ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILES 8672

94 SCOMM 9: HOUSE SPEC. COMM. ON PERMANENT FUND 1977-78

ASSUMPTIONS:

1. 60% OF CONSTRUCTION WORKERS ARE NON-LOCAL
2. 35% OF CONSTRUCTION WORKERS ARE SINGLE WORKERS
3. FAMILY SIZE OF FAMILY CONSTRUCTION WORKERS = 3.4
4. SUPPORT WORKERS REQUIRED / CONSTRUCTION WORKER = 0.6
5. PEAK CONSTRUCTION EMPLOYMENT = 1700
6. SUPPORT WORKERS / FAMILY = 0.46
7. SUPPORT WORK FORCE: 20% NON-LOCAL WITH FAMILY
   30% NON-LOCAL AND SINGLE
   50% LOCAL RESIDENT .

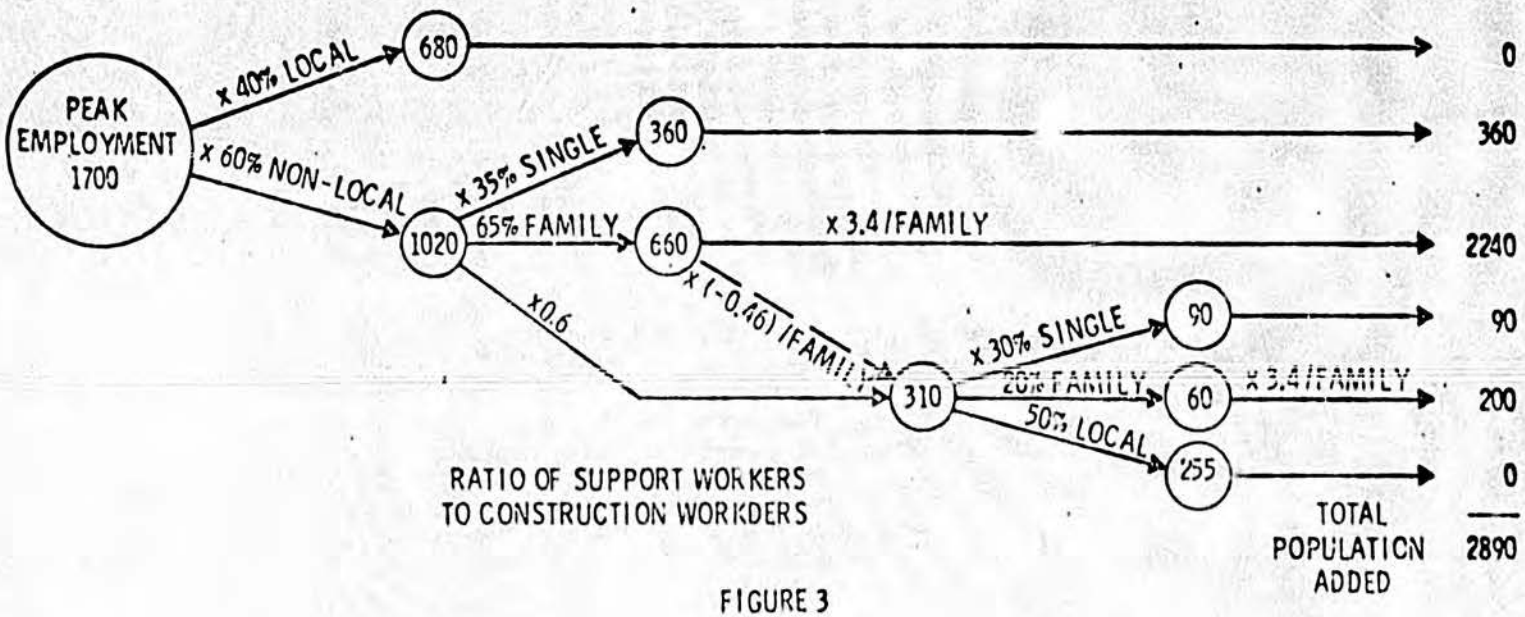

FIGURE 3

TABLE 6. Age Profile of Construction Workers

Age Categories	Local Construction Worker	Non-Local Construction Worker	Non-Local Support Worker	United States
14-24	7.0	24.0	19.6	8.4
25-34	23.7	40.6	52.6	20.5
35-44	23.1	15.9	16.7	16.8
45-64	29.9	18.9	10.1	34.5
65 or over	16.3	0.8	1.0	19.9
Total[1]	100.0	100.0	100.0	100.0

(1) Totals may not add to 100.0 percent because of rounding

(2) Source: U.S. Bureau of the Census, Consumer Income: Household Money Income in 1973 and Selected Social and Economic Characteristics of Households (Washington D.C.: U.S. Government Printing Office, 1974), p. 2.

Source: Construction Worker Profile, A Study for the Old West Regional Commission. Mountain West Research Incorporated. December 1975.

TABLE 7. Educational Status of Construction Workers

Highest Educational Level Completed	Local Construction Worker	Non-Local Construction Worker	Non-Local Support Worker	United States
Less than High School Graduation	28.4	13.5	11.0	39.1
High School Graduate	42.7	43.8	29.5	32.7
Some College	12.9	23.0	26.9	13.1
College Graduate	7.9	7.2	19.2	
Some Graduate School	2.2	2.0	4.5	15.1
Advanced Degree	3.4	1.2	5.8	
Vo-Tech School	2.5	9.2	2.9	--
Total(1)	100.0	100.0	100.0	100.0

(1) Totals may not add to 100.0 percent because or rounding.

(2) Source: U.S. Bureau of the Cenus, Consumer Income: Household Money Income in 1973 and Selected Social and Economic Characteristics of Households (Washington D.C.: U.S. Government Printing Office, 1974), p. 2.

Source: Construction Worker Profile, A Study for the Old West Regional Commission. Mountain West Research Incorporated. December 1975.

ADDITIONAL POPULATION HOUSING PREFERENCES

Additional population or non-locals establishing residences in the area require permanent housing. Housing preferences will be partially site specific and dependent upon existing housing inventories. Table 8 contains data on actual housing type, preferences, and actual housing demand.

TABLE 8. Community Housing Profile

Type of Unit	Percentage		
	Actual	Preferred	Demanded
	Local Construction Worker		
Single Family	0.76	0.87	0.81
Duplex, Townhouse	0.01	0.01	0.01
Apartment	0.04	0.03	0.04
Mobile Home	0.18	0.09	0.13
Other	0.01	0.01	0.01
	Non-local Construction Worker		
Single Family	0.19	0.46	0.34
Duplex, Townhouse	0.02	0.01	0.02
Apartment	0.10	0.08	0.09
Mobile Home	0.53	0.38	0.46
Other	0.16	0.08	0.10
	Non-local Support Worker		
Single Family	0.44	0.70	0.55
Duplex, Townhouse	0.05	0.04	0.04
Apartment	0.16	0.07	0.13
Mobile Home	0.32	0.17	0.25
Other	0.03	0.01	0.02

Note: Actual indicates respondent's present housing type, preferred is respondent's indicated preference, and demanded is type respondent indicates would be purchased if it were available.

Source: Construction Workers Profile, A Study for the Old West Regional Commission. Mountain West Research Incorporated. December 1975.

SOCIOECONOMIC REQUIREMENTS OF NEW POPULATION

A. Educational Facilities

The age distribution of non-local construction worker children is shown in Table 9.

TABLE 9. Age Distribution of Non-Local Construction Worker Children

Age	Total Percentage of Children
less than 5	35.7
5-11	36.3
12-14	11.3
15-17	10.6
18-19	3.5
20-24	1.9
24-29	0.6

Source: Construction Worker Profile, A Study for the Old West Regional Commission. Mountain West Research Incorporated. December 1975.

The number of children per non-local construction worker family is partially dependent upon the length of the worker's stay in the area. One study showed a majority of workers resident 0-6 months in the area were accompanied by 1.6 children and a majority of workers residence of 6-18 months were accompanied by 2.0 children.(6)

Currently accepted multipliers for educational facility requirements are listed in Table 10.

C. Water Supply Requirements

Water supply requirements multipliers are shown in Table 12.

TABLE 12. Water Supply Requirements

Item	Units	Multiplier
Peak Water Consumption	gallons/person/day	250
Yearly Water Consumption	gallons/person/day	180
Water Distribution Cost	cost/acre	$2,000

Source:
(1) Camp Gruber
(2) Fort Union Coal Study

D. Sewage Treatment Requirements

Requirements for waste treatment and waste disposal are shown in Table 13.

TABLE 13. Sewage Treatment Requirements

Item	Unit	Multiplier
Water Treatment	gallons/person/day	520
Sewage Treatment	gallons/person/day	160
Solid Waste Disposal (landfill)	acres/person/year	0.00027
Sewer Collection System Cost	cost/acre	$2000

Source:
(1) Camp Gruber
(2) Fort Union Coal Study
(3) Synthetic Fuels Commercialization Program

TABLE 10. Educational Requirement Multipliers

Item	Units	Multiplier
Elementary Teachers	Students/Teacher	18
Junior High Teachers	Students/Teacher	18
High School Teachers	Students/Teacher	18
School Administrators	Students/Administrator	200
Elementary School Space	Square Feet/Student	95
Junior High School Space	Square Feet/Student	110
High School Space	Square Feet/Student	115
Administrative Office Space	Square Feet/Administrator	150
Elementary School Cost	Cost/Square Foot	$35
Junior High School Cost	Cost/Square Foot	$35
High School Cost	Cost/Square Foot	$90
Administrative Office Cost	Cost/Square Foot	$40

Source: J. R. Young and K. E. Yandon. The Social and Economic Impact of a Camp Gruber Energy Center, BNWL, June 1975.

Anticipated Effects of Major Coal Development on Public Services, Cost and Revenues in Six Selected Counties, Final Report for the Northern Great Plains Resources Program, Montana State University, Bozeman, April 1975.

University of Denver Research Institute, The Social Economic, and Land Use Impacts of a Fort Union Coal Processing Complex, Final Report for ERDA Fossil Fuels, August 1975.

B. Health Care Requirements

Health care requirements multipliers are shown in Table 11.

TABLE 11. Health Care Multipliers

Item	Units	Multiplier
Primary Care	Population/Doctor	1220
Speciality Care	Population/Doctor	1510
Dentist Care	Population/Dentist	2000
Hospital Beds	Population/Bed	250

Source: University of Denver Research Institute, The Social Economic, and Land Use Impacts of a Fort Union Coal Processing Complex, Final Report for ERDA Fossil Fuels, August 1975.

Synthetic Fuels Commercialization Program, Draft Environmental Statement, Energy Research and Development Administration, December 1975.

E. Recreational Facility Requirements

Table 14 contains recreational facility requirements for additional population in the area.

TABLE 14. Recreational Facility Requirements

Item	Unit	Multiplier
Community Park (100 acres)	Population/park	28,000
Neighborhood Park (10 acres)	Population/park	5,000
Playfields (15 acres)	Population/playfield	10,000
Playgrounds (4 acres)	Population/playground	2,700
Swimming Pools	Population/pool	10,000
Tennis Courts	Population/court	2,000
Community Building (5,000 sq ft)	Population/building	30,000
Library (700 sq ft)	Population/library	1,000

Source: University of Denver Research Institute, The Social, Economic, and Land Use Impacts of a Fort Union Coal Processing Complex, Final Report for ERDA Fossil Fuels, August 1975.

F. Local Facility and Employee Requirement

Municipal, county and state, facility and employee requirements are shown in Table 15.

TABLE 15. Local Facility and Employee Requirements

Item	Units	Multiplier
Municipal Administrative Employees	Employees/1,000 population	1.1
County Administrative Employees	Employees/1,000 population	3.9
State Administrative Employees	Employees/1,000 population	12.5
Municipal Administrative Space	Square feet/employee	150
County Administrative Space	Square feet/employee	150
State Administrative Space	Square feet/employee	150
Law Officiers	Officers/1,000 population	2
Police Station	Population/station	12,500
Police Vehicles	Population/vehicle	2,500
Firemen	Firemen/1,000 population	1
Fire Station	Population/station	10,000
Fire Equipment	Trucks/station	2

Source: University of Denver Research Institute, The Social, Economic, and Land Use Impacts of a Fort Union Coal Processing Complex, Final Report for ERDA Fossil Fuels, August 1975.

Synthetic Fuels Commercialization Program, Draft Environmental Statement, Energy Research and Development Administration, December 1975.

Conclusion

Many requirements of the additional population were not included in the previous tables. Additional capacity required on roads, public works, and recreational facilities are too site specific to develop a multiplier. Social problems that are especially prevelant among construction workers were not discussed. Alcohol and drug abuse, family disruption, employment difficulties and environmental degradation are difficult to quantify but do accompany construction projects.

As emphasized in the report it is important to have a site-specific evaluation for each project. The application of these multipliers cannot be considered relevant unless a thorough inventory of existing conditions in the area has been properly conducted. Once an inventory has been completed, multipliers can only be applied when non-local worker characteristics are known. A complete regional analysis is required to establish these characterizations. Only after these analyses are completed, can results be considered applicable in planning purposes.

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17. Project Independence, Federal Energy Administration, Final Task Force Report, November 1974.

APPENDIX E: INTERVIEW SCHEDULE

Appendix E. Interview Schedule

Included in this appendix are the interview schedules for the state and local interviews conducted in Washington, Oregon and California by the research team. It should be noted that the questions in the interview schedules were used as general guidelines for the conversations and, in some cases, not adhered to strictly. The questions provided an orientation and direction to the interview; however, time limitations and the unique characteristics of a site which might make some questions irrelevant, had to be taken into account. In some instances relevant information not anticipated in the interview schedule surfaced during the conversation and the interviewers deemed it worthy to pursue, recognizing the trade-off between completing the questions and gathering new information.

Interview Schedule

Introduction

The purpose of our interviews with respect to this project is to obtain information from state and local officials regarding the mechanisms and processes used for dealing with social and economic impacts associated with the construction and operation of nuclear power plants. This project is funded by the U.S. Nuclear Regulatory Commission which is concerned that the development of nuclear power plants be better coordinated with state and local planning and budgetary cycles. Basically, we would like to discuss what your community experienced in the of social and economic impacts when a nuclear power plant was constructed here. Or, if the plant is not built yet, what impacts you are anticipating and how you are planning for and intending to manage those social and economic impacts. We are particularly interested in your planning, permitting and budgetary cycles.

While this project does not get into the actual development of improved systems for dealing with social and economic impacts in specific locations, it will provide recommendations regarding change in the NRC process so as to be more compatible with state and local planning cycles and processes.

All of the information obtained in these interviews will be kept strictly confidential. The information that you provide will be used to prepare a draft report. We will send

you a copy of our report dealing with how states and local governments deal with social and economic impacts for review to ensure our information is accurate. We strongly urge you to read and make comments on this draft. We want this report to reflect accurately what you have told us and to provide information that is useful to you in social and economic impact analysis and management.

Interview Schedule for Local Officials

We would like to talk a little more specifically about your experience with the _____ nuclear power plant.

1. How was the local community informed about the proposed nuclear power plant?

   -- by whom
   -- form and kinds of information
   -- nature of the contact

   If contacted by the developer (utility), has this contact been ongoing? How much cooperation has there been on plans and information between utility and local government?

2. Has the state had a role in the identification and management of socio-economic impacts (e.g. within site evaluation process). Are there any state requirements of local government? (e.g., submission of plans for housing/servicing new population, etc)

3. What steps has the local government taken to identify how the proposed plant would affect the local community--housing, transportation, public services, schools, etc.

   How does this fit into the existing planning framework;
   Has it required additional resources?

4. What county or local approvals must be obtained for licensing the facility? Were any special conditions placed on the utility or facility before giving these approvals?

5. How has the local government proceeded in addressing the prevention or management of socio-economic impacts? Specifically--(go into questions on particular impact categories)

6. What planning permits are required for capital projects

   a. Zoning
   b. Construction/building
   c. Water and sewer

   How much time is involved in obtaining each/and for the series of permits?

7. Does community have comprehensive plan?

   --check for land use/housing plans, etc.
   --How long does it take to make amendments to plan?

   What is the process involved in making amendments? Are service districts or areas used as a method of directing growth and provision of services?

8. Is a state or local EIS required for capital projects?

   --What steps are involved
   --How long does it take to complete EIS process (through approval)?

9. Local government structure

   --departments/responsibilities/number of professional staff
   --who is responsible (and what role) for planning for expected growth? Who is responsible for projecting employment, personal income, population, etc.

10. Annual budget cycle

    A. What is the decision process for county budget? Description
    B. How much time is involved in going through this cycle?

11. Capital budget cycle

    A. What is decision process for capital projects (e.g., is it done according to special districts, or for all)
    B. What is the time frame--how much time (years, 6 months) etc.)

12. Bonding

A. What kinds of bonding are used by local government to finance specific capital projects? (G.O., revenue)
B. What is the approval process for:

1. G.O.
2. Other bonds (e.g., revenue, councilmanic)
3. Voter approval required

Impact Categories -- What types of impacts occurred or are expected to occur due to construction of the nuclear power plant

Housing
- -- Provision of public housing (especially note need for it based on increasing rents for existing tenants as demand increases; workers may not need it, elderly and others on fixed income may)
- -- Regulation of housing--mobile home standards, building and housing development process

Transportation
- -- Who plans?
- -- Who pays?
- -- What are the impacts or needs resulting from plant construction? (e.g., congestion, increased accidents, need to upgrade old roads, put in new roads, demands on police, on need for transit development or expansion)

Recreation
- -- What problems are encountered in terms of increased demands on facilities and programs (indoor and outdoor recreation)
- -- What has been done or is planned for meeting increased demand?

Education
- -- What are the planning cycles for new school facilities (additions or new buildings) and for additional staff
- -- Were there any substantial impacts on direct classroom teaching or on other school services (e.g., special education, library, lunchroom,medical care, etc.)?

Health Care
- -- Who minitors this and plans for it?
- -- What is the timing of planning for health care facilities?

Police and Fire (Public Safety)
- -- What are projected (or actual) demands on police services; on fire services
- -- If more capacity is needed, is the problem personnel (or other operating costs) or capital facilities (buildings, equipment)?
- -- What are the planning, budgeting, and purchasing cycles for these services?

Solid Waste
- --Is the existing system capable of handling the increase in demand?
- --What can (or was) done to handle the increase? What time frame for planning, what procedure for budgeting; how long to construct, purchase, etc?
- --Were any temporary facilities used to cover lag time between demand and provision of additional services/ facilities?

Water Supply
- --Is there enough water to meet demands of both plant/workers and current residents and businesses?
- --If not, what needs to be done for planning, budgeting--what are the procedures involved (and time frame)?

Sewage Treatment
- --Similar to water supply

Government Administration
- --Are there any significant general burdens on government as a result of development? (e.g., need for more staff, or for restructuring/expanding the organization of local government, problems with revenue flow being too late to allow services?
- --What is/was projected fiscal impact of the facility? Especially timing of revenues, impact of increased demand (or provision of services in response to demands) on tax limits, debt limits, etc.

Welfare
- --Any problems with increased burden on welfare load resulting from workers flowing to area without jobs or being laid off from temporary jobs connected with plant construction? Who pays for welfare costs--state or local jurisdiction? (If sharing, how much for each, and what difference does that make? Could be that in-state migration of workers who are unemployed does not burden the local area in state where state picks up the full tab).

Noise
- --Who handles problems associated with noise "pollution"?
- --What regulations, how enforced?

Land Use
- --What are/were the impacts on the overall development of the area; conflict with comprehensive plan
- --How were such problems dealt with? by whom? What regulatory mechanisms?

Retail
- --Impact of development on retail services--demand for more variety; shortage of goods
- --Does local government have any role in meeting this need (This may be out of the purview of government)

Social Problems
- --What are/were the problems in the areas of juvenile delinquency, alcoholism, crime, etc., that could be attributed to the development of the plant?
- --Is/was there a strain on social service organizations as a result of growth? How do they cope with it?
- --What (if any) role does the local government have in this area?

Psychological Problems
- --What are/were the problems due to the change in way of life and possible perceived decline in quality of life by residents?
- --Conflicts among old and new residents?
- --What is the role of local government?
- --What informal or social mechanisms are there for dealing with such problems?

Interview Schedule for State Officials

1. How does the state licensing process fit into the overall development process of nuclear power plants?

   --At what point in the plant development/planning must the state be notified of the proposed development? (what department or office is involved)?
   --Who is responsible for notifying state?

2. To what extent is the state involved in identifying and managing social and economic impacts resulting from nuclear power plant development? What kind of information on socio-economic impacts is submitted to state: who supplies such information? Do local/county officials provide any information to state on anticipated socio-economic impacts? If so, at what point in licensing process is such information incorporated?

3. Role of state: Does the state have a process/office that has responsibility for ongoing coordination, assistance or monitoring of social and econimic impact assessment and management? What is the specific role of the state in social and economic impact assessment--technical/financial assistance, financial responsibility (bonding, etc.), advisory to local government, liaison between locals and utility or liaison between locals and federal government in obtaining assistance, information generation--neutral role.

4. What requirements are imposed by the state on local government or the developer regarding the identification, prevention and management of social and economic impacts as part of the energy facility siting process? Specify.

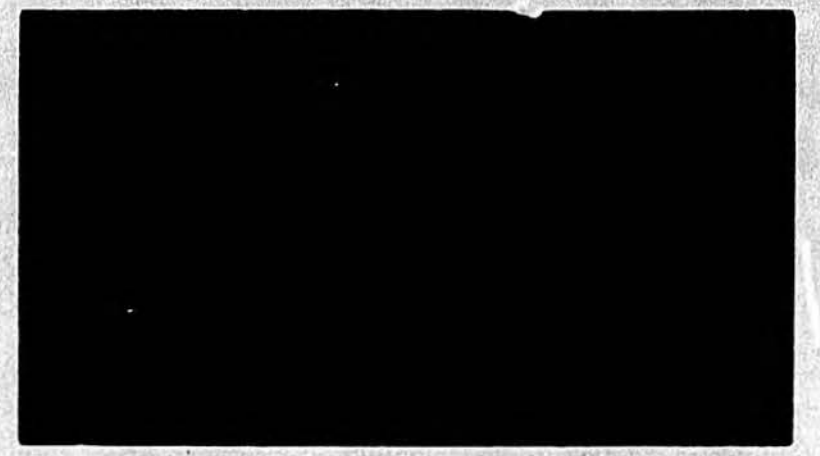
5. How does the state role fit into local planning cycles?

6. Has the state identified a set of social and economic impacts which are commonly associated with nuclear or other power plants--any guidelines for managing social and economic impacts.

A Research Report

LEGAL, INSTITUTIONAL, AND POLITICAL PROBLEMS IN PRODUCING ELECTRIC POWER FROM GEOTHERMAL RESOURCES IN CALIFORNIA

Battelle
Human Affairs Research Centers



LEGAL NOTICE

LEGAL, INSTITUTIONAL, AND POLITICAL PROBLEMS IN PRODUCING ELECTRIC POWER FROM GEOTHERMAL RESOURCES IN CALIFORNIA

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Submitted to:

ERDA--San Francisco Operations Office
EPA--Region 9
FEA--Region 9

Under Contract No. E(04-3)-1163

August 2, 1976

ABBREVIATIONS

AFC	Application for Certification
APCD	Air Pollution Control District
APCO	Air Pollution Control Officer
ARB	Air Resources Board
BLM	Bureau of Land Management
CAC	California Administration Code
CEQA	California Environmental Quality Act
CERCDC	California Energy Resources Conservation and Development Commission
CPUC	California Public Utilities Commission
CZCC	Coastal Zone Conservation Commission
DOG	Division of Oil and Gas
DWR	Department of Water Resources
EA	Environmental Analysis
EAR	Environmental Analysis Report
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ERDA	Energy Research and Development Administration
FEA	Federal Energy Administration
FPC	Federal Power Commission
IID	Imperial Irrigation District
JPL	Jet Propulsion Laboratory
KGRA	Known Geothermal Resource Area

LADWP	Los Angeles Department of Water and Power
NCPA	Northern California Power Agency
NEPA	National Environmental Policy Act
NOI	Notice of Intent
PG&E	Pacific Gas and Electric
PP&L	Pacific Power and Light
PRC	Public Resources Code
RFL	Resource Funding Limited
RWQCB	Regional Water Quality Control Board
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SEC	Securities and Exchange Commission
SLC	State Lands Commission
SMUD	Sacramento Municipal Utility District
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey

CONTENTS

LIST OF ILLUSTRATIONS

CHAPTER 1

SUMMARY

1.1 Introduction

1.1.1 Scope

Geothermal energy constitutes a small but increasingly significant resource for generating electricity in California, but a host of technical and nontechnical problems hamper its full utilization. Although the total potential in California has been estimated to be from 20,000 to 100,000 MWe, planned additions to geothermal electricity-generating capacity total only 3,356 MWe.

Producing electricity from geothermal resources has several major advantages for the general public:

- It has few adverse environmental impacts.
- It demands relatively simple technology to exploit.
- It is a domestic resource, and thus is not subject to foreign embargo.
- It is, at least potentially, renewable through reinjection.

Until recently, however, the lack of a suitable technology for producing power from geothermal resources, other than at The Geysers, meant that geothermal technology was not

competitive with coal, oil, gas, hydro, or nuclear generating technologies.

The major purpose of this report is to identify and analyze the nontechnical problems hampering the production of electricity from geothermal resources and to evaluate possible solutions to these problems. (Other uses of geothermal resources, even though important, are outside the scope of this study.) The nontechnical problems usually occur when one participant in the geothermal process has to deal with another. In its analysis of these problems, the report includes an examination of the participants, their interactions, and the laws that help shape those interactions.

1.1.2 Organization of the Report

The present chapter summarizes the conclusions reached in each of the succeeding chapters, without repeating either the data or the analyses leading to them. Chapter 2 presents an overview of the report and the geothermal development process. Chapters 3 through 7 identify and analyze problems surrounding five technical stages of geothermal development, and Chapters 8 through 12 identify and analyze major problem areas affecting more than one stage. Chapter 13 discusses the major themes guiding the evaluation of proposals, and Chapter 14 evaluates individual proposals for change.

1.2 Chapter 2: Overview

A variety of utilities, government agencies, and others have plans to produce electricity from geothermal resources; the success or expansion of these plans depends on the resolution of nontechnical, as well as technical, problems.

The nontechnical problems surrounding geothermal development fall into 10 major groups: leasing, exploration, reaching agreement for utilization, power plant construction, transmission, financing, environmental reporting, the role of the California Energy Commission, proposed air pollution regulations, and the political economies of individual counties.

Resolving these nontechnical problems requires two related sets of measures. One set would improve the operation of the geothermal development process itself, through streamlining regulatory requirements, developing new ways to meet existing requirements, and ensuring that all the participants understand the requirements and the methods of meeting them. The other set of measures would increase the attractiveness of the geothermal process over other possibilities for investment and for generating electricity.

1.3 Chapter 3: Obtaining Geothermal Leases for Development

Current leasing procedures for federal, state, and privately owned land are by no means perfect and could go

faster; at present, however, they do not constitute the most serious bottleneck to increased production of electricity from geothermal resources. In fact, the procedures appear to be working more smoothly as the participants gain experience in dealing with them. Therefore, although marginal improvements are probably worth making, any major overhaul of the leasing procedures should probably wait until after resolution of problems in other areas.

1.4 Chapter 4: Exploration

The nontechnical problems surrounding exploration activities, particularly the drilling of exploratory wells, varies by geographical location. At The Geysers, the parties involved have learned the procedural requirements and are continuing to learn new ways (both technical and nontechnical) to adapt to them. Nonetheless, the procedures will probably never run as smoothly as in some other areas of the state because the exploratory activities exert impacts that some local residents and environmentalist groups want to avoid. In the Imperial Valley, the process runs very smoothly, both because the exploratory activities exert fewer impacts and because the resistance to the impacts that do occur is less. In addition, a large number of wells already have been drilled, and permits for still more have been granted; thus, the exploration stage is not the source of the major geothermal development problems in the Imperial Valley.

Elsewhere in the state, however, the exploration stage may be a significant bottleneck. There are two reasons for this situation. First, technical and nontechnical problems vary from area to area, so that it is difficult for the parties involved to gain an understanding of procedural requirements and how to adapt to them. Second, some areas are starting to exert strong pressure to protect themselves from the impacts of geothermal development--or at least are taking time in deciding how to react to exploration activity.

1.5 Chapter 5: Selling and Utilizing the Resource

Arranging to sell or use a discovered resource can be a significant bottleneck in the process, but it is less so in some areas of the state than in others. In The Geysers, and presumably in future dry-steam fields, utilities and other users are generally willing to build power plants. The Northern California Power Agency (NCPA) and the Department of Water Resources (DWR) have now joined Pacific Gas & Electric (PG&E) as entities eager to generate electricity from geothermal steam.

In the Imperial Valley, and presumably in future hot-water fields, finding a user for a discovered resource is more of a problem because of the greater uncertainty surrounding both the reservoir and the technology involved. A combination of three basic strategies will probably be necessary in order to make such a resource attractive to

potential users: demonstration projects (probably with at least some government financing) to reduce uncertainty; insurance and regulatory schemes to spread the risk; and organizational integration and regulatory changes to allow power production by entities willing to take risks.

1.6 Chapter 6: Power Plants and Production Fields

Government regulation of power plant siting has been the bottleneck to geothermal development in the Geysers area. Two strategies will help to reduce this bottleneck.

First, key participants should be given as much information as possible about the procedures and how to adapt to them. Most of the participants in The Geysers have a great deal of experience at this point, but neither the California Energy Resources Conservation and Development Commission (CERCDC) (soon to be the major regulator of power plant siting) nor NCPA and DWR (apt to be power plant builders in the near future) have much experience in this area. These entities need to continue their efforts to learn all they can.

The second strategy is to continue research on new ways to minimize both the costs of regulatory procedures and the impacts of geothermal development that create opposition. An example of a cost reduction measure would be state or federal government support of baseline environment studies;

an example of a measure to mitigate impacts would be the development of improved emission and noise control devices.

Beyond these two strategies, the participants have to recognize that basic conflicts do exist, and have to learn how best to resolve the attendant controversies.

Other areas of the state (outside The Geysers) have yet to deal with applications for geothermal power plants. At the present time, these areas should give their attention to the problems identified at previous stages of development. However, the one step they could take now is to begin learning from experiences in The Geysers.

1.7 Chapter 7: Transmission Issues

Transmission problems may become the major bottleneck in geothermal development in the future. The need to transmit power to consumers from a (usually) remote geothermal field increases both the number of participants in the process and the interactions among them. It may seriously affect the financial feasibility of at least the first few plants in a given field. There is some excess capacity in the present system that will allow small plants to transmit power over existing lines, but this excess does not exist for all areas of high geothermal potential. In addition, the excess is small enough that even the first few full-size plants will require an increase in the capacity of the existing transmission system.

Compounding the technical and economic problems is the necessity of achieving agreement between the owners of existing transmission facilities and potential plant builders. Historically, such agreements have been difficult to reach, and both sides have avoided the necessity of making them whenever possible. Because a great deal of uncertainty exists both about the legal, institutional, and political aspects of transmission and about the future of geothermal development the evaluation of proposals at this time is very difficult. The only recommendation that can be made at present is that the area be given very careful attention now, before it becomes a major bottleneck.

1.8 Chapter 8: Financial Aspects of Geothermal Development

While geothermal development has to be a competitive investment to attract resources, it does not require such significant amounts of capital as to strain the capital market. In places like The Geysers, the capital market can function normally, although there may be a need for special tax provisions to reflect the public's interest in geothermal development--for example, in its ability to reduce the country's dependence on foreign sources of energy.

In areas with a resource other than dry steam, the status quo will produce very slow development. Substantial uncertainty surrounds both the resource and the technology

it requires. Investor response, therefore, is to proceed cautiously. The problem is particularly severe because the principal investors in this market--the utilities--are quite cautious in nature. Investors such as developers, who would be less averse to risks, feel that existing law keeps them from building power plants and selling power.

The basic response to this problem will be the approach outlined in Chapter 6: demonstration programs to reduce uncertainty, insurance schemes to spread risk, and regulatory changes to allow the more risk-taking entities to build power plants.

1.9 Chapter 9: Environmental Impact Reporting

Environmental reporting procedures, like any new process, need time to smooth out. Initially, the process will move very slowly, but as the participants learn about the process and develop ways to adapt to it, the procedure should run more smoothly. Therefore, what is needed most at this point are techniques for giving the participants information about the process and for helping them develop new methods for adapting to it. These techniques include baseline environmental studies, careful preparation for public hearings, and project planning that takes into account procedural time requirements. However, there may be some basic conflicts among the participants in the environmental reporting process; in such cases, the best one can

hope for is that the procedures would allow the conflict to be resolved as quickly as possible.

1.10 Chapter 10: The California Energy Resources Conservation and Development Commission

CERCDC, a significant new participant in the geothermal development process, has already taken some steps to help geothermal development. Additional steps that it can take include:

- Acting as a disseminator of knowledge (its ongoing efforts to give its siting staff as much advance preparation as possible represent a start in this direction).

- Moving carefully in asserting its new responsibilities so that it achieves political accommodations with the other parties in the geothermal development process, particularly the county planning commissions.

- Acting as a promoter of geothermal development through its research and demonstration activities and its ability to persuade the federal Energy Research and Development Administration (ERDA) to undertake particular research and demonstration activities.

- Conducting its regulatory activities with a favorable view towards geothermal development.

Of course, CERCDC has a large number of responsibilities besides geothermal development, including such matters as environmental protection; how it resolves conflicts among these matters in discharging its responsibilities will have significant impacts. Nevertheless, CERCDC still has some power to make tradeoffs in favor of geothermal development.

1.11 Chapter 11: Reviewing New Stationary Sources of Air Pollution

The proposed new source review rules, as originally written by the Air Resources Board (ARB), could have posed substantial problems for the granting of permits both to construct and to operate geothermal facilities, particularly in The Geysers. Currently, the Air Basin Coordinating Councils and the Air Pollution Control Districts (APCDs) are reviewing those proposed rules, and the careful reshaping of the rules should eliminate most, if not all, of these problems. In The Geysers, the development and use of mitigation measures such as new emission control devices--often with government encouragement and sometimes with government financial support--will also help to solve some of these problems.

1.12 Chapter 12: The Political Economies of Counties

Even though the issues surrounding geothermal development will vary from county to county, one can predict, and thus prepare for, many issues by studying the ways in which geothermal development's probable impacts would interact with a given county's political economy--i.e., its citizens' attitudes, social and economic activities, and political procedures. Because impacts that occur in one place might not occur in another, and those that are acceptable in one place might not be acceptable elsewhere, analysis is required to predict both the interactions and the development of responses to them.

The state government should not attempt to respond to the variations in issues by shutting the local officials and residents out of the process. Local concerns need consideration because geothermal development exerts its most immediate impacts at the local level, and these impacts can best be controlled locally. However, geothermal development also has impacts beyond the local level, and thus state concerns also need to be included in decisions about the resource.

1.13 Chapter 13: The Analytical Context

Several themes should guide the analysis of proposals for changing the geothermal development process:

1. In general, streamlining an existing process will work better than instituting a new one, because the participants need time to learn how to operate within any process.

2. Notwithstanding the above, two kinds of major changes have a very good chance to improve the geothermal process:

   a. Attempts to increase the attractiveness of the geothermal development process (particularly as a means of generating electricity) over other investment opportunities. (Of course, many of the factors affecting its relative attractiveness are outside the geothermal process itself--and hence outside the scope of this report.)

   b. Attempts to bring about more organizational integration in the development process, to reduce the number of times that one participant has to deal with others.

3. Any analysis of geothermal development has to recognize that geothermal resources are different from other energy sources in two ways:

   a. More uncertainty surrounds both the discovery and measurement of the resource and the power generation technology.

b. The efficient plant size is much smaller.

4. The analysis of proposals for change should attempt to assess two factors:

   a. The time, money, and trouble required to bring them about.

   b. The differences they will make, once adopted, in the time, money, and trouble involved in the geothermal development process.

1.14 Chapter 14: Evaluation of Individual Proposals

There are three major types of proposals that merit the time, money, and trouble required to adopt them:

1. Proposals designed to streamline the existing procedures and improve the ways in which individual participants adapt to them. Proposals in this category include:

   a. Improving the flow of information--particularly from institutions with substantial experience to those without.

   b. Giving areas targeted for geothermal development outside help in assembling baseline data useful for later environmental documents.

c. Placing the major research and development emphasis on problems whose solution would have an immediate impact (e.g., noise and emission control in The Geysers, and scaling and corrosion control for hot water resources).

2. Proposals designed to improve the attractiveness of geothermal development--particularly as a means of generating electricity--over alternative investments. Proposals in this category include:

   a. Allowing the deduction of intangible expenses as a current expense and the deduction of a fixed percentage of income as a depletion allowance.

   b. Providing governmental financial participation through grants, loans, and loan guarantees, particularly for demonstration projects.

   c. Establishing regulatory or insurance schemes that will help spread the risks involved.

3. Proposals designed to reduce the number of participants that must deal with each other for a given power plant. Proposals in this category include:

a. Encouraging exploratory and development work by utilities and major consumers.

b. Allowing developers to build power plants and sell power without drastically changing their regulatory status.

c. Supporting research and development to facilitate transmission of power once generated.

There are also proposals that should be avoided, at least at present. These include:

1. Proposals that add more steps in the regulatory process--for example, proposals for environmental appeals boards.

2. Proposals aimed at removing geothermal development from local control or the environmental review process.

3. Proposals involving major overhauls of the existing leasing system.

4. Proposals involving significant changes in normal patterns of property taxation.

5. Proposals using federal or state "expediters" to resolve conflicts or to provide information.

1.15 Acknowledgments

The authors are indebted to the many people who provided input for this report. They include individuals in the geothermal industry; in state, local, and federal government agencies that deal with geothermal development; members of environmental interest groups; individuals involved in research on geothermal problems; and private citizens. Many of these individuals reviewed an earlier draft of this report and offered valuable criticisms and suggestions. They did not, however, review the final revision. The authors, therefore, obviously take full responsibility for any errors of omission or commission that appear in this report.

CHAPTER 2

OVERVIEW

2.1 Objectives and Scope

The major purpose of this study is to suggest ways to increase the rate at which electricity is produced from geothermal resources in California. Geothermal resources obviously have other uses--for instance, in space heating and agricultural processing--but these are beyond the scope of the present report, even though they have great potential value. Increasing the production of electricity from geothermal resources involves solving both technical and nontechnical problems. This report focuses on the non-technical problems related to geothermal development.

It should be noted that some changes in the competitive position of other electricity-generating technologies may exert far more effect on the rate of geothermal development than any changes in the process itself. For example, if the final costs of producing electricity from nuclear and oil-fired power plants were to rise significantly, geothermal power's competitive position would improve dramatically. Such a rise in costs could come from either economic conditions or political factors (e.g., stronger air pollution laws or nuclear safety requirements). In such circumstances, geothermal development might accelerate without changes in

the regulatory situation. However, such changes vis à vis other technologies are not within the scope of this report.

The report highlights situations in the present geothermal development process where legal, institutional, or political conditions create impediments to development or are apt to do so in the future; it does not give a complete description of the process, since such a description appears elsewhere.[1] The conclusion examines proposals for changes in laws, administrative procedures, business operations, research activities, and direct government action. Some technical proposals for change are also discussed, but only in terms of how they might help resolve a nontechnical problem.

Geothermal energy constitutes a small, but significant, resource for generating electric power in California. Locations of California's major Known Geothermal Resource Areas (KGRAs) are shown in Figure 1. As of May 1, 1976, geothermal energy accounted for 502 MWe of net electric power generating capacity out of a total generating capacity of 39,607 MWe sited in the state.[2] However, as of May 1976, California utilities had announced plans for 3,356 MWe of new geothermal power plant capacity by 1995.[3] See Figure 2 for a summary of utility plans. By comparison, the total potential for power production from California geothermal resources has been estimated to be anywhere from 20,000 to 100,000 MWe.[4]

The reasons for the disparity between the potential and the actual plans are to be found not only in numerous technical problems, but also in a variety of nontechnical areas

Fig. 1. Locations of California's major Known Geothermal Resource Areas (KGRAs).

Fig. 2. Planned installed capacities of California utilities. Note that planned additions to capacity occur fastest in nuclear plants (16.8%/yr), second fastest in geothermal plants (10.7%/yr), and third fastest in coal plants (6.9%/yr).

	Capacity (MWe)		
	1975	1985	1995
Nuclear	1,379	7,823	30,762
Geothermal	502	2,078	3,858
Oil and gas	22,707	27,462	27,348
Coal	2,287	5,719	8,653
Transfers	2,951	2,305	1,976
Hydropower	9,781	11,544	14,432
Solar, wind, and fuel cell	0	120	680
Total	39,607	57,051	87,709

Planned Installed Capacities of California Utilities

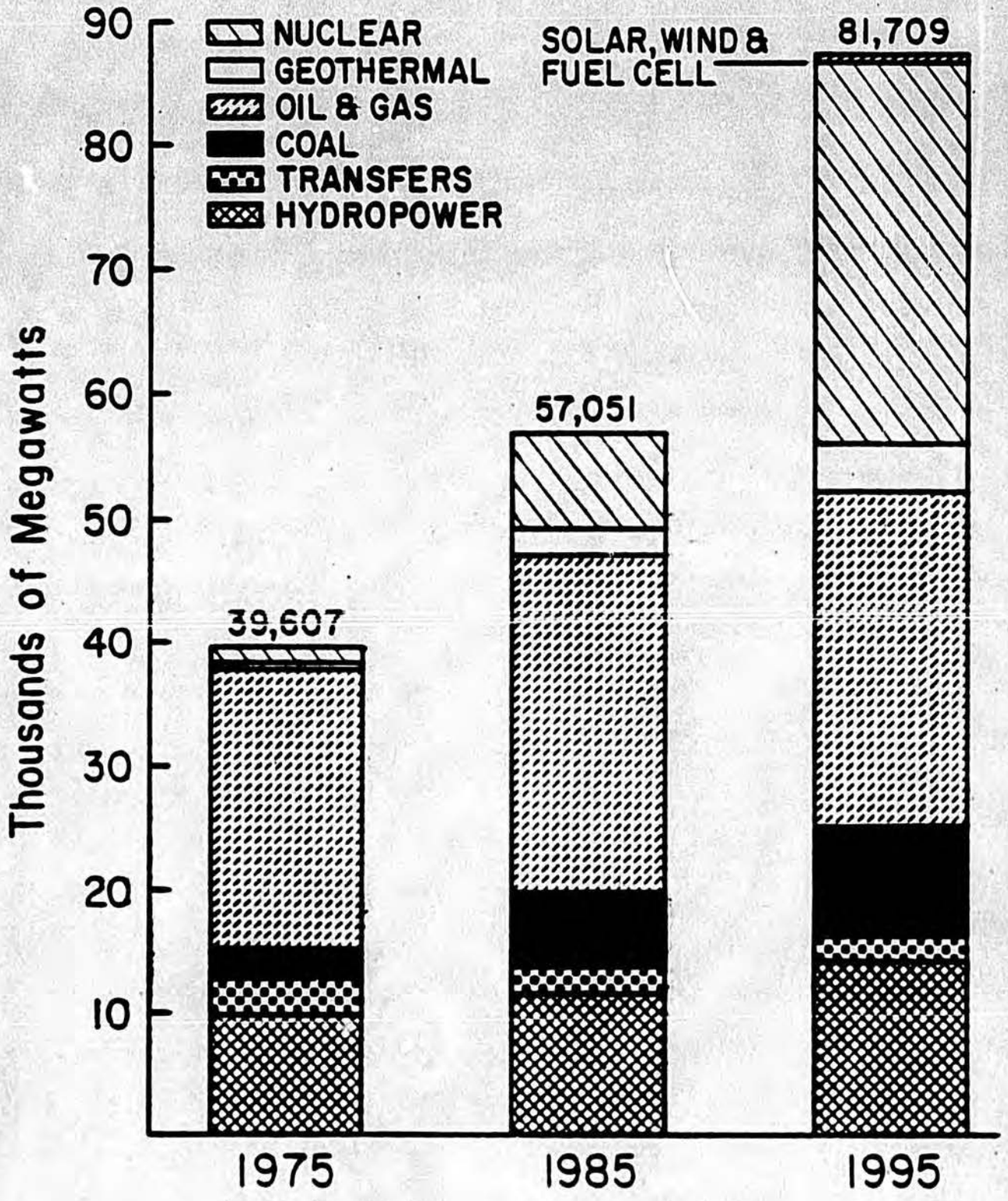

Fig. 2

such as financing the plants; obtaining licenses or permits for exploration, development, and operation; environmental impact review; and a host of other matters. While most attention has been directed to producing novel technology to enhance geothermal development, the nontechnical problems of leasing, licensing, and permitting also appear to be a reason for significant and costly delays in geothermal development.

2.2 Legal, Institutional, and Political Analysis

Legal, institutional, and political analysis involves a comprehensive examination of the operating milieu of the participants in the geothermal development process. The subject matter of this analysis includes relevant laws, the interactions which occur among participants, and the characteristics of the agencies, businesses, and interests involved in geothermal development. By focusing attention on the behavior of the significant parties in the development process and the constraints under which they operate, it is possible to identify major problems in the system and specify practices or reforms which may help the development process function more effectively.

Legal analysis focuses on applicable federal, state, and local laws (court decisions, statutes, and regulations). Laws state basic rules under which the process of geothermal development occurs. For example, they specify environmental impact limitations, leasing procedures, responsibilities

of companies to the public, tax burdens, and acceptable business practices.

Institutional analysis focuses on the participants in the process: firms involved with geothermal energy, public agencies which regulate it, private groups which seek to control development, and others. The principal participants in geothermal resource development are: (1) lessors, (2) investors, (3) production field developers and operators, (4) electric power producers, (5) regulators, (6) environmental and other public interest groups whose interests are not geographically limited, and (7) citizens of communities affected by geothermal development projects. Institutional analysis examines the objectives of these participants, their operating procedures, their defined tasks and responsibilities, their organizational structure, and pertinent behavior. The analysis also studies changes in behavior that come about as a result of learning, modification of objectives, or actions taken by other participants.

The third focus of study is political. In the present context, this is the analysis of interactions that take place among participants. This component of the study is concerned primarily with negotiation, litigation, competition, cooperation, and other forms of interaction.

Conducting the comprehensive legal, institutional, and political analysis makes it possible to provide at least tentative answers to such practical questions as:

1. What existing legal requirements act as major retardants at the various technical stages in the development process?

2. Where in the development process do major jurisdictional ambiguities occur?

3. What factors make geothermal investors reluctant to embark on various courses of action? How are their reasons related to such problems as financial risk, uncertainty about regulatory agency response, unfavorable tax conditions, the state of the economy, expected rate of return, and technological considerations?

4. What "problems" or present impediments to geothermal development are essentially self-correcting or will work themselves out without governmental assistance?

5. Are the principal causes for various development delays to be resolved by changing particular laws, by subsidizing various research and development activities, or by clarifying the meaning of existing requirements?

6. What technological innovations might, on balance, alleviate existing procedural problems?

7. What technological innovations might make geothermal electric power generation a more financially attractive venture?

8. How might the experience and knowledge gained by one regulator be effectively passed on to another regulator who is inexperienced in the problems surrounding geothermal development activities?

9. How might government agencies assist private geothermal developers in a manner agreeable to both, while protecting the interests of the general public?

10. What proposals for increasing geothermal development might actually produce an opposite reaction from that which is desired, or an even more undesirable set of side effects?

2.3 Structure of the Geothermal Industry

To suggest nontechnical reforms that might speed utilization of geothermal resources, it is necessary to understand the present organization of the geothermal industry. Problems that develop in one segment of this industry can have substantial impact on operations of other parts of it, although the link between the cause of the difficulty and the consequence may not be direct. Similarly, problems may

have solutions that are indirect or are located in a different stage of the geothermal development process. Thus, the most appropriate or effective solutions may not always be the most obvious or direct.

Geothermal development activities can be examined in two different ways: as a set of technical development stages, or alternatively as a set of business arrangements. Both technical and business activities are regulated to varying degrees by federal, state, and local governments.

There are five major technical stages in the geothermal development process: (1) the leasing of potentially productive lands; (2) geotechnical exploration of leaseholds to identify the quality and quantity of geothermal resources; (3) the development and operation of commercial-scale geothermal production fields; (4) construction and operation of power plants; and (5) transmission of electricity to end users, whether they are industrial users located at the production site or residential users located at a distance from the site.

Entrepreneurs[5] in the geothermal business can become involved in one or more of the technical development stages. A single organization can undertake activities in all the technical phases of the development process. For example, the city of Burbank is beginning ventures in which it would lease its own steam field, operate its own power plant, and transmit power to its own customers. In contrast, the

business arrangements at the Geysers steam field are more specialized. For existing plants, three companies (Magma, Union, and Thermal) own the steam field leases, production wells, and steam delivery lines, while PG&E owns the power plants and the transmission lines.[6] Other variations in business arrangements will doubtless emerge in producing fields elsewhere in California. However, at present, the most likely arrangement appears to be the specialized form, in which one group of entities develops the geothermal production field while a different set generates electricity.[7]

Whether one or a number of organizations develop the resource at a given site, their activities will be subject to a variety of regulations. Thus, the goals and objectives of the regulatory bodies are also very significant in determining how geothermal resource development actually takes place.

Entrepreneurs and regulators often find that, in pursuing their separate objectives, they come into conflict with each other. Entrepreneurs want to obtain the required permits and licenses with the minimum feasible loss of time and money. Regulators, however, have the objective of ensuring adequate compliance with various licensing and permitting requirements. In discharging this responsibility, regulators may often proceed far more slowly or cautiously than the entrepreneurs would like, or may, in

fact, prohibit some actions. Similarly, entrepreneurs may, in the view of regulators and intervenors, attenpt to avoid full compliance with regulatory requirements.

The mandates of various regulators vary substantially. Some governmental agencies have specialized objectives. For example, the local agencies that must grant conditional use permits for exploratory wells are principally concerned with surface environmental impacts. The California Public Utilities Commission (CPUC), in contrast, must consider broader questions, such as the need for additional electric power generating capacity, costs to the public, and a wide range of environmental impacts. Discrepancies and overlaps in the mandates of the various regulators lead to conflicts not only between regulators and entrepreneurs but also among regulators.

This study examines points in the process where the participants must deal with each other, and focuses on the interactions that create significant difficulties. Interactions in this sense include everything from contracts between private parties to litigation between business and regulatory interests.

2.4 Development Sequence

Generalization about problems retarding geothermal development is difficult because there is electric power production at only one site in California. Also, no operating power plant, either at The Geysers or elsewhere, has

been subjected to review by CERCDC.[8] However, substantial experience has been gained in leasing and exploration in several areas of the state. Also, CPUC has processed three applications for a total of four power plants under guidelines laid down pursuant to the California Environmental Quality Act (CEQA). Thus, any discussion of a "typical" set of difficulties in the sequence of development is based on industry experience to date and on predictions about situations most likely to occur in the future. Given these caveats, the general development sequence is as follows:

1. Land for geothermal development is leased from three principal sources:
   a. The federal government, generally through the Bureau of Land Management (BLM). Other agencies, such as the Forest Service and the Navy, are also involved.
   b. The California state government, primarily through the State Lands Commission (SLC).
   c. Private firms and individual landowners.

2. Leasing of state and federal government land is conducted according to statutory requirements and involves coordination among a number of agencies.

a. For federal lands, BLM generally has leasing responsibility, but land in the control of another agency (e.g., the U.S. Forest Service) requires the permission of that agency. Assessment work is done by the United States Geological Survey (USGS) and the Bureau of Reclamation.

b. For state lands, SLC has primary responsibility, but, as in the case of the federal government, other agencies must give permission when they have control of the land in question. So far, SLC has done its own assessment work.

3. Lessees include, or may include:

a. Oil companies, particularly Union, Burmah, Natomas (Thermal), Chevron, Phillips, McCulloch, Shell, and Pacific Energy.

b. Purely geothermal companies, including the Magma companies (Magma Power, Imperial Magma, Magma Energy), Geothermal Kinetics, Republic Geothermal, Earth Power, and Cal-Energy Company.

c. Electric utilities, such as San Diego Gas and Electric (SDG&E) and Southern California Edison (SCE).

d. Federal, state, and local government agencies, including the Bureau of Reclamation (federal), DWR (state), and the city of Burbank (local).

e. Heavy users of electricity, such as Dow Chemical and AMAX Incorporated.

f. Geothermal investors, such as Diablo Exploration Company.

4. Exploration and evaluation of the production potential of leaseholds require geotechnical survey work. This work involves geological and geophysical evaluation of a site and drilling of test wells to prove up a production field. Up to two years of time may be involved in the assay work prior to drilling test wells. The major expense, however, is in the actual drilling.

a. Financial backing for exploration and evaluation work comes from various combinations of the following: the developers' own resources, lenders, outside investors, and other sources of venture capital.

b. Survey activities may be conducted by independent drilling companies, geothermal divisions of oil companies, and a few specialized survey firms, such as Geonomics, Phoenix Geophysics, and a number of others.

c. Exploratory drilling activities are usually conducted by contract drilling companies in close consort with the geothermal operator. However, Republic Geothermal and Geothermal Kinetics have their own drilling rigs and do their own drilling.

d. Evaluation activities are done both by the lessees and by the potential buyers in order to confirm the feasibility of using the resource.

5. Once the decision has been made to develop a geothermal field, the construction of a power plant and the drilling of production wells will normally proceed simultaneously.

   a. At a given site, the production wells are usually drilled by the same people who drilled the exploratory wells; indeed, successful exploratory wells are used as production wells.

   b. Power plant construction is done by engineering firms hired by the power producer--whether a heavy industrial user, an electric utility, or a government agency.

6. To date, transmission of electricity to end users has been accomplished by building short connecting

lines to the major preexisting transmission grid. PG&E's 23-mile Fulton line (230 kv) was built in 1972 to tie its Units 5 through 15 with the interconnected system. It appears that the cost of building transmission lines could be a retarding factor for the development of geothermal fields that cannot be conveniently linked to the large interconnected power lines.

7. Major problem points, where actors in the process either have to obtain government permission to proceed or must negotiate an agreement with another party in the process, include but are not limited to the following:

   a. When explorers try to obtain leases on potentially valuable land.

   b. When explorers try to obtain permission to conduct geotechnical assay work or to drill on leased land.

   c. When developers try to negotiate contracts to sell their potential geothermal resources to power producers.

   d. When power producers try to obtain permission to construct and operate power plants and

developers try to obtain permission to drill a complete set of production wells and construct pipelines.

e. When power producers try to negotiate for necessary transmission facilities and new transmission lines.

2.5 Current Development Plans

The most immediate plans to develop additional electricity-generating capacity from geothermal resources are those of PG&E.[9] By 1995 PG&E has indicated it hopes to add 1,796 MWe to its existing 502 MWe of capacity at The Geysers in Northern California.[10] Three other organizations are also investigating the possibility of generating power at The Geysers. Other companies have planned to add geothermal generating capacity sometime in the future. The technical feasibility of producing electric power from geothermal sources has been demonstrated in Mexico, New Zealand, Italy, Iceland, and Japan as well as at the Geysers area. However, at present all plans to develop the hot water resources in California are somewhat tentative. Summarized below are some of the formal and informal expressions of intent to develop geothermal resources at The Geysers and elsewhere.

Pacific Gas and Electric Company. PG&E is still unsure of the total resources available at The Geysers and is basing its current planning on those resources whose existence has been established to their satisfaction. As noted,

these plans call for a total of 2,298 MWe by 1995. However, a number of other estimates of the total potential of the Geysers area have placed the potential installed capacity at a maximum of 4,800 MWe. PG&E agrees that, if the steam resource is indeed that large, they will be happy to develop to that limit.

Northern California Power Agency (NCPA). NCPA, an agency exercising the joint powers of 11 public power cities and one rural cooperative, has for a number of years been attempting to build a 220 MWe facility in the Geysers area. It recently contracted with Resource Funding Limited (RFL) for the development and purchase of steam resources in the Geysers area.[11] It plans for a total of 165 MWe under this arrangement, with at least 33 MWe by 1981, and is seeking to contract for even more steam.[12] However, at this writing, it has not yet completed negotiations for transmission of electricity output to its customers nor obtained a site for its proposed generating facility.

California Department of Water Resources. By 1978, DWR must renegotiate the rates and charges in a power supply contract with the four major utilities in the state for electricity to operate the pumping plants of the State Water Project. The revised rates and charges will become effective in 1983. DWR is exploring the possibility of building its own generating plants as an alternative to purchasing all its power, and geothermal power is one of the options it is considering, along with partial ownership of a

large coal or nuclear plant. Related activities include some discussions with SLC about leasing state land at The Geysers and preliminary negotiations with private steam suppliers in the same area.[13] Present plans are for 200 MWe by 1986, in increments of 50 MWe per year, starting in 1982.[14]

San Diego Gas and Electric Company. SDG&E, with the partial financial backing of the U.S. Energy Research and Development Administration (ERDA), has constructed a demonstration plant using a binary cycle, thermal test loop at Niland in the Imperial Valley. If test results are favorable after 12 to 18 months of operation, a 10 MWe turbine generator set will be installed. If the unit operates successfully for at least one year, the company intends to begin construction of a 50-95 MWe unit. In 20 years, SDG&E could conceivably have as much as 300-500 MWe installed capacity. However, SDG&E's submission to CERCDC shows no geothermal capacity before 1995.[15]

Southern California Edison. SCE presently lists 650 MWe of geothermal capacity to be added to its system by 1995.[16] Through its Mono Power subsidiary, SCE is investigating areas in the Imperial Valley, the Randsberg KGRA, and the Mono Lake-Long Valley KGRA.[17] However, SCE has had trouble in obtaining leases on federal lands.

Electric Power Research Institute (EPRI). EPRI, a research and development organization funded by the nation's

utilities, plans to install a 50 MWe geothermal demonstration project in the Heber area of the Imperial Valley.[18] This may be done with the participation of SDG&E or SCE. EPRI is looking for at least some financial help from ERDA on this project.

Sacramento Municipal Utility District (SMUD). SMUD plans to develop 100 MWe of geothermal capacity by 1985 and a total of 300 MWe by 1995.[19]

City of Burbank. Burbank, through its Public Service Department, owns and operates a municipal utility and now holds leases on federal KGRAs in Imperial Valley and Long Valley. They also have made noncompetitive lease applications on lands in California and Oregon. Through a joint venture with Republic Geothermal, Burbank plans to develop 200 MWe of capacity in these geothermal areas by 1995.[20]

Imperial Irrigation District (IID). IID plans to build 50 MWe of geothermal capcity by 1980, 50 more by 1983, and a total of 200 MWe by 1995.[21]

Dow Chemical Company. Dow is a minority holder in the Magma Power Company and is represented on the Magma Board of Directors. Through an arrangement with Magma, Dow is attempting to develop geothermal resources discovered by Magma in the Geysers area and in Surprise Valley, Modoc County, to supply electricity exclusively for use at its chemical plant in Pittsburg, California. Dow hopes to

produce at least 50 MWe and perhaps 100 MWe from these geothermal projects. Dow is also involved in research projects to curb H_2S emissions.[22]

City of Santa Clara. Santa Clara, a member of the NCPA, has shown interest in building a 50 MWe facility near Gilroy Hot Springs.[23] At this writing, the city's plans are very speculative.

Los Angeles Department of Water and Power (LADWP). LADWP owns land in and near the Mono Lake-Long Valley KGRA and is conducting geologic investigations to determine the feasibility of geothermal plants in the area. It has contributed $25,000 to the drilling program of the city of Burbank in the same region in return for information obtained by that program. It is also looking at Roosevelt Hot Springs in Utah and sites in The Geysers.[24]

Others. This list is not intended to be exhaustive. For instance, at least some outside observers believe that Pacific Power and Light (a privately owned utility in Oregon) is interested in geothermal resources in the Glass Mountain and Surprise Valley KGRAs.

2.6 Speeding Development: Influence Strategies

There appear to be two major types of strategies that would be useful for accelerating utilization of geothermal resources. One is to streamline the set of regulatory activities; the second is to enhance the relative attractiveness

of geothermal power. To some extent these two strategies are interrelated, as delays in the regulatory process can act as deterrents to involvement in geothermal development. Consequently, streamlining of the regulatory process might make the development of geothermal resources somewhat more attractive than at present. However, streamlining alone will not make geothermal power an attractive power source. What will be needed is a set of reforms that address all the legal, institutional, and political problems that limit the attractiveness of the geothermal industry to investors.

Producing electric power from geothermal resources is a relatively new process in California. With the exception of The Geysers, U.S. utilities have little experience with the use of geothermal resources to produce electric power. Thus, when a utility decides to produce electricity with geothermal resources, a host of relatively new problems are presented both to the utility and to regulators.

The National Environmental Policy Act (NEPA) and CEQA require that comprehensive reviews be conducted of the potential environmental impact of large-scale developments. In California this means that private entrepreneurs cannot obtain permits to conduct exploratory drilling and licenses to construct power plants until very detailed environmental studies have been prepared.[25] Public entrepreneurs can take no action until such studies are completed.

Environmental reporting requirements highlight one of the principal difficulties that face any new technology in regulated areas. Both utilities and regulators must learn how to deal with the specific problems related to that technology. Time is required for the principal business and governmental actors to learn what is required of them, which issues they have to settle, which rules they have to learn, and, in general, how they are to conduct their business. New regulators, new business firms, and new groups of the public become involved when new technological processes and regulatory schemes are introduced. To an important extent, the two occurred simultaneously in the geothermal industry. The learning process takes time, both to define the new information and procedures required and then to deal with the backlog caused by the first delays.

Some of the institutional learning necessary in the geothermal licensing process has already taken place, and more will come in the future. Therefore, many of the problems presently besetting geothermal development are self-correcting, in the sense that they require no change in regulatory policy. For example, as regulators and entrepreneurs build up experience with CEQA, they should be able to produce and certify Environmental Impact Reports (EIRs) and complete the permitting processes in less time. It should not be presumed, however, that this self-correcting tendency will automatically emerge. Individuals involved in the process must actively seek resolution of the problems that face them.

Many suggestions for accelerating the geothermal development process require major overhauls of substantive and procedural requirements. Given the lag introduced when the institutional participants must learn new standards and procedures, such actions have the potential to produce even greater delays than exist at present. Implementing a new statute or regulation or bringing a new government agency into the review process necessarily involves a period of learning--in some cases a long one. Litigation is also an ever-present possibility. Therefore, major overhauls may engender even greater delay than now exists. Short of resolving the basic conflicts involved, the most expedient way to accelerate the development process may be to streamline the existing system or to accelerate institutional learning.

2.7 Evaluating Proposals for Change

The major purpose of all proposals in this report is to help increase the rate of geothermal development. To that end, each proposal will be examined according to the following general criteria:

1. What would be its effect on the time involved in geothermal development (e.g., could the change accelerate the process)?

2. What would be its effect on the money (both costs and returns) involved in geothermal development?

3. What would be its effect on the trouble involved in geothermal development (e.g., litigation or institutional learning)?

While time and trouble could often be expressed in monetary terms, there is at least some value in discussing them separately for purposes of illustrating different kinds of delays or impediments. Time and money are relatively self-explanatory. Trouble includes a variety of factors that do not have common monetary equivalents. Examples would be objections by intervenors on various grounds, adverse environmental impacts, or jurisdictional disputes. The time, money, and trouble estimates will include all the problems associated with putting the proposed change into effect and the problems that might arise once the recommendation is in force.

2.8 Organization of the Report

Because the regulatory system is organized to deal with particular steps in the technical process, this report discusses legal, institutional, and political problems as they occur at each stage of the technical development sequence. In addition, the report devotes separate chapters to a discussion of special factors that have impacts at more than one technical stage of development. These special factors are: (1) financial aspects of geothermal development; (2) the environmental reporting process; (3) the emerging

involvement of CERCDC; (4) the impacts of proposed rules for reviewing new sources of air pollution; and (5) the political economies of counties with geothermal resources.

The purpose of this organizational scheme is to highlight both the major areas in which problems exist and the changes that may accelerate the development process. Having outlined these areas of both difficulties and opportunities, the report goes on to discuss, in its final chapters, the impacts of new and existing proposals for change.

Chapter 2

FOOTNOTES

1. A comprehensive report, entitled Report on the Status of Development of Geothermal Energy Resources in California, has been prepared by the Jet Propulsion Laboratory of the California Institute of Technology for CERCDC (JPL Document 5040-25, March 31, 1976). (Hereinafter cited as JPL Report.)

2. Compiled from plans submitted to CERCDC. Docket #75-FOR-3.

3. Ibid. In March 1975, plans submitted to the CPUC under General Order 131A indicated only 1900 MWe planned for 1995.

4. JPL report, op. cit.

5. The term "entrepreneur" includes all individuals, corporations, or public agencies that do at least one of the following: acquire leases, explore for and develop resources, generate electricity, or transmit electricity.

6. Other companies (Burmah, Shell, and Pacific Energy) also hold leases within what may generally be considered the known productive steam area at The Geysers. Burmah and Pacific Energy will soon have their fields connected to power plants.

7. Some controversy exists on this point. Some industry observers feel that an arrangement likely to emerge in new fields will be the production of electricity by the developer with sale to utilities. Another possibility is that power would be produced by an operator such as Dow or AMAX for use in its own industrial plants.

8. CERCDC must provide siting approval for all thermal power plants greater than 50 MWe in size for which application was made after January 1, 1977. See the Warren-Alquist Act, Public Resources Code, Section 25000, et. seq.

9. A detailed discussion of resource estimates, leaseholdings, and development plans is available in JPL report, op. cit. Figures are also available from plans submitted to CERCDC.

10. PG&E submission to CERCDC: Docket #75-FOR-3.

11. NCPA-RFL Contract, dated April 13, 1976.

12. Discussion with NCPA.

13. Discussion with DWR.

14. Ibid.

15. Submission to CERCDC.

16. Ibid.

17. Discussion with M. D. Whyte, Manager, Electric Systems Planning, SCE.

18. Discussion with EPRI.

19. Submission to CERCDC.

20. Ibid.

21. Ibid.

22. Discussion with Dow.

23. Discussion with NCPA.

24. Discussion with Jerry Matosec, LADWP.

25. CEQA requires an Environmental Impact Report (EIR); NEPA requires an Environmental Impact Statement (EIS). Both allow less formal documents in some cases.

CHAPTER 3

OBTAINING GEOTHERMAL LEASES FOR DEVELOPMENT

3.1 Overview

Geothermal leasing programs of both the federal and state governments have been the subject of considerable controversy and analysis. Substantial debate has occurred over whether the leasing stage provides a major influence point for increasing the rate of development. The situation is by no means clear-cut. There are several reasons for this:

1. A great deal of land is already leased, presumably enough to allow much more development than has yet occurred--roughly 271,000 acres, of which some 7,000 are used for production at The Geysers. Many people in the industry insist, however, that the figures are somewhat misleading, since the critical factor appears to be the quality of the leased acreage rather than the amount. Much of the acreage presently leased is of low potential. Withholding land that has high geothermal potential can at least slow down discovery of additional useful resources.

2. Another argument is made that leasing land faster may actually slow further development by taking resources away from other stages. But others insist that increasing the rate of leasing activities, particularly in areas of high potential, can permit preliminary geotechnical exploration to proceed at a much more rapid rate. Low-potential leases can thus be prospected and the leases thrown back if early exploration shows little promise of finding high-quality resources.

3. Some critics maintain that rapid leasing may provide windfall profits to a few at the expense of the general public. The counterargument is that the geothermal business is a high-risk undertaking, and most of the firms involved have to guarantee investors a high rate of return on successful ventures in order to raise needed capital.

4. Given that each procedural or regulatory change requires substantial amounts of institutional learning, any major changes that might be introduced run the risk of not producing a net increase in the speed of leasing in the immediate future. Again, the counterargument is that in agencies which have leased a good deal of land, more streamlined procedures are emerging.

Increasing the speed at which land is leased, especially land of high quality, could result in a more rapid proving up of the total resources available. In the short run (5 to 10 years) it appears that such action is not likely to enhance the net rate of utilization. However, as proving a resource is the first step toward ultimate utilization, changes or improvements in leasing procedures should be seen as improving the long-term (10 to 30 years) potential for utilization.

Some major issues need to be resolved to make geothermal development a highly attractive investment. These include changes in state and federal regulations on the amount of land any one developer can lease and on the amount of time he can hold any one lease under various performance stipulations. However, since both the federal and state systems are now operating and are beginning to reduce the backlogs of lease applications, major changes in the leasing process should probably wait until more critical problems at other stages of geothermal development are resolved.

3.2 Role of This Stage in the Development Process

As of May 1976, the federal government had leased 36,900 acres of the approximately 1.4 million acres in federal KGRAs.[1] The other acres are still awaiting competitive lease sales, which have been scheduled at intervals

over the next several years. Of the federal acreage that has not yet been declared part of any KGRA, some 2 million acres have pending lease applications.[2] Only 6,300 acres of non-KGRA land has been leased.[3] Of the approximately 500,000 acres of state land with geothermal potential, only about 36,000 acres are under lease or prospecting permit.[4]

Those acres still to be leased do exert some pressure on the overall process of geothermal development. On the one hand, some are potentially valuable. If these are leased, they are apt to receive more rapid development than some of the areas with lower potential that have already been leased. Those contemplating development activities may want to delay development on their lower-potential areas until someone has exploited these higher-potential areas.

The acres yet to be leased also have a strategic implication. Both the state and federal governments have laws about the operation of geothermal fields as units, a method that allows one leaseholder to cooperate with another. However, since rental rates for unleased land can be increased when geothermal discoveries are made on nearby parcels, a developer may want to delay exploiting fields containing unleased land until all the land is leased, so that discoveries do not simply lead to higher rental rates for the rest of the field.

3.3 Procedural Problems

Four major procedural problems have hampered the geothermal leasing process. These are: (1) lack of a clear legal definition of geothermal resources; (2) cash payment requirements at the time of lease sales; (3) the time required to obtain a lease; and (4) conflicting objectives of lessee and lessor.

With respect to the first problem, determining ownership of a particular geothermal resource may be difficult. The federal government, the state government, and private landowners have occasionally separated ownership of the surface of a piece of property from the ownership of the "minerals" under that property. Whether mineral ownership includes geothermal ownership has been a subject of controversy. Since the controversy concerns the construction of past documents and legislation, these issues will have to be resolved by the courts. One case, United States v. Union Oil Company, has already held that the mineral reservation in the Stock Raising Homestead Act did not include a reservation of the rights to geothermal resources. This case is now before the Ninth Circuit Court of Appeals. Another case, Pariani et al. v. California et al.,[5] which is pending decision, is concerned with whether a state reservation of

mineral rights includes geothermal rights. Finally, a private reservation of mineral rights has been held to include geothermal energy (Geothermal Kinetics v. Union Oil et al.)[6] This case too is on appeal.

Two factors help mitigate the consequences of this ownership problem on the rate of geothermal development. First, the issue is already before the courts, and one can expect a resolution of the issue soon, at least for general federal and state reservations. Second, in several cases, the various alleged owners have allowed the developer to put rents and royalties into an escrow account until ownership can be determined. However, a clear legal definition is important for reasons other than ownership, including regulation and tax treatment.[7]

With respect to the problem of cost, the demand by landowners for a cash bonus at the time of the lease sale can put a severe strain on the financial resources of the smaller geothermal developers. In an area with very high potential such as The Geysers, cash bonuses to the federal government have been as high as $3,000 per acre.[8] In addition, both the state and federal governments will not lease land without first performing a careful environmental study of the impacts geothermal development might cause in that area. These studies have cost from a few hundred dollars to

$200,000.[9] When the state of California is the lessor, these costs are absorbed by the developer and, again, can put a strain on his financial resources.

These two problems contribute to the third difficulty, the amount of time required to fulfill the procedural requirements for obtaining a lease. Litigation of ownership questions can take a long time, as can collection of data for environmental impact reports. In addition, both the state and the federal governments have a backlog of lease requests, so that granting a lease on any individual parcel of land will require not only the time for processing that parcel but also the time for processing all the applications ahead of it.

The fourth problem is related to the conflicting objectives of those wanting to acquire leases and those who have them to sell. In California's recent past, three motives have predominated among those seeking to obtain leases of geothermal resources: (1) some entrepreneurs want to gain land for geothermal development; (2) some corporations or individuals want to obtain geothermal rights for investment purposes (that is, they want to hold the geothermal lease until it becomes very attractive to someone else and then sell their rights to that company--they have little or no intention of developing the leasehold themselves); and (3) some potential lessees apparently want to protect their

competitive position (that is, they have no immediate desire to develop the geothermal resources, but should the development of geothermal resources become more attractive, they want to have some resources they can develop).

Clearly, an increase in the relative attractiveness of geothermal resources would exert different effects on each of the three types of leaseholders. For those holding leases for development, an increase in attractiveness would produce little or no change, since they were already committed to development. For those interested in speculation, an increase in attractiveness would lead them to sell their geothermal rights. For those interested in protecting their competitive position, however, an increase in the attractiveness of geothermal power might lead them to start development more quickly than they would otherwise.

Evidence from leases signed by private, state, and federal landowners who have leased the geothermal rights to their land indicate varying combinations of three primary motives: (1) to gain immediate financial return, as shown by the use of cash bonuses; (2) to minimize environmental damage, as shown by the elaborate environmental reporting processes required by both the federal and state governments;[10] and (3) to have a guaranteed or steady flow of cash. Some lessors have shown very little evidence of a commitment to rapid development of the resource, since they set a low

level of rental charges and fail to include penalties for lack of development. This is a prudent policy for landowners who want a steady flow of cash over the life of the lease. A requirement for rapid development could terminate the rent if the lease proved to be of no further value to the developer.

The interest of some landowners in rapid development may be increasing, however. A few recent private leases have included time periods over which development must occur, and both the state and the federal government are discussing methods by which they can force development on their leased lands.

All three types of landowners--private, state, and federal--want to get the maximum value from the land they have to lease. But as noted, they have different incentives to set lease rentals and performance standards. They also have different incentives to wait for an increase in either the general value of geothermal lands or the specific value of their parcel of land. However, the federal government does face political pressure to lease land quickly. Since geothermal development at present has a long and uncertain path from the obtaining of the lease to the revenue-producing stage of geothermal electricity production, the landowner has strong incentive to focus on the cash bonus or

rental fee at the beginning of the lease, at the expense of considering royalties that might occur later. Lessees, on the other hand, are in a business that has relatively high risks. Consequently, they would prefer not to pay large amounts of money for leases that they may not be able to develop or sell for a long time.

3.4 Interactions with Governments

3.4.1 Federal

The federal government became involved in the process of leasing because of its position as the owner of land with geothermal resources. BLM issues both competitive and noncompetitive leases. Noncompetitive leases are issued for land not in a federal KGRA,[11] and for which no one else has applied within the same filing period. An Environmental Analysis Report (EAR) is required before BLM can issue the lease; in some cases an EIS might be required.[12] If the land is managed by an agency other than BLM, that agency must also give permission. A range of rents before production and a range of royalties after production begins are set by the Geothermal Steam Act of 1970.[13]

Leases for land within a federal KGRA are issued by competitive bid, using the cash bonus form of bidding. BLM has the legal authority to use other types of bidding, but probably will not use them because USGS and BLM perceive that bidding based on something other than a cash bonus will delay the return to the government and will involve too much administrative burden.

Before a piece of land is offered for competitive bid, the managing agency prepares an EAR with the help of the USGS. An EIS could be required in some cases. In addition, USGS performs a preliminary assessment of the potential of the land for the purpose of setting minimum bids. (Because the statute says, "The Secretary [of the Interior] shall lease such lands" rather than "The Secretary may," several participants have questioned BLM's power to set a minimum bid. One of these participants is Shell Oil, which is fighting the issue through the administrative appeal process.)[14]

Leases on lands controlled by federal agencies other than BLM have not been granted as rapidly as some in the industry might desire. At least part of the problem stems from the multiple, and potentially conflicting, mandates under which such agencies as the Forest Service must operate. In the case of reviewing applications for geothermal leases, the Forest Service must operate on the assumption that once a lease is granted, it will be developed to full capacity. Thus, before any lease is granted, the Forest Service, with

USGS assistance, must be certain that such development will involve minimal disruption of surface resources. A decision to grant a lease must thus be based on a detailed environmental analysis and a consideration of any special stipulations that may be required.

Forest Service personnel have noted that an environmental assessment is expensive and time-consuming and must be coordinated with the other Forest Service obligations. It has also been noted that the agency has a small staff qualified to evaluate bids that are made.[15]

It has been suggested that agencies such as the Forest Service worry that once they grant a lease, they will lose control of the development process. If they were given some assurance of continued control, permission might come much faster. Since the Forest Service controls roughly one-half of the land for which noncompetitive applications have been filed, working out an acceptable resolution of these concerns may accelerate this part of the federal leasing process.[16]

3.4.2 State Lands[17]

The state of California owns a substantial amount of land with good geothermal potential. Prospecting permits are issued on a first-come, first-served basis on lands that have not been classified by SLC as being within a state KGRA