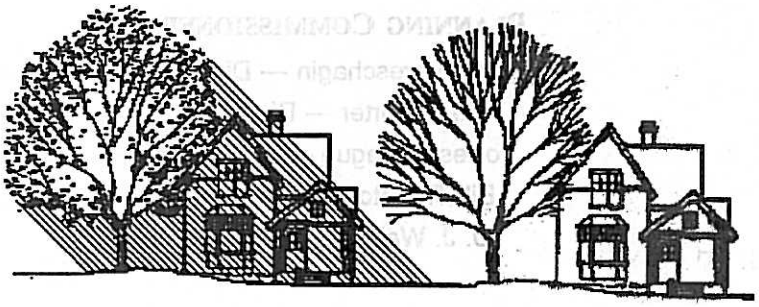
CRC

GLENN COUNTY



ENERGY ELEMENT
of the
GENERAL PLAN

JUNE 1993

GLENN COUNTY

BOARD OF SUPERVISORS

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BOARD OF SUPERVISORS
COUNTY OF GLENN, STATE OF CALIFORNIA

RESOLUTION NO. 93-61

RESOLUTION MAKING DETERMINATIONS, REASONS AND FINDINGS AMENDING THE GENERAL PLAN OF GLENN COUNTY.

WHEREAS, the *General Plan* is a comprehensive, long-term plan for growth and development in Glenn County over the next twenty years (1992-2012); and

WHEREAS, public hearings were held by the Board of Supervisors and also by the Planning Commission on the amendment to the General Plan including the following required elements: the Land Use Element, the Circulation Element, the Housing Element, the Conservation Element, the Open Space Element, the Noise Element and the Safety Element; and the optional Energy Element; and

WHEREAS, the *General Plan* was extensively reviewed by the Citizen Planning Advisory Committee; and

WHEREAS, the Energy Element was reviewed by the Energy Element Advisory Committee; and

WHEREAS, pursuant to Section 65090 of the California Government Code, notice of a hearing before this Board was given by one publication in a newspaper of general circulation in the County of Glenn; and

WHEREAS, the Board of Supervisors after considering all the evidence, both written and oral, presented at said public hearing, did find that there was sufficient information to enable it to make a decision.

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors with the following findings:

1. That an Environmental Impact Report has been prepared and the revised *General Plan* may cause significant adverse impacts to the environment. The Environmental Impact Report has been certified and a Statement of Overriding Considerations for those impacts that cannot be mitigated to insignificant has been adopted.

2. That a Negative Declaration has been prepared for the Energy Element and is hereby approved.

BOARD OF SUPERVISORS
COUNTY OF GLENN, STATE OF CALIFORNIA

RESOLUTION NO. 93-62

* * *

RESOLUTION MAKING DETERMINATIONS, REASONS AND FINDINGS ADOPTING THE GENERAL PLAN AND ENERGY ELEMENT STANDARDS.

* * *

WHEREAS, the *General Plan* is a comprehensive, long-term plan for growth and development in Glenn County over the next twenty years (1992-2012); and

WHEREAS, the General Plan and Energy Element Standards contained in the General Plan and the Energy Element Documents are not part of the General Plan but are intended to guide implementation of the Plan and are intended to be amended from time to time; and,

WHEREAS, public hearings were held by the Board of Supervisors and also by the Planning Commission on the Standards contained within the General Plan and the Energy Element documents; and

WHEREAS, the *General Plan* Standards were extensively reviewed by the Citizen Planning Advisory Committee; and

WHEREAS, the Energy Element Standards were reviewed by the Energy Element Advisory Committee; and

WHEREAS, pursuant to Section 65090 of the California Government Code, notice of a hearing before this Board was given by one publication in a newspaper of general circulation in the County of Glenn; and

WHEREAS, the Board of Supervisors after considering all the evidence, both written and oral, presented at said public hearing, did find that there was sufficient information to enable it to make a decision.

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors with the following findings:

1. That an Environmental Impact Report has been prepared and certified and the revised General Plan and Standards will cause no significant adverse impacts to the environment but will provide a benefit to the environment.

2. That a Negative Declaration has been prepared for the Energy Element and Standards and is hereby approved.

and with the following reasons:

1. That the revised *General Plan* will provide a benefit to the County of Glenn by providing for a coordinated plan of development for the unincorporated area within the County; and that the adoption of these Standards is necessary in order to implement the *General Plan.*

2. That the Energy Element Standards will result in cumulative impacts that have a positive net effect on the environment.

BE IT FURTHER RESOLVED that the Board of Supervisors orders that the Glenn County General Plan Standards and Energy Element Standards are hereby **ADOPTED** as set forth in Exhibit "A" attached hereto and made a part hereof.

This Resolution was adopted by the Board of Supervisors of the County of Glenn at a regular meeting thereof on June 15, 1993 by the following vote:

AYES: Supervisors Baker, Burbank, Harris, Hansen, and Mudd (Chairman)

NOES: None

ABSTAIN: None

ABSENT: None

Dick Mudd
CHAIRMAN,
Board of Supervisors,
Glenn County, California

ATTEST:

Connie Ortega, Deputy
for Carolyn Davis, County Clerk-Recorder
and ex officio Clerk, Board of Supervisors
Glenn County, California

APPROVED AS TO FORM:

DAVID FRANK, COUNTY COUNSEL
Glenn County, California

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EXECUTIVE SUMMARY

The Energy Element of the Glenn County General Plan has been prepared to establish comprehensive goals, policies, objectives, programs, and standards regarding energy use and energy facility development in the county. The purpose of the Energy Element is to increase energy efficiency in the county, determine the extent of the county's energy resources, determine what energy facilities could feasibly be developed in the future, and provide policy guidance for land use decisions involving energy facilities.

The County's rationale in developing the element is mostly economic. Glenn County is a rural area dependent on an agricultural economy. Energy efficiency and the development of renewable resources can reduce the annual energy expenditures of individuals and businesses, provide the potential for the County to own its own municipal utilities, support and create local jobs, and generally keep more of the dollars spent on energy commodities circulating in the local economy, rather than to utilities and remote resource providers. Care is taken to protect important resources of the county, including agricultural lands, water and air quality, recreation opportunities, historic resources, tourism, natural vegetation, wildlife, and wildlife habitats.

It is the goal of the Energy Element to support and encourage Glenn County residents to pursue lifestyles that make the most efficient use of all natural resources, especially energy; improved construction practices will provide for energy efficiency in all new construction and remodeling.

Another goal of the Energy Element is to coordinate the other elements of the Glenn County General Plan to place County services so that they are provided efficiently and economically.

The final goal of the Energy Element is to see the development of renewable energy facilities in Glenn County that support a diversified and stable economic base while preserving valuable agricultural land and protecting public health and safety and the environment.

EFFECTIVENESS OF EFFICIENCY MEASURES

The County can create considerable cost savings in utility bills by performing energy efficiency and conservation retrofits in County buildings and facilities. We assume that retrofit measures will save a minimum of 20 percent. The County currently spends $233,600 on energy bills each year. This translates into a minimum savings of $46,720 each year. Given the age of some County offices, the number could be as high as $116,800 (50 percent) or more.

There are 586,525 acres of grazing and farmland in Glenn County, and 55,425,000 kwh were used by the agriculture sector last year. About 80 percent (44,340,000 kwh) was used in pumping water. Assuming that more efficient methods of pumping water are able to increase efficiency 10 percent, a total of 4,434,000 kwh could be saved. Agricultural water rates range between 6.5¢ to 13¢ a kwh (PG&E, 1991), making the total savings $288,210 to $576,420 each year.

Transportation makes up a very large percentage of total energy use in the county. Land use and alternative transportation strategies that reduce passenger vehicle fuel use will have a tremendous effect on reducing energy use in the county. There is a great potential savings in long-term energy use represented by land use strategies presented in this document. Monetary savings will come immediately in reduced fuel use, and secondary savings will come in 10 or 20 years when Glenn County does not have to build a new sewer plant, enlarge a water distribution system to supply a remote rural subdivision, or add lanes to county roads and subsidize a bus system because of traffic congestion. Because the Glenn County economy relies on a large amount of bulk transportation of agricultural products, strategies that reduce fuel use by heavy trucking will also have a significant effect on overall use.

Because there are not a lot of large commercial and industrial business in Glenn County, past energy use tends to fluctuate considerably according to manufacturing or distribution decisions by individual companies. While retrofits to existing businesses can incrementally reduce energy use, the greatest savings will come in the construction of a new large commercial or industrial enterprise, where business will be required to meet the state regulations of energy efficiency in new construction. Encouraging and facilitating cogeneration as a part of new large enterprises will have a significant effect on energy use by this sector in the future.

Residential Energy Use has remained fairly constant in the past. Efficiency improvements to existing buildings could result in significant savings in electricity and natural gas. Mandates for new construction will maximize energy efficiency in new homes.

Although the measures mentioned above will have the greatest effect on energy savings in Glenn County, all the programs are very valuable. A study on the effectiveness of educational programs on conserving energy showed that information campaigns produce an average of 4 percent energy savings. (Although this is not a high rate, the cumulative effects can be enormous. If every individual uses 4 percent less energy each year for ten years, at the end of ten years that person would be using 34 percent less than when they started.) The total 1990 residential kilowatt-hours in the county were 80,636,476. A 4 percent saving at 12¢ per kwh gives a saving of $387,055.

EXPLANATION OF TABLE

This plan describes goals and policies for energy efficiency and for siting new energy facilities. The plan also provides detailed descriptions of programs or standards to achieve those goals and policies. Each program or standard notes an objective, a specific lead agency (the governmental agency that has the primary responsibility), funding, and time frame. The level of detail has produced a lengthy document, so Table A summarizes the programs and standards and the pay-back period.

The pay-back period to the County is the time it takes to recover the costs needed to implement the program. In some cases, it is difficult to establish an exact time or date. In these instances, the pay-back period is related back to how many times the program must be implemented, e.g., the number of homes that need to be retrofitted, the number of energy facilities that need to be built, or the number of bicycle trips that must result from the program.

The pay-back period for the investor is the time it takes to recover the costs associated with applying the programs in their home or business.

Table A: Summary of Programs and Standards and Pay-back Periods
Glenn County Energy Element

Program/ Standard	Action Required	County Costs & Pay-back Period[1]	Private Sector Costs & Pay-back Period
ENERGY EFFICIENCY GOALS			
Efficiency 3.1.1	Monitor Glenn County energy use.	$250 expenditure. Indefinite.	Not applicable.
LAND USE PLANNING			
Land Use 3.2.1	Incorporate energy efficiency priorities into the Land Use Element.	No additional costs. Immediate.	Unknown.[2] Probably two to four years.
Land Use 3.2.2	Incorporate pedestrian and bicycle master plan in to the Transportation Component.	No additional costs. Immediate.	Not applicable.
Land Use 3.2.3	Amend land division ordinance to include energy efficient design and solar access.	Minimal costs. Immediate.	Reduced utility bills. Immediate.
TRANSPORTATION			
Transport 3.3.1	Identify sites within the county that are suitable for park-and-ride lots.	$252 expenditure. Unknown.	Not applicable.
Transport 3.3.2	Set development fees for bike facilities and install in key public locations.	$252. Three bicycle trips each day, two miles long each way.	Reduced transportation costs. Immediate.
Transport 3.3.3	Amend zoning code to require bike facilities at all County buildings.	Minimal costs. Immediate.	Reduced transportation costs. Immediate.
Transport 3.3.4	Amend zoning code to prohibit drive through windows.	Minimal costs. Immediate.	Reduced pollution and fuel use. Immediate.
Transport 3.3.5	Amend zoning code to permit telecommuting, satellite offices, and telework centers.	Minimal costs. Immediate.	Reduced transportation costs. Immediate.
Transport 3.3.6	Amend land division ordinance and zoning code to reduce required street widths.	$504. Less than one year.	Reduced cooling bills. Immediate.
Transport 3.3.7	Petition against any opposed changes in rail service.	$5,040. Thirteen months.[3]	Reduced trucking costs. Unknown.
Transport 3.3.8	Develop contingency plan to purchase rights-of-way if rail service is changed.	$2,050. Seven months.[4]	Reduced trucking costs. Unknown.
Transport 3.3.9	Investigate possibility of establishing a freight depot in the county.	$2,050. Five months.[5]	Reduced trucking costs. Unknown.
Transport 3.3.10	Monitor traffic volumes on all major corridors on a biannual basis.	Minimal costs. Unknown.	Reduced pollution and fuel use. Immediate.

Program/ Standard	Action Required	County Costs & Pay-back Period	Private Sector Costs & Pay-back Period
RESIDENTIAL BUILDINGS			
Resident 3.4.1	Develop guidelines for energy efficient residential construction.	$1,915.[6] Three months.	Unknown.[7] Probably two to four years.
Resident 3.4.2	Require energy retrofits at time of major renovation.	$252. Two retrofitted homes.	$635. Four years.
Resident 3.4.3	Require energy audits at time-of-sale for residential units.	$252. Two retrofitted homes.	No cost to investor. Immediate.
Resident 3.4.4	Report on availability of rehabilitation loans for retrofits.	$252. Two retrofitted homes.	Reduced utility bills. Immediate.
Resident 3.4.5	Obtain CDBG loans to support energy efficient rehabilitation.	$1,260. Seven retrofitted homes.	Reduced utility bills. Immediate.
Resident 3.4.6	Investigate Energy Partners program in Glenn County.	$252. Two retrofitted homes.	Reduced utility bills. Immediate.
Resident 3.4.7	If residential programs do not meet objective, enact retrofit at time-of-sale ordinance.	$756. Five retrofitted homes.	$635. Four years.
Resident 3.4.8	Participate in Title 24 and solar review course.	$956.[8] Construction of six efficient homes.	Reduced utility bills. Immediate.
Resident 3.4.9	Allow and encourage solar applications for home use.	Minimal costs. One solar home.	Reduced utility bills. Immediate.
Resident 3.4.10	Enact tree planting ordinance to increase shade and reduce cooling costs.	$4,400 a year. 42 trees after five years.[9]	$40. Nine months after five years.
Resident 3.4.11	Amend land division ordinance to require individual meters on multi-family units.	Minimal costs. Immediate.	Reduced utility bills. Immediate.
Resident 3.4.12	Give rebate to residents that replace standard toilets with ultra-low flush toilets.	$1,000 a year.[10] Unknown. Significant reduction in water use.	$150 less $50 rebate. 23,000 gallons a household each year.
Resident 3.4.13	Mail out info on retrofits and conservation to new utility customers.	$384.[11] One retrofitted home.	Unknown. Probably two to four years
COMMERCIAL AND INDUSTRIAL BUILDINGS			
C & I 3.5.1	Develop energy efficient commercial and industrial construction program.	$315. Less than one new efficient business.	Unknown. Probably two to four years.
C & I 3.5.2	Mail out information on retrofits and conservation to businesses.	$750.[12] Three retrofitted businesses.	Unknown. Probably two to four years.
C & I 3.5.3	Enact retrofit at time-of sale ordinance for commercial and industrial enterprises.	$756. Three retrofitted businesses.	$580. Two years.
C & I 3.5.4	Revise application requirements to require proof of a recent energy audit.	$157.50.[13] One retrofitted business.	None. Immediate.

Program/ Standard	Action Required	County Investor Costs & Pay-back Period
PUBLIC FACILITIES		
Public 3.6.1	Hire architect experienced in solar design to design the next County building.	Unknown. Probably around $10,000. Pay-back probably in ten years.
Public 3.6.2	Conduct energy audit of all County offices and buildings and do retrofits.	Unknown. Probably $50,000 to $100,000. Pay-back probably in two to five years. Current costs are $233,600 a year.
Public 3.6.3	Maintain efficient vehicle replacement and evaluate efficiency of County fleet.	No additional costs. Immediate.
Public 3.6.4	Present options to Board on possible alternative fuel vehicles for County fleet.	$252. One alternative fuel vehicle.
Public 3.6.5	Include energy and transportation impacts in siting decisions for County buildings.	No additional costs. Immediate.

Program/ Standard	Action Required	County Costs & Pay-back Period	Private Sector Costs & Pay-back Period
AGRICULTURAL LAND USE			
Ag 3.7.1	Amend zoning code to specifically allow alternative energy facilities and fuels.	Minimal costs. One facility application.	No additional costs. Immediate.
Ag 3.7.2	Recommend a program to Board on ways to save water through more efficient pumping.	$3,780. Unknown pay-back.	Reduced utility bills. Immediate.
Ag 3.7.3	Conduct regular sessions for farmers on experimental farm techniques.	$1,323. Unknown pay-back.	No direct costs. Unknown pay-back.
Ag 3.7.4	Forward recommendations on federal and state programs to appropriate parties.	$945.[14] No pay-back.	Not applicable.
ENERGY EDUCATION			
Educate 3.8.1	Formalize conservation and energy efficiency programs in county schools.	$157.50 Five people conserving energy.	None. Immediate.
Educate 3.8.2	Organize construction season kickoff fair to promote energy efficient construction.	$500.[15] One month. See program 4.1.	None. Immediate.
Educate 3.8.3	Organize a business seminar to promote energy efficient retrofits and new construction.	$500. Eight months. See program 5.1.	None. Immediate.

Program/ Standard	Action Required	County Costs & Pay-back Period	Private Sector Costs & Pay-back Period
RECYCLING AND REUSE			
Recycle 3.9.1	Amend zoning code to permit recycling in all commercial and industrial zones.	Minimal costs. One business application.	No additional costs. Immediate.
Recycle 3.9.2	Adopt waste reduction and recycling ordinance that gives incentives to recycle.	$2,520. Unknown.	Less fees to those who recycle. Immediate.
Recycle 3.9.3	Set up collection centers for recyclable goods in all County buildings.	$300.[16] One to two years.	Not applicable.
Recycle 3.9.4	Give preference to recycled products when selecting purchase items.	Minimal costs. Immediate.	Not applicable.
ENERGY FACILITY GOALS			
Facility 4.1.1	Amend zoning code to require pre-application conference.	Minimal costs. One facility application.	No additional costs. Immediate.
Facility 4.1.2	Amend application requirements to include information on energy savings and efficiency.	Minimal costs. One facility application.	No additional costs. Immediate.
Facility 4.1.3	Amend zoning code to establish additional standards for energy facility siting.	Minimal costs. One facility application.	No additional costs. Immediate.
Facility 4.1.4	Amend zoning code to establish cost analyses of government facility proposals.	Minimal costs. One facility application.	No additional costs. Immediate.
GAS FIELD AND WELL DEVELOPMENT			
Gas Well 4.2.1	Amend zoning code to establish additional standards for gas well permit approval.	Minimal costs. One facility application.	Some additional costs.[17] Less than one year.
BIOMASS FACILITIES			
Biomass 4.3.1	Amend zoning code to establish additional standards for biomass facility approval.	Minimal costs. One facility application.	No additional costs.[18] Immediate.
Biomass 4.3.2	Include Air Pollution Control District in initial review of project.	Minimal costs. One facility application.	No additional costs. Immediate.

Program/ Standard	Action Required	County Costs & Pay-back Period	Private Sector Costs & Pay-back Period
COGENERATION FACILITIES			
Cogen 4.4.1	Amend zoning code to permit single-building cogeneration facilities with little review.	Minimal costs. One facility application.	No additional costs. Immediate.
Cogen 4.4.2	Amend zoning code to establish additional standards for cogeneration facility approval.	Minimal costs. One facility application.	No additional costs. Immediate.
Cogen 4.4.3	Include Air Pollution Control District in the initial review of the project.	Minimal costs. One facility application.	No additional costs. Immediate.
HYDROELECTRIC FACILITIES			
Hydro 4.5.1	Amend zoning code to establish additional standards for hydroelectric facility approval.	Minimal costs. One facility application.	No additional costs. Immediate.
Hydro 4.5.2	Report on the effects of hydroelectric facilities on the dissolved oxygen levels in streams.	No additional costs. Immediate.	$100 Expenditure. No pay-back.
Hydro 4.5.3	Amend zoning code to require emergency plan for drought and excessive rain.	Minimal costs. One facility application.	No additional costs. Immediate.
WIND ENERGY CONVERSION SYSTEMS			
Wind 4.6.1	Amend zoning code to establish additional standards for single wind turbine approval.	Minimal costs. One turbine application.	No additional costs. Immediate.
Wind 4.6.2	Amend zoning code to establish additional standards for commercial wind system approval.	Minimal costs. One facility application.	No additional costs. Immediate.
Wind 4.6.3	Require reports from wind facility operators on avian and wildlife deaths.	$1,260 expenditure. No pay-back.	Minimal expenditure. No pay-back.
SOLAR SYSTEMS			
Solar 4.7.1	Amend zoning code to establish additional standards for solar facility approval.	Minimal costs. One facility application.	No additional costs. Immediate.
Solar 4.7.2	Amend zoning code to permit individual solar panels for on-site space and water heating.	Minimal costs. One solar panel installation.	No additional costs. Immediate.

Program/ Standard	Action Required	County Costs & Pay-back Period	Private Sector Costs & Pay-back Period
THERMAL CONVERSION FACILITIES			
Thermal 4.8.1	Amend zoning code to establish additional standards for fossil fuel power plant approval.	Minimal costs. One facility application.	No additional costs. Immediate.
Thermal 4.8.2	Amend zoning code to establish additional standards for nuclear power plant approval.	Minimal costs. One facility application.	No additional costs. Immediate.
Thermal 4.8.3	Include Air Pollution Control District in the initial review of the project.	Minimal costs. One facility application.	No additional costs. Immediate.
GAS AND OIL PIPELINES			
Pipelines 4.9.1	Amend zoning code to establish additional standards for gas and oil pipeline approval.	Minimal costs. One facility application.	Some additional costs. Less than one year.
Pipelines 4.9.2	Amend pipeline franchise agreement application to include impacts of possible leaks and spills.	Minimal costs. One facility application.	Some additional costs. Less than one year.
TRANSMISSION LINES			
Transmit 4.10.1	Amend zoning code to require preliminary alignment of transmission line proposal.	Minimal costs. One facility application.	Minimal costs. Immediate.
Transmit 4.10.2	Amend zoning to establish additional standards for transmission line approval.	Minimal costs. One facility application.	Additional costs. Two to four years.

ENDNOTES TO EXECUTIVE SUMMARY TABLE

1. The total costs of implementing almost all of the programs and standards would be $36,533. Updating the zoning code and subdivision ordinance would require another $2,520 (80 hours of time). This figure does not include retrofits to the County buildings and offices, which could cost anywhere from $50,000 to $100,000. When a new county building is being designed, hiring an architect experienced in energy efficient and solar design will probably cost another $10,000. Unless stated otherwise, all costs are based on work-hours of an employee paid $31.50 an hour.

2. There will probably be a costs savings in public facilities, although this might be offset by an increase in residential construction costs.

3. Based on a 10 percent increase in fuel used by heavy trucks in the county as train cargo is carried by trucks instead.

4. Program would be funded by the Clean Air and Transportation Improvement Act. Based on a 10 percent increase in fuel used to transport cargo by trucks instead of trains.

5. Program would be funded by the Clean Air and Transportation Act. Pay-back based on a 20 percent decrease in trucks that would instead use trains.

6. Based on $1,890 in labor and $25 copying costs.

7. The exact costs and benefits will depend on the energy efficiency features the builder chooses to include.

8. This assumes that two personnel would attend a day-long course costing $100, and four additional people would spend two hours reviewing the material with the two who attended the course.

9. The costs are based on a summer employee being paid $10 an hour. The pay-back period is delayed until the trees mature. The costs of this program could be significantly reduced if volunteers donate time to plant trees.

10. Costs based on twenty rebates of $50.

11. This is the cost of mailing 254 packages with $1.50 postage.

12. Based on mailing 500 packages with $1.50 postage.

13. This assumes that one person from each department will spend one hour in revising applications.

14. Based on one representative from each group spending three hours attending the forum.

15. This includes the cost of six hours of labor, presentation materials, and refreshments (See also 8.3)

16. Cost of 20 trash cans at $15 each.

17. Because there are currently regulations regarding gas wells and pipelines in the Zoning Code, it is assumed that submitting an application under the new requirement will entail some additional costs.

18. In cases where there are no current regulations regarding facility siting, the additional costs are zero.

Chapter One
INTRODUCTION

PURPOSE AND REPORT ORGANIZATION

BACKGROUND

The Energy Element of the Glenn County General Plan has been prepared to establish comprehensive goals, policies, objectives, programs, and standards regarding energy use and energy facility development in the county. The purpose of the Energy Element is to increase energy efficiency in the county, determine the extent of the county's energy resources, determine what energy facilities could feasibly be developed in the future, and provide policy guidance for land use decisions involving energy facilities.

California state law requires that every county and city adopt a general plan that covers seven topics or "elements." Those mandatory elements are land use, circulation, housing, conservation, open-space, noise, and safety. The Glenn County General Plan will also include an Economic Development Element and a Capital Facilities Element. The general plan serves as a blueprint for community growth and change. The plan contains goals, objectives, policies, and programs to guide decisions by county government on private land development and the provision of public services and facilities. As social, economic, and environmental conditions change over time, it is important that the general plan be periodically revised to effectively address both current conditions, and community expectations about the future. Although the Energy Element is an optional component of the general plan, it still carries an equal weight and stature as the mandatory elements. By law, all components of the general plan must be internally consistent.

The County's rationale in developing the element is mostly economic. Glenn County is a rural area dependent on an agricultural economy. Energy efficiency and the development of renewable resources can reduce the annual energy expenditures of individuals and businesses, support and create local jobs, and generally keep more of the dollars spent on energy commodities circulating in the local economy, rather than to utilities and remote resource providers. Care is taken to protect important resources of the county, including agricultural lands, water and air quality, recreation opportunities, historic resources, tourism, natural vegetation, wildlife, and wildlife habitats.

The process used to prepare this Energy Element involved four working papers first being prepared by the County's consultants. The first paper, *Environmental Resources and Energy Technologies—Draft Environmental Setting*, described the county's environmental setting and the potential environmental consequences of energy facility development. The second paper, *Energy Facility Siting in Glenn County—Working Paper*, reviewed the operational characteristics of various energy facilities and the viability and likelihood of such facilities being located in Glenn County. The third report, *Energy Efficiency and Conservation—Working Paper*, examined past and present patterns of energy use in Glenn County and identified energy efficiency and conservation programs to reduce the overall use of energy. The purpose of the final report, *Draft Energy Element Policy Plan*, was to develop goals and policies for energy conservation and efficiency that are appropriate for the County and to establish standards for the siting, construction and operation of energy facilities.

The analysis and recommendations of all the previous reports have been incorporated into this document. Accompanying this plan are the environmental documents required by the California Environmental Quality Act (CEQA). Following review of the Draft Energy Element and CEQA documents by the County's citizens advisory committee, the consultants will make the necessary corrections and submit revisions of both items. These items will be the subject of public hearings before the Planning Commission and Board of Supervisors. The Board will have the final authority to adopt the Energy Element.

REPORT ORGANIZATION

The Energy Element is divided into five chapters. This chapter, *Introduction*, provides background material on the Energy Element and information on energy measurement and production. The next chapter, *Energy Use in Glenn County*, provides specific information on the factors affecting energy use, past energy use in the County, and current zoning regulations for energy facility development.

The third chapter, *Energy Efficiency*, presents the goals, policies, and programs for increasing energy efficiency in Glenn County. Background material on methodology and expected savings is provided after the program discussion.

Facility Siting is the topic of Chapter Four, which contains goals, policies, and standards for energy facility siting. Background material covers energy technologies and mechanics, the viability of the facility in Glenn County, opportunities, constraints, necessary applications, agencies with review authority, and environmental and land use issues.

The *Conclusion* is found in chapter five; it summarizes the programs and standards and provides a reference guide to consistency requirements. *Appendices* follow at the end of the document.

DEFINITIONS OF GOALS, POLICIES, PROGRAMS, AND STANDARDS

The Energy Element sets forth the proposed goals and policies which are relevant to energy efficiency and energy facility development. By definition, a goal expresses, in general terms, community values which set a direction or ideal future end, condition, or state.

Policies are specific statements to be used in guiding decision making, based on the Glenn County General Plan goals. Policy statements will often contain the words "should" or "shall." As set forth in the *State of California General Plan Guidelines*, the word "shall" indicates an unequivocal directive. The word "should" signifies a less rigid directive, to be honored in the absence of compelling or contravening considerations.

In the context of the Energy Element, programs are those measure which carry out policies. These programs may represent an action, procedure, or technique which will achieve the established goals and objectives. Standards represent rules or measure which establish a level of quality or quantity that must be complied with or satisfied. Once adopted, standards provide specificity to the goals, objectives, and policies contained in the general plan.

THE ENERGY STORY AND THE CEC

The following passage is primarily based on *The 1992-1993 California Energy Plan* which is the *Biennial Energy Report of the California Energy Commission*. The passage describes the CEC's interest in funding such programs as the Glenn County Energy Element.

> "Energy is a necessary commodity often taken for granted. We gas up our vehicles, turn on our lights, heating and air conditioning systems, and run our industries and businesses often without realizing the sources of our energy and the many implications of energy use.
>
> "California is the fastest growing state in the nation. During the past 15 years, the state's population increased 33 percent and is expected to continue growing. Glenn County has grown 3 percent during each of the past three years. This compares to a 1.5 percent growth rate for each of the previous seven years. As demand for energy increases as a result of the growing population, awareness of our energy supply limits and of ways to reduce energy use will become more and more important.
>
> "Nearly half (48 percent) of all energy consumed in California is used for transportation —and virtually all of this energy is derived from petroleum. The state's residential and commercial sectors, accounting for 21 percent of total energy use, rely mostly on natural gas and electricity. In Glenn County, the residential and agricultural sectors use the greatest amount of electricity. Restrictions on surface water use are expected to increase the use of electricity and diesel fuel for water pumping. California's expanding population has increasingly been moving into the state's warmer valley regions, including the northern Sacramento Valley. Left unchecked, these energy demands will require costly new electricity generating facilities which might be needed for only a few peak hours daily.
>
> "Electricity is approximately 48 percent dependent upon fossil fuels (oil and natural gas) for its generation. Despite our gains in diversifying the mix of energy resources (such as hydroelectric, nuclear, geothermal, wind, biomass, and solar) used in California to generate electricity, over 90 percent of the total energy consumed in this state still comes from fossil fuels.
>
> "California currently obtains 47 percent of its crude oil supply from inside the state. Another 48 percent currently comes from Alaska. Both sources are in decline. Without changes in present consumption patterns, use of foreign oil is expected to increase over the long term. Despite California's current relative independence of foreign oil, world prices of oil are set by OPEC (the Organization of Petroleum Exporting Countries) with the intent of dominating the world oil market and steadily increasing oil prices. Low energy prices have created the greatest barrier to the development of alternative energy sources and increased energy efficiency in this country.
>
> "Population and economic growth, together with the lowest gasoline prices (adjusted for inflation) in 25 years, could increase petroleum consumption in California as much

as 32 percent by the year 2009. Yet current state facilities are at capacity for transporting, refining and distributing crude oil and petroleum products. Constructing new infrastructure would entail a wide range of economic and environmental issues.

"Increasing fossil fuel use raises other concerns. According to the California Air Resources Board, 80 percent of the state's air pollution is caused by burning fossil fuels. Air pollution affects the quality of life in our state, including the health care costs of its residents. Emissions from vehicles as well as power producing facilities result in the formation of acid rain with its negative effects on agricultural and forest productivity. The state is concerned about and is studying the various implications for the California economy of possible climate changes resulting from the increase in $C0_2$ in the atmosphere. The CO_2 emissions primarily result from our transportation sector.

"Three-fourths of all petroleum consumed in California is used for transportation. This energy use is growing faster than our population. Increases in vehicle fuel economy are being overshadowed by an increase in the number of vehicle miles traveled. According to the California Department of Transportation, if there are no major shifts in land-use patterns or modes of travel, the number of highway miles traveled will increase 51 percent by 2005. For this reason the Glenn County Energy Element addresses land use planning and transportation.. California is presently the third largest consumer of gasoline in the world. Only the United States as a whole and the former Soviet Union exceed this volume. Yet we know that high energy consumption in not necessary to assure economic prosperity. Today, both Japan and Germany consume half as much total energy to produce the same amount of goods as the United States. To remain competitive in the world marketplace, we must recognize the values of energy efficiency itself as a benign source of energy.

"Energy efficiency and energy conservation are the most cost effective strategies for meeting projected energy demands. Dollars otherwise paid to utilities for electricity or natural gas or for vehicle fuel can strengthen local businesses, can be invested in local communities and can strengthen consumer buying power. Major utilities, recognizing that investing in efficiency is less costly than investing in new sources of power, are developing shareholder incentive mechanisms to promote efficiency. Energy efficiency is also the lowest cost alternative for improving air quality for the state as a whole. The state is also pursuing the development of alternative and renewable energy sources to further assure a diverse and stable energy supply.

"The State Legislature established the California Energy Commission in 1974 as the state's principal energy planning and policy making organization in order to address the energy challenges facing the state. The policies formulated by the Energy Commission are intended to provide a reliable and affordable energy supply necessary for economic health and are consistent with protecting the state's environment and its public health, safety, and general welfare. Long term prosperity will demand watchful care over the state's assets and resources, such as water, clean air, farm land, wildlife habitat, and recreational and scenic attractions. These policies are inextricably related to the economic development, transportation and air quality goals of California's cities and counties. The updating of the Glenn County General Plan presents opportunities to develop these goals.

"Through Siting and Permit Assistance Program grants such as this one to develop an Energy Element for the Glenn County General Plan, the California Energy Commission is working to provide a more secure, stable, and environmentally and economically sound future for Glenn County and for California."

—Jackie Stroud, California Energy Commission

ENERGY USE AND PRODUCTION

ENERGY

Although nearly everyone has some knowledge or intuitive understanding about how energy can be produced and used, a brief review of basic energy principles may be helpful in understanding the terms and issues discussed in this plan.

Energy can be produced in a variety of forms: heat (thermal energy); motion (mechanical or kinetic energy); or chemical reactions (chemical energy). In each case, a physical system becomes capable of producing energy (and doing work) as a result of a change in the "state" of the system. For example, energy can be produced in a fossil fuel power plant by burning (changing the state) of oil or natural gas to generate heat, which is used to convert (or change the state) of water to steam. The heat energy in the steam is then converted to mechanical energy when the steam is directed through a turbine, which turns a generator, which produces electricity. Several methods of energy production are discussed in greater detail in *Chapter 4 Facility Siting.*

Two types of energy processes exist in nature. Spontaneous processes occur naturally without the need for an outside agent to trigger them. Such processes include sunlight and waterfalls. Non-spontaneous processes require some energy input to begin energy production. Oil contains energy that can be harnessed when it is burned, and a match or spark plug can act as the outside agent that releases the energy from oil.

ENERGY MEASUREMENT

Ultimately, energy is used to accomplish work. In this respect, energy and work are synonymous, and in science the two terms are interchangeable. Energy, or work, is the product of a force being applied for some distance. Calculating energy use in Glenn County requires examining several end-uses, specifically kilowatt hours of electricity, cubic feet of natural gas, and gallons of gasoline.

The standard unit for measuring thermal Power, measured in watts, is an amount of energy applied per unit time. One watt is equal to one joule of energy applied for one second. For example, if a hydroelectric facility is said to have five megawatts (5 MW) of capacity, this means that it can potentially generate five million joules of energy per second. Appendix A provides more information about various terms commonly used in discussions of energy.

To simplify comparisons, all sources of energy use can be converted into British thermal units (Btu). One Btu is the amount of thermal energy required to raise the temperature of one pound of water 1°F at sea level. Btu conversions for the types of energy used in Glenn County are:

One kilowatt-hour of electricity	3,412	Btu
One cubic foot of natural gas	1,000	Btu
One gallon of unleaded gasoline	125,000	Btu
One gallon of diesel fuel	140,000	Btu

Source: *Draft Siskiyou County Energy Element*, 1992. *Yolo County Energy Element*, 1982.

ELECTRICITY DEMAND

When the California Energy Commission prepared *California's Energy Plan* (1991), conservation measures were a major focus of the study. Instead of viewing conservation simply in terms of savings, conservation was considered to be the most efficient method of energy production. Figure 1-1 demonstrates this fact by showing anticipated future electricity demand in California and the potential savings that can be achieved through improved energy efficiency. The CEC forecast for California electricity consumption (the top curve on Figure 1-1) predicts a demand for approximately 310,000 gigawatt hours by 2009. The energy efficiency and energy conservation programs suggested by the collaborative efforts of the utility companies (the Utility Demand Side Management (DSM) Projection line on Figure 1-1) would reduce demand by 10 percent. The Electric Power Research Institute (EPRI) estimates that changes in efficiency could reduce demand by 40 percent ("EPRI Cost-Effective Potential"). The CEC estimated that the maximum technical potential for efficiency would produce a 60 percent demand reduction. Note that there is actually a potential to *decrease* total energy use through improved efficiency; any efficiency measures that reduce demand by 30 percent or more will decrease the total amount of electricity used.

ENERGY PRODUCTION

The importance of decreasing (or not decreasing) electricity use become more apparent when considering how energy is produced, because some methods of electricity production are themselves more energy-efficient than others. Figure 1-2 shows the relative and absolute efficiencies that occur when natural gas is converted to electricity. Only one-fourth (25 percent) of the original potential energy of natural gas is available after it has been converted to electricity. If natural gas is used directly for heating and cooking, the efficiency rating is close to 100 percent.

Thirty-two percent of California's electricity is generated by burning natural gas. Although Glenn County is served mostly by hydroelectric power, any electricity saved in Glenn County through conservation could be used elsewhere in the state (Klein, 1992). The numbers above the bars on Figure 1-2 note the absolute efficiencies of energy that remain at each conversion step. Numbers inside the bars represent the relative efficiency of each step.

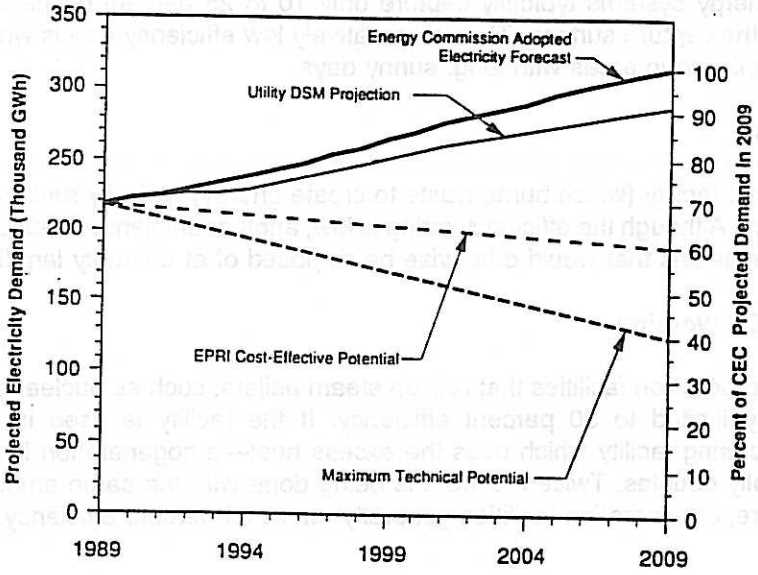
The entire process of converting gas in the ground to electricity at a home or business consumes 75 percent of the original energy resource. The biggest inefficiency occurs when the refined natural gas is converted to electricity at a power plant. Only one-third (33 percent) of the potential energy remains after the conversion process (the number inside the bar on the Figure 1-2 graph). The absolute efficiency drops from 82 to 27 (outside numbers) during this process. This means that 55 percent of the total energy needed to make electricity out of gas is consumed at this conversion point. Reducing the demand for one unit of electricity at a home, office, or industry, can result in a savings of four units of natural gas.

Each type of energy production facility will have different operating efficiency. These average efficiencies are later incorporated into energy facility standards to ensure that permits are not issued to highly inefficient facilities.

Hydroelectric

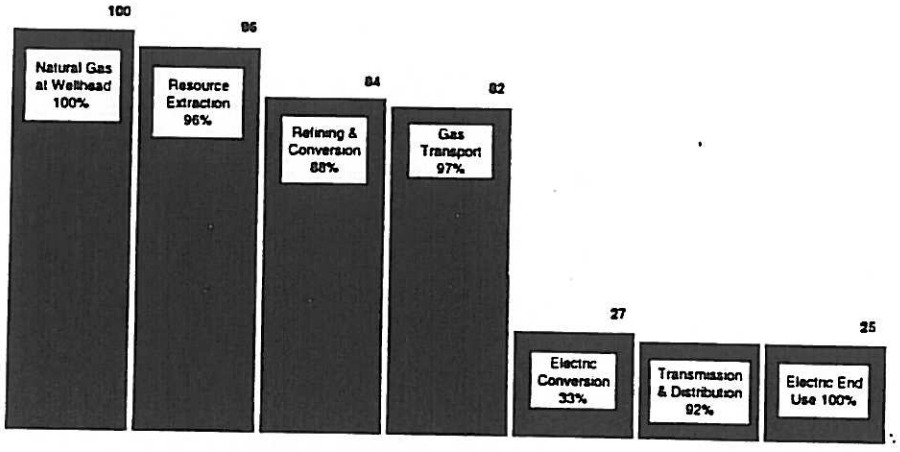
In hydroelectric facilities, the conversion efficiency is around 90 percent; that is, hydroelectric facilities are able to capture 90 percent of the energy inherent in the falling water and can then convert that energy to electricity which can be exported to other areas.

Figure 1-1: Comparison of Future Electricity Demand Scenarios
State of California



Source: California Energy Commission, 1990.

Figure 1-2: Efficiency Staircase of Natural Gas Conversion to Electricity
State of California



Source: California Energy Commission, 1990.

Wind

Likewise, wind energy systems can convert around 75 percent of the energy embodied in wind. The energy captured by wind turbines is often used as mechanical energy to pump water, or it can be converted into electricity.

Solar

Solar energy systems typically capture only 10 to 25 percent of the sun's energy that is striking the capture surface. The comparatively low efficiency rate is why solar facilities are best employed in areas with long, sunny days.

Biomass

A biomass facility (which burns waste to create energy) typically runs at around 20 percent efficiency. Although the efficiency rating is low, another efficiency is realized by making good use of materials that would otherwise be disposed of at a county landfill.

Steam Conversion

Energy production facilities that rely on steam boilers, such as nuclear or coal facilities, are generally limited to 30 percent efficiency. If the facility is used in conjunction with a manufacturing facility which uses the excess heat—a cogeneration facility—the efficiency essentially doubles. Twice the work is being done with the same amount of energy input. Therefore, cogeneration facilities generally run at 65 percent efficiency.

Chapter Two
ENERGY USE IN GLENN COUNTY

FACTORS AFFECTING ENERGY USE

It is important to understand the factors that affect energy use so that one may develop reasonable and feasible conservation and energy efficiency policies. For example, removing air conditioners from homes would greatly reduce residential energy consumption, but such a policy would be impractical given the hot summers in Glenn County. This section describes the factors that affect the use of energy by the residential, commercial, industrial, agriculture, and transportation sectors.

RESIDENTIAL ENERGY USE

Figure 2-1 is a pie chart showing typical residential energy use in California in 1987. Heating and water heating are the largest energy end uses, representing over half the total residential use. The following are the factors that have the greatest effect on residential energy use.

Population

At any given time, the larger the population of an area, the more electricity the area consumes. When discussing long term trends, however, this is not always true. Changes in efficiency or increased energy costs can greatly reduce energy use. For example, between 1980 and 1985, the county population increased by 6.2 percent while residential electricity use actually *decreased* by 2.2 percent.

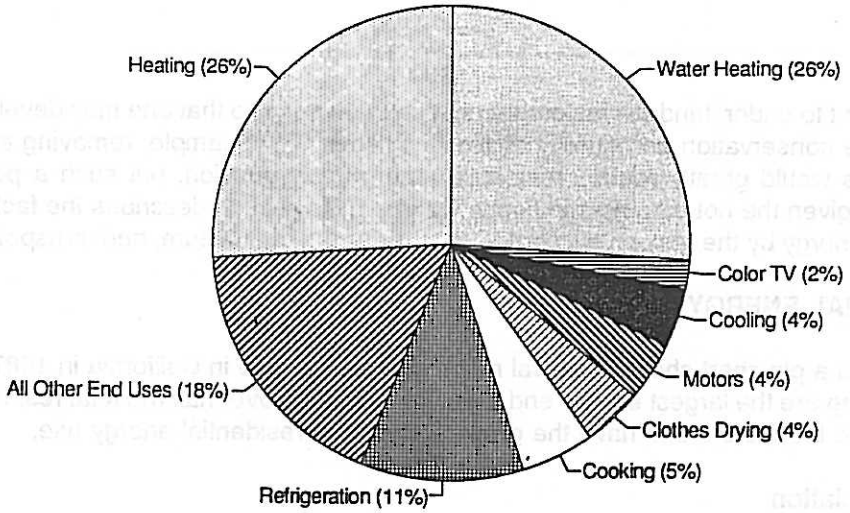
The county experienced a growth rate of 15 percent between 1980 and 1990. Table 2-1 shows the projected Glenn County population as stated in the *Environmental Setting Technical Paper* prepared by Quad Consultants for the Glenn County General Plan Update. Notice that the County anticipates that the population will continue to increase at a modest rate of 1.35 percent each year. At this pace, the county will double its population in 52 years. Most of the increase is expected to be from births, not from migration into the county. An increasing percentage of the population will be elderly (QUAD,1992).

It should be noted that the populations of the cities of Willows and Orland increased 25 percent from 1980 to 1990. Because there are more services available, it is likely that these cities will continue to increase at a faster pace than the unincorporated areas.

Climate

The local climate has a major effect on residential energy use. In general, Glenn County has a climate typical of the Sacramento Valley. Summers are hot and dry and winters are moderately cool. Prolonged periods of cold weather will cause increased energy demand for space and water heating; prolonged periods of hot weather will increase energy demand for air conditioning and cooling. This situation is particularly true if homes are not well-insulated.

Figure 2-1: Residential Energy End Uses
California 1987



Source: California Energy Commission, 1990.

Table 2-1: Past and Projected Population
Glenn County 1980 to 2005

Year	Total Population	Percent Increase
Actual Population		
1970	17,521	NA
1976	19,726	8.9
1980	21,350	9.2
1985	22,700	9.4
1990	24,550	9.2
Total Population Increase	7,029	7.1
Projected Population		
1990	25,000	NA
1995	27,100	8.4
2000	28,800	6.3
2005	30,400	5.6
Total Population Increase	5,400	8.2
Average Annual Increase		1.35

Source: Glenn County Land Use Element, 1985. Quad Consultants, 1991.

Appliances

The efficiency of household appliances also affects energy use. Figure 2-1 shows that the efficiency of heating and water heating appliances could have a significant effect on the total energy used in homes. Older appliances may not operate as efficiently as when they were new, and many older appliances were built when energy conservation was not considered important. Significant advances have been made in recent years in the efficiency of lighting, refrigerators, and cooking appliances.

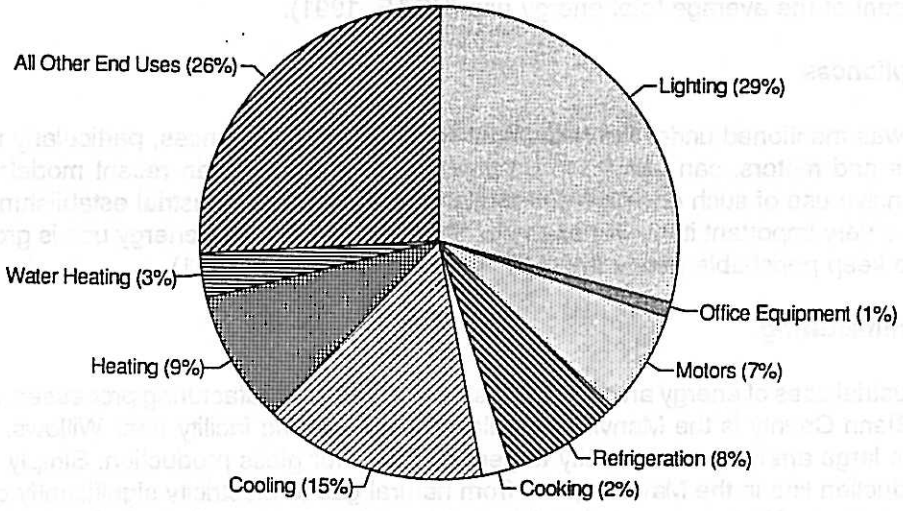
COMMERCIAL AND INDUSTRIAL ENERGY USE

The ways in which energy is used by commercial and industrial establishments in California is shown by Figures 2-2 and 2-3, respectively. Commercial establishments consume the most energy for lighting. Cooling, heating, and refrigeration are also large energy uses. In industrial establishments, petroleum and process heat (used in manufacturing and production processes) account for over half the total energy used.

Heating and Air Conditioning

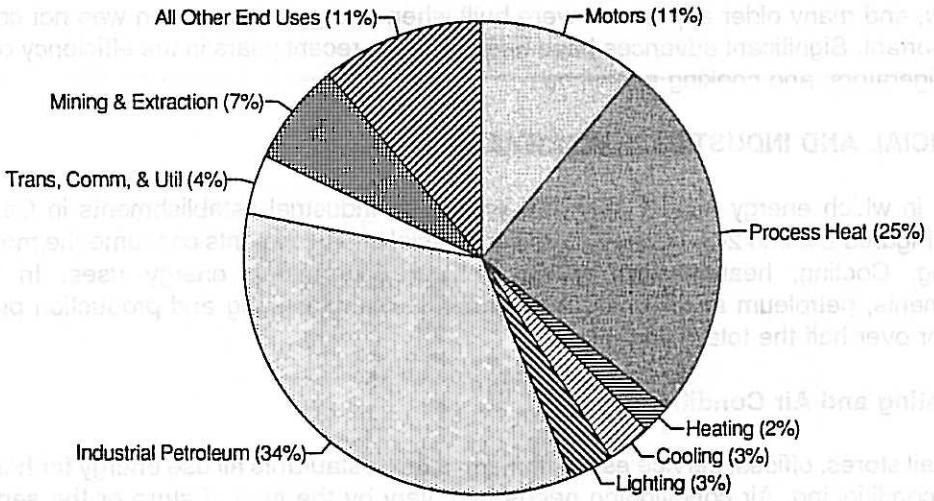
Retail stores, offices, service establishments, and restaurants all use energy for heating and air conditioning. Air conditioning needs may vary by the type of store or the service they provide. For example, only 15 percent of the energy used in grocery stores and hotels/ motels is for heating, ventilation, and air conditioning (HVAC), while 29 percent of the average energy use in other retail stores is for HVAC (PG&E, 1991).

Figure 2-2: Largest Commercial Energy End Uses
California 1987



Source: California Energy Commission, 1990.

Figure 2-3: Largest Industrial Energy End Uses
California 1987



Source: California Energy Commission, 1990.

Lighting

Lighting also consumes large amounts of electricity in commercial establishments. Many retailers maintain that brightly lit shopping areas increase their sales; on average, 50 percent of a retail store's energy use is for lighting. In hotels and motels, lighting constitutes 35 percent of the average total energy use (PG&E, 1991).

Appliances

As was mentioned under the residential section, older appliances, particularly refrigeration units and motors, can use 20 to 50 percent more energy than recent models. The more intensive use of such equipment in many commercial and industrial establishments makes this a very important item. For example, 50 percent of the total energy use is grocery stores is to keep perishable goods frozen or refrigerated (PG&E, 1991).

Manufacturing

Industrial uses of energy are primarily associated with manufacturing processes. An example in Glenn County is the Manville fiberglass manufacturing facility near Willows. This facility uses large amounts of electricity to generate heat for glass production. Simply shifting one production line in the Manville plant from natural gas to electricity significantly changed the use pattern of both gas and electricity in Glenn County as a whole. Industrial facilities may use large amounts of electricity for lighting, though as a percentage of total energy use, this component is generally small. The average light industrial facility spends 40 percent of the total energy used on processing, and another 15 percent on motors (PG&E, 1991).

AGRICULTURE

Most energy use associated with agriculture is for moving water—either pumping groundwater or moving surface water where gravity flow cannot be employed. In California a total of 35 percent of the energy used in crop production is used for irrigation. The other big uses involve field operations, and the production of fertilizers pesticides (see Figure 2-4). It is important to note that the energy used to produce fertilizers and pesticides is not consumed on individual farms. (A comparable situation in residential energy use statistics would be to include the energy required to manufacture refrigerators, heaters, air conditioners, building materials, paving, etc.) The term used to describe this situation is *embodied energy use*. Because embodied energy use on farms is a large part of the total use, it is included in this figure. Also note that most of the uses are not directly monitored by a utility company. Farmers buy barrels of diesel for field operations, pay pilots for aerial spraying, purchase gasoline for trucks, etc.

Pumping Water

The irrigation needs of farms vary depending on crop, climate, and soil characteristics. For instance, in Glenn County in 1980, it was estimated that rice crops used an average of 8.5 acre-feet of water for every acre of crop. Table 2-2 shows the estimates of different crops in Glenn, Colusa, and Tehama counties in 1980. The estimated water use is very similar for the three counties. These figures are indicative of drought year conditions, but water use will vary considerably from year to year.

Table 2-2: Estimated Water Use by Crop
Glenn, Colusa, and Tehama Counties 1980

Crop	Glenn County (acre-feet/acre)	Colusa County (acre-feet/acre)	Tehama County (acre-feet/acre)
Grain	0.9	0.9	0.9
Rice	8.5	8.5	6.8
Sugar Beets	4.0	4.0	4.0
Corn	3.1	3.1	—
Other Field Crops	3.1	3.1	2.8
Alfalfa	5.8	5.8	5.8
Pasture	6.6	6.6	6.6
Tomatoes	3.6	3.6	—
Almond and Pistachio	2.6	—	2.6
Citrus and Olive	2.8	—	2.8
Grape	3.3	3.3	3.4

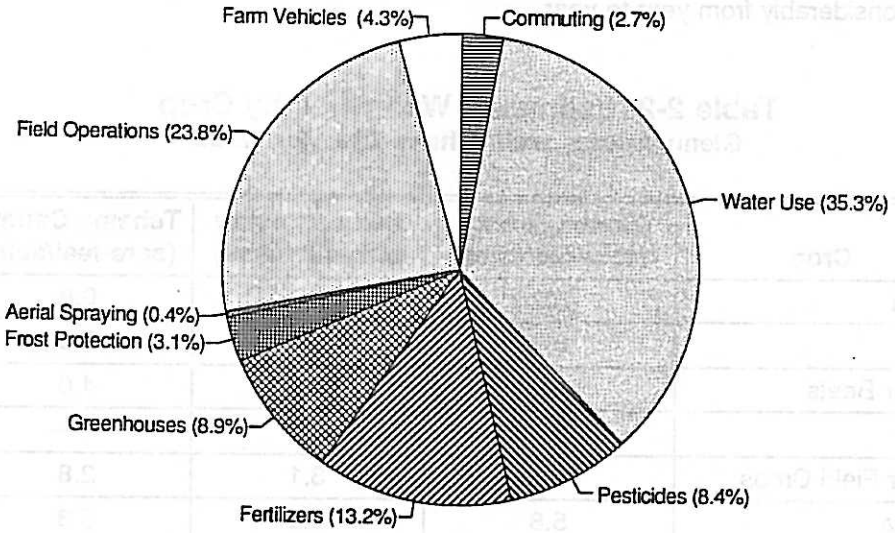
Source: Department of Water Resources Bulletin 113-4, *Estimate 1980 County Average Unit Applied Water*, 1986.

Improving Well Pump Efficiency. As the availability of flowing water for irrigation use becomes increasing scarce, more farmers will be restoring unused wells. The efficiency of the pumps will have a great impact on the energy use in the agriculture sector. For example, one Glenn County farm began reusing eight wells in early 1992. The wells draw from an average depth of 80 feet. Pump tests (performed by PG&E at no charge to the farmer)

showed that the pumps were operating at 40 percent to 61 percent efficiency, with an average efficiency of 47 percent. For $13,000, this farmer plans to rework the three least efficient wells and improve the average efficiency of the wells to 54 percent. This should reduce the total energy needs from 174 kwh/acre feet to 140 kwh/acre feet, with a resulting decrease of 96,560 kwh of electricity annually (2,840 acre feet). At 15¢/kwh, the total saving will be $14,500 the first year, meaning a one year payback on the improvements.

Recirculating Irrigation Water on Rice Farms. The California Department of Fish and Game and the California State Department of Water Resources require that all irrigation water on rice farms be recirculated. Because the pesticides and fertilizers in irrigation water present a threat to fish and wildlife habitat, such water cannot enter the Sacramento River. All water must be pumped back through the irrigation system—thereby using energy albeit saving water resources. A more efficient method would be to incorporate this re-use concept on a regional or basin-wide scale and allow excess water to flow into the irrigation systems of neighboring farms. This would allow farmers to take more advantage of gravitational flows, rather than relying on mechanical energy. This kind of system is used in the Glenn Colusa Irrigation District.

Figure 2-4: Farm Energy Use
California 1978



Source: California Energy Commission, 1990.

Farm Subsidy Program

Most farmers will employ conservation methods strictly for economic reasons. It is in their best interest to make efficient use of water, soils, and energy. Unfortunately, a large part of efficiency is planning in advance, and many farmers are not able to do this because they do not receive water allocations and farm subsidy requirements until late in the winter or early spring. Lobbying for earlier water allocations is probably the best means of effecting a change in this area. Water allocations dictate how many acres of crops (and sometimes the crop) that can be grown that year. This makes it extremely difficult to:

- Plan rotation crops that can fix nitrogen or other nutrients in the soil and cut back on the fertilizer needed for subsequent crops (which saves energy);

- Prepare the field properly after fall harvests—the field is often fully cultivated to cover all possibilities, and full cultivation consumes more energy; and
- Plan field layout and planting programs to minimize the use of equipment (and energy) in the field and minimize wear-and-tear on equipment (ultimately saving manufacturing energy).

Pesticides and Herbicides

Producing and applying pesticides and herbicides consumes up to 21.6 percent of the total energy used on farms in California. Several pilot programs are studying ways to reduce the need for herbicides by planting seeds deeper in the ground. After a short period of watering, the weeds are cultivated with a light mower while the seeds are still germinating below ground (Wong, 1992).

TRANSPORTATION

Figure 2-5 shows the largest energy end uses in California for all sectors and all energy types (electricity, gas, and fuel). The primary consumer of energy in the transportation sector is the automobile. Several factors affect energy use by automobiles including the number of vehicles on the road, the miles driven by those vehicles, and the efficiency with which vehicles burn gasoline. Note that transportation fuel uses (motor gasoline, residual fuel, aviation fuel, and diesel fuel) make up 41 percent of the total energy use in California. Because transportation makes up such a large part of total energy use in California, to effectively decrease total energy use and dependency on fossil fuels there must be a decrease in the number of vehicle miles traveled. Increases in vehicle efficiency have not been sufficient to offset the continually increasing number of vehicle and vehicle miles traveled.

Traffic Characteristics

Because Glenn County is a sparsely settled, rural area, there is generally not a great volume of traffic on the roadways at this time. (Traffic volumes have been increasing, though.) The relatively low population density and lack of public transportation usually require people to drive instead of walk to get where they are going. Even though there are relatively few total vehicle trips in Glenn County compared to an area like Sacramento, the trips may cover longer distances and be more frequent. For instance, a farmer may make several trips during the day to run errands and pick up farming supplies, while a rancher may make several trips to check on livestock in the field.

Orland and Willows have typical commutes patterns, where workers come into the city during the morning and leave during the evening. Transportation studies conducted as part of the general plan update note a commute pattern from Chico (in Butte County) to Hamiliton City (in Glenn County) along Highway 32. This is the only inter-county commute.

Public Transportation Opportunities

Greyhound Bus provides only three northbound and three southbound trips along the Interstate 5 corridor in Glenn County each day. The service cannot provide convenient schedules and routes for Glenn County residents. Also, long distance travelers whose trips begin and end outside of Glenn County can limit the number of seats available for short trips by local residents. Other public transit options include Jimmie's Cab, which operates in both Willows and Orland; Merit Med-Trans, which provides wheelchair accessible vans by arrangement; and Motor Transit, which offers charter and tour bus services in the region.

Additional details on Alternative Transportation Modes can be found under the discussion of that name in the transportation component of the Glenn County Community Development Issue Paper. The Community Development Issue Paper also notes that there is an opportunity to provide increased bus service in the future:

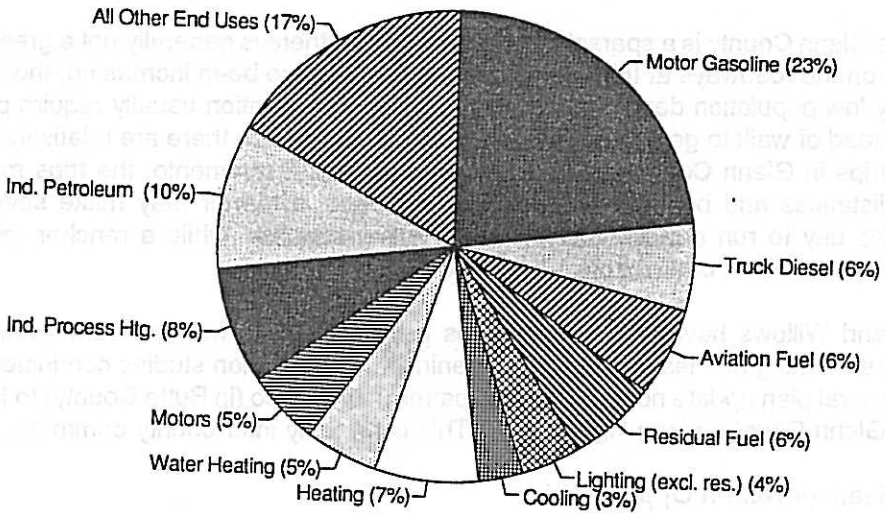
> "The likelihood exists that public transit needs will increase over the next twenty years throughout the county as population increases. The focus will be on the elderly, whose percent of the population can be expected to slowly increase. Also, the growth of traffic in the Highway 32 corridor between Orland and Chico likely will generate sufficient demand to support fixed-route bus service."

Transportation of Agricultural Products

Two factors affect the amount of energy used for the transportation of agricultural products. First is the fact that rail service has been diminished in Glenn County. A line runs through the county connecting Davis and Tehama, but there is no general depot in the county. A branch line runs to the Holly Sugar factory in Hamilton City and a spur serves the Johns Manville facility west of Willows.

The second factor is the prohibition of triples on California roadways. (A triple is a truck tractor that pulls three trailers instead of the standard one or two.) Most truck tractors run more efficiently carrying heavier loads, e.g., two tractors carrying three trailers each will use less energy than three tractors carrying two trailers each.

Figure 2-5: Largest Energy End Uses
California 1987



Source: California Energy Commission, 1990.

PAST ENERGY USE IN GLENN COUNTY

This chapter presents information on past energy use in Glenn County. Past energy use patterns are described and analyzed to determine where energy conservation programs may be both possible and beneficial.

ELECTRICITY USE

PG&E provides electricity service in Glenn County subject to the rules and tariffs of the California Public Utilities Commission. PG&E categorizes its customers into various categories or sectors. Table 2-3 shows past electricity use by sector, and Figure 2-6 graphs electricity use by year. Residential electricity use remained constant from 1976 to 1990, even though the population increased 25 percent during that time. Per capita electricity use steadily decreased from 4,054 kilowatt-hours a year in 1976 to 3,295 kilowatt-hours a year in 1990.

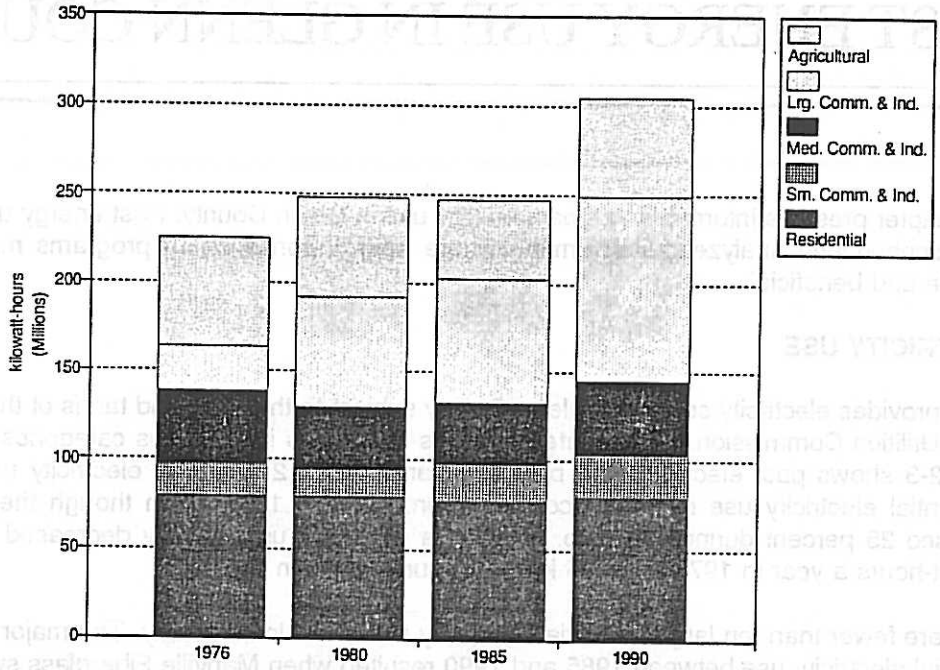
There are fewer than ten large industrial electricity users in Glenn County. The major increase in industrial electricity use between 1985 and 1990 resulted when Manville Fiberglass switched one of their gas process lines to electricity to decrease overall energy use. A corresponding drop in natural gas use also occurred (Freeman, 1991).

Table 2-3: Electricity Use by Sector
Glenn County 1976 to 1990

Sector	Total Kilowatt-hours Each Year			
	1976	1980	1985	1990
Residential	79,425,472	79,104,461	77,386,540	80,636,476
Small commercial and industrial	18,961,343	16,822,149	21,943,513	24,376,031
Medium commercial and industrial	40,356,927	33,885,052	33,916,566	40,687,057
Large commercial and industrial	25,434,400	63,227,200	70,606,400	104,688,000
Agriculture	62,376,633	55,508,879	44,589,232	55,425,000
Street lighting and public uses	998,163	567,930	452,682	427,031
Total Electricity Use	227,552,938	249,115,671	248,894,933	306,239,595
Per Capita Residential Use	4,054	3,705	3,409	3,295

Source: Pacific Gas & Electric Company, 1991.

Figure 2-6: Electricity Use
Glenn County 1976 to 1990



Source: Pacific Gas & Electric Company, 1990.

About half of the agricultural land in Glenn County is range land; another one-third is planted in field and row crops. Forest products (9 percent), fruit and nut orchards (6 percent), and pasture land (3 percent) make up the remaining agricultural lands. Electricity is used in agriculture primarily to move water—both for groundwater pumps and lift stations to pump surface water where gravity flow can not be used. Only a small proportion goes toward water heating, refrigeration, and machinery in dairy operations; although specific data is not available for Glenn County, a conservative estimate would be that 80 percent of electricity used in agriculture is for pumping water. The monitoring of electricity used for agriculture is by meters used only for agricultural production; all agricultural processing plants and all farm residences are in separate categories. The 1980 and 1990 peak electricity use for agriculture corresponds to drought years when groundwater pumping was high. The creation of several new irrigation districts in the early 1980s decreased the amount of groundwater pumping during that period.

NATURAL GAS USE

PG&E also provides natural gas service in Glenn County subject to the rules and tariffs of the California Public Utilities Commission. Table 2-4 shows categories of historical natural gas use while Figure 2-7 illustrates those trends. Residential natural gas use remained constant from 1976 to 1990, despite population growth in the county. The per capita natural gas use went from 170,000 therms in 1976 to 110,000 therms in 1990.

Because there are only a few large commercial uses in Glenn County, the total amounts of natural gas used from 1975 to 1990 are not necessarily useful in establishing trend lines. Over that time period, several jumps occurred in total energy use, largely the result of four company decisions: Holly Sugar switched from diesel to natural gas; Glenn Milk Producers increased production and increased natural gas use by 200 percent; a new cheese processing plant opened in the county; and the Carnation Dairy herd was sold and the plant went out of business.

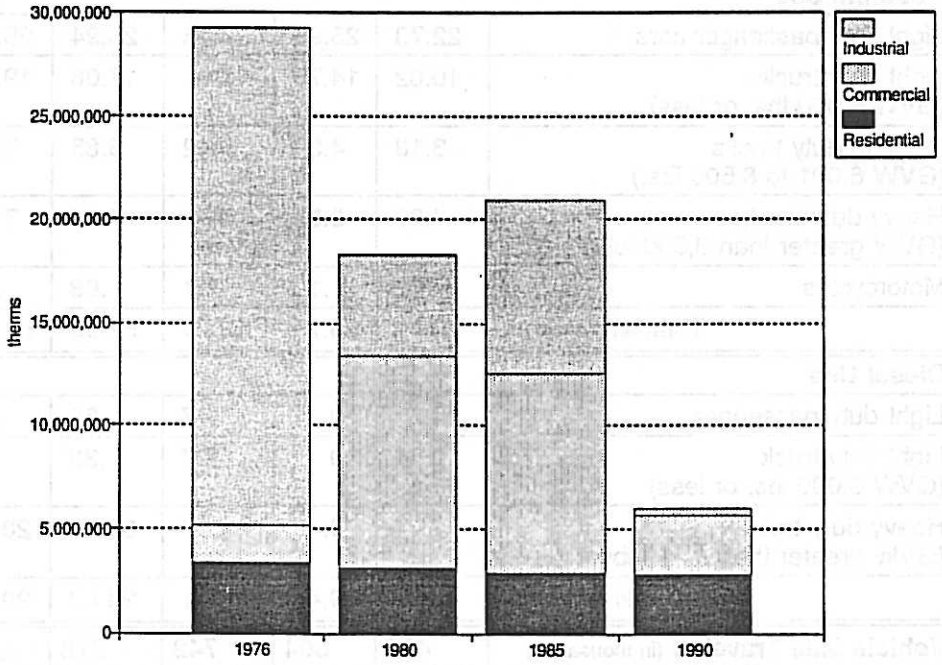
Industrial uses of natural gas decreased dramatically when Manville switched one process line from gas to electricity (Freeman, 1991). Although electricity use is generally more expensive than natural gas (see page 8), the equipment and manufacturing processes at Manville allowed them to save a significant amount of energy by switching to electricity. Previously, natural gas had been used to make glass balls at a remote location, which were then shipped to the manufacturing plant and remelted to make glass fiber. By switching to electricity, Manville was able to manufacture the fiber in a single-step process, eliminating the energy necessary to transport and remelt the glass. It may be possible to reduce energy use even further by increasing efficiency in other areas.

Table 2-4: Natural Gas Use by Sector
Glenn County 1976 to 1990

Sector	Therms Each Year			
	1976	1980	1985	1990
Residential	3,377,630	3,094,050	2,850,380	2,760,460
Commercial	1,899,470	10,271,960	9,731,960	2,972,220
Industrial	24,029,160	5,018,640	8,392,360	312,140
Total Natural Gas Use	29,306,260	18,384,650	20,974,700	6,044,820
Per Capita Residential Use	193	145	126	112

Source: Pacific Gas & Electric Company, 1991.

Figure 2-7: Natural Gas Use
Glenn County 1976 to 1990



Source: Pacific Gas & Electric Company, 1990.

GASOLINE AND DIESEL FUEL USE

Table 2-5 shows past gasoline and diesel fuel consumption for transportation uses in Glenn County. This information was derived by the State Air Resources Board (ARB) to determine the county's air pollution emissions. Note that these figures do not include any agricultural equipment fuel use such as plowing, tilling, hauling feed, etc. (which generally run on diesel fuel), nor do they include non-transportation uses of gasoline or diesel such as lawn mowers, chain saws, diesel generators, etc. Even though Glenn County is an agricultural area, relative to transportation, all other fuel uses comprise an insignificant percentage of the total use.

Table 2-6 presents forecasts of gasoline and diesel fuel use that have been prepared by the California Air Resources Board. Future gasoline and diesel consumption depend upon three important factors: the number of vehicles on the road, the number of miles traveled, and the fuel efficiency of those vehicles. For example, if 100 vehicles travel 10 miles each, then 1,000 miles will be driven. Assuming that, on average, those vehicles travel 20 miles on a gallon of fuel, 50 gallons of fuel will be consumed.

Estimates on the future numbers of vehicles in Glenn County were provided to the ARB by the California Department of Motor Vehicles according the gross vehicle weight (GVW). Estimates of future vehicle miles traveled were provided to the ARB by the State Department of Transportation (Caltrans); ARB then added the fuel efficiency characteristics. The combination of these estimates yield the figures in Table 2-6.

Table 2-5: Average Daily Gasoline and Diesel Use
Glenn County 1970 to 1990

Vehicle Class	Thousands of Gallons Used Each Year				
	1970	1975	1980	1985	1990
Gasoline Use					
Light duty passenger cars	22.73	25.99	25.46	23.94	25.53
Light duty trucks (GVW 6,000 lbs. or less)	10.02	14.75	16.01	17.08	19.40
Medium duty trucks (GVW 6,001 to 8,500 lbs.)	3.18	4.39	5.12	5.85	7.31
Heavy duty trucks (GVW greater than 8,500 lbs.)	4.39	5.56	6.59	6.04	7.24
Motorcycles	.09	.10	.11	.08	.09
Total (in thousands)	40.41	50.79	53.29	52.99	59.57
Diesel Use					
Light duty passenger	0	0	.17	.54	.49
Light duty truck (GVW 6,000 lbs. or less)	0	0	.07	.30	.33
Heavy duty truck (GVW greater than 8,500 lbs.)	7.74	9.49	18.37	23.79	28.24
Total (in thousands)	7.74	9.49	18.61	24.63	29.06
Vehicle Mile Traveled (in thousands)	486	604	742	918	1,181

Source: California Air Resources Board, 1990.

Table 2-6: Projected Average Daily Gasoline and Diesel Use
Glenn County 1995 to 2010

Vehicle Class	Thousands of Gallons Used Each Year			
	1995	2000	2005	2010
Gasoline Use				
Light duty passenger cars	24.15	23.75	22.96	22.93
Light duty trucks (GVW less than 6,000 lbs.)	19.80	18.60	18.63	19.16
Medium duty trucks (GVW 6,001 to 8,500 lbs.)	7.80	7.72	7.93	8.23
Heavy duty trucks (GVW greater than 8,500 lbs.)	8.07	8.99	10.00	11.02
Motorcycles	.10	.11	.12	.14
Total (in thousands)	59.92	59.17	59.64	61.48
Diesel Use				
Light duty passenger	.21	.06	.02	0
Light duty truck (GVW less than 6,000 lbs.)	.16	.04	.02	0
Heavy duty truck (GVW greater than 8,500 lbs.)	30.37	31.75	33.63	36.30
Total (in thousands)	30.74	31.85	33.67	36.30
Vehicle Miles Traveled (in thousands)	1,285	1,363	1,431	1,499

Source: California Air Resources Board, 1990.

Average daily passenger car consumption of gasoline has remained fairly constant during the past twenty years. Use should decrease slightly in the future as passenger cars become increasingly more fuel efficient.

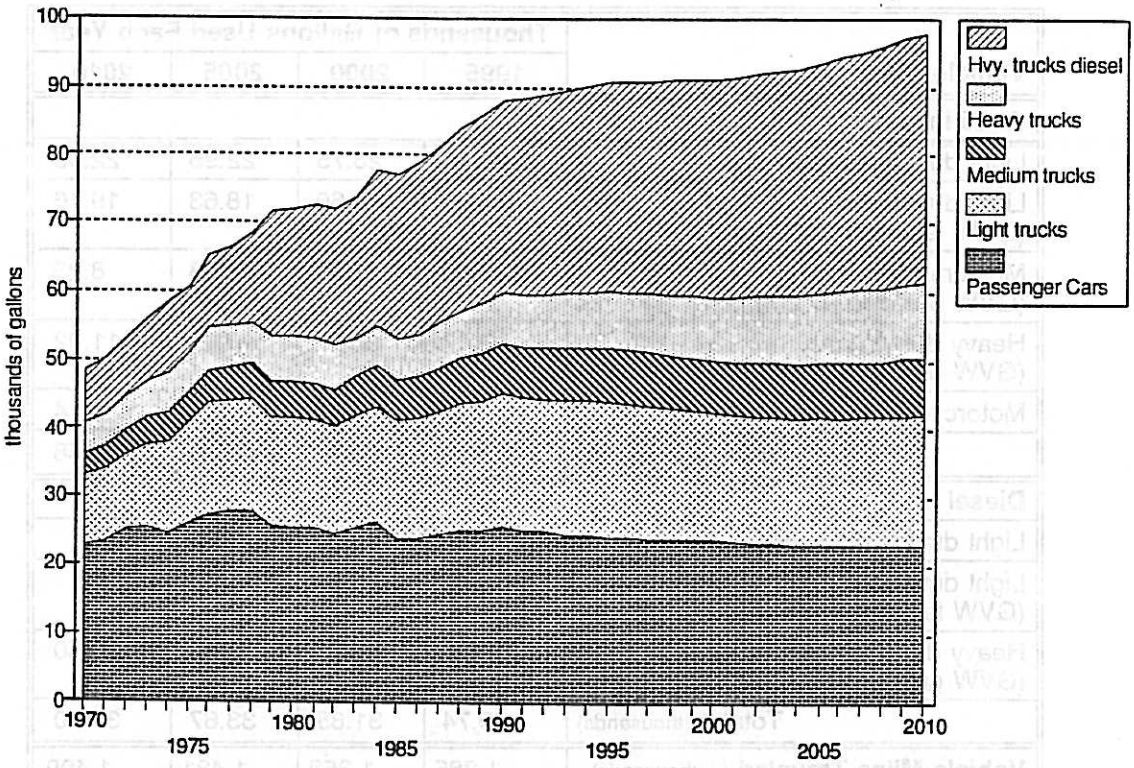
The California Air Resources Board assumes that, unlike automobile engine efficiency, both gasoline and diesel truck engines will not be significantly more efficient in the future. As more trucks are on the road, fuel use will increase proportionally (Lusk, 1991). Heavy trucks consume virtually all the diesel fuel used for transportation in Glenn County. Because of limitations on fuel efficiency gains for diesel engines, use will increase much faster than other fuel uses (Lusk, 1991).

Although the number of vehicle miles traveled increases over time, most local roads and highways can accommodate increased traffic volumes. State Route 32 and State Route 45 are the only roads that have limited capacity remaining (Quad, 1991). Figure 2-8 graphs the gasoline components of Tables 2-5 and 2-6.

OVERALL ENERGY USE

When each type of energy use is discussed separately, as in the earlier sections of this chapter, it is difficult to understand changes in overall energy use over time. An understanding of changes in overall energy use requires that the units of measure for each type of energy source (electricity, natural gas, fuel) be converted to a common unit. Table 2-7 and Figure 2-9 show overall energy use from 1976 to 1990 in British thermal units (Btu). The conversion factors are noted in Chapter One on page 7. Figure 2-10 shows a pie chart of overall energy use in 1990.

Figure 2-8: Projected Average Daily Gasoline and Diesel Use
Glenn County 1970 to 2010



Source: California Air Resources Board, 1990.

This chart notes several interesting trends. Despite a steady increase in the use of transportation fuels, savings in other sectors have reduced the per capita use of energy since 1976. Still, transportation use (see also Figure 2-10) is a very large contributor to energy use in the county. If transportation use continues to increase, it will be difficult for the other sectors to offset transportation increases in the future.

The fluctuating energy use by commercial and industrial businesses suggest that any change in these sectors will have a significant affect on energy use in that sector. Efforts should be made to make any new large commercial or manufacturing business very energy efficient, possibly through cogeneration facilities.

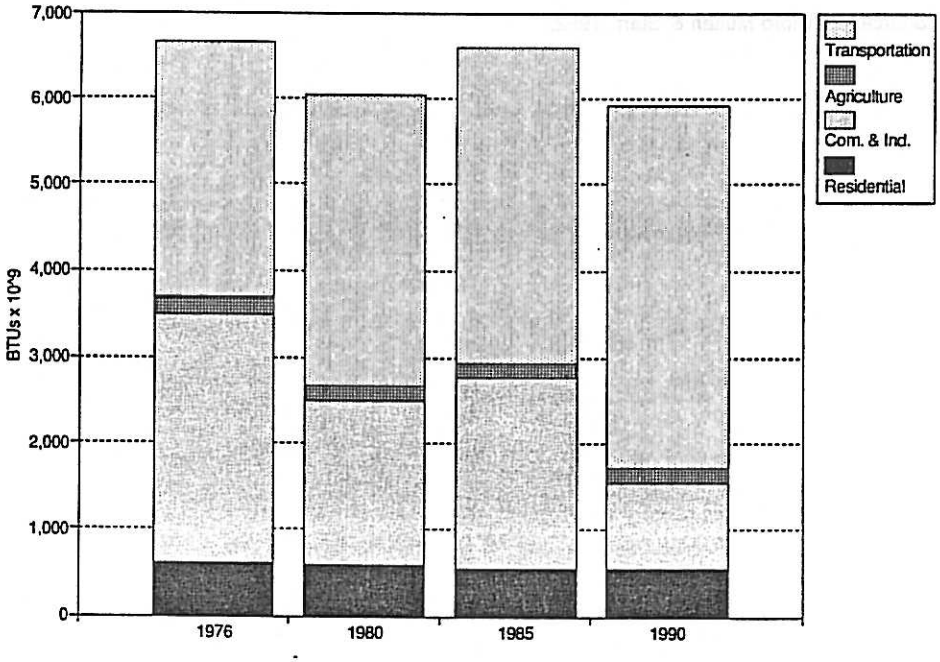
As state water supply of surface flow water available to Glenn County farmers decreases, energy use in the agricultural sector could possibly double. The drought, demands on state water from other municipalities, and protecting salmon runs (endangered species act) all limit the amount of surface flow water; farmers must drill new water wells, thereby increasing overall energy use.

Table 2-7: Overall Energy Use by Sector in Btu
Glenn County 1976 to 1990

Sector	Total Btu x 10^9			
	1976	1980	1985	1990
Residential	609	579	549	551
Commercial and Industrial	2,882	1,918	2,244	1,010
Agriculture	213	189	152	189
Transportation	2,962	3,382	3,676	4,203
Total Energy Use	6,666	6,069	6,621	5,953
Per Capita Use	0.34	0.28	0.29	0.24

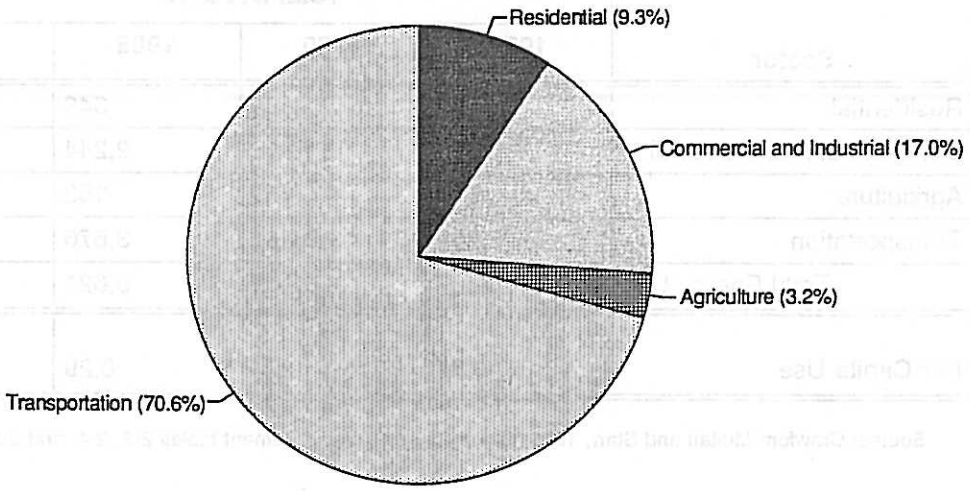
Source: Crawford Multari and Starr, 1992. Glenn County Energy Element tables 2-3, 2-4, and 2-5.

Figure 2-9: Overall Energy Use by Sectors in Btu
Glenn County 1976 to 1990



Source: Crawford Multari & Starr, 1992.

Figure 2-10: Overall Energy Use Piechart
Glenn County 1990



Source: Crawford Multari & Starr, 1992.

CURRENT ZONING REGULATIONS FOR ENERGY FACILITY DEVELOPMENT

The Zoning Code currently contains provisions for natural gas wells, injection wells, windmills, and transmission lines. The code also covers "Public utility buildings and public service or utility uses (transmission and distribution lines excepted), including but not limited to reservoirs, storage tanks, pumping stations, telephone exchanges, power stations, transformer stations, service yards and parking lots." Table 2-8 summarizes the County's zoning designations that allow energy facilities and their land use permit requirements. An empty cell means that the Zoning Code does not specifically permit the use.

PERMITTED USES

Each zoning district within the Zoning Ordinance contains a list of uses that are permitted in that district. As long as the performance standards established by the zoning ordinance are met, a proposed use may be allowed by the Planning Director. Should any of the performance standards not be met, permitted uses require a conditional use permit.

ADMINISTRATIVE PERMIT

Administrative permits may be approved after the Planning Director makes findings similar to those required of a CUP. The administrative permit requires less review than a CUP, and no public hearings are required.

CONDITIONAL USE PERMIT

A conditional use permit (CUP) provides the most detailed level of review of proposed land uses. A CUP must be approved by the Planning Commission after at least one public hearing where the public has had the opportunity to comment on the proposed project. The Glenn County Zoning Ordinance requires the Planning Commission to make a series of findings related to the necessity and/or desirability of the use, site adequacy, and general plan conformity prior to CUP approval.

Table 2-8: Zoning Designations with Facility Siting Requirements
Glenn County Zoning Ordinance

Zoning Designation	Natural Gas Well	Injection Well	Windmill	Public Utilities	Transmission Lines
Timberland Preserve	CUP [1]	—	—	—	P
Recreation	AP	—	—	CUP	—
Foothill Agricultural/ Forestry	AP	—	P	CUP	—
Agricultural Preserve	AP	CUP	P	CUP [2]	—
Exclusive Agricultural	AP	CUP	P	CUP	—
Agricultural Transitional	CUP	CUP	P	CUP	—
Rural Residential Estate	CUP	CUP	P	CUP	—
Rural Residential Estate — North Willows	CUP	—	—	P	—
Single Family Residential	—	—	—	CUP	—
Multiple Residential	—	—	—	CUP	—
Commercial	AP	CUP	—	CUP	P
Industrial	AP	CUP	—	CUP	P
Extractive Industrial	AP	CUP	—	—	—
Commercial/ Industrial Reserve	—	—	P	—	P
Planned Development Commercial	AP	CUP	—	CUP	P
Community Commercial	CUP	—	—	CUP	—
Service Commercial	CUP	—	—	CUP [3]	—

Notes: AP — Administrative Permit; CUP — Conditional Use Permit; P — Permitted
1. Oil wells also.
2. Irrigation devices.
3. Fuel tank farms.

Source: Glenn County Zoning Code Title 19, 1990.

Chapter Three
ENERGY EFFICIENCY

3.1 ENERGY EFFICIENCY

GOALS

The energy efficiency goals of the Energy Element are to:

a. Support and encourage Glenn County residents to pursue lifestyles that make the most efficient use of all natural resources, especially energy; improved construction practices will provide for energy efficiency in all new construction and remodeling.

b. Work with the other elements of the Glenn County General Plan to guide the placement of County services so that they are provided most efficiently and economically.

c. Reduce the per capita consumption of electricity, natural gas, and gasoline such that overall energy use in the county remains relatively constant, even while the population continues to increase.

POLICY

a. It shall be the policy of Glenn County to periodically review overall energy use in the county to monitor the extent to which the above goals are being achieved.

The terms energy conservation and energy efficiency are used often in this plan. Both result in the use of less energy. An example of *energy conservation* is turning down a thermostat to heat a home at 68 degrees rather than 72 degrees. A way of improving home *energy efficiency* in the same situation would keep the temperature at 72 degrees, but use less energy to maintain that temperature by installing wall insulation and a more efficient heating appliance. In the latter case, the energy service (or comfort level) would not change, but the method of achieving the service would be more efficient and use less energy.

Most people have an intuitive understanding of the importance of conservation and energy efficiency—using less energy costs less—not only in monetary cost but also in other costs that are harder to quantify, such as environmental degradation from pollution or resource depletion.

Increased energy efficiency and conservation can produce three main benefits. Business profits will be greater if business energy costs are reduced (all other factors held constant). Residential energy customers will have more disposable income for non-energy purposes if their energy costs are reduced. (This can create additional business benefits if consumers use energy savings to purchase more products.) Finally, energy efficiency and conservation may reduce the need for additional power plants or other energy facilities that could cause undesirable environmental effects. Using a simple methodology, this document quantifies the energy savings that will result from the programs. More complex methodologies are summarized in Appendix B.

Although most utilities (including Pacific Gas and Electric (PG&E)) are privately-owned businesses with the goal of generating profit for shareholders, the State of California regulates utility rates and services. In the 1980s, California's regulators decoupled the utilities' net revenues from their sales volumes—meaning that selling more energy did not necessarily mean an increase in profits. Then, in 1990, the major utility companies collaborated with the California Public Utility Commission (CPUC) and the California Energy Commission to develop a consensus on the link between the investments utilities make in efficiency and the profits that utilities earn.

LOCAL AND REGIONAL EFFECTS

Over the last 20 years, public awareness has grown about how excessive consumption of resources or environmentally destructive human activities can have a negative effect on an entire area or region. For example, a single polluting industrial plant can degrade the quality of irrigation water used by many downstream farms. If allowed to continue, some of our current practices will result in depleted resources and an environment that can no longer support our current standard of living.

Conversely, well-planned energy conservation and efficiency measures can have a positive effect on a local or regional community. Not only can Glenn County sustain its current rural lifestyle and standard of living, but the local economy can benefit as well.

> "A dollar spent on energy usually leaves the local economy rapidly, bound for domestic or foreign energy supplies; however, a dollar spent on energy conservation measures will likely support local businesses providing energy efficiency services as well as benefiting the environment. Subsequently, the 20 percent to 75 percent energy savings realizable by households and businesses is likely to be spent on other goods and services, thereby stimulating the local economy." (U.C. Task Force, 1991)

The term "local multiplier" is used to describe the situation in which each dollar spent locally is, at least in part, *re-spent* locally. A multiplier represents the effect that expenditures for any commodity or service have on the demand for additional manufacturing or employment (Walsh, 1990). The proportion of an expenditure that is re-spent varies widely according to the type of expenditure. The money spent for a carpenter would almost totally be re-spent locally on food, supplies, rent, etc.; on the other hand, most of the money spent on a refrigerator is used to purchase more goods from a supplier outside of the county. Most studies use multipliers ranging from 1.5 — which assumes that 33¢ of each dollar is re-spent locally — to 2.78 — which assumes that 64¢ of each dollar is re-spent locally (Reiner, 1991).

Hypothetically, an owner of an older home in Glenn County (with no insulation, drafty windows, and older appliances) could spend as much as $2,000 a year on utility bills. To cut the bills in half, the homeowner spends $400 dollars on insulation, $600 on a new refrigerator, and $500 on a carpenter to repair the windows and doors. The homeowner has spent $1,500 on supplies and labor, but if we assume that the local multiplier is 2.0, the total activity in the local economy is $3,000. After 18 months, the homeowner has saved $1,500 on utility bills and paid back his investment. Each subsequent month, the homeowner spends less money on utilities and has more disposable income to purchase goods and services in the local economy.

Energy costs in commercial and industrial businesses vary, but they usually account for up to 10 percent of the total operating budget; thus, lowering energy costs can raise profit margins. Higher profit margins will provide a healthier county economy. Money saved on utility bills by the public sector will be available for new or enhanced governmental services.

PURPOSE OF EFFICIENCY GOALS

The energy efficiency goals listed above are general statements of what Glenn County intends to accomplish by carrying out programs and standards of this Energy Element. It must be recognized, however, that the achievement of those goals will depend on coordinated and cooperative efforts among local government, private businesses, public utilities, and individual citizens. Neither county government nor any other single entity can independently cause the goal to be achieved.

Also, energy use in the county can be affected by external factors over which the County has no control, such as the emerging need for farming operation to shift from surface water to new wells for agricultural production. In that case, water which is now obtained and applied with relatively little local energy use will be replaced by water that must be extracted using diesel or electrically powered pumps. Therefore, this transition cannot occur without more energy being consumed.

The monitoring method specified in Program 3.1.1 will provide the county with a tool that can measure the effectiveness of this plan and assist decision makers in evaluating the desirability of possible changes.

PROGRAMS

3.1.1 Every five years, the Planning Department shall obtain statistics regarding total annual energy use in residential, commercial, industrial, agricultural, public, and transportation sectors. If overall consumption substantially increases, Energy Element policies and programs shall be re-evaluated and adjusted to meet the stated objective of maintaining total electricity use at a relatively constant level. *This program implements Policy 3.1.a.*

Implementation

Lead agency: Planning Department.

Coordinating agencies: Planning Commission, Board of Supervisors, Pacific Gas and Electric, Air Pollution Control District, California Energy Commission.

Funding: General fund.

Time frame: A report shall be prepared in January 1996 (using 1995 data) and each subsequent five year period.

3.2 LAND USE PLANNING

POLICIES

It shall be the policy of Glenn County to:

a. Update the Land Use Element to promote a system of energy efficient land development through compact residential areas and commercial/ service cores. Public facilities, commercial areas, and schools shall be grouped into pedestrian- and bicycle-accessible core areas that provide a focal point to the community and promote future use of public transit.

b. Require all new residential development shall conform to state laws on solar access and conservation. The additional land use policies found in Program 3.3.3 of this chapter that apply to new development shall be used to minimize energy consumed by transportation and building construction, anticipate future transportation needs, and take advantage of passive cooling and heating opportunities in subdivision design.

c. Develop a master plan for bicycle paths and pedestrian facilities in new developments and in urbanized areas.

Land use planning is considered the core of the general plan process. When considering the seven topics or *elements* that a general plan is required by state law to address (land use, circulation, housing, conservation, open space, noise, and safety), the issue of land use is probably of greatest interest to the public. The Land Use Element determines the locations within the unincorporated areas of the county where agricultural, residential, commercial, and industrial land uses may occur at present and in the future. The Land Use Element also works with the other parts of the general plan to determine the location, rate, and timing of growth, the development of housing, public facilities, and infrastructure.

Because the County is currently in the process of updating the Land Use Element of the General Plan, the Energy Element can provide a different perspective on land use planning issues that can be employed in the formulation of new land use policies. The first program in this section provides a hierarchy of preferences for residential and commercial development that will be considered in the completion of the Land Use Element. While the proposed land use strategies may run counter to some people's perception of rural living, it is the open, large agricultural tracts that give Glenn County the feeling of a rural environment.

The proposals made in this report assume that Glenn County will remain a rural area in the near future. The past growth trends and population projections published by the Department of Finance support this assumption. However, Glenn County's proximity to Sacramento and position along Interstate 5 make it a candidate for suburban development. In addition, the proximity of Hamilton City to the relatively large employment opportunities in Chico makes it a desirable, inexpensive residential community. As housing costs rise in the Chico area, an increasing number of persons can be expected to reside in Glenn County, where housing is less costly. By implementing policies that require efficient land use patterns, the County can maintain more of its agricultural, rural character, while more effectively managing land and energy resources.

EMPLOYING LAND USE STRATEGIES TO REDUCE ENERGY USE

The land use planning policies in the Land Use Element will also effect energy use; the way in which different land uses are distributed throughout the county, and how they are designed and developed, can significantly influence energy demand.

Decreased Vehicle Use

Appropriate land use planning techniques can generally decrease energy use in three ways. The most useful method is by increasing opportunities for residents to complete shopping and other chores without driving or by driving shorter distances. People are most likely to walk rather than drive if their destination is within one-quarter mile (Calthorpe, 1990). People are also more likely to walk or ride bicycles where there are separate bike paths or sidewalks; people generally do not like walking between cars or crossing multiple-lane intersections. If more people were to walk or ride bikes for short trips, gasoline use would decrease, air quality would improve, and less energy would be used to build and maintain parking lots. Walking is generally encouraged by concentrating commercial areas and housing in one or two key areas; residents support existing and/or new commercial ventures and the local economy is generally improved. By concentrating the population, compact development also facilitates the provision of transit services to an area.

Reduced Utility Lengths

A second method of decreasing energy use through land use planning is to reduce the length and width of roads and/or utility service connections in new development. By reducing the size of lots in developed areas, the physical length of roads and utility service lines and the amount of energy used to manufacture the roads or lines (pipelines, electrical lines, etc.) are both reduced. The gasoline used by Sheriff, police, fire, and other County services in serving such areas is also reduced. It should be noted that the most energy-efficient layout for development in areas with mostly level terrain (such as Glenn County) is often the traditional city form of straight streets forming a grid pattern.

Increased Solar Access

Another way in which land use planning can reduce energy use is through subdivision designs that allow solar access to all buildings. Solar access can passively heat and/or cool buildings, or active systems can heat water.

PROGRAMS

3.2.1 The following priorities for new development shall be included in the Land Use Element update. The objective of this program is to minimize the number of new rural residential subdivisions and encourage energy efficient infill and compact development, such that over 75 percent of all new residential development occurs within existing developed areas. Figure 3-1 illustrates the points noted below. *This program implements Policy 3.2.a.*

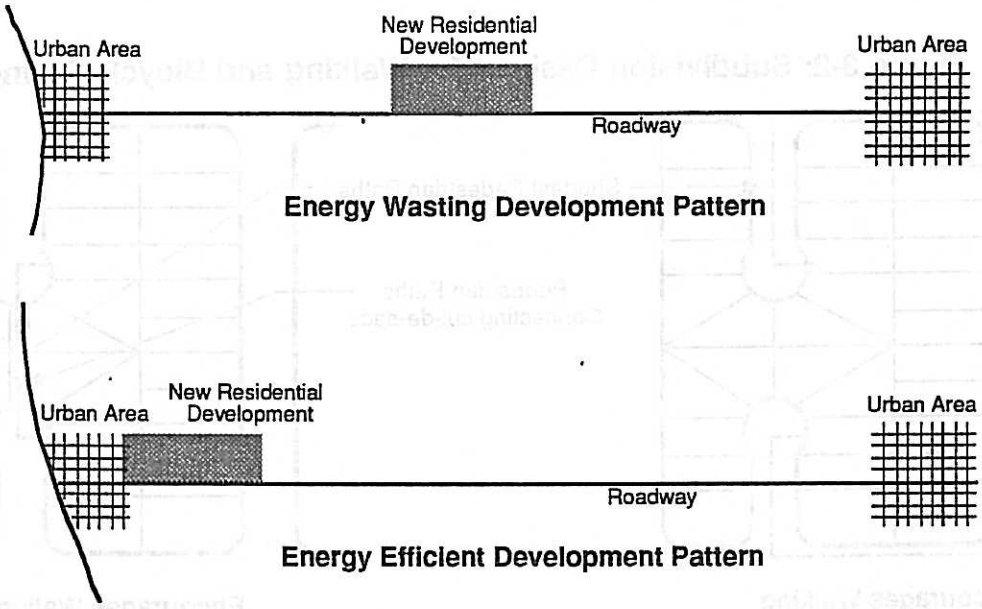
a. The first priority for new residential development is infill development and incrementally expanding the existing developed areas into directly adjacent undeveloped areas. Infill development should reflect any urban limit lines designated in the Land Use Element. The pace of development should match the development of community facilities and infrastructure.

b. If the demand for residential development cannot be accommodated as described above, then the second preference is for major expansion of one or two of the existing urban areas in the county, with concurrent expansion of commercial land uses, so that the urban areas become full-service communities.

c. Should the demand for new housing in Glenn County still require additional land, the third preference shall be to allow the development of one or more compact new towns that provide commercial services and jobs as well as housing.

d. Rural subdivisions that consume productive agricultural lands with five- and ten-acre parcels shall not be allowed.

Figure 3-1: Preferred Land Use Alternatives



Source: Crawford Multari & Starr, 1992.

Implementation

Lead agency: Planning Department.

Coordinating agency: General Plan consultants, Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund, funds allocated for general plan update preparation.

Time frame: The revised Land Use Element shall include the policies stated in this program.

3.2.2 A pedestrian way and bicycle path master plan for urban areas shall be incorporated into the Transportation component of the Community Development Element and all applicable zoning, building, and land division regulations. The bicycle path and pedestrian master plan shall be specifically designed to:

a. Provide safe and convenient links among residences, transit stops (as added), offices and commercial establishments, public buildings, educational facilities, and recreational activities.

b. Locate pedestrian ways and bicycle paths such that they act to reduce accidents between and among motor vehicles, pedestrians, and bicyclists.

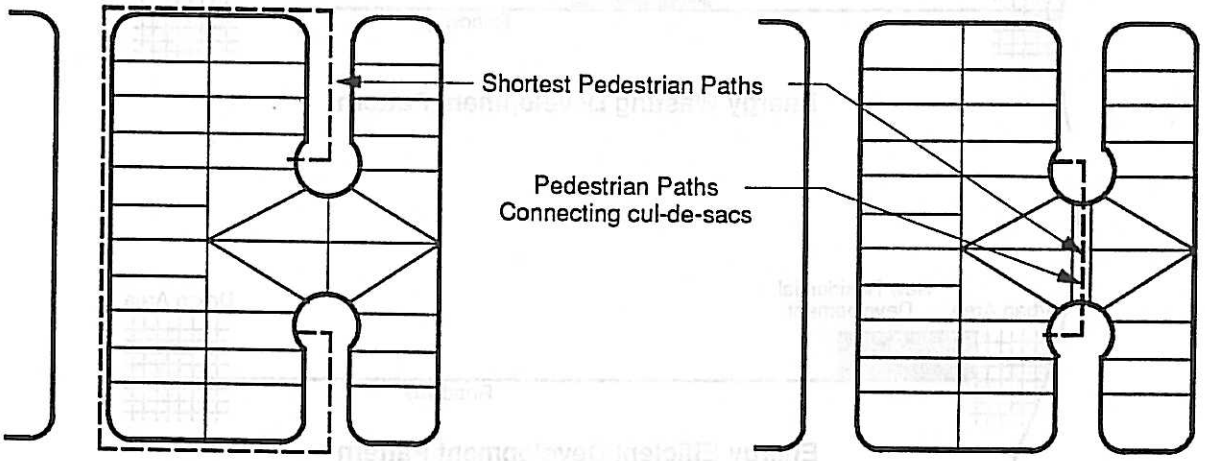
c. Provide street trees near pedestrian and bike pathways.

d. Provide sidewalks on at least one side of the road that have adequate clearance and safe, energy efficient lighting such as metal halide or high pressure sodium lamps.

e. Facilitate commuting by bicycle in developed areas.

The objective of this program is to reduce vehicle use by providing a pleasant walking or biking experience and to minimize energy use for adequate lighting. Figure 3-2 illustrates methods of subdivision design that can encourage walking and bicycle riding. *This program implements Policy 3.2.c.*

Figure 3-2: Subdivision Designs for Walking and Bicycle Riding



Source: Crawford Multari & Starr, 1992.

Implementation

Lead agency: Planning Department.

Coordinating agency: General Plan consultants, California Transportation Commission, Technical Advisory Committee, Planning Commission, Board of Supervisors, Transportation Commission.

Funding: General fund, funds allocated for general plan update preparation.

Time frame: The Transportation component of the Community Development Element shall be amended to include a pedestrian and bicycle master plan.

3.2.3 The land division and zoning ordinances shall be amended to incorporate the policies listed below. The objectives of the program are to: decrease the energy used in the construction of homes, offices, and roads; reduce the energy needed to provide service to an area; and reduce the energy needed to heat and cool homes and work places. Figure 3-3 provides an example of how a site might be designed for proper solar access.[1] Note that "subdivision" applies to residential as well as commercial, office, or industrial areas. *This program implements Policy 3.2.b.*

[1] A more detailed example of energy efficient land use patterns for suburban subdivisions is the "Transit-Oriented Development Guidelines" adopted by Sacramento County. A summary is provided in Appendix C.

All subdivisions

a. The layout of new subdivisions shall provide a network of interconnected neighborhoods or areas. Continuous walls around subdivisions shall not be allowed, although a system of offset berms may be used to protect privacy and control noise.

b. New residential subdivisions sites shall be located along a major or minor arterial that is designated for future expansion in the Transportation component of the Community Development Element.

c. The site design shall employ narrow automobile travel lanes, energy efficient exterior lighting, street trees, and pedestrian and bicycle paths.

d. The site shall be designed such that convenient and accessible sites for transit stops (that may eventually be developed) are provided. This will include locating commercial and public building entrances near the street frontage where bus stops are likely. Features which force pedestrians to cross large parking lots to make use of transit opportunities should be avoided.

e. The site design shall provide sufficient setbacks to allow solar access to all homes. Flexible frontage and setback requirements shall allow building sites with larger yards on the south side of structures for better solar orientation.

f. All existing trees that are species native to California shall be preserved. Drought-tolerant landscaping shall be required for new commercial and public parking lots to shade 50 percent of all paved surfaces. The developer shall install drip irrigation systems for planted trees and shrubs in public areas.

Subdivisions larger than 50 units

g. The subdivision shall be located in proximity to opportunities for employment.

Subdivisions larger than 200 units

h. The plan shall require mixed use development by integrating housing, commercial and office buildings, industry, schools, day care services in proximity to work locations, and transit into the design so that pedestrian access is convenient throughout the development and the various land uses are located so as to support the use of existing and future transit facilities. For example, a grocery store is sited along an arterial frontage such that shoppers can exit directly along the arterial street that may someday have bus service. (For additional guidelines, consult *"Transit Oriented Development Guidelines"*, see Appendix C.)

i. Where possible, the number of necessary parking spaces shall be reduced by designating facilities that will share peak-use parking. For instance, offices are generally open from 8 to 5; those spaces can be counted to handle the parking requirements of a movie theater or restaurant that does the majority of business during the evening.

Implementation

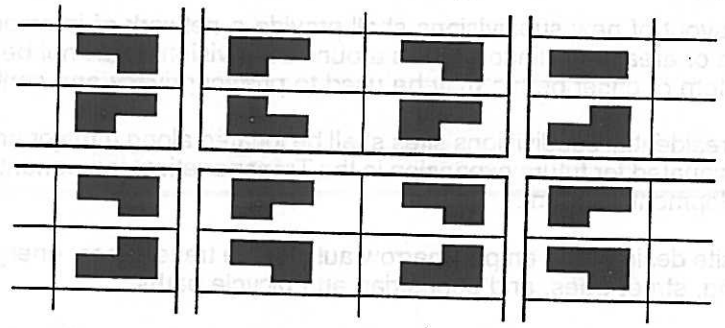
Lead agency: Planning Department.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

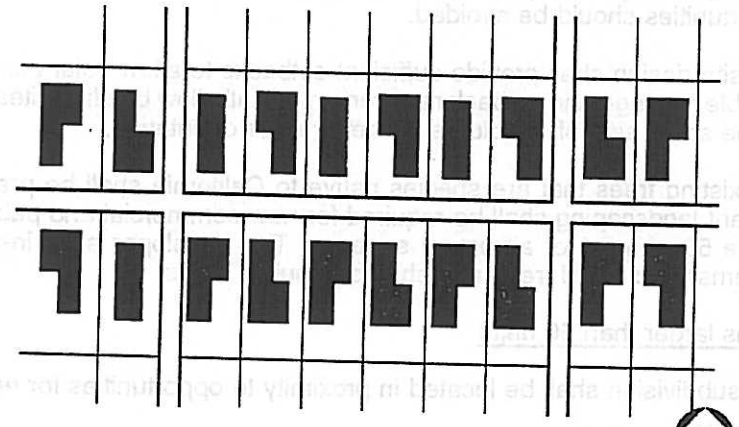
Funding: General fund.

Time frame: The revisions to the land division ordinance shall be completed within three years after the adoption of the Energy Element.

Figure 3-3: Subdivision Design for Solar Access



PREFERRED LAYOUT
Most houses have good southern exposure for light and heat.



AVOID
Most houses have little southern exposure for light and heat.

Source: Crawford Multari & Starr, 1992.

EXPECTED ENERGY SAVINGS

Although the potential savings in long-term energy use are great as development continues, the short-term energy savings may not be significant. The real monetary savings will come in 10 or 20 years when Glenn County does not have to build a new sewer plant, enlarge a water distribution system to supply a remote rural subdivision, or add lanes to county roads and subsidize a bus system because of traffic congestion. Given the prime agricultural lands found in Glenn County, the benefits of saving agricultural land in viable production are enormous. Good land use planning can also protect important gourd water recharge areas.

3.3 TRANSPORTATION

POLICIES

It shall be the policy of Glenn County to:

a. Designate appropriate sites for park-and-ride lots that can be used for car- and van-pooling and for future bus access. The County shall require land to be set aside for future transit access stops as conditions of approval of new commercial or industrial development.

b. Encourage bicycle use by providing bike racks and support facilities at key locations and by implementing a County bicycle master plan.

c. No longer allow drive-through windows for businesses because they promote vehicle idling (with its resultant increased air pollution) and inefficient, non-productive use of energy.

d. Reduce private vehicle commutes by permitting satellite offices and local telework centers in all commercial zoning districts. Home occupations involving at-home access to remote computer facilities shall be permitted in all residential zones.

e. Revise road standards so that all streets, and residential streets in particular, are designed with the minimum pavement width and curb radii feasible, considering projected traffic flow, parking requirements, safety, cost, and energy efficiency.

f. Encourage and facilitate the use of railways as an alternative to trucking materials out of the County by preserving existing services and rights-of-way and investigating the feasibility of a general freight depot.

g. Provide for mass transit, when feasible, along high use corridors.

Forty percent of all the energy used in California is for transportation (CEC, 1990). Transportation strategies attempt to decrease energy use through a variety of means; however, many transportation measures (such as mass transit) require large population centers and concentrated development patterns before they become cost effective.

Because Glenn County is a sparsely settled, rural area, there is not a great volume of traffic on its roadways. Conversely, the relatively low population density, the lack of public transportation, and the trips associated with procuring supplies for agricultural production usually requires people to drive rather than walk. Even though there are relatively few total vehicle trips in Glenn County compared to an area like Sacramento, the trips may cover longer distances and be more frequent.

The Glenn County Air Pollution Control District completed the Draft Air Quality Attainment Plan on July 16, 1991 to respond to the requirements of the California Clean Air Act. The intent of the California Clean Air Act is to improve air quality throughout the state through a variety of measures. An important component of improving air quality involves reducing the number of miles driven by automobiles. Transportation control measures decrease vehicle miles and will result in energy savings as well as improved air quality.

As a result of the Clean Air and Transportation Improvement Act of 1990 (Sections 99600 et seq. of the Public Utilities Code) funds are available for the preservation, acquisition, construction, or improvement of rail rights-of-way, terminals, stations, equipment, or facilities, paratransit vehicles,

and bicycle facilities (among others). Full descriptions of the grant funding programs are provide in Appendix C. Over $1 million in funds is currently available (1992) for Glenn County projects that meet the application requirements.

TRANSPORTATION ISSUE AREAS

Transportation programs can reduce vehicle fuel use by encouraging more people to walk or use bicycles, use public transit, use the railways, telecommuting, and reducing street width.

Bicycles

Bicycles provide an energy efficient, clean, and inexpensive (relative to automobiles) form of transportation. Unfortunately many people do not use bicycles for transportation because 1) there is no place to secure the bike when shopping or working, 2) streets are too narrow or dangerous for bicycles to share the roadway with automobiles, or 3) there are not showers and/or lockers available to allow the bicyclist to change clothes after a long ride. Because of the long distances between rural residences and services, it is unlikely that bicycles will replace a significant number of automobile trips unless showers and locker facilities are available.

As new development becomes concentrated within existing county communities, more residents will be able to walk or ride bikes within the communities. It is not expected that residents will use bicycles to commute or travel between cities or communities. Because Glenn County is a rural area, separate bike lanes are probably not necessary at this time.

Public Transit

Mass transit and carpooling require certain population densities before they become feasible. (Twelve units per acre is considered the minimum density necessary to support bus routes [Calthorpe, 1990].) Being predominantly rural, such measures are generally not appropriate in Glenn County; although planning land for these facilities is appropriate at this time, as mentioned in the discussion of land use policies. The 1986 *Glenn County Regional Transportation Plan* showed a strong desire for improved public transit. Additional information on mass transit, van-pooling, and paratransit can be found in the Transportation/Circulation section of the Community Development Element.

Although effective public transit is not available to present-day residents of Glenn County, the County should make plans with present and future transportation needs in mind. Public transit needs will likely increase over the next twenty years as population increases. In particular, increased traffic volumes on the Highway 32 corridor between Orland and Chico will probably generate sufficient demand to support a bus line. Bus Service to Chico would also provide an AMTRAK passenger service connection.

Railways

The Southern Pacific Transportation Company's West Sacramento Valley railroad track traverses the county. The track extends north from Davis to Tehama, where it joins the more heavily used mainline track from Sacramento. AMTRAK service is available at Chico; its track is located on the east side of the Old Highway 99 W right-of-way and runs through the center of both Orland and Willows. A branch line runs to the Holly Sugar factory in Hamilton City and a spur serves the Manville facility west of Willows. Carload freight service is provided to individual users on request at several sidings, but there are no general freight depots in the county. Freight service to and from the county is generally limited to large shipments that are being moved over long distances, where time is not a factor.

At one time, the railways were widely used to transport goods out of Glenn County. In recent years that practice has slowly diminished. Trucks offer a faster and more flexible method of shipping goods, but trucks also consume more fuel and create greater demands on roadway improvements. Trucks use more energy than railways.

Telecommuting

Telecommuting allows people to minimize or eliminate the time/distance spent commuting to work. There are basically three types of telecommuting:

- Home-based telecommuting involves employees who work at home and communicate with the main office by telephone, computer modem, and/or facsimile machine;
- Satellite centers are set up by a single organization to house its own telecommuters at a location closer to residences. Facilities are linked to the main office via telephones and computers; and
- Local/neighborhood telework centers house telecommuters from more than one employer. Facilities can include computers, copy machines, telephones, secretarial services, meeting rooms, facsimile machines, and other equipment.

There are currently no employers in the area that use large numbers of back-office clerical personnel. These types of employers would be the most likely to employ telecommuting or telework centers. As the population continues to grow, employers may wish to tap into the local labor pool which is relatively inexpensive compared to the Sacramento or Bay area.

Streets

Streets consume large amounts of land and energy and create demand for energy use within homes. Initially, large energy inputs are required to build a roadway. A more narrow road will require less grading and less paving material, and it will leave more land open for residential development. The heat generated from asphalt roadways adds to the energy required to cool buildings during the summer months. A street that is too wide may also encourage faster speeds, be unattractive, discourage walking, and increase water runoff. If separate bicycle lanes are desired in a roadway, the automobile travel lanes or parking lanes should be made more narrow to accommodate a striped bicycle lane.

PROGRAMS

3.3.1 The Land Development Space and Housing Committee shall identify sites for possible use as park-and-ride lots, when such facilities are desired. In the event that a development request would disable use of a site as a park-and-ride lot, an equally suitable site shall be identified. When developed, the park-and-ride lots shall provide user amenities like covered waiting areas, benches, and bicycle parking and storage facilities. The objective is to preserve suitable sites for park-and-ride lots should they be necessary. *This program implements Policy 3.3.a.*

Implementation

Lead agency: Public Works Department.

Coordinating agencies: Transportation Commission, Land Development Space and Housing Committee.

Funding: General fund, Clean Air and Transportation Improvement Act (CATIA).CATIA funding would be available for bicycle facilities.

Time frame: The Public Works Department shall identify a list of suitable sites within three years after adoption of the Energy Element.

3.3.2 The County shall encourage the use of bicycles by purchasing bicycle racks and storage facilities and placing them in select commercial and public destinations in the cities of Willows and Orland. If successful (i.e., the racks are regularly full), the program may be expanded to Artois and Hamilton City. The objective of the program is to have bicycles

replace 5 percent of the daily automobile trips with bicycle trips within five years. *This program implements Policy 3.3.b.*

Implementation

Lead agency: Buildings and Grounds Department.

Coordinating agencies: Individual department directors, County Transportation Commission.

Funding: Buildings and Grounds Department annual budget, development fees, funding from the Clean Air and Transportation Improvement Act.

Time frame: The Buildings and Grounds Department shall apply for CATIA funding within one year after the adoption of the Energy Element. They shall also set and implement a reasonable development fee for the installation of bike racks within three years after the adoption of the Energy Element. These shall be incorporated into the development regulations of the Zoning Code.

3.3.3 Adequate and secure bike racks and storage facilities at a ratio of one per every ten vehicle spaces shall be a mandatory requirement in all new public buildings. Showers and changing facilities shall also be required as funding is secured. The objective of this policy is to increase bicycle use by County employees and people tending to business at County offices. *This program implements Policy 3.3.b.*

Implementation

Lead agency: Buildings and Grounds Department.

Coordinating agency: Board of Supervisors, County Transportation Commission, funding from the Clean Air and Transportation Improvement Act.

Funding: Capital improvements budget, CATIA funding.

Time frame: The Buildings and Grounds Department shall apply for CATIA funding within one year after the adoption of the Energy Element. The Zoning Code and Building Code shall be amended to incorporate this program within four years after the adoption of the Energy Element.

3.3.4 The Zoning Code shall be amended to prohibit new drive-through windows for businesses. *This program implements Policy 3.3.c.*

Implementation

Lead agency: Planning Department.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The Zoning Code shall be amended to incorporate this program within four years after the adoption of the Energy Element.

3.3.5 The Zoning Code shall be amended to specifically permit satellite offices and local telework centers in commercial and industrial areas. Chapter 19.64, Home Occupation Permit, shall be amended to permit home-based telecommuting in all residential zoning classifications. The objective is to facilitate the establishment of satellite offices, telework centers, and home-based commuting. *This program implements Policy 3.3.d.*

Implementation

Lead agency: Planning Department.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The Zoning Code shall be amended to incorporate this program within four years after the adoption of the Energy Element.

3.3.6 The Planning Director shall work with the Technical Advisory Committee to revise the land division ordinance requirements for all streets (and residential streets in particular) to specify the minimum pavement width and curb radii feasible—considering projected traffic flow, parking requirements, bicycle lanes, safety, cost, and energy efficiency. The objective is to reduce the width of vehicle travel lanes constructed in the county. *This program implements Policy 3.3.e.*

Implementation

Lead agency: Planning Department.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The land division ordinance and general development regulations of the Zoning Code shall be revised within four years after the adoption of the Energy Element.

3.3.7 The County shall preserve existing services and railroad rights-of-way. County Counsel shall keep appraised of all proposed service changes and shall petition the Interstate Commerce Commission (ICC) to deny any requests that curtail or diminish service within the county. *This program implements Policy 3.3.f.*

Implementation

Lead agency: County Counsel.

Coordinating agencies: Public Works Department, Board of Supervisors, Interstate Commerce Commission, California Transportation Commission.

Funding: General fund, CATIA funding.

Time frame: The County Counsel shall make this a policy of the County immediately upon adoption of the Energy Element. The Public Works Department shall apply for CATIA funding within one year after the adoption of the Energy Element.

3.3.8 The Public Works Department shall develop a contingency plan to purchase rights-of-way in the event that the ICC denies the County's petition to maintain existing services and right-of-ways. The objective of this program is to preserve existing railroad service and rights-of-way in Glenn County. *This program implements Policy 3.3.f.*

Implementation

Lead agency: Public Works Department.

Coordinating agency: County Counsel, County Transportation Commission.

Funding: General fund, funding from the Clean Air and Transportation Improvement Act.

Time frame: The Public Works Department shall apply for CATIA funding within one year after the adoption of the Energy Element. The Public Works Department shall prepare a brief on ICC regulation regarding abandoned rail lines for the County Counsel within two years after adoption of the Energy Element. The Public Works Department shall prepare a contingency plan to purchase rights-of-way within three years after the adoption of the Energy Element.

3.3.9 The Glenn Chamber of Commerce—Economic Development Inc., shall investigate the costs and benefits of establishing a general freight depot in Glenn County. The relative energy savings should factor heavily in the potential benefits of such a depot. If such a facility is possible and the costs outweigh benefits, the County shall obtain a suitable site and develop a depot. It is the objective of this program to establish a general freight depot if it represents a cost and energy savings to the county. *This program implements Policy 3.3.f.*

Implementation

Lead agency: Glenn Chamber of Commerce—Economic Development Inc.

Coordinating agencies: Southern Pacific, Board of Supervisors.

Funding: General fund, funding from the Clean Air and Transportation Improvement Act.

Time frame: The Glenn Chamber of Commerce—Economic Development Inc. shall apply for CATIA funding within one year after the adoption of the Energy Element. Within four years after the adoption of the Energy Element, the Glenn Chamber of Commerce—Economic Development Inc., shall present the finding and recommendations regarding a general freight depot to the Board of Supervisors.

3.3.10 The Public Works Department shall monitor traffic volumes on all major corridors on a biannual basis to determine if mass transit is a viable option. *This program implements Policy 3.3.g.*

Implementation

Lead agency: Public Works Department

Coordinating agencies: Technical Advisory Committee, Planning Department, California Transportation Commission.

Funding: General fund, funding from the Clean Air and Transportation Improvement Act.

Time frame: The Public Works Department shall evaluate the viability of mass transit within Glenn County every second year beginning in 1996.

EXPECTED ENERGY SAVINGS

Drive-through Windows

Cars are least efficient when idling (0 mpg). A car that idles for 30 seconds uses about the same amount of gasoline as a car that is turned off and restarted. Energy savings are also apparent in the trip generation rates, which are much higher for drive-through windows. The extra traffic and extra idling time make for an inefficient use of energy. This strategy will lead to reduced fuel use.

Bicycles

Passenger vehicles and light-duty trucks average use was 45,750 gallons of fuel each day in 1990. If bicycle trips could replace only 5 percent of the automobile trips made each day, the resultant savings would be 2,288 gallons each day. Total savings in Glenn County would be $2,746 dollars a day and over $1 million a year (assuming $1.20 for a gallon of gas). This strategy will lead to reduced fuel use. The cost of bike racks ranges from $150 to $230 for a rack that can hold 10 to 20 bikes.

Bicycle lanes will probably cost $1.00 to $1.10 per linear foot; the costs will decrease as the length of the lane increases. If the bike lanes are added at the time the road surface is repaved, the additional costs will be minimal. The cost of bike paths and storage facilities used by commuters can be funded by the Clean Air and Transportation Improvement Act.

Railways

Diesel and non-diesel heavy duty trucks consume 35,480 gallons of fuel each year in Glenn County. If only 20 percent of the county's shipping was switched from trucks to railways, over 7,000 gallons could be saved each year. If diesel cost $1.30 a gallon, the total savings would be $9,100. Given the same amount of load and same travel distance, trains are four times (75 percent) more efficient than trucks (Jackson, 1991). This strategy will lead to reduced fuel use.

Keeping abreast of rail service changes will require occasional monitoring by planning department staff. Actively petitioning the Interstate Commerce Commission will require the time of the Planning Director or County Counsel; this is potentially costly, given the technical training necessary.

Telecommuting

Telecommuters averaged a savings of 230 gallons of gasoline per year, if the telecommuter normally drove alone to work. If we assume a $1.20 per gallon of gas, direct savings are (at least) $276 a year for each commuter.

The evaluation of the costs and benefits of a California State telecommuting pilot project (200 participants) found that the program broke even within three years. Benefits were significantly greater than the costs of training, phone/modem support, maintenance, and administration. Direct benefits included decreased sick leave, turnover, parking requirements, and necessary office space. This strategy will lead to reduced fuel use.

Streets

A planner with the City of Visalia estimated that reducing streets from 40 feet to 32 feet lowered the ambient temperatures 10 to 15 degrees Fahrenheit. Each degree decrease can reduce cooling demand by 1 to 2 percent, saving 10 to 30 percent on cooling costs. When combined with the benefits of shade trees, savings can be even more significant. The average cost of cooling a home (from air conditioners, swamp coolers, heat exchanges, etc.) in California is $68.64 per year. This makes a savings of $6 to $18 for each home. The savings in hot climates like Glenn County will tend to be much greater. Narrowing street widths affects all the homes along the length of the street. If 100 homes are along the street, the total savings would be $500 to $1,500 just in cooling costs.

3.4 RESIDENTIAL BUILDINGS

POLICIES

It shall be the policy of Glenn County to:

a. Develop education and incentive program encouraging homeowners, landlords, and tenants to install energy- and water-efficient fixtures and equipment.

b. Require existing homeowners to improve energy and water efficiency upon major renovation of the home.

c. Require existing homeowners to perform an energy audit when selling their home.

d. Require developers to build efficient new homes and provide information regarding costs and pay-back periods to prospective buyers.

e. Mandate that all planning and building personnel enforce Title 24 requirements and existing state solar laws.

f. Require new multi-family units to have individual meters for gas, electricity, and water and separate storage locations for recyclable materials.

g. Promote tree planting in existing residential areas.

This section focuses on improving energy efficiency in individual homes, both new construction and existing units. The recommended programs emphasize educating builders and consumers about the benefits of exceeding the energy efficiency measures required by Title 24 of the California Code of Regulations, rather than imposing additional regulations on new housing that will raise prices. Such construction practices can actually reduce costs to homeowners over the long term. Detailed information on Title 24 requirements can be found in Appendix D.

Often, consumers discard long-term savings potential in favor of immediate cost savings. They do not install extra ceiling insulation at the time of construction to save money, but they end up paying higher energy bills over the life of the house for cooling and heating. If consumers have accurate information, they will be able to better weigh the implications of their decisions. Even simple programs, like supplying apartments and duplexes with separate utility meters, make residents aware of their energy use and encourage conservation.

RESIDENTIAL BUILDINGS ISSUE AREAS

Programs to reduce energy use in residential homes can be accomplished through home improvement loans, energy efficient home construction, and energy audits and efficiency retrofits.

Home Improvement and Retrofit Loans

There are several weatherization or retrofit programs already provided by the Community Action Agency of Colusa County, Glenn County, and Trinity County (Glenn County Community Services Department). The agency places newspaper advertisements describing the different programs at the beginning of the year, but most clients hear about the program from the Social Services Department or through word-of-mouth.

The *California Housing Rehabilitation Program for Owner Occupied Housing (CHIRPOH)* provides loans to elderly, handicapped, or low income residents of Glenn County. The program is funded by the state and serves an average of 25 to 30 households. CHIRPOH provides a low interest loan (3 percent interest rate) available to homeowners that can be used for any rehabilitation projects and is due after 5 years. Elderly residents can pay back the loan when the property is transferred to a new owner.

The *California Energy Conservation Rehabilitation Program (CECRP)* is a grant of up to $2,000 per household. The state grant program is available for low income, farmworkers, elderly, and handicapped persons. The program is geared toward rental units, but farmworkers who own their home are also eligible. All rehabilitation work must be geared toward conserving energy, and the owners must agree to continue renting to low income, handicapped, farmworkers, or elderly persons for the next 5 years. In the last 18 months (ending September, 1991), 25 households in Glenn County have received this grant.

The *Low Income Home Emergency Assistance Program (LIHEAP)* is also a state funded program available to very low income residents of Glenn County. The program provides basic weatherization, wood stoves, attic insulation, ceiling fans, etc. LIHEAP served 51 households from January to September, 1991; with other households still on a waiting list.

The final program is one funded by the State of California and Pacific Gas & Electric. Energy Partners provides home energy analysis, recommendations on ways to save energy, and free weatherization for households in eligible neighborhoods. The only eligible area in Glenn County is Orland. The program began in March of 1991; the community services department is currently reviewing 246 applications for this area (Young, 1991).

PG&E also provides a Target Customer Appliance Program that will replace old and inefficient refrigerators, furnaces, air conditioning systems and water heaters for income-eligible households—at no cost to qualifying customers.

Energy Efficient Home Construction

Energy efficient home construction should contain some or all of the following:

- double-pane windows (two panes of glass enclose a vacuum-tight space that does not allow heat and cold to transfer as quickly as it does in a window with a single pane of glass);
- attic insulation greater than R-19 (soft, fiberglass insulation is given an "R" rating based on its capacity to insulate an area, a higher "R" value indicates greater insulation capability);
- additional wall insulation (older homes may not have insulated walls);
- energy efficient appliances;
- fluorescent indoor lighting (a standard, incandescent light bulb uses more energy);
- dimmer switches and task lighting (dimmer switches allow lower lighting levels and less electricity use while task lighting directs light to necessary areas without wastefully lighting a larger area);
- halogen outdoor lighting (halogen, like fluorescent, are more efficient than incandescent light);
- lighting motion detectors that turn on lights only when they detect a person in the room or area;

- shade trees along southern and western glazing to reduce the heat from windows on hot summer days;
- solar screens that reduce heat from solar radiation coming through windows;
- evaporative cooler which uses less energy than air conditioner;
- microwave oven which uses less energy than an electric or gas oven;
- gas (rather than electric) water heater and range/oven;
- weatherized windows and doors that do not have cracks to cause drafts;
- pools with integrated cleaning and heating systems (including pool covers, active solar heating, and efficient filters, pumps, and motors);
- energy use automatic timers that provide energy use only when it is necessary;
- drip irrigation system that conserve water and reduce energy used in pumping water;
- drought tolerant landscaping; and
- active solar elements and passive solar design.

Pacific Gas & Electric has a showcase program for developers who build homes that exceed the Title 24 standards by 50 percent. This program advertises the homes for free in local newspapers and PG&E publications.

Energy Audits and Efficiency Retrofits

Energy audits are available free of charge from Pacific Gas and Electric. Consumers often view various conservation programs (such as insulation, leak detection, weather stripping, etc.) solely in terms of immediate dollar costs, without adequately considering the long-term energy savings. The results of energy audits will give consumers information regarding the real cost of inefficient energy use. It is more likely that consumers will pursue efficiency measures if they understand how increasing energy efficiency will save money over time. Possible retrofits include:

- install active solar panels for water and pool heating;
- add roof and wall insulation (foam wall insulation can be blown into the wall spaces through small holes in the exterior; it does not require tearing down walls, although it does create numerous small patch marks in exterior walls that must be repainted.);
- switch from propane to natural gas;
- replace some of the older appliances in the home;
- replace old air conditioners with evaporative coolers;
- weatherstrip and caulk windows and doors;
- install storm windows;
- use reflective film on south facing windows;
- replace broken windows with double-pane glass;
- redo landscaping and irrigation systems; and

- trim and fertilize existing shrubs and trees.
- install energy efficient lighting.

PG&E also offers rebates on high energy using appliances (refrigerators, air conditioners, heaters, etc.) and special rates to residences that curtail energy use during peak energy hours (weekdays between noon and 6:00 p.m.). The time-of-use program can reduce bills by as much as 20 percent, but to receive the off-peak rates, owners must sign up for the program with PG&E.

PROGRAMS

3.4.1 The Building Department shall work with the CEC and PG&E to develop an information sheet on energy and water efficient design guidelines and include it as part of all residential development applications. The staff shall also place the information sheet in conspicuous public locations (such as County offices) and places where people purchase building materials (such as lumber yards or hardware stores).

The information sheet shall 1) include information on the benefits of energy-efficient design, 2) provide a list of stores that provide the necessary supplies, and 3) provide phone numbers and addresses of agencies or people that can provide more detailed information. The Building Department shall note whether proposed units exceed Title 24 requirements as the units receive building permits. The objective of this program is for all new housing units to exceed Title 24. *This program implements Policy 3.4.d.*

Implementation

Lead agency: Building Department

Coordinating agencies: Planning Department, Planning Commission, Board of Supervisors, California Energy Commission, Pacific Gas and Electric.

Funding: General fund.

Time frame: The guidelines shall be completed within two years after the adoption of the Energy Element.

3.4.2 The County shall require energy efficiency retrofits in conjunction with any major renovation work to a home. The energy retrofits must include R-30 attic insulation, weather-stripping around doors and windows, insulated hot water heaters, energy efficient lighting, and reduced flow shower head fixtures and faucet aerators. Major renovation work shall include all projects that will involve more than 50 percent of the existing floor area of the house. The objective of this program is to increase energy efficiency of existing homes. *This program implements Policy 3.4.b.*

Implementation

Lead agency: Building Department.

Coordinating agencies: Pacific Gas and Electric, Community Services Department.

Funding: General fund.

Time frame: The building code shall be amended within two years after the adoption of the Energy Element

3.4.3 The County shall adopt an ordinance requiring an energy audit of all residences that are put up for sale. Pacific Gas and Electric can perform the audit for free. The audit shall be provided to all persons interested in the home. The objective of this program is to provide

homebuyers with an energy efficiency comparison of available units, thereby encouraging potential sellers to retrofit their properties. *This program implements Policy 3.4.c.*

Lead agency: Board of Supervisors

Coordinating agencies: Local association of realtors, Pacific Gas and Electric, County Counsel, local title companies.

Funding: General fund.

Time frame: The ordinance shall be adopted within two years after the adoption of the Energy Element

3.4.4 The Community Services Department and the Planning Department shall coordinate their efforts to increase funding for retrofit programs. Existing programs include the *California Housing Rehabilitation Program for Owner Occupied Housing*, the *California Energy Conservation Rehabilitation Program*, and the *Low Income Home Emergency Assistance Program.* The objective of the program is to provide loans given to retrofit existing homes at a pace that matches the expected pace of new development, i.e., 32 to 64 units each year. *This program implements Policy 3.4.a.*

Implementation

Lead agencies: Community Services Department, Planning Department.

Coordinating agencies: Building Department, Buildings and Grounds Department, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: Within two years after the adoption of the Energy Element, the Community Services Department shall prepare a yearly report and meeting with the Planning Director to discuss and review loan programs and their funding.

3.4.5 The Planning Department and Community Services Department shall apply for a Community Development Block Grant to create a revolving low interest loan program for housing rehabilitation that emphasizes energy and water efficiency improvements. The objective is to obtain the Community Development Block Grant within three years and to provide loans given to retrofit homes at a pace that matches the expected pace of new development, i.e., 32 to 64 units each year. *This program implements Policy 3.4.a.*

Implementation

Lead agencies: Planning Department, Community Services Department.

Coordinating agencies: Planning Commission, Board of Supervisors.

Funding: Community Development Block Grant funds.

Time frame: The Planning Director shall include an analysis of the housing rehabilitation loan program in the periodic review of the Housing Element.

3.4.6 The Community Services Department shall pursue methods to make communities in the unincorporated areas of the county eligible for the *Energy Partners* program. *This program implements Policy 3.4.a.*

Implementation

Lead agency: Community Services Department

Coordinating agency: Pacific Gas and Electric.

Funding: General fund.

Time frame: The Community Services Director shall work toward becoming eligible before the end of the current five year cycle of the Housing Element.

3.4.7 If the number of energy efficiency retrofits in a five year period does not equal or exceed the number of new units built during that same period, the County shall require retrofits to prior to the sale of any home. Retrofits shall include: R-30 attic insulation, weather-stripping around doors and windows, insulated hot water heaters, energy efficient lighting, and reduced flow shower head fixtures and faucet aerators. Once such improvements are made, the owner shall then be required to get an energy audit from PG&E (free of charge) and make it available to potential buyers or renters. *This program implements Policy 3.4.b.*

Implementation

Lead agency: Board of Supervisors.

Coordinating agencies: Local association of realtors, County Counsel.

Funding: General fund.

Time frame: If deemed necessary by the conditions of the program, this implementation programs shall be in place within six years after adoption of the Energy Element.

3.4.8 The County shall require that all building inspectors become and/or remain proficient in implementing the Title 24 requirements and existing solar laws. (Including the Solar Rights Act of 1978 in Government Code Sections 66473.1 and 66475.3 and the Solar Shade Control Act of 1978 in Public Resources Code Section 25982.) If certified or official classes are available from the state, at least one member of the department shall attend such a class. That individual shall then instruct the department members in a structured workshop.

The County request an official of the State Energy Resource Conservation and Development Commission of the California Energy Commission to monitor the performance of the building inspectors on an annual basis. The objective is to construct all buildings in accordance with the Title 24 regulations and solar laws. *This program implements Policy 3.4.e.*

Implementation

Lead agencies: Building Department.

Coordinating agencies: Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: Within one year after the adoption of the Energy Element, all planning and building inspectors shall have participated in a review course on the provisions and implementation of Title 24 and of solar access regulations.

3.4.9 To encourage the use of solar energy, the County Zoning Code shall be amended to clarify the following. The objective is to facilitate the use of passive and active solar energy in all new homes. *This program implements Policy 3.4.a and Policy 3.4.d.*

a. Detached solar collectors shall be considered accessory structures and (if less than 1,000 square feet in size) shall be exempt from yard coverage requirements.

b. Height restrictions shall be modified to the extent necessary to allow roof-mounted solar collectors above the roof line of the building. Specifically, in single-story homes there shall be 55 feet between the highest point of the south house to the southern edge of the north house. In two-story homes (30 feet in height or more), the distance shall increase to 82 feet.

c. New subdivisions shall be designed to place the longest dimension of lots facing in a southerly direction.

d. Solar access easements and covenants shall prohibit one homeowner from blocking the sunlight to another home or parcel.

Implementation

Lead agency: Planning Department.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The Zoning Code shall be amended to incorporate this program within four years after the adoption of the Energy Element.

3.4.10 The County shall develop a tree planting program whereby the County will supply the physical labor and tools to plant a tree if residents supply the tree or the necessary funds to purchase a tree. (In the latter case, the County may be able to get a reduced price for the trees by buying in quantity.) The Community Services Director shall solicit assistance from PG&E to advertise the program in their monthly billing statements. The cost to the County would be significantly reduced if donated labor could be used. The County should coordinate with the Glenn Chamber of Commerce on this matter. If the program is popular, it may be more effective to concentrate work in one area at a time. This would save on time and energy needed to move equipment and trees. The objective of this program is to plant 100 trees each year. *This program implements Policy 3.4.g.*

Implementation

Lead agency: Community Services Department.

Coordinating agencies: Buildings and Grounds Department, Public Works Department, Pacific Gas and Electric, Glenn Chamber of Commerce—Economic Development Inc.

Funding: General fund, homeowners.

Time frame: The tree planting ordinance shall be in effect beginning on Arbor Day following the adoption of the Energy Element.

3.4.11 The County shall modify the building and land division ordinances to require that all new multi-family residences and mobile homes have individual meters for gas, electricity, and water. Each complex shall also be provided adequate storage locations for recyclable materials. The objective is to have individual utility meters on all new multi-family residences and mobile homes. *This program implements Policy 3.4.f.*

Implementation

Lead agency: Building Department.

Coordinating agencies: Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The codes and ordinances shall be amended to incorporate this program within three years after adoption of the Energy Element.

3.4.12 Hamilton City is expected to grow within the next 20 years; It is the only unincorporated community that supplies sewer and water services. In order to save capacity, residents will be encouraged to install low-flush toilets that save water and save the energy used to pump water. The County shall institute a program whereby all households within the Hamilton City Community Services District that replace standard toilets with ultra-low flow toilets will receive a $50 credit toward their services bills during that year. The residents shall provide proof of purchase and receipt from the county landfill (where the porcelain will be recycled as paving material) to be eligible for the rebate. The objective of the program is to encourage 20 households each year to replace standard toilets with ultra-low flush models. *This program implements Policy 3.4.a.*

Implementation

Lead agency: Hamilton City Community Services District.

Coordinating agencies: Landfill operator, porcelain recycling firm, Pacific Gas and Electric, California Energy Commission.

Funding: Foregone revenue to the Solid Waste Disposal Enterprise Fund.

Time frame: The Public Works Department shall implement this program within three years after the adoption of the Energy Element.

3.4.13 The Building Department shall provide each new household with a collection of pamphlets on conservation and energy efficiency measures that encourage free energy audits and retrofit programs for existing residential development. Pacific Gas & Electric publishes numerous pamphlets on energy efficiency and conservation methods. The County should coordinate with the local PG&E representative to assemble pamphlets and to acquire the addresses of all new energy customers. The County should then schedule funds in the annual budget to cover mailing and packaging costs. The objective of the program is to mail out approximately 200 packages each year to new PG&E residential utility customers.[2] *This program implements Policy 3.4.a.*

Implementation

Lead agency: Building Department.

Coordinating agency: Pacific Gas and Electric, California Energy Commission.

Funding: General fund, if monies are available. If funds are not available, the County may ask assistance from the California Energy Commission or Pacific Gas and Electric to cover the mailing costs.

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[2] PG&E recorded 194 new residential electric customers and 62 new residential gas customers in the County last year. Some of the new gas customers probably had electric service as well, so between 194 and 256 packages would need to be mailed.

Time frame: The program should be implemented within three years of adoption of the Energy Element. Packages should be mailed out within three months of the household establishing the new service. The program should be reviewed after two years to assess the costs and benefits of the program.

EXPECTED ENERGY SAVINGS

Energy Use in an Average Home

To calculate energy savings that may be expected from various conservation measures, it is important to first know the ways in which energy is used in homes. Table 3-1 shows the percentage breakdown of energy uses within the home. This information comes from CEC's *Energy Efficiency Report*, published in 1990 and is based on the average California household. Although comparable information is not available specifically for Glenn County, the table has been adjusted to reflect past energy use in the county.

Table 3-1: Average Household Energy Consumption by Fuel Type

Household Energy Use	Energy Use	Annual Cost ($)
Electricity Use (kwh/year) cost @ 12¢ per kwh	8,172	980.64
Gas Use (therms/year) cost @ 60¢ per therm	228	136.80
Total Yearly Cost		$1,117.44
Energy Source	**Energy Use (%)**	**Annual Cost ($)**
Electricity Use		
Lighting and miscellaneous	34	333.42
Refrigerators and freezers	24	235.35
Space heating	9	88.26
Water heating	7	68.64
Space cooling	7	68.64
Appliances	19	186.32
Total	100	$980.64
Natural Gas Use		
Space heating	46	62.93
Cooking	6	8.21
Water heating	35	47.88
Other	13	17.78
Total	100	$136.80

Source: Percentages taken from the California Energy Commission, *Energy Efficiency Report*, 1990, Table A-4. Household energy use taken from the per capita energy use noted in Table 2-3 and Table 2-4 and then multiplied by 2.48 persons per household in 1990.

New Construction Programs

The General Plan anticipates a 2005 population of 30,400 — an increase of 5,400 persons over the 1990 population. The average household size in the county is 2.48 persons, so the corresponding increase in housing units would be 2,177 units or 145 units each year in the whole county. Given the higher rate of development in the cities, at most, half of the new homes (72 units) would be in the unincorporated areas of the county. This number is significantly higher than the historic amount and rate of development. During the past ten years, an average of only 23 single family homes have been constructed each year in the unincorporated areas. The population projections appear to anticipate spill-over growth pressures from Sacramento and Woodland.

Energy efficient new residential construction can cut energy consumption by up to 50 percent (Nava, 1991). This would be over $500 each year for each home, giving an overall savings of $6,500 (23 units) to $36,000 (72 units) the first year.

In new construction, a combination of active and passive solar systems can replace all the electricity and gas used for space cooling and space and water heating in a home—as much as $336 each year for each home (based on heating costs detailed in Table 3-1).

Energy Efficiency Retrofit Programs

Depending on how much money a homeowner is willing to invest in energy efficiency and the existing condition of the home, a retrofit on a home can save anywhere from 10 to 75 percent of the monthly energy bill (Nava, 1991). Given an estimated average bill of $1,117 per year, the savings could be between $112 and $838. For this paper, a retrofit is assumed to save an average of 20 percent of the total energy bill, or $224. If only 4 percent of the customers made retrofits to save $224 (costing approximately $800), the expected energy savings would total $1,738 to $2,294 each year. (The CEC has found that, on average, education programs can effect a 4 percent saving.) The cost of energy retrofits can vary widely, depending on the existing condition of the home. We assume that an $800 investment would bring at least a $200 savings.

The 1987 household use figures shown in Table 3-1 recorded that 35 percent of the electricity used in a home goes toward lighting and small appliances—about half of that (17 percent) goes specifically toward lighting. Space heating uses 9 percent and cooling uses 7 percent of the total electricity. Forty six percent of the natural gas used in homes is for heating. The following calculations assume that heating/cooling demand can be reduced by an average of 20 percent by adding roof insulation; fluorescent lighting uses one-third the amount of electricity when compared to standard bulbs (equivalent to a 67 percent reduction). Adding an insulation blanket to an electric water heater can save 5 to 15 percent of the energy use; on gas hot water heaters, the savings range from 7 to 12 percent. The calculations below use an average of 10 percent on both types.

Electric Lighting: $333.42 ÷ 2 * 67% = $111.70 savings
Electric Heating and Cooling: ($88.26 + $68.64) * 20% = $31.38 savings
Electric Water Heating: $68.64 * 10% = $6.84 savings
Gas Heating: $62.93 * 20% = $12.59 savings
Gas Water Heating: $47.88 * 10 percent = $4.79 savings
Total Energy Bill Savings = $167.32 per year

These calculations suggest that adding insulation, hot water blankets, and fluorescent lighting can save up to $167.32 each year for each home. The cost to the home owner would be around $635, assuming a single story, 1,600 square foot home with no roof insulation and 8 light fixtures. R-19 insulation costs 32¢ a square foot. For a 1,600 square foot house, the total insulation bill would be $512. Compact fluorescent bulbs cost about $16 each, for a bill of $128; PG&E provides a rebate of $3 for every screw-in lamp, reducing the total bill by $30. Water heater blankets cost around $15 each. If 10 homes are subject to the ordinance, the total savings would be $1,673. The cost of compact fluorescent bulbs is

rapidly declining while the availability has been increasing. For example, Payless and Thrifty drug stores sell these bulbs for approximately $12 and replacement bulbs are $7 to $8. The pay-back period for these bulbs is usually less than one year (Stroud, 1992).

Direct Billing Program

Two simple methods of conservation, turning off lights and turning up the air conditioner can save money. Turning an air conditioner 1°F below 78°F will raise total energy consumption by 3 to 5 percent. When tenants pay for utility bills directly, the incentive to conserve is much greater. The California Energy Commission has found that information campaigns generally result in a 4 percent reduction in energy. Given the average annual home (Table 3-1), this means a $44.68 each year for each unit. If ten units have individual meters installed, the total savings would be $447.

Tree Planting Program

Plant leaves block about 80 percent of the summer radiation from windows. The effective selections and placement of shade trees not only reduces carbon dioxide buildup, increases property value, and enhances community aesthetics, but shade trees can also reduce air conditioning needs in the summer. Assuming that half of the heat gain in a home comes from windows, this means that shade trees can reduce average heat gain (and cooling costs) by 40 percent. During the hot Glenn County summers, this could save up to $108 each year ($27 dollars a month for 4 months). Savings will probably be greater in homes with less insulation and inefficient air conditioners. The typical cost of trees range from $20 to $40 and tree maintenance can cost up to $10 per year. The pay-back period for this program is longer than most because the tree needs time to grow and mature. The CEC estimates the payback period at around 1.5 to 5.5 years (CEC, 1992).

3.5 COMMERCIAL AND INDUSTRIAL BUILDINGS

POLICIES

It shall be the policy of Glenn County to:

a. Encourage existing business owners to retrofit their property to improve efficiency.

b. Require developers to build efficient new commercial and industrial buildings.

c. Encourage that existing commercial and industrial buildings be retrofited for energy efficiency before they are made available for sale, rental or lease to new tenants. The owners of such buildings shall also obtain an energy audit of the buildings before sale, rental or lease, and make the audit results available to potential buyers or renters.

These policies create energy savings through construction, and the operation of commercial and industrial facilities. Such facilities may use large amounts of energy for manufacturing processes, space heating or cooling, refrigeration, and lighting. While there are relatively few such facilities in Glenn County, their contribution to total energy consumption is significant.

Although savings will vary according to the physical design and the nature of the business, energy efficiency priorities are generally the following: 1) improve inefficient lighting by replacing incandescent bulbs with fluorescent fixtures, adding ballasts, using metal halide or high pressure sodium lights outdoors, and installing motion or light sensors; 2) decrease the cooling load by adding insulation, weatherstripping doors and windows, and improving the efficiency of cooling devices; and 3) replacing inefficient models of major appliances such as heaters, refrigerators, and freezers.

Energy costs in commercial businesses vary, but they usually account for up to 10 percent of the total operating budget; thus, lowering energy costs can raise profit margins. Since business profits typically range from 3 to 10 percent, even reducing energy costs by 1 percent of sales can have a major impact. (CEC, 1988).

ENERGY EFFICIENCY RETROFITS

Commercial and industrial business can increase efficiencies through many ways:

- install reflective window film (which reduces the solar heat that is gained from the windows) on south, east, and west facing windows;
- use evaporative coolers instead of air conditioning (evaporative coolers use energy 80 percent to 90 percent more efficiently than air conditioners);
- replace old air conditioners with more efficient models (older air conditioners require more energy to cool a room than new appliances);
- use a condenser pre-cooler to increase efficiency of refrigeration and air conditioning units (pre-cooler pass air over water to cool off the air before it enters the condenser. Air conditioners work by condensing air. As the air condenses it becomes cooler.);
- clean the condenser coil (a dirty condenser coil can reduce efficiency up to 20 percent);

- adjust the on/off cycles of air conditioning, heating, lighting, and other equipment to reflect the time of use or occupancy; and
- install programmable thermostats to automatically regulate a consistent temperature.

General guidelines for commercial and industrial lighting are:

- keep lighting levels at 35 to 75 footcandles (a footcandle is the amount of light one foot away from the flame of a standard candle);
- convert incandescent fixture to compact fluorescent fixtures;
- use metal halide lamps for outdoor lighting;
- install optical reflectors to double the amount of light emitted from a bulb and remove the lamps no longer needed because of the reflectors;
- use fluorescent current limiters to reduce the power needed for each lamp, reduce the amount of heat produced, and extend the life of the lamp;
- convert incandescent fixtures to fluorescent fixtures;
- use bypass and delay timers or motion detectors in areas that are only occasionally occupied, such as restrooms and storage rooms;
- use a photocell to automatically control an exterior lighting system (the photocell monitors the natural sunlight and turns lights on as the sun goes down);
- replace mercury vapor lamps with (more efficient) high pressure sodium lamps; and
- install sodium lamps for outdoor lighting.

Some methods of reducing the energy consumption by commercial appliances are:

- install a high efficiency upright refrigeration case with doors;
- install glass or acrylic doors on existing open-air refrigeration units;
- replace strip curtains with glass or acrylic doors;
- clean condenser coils on refrigeration units regularly;
- replace an old motor with a high-efficiency model; and
- replace blue-flame burner plates on fryers and griddles with ceramic infrared burners.

PROGRAMS

3.5.1 The Building Department shall develop an information sheet on energy efficient commercial and industrial construction practices. The information sheet shall be included with all the appropriate development permit applications, and shall also be posted in conspicuous public locations (such as County offices) and places where people purchase building materials (such as lumber yards or hardware stores). The information sheet shall provide phone numbers and addresses of agencies or people that can provide more detailed information. The objective of the program is to have half of all new commercial and industrial buildings constructed each year exceed Title 24 standards. *This program implements Policy 3.5.a.*

Implementation

Lead agency: Building Department.

Coordinating agencies: Planning Department, Planning Commission, Board of Supervisors, California Energy Commission.

Funding: Building permit fees.

Time frame: The Building Department shall record when buildings exceed Title 24 requirements as they receive building permits. Within five years after adoption of the Energy Element, the Building Director shall prepare a report to the Commission on the effectiveness of the commercial and industrial guideline program.

3.5.2 The Glenn Chamber of Commerce—Economic Development Inc., shall provide each commercial and industrial business owner with a collection of pamphlets on conservation, energy audits, and utility rebate programs. The County shall coordinate with the local PG&E representative to assemble pamphlets and to acquire the addresses of commercial and industrial customers. The objective is to mail out approximately 500 packages to commercial and industrial utility customers. *This program implements Policy 3.5.a.*

Implementation

Lead agency: Glenn Chamber of Commerce—Economic Development, Inc.

Coordinating agency: Pacific Gas and Electric.

Funding: General fund, if monies are available.

Time frame: The program shall be completed within three years after the adoption of the Energy Element.

3.5.3 The County shall draft a new ordinance that requires energy efficiency retrofits to commercial and industrial buildings that are being sold or leased. The minimum amount of the materials purchased for the retrofit shall equal $1 per square foot of total space. The required retrofits shall be performed before the building is marketed, and shall add R-30 attic insulation (if none exists), add strip curtains on refrigeration units, and replace inefficient lighting fixtures with efficient ones, including energy-saver ballasts, compact fluorescent light bulbs, and (for exterior lighting) high pressure sodium or metal halide lights. Once these improvements are made, the owner should then obtain an energy audit and make it available to potential buyers or renters. The objective is to retrofit five businesses each year. *This program implements Policy 3.5.b.*

Implementation

Lead agency: Building Department.

Coordinating agencies: Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: This implementation program shall be in place within three years after adoption of the Energy Element.

3.5.4 The County shall require that all commercial and industrial business owners present proof of a recent energy audit when applying for a change in service or any new service or license (e.g., renewal licenses, change in use permit, new water or sewer hookups, fire inspection). The objective of this program is to have every business in the county receive an energy audit within five years. *This program implements Policy 3.5.a.*

Implementation

Lead agency: Buildings and Grounds Department.

Coordinating agencies: Building Department, Planning Department, Public Works Department, Parks Department.

Funding: General fund.

Time frame: Within two years, each department shall revise all applications for service or permits so that proof of a recent (within two years) energy audit is required. The energy audit must be performed by a qualified professional.

EXPECTED ENERGY SAVINGS

The information in Table 3-2 shows that 43 percent of commercial electricity use is for lighting. Replacing incandescent light bulbs with compact fluorescent fixtures can save 67 percent of the total lighting energy use.[3] Energy saving fluorescent lamps use 15 to 20 percent less energy than standard fluorescent lamps.[4] Optical reflectors on fluorescent lamps can save an additional 50 percent. Optical reflectors work best in large, open spaces where task lighting is not critical. The reflectors actually double the illumination of a the fluorescent fixture, allowing half of the lamps to be removed.[5] A special lamp (T-8) is also available that uses a different gas than the standard fluorescent (T-12) lamp, but fits in the same socket. The T-8 lamps are more efficient because they can be dimmed to adjust to necessary lighting levels. The T-8 lamps also last longer, reducing operating costs and production energy output.[6]

Heating, ventilation, and air conditioning are also big energy users. Replacing inefficient air conditioners with evaporative coolers can save 80 to 90 percent on energy use. Most evaporative coolers do add moisture to the air, but in the dry Glenn County climate, the extra humidity should not cause problems. New coolers are on the market that do not increase the moisture content.[7] Condenser precoolers also help to reduce air conditioner energy use. Precoolers blow air over water to cool it before it is introduced into the air conditioning system's condenser. Pre-coolers are especially effective at temperatures exceeding 85°F and can yield up to 15 percent energy savings. For cooking needs, infrared fryers have an efficiency rating of around 80 percent. A conventional fryer only operates at around 47 percent efficiency. Replacing deep fryer units with infrared would give an approximated 33 percent savings.[8]

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[3] In addition to cost savings, PG&E offers rebates on many lighting fixtures and major appliances. These rebates are not always guaranteed, but should be investigated at the time of retrofits. PG&E will pay rebates of $3 for every screw-in lamp and $10 for every hardwired lamp.

[4] The PG&E rebate on these items is 50¢ per 4-foot lamp and $1 per 8-foot lamp.

[5] The rebate on these items is $5 per 4-foot lamp and $8 per 8-foot lamp that is removed.

[6] PG&E offers a $30 rebate for ever 4-foot, 2-lamp fixture.

[7] PG&E offers a $200 rebate on every evaporative cooler installed in a business or residence.

[8] PG&E currently offers a $75 dollar rebate for every infrared fryer.

Table 3-2: Average Commercial Energy Consumption by Fuel Type
California 1987

Commercial Energy Use (for a 1,000 square foot space)	Energy Use	Annual Cost ($)
Electricity Use (kwh/year) cost @ 12¢ per kwh	7,433	891.96
Gas Use (therms/year) cost @ 60¢ per therm	231	138.60
Total Yearly Cost		1,030.56
Energy Source	**Energy Use (%)**	**Annual Cost ($)**
Electricity Use		
Lighting	43	383.54
Refrigerators	11	98.12
HVAC	32	285.43
Other	14	124.87
Total	100	$891.96
Natural Gas Use		
Water heating	10	13.86
HVAC	35	48.51
Cooking	6	8.32
Other	49	67.91
Total	100	$138.60

Source: California Energy Commission, 1990.

Two options exist for refrigeration needs. Strips of clear acrylic plastic (strip curtains) can be used in upright refrigerators and cold storage areas help keep refrigeration costs down. The curtains are especially good in high traffic areas, because they do not require opening or closing. The strips are inexpensive and easy to install.[9] Glass and acrylic doors are more efficient that strip curtains, but do require opening and closing the doors. Doors can cut refrigeration energy loss by 50 percent.[10]

The calculations below assume a 67 percent reduction in electricity for lighting by replacing incandescent bulbs with fluorescent bulbs, an additional 50 percent savings when optical reflectors eliminate the need for half the fixtures, an 80 percent reduction in HVAC energy needs by switching to an evaporative cooler, an additional 10 percent savings in HVAC by adding insulation in the walls and roof, a 50 percent reduction in energy used for refrigeration by adding glass doors, a 10 percent savings from insulating the hot water heater, and a 33 percent reduction in cooking energy use by replacing a gas grill with an infrared grill.

[9] PG&E offers rebates of $1.5 for every square foot of area that is converted.

[10] The rebate for glass and acrylic doors is $20 per linear foot.

Electric Lighting: $383.54 * 67% = $256.97 savings
Electric Lighting: $256.97 * 50% = $128.49 savings
HVAC: ($285.43 + $48.51) * 80% = $267.15 savings
HVAC: $267.15 * 10% = $26.71 savings
Refrigerators: $98.12 * 50% = $49.06 savings
Cooking: $8.32 * 33% = $2.74 savings
Water Heating: $13.86 * 10% = $1.38 savings
Total Energy Bill Savings = $732.50 per year

It may be prohibitively expensive for a business to undertake all of these retrofits, but even minor retrofits can yield substantial returns in just a couple years. For example, we will use a 1,000 square foot store that expends 43 percent of its electricity on lighting, 32 percent on air conditioning, and 11 percent on refrigeration. In this case we will assume that the retail building does not currently have fluorescent lamps; adding compact fluorescent light bulbs will reduce the peak demand by 67 percent. Adding insulation in the ceiling will reduce energy use 10 percent, and installing strip curtains will reduce refrigeration use by 15 percent. The possible energy savings are:

Electric Lighting: $383.54 * 67% = $256.97 savings
HVAC: ($285.43 + $48.51) * 10% = $33.39 savings
Refrigerators: $98.12 * 15% = $14.72 savings
Total Energy Bill Savings = $305.08 per year

The cost of making these retrofits would be around $650 dollars. R-30 insulation costs 40¢ per square foot for a total cost of $400. We assume the space is well- lit with ten light fixtures, making the cost of compact fluorescent bulbs $160 ($16 each). Replacing a 28" x 68" area with strip curtains would cost around $120. If five commercial buildings are subject to the ordinance in the first year, a total of $1,525 would be saved. One study of energy conservation retrofits in over 1,700 commercial buildings throughout the country found that the median energy savings were 18 percent of the energy use. Half of the buildings saved between 10 and 30 percent. (Using the California average of just over $1,000, this would be a savings of $100 to $300.) The median pay-back period was three years (CEC, 1992).

3.6 PUBLIC FACILITIES

POLICIES

It shall be the policy of Glenn County to:

a. Become a model energy user in the provision of services and the maintenance of County buildings and facilities. The purpose is to exemplify to developers and homeowners the benefits of energy efficiency and conservation.

b. Incorporate energy efficient design into all new County buildings; all County facilities shall be audited to identify potential energy efficiency improvements. The necessary modifications shall be incorporated into the capital improvements plan and annual budget.

c. Investigate the possibility of purchasing alternative fuel vehicles, especially for the Sheriff's Department, and shall continue to purchase vehicles that are the minimum size necessary.

d. Have the Service Center continue to regularly maintain all County fleet vehicles to increase their efficiency.

This section examines public energy use, including street lighting, heating and cooling of government buildings, and lighting of public facilities.

The County has the opportunity to use the visibility of their position to encourage local residents to initiate energy efficient practices. The County also has the ability to encourage residents to switch to vehicles that run on alternative fuels.

County offices and operations themselves consume a large amount of energy within the county—in 1990, the County paid $233,600 on utility bills. The Community Services Department has the staff expertise to perform energy retrofitting for the County buildings at a reduced cost to the County.

Energy use in buildings made up 32 percent of the total energy used by county governments in California in 1987, energy used in jails was another 33 percent. When two-thirds of the total energy use is for buildings, retrofits will significantly reduce energy use and save money.

Within the time-frame of the general plan, the County will probably build several new buildings. Glenn County is currently considering the construction of a new juvenile hall and a new welfare building. (The new welfare building may be built by a private contractor and leased to the County.) Energy efficient designs should be used in all public facilities. In particular, the County may wish to develop a system of active and passive solar design so that local residents can have an example of each of the systems. A new building could be used as an energy museum or model, with windows or view spaces into functional design features of passive and active solar construction. An architect experienced in solar design should be selected for any such project.

The funding for public facility projects is available through the California Energy Commission. The *Energy Partnership Program* and *Small School District Program* both provide funding of public facility audits and energy efficiency improvements.
Because this discussion is centered on a few specific buildings, generalizations and averages may not apply to Glenn County; nevertheless, 25 percent of energy use in an average community services building is for air conditioning, 45 percent for lighting, 15 percent on motors and ventilation, 5 percent on refrigeration, and the remaining 10 percent is for miscellaneous uses (PG&E).

Because lighting is the largest portion of the total energy use, replacing incandescent bulbs with compact fluorescent lamps will have a big effect on total use. The replacement equipment will be a minimum of 25 percent more efficient. This should also have a significant effect on total use. Additional equipment should be replaced the subsequent year so that all below-average equipment is replaced within five years.

PROGRAMS

3.6.1 The County shall select a person experienced in energy efficient solar applications to design all new County buildings. The County may wish to consider designing one new building as an energy museum or model, with view spaces into functional design features of passive and active solar construction. The objective is to meet or exceed Title 24 requirements in all new County buildings. *This program implements Policy 3.6.a. and Policy 3.6.b.*

Implementation

Lead agency: Buildings and Grounds Department.

Coordinating agency: Board of Supervisors, California Energy Commission.

Funding: Building Construction fund, Energy Partnership funding.

Time frame: The program shall be in effect immediately upon adoption of the Energy Element.

3.6.2 The County shall apply to the California Energy Commission and to the public utilities to identify the energy and water conservation retrofits that will have the greatest rate of return to the county. *This program implements Policy 3.6.a. and Policy 3.6.b.*

The audit shall review the following items:

a. Appropriate lighting levels and ways of employing motion and light sensors, energy saving ballasts, and metal halide or high pressure sodium outdoor fixtures.

b. Appropriate air conditioning, and heating levels and the necessary improvements to County buildings and equipment.

c. The energy savings that would result from shifting municipal sewage treatment major electrical power use to the morning off-peak hours.

d. The energy savings resulting from an active solar system for water heating.

Subsequent audits shall be done every year to ensure that all equipment is running efficiently. The objective of the program is to reduce energy use by a minimum of 20 percent within two years; subsequent retrofits should be continued until the energy use is at least 50 percent of the 1991 baseline.

Implementation

Lead agency: Buildings and Grounds Department, Community Services Department.

Coordinating agencies: Individual department directors, California Energy Commission, local utility providers.

Funding: Buildings and Grounds annual budget, Energy Partnership Program funding.

Time frame: The audit shall be completed within two years after adoption of the Energy Element. Capital improvements shall be scheduled over a five year time frame. The

County shall monitor the performance of energy retrofit improvements and present the findings to the Board of Supervisors annually.

3.6.3 The Service Center shall regularly maintain all fleet vehicles for the proper tire pressure, tuning, wheel alignment, etc. As older vehicles are replaced the Purchasing Agent (Deputy Purchasing Agent) shall continue to purchase the most energy efficient vehicle that will meet the user needs. The objective of this program is to increase fleet fuel efficiency by 5 percent within every five year period. *This program implements Policy 3.6.d.*

Implementation

Lead agency: County Service Center.

Coordinating agencies: Individual department directors, Purchasing Agent, California Energy Commission.

Funding: General fund, Energy Partnership Program funding.

Time frame: The fleet fuel efficiency should be evaluated within one year after the adoption of the Energy Element to establish a baseline use, and yearly thereafter.

3.6.4 The County Service Center shall research the costs, performance, and suitability of vehicles which use alternative fuels for all County departments and for the Sheriff's Department in particular. The objective of this program is to make a recommendation to the Board of Supervisors on the appropriateness of alternative fuel vehicles as part of the County fleet. *This program implements Policy 3.6.c.*

Implementation

Lead agency: County Service Center.

Coordinating agencies: Sheriff's Department, Purchasing Agent, Board of Supervisors, California Energy Commission.

Funding: General fund, Energy Partnership Program funding.

Time frame: The Service Center shall present research and recommendations to the Board of Supervisors within two years after the adoption of the Energy Element.

3.6.5 When establishing sites for new County facilities, including schools, the Planning Department and the Planning Commission shall evaluate the transportation impacts and energy efficiency of siting such facilities. The objective is to cluster County services in two or three key locations. *This program implements Policy 3.6.a*

Implementation

Lead agency: Planning Department.

Coordinating agencies: Individual department directors, School Board, Planning Commission, Board of Supervisors.

Funding: Building construction fund, general fund.

Time frame: The Planning Department shall establish preferred standards for siting public facilities within three years after the adoption of the Energy Element.

EXPECTED ENERGY SAVINGS

New County Building Program

The energy savings would depend on the size of the new public building and the specific energy needs. A smaller building will probably work more efficiently, but the potential savings on a large building would be much larger. The existing County buildings will probably continue to accommodate most of the County's employees. New buildings will most likely house new or expanding departments.

Hiring an architect experienced in solar systems to design an energy efficient building will probably require additional architecture fees compared to a standard building. The additional costs will most likely be offset by the energy savings over the life of the building. Although the specific energy savings cannot be calculated until a project is proposed, it is expected that energy costs will be half of what would occur in standard architectural design following the Title 24 guidelines.

County Building Retrofit Program

Because the County uses a wide variety of building types, ranging from institutional to remodeled residential, the expected savings are difficult to generalize. A detailed energy efficiency study can be performed free of charge as part of the Energy Partnership Program administered by the California Energy Commission. Precise audits can calculate the expected energy savings. For this scenario, we assume that retrofit measures will save a minimum of 20 percent. The County currently spends $233,600 on energy bills each year. This translates into a minimum savings of $46,720 each year. Given the age of some County offices, the number could be as high as $116,800 (50 percent) or more.

Currently there are low interest loans available from the California Energy Commission for energy efficiency projects. The CEC can also assist with the administrative work, including contractor selection. When the County is ready to implement this program, they should investigate the availability of loans from the CEC or public utilities.

County Fleet

The County Service Center has already downsized most of the fleet (115 vehicles) to four cylinder automobiles. Smaller vehicles proved inefficient because employees were unwilling to use the vehicles. Older vehicles are replaced at an average rate of five to ten vehicles each year. Because these practices are already in place the savings will be minimal.

Glenn County has a small fleet, and one of the best methods to increase efficiency is to schedule regular maintenance for the fleet vehicles. Regular maintenance, including minor tune-up adjustment, can improve fuel economy an average of 1 to 5 percent (CEC, 1992). Through the Energy Partnership Program, the CEC can train County personnel in methods to reduce fleet vehicle fuel use.

The County may wish to investigate converting the fleet vehicles to run off alternative fuels such as methanol, ethanol, natural gas, or electricity. These fuels are all renewable, have greater efficiencies, and have less harmful emissions.

3.7 AGRICULTURAL LAND USE

POLICIES

It shall be the policy of Glenn County to:

a. Facilitate the use of alternative energy sources and allow alternative fuels in agricultural operations.

b. Evaluate methods to increase the efficiency of agricultural water pumping, including the possibility of increasing the use of surface water delivery systems and establishing a regional or basin-wide irrigation return system.

c. Develop information and training programs to keep farmers informed of experimental energy and crop production programs.

d. Require the Resource Conservation District to organize a forum to discuss energy conservation efforts that require implementation at the regional, state, or federal level.

Energy is used for agriculture in many ways, but most energy use is for moving water—either pumping groundwater or moving surface water where gravity flow cannot be employed. California agricultural production also depends a great deal on energy-intensive farming methods that use petroleum and natural gas in growing, harvesting, processing, and transporting crops. Energy is required to produce petroleum-based fertilizers and pesticides and to fuel mechanized planting and harvesting equipment. In addition, the distance of farms or ranches from most markets requires that large amounts of petroleum fuels be used for transportation. In range cattle operations most of the energy used is spent on checking cattle and hauling feed. The lighting and heating of agricultural buildings also requires some energy, especially in dairies where the sanitary requirements of milking operations require heated water.

One of the best methods of conserving energy when growing row crops is to reduce machinery use and fertilizer by only applying the needed amount of fertilizer at the appropriate time. Using the correct amount of water will also save energy required to pump the water out of the ground.

AGRICULTURAL LAND USE ISSUE AREAS

Energy Use in farms can be influenced in several ways, including reduced water pumping, improved farming techniques, and recycling waste products as biomass fuels.

Water Pumping and Electricity Use

The electricity used for pumping accounts for approximately 80 percent of total electricity use in agriculture in Glenn County. Almost all farmers and ranchers receive regular energy audits from PG&E. Often they will plan pump inspections on a yearly basis. The lighting and heating of agricultural buildings also requires some energy, though little compared to the amount needed for water transport.

Over 10 million acres of irrigated land are currently under production in California. The energy costs of irrigation vary with the source of water and methods of irrigation. Using ground water requires more energy than relying on surface supplies; sprinkler-type systems generally use far more energy than other methods. (CEC, 1988)

Because agriculture is the largest industry in Glenn County and the largest energy consumer, effectively conserving energy in agricultural operations is of particular interest. A more detailed study should be done by the County or an outside consultant on the possible methods of increasing the efficiency of water pumping for agricultural purposes. Glenn County is fortunate in that most wells only need to be drilled 100 to 300 feet. A "deep" well in the county would be 400 feet, this is shallow compared to the San Joaquin Valley where wells can be 8,000 feet deep or more.

Several computer programs are now available that can design an irrigation system, schedule applications, and evaluate the results. "Jack" by Orange Enterprises, designs an irrigation system while "Roy" (also by Orange Enterprises) uses evapotranspiration information to calculate the exact amount of water needed to replenish soil moisture. The Westlands Water District in Fresno County has developed their own computer program to help farmers evaluate irrigation methods. The "Irrigation Cost Evaluator" (ICE) can evaluate the benefits and costs of different irrigation systems. As part of its investigation of irrigation improvements, Glenn County could consider providing a similar service, or offering low interest loans to farmers for home computers.

Farming Methods That Conserve Energy

There are numerous methods of conserving energy that many farmers have practiced for years. Such practices will vary from farm-to-farm; most farmers employ them as they realize the money that can be saved. Depending on the type of farm or agricultural use, there are different methods of conservation.

One of the best methods of conserving energy when growing row crops is to reduce machinery use by only applying the needed amount of fertilizer at the appropriate time. The timing and amount of fertilizer will depend on the crop. Using fertilizer that can be mixed with irrigation water (fertigation) can also save energy. If fertigation is not possible, then spray applications use less energy and are more effective than ground applications. In rotation crops, growing legumes like clover can fix nitrogen in the soil that can be used later by a crop that cannot fix its own nitrogen. This reduces the overall amount of needed fertilization.

Using the correct amount of water will also save energy. Over-watered crops not only require more energy to pump the water out of the ground, but also to pump the water back for recycling purposes. Using drip irrigation is one method of cutting energy costs, but it is not appropriate for all crops. Money can also be saved by using a low horsepower motor to pump water during off-peak time periods. The water can then be stored for irrigating later in the day.

Cultivating the land for planting is also a variable that effects energy use. Not all soils or crops require that the land be fully cultivated (including discing, plowing, and leveling the field). Some only require that the top four to six inches be broken to allow replanting, which requires much less energy than fully cultivating the field. If farmers know what and where the next crop will be, they can adjust the cultivation. This also has an embodied energy saving in that lighter tilling creates less wear on the tractor and extends the useful life of the machinery. Secondary benefits also include less soil erosion and less air pollution.

In orchards, trickle irrigation and low-volume sprinklers are necessary to save water and energy. Other practices include leveling and keeping the orchard floor clean of debris and removing overhanging limbs. This allows harvesters to move machinery more quickly and efficiently. In mature orchards, mowing weeds rather than discing them will use less energy.

In all agricultural operations, it is important to use the right machinery for the job. It is more efficient to make two passes with a ten blade than four passes with a 5 foot blade.

In range cattle operations most of the energy used is spent on checking cattle and hauling feed. Truck trips should be minimized—carry bigger loads and make fewer trips. If supplemental food is being distributed by truck, consider doing this every two days instead of every day. Keeping cattle clustered in smaller areas and then rotating those areas will also cut down on the travel distances.

Dairies present different possibilities for conserving energy. The sanitary requirements of milking operations require heated water. All water heaters and hot water lines should be insulated. Water heaters should be drained periodically to flush out lime and improve efficiency. Water can also be recycled for irrigation.

Agriculture and Energy Production Facilities

Agricultural operations involve numerous potential opportunities for solar energy use. These include space heating for agricultural residences and for animal shelters, domestic hot water heating, solar assisted heat pump applications and photovoltaic applications for remote electric power requirements.

Biomass and cogeneration facilities should also be permitted in agricultural zones with conditional use permits. As an example of a cogeneration facility, the Sacramento Municipal Utilities District (SMUD) is considering a partnership with Sutter Ethanol Partners to use rice straw as the fuel for producing ethanol. The rice straw will be dissolved in acid (eliminating air quality problems associated with burning) to release the sugars stored in the straw. These sugars would then be converted into ethanol and other products that can be sold or used as alternative energy fuels for vehicles. This specific project would consume 400 tons of rice straw daily and cost over $175 million to build and operate. Smaller scale versions might be feasible in Glenn County.

Several existing organizations provide information on productivity and efficiency to farmers. The Farm Bureau is a privately funded organization with voluntary membership that acts as an advocate for the farming interests of its members; services include a lobbyist in Sacramento, a summer seminar session for teachers, participation in the harvest festival, and membership in the local commerce organization. The Agriculture Stabilization and Conservation Services (ASCS) is in charge of administering the federal farm subsidy programs in the area. They also do special projects on important local topics like rice burning and water programs. The University of California Cooperative Extension provides education services to local farmers. They provide advice and information on general topics or on specific problems. The education efforts extend to adults and youths. (They also administer the 4-H program.) The Agriculture Commissioner's office (part of the Glenn County government) is in charge of the regulation and administration of agricultural use, including chemical, pollution, and burning control.

The County should bring representatives of these organizations together to consider the various programs and examine the possibility to combine resources to either increase the audience or the effectiveness of the energy conservation efforts. Whether the group can agree on a specific program or action remains to be seen. The eventual action could be as simple as a group letter outlining their concerns to the State Legislature.

PROGRAMS

3.7.1 The Zoning Code shall be amended to specifically allow alternative energy facilities, and the use and storage of alternative fuels in agricultural operations shall be a permitted use. Biomass and cogeneration facilities shall be permitted in agricultural zones with conditional use permits. The objective of this program is to encourage the synergistic (mutually-beneficial) relationship between biomass/cogeneration facilities and agricultural practices. *This program implements Policy 3.7.a.*

Implementation

Lead agency: Planning Department.

Coordinating agencies: Agricultural Commissioner, Resource Conservation District, University of California Cooperative Extension, Farm Bureau, Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The Zoning Code shall be amended to incorporate this program within four years after the adoption of the Energy Element.

3.7.2 The Resource Conservation District shall devise a program that evaluates methods to increase the efficiency of agricultural water pumping in Glenn County. One option might be to evaluate all pumps in the County and repair those running below 55 percent efficiency. The objective is to devise and implement a program to increase the energy and water efficiency of agricultural water pumping. *This program implements Policy 3.7.b.*

Implementation

Lead agency: Resource Conservation District, University of California Cooperative Extension.

Coordinating agencies: Planning Department.

Funding: Resource Conservation District budget (federal government funding).

Time frame: With the assistance of the Planning Department, the Director of the Resource Conservation District shall recommend a program to the Board of Supervisors within two years after the adoption of the Energy Element. If necessary, the funds needed to implement the program shall be scheduled into the capital improvements plan. The program shall be completed within five years after adoption of the Energy Element.

3.7.3 The Resource Conservation District personnel shall work in conjunction with the University of California Cooperative Extension, Farm Advisor, Agricultural Commissioner, and local utility providers to find suitable farmers as candidates to speak at the regularly scheduled information meetings. A knowledgeable County employee shall also be available to provide one-to-one assistance to farmers interested in establishing an improved farm programs. The objective of the program is to provide two information and training sessions on improved farm programs each year. *This program implements Policy 3.7.c.*

Implementation

Lead agency: Resource Conservation District.

Coordinating agencies: Cooperative Extension Office, Farm Advisor, Agricultural Commissioner, Pacific Gas and Electric.

Funding: Resource Conservation District budget (federal government funding).

Time frame: The Resource Conservation District shall schedule semi-annual meetings on improved farm programs beginning two years after the adoption of the Energy Element.

3.7.4 Many farm practices are dictated by state or federal government actions, e.g., water allocations and farm subsidy programs. To this end, the agricultural interests of the county should band together to express their interest and concern over state and federal programs.

The Resource Conservation District shall bring together representatives of the Farm Bureau, the Agriculture Stabilization and Conservation Service, the Agricultural Commissioner's Office, the University of California Cooperative Extension, and the Planning Department to discuss energy conservation efforts that require implementation at the regional, state, or federal level. The County shall bring representatives of these organizations together to consider the various programs and examine the possibility to combine resources to either increase the audience or the effectiveness of the energy conservation efforts.

The objective of this program is to agree on at least one program of action to reduce the amount of energy used in agriculture. *This program implements Policy 3.7.d.*

Implementation

Lead agency: Resource Conservation District.

Coordinating agencies: Farm Bureau, Agriculture Stabilization and Conservation Service, Agricultural Commissioner's Office, University of California Cooperative Extension.

Funding: General fund.

Time frame: The Resource Conservation District shall present a semi-annual group progress report to the Board of Supervisors. The first progress report shall be within three years after adoption of the Energy Element.

EXPECTED ENERGY SAVINGS

The Environmental Setting Report for the energy element identified 586,525 acres of grazing and farmland in Glenn County. From the energy use section of this report, we know that 55,425,000 kwh were used by the agriculture sector last year; about 80 percent (44,340,000 kwh) was used in pumping water. Assuming that improved methods of pumping water are able to increase efficiency 10 percent, a total of 4,434,000 kwh could be saved.[11] Agricultural rates range between 6.5¢ to 13¢ a kwh (PG&E, 1991), making the total savings $288,210 to $576,420 each year.

Some pilot programs have been funded by the CEC to study the energy efficiency of planting rice seeds up to eight inches below ground, rather than the standard two to three inches. The potential benefits are decreased herbicide rates, fewer acres treated and re-treated with grass herbicide, and fewer aerial applications associated with fewer acres treated or re-treated with grass herbicide. The pilot programs compare the results of standard planting with grass herbicides, moderate depth planting (four to five inches) with reduced amounts of herbicides, and deep planting (seven to eight inches) with no grass herbicides.

The results of the pilot programs so far show that plant development is the same in all three groups. The harvesting cost is less for the deep planted crop and no money is spent on herbicides, but overall yield is somewhat less. The net profit return per acre is only slightly less than the standard approach ($75 vs. $84). From an ecological perspective, the no herbicide approach is better for the overall environment, requires less embodied energy to produce the herbicide, and no energy is required to apply the herbicide. In the moderate depth planting with reduced herbicide use had the same yield and slightly less production cost, making the net profit $90 per acre. Less diesel fuel is required for herbicide applications to the crop (Scardaci, 1990).

The pilot program mentioned above estimated that moderate depth planting with reduced herbicide use can save at least 25 percent of the diesel fuel used for initial herbicide application. In the deep planting with no herbicide, reductions would be even greater. The authors of the report assume that about half of the current acreage would be suitable for the new approach.

[11] Note that these are only gross averages. The actual costs will vary widely from farm to farm depending on crop and soil condition.

3.8 ENERGY EDUCATION

POLICIES

It shall be the policy of Glenn County to:

a. Sponsor energy education programs to increase public awareness about energy conservation, energy efficiency, and recycling opportunities and to inform people of the potential benefits of such programs.

b. Continue and improve energy education programs in schools. School district driver training classes shall promote fuel efficient driving techniques.

c. Sponsor energy education/awareness construction seminars for contractors, homeowners, realtors, and local business and shop owners.

Energy conservation and efficiency measures sometimes do not work simply because people either do not know about them or do not know of their potential to save energy. Many of the programs listed in this plan rely on education as a means of effecting change.

Adults are sometimes slow to change, but sometimes children can change the habits of adults. A colorful and interesting brochure should be designed and tailored to the conservation measures that children can employ: turning off lights when leaving a room, not letting the faucet run, turning down the heat or air conditioning at night, recycling cans and bottles, purchasing reusable (rather than disposable) items, limiting time spent looking in the refrigerator, etc. (Pacific Gas and Electric uses a coloring book format in their pamphlet, "Energenius.") Teachers and children could then practice these methods in the classroom. Information on fuel efficient driving techniques should also be incorporated into the existing driver education programs if is not done so already. The high schools at Orland, Willows, Princeton, and Hamilton all have driver education programs.

PROGRAMS

3.8.1 The Resource Conservation District shall develop an education program for county schools to provide energy conservation and efficiency information to school-aged children. The County Superintendent of Schools shall then direct the school district superintendents and principals to implement an energy conservation and efficiency curricula. (This program formalizes an existing practice—PG&E makes arrangements to visits schools and other community organizations to discuss conservation techniques.) This program shall also include suggestions for teachers and children to practice recycling and energy saving techniques in the classroom. Another possibility is for the school to set an energy use goal and to use the implementation of programs in the school as an educational tool. The instructors of driver education programs shall be required to give a lecture on ways to more efficiently use fuel through proper driving techniques and vehicle maintenance. The objective of this program is to formally establish energy education programs in county schools. *This program implements Policy 3.8.a and Policy 3.8.b.*

Implementation

Lead agency: Resource Conservation District.

Coordinating agencies: School District superintendents and principals.

Funding: School District Budget.

Time frame: The School District shall enact the education programs within three years after the adoption of the Energy Element.

3.8.2 The County shall sponsor an annual energy education/awareness construction seminars for contractors, homeowners, realtors, etc. Once an information brochure is available for residential builders, a seminar shall be incorporated into a construction season kick-off fair. The fair will have booths for all construction related organizations, such as utility providers (electricity, water, gas, telephone, cable) and the city and County planning and building staffs. The objective of the program is to provide energy efficiency awareness programs for residential developers in the county. *This program implements Policy 3.8.a. and 3.8.c.*

Implementation

Lead agency: Resource Conservation District.

Coordinating agencies: Planning Department, Building Department, Utility Providers, City of Orland planning and building representatives, City of Willows planning and building representatives, Farm Bureau.

Funding: General fund.

Time frame: The Resource Conservation District shall organize a construction season kickoff fair within three years after the adoption of the Energy Element and each subsequent year thereafter.

3.8.3 Similar to the program noted above, the County shall also sponsor energy education and awareness seminars for local businesses and shops. Once the commercial information brochure is completed, the Resource Conservation District shall contact the Bureau of Commerce to establish an appropriate time and place for an informal seminar. The session shall be conducted by a member of the county building or planning staff. Regular meetings shall be scheduled yearly (at a minimum), quarterly, or sooner if needed. The objective is to provide energy efficiency awareness programs for commercial and industrial businesses. *This program implements Policy 3.8.a.*

Implementation

Lead agency: Resource Conservation District.

Coordinating agencies: Building Department, Bureau of Commerce, Glenn Chamber of Commerce—Economic Development, Inc..

Funding: General fund.

Time frame: The Resource Conservation District shall organize a seminar within three years after the adoption of the Energy Element. Similar seminars shall be scheduled at least once during each subsequent year.

EXPECTED ENERGY SAVINGS

A study on the effectiveness of educational programs on conserving energy showed that information campaigns produce an average of 4 percent energy savings. An audit of energy use or other direct feedback on consumption can create an 11 percent savings, while financial incentives can generate 15 percent savings. Combinations of these strategies average around 15 percent but can go as high as 29 percent (CEC, 1988).

Within Glenn County the savings may be small, but the overall savings can make a difference in the nation's energy use. The total 1990 residential kilowatt-hours in the county were 80,636,476. A 4 percent saving at 12¢ per kwh gives a saving of $387,055 or $27.55 per capita per year. (This is based on an estimated 1991 population of 14,051 [Department of Finance, 1991]). There are 5,760 children in the Glenn County School District (Lockett, 1991), giving the county a total savings of $158,688 each year.

3.9 RECYCLING AND REUSE

POLICIES

It shall be the policy of Glenn County to:

a. Encourage and facilitate new reuse and recycling businesses, and to designate appropriate zoning for such land uses.

b. Encourage participation in residential recycling programs by basing waste collection fees on the volume of trash collected, rather than a flat fee. County departments shall establish collection centers for recyclable materials.

c. Give preference to recycled products and/or products that use less packaging or toxic materials.

Recovery of recyclable material from municipal solid waste can both save energy and extend the life of county landfills. Recycling paper, metals, and glass can save significant quantities of energy. Virgin material must be extracted and refined before being used; the use of secondary materials eliminates the energy consumed in extraction and refining. Recycling copper and aluminum reduces energy requirements for the production of new materials by over 90 percent. Energy reductions of over 70 percent can be achieved in steel and low grade paper production. Collecting recyclable material before it goes to the dump or separating and recycling material prior to final disposal at county facilities are two options of material recovery. Voluntary participation is generally high if people are made aware of the program operation and benefits.

Demand and prices for recycled materials are volatile, depending on the price and availability of virgin material. A recycling program needs to establish long term contracts with buyers so that changes in demand do not leave the County with large quantities of material to store or dispose.

Rural households in Glenn County do not receive curbside trash pick-up. Instead, these residents are charged a yearly fee and are allowed to dump wastes at the municipal landfill. Households in the unincorporated areas of Orland, Willows, and Hamilton City do receive curbside service. For more information on solid waste management, please refer to the appropriate section of the Community Development Element.

PROGRAMS

3.9.1 The County Zoning Code shall be revised to conditionally permit recycling businesses in all commercial and industrial zones provided that the performance standards of the Zoning Code are met. *This program implements Policy 3.9.a.*

Implementation

Lead agency: Planning Department.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The Zoning Code shall be amended to incorporate this program within four years after the adoption of the Energy Element.

3.9.2 The County shall develop and adopt an ordinance establishing a waste reduction and recycling program. As part of this program, the County shall identify and research available markets for collected materials. The program shall establish differential rates for households that do not recycle. Because rural residences do not receive curbside service, this may require changes to the method of collection or establishing a pay gate at the landfill. The county landfill shall establish special recycling collection sites for porcelain and rubber items and containers for glass, aluminum, tin cans, plastic, paper, newspaper, and cardboard.

Once the program is in place, the County shall initiate a education campaign that explains the recycling and reuse program, taking advantage of local media sources. An extension of the program shall be to identify large waste generators in the county and approach them individually to provide information on source reduction programs. The objective is to reduce the municipal solid waste by 20 percent within five years after the initiation of the program. *This program implements Policy 3.9.b.*

Implementation

Lead agency: Public Works Department.

Coordinating agencies: Board of Supervisors, local media, California Integrated Waste Management Board.

Funding: Solid Waste Disposal Enterprise fund.

Time frame: An ordinance implementing this program shall be enacted within three years after the adoption of the Energy Element.

3.9.3 The Buildings and Grounds Department shall establish collection areas and pick-up service for recyclable materials in all County buildings and offices. There shall be provisions to recycle paper, glass, aluminum, styrofoam, plastic, and cardboard. The objective of this program is to reduce waste generated by the County departments by 20 to 50 percent within five years after the initiation of the program. *This program implements Policy 3.9.b.*

Implementation

Lead agencies: Buildings and Grounds Department, Public Works Department.

Coordinating agencies: Individual department directors.

Funding: Buildings and Grounds annual budget.

Time frame: This program shall be implemented within two years after the adoption of the Energy Element.

3.9.4 The County Purchasing Agent and all Deputy Purchasing Agents shall give preference to purchasing products made from recycled materials. Such personnel shall also be discouraged from purchasing products that are excessively packaged or packaged with material that are difficult to recycle, namely polystyrene and styrofoam. All styrofoam products shall be replaced by paper products. The objective of this program is to increase use of recycled materials and decrease the volume of wastes. *This program implements Policy 3.9.c.*

Implementation

Lead agencies: Purchasing Agent, Deputy Purchasing Agents.

Coordinating agencies: None.

Funding: General fund.

Time frame: This program shall be implemented within two years after the adoption of the Energy Element.

Chapter Four
ENERGY FACILITY SITING

4.1 ENERGY FACILITY SITING

GOAL

It is a goal of the Energy Element to see the development of renewable energy facilities in Glenn County that support a diversified and stable economic base while preserving valuable agricultural land and protecting public health and safety and the environment.

POLICIES

It shall be the policy of Glenn County to:

a. Require a detailed review of the value of the energy facility development proposals, especially in terms of efficiency in energy production and the use of county resources.

b. Establish detailed standards and regulations regarding the construction and operation of energy production facilities except where pre-empted by state or federal laws or regulations.

Though a variety of governmental agencies may be involved with the review of proposed energy projects, the lead agency is the most responsible for project review and approval. For most energy projects with less than 50 MW of generating capacity, a city or county will be the lead agency and will ultimately either approve or deny the proposed project. The facility standards in this section are intended to provide the County with the necessary information to thoroughly evaluate the proposed energy facilities or energy resource extraction.

Chapter 19.23 of the Glenn County Zoning Code includes a series of performance standards for new land uses; these standards can also be used as guidelines for judging the suitability of an energy facility proposal. The purpose of the performance standards is ". . . to promote compatibility among various uses of land; protect and enhance the rural-agricultural character of the county; protect the health, safety, or welfare of the community; and control noise, dust, odor, smoke, vibration, danger to life and property, or similar causes likely to create a public nuisance."

The Zoning Code standards for erosion control, landscaping, setbacks, noise, open and outdoor storage, and vibrations will apply to all energy facility development. Federal, state, and county regulations on air quality and fire and explosion hazards will influence the design of biomass, thermal conversion, and nuclear facilities. Electromagnetic interference standards will guide the development of wind turbines and transmission lines; and glare and heat standards will be a concern of solar facility development.

Additional guidelines are needed to judge the value of energy resource development and facility siting projects. Such guidelines should address the internal energy efficiency of the project, the energy cost benefit analysis, the impacts on the Glenn County housing market and public services, and the impacts on the environment.

SUMMARY OF ENERGY FACILITY DEVELOPMENT AND OPPORTUNITIES

There are many types of energy facilities that would be practical and applicable in Glenn County. This document examines the feasibility and siting needs of: oil and gas well development, biomass facilities, cogeneration facilities, hydroelectric facilities, wind energy systems, solar power systems, thermal conversion facilities, gas and oil pipelines, and transmission lines.

Based on the potential for various energy facilities discussed in this chapter, five types of facilities may realistically be expected to be proposed within Glenn County: natural gas development, hydroelectric facilities (both large and small scale), biomass conversion and/or cogeneration facilities at industrial or agricultural processing facilities, and additional transmission lines and pipelines. Figure 4-1 illustrates potential sites in the county where such facilities may be proposed. Figure 4-2 displays generalized constraints to energy facility development including areas of residential development, 100-year flood zones, and sensitive habitat areas. Finally, Figure 4-3 presents a composite map of opportunities and constraints that highlights potential conflicts of energy facility development.

It is important to keep in mind that other factors may provide opportunities for, as well as constraints to, energy facility development. For example, agricultural land may provide an energy opportunity for conversion, but it may also pose constraints to energy facilities such as gas wells, transmission lines, or wind and large-scale solar development.

Although specific information on each type of facility is later discussed in detail under separate topics, the following is a summary of facility siting and development, energy development opportunities, and energy development constraints.

Natural Gas

There are some existing energy facilities in Glenn County. Several natural gas wells are operating in the county that produce significant amounts of natural gas. Pacific Gas and Electric Company also operates many natural gas pipelines within the county. There remain significant deposits of natural gas that are expected to be extracted throughout the time-frame of the Energy Element. Additional natural gas pipelines will be needed to connect new gas wells into the existing pipeline system.

Hydroelectric

Several hydroelectric facilities have already been built in the county. The Stony Gorge Hydroelectric System includes three facilities: Stony Creek dam, Black Butte dam, and the High Line Canal. The State Department of Water Resources has conducted engineering feasibility studies that demonstrate significant hydroelectric development potential in Western Glenn County. Primarily studied for supplies to the State Water Project, these projects are currently dormant; though they may be revived as State Water becomes increasingly scarce.

Biomass

There is one biomass facility in the county, the Meadow Glen Farms digester gas project, but it has not operated for several years and is not expected to operate again (aside from occasional back up generator use). The County has entered into an agreement with Total Energy Systems (TES) for a pyrolysis biomass facility at the county landfill. The county's predominant agricultural sector provides significant potential for biomass energy production. Some energy production from cogeneration technology at existing commercial and industrial facilities in the county, though the economics of such systems are not currently favorable.

Transmission Lines

The most visible energy facilities in Glenn County are the hundreds of miles of electrical transmission lines and several substations. These include distribution lines and major inter-state interties. Electrical distribution and transmission lines and associated facilities will continue to be built in response to energy demand created by future growth within the county. Large interties and transmission lines will likely continue to be built between the Pacific Northwest and California, traversing through Glenn County.

Wind

The potential for large-scale wind energy conversion systems is considered remote. Small wind turbine systems for agriculture or rural residential power are potentially feasible.

Solar

Solar energy development is possible in the county, although the probability of a large scale facility being proposed in the near future is small. Small active and passive solar applications for residential space and/or water heating are currently viable.

Thermal Conversion

Several conditions and resources that are essential for conventional thermal (steam) power generation facilities exist in the county (water, access to transmission facilities, remoteness, access to major transportation corridors). However, air quality limitations may significantly constrain such facilities. PG&E claims no intention of proposing such a facility within Glenn County in the foreseeable future.

Oil

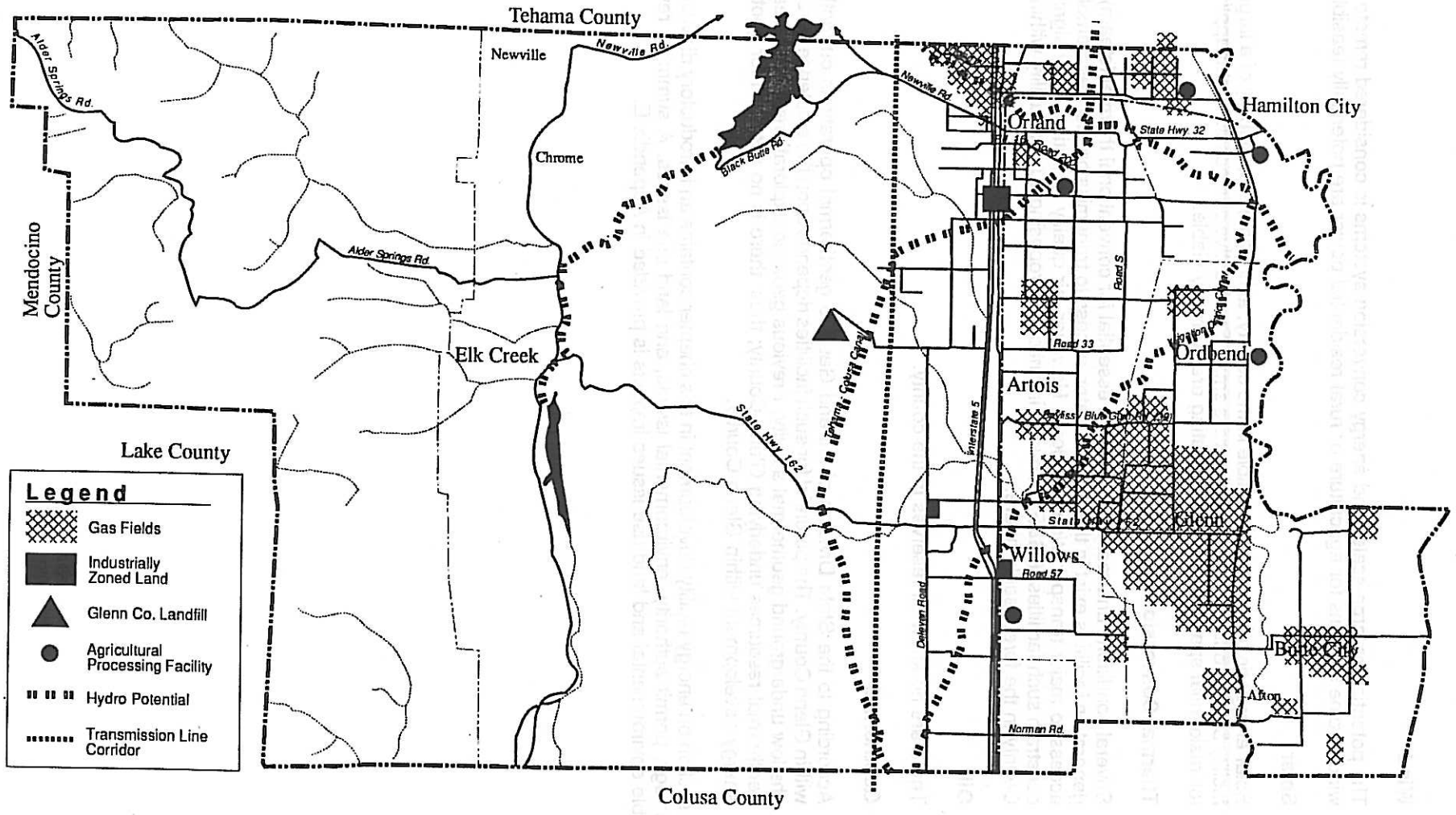
There are no know oil reserves in the county.

Geothermal

According to the State Division of Oil and Gas, no geothermal operations currently exist within Glenn County. The potential for such facilities depends upon the existence of relatively shallow underground geothermal activity. Previous geologic explorations have revealed no geothermal resources underlying Glenn County; thus, there is no potential for geothermal energy development within Glenn County.

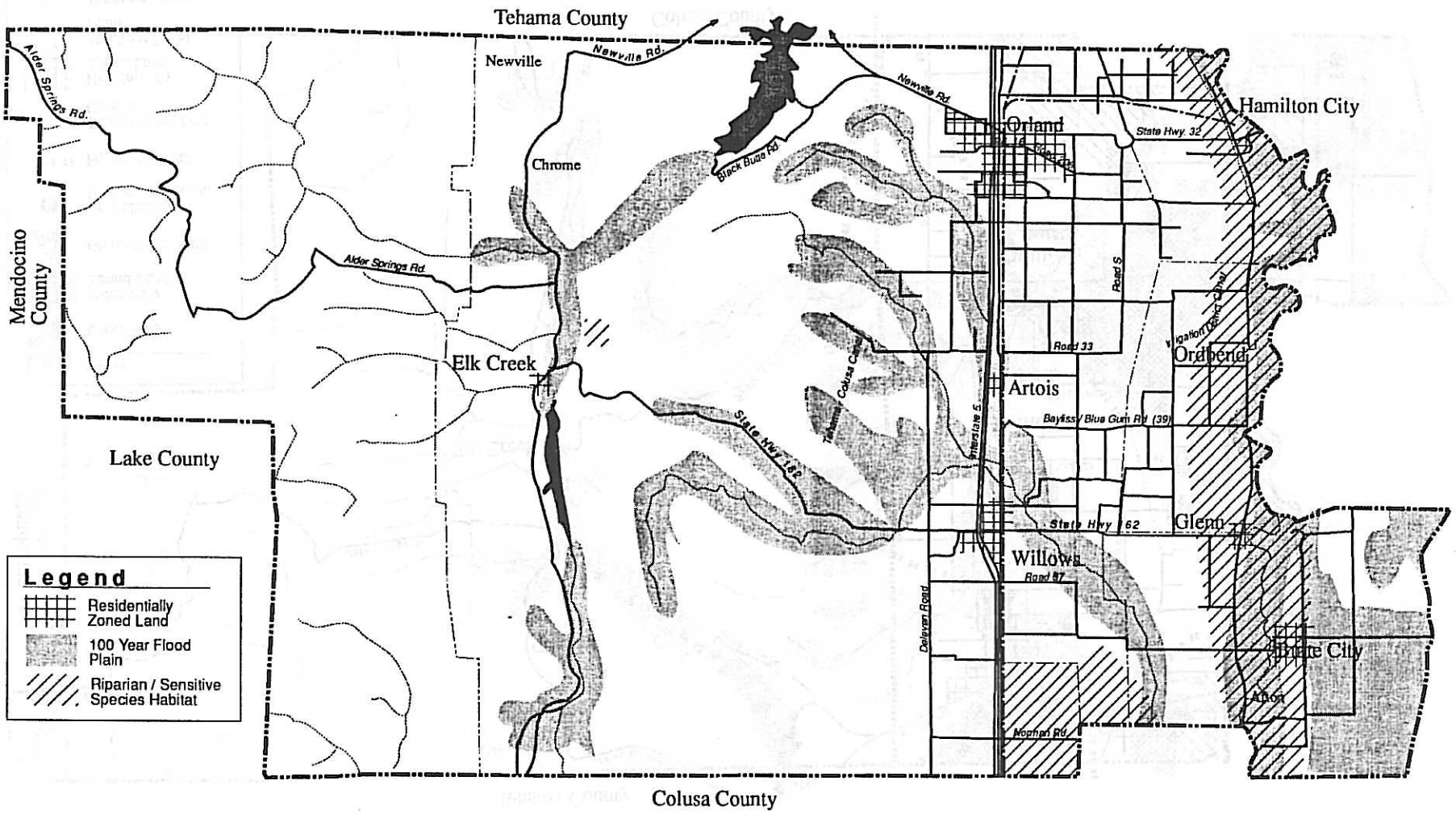
Each section on energy facility development in this chapter contains an introductory discussion on technology, permit authority, environmental issues, and land use issues. A summary review of possible environmental and land use issues impacts is provided in Appendix E.

Figure 4-1: Potential Energy Opportunities



Source: Glenn County Zoning and Land Use Map, 1990. Crawford Multari & Starr Field Study, 1991.

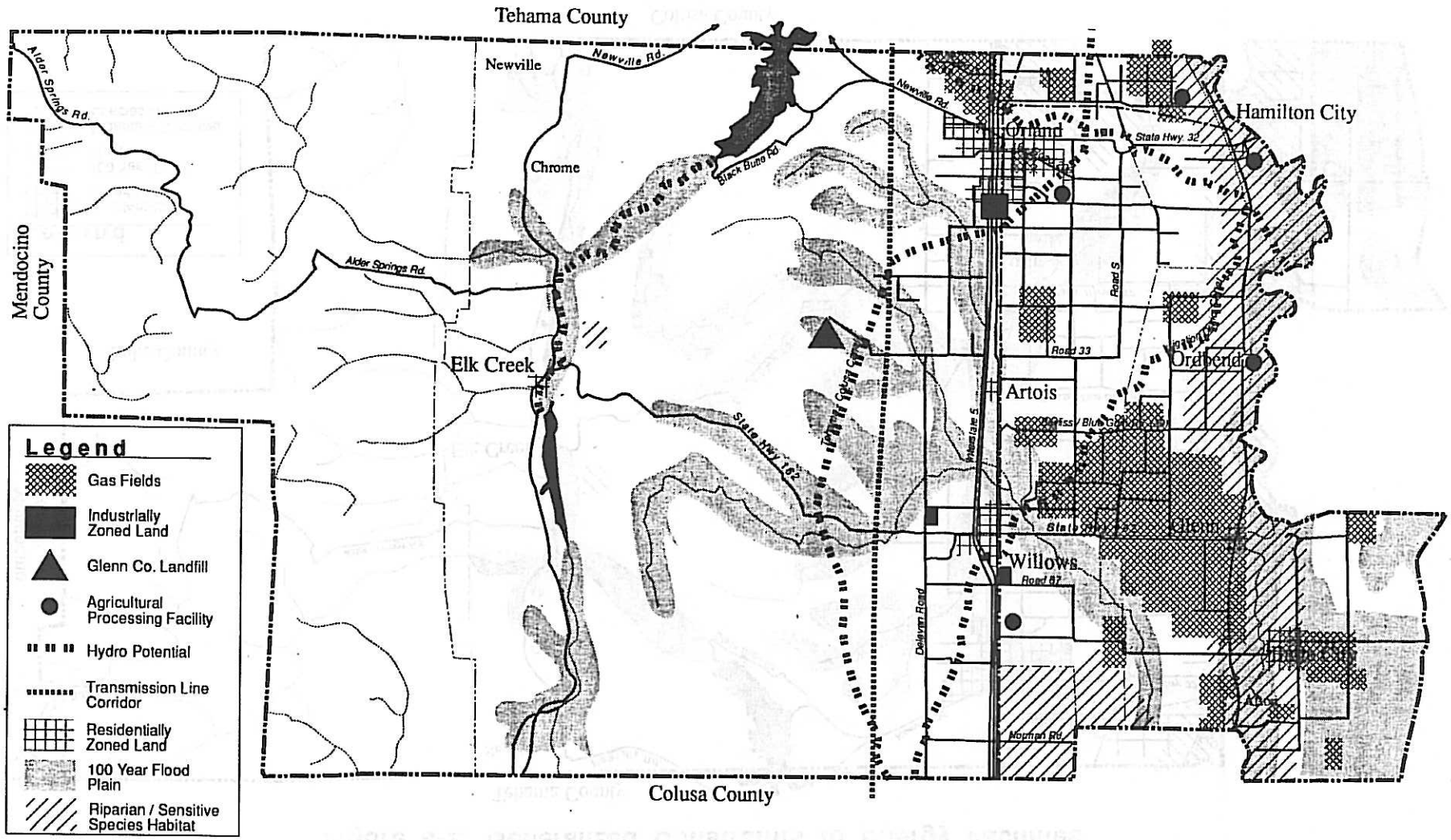
Figure 4-2: Generalized Constraints to Energy Facilities



North

Source: Glenn County Zoning and Land Use Map, 1990. Glenn County Conservation Management Element, 1987. Crawford Multari & Starr, 1991.

Figure 4-3: Potential Opportunities and Constraints to Energy Facilities



North

Source: Crawford Multari & Starr, 1991.

AGENCIES WITH REVIEW AUTHORITY

In addition to those agencies discussed in the subsequent sections, the following table summarizes additional agencies, their permit or review authority, and their jurisdictions. (ABAG, 1987).

Table 4-1: Agencies with Review Authority of Energy Facilities

Agency	Jurisdiction	Permit or Review
FEDERAL AGENCIES		
Army Corps of Engineers	Water development, flood control, and navigation	Dredge and Fill Permit
Bureau of Land Management	Various federal lands	Environmental document review
Bureau of Indian Affairs	Native American land holdings	Environmental document review
Department of Energy	Federal energy programs	Compliance with various federal energy laws and regulations
Environmental Protection Agency	Federal environmental protection laws	Environmental document review
Fish and Wildlife Services	Wildlife protection programs on Corps of Engineers or Interior lands	Application review and comment
Forest Service	National forest land	Environmental document review
National Park Service	National parks, monuments, etc.	Environmental document review
STATE AGENCIES		
Air Resources Board	Stationary pollution sources	Review local APCD permits
Department of Fish and Game	Fish and wildlife management	Streambed Alteration permit, review of all projects affecting fisheries and/or wildlife
Department of Forestry	State forest lands, fire suppression/ prevention	Right of way permit
Department of Health Services	Public water supply, hazardous waste, food safety, etc.	Hazardous waste permit
Department of Parks and Recreation	State park system	Right of way permit
Reclamation Board	Sacramento and San Joaquin watersheds/floodways	Encroachment permit
State Lands Commission	State lands, tidelands, and navigable waters	Right of way permit, dredging permit
Waste Management Board	Solid waste disposal and recycling programs	Solid Waste Facility Permit
REGIONAL AGENCIES		
Air Pollution Control District	Local pollution control program of state Clean Air Act	Conformance with state and federal air quality regulations
Regional Transportation Planning Agency	Transportation Development Act Funds	Environmental document review
LOCAL AGENCIES		
Planning Commission and City Council or Board of Supervisors	Project approval except where preempted by state or federal laws or regulations	Approve projects, certify environmental documents, authorize permit issuance

Source: Crawford Multari & Starr, 1991.

ENVIRONMENTAL REVIEW

The California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) require that the environmental consequences of certain types of development be evaluated before development approval is granted. NEPA applies when a project is proposed on federal land, involves federal funding, or requires a federal permit. In most cases, CEQA requires more detailed analysis and review of proposed projects, and CEQA often overlaps with the provisions of NEPA; hence the following discussion focuses on CEQA requirements.

The first step of environmental review under CEQA involves an initial study of the project's likely or potential environmental impacts. Two results are possible from the initial study:

- A negative declaration, which states that the proposed project will result in no significant environmental impacts (in some instances, conditions or mitigation may be added to a project to lessen expected impacts to the point of insignificance.
- A requirement for an environmental impact report, which will evaluate impacts that are potentially significant.

Some energy projects are categorically exempt from the requirements of CEQA. Specifically, installation of hydroelectric generating facilities with less than 5 MW of generating capacity at an existing dam site, and installation of cogeneration facilities at existing facilities under certain conditions are both categorically exempt.

The lead agency is responsible for the preparation of the required environmental documentation. Once prepared, the lead agency must post legal public notice of the availability of the documentation, certify the environmental documentation as adequate pursuant to CEQA, and consider that information in their decision to approve or deny a project.

OVERALL ENERGY FACILITY STANDARDS

The following standards shall apply to all energy extraction, production, or transmission facilities proposed in Glenn County except where pre-empted by state or federal laws or regulations. These standards apply in addition to the requirements of the following sections that cover specific types of energy facilities.

4.1.1 All energy facility development applicants shall be required to establish a pre-application conference with the Planning Department to review the application requirements and gross impacts of the proposed project. The applicant shall submit a complete, although general, description of the proposed project and any other information necessary to support their proposal. *This standard implements Policy 4.1.a.*

Lead agency: Planning Department except where pre-empted by state or federal laws or regulations.

Coordinating agencies: The Planning Director shall invite all appropriate agencies to participate in the pre-application conference.

Funding: General fund.

Time frame: The Zoning Code shall be amended to include this standard within three years after the adoption of the Energy Element.

4.1.2 To allow the County to adequately evaluate proposals, applications for energy facility projects shall include information on the following. The objective is to obtain necessary information for adequate evaluation. *This standard implements Policy 4.1.a.*

a. The operational energy efficiency of the proposed facility.

b. The cost/benefit analysis to the county represented by construction of the facility.

c. The expected payback period to the investors.

d. An impact assessment of County revenues and expenditures related to the project.

e. An impact assessment of construction on the local housing market, County services, county schools, and nearby residential and recreational areas.

f. Identify each phase in the development of the resource, and a proposed time line for development.

g. Identify areas sensitive to resource recovery or development activities, as established at the pre-application conference and including sensitive habitat and species, surrounding uses, scenic areas, archaeological and cultural sites, and site geology.

h. A description of the impacts of resource development on incorporated, state, and federal lands within the county.

If the applicant does not or cannot provide an adequate analyses, as determined by the Planning Director, the Planning Department shall require that the applicant pay fees to obtain such data and analyses. If the applicant is unwilling to pay the necessary fees, the application shall be deemed withdrawn.

Implementation

Lead agency: Planning Department except where pre-empted by state or federal laws or regulations.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund, development fees.

Time frame: The application requirements shall be amended to incorporate this standard within three years after the adoption of the Energy Element.

4.1.3 To adequately regulate energy facility and resource development, all proposals shall meet the following performance standards. The objective is to approve projects that benefit the county and do not adversely affect the environment or natural resources. *This standard implements Policy 4.1.b.*

Review by Other Agencies or Authorities

a. The necessary permits shall be secured from all affected federal, state, and local agencies.

b. If the proposed facility is within a flood hazard area as designated on Flood Hazard Maps of Glenn County or within a Designated Floodway or Special Flood Plain Combining zone, the rules, regulations and restrictions of the zones shall be conditions of approval.

c. The project shall comply with all applicable fire protection regulations.

d. No facility installation, repair, or maintenance which disturbs the surface of any highway or obstructs its public use shall be started without first obtaining the appropriate permits from the Department of Public Works or, where applicable, CalTrans.

Performance Standards for Facility Design and Operation

e. The energy used in the construction and operation of the proposed facility shall be less than the energy produced by the facility. When applicable, the assessment shall include the energy used in transporting material to the facility and the savings represented by recycling materials or reducing solid wastes.

f. A fiscal impact assessment shall be conducted on the proposed facility, and the anticipated County revenues that would result from the proposal shall exceed or equal the expenditures needed to adequately serve the site.

g. The proposed facility shall not be located in a geologically unstable area, except pipelines and transmission lines which may cross fault lines when necessary. The applicant shall submit a geologic report in areas with a 10 percent or greater slope, and all significant impacts from erosion, landslides, and seismic activity shall be mitigated to insignificant levels.

h. Constructing the proposed facility shall not adversely impact the local housing market, local schools, or other County services, or the applicant has identified measures to mitigate such impacts,

i. The facility owner shall continue to maintain, operate, and repair the facility on a regular basis.

j. All electrical distribution lines on the project site shall be underground up to the transformer, to the point of on-site use, or to a substation.

k. The facility shall not adversely effect the quality or quantity of water downstream, nor shall it contaminate local groundwater or freshwater supplies, as determined by federal stature, the Regional Water Quality Control Board, the State Water Resources Control Board, and applicable local water districts.

l. The proposed facility shall mitigate any adverse effects on birds, fish, and other wildlife or their habitats.

m. The developer shall reduce the risk of hazardous material releases at power producing facilities consistent with requirements of the California Health and Safety Code sections 25500 through 25553. Methods of risk reduction shall include: 1) use of non-hazardous or less hazardous material, 2) use of engineered safety systems, and 3) use of administrative controls.

n. The facility shall not adversely affect air quality as determined by the Glenn County Air Pollution Control District.

Performance Standards for Site Location

o. The proposal for the facility shall identify the route of all existing and proposed transmission lines, and the proposed route shall meet the requirements for transmission lines that are set forth in the Energy Element.

p. The facility shall not be located within a sensitive view corridor, scenic or recreational area, or near noise-sensitive uses such as hospitals, schools, rest homes, etc.

q. The facility shall not be within an environmentally sensitive area such as a wetland, animal or bird refuge, habitat of threatened or endangered species, or habitat of species of special concern.

r. If the proposed location is on an exposed hillside visible from a home site or public road, it shall be screened from view to the approval of the Planning Director.

s. All exterior lighting shall be energy efficient and shall not extend beyond the site.

t. The facility shall be located to avoid known archeological, paleontological, or historic resource sites.

Performance Standards for Construction

u. Hours of construction shall be between 7:00 a.m. and 6:00 p.m. Monday through Friday, near residentially zoned areas and where construction traffic must pass through residentially zoned areas. Extended construction hours may be approved by the Public Works Director when necessary.

v. All facilities shall be sited to minimize the removal of mature trees and overall surface disturbance. The removal of natural vegetation during construction shall be kept to a minimum, and the project site shall be watered to minimize dust leaving the site. Construction dust shall be controlled by appropriate watering or other approved palliative measures.

w. Planting shall be required after construction on sloping sites and shall occur prior to the winter rainy season to curtail soil erosion. The Soil Conservation Service may recommend specific suitable plants for erosion control. The developer shall be required to install and maintain drip irrigation systems for planted trees and shrubs.

x. If a construction site passes through productive agricultural land, construction shall preferably occur immediately after harvest or another appropriate fallow period. If it is not possible to schedule construction when fields are fallow, the farmers shall be compensated for their losses.

y. In the event a prehistoric or historic archaeological site is found during construction, all work within the vicinity of the site shall be halted until a local Indian advisor and the California Archaeological Clearinghouse at California State University, Chico have been contacted. For prehistoric sites, the State's Native American History Commission shall be contacted to provide the names of local Native American tribal representatives. No further work in the vicinity of the find shall occur until the site has been evaluated for significance and appropriate mitigation has been completed.

z. In the event a paleontological resource is found during construction, all work within the vicinity of the site shall be halted until a qualified paleontologist is consulted.

Implementation

Lead agency: Planning Department except where pre-empted by state or federal laws or regulations.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors, Air Pollution Control District, Regional Water Quality Control Board, State Water Resources Control Board, California Department of Fish and Game, Office of Environmental Health Hazard Assessment of the California Environmental Protection Agency.

Funding: General fund, development fees.

Time frame: The Zoning Code shall be amended to incorporate this standard within four years after the adoption of the Energy Element.

4.1.4 Energy facility development projects initiated by governmental jurisdictions other than those within Glenn County shall demonstrate that Glenn County's economic and tax base will not be adversely affected by the development prior to their approval. If the applicant does not or cannot provide an adequate analyses, the County Planning Department shall collect the

necessary fees to obtain such data and analyses. The objective is to not grant approval to projects where the costs of providing services exceed the increased revenues to the County by greater than one percent of the project valuation. *This standard implements Policy 4.1.a.*

Implementation

Lead agency: Planning Department except where pre-empted by state or federal laws or regulations.

Coordinating agencies: Glenn Chamber of Commerce—Economic Development Inc., Planning Commission, Board of Supervisors.

Funding: General fund, development fees.

Time frame: The Zoning Code shall be amended to incorporate this standard within four years after the adoption of the Energy Element.

4.2 GAS FIELD AND GAS WELL DEVELOPMENT

POLICY

a. It shall be the policy of the County to continue to allow gas field and well development where it can be demonstrated that there are no significant impacts on the environment and where there will be minimal conflicts with adjoining uses.

Energy resource extraction operations involve the use of wells or mines to extract existing natural resources from below the earth's surface. Glenn County has significant natural gas resources in several gas fields. It is likely that natural gas production will continue for at least the next 20 years. The purpose of this section is to provide reasonable regulations for the extraction and development of natural gas resources. These standards supplement those administered by the Division of Oil and Gas (DOG).

While a variety of gasses are used as fuel for heating and engines (propane, butane), the term natural gas most commonly means methane gas. Methane is produced through one of the following processes: 1) organic matter in sediments whose decomposition is promoted by heat, 2) the digestive action of microorganisms that convert organic waste material to methane (also known as anaerobic digestion), 3) the conversion of oil or other heavy hydrocarbons into methane at high temperatures, and 4) coal that releases methane as it matures (Oppenheimer, 1980).

The general phases of gas field development include:

- Identification of a particular area as having the potential for recoverable reserves, which can involve seismic testing and other geologic analysis;
- Exploring the area with test wells (also known as prospect wells) to determine the extent of the reserves;
- Development and operation of the field (i.e. wells, tanks, pipelines, and processing facilities necessary to extract the gas and transport it); and
- Abandonment of the field once it is depleted.

Once a gas field is identified as having recoverable reserves, wells are drilled into the geologic formations that contain the gas. Well drilling essentially employs a large drill bit attached to lengths of steel pipe. As the drill penetrates the earth, additional lengths of pipe are added until the driller reaches the desired depth. Large steel structures called "derricks" are used to support the drilling equipment. Figure 4-4 illustrates the drilling equipment.

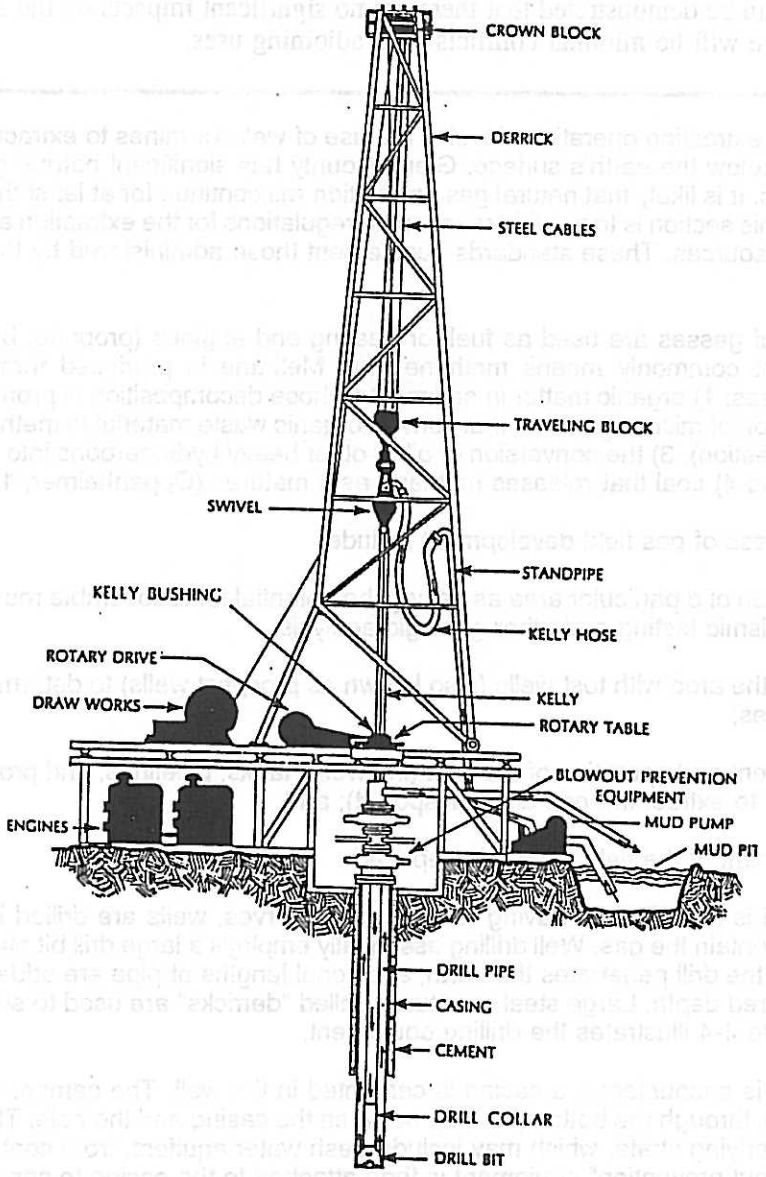
When oil or gas is encountered, a casing is cemented in the well. The cement is pumped down inside the casing, through the bottom, and up between the casing and the hole. The casing serves to protect the overlying strata, which may include fresh water aquifers, from contamination by the oil or gas. "Blowout prevention" equipment is then attached to the casing to contain underground pressure that, in the absence of such equipment, might cause a "gusher" of oil or gas to escape the well uncontrolled.

Unlike oil, which generally requires outside pressure to pump it to the surface, natural gas tends toward the surface under its own pressure once a vent (the well) is provided. In such cases, a

series of valves called "Christmas trees" are attached to the top of the well. These valves control the flow of gas from the well and assist in distributing the gas to delivery pipelines.

Water is often encountered during the drilling process. Because such water is of no use to the producer, it is generally considered waste. Often, it is injected back into designated injection wells once the gas has been removed. Such wells must be approved by the State Division of Oil and Gas and Glenn County. Once the useful life of production and injection wells has expired, they must be properly abandoned by filling the well with cement to seal access to the well and to protect the different layers beneath the well, especially fresh water aquifers.

Figure 4-4: Drilling Equipment



Source: Division of Oil and Gas, *California Oil, Gas, and Geothermal Resources, Fourth edition*, 1988.

During drilling of natural gas wells, specially treated mud is pumped down the drilling pipe to remove the pieces of rock (or "cuttings") dislodged by the drill from the well. Small holes in the drill bit allow the mud to spray through, picking up the rock cuttings from the drill bit. The pressure of

this pumping forces the mud back to the surface in the space between the drilled hole and the drilling pipe. When it reaches the surface, the mud is screened to remove the cuttings, and then recirculated back down the hole to pick up more cuttings.

Because of additives used to create drilling mud and high salinity of deep aquifers that may be encountered, such mud may require special disposal facilities. Two drilling mud disposal sites in Glenn County currently operate under conditional use permits and are limited to accepting nonhazardous drilling mud. At the Fulton Reclamation site, drilling mud is spread and tilled into the soil as a soil amendment to increase the productivity of gravelly soils (McHenry, 1991). The Valley Rock facility is a borrow pit that is being refilled with drilling mud and then closed. Both sites are approaching capacity (Holm, 1991). A recently opened drilling mud disposal site in Colusa County will likely provide sufficient capacity for Glenn County drillers (Benoit, 1991).

FACILITY SITING NEEDS

Gas wells must obviously be located over a subterranean gas resource. In this respect, it is important to identify gas field locations so that the County may make an informed decision regarding possible conflicting uses for the area.

Gas facilities may create geologic problems. Soil erosion from drilling activity can occur during the exploration and initial production of gas wells. The operation of a gas field over time can also cause ground subsidence that may impact infrastructure such as sewer, water, and gas mains.

The underlying geology is also important to the surrounding hydrology of an area. Drilling activities may pollute or adversely affect surface or groundwater resources from accidental spills, producing contaminated drilling mud and potentially increasing erosion and sedimentation to nearby creeks.

EXISTING AND PLANNED GAS WELL FACILITIES

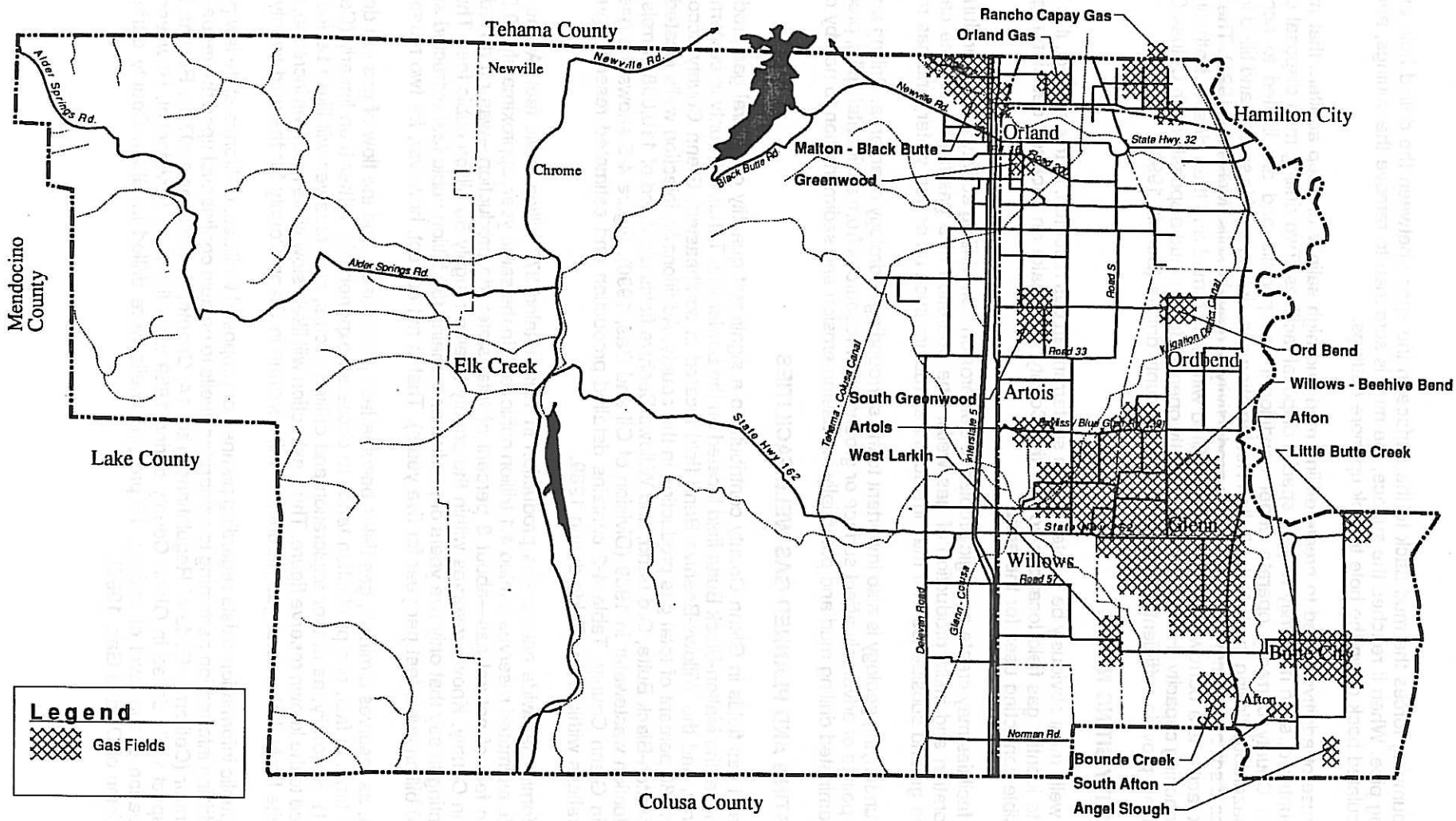
Several gas fields in Glenn County contribute to a significant quantity of natural gas production. Of these, the Malton-Black Butte field located on the border with Tehama County in eastern Glenn County, and the Willows-Beehive Bend field located in southeastern Glenn County account for nearly 80 percent of total gas production in the county. Additionally, injection wells located within the Malton-Black Butte, Ord Bend, and Willows-Beehive fields disposed of 110,058 barrels of gas production wastewater in 1989 (Division of Oil and Gas, 1990). Figure 4-5 shows the gas fields within Glenn County. Table 4-2 contains detailed production and estimated reserve figures for operations within those fields during 1989.

California statewide natural gas production in 1989 totaled 377 billion cubic feet. At the end of 1989, estimated reserves totaled 4.1 trillion cubic feet. In the same year, approximately 10.5 billion cubic feet of natural gas—about 3 percent of total statewide production—was produced within Glenn County. Known reserves within the county totaled roughly 50 billion cubic feet. Thus, it is tempting to say that only five years of production remains (50 billion cubic feet extracted at a rate of 10 billion cubic feet per year for five years). That is not correct, however, for two reasons.

First, as reserves diminish, gas fields become less pressurized, and the flow of gas will decrease over time. In fact, gas production tends to decrease exponentially rather than linearly (Campion, 1991). Secondly, as further exploration and drilling occurs, new reserves will likely be found and added to the known reserve figure. Thus, extraction will likely slow while reserves increase, making it quite likely that natural gas production will continue in Glenn County for the next twenty years.

No public information exists regarding planned or proposed facilities. California state law provides for drilling information pertaining to exploratory wells to be held confidential upon the request of the operator (California Code of Regulations, Title 14, Chapter 4, Sections 1997.1). Results from all prospect wells drilled in Glenn County during 1989 were listed as confidential. However, as an indication of the level of activity, 18 prospect wells were drilled in Glenn County during 1989 (Division of Oil and Gas, 1990).

Figure 4-5: Gas Fields



Source: California Department of Conservation, Division of Oil & Gas, Map Numbers 620 (1991) & 622 (1990).

Because the state Division of Oil and Gas reviews drilling applications only after local government approval, cities and counties are often first to know of planned development. Given the level of recent drilling activity, and known reserves as shown in Table 4-2, the County should expect significant gas exploration and extraction to continue. Such activity will likely be centered around the existing gas fields.

Table 4-2: Natural Gas Production and Reserves
Glenn County

Gas Field	1989 Production (million c.f.)	Cumulative Historic [1] Production (million c.f.)	Estimated Reserves [2] (million c.f.)	Producing Wells [1]	Shut-In Wells [3]
Afton	668	13,476	5,159	15	5
Afton South	0	136	Abandoned	0	0
Artois	0	582	Abandoned	0	0
Bounde Creek	1,123	35,897	4,042	22	3
Greenwood	0	98	Abandoned	0	0
Greenwood South	0	709	Abandoned	0	0
Larkin West	0	3	0	0	1
Little Butte Creek	0	213	487	0	2
Malton-Black Butte	4,365	114,273	18,682	44	8
Ord Bend	1	10,033	86	1	0
Orland	174	286	N/A	1	0
Rancho Capay	95	4,445	660	2	0
Willows-Beehive Bend	4,091	356,874	20,470	87	14
County Field [4]	50	554	N/A	1	5
TOTALS	10,567	537,579	49,099	173	38

Notes: 1. Where gas fields cross county lines, production and numbers of producing wells reflect activity solely within Glenn County.
2. Where gas fields cross county lines, reserve estimates include total gas field reserves.
3. Shut-in wells are wells capable of producing natural gas that are not currently operating.
4. County Field refers to wells not assigned to an existing gas field, or declared a new gas field by the Division of Oil and Gas.

Source: Division of Oil and Gas, 1990.

PERMIT AUTHORITY

The California Department of Conservation Division of Oil and Gas (DOG) oversees production of oil and gas wells to insure and protect public safety and oil, gas, and groundwater supplies. All onshore drilling, production, and injection must conform to DOG regulations. (14 CCR, Chapter 4, Section 1712 et. seq.) Additionally, DOG collects and publishes data on oil and gas extraction, water injection, well ownership, and other data necessary to carry out their oversight function.

However, prior to DOG evaluation of a proposed well, a gas or oil driller must have an approved land use permit from the local agency that oversees the proposed site (Campion, 1991). Since DOG is often consulted during the local agency's review of an application, DOG effectively is able to comment twice on each drilling application. This review procedure insures that Glenn County will have permit authority over future gas development.

The Glenn County Zoning Code specifies evaluation standards to issue an administrative permit for natural gas wells in Section 19.14.050. An administrative permit is granted by the Planning

Director and does not require public review or action by the Planning Commission or the Board of Supervisors. To grant an administrative permit, the Planning Director must currently make findings on the location of the well in relation to nearby roads and residences, the possibility of flood hazards, conformance of project with fire regulations, the disposal of drilling mud, obtaining necessary permits, road maintenance, and conversion of the well to an injection well. This procedure is expanded to ensure a more complete review.

ENVIRONMENTAL ISSUES

Natural gas extraction facilities may adversely impact, or be constrained by the following environmental features:

Geology

Geologic features may be impacted by gas and oil facilities, and such facilities may be constrained by geology as follows:

- increased soil erosion potential during exploration and initial production;
- risk of spills, leaks, or discharges that can contaminate the soil; and
- ground subsidence can damage infrastructure such as sewer, water and gas mains.

Hydrology

Gas production may adversely impact water resources by:

- pumping extracted wastewater into fresh water aquifers through injection wells;
- polluting surface or groundwater resources through accidental spills of material extracted from wells; and
- increasing erosion and sedimentation in nearby creeks.

Air Quality

Air quality may be adversely affected by oil and gas development by generating air pollutants during recovery and refinement and increasing vehicle traffic associated with transport of oil and gas.

Biology

Biological resources may be impacted by gas field development by degrading air, water, and soil quality and by converting wildlife habitat into incompatible industrial uses.

Aesthetics

Natural gas extraction may have adverse aesthetic impacts by occupying large areas of land and by constructing drilling facilities with tall derricks.

LAND USE ISSUES

Gas field development requires initial exploratory activity and later drilling operations that may conflict with noise-sensitive land uses. Seismic testing may involve the use of explosives or "thumper trucks" (trucks equipped with pounding equipment that send sound waves into the ground), and drilling rigs typically operate on a 24-hour basis until a well is completed. Possible hazards include fire and explosion risks, though such events are rare. For these reasons, urban uses (especially residential and commercial) should be buffered from nearby gas fields.

Because of potential impacts to biologic, hydrologic, and aesthetic resources, natural gas extraction should be limited and/or carefully monitored near sensitive areas like wildlife refuges, streams, riparian habitat, and important view corridors. In rural areas that use ground water wells, injection well activity may conflict with established residential uses.

Natural gas wells require above-ground valves, metering equipment, pipelines, and maintenance access roads. Such ancillary items may conflict with existing agricultural uses by hindering the movement of farm machinery and irrigation equipment, as well as effectively removing the land from agricultural production.

STANDARDS

4.2.1 Section 19.14.050 of the Glenn County Zoning Code shall be amended to include all of the following requirements and performance standards for an administrative permit approval. The objective is to mitigate possible environmental and public service impacts associated with gas well development. *This standard implements Policy 4.2.a.*

General Performance Standards

a. Gas field and gas well development shall be subject to the performance standards specified in Standard 4.1.3, except for the limits on the hours of construction. Drilling rigs shall be allowed to operate on a 24-hour basis.

b. The applicant shall execute an agreement with the County that allows the County to require a sound-wall enclosure and visual and/or security barrier (fences) at a later date should the County determine that pump noise or the appearance of the well has become a nuisance to adjoining uses.

Performance Standards for Site Design

c. The project application shall include the location and dimensions of wells and well pads, the location of pads and associated improvements, and the locations of any pipelines or storage tanks and pump facilities.

d. An adequate analysis of potential ground subsidence problems associated with increased mining of natural gas within the larger gas field shall be presented, and demonstrate that the well poses no impacts, or identifies adequate measures proposed by the applicant to mitigate significant impacts.

e. Drilling mud shall be disposed of at an approved disposal site in compliance with the State Integrated Waste Management Plan and the County Hazardous Waste Management Plan. An approved disposal site is one that is approved for disposal of gas well drilling mud and cuttings by both the county and state where it is located.

f. Later conversion of the gas well to an injection well may be permitted with a conditional use permit provided that a water quality analysis has been submitted concurrent with the request for a conditional use permit and the water contains no possible contaminants to ground water resources (see also section 19.74 of the Zoning Code).

Performance Standards for Site Location

g. The proposed gas well site shall be at least 500 feet from the nearest housing unit, and the decibel rating of the pump (measured at a distance of 100 feet) shall not exceed 65 decibels.

h. The gas well site shall be at least 120 feet from a County road right-of-way.

i. The gas well shall not be located on a ridgeline.

Performance Standards for Site Reclamation

j. Once the gas well is no longer operational and/or is not a producing well, the well site shall be reclaimed to its natural state or previous use (whichever is applicable). The gas well abandonment shall be performed in accordance with California Public Resources Code, Chapter 1, Section 3228 and California Code of Regulations, Title 14, Chapter 4, Section 1723.

Implementation

Lead Agency: Planning Department, California Division of Oil and Gas

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors, Regional Water Quality Control Board, Department of Health Services, Air Pollution Control District.

Funding: General fund, development fees, and annual franchise fees.

Time frame: The Zoning Code shall be amended within four years after the adoption of the Energy Element.

4.3 BIOMASS FACILITIES

POLICIES

It shall be the policy of Glenn County to:

a. Permit biomass facilities as a method of producing energy from waste products, where environmental and air quality impacts are minimal and the facility will be compatible with adjoining uses.

b. Require that biomass facilities be constructed and operated so as to minimize air emissions and odors to an acceptable level as established by the California Clean Air Act and the Glenn County Air Pollution Control District.

Biomass refers to various organic waste products from agricultural and industrial processes, such as rice hulls, sawdust, animal manure, waste products from sewage treatment facilities, and municipal landfill materials. This is why the conversion of biomass to energy is also often referred to as "waste-to-energy." Aside from the potential to generate electricity, the use of biomass may also help alleviate waste disposal problems.

Perhaps the simplest form of biomass conversion involves burning flammable materials to boil water and generate steam, which then drives turbines to generate electricity. This works well with small branches left over from logging operations, sawdust created at lumber mills, and agricultural by-products such as orchard tree trimmings and rice hulls. Waste products with higher moisture content such as animal manure and wastewater treatment sludge can often be used in modified steam boilers.

Another method of biomass conversion involves the fermentation of waste products in an oxygen starved environment, also known as anaerobic digestion, to create biogas—a mixture of methane and carbon dioxide. This method is often superior to burning when the waste product is particularly moist. Biogas is also formed as a natural product of waste decomposition in landfills and sewage treatment facilities. Several air pollution control districts within California require that such gas be captured from landfills. The gas can then be burned to create heat and run a turbine which generates electricity. This method has also been successfully demonstrated at cattle feedlots and dairies where animal manure is plentiful, and often difficult and/or expensive to dispose of.

A third method of biomass conversion is gasification, also known as pyrolysis. Pyrolysis exposes a biomass source to high temperatures while limiting the amount of oxygen to keep the biomass from burning. Pyrolysis allows a chemical reaction that releases biogas, which can then be captured and used like natural gas or used to boil water and create steam to drive turbines.

FACILITY SITING NEEDS

The siting needs of biomass conversion facilities depend both on the type of conversion process to be used and the biomass source. Because of transportation costs, conversion facilities located at or near the biomass source would likely be favored by an applicant. If not located at the source of biomass, conversion facilities need road access capable of handling large trucks. Significant quantities of water may be required both for cooling and steam. Access to appropriate disposal facilities may also be required. Because biomass facilities may vent objectionable odors and air pollutants, they should be located downwind from homes and other sensitive land uses.

An existing landfill site may offer advantages over other proposed sites. First, since a landfill is a depository for waste products, many potential biomass fuels may be already transported to the landfill. Although biomass facilities make use of waste products, it is important that materials that can be recycled not be used as a biomass fuel. Such materials save more energy when they are recycled than when used as a biomass fuel.

Additionally, since biogas results naturally from waste decomposition, there may be untapped potential at an existing landfill site. Also, such facilities are generally built to accommodate trucks, and they are located away from sensitive land uses.

EXISTING AND PLANNED BIOMASS FACILITIES

The *California Power Plant Maps* (CEC 1989) lists the location and operational data for various types of biomass facilities within the state. Over one hundred of these various facilities existed state-wide in 1989 with a combined generating capacity of about 642 MW.

The CEC map identifies one waste-to-energy facility in Glenn County. Meadow Glen Farms (now called Gonsalves Farms—located near Orland), constructed a digester gas facility that converted dairy cow manure to methane and burned that product to generate electricity. The facility sold excess power to PG&E. According to the owner, the facility operated for a total of 3,400 hours.

The facility has not operated for at least six years (1985). Part of the reason is a design that does not provide for efficient loading of the facility (Gonsalves, 1991). Additionally, the facility has been converted to operate on propane and currently serves as a back-up generator for the dairy. While technically operable, the owner has no intention of employing the facility other than as a back-up generator.

Glenn County has entered into a contract with Total Energy Systems (TES) for construction of a pyrolysis facility at the existing Glenn County landfill. TES will privately construct and operate the facility, which is expected to process 50 tons of municipal solid waste per day. There is some discussion currently of increasing the capacity of the plant to process 200 tons per day to allow for burning agricultural wastes, though no final decision has been made. Thus, the energy output of the facility remains unknown. Construction is not expected to begin before 1993 (Gilbert, 1991).

BIOMASS POTENTIAL IN GLENN COUNTY

The agricultural industry in Glenn County offers significant potential for biomass energy production. Field crops, fruit and nut trees, and timber production all generate large amounts of residue by-products during various stages of harvesting and processing. Estimates of total potential biomass from agricultural operations can be derived by applying residue factors to various agricultural commodities based upon acreage under cultivation.

The crop residue factor varies among crops. Field crops such as barley, wheat, and beans can generate from 1 to 3 tons of residue per acre each year. Residue also varies from year to year. For example, orchards may only require major trimmings every third year; hence, the amount of trimmings generated per acre of orchard will vary. Finally, the energy content of various types of biomass also varies significantly, ranging from around 6,500 to 8,500 btu per pound (University of California, 1982). Among similar crops, energy potential also depends upon the moisture content.

Table 4-3 presents a simplified overview of the potential for biomass to generate energy within Glenn County based upon 1989 crop production. The table aggregates crops into broad categories and then applies average residue factors to provide a general estimate of biomass tonnage. The potential energy column assumes an average energy content of 7,500 Btu per pound of residue. It is important to note that the figures are approximate.

Converting the total potential energy noted in Table 4-2 into kilowatt-hours (1 kwh ≈ 3,410 btu) yields approximately 4.06 billion kwh, or roughly 13 times the 1990 electricity use in the county. (See Table 2-3).

Table 4-3: Biomass Potential
Glenn County

Commodity	1989 Production Acreage	Residue Factor (tons/acre)	Potential (tons/year)	Potential Energy (Btu)
Field Crops	408,351	2.0	816,702	1.2251×10^{13}
Seed Crops	15,832	1.3	20,581	3.0872×10^{11}
Fruit and Nuts	31,997	1.5	47,995	7.1993×10^{11}
Timber	29,200,000 (b.f.)	1.3 (per 1,000 b.f.)	37,960	5.694×10^{11}
TOTAL	NA	NA	923,239	1.3849×10^{13}

Notes: b.f. — board feet.
Source: Crawford Multari & Starr, *Environmental Resources and Energy Technologies—Environmental Setting*, 1991. U.C. Cooperative Extension, *Agricultural Residues in California*, date 1982

Rice Straw Potential as a Biomass Fuel

Rice comprised the single largest crop in Glenn County in 1990 in both acreage (about 63,000 acres) and valuation (about $50.6 million). Because it is such an important commodity in Glenn County, and because of air quality issues associated with disposing of rice by-products, this section will examine rice, and specifically rice straw, in detail.

A by-product of rice is rice straw, which is generally burned in the field after harvest. Rice straw is burned for two reasons: 1) it is the most cost-effective means of disposal, and 2) because rice straw contains a fungus that causes stem-rot, burning the rice straw is necessary to kill the fungus. Removing the rice straw by cutting, baling, and collecting the loose straw can be nearly as effective in controlling disease as burning, but is quite costly (University of California, 1990).

The California Clean Air Act mandates that emissions of certain air pollutants be reduced to comply with new stricter air quality standards. Because burning rice straw generates a significant portion of air pollution emissions in Glenn County, there is concern in the county as to the effects of the California Clean Air Act on the long-term viability of rice farming in the region. (The water requirements of rice and the scarcity of water in California also question the viability of rice production in the region.)

The WADHAM energy facility in Colusa County, operated by Oxford Energy, currently generates energy by burning rice hulls and rice straw. These fuels are purchased directly from rice mills in the region, including Glenn County. The facility burns about 190,000 tons of rice hulls per year. Rice straw currently comprises only about 2.5 percent of the fuel; the rest of the fuel is rice hulls. Several constraints limit the ability of this facility to burn more rice straw (Ellery, 1991):

- Rice straw must be ground fairly finely to be used; this adds another step to the process and requires special modified equipment to move and load the fuel.
- Rice straw smoke has a high sulphur content that would exceed amounts allowed under the facility's operating permit from the Colusa County APCD.
- Rice straw requires approximately one acre of land per thousand tons for storage. Thus storage requirements can be very land consumptive.

- Ash generated by burning rice straw may in some cases be classified as hazardous waste because of high crystobolite content that results when soils and rocks gathered with the rice straw are burned at high temperatures.

The above factors suggest that the likelihood of using significant amounts of rice straw for biomass energy conversion is small in the near future.

The requirements of the California Clean Air Act coupled with the current inability to use rice straw as a biomass feedstock may significantly affect the rice industry within Glenn County. Unless a market develops for rice straw for some use (such as a biomass feedstock), a ban on rice straw burning would significantly decrease the acreage of rice within the state, possibly by as much as 25 percent. Conversely, if a market for rice straw develops, the acreage planted in rice could increase up to 30 percent throughout the state (University of California, 1990).

PERMIT AUTHORITY

No state or federal agency specifically oversees permitting of small-scale biomass facilities; however, many state agencies may be involved in reviewing a given application. The California Energy Commission has permit authority for biomass facilities greater than 50 MW. While local land use authorities retain control of the final siting decision, various agencies may have review and/or permit authority.

For instance, a direct combustion biomass facility will likely require permits from the local Air Pollution Control District to ensure compliance with state air quality standards. Fermentation processes may also require similar air quality permits, as well as review by the Regional Water Quality Control Board to safeguard surface and groundwater quality from polluted discharges.

ENVIRONMENTAL ISSUES

Biomass conversion facilities, including waste-to-energy projects, may create land use or environmental impacts on the following resources.

Geology

Geologic features may be impacted by biomass conversion facility development, or geology may constrain such development as follows:

- requiring landfill space for ash disposal;
- creating the potential for erosion and soil impacts from crops raised specifically for biomass consumption; and
- increasing runoff and resulting sedimentation and leaching of pesticides and fertilizers.

Air Quality

Biomass conversion facilities may adversely impact air quality by:

- venting by-product emissions such as carbon dioxide, oxides of nitrogen, sulfates, and particulate matter into the atmosphere;
- creating objectionable odors near adjacent sensitive land uses;
- employing grain elevators, screening, and grinding equipment during the fuel loading, drying, and handling processes; and
- increasing vehicle traffic associated with transporting biomass products.

Water

Biomass energy production may impact water resources by:

- using large quantities of water for cooling and washing of facilities;

- creating contaminated waste water; and
- requiring additional treatment facilities to treat contaminated waste water.

Biology

Biomass facilities may adversely affect biological resources by exposing humans, wildlife and habitat to pollution by-products and eliminating endangered species and/or their habitat through removal of forestry slash.

Aesthetics

Aesthetics may be adversely impacted by biomass facilities by:

- creating a relatively large, industrial-type land use;
- employing tall, highly visible stacks to vent exhaust emissions; and
- creating plumes of smoke or steam that are highly visible.

Circulation

Biomass may create adverse circulation impacts by:

- requiring large trucks to transfer biomass products to conversion facilities;
- impacting rural roads which are not designed to handle the weight of fully loaded trucks; and
- creating safety hazards from large trucks that may constrain traffic movement.

LAND USE ISSUES

Biomass facilities are generally large, industrial-type land uses. They can generate smoke and odors that can be offensive or even dangerous to downwind populations. Such facilities may also require the use of large trucks or noisy equipment to move biomass and resulting waste products. For these reasons, facilities should generally be located in areas suitable for industrial development and away from residences, retail commercial areas, recreation areas, or sensitive wildlife habitats.

STANDARDS

4.3.1 Biomass facilities may be granted conditional use permits subject to the following requirements. The objective is to mitigate possible environmental and public service impacts associated with biomass facility construction and operation. *This standard implements Policy 4.3.a. and Policy 4.8.a.*

General Performance Standards

a. The biomass facility shall be subject to the performance standards specified in Standard 4.1.3.

b. The expected efficiency rating of the facility shall be at least 19 percent.

c. The application materials shall identify the quantity of and type of wastes expected to be generated by the biomass facility, and the proposal includes a preliminary agreement with a suitable disposal site to accept the wastes. Paper and cardboard (which can be efficiently recycled) shall not supply more than 25 percent of the fuels for the facility.

d. The proposal shall include a plan for the handling and disposal of potential hazardous materials which may be contained in the waste ashes.

Performance Standards for Site Location

e. The application materials for the biomass facility shall identify the source of sufficient quantities of fuel and water necessary to operate the facility.

f. The proposed site shall be located within a commercial, industrial, or agriculturally zoned area. The proposed facility may operate in conjunction with other uses, especially ones that generate biomass fuels. Biomass facilities may be permissible on Williamson Act lands.

g. The biomass facility shall be located near a railway, or near roadways that can handle the size and frequency of trucks needed to transport biomass fuels and wastes into the facility without diminishing the roadway level of service below the acceptable level as stated in the transportation component of the Community Development Element.

Implementation

Lead agencies: Planning Department, California Energy Commission if facility is greater than 50 MW in capacity.

Coordinating agencies: Resource Conservation District, Technical Advisory Committee, Planning Commission, Board of Supervisors, Glenn County Air Pollution Control District, State Water Resources Control Board, Regional Water Quality Control Board.

Funding: General fund, development fees.

Time frame: The Zoning Code shall be amended to include the standards necessary for permitting a biomass facility within four years after the adoption of the Energy Element.

4.3.2 The Planning Department and the applicant shall consult the Glenn County Air Pollution Control District for preliminary review of the facility and possible air emissions within 30 days of the receipt of the application. The purpose of the meeting will be to discuss additional material that will be needed to adequately evaluate the proposal. The application shall not be deemed complete until all additional materials are submitted. As required by law, the applicant must also submit an application to the Air Pollution Control District concurrent or prior to applying to the County. *This standard implements Policy 4.3.b.*

Implementation

Lead agency: Planning Department.

Coordinating agency: Air Pollution Control District.

Funding: Development fees.

Time frame: The Zoning Code shall be amended to include this standard within four years after the adoption of the Energy Element.

4.4 COGENERATION FACILITIES

POLICIES

It shall be the policy of Glenn County to:

a. Allow cogeneration facilities as a method of reducing energy demand by using energy more efficiently.

b. Require only administrative review of cogeneration projects which are in a single building or adjoining buildings.

c. Allow cogeneration projects which transport heat and/or energy across a public space, but such facilities shall be subject to stricter review that considers the environmental and fiscal impacts of development.

Cogeneration is the process of using waste heat generated by an industrial process for space or water heating, or to generate electricity. Unlike many of the other facilities noted in this report cogeneration is not an energy production method that consumes a resource, but instead is an energy recovery technology. This technology can be applied in thermal power plants or industrial processing facilities.

Cogeneration facilities run on two basic principles. They can use the heat left over from the process of generating electricity for manufacturing or processing (called topping cycle), or they can use heat left over from an industrial process to generate electricity (called bottoming cycle). Some facilities combine both of these aspects; combined cycle systems sequentially produce electricity and heat and then produce electricity from any unused heat. A cogeneration facility, therefore, refers to a facility with two separate and distinct functions; one that produces heat and one that uses heat.

For the purposes of this section, the term "cogeneration facilities" can apply to any one of the following circumstances:

- A new facility that proposes both heat-using and a heat-producing components.
- A proposal to add a heat-using component to an existing heat-producing facility.
- A proposal to add a heat-producing component to an existing heat-using facility.

FACILITY SITING NEEDS

The basic idea behind cogeneration facilities—shared energy use—means that such facilities are best located at thermal power plants, industrial facilities, or agricultural processing plants that can produce or use excess heat.

EXISTING AND PLANNED COGENERATION FACILITIES

No cogeneration facilities exist in Glenn County nor are any currently anticipated.

COGENERATION POTENTIAL IN GLENN COUNTY

There is currently no potential for topping cycle cogeneration facilities in Glenn County because no large thermal power facilities exist.

Industrial facilities within the county may offer the potential for bottoming cycle cogeneration facilities. The Manville fiberglass manufacturing plant located west of Willows generates significant amounts of process heat that currently is vented without being used. However, no plans exist for using the heat for other purposes because of the large capital outlay required (Rapp, 1991). However, Manville's large energy requirements coupled with its proximity to natural gas pipelines and high-voltage electrical transmission lines suggest good potential for cogeneration in the future.

Some agricultural processing facilities within Glenn County may offer limited cogeneration potential. The Holly Sugar plant located in Hamilton City generates significant amounts of process heat. The plant currently uses natural gas for both process heat and to generate electricity at the plant. Holly has evaluated the potential for cogeneration at the facility, but the economics are unfavorable at this time (Norman Bates, 1991).

Sunsweet Dryers operates a prune drying facility in the northeast corner of Glenn County that uses natural gas for its drying functions. The plant operates on average only about 30 days per year during the prune harvest season. Sunsweet operates another facility in nearby Yuba County that employs two cogeneration units, but has no plans for such facilities at the Glenn plant because the short operating season does not provide sufficient time for economical cogeneration (Seibel, 1991).

PERMIT AUTHORITY

Unless larger than 50 MW of generating capacity, cogeneration facilities require no special state or federal permits. The California Energy Commission has authority of facilities greater than 50 MW capacity. Installation of cogeneration facilities at existing facilities are generally categorically exempt from CEQA processing.

ENVIRONMENTAL ISSUES

Because cogeneration facilities are most often added on to existing industrial plants and operations, the type and extent of potential impacts are dependent on the individual project and are not easily generalized. In the case of adding electrical generation facilities to an industrial plant to use waste process heat, the same types of impacts associated with thermal facilities and electrical transmission lines may occur.

If cogeneration facilities are retrofitted to existing industrial facilities, incremental adjacent land use impacts are likely to be insignificant. Cogeneration facilities that are designed as an integral part of a new industrial plant or operation can also be designed to have no significant impacts beyond those normally associated with the industrial operation itself.

LAND USE ISSUES

In many cases, cogeneration facilities can be installed with no new impacts beyond those associated with the original land use.

STANDARDS

4.4.1 Single-building cogeneration facilities shall be allowed with an administrative permit if the facility meets the following criteria. Otherwise, a conditional use permit is required. The objective of this standard is to facilitate development of cogeneration facilities and mitigate potential land use conflicts before they occur. *This standard implements Policy 4.4.a. and Policy 4.4.b.*

General Performance Standards

a. The cogeneration facility shall be within one building or adjoining buildings.

b. Cogeneration facility development shall be subject to the performance standards specified in Standard 4.1.3.

c. The total cogeneration system has an energy efficiency of at least 65 percent.

d. No electricity shall be exported from the site.

e. If proposed in conjunction with an energy production facility, the facility meets the requirements specified in this Energy Element.

f. The proposed facility does not create hazardous waste products, or the applicant has demonstrated that a certified hazardous waste disposal site shall accept the wastes.

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

h. The proposed facility shall comply with emission standards for harmful air pollutants, as determined by the Air Pollution Control District and the California Energy Commission, when appropriate.

Performance Standards for Site Design

i. The proposed location of the facility shall be at least 250 feet from the nearest housing unit on adjacent properties, unless safety problems necessitate larger buffers.

Performance Standards for Site Location

j. The proposed site shall be within a commercial, industrial, or agriculture zoned area.

Implementation

Lead agencies: Planning Department, California Energy Commission for facilities with greater than 50 MW capacity.

Coordinating agencies: Resource Conservation Department, Air Pollution Control District, State Water Resources Control Board, Regional Water Quality Control Board, Technical Advisory Committee, Planning Commission, Board of Supervisors, Office of Environmental Health Hazard Assessment of the California Environmental Protection Agency.

Funding: General fund.

Time frame: The Zoning Code shall be amended to incorporate this standard within four years after the adoption of the Energy Element.

4.4.2 Cogeneration facilities shall be allowed with a conditional use permit if the facility exports energy from the site or if the buildings of the facility are not adjoining, i.e., a street or other public space separates the buildings. The objective of this standard is to facilitate development of cogeneration facilities and mitigate potential land use conflicts before they occur. *This standard implements Policy 4.4.a. and Policy 4.4.c.*

General Performance Standards

a. Cogeneration facility development shall be subject to the performance standards specified in Standard 4.1.3.

b. The applicant shall submit a detailed site plan.

c. The facility shall not pose a threat to the health or safety of the general public.

d. The total cogeneration system shall have an energy efficiency of at least 65 percent.

e. If proposed in conjunction with an energy production facility, that facility shall meet the requirements specified in this Energy Element.

f. The facility shall not create hazardous waste products, or the applicant has demonstrated that a certified hazardous waste disposal site will accept the wastes.

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

h. The proposed facility shall comply with emission standards for harmful air pollutants, as determined by the Air Pollution Control District.

Performance Standards for Site Design

i. The proposed location of the facility shall be at least 250 feet from the nearest housing unit on adjacent properties, unless safety problems necessitate larger buffers.

Performance Standards for Site Location

j. The site shall be within a commercial, industrial, or agriculturally zoned area.

Implementation

Lead agencies: Planning Department, California Energy Commission for facilities with more than 50 MW capacity.

Coordinating agencies: Resource Conservation Department, Air Pollution Control District, State Water Resources Control Board, Regional Water Quality Control Board, Technical Advisory Committee, Planning Commission, Board of Supervisors, Office of Environmental Health Hazard Assessment of the California Environmental Protection Agency.

Funding: General fund.

Time frame: The Zoning Code shall be amended to incorporate this standard within four years after the adoption of the Energy Element.

4.4.3 The Planning Department and the applicant shall consult the Glenn County Air Pollution Control District for preliminary review of the facility and possible air emissions within 30 days of the receipt of the application. The purpose of the meeting will be to discuss additional material that will be needed to adequately evaluate the proposal. The application shall not be deemed complete until all additional materials are submitted. As required by law, the applicant must also submit an application to the Air Pollution Control District. *This standard implements Policy 4.4.a. and Policy 4.4.b.*

Implementation

Lead agency: Planning Department.

Coordinating agency: Air Pollution Control District.

Funding: Development fees.

Time frame: The Zoning Code shall be amended to include this standard within four years after the adoption of the Energy Element.

4.5 HYDROELECTRIC FACILITIES

POLICIES

It shall be the policy of Glenn County to:

a. Allow development of hydroelectric facilities while protecting the natural resources of the County from the potentially damaging effects of water storage and diversions for hydroelectric power generation; any hydroelectric facility proposal shall demonstrate that there shall be no adverse effect on the availability or quality of water downstream or on region recreation opportunities.

b. Require that streams and fish populations be monitored regularly and that in-stream flow studies acceptable to the California Department of Fish and Game or the U.S. Fish and Wildlife service be conducted prior to any site development.

c. Require that all project proposals include a contingency plan to mitigate the adverse effects of drought or excessive rain.

Hydroelectric power plants convert the energy stored in flowing water into electricity; an early example of using flowing water to perform work was a water wheel driving a grain mill or other type of agricultural machinery. This concept of harnessing the kinetic energy contained in moving water is still used today in modern electricity generation. Today, moving water turns turbines which, when connected to a generator, convert the kinetic energy of moving water into electricity.

The potential for water to create electricity depends upon the volume of water flow and the pressure (called "head"). The flow of water is measured in terms of the quantity of water passing a given point within a given time period. Generally, this measure is expressed in cubic feet per second (cfs) or gallons per minute (gpm). Water flow depends upon the size of the channel carrying the water, and will vary according to availability of runoff from snow, rain, springs, or other sources of water supply. The water pressure, or head, depends upon the vertical distance the water falls at the site of electricity generation. This can be expressed as a linear measure of the number of feet of drop, or in terms of the pounds of water pressure created per square inch of space (psi). One psi is equal to approximately 2.31 feet of head.

There are two types of hydroelectric facilities: dams and diversions. Dams raise the water level of a stream to an elevation necessary to generate usable head. Dams can be constructed of earth, concrete, steel, or combinations of such materials. Aside from creating head potential, dams may offer a secondary benefit by providing flood control, recreation opportunities, and water storage. Diversion facilities, as the name implies, typically divert water from its natural channel to run it through a turbine, and then usually return the water to the channel downstream of the turbine.

Small hydroelectric systems generally refer to installations that have a capacity of 15 megawatts (MW) or less (Noyes, 1980). Because power generation depends upon both usable head and the water flow rate, the size distinction is not necessarily dependent upon the head of the installation. Low-head facilities can generate large amounts of power if water flow rates are high. This notion notwithstanding, one meter of head is generally considered the absolute minimum to develop hydroelectricity, though a site with less than ten feet of head will not likely prove economical.

A fundamental precept of small hydroelectric development, as opposed to large facilities, is the relatively small impacts that such facilities would be expected to produce. Generally, such systems

are retrofitted to an existing water conveyance system such as an irrigation diversion or other impoundment. This explains why such systems are often called "run-of-the-river" systems.

FACILITY SITING NEEDS

Hydroelectric energy production generally requires four major components, whether dams or diversions are used:

- An elevation difference to generate head;
- A channel or penstock to convey the water from the dam or diversion to a turbine;
- A turbine that is turned by the moving water and an accompanying outlet that returns the water to stream channel; and
- An electrical generator powered by the rotation of the turbine.

EXISTING AND PLANNED HYDROELECTRIC FACILITIES

The Stony Gorge Hydroelectric System includes three individual hydroelectric facilities: Stony Gorge Reservoir, Black Butte Reservoir, and High Line Canal. Two of the facilities (Stony Gorge and High Line Canal) are located in Glenn County, while the Black Butte Reservoir powerhouse lies in Tehama County (see Figure 4-6).

Stony Gorge Facility

Stony Gorge Reservoir is located in west-central Glenn County and was constructed by the Federal Bureau of Reclamation in 1928, mainly for flood control. The dam is 868 feet long, 140 feet high, and has 50,000 acre-feet of storage capacity. The electrical generating facilities at Stony Gorge Reservoir were retrofitted to the dam structure, and include two steel penstocks with combined flow capacity of 660 cubic feet of water per second (cfs). This flow can create hydrostatic head of 90 feet which turns two horizontally mounted turbines. Support facilities include a switchyard, access roads and a transmission line. The facility has a generating capacity of 4.9 MW and an average annual generation of 12.34 million kwh.

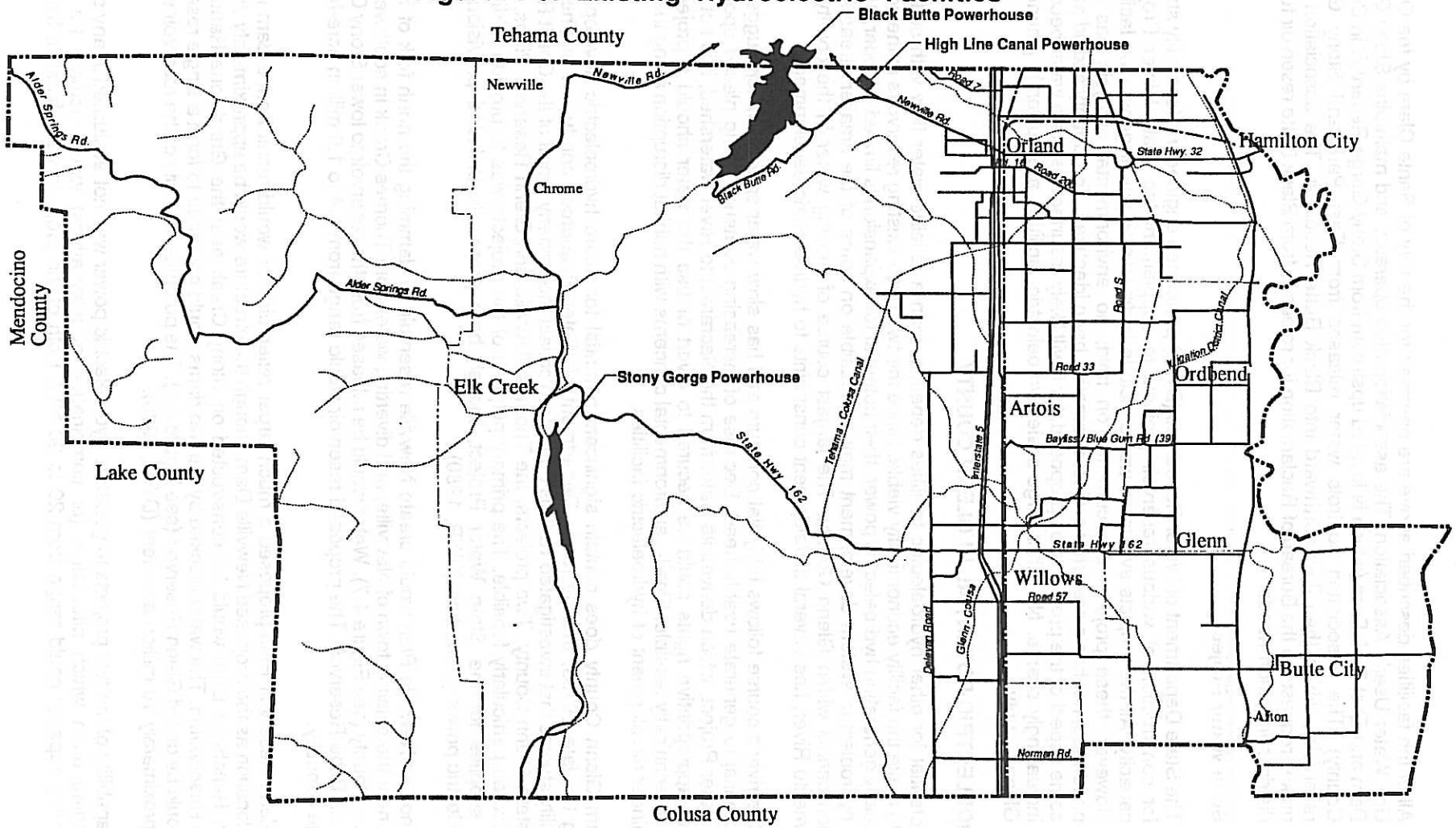
Black Butte Facility

The power generating facilities of the Black Butte Hydroelectric project are in Tehama County, though Black Butte Reservoir itself extends south into Glenn County and is part of the Stony Gorge system. Water from Stony Gorge Reservoir flows into Black Butte Reservoir. The Army Corp of Engineers constructed the earthen dam in 1964. The dam measures 2,970 feet across at its crest and rises 140 feet above the original stream channel. The dam can impound 160,000 acre-feet of water when full. The hydroelectric generating facilities include a 567-foot long concrete-lined penstock, 12 feet in diameter. This pipe allows up to 1,000 cfs of water flow to turn a single vertically mounted turbine. Support facilities include a powerhouse, switchyard, access roads, and transmission lines that connect the facility to the PG&E grid. The installed capacity of the Black Butte facility is 6.19 MW and it generates an average of 15.38 million kwh annually.

High Line Canal Project

The High Line Canal hydroelectric project lies about two miles east of the Black Butte facility. Rather than using a dam, High Line Canal diverts water from South Canal into a six foot diameter reinforced concrete penstock. The penstock drops water 27 vertical feet over 150 horizontal feet at a rate of up to 250 cfs. The water then turns a vertically-mounted turbine, flows through an energy dissipator, and then is returned to South Canal. The facility has .53 MW of installed capacity, and annually produces 1.425 million kwh on average. The canal first produced power in August of 1988.

Figure 4-6: Existing Hydroelectric Facilities



North

Source: City of Santa Clara, 1991.

All of the facilities described above are operated for the City of Santa Clara by the Orland Unit Water User's Association. The association also operates and maintains Stony Gorge Dam and East Park Dam (which is located upstream from Stony Gorge Reservoir in Colusa County). The association controls water releases from East Park and Stony Gorge reservoirs, which then flow northward into Black Butte Reservoir. The association then makes requests to the Bureau of Reclamation for releases from Black Butte reservoir for the district's irrigation needs.

State Water Project

The State Department of Water Resources (DWR) performed engineering feasibility studies for construction of various reservoir projects to supplement the State Water Project's capacity. All the projects evaluated would include hydroelectric power generation facilities. However, these projects are currently on hold; no environmental analysis has been performed, nor has a preferred project alternative been identified. The County should expect some aspect of the project to be proposed, for it will likely resurface as state water becomes increasingly scarce. No other large-scale hydroelectric facilities are currently planned in Glenn County.

HYDROELECTRIC POTENTIAL IN GLENN COUNTY

The potential for other hydroelectric facilities depends upon a reliable water flow with sufficient head to make the facility economically viable. Since the two large existing reservoirs in the county are already generating hydroelectric power, their potential for expansion is limited (Hopper, 1991). Small hydroelectric system development may be feasible on some of the smaller streams and irrigation canals within Glenn County. The largest source of moving water in the county, the Sacramento River, has several development constraints to hydroelectric development.

First, the river's course follows fairly flat contours and has slow water speeds, which suggests a low potential to generate usable head. Because of increasing demands being placed upon the State Water Project, which derives its water from the Sacramento River watershed, it is not clear whether appropriative rights could be secured to divert or use the water should a project be deemed technically feasible. Finally, environmental concerns with habitat disruption along the river may hinder development of hydroelectric facilities.

Western Glenn County does contain significant potential for future hydroelectric development. During the late 1970s, the California Department of Water Resources conducted engineering feasibility studies that investigated various projects to collect the easterly runoff of the Coast Range in western Glenn County. Two projects, the Thomes-Newville and Glenn Reservoir Plans, were identified as particularly feasible. The primary purpose of the projects was to provide additional water supplies for the State Water Project, though both proposals included provisions for hydroelectric power generation (DWR, 1980).

The Thomes-Newville Plan would create Newville reservoir by damming the north fork of Stony Creek near the existing town of Newville, and diverting water from Thomes Creek in southwestern Tehama County (see Figure 4-7). Water would be released from the reservoir to lower Stony Creek via Black Butte Reservoir. The proposed reservoir would range from 1.4 to 1.9 million acre-feet in storage capacity.

The Glenn Reservoir Plan proposed a much larger reservoir that would result from a dam in the same location as the proposed Newville Dam, though the structure would be approximately 30 feet higher. Rancheria Dam would be constructed on Stony Creek near the Grindstone Rancheria Indian Reservation. The water blocked by the two dams would converge to form a single reservoir that would be called Glenn Reservoir (see Figure 4-8). The potential capacity of the reservoir would be approximately 10 million acre-feet (DWR, 1980).

The capability of the two projects to generate hydroelectric power was not evaluated in any detail. Depending upon which alternative (or combination of alternatives) would actually be built, generating capacity could range from 20 to 90 MW. Both of the projects were feasible from an

engineering standpoint. No environmental analysis was performed, however, and the cost per acre-foot of water exceeded acceptable levels at that time. The project has been indefinitely "shelved," though DWR still considers the project likely sometime in the future (Gentry, 1991).

PERMIT AUTHORITY

Hydroelectric facility permitting is administered by local land use authorities except where pre-empted by federal laws and regulations. However, certain aspects of hydroelectric projects will likely require approvals from one or more of the following state and federal agencies. The Federal Energy Regulatory Commission (FERC) has final approval over all hydroelectric facilities.

State Water Resources Control Board

The State Water Resources Control Board (SWRCB) is charged with administering California's water quality and water rights programs. The SWRCB oversees assignment of water rights among competing interests. Many uses of water require a permit from the SWRCB.

California water law predates the gold rush in its origin, taking from accepted English common law. Under this system, water rights accrued to the owner of the land adjacent to the water course. During the gold rush however, a different concept of water rights evolved. Miners believed that an "appropriative" right to water could be claimed by anyone who diverted water for some use. Within a year of becoming a state in 1850, the state legislature recognized the legality of both riparian and appropriative rights. These two main types of surface water rights still exist within the state today.

Riparian rights generally come with ownership of land adjacent to a stream, lake, or pond and have a higher priority than appropriative rights. Land owners can use riparian water for beneficial purposes on riparian land without filing for a permit with one exception; should a riparian land owner wish to divert water for storage and subsequent use during a later season, a water right permit is required.

An appropriative right provides the exclusive authority to use a specified amount of water for a specific use, at a specific location, for a specified time period. Anyone may file for an appropriative right. Appropriative rights are chronologically prioritized; that is, for two identical applications filed an hour apart, the first application filed has precedence over the latter. An appropriative right may also be lost or forfeited by lack of use or abandonment.

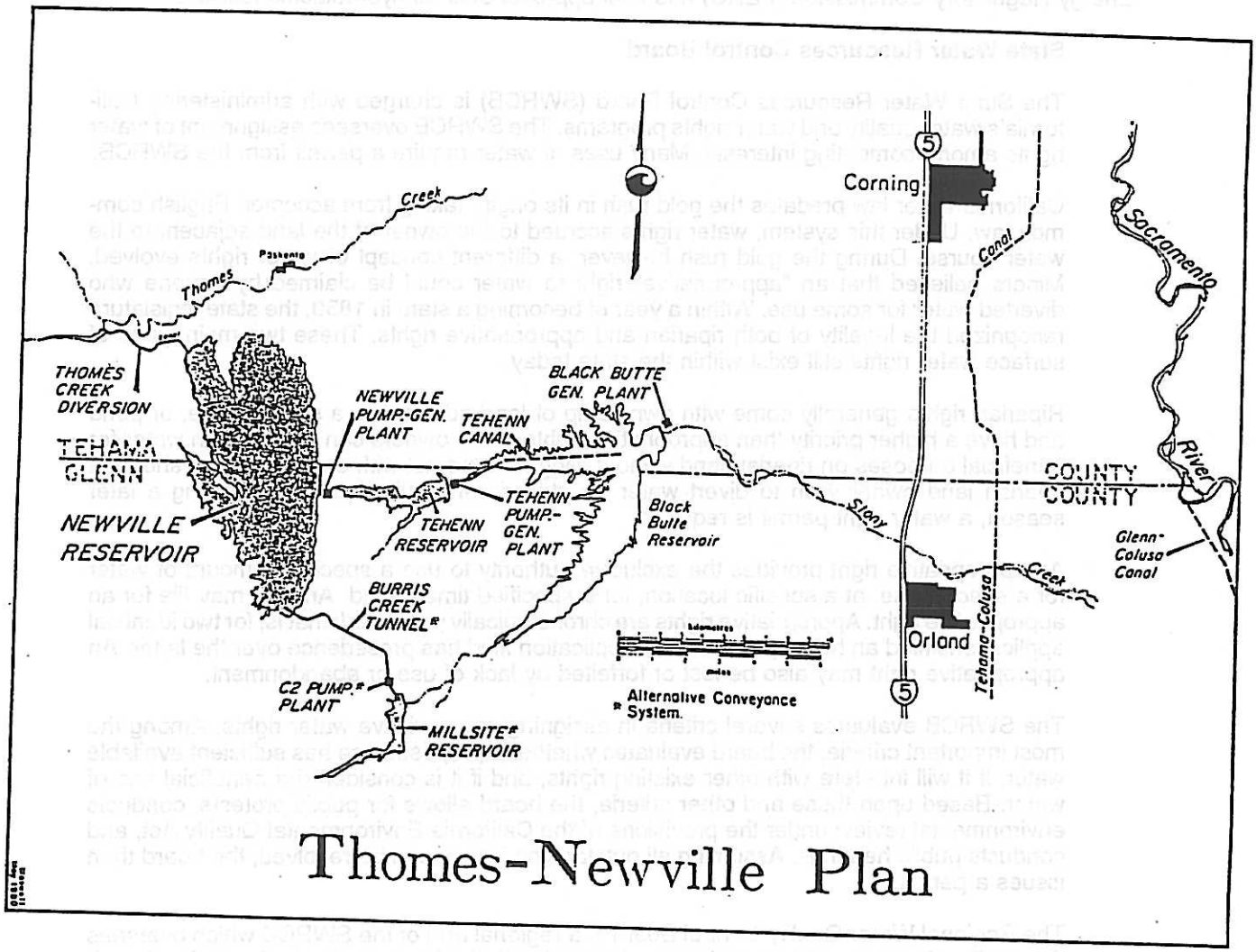
The SWRCB evaluates several criteria in assigning appropriative water rights. Among the most important criteria, the board evaluates whether a proposed use has sufficient available water, if it will interfere with other existing rights, and if it is considered a beneficial use of water. Based upon these and other criteria, the board allows for public protests, conducts environmental review under the provisions of the California Environmental Quality Act, and conducts public hearings. Assuming all outstanding issues can be resolved, the board then issues a permit.

The Regional Water Quality Control Board is a regional arm of the SWRCB which oversees the quality of surface and ground water. Any action that adversely affects the purity of such water falls under the RWQCB's jurisdiction. For example, an industry that discharges effluent into a stream will be required to meet the RWQCB's Waste Discharge Requirements and may be required to secure a National Pollutant Discharge Elimination permit.

Department of Water Resources

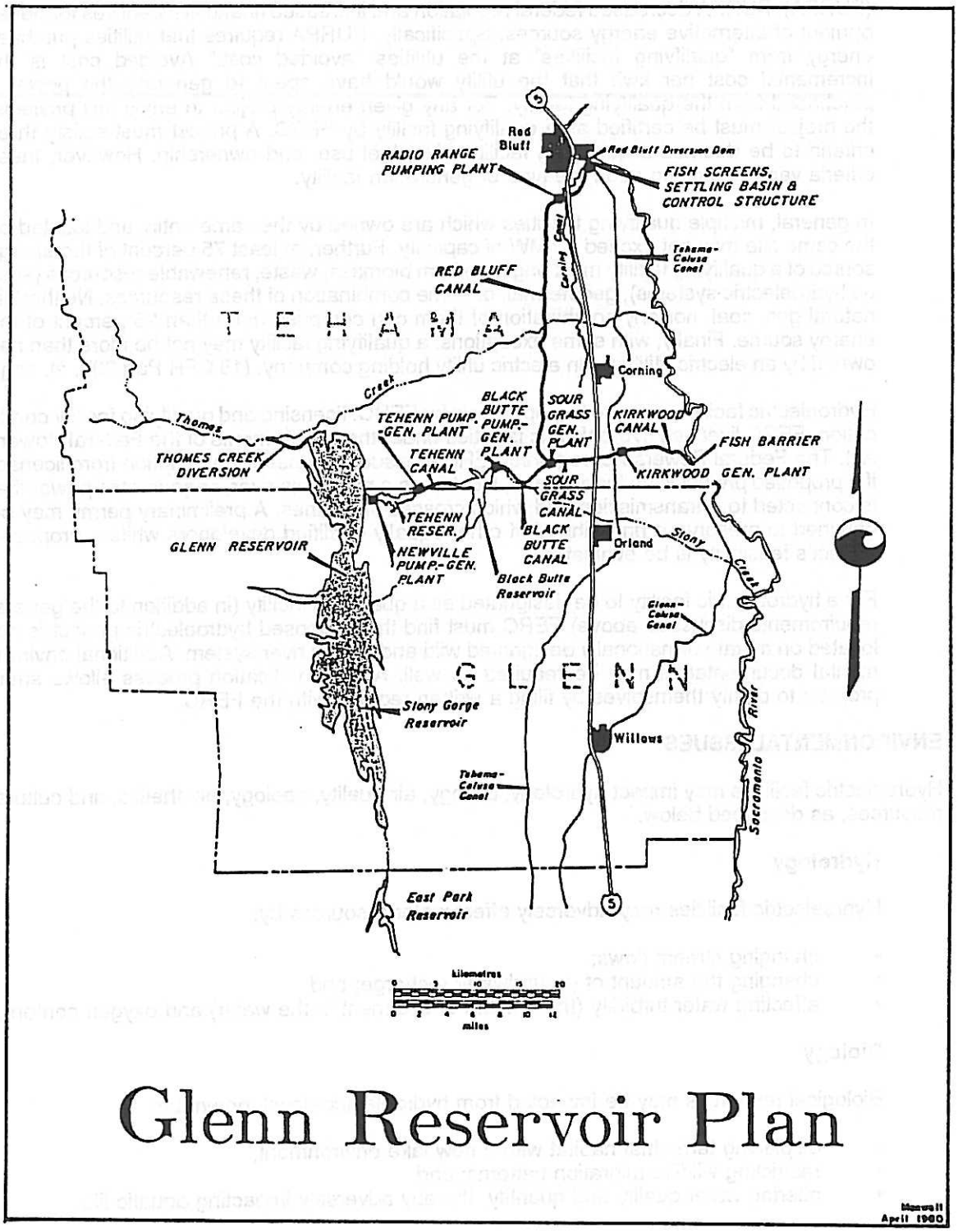
The California Department of Water Resource (DWR) regulates the development of state water. Any proposed use of water will likely require DWR's review to assure that there is no impact on the state water system. Additionally, DWR's Division of Dam Safety oversees and approves construction of dams and reservoirs for holding water. Thus, any hydroelectric project involving a dam will require DWR approval.

Figure 4-7: Thomes-Newville Plan
Glenn County



Source: California State Department of Water Resources, *Thomes-Newville and Glenn Reservoir Plans Engineering Feasibility*, 1980.

Figure 4-8: Glenn Reservoir Plan
Glenn County



Source: California State Department of Water Resources, *Thomes-Newville and Glenn Reservoir Plans Engineering Feasibility*, 1980.

Federal Energy Regulatory Commission

The Federal Energy Regulatory Commission (FERC) is one of the federal agencies charged with implementing the provisions of the Public Utilities Regulatory Policies Act of 1978 (PURPA). PURPA decreased federal regulation and increased financial incentives for development of alternative energy sources. Specifically, PURPA requires that utilities purchase energy from "qualifying facilities" at the utilities "avoided cost." Avoided cost is the incremental cost per kwh that the utility would have spent to generate the power it purchased from the qualifying facility. For any given energy project to enjoy this privilege, the project must be certified as a qualifying facility by FERC. A project must satisfy three criteria to be deemed a qualifying facility: size, fuel use, and ownership. However, these criteria vary depending upon the type of generation facility.

In general, multiple qualifying facilities which are owned by the same entity and located on the same site may not exceed 80 MW of capacity. Further, at least 75 percent of the energy source of a qualifying facility must originate from biomass, waste, renewable resources (such as hydroelectric systems), geothermal, or some combination of these resources. Neither oil, natural gas, coal, nor any combination of them can comprise more than 25 percent of the energy source. Finally, with some exceptions, a qualifying facility may not be more than half owned by an electric utility or an electric utility holding company. (18 CFR Part 292, et. seq.)

Hydroelectric facilities require two approvals by FERC: licensing and qualifying facility certification. FERC licenses hydroelectric facilities under the requirements of the Federal Powers Act. The Federal Powers Act requires FERC to issue a license (or exemption from license) if a proposed project is on federal land, located on a navigable river, or generates power that is connected to a transmission grid which crosses state lines. A preliminary permit may be obtained to preserve a right ahead of other equally qualified developers while a proposed project's feasibility is be evaluated.

For a hydroelectric facility to be designated as a qualifying facility (in addition to the general requirements discussed above) FERC must find that proposed hydroelectric project is not located on a state or nationally designated wild and scenic river system. Additional environmental documentation may be required as well. A self-certification process allows small projects to certify themselves by filing a written request with the FERC.

ENVIRONMENTAL ISSUES

Hydroelectric facilities may impact hydrology, biology, air quality, geology, aesthetics, and cultural resources, as described below.

Hydrology

Hydroelectric facilities may adversely affect water resources by:

- changing stream flows;
- changing the amount of groundwater recharge; and
- affecting water turbidity (the amount of sediment in the water) and oxygen content.

Biology

Biological resources may be impacted from hydroelectric development by:

- displacing terrestrial habitat with a new lake environment;
- restricting wildlife migration patterns; and
- altering water quality and quantity, thereby adversely impacting aquatic life.

Geology

Geologic features may be impacted by hydroelectric facility development and such facilities may be constrained by geology as follows:

- increasing erosion potential during construction;
- creating exposure to earthquake hazards; and
- creating landslide potential.

Aesthetics

Hydroelectric facilities may adversely impact aesthetics by being located on steep, visible slopes to take advantage of hydrostatic head and converting a free flowing natural stream landscape to an industrial-looking facility.

Cultural Resources

Hydroelectric projects may impact cultural resources by reservoirs inundating cultural sites and disturbing or destroying archaeological sites during construction.

LAND USE ISSUES

Dams used to create reservoirs present the possibility of hazards to downstream land uses in the event of dam failure, though such occurrences are extremely rare. Construction and continuing safety inspections required by the State Division of Dam Safety prevent almost all dam failures. While it may be impractical to avoid locating such facilities upstream from major population centers, care should be given to the siting of community emergency response facilities (hospitals, potential emergency shelter sites, control centers, etc.) downstream from reservoirs.

Dams constructed along free-flowing rivers or streams may conflict with recreational uses of the waterway, including certain types of fishing. Conversely, reservoirs can often create new recreational opportunities such as swimming, boating, and fishing. Restricted access near generating facilities can help mitigate any potential conflicts between the facility operation and recreation users.

STANDARDS

4.5.1 The County shall request that the FERC base its permitting decisions on the following findings (in addition to state requirements). The objective of the standard is to mitigate possible environmental and public service impacts associated with hydroelectric facility construction and operation. *This standard implements Policy 4.5.a.*

General Performance Standards

a. Hydroelectric facility development shall be subject to the performance standards specified in Standard 4.1.3.

b. The proposed facility shall have an efficiency rating of at least 85 percent in high load periods and at least 50 percent during part load periods (half of full load).

c. All major earthwork associated with construction shall be scheduled during the summer dry season.

Review by Other Agencies or Authorities

d. Approval shall not be granted until the Regional Water Quality Control Board and Department of Fish and Game have reviewed the streamflow requirement, and conditions have been placed on the proposed facility to mitigate any adverse effects on fish and wildlife or their habitats.

Performance Standards for Site Design

e. Water shall not be diverted from a stream that provides habitat for listed or candidate species of threatened or endangered status, nor is the stream an important spawning stream or other fishery resource.

f. The turbine intakes of the proposed facility shall be designed to prevent fish loss.

Performance Standards for Site Location

g. The proposed hydroelectric facility shall not result in significant adverse impacts to the riparian vegetation along the project waterways.

h. Regional recreation opportunities (swimming, boating, fishing) shall not be adversely affected by the proposed facility or such impacts have been adequately mitigated.

Implementation

Lead agencies: Planning Department, Federal Energy Regulatory Commission.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors, California Department of Fish and Game, California Division of Dam Safety, Bureau of Land Management, Forest Service, State Water Resources Control Board, Regional Water Quality Control Board, Department of Water Resources, Army Corps of Engineers.

Funding: General fund, development fees.

Time frame: The Zoning Code shall be amended to include the standards necessary for permitting a hydroelectric facility within four years after adoption of the Energy Element.

4.5.2 In-stream flow studies that use techniques acceptable to the California Department of Fish and Game, or techniques similar the U.S. Fish and Wildlife Service's *In-stream Flow Incremental Methodology* shall be used to determine appropriate water releases to sustain existing fish populations downstream of any proposed hydroelectric facility. Post construction monitoring shall be conducted periodically (in consultation with the Department of Fish and Game) to determine the effectiveness of the established water releases in protecting downstream fish populations. Modifications in dam operations will be made as determined necessary to sustain the target fish populations. *This standard implements policy 4.5.b.*

Implementation

Lead agency: Facility operator.

Coordinating agencies: California Department of Fish and Game, Resource Conservation District.

Funding: Facility Owner.

Time frame: As a condition of approval, the facility operator shall supply reports to the Resource Conservation District each spring and fall. If the facility fails to provide the appropriate levels for longer than six months (two consecutive monitoring checks), then a substantial fine shall be levied against the facility by the Department of Fish and Game on a weekly basis until the facility complies with the established standards. The exact dates shall be based on the production and life cycles of native fish populations. The condition of approval shall specify standards for "appropriate (oxygen) levels" and "substantial fine."

4.5.3 The developer of the facility shall fund a contingency plan to mitigate the adverse effects of drought or excessive rain. This plan shall be included as part of the conditional use permit and shall be enforced by the Planning Department. The objective is to have a contingency plan ready for implementation when necessary. *This standard implements policy 4.5.c.*

Implementation

Lead agency: Planning Department

Coordinating agencies: Resource Conservation District, Technical Advisory Committee, Planning Commission, Board of Supervisors, California Department of Fish and Game, State Water Resources Control Board, Regional Water Quality Control Board.

Funding: Development fees.

Time frame: The Zoning Code shall be amended to include this condition of approval within four years after the adoption of the Energy Element.

4.6 WIND ENERGY CONVERSION SYSTEMS

POLICIES

It shall be the policy of Glenn County to:

a. Allow (with minimal administrative review) single wind turbines for private use.

b. Permit facilities which harness wind resources when the environmental impacts of such a facility on wildlife are minimal and the use is compatible with adjoining uses.

c. Mitigate any and all interference with broadcast signals associated with wind energy conversion systems.

d. Monitor avian and other wildlife injuries and deaths that result from wind turbines.

The sun is actually the source of wind energy. Different surfaces of the earth (land and water) absorb differing amounts of solar radiation. The different absorption rates create differing ambient air temperatures over various surfaces. Because warm air is more buoyant and tends to rise, air pressure differences are created. Wind is the cooler air moving in to replace rising warmer air.

Moving air, or wind, contains kinetic energy that can be converted to electrical energy. As with water, the kinetic energy of wind has been harnessed for centuries. Perhaps the best known of the early uses are the windmills used to drive water well pumps in agricultural areas throughout the world. Modern wind powered electrical generators work in much the same way as their predecessors; instead of pumping water from the ground, today's windmills are connected to generators that produce electricity. Such facilities are commonly called wind energy conversion systems. Such systems operate by the action of wind turning rotors which can be mounted about a vertical or horizontal axis. The rotor is generally comprised of two or three blades mounted on a tower. The rotor in turn is connected to an electrical generator.

Commercial sized wind generation systems range from 17 KW up to 4 MW in capacity. Large scale facilities often group many of these systems together. Smaller scale systems are also available for home or farm use. A 17 KW generator can provide enough energy to supply several homes or a farm with electricity. In remote locations with no backup electrical supply, battery storage is necessary to provide power during windless periods. Attempting to match peak electrical demands to peak wind periods by planning for high electricity use periods to coincide with times of high wind can help alleviate this problem.

In California in general, and Glenn County in particular, prevailing wind patterns tend to be dominated by the Pacific Ocean. The ocean's cool temperature relative to warmer inland temperatures can create significant air pressure differences. As warm inland air tends to rise, cool air from above the ocean moves in to the vacated area. This phenomenon creates strong on-shore breezes.

Interestingly, coastal mountain ranges can act as a funnel for winds. As winds tend toward shore, the mountains force the air upward. But as the wind rises, it can be trapped by higher layers of warmer air, called inversion layers. With an inversion layer acting as a ceiling, and the mountain ranges creating a floor, winds are forced through mountain passes as they follow the path of least

resistance. After the wind moves through the constriction of a mountain pass, it encounters less resistance and hence tends to pick up more speed. This notion explains why winds are often strongest on the side of a mountain range away from the direction of the wind.

FACILITY SITING NEEDS

As a means of generating electricity, wind energy conversion systems are only effective in areas of strong, frequent, and consistent winds. A minimum average annual wind speed of 10 to 12 miles per hour is required; an average greater than 14 miles per hour necessary for a site to be considered potentially excellent by the CEC. Examples of prime locations within California include the Carquinez Straights and Altamont Pass near San Francisco Bay, Tehachipi Pass and San Gorgonio Pass in the southeastern deserts, and the Warner Mountains in northeastern California.

A commercial-scale facility would require large areas of open and exposed land that have average annual wind speeds exceeding 11 miles per hour. Because wind turbines can cause noise and interfere with broadcast signals, wind farms should be located away from homes, airports, air flight corridors, and noise-sensitive uses. Small wind energy conversion systems may be feasible in the foothill and mountain areas of the western county for agricultural operations or remote residential uses that do not require the amount of power generated by a commercial operation.

It should be noted that significant advances have been (and are still being) made in turbine efficiency. Newer turbines, such as those produced by U.S. Wind Power, function efficiently at average wind speeds lower than 11 mph (Stroud, 1992). As technology progresses, development of wind systems may be increasingly viable in Glenn County.

EXISTING AND PLANNED WIND ENERGY FACILITIES

As of July 1988, 112 operational wind powered electrical generating facilities existed in California. These facilities represent a total of 1,451 MW of generating capacity. Additionally, 57 facilities with combined capacity of nearly 2,000 MW were proposed at that time.

Although no major wind generation facilities currently exist within Glenn County, some small windmills are still employed in the outlying areas of the county to pump well water for agricultural uses. No large scale wind energy conversion facilities are currently planned within the county. Small scale agricultural systems will likely continue to be employed.

WIND ENERGY POTENTIAL IN GLENN COUNTY

Wind generated electricity requires fairly strong average wind speeds for operations to be cost effective. Wind speeds in the range of 11 to 14 miles per hour are necessary for "good potential," while speeds above 14 miles per hour qualify a site as having "excellent" wind generation potential. Other factors affecting the viability of wind facilities include proximity to transmission lines, surface area available for construction of wind turbines, accessibility to major transportation routes, and the expected economic return from such development.

The CEC wind maps identify three potential sites within Glenn County where the mean annual wind speed might create "good" conditions for wind development. Two of these sites occur atop peaks in the coastal range in western Glenn County; on Black Butte and St. Johns Mountain. Two other sites are shared across the border with Lake County; one site is near the headwaters of Clover Creek, and the other in the extreme southwestern corner of the county near Snow Mountain. These sites are shown on Figure 4-9.

All the sites identified on the CEC wind speed map are in relatively remote portions of Glenn County, far from existing transmission and distribution lines, and the sites are relatively small. Large sites are required to allow adequate spacing of wind rotors to avoid competition for the same wind. Given the small sites and their remoteness, the prospect for developing wind generated electric facilities seems poor unless technological improvements enable development of facilities in areas with lower average wind speeds.

Small wind energy conversion systems may be feasible in the foothill and mountain areas of the western county for agricultural operations or remote residential uses that do not require the amount of power generated by a commercial operation. The viability of small systems will vary among locations based upon their exposure to prevailing winds.

PERMIT AUTHORITY

Wind energy conversion systems require no permitting beyond local zoning regulations.

ENVIRONMENTAL ISSUES

Wind energy conversion systems may adversely impact, or be constrained by, the following:

Biology

Wind systems or wind turbines may adversely impact biological resources by:

- killing birds through collisions with rotating blades;
- displacing wildlife habitat by consuming large land areas; and
- creating wind turbine noise which may drive out native species.

Aesthetics

Wind turbine may create adverse visual impacts by requiring land that is exposed to high winds—often very visible ridgelines or hilltops and by converting open space to an industrial type of land use.

Noise

Wind farms may create noise impacts; wind turbines generate noise as well as electricity.

LAND USE ISSUES

Wind energy conversion systems may create land use compatibility conflicts by creating safety problems from mechanical failure which can theoretically result in blades being thrown some distance. There is also often a perception that wind energy conversion systems decrease adjacent property values because of noise and aesthetics. For these reasons, such systems should ideally be located in remote areas away from large population concentrations or prominent ridgelines where such land use conflicts are minimized.

STANDARDS

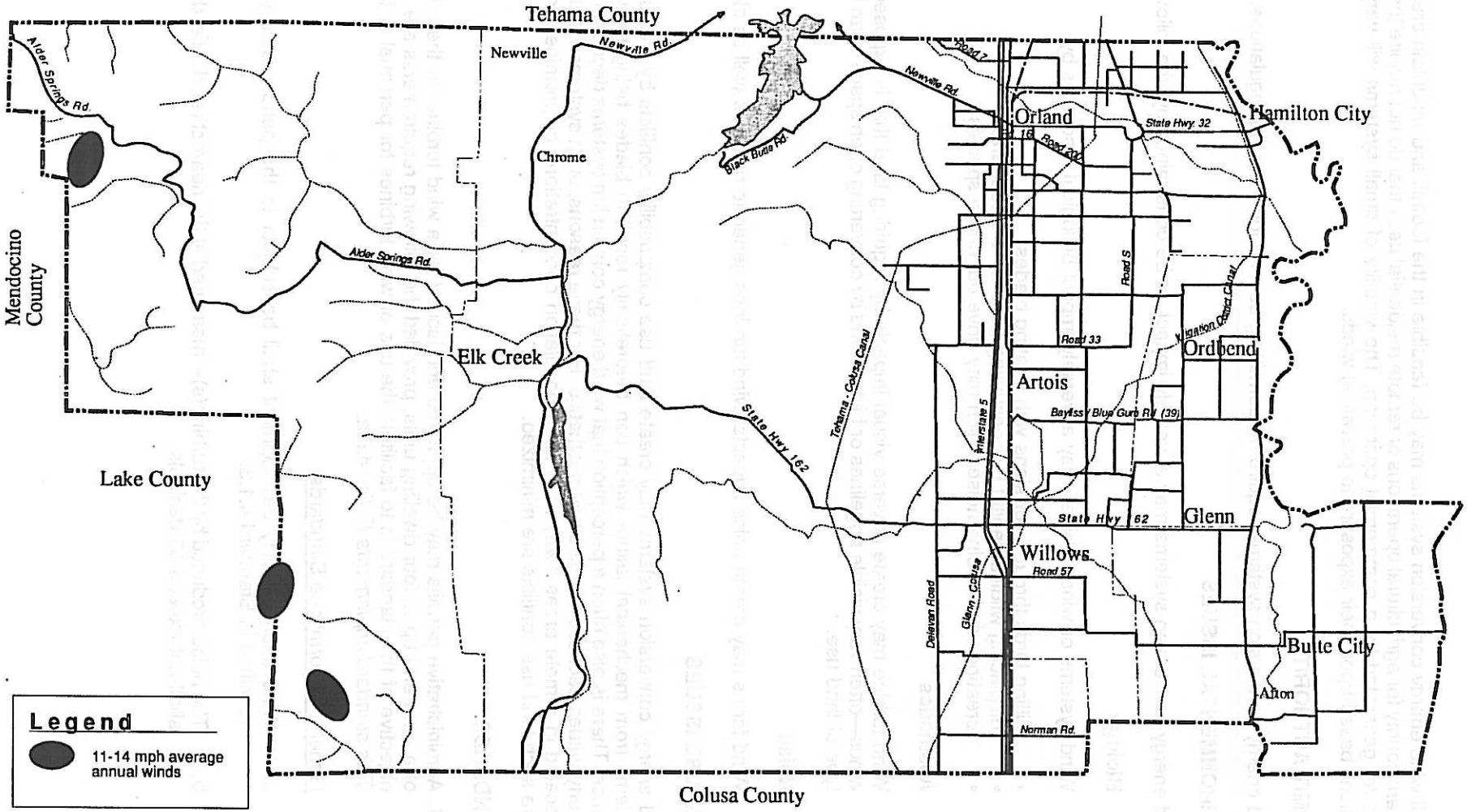
4.6.1 Administrative permits may be approved and issued for a wind turbine for the private use of a farm and up to four dwelling units, provided the following requirements are met. The objective of the standard is to facilitate the use of wind turbines for personal or farm use. *This standard implements Policy 4.6.a.*

General Performance Standards

a. Wind energy facility development shall be subject to the performance standards specified in Standard 4.1.3.

b. The noise produced by the turbine(s)—measured at the nearest residential dwelling—shall not exceed 65 decibels.

Figure 4-9: High Wind Area Locations



Source: California Energy Commission, Mean Annual Wind Speed in California - North Half, 1985.

Performance Standards for Site Design

c. Horizontal axis wind turbines shall be positioned at least two times the length of the total tower height from all nearby trees, structures, and homes.

d. Vertical axis wind facilities shall be positioned at a distance of at least ten blade diameters from any trees, structures, or homes.

e. All anchor points for any guy wires shall be located within property lines and not on or across any above-ground electric transmission or distribution line.

f. Turbines shall not exceed a density of one per 10 acres.

Performance Standards for Site Location

g. If the proposed location of the tower is within a known bird migration route, the tower shall not be operated during seasonal migration periods, and the applicant shall demonstrate a back-up system to supply electricity during those periods.

Implementation

Lead agency: Planning Department.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The Zoning Code shall be amended to incorporate this standard within four years after the adoption of the Energy Element.

4.6.2 The County may allow commercial wind energy conversion systems through conditional use permit approval subject to the following standards. The objective is to mitigate possible environmental and public service impacts associated with wind energy conversion system facility construction and operation. *This standard implements Policy 4.6.a., Policy 4.6.b., and Policy 4.8.a.*

General Performance Standards

a. Wind energy conversion system development shall be subject to the performance standards specified in Standard 4.1.3.

b. The facility shall have an efficiency rating of at least 75 percent.

c. The project shall not create electromagnetic interference that can disrupt local residents or businesses.

d. Noise produced by the turbine (measured at the nearest inhabited structure) shall not exceed 65 decibels.

Performance Standards for Site Design

e. Horizontal axis wind turbines shall be positioned at least two times the length of the total tower height from all nearby trees, structures, and homes.

f. Vertical axis wind facilities shall be positioned at a distance of at least ten blade diameters from any trees, structures, or homes.

g. All anchor points for any guy wires shall be located within property lines and not on or across any above-ground electric transmission or distribution line.

Performance Standards for Site Location

h. If the proposed location of the tower is within a known bird migration route, the tower shall not be operated during seasonal migration periods and the applicant shall demonstrate a back-up system to supply electricity during those periods.

Performance Standards for Site Reclamation

i. If the wind turbine is no longer operational or is not producing electricity, the owner shall dismantle the blades within six months. If the turbine does not operate for a continuous two year period, the site shall be reclaimed to its natural or previous state.

Implementation

Lead agency: Planning Department.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund, development fees.

Time frame: The Zoning Code shall be amended to include the findings necessary for permitting commercial wind energy systems within four years after the adoption of the Energy Element.

PROGRAMS

4.6.3 All wind energy conversion systems that receive administrative or conditional use approval shall be required to report avian and wildlife injuries and deaths that are attributable to the wind turbines. In the event of an avian injury, the operator shall immediately contact a reputable avian rehabilitation center. The species and approximate date of death shall be reported directly to the Resource Conservation District for recordation and evaluation. The Department of Fish and Game shall be consulted for species identification if necessary. The objective is to accurately record avian and wildlife deaths in order to devise a mitigation program, should one be necessary. *This program implements Policy 4.6.c.*

Implementation

Lead agency: Resource Conservation District.

Coordinating agency: Department of Fish and Game.

Funding: General fund.

Time frame: The Zoning Code shall be amended to include this program within four years after the adoption of the Energy Element.

4.7 SOLAR POWER SYSTEMS

POLICIES

It shall be the policy of Glenn County to:

a. Allow solar power systems as commercial energy enterprises where visual and environmental impacts can be minimized.

b. Permit as-of-right individual solar panels for on-site space and water heating in all residential, commercial, and industrial zones.

Ultimately, the sun is the source of all types of energy; without sunlight, no fossil fuels would have been possible, no trees or other potential would exist, and the hydrological cycle would not function as it does. However, when speaking of "solar energy technology" today, we are referring to the direct conversion of sunlight into usable energy. Sunlight can be converted to electricity, or used directly to heat water or space. The uses of active and passive solar space and water heating are also discussed under the *Residential Building* section of chapter three, *Energy Efficiency*.

PASSIVE AND ACTIVE SOLAR HEATING OF BUILDINGS

There are basically two distinct approaches to the solar heating of buildings: active and passive (Mazria, 1979). Active systems use mechanical equipment to collect and transport heat. An example of an active system is the roof plate collector system often seen on homes. These collectors can contain water or air that is pumped through the collectors and heated, then pumped to the spaces to be heated by a mechanical distribution system. A photovoltaic system for a single family residence costs approximately $20,000, though the addition of an air conditioner to the load will increase the cost significantly (Ewan, 1991).

Conversely, passive systems in buildings collect and transport heat through non-mechanical means. Essentially, the structure itself becomes part of the collection and transmission system. Certain types of building materials absorb solar energy and can transmit that energy to the spaces that are to be heated. Passive systems often employ masonry walls or walls with water pipes to store the solar heat gained during the day; this heat is then generated back into the room when the room cools in the evening.

Small solar systems for water and space heating have little impact on the environment or adjoining uses and can be permitted without special review. However, "expiration of U.S. tax credits for [solar thermal technologies] has severely limited domestic market opportunities for solar hot water systems" (CEC, 1987). The Glenn County Building Department reports very little recent residential solar technology development.

Small solar systems can also be used for pool heating. A general rule for installing solar panels to heat swimming pools is that the necessary number of panels is equal to 50 to 100 percent of the surface area of a pool (PG&E pamphlet). Although initially more expensive than conventional pool heaters, solar panels can pay for themselves in three to seven years.

Small active and passive applications of solar thermal technology for space and water heating are currently physically feasible, though their use is not widespread. This is due in part to lack of education, as well as relatively large initial costs of installation. However, concepts such as orienting homes with a southern exposure, and planting deciduous trees to provide shade in

summer and sunlight during the winter are relatively simple to implement if considered early in the design stage.

PHOTOVOLTAIC SOLAR TECHNOLOGY FOR COMMERCIAL APPLICATION

Photovoltaic solar cells absorb sunlight and convert it directly to electricity through the reaction of electrons within the cell. Sunlight reacts with chemically treated silicon cells to release electrons which create direct current (DC) voltage within the cell. The current can then be withdrawn from the cell and fed into transmission lines or stored in batteries.

The two major types of solar energy technology that generate electricity are photovoltaic and solar-thermal facilities. The chemically treated silicon in photovoltaic (PV) solar cells absorbs sunlight and converts it directly to electricity through the reaction of electrons within the cell. Electrical current can then be withdrawn from the cell and stored in batteries, and/or fed into transmission lines for sale to customers. Many PV cells can be joined together to form modules, which in turn are combined to form solar arrays.

Solar thermal technology first collects and concentrates solar energy and then converts the energy into electricity. Most commonly, concentrated solar radiation is used to heat a liquid to gas, which in turn drives a steam turbine connected to an electrical generator. Methods used to concentrate sunlight include parabolic dish mirrors, mirrors arranged in parabolic troughs, and central receiver systems or power towers.

The ability of photovoltaic solar cells to generate electricity depends upon the intensity of light; the more intense the sunlight, the greater the potential to generate electricity. Interestingly, this factor allows photovoltaic cells to generate electricity on overcast days, though in lesser quantities than on clear days. Cells can be joined together to form modules, which in turn are combined to form solar arrays. Arrays are typically connected to power conditioners (devices that convert the direct current [DC] power to the conventional alternating current [AC] that is supplied by power companies). The electricity is then transmitted over conventional transmission lines to the customer.

In the first type of solar thermal technology, groups of parabolic dish mirrors focus sunlight onto a container of oil, liquid sodium, or other material that boils at a high temperature. The heated liquid then passes through a heat exchanger to boil water, which creates steam, which drives turbines. Polymer film mirrors can be used instead of glass to reduce the cost of such structures.

Similar to parabolic dish mirrors, a parabolic trough can be used to concentrate sunlight on a pipe containing oil/sodium within a trough. Rather than focusing the rays on a point as do the parabolic dish mirrors, this technology concentrates the sunlight along a line. This heated oil/sodium is again used to create steam, which in turn drives a steam turbine.

A third type of solar thermal facility uses a central receiver tower with acres of sun-tracking mirrors are focused, to again heat liquid to steam. This type of system has the advantage of a single fluid heating and collecting line, rather than distributed collectors as with the other technologies described above. Figure 4-10 shows examples of the various mirror systems.

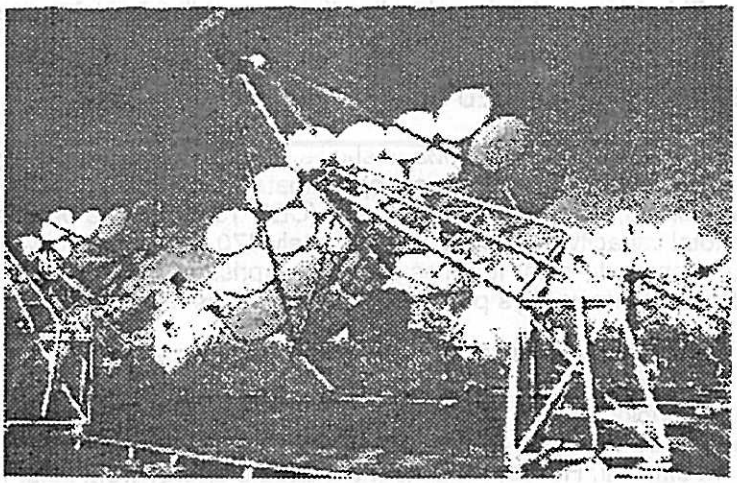
FACILITY SITING NEEDS

Commercial solar power facilities that can generate significant power output require large tracts of open, unshaded land, located in areas that receive substantial sunlight. Five to 24 acres of land is required per megawatt of electrical capacity, depending upon the type of facility proposed. Also depending on the specific type of solar technology, significant quantities of water may also be necessary—both for cooling and conversion to steam.

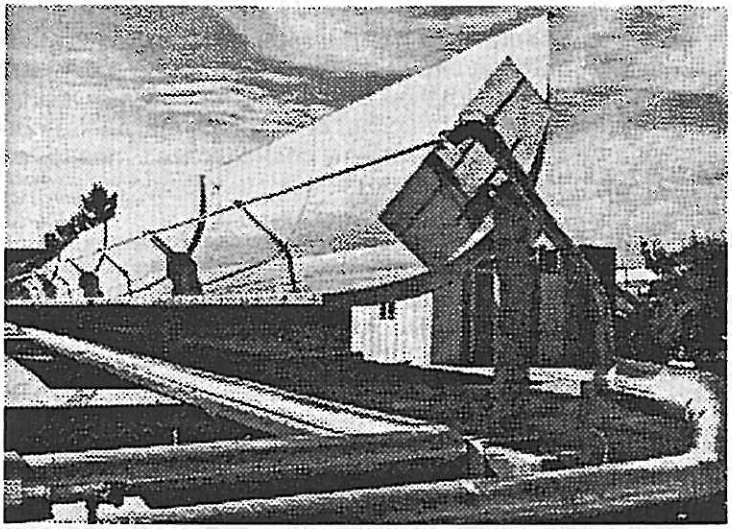
Residential applications may be most economically feasible for remote locations. The California Public Utilities Commission (CPUC) requires PG&E to examine the costs and revenues of connecting new customers. In those cases where the costs outweigh the revenues, PG&E must charge a fee established by the California Public Utilities Commission

Figure 4-10: Solar Thermal Collection Facilities

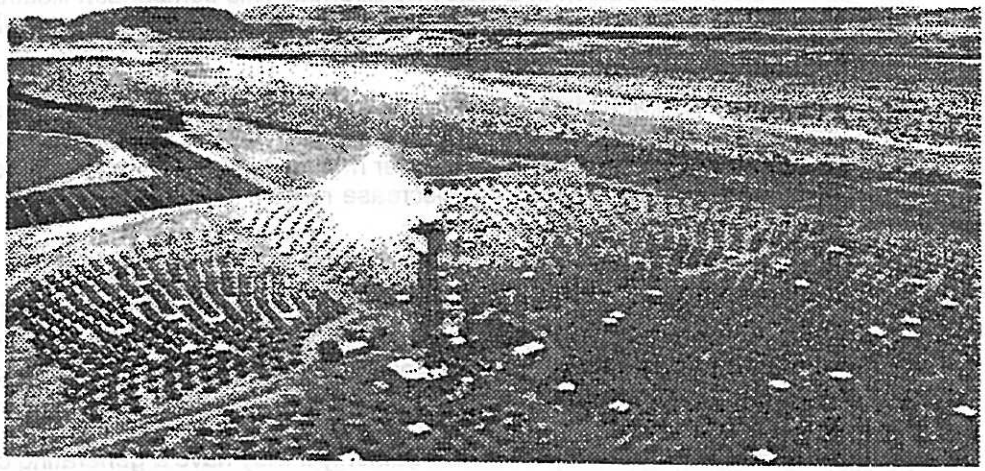
Parabolic dish mirrors



Parabolic trough



Power tower



Source: Association of Bay Area Governments, *Small But Powerful—A Review Guide to Small Alternative Energy Projects for California's Local Decision Makers*, 1987.

For residences that lie beyond 2,000 feet from the nearest transmission line connection, photovoltaic systems may be less expensive than connecting to the existing power grid. Such systems require about $2,000 worth of maintenance and battery replacement costs every five years. This cost can be thought of as the power bill (about $30 per month). Thus, the potential for photovoltaic systems for rural residential is likely limited to the more remote areas of the county.

EXISTING AND PLANNED SOLAR FACILITIES

The *California Power Plant Maps* shows that California has 19 operational solar facilities with a combined generating capacity of approximately 275 MW. Glenn County has no existing large-scale solar facilities, nor are any anticipated (CEC 1989). Three proposed solar facilities would nearly triple total capacity by adding approximately 470 MW of capacity. The majority of existing—and all of the proposed—solar facilities are, not surprisingly, located in southern California where higher incidence of sunny days provide better conditions for solar power generation.

SOLAR ENERGY POTENTIAL IN GLENN COUNTY

Solar technology is not 100 percent efficient; during the conversion of sunlight to electricity, most of the stored energy is lost outside the system. Various solar technologies range from 10 to 50 percent efficient. Hence, the amount of usable energy from solar facilities will be correspondingly smaller. Nevertheless, the potential solar energy resource in Glenn County is significant, although it is unlikely that a power company would propose a large scale solar thermal facility in Glenn County in the near future. The major issue impeding large-scale solar development everywhere (not just in Glenn County) remains the large capital costs and relative inefficiency of solar technology, which increases the cost per kilowatt-hour of electricity. However, as solar energy technology improves and the price of conventional fuels increase over time, solar energy development may become increasingly cost-effective. Thus, solar facility development should be considered possible in the long run.

The feasibility of solar power depends chiefly upon the amount of sunlight that an area receives, also known as insolation. Insolation is a measure of the amount of solar radiation applied to a horizontal surface for a given time period. One such measure is the langley, which is the equivalent of about 0.484 watts per square meter. The state Department of Water Resources tracks the amount of insolation in the state as part of the California Irrigation Management Information System (CIMIS).

Information from the CIMIS station in Orland (Table 4-4) indicates that average daily insolation within Glenn County is about 438 langleys per day. This translates to about 212 watts per square meter of potential energy. The following table summarizes and interpolates information gathered at the Orland CIMIS station between 1983 and 1990, and compares that data to information gathered at the CIMIS station in Barstow, California. This comparison illustrates the difference in potential insolation between the relatively mild climate of Glenn County and the perceived sunnier climate of the southern California desert.

Interestingly, the average daily insolation in Glenn County is not significantly less than in the southern California desert near Barstow, especially during July when Glenn County actually exceeds Barstow. However, during the winter months when Glenn County experiences periods of dense "tule fog", the insolation values decrease rapidly.

PERMIT AUTHORITY

Photovoltaic solar facilities require no special permitting from state or federal agencies; local land use authorities regulate such facilities. For large scale facilities wishing to sell power to a local utility, qualifying facility status must be obtained from the Federal Energy Regulatory Commission as discussed previously under the section on hydroelectric facility permitting.

Solar thermal facilities will fall under CEC authority if they have a generating capacity of more than 50 MW; otherwise, local governments maintain lead agency status.

Table 4-4: Average Daily Insolation in Glenn County and Barstow, CA.

Month	Average Daily Langleys (Glenn Co.)	Average watts/m^2 (Glenn Co.)	Average Daily Langleys (Barstow, CA)	Average watts/m^2 (Barstow, CA)
January	168	81	267	129
February	277	134	338	164
March	385	186	475	230
April	525	254	570	276
May	641	310	666	322
June	693	335	703	340
July	687	333	679	329
August	611	296	618	299
September	486	235	513	248
October	353	171	392	190
November	207	100	291	141
December	220	106	237	115
AVERAGE	438	212	479	232

Source: State Department of Water Resources, *CIMIS Weather Data*, May 1991.

ENVIRONMENTAL ISSUES

Small scale solar applications may create visual impacts and affect land use compatibility. Large scale solar development may create visual, land use compatibility, biological and agricultural impacts. These impacts are summarized below.

Aesthetics

Solar energy facility development may impact aesthetics by placing solar collectors on rooftops, in open fields, or other visually exposed areas and creating glare from mirrors at large solar thermal facilities.

Biology

Biological resources may be impacted by solar facility development by loss of habitat and migration corridors and by creating areas in the air around the target vessel where birds can be killed by the intense heat.

LAND USE ISSUES

Adjacent land uses can interfere with solar energy systems if solar access is blocked by trees or other vegetation. Additionally, mirrors used to concentrate sunlight may create light and glare, which can cause compatibility problems when located near sensitive land uses such as residential areas or airports. Solar energy production may also create conflicts with agricultural land by consuming large areas of open land needed to construct a solar farm. Often the characteristics that define land as a prime candidate for solar development (e.g., large unshaded areas) coincide with those of agriculture.

STANDARDS

4.7.1 Solar energy production facilities may be granted conditional use permits subject to the following requirements. The objective is to mitigate possible environmental and public service

impacts associated with solar facility construction and operation. *This standard implements Policy 4.7.a. and 4.8.a.*

General Performance Standards

a. Solar energy facility development shall be subject to the performance standards specified in Standard 4.1.3.

b. The facility efficiency rating shall be at least 15 percent for a single crystalline system, 11 percent for a poly-crystalline system, 10 percent for a thin film system, and 25 percent for a concentrating system.

Performance Standards for Site Design

c. The proposal for the solar facility shall identify the source of sufficient quantities of water necessary to operate the facility.

d. The applicant shall furnish an analysis of the tracking system showing that no concentrated reflections are directed at occupied structures, recreation areas, or roads.

e. Because solar power systems can create high concentrations of heat and light, conditions shall be placed on the proposed facility to mitigate any adverse effects on birds, fish, and other wildlife or their habitats.

Implementation

Lead agencies: Planning Department, California Energy Commission for facilities greater than 50 MW capacity.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors, California Department of Fish and Game, State Water Resources Control Board, Regional Water Quality Control Board, Air Pollution Control District, Office of Environmental Health Hazard Assessment of the California Environmental Protection Agency.

Funding: General fund, development fees.

Time frame: The Zoning Code shall be amended to include the standards necessary for permitting a solar energy production facility within four years after the adoption of the Energy Element.

PROGRAMS

4.7.2 The Zoning Code shall be amended to allow individual solar panels for on-site space and water heating in all residential, commercial, and industrial zones. The objective is to facilitate the use of individual solar systems for home, commercial, and office use. *This program implements Policy 4.7.b.*

Implementation

Lead agency: Planning Department.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The Zoning Code shall be amended to include this program within four years after the adoption of the Energy Element.

4.8 THERMAL CONVERSION FACILITIES

POLICIES

It shall be the policy of Glenn County to:

a. Discourage the use of thermal conversion plants that rely on fossil or nuclear fuels; instead, the County shall favor solar, wind, and biomass facilities.

b. Allow fossil fuel and nuclear power plants only when alternative energy sources are not an option and where the environmental and wildlife impacts are minimized.

Thermal power facilities use heat to boil water into steam, and then use the steam to drive turbines which generate electricity. The heat is produced by burning a fossil fuel such as coal, oil, or gas.

Nuclear power plants are more complicated than their fossil fuel counterparts. Nuclear fission power is generated through the process of splitting the nuclei of atoms, which releases stored energy from within those atoms. Nuclear fusion is the process of joining, rather than splitting, such atomic particles with similar releases of energy. Nuclear fusion is presently only a theoretical possibility for controlled power generation.

The center of nuclear power generation is the reactor core. The core is comprised of many 12 foot lengths of uranium, also know as fuel rods. Control rods made of cadmium or boron are inserted into the reactor core to control the amount of energy released by the uranium. In the event of any problem in the reactor, the control rods are quickly plunged into the reactor (known as "scramming" the reactor). The control rods thus stop the reaction. Figure 4-11 illustrates this process.

The reactions taking place in the reactor core generate tremendous amounts of heat. This heat is used to convert water to steam, which in turn drives steam turbines to generate electricity.

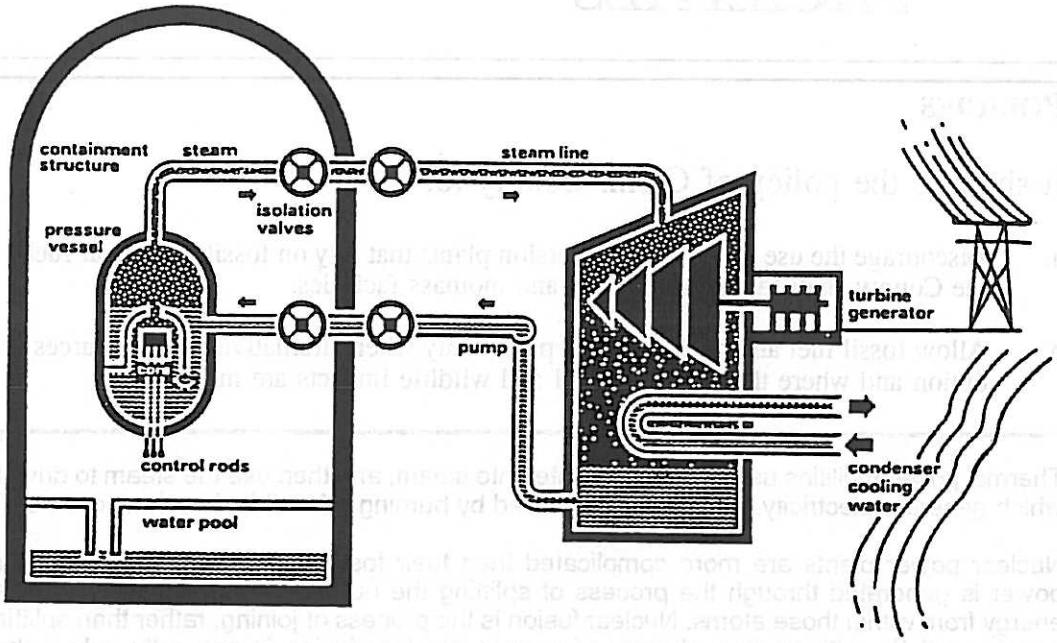
After a year of operation, approximately one-third of the reactor core must be removed as waste. This waste contains several hundred extremely radioactive components, including cesium and strontium, among others. The spent fuel rods must be cooled in large pools of water for about a year before they can be transported. Typically, such wastes are reprocessed, and then buried in remote locations. Safe, long-term storage of nuclear waste is critical because such wastes can remain dangerous for thousands of years. To date, no long-term storage facility is available and most nuclear plants store spent fuel on-site while the Nuclear Regulatory Commission (NRC) continues to work toward the construction of a national repository for such material.

FACILITY SITING NEEDS

Thermal power generation facilities depend upon access to fuel supplies and water. In the case of oil or gas-fired plants, proximity to pipelines is important. For coal-fired plants, access to railroad lines or roads capable of accommodating large trucks is necessary. Nuclear facilities generally receive their uranium fuels on trucks, thus, access to roadways is also important.

Steam generating power plants require large amounts of water; both for conversion into steam and for cooling the combustion processes. Waste disposal from thermal plant operations, including air emissions and solid residues, can present significant problems. Burning oil and coal results in significant air pollution emissions.

Figure 4-11: Nuclear Reactor Schematic



Source: Kaku and Trainer, *Nuclear Power: Both Sides*, 1982.

Natural gas burns cleaner, but still emits some pollutants. Correctly-operated nuclear facilities do not emit pollutants; however, the possibility of accidental releases of radioactive material remains a public concern. These characteristics of thermal power plants suggest that they all should be located downwind of population centers.

Combustion residues such as ash may contain unsafe levels of toxic substances and require special disposal facilities. Radioactive wastes from nuclear facilities present especially difficult disposal problems. Transporting such wastes over any distance increases the potential for accidents and radiation exposure.

EXISTING AND PLANNED STEAM GENERATION FACILITIES

No thermal power plants currently exist within Glenn County, nor are any currently planned.

STEAM GENERATED POWER POTENTIAL IN GLENN COUNTY

Glenn County has some of the necessary characteristics that would interest a utility seeking possible sites for a thermal plant. The county is relatively remote from large metropolitan areas. There is an extensive network of electrical transmission lines that traverse the county, and some of the lines currently have excess capacity. Stony Creek and the Sacramento River provide two relatively stable water sources, although it is unlikely that water rights could be secured from these two sources. These factors cumulatively satisfy some of the siting needs that might lead a utility to propose a thermal power generation facility within Glenn County.

One problem that may limit opportunities for thermal plant construction is that the county has been designated by the State Air Resources Board as non attainment for state ozone and particulate emissions, unclassified for carbon monoxide emissions, and attainment for oxides of nitrogen and sulphur dioxide. The Glenn County Air Pollution Control District is currently writing the Clean Air Plan that will include a new source review rule. Under the current draft, new sources of pollutant emissions (such as a fossil-fuel fired thermal power plant) would be required to offset all emissions in excess of 25 tons per year (Turek, 1991). Air quality would likely be the single largest constraint to thermal power development.

PERMIT AUTHORITY

Glenn County has the authority to permit fossil fuel facilities with less than 50 MW capacity. The California Energy Commission has permit authority over the larger facilities. The United State Nuclear Regulatory Commission has final permitting authority over all nuclear power plant facilities.

The California Energy Commission maintains permitting authority over thermal power plants with 50 MW or more of generating capacity, and electrical transmission lines from such a power plant to the point where the line connects with the utilities transmission system. For thermal power plants with less that 50 MW capacity, the county retains final permitting authority.

The United States Nuclear Regulatory Commission (NRC) oversees the siting and permitting of nuclear power generation facilities within the United States. The NRC maintains ultimate approval authority over such facilities. Title 10, Chapter 1, Part 100 of the Code of Federal Regulations specifies reactor site criteria that the NRC is to evaluate when considering siting a nuclear facility. The regulations state, "Where unfavorable physical characteristics of the site exist, the proposed site may nevertheless be found acceptable if the design of the facility includes appropriate and adequate compensating engineering safeguards." (10 CFR, Chapter 1, Part 100.1(d)).

Although the final authority to approve a nuclear power plant is assigned by federal law to the federal government rather than to the County, the process used by the NRC to consider nuclear power plant proposals provides for significant input from local governments. Title 10, Chapter 1, Part 100 of the Code of Federal Regulation specifies the nuclear reactor siting criteria that the NRC uses when considering a proposed nuclear facility. Additionally, the NRC has published their Regulatory Guide 4.7, Revision 1, titled, "General Site Suitability Criteria for Nuclear Power Station." The document outlines preferred site characteristics for nuclear power facilities, and covers such issues as geologic stability, atmospheric dispersion characteristics, nearby population concentrations, hydrology, biological resources, land use compatibility, aesthetics, and noise.

ENVIRONMENTAL ISSUES

Thermal power generation may cause adverse impacts to or be constrained by geology, air quality, water, biology, aesthetics, and circulation.

Geology

Geologic features may be impacted by thermal power plants because landfill space is required for ash or radioactive waste disposal. Geologic features may also be impacted by the potential for release of radioactive material or oil and gas in the event of an earthquake.

Air Quality

Thermal facilities may adversely impact air quality by:

- venting by-product emissions such as carbon dioxide, oxides of nitrogen, sulfates, and particulate matter into the atmosphere;
- creating objectionable odors; and
- increasing vehicle traffic associated with transporting fuel supplies.

Water

Thermal energy production may impact water resources by:

- using large quantities of water for cooling and conversion to steam;
- creating contaminated waste water; and
- requiring additional treatment facilities to treat contaminated waste water.

Biology

Biological resources may be adversely expose humans, wildlife, and habitat to pollution by-products and may replace wildlife habitat with industrial uses.

Aesthetics

Aesthetics may be adversely impacted by thermal facilities by:

- creating a relatively large, industrial type land use;
- employing tall stacks to vent exhaust emissions that are highly visible; and
- creating plumes of smoke or steam that are highly visible.

Circulation

Thermal power generation may create adverse circulation impacts by:

- requiring large trucks to transport fuel supplies to the thermal plant;
- impacting rural roads which cannot handle the weight of fully loaded trucks; and
- creating safety hazards from large trucks constraining traffic movement.

LAND USE ISSUES

Similar to conversion facilities, thermal power plants are generally relatively large, industrial type land uses. Such facilities may generate smoke and/or odors that can be offensive or hazardous to downwind populations. Thermal power facilities may also require the use of large trucks or other noisy equipment to move fuels and resulting waste products. For these reasons, such facilities should generally be located in areas suitable for industrial development and away from sensitive land uses such as residential, commercial, or recreational areas and sensitive wildlife habitats.

STANDARDS

4.8.1 Fossil fuel powered steam conversion facilities may be granted conditional use permits subject to the following requirements. The objective is to mitigate possible environmental and public service impacts associated with thermal conversion facility construction and operation. *This standard implements Policy 4.8.b.*

General Performance Standards

a. Fossil fuel facility development shall be subject to the performance standards specified in Standard 4.1.3.

b. The project application shall include an analysis of the expected efficiency rating of the facility, and that rating shall be at least 30 percent for steam and oil boilers and at least 51 percent for a combined cycle gas turbine.

c. The project application shall identify the quantity of and type of wastes expected to be generated by the thermal conversion facility, and shall include a preliminary agreement with a suitable disposal site to accept the wastes.

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

Performance Standards for Site Design

e. The application shall identify sources of fuel and water sufficient to operate the facility.

Performance Standards for Site Location

f. An oil or gas thermal conversion facility shall be located near pipelines of sufficient size and volume to supply the facility.

g. A coal-fired plant shall be located near railways or roadways that can handle the necessary size and frequency of trains or trucks needed to transport coal and wastes without diminishing the level of service below the acceptable level as stated in the Transportation component of the Community Development Element.

Implementation

Lead agencies: Planning Department, California Energy Commission for facilities larger than 50 MW in capacity.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors, Air Pollution Control District, Regional Water Quality Control Board.

Funding: General fund, development fees.

Time frame: The Zoning Code shall be amended to include the standards necessary for permitting a thermal conversion facility powered by fossil fuels within four years after the adoption of the Energy Element.

4.8.2 In the event that any nuclear power plant is proposed within Glenn County, the County shall ask the Nuclear Regulatory Commission only grant approval subject to the following findings, in addition to any findings required by federal law. The objective is to mitigate possible environmental and public service impacts associated with nuclear fission facility construction and operation. *This standard implements Policy 4.8.b.*

General Performance Standards

a. Nuclear facility development shall be subject to the performance standards specified in Standard 4.1.3.

b. The proposal includes an evaluation of the criteria specified by the NRC in Title 10, Chapter 1, Part 100 and Regulatory Guide 4.7.

c. The proposal includes an analysis of the expected efficiency rating of the facility and that rating is at least 30 percent.

d. The applicant has submitted an emergency evacuation plan that adequately protects Glenn County and adjacent county residents.

e. The proposal includes a preliminary agreement with a nuclear waste disposal site to accept the wastes.

f. The airborne emissions from the proposed facility will not degrade the air quality beyond the current air quality conditions.

Performance Standards for Site Design

g. The proposal for the nuclear facility identifies the source of sufficient quantities of water necessary to operate the facility.

Performance Standards for Site Location

h. The facility is located near railways or roadways that can handle the necessary size and frequency of trains or trucks needed to safely transport fuel and wastes without diminishing the level of service below the acceptable level as stated in the Traffic Circulation Element.

Implementation

Lead agencies: Planning Department, California Energy Commission, Nuclear Regulatory Commission.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors, Regional Water Quality Control Board, Air Pollution Control District.

Funding: General fund, development fees.

Time frame: The County shall submit a request to the NRC to establish this standard within two years after the adoption of the Energy Element.

4.8.3 The Planning Department and the applicant shall consult the Glenn County Air Pollution Control District for preliminary review of the facility and possible air emissions within 30 days of the receipt of the application. The purpose of the meeting will be to discuss additional material that will be needed to adequately evaluate the proposal. The application shall not be deemed complete until all additional materials are submitted. As required by law, the applicant must also submit an application to the Air Pollution Control District. *This implements Policy 4.8.b.*

Implementation

Lead agency: Planning Department.

Coordinating agency: Air Pollution Control District.

Funding: Development fees.

Time frame: The Zoning Code shall be amended to include this standard within four years after the adoption of the Energy Element.

4.9 GAS AND OIL PIPELINES

POLICIES

It shall be the policy of Glenn County to:

a. Enter into a pipeline franchise agreement that permits subsurface gas and oil pipelines below ground and that meets specific design and siting standards.

b. Request the California Public Utilities Commission to establish review standards similar to those identified in policy a.

Pipelines transport crude oil, refined oil, and natural gas from its place of origin to the site of use. Typically constructed of steel, oil and gas pipelines provide an alternative to trucks for transporting oil and gas. Because this method minimizes the potential for human error inherent in vehicular operation that could result in transported product entering the environment, pipelines are often the preferred method of petroleum transport. Pipelines can be routed above ground or buried. The pipelines and transmission lines traversing Glenn County are shown in Figure 4-12.

FACILITY SITING NEEDS

Pipelines require right-of-way easements to pass through public and private lands. The shortest distance between the origin and destination of the commodity being transported is generally a straight line. However, the potential for soil and water contamination in the event of a spill may constrain straight-line pipeline routing.

EXISTING AND PLANNED PIPELINES

PG&E purchases gas directly from producers; once the gas is metered, it becomes the property of Pacific Gas and Electric. Because PG&E maintains its gas pipelines under boundaries that do not coincide with the county, the mileage of gas distribution lines within the county is unknown.

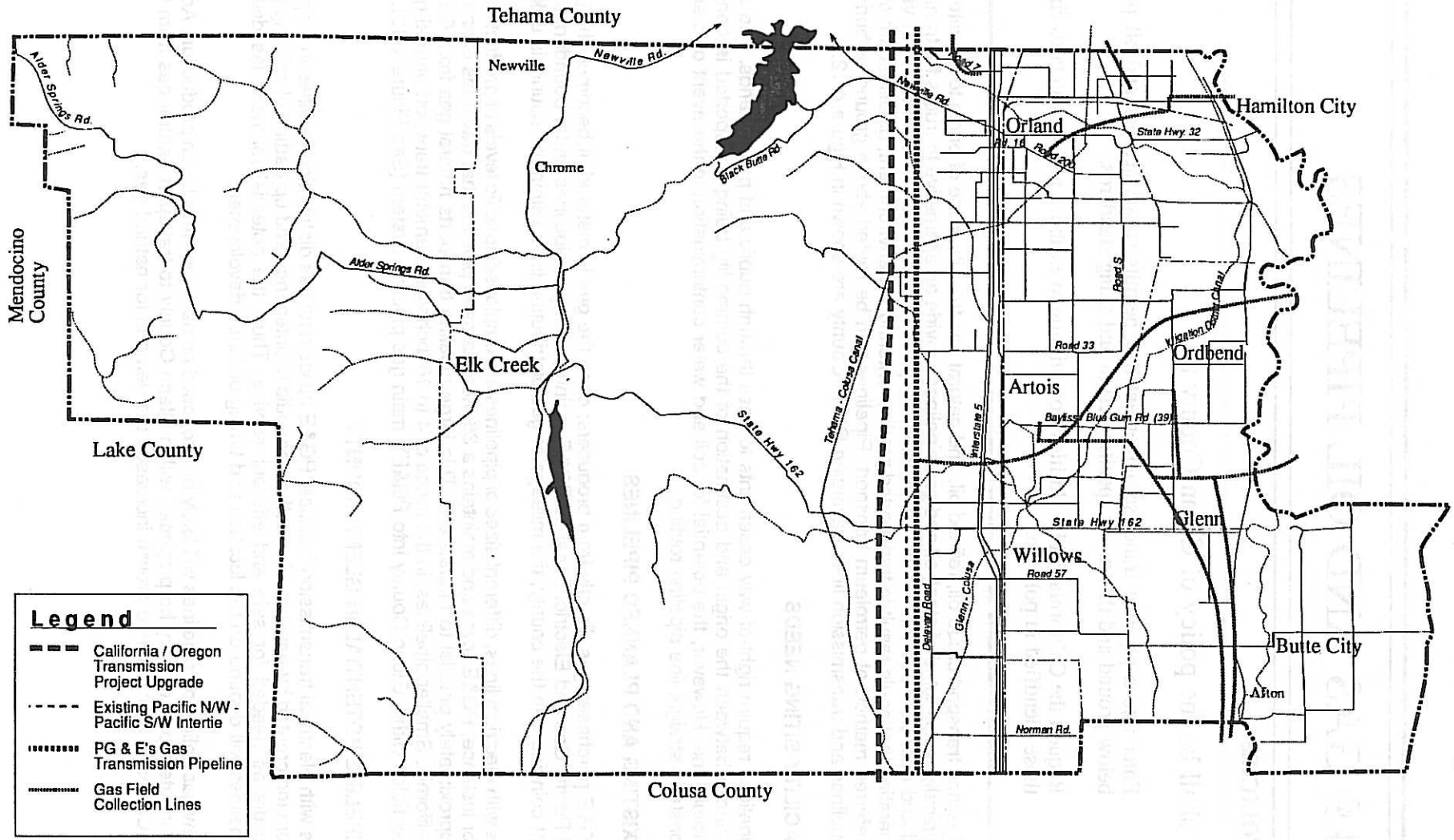
As with electrical lines, different sizes of pipelines are employed specific levels of product transport. For instance, PG&E owns and maintains a 36-inch diameter pipeline that traverses Glenn County approximately parallel to Interstate 5. This large pipeline transports natural gas from Canada to California. Smaller pipelines, in the range of 4 to 16 inches in diameter transport natural gas from gas fields within Glenn County into PG&E's main gas pipeline system (See Figure 4-12).

PIPELINE POTENTIAL IN GLENN COUNTY

As with electrical transmission facilities, PG&E builds new gas distribution facilities in response to demand created by new growth. Further, periodic maintenance and upgrading of existing facilities occurs as needed for safe and efficient service. Thus, the potential for new gas distribution pipelines will depend on the location and timing of future development.

New gas collection pipelines will likely be proposed as new gas wells begin production. Additional interstate pipelines may be proposed within Glenn County to transport natural gas from Canada to California as continued growth increases the demand for natural gas.

Figure 4-12: Pipelines and Transmission Lines



Source: California Department of Conservation, Division of Oil & Gas, Maps S-Z, 1982. California - Oregon Transmission Project EIR / EIS, 1986.

PERMIT AUTHORITY

The County reserves the authority to regulate pipelines constructed by independent producers through a pipeline franchise agreement. All pipelines proposed by investor-owned, public utilities (such as PG&E) are subject to the rules and tariffs of the California Public Utilities Commission.

Oil and gas pipelines are regulated and supervised by the California Public Utilities Commission under the provisions of the Public Utilities Code (CPUC Sec. 701, et. seq.) Similar to electrical transmission facilities, the CPUC must make findings of public need and convenience to allow construction and operation of oil and gas pipelines. The CPUC will consult with local agencies regarding land use issues, but final permitting authority rests with the CPUC.

In 1989, the CPUC decided that the cost and risk of providing gas collection lines should be borne by the gas producers rather than PG&E customers. As a result, PG&E recently discontinued laying gas collection pipelines to individual gas wells. In response, Glenn County created a franchise program that provides gas producers with easements to lay pipelines within County rights-of-way to connect to PG&E's distribution system. In effect, gas transporters pay the County an annual fee (dependent upon the size of the pipeline) for the ability to route pipelines within County owned rights-of-way (Holvik, 1991).

ENVIRONMENTAL ISSUES

Oil and gas pipelines may create adverse impacts, or be constrained by, the following features:

Geology

Geological features may be impacted by oil and gas pipelines through spills, leaks, or other discharges from pipelines that can contaminate the soil (though in the case of a natural gas pipeline leak, because such gas is less dense than air, it would typically vent to the atmosphere with no resultant soil pollution).

Water Resources

Water resources may be adversely impacted by pipeline leaks that contaminate surface or groundwater resources.

Biology

Biological resources may be adversely impacted by pipelines by:

- displacing wildlife habitat and endangered species;
- creating barriers to wildlife migration; and
- contaminating habitat in the event of a spill.

Aesthetics

Pipelines may adversely impact aesthetics by changing a rural landscape to an industrial type land use.

Circulation

Pipelines may adversely impact circulation by hampering movement of automobile and agricultural vehicles. It should be noted that many of these potential impacts can be avoided by laying pipelines underground. PG&E currently lays all of their natural gas distribution pipelines underground, and gas producers lay their collection lines within the County rights-of-way under the County's franchise program.

LAND USE ISSUES

Oil and gas pipelines can create land use conflicts during construction by disrupting existing surface features, land uses, and roadways. The risk of spills and other accidents, as well as needs for occasional maintenance, can cause continuing disruption or potential for hazards for surface land uses. Above-ground pipelines and related pumping and storage facilities may create a sense of industrial development contrary to the prevailing character of the area. Such facilities may also hinder movement of agricultural machinery.

Proposed pipeline routes should avoid residential, commercial, and recreational areas wherever possible. Necessary surface facilities should be screened from the view of adjoining properties.

STANDARDS

4.9.1 Gas and oil pipelines proposed by independent investors may be granted conditional use permits in Glenn County subject to the following requirements. In the case of investor-owned utilities, the County shall request that the CPUC consider these items. The objective is to mitigate possible environmental and public service impacts associated with pipelines and pipeline construction. *This standard implements Policy 4.9.a. and 4.9.b.*

General Performance Standards

a. Gas oil and pipeline facility development shall be subject to the performance standards specified in Standard 4.1.3, except where preempted by state or federal laws and regulations.

Review by Other Agencies or Authorities

b. All pipeline design, construction, testing, and maintenance work performed within the franchise property shall be done in accordance with the latest edition of the Public Utilities Commission General Order No. 112-D, "Rules Governing Design, Construction, Testing, Maintenance, and Operation of Utility Gas Gathering, Transmission and Distribution Piping Systems." The franchise holder shall continue to maintain, operate, and repair pipelines on a regular basis.

Performance Standards for Site Design

c. If it is necessary to lay pipe across or under any portion of the pavement, the Public Works Director shall review all such plans. Pipeline franchise agreement applicants shall be required to lay all pipelines through a tunnel or bore unless the Public Works Director states otherwise.

d. Pipeline construction shall be underground. When circumstances require that the pipeline be above-ground, e.g. bridges, meters, valves, the facility shall be screened or camouflaged from public view as best possible.

e. Trenches for petroleum gas and oil pipelines shall be lined with impervious material to minimize the risk of soil contamination from a pipeline leak or spill. Because natural gas is lighter than air and will not contaminate the soil in the event of a leak, natural gas trenches do not require an impervious lining.

Implementation

Lead agency: Planning Department, California Public Utilities Commission.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors, Resource Conservation District, California Department of Fish and Game, Forest Service, Bureau of Land Management, State Water Resources Control Board, Regional Water Quality Control Board.

Funding: General fund, development fees, annual franchise fee.

Time frame: The Zoning Code shall be amended to include the standards necessary for a Pipeline Franchise Agreement within four years after the adoption of the Energy Element.

4.9.2 The requirements for submittal of a Pipeline Franchise Agreement shall include an evaluation of the impacts to surface or ground water if a leak or spill should occur along the route of the pipeline. If the County deems these impacts to be significant, the franchise agreement shall include an emergency action plan in the event of such a leak or spill. The objective is to have an emergency action plan in the event of leaks or spill for all new pipelines constructed in the county. *This standard implements Policy 4.9.a.*

Implementation

Lead agency: Planning Department, California Public Utilities Commission.

Coordinating agencies: Public Works Department, Resource Conservation District, Regional Water Quality Control Board, California Division of Oil and Gas, California Public Utilities Commission, California Department of Fish and Game, Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund.

Time frame: The Pipeline Franchise Agreement submittal requirements shall be amended within three years after the adoption of the Energy Element.

4.10 TRANSMISSION LINES

POLICIES

It shall be the policy of Glenn County to:

a. Minimize new transmission line construction, and to efficiently locate new lines, when necessary, based on the needs of adjoining farm operations and the environment. The County shall only support new transmission lines when the applicant has exhausted all opportunities to accommodate increased demand by upgrading existing lines.

b. Require that all transmission line development under the permitting authority of the County meet specific design and siting standards.

c. Request the California Public Utilities Commission to review transmission line proposal with the specific design and siting standards stated in this report.

Transmission lines carry large amounts of electricity from generating sources to various portions of the transmission or distribution system of the utility. Transmission lines are generally strung on various towers or poles, constructed from steel or wood; though they can also be laid underground. There are three types of transmission lines, differentiated by the voltages they carry.

"Distribution lines" generally carry voltages less than 50 kilovolts (kv). These lines deliver electricity at the community level and mete out electricity to individual customers.

"Transmission lines" carry large amounts of electricity (also known as bulk power) from power plants to load center. In California, transmissions lines range in size between 50 kv and 765 kv; some utilities refer to lines between 50 kv and 200 kv as sub-transmission lines. The CPUC General Order 131 details the certification process for line in excess of 200 kv. The CPUC is currently amending its review procedures for lines between 50 kv and 200 kv. These amendments, which are expected to be issued sometime in 1992 as General Order 131-D, will confirm the CPUC exclusive jurisdiction over these facilities and will formalize specific procedures by which local agencies can have their concerns taken into consideration (Freeman, 1992).

The third type of transmission line, "interties," typically refer to high voltage (200 kv to 500 kv) lines which connect two or more regional bulk power systems. The California—Oregon Transmission Project (COTP), which runs through Glenn County, is an example of such an intertie. A utility's combination of distribution and transmission lines is called a grid.

While poles and towers can frequently be sited to avoid sensitive areas, excavation required for underground transmission lines and associated transition stations may result in greater environmental impacts. Easement widths for underground transmission lines are generally similar to those required for overhead lines, though greater land use restrictions may be necessary for underground lines to ensure access when necessary.

Transition stations are required where underground lines connect to overhead lines to provide for safe transmission of the power between the lines. Such stations typically occupy half an acre, must be fenced, and visually resemble substations.

Steel conduits are laid in trenches dug between transition stations. Within such conduits, specially manufactured cables are threaded and surrounded by pressurized inert gases, oil or other heat dissipating fluids. Fenced pumping stations are required to circulate such fluids. Splice boxes

located every 2,000 feet along the line provide connecting points for the transmission lines. Splice boxes are also located at every point where the line route turns. Above-ground splice boxes are preferred by utilities because they are easier to maintain and more reliable than underground boxes. Further, because underground transmission lines can not be visually inspected, in the event of a power outage, the time necessary to restore service will likely increase.

FACILITY SITING NEEDS

Transmission lines require right-of-way easements to cross over privately owned lands. Such easements are negotiated directly between project proponents and land owners. Although shorter routes are generally preferable from an environmental, engineering, and economic perspective, regulated utilities take other issues into consideration when selecting transmission line routes. These include geology, terrain, protected and surrounding land uses, local policies, public roads, private access roads, owner's uses and concerns, and service to the public (Freeman, 1992).

Because of the need to maintain an integrated utility system and deliver energy services to developed areas from energy sources in more remote areas, utility facilities must be allowed in all resource areas, land use designations, and zoning districts. Transmission lines must be located near energy loads in order to maintain system reliability and minimize drops in (gas) pressure and (electric) voltage which occur over extended sections of distribution lines (Freeman, 1992).

EXISTING AND PLANNED TRANSMISSION LINE FACILITIES

Pacific Gas and Electric is a private investor-owned utility that provides gas and electric service to the Glenn County region, subject to the rules and tariffs of the California Public Utilities Commission. PG&E owns, operates and maintains electric and gas transmission and distribution lines and associated facilities within Glenn County. PG&E operates 129 miles of 230,000 volt (230 kv) transmission lines, and 112 miles of 115,000 volt (115 kv) transmission lines in Glenn County. The 115 kv lines are currently operated at only 60 kv because of relatively low demand. (PG&E will not release maps showing the location of these facilities for security reasons [Kercheval, 1991].)

The City of Santa Clara owns short lengths of transmission lines within Glenn County. A one-half mile transmission line connects the Stony Creek power house to the Elk Creek substation. Similarly, a 9.5 mile long transmission line transmits electricity from the Black Butte power house to Orland junction, located just north of the City of Orland, where the line connects to PG&E's grid.

The Pacific Northwest—Pacific Southwest Intertie was authorized by the United States Congress in 1964. Owned by PG&E, the intertie links the power-rich Pacific Northwest region with the high power demands of California. This line runs in a north-south direction through Glenn County approximately four miles west of Interstate 5. The intertie consists of two alternating current lines and one direct current line capable of transmitting 5,200 MW of power between the regions. The California—Oregon Transmission Project, currently under construction, will add approximately 1,600 MW of additional transfer capability within the existing transmission corridor (see Figure 4-12).

PG&E constructs distribution lines in response to growth. PG&E prefers siting transmission lines near energy load centers to minimize voltage losses that can occur over long distribution lines. Thus, the county can expect additional transmission facilities in areas designated for development.

TRANSMISSION LINE POTENTIAL IN GLENN COUNTY

Because transmission lines must be located near energy demand, the need for future distribution and transmission lines will, largely be dictated by growth within the county. Large transmission facilities such as interties may periodically be proposed to traverse Glenn County. Because of the County's location between the Pacific-Northwest region and the San Francisco Bay Area/Los Angeles region, additional power transmission facilities may be required over time. The current upgrading of the California—Oregon Transmission Project is an example of this increased capacity need.

PERMIT AUTHORITY

Several agencies have permitting authority over the placement and construction of electrical transmission lines, including the CPUC, the California Energy Commission, the Western Area Power Administration, municipal utilities, utility districts, irrigation districts, cities, and counties.

Public Utilities Commission

Transmission lines that are owned by private utility companies are regulated by the California Public Utilities Commission. The municipal utilities are responsible for the facilities they own, as are federal utilities. The California Public Utilities Commission is a state regulatory body, which among other duties, oversees the permitting of virtually all electrical transmission lines proposed by investor-owned utilities such as Pacific Gas and Electric. The CPUC will solicit input from affected local agencies, but final approval authority rests with the CPUC. The CPUC's permitting process is similar to that of CEQA, with some minor additional steps. Assuming that the required findings can be made, the CPUC issues a Certificate of Public Convenience and Necessity to approve the project.

Additionally, the CPUC oversees the determination of avoided cost energy prices and mediates contracts between the investor-owned utilities and qualifying facilities. The CPUC conducts periodic rate examinations of the three investor-owned utilities in California (Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric). The CPUC does not oversee municipally owned facilities.

California Energy Commission

The California Energy Commission (CEC) is the lead agency for permitting electrical transmission lines connected to a thermal power plant with 50 MW or more of capacity. CEC jurisdiction over the transmission line extends from the thermal power plant to the first point of interconnection. A CEC permit covers all state, regional, and local agency permits, except when investor owned utilities are involved which require CPUC approval. These agencies have opportunities for review and comment on proposed projects, but the CEC has final approval or denial authority. The CEC requires two distinct procedures for electrical transmission line projects: the notice of intention and application for certification.

To begin the permitting process, a project applicant files a notice of intention with the CEC. CEC staff review the application for completeness, and may request additional data from project proponents if necessary. Local, regional, and state agencies may participate in this process to ensure their concerns are addressed. CEC staff then analyze the application on the basis of four criteria:

- the need for the project;
- alternative power plant sites or transmission line routes;
- preliminary environmental and engineering suitability of the project; and
- conformity with local general plans and zoning ordinances.

A public hearing is then held to solicit testimony from responsible agencies. After the hearing, the CEC may then approve or deny the notice of intention.

The application for certification generally follows the same process; it is essentially a more detailed analysis that includes a finding that the proposed project is consistent with the CEC's adopted energy forecast. Additionally, the application for certification must discuss the preferred alternative as identified in the notice of intention. A detailed analysis of environmental impacts is done and mitigation measures are recommended for those impacts determined to be significant. Public hearings are then held, and if the CEC approves the application for certification, a construction and operation certificate is issued.

Under some circumstances, the California Energy Commission may issue an exemption to this process for small power plants. If such an exemption is granted, the project is referred to the local agency for processing.

Western Area Power Administration

Western Area Power Administration (WAPA) is a federal agency whose primary function is to market and transmit energy generated by federal government power projects. WAPA's Sacramento office sells power from California's Central Valley Project, which is operated by the U.S. Bureau of Reclamation. WAPA also oversees transmission of power between the Pacific Northwest and California. For example, WAPA was the lead agency for the California —Oregon Transmission Project, which traverses Glenn County.

Municipal Utilities, Utility Districts, or Irrigation Districts

Certain local agencies, such as municipal utilities, utility districts, or irrigation districts may act as the lead agency for electrical transmission facilities proposed by themselves. Such agencies must still adhere to the California Government Code and CEQA regarding public hearings and environmental documentation. Further, California Government Code Section 53091 states, "Zoning ordinances of a county or city shall apply to the location or construction of facilities for the storage or transmission of electrical energy by a local agency; provided, that such zoning ordinances make provision for such facilities."

Counties and Cities

Counties and cities maintain permit authority over electrical transmission lines proposed by independent, third-party proponents. An example of such a project would be a power line that connected a wind energy conversion system to agricultural buildings or a residence where the electricity would be consumed. As discussed above, counties and cities are also provided with opportunities to comment on other transmission line projects within their boundaries, but not under their direct permit authority.

ENVIRONMENTAL ISSUES

Transmission lines may create adverse impacts upon, or be constrained by, the following environmental resources:

Aesthetics

Transmission lines may impact aesthetics by towers and lines changing or contrasting with the visual character of the landscapes they cross and being particularly visible when such facilities are constructed on prominent ridgelines or hilltops.

Cultural Resources

Cultural resources may be disturbed by excavation activities associated with building access roads or tower footings during transmission line construction.

Geology

Geological features may be impacted, or constrain transmission line development by hazards from landslides, subsidence, erosion, and soil expansion.

Biology

Biological resources may be adversely impacted from transmission lines by loss of habitat resulting from construction and maintenance activities and by bird kill resulting from in-flight collisions with power lines and towers.

LAND USE ISSUES

Transmission lines may cause significant land use conflicts in several ways. First, as with wind energy conversion systems, transmission lines cause significant visual impacts; nearby property owners may feel that such lines and towers decrease real property values. There may be also be adverse health effects to populations located close to high-voltage transmission lines.

Transmission lines may interfere with agricultural operations by preventing or creating hazards for aerial spraying. Additionally, land beneath transmission lines can be taken out of agricultural production because towers and poles restrict farm cultivation equipment. Overhead lines can present electrocution hazards when drilling rigs, cranes, or metallic irrigation lines are used nearby. For these reasons, high-voltage electrical lines should be located away from population concentrations, scenic areas, and highly-productive agricultural lands, where feasible.

STANDARDS

4.10.1 The County shall request that the CPUC (and other permitting authorities) ask all transmission line applicants to first obtain a preliminary approval of the proposed alignment from the Planning Director. The Planning Director shall grant preliminary approval of the alignment based on the following list of preferences:

- First preference should be given to projects that propose to upgrade existing transmission lines.
- Second preference should be for projects that are parallel and immediately adjacent to existing transmission lines.
- Third preference should be for projects that run in existing utility rights-of-way such as those for pipelines, railroads, and communication cables.
- Least preference should be for projects that require new corridors across agricultural, commercial, or residential lands (Sedway Cooke Associates, 1992).

In considering alignment preferences, the County should recognize that the preferences listed above may not represent viable alternatives. The applicant should first show that they have exhausted all opportunities in the higher ranked preference category before being granted preliminary approval for another proposed corridor. The applicant should submit a complete, although general, description of the proposed corridor and any other information necessary to support their request. The objective is to assure that the applicant's request for transmission lines proposes an alignment that should be acceptable to the County. *This standard implements Policy 4.10.a.*

Lead agencies: Planning Department, California Public Utilities Commission, California Energy Commission.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors.

Funding: General fund, development fees.

Time frame: The County should request that the CPUC adopt this standard within two years after the adoption of the Energy Element.

4.10.2 New transmission lines may be granted conditional use permits in Glenn County subject to the following requirements. The objective is to mitigate possible environmental and public service impacts associated with transmission lines and transmission line construction. *This standard implements Policy 4.10.b.* In cases where the County does not have permit

authority, the County should request that permitting agency adopt similar review standards. *This standard implements Policy 4.10.c.*

General Performance Standards

a. Transmission line facility development should be subject to the standards specified in Standard 4.1.3, except where preempted by state or federal laws and regulations.

b. Preliminary approval of the corridor route has been previously granted by the Public Works Director.

c. General Order 95 of the CPUC, which governs all aspects of transmission line design, should be incorporated into the County's standards.

Review by Other Agencies or Authorities

d. The project application should include a soils report prepared by an engineering geologist licensed in the State of California that evaluates the underlying geology along the proposed transmission line corridor and incorporates recommendations to reduce potentially significant geological impacts into the project proposal.

Performance Standards for Site Location

e. The proposed transmission lines should not cross prominent ridgelines, hillsides, or other sensitive view corridors and the profiles of transmission towers are not silhouetted against the sky when viewed from public roads or existing homes.

f. The proposed transmission lines should avoid disrupting raptor nests and known raptor routes because of the potential for collision with the lines.

g. To avoid placing a transmission tower on highly visible ridgelines, the towers should be spaced below the crest or in a saddle to carry the line over a ridge or hill.

h. The transmission line should not cross parks and other recreation areas or areas of sensitive wildlife habitat such as wildlife refuges.

i. Because of health risks that may be associated with the electromagnetic fields generated by high voltage lines, such lines (230 kilovolt or larger) should not be near places of human habitation or places having prolonged or repeated human occupancy.

j. When transmission lines must be located near crop duster airstrips, towers and lines should be designed with high-visibility obstruction markings or lighting, specular conductors, colored spheres on the shield line, reflective markings on transmission line towers, or contrasting paint schemes which enhance tower visibility in landing and take-off areas.

k. Where feasible, a separation of one-quarter mile should be maintained between transmission lines and parallel or perpendicular distribution lines to avoid impediments to aerial spraying. Boxing-in fields by perpendicular transmission and distribution lines should be avoided. The feasibility of placing distribution lines underground within one-quarter mile of transmission lines should be examined by utilities sponsoring new transmission or distribution line projects.

l. In areas where low-level aerial spraying is frequent, alignments which are adjacent to railroad beds and levees should be avoided so that pilots do not need to weave under the lines and over these features.

m. The freedom to use water storage facilities, wells, and pumps could be impaired if a transmission line easement is sited over such facilities.

n. Whenever possible, new transmission lines should avoid productive croplands. When crossings of cropped areas cannot be avoided, the proposed lines should minimize interference with farming practices through use of the following rating system:

1. First preference should be for lines which run along field edges and property lines. In such instances, towers should be spaces at one-quarter mile intervals, preferably along quarter-section lines and at field corners.

2. Second preference should be for lines which run through mid-field areas, parallel or perpendicular to field edges. In such instances, towers should be located at field edges where possible. Tower locations between field edge and an area 50 feet from the field edge are generally least preferable, as such towers are the most disruptive to ground equipment operation.

3. Third preference should be for lines which run diagonally to field edges. In such instances, alignments which sever small parcels off from the main parcel are least preferable. As with mid-field alignments, tower locations between the field edge and the area 50 feet from the field edge should be avoided (Sedway Cooke Associates, 1992).

Implementation

Lead agencies: Planning Department, California Public Utilities Commission.

Coordinating agencies: Technical Advisory Committee, Planning Commission, Board of Supervisors, Bureau of Land Management, Forest Service, California Energy Commission, Western Area Power Administration.

Funding: General fund.

Time frame: The Zoning Code should be amended to include the standard noted above within four years after the adoption of the Energy Element, and the County should request that the appropriate agencies adopt this standard within two years after the adoption of the Energy Element.

Chapter Five
SUMMARY

CONSISTENCY REQUIREMENTS

Most of the programs in this plan propose changes to the County's general plan, zoning ordinance, land division ordinance, or building code. It is important that each of these documents present clear, nonconflicting guidelines for energy efficiency and energy facility siting. This section is intended to aid in the review of all documents for consistency between and among one another.

Table 5-1 is a summary of the programs that propose changes to one or more implementation documents. "Primary" indicates that the program makes specific reference to amending the document. "Secondary" indicates that the document will need to be amended to be consistent with the primary document(s).

Table 5-1: Programs and Standards and Their Implementation Documents
Glenn County Energy Element

Program/ Standard	General Plan	Zoning Ordinance	Land Division Ordinance	Building Code
Land Use 3.2.1	Primary	Secondary	Secondary	Secondary
Land Use 3.2.2	Primary	Secondary	Secondary	Secondary
Land Use 3.2.3	—	—	Primary	—
Transport 3.3.1	—	Primary	Secondary	—
Transport 3.3.2	—	—	—	Primary
Transport 3.3.3	—	—	—	Primary
Transport 3.3.4	—	Primary	—	Secondary
Transport 3.3.5	—	Primary	Secondary	—
Transport 3.3.6	—	Primary	Secondary	Secondary
Resident 3.4.2	—	—	—	Primary
Resident 3.4.9	—	Primary	Secondary	Secondary
Resident 3.4.11	—	—	Primary	Primary
Ag 3.7.1	—	Primary	—	—
Recycle 3.9.1	—	Primary	—	—
Facility 4.1.1	—	Primary	—	—
Facility 4.1.3	—	Primary	—	—
Facility 4.1.4	—	Primary	—	—
Gas Well 4.2.1	—	Primary	—	—

Program/ Standard	General Plan	Zoning Ordinance	Land Division Ordinance	Building Code
Biomass 4.3.1	—	Primary	—	—
Cogen 4.4.1	—	Primary	—	—
Cogen 4.4.2	—	Primary	—	—
Hydro 4.5.1	—	Primary	—	—
Hydro 4.5.3	—	Primary	—	—
Wind 4.6.1	—	Primary	—	—
Wind 4.6.2	—	Primary	—	—
Wind 4.6.3	—	Primary	—	—
Solar 4.7.1	—	Primary	—	—
Solar 4.7.2	—	Primary	Secondary	—
Thermal 4.8.1	—	Primary	—	—
Thermal 4.8.2	Primary	Secondary	—	—
Pipelines 4.9.1	—	Primary	—	—
Transmit 4.10.1	—	Primary	—	—
Transmit 4.10.2	—	Primary	—	—

Source: Crawford Multari & Starr, 1992.

CONCLUSION

Table 5-2 provides a summary of the implementation programs, particularly the lead agency and the program implementation deadline or checkpoint. This table is intended as a summary of the plan and an easy reference for County personnel on upcoming deadlines and necessary actions.

Table 5-2: Programs and Standards, Lead Agencies, and Deadlines
Glenn County Energy Element

Program/ Standard	Action Required	Lead Agency	Deadline
ENERGY EFFICIENCY GOALS			
Efficiency 3.1.1	Monitor Glenn County energy use.	Planning	January 1996
LAND USE PLANNING			
Land Use 3.2.1	Incorporate energy efficiency priorities into the Land Use Element.	Planning	Adoption of Land Use
Land Use 3.2.2	Incorporate pedestrian and bicycle master plan in to the Transportation Component.	Planning	Adoption of Transportation
Land Use 3.2.3	Amend land division ordinance to include energy efficient design and solar access.	Planning	3 years
TRANSPORTATION			
Transport 3.3.1	Identify sites within the county that are suitable for park-and-ride lots.	Public Works	3 years
Transport 3.3.2	Set development fees for bike facilities and install. Apply for CATIA grant within one year.	Buildings and Grounds	3 years.
Transport 3.3.3	Amend zoning to require bike facilities at County buildings. Apply for CATIA grant within 1 year.	Buildings and Grounds	4 years.
Transport 3.3.4	Amend zoning code to prohibit drive through windows.	Planning	4 years.
Transport 3.3.5	Amend zoning code to permit telecommuting, satellite offices, and telework centers.	Planning	4 years
Transport 3.3.6	Amend land division ordinance and zoning code to reduce required street widths.	Planning	4 years
Transport 3.3.7	Petition against any changes in rail service. Apply for CATIA grant within one year.	County Counsel	Adoption of Energy.

Program/ Standard	Action Required	Lead Agency	Deadline
Transport 3.3.8	Develop contingency plan to purchase rail rights-of-way. Apply for CATIA grant within one year.	Public Works	3 years
Transport 3.3.9	Investigate establishing a freight depot in the county. Apply for CATIA grant within one year.	Commerce & Economic Development	4 years
Transport 3.3.10	Monitor traffic volumes on all major corridors on a biannual basis.	Public Works	Beginning in 1996
RESIDENTIAL BUILDINGS			
Resident 3.4.1	Develop guidelines for energy efficient residential construction.	Building	2 years
Resident 3.4.2	Require energy retrofits at time of major renovation.	Building	2 years
Resident 3.4.3	Require energy audit at time-of-sale for residential units.	Board of Supervisors	2 years
Resident 3.4.4	Report on availability of rehabilitation loans for conservation and energy retrofits.	Community Services/ Planning	2 years
Resident 3.4.5	Obtain Community Development Block Grant to support loans for energy efficient rehabilitation.	Planning/ Community Services	Review of Housing Element
Resident 3.4.6	Investigate possibility of setting up Energy Partners program in Glenn County.	Community Services	Review of Housing Element
Resident 3.4.7	If preceding residential policies fail, enact retrofit at time-of-sale ordinance.	Board of Supervisors	6 years
Resident 3.4.8	Have building personnel participate in Title 24 and solar review course.	Building	1 year
Resident 3.4.9	Amend zoning code to allow and encourage solar applications for home use.	Planning	4 years
Resident 3.4.10	Enact tree planting ordinance to increase shade and reduce costs of cooling during summer.	Community Services	Arbor Day following adoption
Resident 3.4.11	Amend land division ordinance to require individual meters on multi-family units.	Building	3 years
Resident 3.4.12	Give rebate to residents that replace standard toilets with ultra-low flush toilets.	Public Works	3 years
Resident 3.4.13	Mail out info on retrofits and conservation to new utility customers.	Building	3 years

Program/ Standard	Action Required	Lead Agency	Deadline
COMMERCIAL AND INDUSTRIAL BUILDINGS			
C & I 3.5.1	Develop guidelines for energy efficient commercial and industrial construction program.	Building	5 years
C & I 3.5.2	Mail out information on retrofits and conservation to businesses.	Commerce & Economic Development	3 years
C & I 3.5.3	Enact retrofit at time-of sale ordinance for commercial and industrial enterprises.	Building	3 years
C & I 3.5.4	Revise application requirements to require proof of a recent energy audit.	Buildings and Grounds	2 years
PUBLIC FACILITIES			
Public 3.6.1	Hire architect experienced in solar design to design the next County building.	Buildings and Grounds/Community Services	Adoption of Energy
Public 3.6.2	Conduct energy audit of all County offices and buildings and do retrofits.	Buildings and Grounds	1 year
Public 3.6.3	Maintain vehicles and evaluate fuel efficiency of County vehicles.	County Service Center	1 year
Public 3.6.4	Present options to Board on possible alternative fuel use vehicles for County fleet.	County Service Center	2 years
Public 3.6.5	Include energy and transportation impacts in siting decisions for County buildings.	Planning	3 years
AGRICULTURAL LAND USE			
Ag 3.7.1	Amend zoning code to specifically allow alternative energy facilities and fuels.	Planning	4 years
Ag 3.7.2	Recommend a program to Board on ways to save water through more efficient pumping.	Resource Conservation	2 years
Ag 3.7.3	Conduct regular sessions for farmers on experimental farm techniques.	Resource Conservation	2 years
Ag 3.7.4	Forward recommendations on federal and state programs to appropriate parties.	Resource Conservation	3 years

Program/ Standard	Action Required	Lead Agency	Deadline
ENERGY EDUCATION			
Educate 3.8.1	Formalize conservation and energy efficiency programs in county schools.	Resource Conservation	3 years
Educate 3.8.2	Organize construction season kickoff fair to promote energy efficient construction.	Resource Conservation	3 years
Educate 3.8.3	Organize a business seminar to promote energy efficient retrofits and new construction.	Resource Conservation	3 years
RECYCLING AND REUSE			
Recycle 3.9.1	Amend zoning code to permit recycling in all commercial and industrial zones.	Planning	4 years
Recycle 3.9.2	Adopt waste reduction and recycling ordinance that gives incentives to recycle.	Public Works	3 years
Recycle 3.9.3	Set up collection centers for recyclable goods in all County buildings.	Buildings and Grounds/ Public Works	2 years
Recycle 3.9.4	Give preference to recycled products when selecting purchase items.	Purchasing Agent	2 years
ENERGY FACILITY GOALS			
Facility 4.1.1	Amend zoning code to require pre-application conference for energy facility projects	Planning	3 years
Facility 4.1.2	Amend application requirements to include information on energy savings and efficiency.	Planning	3 years
Facility 4.1.3	Establish additional performance standards for energy facility siting.	Planning	4 years
Facility 4.1.4	Amend zoning code to establish additional costs analyses of governmental facility proposals.	Planning	4 years
GAS FIELD AND WELL DEVELOPMENT			
Gas Well 4.2.1	Amend zoning code to have additional standards for gas well permit approval.	Planning/DOG	4 years

Program/ Standard	Action Required	Lead Agency	Deadline
BIOMASS FACILITIES			
Biomass 4.3.1	Amend zoning code to establish additional standards for biomass facility approval.	Planning/CEC	4 years
Biomass 4.3.2	Include Air Pollution Control District in initial review of project.	Planning	4 years
COGENERATION FACILITIES			
Cogen 4.4.1	Amend zoning code to permit single-building cogeneration facilities with little review.	Planning/CEC	4 years
Cogen 4.4.2	Amend zoning code to establish additional standards for cogeneration facility approval.	Planning/CEC	4 years
Cogen 4.4.3	Include Air Pollution Control District in the initial review of the project.	Planning	4 years
HYDROELECTRIC FACILITIES			
Hydro 4.5.1	Amend zoning code to establish additional standards for hydroelectric facility approval.	Planning/FERC	4 years
Hydro 4.5.2	Report on the effects of hydroelectric facilities on the dissolved oxygen levels in streams.	Facility Operator	Adoption of Energy
Hydro 4.5.3	Amend zoning code to require emergency plan for drought and excessive rain.	Planning	4 years
WIND ENERGY CONVERSION SYSTEMS			
Wind 4.6.1	Amend zoning code to establish additional standards for single wind turbine approval.	Planning	4 years
Wind 4.6.2	Amend zoning code to establish necessary standards for commercial wind system approval.	Planning	4 years
Wind 4.6.3	Require reports from wind facility operators on avian and wildlife deaths.	Resource Conservation	4 years
SOLAR SYSTEMS			
Solar 4.7.1	Amend zoning code to establish additional standards for solar facility approval.	Planning/CEC	4 years
Solar 4.7.2	Amend zoning code to permit individual solar panels for on-site space and water heating.	Planning	4 years

Program/ Standard	Action Required	Lead Agency	Deadline
THERMAL CONVERSION FACILITIES			
Thermal 4.8.1	Amend zoning code to establish additional standards for fossil fuel power plant approval.	Planning/CEC	4 years
Thermal 4.8.2	Request NRC to establish additional standards for nuclear power plant approval.	Planning/NRC	2 years
Thermal 4.8.3	Include Air Pollution Control District in the initial review of the project.	Planning	4 years
GAS AND OIL PIPELINES			
Pipelines 4.9.1	Amend zoning code to have additional standards for gas and oil pipeline approval.	Planning/CPUC	3 years
Pipelines 4.9.2	Amend pipeline franchise agreement application to include impacts of possible leaks and spills.	Planning/CPUC	3 years
TRANSMISSION LINES			
Transmit 4.10.1	Request CPUC to require preliminary alignment of transmission line proposal.	Planning/ CEC/CPUC	2 years
Transmit 4.10.2	Amend zoning code to establish additional standards for transmission line approval.	Planning/CPUC	4 years

Notes: DOG — California Division of Oil and Gas; CEC — California Energy Commission; FERC — Federal Energy Regulatory Commission; NRC — Nuclear Regulatory Commission; CPUC — California Public Utilities Commission.
Source: Crawford Multari & Starr, 1992.

APPENDICES

A. ENERGY TERMS AND MEASUREMENTS

ABBREVIATIONS

AC: Alternating current
ARB: Air Resources Board
BF: Board feet
BTU: British thermal unit
CATIA: Clean Air and Transportation Improvement Act of 1990.
CEC: California Energy Commission
CEQA: California Environmental Quality Act
CFS: Cubic feet per second
CIMIS: California Irrigation Management Information System
COTP: California—Oregon Transmission Project
DC: Direct current
DOG: California Department of Conservation Division of Oil & Gas
DSM: Demand side management
DWR: California Department of Water Resources
EPRI: Electric Power Research Institute
FERC: Federal Energy Regulatory Commission
GPM: Gallons per minute
HVAC: Heating, venting, and air conditioning
KV: Kilovolt
KWH: Kilowatt hours
NRC: Nuclear Regulatory Commission
PG&E: Pacific Gas and Electric
PSI: Pounds per square inch
CPUC: California Public Utilities Commission
PURPA: Public Utilities Regulatory Policies Act
RWQCB: Regional Water Quality Control Board
SWRCB: California State Water Resources Control Board
TES: Total energy system

TERMS AND MEASUREMENT TABLES

acre-foot: the amount of water which will cover one acre to a depth of one foot. One acre-foot equals 325,851 gallons, or 43,560 cubic feet of water.

barrel: a measure of oil. One barrel equals 42 gallons.

btu: abbreviation for British Thermal Unit. A measure of energy equal to 1,055.1 joules, or .293 watt-hours.

cfs: abbreviation for cubic feet per second. Used to measure water flow. One cubic foot per second equals 448.8 gallons per minute.

energy: the product of a force being applied for some distance, commonly expressed as joules, calories, or British Thermal Units (btu). With respect to electricity, energy is most often measured in watt-hours.

B. THE ECONOMICS OF CONSERVATION

The California Energy Commission (CEC) and the California Public Utilities Commission (CPUC) have jointly published a document that assists in evaluating various conservation programs, particularly those emphasizing energy demand management. That document, *Economic Analysis of Demand-Side Management Programs*, provides a comprehensive methodology for evaluating the economic impacts of conservation programs. This methodology is beyond the scope of this paper, but is discussed here briefly to alert the reader to its presence.

While complex, the basic methodology evaluates the economic effect of various demand management programs from several perspectives. Obviously, any program should be evaluated for its direct economic effect upon the program participant. Perhaps less obvious is the impact on ratepayers. For example, if an insulation program causes an individual consumer to purchase less electricity, the revenues received by a utility will decrease. Decreased revenues from one source may necessitate higher rates for other customers to cover a utility's operating cost.

Additionally, a program's impact upon the cost of providing energy should also be evaluated. For example, if insulating houses saves enough energy to avoid construction of a new power plant, the economic benefits of that action need to account for this result. Finally, conservation programs need to be evaluated in terms of their effects on society at large.

To summarize the four tests:

1. The participant test measures the quantifiable benefits and costs to the participant in an energy conservation program.

2. The ratepayer impact measure test evaluates a conservation program's effect on customer's utility bills. In general, rates will decrease if the change in utility revenues from the program is greater then the change in utility costs.

3. The total resource cost test evaluates a conservation program as if it were a supply of energy. This test weighs the cost of the conservation program against the cost of providing the amount of conserved energy by the next best available means (also known as the "avoided cost" of providing the energy). A variation of this test called the Societal Test includes the value of environmental degradation or preservation and national security that may (or may not) arise from implementing the program.

4. The utility test is effectively the same as the total resource cost test, except that it is viewed strictly from the utility's perspective.

C. TRANSIT ORIENTED DEVELOPMENT GUIDELINES

The following pages are a summary of the guidelines for Transit-Oriented Developments recently developed by the County of Sacramento.

COUNTY OF SACRAMENTO
PLANNING AND COMMUNITY DEVELOPMENT DEPARTMENT
827 7th Street, Sacramento, California 95814
(916) 440-6141

TRANSIT-ORIENTED DEVELOPMENTS
TRANSIT/LAND USE LINKAGE

INTRODUCTION. The demand for affordable housing opportunities in the unincorporated area continues to increase. The Sacramento region must reduce regional vehicle miles travelled (VMT) in order to meet State mandates requiring a reduction in traffic congestion and air pollutant emissions. Using a land use strategy that emphasizes typical patterns of low density residential development will not address these issues. The issues can be addressed by concentrating urban development near integral components of the transportation/transit system and through the physical design and integration of the land use pattern.

The linkage between transit and land use includes the development of higher residential densities and non-residential intensities that are designed to accommodate non-automobile modes of travel at transit stops and along transit corridors. These developments are referred to as **Transit-Oriented Developments (TODs).**

Transit-Oriented Developments not only create a transit/land use relationship, but also create an orderly land use pattern which is conducive to making a community an affordable place to live. The use of TODs create communities that are: a) affordable to the environment because they require efficient use of the land resource and, through transit use, reduce traffic congestion and air pollution; b) affordable for the diverse households moving to Sacramento because a variety of housing types and densities can be constructed in convenient locations; c) affordable to businesses seeking to relocate in Sacramento because their work force can be freed of the gridlock and high housing costs typical in other California regions; and d) affordable to the public taxpayer because TOD infrastructure is efficient.

The transit/land use linkage strategy is applicable in three physical settings;

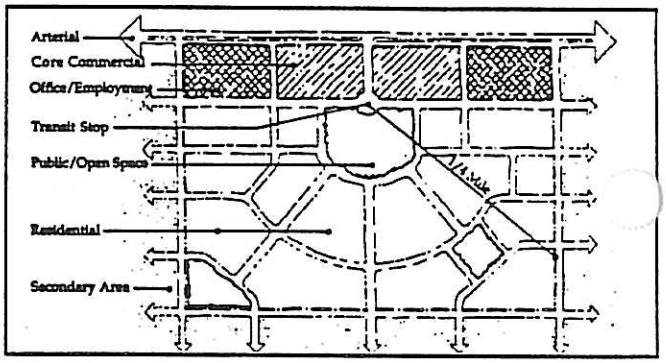
INFILL AREAS: Vacant parcels surrounded by existing urban development;

REVITALIZATION AREAS: Urbanized areas where the quality of development is either significantly underutilized or deteriorated;

METROPOLITAN EXPANSION AREAS: Undeveloped areas within the Urban Policy Boundary.

DEFINING TRANSIT-ORIENTED DEVELOPMENT

Transit-Oriented Developments (TODs) are mixed use neighborhoods of between 20 and 160 acres. TODs shall be located within one-quarter mile walking distance of transit stops. The design, configuration, and mix of uses provide an alternative to traditional suburban development patterns by emphasizing a pedestrian oriented environment and the use of public, transportation. TODs mix residential, retail, office, open space, and public uses, making it possible for residents and employees to travel by public transit, bicycle or foot, and automobile.

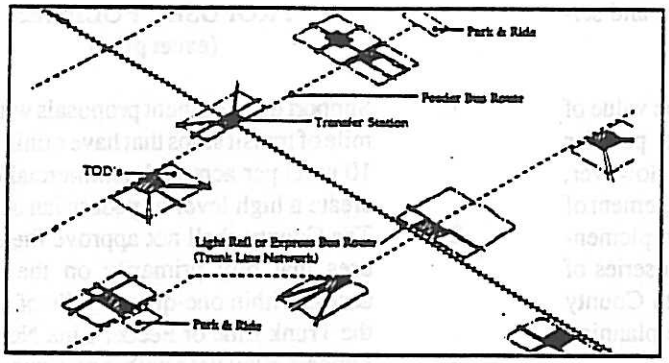


TYPES OF TRANSIT-ORIENTED DEVELOPMENTS

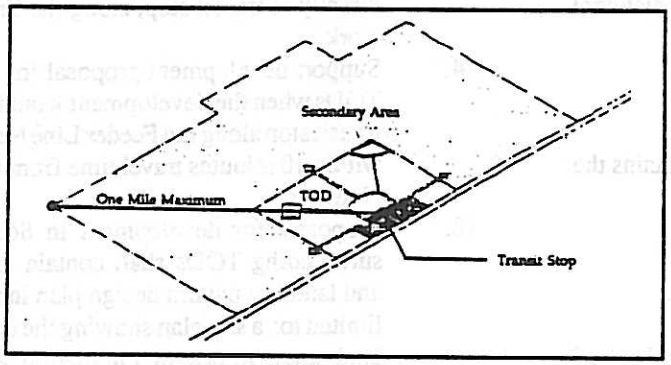
There are two types of transit-oriented development patterns: 1) Urban TODs; and 2) Neighborhood TODs. The two different types of TODs are distinguished by their form and pattern of development and their location relative to components of the transit system.

***URBAN TODs.** Urban TODs should be located directly at a light-rail station, along a Regional Trunk Line of the transit system, or at a Transit Center. Urban TODs should have a higher percentage of job-generating uses, and should be developed at higher residential densities. Urban TODs may have densities of between 7 and 50 units per acre but must have a minimum average density of 15 dwelling units per acre. Office intensities must have a minimum Floor Area Ratio (FAR) of 0.35 and a maximum of 0.60 without structured parking. If structured parking is provided, the FAR maximum is 1.70.*

NEIGHBORHOOD TODs. Neighborhood TODs are mixed-use communities located at a transit stop along a component of the transit system called the Feeder Line System. Neighborhood TODs incorporate a greater percentage of residential uses, and emphasize local retail and office uses. Density standards for a Neighborhood TOD allow densities of between 7 and 30 units per acre but require a minimum average density of 12 units per acre to be maintained. Office intensities must have a minimum Floor Area Ratio (FAR) of 0.35 and a maximum FAR of 0.60 without structured parking. If structured parking is provided, the FAR maximum is 1.00.



Transit-Oriented Developments can be surrounded by lower density residential neighborhoods, called Secondary Areas. Development in the Secondary Area shall be designed to link to the TODs through an interconnected street system with direct and easy access to the transit stop and commercial core.



URBAN DESIGN GUIDELINES

The consulting team of Larry Mintier and Associates and Peter Calthorpe Associates were retained by Sacramento County to prepare guidelines for the implementation of Transit-Oriented Development land use patterns.

SAMPLE GUIDELINES

1D) **Core Commercial Area.** Each TOD must have a mixed-use core commercial area located immediately adjacent to the transit stop. This core area should include convenient shopping areas, offices and public uses such as a town square, post office, library and civic services.

1F) **Non-TOD uses.** Uses which rely extensively upon autos or trucks for their business are not appropriate uses for TODs. Heavy industrial uses, warehousing and distribution facilities, and freeway commercial complexes are not appropriate in TODs.

3D) **Distance from transit stop.** The TOD must not contain land further than 2,000 feet from a transit stop. The Secondary Area may contain land no further than one mile from the transit stop.

4A) **A proportion of uses.** The following is a list of land use types within the TOD and their minimum and maximum permitted percentage of site area:

Use	Neighborhood TOD	Urban TOD
Public	10% min.	10% min.
Core	10-15%	10-30%
Office	0-40%	20-60%
Housing	40-80%	20-60%

5A) **Residential densities.** Residential densities within TOD sites must be a minimum of 7 units per residential gross acre and may be developed to a maximum of 30 units per residential gross acre in Neighborhood TODs and 50 units per residential gross acre in Urban TODs.

5E) **Upper story uses.** Retailers in the core commercial area may add up to two floors of residential and/or one floor of office for every ground floor of retail. The intensity of the retail use must not be reduced and the buildings must be consistent with the design guidelines.

6A) **Commercial building entries.** Primary ground floor commercial building entrances must orient to streets, not to interior blocks or parking lots. Secondary entries from the interior of a block will be allowed. Anchor retail buildings may have their entries from off-street parking lots; however, on-street entries are strongly encouraged.

7B) **Street patterns.** The TOD street system should be clear, formalized, and interconnected, converging to the transit stop and commercial center. Cul-de-sac and dead end streets should be avoided.

8B) **Connections to the core area and the transit stop.** The pedestrian system must provide clear, comfortable, and direct pedestrian access to the core commercial area and transit stop.

11D) **Monument trees.** Landscaping in public open spaces should continue the Sacramento Area tradition of planting "monument" trees.

12A) **Integrating existing viable uses.** Existing on-site uses, which are economically and physically viable, should be incorporated into the overall plan for the TOD. If necessary, improvements should be made to make these uses more compatible with TOD concepts.

THE 2010 GENERAL PLAN

The Sacramento County Planning and Community Development Department is updating the County's General Plan. This General Plan will provide the basis for development within the unincorporated area to the year 2010.

Land is one of the County's most valuable resources. The supply of developable land is limited, while the demand for its use is unlimited. It is imperative that the County use its land resource efficiently. Resource efficiency can be achieved by committing to a pattern of land use that concentrates development in configurations that protect valuable agricultural lands, conserve natural areas and resources, reduce travel distances, reduce air pollutant emissions, and enhance the efficiency of providing infrastructure and services.

Historically, Sacramento County has addressed the value of its land resource through goals, objectives and policies which provided guidance for decision-making. However, past plans have not adequately addressed the management of the land resource. The objectives, policies and implementation measures of the Draft 2010 Plan provide a series of land use strategies which define how Sacramento County will manage and use its land resource during the planning period.

The objectives, policies and implementation measures of the Draft 2010 Plan address: Growth Accommodation and Management, Urban Design, Air Quality/Land Use Linkage, Transit/Land Use Linkage, Jobs/Housing Relation, Redevelopment and Revitalization, Reuse and Infill, Development of Urban Growth Areas, and Inter-jurisdictional Coordination.

THE LAND USE ELEMENT

The Land Use Element of the Draft 2010 Plan contains the following land use strategies:

- Maximize use of the existing urban area;
- Minimize consumption of the non-urban area;
- Relate land use with transit;
- Reduce vehicle trips, and minimize the number of Vehicle Miles Travelled (VMT);
- Reduce the emission of air pollutants;
- Provide diverse housing; types; and
- Configure the design of the urban area in an efficient manner.

Although a separate strategy, the linkage of transit and land use is important to achieving the intent of the Land Use Element of the Draft 2010 Plan.

The linkage of transit opportunities with appropriate land use densities will help to accommodate projected growth, while maintaining Sacramento's quality of life and allowing for continued economic vitality. The Land Use Elemer the Draft 2010 Plan contains the following excerpts reg ing the transit/land use strategy:

TRANSIT/LAND USE RELATION

OBJECTIVE: Locate high residential densities and non-residential intensities that are designed to accommodate non-automobile modes of travel within walking distance of transit stops and along key transit corridors.

PROPOSED POLICIES
(excerpted)

1. Support development proposals within one-quarter mile of transit stops that have minimum densities of 10 units per acre and commercial/office uses that create a high level of pedestrian activity.
2. The County shall not approve the development of uses that rely primarily on the automobile for access within one-quarter mile of a transit stop on the Trunk Line or Feeder Line Network.
3. Support retail uses within one-quarter mile of transit stops on the Trunk Line or Feeder Line Network that allow convenient shopping to and from the transit stop during lunchtime, evenings, and weekends.

13. Support the development proposals for Urban TODs when the development would be located directly at transit stop, along the Trunk Line Network.
14. Support development proposal for Neighborhood TODs when the development would be located at a transit stop along the Feeder Line Network, located within 10 minutes travel time from the Trunk Line Network.
18. Proposals for development in Secondary Areas surrounding TODs shall contain an architectural and land use pattern design plan including but not limited to: a site plan showing the configuration of land uses, routes of circulation and pedestrian movement, elevations of structures, vegetation plan, street plan, and phasing and timing plan.
20. The County shall promote the development of large scale projects as a series of TODs linked by public transit and complemented by TOD Secondary Areas that include residential uses, industrial uses and/or regional parks.

IMPLEMENTATION OF THE TOD CONCEPT IN SACRAMENTO COUNTY

Both the Sacamento County Planning Department and representatives of the local development community have begun to develop plans utilizing the TOD concept. The County has several private proposals, a County initiated project and a Community Plan update, all addressing implementation of the Draft TOD Design Guidelines.

The Laguna West Development project in the southern portion of the community was proposed by River West Developments prior to completion of the Draft TOD Guidelines but contains many of the components described in the Draft General Plan.

The Calvine Special Planning Area (SPA), a 615 acre site at Highway 99 and Calvine Road north of the Elk Grove Community is being planned with the TOD Design Guidelines in mind. The proposed plan for this site shows two mixed-use developments on the site, one planned around a future light-rail station on Calvine Road and the other designed around a feeder bus line that will connect to the light-rail line. Between these two mixed-use cores is an area of low density residential development.

The Planning Department is recommending that the appropriate configurations and densities be designated at this site because of it's proximity to a future light rail line. Outstanding issues remaining include concerns of nearby residents regarding the approval of urban uses at the site and issues of specific site design by site developers.

The Rio Linda/Elverta Community Plan udpate is also addressing implementation of the TOD Design Guidelines. The Planning Department has worked with the Rio Linda/ Elverta CPAC in the development of three alternatives which show from one to three TOD sites within the community. Downtown Rio Linda meets much of the basic framework described by the County's Guidelines including a commercial core and a grid street system. The community was orginally built around the California Northern Railroad which offered service between Marysville and Sacramento. The remains of this railroad right-of-way is clearly evident with the County using much of the length of the right-of-way for a bike trail. The Planning Department hopes that ultimately this right-of-way can be restored to rail use via an extension of a light-rail line. In the current community plan update, however, improved bus service is intended to serve the community and the proposed TOD areas.

For further information:

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D. TITLE 24 REQUIREMENTS

The following pages are excerpts from two books published by the California Energy Commission: *Energy Conservation Manual for new residential buildings* (1985) and *Energy Efficiency Manual — Designing for Compliance* (1986).

Chapter 2
Mandatory Measures

2.0 SUMMARY

This chapter discusses the mandatory features and devices called for in the Building Energy Efficiency Standards. The introduction explains the relationship of mandatory measures to the building features required for compliance with the Standards. Succeeding sections cover the different sets of mandatory measures: building envelope, HVAC and hot water systems, lighting and appliances. Each feature or device is described and cross-referenced to the corresponding section of the code.

Applicable sections of the *Energy Efficiency Standards*: 2-5352, 2-5311, 2-5312, 2-5313, 2-5314, 2-5315, 2-5316, 2-5317 and 2-5318.

2.1 INTRODUCTION

In order to comply with the Standards, all new residential construction covered by this manual must meet or exceed certain minimum conservation levels, no matter what compliance approach one chooses. These minimum requirements are referred to in the Standards as the ***mandatory measures***, and compliance with them is generally shown by including a Mandatory Measures Checklist or notes with plans and other compliance documentation (See Appendix A). The mandatory measures may be divided into three main categories: Building Envelope Measures, HVAC and Plumbing System Measures, and Lighting and Appliance Measures. All specific mandatory measures are explained in detail later in this chapter.

It is important to understand that the mandatory measures represent a minimum level of conservation which may be in addition to or superseded by the features required for compliance with the point system, packages or computer performance methods depending on which is more stringent.

The mandatory measures which may be superseded by the requirements of the compliance approach are marked with asterisks (*) on the Mandatory Measures Checklist, MF-1R. You must list these final requirements and other features specified in the compliance analysis on the Certificate of Compliance, CF-1R.

Example 2-1

A computer method analysis shows that a new house requires R-30 ceiling insulation to comply using the performance approach, but the minimum mandatory insulation level for ceiling insulation is only R-19. The higher insulation level must be installed for the building to comply.

Example 2-2

A small addition to an existing house might appear to comply with only R-11 ceiling insulation using a performance approach. However, R-11 would not be sufficient because the required minimum ceiling insulation level established by the mandatory measures is R-19.

2.2 BUILDING ENVELOPE MEASURES

This section discusses the mandatory features required to assure that the building envelope meets at least a minimum thermal performance level. The building envelope measures primarily regulate the levels and quality of insulation used throughout the building, and the amount of air leakage into or out of the building.

NOTE: Insulation levels in an existing building need not be upgraded to mandatory minimums when showing compliance of an addition unless an increase in existing insulation is part of the compliance calculation (see Section 7.1).

The specific regulations described below deal with ceiling, wall, slab and loose fill insulation, insulation certification and installation, ***vapor barriers*** in climate zones 14 and 16, ***infiltration/exfiltration*** controls and installation of fireplaces.

Ceiling Insulation [§2-5352(a)]

The opaque portions of framed ceilings separating conditioned and unconditioned space must either (1) be insulated between framing members with R-19 or greater insulation or (2) have a ***weighted average U-value*** equivalent to a ceiling with R-19 insulation between framing (see Figure 2-1). The insulation may be of greater insulating value in certain areas of the ceiling and of lesser insulating value in other areas of the ceiling provided that the overall effect is equal to or greater than the equivalent R-value (see the effective cavity R-value of R-19 batt insulation including the effects of wood framing at 16 inches on center in the *Glossary*, Table G-7). Insulation which is not penetrated by framing, such as rigid insulation, also complies with the mandatory ceiling insulation requirement by meeting or exceeding the same R-value. Documenting equivalency with an assembly using R-19 batt insulation penetrated by framing may be done using Form-3R which is

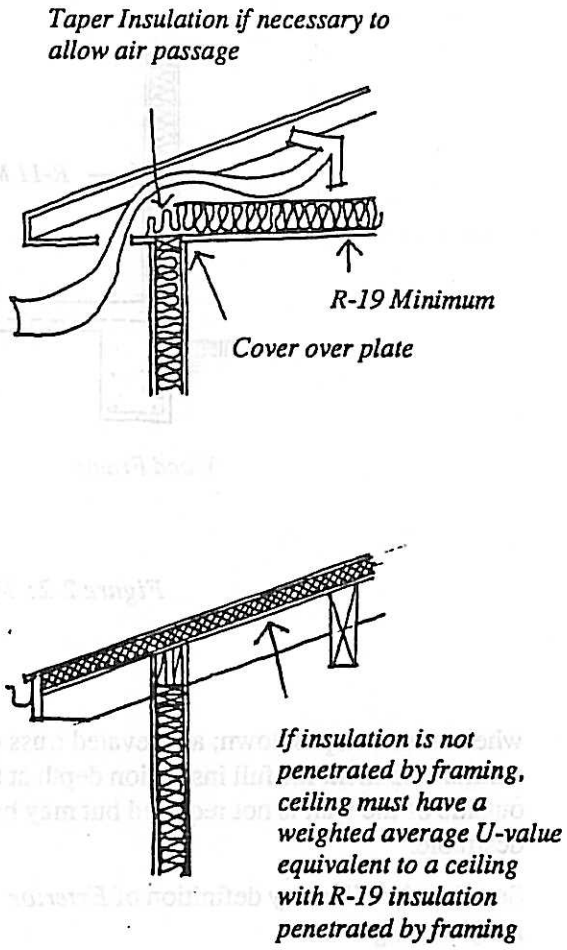


Figure 2-1: Ceiling Insulation

explained in the *Glossary* under *R-Value*. Weighted averages are also explained in the *Glossary*.

Ceiling insulation should not block eave vents in attics. If the flow of air is blocked, water vapor may condense on the underside of the roof, reducing the insulating effectiveness of the insulation and building materials and possibly causing structural damage.

To meet the intent of the ceiling insulation requirement, ceiling insulation should extend far enough to the outside walls to cover the top plate. However, insulation may be tapered at the wall

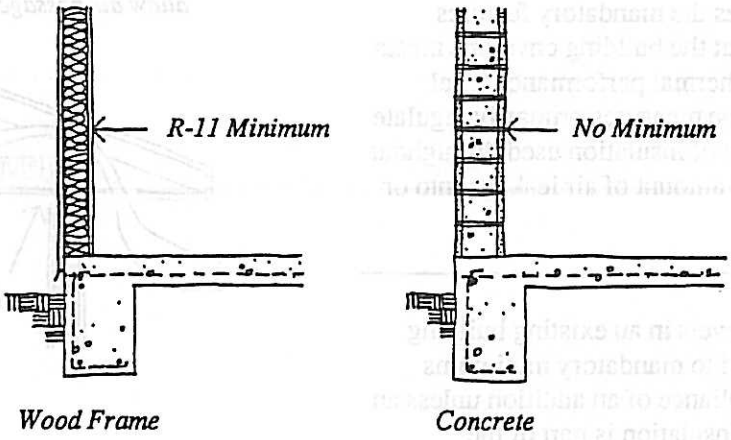


Figure 2-2: Mandatory Minimum Wall Insulation

where a roof slopes down; an elevated truss or similar treatment for full insulation depth at the outside of the wall is not required but may be desirable.

See also the *Glossary* definition of *Exterior Roof/Ceiling*.

Loose Fill Insulation [§2-5352(b)]

When loose fill insulation is installed, the minimum installed weight per square foot must conform to the insulation manufacturer's installed design density per square foot at the manufacturer's labeled R-value.

Blown or poured type insulating material may only be used in attic spaces where the slope of the roof is at least 2 1/2 feet in 12 feet and the distance from the top of the bottom chord of the truss or ceiling joists to the underside of the roof sheathing is at least 30 inches at the roof ridge.

When eave vents are installed, adequate baffling of the vent opening shall be provided to deflect the incoming air above the surface of the material and shall be installed at the soffit on a 45° angle.

Baffles shall be in place at the time of framing inspection.

Wall Insulation [§2-5352(c)]

The opaque portions of frame walls separating ***conditioned*** and ***unconditioned spaces*** must either:

- Be insulated between framing members with R-11 or greater insulation, or
- Have a weighted average U-value equivalent to a wall with R-11 insulation between framing (the *Glossary* describes how to compute U-values and weighted averages).

It is not the intent of the Standards to require framing studs larger than the typical 2 x 4 studs to meet the mandatory measures. Walls which have no framing, such as masonry or concrete exterior walls, do not have to be insulated with R-11 insulation, but may have to meet the minimum heavy or light mass wall package requirements (see Figure 2-2).

Framed foundation walls of heated basements or heated crawl spaces must be insulated above the

adjacent outside ground line with at least R-7 insulation.

Insulation which is not penetrated by framing members, such as rigid insulation over the face of framing, may meet an equivalent minimum R-value which has been adjusted for the effects of wood framing 16 inches on center (see Table G-7). Documenting equivalency with a wall assembly using batt insulation penetrated by wood framing 16 inches on center may also be done using Form-3R which is explained in the *Glossary* under *R-Value.*

See also *Exterior Wall* and *R-Value* in the *Glossary.*

Slab Edge Insulation [§2-5352(k)]

Material used for slab edge insulation must meet the following minimum specifications: a water absorption rate no greater than 0.3 percent when tested in accordance with the American Society of Testing and Materials ASTM-C-272-33 and a water vapor transmission rate no greater than 2.0 perm/inch when tested in accordance with ASTM-C-355-64. Concrete slab perimeter insulation must be protected mechanically and/or chemically from physical damage and ultraviolet light deterioration.

Installation of Additional Insulation [§2-5313]

This section applies to insulation added to existing ceilings, water heaters, solar storage tanks and backup water heaters, and heating and cooling ducts.

Insulation being installed in an existing, accessible attic must meet or exceed the ***R-value*** stated for its location in Table 2-53F of the Standards. The R-value is equal to the total of the R-value of existing insulation, if any, plus the R-value of the new insulation. In areas where adequate accessible space is not available, the contractor may install a lesser amount of insulation.

If exterior insulation is applied to water heaters and storage and backup tanks for solar water heating systems, it shall have a ***thermal resistance*** of at least R-6.

If external insulation is applied to heating and cooling system ducts, it shall conform to the thermal resistance requirements of Section 1005 of the 1982 Uniform Mechanical Code.

Installation Of Certified Insulating Material [§2-5311]

The California Quality Standards for Insulating Materials, which became effective on January 1, 1982, ensure that insulation sold or installed in the state performs according to the stated R-value and meets minimum quality, health, and safety standards.

Manufacturers must certify all insulating materials to comply with California Quality Standards for Insulating Materials. Builders may not install the types of insulating materials listed in Table 2-1 unless the product has been certified by the manufacturer. Builders and enforcement agencies should use the Department of Consumer Affairs *Consumer Guide and Directory of Certified Insulation Material* to check compliance. If an insulating product is not listed in the most recent edition of the directory, contact the Department of Consumer Affairs Thermal Insulation Program at (916) 920-7005.

The California Quality Standards for Insulating Materials also require that all exposed installations of faced mineral fiber and mineral aggregate insulations must use fire retardant facings which have been tested and certified not to exceed a flame spread of 25 and a smoke development rating of 450. Insulation facings which do not touch a ceiling, wall, or floor surface and faced batts on the underside of roofs with an air space between the ceiling and facing are considered exposed applications.

Flame spread ratings and smoke development ratings are shown on the insulation or packaging material or may be obtained from the manufacturer.

Table 2-1. Insulation Materials Subject to Regulation

Type	Form
Aluminum foil	Reflective foil
Cellular glass	Board
Cellulose fiber	Loose fill and spray applied
Mineral aggregate	Board
Mineral fiber	Blankets, board, loose fill
Perlite	Loose fill
Polystyrene	Board, molded, extruded
Polyurethane	Board, field applied
Polyisocyanurate	Board, field applied
Urea formaldahyde foam	Field applied
Vermiculite	Loose fill

Vapor Barriers [§2-5352(f)]

In Climate Zones 14 and 16 a continuous vapor barrier, lapped or joint sealed, must be installed on the conditioned space side of all insulation in all exterior walls, on the floor of unvented attics, and on floors over unvented crawl spaces to protect insulation from condensation.

The Standards define a vapor barrier as material with a permeance of one perm or less, a measure of resistance to the transmission of water vapors. A perm is equal to one gram of water vapor transmitted per square foot per hour per inch of mercury pressure difference.

Vapor barriers are special coverings over framing and insulation that protect the insulation from moisture condensation that could cause it to lose much of its effectiveness. Products such as a continuous polyethylene sheet or wall board with foil backing may meet this requirement, as well as any other product which, according to the appropriate testing procedure, meets the vapor barrier permeance rating of one perm or less. Kraft paper backing on batt insulation may qualify if the paper backing meets the vapor barrier permeance rating, is properly overlapped and is and secured to the framing, top and sole plates. Kraft paper backing may not be acceptable for ceiling applications because of fire code restrictions on flame spread.

See also "Special Infiltration Barriers" below.

Infiltration/Exfiltration Control [§2-5317]

Air leakage through cracks around windows, doors, walls, roofs and floors generally accounts for about one-third of the energy used for home heating and cooling. The Standards contain a number of requirements to control infiltration and exfiltration.

Doors and windows between conditioned and unconditioned spaces must be designed to limit air leakage into or from the building envelope. Manufacturers must test and certify windows and doors to ensure that they limit air leakage. Manufactured doors and windows may be installed only when they are certified as meeting the Standards listed in Table 2-2.

Site-built windows and doors must be caulked, gasketed, weatherstripped, or otherwise sealed. They are not required to be tested and certified in the same way as factory-manufactured doors and

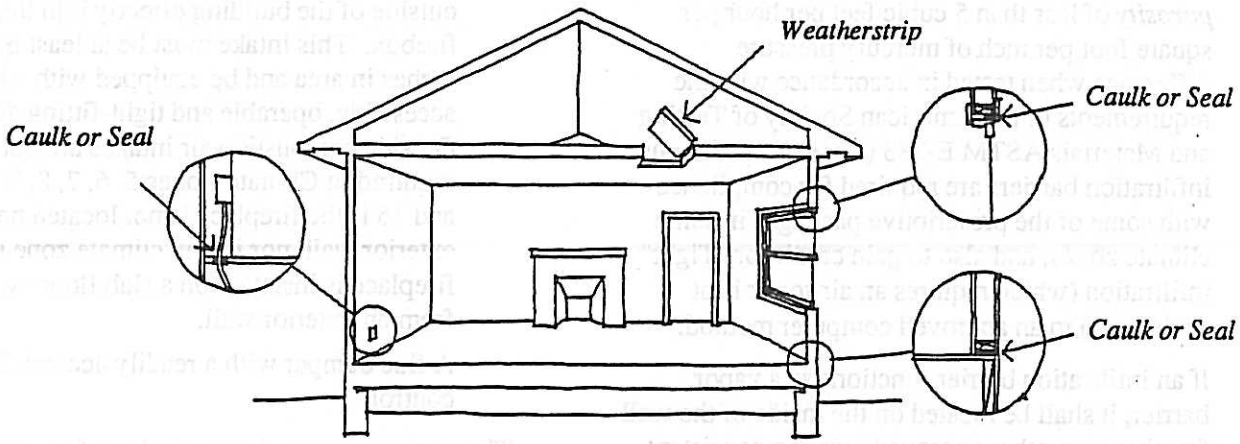


Figure 2-3: Infiltration/Exfiltration Controls

windows. A custom designed and constructed stained glass window is an example of a site-built window.

EXCEPTION: Fire rated doors and windows, unframed glass doors, and exterior elevator shafts do not have to meet the requirements of this section.

Table 2-2. Allowable Infiltration Rates for Manufactured Doors and Windows *

Windows cfm/ft of operable sash crack	Doors cfm/sf of door area
0.37	0.37

* When tested at a pressure differential of 1.567 lb/sf which is equivalent to the pressure of a 25 mph wind. Compliance with the criteria for air leakage must be determined using ASTM Specification E283-73 (Standard Method of Test for Air Leakage through Exterior Windows, Curtain Walls, and Doors).

AAMA 302.9 and 402.9 labels verify certification of products with ASTM testing procedures.

The following openings in the building envelope must be caulked, gasketed, weatherstripped or otherwise sealed (see Figure 2-3):

- Exterior joints around window and door frames, between wall sole plates, floors, exterior panels and all siding materials;
- Openings for plumbing, electricity, and gas lines in exterior and interior walls, ceilings, and floors;
- Openings in the attic floor (such as where ceiling panels meet interior and exterior walls and masonry fireplaces); and
- All other such openings in the building envelope.

Alternative approved techniques may be used to meet the standard caulking requirements for exterior walls, including but not limited to, continuous stucco, caulking and taping of all joints between wall components (e.g., between slats in wood slat walls), building wraps, or rigid wall insulation.

Special Infiltration Barrier [§2-5352(e)]

If the compliance approach chosen requires a continuous infiltration barrier on ceilings and

walls, that infiltration barrier must have an *air porosity* of less than 5 cubic feet per hour per square foot per inch of mercury pressure difference when tested in accordance with the requirements of the American Society of Testing and Materials ASTM E-283 (1973). Continuous infiltration barriers are required for compliance with some of the prescriptive packages in some climate zones, and also to gain credit for "Tight" infiltration (which requires an air-to-air heat exchanger) in an approved computer method.

If an infiltration barrier functions as a vapor barrier, it shall be located on the inside of the wall framing or another approved location consistent with the testing of the product.

Installation Of Fireplaces [§2-5352(d)]

Factory-built fireplaces must be listed as having doors. Installation of factory-built and masonry fireplaces shall include:

- Closable metal or glass doors covering the entire opening of the firebox which can be closed when the fire is burning. A door is not required, however, if it interferes with any device permanently installed in a fireplace designed to increase the circulation of heat (such as heat tube inserts).

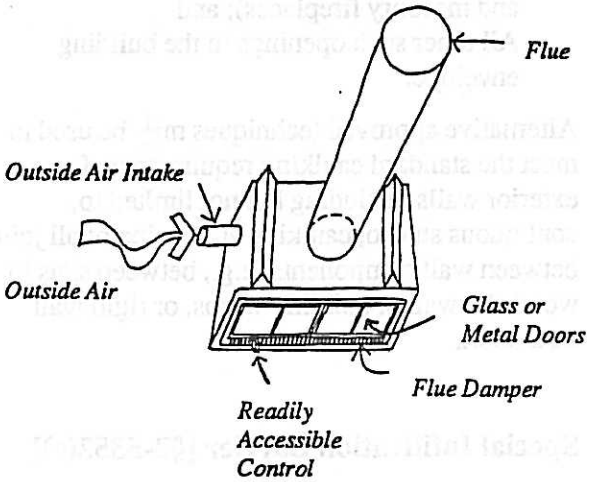


Figure 2-4: Fireplace Installation

- A combustion air intake to draw air from the outside of the building directly into the firebox. This intake must be at least 6 square inches in area and be equipped with a readily accessible, operable and tight-fitting damper. Outside combustion air intakes are not required in Climate Zones 5, 6, 7, 8, 9, 10, 14 and 15 if the fireplace is not located near an exterior wall, nor in any climate zone if the fireplace is installed on a slab floor away from an exterior wall.
- A flue damper with a readily accessible control.

These requirements do not apply to free-standing stoves.

Continuous burning fireplace pilot lights are not allowed. Indoor air vented to the outside to cool a firebox jacket is also prohibited.

2.3 HVAC AND PLUMBING SYSTEM MEASURES

The design and installation of a building's HVAC and plumbing systems have a significant impact on the building's energy consumption. In view of this, the CEC has defined a number of minimum requirements for these systems. The specific areas covered by the regulations include:

- space conditioning equipment sizing, efficiency and controls,
- duct construction,
- water heater and hot water pipe insulation,
- water heater and plumbing equipment certification and
- swimming pool heaters.

The following section discusses each of the relevant mandatory measures in detail, with particular focus on space conditioning equipment sizing considerations.

Space Conditioning Equipment Sizing [§2-5352(g)]

The sizing of residential heating, ventilating and air conditioning (HVAC) systems is regulated by both the *Uniform Building Code (UBC)* and the Building Energy Efficiency Standards. The UBC requires that the heating system be capable of maintaining a temperature of 70°F three feet above the floor throughout the conditioned space of the building. Section 2-5303 of the Standards requires that

> "For the purposes of calculating HVAC sizing for buildings of occupancy R, ... indoor design temperatures shall be 70° for heating and 78° for cooling [See Table 2-3] ... Heating and cooling design loads shall be determined in accordance with the procedures described in the ASHRAE Handbook, 1985 Fundamentals Volume, the ASHRAE Cooling and Heating Load Calculation Manual (1978), or an equivalent computation procedure approved by the Executive Director. Outdoor design air temperatures shall be those listed in the 0.2 percent Winter Dry Bulb column for heating and the 0.5 percent Summer Dry Bulb and 0.5 percent Wet Bulb columns for cooling, based on percent-of-year in ASHRAE publication SPCDX: Climate Data for Region X, Arizona, California, Hawaii and Nevada, 1982."

Table 2-3. Required Indoor Design Temperatures for Sizing Calculations

Heating	Cooling
70°F	78°F

If the actual city location for a project is not included in the ASHRAE listing, or if it appears that the data given for a particular city does not match the conditions at the actual site as well as that given for another nearby city, consult the local building department for guidance.

Section 2-5352 describes mandatory features and devices which include the sizing of heating and cooling equipment.

The following summary of equipment sizing calculations for compliance focuses on the approved method specified in the Standards. Refer directly to the ASHRAE publications for further information. The ASHRAE *Cooling and Heating Load Calculation Manual* is an especially well organized explanation of the topic, particularly Chapter 7, "Residential Heating and Cooling Loads." The manual may be obtained by contacting:

ASHRAE
1791 Tullie Circle, N.E.
Atlanta, GA 30329
(404) 636-8400

The Manual J and SMACNA loads calculation methods have also been approved by the Executive Director.

Design conditions for 641 California locations are found in the ASHRAE publication *Climatic Data For Region X: Arizona, California, Hawaii, Nevada* (Fifth Edition, May 1982). It may be obtained by sending $12.00 payable to "Southern California Chapter ASHRAE, Inc.," to:

Schilling Graphics (Att: Mike Schilling)
626 N. Garfield Avenue
Alhambra, CA 91802

TOTAL SYSTEM CAPACITY AND HVAC SYSTEM SELECTION

The heating and cooling load calculations performed according to the Standards are used to establish lower and upper bounds for the HVAC system capacity of each dwelling unit. Loads can be computed based on a single thermal zone, regardless of the size of the dwelling. *This may be adequate to determine total system capacity, but it may not be satisfactory for equipment selection and system design.* The ASHRAE manual states that:

> "The load can be calculated with the entire structure considered as a single zone; however, final equipment selection and system design is

usually based on a room-by-room calculation, for several reasons: To properly design the distribution system, the designer must know how much conditioned air should be supplied to each room or area of the residence. In addition, the load varies significantly in different areas as a function of time of day.

For example, the distribution system for a room facing west, with large, unshaded windows, may adequately handle morning load, but be totally inadequate when afternoon sun pours energy through the windows. Conversely, designing for very late afternoon solar gains inevitably results in excess capacity at other times. A good thermal design of the house will minimize these load extremes and the resulting problems. Dividing the structure into individually controlled zones can compensate in part for non-uniform load distribution.

When a residence is both heated and cooled, other imbalances may occur from room to room. For example, a room such as a finished basement which is essentially below-grade requires practically no cooling but may have a significant heating load. Some means of shifting the system balance from cooling mode to heating mode may be desirable as well."

HEATING EQUIPMENT SIZING

Section 2-5352(g)1 of the Standards requires that:

"Natural gas and liquefied petroleum gas central furnaces shall be sized to meet at least one of the following requirements:

A. The total output heating capacity of furnaces in the building shall be less than 45,000 Btu/hr; or

B. Output heating capacity shall be less than 1.3 times the sum of the design heat loss rate for the heating zone being serviced by the furnace and 10 Btu per hour per square foot of conditioned floor area in the zone; or

C. Seasonal efficiency shall be greater than 1 percent above 71 percent for every 7,000 Btu/hr the output heating capacity exceeds either the building design heat loss rate or 45,000 Btu/hr, whichever is greater."

Therefore, the maximum output capacity of a central gas furnace system must be less than the largest of the following values for the particular building:

- 45,000 Btu/hr
- 1.3 [Design Heat Loss + (10 Btu/hr-ft^2)(Floor Area)]
- (Seasonal Efficiency - 71) 7000 + (Design Heat Loss or 45,000 Btu/hr)

In addition to the above criteria, all heating equipment sizing must be "in accordance with the building design ... heat gain rate", based upon the ASHRAE method or other method approved by the CEC executive director.

In buildings where design cooling loads are dominant, the furnace or other heating system type may need to be oversized even more in order to achieve sufficient air handling capacity for adequate cooling. This is acceptable as long as the permit applicant provides cooling load calculations that clearly substantiate the need for selecting the larger heating system, and the local enforcement agency concurs with the information presented.

COOLING EQUIPMENT SIZING

Although the energy code does not explicitly limit the output capacity of air conditioning for cooling, the sizing of equipment must still be "in accordance with the building design ... heat gain rate", based upon the ASHRAE method.

The ASHRAE tables associated with heat gain are based on a 75° indoor design temperature, not the 78° temperature required by the Standards. The values in those tables must be modified accordingly.

Setback Thermostats [§2-5352(h) & §2-5315]

All heating systems must have an automatic setback thermostat with a clock mechanism able to set back thermostat set points at least twice in 24 hours.

Heat pumps must have controls which prevent electric resistance supplementary ("strip") heater operation when the heating load can be met by the heat pumps alone, except during defrost. Strip heating is permitted during periods such as start-ups and following room thermostat setpoint advance when controls are provided which use preferential rate control, intelligent recovery, staging, ramping or similar control mechanisms designed to preclude the unnecessary operation of strip heating during the recovery period.

The Standards require that the building occupant must be able to establish the thermostat set points manually. Once set, the clock and thermostat must be able to operate throughout the heating season without further manual operation.

All heating equipment in each dwelling unit must be directly controlled by a setback thermostat. If more than one piece of heating equipment is installed in a residence or dwelling unit, this requirement may be met by either controlling all heating units by one setback thermostat or by controlling each unit with a separate setback thermostat. Separate heating equipment units may be provided with a separate on/off control which is capable of overriding the setback thermostat if desired.

The following heating sytems are *exempt* from this requirement:

- Non-central electric heaters.
- Room air conditioner heat pumps.
- Gravity wall heaters.
- Gravity floor heaters.
- Gravity room heaters.

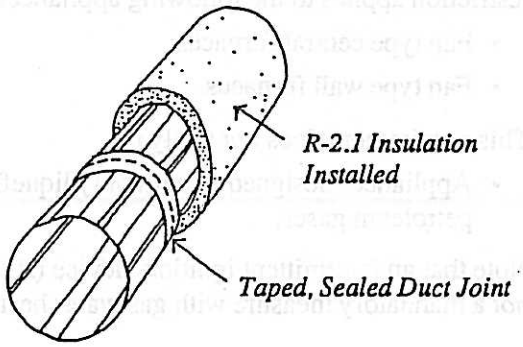


Figure 2-5: Duct Requirements

Ducts [§2-5316(a)]

Energy losses from conditioned air leakage out of HVAC duct systems can be substantial. To limit these losses, the Standards require that ducts be constructed, installed, and insulated according to Chapter 10 of the State Mechanical Code. Chapter 10 requires an installed value of R-2.1 or greater duct insulation and that all joints be sealed and taped. The State Mechanical Code is located in the State Building Standards, Title 24, Part 4. Copies of the State Mechanical Code are available from the Department of General Services.

Exhaust System Dampers [§2-5316(b)]

Exhaust fans and other exhaust systems must be equipped with backdraft or automatic dampers. Some examples of these fans are range-hood exhaust fans used in kitchens or bathroom exhaust fans.

Ignition Of New Gas Space Heating Equipment [§2-5314(c)]

Most new gas space heating equipment cannot be sold or installed if it is equipped with continuously burning pilot lights. In most cases continuously

burning pilot lights have been replaced with electronic intermittent ignition devices. This restriction applies to the following appliances:

- Fan type central furnaces.
- Fan type wall furnaces.

This requirement does *not* apply to:

- Appliances designed to burn only liquefied petroleum gases.

Note that an intermittent ignition device (IID) is *not* a mandatory measure with gas water heaters.

HVAC And Plumbing System Equipment Efficiency Certification [§2-5314]

Only HVAC and plumbing system equipment certified by manufacturers as complying with state Appliance Efficiency Standards at the time of manufacture may be installed. The following types of equipment are subject to this requirement:

- Room air conditioners.
- Central air conditioning heat pumps.
- Central air conditioners with a cooling capacity of less than 135,000 Btu/hr.
- Heat-operated cooling equipment.
- Gas-fired space heaters.
- Heat pumps.
- Gas storage water heaters.
- Electric storage water heaters.
- Oil-fired automatic storage water heaters.
- Showerheads and faucets.

See *SE*, *SEER* and *HSPF* in the *Glossary* for a summary of appliance efficiency standards for gas fired space heaters, air conditioners and heat pumps, respectively.

In §2-5314(b), the Standards set a minimum thermal efficiency of 75% for all:

- Gravity-type central furnaces.
- Fan-type central furnaces with input rates of 400,000 Btu/hr or more.

The Standards do *not* require appliance certification to the Commission for:

- Infrared heaters
- Nonstorage-type electric water heaters.

A certificate of compliance with the Appliance Efficiency Standards must be posted at the building site when any equipment subject to the

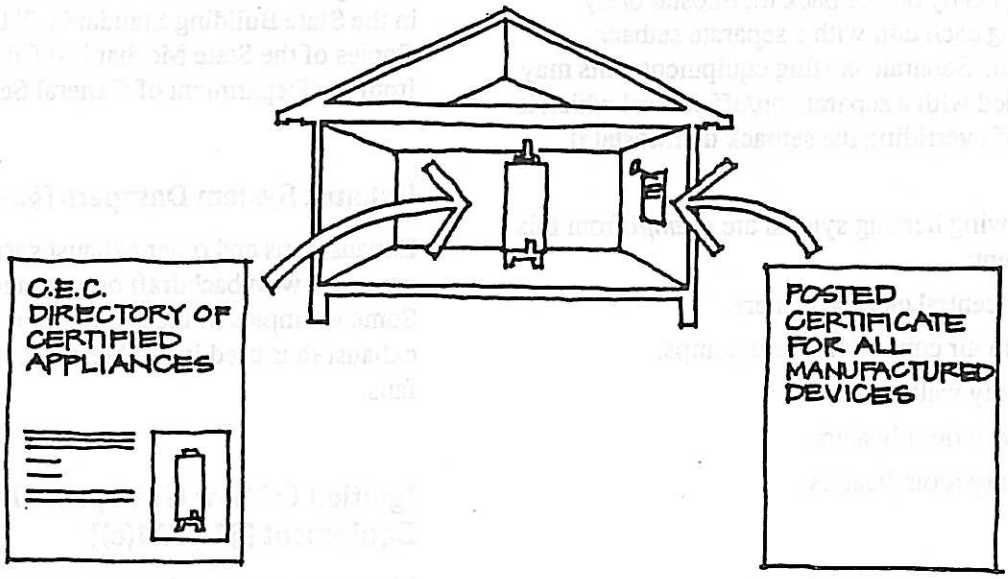


Figure 2-6: Equipment Efficiency Certification

Table 2-4: Sample Listing from the Directory of Gas and Oil-Fan Type Central Furnaces

JUNE 29, 1987 — GAS AND OIL FAN TYPE CENTRAL FURNACES — Brand Name: DAY AND NIGHT — PAGE 42

DESCRIPTION OF MODEL								79/80 STDS		1982/1984 STANDARDS				
MODEL NUMBER	Types Unit	Furnace	DOE Sys. Num.	Duct	Air Flow Cap. at .5" W.C. (CFM) High	Air Flow Cap. at .5" W.C. (CFM) Low	Rated Cooling Capacity (BTUH)	Rated Input (BTUH)	Rated Output (BTUH)	Steady State Eff. (%)	Standby (WATTS)	Annual Fuel Energy Consum. (KBTU)	Annual Fuel Util. Eff. (%)	Annual Aux.Elec. Energy to Heated Space (KWH)	Total Annual Auxiliary Electric Energy (KWH)	Sea. Eff.(%)
395BAW036040	N	G	2	10	U		46000	37000	82.3	5	46530	80.7	728	766	73.6	
395BAW036040	N	L	2	10	U		46000	37000	82.3	5	46530	80.7	728	766	73.6	
395BAW036060	N	G	2	10	U		71000	57000	81.7	5	66780	80.4	690	727	75.5	
395BAW036060	N	L	2	10	U		71000	57000	81.7	5	66780	80.4	690	727	75.5	
395BAW036080	N	G	2	10	U		95000	77000	81.7	5	96353	80.4	765	802	76.6	
395BAW036080	N	L	2	10	U		95000	77000	81.7	5	96353	80.4	765	802	76.6	
395BAW036095	N	G	2	10	U		114000	93000	82.3	5	96535	80.7	637	675	77.4	
395BAW036095	N	L	2	10	U		114000	93000	82.3	5	96535	80.7	637	675	77.4	
395BAW048080	N	G	2	10	U		95000	77000	81.7	5	95013	80.4	1080	1117	75.2	
395BAW048080	N	L	2	10	U		95000	77000	81.7	5	95013	80.4	1080	1117	75.2	
395BAW048095	N	G	2	10	U		114000	93000	82.3	5	95821	80.7	782	820	76.8	
395BAW048095	N	L	2	10	U		114000	93000	82.3	5	95821	80.7	782	820	76.8	
395BAW048120	N	G	2	10	U		143000	116000	81.7	5	135613	80.4	902	939	77.2	
395BAW048120	N	L	2	10	U		143000	116000	81.7	5	135613	80.4	902	939	77.2	
395BAW060095	N	G	2	10	U		114000	93000	82.3	5	95625	80.7	852	890	76.5	
395BAW060120	N	G	2	10	U		143000	116000	81.7	5	134631	80.4	1133	1170	76.5	
395BAW060120	N	L	2	10	U		143000	116000	81.7	5	134631	80.4	1133	1170	76.5	
395BAW060130	N	G	2	10	U		158000	129000	82.3	5	154505	80.7	1008	1045	77.6	
395BAW060130	N	L	2	10	U		158000	129000	82.3	5	154505	80.7	1008	1045	77.6	
396JAW036045	N	G	1	9	D		60000	48000	81.3	5	60501	75.7	658	695	71.1	
396JAW036045	N	L	1	9	D		60000	48000	81.3	5	60501	75.7	658	695	71.1	
396JAW048065	N	G	1	9	D		80000	64000	81.3	5	80884	75.7	830	867	71.4	
396JAW048065	N	L	1	9	D		80000	64000	81.3	5	80884	75.7	830	867	71.4	
396JAW048080	N	G	1	9	D		100000	80000	81.3	5	101964	75.7	847	884	72.1	
396JAW048080	N	L	1	9	D		100000	80000	81.3	5	101964	75.7	847	884	72.1	
396JAW060095	N	G	1	9	D		120000	96000	81.3	5	123198	75.7	830	867	72.8	
396JAW060095	N	L	1	9	D		120000	96000	81.3	5	123198	75.7	830	867	72.8	
398AAW030040	N	G	3	10	U		41000	40000	98.5	5	39570	97.3	450	489	89.8	
398AAW036040	N	G	3	10	U		44000	41000	92.8	5	41877	92.2	418	457	86.0	
398AAW036040	N	L	3	10	U		44000	41000	92.8	5	41877	92.2	418	457	86.0	
398AAW036060	N	G	3	10	U		66000	61000	92.8	5	67433	92.2	553	592	87.2	
398AAW036060	N	L	3	10	U		66000	61000	92.8	5	67433	92.2	553	592	87.2	
398AAW036080	N	G	3	10	U		88000	82000	92.8	5	84911	92.2	524	563	88.3	
398AAW036080	N	L	3	10	U		88000	82000	92.8	5	84911	92.2	524	563	88.3	
398AAW048080	N	G	3	10	U		88000	82000	92.8	5	84622	92.2	602	641	87.8	
398AAW048080	N	L	3	10	U		88000	82000	92.8	5	84622	92.2	602	641	87.8	
398AAW048100	N	G	3	10	U		110000	102000	92.8	5	101676	92.2	688	727	88.1	
398AAW048100	N	L	3	10	U		110000	102000	92.8	5	101676	92.2	688	727	88.1	
398AAW060100	N	G	3	10	U		110000	102000	92.8	5	101543	92.2	724	763	87.9	
398AAW060100	N	L	3	10	U		110000	102000	92.8	5	101543	92.2	724	763	87.9	

Standards is installed (see Figure 2-6). This requirement is defined in Title 20, Section 1403(a)4.

Designers, builders, and enforcement agencies should refer to the California Energy Commission's directories of certified appliances to ensure that the units selected have been certified. Appendix F of this manual lists these directories which are updated periodically. To determine if a model has been certified or decertified after publication of the most recent edition of a directory, contact the Commission's Hotline.

Due to some variation in testing procedures, only energy efficiency ratings listed in Commission directories can be used for compliance; or efficiency ratings listed by manufacturers who have followed the CEC testing procedure.

The Appliance Efficiency Standards require that every gas fan type central furnace with an input rate less than 175,000 Btu/hour and manufactured on or after January 1, 1988, must be certified by the manufacturer to have a *Seasonal Efficiency (SE) of 71 percent or greater for* ***weatherproof*** *equipment or 72 percent or greater for* ***nonweatherproof*** *equipment.* If a furnace was manufactured on or after January 1, 1988, and has not been certified to have the appropriate Seasonal Efficiency, it may not be sold in California.

NOTE: Due to changes in federal testing procedures, some nonweatherproof furnaces which had a published rating of 71% SE before January 1, 1988 may now have a published rating of 72% SE as explained under *SE* (Seasonal Efficiency) in the *Glossary.*

Table 2-4 shows a typical listing from the CEC's *Directory of Gas and Oil-Fan Type Central Furnaces*. The column on the far right-hand side of the page shows the Seasonal Efficiency of each furnace. The directory lists whether or not the furnace is weatherproof in the second column on the left-hand side of the page under Unit Type. Unit Type "W" means weatherproof, while Unit Type "N" means nonweatherproof.

Certain central furnaces, air conditioners and air source heat pumps manufactured on or after January 1, 1988 must meet higher efficiencies than were previously mandated:

- Nonweatherproof central gas type furnaces must have a SE of 72%.
- Central air conditioners and air source heat pumps with an output capacity of less than 65,000 Btu/hr must have a SEER of 8.9.

These equipment types not meeting the above listed efficiencies and manufactured before January 1, 1988 may be sold and installed in California indefinitely. If a performance approach (see Chapters 4 and 5) demonstrates compliance of a building using the lower efficiency (pre-1988 manufactured) appliances, that equipment may be installed if still available.

Note that any equipment covered by the Appliance Efficiency Standards and offered for sale in the State must have the date of manufacture permanently displayed in an accessible place on that equipment.

Water Heater Insulation [§2-5352(i)]

Storage-type water heaters and storage and backup tanks for solar water heating systems must be wrapped with an insulation blanket having an R-value of at least 12. This R-12 blanket must be installed in addition to any insulation inside the outer tank jacket of manufactured water heaters. Alternatively, such tanks may be insulated to a combined level of R-16, when both internal insulation and external wrap insulation are considered. Internal insulation can be included in the combined insulation level only where the R-value of such insulation has been labeled on the tank exterior by the manufacturer (see Figure 2-7). There are no exceptions to these insulation requirements. If a tank cannot be wrapped, then another tank must be used. This includes tanks which cannot be wrapped because of restrictions placed by the manufacturer.

The blanket insulation requirement applies to storage tanks used primarily for domestic water heating systems. It does not apply to storage tanks used primarily for space heating systems or to solar storage tanks mounted outdoors and directly exposed to weather, such as typical breadbox or batch systems.

If external insulation is applied to water heaters and to storage and backup tanks for solar water heating systems in existing rather than new buildings, it must have at least an R-6 rating.

Hot Water Pipe Insulation [§2-5312, Exception I]

Piping in unconditioned space leading to and from water heaters must be insulated with at least R-3 insulation for the first 5 feet of pipe closest to the water heater, or whatever shorter length is in unconditioned space (see Figure 2-7). No pipe

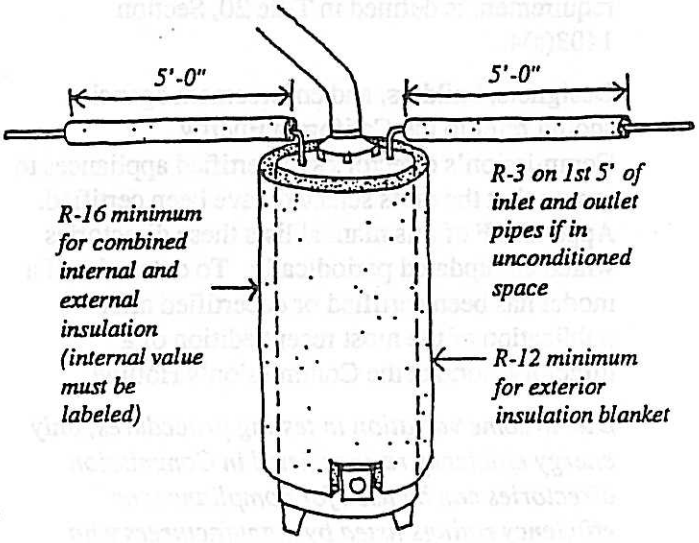


Figure 2-7: Domestic Hot Water

insulation is required in conditioned space or for other non-recirculating piping.

Caution should be exercised in insulating pipes close to heater flues carrying hot combustion gases. It may be necessary to stop pipe insulation short of the storage tank to avoid damage of pipe insulation close to the flue.

It is not necessary to penetrate a fire wall with the pipe insulation. The insulation may end at the fire wall and be continued on the other side if it continues in unconditioned space.

Steam and steam-condensate return piping and recirculating hot water piping in attics, garages, crawl spaces, or unheated spaces other than between floors or in interior walls must be insulated to provide a maximum heat loss of not more than 50 Btu/hr per linear foot for piping up to and including 2-inch nominal diameter and 100 Btu/hr per linear foot for larger sizes.

See the *ASHRAE Handbook and Product Directory*, 1985 Fundamentals volume for reference tables and procedures on pipe heat loss calculation rates. Also see Chapter 6 of this manual.

Swimming Pool Heating [§2-5318]

All new or replacement gas, diesel or electric swimming pool heating systems must meet the following requirements:

The pool heating system must be equipped with:

- An easily accessible on/off switch mounted on the outside of the heater that turns the heater on and off without the need to relight the pilot light or change the thermostat setting;
- A permanent weatherproof plate or card that provides instructions for the energy efficient operation of the swimming pool and for the proper care of swimming pool water when a swimming pool cover is used; and
- A length of plumbing (36 inch minimum) between the filter and the gas, diesel or electric heater to allow for the possible future addition of solar heating equipment.

Any new or replacement gas, diesel or electric swimming pool heater must have a thermal efficiency of at least 75 percent and must be so identified on the plans and the heater.

Outdoor pools equipped with a gas, diesel or electric heater must also be equipped with a pool cover. The pool cover must be one that was manufactured for use as a pool cover, a determination made by the local enforcement agency.

Time clocks must be installed on any new or replacement pool circulation pump so that the pump can be set to run in the off-peak electric demand period (unless required to operate an active solar pool heating system) and for the minimum time necessary to maintain the water in a clear and sanitary condition in keeping with applicable public health standards.

Time clocks are not required where public health standards require 24 hour operation.

All new pools must be equipped with directional inlets which adequately mix the pool water to prevent stratification of the heated supply water and the colder existing water.

These requirements do not apply to hot tubs or spas.

2.4 LIGHTING AND APPLIANCE MEASURES

The Standards also include regulations covering new residential lighting and certain other appliances, which also contribute to overall energy use. The next section details these requirements, which include: minimum efficiency for new light fixtures in kitchens and bathrooms, restrictions on ignition devices for gas fired equipment, and state certification of refrigerators, refrigerator-freezers, freezers and fluorescent lamp ballasts.

Table 2-5. Approximate Efficiency of Luminaires

Light Source	Watts	Lumens	Efficiency Lumens/Watt
Incandescent	75	1,200	16
	100	1,700	17
Fluorescent	20	1,200	62
	40	3,100	78

Lighting [§2-5352(j)]

Installing energy efficient lamps and fixtures can reduce lighting energy costs without sacrificing the quality or quantity of light available.

The Standards require that *general purpose lighting* fixtures in kitchens and bathrooms have an *efficacy* of at least 25 ***lumens per watt.*** Because fluorescent lamps are considerably more efficient than incandescent lamps, fixtures for general lighting will usually be fluorescent. As indicated in Table 2-5, a 40 watt fluorescent lamp is more than three times as efficient as a 100 watt incandescent lamp.

If there is only one fixture in a kitchen, it is considered general lighting. When there is more than one fixture in a kitchen, the general lighting will be obtained from the luminaire whose switch is positioned in a readily accessible location by the entry to the kitchen. A light switch location determines how the occupant will use the lighting and which light is turned on as general lighting because its switch is most accessible.

Luminaires which are used for a specific visual task, such as lighting a kitchen counter or sink or a dining table, need not be considered general lighting if they are in addition to other general lighting .

If there is only one fixture in a bathroom, it is exempt from the minimum efficiency requirements and may be incandescent.

If there is only one fixture in a bathroom, it is considered general lighting. When there is more than one fixture in a bathroom, the general lighting will be obtained from the luminaire whose switch is positioned in a readily accessible location by the entry to the bathroom. A light switch location determines how the occupant will use the lighting and which light is turned on as general lighting because its switch is most accessible.

NOTE: If a privacy door separates two parts of a bathroom, the two parts are still considered one bathroom for the purpose of the lighting requirements.

There is no limit on the amount of lighting installed in kitchens and bathrooms, only a minimum luminaire efficiency for the general purpose lighting fixtures. Figures 2-8 and 2-9 give several examples of bathroom and kitchen lighting and illustrate how the designs can comply. Incandescent fixtures equipped with screw in fluorescent adaptors which can be removed and replaced by incandescent lamps do not comply.

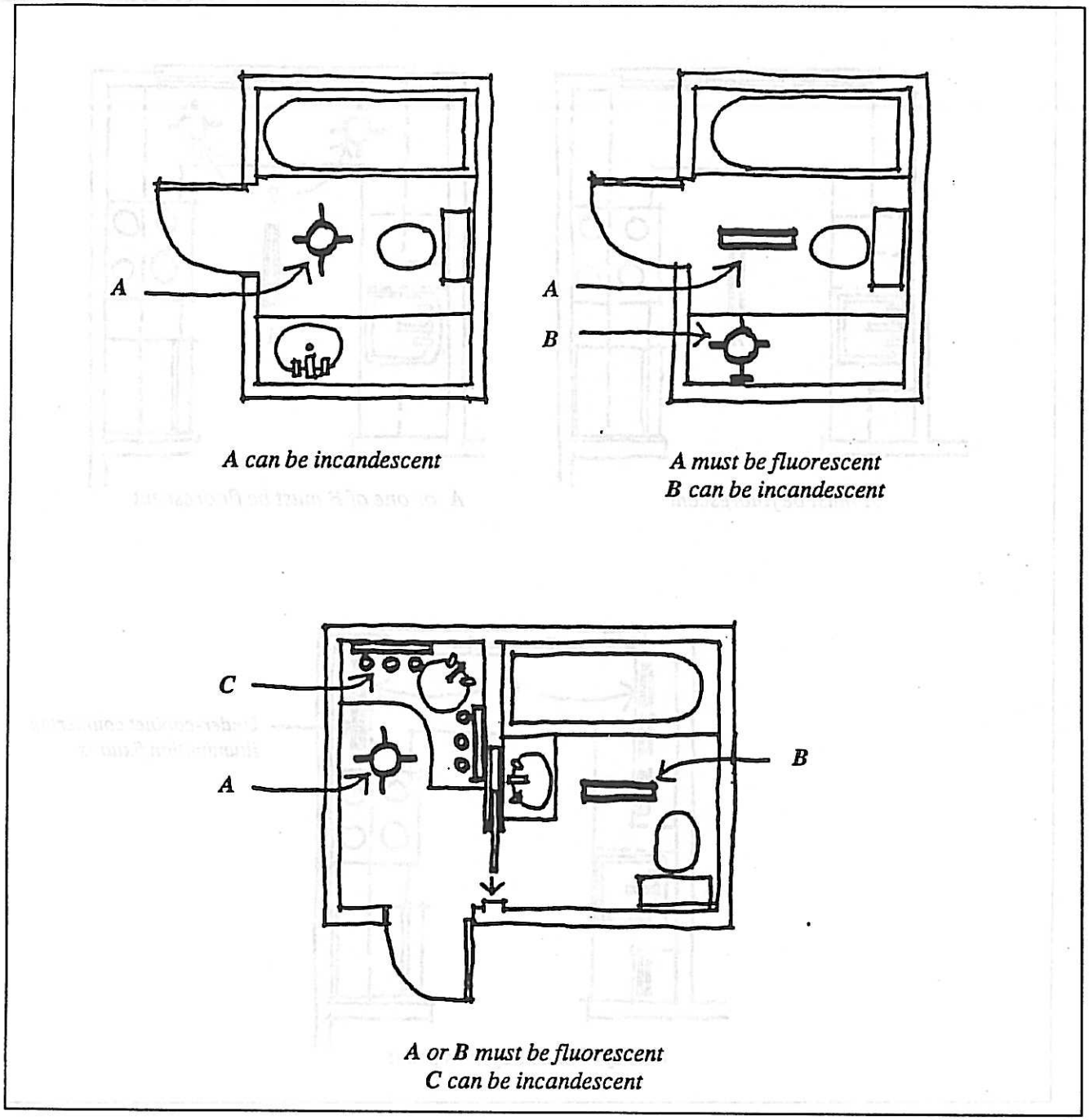


Figure 2-8: Bathroom Lighting Examples

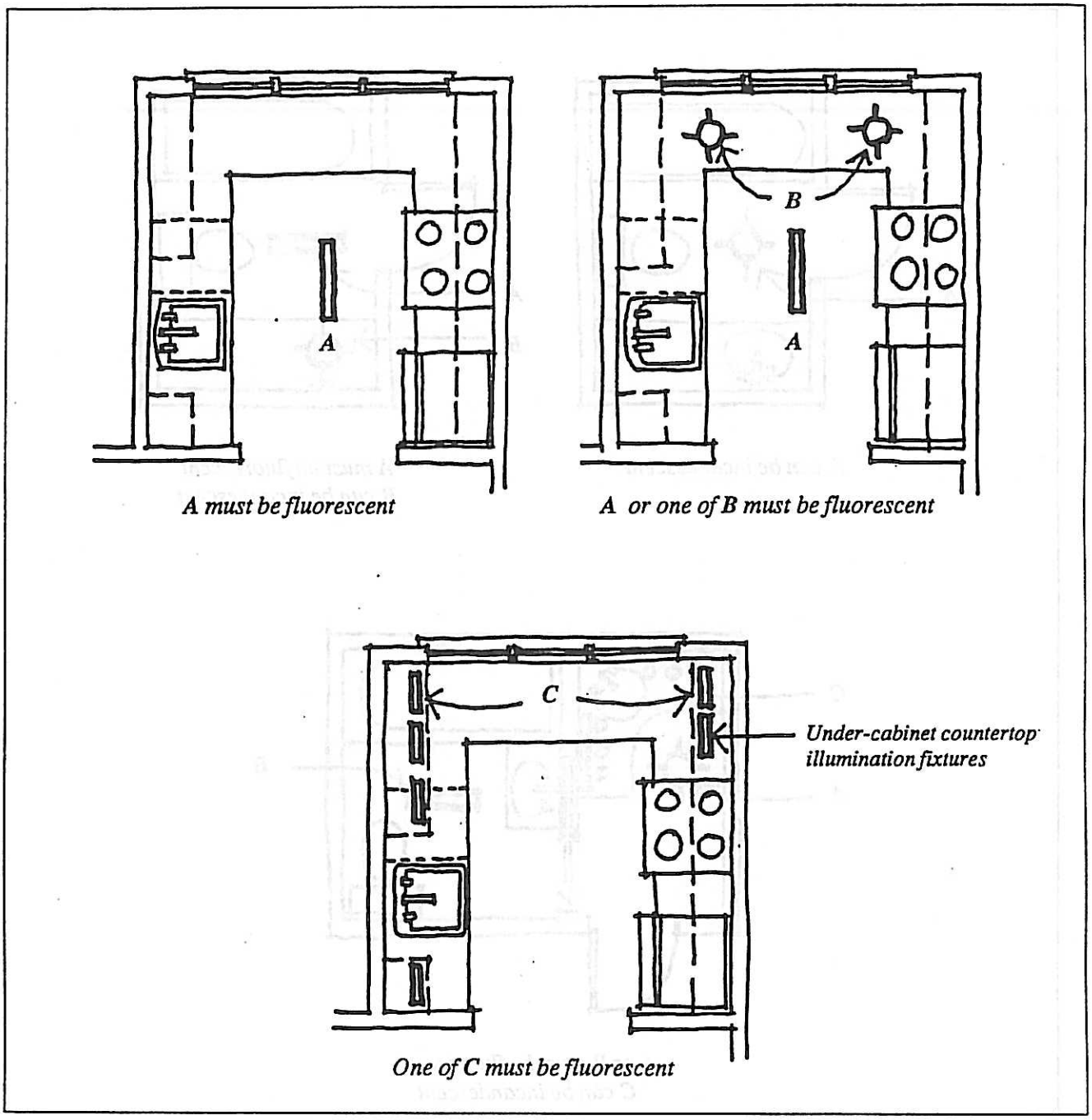


Figure 2-9: Kitchen Lighting Examples

Ignition Of New Gas Appliances [§2-5314(c)]

Most new gas appliances cannot be sold or installed if they are equipped with continuously burning pilot lights. In most cases continuously burning pilot lights have been replaced with electronic intermittent ignition devices. This restriction applies to the following appliances:

- Household cooking appliances.
- Pool heaters.
- Clothes dryers.

This requirement does *not* apply to:

- Appliances designed to burn only liquefied petroleum gases.
- Cooking appliances which do not have an electrical line voltage supply connection and no more than one continuously burning pilot light consuming less than 150 Btu/hr.
- Any pool heater that was sold to the builder before February 24, 1984.

Appliance Efficiency Certification [§2-5314]

You may install only appliances that have been certified by manufacturers as complying with state Appliance Efficiency Standards at the time of manufacture. The following types of equipment are subject to this requirement:

- Refrigerators, refrigerator-freezers and freezers.
- Fluorescent lamp ballasts.

Designers, builders, and enforcement agencies should refer to the California Energy Commission's Directories of Certified Appliances listed in Appendix F to ensure that the units selected have been certified.

These publications are updated periodically. To determine if a model has been certified or decertified after publication of the most recent edition of a directory, contact the Energy Commission's Building and Appliance Efficiency Office Hotline at (916) 324-3376.

Due to some variation in testing procedures, only energy efficiency ratings listed in Commission directories can be used for checking compliance.

No new appliances covered by CEC Standards may be sold or offered for sale in California unless the date of manufacture is permanently displayed in an accessible place on the appliance.

2.5 Mandatory Measures Checklist

A recommended Mandatory Measures Checklist MF-1R form is included at the end of this section and in Appendix A. The individual with overall design responsibility signs the Certificate of Compliance and verifies the applicable mandatory measures are incorporated in the permit documents

As noted on the MF-1R form, certain mandatory measures which may be superseded by conservation levels established in the compliance approach are marked with an asterisk (*).

Mandatory Measures Checklist: Residential

MF-1R

NOTE: Lowrise residential buildings subject to the Standards must contain these measures regardless of the compliance approach used. Items marked with an asterisk (*) may be superseded by more stringent compliance requirements listed on the Certificate of Compliance. When this checklist is incorporated into the permit documents, the features noted shall be considered by all parties as binding minimum component performance specifications for the mandatory measures whether they are shown elsewhere in the documents or on this checklist only.

DESCRIPTION	DESIGNER	ENFORCEMENT
Building Envelope Measures		
* §2-5352(a): Minimum ceiling insulation R-19 weighted average.		
§2-5352(b): Loose fill insulation manufacturer's labeled R-Value.		
* §2-5352(c): Minimum wall insulation in framed walls R-11 weighted average (does not apply to exterior mass walls).		
§2-5352(k): Slab edge insulation - water absorption rate no greater than 0.3%, water vapor transmission rate no greater than 2.0 perm/inch.		
§2-5311: Insulation specified or installed meets California Energy Commission (CEC) quality standards. Indicate type and form.		
§2-5352(f): Vapor barriers mandatory in Climate Zones 14 and 16 only.		
§2-5317: Infiltration/Exfiltration Controls a. Doors and windows between conditioned and unconditioned spaces designed to limit air leakage. b. Doors and windows certified. c. Doors and windows weatherstripped; all joints and penetrations caulked and sealed.		
§2-5352(e): Special infiltration barrier installed to comply with §2-5351 meets CEC quality standards.		
§2-5352(d): Installation of Fireplaces 1. Masonry and factory-built fireplaces have: a. Tight fitting, closeable metal or glass door b. Outside air intake with damper and control c. Flue damper and control 2. No continuous burning gas pilots allowed.		
HVAC and Plumbing System Measures		
§2-5352(g) and 2-5303: Space conditioning equipment sizing: attach calculations.		
§2-5352(h) and 2-5315: Setback thermostat on all applicable heating systems.		
* §2-5316(a): Ducts constructed, installed and insulated per Chapter 10, 1976 UMC.		
§2-5316(b): Exhaust systems have damper controls.		
§2-5314(c): Gas-fired space heating equipment has intermittent ignition devices.		
§2-5314: HVAC equipment, water heaters, showerheads and faucets certified by the CEC.		
§2-5352(i): Water heater insulation blanket (R-12 or greater) or combined interior/exterior insulation (R-16 or greater); first 5 feet of pipes closest to tank insulated (R-3 or greater).		
§2-5312(Exception I): Pipe insulation on steam and steam condensate return & recirculating piping.		
§2-5318(d): Swimming Pool Heating 1. System has: a. On/off switch on heater. b. Weatherproof instruction plate on heater. c. Plumbed to allow for solar. 2. 75 percent thermal efficiency. 3. Pool cover. 4. Time clock. 5. Directional water inlet.		
Lighting and Appliance Measures		
§2-5352(j): Lighting - 25 lumens/watt or greater for general lighting in kitchens and bathrooms.		
§2-5314(c): Gas fired appliances equipped with intermittent ignition devices.		
§2-5314(a): Refrigerators, refrigerator-freezers, freezers and fluorescent lamp ballasts certified by the CEC. Indicate make and model number.		

2. Mandatory Measures

This chapter explains the mandatory measures that apply to all nonresidential buildings, including occupancy types still covered by the first generation standards. When the second generation standards were adopted for the first occupancy in 1984, the first generation mandatory measures were revised and relocated in the regulations. The information in this Chapter is, therefore, more current than information contained in the 'Guides' to the first generation standards.

The mandatory features and devices must be included in the building design whether compliance is shown by the prescriptive or the performance approach. These features have been proven cost-effective over a wide range of building occupancy types and by independent analyses. Many of the mandatory measures have been adopted from nationally recognized codes and standards, such as ANSI/ASHRAE 90A-80 and the NCSBCS Model Energy Code.

The mandatory measures presented in this chapter are organized in three categories, as follows:

- Envelope Measures
- Lighting Systems Measures
- HVAC and Plumbing Systems Measures

It is worthy to note that many of the mandatory features and devices are requirements on manufacturers of building products. It is the responsibility of the designer, however, to specify products in the building design that meet these requirements. The installers of regulated manufactured devices are required to post installation certificates. Local code officials, in turn, are responsible for checking that the mandatory features and devices are installed.

2.1 Envelope Measures

2.1.1. Insulating Materials

Section 2-5311 of the standards specifies the mandatory requirements for building insulation; these include:

Certification. Building insulation must be certified by the manufacturer to meet the California Quality Standards for Insulating Material. The following products are among the materials that are required to be certified:

Aluminum foil
Cellular glass in board form
Cellulose fiber, either loose fill or sprayed applied
Mineral aggregate in board form
Mineral fiber in any form
Perlite loose fill
Polystyrene in board, molded or extruded form
Polyurethane in board form or field applied
Polyisocyanurate in board form or field applied
Urea formaldehyde foam field applied
Vermiculite loose fill

Fire Safety. All insulating materials must be installed in compliance with the flame spread and smoke density requirements of Sections 1712 and 1713 of the 1982 edition of the Uniform Building Code.

Urea Formaldehyde. Urea formaldehyde foam insulation may only be installed on the exterior sidewalls of buildings and a continuous, four mil polyethylene plastic sheet must be provided to separate the insulation from the interior space.

2.1.2. Doors and Windows

Section 2-5317 requires that all exterior doors and windows be designed to limit air leakage. The requirement applies to doors and windows that lead directly to the out-of-doors as well as those that lead to unconditioned spaces such as garages and mechanical rooms.

Manufactured windows and doors must be certified by the manufacturer to meet minimum infiltration requirements. Labels from the Architectural Aluminum Manufacturer's Association (AAMA) or the National Woodwork Manufacturer's Association (NWMA) are evidence that manufactured windows meet the state standards. For operable windows, infiltration is limited to 0.50 cubic feet per minute (cfm) per foot of movable sash crack. For single swinging doors (one leaf), infiltration is limited to 0.50 cfm per square foot of door surface. For double swinging doors (two leafs) the limit is 1.0 cfm per square foot. These infiltration limits are

certified under the pressure conditions of an approximate 25 mph wind. The designer and building official should verify that products specified for the building meet the requirements and have been properly certified by the manufacturer.

Site-constructed doors and windows must be caulked, gasketed, weatherstripped or sealed such that all observable sources of air leakage are treated.

The requirements for both manufactured and site-built products do not apply to fire rated doors and windows, unframed glass doors, and doors or windows that separate elevator shafts from the out-of-doors.

Dampers in elevator shafts are required in certain circumstances. It should be noted that the first generation standards required elevator shaft dampers in all cases. The second generation nonresidential energy standards only require dampers if the elevator shaft is treated as conditioned space. In this event, the walls that separate the elevator shaft from the conditioned space would be treated as exterior walls. This has the following implications.

- If the prescriptive approach is used, the walls would have to meet the insulation requirements for exterior walls. They would also result in a larger exterior wall area to enable more glazing.
- If the performance approach is used, the conditioned floor area of the building will be reduced, possibly resulting in a larger estimated energy use.

2.2 Lighting System Measures

2.2.1. Switching and Circuiting Requirements

Lighting systems must have switching and circuiting capability to enable efficient lighting operation. Most of the switching requirements are intended to allow occupants to turn off unneeded lights. The switching and circuiting requirements are presented here only for illustration; refer to Section 2-5319 for the specific requirements.

Room Switching. Independent lighting controls are required for each area enclosed by ceiling height partitions. If certified occupancy sensors are installed, these may substitute for the requirement for individual room switching.

Accessibility. All manually operated switching devices must be located so that personnel can see the controlled area when operating the switch(es). If there is a master switch as well as local switching, only the local switch need meet this requirement.

Bi-Level Illumination. Areas greater than 100 square feet, with more than 1 watt per square foot of installed lighting power, and for which more than one light source (lamp) provides all illumination, must be controlled in one of the following ways.

Option A: Lighting must be controlled so that the connected lighting load may be reduced by at least 50 percent in a reasonably uniform pattern. This may be achieved in different ways; for example, the output of each luminaire can be reduced or every other luminaire in a row can be shut off. Other patterns of reduction are also possible; the intent is to allow reduction without losing use of part of the space. A dimming control or separate switching for each luminaire are also acceptable approaches. Incandescent dimmers should be used with discretion, however, because they are not as energy efficient as bi-level switching.

Option B: Lighting must be controlled so that it is turned off automatically by a certified occupancy sensor soon after an area is vacated.

Option C: Lighting must be controlled by a programmable timing system that automatically shuts off non-emergency lights. The timing system shall be capable of programming different schedules for weekdays and weekends, with automatic changeover from one schedule to the other. It shall also be capable of being temporarily overridden by occupants, with an automatic return to the original schedule.

Note that Options B and C, to allow programmable timers or occupancy sensors as an alternative to bi-level illumination, is a change from the first generation nonresidential standards.

Natural Lighting. Areas which are daylit by their proximity to windows, skylights, atria, etc. must be circuited and switched so that electric lighting in these areas can be separately controlled. Daylit area is defined in Chapter 3 of this Manual.

Valance Lighting. Valance lighting in retail and wholesale stores shall be switched separately.

Display Lighting. Feature display lighting in retail and wholesale stores shall be separately switched on circuits no greater than 20 amperes. If a wholesale or retail store has more than four 20 ampere circuits of display lighting, the display lighting must be automatically controlled by a programmable timer. The timer must be capable of programming different schedules for weekdays and weekends and provide for temporary override by store personnel. The temporary override must be readily accessible with automatic return to the programmed schedules.

Tandem Wiring. One-lamp or three-lamp luminaires shall be tandem wired to eliminate the unnecessary use of less efficient single lamp ballasts. Tandem wiring refers to the arrangement where a ballast operates a lamp in one luminaire and a lamp in an adjacent luminaire. This requirement applies to recessed or surface mounted luminaires located within ten feet of each other and to pendant mounted luminaires located within one foot of each other. There is an exception to the tandem wiring requirement, however, when two adjacent luminaires have separate switching requirements.

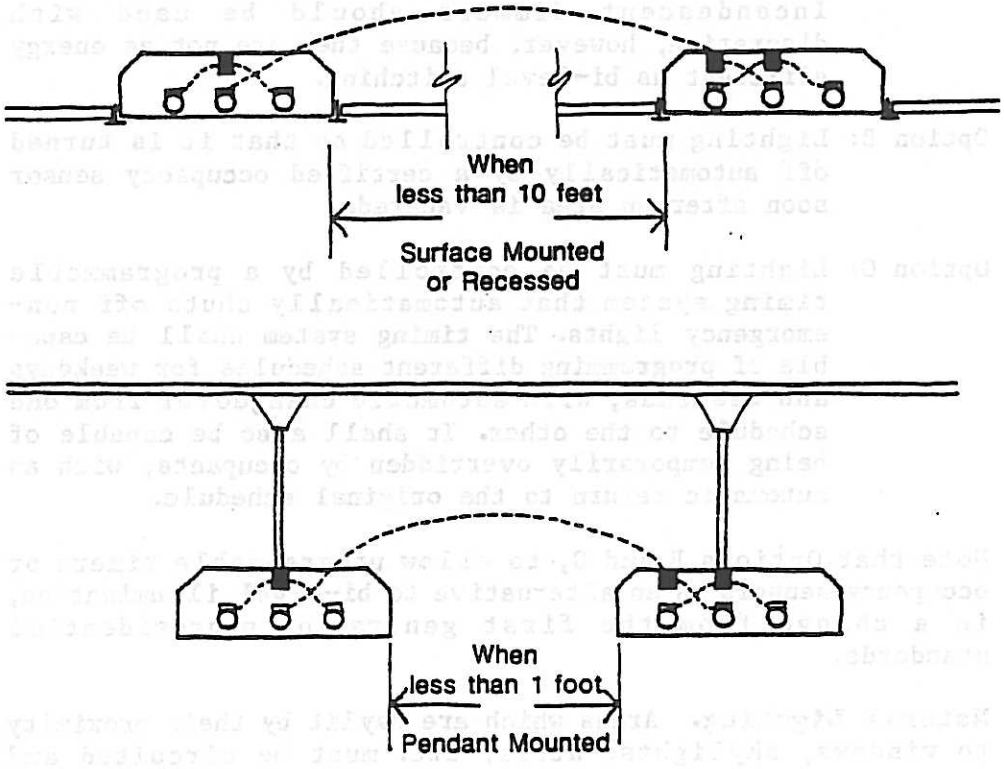
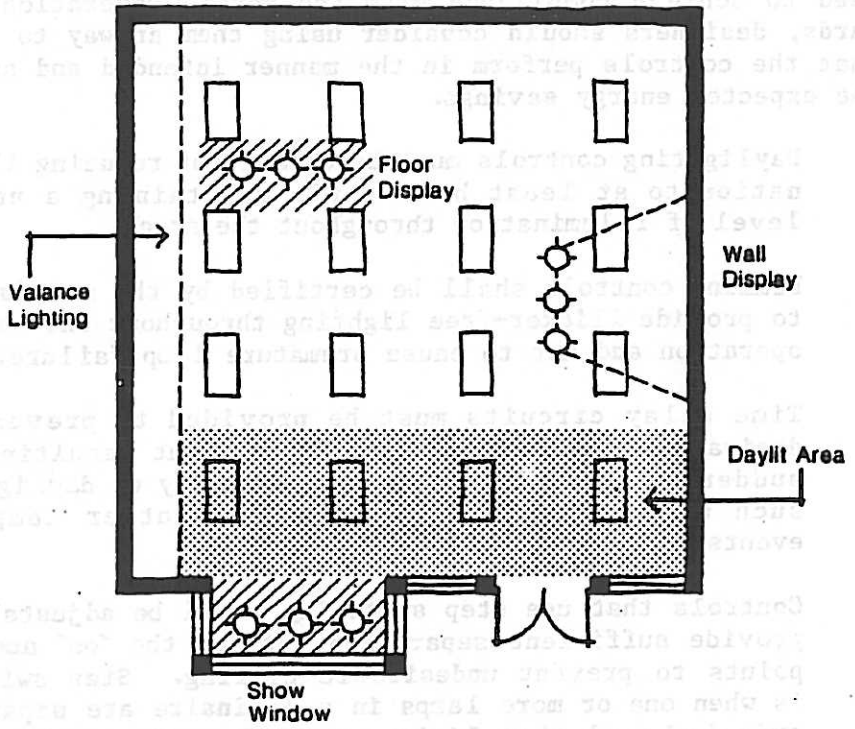


Figure 2-1: Tandem Wiring Requirement

EXAMPLE 2-1
Retail Switching Requirements

SITUATION

The lighting design in a 2,000 sf men's store is shown in the schematic drawing below. General illumination is provided by recessed 2x4 troffers located in a suspended ceiling. Valance lighting is located along one side of the store. The store is designed with two feature displays, one located in the window and one located near the center of the store. Each of these feature displays is illuminated by track lighting located directly above the display.



CODE APPLICATION

The valance lighting must be separately switched from the general illumination. Also each of the feature displays must be separately switched. Since the feature displays are less than four 20 ampere circuits, programmable timers are not mandatory, but the designer may want to consider them anyway to enable more efficient lighting operation. Luminaires located within 15 feet of the glazing must also be switched separately so that they may be turned off when daylighting is available.

2.2.2. Minimum Specifications for Automatic Controls

The following minimum requirements apply to automatic controls that are installed in order to comply with the second generation nonresidential standards, through either the prescriptive or performance approach.

Daylighting and Lumen Maintenance Controls. Both daylighting and lumen maintenance controls have a sensor (usually a photocell) that measures the amount of illumination at a reference location. If the level of illumination is higher than the design illumination level because of the availability of daylight or because the lamps are new, light output from the luminaires will be reduced. While the following minimum specifications are required only if the controls are used to achieve compliance with the second generation standards, designers should consider using them anyway to assure that the controls perform in the manner intended and achieve the expected energy savings.

- Daylighting controls must be capable of reducing illumination to at least half while maintaining a uniform level of illumination throughout the area.

- Dimming controls shall be certified by the manufacturer to provide flicker-free lighting throughout the range of operation and not to cause premature lamp failure.

- Time delay circuits must be provided to prevent undesirable, rapid changes in light output resulting from sudden variations in the availability of daylighting, such as the passing of a cloud or other temporary events.

- Controls that use step switching shall be adjustable to provide sufficient separation between the 'on' and 'off' points to prevent undesirable cycling. Step switching is when one or more lamps in a luminaire are separately switched such that light output from the luminaire is raised or lowered in steps, rather than continuously.

- Photocell sensors shall be of the light diffusing type and of a design that would prevent unauthorized disabling of the control. Photocell sensors, for example, with a built-in sliding door device to shut out light are prohibited.

- Control manufacturers shall provide step-by-step instructions for installation and calibration to design illumination levels.

- Daylighting controls must incorporate certified occupancy sensors or programmable timers capable of separate schedules for weekdays and weekends along with temporary override and automatic return.

- The controls installer must locate photocell sensors according to the designer's or manufacturer's instructions, provide certification that the control is properly calibrated, and install daylighting controls to control only those luminaires within the daylit areas, as defined in the standards.

Occupancy Sensors. Occupancy sensors detect if a room or space is occupied through the use of technology first developed for the building security industry. Various techniques are used to 'sense' the presence of an occupant, including continuous measurements of noise, infrared radiation and other techniques. Occupancy sensor controls contain circuitry that automatically turns off the lights after a space has been vacated. Occupancy sensors that are installed in order to comply with any of the requirements of the standards shall meet the following minimum specifications. The specifications are recommended in all installations, however.

- If the occupancy sensor provides dimming, the controls shall be certified by the manufacturer to provide flicker free operation throughout the expected range of operation and not to cause premature lamp failure.
- Time delay circuits must be provided to prevent undesirable cycling of the lights on and off resulting from persons passing outside the room or from temporary idle moments on the part of an occupant.
- Occupancy sensors that are installed in lieu of the bi-level illumination requirement or the separate switching requirement for enclosed rooms must comply with standards on maximum radiated energy and noise.

2.2.3. Certified Ballasts and Luminaires

Many fluorescent lamp ballasts and luminaires with fluorescent lamp ballasts are certified by the manufacturer to comply with the Appliance Standards for Fluorescent Ballasts (Section 2-5314, Table 53-G, Item 7). While these standards do not cover all types of fluorescent lamps and ballasts, all standard wattage four and eight-foot lamp and ballast combinations, commonly installed in nonresidential buildings, are covered. A directory of certified luminaires is available from the CEC. A directory listing ballast model numbers that meet the minimum efficiency standards is also available. Detailed information on the energy efficiency standards for fluorescent lamp ballasts is available in a separate CEC publication. Appendix H has information on how to obtain these documents. Note that the efficiency requirements for fluorescent ballasts represent a change from the first generation nonresidential standards.

2.3 HVAC and Plumbing System Measures

2.3.1. Equipment Sizing

For the purposes of sizing HVAC equipment, Section 2-5303 of the Standards requires that the designer use the following outdoor design conditions:

Cooling: 0.5% Summer Drybulb
Heating: 0.2% Winter Drybulb

These temperatures are typical conditions selected by HVAC designers for design calculations. The percentages are based on yearly temperature occurrences as indicated in the ASHRAE publication SPCDX Climatic Data for Region X.

Design indoor temperature requirements are not explicitly specified. Designers are allowed to use any temperature conditions within the "comfort envelope" defined by ASHRAE Standard 55-81.

Load calculations must be performed in accordance with the procedures described in the ASHRAE Handbook, 1985 Fundamentals, the ASHRAE Cooling and Heating Load Calculation Manual (1978), or a comparable procedure. Designers may find that computerized load programs based on the ASHRAE procedures are more convenient and flexible.

While load calculations must be performed in accordance with Section 2-5303, the standards do not directly require that equipment selections be based on these calculations. Rather, the issue of equipment oversizing is addressed indirectly in both the prescriptive and performance compliance approaches. Equipment size is limited under the prescriptive approach by the HVAC performance indices which are defined as HVAC equipment energy input per square foot of conditioned area. For the performance approach, actual equipment sizes must be modeled when calculating annual energy use; this indirectly constrains oversizing.

2.3.2. Insulation of Piping and Ductwork

Piping. Piping must be insulated consistent with the requirements of Section 2-5312. The required thickness of piping insulation depends on the temperature of the fluid passing though the pipe, the pipe diameter, and the function of the pipe within the system. Table 2-53E in the Standards specifies the requirements in terms of inches of insulation. This table is repeated as Table 2-1 of this Manual, but is a somewhat simplified form. Runouts are defined as being less

than 2-inches in diameter, less than 12 feet long and connected to fixtures or individual terminal units.

Table 2-1: Minimum Pipe Insulation

Fluid Temperature	Pipe Diameter (in inches)					
	Runouts	<1"	1.25-2"	2.5-4"	5-6"	>8"
306-460	1.5	2.5	2.5	3.0	3.5	3.5
251-305	1.5	2.0	2.5	2.5	3.0	3.0
201-250	1.0	1.5	1.5	2.0	2.0	2.0
105-200	0.5	1.0	1.0	1.5	1.5	1.5
61-104	no insulation required					
40-60	0.5	0.5	0.75	1.0	1.0	1.0
Below 40	1.0	1.0	1.5	1.5	1.5	1.5
Steam Condensate	1.0	1.0	1.5	2.0	2.0	2.0

The thickness of insulation listed in Table 2-1 is based on materials having a thermal resistance in the range of R-4.0 to R-4.6 per inch. Adjustments are required for insulation materials outside this range.

The piping insulation requirements do not apply to piping located within HVAC equipment or piping conveying fluids at temperatures between 60 degrees F and 105 degrees F, such as condenser water piping.

Ducts. HVAC ducts shall be constructed, installed, sealed and insulated in accordance with Chapter 4-10 of the 1986 California State Mechanical Code, which wholly adopts Chapter 10 of the 1985 Uniform Mechanical Code (UMC). Insulation requirements are shown in Table 10-D of the UMC. These requirements are summarized in Table 2-2 for 0.60 lb/cf mineral fiber blankets. The thickness of insulation required will vary with other types of insulation.

Table 2-2: Duct Insulation Requirements

Location of Duct	Mechanically Cooled Buildings	Heated Only Buildings
Building exterior	3-inches	1-inch in most of California, but 2-inches in areas with more than 4,500 HDD.
Unconditioned spaces	1-inch	1-inch
In walls or floor-to-ceiling spaces	1-inch	1-inch

2.3.3. HVAC Equipment Requirements

Certification. Certain types of HVAC and plumbing equipment must be certified by the manufacturer to comply with the CEC Appliance Efficiency Standards. For smaller buildings, most HVAC equipment will require CEC certification. This includes air conditioners up to 135,000 Btu/hr, furnaces, boilers, etc. Equipment that must be certified include:

Room Air Conditioners
Central Air Conditioners (less than 135 kBtu/hr)
Central Air Conditioning Heat Pumps (all)
Fan Type Central Furnaces (less than 400 kBtu/hr)
Boilers
Gas Space Heaters
Wall Furnaces
Floor Furnaces
Room Heaters
Duct Heaters
Duct Furnaces
Water Heaters
Plumbing Fittings

Refer to the Appliance Standards, Title 20, Chapter 2, Subchapter 4, Article 4, Section 1601 for the specific types of equipment that must be certified. Directories of certified equipment can be obtained from the CEC (see Appendix H). The building contractor must provide to the building official model numbers of regulated equipment and documentation that the equipment is certified.

The contractor or subcontractor must post installation certificates for manufactured devices required to be certified. The certificates must be posted adjacent to the building permit for the building and include information about the

certification designation, model number and other relevant information. The certificate must state that the installation is consistent with the plans and specifications for which the building permit was issued.

Gas Efficiency. Some gas-fired heating equipment must also meet minimum efficiency requirements. A minimum thermal efficiency of 75 percent, for instance, is required for fan type central furnaces with input rates of at least 400,000 Btu per hour and all gravity type central furnaces. It is the manufacturer's responsibility to certify that such equipment meets the minimum efficiency requirements.

Cooling Efficiency. Certain cooling equipment must also meet minimum efficiencies. These efficiencies are listed in Table 2-53H of the Standards and here as Table 2-3. It should be noted that the conditions at which the efficiencies are measured, as specified in the applicable American Refrigeration Institute (ARI) test procedure, are not necessarily the actual design conditions for which the equipment is selected and listed on design drawings. The compliance documentation should, therefore, include the manufacturer's certified or catalogued performance at the appropriate ARI test conditions.

Restroom Lavatories. Sinks in public bathrooms are required to be equipped with devices that restrict the use of hot water. This can be achieved by installing either flow restricting devices with a maximum rate of 0.5 gallons per minute, or by using self-closing faucets which limit the flow rate to 0.25 gallons per minute for recirculating hot water systems or 0.5 gallons per minute for non-recirculating systems. Faucet outlet temperature is also limited to no more than 110 degrees F.

2.3.4. Control Requirements

Sections 2-5315 and 2-5316 establish essentially three mandatory control requirements for HVAC systems: off-hour controls, thermostatic control and zoning.

Off-hour Controls. Each HVAC system shall include an automatic device to shut-off or set-back the system during off-hours. A designer can specify a timeclock or programmable controller to meet this requirement. Small systems, such as small exhaust fans which demand less than 500 watts may be controlled by readily accessible switches in lieu of automatic controls. Hotel HVAC systems also are not required to have automatic off-hours controls.

Table 2-3: Minimum Efficiency of Cooling Equipment

Equipment Classification/Type	Condensing Means	EER	COP
A Electrically Driven Air Conditioning	Air	8.2	---
	Evaporative or Water	9.2	---
B Electrically Driven Water Chilling Packages			
centrifugal or rotary type, with condenser	Air	---	2.34
	Water	---	4.04
reciprocating type, with condenser	Air	---	2.46
	Water	---	3.51
reciprocating type, without condenser	Air	---	2.90
	Water	---	3.51
Hydronic Heat Pumps, Reciprocating Type	Water	---	2.75
C Electronically Driven Condensing Units	Air	---	2.78
	Evaporative or Water	---	3.66
D Heat Operated			
direct fired (gas, oil)		---	0.48
indirect (steam, hot water)		---	0.68

For equipment classified as B or C, the COP specified is for the water-chilling package or hydronic heat pump as furnished by the manufacturer. For water-chilling packages the COP does not include energy to drive chilled-water and condenser-water pumps or cooling tower fans. For hydronic heat pumps the COP does not include the energy to drive circulating water pumps or cooling tower fans, but does include the conditioned supply-air fan-motor energy when included as a part of the model number of the hydronic heat pump.

For equipment classified as D, the COP shall be calculated as the net cooling output divided by the total heat input, but excluding electrical auxiliary inputs.

Section 2-5316(b) prescribes off-hour controls for mechanical ventilation systems designed to provide more than 5,000 cfm. Dampers must be installed which close whenever the ventilation fan is turned off. For supply fans, this requires a motorized damper interlocked with the fan or otherwise controlled to close during fan shut-down. On gravity ventilation systems, other than those for combustion air, automatic or readily accessible manually operated shut-off dampers are required.

Thermostatic Control. Subsections 2-5315(b) addresses zone thermostatic controls. For nonresidential buildings, each zone, as defined in Section 2-5302, must have an automatic temperature control device such as a thermostat. Zones may extend to more than one floor, but each floor must have at least one zone. In most cases, each building exposure will require at least one zone, as will interior spaces which are not affected by outside weather conditions.

Thermostatic zone controls must be capable of providing adjustable setpoints in the range from 55 to 85 degrees F. These setpoints are not required to be continuously adjustable. Two or more fixed setpoint sensors, with one setpoint to control cooling and one for heating, may be used instead, provided the setpoints can be changed.

Temperature controls for zones with both heating and cooling capability are also addressed. Such controls must be capable of sequencing the supply of heating and cooling to the zone. Further, the controls must be capable of providing a range adjustable up to 10 degrees F between full heating and full cooling supply to the zone.

Figure 2-2 shows a typical proportional control system which meets this requirement. This type of control is provided by dual setpoint or deadband thermostats. As shown in the figure, with typical two degree throttling ranges (the range between maximum and minimum supply) for both cooling and heating, the 10 degree F range required by this subsection results in a deadband of 6 degrees F. Within the deadband, both heating and cooling operation to the zone are generally shut off.

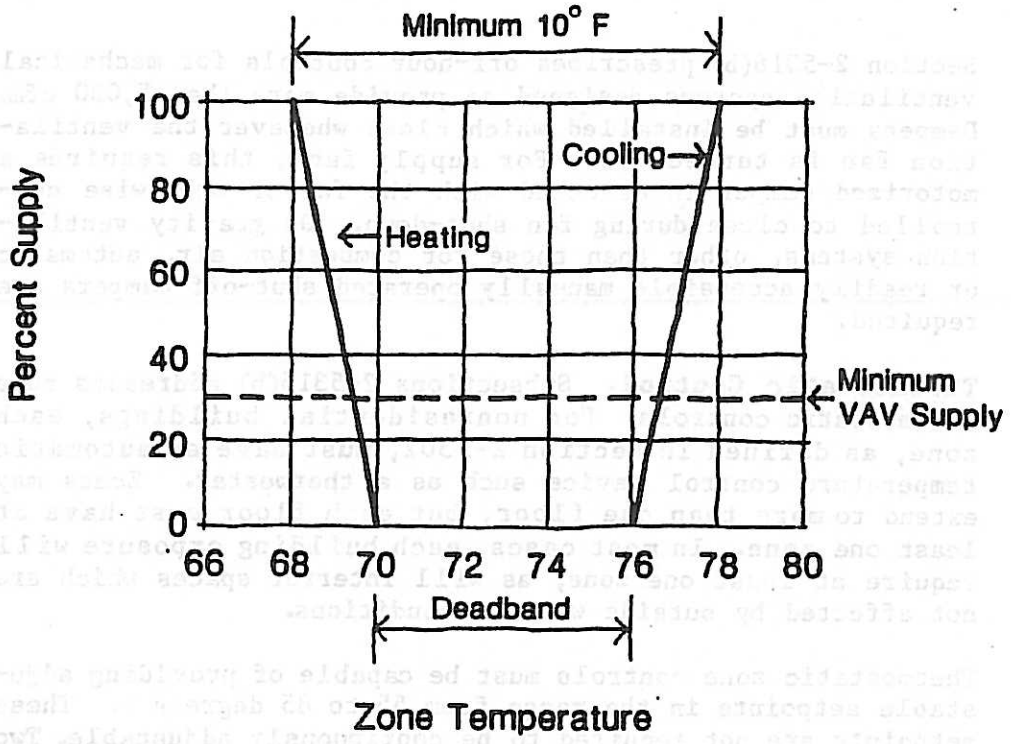


Figure 2-2: Proportional Control System

Most multiple zone air systems, such as VAV systems, do not completely shut off the supply of cooling to the space within the deadband because of the need to maintain minimum ventilation and air circulation rates continuously to each space. During the deadband range, these systems are generally controlled to provide a minimum air flow to the space. This minimum flow will typically result is some inefficiencies, either in overheating or overcooling the space, or because reheat, recool, or mixing of hot and cold air streams is required to maintain space temperatures.

Systems which use reheat or recool for temperature control must be provided with controls which reduce capacity before reheating (or recooling) takes place. Cooling (or heating) reduction can be done by reducing the volume of cooled air to the zone, reducing the volume of air supplied by the whole system, by resetting the cold deck temperature to slightly higher levels or a combination of any of these. For VAV systems, this reduction is inherent. For constant volume systems, which are allowed by the first generation nonresidential energy standards , supply air temperature reset is required to provide the capacity reduction.

Heat Pumps. When electric resistance is used to provide supplementary heating in heat pumps, controls must be installed which keeps the resistance heater from operating when the load can be met by the heat pump alone. The cut-on/off temperatures for the compression heating are required

to be higher than the cut-on/off temperatures of the supplemental heating.

2.3.5. Ventilation Requirements

This Subsection addresses the outside air ventilation requirements for nonresidential buildings covered by both the first and second generation standards. Ventilation requirements that apply to the first generation nonresidential standards are stated in Section 2-5316 of the standards. Ventilation requirements that apply to the second generation standards appear in Sections 2-5316 and 2-5343.

The ventilation requirements, especially for the second generation standards, reflect the growing concern for indoor air quality. The indoor air quality problem, sometimes called "tight building syndrome", has emerged because of fairly recent developments in the design and operation of buildings, including:

- The increased use of synthetic building materials which often "outgas" noxious and even toxic pollutants.
- Tighter envelope construction techniques which reduce outside air infiltration and exfiltration.
- The reduction of ventilation outside air volumes as a cost saving measure.
- Generally lower air circulation rates resulting from reduced lighting power levels and lower building envelope loads found in new building designs. This problem is exacerbated by the use of variable air volume systems which, controlled by temperature requirements only, often can reduce air circulation and ventilation rates below recommended or code required minimums.

Operable Windows. Operable windows may be used to meet the outside air ventilation requirement for nonresidential buildings covered by both the first and second generation standards. The area of operable sash must be equal to or greater than five percent of the conditioned floor area that is to be ventilated for each enclosed space that is to be naturally ventilated.

Documentation. Design drawings should indicate the minimum amount of outside air, in cfm, for each supply air fan system. Documentation of minimum air quantity calculations may be requested by the code official. Air balancing specifications should include the balancing of outside air intakes.

2.3.5.1. Second Generation Standards

The second generation nonresidential energy standards require that HVAC systems meet the requirements of Sections 5 (except 5.7) and 6.1.5 of ASHRAE Standard 62-1981 and are capable of supplying minimum levels of outdoor air. Minimum outdoor air rates are given in Table 3, Section 6.1 of ASHRAE Standard 62-1981. For offices, values should be used for smoking areas (20 cfm per person). For retail and wholesale stores, values should be used for non-smoking. Total air flow rates must be based on the occupant density listed in ASHRAE Standard 62-1981, or the design occupant density, which ever is greater. The quality of outdoor air must meet the requirements of Table 1 of ASHRAE 62-1981. (It is recommended that the additional air quality requirements of Table 2 of this ASHRAE standard also be maintained.)

Treated return air may be used to meet part of the outdoor air requirement, but its use must be consistent with Section 6.1.4 of ASHRAE 62-1981 and provide either a minimum of 5 cfm of outdoor air per person or the amount listed in ASHRAE Table 3, whichever is greater.

While office HVAC systems must be capable of providing outdoor ventilation rates adequate for smoking, it is not necessary that office buildings be operated at these levels of outside air ventilation, provided:

- Areas of the building are designated and maintained as no-smoking areas
- The HVAC system is capable of serving these areas without returning air from areas where smoking is permitted.

Non-smoking areas meeting the above requirements must still be provided with 10 cfm per person of outside air or the rate recommended in ASHRAE Standard 62-1981, whichever is greater.

The ventilation system must have controls which provide the minimum ventilation rate required above whenever the building or space is occupied.

2.3.5.2. First Generation Standards

The first generation nonresidential energy standards require that HVAC systems meet the requirements of ASHRAE Standard 62-1973. Minimum outdoor air rates are given in Section 6 of ASHRAE Standard 62-1973 or 5 cfm per person, whichever is greater. In areas where smoking is prohibited, the "minimum" values should be used as minimum outside air rates. In areas where smoking is permitted, the "recommended" values should be used. The quality of ventilation air must meet the requirements of Sections 3.1 through 3.4 of ASHRAE Standard 62-1973.

When air economizers or other systems are used which use outside air for cooling, the outside air ventilation rates may be reduced to 33 percent of those recommended in ASHRAE Standard 62-1973, as long as at least 5 cfm per person is delivered to each space within the building during periods when that space is occupied.

None of the outside air ventilation requirements apply to buildings in UBC Occupancy Group R.

2.3.5.3. The Dilution Method

The calculation of outdoor air intake for systems serving more than one room or zone may account for dilution of air through the common return system. In this way, the strict code minimum amount of outdoor air need not be provided to all zones at all times, provided enough outdoor air is introduced to the building as a whole to sufficiently dilute return air. In other words, this method accounts for the introduction of outdoor air in excess of the required amount in some zones, which is then returned to the fan system, further mixed with outdoor air, and supplied to a zone which may not be receiving the exact code required volume of fresh outdoor air directly.

The "dilution method" uses the formula:

$$\frac{1}{V} = \frac{TOTCFM}{CFMPP \times TOCC} + 1 - \frac{TOTCFM \times WOCC}{WCFM \times TOCC}$$

Where

V = Fraction of total system supply air required to be outside air
TOTCFM = Total system supply air quantity, cfm
CFMPP = Minimum cfm per person (= 20 for offices)
TOCC = Total number of building occupants
WOCC = Number of occupants in "worst" zone
WCFM = Design air quantity for "worst" zone, cfm

The "worst" ventilation zone will be the zone with the lowest rate of air supplied per person. For a uniformly occupied building, including buildings for which the distribution of occupants is not known at the time of system design, such as a speculative office building, the worst zone will be an interior zone because it will have the lowest design cooling load density.

EXAMPLE 2-2
Dilution Method

SITUATION

Consider a two-zone building having a uniform occupant density of 7 persons per 1,000 ft^2 and the following characteristics:

	Interior Zone	Perimeter Zone	Total Building
Floor Area	4,000 ft^2	6,000 ft^2	10,000 ft^2
Volume	40,000 ft^3	60,000 ft^3	100,000 ft^3
Cooling cfm	3,000 cfm	17,000 cfm	20,000 cfm
cfm/ft^2	0.75 cfm/ft^2	2.83 cfm/ft^2	2.00 cfm/ft^2
Occupants	28	42	70

CODE APPLICATION

The volume of outside air ventilation may be calculated using the dilution method, as shown in the following equation.

$$V = \frac{1}{\frac{20{,}000}{20 \times 70} + 1 - \frac{(20{,}000)(28)}{(3{,}000)(70)}}$$

$$= \frac{1}{\frac{200}{14} + 1 - \frac{(2)(4)}{(3)}}$$

$$= \frac{1}{15.286 - 2.667}$$

= 0.0792 or 7.92% outside air under design cooling conditions

or 0.0792 x 20,000 cfm = 1,584 cfm is needed at all times.

An average 20 cfm/person would only indicate 1,400 cfm, hence, slightly more than the average outside air cfm per person must be supplied to achieve equivalent dilution for a system delivering different air quantities to different zones.

For office buildings with a uniform occupant density, the above equation may be reduced to:

$$\frac{1}{V} = \frac{TCFMPSF}{0.14} + 1 - \frac{TCFMPSF}{WCFMPSF}$$

where

TCFMPSF = Total system cfm per square foot of building conditioned area.

WCFMPSF = "Worst" zone cfm per square foot of zone conditioned area. The worst zone is the zone with the least design cfm under peak cooling conditions.

2.3.5.4. Ventilation Controls

Controls must be provided which ensure that minimum ventilation rates are maintained whenever building spaces or zones are occupied.

For constant volume systems with gravity ventilation, this will generally require no additional controls beyond the standard manually adjusted outside air intake damper. However, specifications should require that the intake damper be calibrated and adjusted to provide the design minimum rates. Dampers that bring in more than 5,000 cfm through mechanical ventilation systems must be interlocked and automatically close when the fans are shut down.

For variable volume systems, where the pressure at the outside air intake generally varies, additional controls may be required to ensure minimum ventilation rates are maintained. Otherwise, when the system is at low supply volumes, outdoor air intake could be lowered below the design minimum. These additional controls may be flow measuring devices or differential pressure measuring controls that modulate outside air dampers to maintain constant outside air flows.

As a practical matter however, most VAV systems serving buildings in mild climates where temperatures seldom if ever go below 15 degrees F, and which also include outdoor air economizer controls, the additional minimum air intake controls are probably not required. This is because when the building is at low volumes, which is when the minimum outdoor intake may not be allowing enough outdoor air introduction, the weather is generally mild or cold. Under these conditions, the air economizer controls will introduce additional outside air to more than compensate for the reduced minimum air intake.

Additional minimum air controls are also seldom required for VAV systems using water economizer systems, because with these systems, minimum ventilation air is generally provided by a separate outside air supply fan that runs at constant volume whenever the building is occupied.

EXAMPLE 2-3

Outside Air Ratio in Typical Office

SITUATION

A worst zone in a typical office is an interior zone. It has a supply air flow rate of 0.4 cfm per square foot, while the total building has a supply air flow rate of 0.8 cfm per square foot.

CODE APPLICATION

Using the dilution method, the percent outside air ventilation may be calculated in the following manner:

$$\frac{1}{V} = \frac{TCFMPSF}{0.14} + 1 - \frac{TCFMPSF}{WCFMPSF}$$

Where:

TCFMPSF = 0.80 cfm/sf
WCFMPSF = 0.40 cfm/sf

$$\frac{1}{V} = \frac{0.80}{0.14} + 1 - \frac{0.80}{0.40}$$

so

$V = 0.21$ *or 21%*

Accounting for air dilution allows the overall outside air rate to be reduced from that which would be required by strict interpretation of ASHRAE 62-1981. For instance, a strict interpretation of 62-1981 would result in a total outside air ratio of:

V = *20 cfm/occ x 7 occ/1000sf / 0.4 cfm/sf*

= *0.35 or 35%*

E. ENVIRONMENTAL IMPACTS

Table E-1 summarizes the likely level of significance of energy technology impacts on various resources. The table presents a generalized overview of expected impacts as discussed above; it is not intended to identify all potential impacts of a particular proposed energy project. It is important to note that not all proposed energy development projects will necessarily result in the level of impacts indicated. Each energy development proposal will differ in the type and magnitude of impacts, and thus should be evaluated with this in mind.

Table E-1: Summary of Land Use and Environmental Issues and Likely Level of Significance

Impacts	Energy Technologies								
	Gas Wells	Oil & Gas Pipelines	Hydroelectric	Solar	Biomass	Wind	Thermal (Steam)	Cogeneration	Transmission Lines
Aesthetics	2	2	3	3	2	3	3	1	3
Agriculture	2	2	2	2	2	2	2	1	2
Air Quality	2	1	1	1	3	1	3	2	1
Archaeology	1	1	2	1	1	1	1	1	1
Biology	2	2	3	2	2	2	2	1	2
Circulation	1	2	1	1	2	1	2	1	1
Geology	2	2	3	1	1	1	2	1	2
Hydrology	2	2	3	1	2	1	2	2	1
Land Use Compatibility	3	2	3	3	3	3	3	1	3
Noise	2	1	1	1	2	2	2	1	1
Public safety	3	2	3	1	1	1	2	1	3

Notes: 1 = Minor or easily mitigated impacts expected.
2 = Moderate impacts expected, probably requiring mitigation to render impact insignificant.
3 = Significant impacts expected.

Source: Crawford Multari & Starr, September 1991.

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