



AUG 8 - 1974

University of Hawaii at Manoa

Hawaii Geothermal Project
Holmes Hall 240 • 2540 Dole Street
Honolulu, Hawaii 96822

August 6, 1974

Dr. Paul Kruger, Director
Advanced Geothermal Energy
Research and Technology
National Science Foundation
1800 G. Street, N.W.
Washington, D. C. 20550

Dear Paul:

Regarding your inquiry on the proposal submitted by the Department of Planning and Economic Development (DPED), I would evaluate it as a complementary activity to the Hawaii Geothermal Project (HGP) and recommend that the two projects proceed in parallel.

Shelley Mark, listed as P.I. for the proposal, is on the Advisory Committee for the HGP and he and/or Gene Grabbe, Program Manager, have been active participants in all meetings of the Committee. DPED has endorsed our geothermal research from the beginning and has had a positive influence on legislative and administrative support for the HGP. The release of the initial \$200,000 of State and County funding was administered through DPED, as well as the \$500,000 legislative funding for exploratory geothermal drilling. Consequently, we do have excellent communications with DPED administration and staff.

After reviewing the proposal as submitted, I can readily understand your concern on possible duplication. Both Bob Kamins, Director of the HGP Socioeconomic Program, and I had discussed earlier drafts of the proposal with DPED staff and identified areas of potential overlap, and some of these still remain -- if the intent were to develop competing programs.

This is certainly not the case and, in reality, there should be very little duplication. DPED is the focal point in State government for land use, planning, economic development, and capital investment. It is in a much better position than the HGP for influencing the overall State decision-making machinery and in initiating legislation on geothermal and other natural energy resources. Assumption of this important role by DPED would permit HGP faculty and staff to engage in the type of research enterprise for which they are better equipped to handle.

At the meeting yesterday of the Governor's Energy Policy Advisory Committee, of which Shelley Mark and I are members and Gene Grabbe is Executive Secretary, favorable action was taken on recommending to the Governor release of

funds to match NSF support for DPED's proposal, if it is forthcoming.

As Director of the Hawaii Geothermal Project, I would welcome this additional input of both State and federal funds through DPED to further development of geothermal power in Hawaii. We shall coordinate the two programs to realize maximum return on tax dollars. Bob Kamins joins me in urging your favorable endorsement of the proposal.

Hope to see you and/or Ritchie at both the Circum-Pacific Energy Conference and the Cal-Tech Geothermal Conference.

Aloha,

John W. Shupe
Project Director

JWS:cms

bcc: Dr. Eugene M. Grabbe ✓

Good luck!
John

*see
file*



DEPARTMENT OF PLANNING
AND ECONOMIC DEVELOPMENT

RECEIVED

JOHN A. BURNS
Governor

SHELLEY M. MARK
Director

EDWARD J. GREANEY, JR.
Deputy Director

250 South King St. / Honolulu, Hawaii 96813 / P. O. Box 2359 / Honolulu, Hawaii 96804

1974 AUG 23 AM 10:14

August 20, 1974

DEPT. OF LAND
NATURAL RESOURCES
STATE OF HAWAII

RECEIVED
DIV. OF WATER &
LAND DEVELOPMENT
SEP 5 10 32 AM '74

The Honorable Sunao Kido
Chairman and Member
Board of Land and Natural Resources
Dept. of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Kido:

Enclosed for your information is a copy of the DPED proposal to the National Science Foundation on "State Management of Geothermal Energy in Hawaii." A more appropriate title would be "Development of State Policy for the Utilization of Geothermal Energy (and other Natural Energy Resources)" since the project will emphasize the role of the State and formulation of policy options in meeting the impact of new energy resources. The Abstract and pages 1-4 give a good summary of the proposal.

We recognize that the Department of Land and Natural Resources is responsible for the management and regulation of the development of State geothermal resources and the action of our 1974 Legislature regarding geothermal resources is cited on pages 17 and 18 of the proposal. We anticipate that this proposed project will complement your Department's activities in working toward a reduced dependence on imported fuels for Hawaii.

For your information I also enclose a copy of a letter from Dean John Shupe, Principal Investigator of the University of Hawaii Geothermal Project, commenting on the DPED geothermal project.

Please advise me if we can supply further information concerning this geothermal project. I would appreciate hearing from you at your earliest convenience since NSF has advised us that the project has been approved.

Sincerely,

Shelley M. Mark
SHELLEY M. MARK
Director

Enclosures

copy to P.O.

9/3

Geother
X 12
DPED

September 11, 1974

Dr. Shelley Mark, Director
Dept. of Planning & Economic
Development
State of Hawaii
Honolulu, Hawaii

Dear Dr. Mark:

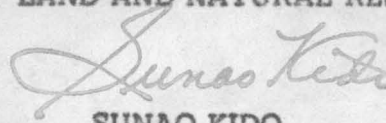
We have reviewed your proposal to the National Science Foundation on "State Management of Geothermal Energy in Hawaii". We agree that this project which will explore the public policy implications, consequences, and management options of geothermal energy for Hawaii is well within the responsibility and objectives of the Department of Planning and Economic Development. We are pleased that you will be developing the State policy for natural energy resources and will be working closely with the University of Hawaii in developing the methodology and technology necessary for geothermal energy development.

The Department of Land and Natural Resources, which has a primary responsibility for managing the natural resources of the State, is cognizant of the problems connected with the development of new energy sources. We desire to stay close to all of the research, development, and management objectives developed by the Department of Planning and Economic Development and the University of Hawaii and will be pleased to assist you in any way we can regarding the research proposal.

We look forward to your keeping us informed of the progress of this project and offer to provide you with all the basic data we have within our department regarding our natural resources of the State of Hawaii.

Very truly yours,

BOARD OF LAND AND NATURAL RESOURCES



SUNAO KIDO
Chairman and Member

RTC: WOW: dh

UNSOLICITED RESEARCH PROPOSAL SUBMITTED TO THE NATIONAL SCIENCE FOUNDATION

State Center for Science Policy and Technology Assessment

Name of Organization (including Branch title, if any)

Hawaii Department of Planning & Economic Development

Address of Organization

State Management of Geothermal Energy in Hawaii

Title of Proposed Project

Amount Requested \$29,850 Proposed Duration 12 mos. Requested Starting Date July 1, 1974

Name of Principal Investigator Dr. Shelley M. Mark

Name of Project Manager if Other than P.I. Dr. Eugene M. Grabbe

Social Security No. [Redacted]

[Redacted]

Title Director, DPED

Project Manager, CSPTA

Telephone (w/area code) (808) 548-6914

(808) 548-4195

Other No. (where message can be left)

Organizational Affiliation

State Center for Science Policy and Technology Assessment

Address if Different from Above

For renewal requests, list previous Grant No.

Endorsements Principal Investigator

Other Endorsements (Formal Proposals Only)

Approving Administrative Official (Formal Proposals Only)

Name Dr. Shelley M. Mark

Dr. Shelley M. Mark

Mr. Henry T. Fukuda

Signature [Handwritten Signature]

[Handwritten Signature]

[Handwritten Signature]

Title Director, DPED

Director, DPED

Accountant, DPED

Date June 24, 1974

June 24, 1974

June 24, 1974

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ABSTRACT

This proposal is for a State of Hawaii research project for defining the role of State government in the utilization of geothermal energy. The proposed project will conduct a systematic review of the existing and potential functions of State and County government with the aim of developing a methodology for, and undertaking an assessment of, the management options open to the State of Hawaii. The process itself would then be applicable in assessing the State's management options over other natural energy resources such as wind, sun and ocean thermal differentials.

The University of Hawaii is presently engaged in a major geothermal energy research project with joint National Science Foundation, State of Hawaii and County of Hawaii support directed toward the utilization of the State's geothermal resources. The proposed State project will complement the University project and explore the processes and actions required to accelerate the transition from University research results to practical applications of geothermal energy to meet the needs of Hawaii. It will explore the public policy implications and consequences of the introduction of geothermal and other new sources of energy in Hawaii.

The project also will serve as a focal point for geothermal energy information dissemination and feedback among the State, County and Federal agencies.

1. Proposal Summary

1.1 Objectives

The objectives of this project are to explore the implications, consequences and management options for the State of Hawaii in the utilization of its natural energy resources, emphasizing volcanic geothermal energy in cooperation with an on-going University of Hawaii geothermal research project. The project will define the role of the State and lay out options in energy policy and actions related to economic growth, new technology management and long term impacts of geothermal energy.

1.2 Research Plan

The project will be process oriented and will be concerned with a study of State, County and Federal government decision-making agencies, regulations and actions related with the introduction of new forms of energy. Surveys, interviews, questionnaires and workshops will be used to gather information, make forecasts and set priorities. Such priorities may lead to technology assessments. Potential conflicts between environmental and energy goals will be identified for ultimate public policy resolution. The project will serve as the focal point in State government for coordination with the University of Hawaii Geothermal and Hawaii Environmental Simulation Laboratory projects.

1.3 Organization and Management

Key personnel involved in the project and their responsibilities are:

Dr. Shelley M. Mark, Director
Department of Planning and
Economic Development

Principal Investigator
Project guidance

Dr. Eugene M. Grabbe, Project
Manager, State Center for Science
Policy and Technology Assessment

Project Manager
Day to day operations

Ms. Norrie Thompson, Research
Associate, State Center for
Science Policy and Technology
Assessment

Research Associate
Coordination, technical
editing, etc.

Consultants and University faculty
and graduate students

Specific research tasks

1.4 Utilization Plan

This is inherently a utilization project in which the participants are also the users. The formulation of policy and action options to meet the impact of new energies will involve the action agencies so that utilization evolves as a major component of the project results.

1.5 Work Plan

Table I is a 12-month schedule for this project broken down by subtasks in three areas. The estimated costs are shown as part of Table I.

- (1) The Role of the State in Geothermal Energy Development
Decision-making in State and County agencies
Constraints, implications and consequences of geothermal energy
Analysis of technologies
Processes for handling new technologies
- (2) Synthesis of a State Natural Energy Policy
Identify economic, environmental and social impacts
Formulate options for State policies
Methodology for resolving conflicts
Actions required by the State
Technology assessments and long-range forecasts
- (3) Coordination
University of Hawaii Geothermal Project and other
State and County natural energy projects
State Advisory Task Force on Energy Policy and the
State Energy Coordinator
Legislative Scientific Advisory Committee
State, County & Federal agencies and Industry
Information Dissemination and Feedback Center

1.6 Personnel

Dr. Shelley M. Mark is Director of the Department of Planning and Economic Development, State of Hawaii, and State Science Advisor. His background is in academic economics, State Government and University Administration.

Dr. Eugene M. Grabbe is a physicist with experience in industrial research and development, technology planning and State science programs.

Ms. Norrie Thompson has experience in technical editing and journalism and has worked in State government agencies and for the State Legislature.

1.7 Educational Component

It is estimated that graduate students will be used for sub-tasks on this project. University faculty will be involved as advisors and consultants.

Table I -4-
Task Schedule

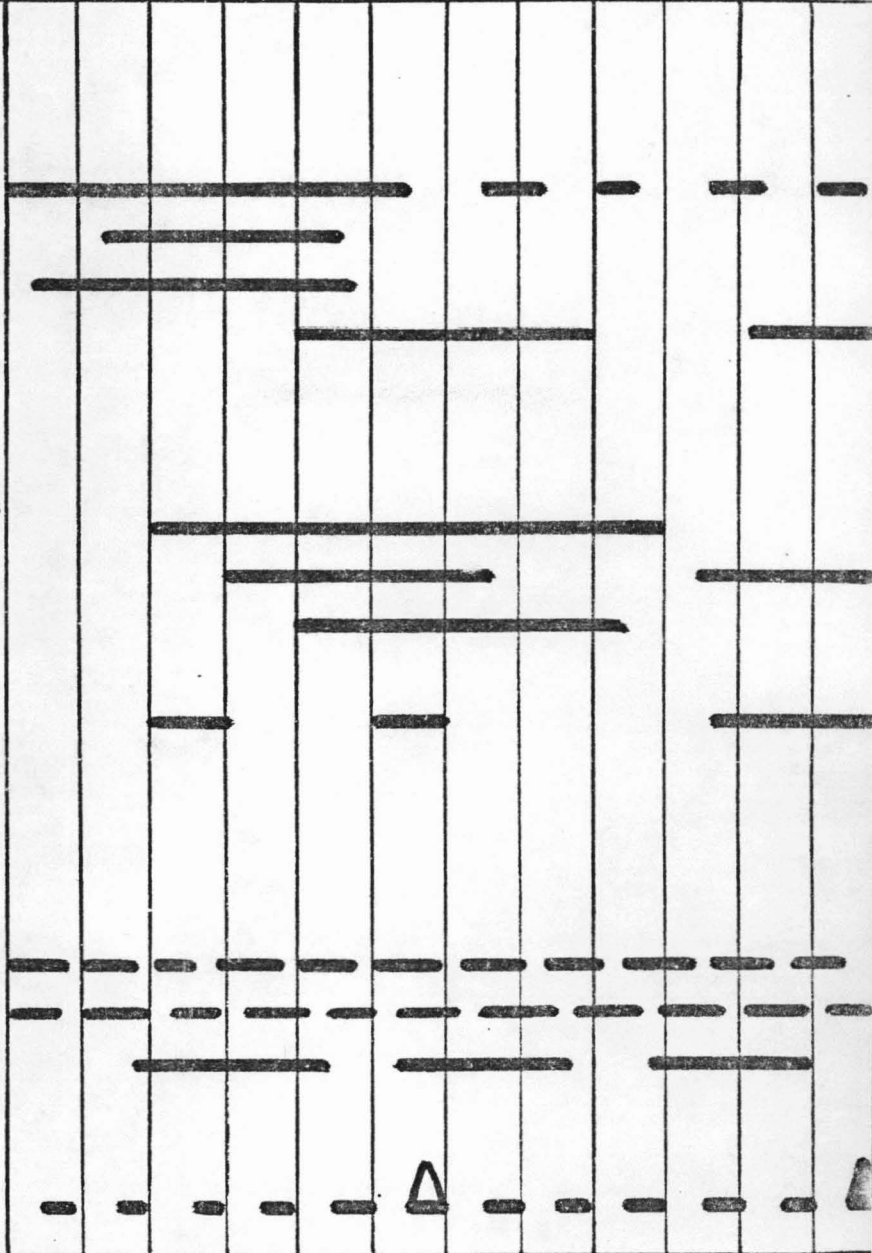
Months from Project Start

Task

1 2 3 4 5 6 7 8 9 10 11 12

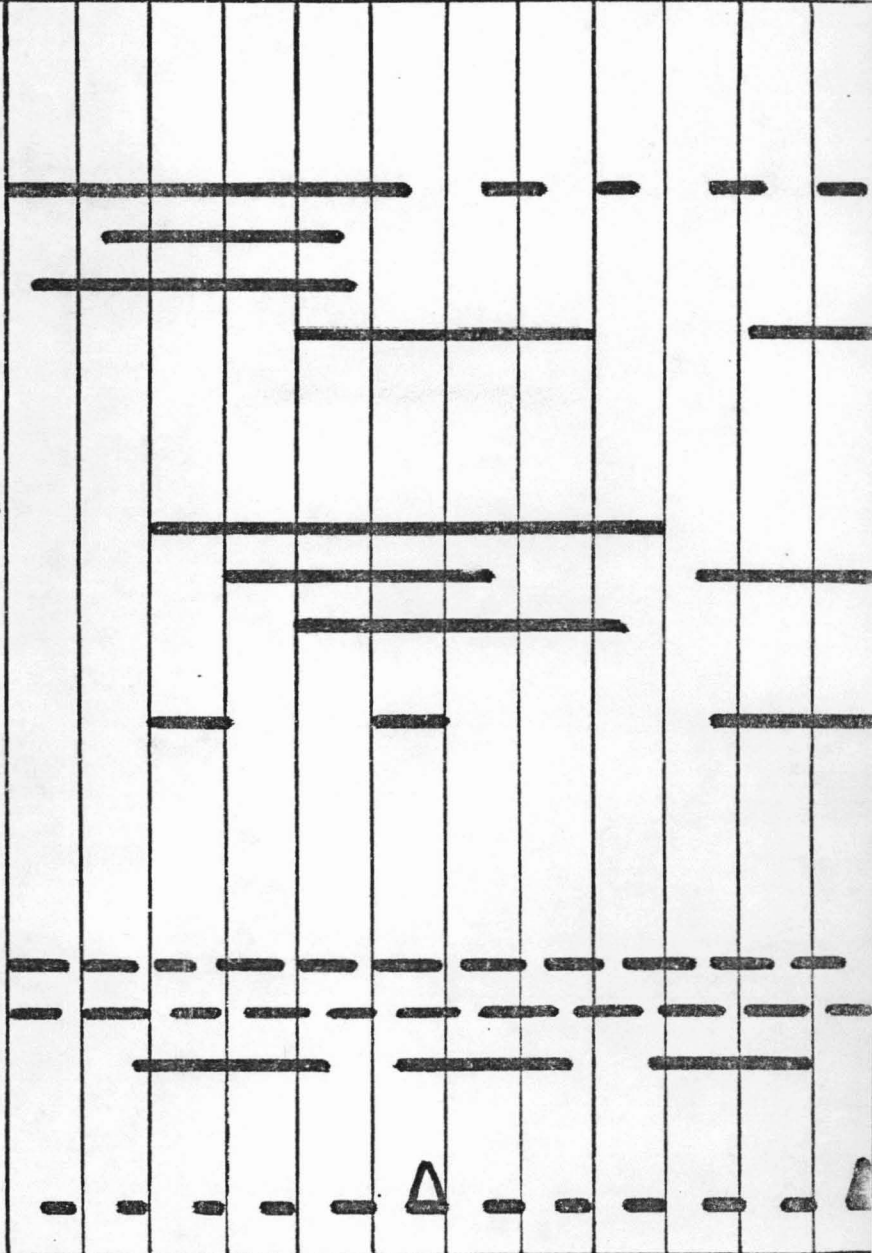
1. The Role of the State in Geothermal Energy Development

- a. Decision-Making
- b. Constraints
- c. Technologies
- d. Processes for handling new technologies



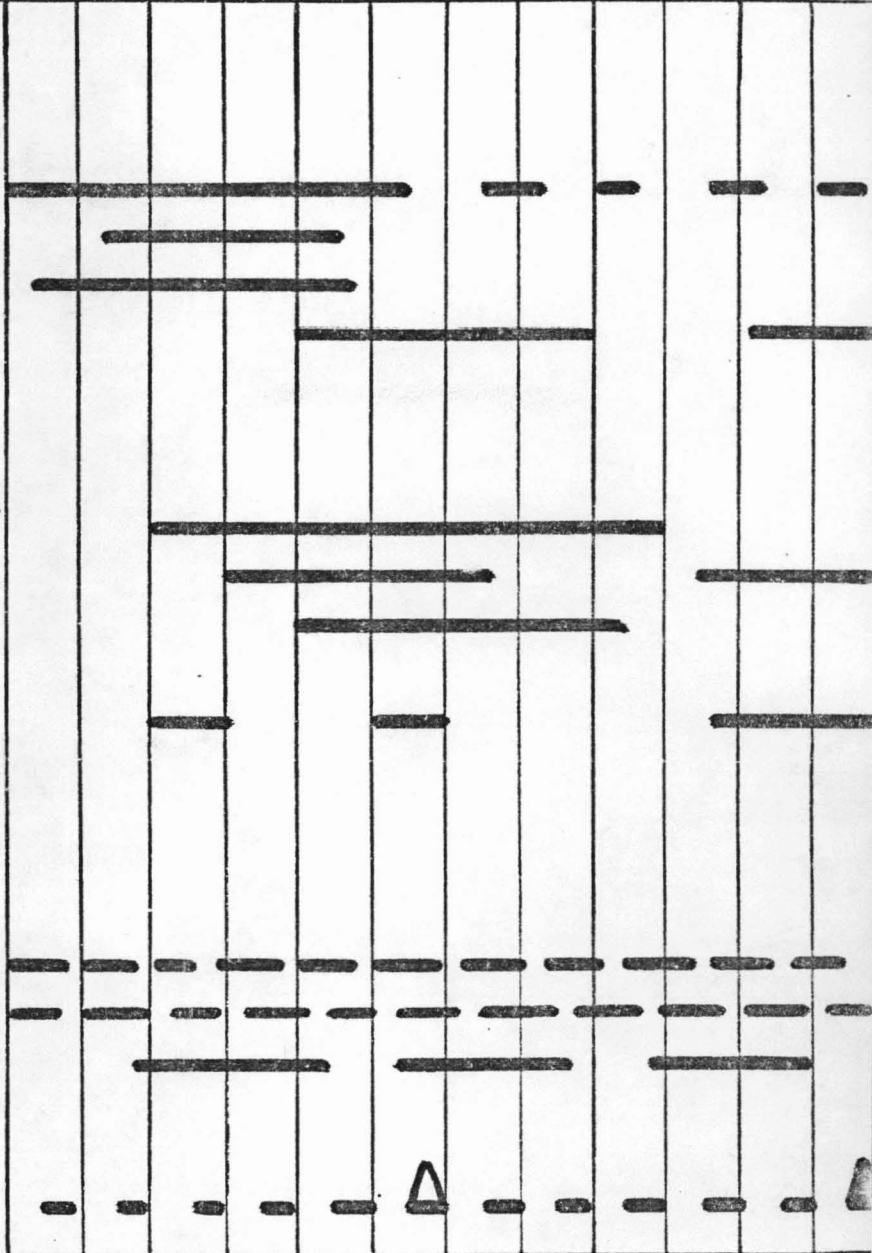
2. State Geothermal Energy Policy

- a. Identify Impacts
- b. Formulate Options
- c. Methodology for Resolving Conflicts
- d. State Actions
- e. Technology Assessment & long-range forecasts

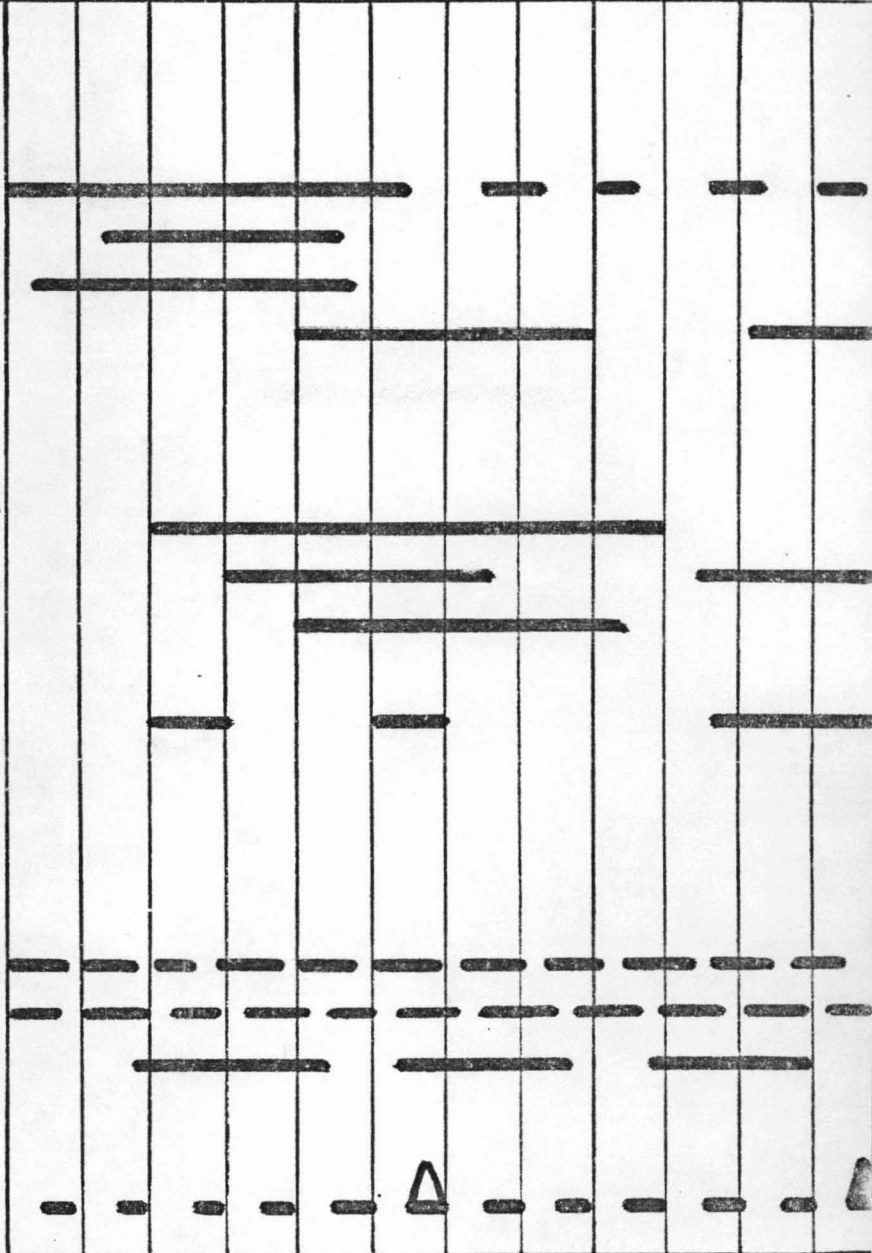


3. Coordination

- a. University of Hawaii
- b. Interagency
- c. Feedback + Feedforward Center



4. NSF Reports



△ = Preliminary Report, Possible Recommendations to the 1975 legislature
▲ = Final Report

Costs by Tasks

1. The Role of the State	\$	14,000
2. State Policy		24,500
3. Coordination		21,200
	\$	<u>59,700</u>

STATE MANAGEMENT OF GEOTHERMAL ENERGY IN HAWAII

2. Narrative

2.1 Project Objectives

● Statement of the Problem.

The State needs to systematically consider its options so that with the advent of geothermal and other new natural energy sources it will be in a position to manage the resources to best serve the State's interests.

The objectives of this proposal are to explore the opportunities, problems and alternatives open to the State of Hawaii in the utilization of new energy sources, emphasizing geothermal energy. The project will complement the University of Hawaii Geothermal Project research, now in progress. Hawaii has no fossil fuels and is completely dependent on imported petroleum for energy. Geothermal resources could provide the State with local environmentally clean energy and the results will assist in solving both local and national energy needs. See Appendix A for an overview of Hawaii's opportunities and problems. The research will try to answer questions on State processes related to new sources of energy in three areas: (1) The Role of the State in Geothermal Energy Development,

- (2) Synthesis of a State Natural Energy Policy and
- (3) Coordination.

• Specific questions are:

(1) The Role of the State in Geothermal Energy Development.

What is the State and County decision-making apparatus at the executive, legislative, and departmental levels? What should be the role of private industry in decision-making? What are the implications and consequences to the State? What is the relation to the State Coastal Zone Management Program? What new technologies are involved, and what processes and mechanisms must be developed by the State to fully utilize these new technologies?

(2) Synthesis of a State Natural Energy Policy.

What will the environmental, economic and social impacts of geothermal energy be? How should conflicts with energy policy be resolved? What management options are available to State and County governments to best meet Hawaii's needs? What actions should be taken by the State? What technology assessments and long-range forecasts concerning natural energy are needed?

(3) Coordination.

What communication and coordination functions are needed among agencies of the State, County, Federal government and industry? What techniques are best suited for a natural energy information center for feedforward (selective dissemination) and feedback in Hawaii?

● Consequences of Successful Research

The results of the project will be the following:

- (1) Provide an understanding of functions of State and County agencies, planning procedures, decision-making processes and industry-government relations, and a process of assessing resource management options.
- (2) Formulate a State policy for natural energy resources and a methodology for resolving conflicts between energy goals and other State goals.
- (3) Recommend specific action options for the State in order to accelerate the use of natural energy resources and lessen dependence on petroleum imports.
- (4) Provide a Hawaii information dissemination center (including feedback and feedforward) for natural energy information.

- (5) Assessments of new technologies related to geothermal energy and their contribution to meet Hawaii's future needs.
- (6) Development of long-term objectives (1990-2000) for geothermal technology utilization by the State.

2.2 Research Plan

2.2.1 The Role of the State in Geothermal Energy Development

- Decision-making in State and County agencies

The functions of State, County and Federal government and industry in planning and decision-making for the development and utilization of geothermal energy will be studied in order to understand the decision-making procedures and to define problem areas. See Appendix B for a discussion of government responsibilities in Hawaii.

Strong and early State and County involvement will insure an application of the University research at an early date, and will insure an understanding of government's role in the developmental management of the resource.

- Constraints, Implications and Consequences of Geothermal Energy

The subtask will examine existing legal constraints and follow the development of rules, regulations and leasing arrangements by the Department of Land and Natural Resources

in implementing the 1974 State Legislature's Act 241 defining "geothermal resources" as minerals. Since geothermal drilling is likely to be close to the shoreline and any generating plant would use seawater for cooling, the implications related to Coastal Zone Management planning now in progress at the Department of Planning and Economic Development should be explored. Social, economic and environmental consequences may be considered through surveys or workshops held in cooperation with the County of Hawaii and the University of Hawaii.

- Analysis of New Technologies Related to Geothermal Energy

The purpose of this task is to develop mechanisms so that the State of Hawaii understands the importance of new geothermal technologies to the State. Work at the University of Hawaii and of other NSF geothermal grantees will be monitored so that the State can play an optimum role in accelerating the utilization of the research results applicable to Hawaii.

- Processes for Handling New Technology

The "New Federalism" places responsibility for problem-solving on state and local governments. Since this places the states and counties in a new role in handling

new technologies, new relationships must be developed among industry, Federal, State and County governments and Universities for utilizing new energy resources. The State should take an aggressive position in developing and coordinating such processes and pressuring the Federal government to increase the funding of geothermal research programs.

2.2.2 Synthesis of a State Natural Energy Policy

• Identify Economic, Environmental and Social Impacts

Opportunities for economic diversification and new industries based on geothermal and other new energy sources will be compiled from an analysis of geothermal energy's economic potential to the State and the Island of Hawaii, being carried out by the University of Hawaii Geothermal Project, and diversification studies made by the County of Hawaii and the State Kohala Task Force

The by-products of geothermal energy exploitation in Hawaii are of great potential significance for the State's economy since they can capitalize on Hawaii's unique phenomena of the close proximity of geothermal heat and low temperature sea water. By-products may include minerals, ranging from salt to precious metals, nutrients for aquaculture, marine pharmaceuticals, and fresh water, which is needed in many localities of Hawaii Island.

New industries which might evolve include manganese nodule processing, hydrogen gas manufacture and chlor-alkali production. Manganese nodules are now viewed as a major resource for iron, nickel, cobalt, and copper metals and some of the largest nodule deposits are found in deep seabeds near Hawaii and crusts are found in the shallower inter-island channels.

The Island of Hawaii may have an excess of power if its geothermal resources are developed. The problem of how to share such benefits with the other islands of the State will be considered. Possibilities include transmission of energy directly, shipment of products, inter-island industries, etc.

Existing industries could be moved to the source island to take advantage of geothermal energy and dovetail with the State's policy of encouraging population growth on the Neighbor Islands. These developments will affect the Island of Hawaii life style and environmental quality. Workshops or surveys in cooperation with the University of Hawaii and County of Hawaii would be valuable to gauge the social impact.

- Formulate Options for State Policies

This project will attempt to lay out the options for the State to enable the State to formulate short, intermediate and long-range policies, and to make decisions of greatest benefit to the government, citizens, and industry in the State.

Geothermal energy policy should mesh with energy planning being carried out by the Department of Planning and Economic Development, authorized by Act 240 of the 1974 Legislature, and the activities of the State Energy Coordinator, also created by the 1974 Legislature. Important factors are national and state policies, public attitudes, technology developments, economic, social and environmental issues. For example, State geothermal energy policy will consider how the development of natural energy sources should best be managed to dovetail with the State's goals of slowed growth generally, and accelerated growth in selected areas.

- Methodology for resolving conflicts

This task will encourage studies of, and assist in obtaining funding for studies of, various methods for making tradeoffs between the community's energy and economic

development needs and desire to maintain the quality of the environment. For example, questions should be answered concerning the amount of environmental degradation that would result from various levels of development of a manganese nodule processing industry on the Island of Hawaii. And what would be the effect on Hawaii's tourist industry of this environmental degradation? These trade-offs will have to be evaluated by a cost-benefit analysis that includes social and environmental costs.

- Actions Required by the State

The possible actions for the State should follow from the analysis of State options. It is anticipated that an interim report will be made at the six months' point of the project, and a final report with recommendations of alternative actions and priorities.

- Technology Assessments and Long-Range Forecasts

Assessments may be needed of new methods of storing and transmitting energy, the hydrogen-based economy, and other novel approaches. Hawaii's relation to the sea is an important factor in such new technology consideration. Utilization of nearby cold nutrient rich deepsea water, minerals and chemicals from ocean water, floating platforms and semi-submersible ships should be considered. In fostering new technology the State must develop mechanisms for evaluating new approaches, monitor technology

developments here and elsewhere, assess new ideas in terms of Hawaii's needs and resources. Additional funding may be required if major assessments are carried out by the Center.

The Hawaii State Center for Science Policy and Technology Assessment has had experience over the past three years in assessing new technology, developing recommendations and formulating policies. A list of the Center's publications is given in Appendix C. Technology assessed has included aquaculture, manganese nodules, modeling, and ocean-related technology. The Project Manager of the Center presented a paper on Hawaii's approaches to technology assessment at the First International Congress on Technology Assessment in The Hague, Netherlands, May 29-June 3, 1973. The paper was very favorably received. The Center was instrumental in the writing and publication of Hawaii and the Sea--1974, an important document surveying Hawaii's opportunities and constraints in relation to the sea.

The long-term impact of geothermal energy and other evolving energy sources on the State of Hawaii, i.e. technology related developments that are likely to occur

during the next 10 or 20 years, need to be examined. Recommendations will be made on what forecasts are of greatest importance to Hawaii. Possible topics include:

- New technology for energy extraction from volcanoes
- Hydrogen based economy - electrolysis or thermal cracking of water
- Photo-biological production of hydrogen or methane
- 100 megawatt nuclear plant for Hawaii
- Other technologies for using the wind, sun and ocean temperature differentials as an energy source

The emphasis on long-term studies will be to isolate those areas for which Hawaii's unique environment provides a natural laboratory for research and demonstration projects.

2.2.3 Coordination

- Inter-Agency Coordination

In its three years of operation, the State Center for Science Policy and Technology Assessment has achieved an excellent reputation for its ability to coordinate activities and disseminate information between various State agencies, the different branches of government, and private industry. This project will require a thorough understanding of the State and County decision-making processes--at the executive, departmental and legislative levels--in order to lay out the options to the State for

managing the resource. Both an understanding of, and good communication with, these various levels of State and County government is essential. The options, and their consequences, must be fully communicated to government decision-makers, and coordination must be maintained as various options are formulated. The development of a process to manage a new energy resource will require the involvement of the following government entities: Governor's Office; Legislature--especially Economic Development, Environmental and Finance Committees; Legislative Scientific Advisory Committee; Governor's Advisory Committee on Science and Technology; and Governor's Energy Policy Task Force--especially Subcommittees on Energy Conservation and Alternate Energy Sources.

State government agencies (see Appendix B, Table IV, for specific responsibilities): Dept. of Accounting & General Services; Dept. of Agriculture; Dept. of the Attorney General; Dept. of Budget and Finance; Dept. of Health; Dept. of Land & Natural Resources; Dept. of Planning & Economic Development (Land Use Commission & Interdepartmental Transportation Control Commission); Dept. of Regulatory Agencies (Public Utilities Commission);

Dept. of Taxation; Dept. of Transportation; Office of Environmental Quality Control; Marine Affairs Coordinator's Office; and the University of Hawaii (especially the Hawaii Geothermal Project and the Hawaii Environmental Simulation Laboratory).

County agencies (Hawaii County): Mayor's Office; Dept. of Accounting & General Services; Governor's Liaison Office; Dept. of Health; Dept. of Land & Natural Resources; Dept. of Planning; Dept. of Regulatory Agencies; Dept. of Taxation; and Dept. of Transportation.

The following are recent State actions pertinent to the development of new sources of energy which this project will continue to follow and coordinate:

June 1974 - Federal Government (National Oceanic and Atmospheric Administration) award of \$250,000 to State for development of a Coastal Zone Management project. The National Science Foundation allocated an additional \$340,000 for the Hawaii Geothermal Project.

The 1974 Hawaii State Legislature (a) allocated \$150,000 to the Dept. of Planning and Economic Development for energy planning and conservation programs, (b) created the position of Energy Coordinator in the Governor's office, (c) defined geothermal resources as "minerals" and allocated \$40,000 to the Dept. of Land and Natural Resources

to establish rules and regulations for the development of this resource, (d) allocated \$55,000 for the establishment of a Natural Energy Institute at the University of Hawaii, (e) allocated \$50,000 for the establishment of a Natural Energy Laboratory on the Island of Hawaii under the Office of the Marine Affairs Coordinator, and (f) allocated \$500,000 in CIP budget as contingency funds for exploration for geothermal energy sources.

● Information Feedforward and Feedback Center

An important aspect of the success of projects concerned with new technology today is keeping the public and citizens' groups aware of coming developments (feedforward) which are planned or underway. An important coordination task of this project will be to serve as the focal point for dissemination of information on geothermal energy and technology pertinent to Hawaii in the State. Such information in a suitable format will be channeled into State and County government agencies, the Legislature, the news media, etc., in coordination with the University. There is a greater citizen interest in Hawaii in science and technology than in most states and so active community participation can be expected. Feedback in response to proposed planning and policies is equally important in

formulating State options and the Center will develop methods for obtaining such feedback as an input to the project.

The Hawaii Center for Science Policy and Technology Assessment has established a reputation for quality reports and effective dissemination of information. It is anticipated that the processes and results developed by this project will be of interest to other states, NSF, AEC, and to other Federal agencies.

2.3 Organization and Management Plan

Dr. Shelley M. Mark, Director of the Department of Planning and Economic Development, and Principal Investigator for this proposed State project, is a member of the "Hawaii Advisory Committee" for the University Geothermal Program and was formerly Professor of Economics on the University faculty. He is also the Governor's Science Advisor and Economic Advisor and the State Energy Coordinator.

The Governor's Advisory Task Force on Energy Policy will provide initial guidance for this project. The Task Force draws its membership from State agencies and the University as well as the private energy sector. Members

include two key University scientists identified with the Geothermal Program, Dr. John P. Craven, dean of marine programs, and Dr. John W. Shupe, dean of engineering and Principal Investigator for the Geothermal Project.

The Project Manager for this proposed State project, Dr. Eugene M. Grabbe, is project manager for the Hawaii State Center for Science Policy and Technology Assessment, and is currently serving as Executive Secretary of the Governor's Advisory Task Force on Energy Policy.

To complete the various tasks, advisors or consultants may be needed. Personnel with the following qualifications may be required:

New Technology: Background in engineering and/or physics with a broad interdisciplinary base in the natural sciences, including energy modulation, instrumentation and control systems, biological systems, ecology, and medicine.

Economics: Background with State and County economics, models and input-output tables, and economic planning and development problems. Experience in working with government agencies, in gathering and assessing data, and performing economic studies.

Environment: Experience in preparing and reviewing environmental impact statements, practical experience in monitoring, setting standards and investigating environmental problems concerned with air, water, and noise pollution. Knowledge of environmental engineering, instrumentation and control systems.

Social Sciences: Background in social studies related to State and County problems. Experience in conducting surveys, gathering data and analyzing information concerned with labor, demography, quality of life, culture, etc. Knowledge of forecasting, futuristics and techniques for studying social impacts.

Legal Areas: Legal experience with State and County problems concerned with land use, environmental planning, health, transportation, water rights, etc. Knowledge of Hawaii Revised Statutes, workings of the State Legislature and preparation of bills.

Table I (Section 1) shows a breakdown of tasks for this project according to the categories listed under 1.2 Research Plan.

2.4 Utilization Plan

The utilization schedule of this project must be tied very closely with the University of Hawaii Geothermal Project (HGP). It is expected that starting early in 1975 the HGP will drill a dozen or so shallow wells on the Island of Hawaii to test for water temperature, salinity and chemical composition near sites selected by geophysical exploration. These will be followed by deeper drillings.

The public and private sectors of the County and State of Hawaii will be involved in planning, carrying out the tasks, and utilization of natural energy resources. The role of the State formulated for geothermal energy should be equally applicable to other natural energy sources such as ocean temperature differentials, solar, etc. At the

national level the results of the project will be disseminated through the National Science Foundation, State Science Advisors, and State Energy Coordinators. Monthly reports and one 6-month report will be made to NSF.

2.4.1 User Group and Markets

Target users for this project are State and county governments, including administrations, departments and legislative bodies, the University, Hawaii industries, power utilities, and agriculture. All of these users will be involved directly or indirectly in the planning or implementation of the project.

The methodologies developed for managing new energy sources and supplies will serve as a model for other states. The User Group most closely related to this project are the Western states and Alaska, where known geothermal areas and active volcanoes exist.

The long-range energy planning of this project will be of value to all states with geothermal potential, active volcanism and other evolving new energy sources. Coastal states, Puerto Rico, the Virgin Islands, American Samoa and the Trust Territories may benefit from those aspects of the project concerned with energy and the sea. The development of energy policies and the results of

assessments of new technologies associated with geothermal energy will be of national interest.

2.4.2 Utilization Process

Recommendations for State policies and legislation will be channeled through state and county agencies. Such recommendations may be concerned with implementation of University research, demonstration programs, economic development, technology assessments, and forecasts associated with geothermal energy.

Since its inception three years ago, the Center for Science Policy and Technology Assessment has been involved in a number of studies, assessments, workshops, and conferences concerned with research and development, areas of science of interest to Hawaii, and current State problems. Appendix C lists the publications resulting from these activities. The Center has demonstrated its capability in directing and coordinating projects concerned with State programs and has been effective in disseminating the results at both the State and national level. The Center's Project Manager has had experience in directing large and small industrial projects.

The State Center for Science Policy and Technology Assessment is in direct touch with research programs in other states through the NSF liaison office and can provide an overview of geothermal developments in other states.

It is also anticipated that reports will be made on a monthly basis to NSF. In the University project, the reports are made on a semi-annual basis and the National Science Foundation is planning to hold semi-annual meetings to report on progress in geothermal programs.

2.4.3 Utilization Budget

The processes described in the previous section will be carried out on an on-going basis during the project. Hence, the cost cannot easily be separated as a line item. The Utilization Budget is estimated at 40% of the total project cost.

2.5 Related Programs and Activities of the Organization

The National Science Foundation has been supporting the Hawaii State Center for Science Policy and Technology Assessment in an experimental program. This proposed geothermal planning project will provide an opportunity to apply the ideas developed under the Center's program to a specific project that is oriented toward both national and State needs. It is proposed that this project be viewed as an add on to the existing grant.

2.6 Related Programs in Other Organizations

NSF is supporting a major geothermal research program at the University of Hawaii with substantial Hawaii State and Hawaii County funding.

NSF has sponsored a number of projects on Geothermal Energy in the Western United States. All of these will be monitored through NSF and personal contacts where appropriate. Of particular interest to Hawaii is the investigation and test drilling on "Hydrothermal Systems of Kilauea, Hawaii" carried out by the Colorado School of Mines during the summer of 1973. A study of this project is of interest not only for its technical contributions but also for its social impact. Initially the drilling project in the Island of Hawaii met with opposition from citizen groups. However, once the project was explained to them, the reaction was favorable and generally there was the feeling that the people would benefit since geothermal steam might reduce the cost of power or prevent costs from rising. The technical results of the project appear to be in accordance with predictions made in the proposal.

NSF is also sponsoring an assessment of geothermal energy being carried out by Futures Incorporated of Connecticut.

Other NSF projects of interest are concerned with energy conversion and solar energy.

Work on geothermal energy sponsored by the U.S. Atomic Energy Commission will also be followed. Projects in solar, wind, wave and current energy will be monitored jointly with the University of Hawaii as well as related programs on energy conversion and transmission for applicability in Hawaii.

A U.S.-Japan Seminar on volcano energy, funded by NSF and Japan was held the week of February 4, 1974 in Hilo, Hawaii. The seminar explored new technologies for harnessing volcanic energy other than through conventional underground steam.

2.7 Educational or Training Components

The Center for Science Policy and Technology Assessment has utilized student interns for specific assessment tasks for two summers and anticipates using some student help on this project. These assignments should provide valuable training for students.

2.8 Vitae and Bibliographies

Those personnel who will actively participate in the management and direction of the project are:

Dr. Shelley M. Mark, Director, Department of Planning and Economic Development - Principal Investigator.

Dr. Eugene M. Grabbe, Project Manager, Center for Science Policy and Technology Assessment, DPED.

Miss Norrie Thompson, Research Coordinator, Center for Science Policy and Technology Assessment, DPED.

Resumes are attached in Appendix D.

2.9 Current Support

The Principal Investigator Dr. Shelley M. Mark is compensated by State funding.

The Project Manager Dr. Eugene M. Grabbe and Norrie Thompson are supported by matching NSF Grant (G-25) and State of Hawaii funds.

This grant runs to June 15, 1974 with a final completion date of July 1, 1974. It is anticipated that the G-25 funds will be expended by that time.

2.10 Applications to Other Potential Sponsors

This proposal is not being submitted to any other organization.

3. Budget

The NSF support requested for the proposed State Geothermal Planning project is \$29,850. It is anticipated that State contribution in terms of cash, services and publications will match the NSF grant. The breakdown is given in Table II.

Hawaii has a wealth of consultants available at the University of Hawaii and in the private sector. Talented graduate

students who need experience on practical projects are also available. It is proposed that consulting services be carried out on a short-term contract basis rather than by a permanent project staff.

TABLE II
PROPOSAL BUDGET
(FY 1975)

Intergovernmental Science and Research Utilization

	NSF BUDGET REQUEST	TOTAL BUDGET
A. Salaries and wages		
1. Senior Staff	<u>10,513</u>	<u>21,026</u>
2. Other Professional Staff	<u>5,043</u>	<u>10,086</u>
3. Secretarial-Clerical Staff	<u>5,281</u>	<u>10,562</u>
B. Staff benefits	<u>3,111</u>	<u>6,222</u>
C. Total salaries, wages, and staff benefits	<u>23,948</u>	<u>47,896</u>
D. Expendable equipment, supplies & rentals	<u>700</u>	<u>1,400</u>
E. Domestic travel.	<u>1,000</u>	<u>2,000</u>
F. Publication costs.	<u>1,500</u>	<u>3,000</u>
G. Communications	<u>300</u>	<u>600</u>
H. Other costs (consultants).	<u>2,402</u>	<u>4,804</u>
I. TOTAL COSTS (C through H).	\$ <u>29,850</u>	\$ <u>59,700</u>

APPENDIX A

GEOTHERMAL ENERGY OPPORTUNITIES AND PROBLEMS FOR HAWAII

AN OVERVIEW

The Hawaiian Islands are located in the Pacific with no other major land masses within a radius of 2,000 miles. Thus, the State cannot enjoy the benefits of inter-state pipelines or electric transmission lines for fuels and energy. The major islands are separated by deep-water channels and, with present technology, it is not economically feasible to transmit electric power between the islands.

Hawaii has no fossil fuels and is, therefore, dependent on imported oil and petroleum products as the main source of energy. Such supplies, which must be shipped over great distances by oil tankers, are inherently vulnerable because they can be interrupted by a variety of actions, from shipping strikes to natural disasters, all outside Hawaii's control.

It would be highly desirable to develop environmentally acceptable energy sources within the State in order to reduce dependence on oil imports and possibly to reduce power costs. There are also many U.S. defense facilities in the Islands including strategic Pearl Harbor, and these facilities would benefit from locally available power. The Navy, for example, has as one of its objectives a reduction of dependence on oil imports.

The Islands of the State of Hawaii are formed by volcanic action, a process that today is continuing to add land to the newest and largest island of Hawaii. An energy resource which appears to have great potential for meeting the State's expanding power requirements is geothermal energy from Hawaii's active and dormant volcanoes. Hawaii is generously endowed with other forms of natural energy which are environmentally acceptable, such as solar radiation, wind, waves, and ocean temperature differentials so that planning for utilization of geothermal energy could provide a model for similar planning efforts for other energy resources.

What makes geothermal power of special interest to Hawaii is the possible multi-purpose uses of this resource. The cost of producing electrical energy from geothermal sources here may turn out to be lower than from burning fuel oil, or may prove to be somewhat greater, depending on the scale of production. However, the geothermal sources offer potential by-products of economic significance. These include minerals which may be recovered from the hot water or steam, minerals and biological materials recoverable from sea water if it is used as a coolant in producing energy, and fresh water remaining after salts and trace minerals are extracted. Within a high-cost economy such as Hawaii's, by-product recovery may turn out to be of special significance, and may provide a model for multi-purpose use of geothermal resources. This may be instructive for future application to other areas of geothermal activity presently concerned only with the generation of electricity.

APPENDIX B

FUNCTIONAL RESPONSIBILITIES OF STATE AND FEDERAL GOVERNMENTS
REGARDING GEOTHERMAL ENERGY IN HAWAII

The development of geothermal energy in Hawaii will require research and development which is presently being carried on by the University of Hawaii. The officials and departments of the State of Hawaii have a history of cooperation with the University and with industry. Since statehood, close working relations have existed among these three sectors and this has yielded many benefits to Hawaii in areas such as agriculture, health, and oceanography. This pattern of cooperation will be continued in the development and utilization of geothermal energy in Hawaii.

DPED is the central comprehensive planning agency for the State of Hawaii with responsibility for the State's General Plan, Economic Development, Economic Research and Analysis, State Statistics, Technological Information Dissemination, and State Science Policy Programs. It is currently functioning as the State's energy planning and coordinating office for the Federal fuel allocation program. The State Department of Regulatory Agencies, which provides staff support for the Public Utilities Commission, is located in the same building as DPED. Other agencies concerned with energy programs are the Department of Land and Natural Resources, the Office of Environmental Quality Control and the University of Hawaii.

Hawaii has two petroleum refineries and additional refined products are shipped to Hawaii from the mainland. One of the refineries enjoys "sub-zone" status with the State's Foreign Trade Zone and sells its products mainly to foreign ships and aircraft and to military installations in Hawaii. There are plans for expansion of one of the existing refineries and additional refineries on the Island of Oahu and on other islands.

The public utilities operate under charters granted by the State Legislature.

Table IV lists the State agencies which are concerned with energy policies and their administration in the State of Hawaii. The most directly related agencies are starred. Some 62 Federal agencies are said to be concerned with energy policy. Those of greatest importance to Hawaii are the Federal Power Commission, Corps of Engineers, Coast Guard, Department of Defense, and the new Federal Energy Office. New Federal legislation on Land Use and Coastal Zone Management may be important.

The County of Hawaii's Planning and Research Departments are responsible for the County General Plan, the most recent issue being dated January 1971.

In the power industry the electric utilities have done a good job of maintaining roughly a 20 percent reserve. Because the Islands are widely separated and inter-island transmission is not technically or economically feasible at this time, each island must have its own generating reserve. On all of the islands many communities are small and, hence, the electric utilities have grown using small local power plants. The Island of Oahu, with the City of Honolulu, has more than 80 percent of the State's population and is the major market for electric power in the State. This is generated largely by steam plants with gas turbines planned for the future. The Neighbor Islands have smaller steam and diesel power plants with a few small hydroelectric installations. Part of the reserve of the power industry is based on electricity supplied by the sugar industry from burning agricultural waste, mainly sugar cane waste products called bagasse. As the population grows this contribution from agricultural products is likely to become less significant.

The gas utility in Hawaii has a substitute natural gas plant in Honolulu and gas is piped to users in the city. Remote areas of Oahu and the Neighbor Islands utilize LPG in tanks.

TABLE IV

State of Hawaii
Agencies Concerned with Energy
Policies and Programs

*State Energy Coordinator.

*Department of Regulatory Agencies - Rates and tariffs, safety, audit, engineering, finance and investigation and compliance. Staff support to Public Utilities Commission.

*Public Utilities Commission - Hearings and decisions on rates and tariffs, new plant sites, etc.

*Department of Planning and Economic Development - General Plan and Plan Revisions for the State. Energy Planning and Conservation. Staff for the Land Use Commission. Statistics, State Economic Model, Center for Science Policy and Technology Assessment, Secretariate of Governor's Advisory Committee on Science and Technology.

*Land Use Commission - Hearings and decisions on land use changes.

*Department of Land and Natural Resources - Land and water management, conservation land, parks and recreation.

*Department of Agriculture - The Division of Weights and Measures monitors the State's fuel distribution.

*Office of Consumer Protection - Enforces the State's gasoline distribution plan.

*Office of Environmental Quality Control - Advisory and coordination functions for environmental programs. Staff support for Environmental Council.

*University of Hawaii - Research and development programs implemented by School of Engineering, Hawaii Natural Energy Institute, Center for Engineering Research, Institute of Geophysics, Environmental Center, Water Resources Research Center and Sea Grant Program.

*Office of Marine Affairs Coordinator is responsible for the State Natural Energy Laboratory on the Big Island.

Department of Accounting and General Services - Conservation programs for energy (lighting, air-conditioning, etc.).

Department of Transportation - Highways, traffic, airports, and harbors.

Department of Health - Enforcement of legislation concerned with air, water and noise pollution.

Inter-departmental Transportation Control Commission - Strategies for avoiding traffic congestion, pollution reduction, and energy conservation. (Housed with the Department of Planning and Economic Development.)

*Key agencies in State energy programs

APPENDIX C

HAWAII STATE CENTER
FOR SCIENCE POLICY AND TECHNOLOGY ASSESSMENT

PUBLICATIONS

The following list includes publications of the Center as well as other publications to which the Center has made substantial contributions:

- "Hawaii and Aquaculture: The Blue Revolution," October 1971.
- "Institute of Marine Biology Fosters Hawaii Aquaculture," E.M. Grabbe and D.L. Jones, in Hawaii Economic Review, Department of Planning and Economic Development, November-December 1971.
- "A Solid Waste Primer," Ginger Plasch, January 1972.
- "Hawaii's Professional Personnel Resources in Science and Technology," E.M. Grabbe, January 1972.
- "University of Hawaii State-Funded Research and Development," E.M. Grabbe, January 1972.
- "Proceedings, Solid Waste Recycling Conference," January 27-28, 1972. Published by the Center for Engineering Research, University of Hawaii.
- "From Ideas to Solutions: The Role of Research and Development in Solving Hawaii's Problems," Conference Proceedings, March 3, 1972.
- "The Legal and Administrative Aspects of an Aquaculture Policy for Hawaii," Gordon Trimble, September 1972.
- "Hawaii's Scientific Resources 1972 Directory," published by the Office of Information and Public Services, Department of Planning and Economic Development.
- "Models of State Activities," E.M. Grabbe, presented to the Sixth Hawaii International Conference on System Sciences, Subconference on Regional and Urban Systems: Modeling, Analysis and Decision-Making, January 9, 1973.
- "Technology Assessment: A Tool for Decision-Makers," E.M. Grabbe, presented to the American Society for Public Administration, December 14, 1972.
- "Short, Low-Cost Technology Assessments in Hawaii," E.M. Grabbe, presented to the First International Congress on Technology Assessment, May 28, 1973, The Hague, the Netherlands.

"Regional and Urban Systems Modeling Assessment Workshop," Ginger Plasch and E.M. Grabbe, January 10, 1973.

"Manganese Nodule Deposits in the Pacific, Symposium/Workshop Proceedings," published by the Hawaii State Center for Science Policy and Technology Assessment, Department of Planning and Economic Development.

"The Quality of Life in the State of Hawaii," published by the Department of Planning and Economic Development, March 1974.

"Hawaii and the Sea--1974," published by the Department of Planning and Economic Development, March 1974.

APPENDIX D

RESUMES

Dr. Shelley M. Mark

Dr. Eugene M. Grabbe

Miss Norrie Thompson