

Chapter 3.4

Emerging Markets for Forest and Rangeland Products and Services



Assessments should identify forest landscape areas where there is a real, near term potential to access and supply traditional, non-timber, and/or emerging markets such as those for biomass or ecosystem services. These might be areas where necessary infrastructure currently exists, is planned or developing, where group certification of landowners has created market supply aggregation potential, or where retention and management of forest cover presents a money saving alternative to an engineered fix – such as a water filtration facility. Strengthening and developing new market opportunities for forest products and benefits provide incentives for forest stewardship and conservation (excerpted from the U.S. Forest Service State and Private Forestry Farm Bill Requirement and Redesign Strategies).

KEY FINDINGS

Emerging markets for renewable energy, ecosystem services and niche products are impacting how forest and rangelands are managed. Developing appropriate policies requires a better understanding of the benefits and environmental impacts of these emerging markets and how society values the various market and non-market products and services provided by forests and rangelands.

Renewable Energy Overview

- In the Mojave and Colorado Desert bioregions the number and size of proposed solar and wind power generation sites has engendered controversy over potential impacts to wildlife habitat. The science-driven Desert Renewable Energy Conservation Plan is intended to become the state road map for renewable energy project development that will advance state and federal conservation goals while

facilitating the timely permitting of renewable energy projects in these desert regions.

Biomass Energy – Current Status and Trends

- Biomass energy from forestlands provides about one percent of California's electricity, while having the potential to provide nearly eight times this amount. Biomass also has unutilized potential for heating homes, businesses and schools and for conversion to liquid transportation fuels (as conversion technology evolves).
- Capturing energy from biomass that would otherwise decay, be disposed of by pile and burn or potentially consumed by wildfire, provides numerous economic and environmental benefits, which are not captured as an actual economic return for operators of facilities that utilize woody biomass material. Case studies confirm that fuels treatment activities involving biomass removal can mitigate wildfire behavior (Cone Fire, 2002).
- The various benefits and environmental impacts of forest biomass removal are complex and further research is required to guide appropriate policies and practices. Questions of long-term biomass supply (especially from public lands), as well as possible ecological and other impacts of biomass removal on forest sustainability, are key issues in California.
- The future of the biomass energy industry in California, at least as it relates to the forestry sector, is uncertain. California had 49 operating biomass plants in the mid-1990s; today there are 33.
- The California Energy Commission, working through the Bioenergy Interagency Working Group, has produced a comprehensive strategy for sustainable development of biomass in the state. The first Bioenergy Action Plan was released in 2006, and the goal is to adopt an updated plan by the end of 2010.

Biomass Energy – Ecosystem Health Analysis

Benefits of making six idle and six proposed biomass facilities operational are derived in terms of treating priority landscapes for ecosystem health from the wildfire and forest pests analyses articulated in previous chapters.

- Currently, 22 percent of high priority landscapes are within 25 miles of an operational biomass facility. Adding 12 facilities would increase this number to 39 percent, and would primarily benefit the Klamath/North Coast, Modoc and Sierra bioregions.
- Even with the additional facilities, 61 percent of high priority landscapes are farther than 25 miles from a facility. Since 57 percent of the high priority landscapes are on U.S. Forest Service lands, coordination across agency boundaries will be critical.

Biomass Energy – Community Safety Analysis

Building upon the wildfire and forest pests community safety analyses presented in previous chapters, this analysis determines the benefits of making six idle and six proposed biomass facilities operational in terms of treating priority communities.

- Currently, only 14 of the 66 priority communities are within 25 miles of an operational biomass facility. Adding the new facilities would reach eleven additional priority communities. Of the remaining 41 priority communities, 31 are in the South Coast bioregion.

- Developing a biomass industry in the South Coast bioregion that addresses the significant wildfire and forest pest threats will be challenging. In the bioregion, there are large acreages in shrub species that are difficult to recover and utilize as biomass, and much of the forestland is in public ownership.

Carbon

- Carbon sequestration is an ecosystem service for which markets are emerging; as part of these markets, the value of the service is quantified, prices determined and dollars generated for carbon credits.
- Markets are emerging for both voluntary exchange between parties (voluntary markets) and in response to the need to reduce carbon impacts as part of regulatory requirements (compliance markets).
- Demand for forest and range-related carbon is projected to be very significant in such markets and other venues.
- Carbon credit supply is constrained by economics, risk and other factors. It is estimated that one to two million metric tons a year will be available to the compliance market from California forests, which is only 10–25 percent of demand.
- Protocols already have been developed for forest and range-related carbon. The development of additional project type protocols for forests and rangelands could promote activities with ecological and economic co-benefits and increase the supply of carbon credits.
- California has large acreages of forest stands that with additional investment, could provide larger, future benefits in terms of forest products, jobs and carbon storage and sequestration. Opportunities also exist on rangeland, but the markets and necessary technologies to capture carbon are not sufficiently developed to quantify these opportunities.

Niche Markets

- There is potential for niche markets to stimulate rural economies through certified products, micro-bio-mass or landowner collaboratives to produce and market timber using small scale or portable milling technologies.

Ecosystem Services

- In many cases, market mechanisms for exchange of values from ecosystem services in California are still limited. Despite this, substantial investments have been made in the state that support ecosystem services. Typically, these investments involve protecting areas that provide unique or high levels of desired services, or restoring areas impacted by past events.
- These investments come through a variety of programs, agencies and stakeholders. Involvement of landowners and the development of partnerships and cooperation have been key factors. To a large degree, the underlying funding comes from public sources, such as ballot initiatives or agency budgets. Augmenting this with emerging market-based solutions could enhance the ability to sustain these important services into the future.

RENEWABLE ENERGY OVERVIEW

Current Status and Trends

Through legislation and executive orders, California has focused on increasing use and development of renewable energy. For example, one of the goals of the Renewables Portfolio Standard (RPS) (SB 107, 2006 and SB 1078, 2002) is to help reduce greenhouse gas (GHG) emissions. Another example is AB 32 which, in large part, is devoted to GHG reduction.

Related executive orders include:

- Executive Order S-06-06 (2006): established a biomass target of 20 percent within the established RPS goals for 2010 and 2020.
- Executive Order S-14-08 (2008): established accelerated RPS targets (33 percent by 2020) as recommended in the Energy Action Plan II. The order also called for the formation of the Renewable Energy Action Team, comprised of the California Energy Commission (CEC), Department of Fish and Game, U.S. Bureau of Land Management and U.S. Fish and Wildlife Service. Through the team, the Energy Commission and the Department of Fish and Game are to prepare a plan for renewable development in sensitive desert habitat.
- Executive Order S-21-09 (2009): directs the Air Resources Board (ARB) to work with the California Public Utilities Commission, the California Independent System Operator, and the Energy Commission to adopt regulations increasing California's RPS to 33 percent by 2020. The ARB must adopt these regulations by July 31, 2010.

The Air Resources Board's Scoping Plan points to achieving the RPS and 33 percent renewable as a key strategy for reducing greenhouse gases. The California Public Utilities Commission, California Energy Commission and Governor Schwarzenegger have sanctioned the Energy Action Plan, requiring that renewable energy sources increase to 33 percent of the state supply by 2020.

As of 2007, California was deriving 11.9 percent of its electricity from renewable energy sources (geothermal, biomass, small hydro, wind and solar) (CEC, 2007). Figure 3.4.1 shows that in 2007, 2.1 percent of the state's energy sources for electricity were derived from biomass, or 18 percent of the total renewable resources. Not all of this can be attributed to forests and rangelands, as biomass energy sources include urban and agricultural waste along with forest biomass.

Potential for Meeting the Renewables Portfolio Standard

Table 3.4.1 shows current and potential future renewable energy infrastructure by bioregion, derived from various sources. The Mojave bioregion has the most existing, and by far the most potential, solar and wind sites. Current sites occupy about 50,000 acres; if potential projects were actually implemented this could grow to well over a million acres, with 1,155 miles of new or updated transmission lines. The Colorado Desert and Modoc bioregions are also candidates for extensive development of renewable energy infrastructure.

Applications for Renewable Energy Projects

As of December 2009, there were 57 U.S. Bureau of Land Management (BLM) applications for solar projects in the California desert district and 93 applications for wind projects in California, many in the desert (BLM, 2010). Two of the more active areas for applications are shown in Figure 3.4.2. A significant portion of public lands are prohibited from renewable energy development due to environmental concerns (ecological reserves, wildlife refuges,

national parks, wilderness and roadless areas, etc). Nonetheless, over 1.45 million acres of public lands in California are under consideration for alternative energy production (California Desert Council (CADC), 2009). Renewable energy development raises a new set of concerns, particularly related to impacts on wildlife habitat, and this creates controversy (CADC, 2009; LA Times, 1/23/09). The science-driven Desert Renewable Energy Conservation

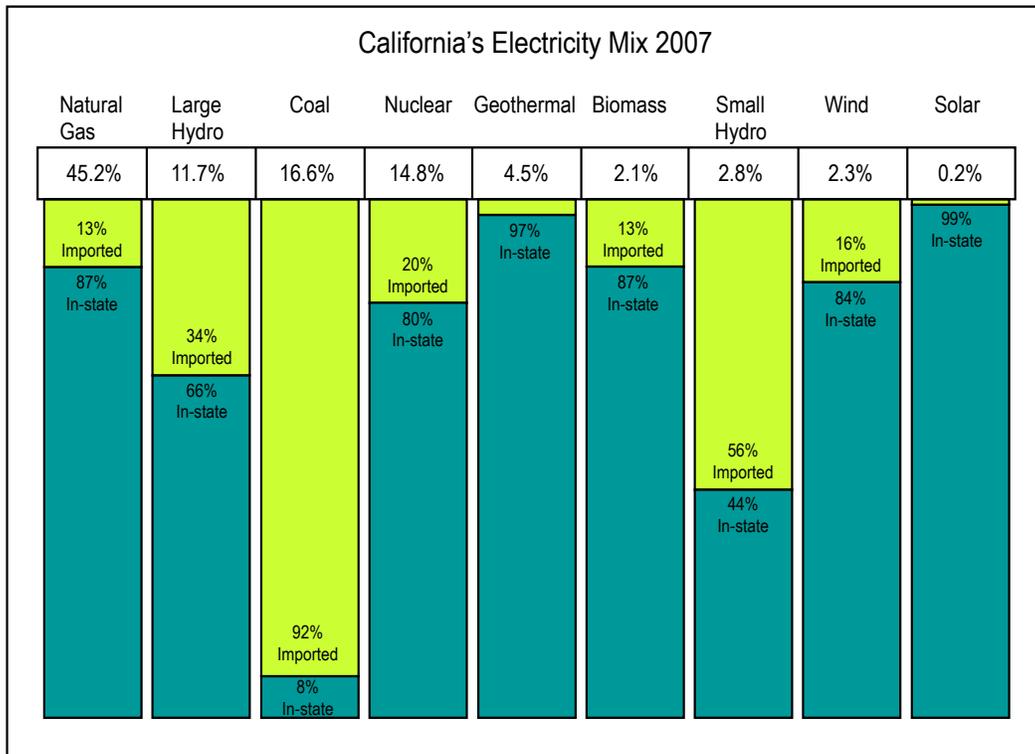


Figure 3.4.1. California energy sources for electricity, 2007. Source: California Energy Commission, Gross System Power Report, 2007

Plan is intended to become the state road map for renewable energy project development that will advance state and federal conservation goals while facilitating the timely permitting of renewable energy projects in these desert regions (Integrated Energy Policy Report, 2009).

While BLM has been the primary agency affected by emerging renewable energy markets in the state, the U.S. Forest Service has conducted a suitability study that identifies numerous areas within national forests in California that are potentially suitable for wind, solar or geothermal energy development (Karsteadt et al., 2005).

Revenue from Lease of Public Lands

Lease of public lands for renewable energy development provides a potential revenue source. For example, a recent competitive auction of lease parcels for geothermal energy resources on federal lands in California, Nevada and Utah generated \$9,098,304 in revenue for 255,347 acres, an average of about

\$35 an acre (BLM, 2009). The California portion amounted to 11,392 acres for \$131,126, about \$12 an acre. Revenue is shared by the state (50 percent), county (25 percent), and BLM (25 percent).

Impact on Rural Economies

Developing renewable energy sources has the potential to create jobs for initial construction of infrastructure and for ongoing maintenance. Job creation for different types of renewable energy development is provided in Table 3.4.2.

Wind Energy

Wind power plants generate mechanical energy, which is converted to electrical energy. Ninety-five percent of California’s wind generating capacity is located in three areas: Altamont Pass (Alameda County), Tehachapi (Kern County) and San Geronio (Riverside County) (CEC, 2009). The cost of wind power generation has decreased by nearly four-fold since 1980, primarily due to improved technology (American Wind Energy Association, 2009), and

Table 3.4.1. Current and potential future¹ renewable energy infrastructure by bioregion

Bioregion	Wind				Solar				Geo-thermal	Biomass ²		Transmission Lines
	Existing		Potential		Existing		Potential		Existing Sites	Existing Sites	Potential Sites ³	Potential New or Updated Miles
	Sites	Acres	Sites	Acres	Sites	Acres	Sites	Acres				
Bay/Delta	9	28,090										297
Central Coast	1	9,544	2	20,787			10	12,774				58
Colorado Desert	1	5,420	37	109,125	4	11,127	42	222,224	5	2		758
Klamath/North Coast			4	12,006						2	5	36
Modoc	1	8,761	54	307,521			2	723	1	5	2	96
Mojave	9	42,918	112	666,822	5	6,260	132	457,180	1			1,155
Sacramento Valley										5		303
San Joaquin Valley			1	38	1	1,277	15	19,809		5		601
Sierra	4	22,630	9	53,666			7	8,953		3	5	200
South Coast	2	4,053	13	27,787								809

¹ Potential future sites includes those from the Renewable Energy Transmission Initiative (RETI), plus current applications on BLM lands.

² Current and potential biomass facilities are based on data assembled from various sources by FRAP, and only includes facilities with the potential to reduce wildfire or forest pest threats on forests and rangelands.

³ Includes six proposed facilities, five that are currently idle, and one operational facility in Carson City, Nevada that under current conditions gets minimal material from California.

Data Sources: RETI, California Energy Commission (2009); Biomass Facilities, FRAP (2010), Renewable Energy Applications, BLM (2009)

Table 3.4.2. Average employment for different energy technologies normalized to the amount of energy produced (or saved in the case of energy efficiency)

Technology	Total Job-Years per GWh
Biomass	0.22
Geothermal	0.25
Solar Photovoltaic	0.91
Solar Thermal	0.27
Wind	0.17
Carbon Capture and Storage	0.18
Nuclear	0.15
Coal	0.11
Natural Gas	0.11
Energy Efficiency	0.38

Data Source: Kammen and Engel, 2009

wind is becoming more competitive with energy sources such as coal and nuclear.

However, wind power requires large tracts of land, impacts visual quality, creates noise, typically operates at only 25 to 40 percent of capacity, and facility construction and maintenance can have extensive

environmental impacts through vegetation clearing and soil disruption. There are significant concerns related to bird and bat mortality due to collisions with turbines and wires. A five year research effort at the Altamont Pass Wind Resource Area found that 1,766 to 4,721 birds are killed annually, including 40 different species, 881 to 1,300 of which are raptors (Smallwood et al., 2004). Newer, larger turbines installed in groups seem to cause fewer bird fatalities per megawatt (MW) than the smaller, older, lattice-style turbines (National Academy of Sciences, 2007; Smallwood et al., 2004).

The California Energy Commission and California Department of Fish and Game have developed guidelines for reducing impacts to birds and bats from wind energy. These include methods to assess bird and bat activity at proposed wind energy sites, design pre-permitting and operations monitoring plans, and develop impact avoidance, minimization and mitigation measures. The U.S. Fish and Wildlife Service

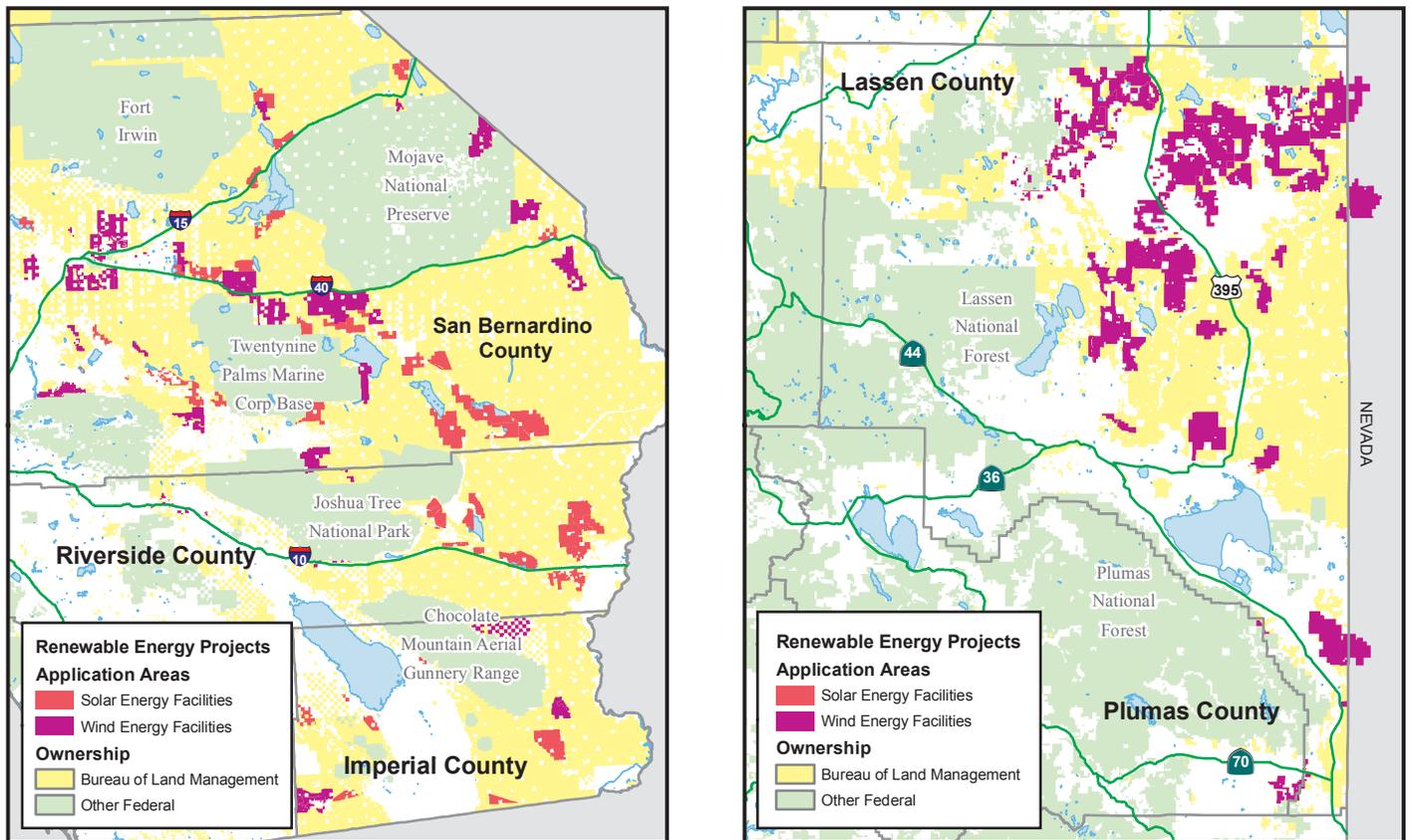


Figure 3.4.2.

Application areas for wind and solar energy development on BLM lands, for two of the more active regions of the state.

Data Sources: Renewable Energy Project Applications in California, BLM, (2008); California Protected Areas Database (CPAD), GreenInfo Network (2009)

also has released voluntary guidelines (National Academy of Sciences, 2007).

Solar Energy

Solar energy converts solar radiation to electricity. There are basically two types of systems that use solar to generate energy. Solar photovoltaic generates electricity directly from sunlight, while concentrated solar thermal panels use light to create heat and steam to drive turbines. A cursory review of BLM applications indicated a fairly equal mix of the two technologies.

Although California has an abundance of solar technical potential, in 2007 only 0.2 percent of total electricity generation was derived from solar, much less than other commercially available technologies such as wind, geothermal or biomass (CEC, 2007).

Some challenges for solar energy development are that the technology can be costly to install, is more appropriate for sunny locations, and its energy production varies seasonally and can drastically fluctuate within minutes due to cloud cover. Also, remote solar energy infrastructure development can require new transmission lines and may cover a large area (see photo on following page) which necessitates extensive permitting processes.

Geothermal Energy

Geothermal power requires thermal aquifers, primarily available where hot magma finds its way close to the surface and heats ground water to usable temperatures above 212°F. California contains the largest amount of geothermal generating capacity in the United States (CEC, 2009), because two tectonic plates meet under its surface, creating a large amount thermal activity.

The majority of California's geothermal plants have been operating since the 1960s in Napa and Sonoma Counties. In addition to operating virtually emission-free, geothermal plants have the smallest land requirements of any major power generation technology. However, suitable sites for geothermal are limited and expensive to establish.

Small Hydroelectric

Small hydroelectric supplied 2.8 percent of California's electricity in 2007, or about 24 percent of the state's electricity from renewable energy sources (CEC, 2007), and the majority of these plants are located in forests and rangelands (Figure 3.4.3).

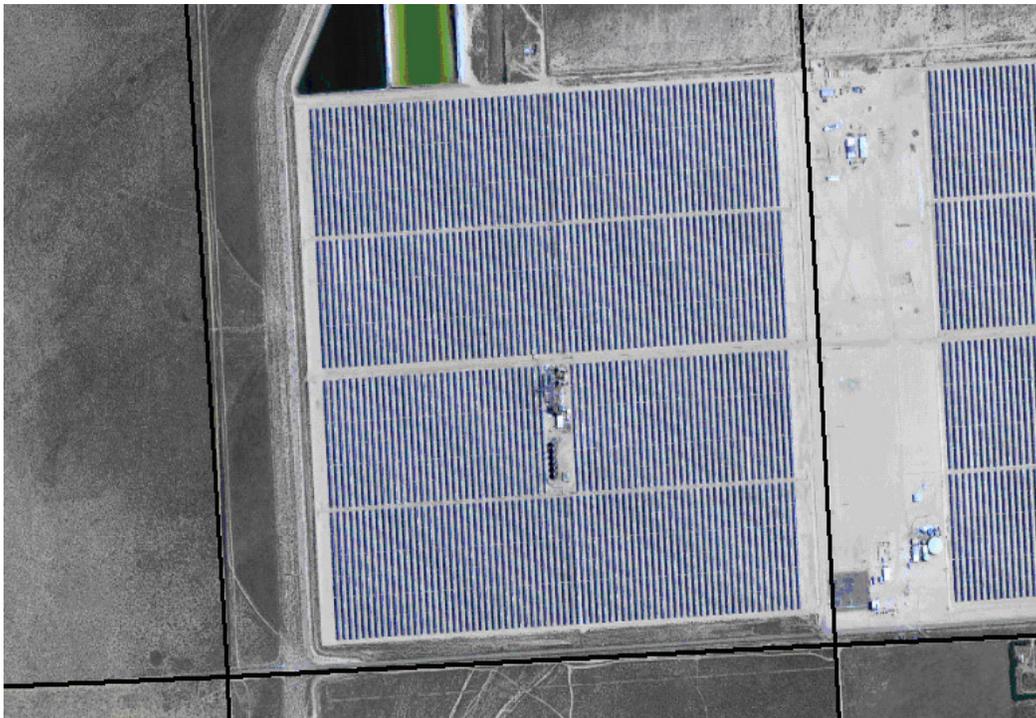
Small hydroelectric (under 30 megawatts) has limited potential for additional facilities, in part due to environmental concerns (Wall Street Journal, 2009). Regulations related to minimum water flows are likely to reduce production from some existing facilities, such that even maintaining current output levels is uncertain (Clay Brandow, personal communication). It is certain that some hydroelectric dams will be removed; for example, recent agreements were signed

that will result in removal of four hydroelectric dams to restore flows in the Klamath River.

Tools

State Assembly Bill 1890 (Brulte, Chapter 854, Statutes of 1996) and Senate Bill 90 (Sher, Chapter 905, Statutes of 1997) created the Energy Commission's Renewable Energy Program. Under this legislation, portions of funds collected from customers through investor-owned utilities can be used as incentives for renewable energy development.

The California feed-in tariff allows eligible small renewable energy generators (as amended by SB 32 in 2009, up to three megawatts) to enter into 10 to 20 year standard contracts with their utilities to sell electricity at time-differentiated market-based prices (Database of State Incentives for Renewable Energy, 2010). The California Public Utilities Commission is currently developing a Renewable Auction Mechanism, in order to provide a more efficient pricing mechanism for renewable energy providers up to 10 megawatts (Local Clean Energy Alliance, 2010).



Solar energy facility occupying an entire square mile of land southeast of California City, San Bernardino County

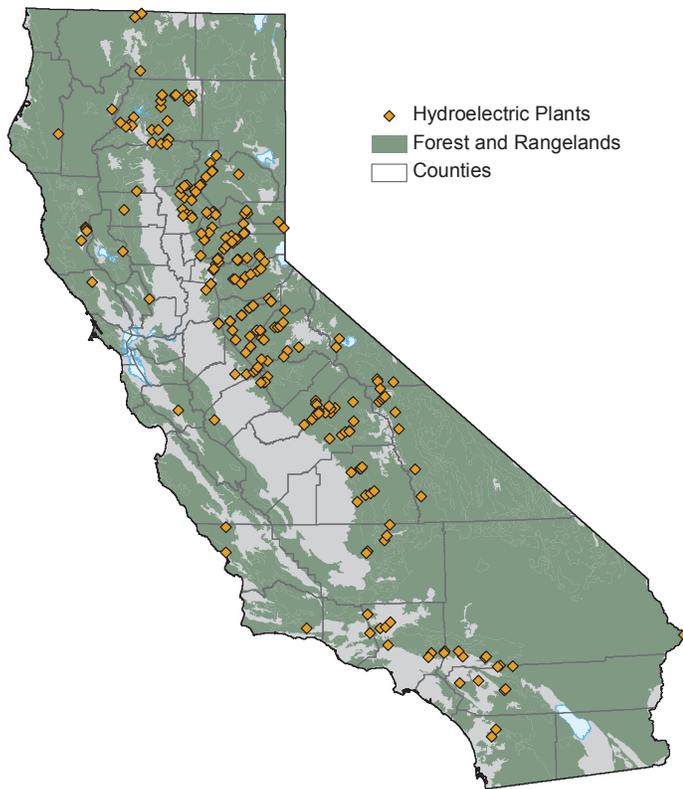


Figure 3.4.3.

Hydroelectric power plants in California.

Data Source: *Hydroelectric Power Plants* (derived from U.S. Army Corps of Engineers (1979), and *Bulletin 160-93 Volume 2, DWR (1989)*), *FRAP (2002)*

The California Energy Commission’s Geothermal Program was created in 1981 (Assembly Bill 1905 (Bosco)) to promote geothermal energy development in California by offering financial and technical support for planning and mitigation projects and research and development to private entities.

The Renewable Energy Transmission Initiative (RETI) was created to facilitate meeting the Renewables Portfolio Standard goals. California currently does not have the transmission infrastructure to move the electricity generated by renewable resources to consumers, so extensive improvements and expansion are needed to reach the renewable energy goals. RETI is meant to be a transparent, inclusive stakeholder driven process. The goals are to identify needed transmission projects, support future energy policy, facilitate transmission corridor designation and transmission, and project siting and permitting. The Conceptual Transmission Planning Group is

using RETI’s conceptual planning as a starting point to develop a California statewide transmission plan to meet the 33 percent by 2020 Renewables Portfolio Standard (California Transmission Planning Group, 2010).

There are federal government incentives to produce wind electricity through tax credits of 1.5 cents per kilowatt-hour. The federal Energy Improvement and Extension Act of 2008 extends tax credits to clean, renewable energy, solar and energy improvement projects.

BIOMASS ENERGY

Current Status and Trends

The Governor’s Bioenergy Action Plan states that biomass-fueled electricity generation constitute 20 percent of the Renewables Portfolio Standard by 2010 (BAP, 2006). As of 2007, biomass energy derived from forests, farms, landfills and other urban wastes provided 2.1 percent of electricity use, or almost 18 percent of all renewable energy (CEC, 2007). Biomass energy from forestlands provides about one percent of California’s electricity use (USFS, 2009; California Biomass Collaborative, 2007), while having the potential to provide nearly eight times this amount (Morris, 2002). Biomass also has unutilized potential for heating homes, businesses, and schools, and for conversion to liquid transportation fuels (as conversion technology evolves). Biomass power has been a part of the state’s power generation portfolio for over 25 years, and has facilitated the treatment and restoration of thousands of forested acres (Mason, 2010).

There are benefits from utilizing biomass energy beyond reduced reliance on fossil fuels. A recent intensive study looked at the long-term (40 year) impact of implementing biomass projects in a Northern California test area, and confirmed the following (USFS, 2009; California Biomass Collaborative, 2007):

- Reduction in greenhouse gas emissions

- Reduction in acres burned by wildfires, as well as severity of fires, with an associated reduction in damages to human infrastructure, economic values from working landscapes, and fire suppression costs
- Negligible impact on habitat suitability
- Minimal cumulative watershed impacts

Numerous studies indicate that the societal benefits derived from biomass removal and utilization are significant (USFS, 2009; California Biomass Collaborative, 2007). Biomass energy displaces the need to burn fossil fuels, and efficiently disposes of materials that would otherwise release methane emissions through decay, pile and burn disposal or wildfire (Reese, 2009). From an air quality perspective, five of six regulated emission categories are reduced by over 95 percent by burning material for biomass versus in open piles or by wildfire (Reese, 2009). Case studies (Cone Fire, 2002) confirm that fuels treatment activities that involve biomass removal can in fact mitigate wildfire behavior. Biomass energy can create jobs in rural economies that have been dependent on traditional resource-based industries. A 50 megawatt (MW) biomass plant can employ about 50 people, and also generate 125 indirect jobs (Reese, 2009). A 1999 study (Morris, 1999) found that 4.9 full time jobs are created for each MW of biomass power generation capacity.

However, there are public concerns about the environmental impacts of biomass removal. The various benefits and environmental impacts of forest biomass removal are complex and further research is required to guide appropriate policies and practices. Questions of long term biomass supply (especially from public lands), as well as possible ecological and other impacts of biomass removal on forest sustainability, are key issues in California (Heinz and Pinchot, 2010).

Other states also are challenged with balancing the need to reduce fire and forest pest risk, stimulate rural economies and expand renewable energy use while minimizing environmental impacts. Oregon passed legislation in 2005 (Oregon SB 1072) to

promote the health of forests and rural economies through active forest management. The State Forester is directed to prepare a report every three years summarizing the effect of biomass removal on plants, wildlife, air and water, and identify changes that are necessary to encourage biomass energy use and avoid negative effects on the environment. The first report emphasized changes to insure that adequate downed wood and snags are left on site. The need for scientific input to help establish appropriate removal/residual policies for forest slash in thinning and fuel reduction treatments by forest cover type, and continuing to encourage logger certification programs to include woody biomass harvesting techniques training (Oregon Department of Forestry, 2008).

In order to use biomass projects as a tool, first there must be a biomass energy facility within reasonable proximity, making the biomass material economically available. Biomass facilities operational in California that have the potential to address wildfire or forest pest issues are shown in Figure 3.4.4. A 25 mile buffer zone around facilities illustrates a gross estimate of the area where biomass material is economically available, given current costs and returns to landowners and energy producers. A more realistic zone would require an analysis of travel costs, road networks, and energy prices.

Secondly, biomass material must be technically available. Areas that are inaccessible, for example steep slopes, are excluded as are areas where regulations or management direction preclude biomass harvesting, wilderness areas or stream and lake protection zones. This second consideration can be complex, in that some areas may be accessible only under certain conditions, for example when a Zone of Infestation for forest pests is formally declared, or after a wildfire. Finally, this definition excludes materials that are likely to be used for higher-value products, for example wood that is suitable for lumber.

Currently, extensive areas of technically available biomass are not served by operational biomass



Figure 3.4.4.

Operational biomass facilities in California. This does not include numerous facilities that have limited potential to address wildfire or forest pest issues, for example those that primarily utilize biomass from landfills, urban waste, or agriculture. Exception – the two Southern California facilities shown on the map currently utilize primarily urban or agricultural wastes.

Data Source: Biomass Facilities, FRAP (2009 v1)

plants. Factors that constrain investment in new facilities include:

- Uncertainty in future energy prices, affecting biomass value and travel costs (Reese, 2009)
- Uncertainty over access to biomass on public lands
- Local opposition to the existence or proposed location of biomass facilities (SDN, 2009)
- Barriers related to permitting (CBC, 2006)

There are currently six idle biomass facilities that potentially could address wildfire and forest pest issues in California (including one in Nevada). The primary reason for closure is a reduction in timber harvesting associated with the current economic downturn (Sierra Pacific Industries, 2009). The Northern Nevada

Correctional Facility biomass plant near Carson City, Nevada currently has minimal impact for biomass removals in California, and is included as an idle plant since under certain future conditions it could service areas in need of treatment in the Lake Tahoe area.

In addition, at least six new biomass facilities have been proposed across the state, which could address wildfire and forest pest issues. It remains to be seen which, if any of these will actually become operational. The optimal scale of new standalone grid energy biomass facilities in the Pacific Coast region, including California, appears to be small to medium (5 to 15 MW). The size of projects involves variables such as fossil energy prices, emerging technologies for liquid fuels, heat and power needs, carbon credit values, energy policy, and local forest conditions (Heinz and Pinchot, 2010).

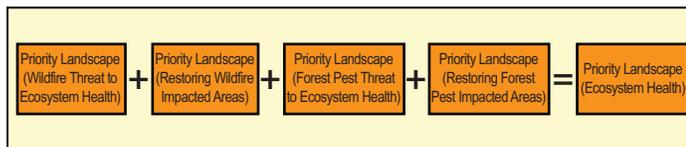
Given current trends, government action may be required if woody biomass utilization is to make a greater contribution towards meeting Renewables Portfolio Standard targets, or facilitate treatment of more areas at risk or damaged by wildfire and forest pests. Government action may also be warranted given that use of biomass for energy generation competes with other renewable energy sources or uses of biomass that are subsidized or otherwise encouraged through various government policies. Example policies include the diversion credit for use of green biomass as daily cover in landfills (BPA, 2009).

Analyses

The potential for biomass projects to play an increasing role in threat reduction and restoration efforts related to ecosystem health and community safety was analyzed, drawing on the analytical results presented in previous chapters. This involved simulating the effects of adding six proposed biomass facilities and making six idle facilities operational. However, a specific strategy to implement this scenario could require actions on multiple issues and a variety of options for addressing them, including changes to policies, programs or practices and funding sources.

Ecosystem Health

The potential for biomass projects to reduce threats and facilitate restoration efforts related to ecosystem health was examined. Each of the four priority landscapes in the following diagram represents priority areas where biomass projects could be applied. For example, biomass projects that thin overstocked stands and remove ladder fuels can reduce wildfire and forest pest threat. Restoring impacted areas often requires removal of dead, dying or infected trees.



These four priority landscapes were combined to create a single priority landscape for ecosystem health, by assigning the maximum of the four component ranks. An area that is ranked high for any of the four inputs is also ranked high in the output. The resulting ecosystem health priority landscape represents areas most in need of treatments, such as biomass projects to reduce threats or restore impacted areas. The analysis involved determining which ecosystem health priority landscapes potentially become economically available as a result of adding the 12 facilities, and summarizing the results by county and bioregion.

Community Safety

A second analysis examined reducing wildfire and forest pest threats to community safety, or restoring impacted communities. Wildfire poses a direct threat to human infrastructure, while forest pests cause tree mortality that leads to indirect impacts from falling trees on roads, power lines and houses.

The analysis determined which priority communities that are currently not economically available due to distance from operational facilities, are within 25 miles of the added facilities.



Results

Ecosystem Health

Figure 3.4.5 shows the ecosystem health priority landscapes that might become economically available as a result of the 12 new biomass facilities.

Table 3.4.3 shows the additional acreage by county of high plus medium priority landscapes that potentially become economically available for biomass projects as a result of adding 12 facilities. A significant portion of these lands are federally owned.

Community Safety

Table 3.4.4 shows communities identified as priorities for protection or restoration in terms of which are potentially served by operational biomass plants, or idle/proposed plants. Southern California is currently not served by facilities that utilize a significant amount of biomass from forests and rangelands and these individual communities are not listed.

Discussion

Ecosystem Health

Proposed and idle biomass facilities potentially can make large areas of priority landscapes economically available for treatment in counties such as Siskiyou, Trinity, Modoc, Lassen, El Dorado, Amador and Placer. This would facilitate treatments to reduce threats from wildfire and forest pests and to restore impacted areas.

However, extensive areas of priority landscapes are not served by either existing, proposed or idle facilities. The first map in Figure 3.4.6 shows priority landscapes for ecosystem health that are not within 25 miles of operational, idle or proposed facilities. This map does not show the extensive areas of high priority landscapes in Southern California, since

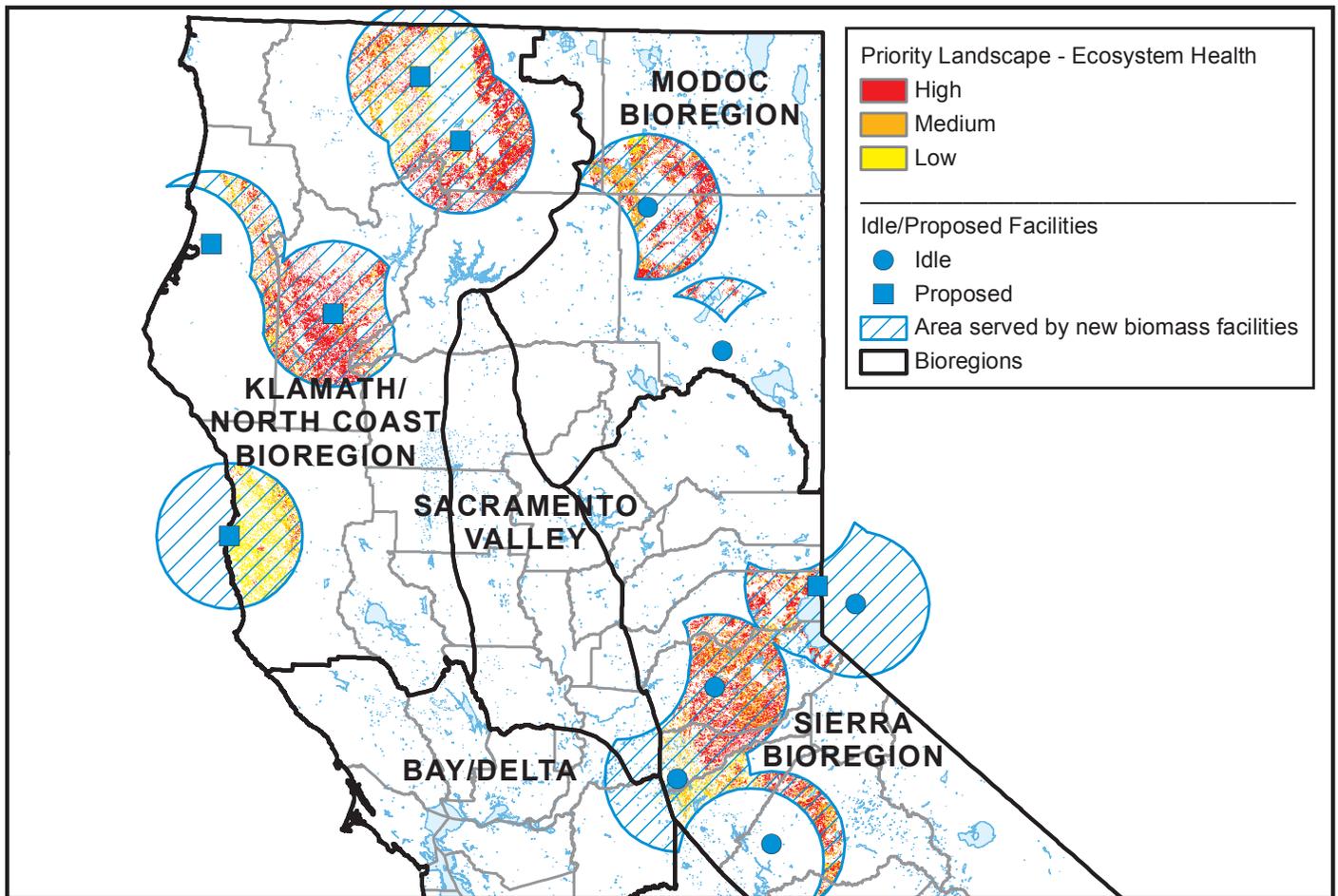


Figure 3.4.5.

Priority landscapes for ecosystem health with potential for new biomass facilities. Priority landscapes that are technically unavailable (e.g., steep slopes, stream buffers, wilderness areas), or have too little biomass to be economically available (less than 50,000 lbs/ha) are excluded in the map. Map shows only the portion of the state that is affected by making the 12 idle or proposed biomass facilities operational.

Data Sources: Biomass Facilities, FRAP (2009 v1); Burn Severity, USFS (2009); California Fire Regime Condition Class, FRAP (2003); California Tree Seed Zones, Buck, et al. (1970); Fire Threat, FRAP (2005); Statewide Land Use / Land Cover Mosaic, FRAP (2006); Aerial Detection Surveys, USFS FHP (2008 v1); Forest Pest Risk, USFS FHP (2009 v1); Fire Perimeters, FRAP (2009 v1); Fuel Rank, FRAP (2002)

in this region of the state there are currently no facilities that utilize significant biomass from forest or rangeland. The second map shows that since so much of these priority landscapes are on federal lands, access to a stable flow of material, especially from national forests, will be a critical factor in terms of whether these areas will ever be served by facilities.

Community Safety

Currently, only 14 of the 66 priority communities are within 25 miles of an operational biomass facility. Adding the 12 new facilities would reach 11

more priority communities. Of the remaining 41 communities, 31 are in Southern California.

Bioregional Findings

Ecosystem Health

Adding the idle and proposed facilities potentially would facilitate treatment of extensive priority landscape areas for ecosystem health in the Klamath/North Coast, Modoc and Sierra bioregions.

However, even if all idle and proposed facilities are made operational, there will still be extensive areas of priority landscapes that are not served by bio-

Table 3.4.3. High plus medium priority landscape (HMPL) acres (rounded to the nearest hundred) for ecosystem health by county that are potentially economically available as a result of making 12 proposed or idle biomass facilities operational

County	HMPL Acres*	Percent Federal
Amador	89,900	9
Calaveras	64,600	14
El Dorado	377,000	53
Humboldt	104,400	49
Lassen	163,900	60
Mariposa	4,000	97
Mendocino	53,600	2
Modoc	166,300	47
Nevada	4,300	16
Placer	141,300	68
Shasta	48,300	54
Siskiyou	485,300	47
Tehama	8,500	87
Trinity	415,700	78
Tuolumne	108,200	78
State Total	2,235,600	54

*counties with less than 1,000 HMPL acres excluded.

mass facilities in these same bioregions, though the majority of this is federal lands.

Community Safety

As a result of adding idle and proposed facilities, 11 additional priority communities could potentially be treated using biomass projects, six of these are in the Lake Tahoe area. Numerous additional communities could be served, primarily in the Klamath/North Coast and Sierra bioregions.

About half of the priority communities identified occur in the South Coast bioregion where biomass projects currently are not a viable treatment tool due to lack of biomass facilities.

Tools

California had 49 operating biomass plants in the mid 1990s, today there are 33 (Reese, 2009). The current environment does not seem conducive to bringing new plants that rely on forest biomass online, or in some cases even keeping existing plants operational. The challenge is to develop strategies that capture the array of benefits provided by biomass energy in terms of incentives for sustainable

Table 3.4.4. Priority communities for protection or restoration for forest pests and wildfire, that are potentially serviced by an operational biomass facility, or idle/proposed facility

County	Priority Community (F = Wildfire; P = Forest Pests)	Biomass Facility (O = Operational; I = Idle/Proposed)
Alameda	Oakland (F)	-
Alpine	Kirkwood (P)	-
Butte	Magalia (P)	O
	Paradise (P)	O
Calaveras	Arnold (FP) ¹	I
	Mountain Ranch (P)	I
El Dorado	South Lake Tahoe (P)	I
Humboldt	Willow Creek (P) ¹	I
Marin	Inverness (P)	-
Mono	Mammoth Lakes (P)	-
Monterey	Aromas (P)	-
Nevada	Grass Valley (P)	-
	Truckee (P) ¹	I
Placer	Dollar Point (P)	I
	Foresthill (P)	I
	Kings Beach (P)	I
	Sunnyside–Tahoe City (P)	I
Plumas	Bucks Lake (P)	O
	East Quincy (P)	O
	Graeagle (P)	O
	Iron Horse (P)	O
	Johnsville (P)	O
	La Porte (P)	O
	Meadow Valley (P)	O
	Mohawk Vista (P)	O
Shasta	Lakehead–Lakeshore (P)	O
Shasta	Redding (F)	O
	Mount Shasta (P)	I
Siskiyou	Weed (P)	I
	Guerneville (P)	-
Sonoma	Healdsburg (P)	-
	Occidental (P)	-
	Monte Rio (P)	-
Tehama	Mineral (P)	O
Tuolumne	Groveland–Big Oak Flat (P)	O
Southern California ²	23 Communities (F)	
	7 Communities (P)	
	1 Community (F;P)	-

¹ Community is just inside the 25 mile buffer of an operational facility, but would be better served by a closer proposed/idle facility.
² San Diego, Orange, Los Angeles, San Bernardino, and Ventura counties.

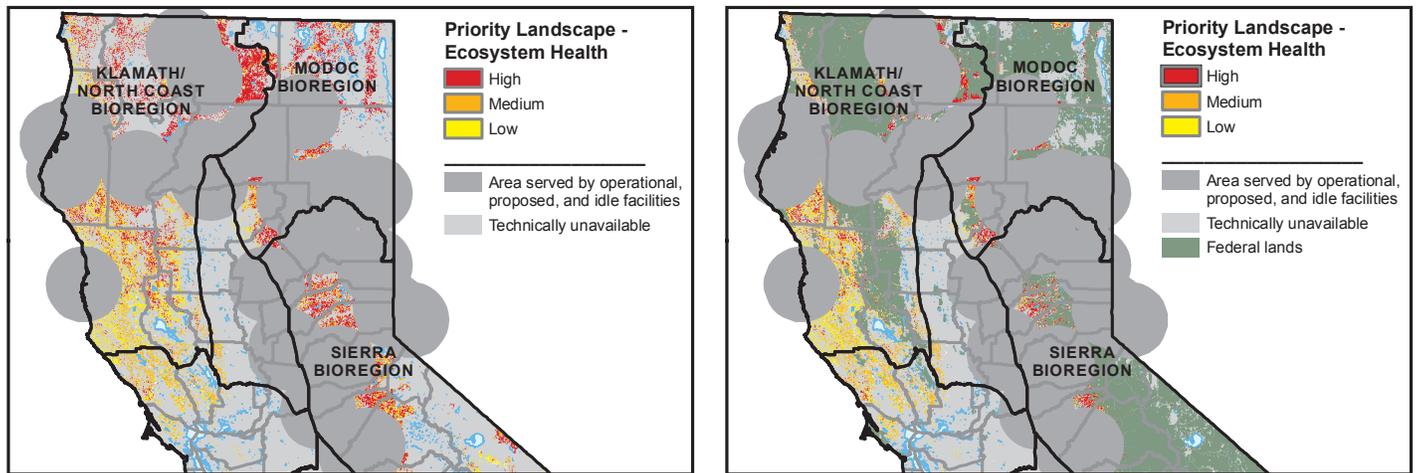


Figure 3.4.6.

Priority landscapes for ecosystem health that are not within 25 miles of operational, proposed, or idle biomass facilities. Data Sources: Biomass Facilities, FRAP (2009 v1); Burn Severity, USFS (2009); California Fire Regime Condition Class, FRAP (2003); California Tree Seed Zones, Buck, et al. (1970); Fire Threat, FRAP (2005); Statewide Land Use / Land Cover Mosaic, FRAP (2006); Aerial Detection Surveys, USFS FHP (2008 v1); Forest Pest Risk, USFS FHP (2009 v1); Fire Perimeters, FRAP (2009 v1); Fuel Rank, FRAP (2002)

development of this technology (California Biomass Energy Alliance, 2006), while monitoring potential environmental impacts and adapting policies and regulations as needed. Transparent and inclusive stakeholder involvement is important in decisions about biomass. Collaborative processes, planning and long-term stewardship contracts are critical for determining and realizing supply from federal lands (Heinz and Pinchot, 2010).

Road Map to the Future

The California Energy Commission, working through the Bioenergy Interagency Working Group, has produced a comprehensive strategy for sustainable development of biomass in the state. The first Bioenergy Action Plan (CEC, 2006) was released in 2006, and the goal is to adopt an updated plan by the end of 2010. There are recommended actions in five areas:

- Resource access and feedstock markets and supply
- Market expansion, access, and technology deployment
- Research, development, and demonstration
- Education, training and outreach
- Policy, regulations, and statutes

Coordinated Resource Offering Protocol (CROP)

In response to the uncertainty for access to biomass from public lands, the U.S. Forest Service and BLM have launched a series of Coordinated Resource Offering Protocols (CROP) pilot projects, including one in the Lake Tahoe region in California (USFS, 2009). For the Lake Tahoe pilot project, a key concern is that 50 percent of CROP resource offering (acreage for biomass removal) has not started in the National Environmental Policy Act (NEPA) process.

The key tenets of CROP projects are to (USFS, 2009):

- facilitate coordination of biomass removal between public agencies;
- facilitate the use of long-term multi-agency stewardship contracts to achieve biomass removal;
- increase the certainty of levelized biomass supply offerings from public agencies;
- invite investment back into a sustainable forest management landscape and
- heighten public trust and support for biomass removal from public lands operating within a transparent process.

CROP projects are of limited application however

due to the fact that they are focused only on biomass material sourced from federal lands. Financial institutions that provide funding for biomass utilization projects are interested in reliable sources of woody biomass material across all land ownership categories.

Integrated Resource Stewardship Contract

A promising contracting tool that the U.S. Forest Service and BLM have been utilizing in recent years is the Integrated Resource Stewardship Contract, which is focused on treatments conducted over three to ten years. Stewardship contracts have proven to facilitate forest fuels reduction and restoration activities at the landscape level. There are numerous examples of these contracts in place or proposed in California for fuels reduction projects to protect communities, endangered species habitat, key watersheds for anadromous fish and for ecosystem restoration (<http://www.forestsandrangelands.gov/stewardship/ca.shtml>).

Biomass Crop Assistance Program

Biomass Crop Assistance Program (BCAP) provides financial assistance to producers or entities that deliver eligible biomass material to designated biomass conversion facilities for use as heat, power, bio-based products or biofuels (USDA Farm Service Agency, 2009). For example, in Butte County BCAP funds made it economically feasible to convert 15,500 dry tons of charred timber into clean energy, and enabled Bamford Company to keep 37 people employed (timberbuysell.com).

CARBON

Carbon sequestration is an emerging market that quantifies and helps pay for an ecosystem service. Terrestrial carbon sequestration is considered in policy and at the project level. The role of carbon in compliance markets along with the economics of carbon and the opportunities in California for forest and rangeland carbon are explored here while the sequestration of carbon by trees and other plants is described in Chapter 3.7.

Carbon accounting may use “on-site” to describe carbon stored in the forest or soil while “off-site” refers to the pool of carbon in wood products, either in-use or in a landfill.

There are two kinds of carbon markets: voluntary and compliance. Voluntary carbon markets are generally unregulated by government, with transactions usually occurring directly between the buyer and seller. Specific systems, protocols and registries exist for the voluntary market. Compliance markets occur under regulatory schemes, usually cap-and-trade, where offsets are sold to emitters. These usually involve contracts between buyer and seller, but are regulated by the trading system so that offsets meet the system criteria, are properly credited, and are not used more than once. Entities may operate in both voluntary and compliance markets to assemble multiple landowners into projects for economies of scale.

Standards and guidelines are necessary to quantify greenhouse gas benefits from forestry and range-related activities. For example, protocols are the rules for carbon accounting that a project developer must follow to quantify reductions, while registries function like carbon credit banks where ownership may be tracked.

Two general approaches to protocol development are project specific (i.e., Clean Development Mechanism) and programmatic (i.e., Climate Action Reserve (CAR)). Project types that relate to forestry include reforestation, avoided conversion, urban forestry and forest management. Range-related project types include manure management systems and soil sequestration. Currently, the most likely forestry protocols to receive near-term adoption under AB32 or Western Climate Initiative (WCI) cap-and-trade systems would be CAR forestry protocols, the CAR manure management protocol and the Alberta Offset System soil sequestration protocol (WCI, 2010).

The State of California has supported the CAR forestry protocols for use in the voluntary market. It is expected that these protocols, or modifications of them, will be used for forestry offsets under a

cap-and-trade compliance market under the Global Warming Solutions Act of 2006, WCI, or a national cap-and-trade program. Other protocols will also likely participate.

Reductions are the metric tons of carbon dioxide equivalent (CO₂e) attributed to a project and may be referred to as credits in general or a more specific name associated with a specific protocol or registry. The quality of credits varies according to many factors, such as the nature of the carbon reduction, the extent to which the carbon removed will stay out of the atmosphere, and the ability to accurately measure and verify the amount of carbon saved.

An “offset” is the term generally used in conjunction with a cap-and-trade program where credits are generated outside of the capped sectors. Offsets are used in lieu of emission allowances. The use of offsets has been controversial, with critics questioning the effectiveness and proponents emphasizing the near-term necessity of offsets.

Within California, the amount of offsets to be allowed under cap-and-trade systems is still unknown. By one estimate, which proposed that four percent of annual GHG emissions in California could be met by each entity with offsets, total annual use of offsets could be about 7.7 million metric tons in 2012–2014, over 16 million metric tons in 2015–17, and over 15 million metric tons each year from 2018–2020 (ARB, 2009). Proposed federal legislation would allow upwards of one billion metric tons of domestic offsets a year with another billion metric tons of international offsets.

The apparent demand for offsets far exceeds the supply, at least in the near term (Sikorski, 2010). Estimates and potential value in markets that are emerging can be made for forest-related supply in California. Live tree carbon stored in California forests is estimated to be 5.1 billion metric tons (teragram, Tg) (see Chapter 1.2); the sequestration rate was 30 million metric tons (gigagram, Gg) per year. The estimate for private timberlands was 1.4 Tg; the sequestration rate was five Gg per year. A widely

held 2020 auction allowance price range for AB 32, WCI and national programs is \$15–\$25 per metric ton (Economic and Allocation Advisory Committee, 2010; Point Carbon, 2010; PEW, 2010). For illustration, applying a \$15 and \$20 per metric ton value to offsets under a compliance market, the theoretical values if all carbon were monetized are:

- Total California forest carbon storage (live trees): \$77–102 billion
- Total California forest carbon sequestration: \$450–600 million/year
- California private timberland forest carbon storage (live trees): \$21–28 billion
- California private timberland carbon sequestration: \$75–100 million/year

Potential market revenue based on the \$15–20 per metric ton assumption for offsets in a compliance market under AB32 is as follows:

- First Compliance Period (2012–2014): \$116–155 million/year
- Second Compliance Period (2015–2017): \$246–328 million/year
- Third Compliance Period (2018–2020): \$226–301 million/year

These estimates are for all offset project types. Sikorski (2010) estimates that about two-thirds of nationwide domestic offsets will be supplied by forestry project types to 2020. This would reduce the potential revenues to the forestry sector accordingly.

In the case of range-related carbon, no estimates have been made on the supply from manure management; there is lack of information on the impacts of technology and other obstacles. Soil sequestration from forests and rangelands was not estimated; the associated protocols are unclear at this point.

The type of forest project is a critical factor when considering possible offset supply to 2020. For example, urban forestry and reforestation project types rely on carbon accruing in young trees, which will be minimal before 2020 although important for

later years. In contrast, the avoided conversion and improved forest management project types could generate substantial credits in the next ten years.

The following assumptions were used in the estimates of credits generated from the avoided conversion and improved forest management project types. The stocking and sequestration estimates are from Chapter 1.2.

- One-half of the 139 metric tons per acre average stocking on forestlands are credited on average on avoided conversion projects
- Avoided conversion projects are 10,000 acres a year
- Sequestration rate is 0.746 metric tons per acre on forestland
- Sequestration rate is 1.244 metric tons per acre on timberland
- Non-industrial forestland owners will participate in the improved forest management projects at 10 to 20 thousand acres a year while industrial timberland owners will participate at 20 to 40 thousand acres a year.
- Improved forest management projects that have initial inventories above common practice are 11 to 23 thousand acres a year and result in immediate credits of 35 metric tons per acre.

Avoided conversion projects would produce 0.7 million metric tons per year. Improved forest management projects, by the CAR protocol, may produce credits in two ways: to incrementally as forests grow and as an avoided emissions type credit for exceeding common practice. Based on analysis of avoided conversion and improved forest management, estimates of annual forest carbon offsets available to a California compliance market for the three compliance periods results in the following:

- Compliance Period 1 (2012–2014):
1.17 to 1.67 million metric tons per year
- Compliance Period 2 (2015–2017):
1.25 to 1.83 million metric tons per year

- Compliance Period 3 (2018–2020):
1.33 to 2.00 million metric tons per year

If these estimates are approximately correct then the forestry sector in California will meet 10–25 percent of the potential offset demand through 2020. Fulfilling the demand for offsets to 2020 will require more landowner participation, other sector offsets, the development of other project types such as soil or avoided emissions from fire, or the use of forestry offsets from outside of California.

Carbon credits will be in demand for both the voluntary and compliance markets. Protocols are in place for many project types. The price of carbon, however, is generally low relative to the value for high quality timber products. A thousand board feet of Douglas-fir that is worth \$400 is approximately four metric tons of CO₂e, which is \$80 at \$20 a metric ton. This value discrepancy combined with the risk associated with a 100-year commitment to maintain the sequestered carbon, which is required for CAR projects, will likely keep supply low. If credits become widely used for mitigating climate impacts identified in the California Environmental Quality Act (CEQA) analyses of development projects, then prices in the voluntary market could possibly exceed prices in the compliance market, further constraining cap-and-trade supply.

Investments in working landscapes could bolster terrestrial carbon inventories and reduce risk of loss. Priority landscapes for carbon are identified in Chapter 3.7. Significant acreages on private and public lands could benefit from management. Carbon management must, however, be considered in the context of the multiple benefits that forests and rangelands provide. Quantities of carbon should be considered in combination with the risk of emission and long-term ecosystem health. Investments in restoring stands converted from either conifer or hardwood cover should be made soon to address ecological restoration and carbon contributions in future decades.

NICHE MARKETS

Definition

Natural Resources Canada defines niche products as “specialty, higher-value, non-commodity wood products that are directed at specific markets that value the unique appearance/quality of a product that has a limited production supply. Niche products are usually produced by smaller manufacturing plants that focus on producing a unique, high quality product in limited volumes. These are usually products that an end-user believes has an added-value component due to unique appearance/quality, end-use, etc. Many niche products have the same number of competitors as established commodity products but niche products have the advantage of being able to create brand or product loyalty to separate themselves from competitors, are more regional in market focus, are more attuned to market/demand changes and trends, and are quick to adapt to changes in market demand.” (Natural Resources Canada, Canada Wood, 2003)

Niche Markets for Certified Products

Niche products are differentiated based on the nature of the process used to create them, in terms of being a more environmentally and socially responsible option for consumers. This typically involves a certification process by third-party entities such as the Forest Stewardship Council (FSC) or Sustainable Forest Initiative (SFI) for wood products, or the USDA National Organic Program for agricultural products. There are also various programs for certification of “natural” beef and grass-fed beef, which are generally less restrictive standards than organic.

“An on-product label that says a product is certified to a program such as SFI or FSC delivers assurance you are making a choice that represents conservation of biological diversity, protection of special sites, sustainable harvests, respect for local communities, and much more” (Larry Selzer, President and CEO, The Conservation Fund).

The demand for certified wood products can be driven by higher level certification programs, for example the trend towards “green building” and

certification programs such as Leadership in Energy and Environmental Design (LEED®) (<http://www.usgbc.org/DisplayPage.aspx?CategoryID=19>).

In some cases, major retailers have endorsed certified products to the point of excluding or limiting selection of non-certified products. For example, Home Depot began endorsing certified wood products in 1999, and now sells more FSC certified wood than any retailer in America (http://corporate.homedepot.com/wps/portal/Wood_Purchasing).

Advantages of Niche Products

The mass marketing business model involves intense competition based on standardized product lines and fierce price competition (Hacker, 2006). Niche markets involve a unique business model that can often command higher prices by competing to meet a unique need for custom products.

Niche products sometimes utilize materials that would otherwise be discarded, or even incur a disposal cost. Eric Oldar of the California Department of Forestry and Fire Protection pioneered a project to utilize urban trees that would otherwise end up in landfills, by investing in portable sawmills and kilns which are loaned to municipalities (Hacker, 2006). The City of Lompoc, which was faced with a tree disposal problem and landfill regulations, was able to meet a need for higher quality park benches, flooring, and other wood products (Gamstetter, 2009). The number of municipalities now using portable sawmilling is widespread throughout the country in response to landfill regulations (Hacker, 2006).

Examples of Niche Products

Niche products are vast and diverse, a list of some of the more interesting or promising in California includes:

- West Coast Arborists, Anaheim: Utilizing the latest technology for urban forestry inventory, planning, and management (<http://www.wca-inc.com/Introduction.aspx>).

- California Hardwood Producers, Auburn: Utilizing tree removals from urban forests and orchards for high quality flooring, cabinets, beams, countertops, etc. (<http://californiahardwood.com/>).
- Humboldt Woodworkers Guild, Humboldt County: Collective marketing of unique high quality, environmentally and socially responsible wood products (<http://woodguild.com/>).
- Calaveras Healthy Impact Product Solutions, San Andreas: In response to local sawmill closures and fire hazard from small trees, this community organizing effort, funded by a \$96,500 USDA grant, implemented a chipping station for landscaping and heating. One customer uses wood chips to heat a four acre greenhouse that supplies fresh organic local produce.
- Sierra Nevada Geotourism: The Sierra Business Council has partnered with the National Geographic Society and the Sierra Nevada Conservancy to develop a website to capture the history, heritage and attractions distinctive to the Sierra Nevada Region, to promote tourism that can conserve the region's historic towns and heritage sites, restore and protect the landscape, and sustain local businesses and communities (<http://www.sbcouncil.org/Projects/Sierra-Nevada-Geotourism>).
- There are many examples of California ranches that produce organic, natural or grass-fed animals and meat products.
- Numerous California livestock operators fill niche markets for various specialty products and services, ranging from beef jerky to ranch tours.

Opportunities for Niche Markets in California

There is a strong potential for niche markets to increase economic activity and employment in the state.

California hardwoods have historically received a lot of attention, since they are an underutilized resource. California is a major consumer of hardwood

lumber (20 percent of nation's production) but the hardwood lumber production industry in the state is almost non-existent; this is in spite of a sizable hardwood tree resource (12 billion cubic feet of timber growing stock) (<http://ucanr.org/delivers/impactview.cfm?impactnum=196>). Although California producers have been unable to compete in traditional high-volume markets, the potential exists for utilizing this resource to fill additional niche markets.

As California loses more sawmills, many landowners will be unable to sell their timber. Portable sawmills provide an opportunity for these landowners to process their own logs, and sell their timber as finished products, commanding a higher price. This will require innovation in terms of forming landowner cooperatives for processing and marketing their products.

While this chapter deals extensively with opportunities for additional large biomass facilities, there is also potential for utilizing small or micro-biomass power generation, particularly for heating homes, businesses and schools. Examples include the U.S. Forest Service State and Private Forestry's Fuels for Schools program being initiated in six western states.

The various certification programs for rangeland products provide an opportunity for some ranchers to increase profitability. This could become especially important if food safety concerns become an emerging issue. For example, grass-fed beef avoids potential food safety concerns that could arise from sending animals to feedlots.

ECOSYSTEM SERVICES

Forests and rangelands provide a number of values which historically have not been captured easily in traditional markets. Examples are: carbon sequestration (until recently), watershed services, wildlife habitat and biodiversity, scenic and related values. Often these are viewed as "public goods" which are provided as benefits to the public at little or no cost. Since landowners are generally not compensated for providing these services, they may not receive

adequate consideration in decisions related to keeping lands in production, or in how they are managed.

Markets have been slow to emerge for a number of reasons, such as the difficulty of defining market units and price, few buyers, and limited support in the investment community. However, a growing recognition of the importance of these services is leading to efforts to quantify their value, which could lead to market-based solutions. At the national level, for example, the Food, Conservation, and Energy Act of 2008 directs states to identify high-value areas for providing various ecosystem services and to delineate threats to those areas. The Act also seeks to facilitate landowner participation in emerging markets for ecosystem services. The Secretary of Agriculture must develop technical guidelines that measure the environmental services benefits from conservation and land management activities. These guidelines will facilitate measurement and reporting protocols and registries. A verification process and guidelines for reporting conservation and land management activities must also be developed (<http://www.fs.fed.us/ecosystems-services/>).

Across the country, some market-based frameworks can be found in the area of ecosystem services. These can include private payments, public payments or incentives and trading schemes. For example, in the case of preserving wildlife and plant diversity, payments for specific areas or programs can come from non-governmental organizations, pharmaceutical, agricultural or other companies, and even the eco-tourism industry. In some cases regulatory frameworks have fostered a way to do market transactions, such as the emergence of conservation and mitigation banking in California and the U.S. Other investments are made in an effort to comply with or lessen cost of regulatory compliance, such as flood control structures or better road design to improve water quality.

Local or regional districts can also serve a quasi-market function. Examples include the East Bay Regional Park District, the Mid Peninsula Open Space District and the Marin Open Space District. These districts

have programs that support ecosystem services directly or indirectly. They utilize property taxes, assessments, fees/rents/other charges, grants, interest and other funding sources. Programs relate to what the voters want and for which they will pay.

Some programs can influence market opportunities for ecosystem services. An example of this is the Private Lands Wildlife Habitat Enhancement and Management Area (PLM) Program administered by the Department of Fish and Game. The program was first authorized in 1983 and has undergone several revisions. The goals of the PLM are to encourage private landowners to manage for the benefit of fish and wildlife. In exchange for developing a management plan and adopting specific wildlife habitat improvements, landowners receive incentives that allow them to better realize the recreational value of wildlife. Incentives can include more flexible seasons and quality hunting experiences. Landowners gain by charging fees for hunting, fishing and other uses, such as photography and observing wildlife. (DFG, 2008). There are now 90 PLM properties that encompass almost 900,000 acres of wildlife habitat (<http://www.dfg.ca.gov/wildlife/hunting/plm.html>).

Conservation easements are another mechanism widely used in California. Many examples exist such as efforts by organizations including the Trust for Public Land, the Nature Conservancy and the California Rangeland Trust. Under a conservation easement, a landowner voluntarily donates or sells certain rights related to their property, such as the opportunity to develop to a private organization or public agency. This entity is willing to hold the right to enforce limitations agreed to by the landowners. Often landowners retain rights to manage the property for ongoing agricultural, rangeland or forestry uses, together with associated habitat, watershed and open space values. These easements are legally recorded agreements and conditions continue with the land when the land is sold. Compensation to the landowner can take several forms, such as direct payments or tax credits. Credits come from various sources. One example of a tax credit is the Natural Heritage Preservation Tax Credit (2000).

Administered by the Wildlife Conservation Board, the Tax Credit Act allows state tax credits for donations of qualified land (fee title or conservation easement) and water rights.

Still another example is the Oak Woodlands Conservation Act (2001). Under the Conservation Act, the Wildlife Conservation Board established a grant program designed to protect and restore oak woodlands utilizing conservation easements, cost-share and long-term agreements, technical assistance, public education and outreach.

In addition, state law provides for tax and zoning approaches that encourage landowners to maintain land in agriculture, ranching and timber production. The two key frameworks are the California Land Conservation Act, better known as the Williamson Act, and the Timberland Production Zone under the Forest Taxation Reform Act. Under both these laws, properties are taxed in a manner that supports continued use of the land for resource production with its related ecosystem service benefits (such as wildlife habitat and watershed health).

The provision of ecosystem services in California has benefited greatly from development of partnerships and cooperation among landowners, governmental agencies, non-profit organizations and other stakeholders. Forms of the partnerships vary, but can be seen in the abundance of watershed groups, Fire Safe Councils and community or neighborhood based organizations. Agencies, landowners, and non-governmental organizations all play key roles. These efforts have facilitated watershed and habitat planning, restoration, management and acquisition, and efforts to improve forest health.

Support for such activities comes from different sources. The main contributors are property owners, non-profit organizations, public agencies and the public. By far, the largest funding sources for projects and for ongoing program support for environmental services comes in the budgets of federal, state and local agencies. Funding comes from general

taxes, special taxes and dedicated funds, user fees, and other sources.

Especially important to support and enhancement of ecosystem services in California has been voter support of four ballot initiatives in the last decade. These are Proposition 40 (2002), Proposition 50 (2002), Proposition 84 (2006), and Proposition 1E (2006). Funds from these initiatives are being used for many aspects of ecosystem services. These include such things as assessment and planning for watersheds, fish and wildlife, infrastructure and habitat restoration and enhancement, habitat acquisition, improving forest health and conservation and technical assistance.

Federal initiatives have also been important. Examples include funding and programs related to: improved water quality; restoration and enhancement of ecosystems, wildlife and fish habitat; and fuel reduction and improved forest health. Some federal programs focus on specific areas and issues such as Lake Tahoe or the forests of Southern California.

Planning for and determination of projects, as well as management and ongoing support that relate to ecosystem services, take many forms. Much depends on enabling legislation and direction in agency budgets of governmental agencies. In addition, program focus and even type or location of projects can be written as part of state or local ballot measures. Goals of landowners, contributors and non-governmental organizations also play a role.

One example is that the importance of forested and rangeland watersheds to water quality and supply has been recognized in various ballot initiatives, related legislation, the CALFED Program and, most recently, in the draft California Water Plan. Public funding has been the primary source of investment in these watersheds. For example, under CALFED, millions of dollars have been invested for watershed assessment, watershed management and technical and staff assistance. A number of agencies, but especially the State and Regional Water Quality Control

Boards and the Department of Fish and Game, have worked with stakeholders to carry out such efforts.

The same is true for investment in forests and rangelands critical to providing biodiversity, habitat and open space. Funding has come from a variety of sources, again largely public in origin. Conservancies, such as the Coastal Conservancy and the Sierra Nevada Conservancy, have been established to provide facilitation, coordination, project focus and management. Several state departments have worked with stakeholders to guide these investments. Key among them is the California Department of Fish and Game, especially the Wildlife Conservation Board (WCB).

Many policies, programs, agencies and stakeholders are involved with making decisions over where to make investments that affect ecosystem services. This typically involves protecting areas that provide unique or high levels of desired services, or restoring areas impacted by past events. Augmenting this with emerging market-based solutions could enhance our ability to sustain these important services into the future.