

California Wood Energy Program¹

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The California Department of Forestry Wood Energy Program was established in 1978 and has been actively participating in many research and demonstration projects to increase utilization of wood for energy. The Wood Energy Program came about partly in response to the energy crisis of the 1970s, but a more important reason was a need to improve the management of the wood resource. The Department of Forestry recognized that an extensive resource was being undermanaged; there were uncoordinated research efforts and many unanswered questions about wood energy. California is rich in wood energy; forests and brushlands have been producing this natural and renewable energy resource for centuries. The timber industry in California has for many years been using captive waste from mills for energy, pulp, and composite products. One purpose of the Wood Energy Program is to expand utilization of the wood resource from more than just sawlogs and captive waste. Only about 40 percent of a tree's fiber is actually removed from the forest. The remaining portions are usually left because they cannot produce lumber and are uneconomical to harvest for pulp or fuel. The Wood Energy Program has worked on pilot projects to expand the utilization of unmerchantable wood, including: gasification, densification, chemical extraction, and charcoal production.

The California Legislature has authorized the Department to conduct research concerning the economic and environmental cost, benefits, and feasibility of utilizing wood for energy production. We are also able to provide technical and other assistance with respect to forest management and species selection to encourage energy production. The projects with which we are involved cover a broad range of fields including equipment design, chemical extraction, nutrient cycling, consumer information, and fuelwood plantations.

It is fuelwood plantations that I would like to discuss [sic] today. Our experience with plantations comes from both contract and in-house fuelwood projects. California has a long history of

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Abstract: Many varieties of eucalyptus adapt well to growing conditions in the coastal and central valley regions of California. The California Department of Forestry is conducting growth research on a variety of sites throughout the state with many species. Eucalyptus is an excellent fuelwood and has potential for other uses, including chemical feedstocks. Plantations established on marginal sites may be an alternative to grazing or agricultural crops.

eucalyptus plantations dating back to the turn of the century when there was a strong push to plant groves of eucalyptus for sawlogs and railroad ties. Unfortunately, the species planted did not lend themselves well for manufacturing into lumber. We are again experiencing rising interest in the use of eucalyptus, primarily for fuelwood. The renewed interest in eucalyptus has been brought about by a variety of factors such as: rising heating costs for conventional fuels, favorable return on fuelwood sales, and for many individuals, energy independence for winter heating.

The California Department of Forestry has two major projects investigating the use of eucalyptus and other fast-growing species for use as fuelwood. The projects are the Biomass Tree Farms and an in-house program growing fuelwood plantations on lands adjacent to Department facilities. The Biomass Tree Farms project was mandated by the legislature in late 1980 under sponsorship of Senator Greene. The purpose of the legislation is to demonstrate the production of biomass on marginal sites. The Department of Forestry has contracted for establishment of 9 plantations throughout the state, which include 8 genera and 17 eucalyptus species. We have also established our own program within the Department to grow fuelwood. This project is in conjunction with our energy conservation program to provide alternative energy for CDF facilities such as fire stations and offices. At some CDF facilities we are growing our own fuelwood to burn in woodstoves. This fuelwood program provides a demonstration to small landowners, reduces our energy costs, and provides research information. Most of the plantations were established in early 1982, and it is too early to present results to make recommendations. However, after one year of experience, we can present some general observations on our initial experiences.

The high rainfall and late rains in the winter of 1981-82 kept soils at field capacity and delayed site preparation and planting until late spring. Adequate soil moisture at the time of planting, relatively mild summer temperatures, and irrigation provided favorable growing conditions. The survival rate in most plantations exceeded 90 to 95 percent. Planting stock was commercially grown containerized seedlings. The most injurious agents we have noted are rodents and deer. *Eucalyptus camaldulensis* has been

heavily browsed in San Luis Obispo and Lake counties by both deer and rabbit. In Lake County, rabbits browsed seedlings to the root collar, but they are sprouting back vigorously. Animal repellents will be used to discourage browsing, and pruning may be required in order to stimulate apical dominance; growth form is very poor.

Gophers were a severe problem in San Mateo County. Site preparation consisted of scalping, and the root mass of competing vegetation provided food supply for gophers. Eucalyptus seedlings which were being irrigated became a preferred food during the dry period when annual grasses died. These incidents reconfirm the importance of adequate site preparation. Control of surrounding vegetation is important because it decreases the competition for seedlings and reduces protective cover for rodents. An aphid species was observed on one specimen of *E. gunnii* in Fresno County, but no other insect or disease problems have been observed. In Yolo County under similar conditions, black locust (*Robinia pseudoacacia* L.) was killed by phytophthora root rot while *E. camaldulensis* showed no sign of infection.

One plantation was established in Merced County on saline alkaline soils; of five species, only *E. grandis* and *E. viminalis* survived, but their growth is not robust. The mild winter temperatures throughout the state may have given us more favorable results than usual. Slight frost damage was noted on tips of *E. camaldulensis* at 750-foot altitude because trees did not harden off. At an 1800-foot site, no damage on *E. globulus* or *E. dalrympleana* was observed. At 3500 feet, all *E. robusta* near the bottom of a drainage were killed by frost; *E. globulus*, *E. rudis*, and *E. macarthurii* at the same site, but higher on slope, received some slight frost damage.

Various silvicultural trials including spacing, fertilization, and irrigation are being performed on the plantations; but it is too early to present any results. Information from these plantations can be used by the small landowner wishing to put marginal lands to use. At the present, we see fuelwood plantations being established for personal use or the commercial firewood market. Large-scale plantations to supply wood-fired power plants are farther in the future. The

current supply of boiler hog fuel is adequate since demand is low. As more wood-fired boilers come on line and hog fuel demand goes up, the feasibility of large-scale plantations will be more practical. At the present time, a small woodlot is the most logical choice. The small plantation of 1 to 10 acres offers many advantages; once established, a fuelwood plantation has fairly low maintenance costs, and the coppicing characteristic of eucalyptus eliminates replanting costs. Fuelwood also stores (and grows) quite well on the stump so harvest is up to the desires of the landowner. This characteristic also allows one to take advantage of changes in the marketplace. The fuelwood market is the least value use for the trees. As fiber values rise from increased demand, we can look forward to higher values and potential pulp or composite markets.

The Department has just completed work with GeoProducts Corporation testing manzanita (*Arctostaphylos* spp.) using the acid hydrolysis process developed by Dr. David Brink at the University of California Forest Products Lab. Tests of manzanita and other types of wood have yielded impressive results. From 1 ton of chipped manzanita, we were able to extract 514 pounds of hexose sugars and 341 pounds of pentose sugars. Fermentation of the sugars produced 36.7 gallons of ethanol. A variety of other chemicals including furfural, torula yeast, and butanol can also be produced. Lignin waste from the chemical process can be used as boiler fuel to complete utilization of the feedstock. Eucalyptus has not been tested, but we would expect it to be a suitable feedstock.

GeoProducts Corporation is studying the feasibility of constructing its first operational plant in another state. This type of plant creates demand for woody material unacceptable for lumber or pulp and provides jobs. Within the next decade I anticipate that one or more wood chemical facilities will be operating within California.

Demand for fiber, energy, and other products from forestlands will require intensive management of our resources. Research we are doing now may provide information key to the most efficient production. Hybrids, eucalyptus, and other exotics can help us meet these challenges.