

detailed transmission plans for those zones identified for development. The North Coast region was not identified as a competitive region, although there is some question as to whether there was adequate involvement by North Coast jurisdictions in the RETI process.

The identified zones are the California Renewable Energy Zones (CREZ) and are also part of the Western Renewable Energy Zone (WREZ) strategy.

FINANCE AND CAPITALIZATION STRATEGIES FOR THE NORTH COAST

Scale-appropriate biomass utilization can be a significant factor in the North Coast Region to leverage renewable energy production potential into a long-term community asset. Rural community development has been elusive, as northern California has been transformed by national and global economic conditions, increasingly complex land management policies at the state and federal level in addition to lagging or non-existent investment in maintaining human capital, infrastructure and technological assets. Although environmental restoration activities have had some limited positive impact, they have not been an economic replacement for the investments of the former timber production economic engine. This formerly strong industry has been reduced through a number of factors including numerous policy decisions and regulatory costs shifts affecting both public and private lands, consolidation of industry participants and facilities, numerous policy decisions and regulatory costs shifts affecting both public and private lands, and an increasingly unstable national and global marketplace.

Agriculture has faced similar constraints and, where climate allows, has attempted to adapt through crop diversity and market diversification. Traditional approaches to rural development have long depended upon changing crops to meet new market opportunities and adding value-added processing to raw materials. Renewable energy strategies, including biomass utilization, can be shaped to intentionally provide community wealth if counties, municipalities, and local citizens can provide capital for and obtain equity positions in production facilities. Communities can also capture benefit through legally binding Community Benefit Agreements negotiated with developers during the permitting process.

Scale and Sector Diversity

Value-added opportunities that exist in the world of biomass utilization offer great diversity in business costs and therefore financing pathways. They range from fairly low capital investments like fire wood, landscaping/erosion control mulches, and compost, to mid-capital investments like biochar, post and poles, and densified wood products, to high capital/high volume uses like electricity and biofuels. Although promising technologies in biomass conversion to biofuels are in development, it is crucial to match the scale of technology to a number of factors including the capital formation capacity of the local area, the sustainability of the volume of biomass feedstock available over time, the operational capacity of the local community and the overall acceptance and support within the community for any particular operation or method.

Any strategy in the North Coast Region should encourage a broad diversity of biomass uses at multiple scales to create a more resilient economic system.

Overall Financing Options

Beyond unique community designed organizations, like Community Development Finance Institutions, listed below, mid capital and high capital projects usually require both traditional debt and equity financing and require experienced development partners.

Equity investment is the highest risk and raises up-front investment necessary to prove project feasibility and attract developers, lenders and other investors. Payback on this investment is uncertain since so little in known about project specifics. Equity investors usually require higher rates of return as compensation for their increased risk. Tax incentives and grants, along with other mechanisms, are often used to increase the reward for equity investors.

Several state and federal grant programs and some private philanthropic grant programs can supply initial equity investment or non-investment cost payment for feasibility studies and business planning, even initial engineering and design.

Debt investors are usually used in the construction and operational phase of the project. Debt is usually secured through "limited recourse financing" also referred to as "project financing". That means that payment of the debt is backed only by the project assets and the revenues the project is able to generate. This can be more expensive financing, with a market rate interest being common.

Governmental loan guarantees can help attract lenders by acting as another form of equity and increasing the confidence in payback. These can be found through a number of agencies, depending

on the nature and timing of the project, and can significantly reduce associated interest rates

Locally Designed Financial Institutions

Local capital can come in the form of both equity participation and traditional debt financing. Private investors, governmental investors, financial institutions, and utility partners are all potential sources of capital.

Community Development Financial Institutions

One possible source of local capital is the *community development financial institution,* or CDFI. These mission-driven financial institutions exist to provide financial services to low-wealth communities underserved by traditional funding institutions.

They are supported, in part, by the U.S. Treasury Department's CDFI Fund, which since its creation in 1994 has awarded more than $1.1 billion to CDFIs, and has issued more than $26 billion in *New Markets Tax Credits*. These tax credits — given for community-based projects — enable investors in these projects to supplement traditional financial returns with substantial savings on income taxes. Through the combined impact of a variety of tools, investors can do good for the community as they do well for their investing portfolios.

Eight CDFIs are located in the NCIRWMP region:

- The Del Norte EDC — Crescent City
- The Yurok Alliance for Northern California — Crescent City
- The Community Credit Union of Southern Humboldt — Garberville
- Karuk Community Loan Fund, Inc — Happy Camp
- Hoopa Development Fund — Hoopa
- Enterprise Funding Corporation — Redlands
- Mendo Lake Credit Union— Ukiah
- Arcata Economic Development Corporation-Arcata

Shorebank Enterprises of Portland, Oregon is a CDFI New Market Tax Credit broker operating in the NCIRWMP region.

Direct Public Offering

Direct Public Offering allows accredited and non-accredited investors to invest in projects of their choosing. It is often used to allow people to invest in local projects that mirror their values. DPOs became legal in California in 2013.

Community Choice Aggregation Entities

The Community Choice Aggregation (CCA) Act allows local entities to purchase renewable power directly from the generation facility on behalf of retail customers. Utilities are required to provide transmission and distributions of that power.

Stacking Capital

Stacking capital means using equity, grants, loans, and other funding mechanisms to finance a biomass project. It allows developers to create attractive projects that fit the needs of most financers. For example, a county might put up initial equity money for project development, a government grant might provide funds for feasibility studies and financing planning, a government loan guarantee might provide part of the construction funds, and equity participation from an end-user or utility might provide the final injection for the project construction and operations.

Counties and communities may need to provide some degree of initial investment in project development in order to attract all the necessary partners and capital. That initial package must cover the following six components:

- *Technology* — The technology to be used to convert the biomass to electricity must be proven and capable of generating reliable estimates of efficiency. Investors and lenders will want a process guaranty from the technology provider to provide assurance that the technology will perform as expected.
- *Feedstock* — Feedstock used to fuel the facility must be reliable. If possible, it is best to be able to utilize different types of feedstock to protect against fluctuations in feedstock production, and it is mandatory to have contracts for the supply of that material. Feedstock contracts should also limit price fluctuation. The feedstock should be located within a reasonable distance to keep transportation costs to a minimum.
- *Output* — The project must have customers that will purchase the power. If connecting to the electricity grid, transmission access must be secured and available from the project site.
- *Project Site* — The site for the project must be secured and have access to necessary utilities and transportation. Permits must also be attainable without too much time or expense. Proximity to feedstock suppliers and interconnection is important because they can have a large impact on the costs of construction

and operations. Local support or opposition to the project should also be considered.

- *Economic Viability* — The costs to construct and operate the project must be less than the income the project will receive from selling its power and co-products. Financial modeling should be completed and tested to determine the parameters for construction and operation costs that provide for profitability. Typically, investors and lenders want financial models to show that, without ongoing or future tax or government incentives, the project will be profitable.
- *Project Agreements* — Bringing a biomass project on line requires multiple parties with matched expectations working together at all stages of the project. These relationships are memorialized in appropriate agreements that set forth the duties and obligations of the parties. The project agreements also directly impact the creditworthiness of the project because investors and lenders look to these agreements to determine the viability of the project.

Potential key financial partners include a diverse group of entities including members of the electrical utility industry. Public Utility Districts, Rural Electric Cooperatives, CCAs, and Investor Owned Utilities have access to capital sources for both equity and debt financing.

SYNTHESIS AND CONCLUSION

SPECIFIC REGIONAL CHALLENGES AND STRATEGIES

A number of common challenges for the region and for local efforts are outlined in this section. We propose potential strategies for each challenge, recognizing that many challenges are exceedingly complex and many are interrelated, and thus strategies must be similarly integrated and sophisticated.

Challenge 1. Energy development is complex, competitive and requires organization.

Affecting policy, developing transmission and distribution upgrades, gaining grid access, and funding for investments in R&D, demonstration and project development for commercial technologies require resources above-and-beyond the capacity of many North Coast counties and businesses.

Although there are a small number of people and groups such as Humboldt and Sonoma Counties that have a more robust knowledge of grid connections and capacity, energy policy, and project development there is still a capacity gap regionally for renewable biomass energy development.

Additionally, there is a challenge with inadequate transmission and distribution infrastructure to potential sites that could be located in an appropriate "field to facility" sphere of influence. A recent study of renewable energy production potential in 20 Northern California counties *(Center for Economic Development 2009)* also identified this factor in the following manner "A lack of adequate transmission capacity will make it difficult to achieve the full resource potential for a number of resources located in remote areas."

Strategy 1. Counties and partners of the North Coast Region should pool their energy through the NCIRWMP or other regional coordination processes to develop shared strategies to affect policy, transmission and distribution development, grid access, and funding for investments in R&D, demonstration and project development for commercial technologies going forward.

Other areas of the state have participated in regional processes through the California Energy Commission's Renewable Energy Transmission Initiative in association with their participating as a California Renewable Energy Zone (CREZ) and through the Sierra Nevada Conservancy. Working to include the North Coast in other processes at the state level, or, at the very least, working towards a similar designation should be a high priority. Organizing and engaging with US Forest Service Region 5, Cal Fire, California Public Utilities Commission, Governor's Office of Business, and other state agency offices as a group with a recognizable name and able comment on statewide plans is an essential first step.

Challenge 2. Limited capacity for engagement in energy development that would yield high benefits for local communities

Local Knowledge Gaps — Although in any particular county/community there is a fairly healthy knowledge of current activity, the North Coast region has only recently achieved more region-wide awareness of local activity. Our interviews revealed lower overall awareness of the energy markets functionality, processes, limitations and regulatory environment than for other regional issues such as water quality and land management issues. The level of knowledge also varies greatly person by person with wide sector-by-sector variance (power, natural resource policy, costs, processes, political environment).

State and Federal Knowledge Gaps — Overall when speaking to state and federal agency contacts and researching their web based resources, we found that there was fairly significant knowledge in some key agencies such as at the CEC, CPUC, DOE, and FERC about regional issues such as feedstock availability and distributed generation goals, but less so with other agencies such as Cal Fire and the Governor's Office. Conversely, in our interview process, there was an overall expression of uncertainty about organizational capacity with regards to education, technical knowledge, market sophistication. One interview subject expressed their surprise that "there were people up there supporting renewable energy" and another expressed that when people from the region come to Sacramento to advocate for an issue they "leave us with a less than favorable impression" about their ability to follow through with a process "without blowing the whole thing to smithereens politically and operationally".

The limited contact we had with Washington, D.C. interview subjects reflected the standard "inside the beltway" knowledge level with an explanation of where the region was taking more time than discussing the issue itself. The North Coast Region should consider all of these conditions as an opportunity. There is room for improvement and market opportunities will likely see parallel improvements with a change in strategy to address these gaps.

Strategy 2. Increase local and regional energy knowledge and capacity for engagement

Organize community groups and aggregate regional knowledge. Develop and distribute educational materials, access technical assistance, prepare information for local decision makers, county staff, and partners to increase their familiarity with state energy policy, the logistics and economics of biomass energy development, transmission / distribution and interconnection processes, and the ecological and social dimensions of biomass energy. Begin community conversations about the forest health restoration values and the place of biomass energy and utilization in restoring and maintaining healthy ecosystems.

These materials, tools, trainings, and potential related site visits and presentations, should educate and engage regional decision makers, staff and the general public regarding not only potential biomass to energy projects but also the overall renewable energy landscape for their individual jurisdictions and the region as a whole, and serve as an impetus for discussion and organizing.

Challenge 3. Financing biomass energy projects while ensuring equitable benefits for counties-of-origin.

While rural counties across the North Coast region contain significant volumes of potentially available biomass feedstock, local counties, communities and businesses rarely have the financial resources to actively participate in financing energy projects that ensure equitable financial returns to those counties and communities where the biomass feedstock is derived. The export of natural resources-derived revenues with limited financial returns, evidenced through the industrial timber model, provides little direct and long-term benefits beyond labor and associated income tax revenues. Exporting all of the revenues from counties-of-origin represents both an undesirable and inequitable model of renewable biomass energy development.

Strategy 3. Engage urban and suburban power customers

For small communities and rural counties to leverage their limited financial resources to become true equity partners in renewable energy projects drawing from biomass resources originating within their jurisdictional borders, new and unique partnerships will be needed.

Many of the rural North Coast Counties and have some liquid assets, and most all have the ability to issue bonds and borrow money at low interest rates. Rural public utilities also may have cash-on-hand that could be invested. Unlike IOU's, most private companies, external POUs and local institutions, either through statute or mission, reinvest revenues in communities-of-origin. Investing as minority equity partners with end-of-line customers may represent a real opportunity for equitable renewable energy development. While such arrangements are outside of the norm and complicate project financing, they also share risk and benefits among the counties-of-origin, and those that will benefit most from the renewable energy both as a mandatory part of their portfolio under AB 32, and as a long-term revenue stream. Joint Power Authorities between urban and rural partners or CCAs, might provide the legal structure to achieve such projects. Community entities are likely to be able to combine access to public funds, New Market Tax Credits, and Direct Public Offering to raise funds in amounts previously inaccessible.

This strategy will require developing working relationships with end-of-line power customers such as IOUs and POUs representing urban customers. Clearly defined and widely supported regional organizing and leadership will be crucial to the success of this strategy. Convening interested urban utilities, rural county leaders, and rural public utilities might serve as a useful first

step in exploring opportunities and challenges associated with this model. An initial step might include forming a North Coast regional ESCO project and to help drive the investigation and forge the necessary partnerships.

Challenge 4. Demonstration and technology commercialization of "scale-appropriate" emerging technologies

Many current biomass industry experts and others who have studied the issues state that a 15–25 MW facility is the minimum capacity required for a stand-alone biomass energy operation to pencil out without contracts that monetize co-benefits. With the addition of the BioMAT program, 1–3 MW now promise profitability, but only while the program is active.

Projects appropriately scaled to economically available and socially acceptable biomass feedstock supplies would in many instances have to be considerably smaller (1–10MW) than is currently feasible given commercially available conversion technologies. While feedstock costs and energy pricing are major factors, this lack of commercially available small-scale conversion technologies represent a major impediment to progress. While there is a long-standing argument that such plants would not achieve the necessary economies of scale and would have exorbitant operating costs, the availability of lower capital-cost technologies could help to overcome these challenges.

Creating incentives that could facilitate the deployment of smaller, localized, facilities while also creating greater opportunities for appropriately scaled facilities to be co-located at existing operating sawmills in the region will be critical. Working with regulators (EPA, CARB, regional AQMDs et al) will be a crucial part of this process.

Strategy 4. Leverage available funding to develop demonstration projects and technology commercialization of "scale-appropriate" emerging technologies

State and federal assistance programs such as the US Forest Service Wood Innovations grant program, California Energy Commission EPIC grant program, USDA Rural Energy for America Program grant and loan guarantees, New Market Tax Credits, Direct Public Offerings, and potentially Cal Fire Greenhouse Gas Reduction funds are applicable and useful for supporting project construction and commercialization of appropriately scaled conversion technologies and projects but have been awarded in limited amounts across our region. In the immediate future, developing projects that qualify for the BioMAT program and therefore have a stable market is likely to result in more projects than those that would not. NCIRWMP may serve as a key entity for organizing and shared strategy development on this front.

Challenge 5. Securing socially and ecologically appropriate biomass supply

Securing adequate biomass feedstock for financing and to profitably operate a biomass energy plant ensures an ongoing challenge for biomass power plants not co-located with a wood product facility. While this is theoretically easier when dealing with private feedstock sources such as industrial timberland owners and/or sawmills, it is still extremely difficult and risky to lock in long-term contracts in the range of 10–20 years, which is the desired duration for attracting financing at reasonable interest rates.

Federal lands represent a large portion of the land base and potential feedstock source in many of the North Coast counties. 10-year stewardship contracts would likely provide the necessary contractual assurances necessary to finance new projects not associated with existing sawmills within the North Coast region, but can take 3–5 years to complete.

Strategy 5. Work on project development through partnerships and collaboration

Regardless of land ownership and feedstock sources, collaboration and partnerships will be necessary to put together secure biomass supply contracts and permits with the level of assurance necessary to attract private or public financing. In the private sector, existing mills and industrial landowners can explore opportunities for partnership. Given that energy production is not the core business of such companies, private sector partnership and financing assistance may well be required to direct their feedstocks towards publicly beneficial biomass energy projects.

Challenge 6. Grid interconnection estimates make up 20–40% of total project cost

For the handful of new community-scale biomass power plants that are being considered in the North Coast region, interconnection cost estimates are prohibitively high. Cost estimates are provided by the grid operator, and actual costs are restricted by the CPUC to be no more or less than 25% of the estimate. Small projects are often distributed, and substations in rural areas are often old. When a new generation project comes online near an old substation, the project bears the cost of necessary upgrades over $300,000. Working with other distributed generation technologies to promote "rate-basing" the total cost of upgrades and finding other

ways to spread the cost across all beneficiaries will reduce the cost of that barrier to project development.

Strategy 6. Strategically target new facility locations and work with partners to strategically avoid overpaying for grid upgrades

Co-locating facilities with existing load and targeting sites near substations with the potential to provide benefits after upgrading beyond capacity to handle additional generation will allow projects to avoid escalating interconnection costs.

Biomass power plants support forest restoration work through direct consumption of forest thinning and waste material, but also as waste disposal facilities for wood product manufacturing businesses such as mills and post and pole plants. Planning systems that consume both types of material lowers the overall cost of fuel and stabilizes material flow through the seasons. Supporting appropriate wood products manufacturing also increases the amount of restoration material that can be consumed, expanding the effect of such systems on the landscape.

Challenge 7. Advocate for biomass energy pricing equity

Discussion of pricing for renewable energy, while key to overall success, is simply the last set of numbers in the long formula that constitutes feasibility. The necessity to increase the value of the resulting energy is affected when the other costs in the formula — engineering, plant cost, cost of money, emissions controls, permitting, operation and maintenance, feedstock costs, transportation and transmission costs are optimally adjusted. Any regional strategy, reflecting both common and very site-specific strategies, needs to examine all of the numbers in the formula.

Still, pricing for biomass energy sized larger than 3 MW, even when listed as renewable under the California's Renewable Portfolio Standard is still currently based upon price of natural gas which is extraordinarily low this decade. Pricing for wind and solar power, and 1–3 MW biomass power, has additional pricing incentives/requirements driving up the cost.

One adjustment that could be made would be to differentiate between solar and wind and larger scale biomass is valuing baseload power generation. Wind and solar plants generate power intermittently and are generally accredited with only 30% availability during peak usage time, whereas biomass is accredited with 100% (i.e. base load power).

Strategy 7. Advocate for fair-accounting energy pricing and co-benefit monetization that acknowledges the many ancillary benefits of biomass energy.

Joining with geothermal and other renewable baseload entities to advocate for fair-accounting energy pricing will strengthen future markets for biomass power. Also following price movement within the BioMAT program and pushing for continued support through the Electric Program Investment Charge will inform future biomass energy opportunities. Pilot and demonstration projects, supported by the Public Utilities Commission, may serve as a first step for more systemic policy direction.

MOVING TOWARDS A UNIFYING REGIONAL STRATEGY

In light of the future energy demands of urban and suburban California and the increased targets for renewable energy under California's Renewable Portfolio Standard, there appears to be a unique opportunity for the development of urban / rural partnerships when it comes to the matter of renewable energy production, transmission and end use customers and organizations.

Leveraging Mutually Beneficial Goals

California imports more electricity from other states than any other state with a large part of that coming from resource driven production in Oregon and Washington (U.S. EIA, 2011). The majority of California's power usage is in urban areas, however use per capita in rural areas can run higher due to both a lack of economies of scale and less investment in energy conservation strategies.

Many urban and suburban areas are emphasizing renewable energy as a priority, in some cases setting their sights on targets above the Renewable Portfolio Standard, and paying a premium to insure its delivery. In our interviews with both urban and rural leaders we found a unique point of synergy in that rural areas are motivated to pursue renewable energy production and have the resources available to produce if the proper investment was made.

Upgrading to Energy 2.0 for California's North Coast

As discussed at the beginning of this document, the rural counties of the North Coast of California are diverse in their mix of resources, topography and utility service providers. However, there are a number of common challenges including rural geography, resource dependent economies, high poverty, low education levels, aging populations, poor access to markets and historically low levels of investment in technology and human

capital. These challenges can forge a unified mission for the development of renewable energy production and utilization within which biomass energy can play a role.

In order to take the next steps in this endeavor we have listed a few key recommendations to get the region moving in that direction.

1. Build Regional Energy IQ

Knowledge is power and in this case the power is defined in terms of both regional strength and energy production and delivery. A significant effort should be made in increasing the Energy IQ for the region. Starting with local elected leaders and staff, wide distribution of how energy markets work, the status of the local and regional infrastructure and the resources available to local governments and private enterprise are all key points to be included in increasing the regional Energy IQ.

2. Enhance Networks, Outreach, and Advocacy

As previously discussed there is a unique convergence happening with the recent analysis of renewable energy resources on the North Coast, the emergence of unique energy governance structures in urban areas and the recent increase in the RPS standard. Rural supply, meet your new best friend, urban demand. At times, these two factions have been at odds on a range of issues but the coalescing on the renewable energy issue demands that this relationship be healed, nurtured and expanded on to the economic benefit of both regions.

3. Organize Regionally

Individually the rural counties of the North Coast hold little sway in Sacramento and Wall Street, especially in the current dynamic economic environment. Examples of regional organizing from the North Coast Region are few but those examples demonstrate success when they are implemented. NCIRWMP is one of those entities, as is Redwood Coast Connect that was initiated by Redwood Coast Rural Action (RCRA) to initiate the implementation of high-speed Internet infrastructure within the region. Organizing regionally around Energy 2.0 for the North Coast is crucial to insure that both the economic and ecologic benefits are maximized for the people and landscapes of the region.

4. Enhance Networks, Outreach, and Advocacy

As previously discussed there is a unique convergence happening with the recent analysis of renewable energy resources on the North Coast, the emergence of unique energy governance structures in urban areas and the recent increase in the RPS standard. Rural supply, meet your new best friend, urban demand. At times, these two factions have been at odds on a range of issues but the coalescing on the renewable energy issue demands that this relationship be healed, nurtured and expanded on to the economic benefit of both regions.

5. Leverage An Existing Entity To Drive The Process

The North Coast counties will benefit to the extent that they are represented at the table and to the extent that they able to apply technical, social and political expertise to their participation. The rural counties and urban centers alike stand to benefit from the potential of speaking with a single regional voice.

There is little need to remake the wheel to get these efforts underway since a number of regional organizations exist, including NCIRWMP, that include representation from elected members in each county. In our review of the current political environment, state agency assistance available and future market demands, it would not take a great effort to build this process into an existing regional organization's portfolio of services offered to their county government members.

The collaborative structure of NCIRWMP and its ability to bring together the collective energies and intent of the 7 North Coast counties offers a significant opportunity for the member counties in their exploration of renewable energy and sustainable development opportunities.

CONCLUSION

We are at a unique point in time, considering the rapidly changing energy environment in California and the combination of urban demand and potential rural supply.

This is more than putting solar panels in a desert or windmills on a hill. Energy 2.0 for the North Coast could be a method to integrate the renewable energy and environmental values of the state with long-term local economic sustainability, self-worth and success. The region comprising the IRWMP can be a key player in assisting the State of California's to meet its renewable energy goals but not without adequate financial and organizational support. We would encourage local, state and federal representatives to assist in lending adequate support in pursuit of these objectives.

With a well thought out strategy that engages, supports, and reinforces local elected leadership, the North Coast's energy resource counties could represent an un-stoppable force that delivers unmatched environmental and socio-economic benefits. Now is the time to act.

ACKNOWLEDGEMENTS

The Watershed Research and Training Center would like to acknowledge that this document was a combined effort with many uncompensated hours of work from a variety of knowledgeable contributors. These range from college professors to agency technical staff to local elected officials. We are grateful for their generous assistance and investment of time.

Special thanks also go to Ryan Coltrin of the Watershed Research and Training Center for his invaluable contributions to this document.

We would also like to acknowledge that any lack of clarity, or mistakes, within this document are those of the authors and not of our volunteer contributors or review team.

We appreciate all of the support from California's North Coast Region and hope that this document can assist in moving the region towards new energy, economic and ecologic health.

We are grateful for the opportunity to make this contribution.

— The Watershed Research and Training Center
Hayfork, CA

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AGENCY AND REGULATORY ADDENDUM

FEDERAL

Federal Energy Regulatory Commission (FERC) — http://www.ferc.gov/

From their website: "The Federal Energy Regulatory Commission, or FERC, is an independent agency that regulates the interstate transmission of natural gas, oil, and electricity. FERC also regulates natural gas and hydropower projects. Mission: Reliable, Efficient and Sustainable Energy for Customers. Assist consumers in obtaining reliable, efficient and sustainable energy services at a reasonable cost through appropriate regulatory and market means."

FERC potential influence on biomass to energy strategy: FERC's role would be limited but may have an effect on transmission projects that have interstate ramifications. Examples would include California's Renewable Energy Transmission Initiative, Western Renewable Energy Zones and potentially upgrades to the California-Oregon intertie. General monitoring of FERC's involvement and advocacy opportunities in these projects would be a part of any long term strategy.

U.S. Department of Energy (DOE) — http://www.energy.gov/

From their website: "The Department of Energy's overarching mission is to advance the national, economic, and energy security of the United States; to promote scientific and technological innovation in support of that mission; and to ensure the environmental cleanup of the national nuclear weapons complex."

DOE Potential influence on biomass to energy strategy: DOE could be an advocate in both pilot program funding and technology research funding. Although it appears that no current funding specific to wood based bio energy this would be something to focus on in any federal advocacy. There may also be an options with DOE (similar to the RUS/FFB option mentioned below) to work with DO Treasury as a financier with DOE acting as a loan guarantor.

U.S. Department of Agriculture (USDA) — Although the USDA will have an obvious influence, through the U.S. Forest Service, on feedstock levels for biomass energy on the North Coast, for the sake of this document we are going to limit their influences to funding and potential pilot programs and policy issues.

USDA — http://www.usda.gov ***Rural and Community Development*** — http://tinyurl.com/4krke96

USDA potential influence on biomass to energy strategy: USDA proper, in addition to its Rural and

Community Development branch, has a number of grant and loan guarantee programs for both feasibility and facility construction. Additionally, the Rural Utility Service, http://www.rurdev.usda.gov/Utilities_LP.html, has some potential larger financing options available in conjunction with the Federal Finance Bank (FFB) where FFB would be the financing entity and RUS would act as the loan guarantor. Loans have the potential to be made at the current Treasury rate.

US Forest Service — http://www.fs.fed.us/

USFS potential influence on biomass to energy strategy: As identified earlier in this document, the USFS has a significant impact on the feedstock opportunities related to biomass energy projects and should be encouraged to participate and support regional collaboration and stewardship contracting agreements to insure both forest and ecosystem health while insuring adequate and sustainable feedstock supplies. There are (number) national forests within the North Coast Region. Working towards unified regional engagement with these national forest contacts should be a part of any regional strategy.

U.S. Environmental Protection Agency (U.S. EPA) — http://www.epa.gov/aboutepa/whatwedo.html

From their website: The mission of EPA is to protect human health and the environment. EPA's purpose is to ensure that: all Americans are protected from significant risks to human health and the environment where they live, learn and work; National efforts to reduce environmental risk are based on the best available scientific information; federal laws protecting human health and the environment are enforced fairly and effectively; environmental protection is an integral consideration in U.S. policies concerning natural resources, human health, economic growth, energy, transportation, agriculture, industry, and international trade, and these factors are similarly considered in establishing environmental policy; all parts of society — communities, individuals, businesses, and state, local and tribal governments — have access to accurate information sufficient to effectively participate in managing human health and environmental risks; environmental protection contributes to making our communities and ecosystems diverse, sustainable and economically productive; and the United States plays a leadership role in working with other nations to protect the global environment.

U.S. EPA potential influence on biomass to energy strategy: The most significant and timely impact that the U.S. EPA can have on biomass energy is in their rulemaking in regards to emissions. On February 21, 2011, EPA established Clean Air Act emissions standards for large and small boilers and incinerators that burn solid waste and sewage sludge. These standards cover more than 200,000 boilers and incinerators that emit harmful air pollution, including mercury, cadmium, and particle pollution. If these revised standards hold as written the effects on smaller scale biomass to energy facilities will be minimal.

Complete documentation: http://www.epa.gov/airquality/combustion/actions.html#feb11

STATE OF CALIFORNIA

California Energy Commission (CEC) — http://www.energy.ca.gov/commission/index.html

The California Energy Commission is the state's primary energy policy and planning agency. The CEC has a produced a number of biomass energy and feedstock inventory studies which are cited in this document.

CEC potential influence on biomass to energy strategy: The influence that the CEC can have on biomass to energy projects is wide and deep including the public goods charge and renewable energy transmission initiative to name a few.

Public Utilities Commission (PUC) — http://www.cpuc.ca.gov/PUC/

From their website; "The CPUC regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies. The CPUC serves the public interest by protecting consumers and ensuring the provision of safe, reliable utility service and infrastructure at reasonable rates, with a commitment to environmental enhancement and a healthy California economy. We regulate utility services, stimulate innovation, and promote competitive markets, where possible."

CPUC Potential influence on biomass to energy strategy: Feed in tariff, mandatory improvements of transmission capacity

California Air Resources Board (CARB) — http://www.arb.ca.gov/homepage.htm

From their website: "California's Legislature established the Air Resources Board (ARB) in 1967 to: Attain and maintain healthy air quality, Conduct research into the causes of and solutions to air pollution and systematically attack the serious problems caused by motor vehicles, which are a major cause of air pollution in the State. Since its formation (see a history of ARB), the ARB has worked with the public, the business sector, and local governments to protect the public's health, the economy and the state's ecological resources through the most cost-effective reduction of air pollution."

CARB potential influence on biomass to energy strategy: Most of the impacts of CARB on biomass to energy projects take effect through the local Air Quality Management Districts listed below.

These would include enforcement of existing emissions thresholds and negotiation and analysis of net carbon life cycle emissions.

Regional Air Quality Management Districts (AQMDs) — http://www.arb.ca.gov/capcoa/roster.htm
There are four AQMD's that regulate the region. They are as follows:
North Coast — http://www.ncuaqmd.org/
Northern Sonoma — http://www.arb.ca.gov/capcoa/roster.htm#NORTHERN1
Mendocino — http://www.co.mendocino.ca.us/aqmd/index.htm
Modoc — http://www.arb.ca.gov/capcoa/roster.htm#MODOC
Siskiyou — http://www.co.mendocino.ca.us/aqmd/index.htm
AQMDs' potential influence on biomass to energy strategy: Potential emissions from biomass to energy facilities are analyzed by these regional AQMDs. With any potential biomass to energy project that has the possibility of emissions the AQMD with jurisdiction should be consulted from pre-feasibility all the way through the environmental assessment to, potentially, project completion.

ELECTRIC UTILITIES AND RELATED ORGANIZATIONS ADDENDUM

Investor Owned Utilities (IOUs)

California has a handful of investor owned utilities and, when their customer bases are combined, they serve the vast majority of California's power customers.

There are two IOUs operating within the region:

Pacific Gas & Electric (PG&E) — http://www.pge.com/

Pacific Gas and Electric Company, incorporated in California in 1905, is one of the largest combination natural gas and electric utilities in the United States. PG&E serves customers in four of the seven counties in the region: Humboldt, Mendocino, Sonoma and Trinity

Pacificorp (also known as Pacific Power) — http://www.pacificpower.net

Formed in 1910, PP&L started from several small electric companies and served 7,000 customers in Astoria and Pendleton in Oregon, and Yakima and Walla Walla in Washington. Pacific Power serves customers in three of the seven counties in the region: Del Norte, Modoc and Siskiyou.

Coops

The typical co-op, or "mutual association" as they were sometimes referred to, usually consisted of a small group of neighbors, maybe three or four adjoining farms, or a dozen or so inhabitants of a rural community. Together they dug the holes, set the poles and strung the wires by hand, connecting their homemade electrical systems to a small generator, usually diesel-fired, which would be adequate to power a couple lights for each house and barn, plus a few small motors or other minimal use appliances when the plant was fired up. There is only one electric co-op within the North Coast Region.

SVE (Surprise Valley Electric Corporation) — http://www.surprisevalleyelectric.org/

Founded in 1936 as part of the wave of the Rural Electrification Act, SVEC has continued to grow throughout the rural areas and communities of northern California, southern Oregon and northwest Nevada. In 2009 SVEC served 6175 meters and 2219 miles of line. SVEC historically has purchased a large percentage of its power from the Bonneville Power Administration (BPA) because its service area is located within the Bonneville service boundary. Surprise Valley is the only California co-op that can purchase wholesale electricity from that federal power agency. SVEC serves customers in just one of the counties in the region: Modoc

Publicly Owned Utilities (POUs)

These are publicly owned entities that, by and large, operated through a special district governance model or operate as a subset of an incorporated city. With governing boards chosen by the electorate (or at least reporting to a similar board) these entities operate in accordance with California's public meeting laws and work for the public good within their designated spheres of influence.

There are four POUs operating within the region: Trinity Public Utilities District (TPUD) — no website available

Established in the early 1980's the TPUD began with a small service encompassing only the county seat of Weaverville and has made a slow determined expansion to its current service area of almost ¾ of the county. The TPUD is a special district and has an elected board of directors that is independent of any other municipal organization. Although the TPUD has the authority to operate in the entire county, the geographic area south of the Highway 3 / 36 junction and the area west of the Cedar

Flat Bridge on Highway 299 are both still served by PG&E. TPUD's source of electric generation is the turbines associated with Trinity Dam as part of the Central Valley Project. TPUD has an allocation of 25 megawatts out of the 140 megawatts generated from this project and is does not have the authority to sell or utilize this allocation outside of the boundaries of the county. Currently TPUD only utilizes approximately 5 megawatts of this allocation. The TPUD is located within Trinity County.

Shelter Cove Resort Improvement District — http://www.sheltercove-ca.gov/

This is a special-purpose district established in 1965 and was formed for the purpose of installing and maintaining facilities that provide electric, water and sewer services for the Shelter Cove Sea Park Subdivision. The District also manages the greenbelt areas within the development, the day use airport and the Shelter Cove Volunteer Fire Department. Shelter Cove is located in Humboldt County.

City of Ukiah — http://www.cityofukiah.com/pageserver/?page=utilities_main

Ukiah Public Utilities is Mendocino County's only customer-owned utility. Your utility supplies electricity, water and wastewater treatment to Ukiah's 15,000 plus residents and businesses. Ukiah Public Utilities is governed by the City Council. The City Council is responsible for determining policy for the utilities. The Director of Ukiah Public Utilities is responsible for all utility operations and reports to the City Manager. Ukiah is located in Mendocino County.

City of Healdsburg — http://www.ci.healdsburg.ca.us/index.aspx?page=62

With 11 employees in the electric department, the City-owned utility provides electric service to 5,579 meters. The electric utility is responsible for power procurement for the City, compliance with various state and federal regulatory requirements, and providing conservation and renewable energy programs for its customers. It includes overseeing the City's share of the Northern California Power Agency's (NCPA) generation projects, the Federal Western Central Valley Project allocation through the Western Area Power Administration, as well as the City's share of the California/Oregon transmission project and various long and short-term power contracts both for existing future power needs. The department is also responsible for the operation and maintenance associated with the reliable distribution of electricity to residential and commercial customers through the City's interconnection with PG&E's 60 thousand volt transmission line at Healdsburg's Badger Electric Substation. Healdsburg is located in Sonoma County.

Non-traditional Utility / Producers / Purchasers

A new model that may be on the rise is a traditionally non-electric oriented utility that enters into power production for its own bottom line to produce its own power. The most visible example of this is the region is the Sonoma County Water Agency.

Sonoma County Water Agency — http://www.scwa.ca.gov/energy-sustainability-projects/

With a number of water treatment facilities that have traditionally run on either purchased power or natural gas fired systems, in recent years the agency has issued bonds and employed other financial tools to make investments to reduce their long term baseline costs (and carbon footprint) by producing their own renewable energy. Sonoma County Water Agency is governed by the members Sonoma County Board of Supervisors, acting as agency board of directors.

Siskiyou County Power Authority — http://www.co.siskiyou.ca.us/GS/spa.aspx

In 1983, Siskiyou County and the Siskiyou County Flood Control and Water Conservation District entered into a joint powers agreement pursuant to Government Code 6502. The agreement created a public entity known as the Siskiyou Power Authority, and entity separate and distinct from its member entities. Its purpose is to operate and maintain power facilities at the Box Canyon Dam for the purpose of generating and selling 10 Mw of hydro-electric power. The members of the Siskiyou County Board of Supervisors act as the directors of both the Flood Control and Water Conservation District and the Siskiyou Power Authority.

Power and Water Resources Pooling Authority (PWRPA) — http://www.pwrpa.org

The Power and Water Resources Pooling Authority (PWRPA) is a Joint Powers Authority comprised of 9 Irrigation Districts that organized in 2004 under California State law to collectively manage individual power assets and loads. The Authority serves 15 water purveyors and spans a significant portion of the Sacramento-San Joaquin Valleys and coastal counties of California. The Authority's power load ranges from 20 to 120 MW from Winter to Summer consuming 290 to 520 GWH of energy annually to convey, treat, and recycle water for their growers and consumers. The Participants individual loads range from 2 to 35 MW.

Although principally formed to coordinate power supplies, these districts and agencies recognize the interchangeability of water management and

power requirements; accordingly, as the name reflects, the participants envision alternative water-management options and potential exchanges as a potentially significant role for the Authority. Sonoma County Water Agency, Westlands Water District and Santa Clara Valley Water District are just a few of the participating members in PWRPA.

Aggregate Power Purchasers

In response to the historic wide range of small power producers that are connected to the grid and the significant amount of small to medium utilities that are purchasing power from multiple sources, aggregate power authorities have taken more and more of a role in coordinating multiple sales and purchases of power for public entities. The Northern California Power Authority (NCPA) is the entity operating within the region.

Northern California Power Authority (NCPA) — http://www.ncpa.com/

NCPA is a not-for-profit joint powers agency that represents and provides support for 17 member communities and districts in Northern and Central California. NCPA was founded in 1968 as a forum through which community-owned utilities could prevent costly market abuses. NCPA owns and operate several power plants that together comprise a 95% emission-free generation portfolio. NCPA's members collectively reflect a 50% carbon-free resource portfolio.

Transmission and System Operators

Historically much of California's power was produced, transmitted and sold by one entity, Pacific Gas & Electric. As the market started to be populated with Public Utilities (POUs) and other Investor Owned Utilities (IOUs) additional pressure was put on the electric grid in terms of power going in, power going out and how to supply peak demand. Although controversial at the time (and still questioned by some in the industry) the solution that was implemented for much of California's electric grid was to insert a regulatory agency into the scheduling and transmission operation.

California Independent System Operator (CAISO) — http://www.caiso.com/

In our seven county area the main system operator is the California Independent System Operator (CAISO). CAISO manages the scheduling of power on the lines formerly managed by PG&E. An Independent System Operator (ISO) is an organization formed at the direction or recommendation of the Federal Energy Regulatory Commission (FERC). In the areas where an ISO is established, it coordinates, controls and monitors the operation of the electrical power system, usually within a single state, but sometimes encompassing multiple states.

Western Area Power Administration (WAPA) — http://www.wapa.gov/

WAPA has separately regulated, and somewhat parallel, network of transmission lines. WAPA markets and delivers reliable, cost-based hydroelectric power and related services within a 15-state region of the central and western U.S. They are one of four power-marketing administrations within the U.S. Department of Energy whose role is to market and transmit electricity from multi-use water projects. For example, WAPA enters the North Coast region in Trinity County due to the power plants at Trinity Dam that are managed by the Bureau of Reclamation and in Sonoma County, where the City of Healdsburg is also connected to the Western part of the Central Valley Project. The Trinity Public Utilities District (TPUD) recently completed a direct-tie to the WAPA system, allowing the TPUD to receive and deliver power to the larger grid without having to transmit power over the CAISO system, depending on the final customer's location and connections.

Transmission Agency of Northern California (TANC) — http://www.tanc.us/index.html

In a similar and somewhat complimentary role to NCPA, the Transmission Agency of Northern California (TANC) assists its publicly-owned Member utilities in providing cost-effective energy supplies to their customers, through long-term ownership or contracts for service over high-voltage transmission lines within California and the western United States.

RESOURCES

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