Sierra Nevada Forest Health, Wildfire Risk Reduction and Biomass Utilization for Energy

Contents:

1. The Spirit of Blodgett: Workshops on Forest Health, Climate Change and Air Quality at Blodgett Forest Research Station in Central Sierra Nevada
   Placer County Air Pollution Control District

2. Mokelumne Watershed Avoided Cost Analysis: Why Sierra Fuel Treatments Make Economic Sense
   The Nature Conservancy, Sierra Nevada Conservancy, and US Forest Service

3. The Rim Fire: Why Investing in Forest Health Equals Investing in the Health of California
   Sierra Nevada Conservancy

Placer County
AIR POLLUTION CONTROL DISTRICT

110 Maple Street, Auburn, CA 95603 • (530) 745-2330 • Fax (530) 745-2373 • www.placer.ca.gov/apcd

April 2, 2014

Placer County
AIR POLLUTION CONTROL DISTRICT

110 Maple Street, Auburn, CA 95603 • (530) 745-2330 • Fax (530) 745-2373 • www.placer.ca.gov/apcd

Thomas J. Christofk, Air Pollution Control Officer

THE SPIRIT OF BLODGETT

During the summer and fall of 2012 and 2013, a series of workshops focused on forest health, climate change and air quality were held at the Blodgett Forest Research Station located in the central Sierra Nevada. Sponsored by the University of California College of Natural Resources, Placer County Air Pollution Control District, CAL FIRE, and US Forest Service, the findings and recommended solutions from these workshops and follow-up meetings are summarized below.

Problem

California's 2013 fire season has demonstrated just how at risk our forests are to catastrophic wildfire. Many communities and millions of acres of forest ecosystems are at significant risk to catastrophic events like the Rim Fire. In response, CAL FIRE, the US Forest Service, and the Sierra Nevada Conservancy are teaming with regional partners including Fire Safe Councils, Resource Conservation Districts and local Fire Districts to implement strategic projects to proactively restore forest health and treat hazardous forest fuels by implementing sustainable forest management projects. In addition to protecting communities, forest resources, wildlife habitat, watersheds and recreational lands, these efforts reduce greenhouse gases, improve air quality, benefit water quality and quantity, lower firefighting costs, address energy security, and increase local jobs and rural community vitality.

These projects are quite costly, with treatment expenses as high as $1,200 per acre. Public funding to support proactive forest fuels treatment is declining and will likely cause many projects to be cut back or completely curtailed. The scale of the current challenge is enormous and continues to increase due to a variety of factors, including (but not limited to) the dynamic nature of California forests, climate change, and reduced funding allocated to hazardous fuels treatment activities. The table below summarizes the scale of the challenge.

CALIFORNIA FOREST OWNERSHIP	HIGH, VERY HIGH AND EXTREME FIRE THREAT[1] ACRES	CURRENT TREATMENT ACRES/YR	TARGETED TREATMENT ACRES/YR	FOREST BIOMASS TARGETED FOR REMOVAL TONS[2]/YR
US Forest Service	8,985,800	60,000	200,000 - 500,000	4,800,000 - 12,000,000
Other Public	1,768,300	25,000	50,000 - 80,000	1,200,000 - 1,920,000
Private	7,244,400	40,000	175,000 - 300,000	4,200,000 - 7,200,000
Totals	**17,998,500**	**125,000**	**425,000 - 880,000**	**10,200,000 - 21,120,000[3]**

The Blodgett Forest Research Station workshops were convened to address the challenges associated with wildfire risk, forest health, and the impacts of climate change. The discussions identified the need for supporting forest management activities through non-traditional, market-based funding approaches that properly and fully recognize and value the significant and wide

[1]Figures are provided by CAL Fire - Fire and Resource Assessment Program.
[2]Green tons of excess forest biomass assuming 24 GT/acre.
[3]Enough forest biomass to support 1,275 to 2,640 MW of baseload bioenergy generation capacity.

range of ecological and economic benefits that can result from proactive and sustainable forest management and fuels reduction projects.

Opportunity

An alternative, market-based opportunity to generate cost recovery funding to support these projects is the utilization of woody biomass generated as a byproduct of forest management and hazardous forest fuels reduction activities. A variety of value-added uses for woody biomass waste currently exists, including soil amendment, firewood and posts/poles. In forested regions of California, excess forest biomass from forest management and fuels reduction projects is utilized as feedstock for baseload renewable power generation. In agricultural regions, excess biomass from orchard operations is collected and delivered to bioenergy facilities. These activities mitigate air emissions from open burning (consistent with Senate Bill 705).

California has the most significant bioenergy infrastructure in the United States; however, this infrastructure is aging and some facilities have closed in recent years. There are currently 30 commercial-scale bioenergy facilities operating in the state with a generation capacity of approximately 600 megawatts (MW) of renewable power. There is a need to support this existing infrastructure (including bioenergy plants that are currently idle) while initiating development of additional, strategically located bioenergy facilities in California.

Societal Benefits

A robust and expanding California bioenergy market sector provides a number of compelling societal benefits, some of which are in addition to typical benefits of other renewable energy technologies.[4]

- **Promotes healthy forests and defensible communities.** Provides a ready market value for woody biomass material generated as a byproduct of forest management, hazardous fuels reduction and forest restoration activities.[5] This helps encourage projects that contribute to defensible communities and healthy forest ecosystems through the generation of income to fund additional treatment activities.

- **Protects key watersheds.** A significant portion of California's in-state water resources flow from forested landscapes. Healthy forest ecosystems in these upland watersheds ensure that sustainable quantities of high quality water for both domestic and agricultural uses will continue to flow.[6,7,8,9] In addition, water to support California's significant hydropower assets originates in these watersheds. This is particularly

[4]C. Mason, B. Lippke, K. Zobrist et al., "Investments in Fuel Removals to Avoid Forest Fires Results in Substantial Benefits," Journal of Forestry, January/February 2001, pp. 27-31.
[5]M. North, P. Stine, K. O'Hara, W. Zielinski, and S. Stephens, "An Ecosystem Management Strategy for Sierran Mixed-conifer Forests," USDA Forest Service, PSW General Technical Report PSW-GTR-220, 2009.
[6]D.G. Neary, K.C. Ryan and L.F. DeBano (eds.), Wildland Fire in Ecosystems: Effects of Fire on Soils and Water, Gen. Tech. Rep. RMRS-GTR-42-vol 4. Ogden, UT, USDA Forest Service Rocky Mountain Research Station, 2005.
[7]R.R. Harris and P.H. Cafferata, Effects of Forest Fragmentation on Water Quantity and Quality. Paper presented to the Conference on California Forest Futures, Sacramento, CA, May 23-24, 2005.
[8]J.D. Murphy, D.W. Johnson, W.W. Miller, R.F. Walker, E.F. Carrol, and R.R. Blank, "Wildfire Effects on Soil Nutrients and Leaching in a Tahoe Basin Watershed," Journal of Environmental Quality, Volume 35, 2006, pp. 479-489.
[9]Numerous studies led by Lee H. MacDonald, Colorado State University, Department of Forest, Rangeland, and Watershed Stewardship.

important given the predicted effects of climate change on future water production and the ability of forest management projects to protect and enhance both quality and quantity of water from forested landscapes. Increased water yield of 9-16%[10] could result should additional forest acres be thinned within a watershed (see targeted treatment acres table on page 1).

- **Provides net air quality and greenhouse gas benefits.** Forest biomass material that would otherwise be disposed of by open pile burning, in prescribed broadcast burns, or would have been consumed in a wildfire, can be utilized in a controlled manner to provide renewable energy (energy conversion units including boilers and gasifiers that are equipped with Best Available Control Technology), thus reducing air emissions and improving regional air quality. The air quality benefits are significant, with 95-99% reduction in particulate matter, carbon monoxide, and volatile organics, and a 60-80% reduction in nitrogen oxides when compared to open burning.[11,12,13] An additional climate change benefit results from replacing fossil fuel fired power generation with renewable bioenergy.

- **Provides economic development and employment.** Most bioenergy facilities are sited in rural areas that are currently experiencing significant economic hardship. Jobs include plant operations and maintenance as well as fuel collection, processing and transport. Approximately five jobs are created per MW of bioenergy generation.[14]

- **Reduces waste going to landfills**. Wood waste destined for landfills can be recovered and utilized, thus extending the service life of landfills and reducing the need to develop additional landfill facilities while producing renewable energy and reducing greenhouse gases.

- **Delivers distributed, baseload generation**. Locating new, small-scale bioenergy facilities strategically across forested regions in California may mitigate the need for transmission/distribution system upgrades, as small generation facilities require relatively little transmission capacity to deliver power to load centers. This will also provide strategic 24-7 baseload generation in regions that are remote and prone to inconsistent power availability, thus minimizing the need for large diesel fired generator sets that serve as standby generation.

- **Protects transmission/distribution infrastructure.** Power distribution infrastructure in California is significant. Many of the state's generation assets utilize transmission and distribution systems located in forested regions to deliver generation to load centers.

---

[10]R.C. Bales, et al., "Forests and Water in the Sierra Nevada: Sierra Nevada Watershed Ecosystem Enhancement Project," November 2011.
[11]Bruce Springsteen, Tom Christofk, Steve Eubanks, Tad Mason, Chris Clavin, and Brett Storey, "Emission Reductions from Woody Biomass Waste for Energy as an Alternative to Open Burning," Journal of the Air and Waste Management Association, Volume 61, January 2011, pp. 63-68.
[12]Greg Jones, Dan Loeffler, David Calkin, and Woodam Chung, "Forest Treatment Residues for Thermal Energy Compared With Disposal by Onsite Burning: Emissions and Energy Return," Biomass and Bioenergy, Volume 34, 2010, pp. 737-746.
[13]Carrie Lee, Pete Erickson, Michael Lazarus, and Gordon Smith, "Greenhouse Gas and Air Pollutant Emissions of Alternatives for Woody Biomass Residues," prepared by the Stockholm Environment Institute for the Olympic Region Clean Air Agency, November 2010.
[14]G. Morris, The Value of the Benefits of US Biomass Power, November, 1999, NREL Publication SR 570-27541.

Forest management and hazard reduction projects can reduce the likelihood of wildfire damage to valuable power distribution infrastructure.

- **Utilizes renewable and sustainable feedstocks.** Bioenergy facilities are sized appropriately to utilize biomass from sources that continue to produce biomass in a long-term, sustainable way.

- **Helps California meet greenhouse gas reduction, waste reduction, air quality and renewable energy objectives.** The bioenergy market sector helps the state meet specific policy objectives as set by the California legislature and the Governor:

  - AB 32 – Greenhouse Gas Reduction.
  - AB 939 – Waste Reduction – Reduced Landfill Deposits.
  - SB 1078 – Establishes a Renewable Portfolio Standard for California.
  - Executive Order S-06-06 – Sets Bioenergy Production Targets.
  - SBX 1-2 – Increases the Renewable Portfolio Standard to 33%.
  - SB 1122 – Establishes a 250 MW set aside for bioenergy projects scaled at up to 3 MW of generation capacity.
  - SB 705 – Requires commercial orchard growers located in the San Joaquin Valley Air Pollution Control District jurisdiction to minimize use of open burning to dispose of orchard prunings and orchard removal material.

- **Reduces wildfire suppression costs.** Forest management fuel reduction activities significantly reduce the economic costs for fighting wildfires. Fire suppression costs on US Forest Service managed lands in California averaged $2,114 per acre between 1995 and 2004.[15]

Barriers

- Appropriated budgets for federal land management activities are far less than necessary for adequate levels of sustainable forest management and hazardous fuels reduction.

- Due to the loss of forest products manufacturing in California, there are fewer facilities and contractors available to implement forest management activities. Retrofitting manufacturing sites for the processing of biomass waste material generated as a byproduct of forest management and hazard fuels reduction activities is economically and logistically challenging.

- Woody biomass that is a byproduct of forest management and hazard fuels reduction projects has value for energy production or other products (like soil amendment) and therefore offers the potential for cost recovery revenue for forest owners and managers. However, woody biomass market value as a renewable fuel has dropped in recent years (partly due to low-cost fossil fuels like natural gas and the relative low cost of other

[15] K.M. Gebert et al., "Estimating Suppression Expenditures for Individual Large Wildland Fires," Western Journal of Applied Forestry, 2007, pp. 188 to 196.

renewables such as solar), so large volumes of woody biomass are currently not utilized and are instead open-burned on site.

- There is a lack of consensus among key interests as to what constitutes sustainable forest management. This often results in appeals or litigation that delay new project implementation.

- Current wholesale power market pricing, formulated primarily for natural gas fired plants, does not provide adequate funding to sustain existing and new bioenergy facilities.

- Many of the investor owned utilities are focused on least cost/best fit for renewable generation (as a result of CPUC guidance), which does not favor the relatively high cost bioenergy generation sector.

Solutions

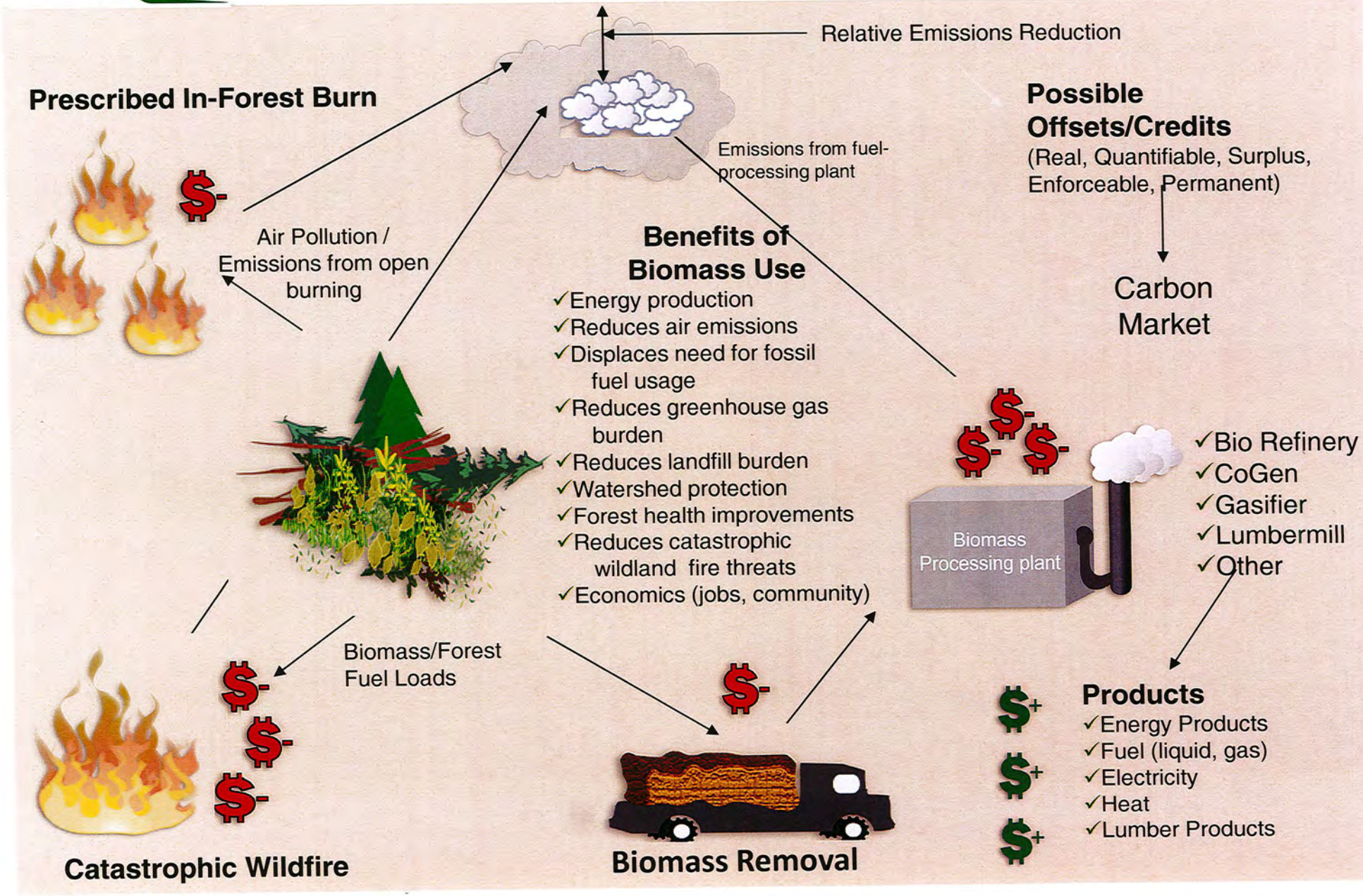
Solution sets that provide specific and tangible results to address forest health and wildfire defensible communities are identified below, grouped as short-term and longer-term targets. There is a sense of urgency to implement these solutions, as we know that the current state of California forest landscapes, watersheds and rural communities is not sustainable and will continue to be impacted by catastrophic wildfire and climate change.

Short-Term Solutions
• AB 32 Investment Plan - State should invest in forest health projects now to realize carbon storage enhancement by 2050.
• CPUC - SB 1122 implementation process - focus on fair and equitable treatment of forest bioenergy projects. Provide input on societal and ratepayer benefits (CPUC workshop planned winter of 2013). Share Mokelumne Watershed Avoided Cost Study findings with the CPUC. Help CPUC develop balancing account for IOU's to share costs that benefit all ratepayers/society. (Consider cost shifting options - post AB 1890.)
• Brief key state agencies (CPUC/CEC) on the need to invest EPIC $ in research, development and deployment of emerging bioenergy technologies.
• Brief key federal agencies and elected officials (USDA/DOI) on the need to increase investment in forest restoration and fuels treatment activities and associated need to develop a plan to dispose of the wood waste that will be generated as a byproduct of such investment.
• Coordinate implementation of bioenergy technology workshops to align key players (e.g., financial institutions, project developers, investors, state agencies) to the potential opportunities. Consider asking Cal EPA/BAC and/or UC Extension to sponsor these workshops.
• Support upcoming forest biomass technology and finance summit to conduct outreach regarding the understanding of technology and finance of distributed generation forest biomass facilities in California.
• Meet with elected officials (e.g., Assembly Members Dahle and Gordon) to brief them on Wood Energy Group and BWG initiatives. Discuss possible field trip to Blodgett or other appropriate locations.
• Participate in Biomass Work Group meetings to continue to help build support for sustainable forest management and bioenergy development among a broad range of interests.

Longer-Term Solutions

- Continue to explore market-based credit programs associated with the multiple benefits that forest biomass to energy provides, including establishing mechanisms through the California Environmental Quality Act, the regulations related to the Renewable Portfolio Standard program, and other existing and possibly new statutory programs.
- Research in support of a biomass to biochar GHG emissions offset protocol.
- Research relating to the benefits of methane and black carbon reduction from the avoidance of open pile burning.
- Continue to pursue research related to defining the GHG benefits of sustainable forest management that reduce the negative impacts of wildfire.
- Participate in least cost/best fit and baseload energy discussions. Work to address current contractual and regulatory dynamic so existing biomass infrastructure can continue to exist.

Biomass Emission / Economic Process Model



Mokelumne Watershed Avoided Cost Analysis:

Why Sierra Fuel Treatments Make Economic Sense

High-severity wildfires in forests of California's Sierra Nevada pose a serious threat to people and nature. Although proactive forest management can reduce the risk of high-severity wildfire, the pace and scale of fuel treatments is insufficient, given the growing scope of the problem. Using the upper Mokelumne River watershed as a representative case, we sought to answer the following question: Does it make economic sense to increase investment in fuel treatments to reduce the risk of large, damaging wildfires? Our analysis suggests that the economic benefits of landscape-scale fuel-reduction treatments far outweigh the costs of wildfire.

Recent wildfires in California and the West have destroyed lives and property, degraded water quality, put water supply at risk, damaged wildlife habitat and cost hundreds of millions of dollars. For example:

- The 2013 Rim Fire—located just south of the Mokelumne River in the central Sierra Nevada—burned nearly 257,000 acres, much of it at high severity, at a cost of more than $127 million, not including the costs to the economy and tourism.
- The 2013 Yarnell Fire in Arizona killed 19 firefighters, destroyed more than 100 homes and damaged the town's water system.
- The 2002 Hayman Fire in Colorado burned 138,000 acres, destroyed more than 600 structures, and deposited more than 1 million cubic yards of sediment into Strontia Springs Reservoir—a primary drinking water source for the City of Denver—at a growing cost of more than $150 million.

The Sierra Nevada provides more than 60 percent of the developed water supply for California. High-severity wildfire places this water supply at risk. The upper Mokelumne River watershed in the central Sierra Nevada supplies drinking water to 1.3 million residents of the San Francisco Bay Area and provides valuable goods and services, including but not limited to forest and agricultural products, hydropower energy, recreation, wildlife habitat and carbon sequestration. Like other Sierra Nevada and western watersheds, much of the Mokelumne watershed is at very high risk of wildfire (figure ES-1).

Although wildfire and the associated costs are increasing in the western United States, few studies have taken a hard look at the costs and benefits of fuel treatments to determine if an increased investment in treatments makes economic sense. Through a collaborative process with key stakeholders and using state-of-the-art models for fire, vegetation and post-fire erosion, we analyzed the potential impacts of a landscape-scale fuel treatments program in the upper Mokelumne watershed. In addition, we examined who would benefit the most from investing in fuel treatments and reducing the risk of high-intensity wildfires. Our findings can help inform forest management not only in the Mokelumne watershed, but also in similar watersheds throughout the Sierra Nevada and the western United States.

The Nature Conservancy
Protecting nature. Preserving life.

SIERRA NEVADA CONSERVANCY

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

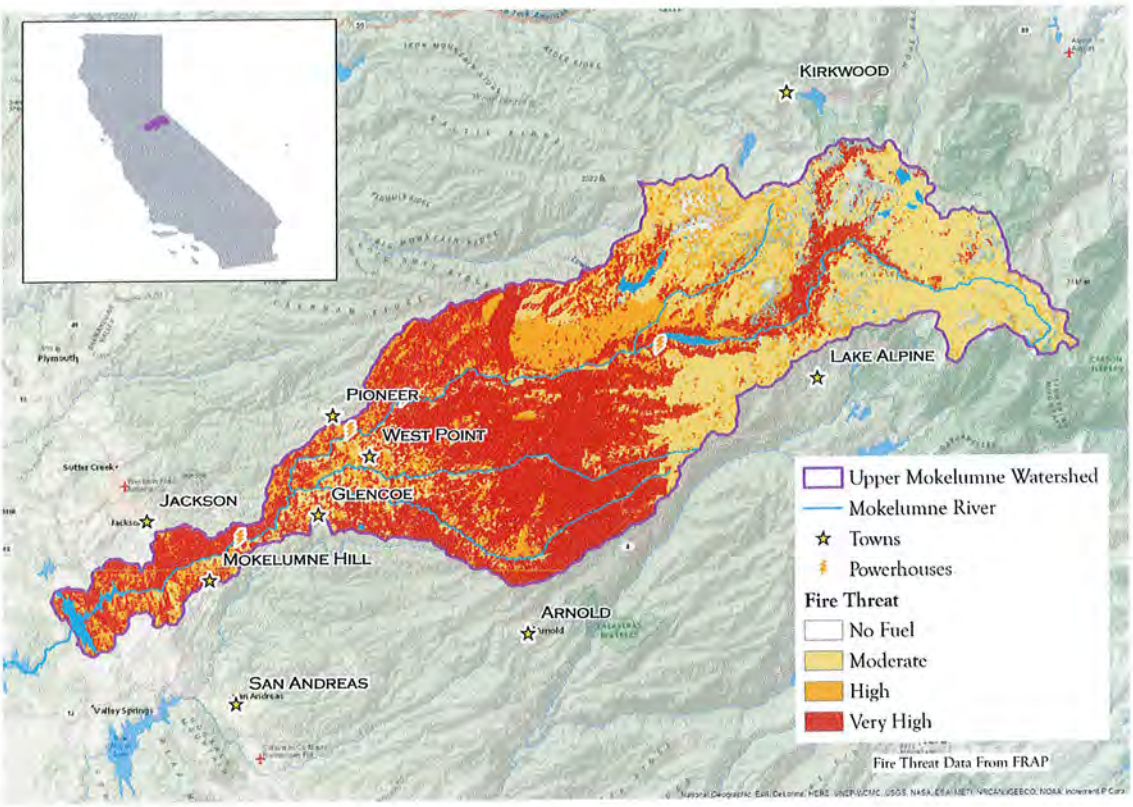


FIGURE ES-1. Fire Hazard in the Upper Mokelumne Watershed

Process

In February 2012, the Sierra Nevada Conservancy, The Nature Conservancy, and the U.S. Forest Service convened a diverse group of stakeholders to consider whether an economic case could be made for increased investment in fuel reduction in the upper Mokelumne watershed. This group included land managers (the Forest Service, Bureau of Land Management, Sierra Pacific Industries); water and electric utilities (East Bay Municipal Utility District, Pacific Gas & Electric); state and local agencies (California Department of Water Resources, California Department of Forestry and Fire Protection and county governments); environmental organizations (Sustainable Conservation, Environmental Defense Fund); and local stakeholders (Foothill Conservancy, Amador-Calaveras Consensus Group, West Point Fire District).

We established an Advisory Committee to help guide the overall process and analysis, a Technical Committee to address issues relating to science and modeling, and a consulting team, led by ECONorthwest, to conduct the economic analyses. Using a collaborative process, we developed a site-specific fuel-treatments scenario, targeting areas of high fire risk to homes, communities and utility infrastructure, as well as post-fire sediment erosion risk to waterways. We commissioned studies to simulate the outcomes of future fires with and without fuel treatments—specifically forest thinning and controlled burning. The Advisory Committee, Technical Committee and consultants subsequently reviewed the analysis, vetted and approved each chapter of the report and endorsed the report's findings and conclusions.

Analysis

Our analysis focused on modeling wildfire in the Mokelumne watershed both with and without implementation of the fuel-treatments scenario. We analyzed the size and intensity of five potential representative fires based on fire history in the region, current forest conditions and state-of-the-art wildfire models. We modeled the fuel-treatments scenario to identify how active forest management would likely modify wildfire behavior and post-fire erosion over a 30-year time period. Using these results, we quantified the financial costs and benefits of the treatments, focusing on those elements to which a dollar value can readily be assigned such as homes, infrastructure, timber, biomass energy, carbon and employment.

The analysis was based on conservative assumptions regarding potential costs and benefits, not a worst-case wildfire scenario. For example, the nearby 2013 Rim Fire was significantly larger than all five modeled fires combined and burned at higher intensity. In addition, we did not consider wildfire impacts with economic values that could not be readily determined, such as the effects of fire on wildlife habitat, recreation, tourism, and public health and cultural sites. Thus, in multiple respects, our conclusions likely underestimate the costs associated with future wildfires and the benefits of active management, suggesting an even stronger case for action.

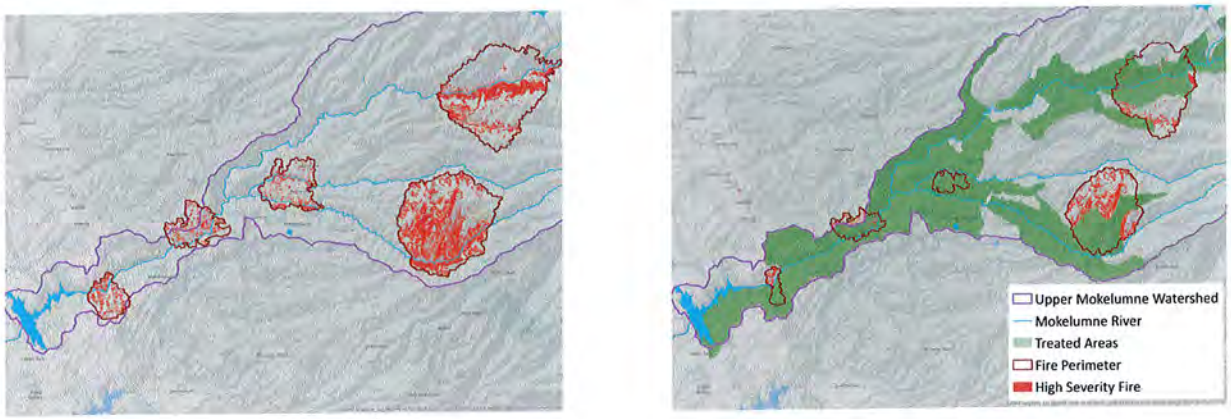


Figure ES-2. High-intensity Wildfire Pre- and Post-Treatments

Key Findings

- **Fuel treatments can significantly reduce the size and severity of wildfires.** Proactive forest management can significantly modify fire behavior by reducing fire severity, size and rate of spread. Our results showed that the modeled fuel-treatments scenario reduced the size of each of the five fires by 30 to 76 percent, or a total reduction in size of approximately 41 percent. More importantly, the modeled scenario reduced the acreage of high-intensity wildfire by approximately 75 percent (figure ES-2).

- **The economic benefits of modeled fuel treatments are 2-3 times the costs.** In total, across the categories of benefits quantified in this report, the value of avoided costs significantly exceeds the cost of fuels management (figure ES-3). The avoided losses in terms of both costs and lost income opportunities include the value of structures saved from wildfire and the costs of fire suppression and post-fire restoration, as well as potential revenue from carbon sequestration, merchantable timber and biomass that could be used for energy. For each cost category, we estimated a range of values from low to high. Using the high estimates for benefits ($224 million) results in a benefit-cost ratio for the fuel-treatments scenario of 3.3:1. Even when applying a more conservative approach, using the low estimate for benefits ($126 million), the benefits of investing in fuel treatments are nearly twice the costs, with a benefit-cost ratio of approximately 1.9:1.

- **There are many beneficiaries from increased fuel treatments, especially taxpayers.** The economic benefits of fuel treatments accrue to a wide range of landowners, public and private entities, taxpayers and utility ratepayers. As shown in figure ES-4, the primary beneficiaries are the State of California, federal government, residential private property owners (and their insurers), timber owners, and water and electric utilities. By comparison, the costs of fuel treatments are largely borne by public land managers (and, by implication, taxpayers). An accelerated fuel-treatments program would also result in an estimated 35-45 jobs relating to fuel treatments and 7-10 biomass-to-energy jobs over a 10-year period. These figures represent a significant addition to the current number of such jobs in these rural areas.

Costs		
Fuel Treatment	$68,000,000	$68,000,000
Benefits	**Low**	**High**
Structures Saved	$32,000,000	$45,600,000
Avoided Fire Cleanup	$22,500,000	$22,500,000
Carbon Sequestered	$19,000,000	$71,000,000
Merchantable Timber from Treatment	$14,000,000	$27,000,000
Avoided Suppression	$12,500,000	$20,800,000
Biomass from Treatment	$12,000,000	$21,000,000
Avoided Road Repairs and Reconstruction	$10,630,000	$10,630,000
Transmission Lines Saved	$1,600,000	$1,600,000
Timber Saved	$1,200,000	$3,130,250
Avoided Sediment for Utilities (water supply)	$1,000,000	$1,000,000
Total Benefits	**$126,430,000**	**$224,260,250**

Figure ES-3. Total Costs and Benefits for Fuel-Treatments Scenario

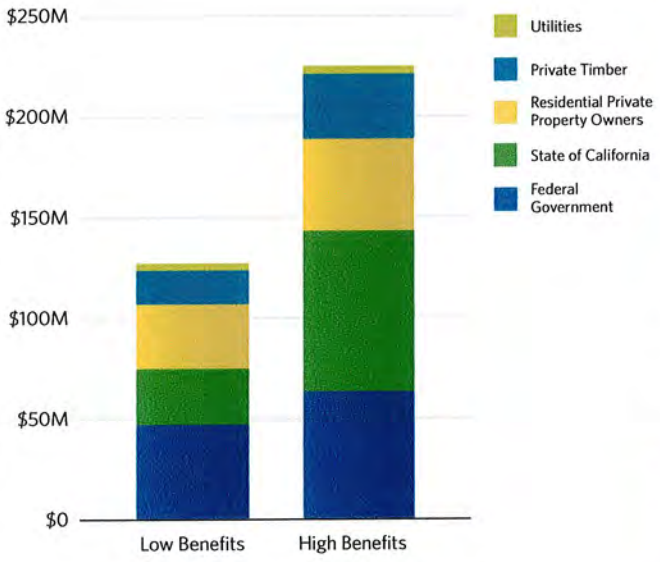


Figure ES-4. Fuel Treatments Beneficiaries

Summary

In sum, our analysis shows that it makes economic sense to invest in forest management to reduce the risk of destructive, high-severity wildfires in the upper Mokelumne watershed. Although achieving such benefits requires a significant increase in the pace and scale of fuel treatments, the long-term cost savings far exceed the costs of the initial investment. To the extent that the Mokelumne is representative of other fire-adapted forested watersheds of the Sierra Nevada and the western United States, this report makes the economic case for significantly increasing investment in fuel treatments in western forests.

FOR A COPY OF THE FULL REPORT:
SierraNevada.ca.gov/Mokelumne

FOR MORE INFORMATION:

The Nature Conservancy
Protecting nature. Preserving life.

David Edelson
dedelson@tnc.org

Kristen Podolak
kpodolak@tnc.org

SIERRA NEVADA CONSERVANCY

Kim Carr
kim.carr@sierranevada.ca.gov

Nic Enstice
nic.enstice@sierranevada.ca.gov

Sherry Hazelhurst
shazelhurst@fs.fed.us

Produced in cooperation with the USDA Forest Service.
Photography: Cover: © Katherine K. Evatt and Foothill Conservancy; This page: Above: © Mathew Grimm / Environmental Defense Fund; Below: © Noah Berger EPA

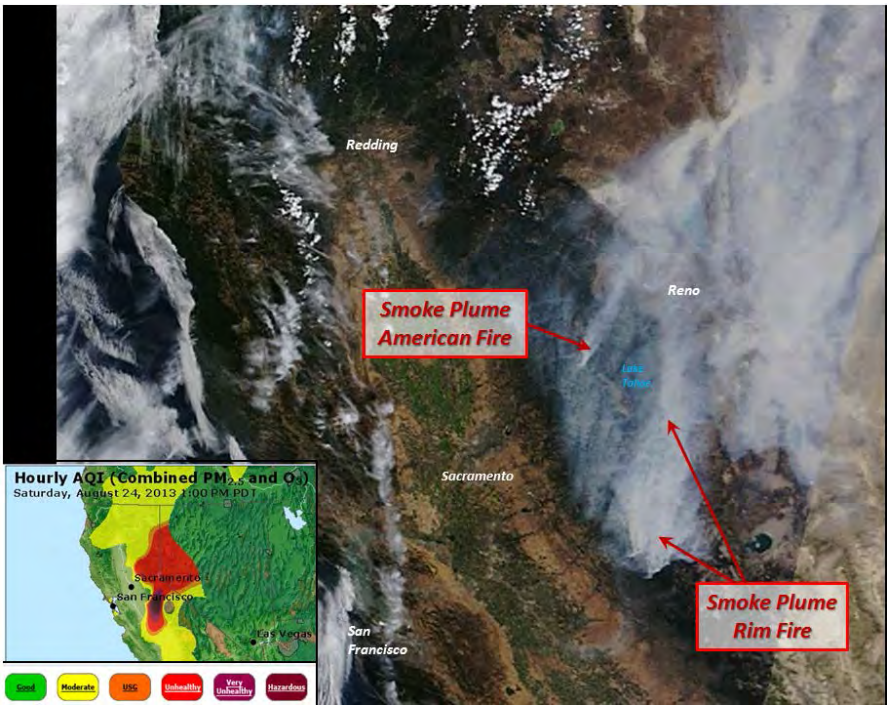
The Rim Fire: Why investing in forest health equals investing in the health of California

What happens in the Sierra doesn't stay in the Sierra

On August 17, 2013 the Rim Fire began burning in the steep, rugged canyons of the Stanislaus National Forest, headed for Yosemite National Park. As devastating as the event was to the local landscape and communities, the impacts of the Rim Fire were widespread:

- On August 23rd, Governor Brown declared a **state of emergency for the City of San Francisco** due to the threat that the fire posed to water and power resources at Hetch Hetchy - the reservoir that serves 2.6 million people in the Bay Area.

- **Air quality warnings** were issued for Lake Tahoe, Carson City, and Reno, **more than 100 miles away**. Some hotels in South Lake Tahoe experienced as much as a 20% drop in business as a result of the smoke.



The smoke plume from the Rim Fire stretched across the Sierra and in to Nevada, creating unhealthy air as far away as Reno and Carson City.

*Initial estimates indicate that the Rim Fire released **11,352,608 metric tons of greenhouse gas** emissions. Based on the U.S. EPA's web site, those emissions are roughly equivalent to:*

- Annual **greenhouse gas emissions** from **2.3 million cars**
- **Carbon dioxide emissions** from **1.2 billion gallons of gas** consumed
- **Carbon dioxide emissions** from the electricity use of **1.5 million homes** for 1 year
- Annual **carbon dioxide emissions** of **3.2 coal fired power plants**

Fire's impacts will be long-term

Decades of fire supression, a changing climate, and a shortage of forest restoration efforts have led to the current unhealthy condition of many of our Sierra forests, resulting in an increase in the frequency of larger, more damaging fires. These fires, like the Rim Fire, take longer to heal and can result in long-term impacts on water quality and supply.

- The Rim Fire burned so hot in some areas -- **five times hotter than boiling water** -- that it changed soil chemistry and structure. These "high burn" areas are **more erosion-prone**.
- Nearly 100,000 acres, about **40% of the area**, burned at **high intensity**. Ecologists say that it could take **30 to 50 years** for the forest to reestablish itself in these areas.
- Denver Water is still spending **millions of dollars** to stem erosion **12 years after** the Hayman Fire burned across 215 square miles in the foothills south of Denver. The Rim Fire has consumed nearly 2 times that area at 402 square miles.

The Rim Fire illustrates both the need to address existing forest conditions in the Sierra and the direct relationship between the Sierra Nevada and the rest of California. More than **60% of California's water** originates in the Sierra Nevada, and Sierra forests store enough carbon to offset the annual carbon dioxide emissions of 108 coal fired power plants. Investing in forest health and reducing the risk of large damaging fires, like the Rim Fire, is essential to ensuring that these Sierra benefits continue to exist in the future.

Photo Credit: USFS Mike McMillian

Rim Fire: Largest fire in recorded history of the Sierra Nevada

The Rim Fire doubled in size during the early stages. In less than 3 weeks it grew to be the largest wildfire in the Sierra Nevada and the 3rd largest in California history.

- To date the Rim Fire has burned, 257,314 acres, about 402 square miles or an area equal to eight times the size of San Francisco.
- Supression cost to date: $127.2 million
- Cost of emergency road, trail, and watershed stabilization efforts to date: $8.5 million
- An estimated $900,000 was spent to purchase alternative energy when 2 of San Francisco Public Utility Commission's (SFPUC) 3 hydroelectric powerhouses were taken offline as a result of the fire. The exact cost to repair the damage to these powerhouses is still unknown, but SFPUC estimates it to be in the millions.
- Habitat for many species, including listed or proposed for listing species such as the California spotted owl, great gray owl, and Pacific fisher was drastically altered.
- Losses to the ranching community, such as destroyed grazing land, killed livestock, and damaged infrastructure, are estimated to be in the millions.
- Tuolumne County budget projections show about $275,000 less in estimated income from the tourism-driven occupancy tax on hotels, campgrounds, and other lodging.

Investing in forest health, clean energy

During the past five years, over 4.5 million acres of California forests have been impacted by wildfire. Many predict that the size and severity of these fires, like the Rim Fire, will continue to increase unless investment is made in proactive forest restoration treatments. This sustainable forest management includes removing excess biomass, or small diameter trees, branches, and diseased wood, that act as fuel for a fire. Biomass represents a huge untapped resource for the generation of heat and power and its removal can improve forest health and reduce the risk of catastrophic wildfire. In fact, burning biomass in a controlled facility to generate power, as opposed to an open fire, can reduce carbon dioxide emissions and create jobs for rural economies.

The Sierra Nevada Conservancy is a state agency that carries out a mission of protecting the environment and economy in a complementary fashion across 25 million acres, one-quarter of the state. To learn more, please visit the Sierra Nevada Conservancy Web site.

11521 Blocker Dr., Suite 205 Auburn, CA 95603
(530)823-4670 (877)251-1212
SIERRANEVADA.CA.GOV