LASSEN COUNTY ENERGY ELEMENT

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Introduction

Introduction

The Lassen County Energy Element is an integral part of the series of Elements which comprise Lassen County's General Plan. The Energy Element responds to, and derives its authority from, the California Government Code, which requires each city and county to adopt a General Plan. The role of the General Plan is to act as a "constitution" for development. It is the foundation upon which all land use decisions are based, expressing community development goals and policies relative to distribution of future land uses. State Planning and Zoning law requires that a General Plan be an integrated, internally consistent document that includes extensive background data supporting the proposed objectives, policies, standards, and actions of the Plan. In addition to seven mandatory Elements (land use, housing, circulation, safety, open space, conservation, and noise), the Government Code permits local agencies to adopt optional Elements, such as an Energy Element, to reflect and accommodate local conditions and circumstances.

In response to the development which has occurred, and in anticipation of development that may occur in the future, Lassen County has prepared this General Plan Energy Element (Element). The Element constitutes a new component to the County's planning documents, and is intended to be used in conjunction with the other existing Elements.

The preparation of this Element involved a variety of individuals, organizations, and sources. The Element has particularly benefitted from the County's participation in the California Energy Commission (CEC) Siting and Permit Assistance Program. In addition, the joint workshops with the Citizens Advisory Committee (CAC), appointed by the County, were critical in the formulation of the draft document. The CAC was instrumental in defining the issues that needed to be addressed, and formulating and refining the Element's goals and policies.

The objective of the Element is to provide readers with comprehensive energy resource information, pertinent technical background, information on future energy use possibilities in the County, and a concise description of policies and implementation measures in a manageable and useful format. The primary intent of the Element is to present specific policies and procedures that will not only ensure a balance between energy development, environmental protection, and preservation of other natural resources, but will also facilitate the siting and permitting of energy facilities within the County (thus, enhancing and diversifying the County's economic base). To achieve this intent, a number of studies (environmental setting, facility siting, and energy conservation) were completed to provide the basis for policy development. These studies, together with the goals and policies (Policy Plan) that were derived from them, constitute the Energy Element. The Element's organizational structure includes an introduction, four separate but interrelated chapters, and an appendix. These components are described below:

Introduction - The introduction briefly explains the intent and function of the Energy Element and describes the different components of the Element.

1. Energy Environmental Setting - A general overview of the regional environmental setting is provided within each issue or resource area (e.g., air quality, biology, cultural resources, land use) to facilitate the analysis necessary for developing energy element policies. The focus of this chapter is on resources that could affect, or be affected by, energy development in the County.

2. Energy Facility Siting - This chapter provides an evaluation of the various types of energy-producing facilities that may be sited in Lassen County, the potential for development of these facilities, and siting considerations associated with each type of energy facility/technology. This evaluation establishes the basis for defining specific policies and procedures to ensure compatibility of future energy facilities with adjacent land uses.

A brief inventory of existing energy facilities is provided, followed by descriptions of specific energy production technologies. The evaluation of each energy technology is divided into discussions of historical uses in the County, existing and proposed facilities, and feasibility for future development. In addition, environmental issues and regulatory procedures particular to each energy technology are described.

3. Energy Conservation - This chapter presents a discussion of the type of energy provided to county residents, energy consumption patterns, the options to reduce local energy use, and a description of existing energy conservation opportunities in the County. The objective is to promote energy efficiency and reduction of energy waste.

4. Policy Plan -This chapter contains goals and policies pertaining to energy resource development in Lassen County. The goals presented express the ultimate purpose of the Element. They are general in nature, and apply equally throughout Lassen County. Policies address the siting, short-term construction, and implementation of each energy technology in order to minimize or eliminate adverse impacts from energy development. The Plan also includes policies which promote energy conservation and economic measures.

Appendix - Numerous sources of information were used to establish the baseline setting of each of the energy resource categories and potential energy technologies to be developed in the County. Appendix A provides a list of persons and publications consulted during preparation of the Element. Appendix B provides the bibliography used, and Appendix C lists the preparers of this document.

1. Environmental Setting

CHAPTER 1

Environmental Setting

1.1 INTRODUCTION

The study area for this General Plan Element includes the unincorporated areas of Lassen County. A map of the County and its Planning Areas is presented in Figure 1-1. The unincorporated areas are comprised of numerous small rural communities, including the population center of Westwood. Federal lands under National Forest jurisdiction are briefly described but are not the focus of this study since the County has no regulatory control over federal lands.

The purpose of presenting the following environmental setting information is to provide a basis for analysis of the potential energy resources in the County and to identify the types of impacts on the County's physical, biological, and social environment that may result from energy development and conservation. To facilitate the analysis necessary for developing element policies, a general overview of the regional environmental setting is provided within each issue or resource area. The focus of this information is on resources that could affect or be affected by energy development in the County. Much of the environmental setting information is drawn from other county documents. Most of the cited documents are available for reference at the County Planning Department.

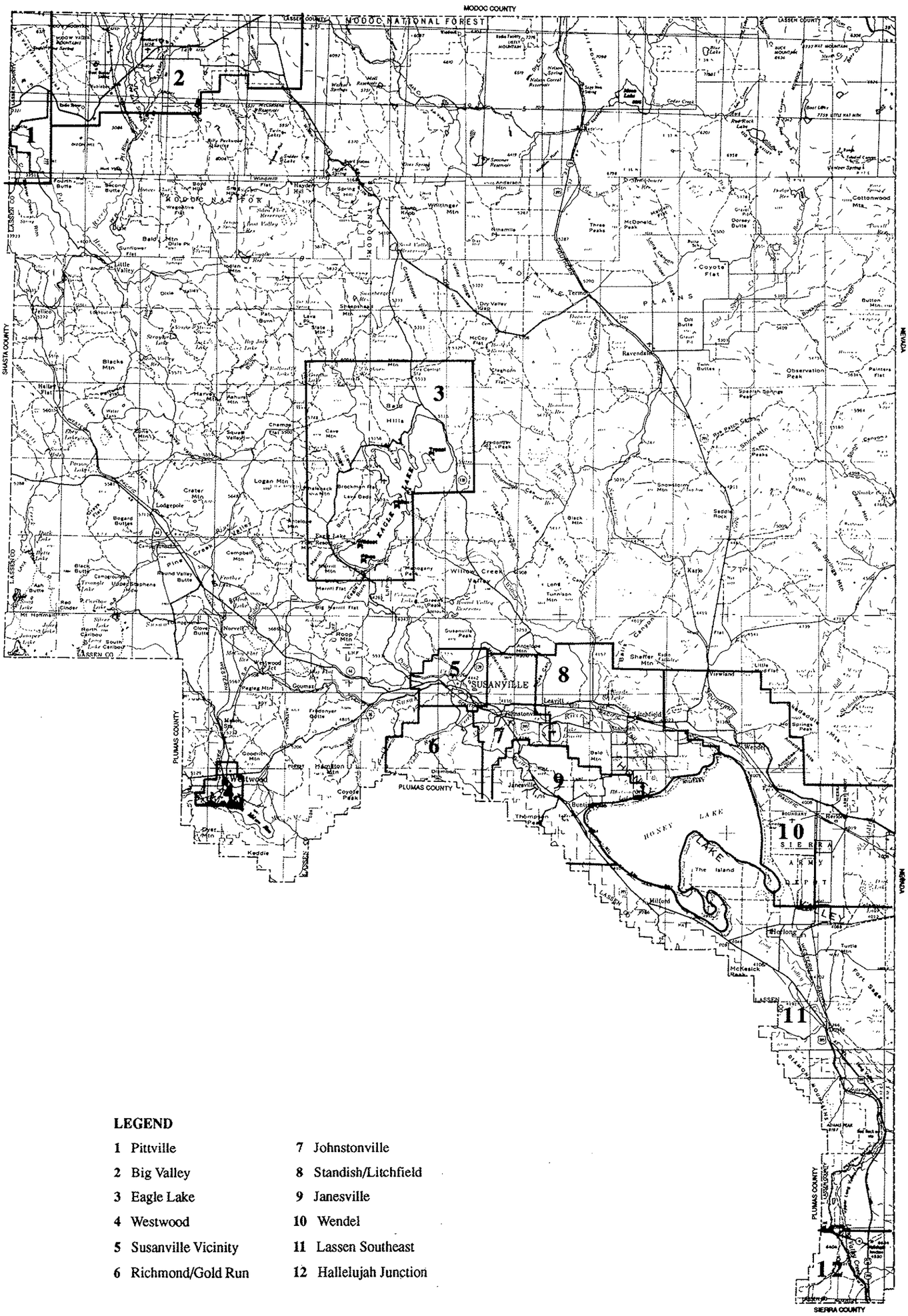
1.2 SETTING

Lassen County is situated in northeastern California, adjacent to the Nevada border. This sparsely populated county is bordered by Modoc County to the north, Sierra and Plumas Counties to the south, Shasta County to the west, and Nevada's Washoe County to the east. The County encompasses a variety of topographical features and physical resources. It is located at the conversion of the Sierra Nevada and the Cascade Mountains. Susanville represents the dividing line between Lassen and Plumas National Forests to the west and the Modoc Plateau to the east. A substantial portion of the County is mountainous, with several peaks rising over 8,000 feet in elevation. With a growing season of only two to four months, the climate in the County is considered relatively severe. Precipitation varies from over 40 inches at the west County line to less than 8 inches in the desert area at the California-Nevada State line.

1.2.1 Air Quality

Regional Setting

The airshed of Lassen County and two other counties (Modoc and Siskiyou) is wholly contained in the Northeast Plateau Air Basin. The few air monitoring stations in operation in the basin include a sampler of particulate matter 10 microns or less (PM_{10}) in Alturas and



LEGEND

1 Pittville	7 Johnstonville
2 Big Valley	8 Standish/Litchfield
3 Eagle Lake	9 Janesville
4 Westwood	10 Wendel
5 Susanville Vicinity	11 Lassen Southeast
6 Richmond/Gold Run	12 Hallelujah Junction

0 5 10 Miles

Lassen Energy Element
Energy Setting

Figure 1 – 1
LASSEN COUNTY PLANNING AREAS
Michael Clayton & Associates

a total suspended particulate (TSP) and PM_{10} sampler in Yreka. The station in Yreka also monitors ozone concentration. There are no permanent monitoring stations in Lassen County. Honey Lake Power Plant was monitored for PM_{10} for one year and registered two days of violation. Hayden Hill Gold Mine (AMAX) has recently started monitoring for PM_{10}. No monitoring results were available for review.

The overall air quality of Lassen County is considered good and the air basin encompassing the County has not been designated as a non-attainment basin under the Federal Clean Air Act. Non-attainment areas do not meet federal and/or state air quality standards for specific criteria pollutants. Under the state air quality standards, the basin is in attainment for nitrogen dioxide, sulfur dioxide, and lead; and unclassified for carbon monoxide (CO). Non-attainment of the PM_{10} state standard occurs in Modoc and Siskiyou Counties. Lassen County is unclassified for PM_{10}, ozone, and carbon monoxide, and in attainment for nitrogen dioxide, sulfates, and lead. An air basin is unclassified for a criteria pollutant when the available data is insufficient to determine attainment status.

In general, air emission sources in Lassen County are associated with motor vehicles, lumber mills, wood burning stoves, wildfires, and fugitive dust from unimproved roads and unvegetated lands. Major stationary sources of emissions include:

1) five cogeneration plants - Honey Lake Power Plant in Wendel; Susanville Forest Products in Susanville; Sierra Pacific Industries in Susanville; Mount Lassen Power Plant in Westwood; and Big Valley Lumber in Bieber;

2) four aggregate/asphalt plants - one in Doyle; two in Viewland; and one in Milford;

3) Sierra Army Detonation Plant in Herlong;

4) California Correctional Center; and

5) Hayden Hill Mining Project.

Periodic emissions occur from agricultural activities, such as disking and agricultural waste burning; and from wild and forest management fires. Isolated incidents of air pollution may occur during the colder months when wood-burning stoves are heavily used. This problem is particularly accentuated when a temperature inversion occurs. The County has one small medical waste incinerator in operation at the California Correctional Center. It is regulated by the Air Pollution Control District.

Typical emissions from wood burning plants are CO, PM_{10}, and nitrogen oxides (NO_x). Wild and forest management fires would have similar types of emissions. Dioxins, furans, and cadmium are a few air dispensed toxic compounds that could result from major medical waste incinerators.

Regulatory Setting

The Federal Clean Air Act of 1970, and subsequent amendments, established air quality standards for several pollutants. These federal standards are set by the Environmental Protection Agency. The State of California has adopted its own standards, which are set by the California Air Resources Board (ARB). The ARB is responsible for coordinating both state and federal air pollution programs in California. In addition, the State Legislature passed the California Clean Air Act (AB 2595) in 1988 which implements a planning process to complement the existing State standards. These recently adopted regulations generally parallel the federal Clean Air Act in structure, but are more stringent for some criteria pollutants and outline a more rigorous planning process than federal guidelines. The criteria pollutants for state and federal air quality standards are: ozone (O_3), carbon monoxide (CO), particulate matter of 10 microns or less (PM_{10}), nitrogen dioxide (NO_2), lead (Pb), and sulfur dioxide (SO_2).

The California Air Resources Board has retained authority over mobile sources, but has delegated much of the control of stationary sources to local agencies, such as state air quality management districts and air pollution control districts. Air quality controls and standards in Lassen County are governed by the Lassen County Air Pollution Control District (APCD). The APCD is responsible for ensuring that the state and federal ambient air quality standards are achieved and maintained within the County. In order to achieve this goal, the APCD administers a set of rules and regulations which establishes permit requirements and procedures for activities involving air emissions.

Energy development projects would be required to comply with the APCD regulations. The Lassen County APCD requires an Authority to Construct Permit to be filed prior to construction of any facility that may emit pollutants from a stationary source into the atmosphere. Typically, biomass, cogeneration, waste-to-energy, and geothermal facilities would be required to obtain the Authority to Construct Permit. The project would be required to comply with the District's regulations, which include general permitting requirements, siting requirements for new sources, and specific prohibitions of excessive emissions.

After construction of the facility is complete according to terms established in the Authority to Construct, a Permit to Operate must be obtained from the District for all pollutant-emitting equipment.

Lassen County APCD has recently reviewed and updated its regulations. This new set of regulations include permit requirements for cogeneration and resource recovery facilities, and for energy power plants.

1.2.2 Biology

Regional Setting

Lassen County has a wide variety of plant and animal species. These species are important because they have intrinsic value and inherent worth; offer educational, recreational, and

economic opportunities; constitute significant components of the ecosystem; and maintain ecological balance and environmental quality. Information on Lassen County's biological resources were obtained primarily from studies conducted as part of the County's Area Plan program. Please refer to Figure 1-1 for the location of planning areas within Lassen County. The following is a summary of plant and animal species occurring within the County. A complete list of sensitive biological resources and special natural communities in Lassen County is presented in Table 1-1.

In northwest Lassen County, the native vegetation ranges from various species of brush, riparian habitat, oak, sagebrush, and juniper in the lower elevations to forests of mixed conifers and oak in the higher elevations. Wildlife are both abundant and diverse in this portion of Lassen County, and include several native mammal and bird species no longer found in other areas of California (Pittville Area Plan EIR 1983). The Day Bench, a geological feature within the Pittville Planning Area, is a major spring and fall migration corridor for the Day Bench Deer Herd. A den belonging to the Sierra Red Fox, a State threatened species, was discovered in the Day Bench area. The Southern Bald Eagle and the American Peregrine Falcon have also been observed within the Planning Area (Pittville Area Plan EIR 1983). Both species are listed as endangered by the California Department of Fish and Game on the Rare and Endangered Species List.

Vegetation found within the Eagle Lake Planning Area, in the central part of the County, is typical of that associated with a rainshadow climate. Vegetation north and east of the lake consists primarily of sagebrush, scattered juniper, and isolated pine woodlands. Extensive pine and fir woodlands are located south and west of the lake. A large portion of this land is used for commercially produced timber. More than 280 plant species are found in the Eagle Lake Basin, eight of which are included on the California Native Plant Society's list of rare and endangered plants. Several wetland communities are also found within the Planning Area and include: riparian woodland, wet meadow, and freshwater marsh. Approximately 220 different species of mammals, birds, reptiles, and amphibians occur in the Eagle Lake Basin, some of which are unique to the Basin. The Eagle Lake Trout is unique to Eagle Lake and found nowhere else in the world as a native species. The Wolverine, Sierra Red Fox, and Southern Bald Eagle, all listed by State or Federal Agencies as rare or endangered, are found in the Planning Area.

The vegetation and wildlife resources of Westwood, Susanville Vicinity, Johnstonville, and Hallelujah Junction Planning Areas were found to be representative of the biological resources encountered in the southern portion of the County.

The Mountain Meadows area, adjacent to the Westwood community, indicates the diversity and abundance of biological resources in southwest Lassen County. The Mountain Meadows area is rich in riparian corridors, wetlands, and wildlife, and encompasses several species of mammals and birds listed as Threatened or Endangered Species by the California Department of Fish and Game. These species include the Bald Eagle (endangered), Bank Swallow (threatened), Great Gray Owl (endangered), Sandhill Crane (threatened) Sierra Nevada Red Fox (threatened), Spotted Owl (threatened), Willow Flycatcher (endangered),

Table 1-1
Sensitive Biological Resources of Lassen County

Species		*Status*
Common Name	Scientific Name	
Bats		
Pale Big Eared Bat	*Plecotus townsendii pallescens*	Species of Concern (CDF&G)
Birds		
Bald Eagle	*Haliaeetus leucocephalus*	State/Federal Endangered
Bank Swallow	*Riparia riparia*	State Threatened
California Gull	*Larus californicus*	State Endangered
Double-crested cormorant	*Phalacrocorax auritus*	Species of Concern (F&G)
Golden Eagle	*Aquila chrysaetos*	Species of Concern (F&G)
Great Blue Heron	*Ardea herodias*	None
Greater Sandhill Crane	*Grus canadensis tabida*	State Threatened
Long Eared Owl	*Asio otus*	Species of Concern (F&G)
Northern Goshawk	*Accipiter gentilis*	Species of Concern (F&G)
Osprey	*Pandion haliaetus*	Species of Concern (F&G)
Prairie Falcon	*Falco mexicanus*	Species of Concern (F&G)
Swainson's Hawk	*Buteo swainsoni*	State Threatened
Willow Flycatcher	*Empidonax traillii*	State Endangered
Fish		
High Rock Springs Tui Chub	*Gila bicolor ssp.2*	Species of Concern (F&G)
Modoc Sucker	*Catostomus microps*	State/Federal Endangered
Mammals		
Pacific Fisher	*Martes pennanti pacific*	Species of Concern (F&G)
Sierra Nevada Red Fox	*Vulpus necator*	State Threatened and Federal Candidate
Wolverine	*Gulo gulo*	State Threatened and Federal Candidate
Special Natural Communities		
Northern Volcanic Mudflow Vernal Pool		
Ponderosa Dune Forest		

Source: California Natural Diversity Data Base, Department of Fish and Game, 1992

Table 1-1 (Continued)
Sensitive Biological Resources for Lassen County

Species		*Status*
Common Name	Scientific Name	
Plants		
Alkali cord grass	*Spartina gracilis*	CNPS List 4
Ash beardtongue	*Penstemon cinicola*	CNPS List 4
Bailey's ivesia	*Ivesia baileyi var. baileyi*	CNPS List 2
Baker's globe mallow	*Iliamna bakeri*	CNPS List 4
Boggs Lake hedge-hyssop	*Gratiola heterosepala*	CNPS List 1B, State End. and Federal Candidate
Center Basin rush	*Juncus hemiendytus var. abjectus*	CNPS List 4
Cusick's stickseed	*Hackelia cusickii*	CNPS List 4
Cut-leaved butterweed	*Senecio eurycephalus var. lewisrosei*	CNPS List 1B
Deschutes milk vetch	*Astragalus tegetarioides*	CNPS List 1B, and Federal Candidate
Doublet	*Dimeresia howellii*	CNPS List 4
Douglas' draba	*Draba douglasii var. douglasii*	CNPS List 4
English sundew	*Drosera anglica*	CNPS List 2
Egg Lake monkeyflower	*Mimulus pygmaeus*	CNPS List 1B and Federal Candidate
Holmgren's skullcap	*Scutellaria holmgreniorum*	CNPS List 1B
Lassen County blue grass	*Poa fibrata*	CNPS List 3 and Federal Candidate
Liddon's sedge	*Carex petasata*	CNPS List 3
Mathias' button-celery	*Eryngium mathiasiae*	CNPS List 4
Modoc bedstraw	*Galium glabrescens ssp. modocense*	CNPS List 1B
Ornate dalea	*Dalea ornata*	CNPS List 2
Pine Creek evening-primrose	*Camissonia boothill ssp. alyssoides*	CNPS List 2
Playa phacelia	*Phacelia inundata*	CNPS List 2
Plumas County beardtongue	*Penstemon neotericus*	CNPS List 4
Prostrate buckwheat	*Eriogonum prociduum*	CNPS List 1B
Raven's lomatium	*Lomatium ravenii*	CNPS List 4
Sierra corydalis	*Corydalis caseana ssp. caseana*	CNPS List 4
Sierra Valley evening-primrose	*Camissonia tanacetifolia ssp. quadriperforata*	CNPS List 3
Spiny milkwort	*Polygala subspinosa var. subspinosa*	CNPS List 2
Stoloniferous pussytoes	*Antennaria flagellaris*	CNPS List 2
Susanville milk vetch	*Astragalus inversus*	CNPS List 4
Tracy's collomia	*Collomia tracyi*	CNPS List 4
Volcanic daisy	*Erigeron elegantulus*	CNPS List 4
Yakima bird's-beak	*Cordylanthus capitatus*	CNPS List 2

Note: California Native Plant Society (CNPS): List 1B (plants rare and endangered in California and elsewhere); List 2 (plants rare and endangered in California, but common elsewhere); List 3 (plants needing more information; and List 4 (plants of limited distribution - a watch list)

Source: California Native Plant Society

and Wolverine (threatened). Four known Bald Eagle nests occur in the Mountain Meadows Reservoir area. The Spotted Owl is found primarily on the south slope of Dyer Mountain (Frank Hall, pers. comm.). Several other species found in the area, approximately 20 birds and four mammals, are listed as Species of Special Concern. These species, found primarily in the Mountain Meadows surroundings, are mainly raptors and waterfowl. Other Species of Special Concern include the American Badger, Pacific Fisher, Sierra Nevada Snowshoe Hare, and Western White-Tailed Hare (Frank Hall, pers. comm.). Fish species in the Mountain Meadows Reservoir include the Large Mouth Bass and the Rainbow Trout. The lake is filled primarily with naturally occurring fish and are not planted. However, several of the springs emptying into the Reservoir are planted with trout. Vegetation found in the Westwood area includes mixed coniferous forests in mountainous areas including red and white fir and Jeffrey fir species; riparian corridor communities; and wetland plant communities. Major deer migration routes cross the forested and brush land areas. These areas also serve resident deer populations.

There is a variety of pine forests within the Susanville Planning Area including Yellow Pine and mixed Pine-Fir forests, and mixed Pine-Juniper woodlands. These forests encompass Jeffrey and ponderosa pines, cedar, white fir, Douglas fir, black oak, and juniper trees. These pine forests are typically used for commercial timber production (Susanville Vicinity Area Plan and EIR 1984). Fish and wildlife species within the Susanville Planning Area are also diverse, and include trout, bass, deer, antelope, and quail. However, many human-related activities in the area have begun to encroach upon wildlife habitat.

Potential natural vegetation in the Johnstonville Planning Area, located in the Honey Lake Valley, is significantly different from existing vegetation (Johnstonville Planning Area Master Environmental Assessment 1983). Human-related activities have altered or limited naturally occurring vegetation types in many locations within the area. Existing plant communities include forested areas, savanna brushlands, meadowlands, and riparian corridors. Mixed Pine-Fir forests occur at higher elevations and Yellow Pine forests occur in the lower regions. Sagebrush and other shrub-type plants occur in the drier areas. Meadowlands are usually located in flatter areas in proximity to streams or springs, and riparian areas are located adjacent to water bodies such as the Susan River, a major riparian corridor and fishery river. No rare, threatened or endangered plants listed by either the State or Federal government have been identified as existing within the Planning Area. Several species of big game and waterfowl, as well as a variety of other fur-bearing animals and birds occur within the area. Wildlife occurring in the area include two birds (the Greater Sandhill Crane and the Southern Bald Eagle) and one mammal (the Sierra Red Fox) listed on the State Rare, Threatened, and Endangered Species list. A deer migration corridor that is used by the Bass Hill deer herd, crosses the southern portion of the Planning Area.

Vegetation found within the Hallelujah Junction Planning Area is typical of semi-arid climates. Habitat types include various sagebrush scrub and grassland, Northern Juniper Woodland, and coniferous tree species. These habitats provide both excellent cover and forage for deer as well as a variety of other mammals and birds. The Lassen-Washoe deer herd migration corridor passes directly through this Planning Area. The Southern Bald Eagle and the Golden Eagle, both identified as endangered species, are found in the

Petersen Mountains located in the eastern portion of the Planning Area (Hallelujah Junction Area Plan 1984).

Regulatory Setting

Pursuant to the Federal Endangered Species Act, it is illegal to take or harm any federal listed species. In addition, federal involvement in a project usually involves consultation with the Fish and Wildlife Service and interagency agreements specifying conservation measures for species that are candidates for federal listing as threatened or endangered. Under the California Endangered Species Act, the California Department of Fish and Game (CDFG) has jurisdiction over the taking of rare, threatened, and endangered species, and a Memorandum-of-Understanding with the CDFG is required for development and implementation of mitigation measures for unavoidable impacts to these species. Both the California Environmental Quality Act (CEQA) and the Endangered Species Act mandate consultation with the CDFG regarding rare, threatened, and endangered species. Through consultation with the CDFG, alteration of project design or mitigation measures are required to compensate for loss of rare, threatened, or endangered species. CEQA also requires consideration of species which are not officially listed as threatened or endangered, but deserve such status.

1.2.3 Cultural Resources

Regional Setting

The County's General Plan Planning Areas are used to provide an overview of this topic. Within the Pittville Planning Area, many areas have the potential to contain moderate to highly significant cultural finds (Pittville Area Plan 1986). The most likely areas for discovery of archaeological resources are along major drainages, such as the Pit River, Beaver Creek, and Frazier Creek (Pittville Area Plan EIR 1983). Other culturally sensitive sites may exist in the Big Valley Mountains. No significant historic sites have been located within the Planning Area (Pittville Area Plan 1986).

Early Native American use of Eagle Lake was mainly seasonal in nature, primarily in the spring, summer, and fall months. While few archaeological field surveys and reconnaissance have been conducted (Eagle Lake Area Plan 1982), evidence recovered from surveys indicates that Eagle Lake was the primary attraction and the majority of sites located within the Planning Area appear to be associated with water-related hunting activities. Euro-American discovery and settlement of the area did not occur until the mid-1800's. A livestock operation was established along Pine Creek, and sheep ranching also became a major industry during this period.

Cultural Resources in the Honey Lake Valley are particularly abundant. Human presence in the Valley is believed to date back 12,500 to 50,000 years (Susanville Area Plan 1986). Native American groups occupied the Valley area in more recent times. Eleven archaeological sites are recorded within the Susanville Planning Area, and an additional 18 sites are recorded in the immediate vicinity of the Susanville Planning Area (Susanville Area Plan 1984).

Petroglyphs that may date back more than 9,000 years ago are located in the southeastern portion of the County (Johnstonville Planning Area). The remains of 22 house pits are contained within an archaeological site located 3 miles east of Susanville. Only one Native American settlement is known to have existed within the Johnstonville Planning Area. It was a Maidu Indian encampment and cemetery. A total of nine archaeological sites have been identified within the Planning Area (Johnstonville Planning Area MEA 1983). Most of the Planning Area has been identified by the California Archaeologic Inventory Information Center as being "highly sensitive" regarding the potential for cultural resources. Cultural resources are sensitive and vulnerable to significant impacts from any development related activities which involve land alteration.

Five archaeological sites have been identified in the Hallelujah Junction Planning Area (Hallelujah Junction Area Plan EIR 1984), three of them are on public lands, two in private. Areas situated adjacent to drainages are those with the greatest potential for occurrence of cultural resources within the Planning Area.

Regulatory Setting

Significant cultural resources are protected under the California Environmental Quality Act (CEQA), and, if the project is federally funded or regulated, the National Environmental Policy Act (NEPA). Interpretation and application of these laws on the state level is the responsibility of the Office of Historic Preservation. Responsibility on the local level is vested with the "lead agency". The lead agency is the governmental agency undertaking or regulating a particular project. Cultural resources are protected by these regulations and laws.

Cultural resource evaluations are undertaken as part of the County application processing in order to determine the presence or absence of "potentially significant cultural resources". No specific rules or regulations determine precisely what gives significance to a particular feature, but generally, a nominated archaeological feature must be representative of some important past human activity, must have some integrity of deposit, and must have the potential to answer questions about the past through the application of archaeological methods.

Native American burial sites and sacred sites are protected by the Native American Heritage Commission through the County Coroner. Current law requires that the coroner must be notified upon the discovery of any human remains. If the discovered remains are prehistoric Native American burials, the coroner must call the Native American Heritage Commission. The Commission then names the "most likely descendant" of the discovered remains. This descendant then confers with the landowner to determine an appropriate place for reburial of the remains.

The overall cost of mitigation of negative impacts to cultural resources is limited by Appendix K of the California Environmental Quality Act (CEQA) Guidelines. The formula for the maximum cost of mitigation measures depends on the magnitude of the project being undertaken. The limitations of Appendix K do not apply to projects overseen by federal agencies. Expenditures to satisfy obligations under the jurisdiction of the Native American

Heritage Commission are not part of the mitigation process under CEQA, and are not counted as expenditures under Appendix K.

1.2.4 Geology

Regional Setting

Geologic events such as volcanism, faulting and uplifting have played a prominent role in shaping the landscape of Lassen County. These geologic events have also allowed the formation of geothermal systems which constitute an important energy resource in the region. Local geothermal systems seem to result from the combination of a heat source, significant precipitation in surrounding mountainous areas, extensive faulting allowing water to circulate down and through the deep formations, and the presence of a low permeability layer of rocks (at intermediate depth) confining the flow to the high temperature bedrock (See Ground Water, Section 1.2.10). Geothermal springs are often the result of faults acting as conduits for the upward movement of geothermal waters. The following paragraphs describe the geologic history, structure, and soils of Lassen County.

Geologic History. In the early part of the Paleozoic era, what is now Northeastern California was covered by ocean waters. During the late Paleozoic era (up to the beginning of the Mesozoic era - approximately 225 million years ago), volcanic activities caused the area to be periodically uplifted to above sea level. During these periods of uplifting, volcanoes and lava beds shaped the region's topography.

The end of the Cenozoic era was the time of four Ice Age stages. During the most recent glacial stage, Lake Lahontan stretched from Honey Lake Valley east and south to Walker Lake in Nevada, a distance of about 300 miles. Lake Lahontan had a maximum surface elevation of about 4,400 feet and a maximum depth of about 400 feet in the Honey Lake basin. During the interglacial stages, the land slowly returned to a desert climate and many of the lakes dried up, only to reappear once again during the next glacial stage. Other areas in the County also covered by water during the Cenozoic era include the Willow Creek Valley-Secret Valley region which was once the site of a vast irregular lake bordered by volcanic mountain ranges. At one time, Eagle Lake probably drained into Willow Creek Valley through a wide canyon north of Deans Ridge (DWR 1963). Volcanic activity subsequently caused the topography to change, Black Mountain to be uplifted, and lava flows to cover lake sediments and block the surface outlet of Eagle Lake.

Most of the northern portion of Lassen County was an area of active basaltic fissure flows up to approximately 12 million years ago. General uplifting of the region at that time formed the Cascade Range and the Modoc Plateau. During the uplifting, the Modoc Plateau was block faulted and subjected to outpourings of viscous lava which overlays the original lava flow. In addition, the Cascade Range was uplifted high enough to cut off moisture from the Modoc Plateau, which became increasingly more arid.

The climate has slowly become warmer and drier during the last 10,000 years. The glaciers were the first to disappear, followed by most of the lakes that once filled the valleys. The

few lakes that remain today are mostly mere remnants of the ancient lakes. In Lassen County, Lake Lahontan has been reduced to what is known today as Honey Lake. The ever-active forces of erosion continue to slowly wear down the mountains and fill in the valleys. In addition, movements of the earth's crust are slowly changing the County's landforms, pushing up the mountains and dropping the valleys as evidenced by earthquakes in historical times.

Physiographic Provinces. Lassen County lies at the intersection of four major physiographic provinces: the Sierra Nevada, the Cascade Range, the Modoc Plateau, and the Basin and Range. Elevations range from 3,200 feet near Pittville to the 8,737 foot Hat Mountain at the northeastern corner of the County.

These physiographic provinces are determined by their geologic structure and formation. The Sierra Nevada is comprised of strongly deformed and metamorphosed rocks of Paleozoic age (570 million years ago) that have been intruded by a granitic batholith of Mesozoic age. Plutons of granitic rock, probably of Cretaceous (approximately 150 million years ago) or earlier age, intrude the metamorphic rock with mineralization that often shows along the veins and seams of gold-bearing quartz that intruded the fissures and joints of the granitic rock. The rocks of the Sierra Nevada are essentially the exposed granite of the Sierra Batholith and associated sedimentary and contact metamorphic rocks with some late Tertiary volcanics located in the northern section of the province. The Diamond Mountains, near Susanville, are the northern most part of the Sierra Nevada range.

The Cascade Range extends from the northern end of the Sierra Nevada to the Canadian border and is especially noted for the many great and recently active volcanoes scattered along its entire length. This area contains basaltic fissure flows that were active during the Miocene (28 million years ago) and Pliocene time (12 million years ago). During the beginning of the Pleistocene (2.5 million years ago), at the climax of the Cascadian Orogeny, this lava plateau was elevated and faulted, thus, the present Cascade Range was formed. The exposed rocks of the California Cascades are predominantly volcanics of great variety and form.

The broad Modoc Plateau is an undulating platform composed of assorted volcanic materials, principally Miocene to recent basaltic lava flows. It lies in the center of the County, and extends to the western, northern, and northeastern boundaries. The average elevation of the area is 4,500 feet above sea level, but many peaks exceed this level. Canyons that have been entrenched by the Pit River are also present in the region. The Modoc Plateau consists of a series of northwest to north-trending block faulted ranges and basins filled with broad "plateau" basalt flows interspersed with small volcanoes, and lake deposits resulting from the disruption of drainage by faulting or volcanism. The geologic history of the Modoc Plateau is closely connected to that of the Cascade Range and Basin and Range provinces.

The Basin and Range province consists typically of north-south trending fault-block mountains separated by valleys, many of which are closed basins. Most of the province is located in neighboring Nevada, and the California portion is divided into three segments. The Honey Lake Valley segment is located in Lassen County and has interior drainage, a

common characteristic of the province. The area is usually included in the Basin and Range province because it is a triangular wedge dropped down between the granitic rocks of the Sierra Nevada and the volcanics of the Modoc Plateau. The sharply defined structure of the valley, formed by the presence of fault zones along its borders, is characteristic of the Basin and Range Province. The floor of the Honey Lake Valley is a flat-lying sequence of Pleistocene to Recent age (past 10,000 years) sediments. These sediments include sand deposited by wind (aeolian sands), sediments deposited on the valley floor by a stream when emerging from a narrow canyon (alluvial fan deposits), and sediments deposited by water in the lake bed (lacustrine deposits). Some of the lacustrine deposits originated in the huge Lake Lahontan. The Lake's old shorelines are conspicuous around much of Honey Lake Valley and are marked by terraces, gravel bars and sand spits.

Soils. Volcanic and sedimentary rocks formed the majority of the soils in the region. In general, the soils in the County can be separated into two broad groups: 1) residual soils, which have developed in place, and 2) transported soils, which were formed by sediments deposited by wind, water, or ice.

Residual soils are found mainly in mountainous and hilly lands. They differ as a result of climatic factors and parent material. Residual soils vary from very shallow on lands having considerable rock present on the surface and throughout the soil profile, to deep on lands having little or no rock present. These soils usually drain well and are suited for agricultural crops. However, suitability of these soils for irrigated crops is often limited because of the complex topographic conditions (DWR 1963).

Transported soils vary in their physical and chemical characteristics according to the nature of the deposition, parent material, and the degree of development that has taken place since their deposition. In Lassen County, this group of soils can be broadly classified as old valley fillings, basin and lacustrine soils, and Recent alluvium.

Old valley soils are present in many mountain valleys in the region. They are formed from old valley deposits and remnants of former alluvial fans, and have often undergone significant changes in profile characteristics since their deposition. Leaching and other soil forming processes have brought about soils varying from those underlain with dense claypans or cemented hardpans to those with moderately compact subsoils. Old valley soils are generally suitable only for crops with fairly shallow roots.

Basin and lacustrine soils are formed from fine sediments deposited in overflow basins or in fresh water lakes. These soils are often fine-textured and imperfectly or poorly drained, which allows for accumulation of salts. Much of the saline soil in the County could be reclaimed by improvement of local drainage (DWR 1963). Certain of the alkali lacustrine soils, because of the greater difficulty in reclamation, are not considered as potentially irrigable, particularly in Surprise Valley and Honey Lake Valley. Otherwise, the basin and lacustrine soils are suitable for many climatically adapted medium and shallow rooted crops.

Alluvial soils are of relatively recent origin and are the richest soils in the region. In general, these soils are moderately deep, friable, and medium-textured and have undergone little or no change in their profile characteristics since deposition. They have been

deposited in the flood plains and are found, to a limited extent, in the ground water basin areas of the County.

Seismicity. The County lies between Mount Lassen, a volcano that erupted in 1914, and the Walker Lane fault zone in western Nevada. Numerous fault zones, generally trending in a north-south direction, are located within Lassen County. Vertical displacement along some of these faults has been responsible for the uplifting of several mountains in the region. Recent activity includes the Fort Sage earthquake of 1950, which recorded 5.6 on the Richter scale. In 1976, an earthquake of recorded magnitude of 4.5 on the Richter scale occurred in the vicinity of the Antelope Mountains, five miles northeast of Susanville. In 1979, an earthquake with a recorded magnitude of 5.2 on the Richter scale occurred on the Honey Lake fault zone near Doyle (Harding Lawson Associates 1989).

Major seismic features in Honey Lake Valley include the Litchfield, Amedee, Wendel, Fort Sage, and Honey Lake fault zones. Seismic activity along these faults could result in ground shaking, liquefaction, landslides, and slope failure within the County. According to the Uniform Building Code, Lassen County is within Seismic Zone III. This classification indicates that major damage could occur in the County during an earthquake event. A number of areas in Lassen County are identified as Alquist-Priolo Special Study Zones. These zones include areas where active faults present hazards in terms of potential surface fault-rupture. No structures for human occupancy can be located across fault traces in these zones.

1.2.5 Land Use

Regional Setting

Lassen County is comprised of a diversity of land uses ranging from urban in the Susanville area, to agricultural and recreational in the outlying rural areas. The predominant land use in the County is agriculture. The most intensively farmed areas are located in Honey Lake Valley in the southeastern portion of the County. Greenhouse operations are also being installed in the County and their numbers may increase, depending on the availability and economic feasibility of geothermal heating. Cattle raising takes place throughout the County.

Total value of agricultural commodities in Lassen County, including timber, livestock, and wildlife management production was 87.7 million dollars in 1990. Field crop production totalled 23 million dollars and included hay, alfalfa, and grain. Vegetable and nursery crops totalled 12.9 million dollars, of which 11.4 million was generated by sales of strawberry plants. Production of saw timber generated 22 million dollars, while livestock and poultry generated 10.6 million dollars (Lassen County Department of Agriculture 1990).

Over 60 percent of the County is in public ownership. The largest amount (35 percent) is administered by the Bureau of Land Management and is comprised primarily of public range lands in the eastern section of the County. About 20 percent of the public lands are regulated by the U.S. Forest Service (County General Plan, 1968). In the western region

of the County, a substantial portion of the forested area is National Forest land, under the jurisdiction of Lassen National Forest or Modoc National Forest. The Plumas National Forest encompasses forested areas in the southwestern portion of the County. Timber production has been a major land use in the County. In 1968, 42 percent of the land was forested. A variety of pine forests are found in the western portion of the County (See Section 1.2.2, Biology).

The urban areas, including the incorporated portions of the County, occupy only a small percentage of county land. The county seat and economic center is Susanville which is the only incorporated community in the County.

The rural areas of the County offer natural features that are used for recreational activities. Many outdoors activities are possible within the County, due to its abundance of fish and wildlife, and wide range of topographic, geologic, and climatic conditions. These activities include hunting, fishing, boating, hiking, backpacking, rockclimbing, and bird watching. Recreational opportunities are enhanced by the numerous areas open to public use, including the Lassen Volcanic National Park; the Caribou Wilderness area; the Honey Lake and Doyle Wildlife areas; the Plumas, Modoc and Lassen National Forests; and lands managed by the Bureau of Land Management. Eagle Lake, in the western portion of the County, is a major recreational area in the region.

Hunting is one of the most popular recreational activities in the County. Big game consisting primarily of mule deer and antelope, and upland game consisting of pheasant, quail, dove, sagehen, blue grouse, chukar partridge, rabbit, and squirrels are abundant. The County also contains several waterfowl resting areas during the migratory periods such as Honey Lake, Big Valley, Eagle Lake, and Mountain Meadows Reservoir. Hunting opportunities, as well as various types of nonconsumptive wildlife use such as sightseeing, photography, and nature study are provided in these areas. Several private hunting clubs exist in the County, including clubs located in ranches where pheasants are raised for hunting opportunities.

Approximately five years ago, the Private Lands Wildlife Management Program (authorized by Assembly Bill 580) was implemented in Lassen County. The objective of the program, which has since been revised and now named the Private Lands Habitat Enhancement and Management Area Program, is to actively encourage the propagation, conservation, and wise use of fish and wildlife populations located on private lands. It is expected that wildlife populations, including game and non-game species, would benefit and increase as a result of improved vegetation and habitat, and protection of existing habitat and wildlife resources from changes in land use. In 1990, there were 137,167 acres in Lassen County under a program attempting to increase populations of deer, antelope, and waterfowl. The majority of this acreage was dedicated to deer management (91,167 acres). Acreage under the management program yielded 81 deer, and generated a revenue of $64,800 in 1990. Total annual wildlife production value was $85,300 (Lassen County Department of Agriculture 1990). Additional revenue is generated from travelling to the County for hunting and wildlife viewing opportunities, and from purchase of equipment (Frank Hall, pers. comm.).

Fishing opportunities exist in several water bodies within the County such as the Mountain Meadows Reservoir, Moon Lake, Susan River, and Eagle Lake. Trout is the most popular cold water species in the County's streams and mountain lakes, and include the unique Eagle Lake trout. Largemouth bass, bluegill, pumpkinseed sunfish, and brown bullhead are warm-water species found in the County's reservoirs.

Regulatory Setting

The County General Plan contains numerous state-mandated elements which provide general direction and development goals for the County. The General Plan is augmented by several Area Plans which cover selected portions of the County and include analysis of the specific planning issues within a defined area. These Area Plans serve to update land use policies and designations of the General Plan and guide development within a given area. Area Plans have been prepared for the Johnstonville, Wendel, Eagle Lake, Pittville, Hallelujah Junction, and Susanville Vicinity Planning Areas. The County has also updated certain elements of its General Plan, including the Housing Element (1986) and the Noise Element (1989). A Solid Waste Management Element was adopted in 1986.

The provisions of the General Plan are implemented by the County Zoning Ordinance which specifies permitted land uses within each zone district. The Zoning Ordinance also establishes regulations for site development, including building height and setback requirements. State law requires the zoning ordinance to be consistent with the General Plan. Zoning regulations regarding energy production facilities vary, depending on the type of energy development. Detailed information on the zone provisions for each type of energy facilities are provided in Chapter 2.

1.2.6 Noise

Regional Setting

The Noise Element describes the general noise setting for the County (i.e., ambient noise levels), and identifies major noise sources in the community. Roadways, railroads, industrial facilities, airports and other stationary noise sources contribute to the community noise environment.

Existing energy-related noise sources identified in the County include the use of diesel generator powered pump stations for agricultural needs; cogeneration plants, turbine generators, and diesel generators used in lumber mills; and a biomass power plant (Mount Lassen Power Plant). The following energy-related facilities are identified in the Noise Element as having a potential for impacting the immediate vicinity:

1) Big Valley Lumber Company - a forest products processing plant operating a planing mill during the day and a sawmill 24 hours per day, seven days per week. Noise generating equipment includes saws, planers, fans and a cogeneration plant which operates 24 hours per day. Activities in the facility contributing to noise levels include material handling with fork-lifts and the use of heavy trucks.

2) Susanville Forest Products - This lumber manufacturing mill operates from 6 a.m. to 1 a.m., Monday through Friday. Noise generating equipment includes high pressure blowers, conveyers, saws, a cogeneration plant, and diesel generator. Heavy truck traffic also contributes to the noise environment.

3) Sierra Pacific Industries - This lumber manufacturing plant operates saw and planing mills until the evening hours and a power house 24 hours per day. Noise-generating equipment includes saws, planers, heavy trucks, a turbine generator, and five diesel generators.

4) Mount Lassen Power Plant in Westwood - This woodwaste burning plant used for electricity production operates 24 hours per day. Noise generators associated with the facility operations include heavy trucks providing fuel, front loaders, conveyers and fans.

The Noise Element map also shows Honey Lake Power Plant as one of the major noise sources in the County. This biomass power plant utilizes geothermal fluids to preheat boiler feed water. The plant operates 24 hours per day. Noise generating equipment includes the boiler, generator, conveyor systems, and motor vehicles.

Regulatory Setting

The main policy document regulating noise in Lassen County is the General Plan Noise Element (Element) adopted in 1989. Lassen County currently has no Noise Ordinance, therefore, the guidelines in the Element are used for new development. Goals and objectives regarding noise levels, and specific policies to be implemented by the County to minimize noise conflicts are contained in the Element. To avoid noise conflicts in the County, the Element establishes a land use pattern that minimizes the exposure of community residents to excessive sound levels. This is accomplished by preventing the introduction of new noise-producing uses in a noise sensitive area, and by preventing encroachment of noise sensitive uses on areas with existing industrial facilities. Guidelines for the preparation of a Noise Ordinance are included in the Element. The Noise Ordinance would establish responsibilities and procedures for noise measurement, enforcement, abatement, and variances.

The Element defines a noise-impacted area as an area exposed to existing or projected exterior noise levels exceeding 60 dB L_{dn}/CNEL. L_{dn} represents a day-night average sound level and CNEL is the Community Noise Equivalent Level. County policies state that noise produced by industrial uses shall not exceed 70 dB L_{dn}/CNEL at the nearest property line.

1.2.7 Socioeconomics

Regional Setting

Population. Lassen County has historically undergone a slow growth in population. The total population in 1965 was only 3,000 over the 1940 figure. The decade between 1950 and 1960 saw a 26% loss of population in the County, almost entirely due to an out-migration of young people in the labor force after a down turn in the lumber industry (General Plan 1968). In recent years, however, Lassen has experienced a population growth rate significantly higher than the state-wide California average. During the decade from 1970 to 1980, the County's population grew by 29%, compared to 18.6% for the state (see Table 1-2, Lassen County Population) due to a shift in emphasis from a lumber to a services and trade-oriented economy. The 1990 Census preliminary counts show an additional growth of 27% over the 1980 totals. The County's recent population growth has occurred primarily in the unincorporated areas, which had 10,131 more residents in 1990 than in 1970. This constitutes a growth rate of approximately 100 percent over twenty years.

Table 1-2
Lassen County Population

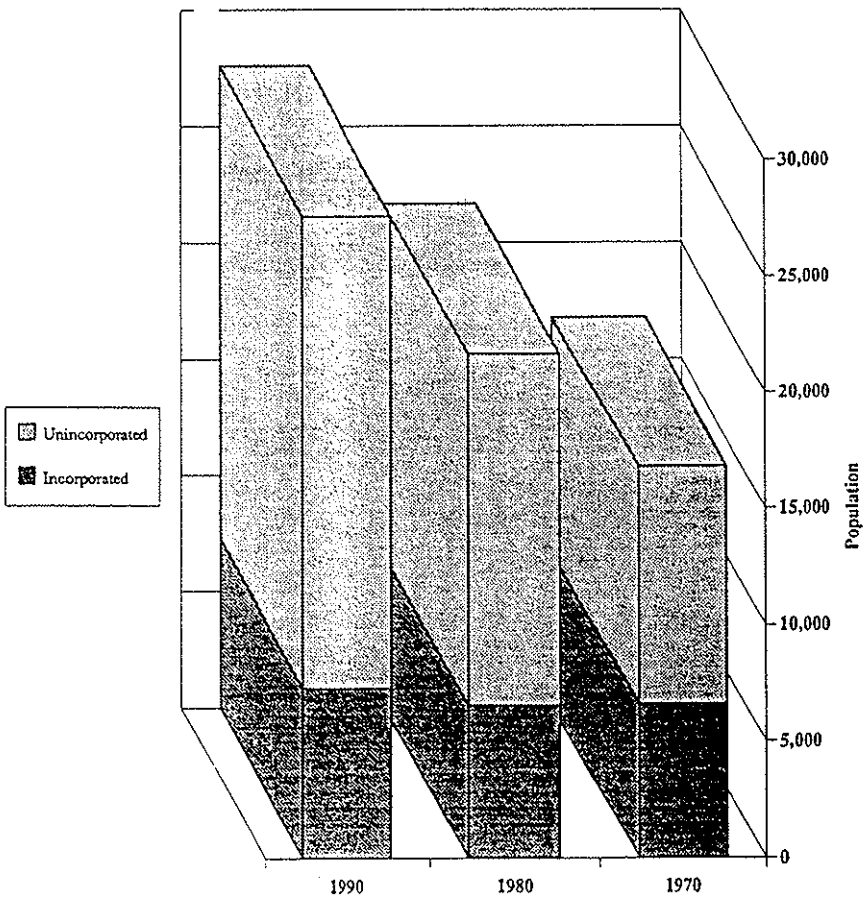
	1970	*1980*	*1990*
Incorporated (Susanville)	6,608	6,520	7,279
Unincorporated*	10,188	15,141	20,319
Total	16,796	21,661	27,598

* A portion of the unincorporated total population consists of residents in the unincorporated portion of the Susanville urban area.

Source: U.S. Census

In 1970, the incorporated area of the County (Susanville) accounted for 39% of the total population, a percentage that has experienced a constant decline. The 1990 Census shows that, at present, only 26% of the county population lives in Susanville (see Figure 1-2).

Figure 1-2
Lassen County Population



Source: U.S. Census

Source: U.S. Census

Population growth in real numbers of individuals in the last 20-year period was only 671, a total growth rate of 10%. This slow growth in Susanville's population is believed to be caused by an out-migration of young adults due to limited job opportunities (Susanville Vicinity Planning Area 1982) and the limited annexations of adjoining lands for residential development.

In 1980 the median age in Lassen County was 29 and approximately 13% of the total population was over 60 years old. The Department of Finance's (DOF's) population projections in Table 1-3 show that the County's population is expected to continue to increase, reaching a total of 35,652 in the year 2000. It is estimated that, at that time, the population over 60 will represent 16% of the total population and the overall median age will be 37. Estimates for the year 2020 indicate a median age of 41 and the population over 60 constituting 24% of the total.

Table 1-3
Lassen County Population Projections

	1990	*2000*	*2020*
Total Population	27,800	35,652	43,960
Age 0 - 17	6,910	7,625	9,478
Age 18 - 64	18,051	24,344	28,175
Age > 64	2,839	3,683	6,307
Median Age	32	32	33

Source: DOF Projections, Report 93-P-3 (1993)

Employment. Lassen County is generally rural in character with approximately 42 percent of the land forested. Large parts of the County are included in Lassen, Plumas, and Modoc National Forests. The county seat and largest urban area is Susanville, the largest employment, transportation, and retail center. Lassen County's civilian labor force reached a total of 10,075 in December 1990 (see Table 1-4), an increase of 3% over 1989.

Lassen's economy relied on the timber industry and the agriculture sector until the early 1980s when the government sector became the largest source of employment in the County. In 1989, Government accounted for nearly 50% of the total nonagricultural wage and salary employment (see Table 1-5). A major part of these jobs are with the California Correctional Center, the Sierra Army Depot, Lassen Schools and College, and Lassen County. The California Correctional Center recently expanded its facilities and increased its number of employees. Services and retail trade are also important for the local economy, and provided 27% of total employment in 1989. Manufacturing, which is comprised of lumber and wood product industries, was the next largest employment sector.

Table 1-4
Lassen County Civilian Labor Force, Employment and Unemployment

	1989	*1990*
Civilian Labor Force*	9,750	10,075
Employment	8,925	8,950
Unemployment	825	1,125
Unemployment Rate	8.4	11.2

* Civilian Labor Force includes non-military workers age 16 and over.

Source: Employment Development Department. Data for December 1989-1990. (Gene O'Riordan, research analyst)

Table 1-5
Lassen County Annual Average Wage and Salary Employment

Industry	*1988*	*1989*
TOTAL JOBS*	7,975	8,200
Total Agriculture, Forestry, & Fishing	300	275
Total Non-agriculture	7,675	7,925
Construction and Mining	275	275
Manufacturing	700	775
Transportation and Public Utilities	250	250
Wholesale Trade	125	125
Retail Trade	1,075	1,075
Finance, insurance & real estate	225	200
Services	1,100	1,150
Government	3,925	4,050
Federal	1,100	1,175
State	1,150	1,200
Local & Education	1,675	1,700

* Total differs from Civilian Labor Force because employment in this table does not include self-employed people.

Source: EDD Annual Planning Information, Lassen County, June 1990

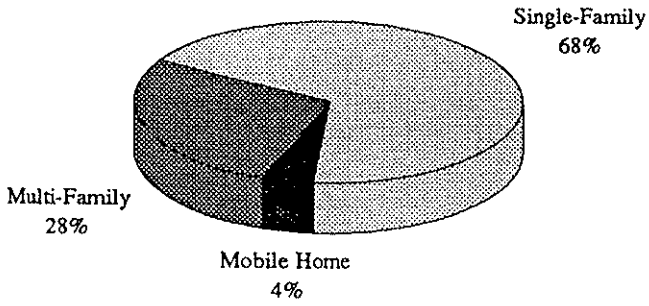
Housing. Housing estimates developed by the Department of Finance for 1990 are shown in Table 1-6. The majority, or 57 percent, of the housing supply in Lassen County consists of frame-built single-family dwellings. Multi-family dwellings and mobile homes compose the remainder of the existing housing stock. There are 1,688 multiple housing dwellings (2 or more units) and 2,872 mobile homes in the County. Mobile homes are particularly popular in Lassen County due to their affordability and location flexibility. Most mobile homes are located in the unincorporated areas of the County where they constitute 35% of the total number of units (see Figure 1-3). Mobile homes are often used as second and recreational homes, occupied only during a portion of the year. The 1980 Census identifies 21% of the total number of mobile homes under the category of "vacant seasonal and migratory units". This condition is also reflected in the 1990 vacancy rate, which the DOF estimated at 24% for the unincorporated area of the County. This rate would be much more modest if it was acknowledged that a portion of these units are second-homes.

Table 1-6
Lassen County Housing Estimates
January 1990

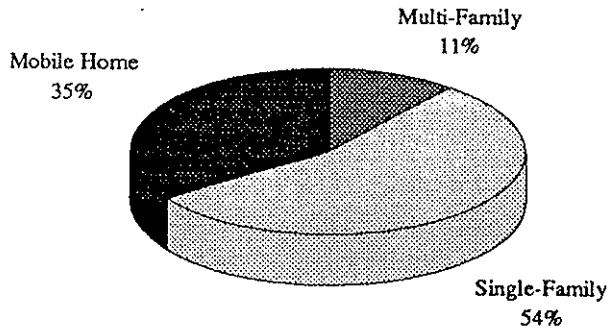
	Single-Family	*Multi-Family*	*Mobile Homes*	*% Vacant*	*Total*
Incorporated (Susanville)	2,085	818	150	6%	3,053
Unincorporated	4,140	870	2,722	24%	7,732
Total	6,225	1,688	2,872	19%	10,785

Source: DOF, Report E-5 (January 1990)

Figure 1-3
Lassen County Housing Estimate
January 1990



Incorporated (Susanville)



Unincorporated

Source: Department of Finance, 1990

1.2.8 Transportation

Regional Setting

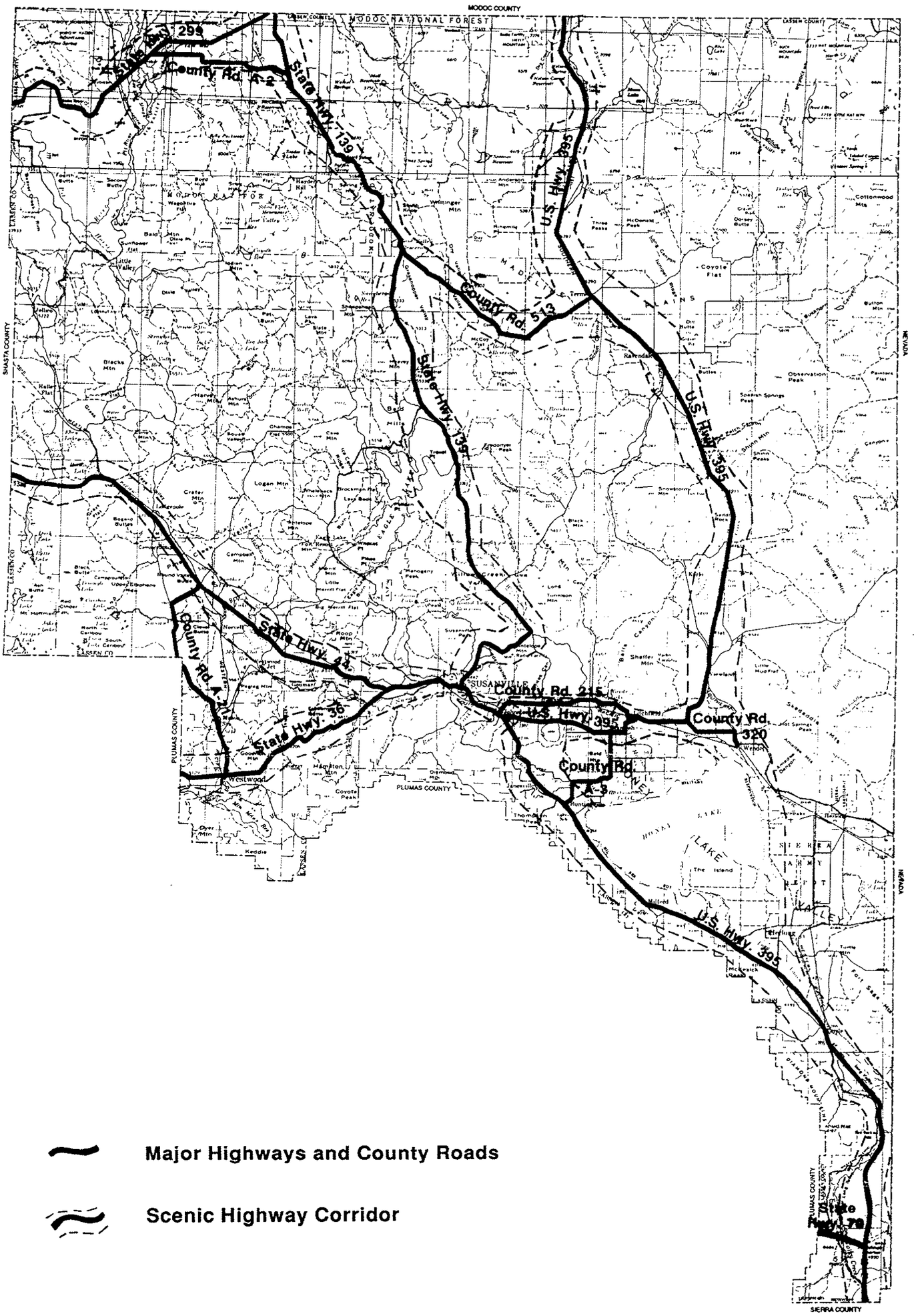
Lassen County is served by one U.S. Highway and five state highway routes, which provide the main regional transportation routes for automobiles and trucks, and access to the adjacent state and the surrounding counties. The highway network includes US 395, and State Routes 36, 44, 70, 139 and 299 (see Figure 1-4).

U.S. Highway 395. US 395 is a north-south route connecting the County to Alturas to the north, to Reno to the south, and to other points along the eastern Sierra. With the exception of a short four-lane stretch between the southern border of the County and Hallelujah Junction, U.S. 395 is a "two-lane road with a 24-foot-wide driving surface, graded, graveled shoulders", and periodic passing lanes (Steffen Robertson and Kirsten 1991). The average daily traffic count on this highway varies from 1,400 vehicles, north of Johnstonville, to 6,400 vehicles south of Johnstonville (State of California 1990). Levels of service also vary from A at the four-lane section and between Litchfield and Alturas, to D between Constancia and Milford (Steffen Robertson and Kirsten 1991).

State Highway 36. State Highway 36 provides regional access from Lassen County to the west, and to the Sacramento Valley. This roadway links Red Bluff and Interstate Highway 5 to US 395. The portion of this highway running through Susanville, and for several miles west of its city limits, is "4-lane with shoulders that vary from no shoulder to ten feet in width" (Steffen Robertson and Kirsten 1991). West of this section, it narrows to a 2-lane road with eight-foot shoulders. The level of service is currently classed MI (maintain and improve), which is equivalent to a level F (Steffen Robertson and Kirsten 1990). The average daily traffic count ranges from 4,900 west of Susanville, to 9,000 east of Susanville, with the highest count, 19,000 occurring within the Susanville city limits (State of California 1990).

State Highway 44. State Highway 44 connects the County to Redding and to points in the north and west in neighboring counties. It intersects Highway 36 approximately 7 miles west of Susanville. The portion of State Highway 44 located within Lassen County has an annual average traffic count of 1,900 per day vehicles and a service level of C (State of California 1990). Within Lassen County, Highway 44 is a two-lane, 24 to 32 foot wide roadway with no paved shoulders (Caltrans 1984).

State Highway 70. State Highway 70 links the southernmost portion of the County with Plumas County, and connects with U.S. Highway 395 at Hallelujah Junction. From this junction to the western border of the County, State Highway 70 is primarily a two-lane, 32 foot wide roadway with shoulders ranging from no shoulder to 8 feet (Caltrans 1990). Within Lassen County, this roadway has an average daily traffic count of 2,950 vehicles and a level of service D (State of California 1990, Caltrans 1990).



Major Highways and County Roads

Scenic Highway Corridor

0 5 10 Miles

ource: USGS 1:250,000 Quadrangles; Alturas 1971, Susanville 1962, and Chico 1970.
ase map compiled and prepared by Michael Clayton & Associates, 1991.

Lassen Energy Element
Energy Setting

Figure 1 – 4
TRANSPORTATION NETWORK
AND SCENIC CORRIDORS
Michael Clayton & Associates

State Highway 139. State Highway 139 connects central Lassen County to northern Lassen County, Modoc County and Klamath Falls, Oregon. It intersects with State Highway 299 near the Modoc County line. Within Lassen County, State Highway 139 is primarily a two-lane roadway with 11-foot lanes and a level of service A. Its average daily traffic volume varies from 310 vehicles near the County's northern border, to 5,600 vehicles within the Susanville City limits (State of California 1990).

State Highway 299. State Highway 299 connects northwestern Lassen County with Modoc County to the north, and Shasta County to the west. Within Lassen County, State Highway 299 is primarily a two-lane roadway with 12-foot lanes and a level of service C. Traffic volumes range between 1,150 and 1,900 vehicles per day (State of California 1990, Steffen Robertson and Kirsten 1991).

The Lassen County transportation system also includes a county road network and a municipal street system within the incorporated city of Susanville. A number of major county roads are depicted in Figure 1-4 In addition, the County is traversed by rail facilities belonging to the Southern Pacific and Western Pacific railroads. The Southern Pacific line provides connection to Klamath Falls, Oregon and to Nevada. The Western Pacific line provides a rail link to the rest of California.

Greyhound has a passenger and freight service line operating between Reno and Alturas on U.S. 395. A daily bus service is also available to Red Bluff. At present, there is no regular commercial airline service into the area. The closest airline service is in Reno, Nevada. Charter service is available at the Susanville Municipal Airport.

The Lassen Regional Transportation Plan, updated every two years, is the comprehensive policy document regulating circulation in the County. It is the guide to managing the development of future transportation and circulation systems.

1.2.9 Visual Resources

Because of the rural and natural features of the region, Lassen County maintains many scenic qualities including mountains, lakes, creeks, rivers, and forests. Visual impact is therefore, a major concern, and one that must be seriously considered when contemplating any changes to policies which will affect the environment.

Scenic resources within each planning area are assessed and categorized based on the following criteria: judgement of inherent scenic quality, character and diversification; sensitivity with regard to the amount and type of public exposure to the particular landscape; the distance at which a landscape is perceived (foreground, middleground, background); and the extent to which an area's scenic quality is impacted. The Lassen County General Plan identifies "scenic highway corridors" along highways and certain county roads. These scenic highway corridors are depicted in Figure 1-4. In addition, several scenic corridors have been

more specifically identified by the County in various Area Plans as potentially eligible for scenic highway status. These areas include:

- State Highway 139 from the northern end of the Susanville Planning Area to the northern border of Section 28. The area provides views of the valley and the Diamond Mountains.

- State Highway 36 from the western border of the Susanville Planning Area to the Susanville City limits. Views of the valley and the Susan River are provided along this route.

- State Highway 36 from the eastern border of the Susanville planning area to the U.S. Highway 395. Agricultural lands and the rural Honey Lake Valley area are visible from this portion of Highway 36.

- U.S. 395 and a broad area at least one mile wide on either side through the Johnstonville and Hallelujah Planning Areas.

- State Highway 299 and Pittville Road (County Road 430) through the Pittville Planning Area.

Regulatory Setting

The visual regulatory setting of Lassen County is presently defined by the policies established in the existing Area Plans and the design review requirements of the County's zoning provisions. Specific policies address protection of visual resources from adverse effects of development.

1.2.10 Water Resources

Lassen County lies between the eastern slope of the Sierra Nevada and the Cascade Range, the Modoc Plateau, and the western portion of the Basin and Range. The climate in the County is semiarid, with cold, wet winters, and warm, dry summers. At the higher elevations, much of the precipitation falls as snow, contributing to a winter snowpack that maintains streamflows into the spring and summer months. However, parts of the County are situated in a rain shadow area. Air masses moving landward from origins in the central and Northern Pacific, successively encounter the Coast Range, the Klamath Mountains and the Cascade-Sierra Range, and lose most of their moisture before they reach Lassen County. This phenomenon results in a mean seasonal precipitation that varies from less than eight inches in the eastern valleys of the County to over 40 inches at Juniper Lake, in the Lassen Volcanic National Park, situated on the ridge of the Cascades. Maximum monthly precipitation generally occurs in January. Except for local showers and thunderstorms which occur in the mountainous areas, summers experience minimal precipitation.

Surface Water

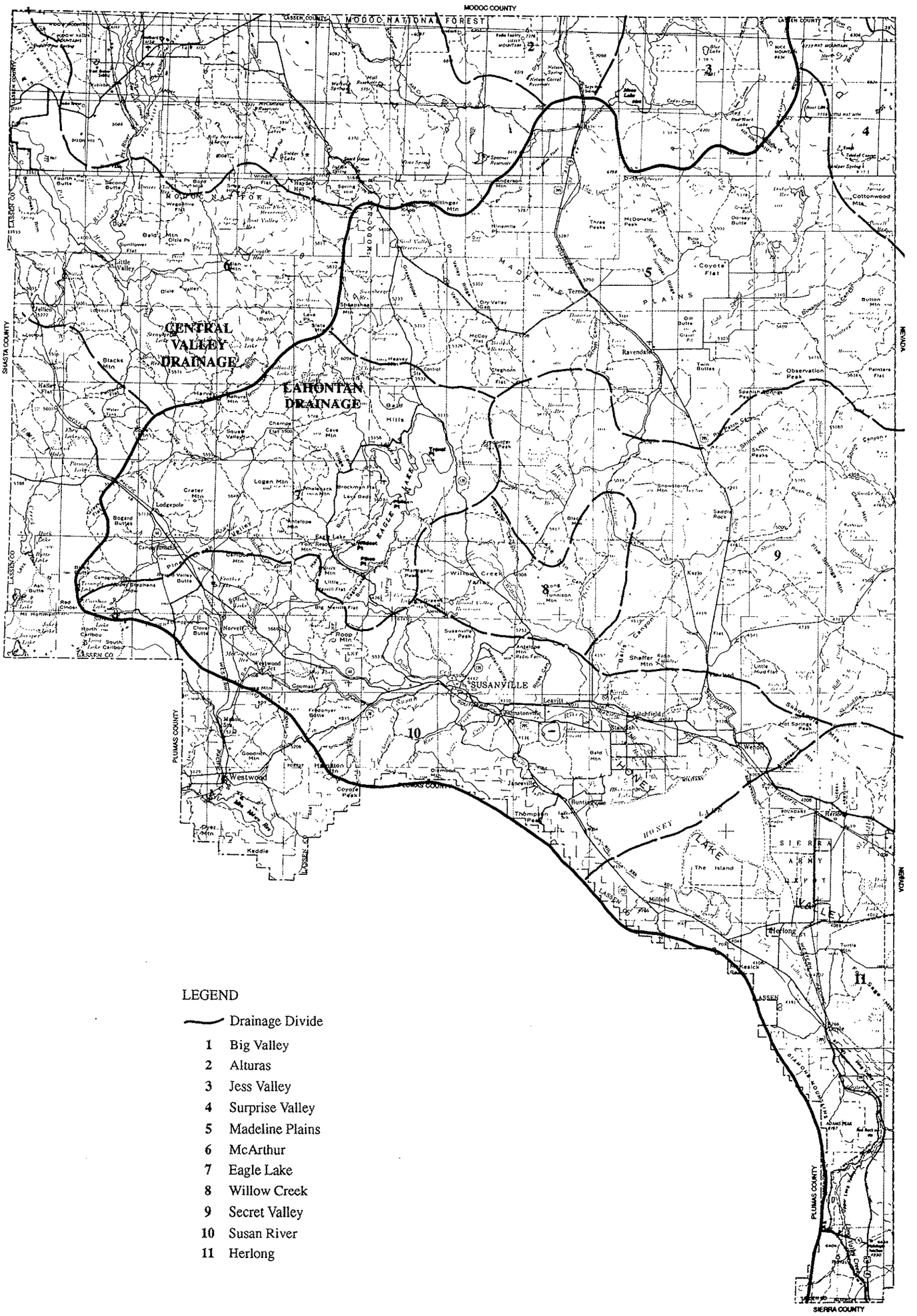
The principal sources of the County's surface water supplies are the Susan River which serves the Susanville and Upper Honey Lake areas; the Pit River which serves the Big Valley area; and Willow Creek which serves an area north of Susanville. Water flows through Lassen County to the Central Valley and to the Lahontan Drainage Basins. These basins comprise two of the nine major hydrographic divisions of the State of California. In Lassen, the divide between the Central Valley and the Lahontan watersheds follows the County's southwestern boundary with Plumas County, passes east of Westwood, and then crosses the County in a north-easterly direction from a point east of Lassen Park to Madeline (See Figure 1-5). The Pit River drainage is part of the Central Valley Basin.

The Lahontan Basin in Lassen County consists of four closed basins. They are: Honey Lake, Eagle Lake, Madeline Plains, and Alkali Lakes. In these basins, streams flow from the drainage basin to the valley and remain there, rather than eventually flowing to the ocean. Major tributaries of Honey Lake basin are the Susan River, Willow Creek, and Long Valley Creek. Pine, Papoose, and Merrill Creeks are important streams entering Eagle Lake, with Pine Creek being the most significant of the three. The Pine Creek watershed encompasses 56% of the entire Eagle Lake watershed and provides approximately 75% of the total surface inflow. The Madeline Plains basin has no significant streams. It receives some runoff from Cold Spring, Red Rock, and Buckhorn Canyon Creeks originating in the northeastern corner of the County. These streams flow intermittently during, and immediately following, periods of rainfall. Most of the precipitation in the Madeline watershed is either consumed in the evapotranspiration process or percolates to the ground water basin underlying much of the plains. Within Lassen County, the Bear Creek watershed provides the most runoff to the Alkali Lakes. The Alkali Lakes basin also contains lands in Modoc County.

Major surface water features include two natural lakes, Eagle Lake and Honey Lake, and several reservoirs including: Mountain Meadows, McCoy Flat, and Leavitt Lake. Most of the county reservoirs were constructed by private individuals for irrigation purposes. The following is a description of the size and use of some of these reservoirs and lakes.

- Eagle Lake is the second largest natural lake that lies entirely within California; only Clear Lake is larger. Eagle Lake is a fresh water body covering 34 square miles. It is 6 miles long, and its width varies from 1.2 to 4 miles. Eagle Lake is composed of three basins connected by narrow channels. The north and middle basin average depths of only 10 feet; the south, more than 90 feet (Lassen County Almanac 1991).

- Honey Lake is situated in the central portion of Honey Lake Valley, and covers an area of approximately 93 square miles. Water depths are variable by season and locale and the lake is occasionally dry during the summer months. The average depth of Honey Lake, when full, is approximately five feet, providing a storage capacity of 297,600 acre-feet of water. This water, due to its high mineral content,



LEGEND

- Drainage Divide
- 1 Big Valley
- 2 Alturas
- 3 Jess Valley
- 4 Surprise Valley
- 5 Madeline Plains
- 6 McArthur
- 7 Eagle Lake
- 8 Willow Creek
- 9 Secret Valley
- 10 Susan River
- 11 Herlong

0 5 10 Miles

Lassen Energy Element
Energy Setting

Figure 1 –5
LASSEN COUNTY DRAINAGE AREAS
Michael Clayton & Associates

is usually not appropriate for livestock or agricultural use. There has been some recent limited irrigation conducted with water collected from the surface of the lake and mixed with fresh groundwater (Harding Lawson Associates 1987).

- Mountain Meadows Reservoir was built by PG&E for the generation of electric power in Plumas County. The reservoir is located on Hamilton Creek, south of Westwood, and has a storage capacity of 24,800 acre-feet.

- McCoy Flat Reservoir, located on the Susan River, is used for irrigation purposes, and has a storage capacity of 17,290 acre-feet.

- Lake Leavitt was also built for irrigation purposes. It receives its water as a diversion from the Susan River, and provides a storage capacity of 14,000 acre-feet. Both Leavitt Lake and McCoy Flat are owned by the Lassen Irrigation Company.

Ground Water

Lassen County overlies four principal ground water basins: Willow Creek/Secret Valleys, Honey Lake Valley, Madeline Plains, and Big Valley. Ground water is the major source of water supply for industrial, and domestic uses in the unincorporated area of the County. It is also a supplemental source of water for irrigation in Honey Lake Valley, where new wells are drilled each year for irrigation purposes (Department of Water Resources 1975). Ground water pumping also occurs in Big Valley, and includes the drilling of numerous high yield irrigation wells.

Water-bearing geologic formations in Lassen County include lava flows, lake deposits and more recent valley sediments. Moderately to highly permeable basalt flows cover extensive areas in Willow Creek and Secret Valleys. These lavas constitute ground water recharge areas and act as aquifers. The recent lavas appear to transmit water from Eagle Lake into Willow Creek Valley, some of which probably surfaces at the numerous springs that feed Willow Creek. In Secret Valley, older lavas are interbedded with lake deposits beneath the valley floor and constitute the principal aquifers. They may yield large amounts of confined water to local wells.

In Honey Lake Valley unconsolidated basin-fill deposits on the valley floor and fractured volcanic rocks in the northern and eastern upland areas are the principal ground water aquifers. The Honey Lake Valley ground water basin is composed of three major geologic units. The upper unit consists primarily of alluvial and near-shore lake sediments and typically extends from the soil surface to a depth of 1,500 feet. This unit includes the region's freshwater aquifers, which is generally of sufficient quality for domestic and agricultural use. The unit below the freshwater-bearing unit is characterized by a thick (3,000 feet) sequence of volcanic materials which is relatively impermeable and forms a barrier between the fresh waters of the upper unit and the geothermal waters of the bottom unit. Fractured and faulted granitic rocks characterize the third unit. The fractured nature of these materials allows the water to flow through what would otherwise be impermeable crystalline rock. This geologic unit serves as a reservoir for the area's geothermal water. Geothermal and fresh groundwater typically originate as precipitation in the mountainous

areas surrounding Honey Lake Valley (DWR 1963). Water infiltrates the volcanic formations of the mountains and percolates vertically and laterally to and beneath the valley floor area. Because the valley is a closed basin with no surface outlet, ground water movement is largely controlled by topography, and the dominant flow is toward Honey Lake.

The topography of the Madeline plains consists of gently rolling mountains and plateaus of volcanic origin, broken by steep rocky escarpments created by faults. The plains were formerly a lake basin but over time, the basin was filled by sediment, making it almost entirely flat. The Madeline ground water basin underlies most of the valley floor. Precipitation on the mountainous area surrounding the plains is the major source of ground water recharge. Surface water is found in localized depressions throughout most of the year.

Water Quality

Water quality conditions vary throughout the County, depending upon the source type (surface water, freshwater wells, geothermal) and location in the basin (mountains versus valley).

Surface Drainage Water - Runoff. Surface water originating on the eastern Sierra Nevada watershed, and draining into the valleys of the Lahontan Drainage Basin is generally of excellent quality. Susan River water, for instance, reflects the mineral quality of its tributaries and snowpack sources. The surface water contains calcium bicarbonate, is soft to slightly hard, and is satisfactory for all beneficial uses. Thus, despite the occasional occurrence of organic pollutants, water from the Susan River and other surface drainage courses represent relatively high quality water sources in the County.

Lake Surface Water. In general, surface water of the Lahontan Basin flows to the highly mineralized lakes of the closed basins and remains there, rather than flowing to the ocean. Therefore, mineral and other chemical constituents in the surface water continually accumulate in lakes.

Honey Lake contains high concentrations of sulfate, fluoride, boron, sodium, and chloride. Total dissolved solids (TDS) frequently exceed 2,000 mg/l. The high mineral content of the lake has generally precluded its use for livestock watering or crop irrigation. In recent years, however, limited quantities of the less saline water have been collected at the lake surface, mixed with fresh water, and used for irrigation in the eastern part of the valley. A surface water skimmer is used for collecting the lake water (Harding Lawson Associates 1987). In high water years, such as the early 1980s, water has been pumped from the lake to irrigate areas in the western side of the valley. Honey Lake Power Plant was originally intended to discharge its wastewater, (primarily geothermal well water), into the lake, but the project was modified and the plant currently discharges its effluent into the ground through an injection well. At this time the Amedee geothermal project discharges its effluent into long, winding surface channels and, eventually, to wetlands along Honey Lake.

The water in Eagle Lake is highly alkaline (sodium bicarbonate) with a moderately high pH and hardness. It requires softening prior to domestic use, and is not appropriate for unrestricted irrigation use (Lassen County, No date). The lake consists of three basins connected by narrow channels all having somewhat different chemical, physical and

biological characteristics. The north and middle basins are relatively shallow (average depth 10-15 feet), allowing the water to be continually mixed and oxygenated by wind action. The south basin is deeper (average 50-60 feet up to 90 feet maximum) and stratifies in the summer and fall. The south basin is the highest in production of algae and plankton. Little is known at this time about the lake's capacity to assimilate and store additional nutrients. Increased recreational and residential use of the Eagle Lake area, may impact water quality conditions of the lake (Eagle Lake Area Plan).

Freshwater Wells. Ground water in Honey Lake Valley varies greatly in mineral quality. The ground water in the valley south of Herlong and along the southwestern side of Honey Lake generally ranges from calcium to sodium bicarbonate in character, and is usually excellent in quality. This water is suitable for most domestic, agricultural, industrial and municipal uses. Good quality ground water is generally found in the Susan River drainage area northwest of Bald Mountain, but 60% of the wells in the drainage east of Bald Mountain yield poor quality water (DWR 1963). In addition, wells in two areas of Honey Lake Valley yields water which contains hazardous concentrations of total dissolved solids, boron, fluoride, and nitrate. One area north of Honey Lake extends from the lake to Litchfield and the other area includes the Sierra Ordnance depot and the immediate vicinity of the depot (DWR 1975).

Geothermal Water. Numerous geothermal springs are located throughout the basin. They are often the result of faults acting as conduits for the upward movement of geothermal water. Amedee and Wendel Hot Springs are examples of this geologic occurrence (Harding Lawson Associates 1987). Geothermal water is also obtained from production wells drilled throughout the Honey Lake Basin. The hot springs located near Wendel contain sodium sulfate with high concentrations of chlorides and total dissolved solids (Lassen County No date). Susanville geothermal water contains 800 mg/l (milligrams per liter) of total dissolved solids. Even though Susanville's geothermal water quality is considered excellent in comparison to geothermal waters in other parts of California, the Lahontan Regional Water Quality Control Board is concerned with the potential impacts surface discharge of geothermal fluids from the Susanville's geothermal heating system may have on local water supplies (Susanville Vicinity Planning Area 1982).

In general, geothermal fluids contain a greater concentration of heavy metals and salts than local fresh waters, and the separation of these two types of water is imperative for the protection of most domestic and municipal freshwater uses.

Impairment of ground and surface water resources in the Lahontan Drainage Basin is caused primarily by discharges of domestic and industrial wastes. Domestic waste impact on water quality can occur by means of leakage from septic tanks or cesspools. Industrial wastes of concern in the County would be associated with the lumber industry. This is of particular importance in the Susanville area where milling facilities are located adjacent to the Susan River.

Ground water in a closed basin such as Honey Lake Valley is continually subject to water quality impairment resulting from use and reuse. With each use some water is lost from the basin but most of the soluble salts remain. Some uses also contribute additional salts to

the basin. As a result, poorer quality water is usually found in the lower portions of a closed basin.

Water Supply

The source of most of the Susan River's stream flow is precipitation and the melting snowpack of the higher elevations. In winter and spring, water in the upper river is stored in McCoy Flat and Hog Flat reservoirs by the Lassen Irrigation District. This water is usually released to the river channel in the summer, where it mixes with the natural flow before being rediverted into Lake Leavitt for further distribution by the District.

The City of Susanville obtains most of its domestic water supply from two springs, Cady and Bagwell, which provide a total flow of 1,500 gallons per minute (gpm). During the summer, water from two freshwater wells supplements the City's water needs.

Most water users in the Big Valley area irrigate on a rotation schedule, sometimes using flooding techniques. Much of the runoff is recovered and reapplied, resulting in a relatively high irrigation efficiency for the valley. Water use concentrates primarily in the valley floor along the Pit River (DWR 1975).

Even though the Honey Lake ground water basin includes a portion of Washoe County in Nevada, most of the ground water recharge and pumping occurs in Lassen County. While approximately 13,000 acre-feet of ground water pumping has been permitted for use in ranches located in Nevada, pumping in Lassen County accounts for 45,000 to 50,000 acre-feet of ground water extraction (Glen Pearson, pers. comm.). Monitoring of water wells in the Honey Lake Valley indicates that in the past years water levels have been dropping. Before the recent drought started, water pumping occurring within the valley was within safe yield (Glen Pearson, pers. comm.). However, additional growth occurred since the drought condition started, in approximately the mid-1980s, and high yield wells (2,000 gpm) were developed in Honey Lake Valley to supplement surface water irrigation supplies. Until the precipitation returns to normal, it will not be possible to determine if current ground water pumping rate is within safe yield.

Regulatory Setting

There are three watermaster service areas situated in Modoc and Lassen Counties (Ash Creek, Big Valley, and South Fork Pit River), and one service area entirely within Lassen County (Susan River). The primary purpose of watermaster service is to distribute water among users in accordance with their established water rights. This is accomplished by apportioning available supplies in streams which have had water rights determinations. Water rights determinations for purposes of establishing a watermaster service area may be accomplished by "statutory" adjudication, "court" adjudication, permit or license to appropriate, or by agreement. As provided by the California Water Code (Part 4 of Division 2) the Department of Water Resources is responsible for the distribution of surface water in the watermaster service areas (DWR 1975).

For surface water diversion outside watermaster areas, a Statement of Water Diversion and Use must be filed with the State Water Resources Control Board (Board) if direct use of

water is to occur in land bordering a water body. No permit is required because the owner of land adjacent to a stream, lake or pond is entitled to a riparian right over the natural flow of water which passes the property. However, a water right permit is required to store water during one season for use during another season or if the water is to be used in non-riparian parcels.

The direct use of underground water on overlying land does not require a permit from the Board if the water is percolating through a ground water basin. If the source of water is a subterranean stream flowing in a known and definite channel, a Statement of Water Diversion and Use must be filed with the Board for use of water on overlying land. If water from a subterranean stream is proposed to be stored from one season to another or to be used on non-overlying land a water right permit must be obtained from the Board.

Water Quality in Lassen County is managed by local agencies in accordance with state standards. The County has not instituted a set of local standards pertaining to surface water discharge, wastewater reclamation, and drinking water and thus relies on State-established standards. Jurisdiction relating to permitting, citations, and monitoring or surveillance programs required for water quality control is managed by a combination of state and local agencies. Lassen County is under the jurisdiction of the Central Valley and the Lahontan Regional Water Quality Control Boards. Any facility or activity that will discharge waste to surface water must obtain a federal National Pollutant Discharge Elimination System (NPDES) permit from the Regional Water Quality Control Board (RWQCB). If the wastewater will be discharged to land, the quality of the wastewater must comply with waste discharge requirements set by the RWQCB. The Regional Water Quality Control Board evaluates permit applications to determine whether the proposed discharge is consistent with the adopted water quality objectives, the Basin Plans, and the federal effluent limitations.

2. Facility Siting

CHAPTER 2
Facility Siting

2.1 INTRODUCTION

This component of the Energy Element of the Lassen County General Plan provides an evaluation of the various types of energy-producing facilities that may be sited in Lassen County. The purpose of this chapter is to assess the potential for development of various forms of energy and to identify facility siting considerations. This evaluation establishes the basis for defining specific policies and procedures to ensure compatibility of future energy facilities with adjacent land uses. The intent is to provide sufficient information to enable decision makers to make informed land use decisions regarding energy development and to inform potential project developers of facility siting criteria and regulatory procedures.

The types of energy facilities specifically addressed here include Biomass, Cogeneration, Geothermal, Hydroelectric, Solar, Waste to Energy, and Wind. Transmission lines and natural gas pipelines are also addressed in separate sections. Information was gathered from a wide variety of sources and was supplemented by site visits to existing energy facilities in the County.

Following a brief inventory of existing energy facilities in Section 2.2, the remaining sections focus on the specific types of energy production. The evaluation of each energy technology is divided into discussions of historical uses in the County, existing and proposed facilities, and feasibility for future development. In addition, environmental issues and regulatory procedures particular to each energy technology are described and siting considerations are identified.

2.2 FACILITY INVENTORY

In the initial phase of preparing this component of the Energy Element, the existing energy facilities in Lassen County were inventoried and the environmental impacts associated with development of these facilities were assessed. This assessment was necessary to evaluate the type and range of potential environmental impacts and to establish the basis for defining specific policies for future energy development. An overview of the existing energy facilities is summarized in Table 2-1, and their specific types of energy production and associated environmental impacts are described in more detail in Section 2.3.

At present, total electrical production in Lassen County is approximately 100 MW. A major part of this power is generated by two power plants: HL (Honey Lake) power plant, a hybrid facility using biomass and geothermal resources to produce 35.5 MW; and Muck Valley, a hydroelectric facility on the Pit River generating 30 MW. Three cogeneration units fueled with wood waste from lumber mills are responsible for production of 22.5 MW. Two lumber companies in Susanville, Sierra Pacific Industries and Jeld-Wen, Inc., operate cogeneration units. The third company is Big Valley Lumber in Bieber. Another facility using wood chips to generate power is Mount Lassen Power Plant in Westwood, a biomass

Table 2-1
Existing Energy Facilities in Lassen County

Facility	Type	Size	Date operation started	Location
Mount Lassen Power Plant (Formerly Ultrasystems)	Biomass	11.5 MW	10/84	Westwood
Honey Lake Power Plant*	Biomass/Geothermal	35.5 MW	07/89	Wendel
Big Valley Lumber Company	Cogeneration (Biomasss)	7.5 MW	10/82	Bieber
Jeld-Wen, Inc. (Susanville Forest Products)	Cogeneration (Biomass)	2.5 MW	06/83	Susanville
Sierra Pacific Industries	Cogeneration (Biomass)	12.5 MW	09/84	Susanville
Amedee Geothermal Plant	Geothermal	1.5 MW	12/88	Amedee
Wineagle Geothermal Plant	Geothermal	0.69 MW	09/82	Wendel
Muck Valley Project	Hydroelectric	30 MW	12/88	Pit River
Lassen College	Waste-To-Energy	1.5 MW	10/84 shut down in 1985 currently inoperative	Susanville

* Includes use of geothermal water to preheat boiler feedwater

Source: Michael Clayton & Associated 1991, Lassen County Planning Department 1991

facility with generation capacity of approximately 11 MW. Geothermal power production in the County is limited to two power plants, Wineagle and Amedee. Both plants are located on the northern shore of Honey Lake, near Wendel. Total geothermal production is 2.2 MW. Lassen Community College's Waste-to-Energy plant was designed to serve as a teaching facility and to generate 1.5 MW of electricity from combustion of solid waste. This plant was shut down in 1985. A proposal to expand and reopen this facility is currently being reviewed by state and local agencies. Energy facilities operating in Lassen County are shown in Figure 2-1.

2.3 ENERGY TECHNOLOGIES AND FUEL TYPES

2.3.1 Biomass

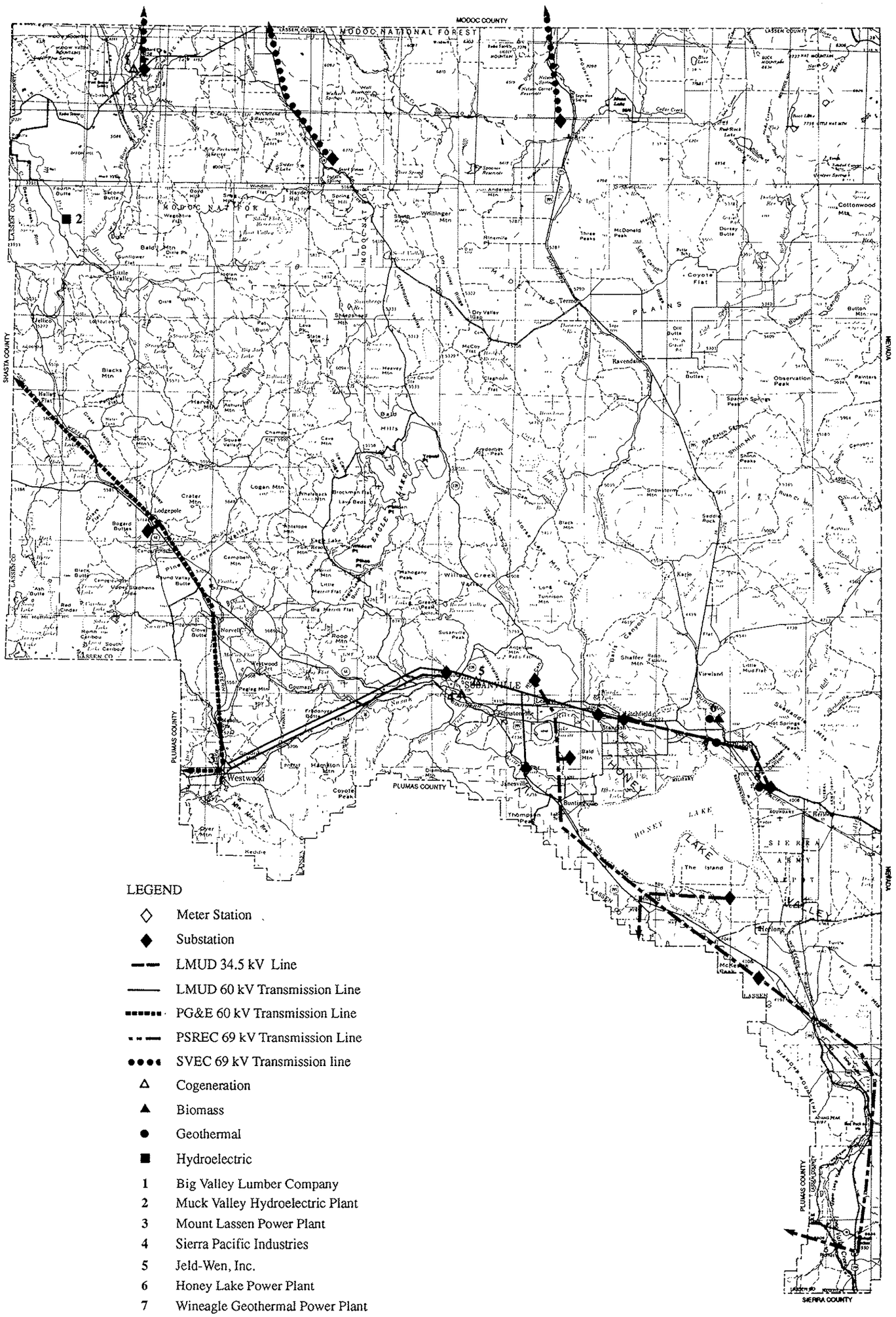
In an energy production context, the term biomass refers to wood residues produced by timber activities in forests, small trees and brush harvested for "biomass" or firewood purposes, wastes produced as a result of agricultural activities, and dairy and animal product wastes. These biomass wastes are used as fuel to generate energy. Firewood for home use and wood residues from forest management activities are the most commonly used biomass fuels. Biomass materials are derived from several other sources including: wastes produced by agricultural operations, such as pits, shells, and crop prunings; urban wood residues that normally end up in landfills; and animal wastes produced by dairy farms, pig farms, and cattle ranches. However, these sources are not commonly used to produce energy on a commercial scale. For practical purposes, this section will focus on wood wastes as a biomass source.

Most biomass plants are privately owned and function in a cogeneration capacity (CEC 1985). That is, they use a portion of the energy to run their operation (i.e., a lumber mill), then sell the remaining energy back to an established grid power system (e.g., PG&E). This section focuses on biomass energy production facilities that do not have a cogeneration function. Cogeneration is discussed in Section 2.3.2, Cogeneration.

Technology Overview

In general, the use of wood as a fuel source to produce energy on a broad scale is increasing in popularity. There are currently one hundred biomass energy facilities in California that function with an installed capacity of approximately 300 megawatts (MW) and use a total of five million tons of biomass per year (CEC 1986). Wood residues from forest processing techniques account for over 80 percent of all biomass materials used to produce energy. Collection of biomass materials involves several phases. Timber is cut down and is taken to the mills for processing. The limbs, bark, and any other wood wastes are usually removed at the mill. The woody residue is then used as a fuel to produce energy. Cull logs, those which are rotten, damaged or otherwise not suitable for lumber purposes, are also used as biomass fuel.

Another method of obtaining biomass fuel involves in-forest harvesting. This process involves removing the precommercial thinnings and excess wood waste on-site as the timber



LEGEND

- ◇ Meter Station
- ◆ Substation
- — — LMUD 34.5 kV Line
- ——— LMUD 60 kV Transmission Line
- ▪▪▪▪▪ PG&E 60 kV Transmission Line
- ▪ ▪ — PSREC 69 kV Transmission Line
- ●●●● SVEC 69 kV Transmission line
- △ Cogeneration
- ▲ Biomass
- ● Geothermal
- ■ Hydroelectric
- 1 Big Valley Lumber Company
- 2 Muck Valley Hydroelectric Plant
- 3 Mount Lassen Power Plant
- 4 Sierra Pacific Industries
- 5 Jeld-Wen, Inc.
- 6 Honey Lake Power Plant
- 7 Wineagle Geothermal Power Plant
- 8 Amedee Geothermal Power Plant

0 5 10 Miles

Source: California Energy Commission, 1981
and Michael Clayton & Associates, 1993.

Lassen Energy Element
Facility siting

Figure 2 – 1
EXISTING ENERGY FACILITIES

Michael Clayton & Associates

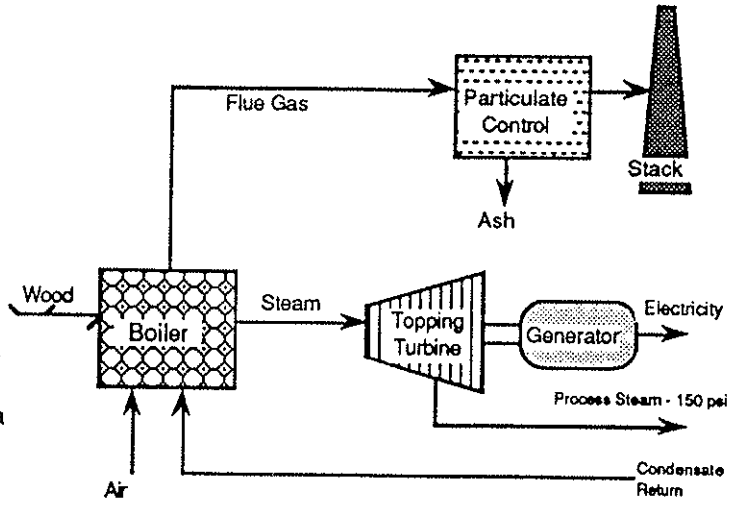
is harvested. This includes wood and wood waste that is not suitable for commercial uses, small trees, shrubs, and chaparral.Biomass energy facilities utilize three primary methods of biomass conversion into energy: direct combustion, methane fermentation, and gasification.

Direct Combustion. Direct combustion is the most predominant biomass conversion technology and is frequently used on a commercial scale. Approximately 90% of all biomass operations in California utilize direct combustion techniques. This process involves burning biomass materials to produce steam, process heat, and/or to produce electricity. When the biomass materials are burned, energy is released in the form of heat. The heat is then converted into energy. There are four basic types of direct combustion systems: pile burners, spreader-stokers, suspension firing, and fluidized bed (See Figure 2-2).

Figure 2-2
Technology of Biomass-Fired Plants
Direct Combustion

DESCRIPTION

- Direct combustion systems burn biomass residues as fuel, with conventional steam boiler technology.
- Major biomass fuels include forestry and mill wastes, agricultural field crop, agricultural food processing, noncommercial wood and urban wood wastes.
- The four methods of biomass combustion are pile burners such as incline grate systems, spreader-stokers which include fixed dumping and traveling grates, suspension and cyclonic burners, and fluidized bed combustors.
- Imporant fuel-related parameters in selecting a combustor type are heat content, moisture content, ash fusion temperature, bulk density and particle size.
- Overall plant efficiencies range from 19 to 22% for large condensing facilities producing only electricity to over 65% for cogeneration facilities utilizing steam for process heating.



Wood Fired Power Plant

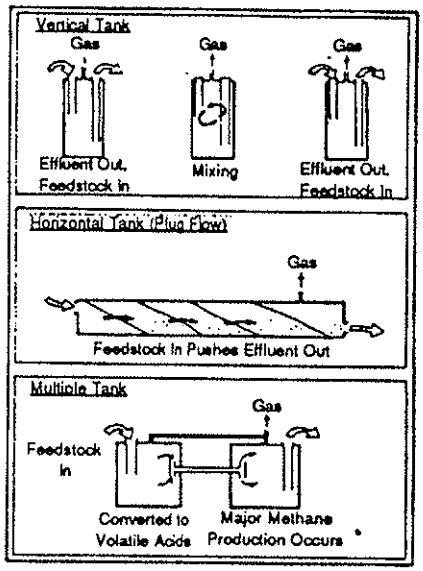
Source: California Energy Commission 1991

Methane Fermentation. Methane fermentation involves the trapping of natural gases that are produced as a result of anaerobic decomposition of animal wastes. This "biogas" can then be burned in place of natural gas to produce heat and/or electricity. Methane fermentation is primarily used in a self-sustaining capacity on large cattle ranches and dairy farms to satisfy energy needs, and to avoid water quality and animal waste disposal problems. There are three basic types of methane fermentation systems: completely mixed, plug flow, and batch load (See Figure 2-3).

Figure 2-3
Technology of Biomass-Fired Plants
Methane (Anaerobic) Fermentation

DESCRIPTION

- Anaerobic fermentation is a gasification process that occurs in the absence of oxygen. It avoids odor and water pollution caused by unprocessed wastes, while producing gas fuel to produce electricity or fire a boiler.
- Methane is produced from animal manure and high moisture content agricultural food processing residues are decomposed by microbes.
- The four types of reactors used for anaerobic digestion are mixed, contact, packed bed and plug flow.
- The mixed reactor is a storage tank for waste.
- The contact reactor is similar to the mixed, but solids are settled out and recycled.
- The packed bed reactor is a vertical cylindrical vessel with a support matrix that provides a place for microbes to attach.
- The plug flow reactor moves feed through the reactor in a distinct plug.
- Each application requires a specially designed system.



Continuous Flow Type Digesters

Source: California Energy Commission 1991

Gasification. Gasification is the chemical reduction of biomass material in the absence of oxygen to the point at which a combustible gas is produced. The resultant gas can then be burned. This type of process is relatively inefficient, and is not economically competitive with the direct combustion process. There are three basic types of gasifiers: fixed bed updraft, fixed bed downdraft, and fluidized bed (See Figure 2-4).

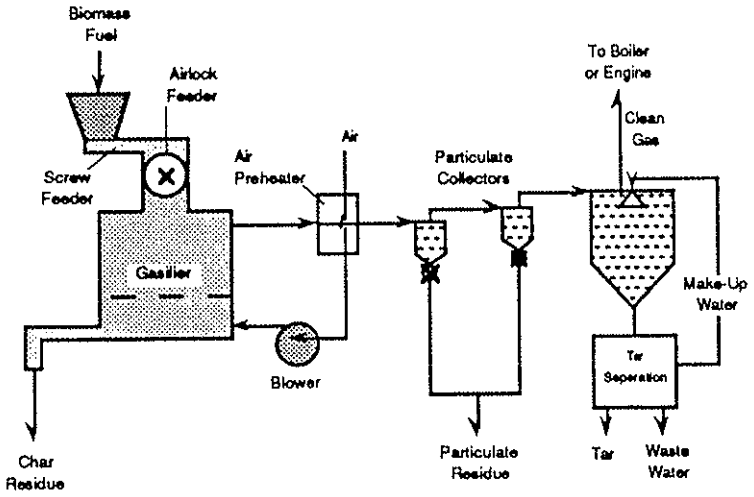
History of Biomass

Biomass fuels (firewood) in Lassen County have historically been used for domestic purposes, including space heating and cooking. The first facilities using biomass fuel to produce energy were lumber mills operating in a cogeneration capacity. In an effort to meet on-site energy needs and reduce energy costs, the technology necessary to produce electricity from mill waste was developed. A portion of the electricity produced was used to operate machinery and the remainder was sold to PG&E. The first facility capable of using biomass to produce energy as its sole product was Mount Lassen Power Plant in Westwood, which began operating in 1984. In 1989 Honey Lake Power Plant, another facility using biomass to produce energy, started operating near Wendel.

Figure 2-4
Technology of Biomass-Fired Plants
Gasification

DESCRIPTION

- Biomass fuel is reacted with substoichiometric quantities of air and oxygen along with moisture to produce gas which contains hydrogen, methane, carbon monoxide, nitrogen, water and carbon dioxide.
- The gas is burned directly in a boiler, or scrubbed and combusted in an engine-generator to produce electricity.
- The three types of gasification technologies available for biomass fuels are the fixed bed updraft, fixed bed downdraft and fluidized bed gasifiers.



Source: California Energy Commission 1991

Existing and Proposed Facilities

Currently there are two biomass energy conversion facilities located within Lassen County. The Mount Lassen Power Plant is located in Westwood and the Honey Lake Power Plant is located east of Susanville adjacent to Honey Lake. These facilities are described in the following paragraphs. Three other facilities in the County operate in a cogeneration capacity. They function primarily as lumber mills and sell their excess energy to PG&E. The cogeneration facilities are: Big Valley Lumber Company in Bieber, Susanville Forest Products (Jeld-Wen Inc.) in Susanville, and Sierra Pacific Industries in Susanville. For descriptions of the cogeneration facilities see Section 2.3.2.

Mount Lassen Power Plant. This biomass plant is situated approximately one-half mile west of Westwood and was built by Ultrasystems located in Irvine, California. The facility originally began operating as Ultrapower 2 in October 1984. Pacific Energy purchased the facility in November 1987 and changed its name to Mount Lassen Power Plant. A variety of wood wastes are used to produce power. The facility has a total production capacity of 11.4 MW of electricity. The majority, 10 MW, is sold to PG&E. A small portion, approximately 1.4 MW of electricity, is used to operate the facility.

When plant operations began, the main source of fuel came from lumber mill residues. Currently, the majority of fuel comes from in-forest chipping (Shawn Gleason, pers. comm.). Approximately 90% of the fuel comes from forest residues processed by a mechanical tree

harvesting method known as whole tree chipping. A feller buncher is used to shear trees and stack them in piles, and then a whole tree chipper processes the trees and blows the chips into vans for transport to the power plant. This in-forest chipping operation is economically feasible in precommercial thinning areas exceeding 200 acres and producing a minimum of 20 green tons per acre of chips. Most of the fuel is obtained from local sources, however, a portion is obtained from sources as far away as Lakeview, Oregon. Hauling distance usually does not exceed 50 miles to keep prices affordable to power plants. Wood wastes are purchased through a contracted third party and delivered to the facility via trucks.

Approximately 520 wet tons of wood are needed daily to maintain current energy production rates. This is equivalent to 22 truckloads of wood wastes per day (Shawn Gleason, pers. comm.). The number of trucks delivering wood wastes varies significantly throughout the year. Collection of biomass materials is concentrated primarily during the summer months. The facility receives approximately 55 - 60 truckloads each day during this period. The number of truckloads drops to 1 - 2 per day during the winter months. The excess fuel received during the summer months is stockpiled at the facility and burned later during the winter. The trucks have the capacity to haul approximately 45,000 - 50,000 pounds of wood residues per load.

Most fuel received at the plant is pre-cut into approximately 2-inch chips and ready to be used (Shawn Gleason, pers. comm.). When oversized fuel is received it is cut down to the standard size. A small chipper is located at the facility and has the capacity to chop approximately 10 percent of a day's fuel supply (52 wet tons). The wood is then dried in a fuel dryer where a maximum of 10 percent of the wood's moisture content is removed (Shawn Gleason, pers. comm.). Wood being burned usually ranges between 35 - 45 percent moisture. Wood containing up to 55 percent moisture can still be burned fairly efficiently. The combustion of wood chips containing less than 30 percent water can become extremely volatile and potentially burn out of control (Shawn Gleason, pers. comm.).

Ash produced from the burning process is removed from the facility and is disposed in various ways including: dumping ash in area landfills; dispersing ash in forested areas in the County; using ash as a low-grade fertilizer on agricultural fields; and using ash as a soil enhancer on ranch lands.

The process of burning wood residues periodically contributes to poor air quality and emissions in excess of allowable limits in the region. Occasionally, facility operations must be reduced or cease in order to meet the Lassen Air Pollution Control District's carbon monoxide emission limits as well as other air quality emission requirements.

Honey Lake Power Plant. Honey Lake Power Plant (HL Power) is an electrical power producing facility located 2 miles north of Honey Lake, near the town of Wendel. It was constructed by GeoProducts Corporation from California and National Energy Production Corporation from Washington after obtaining a use permit from Lassen County. Operation started in July 1989 under the management of Operational Energy Corporation. The power

plant is composed of a wood-burning and a geothermal component. Total production capacity is 35.5 MW.

The wood-burning component of the plant uses a conventional wood-fired steam boiler to generate high-pressure steam which drives a turbine generator capable of producing approximately 35 MW of electricity. The boiler feedwater is pre-heated by geothermal waters in a heat exchanger. The primary fuel used for heating the boiler is wood residue obtained from ongoing forest harvest operations. Most of the fuel is obtained within a 50-mile radius of the Wendel area. A small percentage (10%) comes from as far as Lakeview, Oregon (Ralph Sanders, pers. comm.). While the potential fuel procurement area includes public and private forest resources, the bulk of the fuel used at the plant comes from private forest lands under exclusive contracts with HL Power Company. All wood fuel is procured and delivered to the plant by trucks owned and operated by independent contractors. Approximately 440,000 tons of green wood (wet weight) is required annually to operate the wood-burning cycle. Wood residue is delivered to the plant in 25-ton trucks. Fuel demand is 50 trucks per day (Ralph Sanders, pers. comm.).

Types of wood fuel used in the plant include chipped logging waste (slash), cull logs, and precommercial thinnings. The fuel material received at the plant is usually precut into approximately 2-inch chips. Occasionally, larger material is received and must be reduced in size during wood processing activities. When oversized fuel is received it is cut down into 3-inch chips. Chip moisture content ranges from 35 percent during summer months to 50 percent during winter months. This range of moisture content is considered acceptable for efficient boiler operation (Ralph Sanders, pers. comm.). No fuel drying is required.

Transport of the electricity generated is via a transmission line constructed from the site to Susanville. Electricity (30 MW) is sold to Pacific Gas and Electric under existing long-term power sales contracts. HL Power Company holds a Standard Offer No. 4 contract with PG&E which is valid until 2019. The firm price portion of the contract is valid until 1999 (Ralph Sanders, pers. comm.). The power is metered in Susanville, 23 miles away from the plant, and delivered in Westwood. For a description of the geothermal component of the plant, please refer to Section 2.3.3, Geothermal.

Feasibility for Future Development

Technical Considerations. There are several technical factors that limit the development of biomass conversion facilities. Some examples include: availability and limited capacity of existing utility transmission lines; limited availability of low-cost fuels; competing demands for wood; location and accessibility of fuel; adoption of more stringent environmental siting regulations; and stricter air pollution emission requirements.

Presently, five facilities in Lassen County, including three cogeneration facilities, utilize wood wastes to produce energy for sale. The two biomass plants obtain fuel from ongoing forest harvest activities. Their area of fuel procurement consists of public and private forest resources located in Lassen and surrounding counties, and often coincides with fuel

procurement areas for other wood-burning operations in the surrounding counties. The cogeneration facilities meet their fuel needs by burning wastes produced by their lumber mills and by purchasing additional fuel from lumber contractors. Table 2-2 shows other wood-fueled power plants located in Modoc, Shasta, Plumas, and Butte counties which may compete for fuel in the region.

Portions of three National Forests are located in Lassen County: Plumas, Modoc, and Lassen. Residues from commercial logging operations in the National Forests have the potential to provide a steady supply of fuels for biomass energy conversion. However, the National Forest Service policy favors individual domestic firewood users over commercial wood users (Lassen National Forest 1986). The following is a summary of fuel availability in the nearby National Forests.

Table 2-2
Location and Estimated Production of Existing Power Plants in Surrounding Counties

Location (County)	*Owner*	*Capacity (MW)*
Alturas (Modoc)	Calandor Pine	3.0
Burney (Shasta)	Sierra Pacific	20.0
Burney (Shasta)	Pacific Energy	11.5
Chester (Plumas)	Collins Pine	12.0
Quincy (Plumas)	Sierra Pacific	20.0
Anderson (Shasta)	Catalyst	7.0
Anderson (Shasta)	Roseburg Lumber Co.	3.0
Anderson (Shasta)	Wheelabrator-Shasta	49.9
Oroville (Butte)	PAC-ORO Power	18.0
Oroville (Butte)	Koppers Co.	5.5

Source: CH$_2$M Hill et al. July 1986. Draft EIR Signal Cottonwood Energy Facility.

Lassen National Forest. Approximately 40 percent of Lassen National Forest, which encompasses approximately 800,000 acres of timber lands, is located within Lassen County. Currently, the primary users of biomass materials are domestic firewood collectors (Lassen National Forest 1986). Until the mid-1980s, relatively little of the wood residues from forest harvesting activities was collected and utilized for energy production (Lassen National Forest 1986). However, the use of biomass as a fuel to produce energy is increasing in popularity. Approximately 2,600 acres of timber lands within the Forest are currently thinned each year and the remaining slash and cull logs are removed and used as fuel.

In the late 1980s, Lassen National Forest started requiring removal of slash left by precommercial thinning and timber sales. This requirement was included in the Forest's

policy in an effort to reduce biomass buildup and reduce the threat of forest fires. Recent timber contracts often state that slash and wood residues must be removed during timber harvests. Many companies now remove the entire tree intact from the forest (Walter Levings, pers. comm.). The excess wood wastes are then removed at the mill and are available for use in a cogeneration capacity.

The yield of wood waste averages 20-25 green tons per acre (Walter Levings, pers. comm.). Using the lowest estimate (20 tons/acre) and the current area of timber lands being harvested (2,600 acres), approximately 52,000 tons of biomass waste are produced by Lassen National Forest every year. The Forest is trying to maintain sales of 3,000 acres of timber per year; however, these sales fluctuate annually.

Modoc National Forest. In 1990, approximately 40,000 green tons of wood wastes were sold for energy production (Howard Stearns, pers. comm.). The Forest Service estimates that in the next five years the annual figure will rise to 100,000 tons per year (Howard Stearns, pers. comm.). Wood wastes collected in the Forest are hauled away by a single contractor and then sold to power plants. The contractor sells primarily to local power plants located in Burney, Wendel, and Westwood.

Plumas National Forest. A small portion of Plumas National Forest overlaps the southern boundary of Lassen County. In 1988, approximately 163,000 dry tons of wood wastes were produced annually from logging operations in Plumas National Forest (Plumas National Forest 1988). However, due to the current pending legislation regarding the status of the spotted owl, that figure has been recently cut by more than half (Ray Churchill, pers. comm.).

Recently, the economic feasibility of removing wood wastes has also significantly changed. Until 1989, companies were subsidized $400 per acre to pile slash and other wood wastes produced by their logging activities. The piles were then burned by the Forest Service to reduce the threat of forest fires. This subsidy is no longer available. However, lumber companies have now realized the economic advantages of burning wood wastes to generate energy and many of them have streamlined their operation to include removal of wood waste from their logging activities (Ray Churchill, pers. comm.).

Biomass collection is currently concentrated in the eastern portion of the Forest, in the Milford District. Individuals gathering wood for domestic space heating purposes are allowed to gather wood at the most accessible locations. Several biomass-fuel plant operators currently have permits to collect wood residues in Plumas National Forest (Ray Churchill, pers. comm.). Competition for high quality firewood already exists between private individuals and Sacramento Valley and Nevada commercial firewood companies. This competition, coupled with the use of biomass as a fuel for power generation will further decrease firewood supply (Plumas National Forest 1988). Two sawmills and one public school within the forest use mill wastes to generate energy (Plumas National Forest 1988).

Private Land Holdings. Several privately-owned companies hold and/or manage large tracts of timber lands in Lassen County including Beaty & Associates, Roseburg Resources Co., and Fruit Growers Supply Company. The primary function of these companies is to manage timber lands for merchantable timber production. Wood residues are produced as a result of the lumbering and forest management activities. Currently, a portion of this wood residue is sold to energy producing facilities.

Alternative Fuel Sources. The juniper tree has been identified as having good potential as an alternative fuel source for biomass energy production facilities. Thousands of acres of junipers are located in Lassen County, primarily in the central portion of the County. Most of these lands are currently managed by two federal agencies: the U.S. Bureau of Land Management and the U.S. Forest Service. Juniper trees typically grow in clusters; these clusters are dispersed throughout rocky terrain. The trees are located in remote areas, and many are currently inaccessible, even for smaller vehicles (Howard Stearns, pers. comm.).

Juniper tonnage per acre are comparable to wood waste tonnage per acre produced by forest harvesting techniques. This is due to the fact that juniper collection typically involves removing the entire tree; as opposed to wood waste collection techniques in which only stems, branches, and wood residues are collected. Juniper trees and other tree species typically found in Lassen County have similar efficiency (the amount of heat produced) rates. When burned, juniper generates approximately 24 million Btu/cord; most tree species found in the County generate between 19 - 35 million Btu/cord (CDF 1983).

A variety of technical considerations and environmental impacts could limit the collection and development of junipers as a viable alternative fuel source for biomass energy production (Howard Stearns, pers. comm.). Because junipers are located in rocky and remote areas, numerous roads would have to be constructed for vehicle access to collection sites. Environmental impacts associated with road construction include: increased soil erosion, soil compaction, degradation of water quality, loss and degradation of wildlife habitat, and loss and degradation of plant species. Low ground impact harvesting and transporting equipment would have to be developed to mitigate these impacts. Most areas where juniper is located have not previously been subjected to environmental review or archaeological surveys (Howard Stearns, pers. comm.). Therefore, an additional constraint could be potential existence of archaeological sites on these lands. Archaeological surveys, as a part of the permit process, could potentially reduce this impact.

Economic Considerations. Biomass energy conversion is becoming less economically attractive due to a variety of factors including: a lack of low cost, easy-to-burn fuels (partially caused by companies that have streamlined their lumber operations and as a result generate less biomass materials); competition for existing collection sites as well as competition for biomass materials left by lumbering activities; the ability to locate the plant near the fuel source, which can result in potentially significant reduction in transportation costs; elimination of Standard Offer No. 4, which reduced the price per kilowatt hour (kWh) paid to the energy plant by the utility company and also eliminated the requirement that the large power utility grid purchase the power produced by the plant; and cost associated with

compliance requirements and other regulations required by the local Air Pollution Control District and the California Air Resource Board.

Several social benefits can be attributed to the development of biomass energy facilities including: additional jobs in a depressed economy; a longer and more stable work season, because laborers are needed year round to keep the facility operating; and increased revenues to the County, from local taxes generated by the sale of energy to the utility and also the portion of the sales from local National Forest green timber sales.

Timberlands generate revenue other than property tax for Lassen County. Since 1977, California has levied a yield tax on the sale of stumpage. The yield tax is assessed only at the time of harvest, and is collected on timber harvested both on public and private lands. The timber yield tax now stands at 2.9 percent of the immediate harvest value of timber cut. Approximately 80 percent of yield tax revenues are returned to the Counties of origin. The presence of timberland holdings by the National Forest Service in Lassen County also generates revenue for the County. Pursuant to the Forest Taxation Act of 1976, the U.S. Forest Service must return 25 percent of its timber harvest revenues (Forest Reserve) to the Counties in which the forests are located. Half of the Forest Reserve monies returned to the County are used to fund schools; the other half funds road construction and repair projects.

Environmental Issues

The production of energy using biomass fuel is a lengthy operation. The process involves several phases including: removing wood fuels from the forest; transporting the fuel to the facility; pretreating or processing the fuel to be burned; and finally removing and disposing the ash. The fuel harvesting phase is likely to generate the most impacts on the environment. A variety of vehicles, forest harvesting machinery, techniques, and processes are used to remove biomass fuel.

The forest ecosystem is a very fragile system of plant and animal species that are dependent on one another for survival. Biomass plays a key role in forest ecology by recycling nutrients back into the soil, by increasing the soil's capacity to hold moisture, by providing forage and habitats for wildlife, by decreasing soil erosion, and increasing soil and slope stability. When a particular element of the forest is removed, whether by naturally occurring forces or by human-related activities, all tiers of the forest community have the potential to suffer significant adverse impacts. When managed properly, forests have the capacity to be utilized to their maximum natural resource potential, yet can still maintain a viable ecosystem.

There are both environmental advantages and disadvantages to using biomass fuels to produce energy. A major advantage in using biomass as a fuel source is that wood products and wood wastes are a renewable resource. They can also be used and replenished concurrently. Other benefits include:

> ***Reduction of Diseases.*** One fuel source that is collected for biomass combustion includes dead, dying, and diseased vegetation that is not suitable

for merchantable timber products. Removing unhealthy species from the forest decreases the threat of diseases spreading and ensures survival of the fittest vegetation species.

Reduced Threat of Forest Fires. Removal of biomass materials involves collection of wood wastes and other living materials near the ground's surface. This growth is the primary fuel for forest fires. Removal of this lower biomass layer reduces the threat of forest fires.

Reduction in Insect Populations. Wood wastes, cull logs, and other rotten downed materials provide habitat for insect populations that could damage healthy timber stands. Consequently, removal of these biomass materials reduces the habitat and therefore the threat of these insect populations.

Reduction of Air Pollution Caused by Open Burning. Normal Forest Service management activities include routine control burns to eliminate fuel buildup and to avoid potentially disastrous forest fires. Gathering biomass materials, that occur naturally or are produced as a result of forest harvesting activities, frees the Forest Service from this task. The air quality in the forest is not degraded because the material is not burned in an uncontrolled, unfiltered method.

There are also disadvantages to using biomass fuels. These disadvantages, as well as environmental concerns, are discussed below.

Loss and/or Degradation of Wildlife Habitat. Biomass materials normally remain on the forest floor. These materials act as wildlife habitat and forage. Depending upon the method and extent of biomass removal, a reduction and/or loss of plant diversity, wildlife forage and habitat areas could occur. Construction-related noise, noise associated with machinery used for fuel collection, and noise associated with routine energy facility operations could also adversely impact wildlife. Siltation of waterways from increased soil erosion within de-forested areas could reduce oxygen levels and degrade the water quality to a level at which fish and other aquatic species could be reduced in numbers.

Loss and/or Degradation of Plant Species. The removal of large amounts of trees and other plant species from the forest could result in a significant reduction in number and variety of species. As stated above, if biomass removal is not properly and carefully monitored, the loss of diversity of vegetation may have long-term impacts on related wildlife resources. Also, substantial cuts of lodgepole pine for power generation will adversely affect the availability of this preferred species for home firewood use.

Traffic-Related Impacts. Large trucks transporting biomass materials and forest harvesting machinery could significantly increase roadway use in the vicinity of both the energy facility and at the collection site. The increase in truck traffic could have major impacts on county roads. Construction and use of unpaved roads to fuel collection sites could result in several adverse impacts including: degradation of water quality from increased soil erosion, increased soil erosion, compaction of soil that can eventually reduce its productivity, and degradation of wildlife habitat from removal of biomass material.

Air Quality Impacts. The collection, transport, burning, and disposal of biomass materials has the potential to have significant air quality impacts. The machinery used during collection of biomass materials, haul trucks, and combustion of biomass materials, generate air pollutants. These air emissions could potentially degrade the existing air quality, exacerbate air pollution problems, and even cause health risks. Typical emissions from wood burning plants include: carbon monoxide (CO), particulate matter of less than 10 microns in diameter (PM_{10}), and nitrogen oxides (NO_x).

Degradation of Soil Quality/Increase in Soil Erosion. Biomass material, including dead or downed material, is vital to the fragile forest ecosystem. Two major roles biomass residues serve in the forest community include recycling nutrients back into the soil and protecting the soil from erosion by providing ground cover. When biomass that normally remains on the forest floor is removed, the nutrient cycle is broken. The naturally occurring soil nutrients are lost and the soil quality is degraded. The use of heavy logging machinery results in compaction of and damage to existing soil classes. This process contributes to further damage to the soil quality. The natural vegetation provides an intricate root system that holds the soil together and provides slope stability. When the vegetation is removed, slope stability can be adversely impacted.

Noise-related Impacts. Noise levels would be increased from biomass facility development. Noise impacts could potentially result from all phases of the process including: construction related impacts, elevated noise levels from forest harvesting machinery used in the collection of biomass materials, routine facility operations and maintenance activities, and increased noise levels from truck traffic in and around the facility as well as at the fuel collection site.

Construction-related Impacts. Grading of sites for development of facilities could cause disturbance to the soil and could potentially result in localized erosion. Biomass harvesting at fuel procurement sites would cause ground disturbance from construction of roads and landings as well as from heavy equipment operations. These actions would increase the potential for soil

erosion at the harvest sites, and possibly a reduction in water quality in the watershed.

Hazardous Materials Management. Biomass and cogeneration technologies sometimes use hazardous materials in their processes. For example, anhydrous ammonia is used for controlling nitrogen oxide (NO_x) emissions, and anhydrous chlorine is used for cooling water treatment. In addition, ash generated by biomass combustion can contain unsafe levels of toxic substances and be considered hazardous waste. Burning of rice straw, for example, may produce ash with a high crystobolite content due to the high temperature combustion of soils and rocks gathered with the rice straw. The accidental release of hazardous waste or other extremely hazardous materials, if not properly mitigated, may result in significant impacts to people living or working in the area where the project is located. Health and safety effects resulting from the hazardous waste and materials associated with energy facilities constitute a potential hazard to the public. Transporting such materials over any distance increases the potential for accident and public exposure to them. Adequate mitigation measures are necessary to ensure safety and minimize the risk of exposing the public hazardous material associate with energy facilities.

Regulatory Environment

Several permitting issues are associated with biomass development. They include: air quality and associated regulations regarding air emission offsets; availability of fuel supply and ash disposal; local zoning ordinances. The following is a summary of the federal, state, and local regulations applicable to biomass development.

Depending on the size of the facility, the federal Environmental Protection Agency may require a study of Prevention of Significant Deterioration (PSD) assessing potential impacts to air quality. There are several circumstances in which a PSD would be required. They include: 1) biomass power plants that would generate greater than 250 tons of any regulated pollutant per year; 2) facilities proposed in an area where air quality is better than the National Ambient Air Quality Standards (NAAQS) for a given pollutant; and 3) facilities proposed in an area which is classified as nonattainment for one or more criteria pollutants, and is classified as attainment for other pollutants.

The California Energy Commission's (CEC) siting process applies to thermal power plants that produce energy at a rate of 50 MW or more. Applicants must apply directly to the CEC for a certification process. This process incorporates other State and local agency reviews and permits. In its review of power plant siting applications, the CEC determines whether a project conforms with all applicable federal, state and local laws, ordinance, regulations and standards. The California Integrated Waste Management Board (CIWMB) acts as an advisory agency for biomass projects of less than 50 MW generation capacity. Local agencies forward copies of permit applications and recommendations to the CIWMB for review and approval. County agencies are required to send copies of project-specific

environmental documents to the State Clearinghouse. This is required by the California Environmental Quality Act (CEQA) under Section 15205(b).

Local agencies have permitting authority for power plants with less than 50 MW of generation capacity. Numerous local agencies hold permitting authority for different phases of construction, operation, and maintenance of power producing facilities. Permitting authorities include: the City and County Planning Departments, Building Department, Health Department, the Regional Water Quality Control Board (RWQCB), and the Air Pollution Control District (APCD).

Biomass project proponents must submit to the RWQCB a report of waste discharge if the waste water would not be discharged to community sewers. The RWQCB issues a "Waste Discharge Requirement" which acts as the equivalent of the federal National Pollution Discharge Elimination System (NPDES) permit required under the federal Clean Water Act. The local APCD issues an Authority to Construct permit and a Permit to Operate for facilities less than 50 MW or a Determination of Compliance (DOC) as part of the California Energy Commission (CEC) Application for Certification (AFC) process for facilities greater than 50 MW (CEC 1985).

The Lassen County Air Pollution Control District requires an Authority to Construct permit to be filed prior to construction of a biomass facility. The application process for the Authority to Construct Permit includes identification of several components of the proposed facility, including: type of application, description of facility and process, description of burning equipment, and fuel type.

If a facility is subject to a New Source Review as determined by the Lassen County Air Pollution Control District, additional facility information is required. New Source Review is an analysis and evaluation of the proposed facility and all anticipated emissions produced by the plant. The Review is conducted to determine if construction or operation of a facility will result in a significant deterioration of air quality in the region or if the additional emissions will cause an area to become a nonattainment area for a particular pollutant. All energy producing facilities, with the probable exception of wind and solar farms, would be subject to New Source Review (Michael Murphy, Pers. Comm.). New Source Review includes: air quality impact analysis for all emission points and fugitive emissions; identification of all facilities within the air basin currently owned or operated by the applicant and compliance status of these facilities; anticipated energy supply required for facility operation; identification of number and type of cargo carriers that could potentially transport supplies and fuel to the facility site; and proposed mitigation measures for compliance.

After completion of construction according to terms established in the Authority to Construct, a Permit to Operate must be obtained for all facilities emitting pollutants into the atmosphere.

In Lassen County, biomass energy development is allowed in several zone districts, either by right or by obtaining a use permit. See Table 2-3 for listing of zoning districts allowing energy production facilities.

Table 2-3
Energy Facility Zoning

	General Agricultural District A-1	Agricultural District A-3	Forest Recreation District F-R	Light Industrial District M-1	Heavy Industrial District M-2	Limited Industrial District M-L	Primitive Area District O-D	Exclusive Agricultural District E-A	Upland Conservation District U-C	Upland Conservation/ Resource Management District U-C-2	Timber Production Zone District TPZ	Flood Plain Combining District F	Hydroelectric District H-R
Biomass				P	P	P		P	P	P		P	
Cogeneration				P	P	P		P	P	P		P	
Geothermal		P		P	P	P		P	P	P	P	P	
Hydroelectric			R,P	P	P		P	R,P	R,P	R		P	R,P
Solar				P	P	P		P	P	P		P	
Waste-To-Energy	P												
Wind				P	P	P		P	P	P		P	
Transmission Lines													

R - Allowed by Right
P - Allowed by Use Permit

2.3.2 *Cogeneration*

Cogeneration is the use of a single fuel to simultaneously produce two forms of energy, usually heat (thermal energy) and electricity. Therefore, cogeneration is a technology, not a fuel. The technology may be used in a variety of ways including: dual-purpose powerplants, waste to energy systems, direct heating systems, and total energy systems. A facility can reduce its fuel requirements between 1 and 30 percent by using cogeneration processes (CEC 1982).

The greatest potential fuel savings from cogeneration are associated with industrial uses. Industries often use process steam in applications requiring low temperature heat (less than 400° Fahrenheit), but generate steam through direct combustion of fossil fuels or biomass with resulting temperatures of over 2,000° Fahrenheit. By using high temperature combustion heat to generate electricity, and then using the normally wasted exhaust heat for the industrial process, substantial fuel savings can be achieved. Cogeneration can provide improved efficiency, greater control of facility operations, increased reliability of electrical service, and self-sufficiency.

Technology Overview

Cogeneration technology has received a renewed interest recently from energy consumers due to a variety of reasons. First, the cost of fuel and electricity has increased rapidly while the reliability of supply has decreased. Second, recent legislation has reduced the institutional barriers that had previously obstructed cogeneration development. Many groups have also realized the need to conserve limited energy resources and have a desire to become more self-sufficient. In 1988, a total of 163 cogeneration facilities were operating in California with a total capacity of 1,454,060 kW (PG&E 1988). Cogeneration technology has several unique characteristics including: it is an established and historically proven technology; it makes use of energy which would normally be lost; it can be effective using a variety of fuels; and it can be adapted by a large number of existing facilities without significant redesign.

California energy policies have been developed to actively encourage development and operation of cogeneration facilities (CEC 1982). The California Public Utility Commission (CPUC) has provided incentives to encourage utilities to pursue cogeneration ventures. In addition, the State set a goal of 6,000 MW of electric generation capacity using cogeneration by 1990; the Office of Planning and Research (OPR) implemented a cogeneration information program; and the California Energy Commission (CEC) funded a variety of cogeneration feasibility studies and demonstration projects.

Facilities that use cogeneration technology operate with an efficiency ranging from 2 ½ - 3 times greater than systems using conventional utility generating processes to produce electricity. The energy produced from cogeneration processes can either be used for direct heating or cooling purposes or it can be used to produce electrical or mechanical energy. Examples of direct heating and cooling applications include residential space heaters and

air conditioners. Electrical or mechanical energy can be used to operate a facility (i.e., lumber mills) or excess electricity can be sold to PG&E. Virtually any heat engine system can be modified with a waste heat recovery boiler to create a cogeneration system.

In Lassen County, private lumber companies are the primary users of cogeneration technology. Wood wastes and other biomass fuels produced from lumber activities are used to produce energy. The energy is then used to operate the facility and equipment; excess energy is sold to PG&E.

There are three types of cogeneration systems that have been developed to reclaim waste heat and convert it to energy: topping, bottoming, or combined cycle.

Topping Cycle. The topping cycle is the most commonly used system. Electricity is produced first; then the exhaust heat is used to produce thermal energy (See Figure 2-5).

Bottoming Cycle. The bottoming cycle is a reverse of the topping cycle. This process involves generating high temperature thermal energy first, then the waste steam is used to turn a turbine and produce electricity (See Figure 2-5).

Combined Cycle. The combined cycle simultaneously produces thermal energy and electricity. Direct heat is also produced from any heat that cannot be used initially.

The process by which biomass and cogeneration technologies are used to produce energy are very similar. However, several system components are unique to the cogeneration system including the prime mover, the thermal distribution system, associated electrical switchgear and paralleling equipment, supplementary boilers (if required), fuel storage or pipeline interconnections, and system controls and performance monitoring equipment. The prime mover is the most important component of a cogeneration system. It is the equipment or heat engine that converts the fuel's energy to mechanical energy.

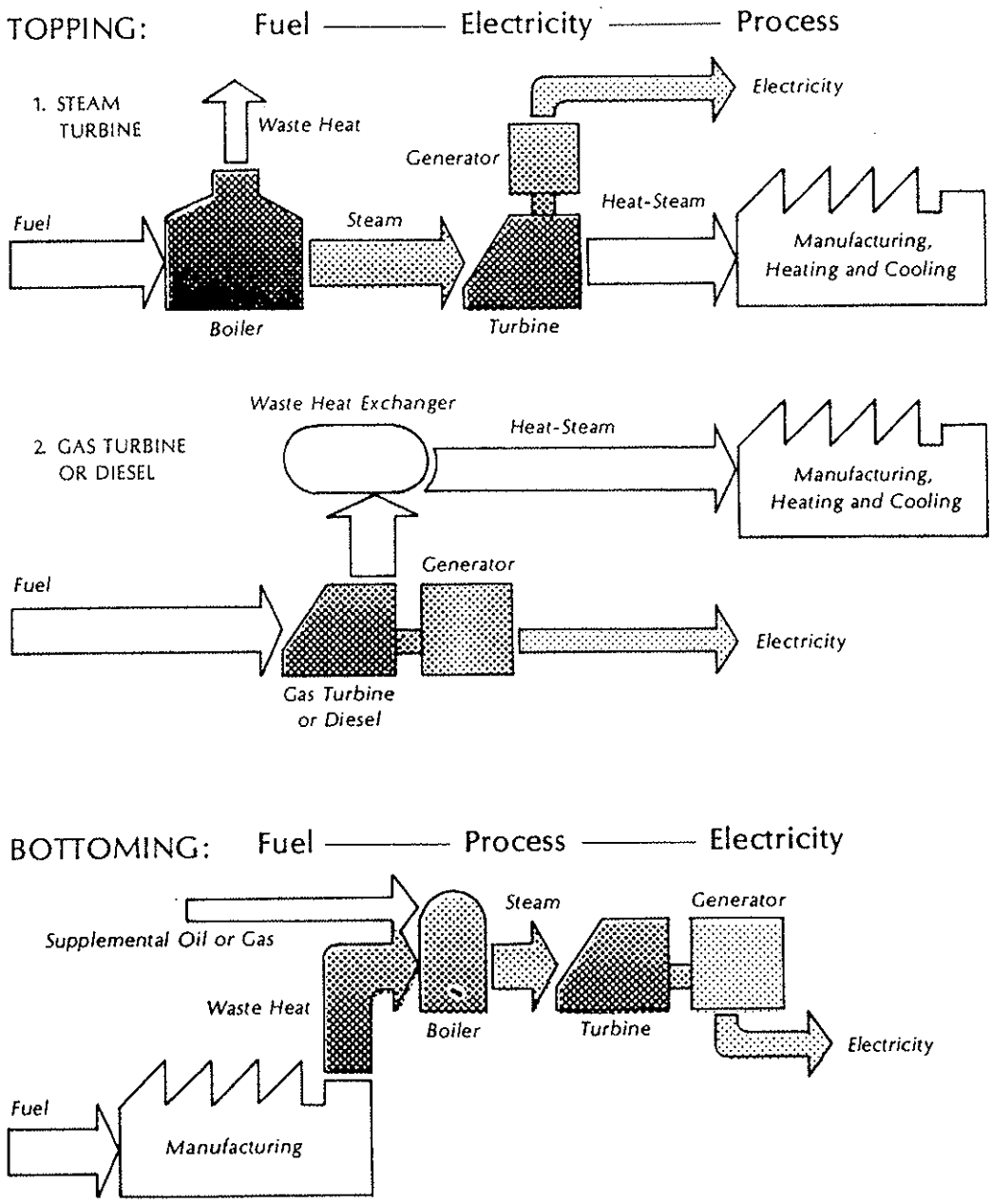
History of Cogeneration

Cogeneration facilities in Lassen County have historically been associated with the lumber industry. The lumber mills produced a substantial amount of wood wastes and required a considerable amount of energy for facility operation. Cogeneration technologies were developed and implemented in an effort to meet the on-site energy needs, reduce the facility's energy costs, and make use of woody residues from lumbering activities. The Big Valley Lumber Company was the first facility in Lassen County adapted to utilize cogeneration technology. A full description of this facility, as well as other cogeneration facilities is described below.

Existing and Proposed Facilities

Currently there are three cogeneration energy conversion facilities located within Lassen County. They are the Big Valley Lumber Company located in Bieber, Jeld-Wen, Inc.

Figure 2-5
Cogeneration Operating Cycles



Source: California Energy Commission 1982

(Susanville Forest Products) located east of Susanville, and Sierra Pacific Industries located southeast of Susanville. The operations at the existing cogeneration facilities are summarized below.

Big Valley Lumber Company. This facility produces kiln dry lumber for finishing mills. Big Valley Lumber Company is located in the town of Bieber, in northwestern Lassen County. The lumber mill has been operating since the late 1960s. The driest wastes were burned to produce steam that was used in the drying kilns. Waste that contained too much moisture was burned in a tepee burner. The facility was adapted for a cogeneration unit which began operation in August 1983. Approximately 90 percent of the biomass fuels used at the cogeneration facility is wood waste generated by on-site lumber activities. The remainder comes from external sources such as wood product manufacturers and private forest lands within the County. Approximately 33 percent of the energy produced is used for in-house lumber operations. The remaining 67 percent is sold to PG&E (Bruce Main, pers. comm.). Big Valley Lumber has a contract with PG&E to sell a maximum of 7.5 MW of electricity at any given time. The mill requires approximately 3,500 dry tons of wood waste per month to maintain its current operation (Bruce Main, pers. comm.).

Jeld-Wen, Inc. (Susanville Forest Products). This facility is located east of the city of Susanville and consists of a saw mill, a plane mill, and a remanufacturing plant. Windows and doors are produced at this facility. The facility was adapted for a cogeneration unit and has been operating in this capacity since 1984. The plant produces 2.5 MW of electricity using wood waste produced from on-site lumber activities. Approximately 1.5 MW is used internally to maintain lumber mill operations. The remaining 1.0 MW is sold to PG&E. Wood wastes burned at the mill are obtained from National Forests located in Lassen and Plumas Counties. Due to rising timber costs, the plant currently operates only one worker shift per day while the turbine operates 24 hours per day.

Sierra Pacific Industries. Located southeast of Susanville, this mill has been operating with a cogeneration unit since September 1984 and has a capacity to generate 13 MW of electricity. The average energy output is 12.5 MW (Jack Stanley, pers. comm.). Approximately 30 percent of the energy produced is used to operate the mill; the excess power is sold to PG&E. The cogeneration facility requires approximately 180,000 tons of fuel per year and approximately 30 tons of fuel per hour to operate at maximum capacity. Most of the fuel is obtained from the mill operations. However, the facility must purchase approximately 200 tons of additional wood waste per month to meet fuel needs (Jack Stanley, pers. comm.).

Feasibility for Future Development

A large potential for development of cogeneration systems at existing facilities currently exists within California. Approximately 4,000 MW of electricity can be produced using cogeneration processes by 2002 (CEC 1981). Typically, cogeneration technology can be used in the following applications: manufacturing plants, industrial facilities, and institutional facilities. In Lassen County, several types of facilities could potentially be adapted or

initially designed to utilize cogeneration technology. These facilities include: lumber and wood processing mills; commercial office space; county government offices; schools and other educational facilities; hospitals; landfills; and prisons. Developers of new facilities could be encouraged to investigate the feasibility of incorporating a cogeneration unit into the facility operation.

Cogeneration is one of the more versatile alternative energy technologies currently available. A variety of fuels can be used to produce energy in a cogeneration unit including oil and natural gas, coal, biomass materials (e.g., lumber mill wastes), and municipal wastes.

Technical Considerations. There are several limiting factors to the development of cogeneration facilities including: technical feasibility; siting constraints; and air quality constraints. Technical feasibility for construction of new cogeneration facilities and conversion of existing facilities for cogeneration can be evaluated by considering several major factors. These factors include: sustainable demand for thermal energy and electricity; ability to adapt or design a facility and associated equipment for cogeneration; and availability of fuel. The availability of transmission lines and sufficient capacity are also important factors for determining the feasibility of cogeneration plants designed to sell excess electricity as costs associated with the construction of transmission lines necessary to connect the facility to the electric grid can be substantial.

Siting constraints and air quality constraints for Cogeneration and Biomass are similar. See Section 2.3.1, Biomass for a description of these factors.

Economic Considerations. There are several considerations for preliminary economic assessment:

1) A cogeneration arrangement that generates excess steam will be marginally successful unless a steam customer is located within approximately one mile of the cogeneration plant.

2) Relatively constant thermal loads are better than "fluctuating" loads. If the thermal load factor (ratio of average to peak demand) is less than 30 percent, cogeneration should probably not be pursued.

3) Industrial and other facilities which produce waste heat and also require air conditioning and high cooling loads may provide good opportunities for cogeneration, because the waste heat produced by the facility can be converted to electricity, which can then be used to cool the facility without having to purchase higher priced electricity from the utility grid during peak use periods when cooling is needed most (CEC 1982).

The economic feasibility of future development of cogeneration facilities is linked with the world oil market. If a facility is able to purchase energy from a utility company cheaper than it can produce it, there is little if any benefit in operating a cogeneration facility. To

adapt an existing facility with a cogeneration system requires a substantial capital investment. Therefore, the cost savings must be sufficient to yield a satisfactory return on the initial investment.

An additional benefit of operating with a cogeneration system is that the facility has an extremely reliable source of energy on-site. The facility is not dependent on the supply or cost of energy provided by the local utility company, except in a "standby" mode in the event of an interruption in power from the cogeneration system.

Environmental Issues

The type and severity of potential impacts associated with cogeneration facilities are directly tied to the type of fuels used. Fuels can include: coal, oil, gas, biomass, medical waste, and urban waste.

The principal impact associated with cogeneration facilities is the degradation of air quality. The specific pollutants produced depend on the fuel. In general, combustion of fuels in cogeneration units generate the following air pollutants: oxides of nitrogen (NO_x), total suspended particulates (TSP), carbon monoxide (CO), and sulfur dioxide (SO_2). Coal-fired units produce significantly more carbon dioxide emissions per unit energy released than other fuels, including oil and natural gas. In addition, a pollutant of special concern with coal is sulfur. High-sulfur coal (over three percent sulfur content) can release substantial amounts of sulfur gas, notably sulfur dioxide, which are poisonous and extremely irritating to eyes and lungs. Sulfur gases can react with water in the atmosphere and produce sulfuric acid, a very strong acid which can fall to earth as acid rain, damaging vegetation and killing fish and other aquatic life. Cogeneration units fueled by medical waste or urban waste can potentially produce air emissions high in metal, organic, and chemical emissions which may be hazardous to public health. Emissions produced as a result of burning fuel in a cogeneration facility can potentially degrade the existing air quality, and even pose significant health risks if control measures are not used. However, facilities that generate less than 50 MW of electricity can usually meet air emissions requirements (CEC 1982).

In general, facilities fired by biomass, coal, medical waste, or municipal waste generate ash that must be disposed of properly. Non-hazardous residues can be hauled to approved landfill sites, while hazardous residues must be disposed of in special sites accepting toxic materials. Ash handling should be conducted properly to avoid potential increase in local TSP emissions. Proper management is also required if the facility uses hazardous materials such as anhydrous ammonia for nitrogen oxide (NO_x) emission control, or anhydrous chlorine for cooling water treatment. Accidental release of hazardous materials, if not properly mitigated, may result in significant impacts to people living or working in the area where the project is located. Adequate mitigation measures are necessary to minimize, if not eliminate, public health hazards due to the use of hazardous materials in cogeneration facilities.

Operation of cogeneration facilities can exceed noise level standards and impact the surrounding land uses. Typically, the majority of the heavy equipment used in a facility, such as boilers, turbine generators, pumps, and incinerators are located inside a structure which provide noise attenuation. However, some equipment such as cooling towers, air scrubbers, and ash processing machinery are located outside of a building and can constitute potential noise sources. Increased truck traffic to and from the cogeneration facility, hauling combustion fuel, can also contribute to higher ambient noise levels. In addition, truck traffic required to supply fuel to the cogeneration facility can impact the level of service on local roads and increase the potential for traffic accidents. Increased truck traffic can also result in permanent deterioration of roadbed surface conditions.

Development of a cogeneration facility can cause construction-related impacts such as disturbance to the soil during grading of the site; increased air emissions during earth-moving activities; and increased traffic, including slow moving equipment, on local roadways. Ground disturbance due to construction of foundation and access roads can result in substantial impact to cultural resources. Other impacts associated with construction and operation of cogeneration facilities include visual intrusion, loss or degradation of vegetation and wildlife habitat, and loss and degradation of plant species.

At present, cogeneration facilities operating in Lassen County are lumber mills. The potential impacts from cogeneration lumber mills and biomass wood-burning facilities are similar and are described in Section 2.3.1, Biomass. Waste-to-Energy facilities, including facilities burning medical wastes, are discussed in Section 2.3.6.

Regulatory Environment

Cogeneration projects are subject to many of the federal, state, and local regulations affecting industrial facilities as well as other regulations pertaining specifically to the generation of electricity. The California Energy Commission (CEC) is authorized by the Warren-Alquist Act of 1975 to regulate the siting of all thermal power plants larger than 50 MW, including cogeneration plants. The County would also have regulatory power over cogeneration facilities to ensure compliance with local general plan and zoning provisions. for projects under 50 MW, the County would be the lead agency and would conduct the environmental review required under CEQA.

Numerous other federal and state regulations covering a variety of issues pertain to development of cogeneration facilities including: fuel use (Federal Fuel Use Act - FUA, Natural Gas Policy Act - NGPA, and the California Public Utilities Code - CPUC), power exchanges (Public Utility Regulatory Policies Act - PURPA and Fuels Use Act), environmental quality, financing and ownership, and health and safety. Fuel sources used for cogeneration can include wood wastes, agricultural wastes, oil, and gas. Fuel use is regulated primarily by the federal government. Regulations pertaining to environmental impacts such as air quality and water quality are discussed in Section 2.3.1, Biomass.

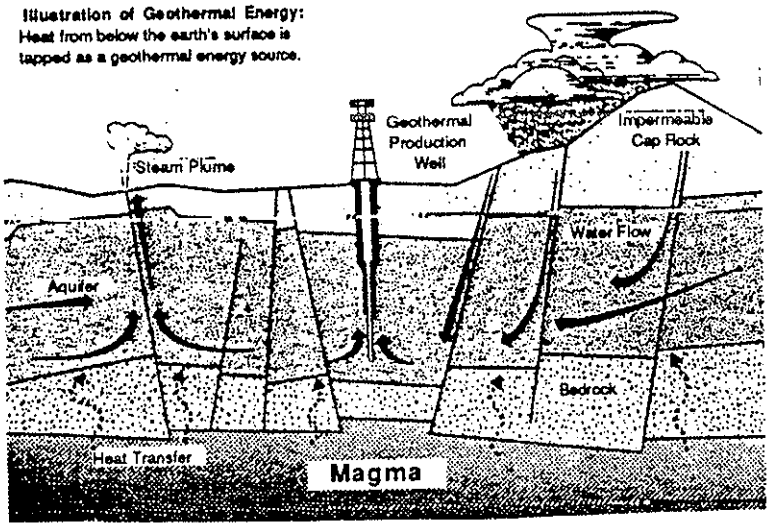
2.3.3 *Geothermal*

Geothermal energy is derived from natural heat contained in the earth and is typically utilized by tapping naturally-occurring steam and hot water near the earth's surface. In general, temperatures in the earth's crust increase steadily with depth. Due to the technical difficulty of capturing this heat at great depths, the use of geothermal energy is only economically feasible in areas with high geothermal gradients (higher temperatures found closer to the earth's surface). Also, in order to be economically feasible, geothermal development often requires the existence of groundwater resources. This type of geothermal resource is known as a hydrothermal system. In a hydrothermal system, the earth's heat is transferred from a high-temperature source to circulating water, which then moves up towards the earth's surface where it can be extracted. Hydrothermal systems are easier and less costly to develop than hot dry rock systems. Hot dry rock systems require drilling of wells and induced circulation of water pumped in from the surface to make use of the heat from rocks.

Technology Overview

Geothermal Systems. Geothermal resources are often associated with recent volcanic activity and movement of the earth's surface (plate tectonics). The high incidence of geothermal resources around the Pacific Rim, and along continental plate boundaries in the Philippines, Italy, United States, and New Zealand are evidence of these processes. Molten rock (magma) rising into the earth's crust brings unusually hot material close to the surface. Heat from the cooling magma heats any groundwater circulating nearby and creates geothermal waters or steam (See Figure 2-6).

Figure 2-6
Illustration of Geothermal Resources



Source: California Energy Commission 1991

Not all geothermal waters are created by intrusion of magma. When groundwater circulates at great depths, it becomes heated, and if this water rises to the surface, it can be captured and used as a geothermal resource. In certain areas, heat flow through the earth's crust can be anomalously high as a result of deep faulting and fracturing allowing contact between circulating ground water and deep heat sources. The Basin and Range Physiographic Province, which covers the eastern portion of Lassen County, contains numerous geothermal areas fueled by this type of heat source. Heat is transferred from a high-temperature source to circulating water, which then moves along faults to levels closer to the surface where exploration of this geothermal resource is feasible (HLA 1989a).

Geothermal Uses. Geothermal resources have been used for centuries for cooking, bathing, and medicinal applications. Since the early 1900s, with the help of modern technology, this natural energy has been used for the purpose of generating electricity, and heating space and water. Natural steam at Larderello, Italy, has generated power since 1904. The Geysers, north of San Francisco, California, is the largest steam system used to produce electricity in the United States. Built in 1960, the existing facilities can produce nearly 2,000 megawatts, enough to power almost 2 million households. In Iceland, steam and hot water are pumped into buildings for space heating and are used to warm greenhouses where fruits and vegetables are grown all year. The use of hot water resources for aquaculture, vegetable dehydration, and greenhouse heating are some of the more recent applications of geothermal energy. Figure 2-7 illustrates some direct uses of geothermal resources.

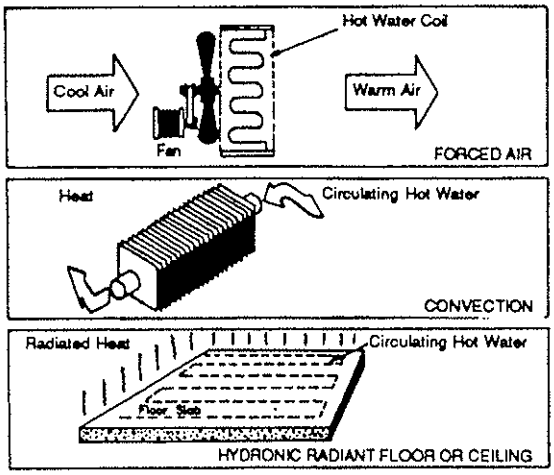
The use of geothermal energy depends largely on the temperature of the geothermal fluid. Some geothermal areas may be so hot that the water is turned to steam. The steam can be piped directly into turbines to produce electric power. A minimum temperature of 300° F is required for economical operations of geothermal steam power plants (HLA 1987).

Moderate temperature geothermal water can be used to produce electricity if a secondary fluid which vaporizes at a lower temperature than water is used. The secondary fluid is pumped through heat exchangers where it is heated to its boiling temperature by geothermal fluids, and as the secondary fluid expands and vaporizes it turns a turbine which produces electricity (see Figure 2-8). Geothermal water at temperatures as low as 180° F (HLA 1989a) can be used to effectively operate these binary systems also known as Organic Rankine Cycles (ORC). In places where electrical production is not feasible, the groundwater may be warm enough (120-180°F) to be circulated directly through homes and greenhouses for space heating. The minimum temperature needed to operate a heat exchanger efficiently is 120° F. Most of the geothermal resources in Lassen County are moderate to low temperature systems.

Figure 2-7
Direct Uses of Geothermal Resources

DESCRIPTION

- Moderate (220° to 350°F) and low (below 220°F) temperature geothermal resources are used as fuel for direct-use water heating, space heating and cooling.
- Each application requires a production well and often an injection well.
- Heat exchangers are used to reduce degradation of equipment from potentially corrosive geothermal water.
- For water heating, geothermal fluid is pumped directly into existing water heater or storage unit.
- Higher resource temperatures coupled with standard forced-air, baseboard convection and radiant panel systems are used for space heating.
- Lithium-bromide and ammonia-water absorption chillers can be used for space cooling with geothermal energy.



Space-Heating Systems Suitable For Geothermal Applications

Source: California Energy Commission 1991

History of Geothermal Uses in Lassen County

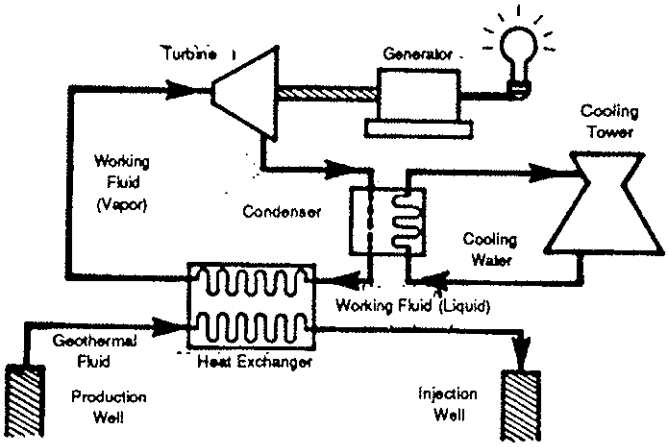
Lassen's geothermal resources were discovered and put to use during the first settlements in the region. There is evidence of Native Americans' use of hot springs in the Honey Lake Valley. At the end of the nineteenth century, Amedee's hot springs, at the northern shore of Honey Lake, became a focal point in local development plans. At that time, the town of Amedee became a major railroad shipping area, a commercial center, and the site of a resort. However, the continual economic stagnation in the region throughout the years, the shift of the railroad station to nearby Wendel, lack of patrons, and fire damage, resulted in the closure of the spa.

A low temperature geothermal system is known to exist beneath the City of Susanville. In the 1930s, geothermal waters obtained from wells were used in the municipal swimming pool and the mill ponds to keep the ponds free of ice and thereby extend the mill operating

Figure 2-8
Illustration of Geothermal Binary Cycles

DESCRIPTION

- Binary cycle power plants utilize a working fluid other than the geothermal brine to power a steam turbine.
- Hot (~300°F) geothermal brine (kept under pressure so it will not flash into steam) passes through a heat exchanger, where the heat vaporizes an organic fluid with a low boiling point (freon, isobutane).
- Corrosive fluid components affect the heat exchanger, but not the remaining components.
- The vaporized hydrocarbon is piped to a turbine-generator, condensed (air cooled or evaporative cooled), and returned to the heat exchanger.
- The geothermal fluid is often injected back into the reservoir.
- Binary cycle units can produce electricity from relatively low temperature geothermal resources.



Binary System

- Generating capabilities range from 0.5-65 megawatts.
- Binary cycles are insensitive to the presence of non-condensable gases and have nearly no emissions.

Source: California Energy Commission 1991

season. Several geothermal wells were drilled at that time to provide heat to mill operations. In recent years, the use of geothermal resources in Lassen County has received renewed interest due to the need for diversified energy development. The County has experienced a marked increase in geothermal project development, expansion, and improvement. Existing geothermal facilities, including projects in Wendell, Amedee and Susanville, are described in the following paragraphs.

Existing and Proposed Facilities

City of Susanville. A district heating system has been in operation in downtown Susanville since 1983. The system provides geothermal waters for domestic water and space heating to two separate groups of buildings. It serves eight government buildings, a 35-unit apartment complex, and 22 low income single-family detached residences. Government structures heated by the system include the Veteran Memorial Building, Courthouse Building, Courthouse Annex, the Jail, the city and the county Shops, the High School (gymnasium and workshops), and the Municipal Swimming Pool. The swimming pool is no

longer filled with water from its own 109-degree geothermal well. At present, the City's return line goes through the swimming pool facility where heat exchangers are used to heat the pool water. The original geothermal well is still used when filling the pool and for mixing water.

Susanville heating district uses two geothermal production wells and a network of lines to provide heat to the buildings. The two wells are: Susie 1 (650 feet deep), and Naef (550 feet deep). The water temperature is 176° F at the Susie 1 well and 160° F at the Naef well. When operating at full capacity, the City pumps seven hundred fifty gallons a minute out of the two wells. After circulating through the system, the water temperature is 130° F. This water is discharged into an open irrigation ditch (Ramsey ditch) where it is used by a small group of farmers to supplement their water allocation of 2 cubic feet/second for livestock and irrigation uses.

Grants have been provided to the City of Susanville to finance the initial resource assessment, well drilling, and building retrofitting. The California Energy Commission (CEC) continues to assist the City through grants and technical support. When a building is considered for geothermal heat, the CEC contracts out the review of the unit to determine its feasibility for use of geothermal heat. In Susanville, geothermal domestic water and space heating is provided by using heat exchangers to extract heat from the geothermal fluid. Fans are used to circulate the hot air and heat the space. The cost of retrofitting varies depending on whether the old heating system uses steam or hot water. A building heating system which uses hot water, as opposed to steam, is easier to retrofit for geothermal heating. The technical assistance for geothermal conversion is funded by the CEC, but the actual cost of retrofitting is the homeowner's responsibility. Grant money from the Department of Housing and Urban Development (HUD) was used to retrofit the 22 low-income single family homes located near the Naef well. It cost approximately $1,500 to retrofit each house, not including improvement to existing insulation. The CEC currently requires upgrading of insulation for all structures that are connected to the geothermal system.

Geothermal heating use is metered similar to water. These meters measure BTU (British Thermal Unit), a thermal unit that indicates the amount of heat used to provide domestic water and space heat to the building. The price of the BTU is determined based on the ten year average of oil heating bills. It is 75 % of the average price of an oil-generated BTU during the 10 years prior to connection of the new building. The problem with this system is that the cost of geothermal energy is affected by fluctuations of oil prices that have no relation to the cost of producing geothermal energy. Also, as oil prices go down, a building that came into the network at times of high oil prices may currently pay more for its geothermal heating than if it were operating with oil.

Even though the City has been operating the district heating system since 1982, the geothermal source has been very constant (Graham 1991). The system has the capacity to be expanded significantly to provide heating to additional buildings. Potential future users of the geothermal heat source include the Hospital, the Diamond View Elementary School and its gymnasium, Post Office, City Hall, and County building.

No expansion is expected to occur until the system's current discharge practices are modified. Even though the geothermal water being discharged contains only 650-850 TDS (Total Dissolved Solids), which is good quality if compared with acceptable levels for drinking water (500 to 1000 TDS), it is an effluent, and its discharge is regulated by the Regional Water Quality Control Board (RWQCB). The RWQCB is considering requiring termination of current discharge procedures. The Board is in the process of revising the City's discharge permit and assessing discharge compliance through the use of performance standards. If current discharge practices are determined nonconforming with surface disposal regulations, the City may have to re-inject spent geothermal fluid into the ground. At present, only one injection well is in operation. It is located near the 35-unit apartment complex and it accepts 150 gallons per minute. After drilling several test wells, in an effort to find additional injection sites, the City recently drilled a tentative injection well. Unfortunately, this well can only accept 20 gallons per minute (Graham 1991). The City is required to stop the surface discharge of geothermal effluent by 1994. Expansion of the existing geothermal network is on hold until the discharge problem is solved.

The major cost associated with the operation of Susanville's heating system is the electricity used for pumping geothermal fluid from the wells. The 1990 annual pumping bill for Susie 1 was approximately $57,000. Maintenance of the system also requires the use of a vehicle and the half-time service of a City employee.

Tsuji Nursery and Other Geothermal Uses in the Susanville Area. Located on Sierra Road south of the Susanville City limits, Tsuji Nursery pumps hot water from two wells to heat greenhouses where roses and carnations are produced. Space heating is accomplished by circulating water through hoses installed at the periphery of the flower beds. The system is operated during each night; long hours of operation are required in winter time, and very few hours are required in Spring and Fall. Geothermal water temperature is approximately 165° F at production and depending on the season, it ranges from 90 to 140° F at disposal. The spent water is currently discharged at a surface ditch located south of the City. The Lahontan Regional Water Quality Control Board is evaluating geothermal operations in the region, including Tsuji Nursery. If the Board determines that surface discharges are adversely impacting water quality, such discharges will be ordered to cease.

Other geothermal energy applications within the City of Susanville include the use of 120°F geothermal water to heat the Church of Latter Day Saints buildings, and the use of 118° F water for cleaning equipment at the Miller's Custom Work business. Both these facilities have their own geothermal well. In addition, the Sierra Pacific Industries' well located northeast of Susanville yields water at 79° F (Division of Oil and Gas 1975).

California Correctional Center. The California Correctional Center, situated east of Susanville near Litchfield, also has its own wells supplying hot water for space heating. The system was constructed and is now operated by a public/private joint venture between the City of Susanville and Carson Development Company, an investment group in Sacramento.

The City used CEC grant money for this project. Carson Development owns the system until 1995, when the system becomes City property. In general, the maintenance of the geothermal facilities is provided by a Center employee. However, the City also supervises the system to assure its proper operation.

The Center's heating demand totals 5,000 gallons of oil per day, and 20% of this demand (or 1,000 gallons) is now provided by the geothermal system. The geothermal heating system comprises two wells (Johnson 1 and 2) located east of the Center. One well produces 700 gallons per minute of water at 180° F. The other well serves as a backup. The spent geothermal fluid is discharged into holding ponds, and then into a surface ditch that crosses the Johnson property and is eventually released into the Susan River. This surface disposal will have to be modified to comply with the Lahontan RWQCB waste discharge requirements (Graham 1991).

Amedee Geothermal Power Plant. Located at the northeastern edge of Honey Lake (see Figure 2-1), Amedee Hot Springs have been known and visited since the end of last century. In the beginning, the site was used by Native Americans for steam baths. By 1890 a settlement existed in the area and the springs were used as an attraction for additional development. A resort was established in the town of Amedee for a short time period. The region's economic decline continued throughout this century and today the town of Amedee no longer exists. Only a few abandoned buildings remain in the area. Amedee's geothermal resource, however, continue to attract interest. In the 1960s, Magma Power Co. drilled a geothermal test well in Amedee. The well bottomed at 2,000 feet with a temperature of 225° F (Wendel Planning Area Master Environmental Assessment 1983). In the 1970s, Gulf Mineral Resources Co. leased the area and drilled a 5,000-foot-deep exploratory well where a temperature of 230° F was recorded.

Developments on the site at the end of the 1980s resulted in the construction of an electrical generating plant which is still in operation. The existing facility is owned by a limited partnership between U.S. Energy Corporation from Washington D.C. and TransPacific Geothermal from Oakland, California. Power production started in December 1988. The plant generates electricity using an Organic Rankine Cycle. Figure 2-8 provides an illustration of geothermal applications using binary cycles. Geothermal water is used to heat a secondary fluid (e.g., freon), which boils at a much lower temperature than water. As the freon vaporizes it turns the turbines and produces electricity. The equipment was produced by Barber Nichols System in Colorado. A phone alert system is in place to automatically warn a maintenance person if a problem occurs. The electrical generating plant has been in operation for two and a half years. When operating at full capacity, 3,400 gallons/minute of geothermal waters are pumped from two 1,000-foot deep production wells. Casings of the wells have a 30-inch diameter at the surface, and an 8-inch diameter at the depth of 1,000 feet. At present, the temperature of the first well is 207° F, down from the initial 226° F. The second well continues to yield waters at the same initial temperature of 222° F. After flowing through the plant the water temperature is 165° F. This water is then circulated through 3 ponds where it cools to 50-65° F for re-use. Cooling of discharged fluids is provided by long winding surface channelways located on the plant's 3,400-acre site.

This system allows the water to cool down and also to be absorbed into the ground. Discharged waters have 840-860 ppm of Total Dissolved Solids (TDS). Surface disposal of the spent water on the property was approved by the Regional Water Quality Control Board and the Department of Fish and Game for wildlife purposes (Matti Ripatti, pers. comm.).

Current production ranges from 1.4 to 2 MW. Power is sold to PG&E with whom the plant operators have a purchase agreement for the next ten years. This agreement includes a bonus for power production during peak capacity times. There are plans to drill one additional well in the near future. This well would be approximately 2,000 feet deep and would enable a power production increase to 2.2 MW using the existing equipment. The Amedee site could produce from 5 to 8 MW of power if additional equipment is installed and additional wells are drilled (Matti Ripatti, pers. comm.).

There are plans to operate a vegetable production facility or a fish farm using the heat from Amedee Power Plant tailwaters. It is anticipated that forty to eighty acres of greenhouses could be heated by the plant's tailwaters (Matti Ripatti, pers. comm.).

Honey Lake Power Plant. Honey Lake Power Plant (HL Power) is a power producing facility located two miles north of Honey Lake, near the town of Wendel (see Figure 2-1). It was constructed by GeoProducts Corporation from Walnut Creek, California and National Energy Production Corporation (NEPCO) from Redmond, Washington after obtaining a use permit from Lassen County. Operation started in July 1989. The plant is now operated under the management of Operational Energy Corporation, a subsidiary of NEPCO. The power plant is composed of wood-burning and geothermal components. Total production capacity is 35.5 MW.

The geothermal component uses 550 gallons per minute (gpm) of geothermal fluid to preheat the boiler feedwater. The boiler feedwater is circulated through heat exchangers where it is heated to 235° F temperature by geothermal waters. Further water heating, necessary for electricity production, is provided by the burning of biomass fuel. Geothermal water used in the plant is obtained from a 5,800-foot deep production well located in the plant vicinity. The fluid is transported to the plant by surface installed pipelines insulated to minimize temperature losses. Fluid temperature is 247° F at the beginning of the feedwater preheating process and 110° F at disposal. Waste geothermal water is disposed of in a 5,100-foot deep re-injection well. This well is currently accepting a total of 850 gpm of water, which includes water from the boiler and cooling water tower. A third geothermal well exists at the plant site and functions as a stand-by well for emergency use. In the past this well was used for re-injecting waste fluids into the ground, but it also has the potential to function as a production well.

The Honey Lake Power Plant designers investigated the possibility of using geothermal energy to dry wood fuel and to preheat the combustion air, however, at the design stage of the project these uses were found unnecessary. At present, the moisture content in the plantbiomass fuel ranges from 35% at summer time to 50% in winter. This moisture content is acceptable for the boiler operation, and no drying is required.

Electricity generated by the plant is transported via a transmission line from the site to Susanville. Electricity is sold to Pacific Gas and Electric (PG&E) under existing long-term power sales contracts. HL Power Company holds a Standard Offer no. 4 contract with PG&E which is valid until 2019. The firm price portion of the contract is valid until 1999 (Ralph Sanders, pers. comm.). Approximately 30 MW of the power is presently sold to PG&E. The power is metered in Susanville, 23 miles away from the plant, and delivered to the utility network in Westwood. For a description of the wood-burning component of the plant, please refer to section 2.3.1, Biomass.

Wineagle Power Plant. For many decades a hot spring has been known to exist at the shore of Honey Lake, approximately 1.5 miles west of Wendel. This resource has attracted interest on several occasions. In the early 1960s, Magma Power Co. drilled a shallow geothermal well (620 feet) in the area which measured a bottom hole temperature of 147° F. In 1972, Gulf Mineral Resources Corporation leased the area and drilled a 5,056-foot deep exploratory well, which yielded water at 240° F temperature (Wendel Planning Area Master Environmental Assessment 1983). This exploratory well was later converted to production, providing space heating for two greenhouses used to grow tomatoes.

In 1984, Wineagle Power Plant (Wineagle) started operating in the area adjacent to the greenhouses. Wineagle uses two binary power cycles (Organic Rankine Cycles) to generate 0.69 MW of electricity for sale to PG&E. The plant is supplied with approximately 800 gpm of water from a geothermal well on the site. The well was drilled to a depth of about 1,350 feet and initially produced water at a temperature of 228° F (HLA 1989a). Current temperature is approximately 220° F (Matti Ripatti, pers. comm.). Disposal of geothermal effluent is done in surface channelways connected to the nearby Honey Lake. The temperature of geothermal effluent varies from 175° to 200° F (Johann Otto, pers. comm.). Until 1987, this effluent was made available to the adjacent greenhouse complex and an ornamental fish farm.

Wineagle is owned and operated by a general partnership between Barber Nichols from Arvada, Colorado, and Carson Development Company from Sacramento, California. Even though there were plans in the past to expand Wineagle facilities by drilling two additional wells and installing two ORC wellhead generators (HLA 1989a), these plans have been abandoned and no expansion is expected to occur in the near future.

Feasibility for Future Development

Technical Considerations.

Power Production. Typically, development of geothermal resources for electrical generation involves three phases: exploration, development of a production field, and plant construction and operation. Geothermal exploration employs techniques such as geologic mapping, geochemistry, and geophysics to determine the possible location of geothermal water prior to drilling of exploratory wells to evaluate the resource. After the resource is located and defined, a well production field is developed. Well drilling is the major cost

component of both exploration and field development phases. Drilling during development of a production field is similar to exploration drilling except that more wells are drilled, the drilling targets are better defined, and well and casing diameters are often slightly larger to allow for increased production (HLA 1989a). The larger the size of the well casing, the more costly is the drilling. A 2,000-feet deep temperature observation hole, with a 4-½ inch diameter can be drilled in a few days by a truck-mounted drilling rig. Drilling of a production well, however, may involve construction of access roads and transport of a drilling rig and ancillary equipment to the site from outside of the County. In addition, the drilling takes more than a few days to be completed. The third phase of geothermal development for electrical generation involves the construction and operation of a plant suited to the characteristics of the resource. The size and the type of plant depends on the resource extent, temperature, and pressure.

Additional drilling continues over the life of the field to maintain a sufficient supply of geothermal fluid. However, if the reservoir pressure becomes excessively low, it may be more economical to operate the plant below capacity than to drill the wells necessary to maintain full operation. Injection wells can be used to dispose of spent geothermal fluids and to offset declines in reservoir pressure through injection of water into the reservoir. The use of re-injection to keep the pressure from declining is not always successful. In addition, there is always the risk of colder injected water affecting the temperature of the production wells.

Occurrence of geothermal resources in Lassen County varies from low to moderate temperature systems. Because these resources are not hot enough to naturally produce steam, the use of conventional geothermal power plants (i.e. transporting steam to a turbine and generating electricity) is not feasible in the County. As described above, existing geothermal power plants in the County utilize an Organic Rankine Cycle (binary cycle system) to produce electricity. Since this system uses a secondary fluid that vaporizes at a much lower temperature than water, it can effectively operate with geothermal water at temperatures as low as 180° F (HLA 1989a). For further explanation of the Rankine Organic Cycle please refer to the description of the Amedee Power Plant.

Available capacity in transmission lines is a determinant factor in the technical feasibility of additional power plants in Lassen County. In the past, applications for use of bulk transmission capacity on the Pacific Intertie have been placed on hold due to capacity constraints. The unavailability of capacity in local and regional transmission systems may prevent utility companies from purchasing energy from potential energy producers.

Other Uses. When a geothermal resource is not sufficient to produce electricity, the available heat can still be used to reduce energy costs in some operations. Moderate and low temperature geothermal fluids have potential for use in several applications including space heating, process heating, refrigeration, air conditioning, and drying.

Economic Considerations. The economic feasibility of new geothermal power plants in Lassen County depends largely on the price developers can obtain for the power produced.

Recent changes to legislation have eliminated long-term utility contracts which favored small power producers. Electricity sold by power plants is now subject to lower rates from utility companies. As a result, it is difficult for geothermal facilities that sell power to utility companies to be built and operated profitably. Some of the existing facilities are operating under long-term purchase agreements (PG&E's standard offer number 4) which guarantee a good purchase price for the power produced.

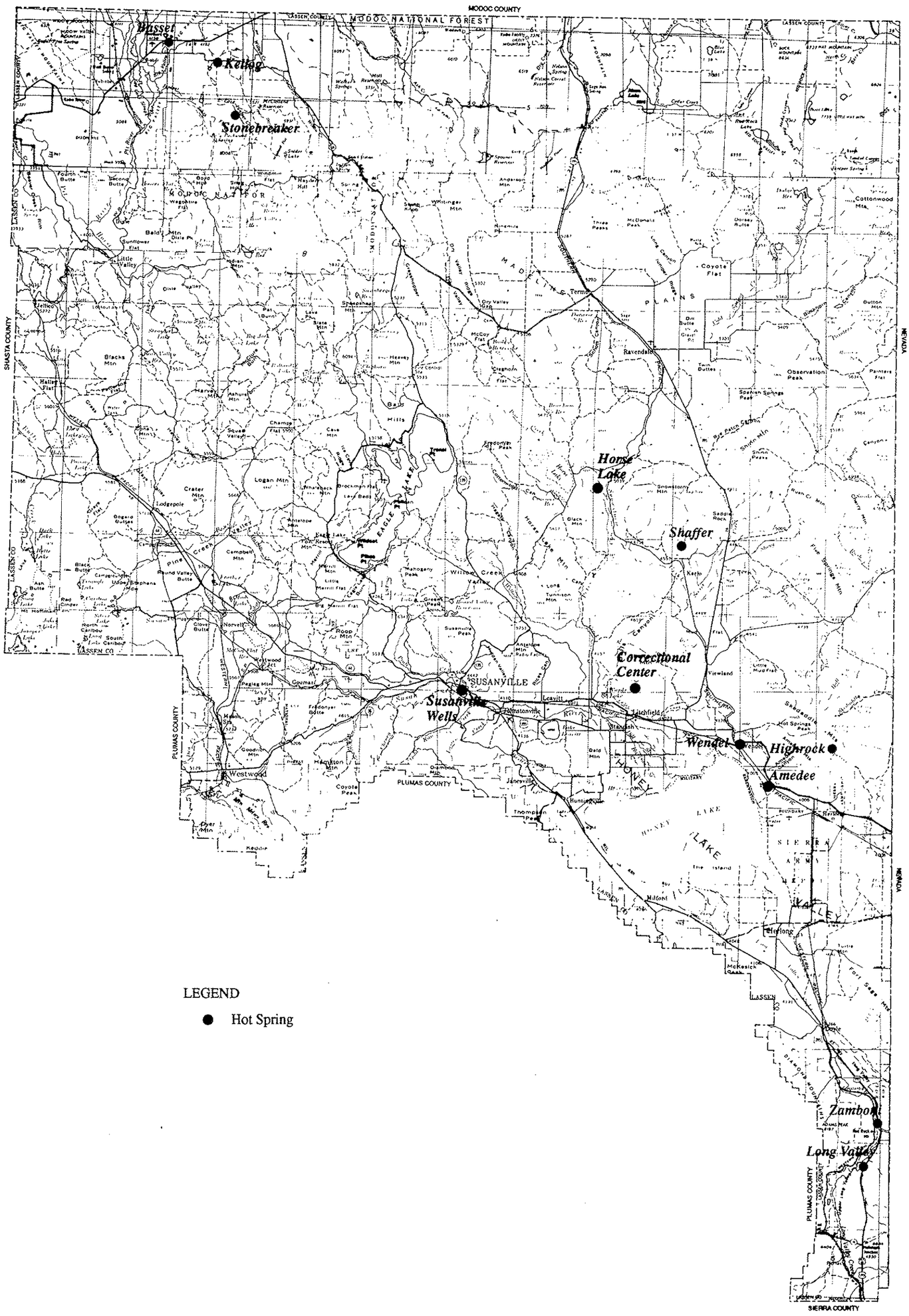
Construction of additional geothermal power plants in Lassen County will also depend on further investigation to determine available resources. After the resource is located and proven, the major costs of geothermal development will involve drilling of wells and construction of plants.

Under state-funded assistance programs, geothermal developers may be able to obtain assistance including geologic evaluation, resource assessment, economic and engineering feasibility analyses, and project planning reviews. In addition, local governments are eligible to apply for funding through grant and loan programs for evaluation and development of direct-use and small-scale electric systems.

An economic application of geothermal resources could include the use of geothermal heat to offset fuel costs in industrial operations. Proper development of geothermal resources could reduce operation costs and provide the competitive edge needed to attract industries to the County. Industrial facilities using steam in product processing could also reduce energy cost by using moderate temperature geothermal water to preheat the boiler feedwater, similar to the process used at the Honey Lake Power Plant. In certain facilities geothermal water can also be used for cleaning equipment. Even after the hot water has circulated through an electricity-producing system (Amedee Geothermal Plant), or a heating district (City of Susanville), it contains residual heat that could be used for activities requiring lower temperature heat, such as fish farm, vegetable and flower production.

Because of the low population in some geothermal resource areas and the long distances to major transportation centers, large industrial operations in Lassen County seem improbable. Moderate temperature geothermal water occurring in the rural portion of the County could be used for greenhouse heating or other agricultural developments. Raising seedling conifers for local reforestation operations, fish hatcheries, warm-water fish production, vegetable production, and growing flowers for local and regional markets are examples of possible applications for geothermal energy in these areas. Depending on the value of the product generated, large agricultural operations may be necessary to offset the cost of transporting the products to major markets.

Resource Availability. The following paragraphs provide a discussion of the County's four major areas of geothermal occurrences and some potential uses of these resources. Figure 2-9 shows the location of potential geothermal resources within the County.



Lassen Energy Element
Facility Siting

Figure 2 – 9
POTENTIAL GEOTHERMAL RESOURCES

Michael Clayton & Associates

City of Susanville. A reservoir of warm water is known to exist beneath the City of Susanville between the foothills to the southwest and the Susan River. Apparently the normal faults cutting the volcanic rocks located southwest of Susanville extend under the valley sediments and allow for the upward movement of geothermal water (Division of Oil and Gas 1975). There is no surface expression of thermal water and the warm water is found only in wells. No warm water has been found north of the Susan River. Thermal water in shallow aquifers is apparently cooled by shallow ground water as it moves toward the river. Temperatures of existing wells indicate considerable variation of ground water temperatures within the zone. Because of the moderately low temperatures encountered, and the reservoir's near proximity to an urban center, domestic water and space heating are probably the best applications for Susanville's thermal water.

Other applications using low temperature heat could also be implemented. Possible uses indicated by the Susanville Vicinity Master Environmental Assessment (Lassen County 1982) include refrigeration, food processing and dehydration, lumber and paper drying, feed lot heating, and fish farming. It is worth noting that a successful flower production facility is currently in operation south of the Susanville City limits.

Wendel-Amedee Area. The Wendel-Amedee area includes Wendel and Amedee Hot Springs and the small communities of Wendel and Amedee. Located 25 miles east of Susanville, the area is bounded on the southwest by Honey Lake, and on the north and northeast by Shaffer Mountain and the Amedee and Skedaddle Mountains. These mountains are composed of jointed and fractured rocks which may provide paths for deep circulating waters that surface as hot springs. At Wendel Hot Spring, water flows from basin deposits near the intersection of the Litchfield and Wendel faults. Prior to drilling of production wells in the vicinity, the spring issued 310 gallons per minute of water at 205° F (Division of Oil and Gas 1975). Amedee Hot Springs used to discharge 130 gpm of water at 203° F from basin deposits near the intersection of the Litchfield and Amedee faults (Division of Oil and Gas 1975). As described previously, several wells have been drilled in the Wendel-Amedee area for electricity production (Amedee and Wendel Power Plants) and for heating purposes (Honey Lake Power Plant). Highrock Spring is another hot spring in the area. This spring has a flow rate of approximately 525 gallons per minute (Lassen County No date) and is located 10 miles southeast of Amedee. Based on previous studies and on results from test wells it appears that the geothermal wells in Honey Lake Valley draw upon a large, but poorly understood, flow system (HLA 1987). Information on the basin's safe geothermal well yield is not available at this time. Further investigation would have to be conducted prior to drilling additional wells in the valley. However, geothermal water disposed by the existing facilities contains residual heat that could be used for activities requiring low temperature heat, such as nurseries, rearing ponds for crayfish and shrimp, and greenhouse operations. Raising seedling conifers in controlled environments using geothermal heat is also a potential use. Extensive logging in nearby areas creates a large demand for seedlings for reforestation (Division of Oil and Gas 1975).

Long Valley. A study of the geothermal resource in Long Valley (HLA 1989b) indicates the potential for geothermal systems in the southern portion of the County. Geothermal occurrences in the area include Zamboni and Long Valley Hot Springs, approximately five miles apart, and an area near the town of Doyle where high mercury content in the soil indicates the potential for subsurface geothermal water. Three soil mercury anomalies were identified in the Doyle area, one to the north of town, one to the southeast, and one in the town of Doyle itself. Both Zamboni and Long Valley Hot Springs appear to be located at the intersection of a minor cross fault and the Diamond Mountains fault. The temperature of Long Valley Hot Springs (130° F) is higher than any other surface water in the study area and the flow rate is unusually high. The springs flow at an aggregate rate of 600 gpm from two orifices located 500 feet apart. Zamboni Springs discharge 50 gpm of water at 104° F. The water flows from three orifices (HLA 1989b) beneath the Western Pacific railroad tracks located 5 miles south of Constantia. In addition, several warm springs were identified in the southern part of the valley discharging water at temperature of 75° F.

Since Long Valley is in the southern portion of Lassen County, closer to the City of Reno, the use of geothermal energy for greenhouse and aquaculture operations may be economical. These operations could provide fresh vegetables or warm-water fish to be sold in Reno.

Big Valley. The Big Valley area in northern Lassen is surrounded by volcanic ridges on the west and on the east. These mountains are fault blocks that have been uplifted and tilted to the east. The occurrence of hot springs in the valley alluvium may be related to bedrock faulting below the valley fill. There are three hot springs in the Big Valley area: Basset, Kellog, and Stone Breaker Hot Springs. Basset Hot Springs is located two miles northeast of Bieber on State Highway 299. The springs discharge 52 gpm of water at 174° F. In the past, a geothermal-heated commercial pool used to be operated at Basset Hot Springs (Division of Oil and Gas 1975). Kellog Hot Springs, located seven miles east of Bieber on county road A2, discharges four gallons per minute of geothermal water at 172° F. Water from Kellog Hot Springs is used to heat a bathhouse, several cabins, and a building where chickens were raised. These facilities are no longer in operation (Division of Oil and Gas 1975). Stone Breaker Hot Springs, located eight miles southeast of Bieber, discharge water at 165° F temperature (Lassen County No date).

Industrial opportunities in the Big Valley area include a lumber mill in Bieber and extensive deposits of diatomaceous earth west of the valley. The use of geothermal fluid to provide hot water to the boilers could reduce fuel costs in the lumber industry. The commercialization of the diatomaceous earth could be made more attractive if geothermal water is used to provide the heat required to process the resource (Division of Oil and Gas 1975).

Environmental Issues

Potential Environmental Impacts. If compared with development of other sources of energy such as fossil fuel and biomass, geothermal development is relatively non-polluting. It

should be noted, however, that development of geothermal power plants and other facilities has the potential to effect the environment if not planned properly.

Typically, geothermal water has a greater concentration of heavy metals and salts than fresh water. Development and operation of facilities using geothermal fluids could impact the quality of surrounding water resources if mixing of geothermal and fresh water occurs. Mixing opportunities include improperly constructed geothermal wells, failure of well casings, and surface discharge of geothermal effluent. Separation of geothermal and fresh waters is imperative to preserve fresh water quality in Lassen County.

Surface disposal of geothermal effluent may also effect waterfowl and wildlife. Geothermal water, if discharged into a surface water body, can change the chemical concentration of the water body and degrade the quality of water and aquatic habitat. Repeated exposure to fluids high in metals may cause chronic effects in waterfowl and other wildlife. In addition, high temperature water on the surface could present a hazard to the safety of humans, livestock, waterfowl or wildlife.

Fresh water supply for geothermal power facilities would most likely come from ground water reservoirs which are the major source of water supply for municipal, industrial and domestic uses in Lassen County. Pumping of large amounts of ground water could result in long-term drawdowns. The amount of fresh water required by geothermal operations depends on the type and design of the facilities. A power plant may have a large demand for water if the plant's cooling tower and fire protection system use fresh water.

Geothermal wastes include well drilling muds and fluids, cooling tower sludge, and miscellaneous wastes such as paints and oily substances. Typically, cooling tower sludge contains a high concentration of heavy metals and may be classified as hazardous.

Extraction of fluids from geothermal reservoirs could potentially result in depletion of the resource. Also, continued pumping of geothermal fluid could cause an intrusion of cold water into the reservoir and a subsequent reduction of water temperature. Pumping of geothermal water can also impact flows from natural hot springs and yields from other existing geothermal wells.

Extraction of geothermal fluids may cause the underground material to compact, which could lead to surface subsidence. Fluid extraction from the soil interstitial pores could cause a decrease in reservoir pressures and in soil support. Ground subsidence is more likely to occur in soft sedimentary rock where the formation is generally supported by the fluids. Ground subsidence is not likely to be significant in geothermal reservoirs in Lassen County occurring in hard fractured rocks where the fluids do not play a supporting role.

Since the wells remove heat from the reservoir, surface subsidence could also result from the cooling and contraction of rocks below the earth's surface. However, unless a great volume of fluid is extracted, the potential for subsidence as a result of rock contraction is low.

In addition, development of geothermal facilities could result in impacts to local topography, soils, and cultural resources due to grading, excavation and filling required to construct buildings, pipelines, roads and transmission lines. Increased erosion and siltation rates may occur in the initial years after project construction, particularly if located on steep slopes. Cultural resources located in the areas being developed may be disturbed by construction activities. Areas of special concern are riparian areas, since water bodies have traditionally attracted prehistorical and aboriginal inhabitation. Short-term air quality, traffic, and noise impact could also occur during drilling of wells and construction of geothermal facilities.

Air emissions are released during well drilling and testing, and operation of the power plant cooling towers. Pollutants associated with geothermal facilities depend on the chemical composition of geothermal resources, and may include hydrogen sulfide, ammonia, boron, sulfur dioxide, sulfates, and suspended particulate matter. Air quality monitoring conducted in the Geysers, the biggest geothermal operation in California, indicates that hydrogen sulfide is the only pollutant likely to exceed an ambient air standard (Lake County 1989).

Noise impacts associated with geothermal development are short-term effects resulting from construction activities and noise generated by operation of power plants and cooling towers. Impacts to sensitive receptors are site specific and depend on terrain and natural barriers.

The greatest biological impact resulting from development of geothermal facilities is animal and plant habitat loss. Impact to wildlife may also occur depending on the temperature, chemical qualities, and discharge procedures of geothermal fluids.

Depending on the local topography and vegetation, construction of geothermal structures could constitute a visual impact on natural landscapes. Man-made structures such as drill rigs, cooling towers, industrial-type buildings, pipelines and transmission lines may contrast sharply with the natural landforms, especially if located on flat areas like Honey Lake Valley.

Land Use Conflicts. Because geothermal fluids are subject to heat and pressure loss during transport, the power plant or geothermal facility must be constructed near the production wells. A distance greater than one mile is generally not feasible because of pressure losses. Geothermal facilities must therefore be sited at close proximity to the resource.

Potential land use conflicts resulting from development of geothermal facilities include visual impacts due to construction of pipelines and structures, and noise generated by pumps, boilers, and on-site activity. Noise levels generated by the twenty-four hour operation of power plants may be inconsistent with the County's day-night noise standards. If the geothermal facility is located in an unpopulated rural area the noise impact will not be as relevant. However, the facility could constitute an impact to wildlife habitat and corridors.

The area required to support a geothermal power plant varies. The amount of land disturbed by the installation of access roads, wellhead, pipelines, turbine building, and cooling tower is usually small. Actual acreage requirements vary depending on the size of

the plant and the characteristics of the resource, but typically a power plant site requires about five acres of flat graded surface area (HLA 1989a).

Moderate temperature geothermal uses are compatible with many open space uses, but can conflict with residential development. Impacts that create conflict include noise, odors, traffic, visual alteration, and the presence of power transmission lines. Land use impacts resulting from direct use of low temperature resources are usually negligible. Retrofitting buildings to provide geothermal space and hot water heating create no land use conflict. However, construction of greenhouses to take advantage of geothermal resources may be considered incompatible with residential uses, and may be more appropriate in light industrial, commercial or agricultural zoning districts.

Regulatory Environment

All geothermal projects in Lassen County are subject to review by various federal, state and local agencies. The public agency having the principal responsibility to conduct the environmental review and approve the project ("the lead agency") varies depending on the type of the project. State legislation designates the California Department of Oil, Gas and Geothermal Resources as the lead agency for the drilling of exploratory wells. The California Energy Commission (CEC) has the jurisdiction over thermal electric power plants with a generating capacity of 50 MW or larger. Lassen County is the lead agency for plants producing less than 50 MW and for field development projects on private and state lands outside Susanville City limits. If the project is located on federal land or on land with federal mineral rights the lead agency is the Federal agency which manages the lands in question (e.g., Bureau of Land Management, Forest Service). When the mineral rights are owned by the state, the State Lands Commission (SLC) is the designated lead agency for the leasing of the mineral rights, and the California Department of Oil, Gas and Geothermal Resources is the lead agency for exploratory wells.

Other state and local agencies such as the Department of Fish and Game, Regional Water Quality Control Board, Lassen County Air Pollution Control District, and the County are responsible agencies and must also approve the project. The County ensures that the use of unincorporated land for geothermal purposes complies with local general plan and zoning provisions. Under Chapter 18.102 of the Lassen County Code, General Provisions and Exceptions, geothermal exploratory and production wells, and geothermal production projects may be permitted in all districts subject to securing a use permit, except in O-S (Open Space), O-D (Primitive Area), and O-H (Historical Site) Districts, where these uses are prohibited. If sufficient information is submitted, including a description of the proposed production phase, a single permit may be issued for exploratory wells, production wells, and for the geothermal production project.

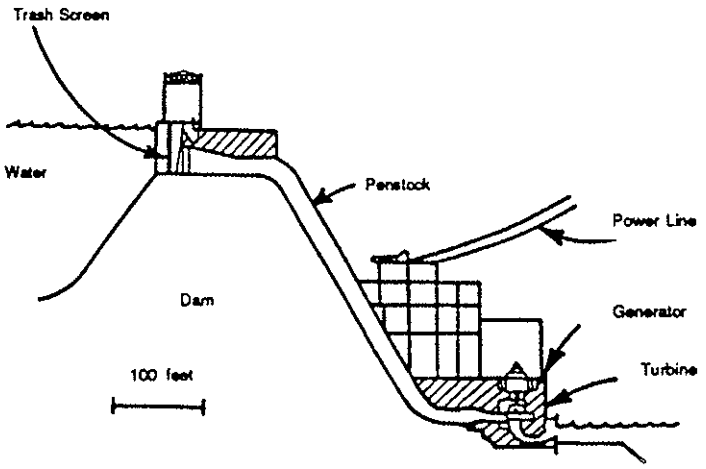
2.3.4 Hydroelectric

Technology Overview

The primary requirements for the generation of hydroelectric power are large volume and rapid movement of water. Hydroelectric facilities vary in design and layout, but typically all projects contain a dam or diversion structure to control water and create a hydrostatic head, a turbine to convert water flow to mechanical energy, and a generator to convert the mechanical energy into electricity (see Figure 2-10). A powerhouse encloses one or more water turbines and generators, along with electrical switchgear and other related equipment. Reservoir projects use water which has been stored behind a dam while run-of-the-river projects use current water flows to produce power. Typically, the diversion structure of a run-of-the-river project diverts only a portion of the total water flow.

Figure 2-10
Illustration of Hydroelectric Systems

DESCRIPTION



- Hydroelectric systems transform potential and kinetic energy contained in falling water into electrical energy through water wheels or hydraulic turbines.
- Potential (head) energy and water flow-rate determine the output of power from the plant.
- Complete systems include water intake system, supply pipe to powerhouse, turbine/generator, water discharge system, and transmission system.
- Projects are classified as run-of-river, diversion, storage, pumped-diversion, pumped-storage, or combined pumped-storage.
- Plant efficiencies range from 85 to 90%. Capacity factors vary from 20 to 90%.
- The quality of the water resource is determined by its stored energy, or "head." The head of a resource is roughly equivalent to the vertical distance the water falls before impacting the turbine, or the height of water directly above the turbine inlet. A head of 66 feet is considered a low quality resource.

Source: California Energy Commission 1991

The principal characteristics of hydroelectric facilities are determined by the combination of site-specific head and stream flow. The head is the difference in elevation between two points in a stream (i.e., the height of a dam) and is directly associated with the pressure of the mass of water at the lower point. The higher the head, the more pressure exists at the lower point. The head available at a site usually determines the type of turbine to be used, and stream flow is an important factor in calculating the site's capacity. The two general types of hydraulic turbines that may be used in small scale hydroelectric facilities are: 1) the impulse turbine which has one or more jets that discharge water onto the buckets of a runner; and 2) the reaction turbine, which is submerged in the stream flow.

Hydropower is a renewable source of energy. Water is not consumed as it produces energy. The water can be reused further downstream. Power can still be produced downstream from a powerhouse, if subsequent hydroelectric facilities are constructed. The water stored in the Mountain Meadows Reservoir located in Lassen County generates power at the Hamilton Branch Powerhouse in Plumas County and at other downstream hydroelectric facilities such as Cresta, Poe, and Thermalito Powerhouses.

History of Hydroelectric Facilities

The production of electricity using the energy of falling and flowing water has a long history in Northern California. Hydroelectric power was first introduced in the region during the late 1800s when water wheels were used to power electric lights and motors in several mining operations and surrounding towns. In 1885, the completion of a commercial hydroelectric plant near the town of Folsom and the construction of high-tension transmission lines provided the city of Sacramento with electric current for power and light. This development was followed by further hydroelectric development in the Sierra foothills. The steep descent of the Sierra rivers was favorable for the production of electricity using the energy of flowing water. Many companies were organized to finance and develop the region's power needs. Eventually, these companies were bought out by Eugene de Sabla Jr. and John Martin, who were primarily responsible for development of the Pacific Gas and Electric (PG&E) system. These two men built hydroelectric power plants and consolidated utility systems to form the foundation of PG&E, the major utility company currently providing Lassen County with wholesale electricity.

In 1924, water from Hamilton Branch Creek in southern Lassen County was diverted and stored in the Mountain Meadows Reservoir for the purpose of power generation. This reservoir is located south of the town of Westwood, near the county border, and power generation occurs at Hamilton Branch Powerhouse in Plumas County. This facility supplied a lumber mill in Westwood and the towns of Westwood and Chester. Since PG&E's purchase of the project in 1945, Mountain Meadows facilities have been integrated into the North Fork Feather River hydroelectric development and the power produced is transmitted through the electric grid (PG&E 1980).

In 1988, Muck Valley Hydroelectric Power Plant started operating on the Pit River.

Other Existing and Proposed Facilities

Located east of Pitville, the Muck Valley Hydroelectric project started generating electricity on the Pit River in December 1988. The facility is owned by the Malacha Hydro Limited Partnership. Total production capacity is 30 MW. Power produced is sold to PG&E under a long-term energy and capacity purchase agreement. The facility consists of a 4½-foot-high diversion structure on the Pit River and a 22,000- foot-long tunnel that goes into a reservoir. A total of 8,500 acre feet of water is stored behind the Collett Dam. The Muck Valley project started operating in 1988 with the diversion structure and the tunnel. The reservoir was added later to allow for peak power production (Jerry Lutticken, pers. comm.).

In April 1991, the Federal Energy Regulatory Commission denied competing applications and issued an order granting a preliminary permit to the South Fork Irrigation District for a pumped storage hydroelectric project. The project, which would occupy land administered by BLM, would store water at the existing Moon Lake (also known as Tule Lake) in Lassen County. Electricity would be produced at peak periods by releasing water from this reservoir at a higher elevation through a powerhouse to a lower reservoir in Modoc County. Water would then be pumped back up to the higher reservoir at off peak periods. The proposed capacity of the South Fork project is 264 MW.

Feasibility for Future Development

Technical Considerations. Although there is little potential for development of new large scale hydroelectric plants in Lassen County, there may be a potential for small "low-head" hydroelectric facilities. Recently, low-head hydroelectric projects have become more popular in California due primarily to the unavailability of new building sites for large hydroelectric facilities. Hydropower could also be generated by adding hydroelectric-generating facilities to dams already in place for flood control, water supply, and recreational purposes. In the future, potential energy to be derived from hydropower in Lassen County will most likely involve construction of small hydroelectric projects or construction of power-producing facilities at existing dams, canals and pipelines. A list of potential small hydroelectric projects at existing hydraulic facilities in California was prepared by the Department of Water Resources in 1981. It includes three facilities in Lassen County which are shown in Table 2-4. The estimated capacity shown for Moon Lake was based on the dam existing at that time, and differ substantially from the capacity being proposed now by the South Fork Irrigation District.

The feasibility of future hydroelectric projects in Lassen County will also depend on available capacity in local and regional transmission lines. Capacity constraints on existing transmission systems may delay or preclude the development of hydroelectric power plants in the County.

In 1987, the technical and economical feasibility of constructing a multiple use water storage reservoir on the Susan River was examined in a reconnaissance level feasibility study prepared by Tudor Engineering Company under a grant from the California Energy

Table 2-4
Potential Small Hydroelectric Projects at Existing Reservoirs in Lassen County

Facility	*Owner*	*Estimated Capacity (kwh*	*Head*	*Flow*
Round Valley Dam	Jack & Thomas Swickward	90	40 feet	35 cfs
McCoy Flat Dam	Lassen Irrigation Company	50	15 feet	46 cfs
Moon Lake (Dam)	R.W. Akers	75	14 feet	80 cfs

Source: Department of Water Resources, Bulletin 211, 1981.

Commission. The project consisted of constructing a reservoir primarily for water supply, with the secondary purposes of hydroelectric generation, flood control, and recreation.

Three sites were studied west of Susanville, and it was concluded that, due to the head available between the proposed dam and powerhouse, Crazy Harry Gulch would be the most appropriate project site. It was determined that a feasible project would consist of a roller compacted concrete dam about 170 feet high to impound a storage volume of 17,000 acre-feet, and a 2,200 kW powerhouse (assuming that the required load factor for a peaking type power project would be 14 percent). The potential annual energy production at this site was projected to be 10 GWh. No follow-up studies of a Susan River hydroelectric project have been conducted since the reconnaissance level study.

Economic Considerations. The economic feasibility of constructing hydroelectric power plants in Lassen will depend primarily on the price developers will be able to obtain for the power produced. As a result of the recent elimination of advantageous long-term purchase agreements with utility companies, it may be difficult for developers of new facilities to sell power at favorable prices. Electricity sold by hydroelectric facilities is now subject to lower rates from utility companies. Feasibility studies would be needed to determine if development of hydroelectric facilities in the County would be economically viable.

Environmental Issues

Environmental effects caused by hydroelectric development are usually associated with water impoundment. Creation of a reservoir has the potential to alter hydrologic patterns and affect biological resources including riparian vegetation and threatened and endangered species habitat. Construction of access roads, transmission lines, conduits, powerhouses, and other hydraulic facilities also has the potential to adversely affect the environment.

Effects on natural hydrologic patterns due to creation of a reservoir may result in changes in downstream flow and groundwater recharge. These alterations can result in changes in the character, quality, and local environment of a waterway. The rate and quantity of flow in a water channel influences plant and fish life, riparian vegetation, dissolved oxygen content, sedimentation, temperature, and turbidity. These elements of water quality are not expected to be significantly affected by small scale hydroelectric facilities. A decrease in groundwater recharge due to construction of hydraulic facilities could alter the downstream water table. Groundwater is an important source of water for the County, and the process of groundwater recharge plays a critical role in regenerating that supply. Any decrease in groundwater recharge could produce changes in the County's available water supply, causing a drop of the water table level and requiring deeper wells. Lower water table may reduce the moisture available in the soil and result in potential problems for agricultural crops and vegetation cover.

Creation of a reservoir necessarily floods much of the stream valley behind the dam and displaces terrestrial habitat with a new lake environment. In addition to inundating terrestrial and riparian habitats, the reservoirs and associated canals and pipelines can also affect migration patterns for wildlife and fish. In addition, the operation of a hydroelectric facility can result in impacts to downstream habitats. The temperature and oxygen content of the water may be modified by a stratified reservoir, and the release of this water may influence the downstream temperature and dissolved oxygen content. Temperature and oxygen content in the water have a significant effect on plant and fish life in the stream channel. Decreased stream flow may also change water temperature regimes, and reduce quantity and quality of the downstream riparian plant community.

Increased sedimentation resulting from construction of hydroelectric facilities may potentially affect fish spawning habitat and reduce fish food production. Changes in stream flow as a result of water diversion may also increase sedimentation and accumulation of sand and fine organic matter on spawning gravel areas. Cracks between rocks forming the streambeds are important elements of spawning areas and as sediments fill these cracks degradation of the spawning habitat occurs.

Construction of hydroelectric facilities also has the potential to modify the character of recreational opportunities offered in the project area. Construction of a reservoir would alter the character of existing fishing opportunities. New reservoirs may create new boating and swimming opportunities but also has the potential to degrade or eliminate boating and river rafting opportunities. Construction of access roads may increase hunting and hiking opportunities. Construction of hydroelectric facilities could decrease the visual quality of an area and thus, alter the value of some recreational experiences for which visual quality is a primary expectation. Other potential effects of hydroelectric development include impacts to cultural resources resulting from construction disturbances or inundation of cultural sites.

If generation facilities are to be added to existing dams and hydraulic structures, the environmental impacts would be less significant than with construction of a new reservoir.

However, changes to the downstream flows and related impacts to biological resources could still occur with operation of such facilities.

Regulatory Environment

Hydroelectric projects in Lassen County are subject to the review and permit requirements from several federal, state, and local agencies. The Federal Energy Regulatory Commission (FERC) is authorized by the Federal Power Act and the Public Utility Regulatory Policies Act to license non-federal projects occurring in the County. Hydroelectric projects on non-Federal lands must also comply with the provisions of the California Environmental Quality Act of 1970 (CEQA). In general, FERC is the lead agency for hydroelectric projects and would be responsible for conducting the environmental review required under CEQA and NEPA.

The Endangered Species Act of 1973 gives authority to the U.S. Fish and Wildlife Service to review proposed projects for potential impacts on endangered species. The Clean Water Act authorizes the U.S. Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (ACOE), and state water quality agencies to grant permits in an effort to control water pollution. The ACOE is also responsible for implementing the River and Harbor Act of 1899 by issuing permits for construction or dredging in a public waterway. Enforcement of the River and Harbor Act ensures the maintenance of the basic natural features of a waterway.

Hydroelectric plants producing under 5 MW of power are permitted by right in the following county zoning districts: Forest Recreation (F-R), Exclusive Agricultural (E-A), Upland Conservation (U-C), Hydroelectric (H-R), and Upland Conservation/Resource Management (U-C-2). A use permit is required for plants under 5 MW in the light and heavy industrial districts (M-1 and M-2), the Primitive Area (O-D), and the Flood Plain Combining (F) districts. Plants producing over 5 MW of power are permitted by right in U-C-2 district and by use permit in the following districts: E-A, U-C, H-R, M-1, M-2, O-D, and F. A summary of the zoning districts permitting hydroelectric facilities by right or by use permit is provided in Table 2-3.

2.3.5 Solar

Technology Overview

In 1986, solar energy in California included production of 128 MW of electricity, and a potential to produce 76 MW from facilities under construction. An additional 500 MW of electrical capacity was proposed for construction (ABAG 1987). These numbers are significantly lower than other alternative energy sources; however, they demonstrate that solar energy could potentially become a significant energy resource in California.

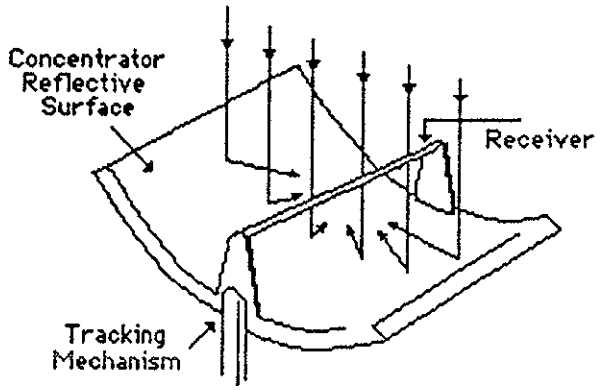
There are two primary technologies available to capture solar energy and convert it to electricity. These technologies are: solar-thermal processes and photovoltaic processes. They are discussed in the following paragraphs.

Solar-thermal. This process involves first collecting and then converting incoming solar radiation into heat energy or electricity. The basic procedure in the solar-thermal process is to collect the solar energy, concentrate it in a given area, then use the heat to convert a liquid into steam, to turn electric turbines. Several different methods are used to collect and concentrate solar-thermal energy. These methods include parabolic dish mirrors, mirrors arranged in parabolic troughs (See Figure 2-11), and central receiver systems. Another method to harness solar-thermal energy is the solar pond. Solar ponds consist of two layers of water, fresh water on top and heavier salt-water underneath. Because the layer of salt-water is heavier, it is prevented from the natural mixing process and therefore does not lose its heat to the air. Heat accumulated in the salt-water layer approaches the boiling point. The heat energy is then converted, using a heat engine, into mechanical energy. A generator is used to convert the mechanical energy into electricity.

Figure 2-11
Illustration of a Solar Thermal System - Parabolic Trough

DESCRIPTION

- The working fluid (usually water or oil) circulates through a tube receiver that runs along the focal line of a reflecting trough.
- Troughs track the sun in two directions (usually E - W) and may be connected in series or parallel combinations for desired volume and temperature.
- Steam directly drives a turbine, or hot oil produces steam in a steam generator for driving a turbine generator.
- Thermal energy storage can be provided with an insulated reservoir.
- Parabolic troughs are sized to drive specific steam turbine units.
- Hybrid systems use natural gas to boost temperatures or run the plant at times of low insolation.
- Projects require 600 acres of low cost land with high solar flux per 100 megawatts of capacity.



Parabolic Trough

Source: California Energy Commission 1991

Photovoltaics. This process involves the direct conversion of solar energy into electrical energy (See Figure 2-12). The cell is the basic unit of a photovoltaic (PV) system. Cells are arranged into modules commonly referred to as solar panels. The current generated by the PV system is directly related to the intensity of insolation and the angle of the module to the insolation. PV systems can produce power even in overcast and cloudy conditions.

Large solar energy production facilities have been developed in vast open areas in California. These "solar farms" produce bulk energy for transmission to the utility grid to supplement the regional energy needs.

History of Solar Energy

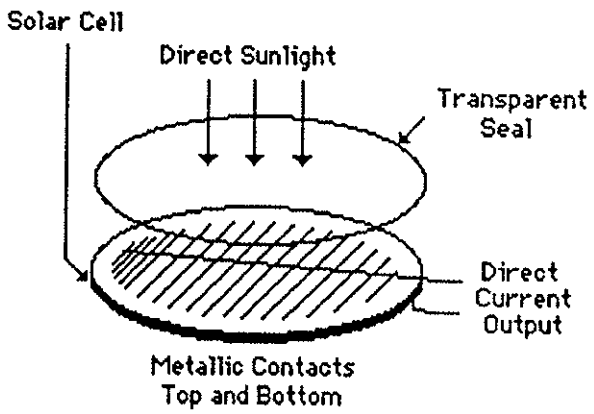
Solar energy refers to the portion of energy radiated by the sun which is intercepted by the earth. Due to the dispersed nature of the resource, appropriate technology is required to collect and utilize solar energy. As described above, direct production of electricity using solar energy is accomplished through photovoltaic cells.

The photovoltaic effect was first observed in the mid-1800s when French physicist Edmund Bequerel found that sunlight could be used to produce electricity. It wasn't until much later, in the early 1950s, that this technology became a viable fuel source for energy production.

Figure 2-12
Illustration of Photovoltaic Effect in Silicon - Solar Production of Electricity

DESCRIPTION

- The photovoltaic effect in silicon and other semiconductor materials arises when atoms in two or more specially prepared layers absorb light, freeing electrons and creating electron holes.
- The junction between the layers creates a voltage which separates the charge carriers, creating an electrical current.
- Single or polycrystalline silicon is used as the semiconductor material. These are the most mature of the photovoltaic cell technologies.
- Performance is very reliable and stable, with 15% conversion efficiencies for single crystalline, and 11 to 12% for polycrystalline cells.
- Crystalline silicon photovoltaic cells are expensive due to the need for high-purity silicon and a costly manufacturing process.



Source: California Energy Commission 1991

For many years, photovoltaic cells have been the principal power source for satellites and, more recently, for remote areas difficult to reach with power lines.

Solar thermal systems were also developed to use solar energy for a variety of purposes, including generation of steam to produce electricity, space heating of buildings and homes, and heating water for domestic uses. Some solar power plants exist in California. There are presently no solar facilities in Lassen County producing electricity in a commercial capacity. Solar energy production within the County has traditionally been associated with small scale domestic use and remote sites such as fire lookout towers.

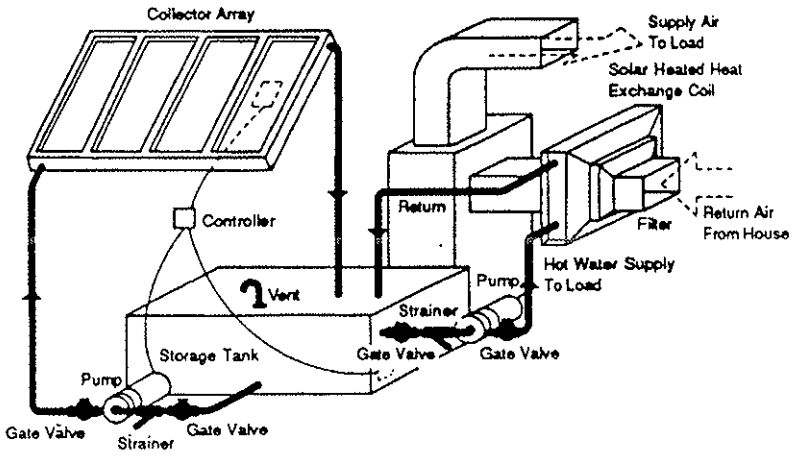
Existing and Proposed Facilities

Most of the existing and proposed solar developments in California are located in the desert regions in the southern half of the state. Currently, there are no existing or proposed commercial solar energy producing facilities in Lassen County. As indicated above, solar developments in the County are associated primarily with single-family residences. Solar energy produced on this scale can be used for a variety of purposes including space heating, domestic water heating, and to supplement domestic electricity demands (see Figure 2-13 through 2-15 for illustrations of active and passive solar systems).

Figure 2-13
Illustration of Active Solar Space Heating Systems

DESCRIPTION

- Active solar heating systems typically provide 20 to 60% of total house space heating requirements as well as most water heating requirements.
- Conventional gas and electric space and water heating systems are typically used to meet additional load requirements.
- Solar collectors collect and transfer the sun's heat to a working fluid.
- Storage allows for use of collected solar heat during nighttime or overcast days.
- The distribution system transfers solar heat from collectors to storage or directly to space conditioning equipment (conventional forced air heat system), typically by a heat exchanger.
- Microprocessor controllers or thermal sensors activate pumps, blowers, and freeze protection systems where required.



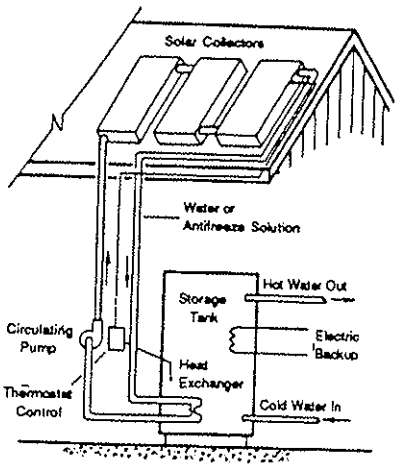
Active Solar Heating System

Source: California Energy Commission

Figure 2-14
Illustration of Active Solar Water Heating System

DESCRIPTION

- Active solar systems can typically provide 50 to 80% of a family's hot water needs.
- Conventional gas or electric water heater are typically used for additional load requirements.
- Solar collectors collect and transfer the sun's heat to a working fluid.
- The distribution system transfers solar heated fluid from collectors to a storage tank and returns cooler fluid to collectors for heating.
- Insulated water tank stores solar heated water for use during nighttime or overcast days when direct solar heating is not available.
- Microprocessor controllers or thermal sensors activate pumps and freeze protection systems where required.
- Open loop systems circulate potable water through collectors for direct heating.
- Closed loop systems circulate a fluid that exchanges heat collected in storage tank through a heat exchanger.



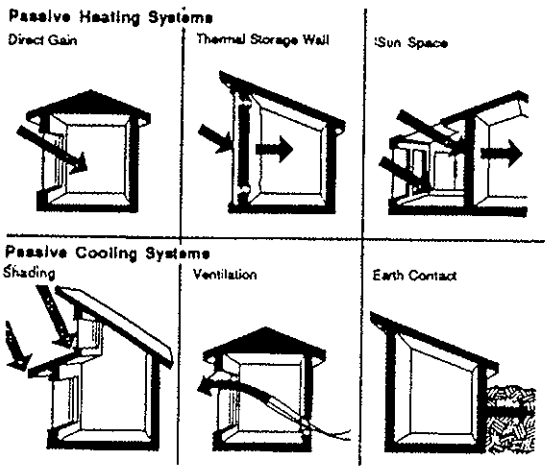
Closed Loop Active Solar Water Heating System

Source: California Energy Commission 1991

Figure 2-15
Illustration of Passive Solar Space Heating System

DESCRIPTION

- Heating applications use window glazing to collect heat.
- Thermal mass stores collected heat and tempers internal temperature fluctuations.
- Direct gain systems expose the living space and thermal mass directly to solar gain; indirect systems (thermal storage walls) buffer solar gain from the living space; isolated systems (sun spaces) collect solar gain in a separate area from the living space.
- Cooling applications include shading to reduce solar gain and create cool air around walls, natural ventilation to collect outdoor cooling breezes within buildings, and earth contact to draw on natural cooling available from constant ground temperatures.
- Hybrid systems exist and may include mechanical components.



Source: California Energy Commission 1991

Feasibility for Future Development

Sunlight is the "fuel" supply for solar energy. In that respect it is a clean, unlimited, and potential energy source for almost any location and application. However, several other factors limit the feasibility of large scale solar energy producing facilities. Some of the primary factors affecting the feasibility of developing both energy and cost efficient solar facilities are the location of the proposed facility, solar access, and local weather patterns.

Technical Considerations.

Facility Location. One of the primary factors associated to proper facility siting includes the area's latitude (distance from the equator), which directly affects the intensity of the radiation and the amount of energy able to be derived from the solar radiation. Areas where the sun is high in the sky or passes directly overhead receive the strongest, most intense insolation. The more intense the insolation being received, the more energy can be derived from the sunlight.

Solar Access. Solar access refers to the unobstructed exposure to the sun. This is essential for a solar collector to operate at maximum efficiency. Solar access deals with a number of variables. These variables include the constant change of the sun's position in the sky (solar declination) from season to season, the tilt and orientation of the photovoltaic collection panels, the existence or future development of structures adjacent to the solar collection surface which may interfere with solar collection, and the presence and type of vegetation adjacent to the collector. These variables are important because they all have the potential to compromise the efficiency of energy collection. In order to operate efficiently, the solar panels must be free from shadows or other obstructions during peak solar collection periods.

Weather Patterns. Commercially successful solar energy producing facilities are typically located in areas that experience long, hot, cloudless summers, and relatively mild winters. Lassen County experiences harsh weather conditions: the mean annual snowfall ranges from 32 to 96 inches per year. The minimum temperature is below 32° F more than 120 days per year and the temperature is over 90° F less than 30 days per year. Snow is often on the ground for extended periods between September and March. The potential for commercial solar energy development in Lassen appears to be limited due to the weather patterns in the County.

Economic Considerations. On a national basis, federal policy offers considerably more funding for research, development, and demonstration programs that utilize conventional fuel sources (e.g., natural gas, oil, nuclear, and coal), than for programs involving solar energy facilities. The major cost associated with the development of photovoltaic energy technology is related to the cost of producing the solar cells and modules (panels). The processes involved in constructing each cell from silicon is time consuming and expensive. Costs incurred from producing solar technology currently exceed the value of the energy produced when compared to other fuel sources.

Therefore, at present, solar energy is not cost-efficient. The development of advanced manufacturing techniques is needed to reduce the cost of constructing solar facilities and make solar energy production more cost effective. The economic feasibility of constructing solar energy producing facilities in Lassen County will depend primarily on advancements in research and development of solar technologies that would reduce associated costs. In addition, the developers must receive a sufficient price for power produced by solar technology to make it a profitable venture. Detailed feasibility studies would be needed to determine if development of solar energy facilities in the County would be economically feasible.

Environmental Issues

Solar energy production has few environmental impacts, relative to other means of energy production. The major impacts associated with solar facilities may, depending on site selection, involve loss of open space and agricultural land; degradation of visual resources from siting solar arrays (collection surfaces) in areas that were previously open, "rural" areas; public safety issues including equipment failures, fires, vandalism, and air traffic problems; potential loss of wildlife habitat and plant and animal species from construction, operation, and maintenance of solar facilities; and potential geotechnical related impacts including landslides and erosion.

The production of energy using solar technologies requires an intensive use of land. Typically, large tracts of open lands are needed to construct a solar farm. Table 2-5 shows the average acres required per MW of electricity produced by solar technology. Often the qualities that define prime agricultural land are similar to requirements for solar farm locations. Competition between land uses should be regulated by implementing detailed planning guidelines. Land uses which do not shadow solar panels or are not visually sensitive to light industrial uses are considered compatible with solar development.

Table 2-5
Land Area Requirements For Solar Facilities

Solar Technology Used	*Average Acres Per MW*
Parabolic Trough	5
Parabolic Dish	6
Power Tower	12
Photovoltaics	10 - 24

Source: Association of Bay Area Governments 1987

The major advantages to using the sun as a fuel source is that it is a "clean", free, and unlimited fuel supply; and there is plenty of the "fuel" for everyone to use. Any emissions or other wastes produced from solar energy production are in negligible amounts, and would not be a significant impact.

Regulatory Environment

New solar projects proposed in Lassen County will be reviewed by the California Energy Commission (CEC) if they produce an excess of 50 MW of electricity. However, most solar projects produce less than 50 MW. For these projects, the CEC acts as an advisory council to County and City Planning Departments and other local agencies. The CEC offers advice and suggestions for proposed energy development projects.

There are currently two state laws in effect which were designed to protect an individual's solar access rights. They are the Solar Shade Control Act and the Solar Rights Act. The Solar Shade Control Act prohibits the planting of any tree or shrub on property adjacent to a previously installed solar collector which would block the collector during 10:00 a.m. and 2:00 p.m. The Solar Rights Act specifically recognizes the legality of easements for solar access between property owners, prohibits ordinances or covenants restricting the use of solar systems; and requires tentative subdivision maps to provide for solar access.

Lassen County retains regulatory and permitting authority for siting and approval of proposed solar energy facilities in accordance with its Zoning Ordinance. The County would function as the lead agency for all proposed solar projects producing less than 50 MW of electricity. New solar energy developments in Lassen County would be subject to Lassen County General Plan requirements, the County Zoning Ordinance, and approval of a use permit.

2.3.6 Waste-to-Energy

Technology Overview

Waste-to-Energy (WTE) facilities produce steam for electric power from municipal and commercial solid waste or medical waste. WTE technologies, which are constantly being updated and refined, consist of two main types of facilities - mass burn and refuse derived fuel (RDF) facilities. Mass burn facilities combust unprocessed or minimally processed refuse using waterwall, refractory, or modular system boilers. Steam is then sold or used to generate electricity via steam turbines. RDF boilers require preliminary processing and sorting of the solid waste fuel to screen out oversized material and to provide uniform size distribution. There are presently no RDF facilities in California, although the technology is established in other areas of the country. Poor performance of some existing RDF facilities indicates that additional technologic refinement is needed regarding fuel handling and processing. It is anticipated that several new RDF technologies are due to become commercially available in the near future, particularly fluidized-bed boiler technology.

Although many WTE technologies have been successfully demonstrated in other countries, they have only recently become commercialized in California. There is a poor public image of WTE facilities due to potential environmental and economic impacts.

Fuels for WTE facilities include municipal and commercial solid wastes, and medical wastes (although medical wastes are classified as a special waste requiring specific permits). Municipal and commercial solid waste is composed of various household and industrial debris such as paper, plastic products, foliage, outdated packaging materials, wood boxes, oily rags, and animal and vegetable waste. Large bulky items are not acceptable as WTE fuel. Materials typically prohibited in the waste stream fuel include automobile scrap, construction scrap, hot water heaters, explosives, pesticides, and large metal containers. Medical waste is composed of a number of infectious and non-infectious waste generated at hospitals, clinics, medical testing laboratories, and medical research facilities. It includes empty pharmaceutical containers, laboratory and blood byproducts, human anatomical and pathological specimens, test animals, and disposable materials such as needles and broken glass.

Existing and Proposed Facilities

A Waste-to-Energy facility was built in 1984 by the Lassen Community College in Susanville for use as a teaching facility. The plant was designed to burn solid waste and produce hot water for space heating and steam for electrical generation. Excess power and steam would be sold to generate income to the College. This waste-fueled cogeneration facility was in operation from October 1984 to May 1985 when it was shut down for a number of reasons including insufficient fuel supply, regulatory non-compliance, and equipment failure (McClelland Consultants 1990). Municipal refuse, tires, and wood waste were incinerated at the plant.

Recently, Lassen Community College, in association with Susanville Resources, Inc., a private corporation, applied for rezoning and a Conditional Use Permit from the County to modify and reopen the facility as a commercial waste treatment facility. The proposed project involved modernization and expansion of the existing facility and incineration of medical and commercial wastes in addition to municipal solid waste. A total of 125 tons of waste would be burned daily. Total power production would be 1.5 MW, part of which would be sold to the utility electric power grid. The cogeneration facility would also produce steam which would be used for space heating at the Community College. Operation of the facility would include educational and training opportunities for the College students. The proposed project included a materials recovery facility and an ash monofill to be located at the county-owned Bass Hill Landfill.

The municipal and commercial solid waste fuel would come from several areas within Lassen County and from commercial generators outside the County. All municipal solid waste would be transported to the Bass Hill Landfill where it would be processed by the materials recovery facility to separate recyclables from combustible material. Household hazardous waste would also be removed. Trucks would transport the sorted waste to the Lassen Community College WTE facility. Medical waste would be delivered directly to the facility from California and nearby states.

The project applications were withdrawn from the County in November 1991. There was public concern that operation of the expanded WTE facility as a commercial medical waste facility would result in increased traffic, noise, and air toxic emissions which might be incompatible with existing and future surrounding land uses (educational, residential, and business park). Also, part of the waste stream would consist of infectious waste and there has been concern expressed by the public regarding the health risk for students and employees at the site, and for local residents. Discussions on the proposed expansion and reopening of the plant are currently taking place at the state and local level, but no new application has been submitted to the County.

Feasibility for Future Development

The economic viability of WTE facilities depends on local tipping fees and electricity prices. Facilities commonly charge a fee to garbage haulers similar to the fee charged at a landfill. Tipping fees must be high enough to justify the waste-burning facility. A general problem in California is the artificially low landfill tipping fees which do not take into account the cost of replacing landfills and future land costs. Therefore, WTE facilities have yet to compete economically because of these undervalued tipping fees.

Another issue associated with the feasibility of future WTE facilities in Lassen County is fuel supply. Because of the rural character of northeast California the area's potential to produce municipal and commercial waste is limited. In general, the viability of WTE facilities depends on the existence of local fuel supply. The need to transport waste from distant locations is often uneconomical. The poor public image of WTE facilities, which are usually related with potential environmental impacts, may also prevent future development of WTE facilities in the County. Public concern with incineration of waste, especially medical waste, include nuisance and health risks related to air emissions, odors, noise, increased traffic volume and visual impacts. In November 1990, over 80% of the voters voted "No" to the question "Should a facility for the incineration of materials, including medical wastes be operated at an alternative site within Lassen County?"

Operation of a WTE plant often requires operation of accessory facilities such as a materials recovery center and an ash disposal system. Processing of waste at materials recovery centers or refuse sorting stations ensures the removal of recyclables from the waste stream, as well as materials which can not or should not be burned. The remaining waste is generally composed of the material sought for combustion.

Environmental Issues

WTE facilities are similar to pure biomass plants in terms of environmental issues. Benefits associated with these facilities are derived from their ability to achieve two purposes - reduce landfill needs within a community, and produce electricity. Typical impacts associated with a waste-to-energy facility include conflict with adjacent land uses, nuisance and potential health risk from air emissions and noise generated by the plant, increased truck traffic to the site, and visual impacts.

Air emissions from the burning of municipal solid waste are high in metal and semi-volatile organic emissions. Emissions associated with combustion of medical waste, another common fuel to WTE facilities, are generally high in organic and chemical emissions. Chemical emissions from cogeneration facilities must be reduced with appropriate air pollution control methods to avoid risk to public health. Air emissions and ash disposal are common environmental issues that must be addressed in the review of any permit application. Ash residues are potentially hazardous materials and advanced technologies are needed to reduce the amount of produced ash.

Operation of cogeneration facilities could exceed noise level standards and impact the surrounding land uses. Stationary noise generating equipment associated with cogeneration facilities includes incinerator, boiler, turbine generator, compressors, pumps, conveyors, air scrubbers, ash processing equipment, and cooling towers. While the majority of this equipment would typically be enclosed within structures and shielded from the outside by walls and ceiling, there are some, such as the cooling towers, ash processing equipment and air scrubbers that would most probably be located outside of a building and constitute potential noise sources. Increased vehicular and truck traffic volume to and from the site could also contribute to higher ambient noise levels.

Typically, operation of a WTE facility would require a substantial number of truck trips from the fuel source to the plant. WTE facilities are often sizable operations which replace several landfills and the traffic associated with landfill operations. This additional truck traffic could impact the level of service on local roads and increase the potential for traffic accidents. Another impact associated with increased truck traffic is the permanent deterioration of roadbed surface conditions. Other potential impacts associated with construction of WTE facilities include impacts on visual resources, vegetation and wildlife, and cultural resources.

Regulatory Environment

WTE facilities are subject to many of the federal, state, and local regulations pertaining to electricity generation as well as other regulations affecting waste disposal activities. The CEC has the regulatory authority over the siting of thermal power plants larger than 50 MW, including cogeneration plants. For projects under 50 MW, the County would be the lead agency and would conduct the environmental review required under CEQA. In any case the facility would have to comply with local general plan and zoning provisions.

There are numerous other state and local regulations which establish permit requirements regarding disposal of solid waste. These permit requirements include 1) Solid Waste Facility Permit issued by the California Integrated Waste Management Board and administered by the Lassen County Environmental Health Division; 2) Waste Discharge Permit issued by the Regional Water Quality Control Board; 3) Hazardous Waste Facility Permit issued by the California Department of Health Services; and 4) Authority to Construct and Permit to Operate issued by the Lassen County Air Pollution Control District. For the incineration of medical wastes, a Medical Waste Facility Permit from the California Department of Health Services is also required.

2.3.7 *Wind*

Technology Overview

Increased development of commercial wind farms has occurred in the past few decades. Wind turbines currently produce more than 6,000 MW of electricity in California. In addition, facilities capable of producing several hundred megawatts have been proposed for construction and are currently under review and obtaining permits for construction and operation.

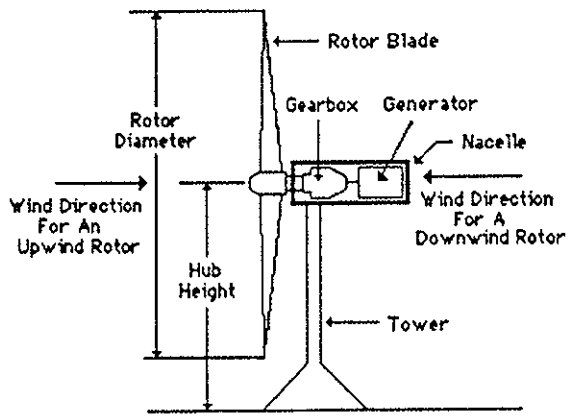
Wind turbines are used to generate electricity from the wind. When the wind reaches a certain speed the rotor begins to turn. However, no electricity is produced until the rotor reaches a certain minimum speed, called the cut-in speed. The cut-in speed for each type of turbine varies, and is dependent upon several factors including the number and diameter of blades and orientation of the axis. When the turbine eventually reaches the cut-in speed, a generator shaft begins to turn and electricity is produced. Typically, electric generation capacity of commercial wind turbines ranges between 17 kW and 2,500 kW. The optimum wind turbine size has not yet been determined (CEC 1984). The turbine's blades or rotor can either be situated on a horizontal or vertical axis as described below.

Horizontal Axis Rotors. Because these rotors are on a horizontal axis, they must constantly change position to face the wind head on (Figure 2-16). Usually, the number of blades on a horizontal wind turbine varies between one and five blades. Turbines with fewer blades than conventional five-bladed turbines are more efficient and produce more energy from

Figure 2-16
Illustration of a Horizontal-Axis Wind Turbine

DESCRIPTION

- Wind energy is converted into rotational energy to drive an electric generator.
- Rotor, gear box, tower, control equipment and power conditioning equipment are required to produce electricity.
- Yaw control systems keep the rotor directed into the wind.
- Projects are designed to interface directly with a utility power grid, and involve varying numbers of turbines
- A standard offer contract with a utility must be negotiated.
- Capacity factors averaged 13% for projects operating in California during 1985 and 1986, but increased to 16% during 1987, 17% during 1988, and 18% during 1989.



Horizontal-Axis Wind Turbine (HAWT)

Source: California Energy Commission 1991

high speed winds because the rotor is able to turn faster. Typically, turbines with two- to three- blades are the most productive. Most commercial wind farms currently utilize the two- to three-blade horizontal axis wind turbine (Leckie, Masters, et al. 1981).

Vertical Axis Rotors. Vertical axis turbines include the Darrieus or "egg beater" model and the Savonius or "S" rotor. Because these rotors are on a vertical basis, they are always facing into the wind, and have no difficulty maximizing wind collection. They perform well even during gusty winds that often shift direction. Darrieus rotors have a very low starting torque and usually require an auxiliary starting system to start turning. The Savonius model rotates much slower than other types of rotors, and is less than half as efficient as other turbine models.

Periods of extremely high winds can prove very damaging to wind turbines and generators. These high winds can break rotors, bend turbines, and burn out electric generators. However, mechanisms can be incorporated into the rotor design to disconnect the facility from power production during periods of high winds.

History of Wind Energy

Wind is the result of solar radiation penetrating the earth's atmosphere and heating the earth's land and ocean surfaces. Air moves in response to differences in pressure, which are often related to differences in surface temperature. As air masses move, winds are produced. Wind energy is a relatively old technology. It has been used for many centuries in rural areas in Europe and the Middle East. During the 1930s and 1940s, hundreds of thousands of small-capacity wind-electric systems were successfully used on farms and homesteads in the United States, before the implementation of the rural electrification program in the early 1950s. More recently, technology has been developed to utilize wind power to produce heat and electricity.

Wind energy can be harnessed using turbines. The energy produced can then be used to do physical or mechanical work (e.g., pump water and grind grain) or it can be converted into electricity. Of all the alternative fuels currently being developed, wind energy appears to have the most potential for development by the year 2000 (CEC 1980). California currently leads the nation, and the world, in wind energy production. Approximately 95 percent of the world's wind energy production occurs in California (ABAG 1987). Sites with good to excellent wind energy potential are fairly evenly distributed throughout the state. The CEC estimates that if wind energy is developed to its maximum potential, approximately 40,000 MW of electricity could be produced in California. Most wind energy producing facilities are privately owned and sell the energy produced to utility companies such as PG&E and Southern California Edison.

Feasibility for Future Development

No commercial wind generation facilities currently exist or are proposed in Lassen County. The majority of commercial wind turbine developments in California are located primarily in four counties: Alameda, Kern, Riverside, and Solano.

Wind energy has the potential to become a major source of electrical power in California. Preliminary measurements and field surveys indicate that California has the potential to produce several thousand more megawatts than it currently does.

Within Lassen County several sites have been identified as having excellent wind resource potential. These areas include well-exposed topographic features located at high elevations, usually above 6,500 feet. The primary site within the County identified as having excellent potential for wind development is the Diamond Mountains. This area includes portions of the range's 60-mile crestline, and is situated along the entire southern boundary of the County. Several other areas, primarily associated with isolated mountain peaks dispersed throughout the County, also have excellent potential for wind development. These peaks include Observation Peak, Shinn Mountain, Snowstorm Mountain, Hot Springs Peak, Coyote Peak, Fredonyer Peak, Cave Mountain, Antelope Mountain, Blacks Mountain, Bogard Buttes, Crater Mountain, Roundvalley Reservoir, Roop Mountain, and the area just south of Doucasse Reservoir (PG&E 1980).

Technical Considerations. Potential sites for location of large-scale wind turbine developments are often evaluated using two main criteria: average annual wind speeds and average elevation. Wind farms must be located in an area with strong and persistent winds with an average annual wind speed of 10-12 miles per hour. Locations with average wind speeds of 13 - 14 mph have excellent wind generation potential. An average elevation of approximately 6,000 feet is generally considered best for wind farms. Adequate space must also be provided between each turbine to maximize the energy generated.

Within the Diamond Mountain range, approximately 25% of the ridgeline has average wind speeds of 14 - 17 mph. Several other areas, primarily mountain passes at lower elevations that channel the prevailing westerly or southwesterly flow, also have potential for energy production using wind resources. Approximately 0.4 billion kWh of electricity could be generated annually from the Diamond Mountains, and 20 million kWh/year could be generated at each of the mountain peaks in Lassen County (CEC 1980).

However, several factors including elevation, weather patterns, and topography, severely limit the potential for wind development in the Diamond Mountains. Average elevation of the range is less than the 6,000 foot optimal requirement. A few peaks in the range are considerably higher than the average elevation. However, the majority of the ridgeline is not well situated to achieve maximum wind power. Wind speeds in these mountainous areas of the County reach their peak during winter months when weather patterns, including snowstorms and icing could severely damage wind turbines. In addition, because the majority of the ridgeline is uneven and erratic, space requirements for siting turbines in clusters would not be possible in most areas. As previously discussed, several isolated mountain peaks were described as having good to excellent potential for wind generation development. However, very few turbines could be located on these peaks due to the space requirements of each turbine.

Another limiting factor that could hinder development of wind farms in Lassen County is the location of existing transmission lines and the available capacity of these lines. Because potential wind development sites are located in remote, mountainous areas of the County, there may be no existing transmission lines in the area to carry the electricity. In addition, the capacity of the existing system may not be adequate to accommodate additional load produced by new energy facilities.

Economic Considerations. The County's harsh winter weather, combined with the remoteness of potential wind farm development sites in the County would add substantial costs to facility development and operation. A potentially significant problem for energy companies that may construct wind farms in the remote areas of the County is the availability of existing transmission lines and transmission line capacity to transport electricity produced by the turbines to the utility grid. If either of these elements is not available, new lines may have to be constructed to accommodate the additional load. Costs associated with the need to upgrade existing or construct new transmission lines are significant and could make the development of certain wind generation sites infeasible. The CEC implemented several programs and financial incentives to encourage the development of commercial wind energy production. Some incentives include loans and grants, exemptions from portions of property tax, tax credits, sales tax, and income tax. Economic feasibility of constructing wind facilities in Lassen will depend on the price developers will be able to obtain for the power produced and whether they will obtain adequate return on their investment. Feasibility studies would be needed to determine if development of wind farms in the County would be economically feasible.

Environmental Issues

Land uses considered compatible with wind energy development are uses that would not impede wind movement through the project area or be visually sensitive to light industrial uses. Wind is an inexhaustible and environmentally clean resource. However, there are many political, engineering, environmental, and economic issues which must be addressed before the continued growth and development of wind energy facilities is assured.

Degradation of Visual Quality. Potential sites for wind developments in Lassen County are associated with mountain peaks and ranges. These areas are currently pristine, isolated, aesthetically pleasing areas that provide wilderness recreation lands for county and non-local residents. Wind farm developments could compromise the visual quality of the area, introducing man-made elements into the natural landscape.

Intensive Land Use. Wind turbines must be spaced properly, at a relatively low density, to take full advantage of the wind's power. Therefore, development of wind facilities would require large tracts of open land to receive the maximum wind passing through an area.

Potential Loss of Wildlife and/or Wildlife Habitat. Wildlife, primarily bird populations, could be negatively impacted by the development of wind energy facilities. Birds could be killed

from collisions with wind turbines or by electrocution from contact with associated transmission lines.

Soil Erosion. Development of wind turbines would require removal of trees and other plant species that would obstruct the wind and hinder the resource's maximum potential. Areas of exposed soil in these locations could result in localized soil erosion. Removal of native vegetation and perennial grasses on mountain peaks could also contribute to increased soil erosion at the turbine site.

Decrease in Water Quality Due to Soil Erosion. An increase in soil erosion resulting from removal of vegetation at the development site could potentially degrade the water quality. This could lead to siltation of streams in the drainage area, which would directly impact fish and other aquatic life.

Decrease in Air Quality. Wind turbines must be sited in areas of persistent winds. Removal of vegetation and grasses would leave the soil exposed. As a result, a potential degradation of the air quality from dust created by the exposed soil could result.

Cultural Resources. The extensive nature of wind energy developments and the ground disturbance due to foundation and road construction create potential for substantial impacts on cultural resources.

Electromagnetic Interference. Areas where the turbines and associated transmission lines would be sited are located in higher elevation areas of the County. This could potentially result in electromagnetic interference with radio waves, microwaves, and other telecommunication lines in the County.

Public Safety. Operation and maintenance activities, as well as turbine locations in isolated areas of the County, could potentially pose threats to public safety (e.g., wild fires, vandalism, air traffic, and equipment failure).

There are many benefits to producing energy from the wind. Wind is a clean, non-depletable, free resource. Wind energy production is a proven technology and is particularly developable in California. When compared to other alternative energy technologies wind energy production has many advantages including: impacts to air and water quality are minimal; no water is needed for operation of wind turbines; the construction and start-up period required for wind turbine development is relatively short; production of wind energy requires the creation of many jobs for construction, operation, and maintenance. Operation of wind turbines does not produce air pollutants or waste heat, nor are coolant ponds and wastewater discharge areas required.

Several small utility companies (e.g., Lassen Municipal Utility District, Surprise Valley Electrification Corporation, and Plumas-Sierra Rural Electric Cooperative) serve portions of Lassen County. These local companies could benefit from the additional power produced by wind turbines in their service area.

Regulatory Environment

The CEC does not regulate or have permitting authority for facilities that do not use thermal processes to generate electricity. Wind energy is converted directly to electricity without using thermal processes and thus, are not regulated by the CEC. Instead, the CEC acts as an advisory council to County and City Planning Departments and other local agencies, offering advice and suggestions for proposed energy development projects. In addition, the CEC offers a variety of financial incentives and other programs, including loans and grants to encourage development of wind energy facilities. In 1977, a Wind Energy Program was implemented by the CEC. A primary goal of this Program included accelerating development of commercial wind energy technology.

Lassen County retains regulatory and permitting authority through its zoning and use permit requirements for siting and approval of proposed wind energy developments and would function as the lead agency for all proposed wind power projects.

2.3.8 Transmission Lines

Technology Overview

Transmission lines can be classified by voltage capacities, structure types, and right of way requirements. The classification of "transmission lines" varies between utilities. Transmission lines provide bulk transfer of electricity by connecting points of generation (power plants) with substations or by connecting substations with other substations near load centers. Transmission lines in California typically carry between 60 kV and 500 kV of alternating current, although some high voltage lines (up to 1000 kV) carry direct current. Subtransmission lines (60 kV to less than 200 kV area a category of "transmission lines". The 500 kV transmission lines generally comprise the regional or interstate intertie network for bulk power transfers.

The conductors (wires) of a transmission line can be supported by different types of structures depending on the design voltage and cost. Subtransmission lines are typically supported by either double or single wood pole structures. Higher voltage lines, 200 kV and above, are usually supported by steel lattice or steel pole structures.

Transmission lines are often planned for and sited through the use of a study corridor. A corridor is a linear strip of land, generally one to five miles wide, with technological, environmental, and topographical factors, and containing one or more utility, communication or transportation facilities. A study corridor is a land use designation, identified for the purpose of establishing policy direction for the preferred location of compatible linear facilities and compatible and conflicting land uses. It does not imply entitlement of use. Appropriate environmental review and regulatory permitting must precede occupancy on a project-specific and cumulative impact basis.

Existing and Proposed Facilities

At present, there are no 500 kV transmission lines in Lassen County. The highest voltage lines in the County are 69 kV lines. There are several substations and one meter station in the County. A substation is a facility where high voltage electricity is converted to a lower voltage. A meter station is a facility that gauges or measures electricity being transmitted through the system. The location of major transmission lines, substations, and meter stations in Lassen County is indicated in Figure 2-1.

Four utility companies currently provide electric power to Lassen County: Surprise Valley Electrification Corporation (SVEC), Lassen Municipal Utility District (LMUD), Plumas-Sierra Rural Electric Cooperative (PSREC), and Pacific Gas & Electric Company (PG&E). The general location of the 60 and 69 kV transmission lines in the County are as follows:

- SVEC operates three 69 kV lines in northern Lassen County: a line extending along Hwy 395 from a substation near the town of Madeline to a substation near the town of Likely in Modoc County; a line extending along County Road 91 connecting a substation east of the town of Bieber to a substation near the town of Lookout, Modoc County; and a recently constructed three-phase line paralleling State Highway 139 and connecting the Hayden Hill Mining Operation to a substation near the town of Adin, Modoc County.

- LMUD operates several transmission lines in southern Lassen County including: two 60 kV lines extending from Westwood, east to a substation in Susanville; one 60 kV line extending from Susanville, east to a substation in Standish, then continuing southeast at 34.5 kV to the Sierra Army Depot; and a 60 kV line extending south from Highway 395 at Leavitt Lane to Janesville Substation.

- The 69 kV lines operated by the PSREC include a line that crosses an LMUD line east of Susanville and continues south to the county boundary, and then southeast along the county boundary to a substation on the southern shore of Honey Lake; a line that extends from the Herlong Access Road, south to the Portola area in Plumas County; and a line that extends south from Milford, over the Diamond Mountains, to Portola.

- PG&E operates two 60 kV lines in Lassen County: one paralleling State Highway 44 and connecting Westwood to Burney, Shasta County; and one extending from Westwood to Chester, Plumas County.

The Sierra Pacific Power Company has proposed the construction of a 345 kV transmission line extending from southern Oregon to Reno, Nevada. This line would cross northeastern California, including Lassen County. As of spring of 1993, route studies were in progress and project completion was scheduled for the end of 1996. This transmission line is expected to provide reliable backup to Lassen County's energy supplies, as well as create new opportunities for public-owned utilities to acquire Federal energy from the Northwest

region. No specific plans for lines transmitting power from this line to suppliers in Lassen County have been released.

Potential for Future Development

A number of factors will influence the need for development of new transmission lines in Lassen County including an increasing demand for power spurred by continued growth in the County, and a desire to access lower cost electricity from additional suppliers.

Technical Considerations. The planning, design, location, and construction of transmission lines and ancillary facilities involve numerous factors including: determination of existing and future electrical needs; location of facility terminals and substations; need for system reliability; anticipating the need for utility rights of way; numerous environmental and social factors; safety considerations; geotechnical and engineering considerations; area land use plans; both public and private land ownership; local and regional economic factors; and federal, state, and local regulations.

Winter weather conditions in Lassen County are harsh. The region can experience severe snowstorms and long periods of ice, snow, and extremely cold weather. Due to these weather conditions, power lines need to be large enough and strong enough to withstand heavy snow storms and subsequent stress on the lines from the additional weight of the snow.

Economic Considerations. Costs associated with construction, operation, and maintenance of transmission lines are significant. If new lines need to be constructed as a result of new power plants in remote areas, the economic feasibility of the plant should be thoroughly analyzed including the cost of transmission line construction, operation, and maintenance.

Environmental Issues

There are several beneficial aspects to the development of transmission lines including energy self-sufficiency for an area, provision of a recreational corridor in the right of way, fiscal benefits to the Lassen County residents from increased revenue, and the fact that the transmission rights of way act as fire breaks due to the break in fuel (vegetation).

There are several stages in the construction, operation, and maintenance of a transmission line. Some tasks include: clearing vegetation from the route; construction of access roads and transmission line towers; stringing the conductors (lines); post construction clean-up activities; and long-term facility maintenance.

Transmission lines affect land uses adjacent to the corridor. Impacts from construction, operation, and maintenance activities associated with transmission lines are both short-term and long-term.

Construction-Related Impacts. The effects of transmission line and access road construction can vary greatly according to the physical and biological characteristics of the environment and the existing land uses of adjacent properties. The extent of such activities as removal of natural vegetation, grading, and the physical displacement of other land uses should be taken into consideration when determining facility siting. Although construction is temporary, the effects of building new access roads and stringing the towers could include: soil erosion, noise, and disturbance of vegetation and wildlife habitat. The access to undeveloped areas, often provided by the construction of new roads, has the potential to impact wildlife resources. Additional hunting activities and increased development that may result from increased access may cause disturbance to wildlife during critical periods (e.g., antelope kidding, deer fawning, raptor nesting, use of sage grouse leks). Also, due to ground-disturbing activities such as vegetation removal and access road construction, there is the potential for significant impacts to cultural resources.

Operational- and Maintenance-Related Impacts. Several impacts could potentially result from the permanent placement of poles, towers, and transmission lines. In rural areas, placement of structures can conflict with land uses such as logging, agriculture, and recreation. Depending upon the terrain and proximity to travel route and scenic areas, transmission lines may result in impacts to visual resources. Transmission lines could potentially pose fire hazards if lightening strikes a wire causing it to fall and to come in contact with vegetation.

Electromagnetic Effects. There also exists today concern regarding the issue of electromagnetic fields (EMF) from high voltage transmission lines and associated risks to public health. Increasingly, scientists, regulators, and the public are asking whether human exposure to these fields involves risks to health or environment. Although scientific studies have generated a considerable volume of literature about biological effects produced by electric power systems, no scientific consensus has been reached on whether EMFs are hazardous to human health. In some cases, the biological effects of fields are complicated and still not fully understood by the scientific community. There is evidence that these fields can produce biological effects. It is not yet clear, however, if these effects could result in any risk to public health, and it is not clear what aspect of 60 Hz fields of EMF (if any) poses a risk.

The amount of exposure to these fields diminishes with the distance between the source of the fields and the objects exposed to them. In addition to distance, trees and most large structures provide shielding from electric fields. Houses, for example, can reduce electric fields from power lines by about 90 percent. There is evidence that suggests that across the range of field strengths commonly encountered by people, stronger fields may not pose greater risks than weaker ones. This means that the usual assumption that "more is worse" may not be correct for the case of 60 Hz fields. With the scientific evidence that is now available, it is not possible to establish safe field standards. There is a great deal of research currently being conducted by the CPUC jointly with the California Department of Health Services (DHS) to study the risks associated with exposure to EMF. Three specific research projects are underway and will not be completed until sometime in 1992. The

CPUC currently indicates that it is premature to regulate fields around electric power facilities. The CEC has reached the same conclusion, but requires that electric field levels not exceed existing magnitudes. No regulations will be adopted until the scientific community confirms that health hazards can result from exposure to EMFs.

Potential Hazard to Bird Species. Several bird species, including birds of prey and raptors (i.e., bald eagles and falcons) perch on the highest structure in an area. In many cases, transmission line towers appear an ideal roosting spot for these birds. There is a potential for electrocution from distribution and subtransmission lines if the bird perches on the wires or transformers. Special bird guards and line configuration can assist in significantly reducing the electrocution hazard. Because power lines provide perching sites for raptors, when they are constructed near sage grouse leks they may result in increased predation by raptors on sage grouse population. Transmission poles, towers, and lines also present a hazard of collision to birds flying through the area. Studies indicated increased bird mortality due to collision with electric line structures, particularly in areas where birds have to cross the line in their daily migration between sleep and food areas. In areas of great bird population and activity (e.g., near wetlands), aerial markers can be installed on the lines to increase visibility and reduce collision mortality.

Visual Intrusion. Transmission lines also have the potential to conflict with valuable visual resources in Lassen County. Transmission lines and their associated access roads often disrupt the scenic quality and visual continuity of the natural landscape. These areas are an integral part of the visual resources of Lassen County. However, the transmission line itself usually has the greater aesthetic consequences due to its visibility on the landscape.

Regulatory Environment

The authority to regulate siting of transmission line projects is defined by a variety of local, State and Federal laws. Federal laws include special energy statutes and going through the National Environmental Policy Act (NEPA) process. State laws in California include the Public Utilities Code, the Warren-Alquist Act, the California Environmental Quality Act, and legislation giving special utility districts authority to provide electric power. Several factors determine which agency has permitting authority over a given project. These factors include project ownership and, if the transmission line is associated with a power plant, the type of energy producing facility.

Federally-sponsored projects are subject to review and approval procedures established by various federal agencies. In addition, federal review and procedural requirements take precedence over state regulations. Due to the complexity of issues involved in transmission line siting, frequently both Federal and State agencies share permitting authority.

State agencies having permitting authority over the siting and construction of electrical transmission lines include the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC). The extent of CPUC or CEC involvement and permitting authority is dependent upon the agency proposing development of the

transmission line, whether it is a public utility (e.g., PG&E); rural electric cooperatives (e.g., PSREC and SVEC); or a municipal utility district (e.g., LMUD).

The CPUC regulates any electrical power line project proposed by public utilities. In this context investor-owned utilities, such as Pacific Gas and Electric, are considered public utilities. For transmission lines with voltage greater than 200 kV, the CPUC General Order 131-C requires the project developer to obtain a Certificate of Public Convenience and Necessity (CPCN) permit after an environmental review is conducted under the California Environmental Quality Act (CEQA). This is typically a 12-month process. Local County General Plan polices and Zoning Ordinance provisions must be considered by the CPUC when considering each individual transmission line application of transmission lines in excess of 200 kV. Under General Order 131-C, transmission line projects below 200 kV can be constructed without obtaining a CPCN and are not necessarily subject to CEQA review. The CPUC is amending its regulations to include review procedures for transmission lines between 50 and 200 kV. The proposed General Order 131-D, currently under consideration, would require that an Authority to Construct permit be obtained for these lines (Meyer, pers. comm.)

The California Energy Commission has transmission line siting authority for lines associated with thermal power plants with 50 MW or more of capacity. The CEC's siting authority extends from the power plant to the point where the new transmission line connects with an existing transmission substation or line. The CEC review, however, also covers changes and impacts beyond the connection. The CEC maintains permitting authority for transmission lines associated with nuclear, geothermal, and alternative energy producing thermal sources. The CEC has adopted transmission line siting regulations and approval procedures. During project review, the CEC must review county ordinances and determine whether or not the project complies with the ordinances. The CEC review process involves two phases including a 12 to 18 month "Notice of Intent" period. The second phase, leading to the agency's final decision, is the "Application for Certification" (AFC) process. The CEC permit covers all state, regional, and local agency permits, except when a project greater than 200 kV is proposed by an investor-owned utility, in which case a CPUC approval would also be required.

Certain local agencies, such as municipal utility districts (i.e., LMUD), may act as the lead agency for electrical transmission lines proposed by themselves. They must still adhere to the California Government Code and CEQA regarding public hearings and environmental review and may also be subject to the CEC's authority. In addition, under the Public Utilities Code (Section 12808.5) municipal utility districts proposing new transmission lines of 100 kV or greater must obtain project approval from the local legislative body (i.e., City Council or County Board of Supervisors).

New electrical transmission lines proposed by independent, third-party proponents (e.g., rural electrical cooperatives) are regulated by the local government, and must also obtain project approval from the local legislative body. During the approval process, the County would require facility compliance with applicable General Plan policies and County Zoning Ordinance regulations.

2.3.9 *Natural Gas*

Technology Overview

Natural gas has met approximately 30 percent of California's total energy requirements for over a decade. According to the California Energy Commission's 1992-1993 California Energy Plan, natural gas is becoming the "fuel of choice" because of its low price and clean-burning characteristics.

Only 16 percent of the natural gas supplies used in California is produced within the state. The majority of California's natural gas supplies is obtained from sources outside the state, including approximately 61 percent from the southwestern states, 1 percent from the Rocky Mountain area, and 22 percent from Canada.

Natural gas can provide considerable energy savings to residential users. Compared to propane at $1.15 per gallon, natural gas at $0.70 per therm would provide a 44 percent savings for comparable residential energy use. This is assuming a BTU heat content of 100,000 BTU per therm of natural gas and 91,500 BTU per gallon of propane. Residential water heating can cost three times less if natural gas is used instead of electricity (Tuscarora Gas Transmission Company 1992).

Along with residential use, natural gas can serve an additional energy function by generating electricity. Over one-third of California's electrical supplies is gas-generated. Increases in natural gas use are expected as a result of new regulations being imposed by local air quality management districts. Electricity can be generated by using new gas turbines, or by modifying biomass and cogeneration power plants to allow for gas to be used as a fuel supplement.

History of Natural Gas Uses in Lassen County

Lassen County has no known natural gas resources with the potential to serve the public. The County is not currently served by pipelines transporting gas produced outside its territory, and therefore Lassen County residents do not have access to natural gas services.

Feasibility of Future Development

In March of 1993, Tuscarora Gas Transmission Company (a subsidiary of Sierra Pacific Resources of Reno) and TransCanada Pipelines announced their intent to construct a new natural gas pipeline to serve northern Nevada and northeastern California. The proposed 200-mile pipeline would extend southeast from Melin, Oregon through northeastern California, to a location near Reno, Nevada. The initial capacity of the pipeline was projected to be 120 million cubic feet per day. The primary source of natural gas transported by the pipeline would be the Western Canadian Sedimentary Basin reserves.

In March of 1993, the Tuscarora Gas Transmission Company accepted requests for natural gas transportation services from interested companies. These requests would be used to reserve capacity on the pipeline and facilitate the planning and sizing of the facility. An

agreement would entail the signing of a binding transportation service contract for a 15-year or greater period.

Both the City of Susanville and the Lassen Municipal Utility District (LMUD) submitted competing bids for capacity in the pipeline. The City's bid was for 2,500 decatherms per day for 30 years. LMUD's bid was for 3,000 decatherms per day during the winter and 1,000 decatherms per day during the summer. The bids were only for capacity on the pipeline and did not include purchase of gas from Canada. At the time this Energy Element was printed, the issue of which agency will be awarded a contract and become the provider of natural gas services in the Susanville area remained unresolved.

Environmental Issues

As with electrical transmission lines, the impacts of pipeline construction can vary greatly according to the physical and biological characteristics of the environment. Although construction is temporary, impacts due to construction of pipeline facilities and access roads could include: soil erosion, noise, and disturbance of vegetation, including threatened and endangered plants, and wildlife habitat. Wildlife may be disturbed during critical periods of their life cycles (e.g., antelope kidding, deer fawning, raptor nesting, use of leks by sage grouse).

The laying of pipelines across open space and agricultural areas will disturb vegetation and may cause a noticeable scar or path of weeds if not properly revegetated. This issue is especially significant in scenic areas. The laying of pipelines across public roadways requires trenching and patching of road surfaces and presents a temporary disruption of transportation.

Due to the extent of ground disturbance involved in laying pipelines, there is also potential for impacts to cultural resources.

It should also be noted that, if the routing of a pipeline is intended to or may establish a utility corridor which might later be used for electrical transmission lines, the environmental review of the route must take into account the subsequent and full development of the corridor (i.e., including the transmission lines).

Safety concerning potential ruptures of pipelines and adverse effects of escaping gas is an issue. The hazards posed by leaking gas are primarily fire and explosion and, when the gas contains hydrogen sulphide, toxicity. Considering the magnitude and volume of natural gas operations, the safety record of the pipeline industry is very good. The extent of safety provisions should be relative to a risk analysis of the project and the characteristics of its route, including population density.

Measures to enhance pipeline safety should be designed to reduce both the causes and consequences of pipeline rupture. These measures can be "strategic"; that is, designed to prevent the accidental rupture in the first place, such as restricting access to pipeline rights of way. Or they can be "tactical", coming into play when a rupture does happen to decrease its effects, such as an emergency response plan.

Environmental concerns related to gas-fired electrical generation include noise and air quality. Gas is generally considered to be an attractive energy source for power generation because it burns relatively clean with low emissions of particulate and sulfur dioxide air pollutants. However, emissions of nitrogen oxide, another air pollutant, can be relatively high. The major land-use consideration when siting a gas power plant is the proximity to residential and recreational areas. Due to the high noise levels commonly associated with power plants, they would be inconsistent with residential and recreational uses.

Regulatory Environment

Pipeline companies must apply to the Federal Energy Regulatory Commission (FERC) under Section 7(c) of the Natural Gas Act for a Certificate of Public Convenience and Necessity. This permit is required to construct and operate facilities transporting gas interstate, as well as for interstate sales of gas for resale. In most cases, FERC would be the lead Federal agency for environmental review of a pipeline project.

New distribution systems that are contained within California are subject to regulation by the California Public Utilities Commission (CPUC). In such cases, the developer must obtain a Certificate of Public Convenience and Necessity from the CPUC. The California Energy Commission established a state energy policy in 1986 to promote the expansion of California's interstate natural gas pipeline system. In response to this policy, the Public Utilities Commission recently issued a decision outlining conditions for supporting the construction of new interstate pipelines.

Although no conditional use permits are required at this time for public utility pipeline projects, Lassen County requires that project proponents submit maps showing proposed routes of transmission lines with design specifications to the County Planning Commission. Routes mutually acceptable to the Planning Commission and the project proponents are to be determined in writing. The Planning Commission must make findings concerning the consistency of the routes with the General Plan.

3. Energy Conservation

CHAPTER 3

Energy Conservation

3.1 INTRODUCTION

In the 1970s, concerns over the limitation of conventional energy resources and fear of energy shortages, were evoked by the energy crises caused by the Organization of Petroleum Export Countries (OPEC) oil embargo. Even though the vulnerability apparent at that time is still present, the renewed interest in energy issues manifested since the end of the 1980s is dominated primarily by an environmental protection agenda. Environmental concerns include: the effects of fossil fuel combustion such as air pollution, global temperature warming, and acid rain; impacts resulting from construction of hydroelectric plants; the hazards associated with nuclear power such as disposal of nuclear waste; and the potential for major oil spills related to coastal oil exploration, pumping, and treatment.

In the context of both the 1970 energy crises and current environmental considerations, energy conservation and efficiency programs have become important components of energy planning. A successful program to reduce consumption of conventional energy resources and increase the use of renewable resources will not only reduce the disruptions to community life resulting from energy shortages, but also reduce environmental impacts related to energy production and consumption. In addition, a successful program to reduce use of conventional energy resources can contribute to state and federal efforts to promote energy conservation.

For the purpose of meeting the energy demand of a local population and economy, a kilowatt-hour preserved from waste by an energy conservation or efficiency measure is generally equivalent to a kilowatt-hour delivered to customers by a new power plant. Energy savings created in large quantity on a predictable schedule are energy resources. It is important to realize that conserving energy is a way of producing energy, and that energy production in Lassen County will be maximized by a reduction in consumption due to energy conservation and the use of renewable resource technologies. It must be said that often a saved kilowatt-hour, therm, or barrel of oil is much cheaper than an additional unit of energy production (Cavanaugh 1989).

Opportunities abound for getting more service out of less energy. The last decade has seen extraordinary progress in the state of the art for energy efficiency in buildings, appliances, lights, and industrial processes. In the home, invigorating showers can be delivered by the best inexpensive low-flow shower heads with less than half the water and water-heating energy than the average model needs. At the office, improved designs and technologies in lighting allow savings of 75 percent or more. The opportunities for saving energy are even more significant in cold climate regions, such as Lassen County, where appropriate siting and weatherization of buildings can reduce space heating needs and provide direct energy- and cost-savings results.

A discussion of the type of energy provided to county residents and the options (opportunities) to reduce local energy consumption by users are presented in the following pages. Energy required for space and water heating, lighting, industrial processes, and transportation can be greatly diminished by reducing wasteful energy consumption practices and habits. The policies suggested at the end of this section envision an energy conservation program through the reduction of energy waste. The opportunity to enforce these policies should be determined by the County in the preparation of an Energy Conservation Ordinance.

Another common approach to energy use and resource conservation is the recycling of materials. The opportunities and constraints of recycling in Lassen County should be the subject of a future study. Energy generation from agriculture and timber wastes as well as cogeneration from waste heat in industrial facilities are discussed in Chapter 2.

3.2 ENERGY SOURCES

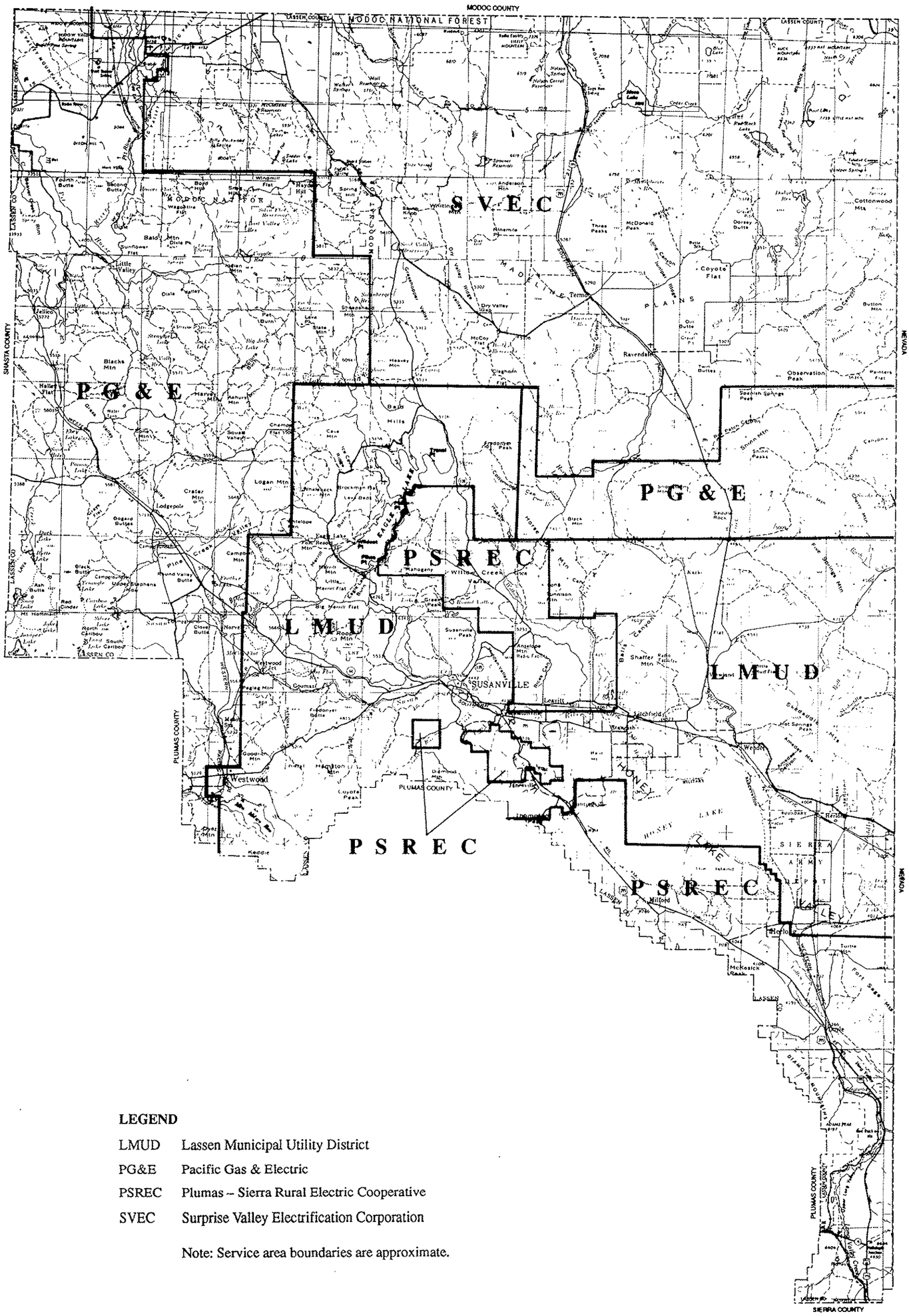
Energy needs in Lassen County are met by a diverse energy system. Electricity, gas, and wood are the primary energy sources used to meet local energy needs. Heating oil is used as an alternative fuel to spaceheat some households in the County. The primary energy source used for transportation purposes is fossil fuel.

3.2.1 Electricity

Electrical Utility Companies

Currently, four utility companies provide electricity to Lassen County residents including Lassen Municipal Utility District, Plumas-Sierra Rural Electric Cooperative, Surprise Valley Electrification Corporation, and Pacific Gas & Electric Company. Service areas of these companies are depicted in Figure 3-1 and the number of customers served is shown in Table 3-1. Three service providers in the County (Lassen Municipal Utility District, Plumas-Sierra Rural Electric Cooperative, and Surprise Valley Electrification Corporation) are not regulated by the California Public Utilities Commission. Each of the four utility companies providing electricity to Lassen County is briefly described in the following paragraphs.

Lassen Municipal Utility District (LMUD). LMUD began operating in 1988, when the District took over the electric franchise previously owned by C.P. National. LMUD is a public agency with a Board of Directors elected by the registered voters in the District. LMUD is the major utility company operating in Lassen County. Its service area encompasses nearly 50 percent of the county population and includes the population centers of Susanville, Johnstonville, Westwood, Litchfield, and Standish. As shown in Table 3-1, in the summer of 1990 Lassen Municipal Utility District served a total of 9,236 customers: 8,024 residential, 1,102 commercial, 108 agricultural, and two industrial customers (Herlong Sierra Army Depot and Lassen Junior College).



LEGEND

LMUD	Lassen Municipal Utility District
PG&E	Pacific Gas & Electric
PSREC	Plumas – Sierra Rural Electric Cooperative
SVEC	Surprise Valley Electrification Corporation

Note: Service area boundaries are approximate.

0 5 10 Miles

Lassen Energy Element
Energy Conservation

Figure 3 – 1
ELECTRIC UTILITY SERVICE AREAS

Michael Clayton & Associates

Table 3-1
Customer Inventory by Utility Provider

Lassen Municipal Utility District (Summer 1990 - July, August, September Average)

Residential Customers	8,024
Commercial Customers	1,102
Agricultural Customers	108
Industrial Customers (Herlong Sierra Army Depot and Lassen Junior College)	2
Total Customers	9,236

Plumas Sierra Rural Electric Cooperative (in Lassen County)

Residential Customers	1,500
Commercial Customers	150
Agricultural Customers	70
Industrial Customers (Litchfield Developers and California Correctional Center)	2
Total Customers	1,722

Surprise Valley Electrification Corporation (in Lassen County)

Total Customers	256

Pacific Gas & Electric Company (in Lassen County)

Total Customers	959

Source: Michael Clayton & Associates 1991

LMUD's peak demand is approximately 30 MW (Don Battles, pers. comm.). LMUD provides electricity to their customers with power purchased from Pacific Gas & Electric Company (PG&E). This power is generated and transmitted to the County by a large network of power plants and transmission lines located throughout California. Power generation facilities contributing to the PG&E network include the nearby Caribou Power House located on the Feather River.

Plumas-Sierra Rural Electric Cooperative (PSREC). PSREC was formed in 1938 as a result of the implementation of the federal Rural Electrification Act. PSREC is a customer-owned utility. In order for an individual to purchase electricity, they must join the cooperative and pay a membership fee (Bob Marshall, pers. comm.). Its service area encompasses rural areas of several counties including Plumas, Lassen, and Sierra Counties. Within Lassen County, their service area encompasses the southeastern portion of the County. PSREC power is purchased mainly from the Western Area Power Administration in Sacramento. The power is then physically supplied via PG&E transmission lines to Quincy, where it is transmitted to PSREC customers.

Peak demand of Plumas-Sierra REC is approximately 25 MW of electricity. Within Lassen County, PSREC's demand is approximately 11 MW of electricity, and is used to serve 1,500 residential customers, 150 small commercial customers, 70 Agricultural, and 2 industrial customers (Litchfield Developers and the California Correctional Center) (Bob Marshall, pers. comm.). The Correctional Center, with its electricity use ranging between 1 - 2 MW, is Plumas-Sierra's largest customer.

Surprise Valley Electrification Corporation (SVEC). SVEC was formed in 1938 and, like PSREC, is a member-owned utility. In order to purchase electricity, an individual must join SVEC and pay a membership fee. SVEC's service area encompasses portions of Oregon, Nevada, and portions of Lassen and Modoc Counties in California. Within Lassen County, SVEC serves approximately the northern one-third of the County with power purchased solely from Bonneville Power Administration (Jim Hayes, pers. comm.). SVEC provides electricity to approximately 3,501 metered customers in Modoc and Lassen Counties. This figure includes residential, commercial, industrial, and agricultural customers. SVEC's total current capacity in Lassen County is approximately 3 MW of electricity. In addition, the new Hayden Hill Mining Operation, scheduled to start operating in the summer 1992, is within SVEC's service area. This mining operation will be located south of the town of Adin, in northern Lassen County, and will use approximately 10 MW of electricity (Jim Hayes, pers. comm.).

Pacific Gas & Electric Company (PG&E). PG&E has been in operation since 1852. PG&E is an investor-owned utility serving customers in Northern and Central California. Within Lassen County, PG&E's service area is limited to the western portion of the County and serves electricity to approximately 959 customers. Electricity purchased from PG&E by local customers is generated and transmitted to the County by a large network of power plants and transmission lines located throughout California. PG&E power comes from a diverse mixture of energy resources including fossil fuels (28% - mostly natural gas), nuclear (19%), hydropower (9%), and geothermal (9%). A portion of the power supplied by PG&E (35%) is power which the company has purchased from other utilities and from independent power producers. This purchased power is generated by a variety of sources such as wind, geothermal, biomass, solar, and hydropower.

Lassen County electrical power generation facilities that sell power to PG&E consist primarily of biomass, geothermal, and small cogeneration facilities. Local power production accounts for approximately 90 MW of electricity. A complete listing of local energy production facilities and MW of electricity generated is found in Table 3-2.

Table 3-2
Local Energy Production Facilities
and Amount of Energy Sold (in Megawatts)

Energy Production Facility (Location)	Total Energy Produced (MW)	Amount Sold to PG&E
Mount Lassen Power Plant (Westwood)	11.5 MW *	10.0 MW
Honey Lake Power Plant (Wendel)	35.5 MW *	30.5 MW
Big Valley Lumber Cogeneration Facility (Bieber)	7.5 MW	7.5 MW
Jeld-Wen, Inc. (Susanville)	2.5 MW *	1.0 MW
Sierra-Pacific Industries (Susanville)	12.5 MW *	9.0 MW
Amedee Geothermal Power Plant	1.5 MW	1.5 MW
Wineagle Geothermal Power Plant	0.69 MW	0.69 MW
Muck Valley Hydroelectric Project (Pit River)	30.0 MW	30.0 MW

* The difference between energy produced and amount sold is the amount of energy used to run equipment.

Source: Michael Clayton & Associates 1991

Electrical Power Rates in Lassen County

The price of electricity paid by County residents varies depending upon the utility company serving the area and time of use. The price of electricity per kilowatt-hour (kwh) ranges from 3.9 cents/kwh to 10 cents/kwh. Some companies have a tiered price structure (e.g., PG&E) and charge higher prices if the daily consumption exceeds a certain energy usage (See Table 3-3 for electric rates charged by each utility company).

Table 3-3
Electric Costs by Utility Company for Residential Users
(in dollars)

Lassen Municipal Utility District	0.09 per kwh
Pacific Gas & Electric Company*	
Quincy/Zone Z1	0.109 per kwh 0 - 33.9 kwh/day
	0.136 per kwh over 33.9 kwh/day
Burney/Zone Y1	0.109 per kwh 0 - 34.9 kwh/day
	0.136 per kwh over 34.9 kwh/day
Plumas-Sierra Rural Electric Cooperative	0.066 per kwh 0 - 1,500 kwh/month
	0.043 per kwh over 1,500 kwh/month
Surprise Valley Electrification Corporation	0.039 per kwh

* PG&E customers have the choice to be metered on a "time-of-use" meter or the "basic rate" meter. Customers charged on the time-of-use system are discouraged from using electricity between the hours of 12:00 p.m. and 6:00 p.m., Monday through Friday (Margaret Siegenthaler, pers. comm.).

Source: Lassen Economic Development Corporation 1991

As shown in Table 3-3, there is a significant variation in the rates customers pay for electrical power in Lassen County. A primary factor in this variation is the price of wholesale power purchased by utility companies. Three electricity providers in the County (LMUD, PSREC, SVEC) depend on wholesale power purchase to serve their customers. Generally, the cost of wholesale power purchased from federal agencies is significantly lower than wholesale power purchased from another utility company. Lassen Municipal Utility District, for example, buys its power from PG&E at 7 cents per kilowatt hour, while PSREC buys federal power from the Western Area Power Administration at 3.5 cents per kwh and SVEC buys federal power from the Bonneville Power Administration at 2 cents per kwh. Because PSREC and SVEC are able to purchase power from federal agencies, their electrical rates are lower than LMUD's. Because of this difference in electrical rates, the electricity costs for a county consumer vary substantially depending on where the consumer is located. Table 3-4 shows how the electrical costs of a household and a commercial facility in the County vary depending on the utility company serving them.

As a municipal utility district, LMUD is qualified to obtain federal electricity, however, no federal power allocation has been granted to the District. One of LMUD's major priorities has been to obtain lower cost sources of power. Efforts undertaken by the LMUD Board of Directors include negotiations with the Trinity County Public Utility District to purchase future capacity on the California-Oregon Transmission Project, and negotiations with the Western Area Power Administration (WAPA) to secure a power allocation. WAPA is the primary supplier of federal power to publicly-owned utilities in California, and currently does not have additional capacity allocations to grant to LMUD. However, some districts served by WAPA have greater allocations than they currently utilize. LMUD has applied to be included as a member, and to be granted an allocation of federal energy when WAPA revises its Power Marketing Plan in 1994. In addition, it may also be possible, with an amendment of the Northwest Public Power Act, for LMUD to obtain federal power from the Bonneville Power Administration.

A peculiar variation in the rates customers pay for electrical power occurs in the community of Bieber, north Lassen County. The community is divided between two utility companies. PG&E serves the town center and SVEC serves the "new" part of town along Highway 299 to the northeast. The cost of electrical power is having an impact on the emerging land use pattern as prospective commercial developers, attracted to the lower energy costs of the SVEC service area, choose to develop in the new part of town.

The cost of power is a determining factor in Lassen County's economic development, as recognized in the March 1990 Lassen County Economic Development Plan. Relevant goals and policies in the plan include: *"To improve utility service within the county"* (Goal 7); and "Enhance the competitiveness of utility rates" (Policy 7A).

Table 3-4
*Estimated Monthly Electricity Costs**
(in dollars)

Utility	Household (@ 600 kwh/month)		Commercial (@ 3000 kwh/month)	
	Rate	Cost	Rate	Cost
LMUD	$0.09/kwh	$54	$0.11/kwh	$330
PG&E	$0.109/kwh	$65	$0.136/kwh	$408
PSREC	$0.066/kwh	$40	$0.043/kwh	$129
SVREC	$0.039/kwh	$23	$0.039/kwh	$117

* Rates used are "typical" and may vary, especially in the case of PG&E, which has a variety of rate schedules. Also, costs do not include monthly service charges.

Source: Lassen County Planning Department 1992

3.2.2 Gas

PG&E provides electricity and natural gas to most customers located within their service area. However, due to the lack of natural gas resources and infrastructure, PG&E does not provide natural gas to customers in Lassen County. Since natural gas is not available, propane is the gas used to meet energy needs in Lassen County. Propane is a byproduct of the petroleum refining process, which is in liquid form when under pressure and in gas form when at atmospheric pressure levels. Similar to natural gas, propane can be used as a fuel for a variety of purposes, including space heating and running appliances. Propane is available and widely used in Lassen County. Unlike natural gas which can be distributed by pipeline over several miles, propane can only be distributed by pipeline over a short distance and requires storage tanks near the location of use (Rachel Coscarelli, pers. comm.).

Propane is distributed via trucks to customers throughout the County. Individual storage tanks are typically located on cement pads outside each home. Tanks for individual residences usually range between 50 - 500 gallons in capacity. Propane tanks for commercial use range in capacity between 500 to several thousand gallons. A new trend, particularly in the newer residential subdivisions throughout the County, is to have stationary tanks ranging in size from 500 - 1,000 gallons located throughout the subdivision. Underground gas lines distribute the propane to individual residences. These units are on a metered system and are only charged for the amount of propane used each month. Customers on

the metered system can obtain propane at a lower cost because no tank rental fees or sales taxes are incurred (Rachel Coscarelli, pers. comm.).

Several companies, both local and in neighboring counties, provide propane to area residents. These companies include Amerigas Chester, Amerigas Susanville, Petrolane Susanville, Petrolane Alturas, Lassen Plumas Gas, and Bethels Propane in Alturas. Propane prices range from $1.22/gallon to $1.52/gallon, and vary depending on the time of year, the amount of gas purchased, and current petroleum prices.

As with electricity, furnaces are by far the biggest users of propane fuel. Depending upon the size of the furnace and the efficiency of the heating system, space heating can utilize 100 gallons of propane every 2 - 3 weeks during periods of maximum use (cold weather). Many residences have relatively old and inefficient furnaces and therefore, require more propane than newer, more efficient models (Rachel Coscarelli, pers. comm.). If propane is used only to run a stove and range, a 50-gallon residential tank can last between 7 - 12 months. Typically, a water heater uses a minimum of one gallon of propane per day and may use more, depending on the number of showers, dishwasher usage, and wash loads.

3.2.3 Wood

In 1980, most homes in Lassen County were heated using wood (See Table 3-5). Today, area residents continue to rely on wood fuel as an important source for domestic space heating. A wood-gathering permit can be obtained from the U.S. Forest Service for a set-fee of $5.00 per cord. A minimum of two cords and a maximum of 10 cords per household can then be gathered. A household in Lassen County uses an average of five cords a year for space heating. A free use permit is also available for collection of wood material already on the forest floor, and wood residue left from logging activities on U.S. Forest Service lands.

The Bureau of Land Management also issues wood-cutting permits at $5.00 per cord. In Lassen County, juniper is a common species harvested for home heating purposes on BLM lands.

Portions of three National Forests are situated within Lassen County: Lassen National Forest; Plumas National Forest; and Modoc National Forest. Residues from commercial logging operations in the forests have the potential to provide a steady supply of wood fuel for domestic heating purposes (See Biomass, Chapter 2). Wood can be precut and delivered to all areas in the County for approximately 80 - 105 dollars per cord, depending on the time of the year and the type of wood purchased. Hardwoods (e.g., oak) are more dense than softwoods (e.g., pine, fir, and cedar); therefore, they contain more British Thermal Units (BTU's) of heat per equal volume of wood. Because wood is sold by volume (in units of cords) and not by weight, this is an important factor when selecting wood for spaceheating purposes. A cord of softwood can last about one month during the coldest months, depending on the size and insulation of the home, and the efficiency of the wood stove.

Table 3-5
Lassen County (1980)
Number of Housing Units and Type of Energy Consumed by Energy Need

Fuel	*Space Heating*	*Water Heating*	*Cooking*
Electricity	1,147	4,990	4,893
Bottled, tank, or LP gas	1,497	2,112	2,305
Fuel oil, kerosene, etc.	953	114	-
Wood	3,622	-	-
Coal or coke	15	-	-
Utility Gas	91	72	72
Other fuel	75	58	106
No fuel used	-	54	22
	7,400	7,400	7,400

Source: 1980 Census of Housing, Detailed Housing Characteristics, California. U.S. Department of Commerce. Bureau of Census.

3.2.4 Heating Oil

Two heating oils are available as alternative fuels for space heating. One is diesel fuel. The other is a higher quality oil which burns cleaner (with less emissions) and is more efficient (generates more heat/BTU per gallon burned) than diesel fuel. Prices for the higher quality heating oil range from $1.04/gallon to $1.55/gallon. Prices for diesel fuel range from $0.92/gallon to $1.00/gallon. Local distributors such as Good's Petroleum, Leo S. Jones, Allied Petroleum, and Westwood Fuels provide heating oil to Lassen residents.

3.3 *ENERGY CONSUMPTION PATTERNS*

To facilitate the assessment of local energy consumption patterns, it is useful to determine the types of energy consumed in Lassen County and the purposes of this consumption. Table 3-6 shows the total annual sale of electricity in the County, broken down by economic sector. As shown in this table, residential uses are the major consumers of electrical power, followed by commercial uses. While electricity is definitely an important energy type in Lassen County, other types of energy are also used, and the relative importance of each of them is indicated by the general trend of energy uses identified in the residential, commercial, industrial, and agricultural sectors.

Table 3-6
Lassen County Electricity Sales
(in kwh)

Sector	*Year 1990*	*Year 1991*
Residential	87,300,980	93,796,876
Commercial	53,690,658	56,641,475
Transportation, Communications, Utilities	13,104,161	14,268,540
Assembly Operations	63,075	130,998
Process Operations	963,565	178,764
Mining/Construction	510,349	326,317
Agriculture	24,660,386	24,825,924
Others	470,891	609,234
TOTAL	180,764,065	190,778,128

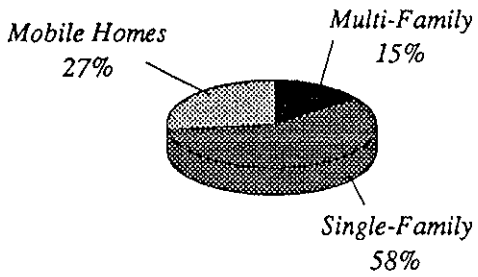
Source: California Energy Commission

3.3.1 *Residential*

Various factors influence the type and amount of energy consumed in a residential structure including: 1) the type of dwelling unit; 2) the size and orientation of the structure; 3) the number of occupants and their habits; 4) the weather conditions and the time of year; 5) the thermal integrity of the building (level of insulation and number and location of windows); 6) the number of appliances (e.g., washing machine or clothes dryer); and 7) the type of appliances (e.g., gas versus electric heaters and ranges).

In general, the most important factors influencing residential energy consumption are the type of house (mobile homes, detached single-family or multi-family structure), and the number of major appliances. Mobile homes and single-family homes require more energy for space heating than a multi-family unit, due primarily to the amount of heat loss through external walls. In addition, a single-family residence usually houses more occupants, and therefore requires more energy for operation of major appliances than a multi-family unit. As shown in Figure 3-2, 58% of the housing supply in Lassen County consists of single-family dwellings, and 27% of mobile homes. Typically, mobile homes are less energy efficient than conventional homes. Older mobile homes, in particular, have a tendency to be even less energy efficient because: 1) lower insulation standards were in effect at the time they were manufactured; and 2) old mobile homes are more likely to have been moved several times and may, as a result have reduced structural integrity, and increased air infiltration.

Figure 3-2
Types of Dwelling Units in Lassen County



Source: Lassen County Housing Estimates, DOF, Report E-5 (January 1990)

Source: Lassen County Housing Estimates, DOF, Report E-5 (January 1990)

Some residential energy needs can be fulfilled by either gas or electricity (e.g., space and hot water heating, cooking, clothes drying). Others are dependent solely on electricity for their operation (lighting, radio, television). In Lassen County, space heating is the most energy consuming activity in residential structures. Hot water heating is the second most energy consuming activity in a residence; cooking is third. In moderate climates, space heating can account for approximately one-third of residential energy consumption. In colder climates, such as in Lassen County, space heating may account for an even higher percentage of the residential energy consumption (as much as one-half). C.P. National, a utility company purchased by Lassen Municipal Utility District in 1988, compiled data on the average residential energy use in the Susanville area. The results of the study indicated that for houses with electric space heating, the total kilowatt-hours used during winter months were twice as high as electric loads during the summer months (See Table 3-7).

Table 3-7
Average Use of Electricity in the Susanville Area

Type of Use		*kwh/month*
Basic (lights and kitchen appliances)		500 - 600
Basic plus electric hot water heater		800 - 1400
Basic, hot water plus electric space heating	Summer	800 - 1400
	Winter	2000 - 4000

Source: Susanville Vicinity Planning Area Master Environmental Assessment, October 1982

As indicated in the 1980 Census of Housing (Table 3-5), wood was the dominant fuel type for space heating in Lassen County (3,622 houses); followed by bottled, tank, or LP gas (1,497 houses); and electricity (1,147 houses). Electricity was the primary energy source used for water heating (4,990 houses) and cooking (4,893 houses); followed by bottled, tank, or LP gas. A recent survey of residential energy use in the Plumas-Sierra REC service area indicates that the majority of residences in the region continue to use wood for space heating and electricity for water heating and cooking (See Table 3-8). The 1990 Census of Housing, which only contains house heating fuel information, shows that wood continues to be the fuel most used for residential space heating in Lassen County (Table 3-9). The types of fuels used for residential space heating in the County in 1990 are depicted in Figure 3-3.

Table 3-8
Plumas-Sierra REC Service Area
Percentage of Residences and Type of Energy Used

Fuel	*Space Heating*	*Water Heating*	*Cooking*
Wood	51%	-	-
Electricity	27%	72%	69%
LP, propane, butane	12%	20%	15%
Natural Gas	1%	1%	1%
Solar	-	2%	-
Other	9%	5%	15%
	100%	100%	100%

Source: Northern California Power Agency. 1987 Residential End Use Survey. Appendix G. Plumas-Sierra Rural Electric Cooperative Crosstabulations, August 1988

In certain areas of California natural gas is frequently used for space heating and hot water heating. However, Lassen County residences do not have access to natural gas, so their occupants rely more on electricity to meet their energy needs. As indicated in Table 3-5, in 1980, very few residences (1.2 % of the total houses in the County) were served with gas distribution systems (utility gas). This utility gas is usually available in the form of large propane tanks with underground distribution lines connected to individual residences throughout a subdivision. As indicated by the 1990 Census data, gas distribution systems have become more popular in recent years. Table 3-9 shows that in 1990, 2.2% of Lassen County's housing stock used gas distribution systems for space heating, a total of 185 residences (as opposed to 91 in 1980).

3.3.2 Commercial

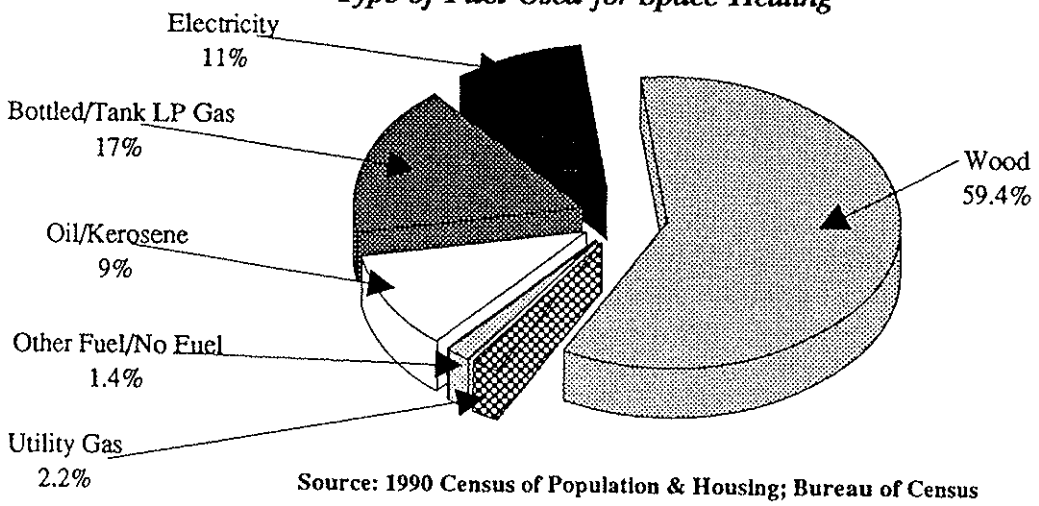
Generally, commercial activities use electricity rather than gas. Lighting typically accounts for the largest energy use in commercial buildings (approximately half of all electricity used). Air-conditioning and space-heating are the second and third largest energy consumers in most types of commercial buildings. Energy consumption patterns are atypical in grocery stores and supermarkets where large refrigeration units dominate as the largest user of electricity.

Table 3-9
Lassen County (1990)
Number of Housing Units and Type of Fuel Used for Space Heating

Fuel	*Housing Units*	*Percentage*
Electricity	941	11
Bottled, Tank of LP gas	1,456	17
Fuel Oil, Kerosene, etc.	763	9
Wood	5,075	59.4
Utility Gas	185	2.2
Other Fuel	110	1.2
No fuel used	13	0.20
	8,543	100%

Source: 1990 Census of Population and Housing. U.S. Department of Commerce. Bureau of Census.

Figure 3-3
Type of Fuel Used for Space Heating



Source: 1990 Census of Population & Housing; Bureau of Census

Source: 1990 Census of Population and Housing. U.S. Department of Commerce. Bureau of Census.

As shown in Table 3-6, the commercial sector is the second major consumer of electrical power in the County. In 1991, commercial uses in the Lassen County purchased approximately 56,641 MW of electricity from the utility companies.

3.3.3 Industrial

In contrast to energy consumption in the residential and commercial sectors, industrial patterns of energy consumption depend upon the specific type of industrial operation. Energy use within the general category of "industrial processes" includes a number of more specific uses. Some industry facilities use gas to heat water and most facilities use electricity for lighting, motor operation, and the operation of more sophisticated electronic equipment.

In Lassen County, the major industrial activities are lumber and wood processing. The three largest lumber mills operate cogeneration units which utilize wood waste as fuel to generate the electricity needed to operate the facility, as well as extra energy to sell (See Cogeneration, Chapter 2). Electricity use includes lighting, operation of motors, conveyor belts, chipping machines and manufacturing equipment.

Other industrial facilities in the County include power plants such as the Mount Lassen Power Plant, the Honey Lake Power Plant, and the geothermal wellhead generators in the Honey Lake area. Typically, a portion of the energy produced by Lassen County cogeneration units and power plants is consumed by the plant's operations, and the remainder is sold to the regional electric grid.

Major institutional customers of utility companies serving Lassen County include the Lassen Junior College, the Herlong-Sierra Army Depot, and the California Correctional Center. These facilities consume substantial amounts of electricity for their energy needs.

3.3.4 Agricultural

In general, the main energy type used in the agricultural sector is electricity, which is required to operate irrigation pumps in the summer. In Lassen County, the operation of electrical irrigation pumps in the summer constitutes the major use of energy in the agricultural sector. The seasonal character of the agricultural sector's electrical use is reflected in the Lassen Municipal Utility District electricity sales presented in Table 3-10.

As shown in this table, the average monthly use of electricity during the summer (956,398 kwh) for the agricultural accounts, is one hundred times as high as the average monthly use during winter (9,566 kwh).As an alternative, agricultural pumps are often powered by on-site diesel engines and, less often, by gasoline and propane engines. Agricultural facilities in the County have attempted to take advantage of geothermal water to provide space heating to greenhouses where vegetables, flowers, and tropical fish have been produced. Some of these attempts have had limited success. However, a nursery is still operating two geothermal-heated greenhouses located outside Susanville City Limits (See Geothermal, Chapter 2).

Table 3-10
Lassen County (1990)
Average Monthly Electricity Sale within Lassen Municipal Utility District Service Area

Type of Account	*Number of Accounts*	*Electricity Sale (kwh)*
Winter[1]		
Residential	7,558	6,117,944
Commercial	1,066	3,061,617
Industrial		
Herlong Sierra Army Depot	1	938,004
Lassen Junior College	1	236,000
Agricultural	80	9,566
Total	**8,706**	**10,363,131**
Summer[2]		
Residential	8,024	4,477,790
Commercial	1,102	3,038,912
Industrial		
Herlong Sierra Army Depot	1	951,980
Lassen Junior College	1	180,400
Agricultural	108	956,398
Total	**9,236**	**9,605,480**

1 January, February and March average
2 July, August, and September average

Source: Lassen Municipal Utility District, 1990 Quarterly Reports to the California Energy Commission.

The amount of power needed for agricultural use is dependent on a number of factors, including the method of irrigation (flood or sprinkler), the efficiency of the pump, and the lift from the well.

A recent study on agricultural pumping conducted by the Soil Conservation Service investigated how the cost of using diesel compared with the cost of using utility electrical power for pumping water (Table 3-11). Using rates from the Plumas Sierra Rural Electrical Cooperative, the study indicated that, excluding maintenance costs, the cost of pumping using electrical power was 35% higher than when using diesel. For both energy types, the cost of pumping raised dramatically when a lowering water table required more horse power, and more energy, to maintain a constant flow of 900 gallons per minute. During drought periods, the increasing depth of the ground water table is a critical factor in determining the cost of agricultural irrigation in the County. It should be noted that air quality impacts becomes an issue when on-site diesel engine pumps are operated.

Table 3-11
*Increased Pumping Cost with Lowering Water Table**

Gallons per Minute	Added Depth	Added Horse Power	Annual Cost	
			PSREC	*Diesel*
900	20 feet	6.1	$ 880	$ 651
	40 feet	12.2	$1,760	$1,302
	60 feet	18.2	$2,625	$1,943

* Fuel cost only. Maintenance costs not included. Typical operation - 2,500 hours of annual pumping.

Source: Soil Conservation Service

3.4 OPPORTUNITIES FOR ENERGY CONSERVATION

The rate of use of electricity, propane gas, and wood fuel can be significantly reduced simply by reducing wasteful energy consumption practices and habits. Typically, houses built prior to the 1970's have single-pane windows, minimal insulation, and little or no weatherstripping. Geographic location, climate, and energy efficiency were not considered when designing and building residential dwellings. The primary concern at the time of construction was typically economic - in an effort to keep the initial cost of building, equipment, and materials as low as possible. Electrical lighting was often used where windows could have provided much of the lighting needed. Appliances were often inefficiently designed, and had little insulation. In addition, poor design often resulted in installation of residential furnaces which were oversized in capacity for the heating requirements of the structure.

The current trend in housing construction is towards a more energy efficient design. Today environmental and economic concerns tend to provide greater incentives to save energy. Options for improving energy efficiency of residential dwellings, buildings, equipment, and operations are numerous. Most of the current options are not new nor highly technical, however, they were not economically viable alternatives in the 1970's due to the low-cost of energy supplies at the time. Some conservation measures result in moderate cost increases for buildings or appliances, while other measures are achieved by merely designing facilities or using energy differently, and cost no more than conventional designs. Advances in electronics, manufacturing processes, and materials help reduce the cost of "designed-in" energy efficiency in today's building construction.

State energy efficiency standards for residential and non-residential buildings first became effective in 1978 with enforcement of Title 24 of the California Administrative Code. Title 24 contains provisions for energy conservation in new buildings which create energy savings of approximately 50% over residential construction practices used prior to their enactment. It should be noted that failure to incorporate certain efficiencies into the design of long-lived buildings and appliances are often irreversible for the lifetime of the items in question. Refrigerators and furnaces now often last 20 years or more, and building lifetimes are measured in one or one-half centuries. In general, incorporation of energy conservation measures during the design and construction of new homes is easier and more cost effective than improving the energy efficiency of existing homes. However, since today's existing building stock is responsible for the major portion of energy consumption, it is also imperative to promote, and at times require, energy conservation measures in existing structures. In Lassen County, the number of residences built prior to 1970 accounted for 68% of the housing stock in 1980 (1980 Census of Housing). Options for reducing local energy use in old and new buildings are discussed below in terms of the energy uses of space heating, water heating, lighting systems, appliances, industrial processes, pumping, transportation, and land use.

3.4.1 Space Heating and Cooling

Space heating was previously identified as the largest energy consumer in residential buildings and the second largest in commercial buildings, therefore, the efficiency with which a home or office can be heated and retains that heat is critical for effective energy conservation. The efficiency of a structure's space heating depends on a number of factors including: the orientation and construction of the building; the building insulation level; the type of heating equipment and fuel used; and the habits of the building's occupants.

The type of building and its orientation, size, and volume contribute to the resulting energy needs for space heating. Typically, units which share common walls, such as multi-family and some commercial units, use significantly less energy than single-family residences and mobile homes. Common walls reduce the outside surface-to-volume ratio of each unit, and therefore, reduce the surface area subject to heat loss. Buildings oriented in a south-facing direction, with their long axis in an east-west orientation, can take maximum advantage of solar radiation and thus, reduce heating energy needs. In addition, adequate landscaping, providing shading in summer and solar access in winter, can maximize the use of solar designs in space heating.

To comply with Title 24 of the California Administrative Code, new residential and non-residential buildings must have at least R-11 insulation in the walls and R-19 in the ceiling. Ceiling insulation requirements are higher (R-30 or R-38) for mountainous regions, like Lassen County. Title 24 requirements for higher R-values insulation depend on the building characteristics such as the amount of glazed surface (windows), location and orientation of the house to insolation, and type of building materials used. The "R-value" is the resistance of a wall, ceiling, or floor to heat flow, and is directly related to the extent of insulation. The greater the "R" value of an insulating material, the greater resistance it has to heat flow.

Improvement of insulation level of existing buildings can substantially reduce the energy required for space heating. Adding R-30 insulation to an un-insulated ceiling can result in a 20 to 40% decrease in space heating costs. By doubling the R-value of insulation, heat loss is cut in half. Insulation not only keeps homes warm during the winter, but keeps heat out and homes cooler during hot weather.

The thermal integrity of a structure may often be compromised by heat losses through windows and exterior doors. Typically, more energy is lost through windows than any other surface in a building, including walls, ceiling, and floors. Adequate weatherstripping and caulking of such openings can cut down air infiltration and provide significant energy savings. However, weatherstripped single-paned windows would still be very energy inefficient due to heat losses occurring through the panes. Double-paned windows can be installed to reduce these heat losses. Some windows, recently made available in the market, are particularly energy efficient. These high-performance windows have energy-savings frames (wood, aluminum with thermal breaks, or vinyl), double or triple panes with an air space of a half inch or more between panes, an inert gas that fills that air space, and glass that reduces heat transfer. This glass is coated with a substance that blocks the flow of heat but not light and is commonly known as low-emissivity glass. Windows with a layer of nontoxic argon gas (a better insulator than air) between two panes of low-emissivity coated glass are four times as effective at reducing heat flow than a single pane, and are twice as effective as most double-paned windows.

Air leaks around ducts are another source of heat loss. Faulty ductwork accounts for approximately 10-30% of heat loss in an average home. Substantial energy savings can be provided by repairing disconnected ducts; insulating ducts in unheated spaces (crawl spaces, attics, outdoor locations); and sealing air leaks around plumbing, chimneys, and vents. In commercial buildings, adequate insulation of air ducts, plenums, pipes, and storage tanks in HVAC systems also result in energy savings.

The type of equipment and fuel used are important factors in determining the efficiency of a structure's space heating and cooling. When the energy losses in the thermal conversion process and transmission of electricity are taken into consideration, space heating with natural gas is 60-75% efficient compared to electric resistance space heating efficiencies of 25-40%. Whether equipped with gas or electricity, there are many opportunities for increasing the efficiency of space heating and cooling if building occupants are willing to maintain the equipment properly and to make some behavioral changes. Approximately 10% of energy savings is obtained if the furnace coils and filters, and air conditioning filters are cleaned and replaced regularly. Setting back the thermostat at night during winter and shutting off the pilot light during the warm seasons can reduce furnace energy use by as much as 30%. Closing draperies and blinds during daytime, using fans instead of air conditioning when the weather is mild, and avoiding the use of heat producing appliances (iron, ovens, dishwashers) in the hot hours of the day can reduce air conditioning energy use. Lowering the winter thermostat temperature setting and raising the summer setting reduces the rate at which heat flows in and out of a structure.

3.4.2 Water Heating

Water heating is the second largest energy consumer in single-family residences. Inefficient energy use for domestic water heating results from 1) little or no insulation surrounding the water heater tank, 2) maintenance of the water at a higher temperature than needed, 3) installation of a tank larger than needed for the hot water requirements of the residence, 4) poor location of tanks, and 5) wasteful use of hot water.

One of the major sources of inefficient thermal performance is the lack of adequate insulation around the hot water tank. Installation of an R-16 tank insulation jacket can provide substantial reduction in annual energy use for water heating purposes. Energy savings can be also obtained by reducing the thermostat setting by 10°F on a typical water heater and by installing low-flow shower heads and faucets. Adding flow restrictors to showers and faucets reduces the amount of water used and reduces the energy needed to heat and pump water.

Title 24 requirements for water heaters in new buildings include insulation of water pipes traversing unheated spaces, and specific performance standards for all plumbing fixtures to limit water flow. The use of electric resistance water heating is generally discouraged due to its inefficient use of energy.

3.4.3 Lighting Systems

Lighting is typically the largest energy consumer in the commercial sector. It is also an important energy use in residential buildings. Lighting systems, particularly in commercial buildings, tend to provide equal lighting to all parts of the interior space, even to areas designated for activities which do not require the same light intensity. This common practice of unnecessary light fixtures may result in considerable energy waste. It is estimated that most new commercial buildings waste up to half their lighting energy consumption (Cavanaugh 1989). Additional energy is wasted in the hot weather seasons because lighting adds heat to the building interior, and requires air conditioning equipment to operate longer. An efficient lighting system would illuminate activity areas selectively, according to the lighting needs of the activity conducted in the area. Options for reducing the energy requirements of lighting in existing buildings include: disconnecting unnecessary light fixtures (delamping), replacing incandescent lights with more efficient fluorescent or sodium-vapor lighting (relamping), and using daylight wherever possible to provide much of the required interior lighting. In new buildings, there is a definite opportunity for reducing the energy requirements of lighting through design of floor plans favoring the use of daylight.

Incandescent bulbs are particularly wasteful of energy. In general, three fourths of the electricity used by an incandescent bulb becomes waste heat, not light. Fluorescent lights are more efficient. As opposed to conventional fluorescent lamps, compact fluorescents typically have electronic ballasts for instant starting. An 18-watt compact fluorescent bulb provides as much light as a standard 75-watt incandescent bulb and releases less waste heat. These compact bulbs cost more than incandescent bulbs but they last up to ten times longer

and use as little as 25% of the energy used by incandescent bulbs. Savings occur over the life of the lamp. Compact fluorescents are best suited to areas where light is frequently used. An 18-watt compact fluorescent lamp used 12 hours a day can pay for itself in one year.

3.4.4 Appliances

In general, a large number of existing appliances in today's homes were designed and built in an era of cheap, abundant energy. They were designed to reduce manufacturing costs and be fairly durable, with little or no concern for energy efficiency. Now that energy costs have made operation of appliances more expensive, there is sufficient reason to design and use equipment which is more energy efficient. The savings could be substantial and would last for the lifetime of the appliance.

Efficiency standards were adopted in California for appliances requiring significant energy consumption. These standards apply for new electric refrigerators, freezers, gas space heaters, water heaters, plumbing fittings, gas clothes dryers, and air conditioners. Refrigerator efficiency regulations adopted in the 1970's phased in standards that required 1980 models to use at least 20% less electricity than 1975 models. Later, a second generation of California standards established additional efficiency requirements. Typically, appliance-efficiency standards set minimums that all manufacturers must meet, and a required measure of operation efficiency is stated for each appliance. The federal government also has appliance standards establishing minimum operating efficiencies. All consumer appliances, for example, are regulated by the National Appliance Energy Conservation Act.

Since appliance-efficiency standards have been adopted by the State of California, households replacing their older appliances with newer units would automatically have more efficient and less energy consuming equipment. In addition, there are a number of voluntary options that can reduce energy used for appliance operation. These options are primarily associated with proper maintenance of the equipment and with reduction of the frequency and duration of appliance use in residential buildings. A list of these options, which are often recommended by utility companies, is included below:

- Check the seals around the door edges of refrigerators and freezers and make sure they are in good condition. Keep the condenser coils clean so that the refrigerator can operate most efficiently. Keep manual units as frost-free as possible - ice buildup must be less than 1/4 inch. Keep freezer packed with food - the food acts as insulation and allows less air to spill out.

- Operate dishwasher with full loads only. Use short-wash cycles as much as possible. Skip the drying cycle and prop dishwasher doors open to air dry dishes.

- Run clothes washers with full loads only. Wash in cold water whenever possible. Hang-dry laundry instead of using a dryer.

- Avoid preheating oven. When using the oven cook as many foods at one time as possible. Avoid opening the oven door while food is cooking - the temperature drops about 25 degrees each time you open the oven door.

- Use a toaster oven, microwave or broiler oven whenever possible - they generally use half the energy of a regular oven.

- Match the pan to the size of the rangetop element and use the lowest heat possible to cook foods. Use tight-fitting covers on pots as much as possible.

- Insulate waterbeds and keep waterbeds made.

- Clean filters regularly in furnaces and heaters. Maintain heater outlets and air intakes in a clean condition.

- Whenever purchasing a new air conditioner, as with all appliances, choose the model with the highest energy efficiency you can afford, usually expressed as the highest seasonal energy efficiency ratio (SEER). The higher the SEER, the less the air conditioner costs to run. Purchase a central air conditioning system that matches the building size.

3.4.5 Industrial Processes

In general, monitoring of industrial processes and changes in timing of processing operations can result in substantial energy savings. Some options for achieving industrial energy conservation include maintaining optimal boiler efficiencies by monitoring flue gases and adjusting boiler equipment, and using automatic timing devices on equipment which is used only intermittently. However, because of the diversity among industries, energy conservation measures in the industrial sector must be identified on a plant-by-plant basis.

The cost of modifying industrial equipment to improve energy efficiency is often substantial, but it is an investment which often result in significant dollar savings. In the past decade, investment in equipment to recover waste heat and generate electricity (cogeneration) has been successfully done in several lumber mill operations in the County (Energy Facility Siting, Section 2.2). Other opportunities for energy conservation exist for new and existing industries. New processes coming into use for a number of industries will decrease the energy requirements of new plants and equipment. The design of new facilities and processes can include capital or labor-efficient alternatives which provide energy savings. In addition, current energy prices have made energy conserving alternatives more economic as the energy cost savings potential offset the added capital costs.

3.4.6 *Pumping*

Crop irrigation in Lassen County requires the use of electricity to pump water from the ground and is the primary energy use in the agricultural sector. Adequate maintenance and adjustment of agricultural pumping equipment can result in improved energy efficiency and thus, in energy savings. Typically, the intense need for agricultural water pumping in the summer greatly increases the electricity peak load of utility companies. Some companies encourage crop irrigation to be done during off-peak, night time hours. This is usually done by establishing a time-of-use rate which keeps energy costs low when used during off-peak hours. Scheduling irrigation for off-peak periods tends to reduce evaporation.

Reducing the amount of water needed is a basic step in reducing agricultural energy needs. This water need reduction may be obtained by improved irrigation system efficiency such as proper methods of water application for the crop being grown (flood or sprinkler), optimum cropping patterns, and simply minimizing ditch loss.

Other methods of improving the efficiency of pumping systems, thereby reducing energy needs, is minimizing the pumping head by reducing lift in the well, using adequately sized pipes, and using low pressure nozzles where possible. In some cases, the gear ratio of the engine and pump can also be improved.

3.4.7 *Transportation and Land Use Planning*

In general, the energy required to meet transportation needs is directly related to land use development patterns. It should be noted that, traditionally, land use development in California has occurred in a particularly energy inefficient manner. The low density and suburban residential developments which characterize most of today's urban development require substantial energy consumption for transportation, and result in costly and less efficient provision of public services. In addition, suburban subdivisions are often located far from employment and commercial centers. Provision of public transportation in such low density development is often not economically viable and thus, this development pattern requires greater dependence on private transportation.

Strategies proposed to promote energy conservation in the transportation sector involve reduction of car miles travelled in favor of an increase in use of public transportation. Such strategies include attempts to make public transportation more attractive, with more frequent schedules and more convenient bus stops, and to decrease the relative appeal of using private cars by reducing the number of long-term parking opportunities in urban centers, and increasing parking and toll fees. Some measures encourage the use of alternative modes of transportation such as bicycles, vanpools and carpools. Other measures include:

- Preferential parking for carpools and vanpools
- Transit pass sales on worksites
- Compressed work weeks

- Provision of showers and lockers at worksites for bicyclists and walkers
- Incentives to employees not driving alone
- Provision of secure bike parking at various locations including worksites, commercial centers, and bus stops
- Use of electronic media for telecommuting and shopping.

For new development, a more effective reduction of individual automobile use can be achieved through efficient land use planning to reduce the distances between home-work-shopping-recreation areas. Because distances between residential, commercial, and industrial developments influence an individual's decision to walk, bicycle, drive or use public transit, land use policies need to consider the location of housing in relation to shopping and employment centers. Recreation opportunities should also be provided within, or in the vicinity of, a residential neighborhood. Higher density and clustered development should be encouraged. Development of vacant lots within developed areas (infill) should be preferred over leapfrog development. Large commercial and office developments should be required to devote space for shops and services (such as dry cleaners, banks, convenience stores, and restaurants) to serve employees. In addition, the design of street layouts in the neighborhood should favor walking, bicycling, and the use of public transportation. Bicycle routes and pedestrian pathways should be provided connecting residential units with nearby schools, recreation facilities, centers of employment, and commercial areas. Bus stops should be at convenient locations. A balanced growth and distribution of commercial, industrial, and residential expansion in a community can decrease the number and length of vehicle trips and assure more efficient usage of transportation-related energy.

3.4.8 Implementation of Energy Conservation Measures

Several opportunities for energy conservation and efficiency have been outlined in the previous pages. From the current standpoint of increasing environmental and economic concerns, it is clear that improving the efficiency of energy use makes sense. Efficient energy use reduces costs incurred with energy production and avoid environmental disruption generally associated with construction and operation of additional power generating facilities. However, there are many barriers to full implementation of energy efficiency improvements and energy conservation measures.

Most often, indifference to energy efficiency is the result of inadequate information. Many people are not aware or do not believe that conservation measures can significantly reduce future energy costs. Many believe that energy conservation will mean changing their lifestyle and sacrificing their comfort. Perhaps most importantly, few people are aware that many energy conservation investments can pay for themselves in relatively brief time periods through the energy dollars they save.

The reluctance to make long-term investments in energy efficiency can also result from another set of circumstances. Quite often decisions about efficiency levels in a building are made by property owners or developers who will not be paying the energy bills. Sometimes, these buildings are occupied by renters or transient owners, who are usually unwilling to

make long-term efficiency improvements that would primarily benefit subsequent users.

Public advertisements and education programs are the main tools for distributing energy conservation information and dispelling some of these constraining perceptions. Utility-sponsored advertising for energy conservation is an educational mechanism that could be used. Some utilities already include energy conservation suggestions with their monthly bill, sometimes in the form of a newsletter. Energy conservation campaigns and information clearinghouses, sponsored by community groups or local governments, are another effective approach.

Education aimed at informing people about the overall dollar savings that result from energy conservation investments is one strategy of overcoming the cost barrier associated with major energy conservation improvements. Particularly needed is consumer information specific to Lassen County that provides dollar cost and saving estimates for energy conserving measures implemented within the local region.

It must be noted that the existing stock of residential and commercial buildings will continue to consume the bulk of energy in Lassen County. A combination of education, incentive strategies, and legislation enforcing retrofitting and performance criteria requirements will be necessary to eliminate energy waste in these buildings. Of particular concern is the stock of mobile homes in Lassen County, which comprise approximately 27 percent of existing housing stock in the County. As indicated previously, this type of housing is very energy inefficient for space heating. There is a definite opportunity for energy conservation in the rigorous enforcement of Title 25 requirements on new mobile homes in the area, and in the adoption of legislation requiring energy efficiency improvements on older mobile homes at the time of resale. In addition, mobile homes heated with wood stoves should be required to use high efficiency stoves.

3.5 EXISTING ENERGY CONSERVATION OPPORTUNITIES IN LASSEN COUNTY

Opportunities for insulating and weatherizing homes have been offered to residents of Lassen County, on different occasions, by different agencies. In the 1970s, C.P. National provided loans for installation of increased insulation and double-paned windows in homes within its service area (Sharon Edwards, pers. comm.). More recently, the California Energy Commission has made assistance programs available for upgrading insulation of buildings being connected to geothermal heating systems (Dan Graham, pers. comm.).

3.5.1 Lassen Economic Development Corporation

At present, weatherization and energy crisis intervention programs are available at the Lassen Economic Development Corporation (LEDC). Working in conjunction with the Lassen County Housing Program, the LEDC provides federally funded energy assistance for low-income, elderly, or handicapped residents in the County. Assistance is based on income level and availability of funding. The energy crisis intervention program, which provides up

to $300/household/year in assistance for paying energy bills or fuel costs, is available all year round but is especially in demand during the winter season when it is often used for paying heating bills. In addition, residents who qualify for weatherization assistance are able to have energy conserving measures installed in their homes at no cost. Weatherization measures provided by the agency include minor housing envelope repairs, attic insulation, storm windows, weatherstripping of windows and outside doors, installation of low-flow shower heads and water heater blankets. The program limits weatherization expenditures to $2,000 per household. The LEDC has existed since 1979 and has been responsible for weatherization of a number of homes in the County. In the past few years, the agency provided weatherization to 100 houses in 1988, 205 in 1989, and 174 houses in 1990. The average expenditure for weatherization is $950 per house.

3.5.2 Plumas-Sierra Rural Electric Cooperative

Since 1979, Plumas-Sierra Rural Electric Cooperative (PSREC) has offered energy surveys, energy conservation consulting, and inspections for residential, commercial, and industrial customers. An energy survey of a structure may include the use of infrared cameras and blower doors which allow detection of missing insulation and existing air leaks. The cooperative's loose-fill insulation blower is available for customer use at no cost. PSREC offers low-interest loans for installation of energy conservation measures such as storm windows, weatherstripping, insulation of water heater and pipes, attic, wall, floor, and ducts. Rebates for installation of ground-source heat pumps are also available. In addition, PSREC offers siting and design assistance to builders of new structures in its service area. Construction plans and building sites are reviewed and suggestions to increase solar exposure and energy efficiency are provided.

To reduce peak usage of electricity, PSREC has promoted the use of timers in hot water heaters and in irrigation pumps. A pilot project on 35 residences indicated that the use of timers and direct measurement could result in substantial reduction of peak usage. The installation of load control equipment in a number of irrigation pumps (totalling 3 MW) has allowed PSREC to shut them off in critical peak hour periods in the summer, thereby lowering irrigation bills.

3.5.3 Pacific Gas & Electric Company

Pacific Gas & Electric Company offers a variety of energy-saving programs to its customers. They include incentives to builders of energy-efficient structures, rebates to residential customers improving insulation of their homes and purchasing energy-efficient appliances, and to commercial customers purchasing energy-efficient equipment. To qualify for incentives, builders must exceed Title 24 building requirements in commercial buildings (by installing high-efficiency motors, refrigeration, lighting, and air conditioning systems), or reduce the estimated cooling requirements of a home by 10% or more from current Title 24 energy efficiency requirements. Residential customers are offered rebates to install additional ceiling insulation or purchase energy-efficient refrigerators or central air conditioning. They can also obtain discount coupons for the purchase of heating and air conditioning filters, low-flow showerheads, and water heater blankets. An energy-savings program designed to make users more aware of how they use gas and electricity is also available. An energy auditor analyzes the customer's energy usage and suggests ways to

make it more efficient by adjusting water heater and furnace thermostats, and improving the maintenance of appliances. In addition, a direct assistance program is available for income-eligible customers, to have their old and inefficient refrigerators, furnaces, and water heaters replaced, and receive free weatherization of their houses.

In Lassen County, PG&E has provided free ceiling insulation, water heater blankets, and low-flow showerheads to a number of income-eligible homes in Bieber (Roger Borkey, pers. comm.). In addition, low-interest loans for home insulation and weatherization have been available to non-qualifying customers.

Since 1973, a rebate for adjustment of irrigation pumps has been available for agricultural customers. Installation of timers on agricultural pumps to avoid irrigation during peak hours (noon to 6 p.m.) also qualifies for a rebate. Time-of-use rates are available for residential, commercial, industrial, and agricultural customers. Customers can save money by using less electricity during peak hours (noon to 6 p.m.).

3.5.4 California Energy Commission Energy Efficiency Studies

Recent studies conducted by the California Energy Commission (CEC) Energy Efficiency and Local Assistance Division indicates that substantial energy savings may result from installation of energy conservation measures in several public buildings in Susanville. The CEC analyzed these facilities and subsequently developed energy efficiency plans proposing improvements to each facility. If implemented, these conservation measures would result in substantial savings in both the amount of energy used and dollars spent by the County for energy consumption. The CEC has financial programs available to fund recommended improvements at competitive interest rates. Loans are available for a variety of project types including: lighting improvements, motor and pump replacements, building insulation, heating and air conditioning modifications, automated energy management systems, energy generation projects, and street lights. Both existing buildings and new or proposed buildings and facilities are eligible for CEC loan programs. Loans from CEC can finance up to 100 percent of the cost of efficiency projects. For some projects, a 25 percent match may be required. Typically, in order to qualify for CEC loans projects must have a payback of no more than 6.5 years. Three reports were prepared. One encompasses a group of County buildings, the other a group of City buildings, and a third report was prepared on the proposed County Adult Detention Facility in Susanville. Summaries of these reports are presented below:

- Energy use and conservation measures at the County Courthouse, the Courthouse Annex, the Administration Building, and the Roosevelt Annex were the subject of one report. The County currently spends over $90,000 annually for energy usage at these facilities (CEC May 1990). Electricity usage accounts for $76,878; fuel oil consumption accounts for $14,013. The recommended conservation measures would require an initial outlay of approximately $69,000 to implement, but would result in approximately $25,535 in energy savings every year. The payback to the County for the cost of the measures would be approximately 2 1/2 years. These savings would continue in excess of $25,000 annually after the payback in full. Some of the proposed conservation measures include: conversion to more efficient fluorescent lighting fixtures from

existing incandescent lighting, reducing the electrical load generated by lighting in overlit areas, improvements to efficiency and control of interior lighting systems, and conversion to more efficient heating systems. The largest project involves improvements to the Courthouse Annex. Suggestions include replacing the inefficient electric resistance heating system with propane, a $40,000 investment which would save the County $15,000 each year.

- Energy consumption and potential savings from conservation measures at several City of Susanville buildings (Public Works Building, Police Station, City Hall, Fire Station, and Roosevelt Pool) were analyzed in another report. The City currently spends $51,122 per year on energy purchases for these facilities; $46,475 is spent for electricity and $4,647 is spent for fuel oil (CEC October 1990). Conservation measures totalling approximately $12,000 would save the City $5,300 annually (Darrel Mills, pers. comm.). Recommended measures include: improvements to the existing lighting and ventilation systems that would improve both the efficiency and the control of the current systems. The average payback of proposed conservation measures is approximately 2.3 years.

- The proposed Adult Detention Facility in Susanville was analyzed in a third report. Measures recommended by the CEC for implementation into the design and construction of the new facility would cost approximately $28,000. The County would save approximately $70,607 annually in energy savings. Payback for the cost of the efficiency measures would be approximately 6 months. Improvements included replacing incandescent lighting fixtures with fluorescent fixtures, converting electric appliances to propane, replacing the cooling tower with a more efficient model, improvements to air ducts, and installing supply and return fans.

At present, only a few lighting improvements recommended for the county facilities have been implemented. No energy efficiency improvements have been made at the City facilities analyzed in the reports (Mazi Shirak, pers. comm.). The energy efficiency analysis conducted for the Adult Detention Center in Susanville was completed too late in the design process and none of the suggested efficiency improvements were incorporated in the final design of the facility (Anne Peterson, pers. comm.).

3.6 CONCLUSION

Successful implementation of energy conservation programs would have some economic effects in Lassen County. In general, one can reasonably expect that much of the annual energy savings could be reinvested in the local economy, rather than on additional energy purchases. In addition, if retrofits and efficiency improvements are performed by local businesses, the local economy would benefit again. These investments in the local economy would generally offset any losses in local utility tax revenues.

For most utility companies, energy savings from conservation programs avoid the cost of purchasing increased capacity to serve demand. For these companies, successful energy conservation programs can help lower the cost of energy to customers. Other utility companies have different operational constraints and price structures, and may have to raise

the cost of energy to their customers if energy consumption in their service area is decreased substantially. Since Lassen County is served by four electrical utility companies, it is possible that energy conservation in the four service areas will affect energy costs differently.

As a general rule, however, unnecessary energy waste and inefficiencies do not make sense in today's environmental and political context, and it is in the County's best interest to promote economically viable energy conservation measures.

4. Policy Plan

CHAPTER 4
Policy Plan

4.1 INTRODUCTION

This Policy Plan has been developed in response to energy development and use issues in Lassen County, and in anticipation of development that may occur in the future. The assumption upon which the Policy Plan's goals and policies were developed is that poorly planned or managed development can have adverse effects on the environment and be costly to both public and private sectors. Over time, soundly planned and managed development will be more environmentally acceptable and profitable than poorly managed development. This Policy Plan intends to establish a coordinated County planning framework for energy resource development and serve as a guide for local decision makers. It includes a set of goals and policies to guide energy development and production within the County.

Goals are statements of values or aspirations held by the community. They are general in nature and apply equally throughout Lassen County. Policies are more precise statements expressing how goals will be achieved. The policy list includes siting, construction, and other general policies for development of all types of energy technologies. It also includes policies and implementation measures specific to each type of energy technology, and to energy efficiency, conservation, and economic development issues.

The Policy Plan proposes realistic, enforceable policies to resolve conflict and establish long range planning directives for the County with regards to energy development. The focus of this document is to balance energy production and use with natural resource protection and energy conservation, to support opportunities for energy development while minimizing adverse environmental impacts, and to integrate energy development into the mix of land uses found in the County resource areas. Thus, the Element contains specific policies that direct energy resource development in the County and establish criteria for these development activities.

It must be understood, however, that the County also needs to balance progressive energy policies with the social and economic realities of a primarily rural community. The County has financial constraints to its ability to implement a comprehensive energy program. The County is also sympathetic to the economic constraints and social attitudes of its residents who may not rush to embrace, or be able to initially afford, innovative energy conservation concepts.

Furthermore, the ability to successfully apply many of the policies and implementation measures set forth in this Energy Element directly relates to the future availability of funding and technical assistance from State and Federal sources.

The following goals and policies indicate the direction the County believes it should take in addressing its energy issues, and it resolves to work constructively with its residents and property owners, as well as with energy facility operators and prospective project developers, to accomplish these goals.

4.2 GOALS

1. *A physical and social environment that contributes to and enhances the County's quality of life, including perpetuation of its rural lifestyle.*

2. *Energy development that minimizes land use conflicts and maximizes effective mitigation of environmental impacts to protect public health, safety, and natural resources.*

3. *Adequate and reliable supplies of energy to Lassen County consumers at the most economic rates possible.*

4. *Efficient utilization and management of the County's natural energy resources.*

5. *Development criteria and guidelines for all types of potential energy projects.*

6. *Cost effective and affordable energy conservation and efficiency practices that are economically viable for all segments of the community.*

4.3 POLICIES AND IMPLEMENTATION MEASURES

The standards set forth in the policies of this Energy Element shall be applied by the County as guidelines in the review and consideration of project proposals, and in the promotion of energy conservation. Variation by the County from these guidelines is acceptable, provided that the County has demonstrated or accepted evidence that particular variations will satisfy the intent of the policy.

4.3.1 Policies for All Energy Technologies and Fuel Types

4.3.1.1 Siting Policies

1. No energy facility which handles, utilizes, stores or produces hazardous or acutely hazardous materials shall be sited within 1,000 feet of the outer boundary of sensitive receptors including schools, hospitals, residences, or day care facilities. Health Risk Assessments and/or other analysis will be conducted to determine the actual buffer zone above 1,000 feet required for specific projects to ensure public health and safety.

2. The development area (i.e. grading) shall be limited to relatively level areas where feasible. The site selection for proposed developments shall minimize the potential for erosion and sedimentation.

3. Facilities shall be sited to minimize impacts on critical wildlife habitats and rare, threatened, and endangered wildlife and plant species.

4. The County will consult with and consider biological resource recommendations made by resource protection agencies, including the California Department of Fish and Game and the U.S. Fish and Wildlife Service.

5. When determined by the County to be warranted through the CEQA process, biological resource surveys will be completed at the proper times of year by qualified specialists to identify rare, threatened, and endangered species and their habitats.

6. Except for properly engineered hydroelectric facilities, a buffer strip of undisturbed land, within which activities shall be restricted or prohibited, shall be maintained by the developer immediately adjacent to surface water resource. The buffer width shall be determined through the CEQA process.

7. Energy facilities shall not be located in a floodplain, except for properly engineered hydroelectric facilities, nor significantly impact wetlands without appropriate mitigation.

8. For projects requiring energy transmission, information on the capacity and current load on existing utility transmission lines in the project vicinity shall be considered by the County prior to project approval to determine if the project will exceed the available transmission capacity.

9. Energy projects shall be sited to minimize impacts on prime agricultural areas.

10. When determined to be warranted by the County through the CEQA process, in consultation with applicable agencies, an archaeological and/or paleontological survey will be required to identify potential impacts to resources and to determine necessary mitigation.

11. WTE facilities shall not be located near airports if high stack and restricted air space considerations present a negative impact on the safety and growth potential of the airport.

12. Energy facilities which require heavy truck traffic shall be located on access routes that minimize transport through residential areas and impacts to schools and hospitals.

Implementation Measures.

a. The County shall revise its zoning regulations to clarify the types of energy production facilities allowed in specific zoning districts.

b. The County will require detailed site and project information as part of project applications and the California Environmental Quality Act (CEQA) review process to address the environmental concerns identified in this Energy Element in consideration of specific applications for energy facility use permits.

c. In consultation with responsible and trustee agencies, the County shall determine, pursuant to CEQA and other applicable laws, when a proposed project may have a significant effect, the extent of information needed to address the impacts, and the type and degree of mitigation needed.

d. The County shall update its Land Use, Circulation, Conservation, and Open Space Elements, when the opportunities and funding are available, to address siting and resource management issues related to energy production.

e. The County shall require a pre-filing conference of all energy facility development applicants to review application requirements and possible impacts of the proposed project.

f. If an applicant is unable to provide adequate information regarding a proposed project, the County shall require the applicant to cover expenses sufficient for the County to obtain the necessary data and analysis.

g. The County shall revise its zoning regulations to require the submission of a Business Plan (pursuant to CHS Code Section 25500 et seq.) and/or a risk management and prevention program (RMPP) (pursuant to CHS Code Section 25531 et seq.) as part of the application for a building permit, when applicable.

h. Any energy project requiring permits from other local, state, and Federal agencies shall obtain those permits in conjunction with the application for a Use Permit to construct and/or operate an energy facility.

i. Proposed projects will be reviewed in respect to potential impacts on airports according to the County's Airport Land Use Plans.

4.3.1.2 Construction Policies

1. Surface disturbance and erosion during grading activities shall be kept to a minimum. Clearing limits for each facility shall be defined in a site development plan, and no vegetation removal shall occur outside these areas, except for fire safety considerations as required by the local fire authority.

2. No sedimentation from the project shall be allowed to run off the site in a manner which has not been appropriately designed and approved.

3. Excess earthen materials (e.g., rocks, boulders, and soil) shall only be removed from the site and disposed of by the developer in approved disposal sites according to an approved plan.

4. Storm water runoff shall be channeled to existing natural waterways only to the extent that it will not increase surface flows to the point of unnatural channel abrasion, or result in an unacceptably adverse impact to water quality.

5. The developer shall not discharge materials to a sump that are not approved by the County or the state agency of jurisdiction. Any waste removed from the sump shall be disposed of by a method and at a disposal site approved by the agency of jurisdiction.

6. Areas of cleared vegetation (e.g., construction sites, access roads) subject to vehicle traffic shall be watered or otherwise treated by the developer to reduce fugitive dust (particulate) emissions. Treatments shall be controlled so as not to significantly impact surrounding water quality, vegetation, or wildlife.

7. Heavily traveled roads shall be paved by the developer, or other standard engineering and construction techniques shall be used to minimize erosion, as provided by County Code and other related regulations (Grading Ordinance).

8. Stream crossings shall be located, designed, and constructed to the specifications of the County, the California Department of Fish and Game, the U.S. Army Corp of Engineers, or agency of primary jurisdiction.

9. Project construction shall minimize disturbance of critical wildlife habitats, including, but not limited to, antelope kidding grounds, sage grouse leks, deer fawning areas, important deer winter ranges, and raptor nest sites. The potential effects shall be considered by the County during environmental review of the project application.

10. Construction activities shall minimize the potential of disturbing archaeological or paleontological sites.

11. Any storage of hazardous materials on-site shall be adequately contained by structure or containers designed to prevent accidental release during operation or under adverse conditions.

12. The use of native species for revegetation of disturbed areas shall be promoted in accordance with site-specific revegetation objectives.

Implementation Measures.

a. An erosion control plan, revegetation plan, and drainage plan shall be submitted by the applicant to the County for approval prior to the approval of a Use Permit.

b. Cut and fill areas shall be stabilized to minimize erosion and shall be rehabilitated by the developer to slopes of 3:1 or less. Construction fills shall be compacted to a minimum 90 percent relative compaction to minimize erosion. If significant erosion occurs, the developer shall take prompt remedial action.

c. The County shall revise its zoning regulations to specify conditions under which bonding or other financial assurance to insure the reclamation of disturbed areas will be required of the applicant.

d. Erosion and sedimentation control plans shall include a maintenance plan that provides for inspection and repair, if necessary, of all erosion control structures prior to seasonal runoff periods. Revegetation plans shall provide for the reestablishment of ground cover and vegetation to include indigenous plants and to provide maximum erosion control and wildlife habitat.

e. Topsoil shall be stockpiled by the developer for later redistribution over the disturbed areas prior to revegetating pursuant to the revegetation plan approved by the County.

f. In areas requiring removal of vegetation but no grading, root crowns shall be left intact to retard soil erosion.

g. The success of a project's revegetation program shall be assessed by the County each Spring for three years following initial planting. If the original effort is deemed unsuccessful by the County, additional revegetation by the developer will be required before the next fall.

h. Developers shall submit a drainage plan showing the distribution of storm water runoff and measures to prevent unnatural channel erosion.

i. Energy dissipators and a collection device to reduce runoff velocities will be required where determined necessary by County or the appropriate state agency.

j. Culverts and ditches shall be regularly cleaned and maintained by the operator to reduce the possibility of overflow and resultant erosion and siltation.

k. Developers shall insert a site avoidance clause for the contingency of archaeological or paleontological discoveries in construction contracts.

l. The developer shall be required to cease operations if an archaeological or paleontological site is uncovered during site construction. Operations will not continue until a qualified specialist has inspected the site and appropriate mitigation measures have been approved by the County and taken by the developer.

m. Following project approval, if significant modifications and/or changes in operation are proposed, the changes must be reviewed and approved by the County to ensure that potential impacts which were not addressed during review of the original project are considered.

n. The County shall work with the applicable State and Federal agencies to apply appropriate design and construction standards for the storage of hazardous materials.

o. Approved projects shall include a mitigation monitoring and compliance program to ensure compliance and successful implementation of applied mitigation measures.

p. Structural design criteria, in regard to the visual impacts of the facility, will be prescribed by the County for each project permit, based on the extent of impact and the visual sensitivity of the site.

4.3.1.3 General Policies

1. With the exception of wellhead facilities, energy production projects shall not be permitted by the County on prime agricultural lands or important wildlife habitat areas as designated in the County General Plan.

2. Energy projects will be required to minimize and repair consequent damage to public roads.

3. Energy facilities shall comply with noise standards established in the Noise Element and shall be consistent with Federal safety standards.

4. The County shall take measures to minimize potential risks from seismic activity through requirements for proper design, construction, and safety measures. Any storage of hazardous materials on-site shall be adequately contained by structures/containers designed to prevent release of contents by seismic activity.

5. The County shall require applicants to address and minimize the risk of hazardous accidents or spills.

6. Developers shall provide adequate sewage handling/disposal facilities at development sites in accordance with County regulations.

7. The proposed level of efficiency and conservation of water use shall be considered by the County in applications for energy facilities.

8. The County shall encourage and cooperate with State and Federal agencies in updating and maintaining an inventory of energy resource information and coordinated permitting procedures.

9. The County encourages feasibility studies for the environmentally-sound development of methane fermentation and gasification facilities and other innovative technologies to produce energy.

Implementation Measures.

a. Specific development and operating conditions of approval shall be set forth in any approved Use Permit for an energy facility.

b. Construction, operation, and maintenance of all facilities shall comply with the air quality requirements of the Lassen County Air Pollution Control District.

c. Energy facility operators shall obtain the necessary water quality permits from the Regional Water Quality Control Board.

d. The developer shall comply with the requirements of fire prevention policies prescribed by the California Department of Forestry and/or the County.

e. The County shall, when appropriate, coordinate efforts with the California Energy Commission to provide permit assistance for all energy technologies.

f. The developer shall comply with County and State regulations concerning hazardous materials and prepare spill containment and contingency plans for any proposed project that involves hazardous materials.

g. Road mitigation fees or road maintenance agreements shall be established prior to project approval as mitigation for projects which will significantly impact road maintenance requirements.

h. Project applicants shall propose an appropriate level of car pooling for projects which present a potential for significant impact on traffic and/or air pollutant levels.

i. Road conditions and implementation of related mitigation measures shall be monitored by the County as part of an approved project's mitigation monitoring and compliance program.

j. Materials from cleanup of accidental on-site hazardous material spills and materials from waste sumps (i.e., muds) shall be analyzed for pollutant concentrations and properly disposed of at an approved disposal facility, pursuant to Regional Water Quality Control Board and/or Department of Health Services requirements.

k. Project applications shall identify the type and quantity of wastes expected to be generated, and shall include a preliminary agreement with a suitable disposal site to accept the wastes.

l. The developer shall provide safety training for employees involved in hazardous materials handling or transport.

m. The County will negotiate memorandums of understanding with, and make grant applications to, appropriate state and Federal agencies to develop and maintain an energy resource data base.

4.3.2 Policies for Each Energy Technology and Fuel Type

NOTE: All energy production facilities, regardless of technology or fuel type, shall comply with policies and implementation measures identified above for siting, construction and general policies, as applicable.

4.3.2.1 Biomass

1. Biomass plants shall be sited near primary fuel sources to minimize the costs and environmental impacts associated with hauling fuel from long distances.

2. Biomass facilities may be permitted by Use Permit in non-prime agricultural and upland conservation zones when it is determined by the County that the site is necessary in order to be near agricultural fuel sources, and the County makes a finding that locating such facilities will not be detrimental to existing or potential agricultural uses on surrounding lands.

3. The County shall consider the impacts of proposed new biomass facilities on the availability and sustainability of timber resources.

4. The County discourages the wholesale use of lodgepole pine as a fuel source for biomass facilities and supports public and private land management of lodgepole primarily for home use as firewood.

5. The use of alternative biomass fuel types, such as juniper wood, is encouraged by the County provided that the biomass harvest is conducted in an environmentally sound manner.

6. The County encourages the Forest Service and timber management agencies to prioritize and expedite the harvest of salvage timber (e.g., bug-and-fire-damaged trees) for biomass fuel.

Implementation Measures.

a. Biomass harvest activity shall be subject to U.S. Forest Service, Bureau of Land Management, and/or California Department of Forestry review and permitting, where applicable.

b. Updated reports on the regional availability and sustainability of biomass fuels shall be required and considered by the County prior to the approval of additional biomass plants.

c. All biomass harvest operations and biomass plants shall have the necessary permits and adhere to mitigation measures outlined by the Regional Water Quality Control Board.

d. Specific development and operating conditions of approval shall be set forth in any approved Use Permit for a biomass facility.

e. The County will communicate its policies regarding biomass harvest practices to the applicable Federal and State resource management agencies.

4.3.2.2 Cogeneration

1. Due to fuel-type similarities, cogeneration facilities shall be subject to all applicable policies and implementation measures adopted for biomass facilities.

2. Cogeneration facilities may be permitted by Use Permit in commercial and industrial zones when proposed as an accessory use to a permitted facility.

3. Proponents of new industrial facilities are encouraged to investigate the feasibility of including a cogeneration unit in the facility.

Implementation Measures.

Refer to implementation measures for biomass projects.

4.3.2.3 Fossil Fuel

1. Oil or gas thermal conversion facilities shall be located near pipelines of sufficient size and volume to supply the facility.

2. The application for a fossil fuel facility shall identify sources of fuel and water sufficient to operate the facility.

3. The project application shall include a plan for the handling and disposal of potential hazardous materials which may be contained in the waste ash.

Implementation Measures.

a. The County shall, through the CEQA process, consider and determine acceptable levels of impact for services which could be affected by proposed fossil fuel energy facilities.

b. Any proposed coal-fired plants shall be located near railways or roadways that can accommodate the necessary size and frequency of trains or trucks needed to transport coal and wastes without diminishing existing levels of service below the acceptable level as determined by the County.

4.3.2.4 Geothermal

1. During drilling operations, no hydrocarbon base cleaning agent, waste oils or greases, and liquid fuel shall be released directly onto the surface of a drill pad.

2. Drilling activities shall occur in a manner that minimizes the generation of hazardous materials and waste, allows for their recycling whenever practical, and is in compliance with all waste management policies and regulations.

3. No uncontrolled discharge of geothermal fluids to the site or surrounding area shall be permitted.

4. The County encourages proposed geothermal projects to provide opportunities for additional uses of geothermal resources by cascading from higher temperature uses to lower temperature uses prior to disposal.

5. The County encourages the sharing of production and injection wells where feasible to provide for efficient utilization of the geothermal resource.

6. Surface water and groundwater quality shall be protected by environmentally sound construction and operational methods that minimize sedimentation and prevent accidental discharges.

7. The County encourages carefully planned injection of geothermal fluids as an alternative to surface disposal.

8. The County discourages geothermal development in riparian or wetland habitats. While this does not preclude the construction of access roads and transmission pipelines through such areas if necessary, projects shall minimize and, if possible, avoid such crossings.

9. The County encourages potential developers to utilize technical and financial assistance programs offered by the State of California Energy Commission's Office of Research and Development.

Implementation Measures.

a. Geothermal drilling operations shall comply with the requirements of the California Division of Oil, Gas, and Geothermal Resources and the Regional Water Quality Control Board and, unless otherwise approved, shall comply with the policies set forth in this section.

b. To protect vegetation, access to the drill sites shall be restricted to existing or proposed roads as defined in the project description. Well pad size, road width, and turnouts shall be no larger than necessary to preserve plant cover. Pipelines shall follow roads wherever possible to minimize disturbance.

c. After the completion of waste discharges to a sump, the requirements of the Regional Water Quality Control Board and/or Department of Health Services shall be met and the sump shall be abandoned to the satisfaction of the Division of Oil, Gas, and Geothermal Resources.

d. Developers shall be required to submit to the appropriate jurisdictional agency a contingency plan for spills that could impact water quality.

e. As part of the application process for new power plants, documentation shall be required by the County demonstrating sufficient geothermal resources to support existing and proposed power generation.

f. Sufficient geophysical analysis shall be submitted with the application to determine the potential of ground subsidence.

g. Geothermal production wells and nearby freshwater wells shall be monitored by operators to allow detection of casing failure and loss of geothermal fluids from the system.

h. Production rates from wells shall be recorded by the operator on a continuing basis. Pressure and temperature data shall be monitored to evaluate long-term effects of resource production.

i. Geothermal injection wells and local freshwater wells shall be monitored by the operator to allow detection of casing failure and escape of geothermal fluids to the ground-water system.

j. The County shall require that developers having surface discharge of geothermal fluids cooperate with environmental monitoring programs conducted by other agencies (e.g., California Department of Fish and Game, Regional Water Quality Control Board) to determine any cumulative impact to water quality, vegetation or wildlife.

k. Specific development and operational conditions of approval shall be set forth in any approved Use Permit for a geothermal facility.

l. All County permits shall require that geothermal operations be abandoned and reclaimed by the operator upon completion of the life of the facility in accordance with an approved reclamation plan and the requirements of the Division of Oil, Gas, and Geothermal Resources.

m. Hydrocarbon base cleaning agents, waste oils and greases and fuel shall be contained and removed from the site. Any accidental discharge of the materials mentioned above shall be removed and properly disposed by the developer. A report shall be filed with the agency of jurisdiction.

n. Equipment service and fuel transfer areas associated with drilling operations and the area occupied by the drilling rig shall drain into a sump.

o. The County shall participate in State-funded programs for low temperature resource exploration, utilization, and information dissemination projects. The projects shall include evaluating the potential for using low temperature resources when constructing or renovating public facilities.

p. The County shall negotiate and execute cooperative agreements with state and Federal agencies to provide for multi-agency review of geothermal resource management issues.

4.3.2.5 Hydroelectric

1. Exposed surfaces associated with construction of hydroelectric projects shall be stabilized by the developer prior to the winter rainy season. Revegetation is the preferred method for slope stabilization.

2. Any construction associated with hydroelectric projects that could disrupt the normal stream flow regime or water quality shall be mitigated through appropriate planning and engineering design.

3. Hydroelectric projects shall not result in significant adverse impacts to fish populations of the project waterways.

4. Hydroelectric projects shall not result in avoidable significant adverse impacts to riparian vegetation along the project waterways, as determined in the environmental review phase of the application.

Implementation Measures.

a. The California Department of Fish and Game shall be consulted during the environmental review phase of the application to determine significance criteria for adverse effects on fish and wildlife populations and habitat.

b. Dissolved oxygen levels in water released from a dam shall be monitored by the facility operator (in consultation with the California Department of Fish and Game) to ensure appropriate levels to sustain fish populations downstream.

c. Hydroelectric projects shall include a fishery management plan to mitigate adverse impacts to fish populations of the project waterways and, when possible, enhance fishery resources.

d. Adequate water releases from hydroelectric projects shall maintain the minimum streamflow requirements determined for specific projects through the environmental review process.

e. Turbine intake structures associated with hydroelectric facilities shall be designed and screened to prevent loss of fish.

f. Specific development and operational conditions of approval shall be set forth in any Use Permit for a hydroelectric project.

4.3.2.6 Solar

1. Commercial solar conversion facilities may be permitted by Use Permit in commercial, industrial, non-prime agricultural and upland conservation zone districts if the facilities are determined by the County to be compatible with surrounding land uses.

2. Solar conversion facilities shall be designed to promote public safety and control public access to the sites.

3. Solar access requirements associated with new solar facilities shall not significantly impair existing land uses adjacent to the project site.

Implementation Measures.

a. Specific development and operational conditions of approval shall be set forth in any approved Use Permit for a solar conversion facility.

b. All proposed commercial solar energy conversion facilities shall conform to applicable zone district setback requirements established in the Zoning Ordinance. More stringent setback requirements may be established by the County as a condition of approval for specific projects, if deemed appropriate.

4.3.2.7 Waste-to-Energy

1. Proposed Waste-to-Energy (WTE) facilities shall be reviewed by the County as waste treatment facilities with cogeneration components; the primary consideration of the application shall be for the waste treatment aspects and use of the facility.

2. Waste-to-Energy facilities which propose to use infectious or hazardous waste from off-site sources must be designated for such uses in the General Plan.

3. WTE facilities shall be located in appropriately zoned industrial areas compatible with Waste-To-Energy technology and associated impacts.

4. WTE facilities shall be located in proximity of the fuel source area to reduce transportation impacts, costs and energy consumption.

5. WTE facilities shall be located near highways and access routes that minimize transport through and impacts to residential areas and institutional facilities (schools, hospitals).

Implementation Measures.

a. The siting of WTE facilities shall be considered in conjunction with the appropriate policies of the County's Integrated Waste Management Plan and/or Solid Waste Management Plan.

b. Specific development and operational conditions of approval shall be set forth in any approved Use Permit for a WTE facility.

4.3.2.8 Wind

1. Wind facilities may be permitted by Use Permit in industrial, upland conservation and non-prime agricultural zone districts if the facilities are determined by the County to be compatible with surrounding land uses.

2. The siting of wind conversion facilities shall avoid residential areas.

3. Proposed wind conversion facilities shall be designed to promote public safety and control public access to the sites.

4. Proposed project applications shall include an evaluation of avian and other wildlife impacts and propose a program to mitigate such impacts.

Implementation Measures

a. Proposed wind conversion facilities shall conform to the applicable zone district setback requirements established in the County Zoning Ordinance. More stringent setback requirements may be established by the County as a condition of approval on a project and site specific basis.

b. Unless variations are qualified on a project specific basis, horizontal axis wind turbines shall be positioned at a distance of at least two times the total tower height from all nearby trees or structures, and vertical axis facilities shall be positioned at a distance of at least ten blade diameters from any trees or structures.

c. Specific development and operational conditions of approval shall be set forth in any approved Use Permit for a wind facility.

4.3.2.9 Transmission Lines and Natural Gas Pipelines

1. The County shall require, to the extent allowed by law, that proposed electrical transmission line and natural gas pipeline (pipeline) plans be submitted to the County for review in the initial stages of route planning and impact assessment. Such review shall include public hearings before the Planning Commission and the Board of Supervisors in order to solicit public review and to aid the County in preparing comments regarding impacts, routing considerations, and the General Plan consistency of the proposals, including compliance with the standards set forth in this Energy Element.

2. Transmission lines and pipelines shall be sited to minimize impacts on natural resources including: seasonal and permanent wetlands; riparian habitats; critical wildlife habitats;

rare, threatened, and endangered plant and animal species; and areas of significant waterfowl concentration.

3. Transmission lines and pipelines shall be designed and routed to minimize erosion and siltation of water courses.

4. Transmission lines shall not be sited in locations capable of jeopardizing public safety at existing or planned airports.

5. Existing transmission line corridors, rights of way, and easements shall be used whenever practical in siting additional transmission lines and pipelines.

6. The siting of transmission and pipeline routes shall minimize impacts to areas with established, or which are zoned for, concentrated residential development.

7. Siting towers and alignments of transmission lines and pipelines through agricultural fields, which significantly reduce agricultural production, shall be avoided. Lines should follow existing property lines or routes which otherwise minimize the splitting of parcels.

8. The siting of transmission lines shall minimize impacts on scenic views and shall be visually integrated with the surrounding setting. If located along a highway, the route shall favor the side of least scenic value. Siting of transmission lines on ridgelines or other visually prominent features should be avoided. Whenever possible, hills or topography should be used to screen transmission lines from the public field of view.

9. The ground surface above underground powerlines and pipelines shall be reclaimed in a manner integrated with the surrounding landscape to minimize visual impacts.

10. A fire suppression plan, including identification of the availability of suitable water supplies, shall be developed for all transmission lines and pipelines.

11. Subject to the standards set forth above, the County supports the development of well-planned transmission lines and pipelines which will aid the County in obtaining more economical power and natural gas resources.

Implementation Measures

a. The County shall amend its zoning and development ordinances to clarify the process whereby proposed transmission lines and pipelines are reviewed, and to establish applicable fees for such review.

b. The County shall encourage and cooperate with all companies anticipating the construction of new transmission lines or pipelines in Lassen County to develop or contribute to the preparation of a routing plan. The plan shall address the appropriate

level of environmental review for proposed routes and shall respond to the policies and standards set forth in this Energy Element and the General Plan.

c. The County shall consider appropriate land use designations and identification of environmentally sensitive areas related to transmission and pipeline corridors when it revises its General Plan Land Use, Open Space, and/or Conservation Elements.

d. The County shall seek to establish agreements with the California Public Utilities Commission, the California Energy Commission, and other applicable agencies, to require all transmission line applicants to first obtain preliminary consent from the County, in the form of General Plan consistency findings, of proposed alignments, and that public hearings held by these agencies in consideration of proposed projects be held in Lassen County.

4.3.3 Energy Conservation Policies

4.3.3.1 General Energy Conservation Policies

1. The siting and design of new development shall maximize solar access and minimize the need for heating, cooling, and lighting.

2. Whenever possible, new buildings shall be oriented with major window areas located on the southern walls and coordinated with landscaping for passive solar heating and cooling.

3. The County encourages electrical providers to employ "integrated resource planning" to balance energy production and supply with demand.

4. The County supports the use of drought-tolerant and water conserving landscaping in new development.

Implementation Measures.

a. The County shall develop and enforce energy efficiency standards for new buildings based on Title 24, California Administrative Code.

b. The County shall train building inspectors to look for energy-inefficiencies related to Title 24.

c. The County shall adopt a Solar Access Ordinance preventing new structures from shading a substantial portion of existing structures or vacant lots.

d. County Building Inspectors shall review building permit applications and advise applicants regarding the maximization of solar and other energy conservation features.

e. The County, in conjunction with electric utility companies, shall provide energy conservation information and technical assistance to inform consumers of the savings resulting from energy conserving and solar design measures implemented in new and old structures within the County.

f. The County shall consult with local utility companies to develop standards and obtain information when reviewing large-scale commercial projects and major subdivisions. Consultations shall be conducted during the design and approval process to incorporate energy-efficiency suggestions into project development plans.

g. Building inspectors shall be provided with annual training to update their knowledge of solar and other energy conservation design developments.

4.3.3.2 Residential Development

1. Applicable general energy conservation policies and implementation measures identified above shall apply to residential projects.

2. The County encourages builders to design and build new residential units with solar domestic water heating or with the capability (e.g., solar access, and proper plumbing stubbed for solar) to install and maintain solar water heating systems in the future.

3. Code, Covenants, and Restrictions (CC&Rs) for residential development in the County shall not contain provisions preventing the use of solar space heating or water heating.

4. Basic energy conserving improvements, such as insulation blankets for hot water heaters; low flow showerheads; weatherstripping for doors and windows; and ceiling, floor, and duct insulation are recommended prior to resale of residential units.

5. The County supports the expansion and increased effectiveness of local weatherization and energy crisis intervention programs, such as the Lassen Economic Development Corporation.

6. Appropriate landscaping shall be incorporated into residential development plans. Streets oriented in an east-west direction shall be planted with deciduous trees to allow sun in the winter and provide shade in the summer. Streets running north-south shall contain an appropriate mix of evergreens, where appropriate, to provide windbreaks, but not restrict solar access.

Implementation Measures.

a. The County shall promote the incorporation of solar space heating systems into development plans by keeping related codes current and making solar design information available to the public.

b. The County shall, through the Building Inspectors office, provide information for the public on energy conserving measures for new residences and for renovations and additions.

c. The County shall amend its subdivision review procedures to encourage drought-tolerant and water conserving landscaping in residential development.

4.3.3.3 Commercial Development

1. Building layout and design shall minimize energy use for space heating and lighting.

2. The applicable general energy conservation policies and implementation measures identified above shall apply to commercial projects.

Implementation Measures.

a. The County shall provide information on energy conserving measures for commercial and industrial buildings when reviewing building permits for new structures, renovations and additions.

4.3.3.4 Land Use and Transportation

1. In order to minimize vehicular travel and the resulting consumption of fuel, the pattern of residential, commercial, and industrial land use shall be compact and relate to transit routes and centers.

2. Development of vacant lots within developed areas (infill), or orderly expansion to adjacent areas, is encouraged over leapfrog development.

3. Bicycle access and convenient bicycle parking spaces shall be required at schools, libraries, parks, multi-family residential development, and commercial centers. Streets and roadways in the County shall, within design and economic constraints, have bike lanes or shoulders providing for safe bicycle riding.

4. Plans for parks and public open spaces shall include provisions for bicycle and pedestrian pathways.

5. New, large employment sites are encouraged to include shops and services on-site or within one-quarter mile to reduce vehicle use and automobile dependence and promote walking.

6. The County supports the expansion of public transportation services.

Implementation Measures.

a. The County shall, through its General Plan and zoning, provide for the siting of high density or clustered housing within easy walking distance of commercial and employment centers.

b. The County shall review and, where necessary, amend its General Plan Land Use and Circulation Elements and development ordinances to support energy conservation and facilitate the provision of alternative transportation opportunities. These opportunities shall include public transportation, and bicycle and pedestrian pathways.

c. The County will amend its zoning ordinance to require that large employment centers shall have provisions facilitating the use of public transportation and/or other alternative modes of transportation such as vanpools, carpools, and bicycling.

d. The County shall consider the availability of public transportation opportunities in its land use decisions, especially in the approval of residential projects.

e. The acquisition of rights of way shall be considered by the County wherever such routes can establish or contribute to a local bikeway or trail system.

4.3.4 Economic Development and Energy Supply Reliability

4.3.4.1 Economic Development Policies

1. In order to stimulate economic development in Lassen County, as well as to provide electricity to local consumers at the most economic rates possible, the County supports the efforts of local utilities to obtain wholesale power at lower costs. These efforts include:

• Applications by the Lassen Municipal Utility District (LMUD)to obtain an allocation of Federal energy from the Western Area Power Administration; and

• The inclusion of Lassen County, in whole or part, in the Northwest Public Power Act, thereby facilitating the purchase of power from Federal sources in the northwest.

2. Lassen County supports efforts to deliver natural gas to the county as a means of obtaining additional economic sources of energy.

Implementation Measures

a. The County shall cooperate with local publicly-owned utilities in support of applications and legislation which will facilitate the availability of wholesale Federal energy.

b. The County will cooperate in the project review of natural gas pipelines which will serve Lassen County, subject to the criteria of this Energy Element.

4.3.4.2 Energy Supply Reliability

1. Lassen County encourages electric energy suppliers in the county to enter into cooperative agreements and make system improvements providing for the efficient intertying of distribution systems to alleviate the potential for prolonged or frequent power outages affecting the safety and welfare of anyone in the county.

2. The County supports the use of locally produced power to ensure the reliability of power needed in Lassen County during disruption of normal power service.

3. If there is an issue as to which entity or entities should be the supplier of natural gas in Lassen County, the County favors the entity or entities which can best provide service to the largest unincorporated area of the County in the most economical, efficient and expeditious manner.

Implementation Measures

a. The County will, as needed, conduct workshops and other meetings in cooperation with electric and natural gas suppliers in order to understand and influence supply and distribution issues for the greater interest of the people of Lassen County.

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B. BIBLIOGRAPHY

Association of Bay Area Governments. 1987. Small But Powerful; A Review Guide to Small Alternative Energy Projects for California's Local Decisionmakers.

California Department of Fish and Game. California Natural Diversity Data Base. 1992. "Rare Find" database search results for Lassen County. Sacramento, California.

California Department of Transportation (Caltrans), District 2. May 1984. Draft Route Concept Report: Route 44

California Department of Transportation (Caltrans), District 2. September 1990. Route Concept Report: Route 70.

California Division of Oil and Gas, Geothermal Unit. 1975. Report Number TR13: The Potential of Low Temperature Geothermal Resources in Northern California.

California Energy Commission. May 1980. Location of Sites for Wind Power Development in Northeastern California - Consultant Report.

California Energy Commission. May 1980. Wind Resource Assessment in California - Contractor Report.

California Energy Commission. September 1981. Environmental Assessment of Small Hydroelectric Development at Existing Sites in California.

California Energy Commission. November 1981. Local Energy Planning Handbook.

California Energy Commission. 1982. Cogeneration Handbook. Publication No. P500-82-054.

California Energy Commission. 1985. Biomass Energy Development in California: Status Report.

California Energy Commission. 1985. California Energy Plan.

California Energy Commission. April 1985. Wind Atlas.

California Energy Commission. June 1985. Resource Estimates of Small Power Technologies and Cogeneration in California.

California Energy Commission. 1986. Biomass Energy Report.

California Energy Commission. 1986. Local Agency Siting and Permit Assistance Program: California Power Plant Maps.

California Energy Commission. May 1986. Solar and Wind Technology Tax Incentive Impact Analysis.

California Energy Commission. May 1986. Solar and Wind Technology Tax Incentive Impact Analysis. Appendix A - Reviewer's Comments.

California Energy Commission. 1987. California's Energy Outlook - Biennial Report.

California Energy Commission. 1987. Fuels Report.

California Energy Commission. July 1988. Building Energy Efficiency Standards.

BIBLIOGRAPHY (continued)

California Energy Commission. April 1989. California Power Plant Maps - Map Compendium.

California Energy Commission. April 1990. Energy Efficiency Study for Lassen County Adult Detention Facility.

California Energy Commission. May 1990. Energy Efficiency Study for Lassen County Facilities.

California Energy Commission. October 1990. Energy Efficiency Study for City of Susanville Facilities.

California Energy Commission. June 1991. Energy Technology Status Report.

California Energy Commission. January 1992. Letter to Lassen County Planning Department with comments on the Lassen Energy Element Environmental Setting.

California Native Plant Society. Smith, J.P. Jr., and K. Berg. 1988. Inventory of Rare and Endangered Vascular Plants of California. Special Publication No. 1, 4th Edition. Sacramento, California

Cavanaugh, Calwell, Goldstein, and Watson. Spring 1989. National Energy Policy. World Policy Journal.

County Supervisors Association of California. 1985. California Counties Fact Book.

Department of Water Resources. February 1963. The Resources Agency of California. Northeastern Counties Ground Water Investigation. Bulletin No. 98.

Department of Water Resources, Northern District. April 1975. The Resources Agency. Lassen County - Land Uses and Water Demands, State of California.

EDAW. December 1983. Future Constraints to Transmission Line Route Selection.

Harding Lawson Associates. September 1987. Honey Lake Power Plant Project Final Environmental Impact Report.

Harding Lawson Associates. January 1989. Long Valley Geothermal Resource Assessment.

Harding Lawson Associates. January 1989. Wendel-Amedee Geothermal Resource Management Report.

Holton Associates. February 1989. Hydroelectric Development Within the North Yuba River Basin of Sierra County. Environmental Assessment.

Hornbeck, David. 1983. California Patterns - A Geographical and Historical Atlas.

Lake County Planning Department. May 1989. Lake County Geothermal Resource and Transmission Element. Volume 1: Resource Base, Growth Scenarios, Goals and Policies, Implementation Measures.

Lake County Planning Department. May 1989. Lake County Geothermal Resource and Transmission Element. Volume 2: Planning and Environmental Analysis.

Lassen County. No Date. Economic and Industrial Survey - Land Use and Zoning. City of Susanville, California.

Lassen County. September 1971. Comprehensive Water and Sewer Plan for Lassen County, California.

BIBLIOGRAPHY (continued)

Lassen County Air Pollution Control District. April 1991. Lassen County Air Pollution Control District Regulations.

Lassen County Almanac. February 12, 1991. Lumber Legacy Alive in Westwood.

Lassen County Department of Agriculture. Annual Crop Report for year 1990.

Lassen County Planning Department. 1968. Lassen County General Plan: 1990.

Lassen County Planning Department. September 1982. Eagle Lake Area Plan.

Lassen County Planning Department. October 1982. Susanville Vicinity Planning Area Master Environmental Assessment.

Lassen County Planning Department. February 1983. Johnstonville Planning Area Master Environmental Assessment.

Lassen County Planning Department. September 1983. Wendel Planning Area Master Environmental Assessment.

Lassen County Planning Department. November 1983. Pittville Area Plan EIR.

Lassen County Planning Department. August 1984. Susanville Vicinity Area Plan and Draft EIR.

Lassen County Planning Department. November 1984. Hallelujah Junction Area Plan EIR.

Lassen County Planning Department. December 1986. Pittville Area Plan.

Lassen County Planning Department. August 1987. Johnstonville Area Plan EIR.

Lassen County Planning Department. December 12 1989. Noise Element of the Lassen County General Plan.

Lassen County Planning Department. March 1990. Lassen County Economic Development Plan.

Lassen County Times. February 12, 1991. 1991 Lassen County Almanac. Special Supplement.

Lassen County Times Newspaper. Articles from following dates: March 12, 1991; May 7, 1991; May 20, 1991; June 29, 1991; July 16, 1991; July 23, 1991; July 30, 1991; and August 6, 1991.

Lassen Municipal Utility District. 1990. Quarterly Reports to the California Energy Commission.

Leckie, Jim and Masters, Gil, et al. 1981. More Other Homes and Garbage.

McClelland Consultants. October 1990. Lassen College Cogeneration Facility/Expansion Draft Environmental Impact Report.

Michael Brandman Associates. 1991. Draft Environmental Impact Report for the California State Prison.

BIBLIOGRAPHY (continued)

Miller, Kenneth. 1989. Geology of California.

Montgomery, Carla. No Date. Environmental Geology.

National Association of Counties. National League of Cities. August 1982. Community Energy Strategies.

Northern California Power Agency. August 1988. 1987 Residential End Use Survey. Appendix G. Plumas-Sierra Rural Electric Cooperative Crosstabulations.

Northern California Power Agency. August 1988. 1987 Residential End Use Survey.

Northern California Power Agency. December 1988. 1987 Residential End Use Survey. Appendix G. Plumas-Sierra Rural Electric Cooperative Crosstabulations.

Northern California Power Agency. August 1988. 1988 Commercial End Use Survey.

Northern California Power Agency. September 1991. Conservation Report.

Pacific Gas & Electric Company. December 2, 1980. Correspondence from Richard H. Moss, Pacific Gas & Electric Co. to Walter G. Pettit, Chief, State Water Resources Control Board.

Pacific Gas & Electric Company. 1988. Cogeneration and Small Power Production Quarterly Report.

State of California. Business, Transportation and Housing Agency. Department of Transportation. Division of Traffic Operations. 1990. 1990 Traffic Volumes on California State Highway System.

State of California, Department of Conservation, Division of Oil and Gas. 1987. 73rd Annual Report of the State Oil and Gas Supervisor.

State of California, Department of Corrections. April 1991. Draft EIR for the California State Prison, Lassen County.

State of California, Department of Water Resources. February 1963. Northeastern Counties Ground Water Investigation.

State of California, Department of Water Resources. April 1981. Bulletin 211 - Small Hydroelectric Potential at Existing Hydraulic Structures in California.

State of California, Office of Planning and Research. November 1984. California Permit Handbook.

State of California, Public Utilities Commission. March 17, 1989. Memorandum to Local Planning Officials.

Steffen Robertson and Kirsten (U.S.), Inc. September 1991. Hayden Hill Project Environmental Impact Report/Environmental Impact Statement. Lassen County, California. Volume I and II.

Stewart, Weir & Co. June 1986. The Corridor Concept - Theory and Application.

Tarbuck, Edward and Lutgens, Frederick. 1987. The Earth: An Introduction to Physical Geology.

BIBLIOGRAPHY (continued)

Tudor Engineering Company. No date. Susan River Multiple Purpose Water Resources Project Reconnaissance Level Feasibility Report.

Tuscarora Gas Transmission Company. 1992. Comparison of Natural Gas Versus Electric Water Heating Costs; Residential.

U.S. Department of Commerce, Bureau of the Census. 1980. Detailed Housing Characteristics, California.

U.S. Department of Commerce, Bureau of the Census. 1990. Census of Population and Housing, California.

U.S. Department of Energy. No Date. The Comprehensive Community Energy Management Program: An Evaluation.

Ventura County Planning Division, Resource Management Agency. May 24, 1988. Ventura County General Plan - Resources Appendix.

Yolo County Community Development Agency - Planning Division. 1990. Transmission Line Element of the Yolo County General Plan.

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