Economics of Fuels Management and Forest Thinning

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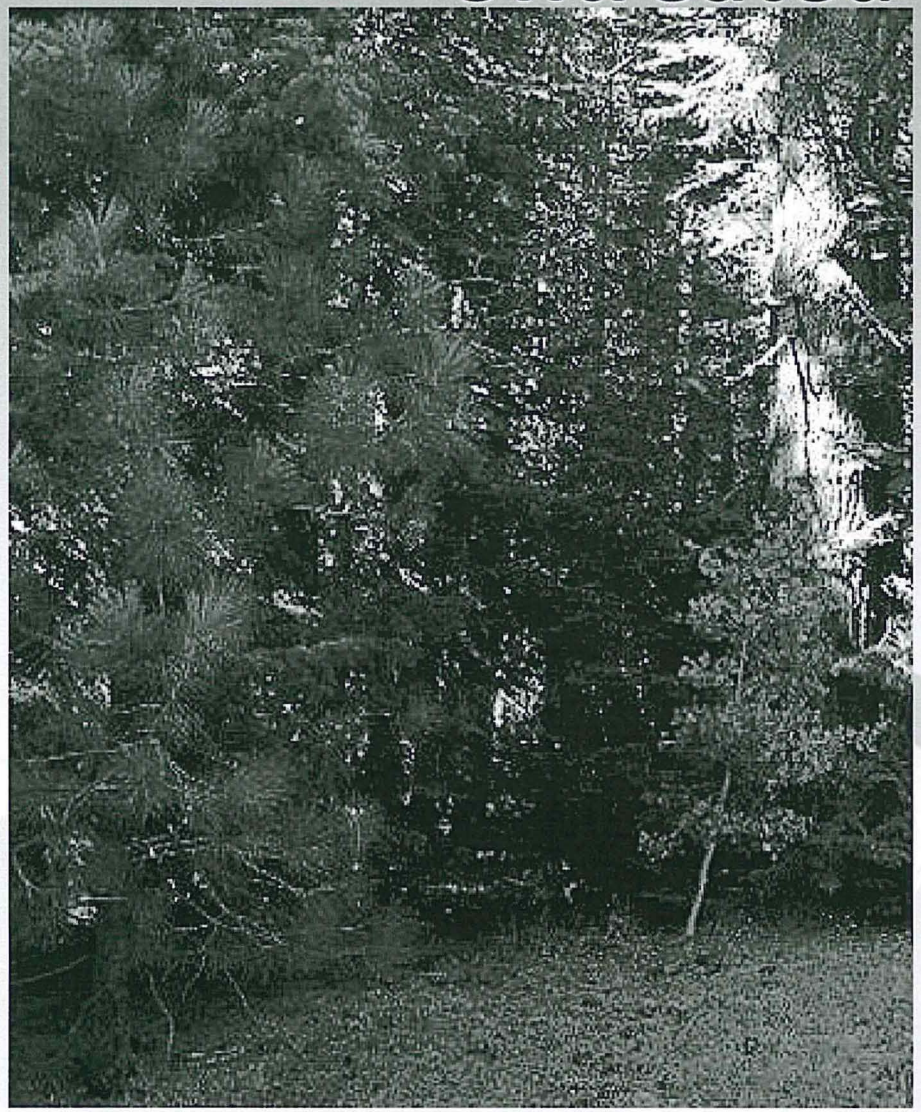
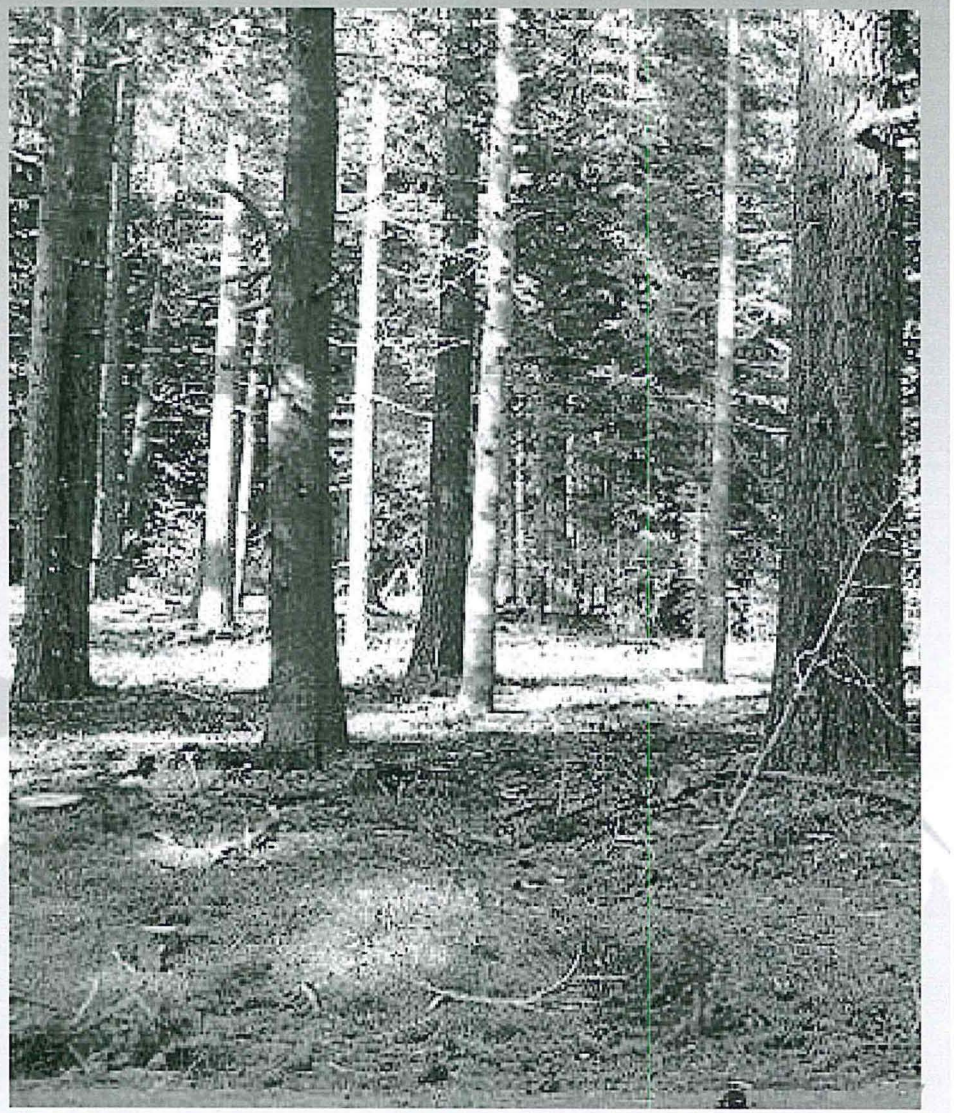
Sierra Nevada Conservancy

Forest Conditions: Untreated and Treated





Pile and Open Burning

Waste Diversion

Open pile burning

Closed burning

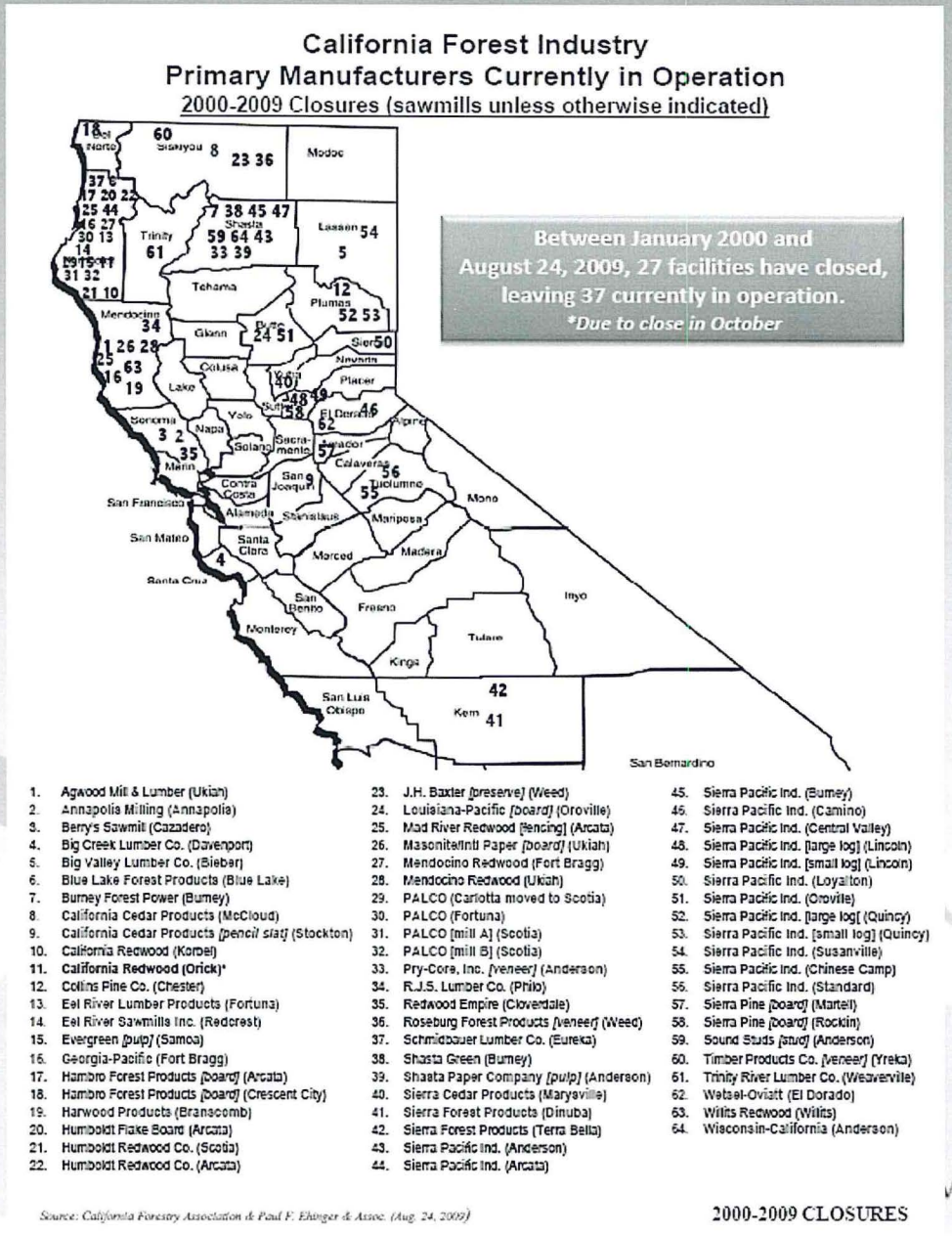
Woody Biomass Utilization

Value-added end uses:

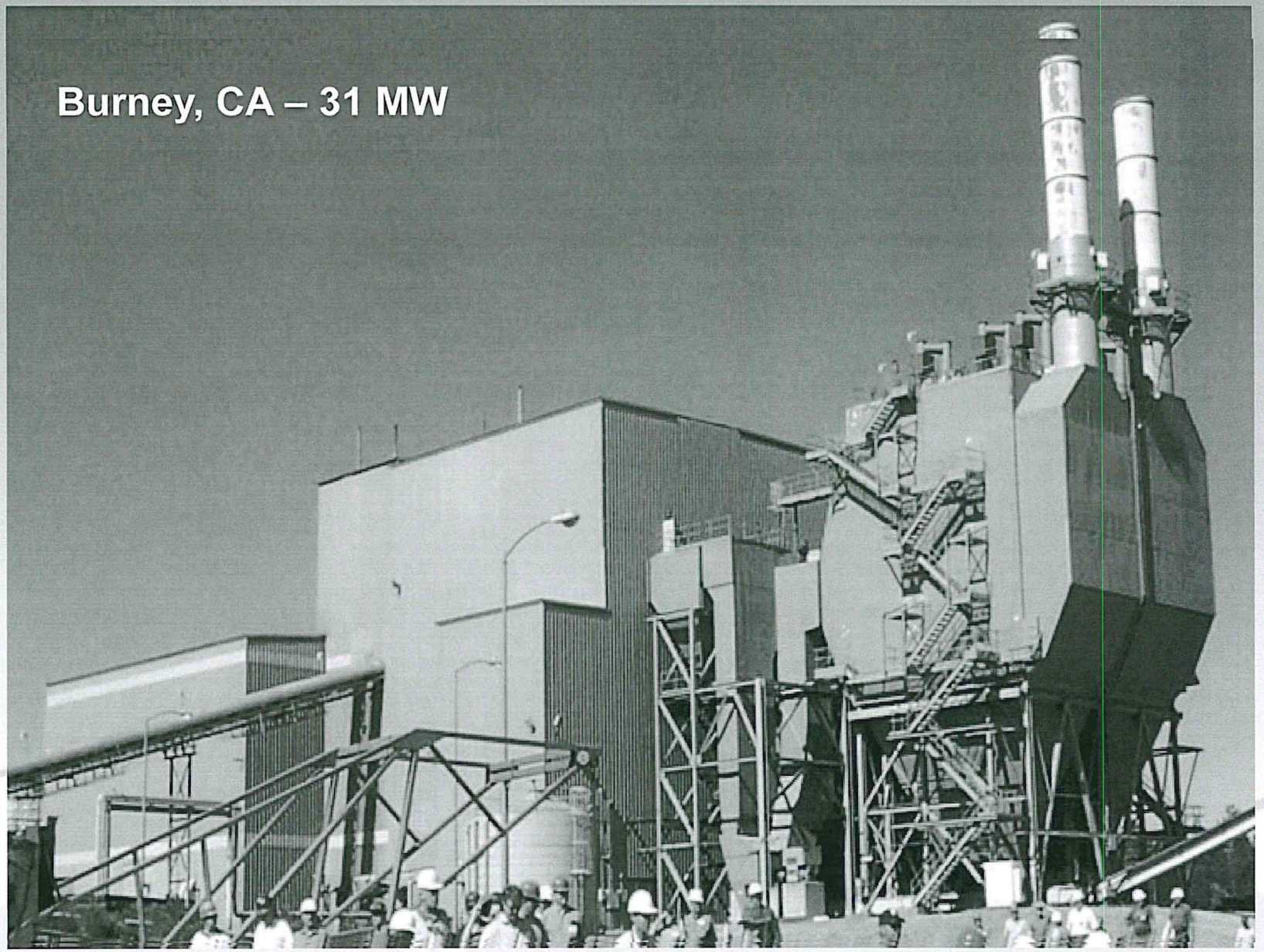
- Lumber products, composite panels, pulp
- Soil amendments
- Densified fuel pellets
- Animal Bedding
- Landscape cover
- Biofuels (ethanol, renewable diesel)
- Biomass power (generation or cogeneration)

Wood Processing Infrastructure

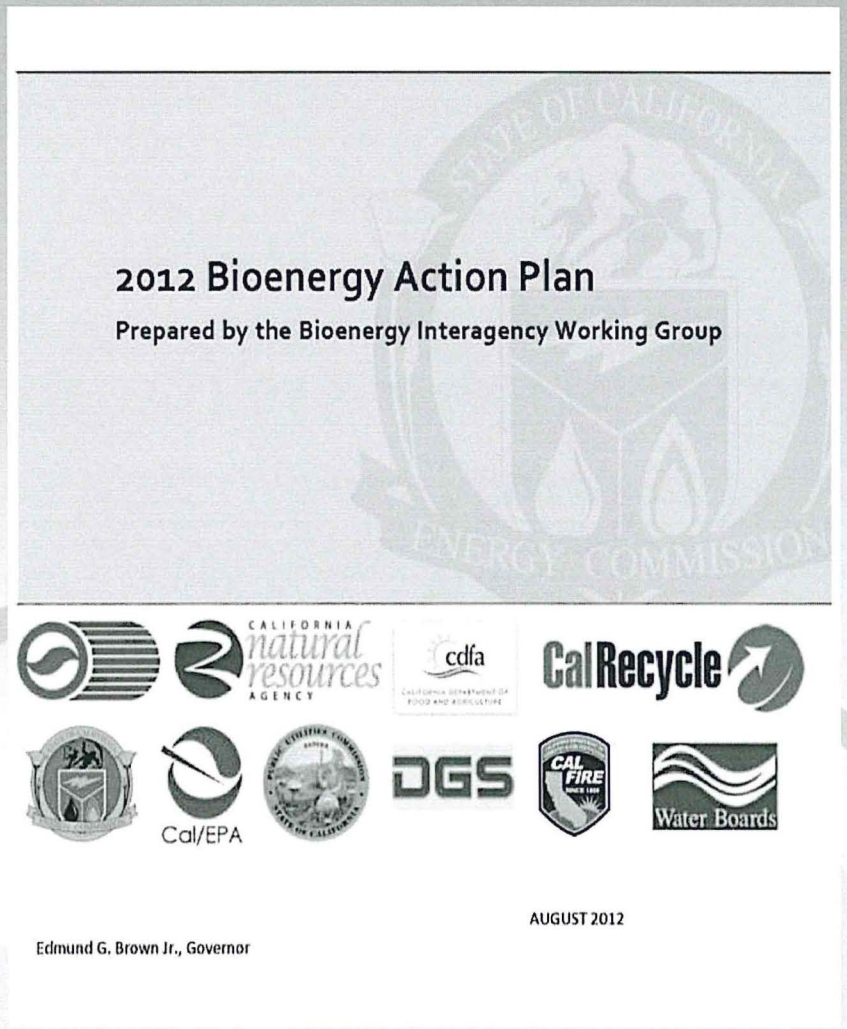
There is a continued decline in wood processing facilities (Red indicates closures in last decade). Currently, there are only 3 mills operating between I-80 and Mexico in the Sierra Nevada.



Burney, CA – 31 MW



California Bioenergy Action Plan



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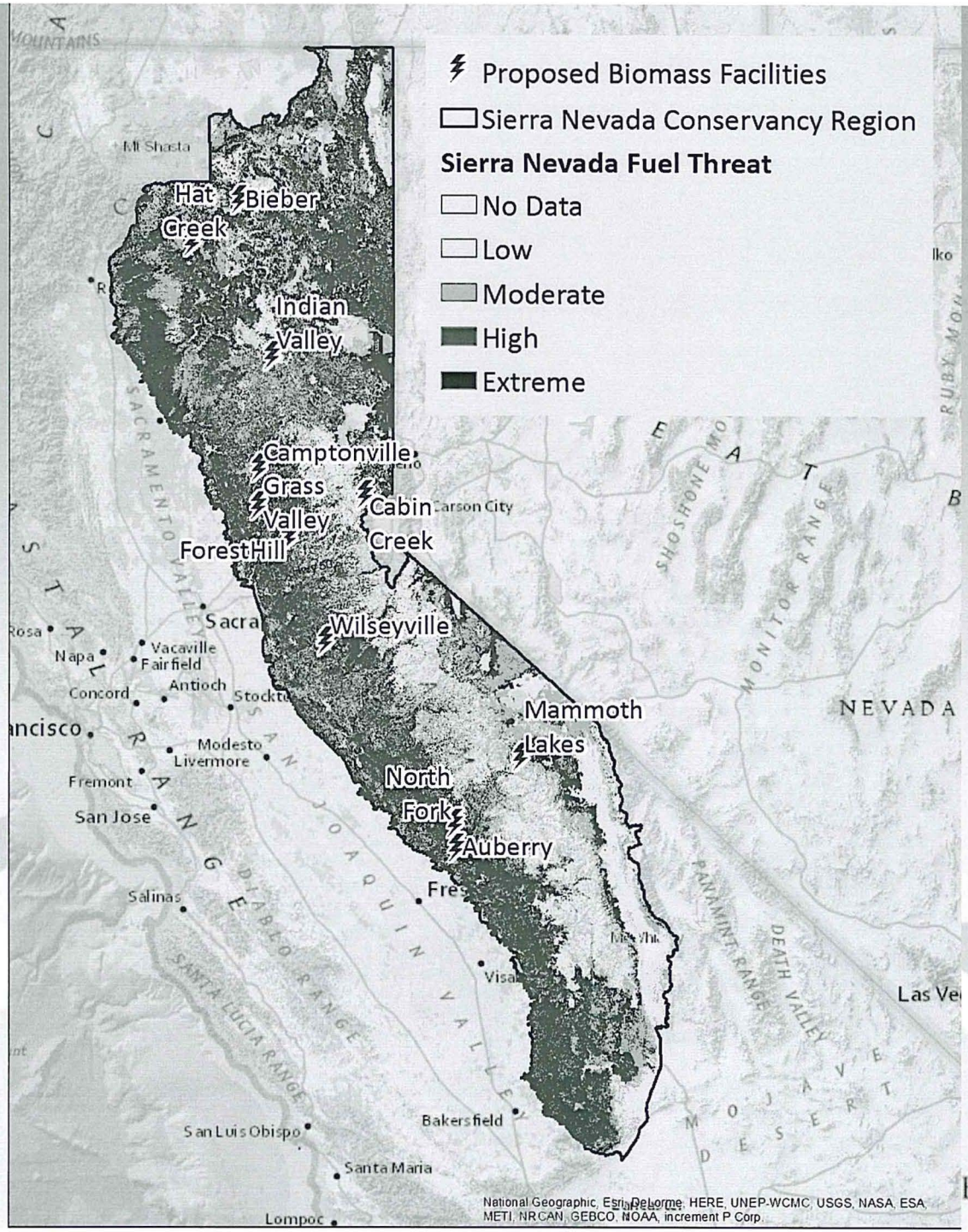
SB 1122 Impact on Biomass

- Creation of markets for woody biomass from hazardous fuels reduction
  - 50 Mw of distributed energy will utilize approximately 400,000 (BDT) of forest biomass
  - Support treatment of approximately 30,750 acres per year

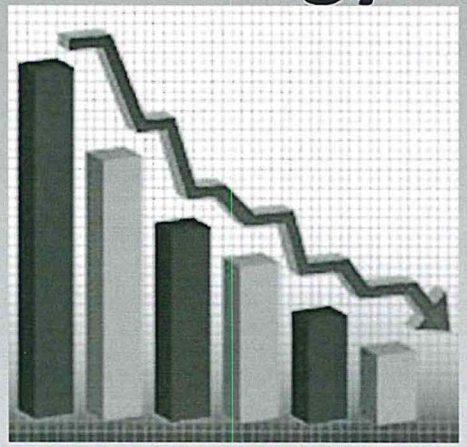
Woody Biomass Energy Facility


Proposed Biomass Facilities
Sierra Nevada Conservancy Region
Sierra Nevada Fuel Threat
No Data
Low
Moderate
High
Extreme
Hat Creek
Bieber
Indian Valley
Camptonville
Grass Valley
Cabin Creek
Forest Hill
Wilseyville
Mammoth Lakes
North Fork
Auberry
Mt Shasta
Carson City
Sacra
Napa
Vacaville
Fairfield
Antioch
Concord
Stockt
Modesto
Livermore
Fremont
San Jose
Salinas
Visa
Bakersfield
San Luis Obispo
Santa Maria
Lompoc
NEVADA
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
SANTA LUCIA RANGE
DIABLO RANGE
SHOSHONE MO
MONITOR RANGE
PANAMINT RANGE
DEATH VALLEY
MOJAVE DESERT
National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Challenges to Increasing Forest Bioenergy

Increasing Wildfire and Associated Costs

Fewer wood Processing facilities



Declining Budgets

Regulation & Project Review

Litigation

Cheaper Renewables

Budding Industry Risks

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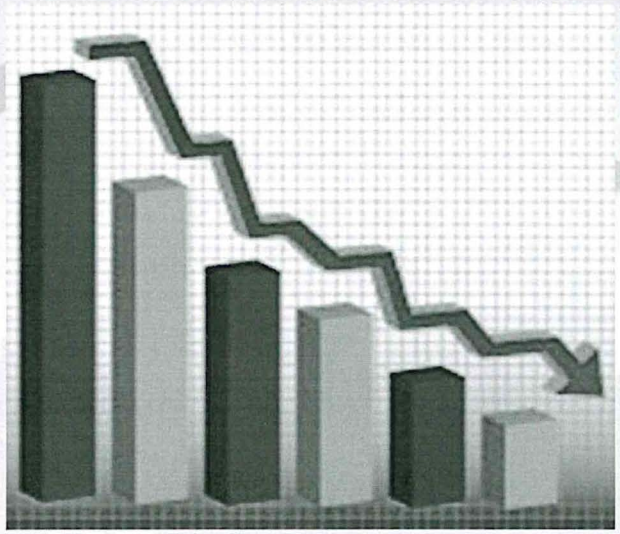
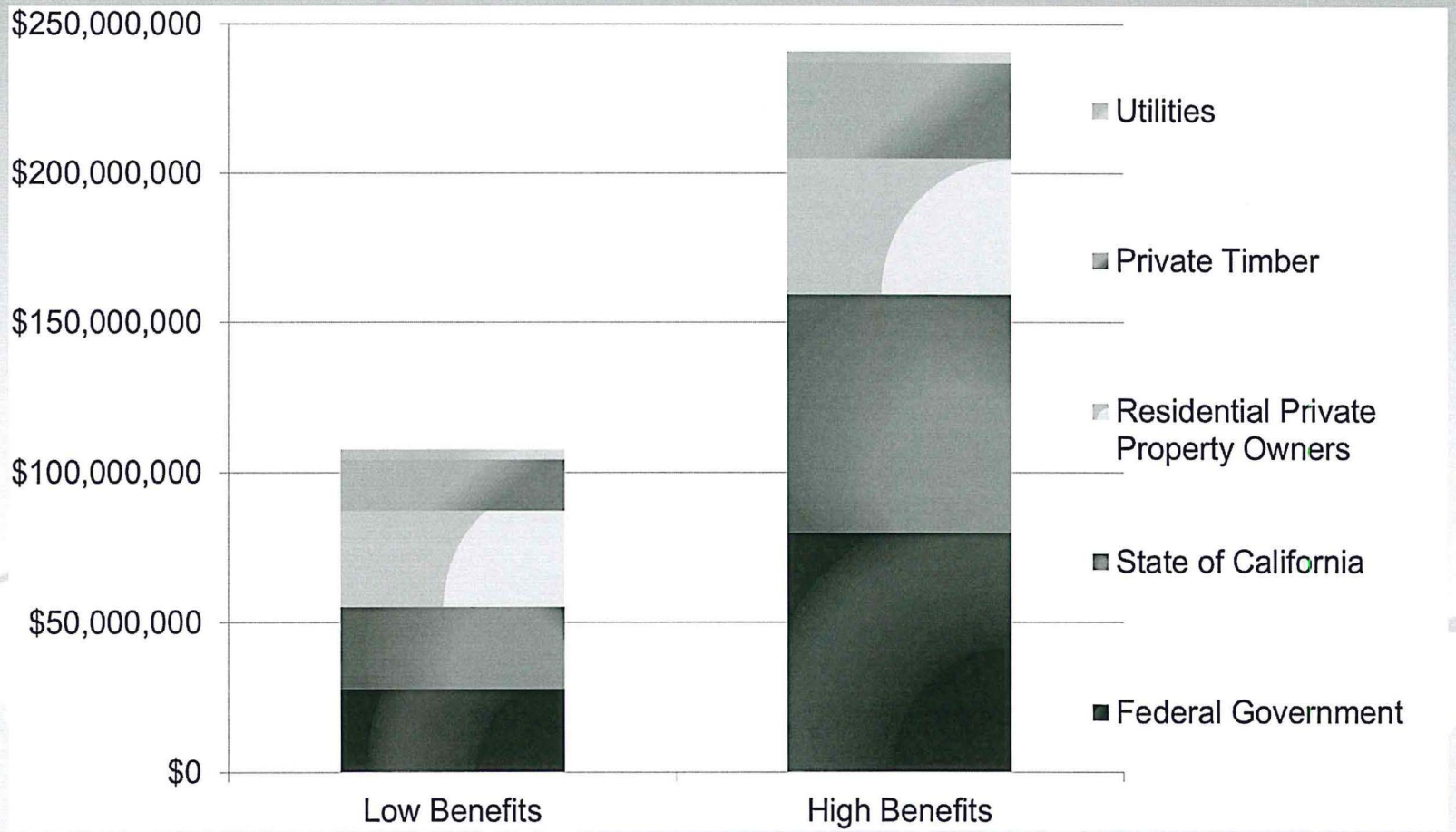
Mokelumne Watershed Avoided Cost Analysis

To answer the question –

Does it make economic sense to increase investment in fuel treatments to reduce the risk of large, damaging wildfires?



Avoided Cost Analysis Key Finding



USDA Forest Service

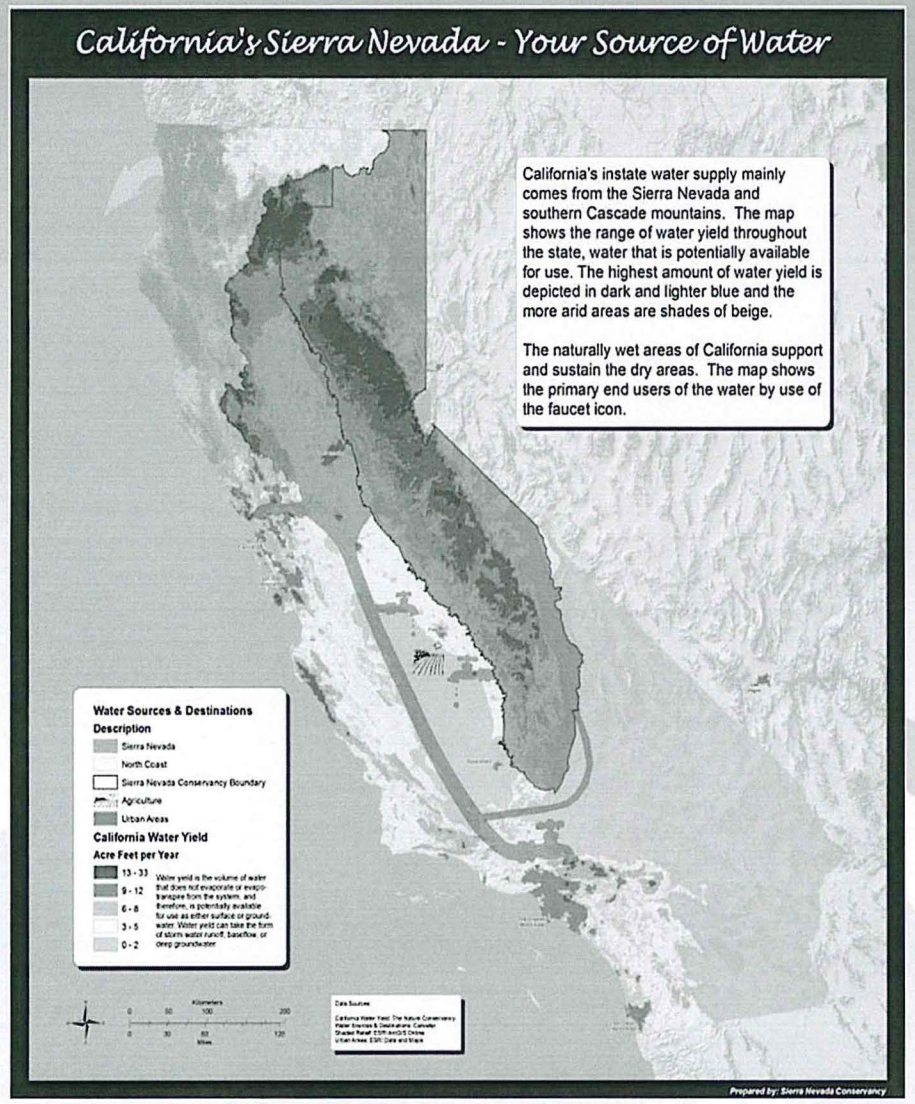
- Manages 20% of California land and the majority of forested lands
- Of the 20 million acres, 6 – 9 million acres have been identified as needing treatment

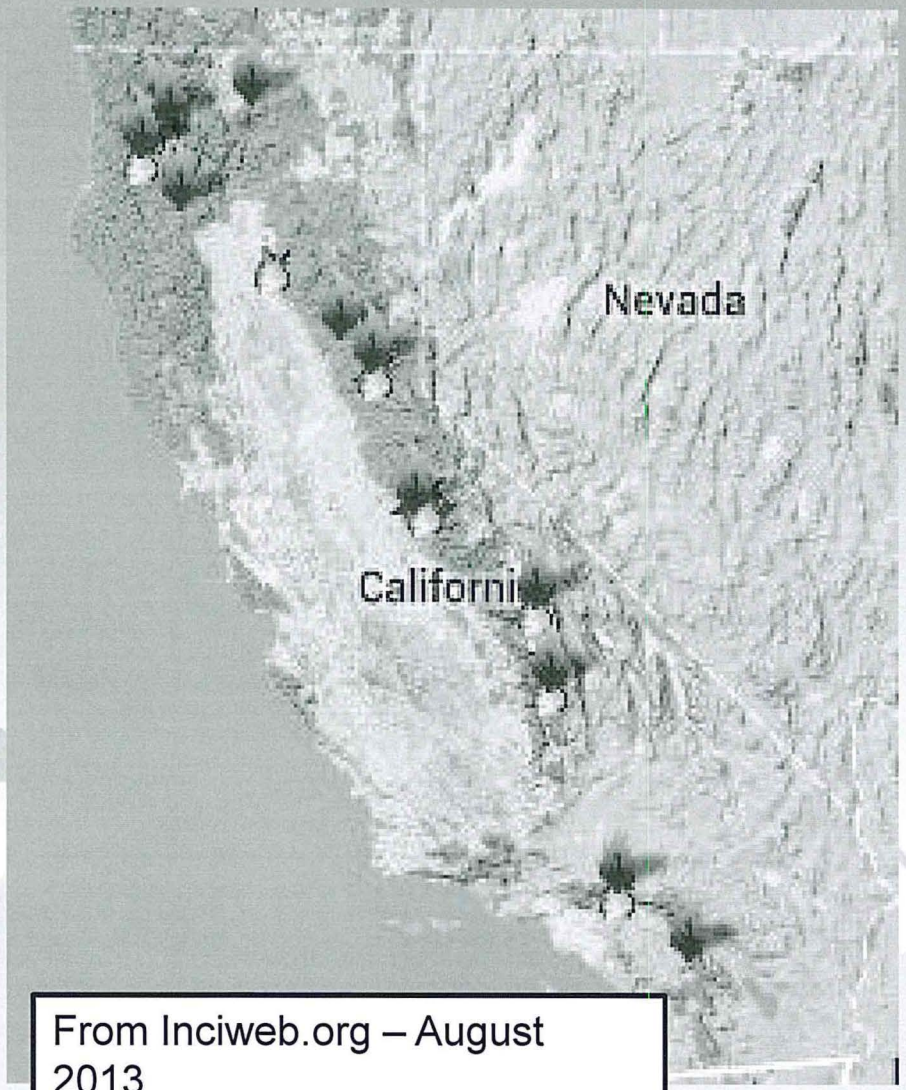
- Current pace of work: 160,000 – 200,000 acres/year
- Needed pace of work: 500,000 acres/year

Multiple Benefits

- Climate adaptation strategy
- Local, Renewable Energy
- Jobs (4.9 jobs/MW)
- Supports hazardous fuels reduction and healthy forests
- GHG emissions reduction
- Reduces waste material destined for landfills
- Net improvement in air quality
- Cost savings or revenue for communities, businesses, state and federal government

Water and Fire





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Conclusion

- Many challenges to establishing a resilient, healthy forest
- Multiple environmental, economic and societal benefits of biomass energy makes it worth facing these challenges

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.

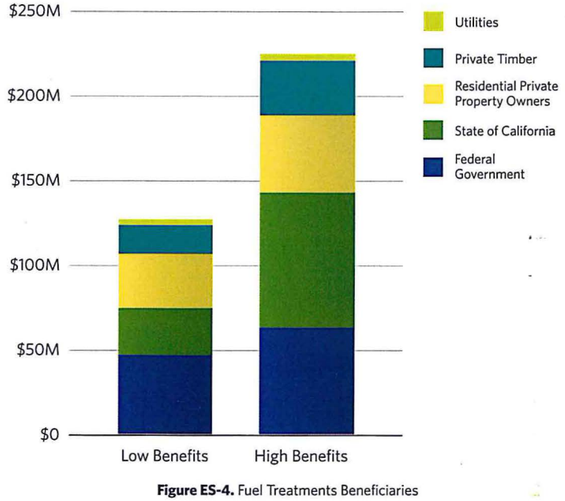

Figure ES-4. Fuel Treatments Beneficiaries

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

FOR MORE INFORMATION:

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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.

K. Carr #2 BOS 8-25-14

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FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

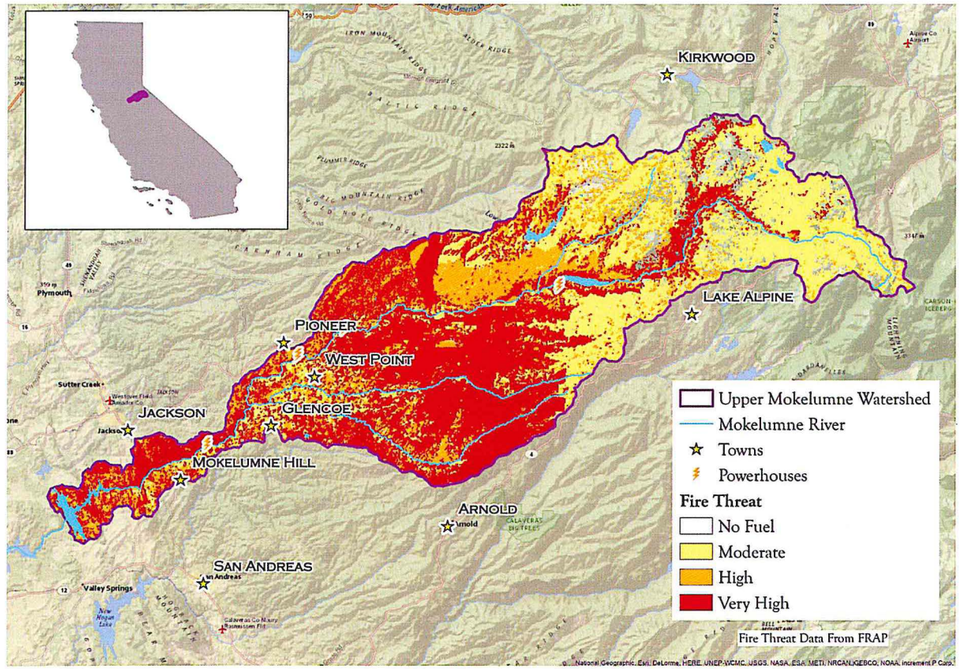

FIGURE ES-1. Fire Hazard in the Upper Mokelumne Watershed

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.

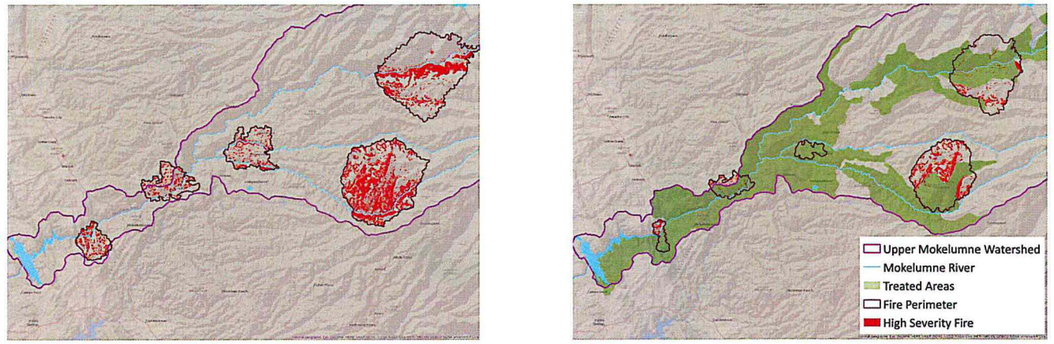

Figure ES-2. High-intensity Wildfire Pre- and Post-Treatments

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