

GLO 1344

WRIGHT  
HURT

COMMERCIALIZATION PLAN  
FOR  
GEOHERMAL HYDROTHERMAL RESOURCES

by  
RESOURCE APPLICATION  
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*Developed in short time -- is sketchy -- by GRO-*

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Commercialization Plan  
for  
Geothermal Hydrothermal Resources

Background

The geothermal/hydrothermal resource development and commercialization program was authorized through several statutes involving multiple agency responsibility and dispersed authority. The Geothermal Steam Act of 1970 (P.L. 581) authorized the Secretary of the Interior to lease and regulate the use of geothermal steam and associated geothermal resources on Federal lands. The Geothermal Research and Development Act of 1974 (P.L. 93-410) and subsequent reorganization acts (P.L. 93-438, P.L. 93-577, P.L. 95-91) established an Interagency Geothermal Coordinating Council (IGCC) and named the Department of Energy (DOE) as lead agency for coordinating the Federal Geothermal Energy Program. The program is designed to enable industry to maximize utilization of the Nation's geothermal resources in an environmentally and socially acceptable manner and establish the resource as a significant contributor to national energy needs.

Hydrothermal geothermal resources are reservoirs at moderate depths (generally 2000 to 7000 feet) containing steam and/or hot water under pressure at temperatures up to about 350°C. Steam and hot water produced by wells drilled into these resources can be used to generate electricity and to provide thermal energy for space heating, industrial processing and agricultural uses. Most of the currently known hydrothermal resources in the United States are in the West, although the eastern United States may have substantial low-to-moderate temperature (up to 150°C) resources under the Atlantic Coastal Plain. Hydrothermal sources are already in commercial use for space heating applications, though the absolute amounts of energy used are very small. Vapor-dominated reservoirs are currently being utilized for commercial generation of electric power at The Geysers in California. Commercial-scale electric generation at several higher-grade liquid-dominated reservoirs is planned in the early 1980's. A number of other higher-grade reservoirs are also ready for commercialization, but if hydrothermal geothermal energy is to come close to achieving its potential, determined and sustained effort must be placed on finding new resources to add to the reserves.

Though the basic technological readiness for electric and direct thermal applications has been established, technology advances and financial incentives can extend the umbrella of economic competitiveness (and environmental acceptability) to greater portions of the resource (i.e., to lower-grade resources). Risk-reducing incentives are needed, particularly for electric applications, until successful operating histories can build confidence.

Along with cost-competitiveness, institutional barriers and uncertainties about the performance of hydrothermal resources are the primary impediments to commercialization; environmental assessment procedures delay permitting

procedures; uncertainties in reservoir performance and longevity make capital investments risky and downgrade the perceived reliability of a geothermal application.

An industrial infrastructure exists for utilizing geothermal energy for electric generation: petroleum and mineral exploration and development companies are active in finding geothermal resources and making them available to users. A few electric utilities are already planning and building facilities to use geofluids to generate electricity, but modifications to the conventional modes of utility participation in commercialization of this resource at least in the early high risk stages of development, are probably necessary to speed commercialization. One solution to this need may be provided by interim risk-absorbing companies (IRAC's) which would build and operate generating plants and sell power to the utilities for distribution. The industrial and manufacturing support base for direct thermal applications is much less well established than the support base for electric applications. Furthermore, the imposition on direct thermal users of leasing and permitting requirements equivalent to those for electric uses will create probability cost burdens for small leases. Direct thermal applications will also be hindered by the need to locate the user within a few tens of miles of the reservoir. Space conditioning and agricultural industrial process heat applications will be demonstrated with DOE contract assistance. No significant technological problems are anticipated.

With the passage of NEA important financial incentives have been provided to the geothermal industry. One expected result is an upsurge in availability of venture capital, particularly for development of electric applications.

I. PROGRAM--OBJECTIVE AND GOALS

A. Objective

Stimulate the private sector to accelerate the development and commercialization of geothermal/hydrothermal resources.

B. Goals

To accelerate the annual rate of commercial utilization of geothermal energy from the present 0.04 Quads/Year to the IGCC estimates for achievable goals for hydrothermal electric and direct heat applications for the years 1985 and 2000 as shown below:

TABLE 1. GOALS FOR HYDROTHERMAL UTILIZATION

	<u>1985</u>	<u>2000</u>
<u>Electric Power Applications</u>		
Electric Capacity <sup>1/</sup> (MWe)	3000-4000	20,000-40,000
Quad/Year <sup>2/</sup> (x 10 <sup>15</sup> Btu)	0.2-0.3	1.5-3
Market Penetration <sup>3/</sup> (%)	2	15
<u>Direct Thermal Applications</u>		
Energy Usage (Quad/Year)	0.1-0.2	0.5-2.0
Market Penetration <sup>4/</sup> (%)	4-8	10-15

1/ Includes existing capacity at The Geysers, California

2/ Fossil fuel equivalent at a burn rate of 10,200 Btu/kWh

3/ Percent of projected new base and intermediate generating capacity needed in the WSCC region for electric generation

4/ Estimated market penetration in percent of projected energy consumption as direct heat for which geothermal resource temperatures and heat form (hot water) are suitable and for which resource and potential users are collocated.

C. Strategy

- o Stimulate industry to explore for and establish reserves.
- o Reduce institutional impediments to commercial development.
- o Reduce technological and environmental risks.
- o Provide temporary financial incentives to offset deterring effect of new technology risks.
- o Stimulate public awareness and active consideration of geothermal potential.

II. PROGRAM ACTIVITIES AND PLANS

A summary of program activities and plans are presented below. A more detailed presentation of the program elements is given in Addendum 1.

A. Program Activities

o Develop Site-Specific Development Plans

In conjunction with state and local groups and the private sector detailed commercialization plans will be prepared which will identify for each site actions required by both the Federal and non-Federal entities.

o Coordinate Interagency Planning and Budgeting

Provide through coordination of Federal agencies activities in geothermal development a single point of focus within the geothermal community (public and private sectors) for commercialization in order to assure timely implementation of program activities; special emphasis will be placed on Federal leasing and permitting activities.

o Monitor Program Progress

In order to redirect or revise, as necessary, goals, objectives and priorities related to program efforts. A national program monitoring system will be established. This system will track such activities as lease sales, reservoir development, plant construction commitments, and other indicators of the pace of progress toward national power-on-line goals.

o Develop Legal and Institutional Initiatives

Alternative regulatory, legislative and administrative solutions to legal and institutional impediments will be identified and evaluated. Those deemed most suitable will be promoted through appropriate administrative channels such as the Interagency Geothermal Coordinating Council (IGCC).

o Establish User Commitments Initiatives

An analysis will be made of potential market sectors to determine the commercial applicability of geothermal/hydrothermal resources and to estimate costs of resource development, and energy conversion, and for direct heat uses costs of transport and distribution so that marketability of the resource will be assessed. This work and product marketing studies will involve the private sector decision-makers as a means of stimulating user commitments to geothermal energy use.

o Support Infrastructure Development

Cost study analysis will be completed to show cost-effectiveness of geothermal applications with particular orientation to the interests of funding organizations; this will include a consideration of the institutional and financial aspects of structuring geothermal ventures.

o Undertake Outreach Activities

Awareness of the potential benefits of geothermal energy by the geothermal community and the public at large will be increased through an integrated program of public education and information dissemination.

o Participate in International Marketing Activities

Through international cooperation, operating experience and technical and economic data from other countries will be sought to aid U.S. commercialization efforts, and market opportunities developed, particularly in the lesser developed countries.

o Provide Financial Incentives

The need for new or modified financial incentives (such as the Geothermal Loan Guaranty Program) to offset risk, economic

uncertainties and social values associated with development and utilization of hydrothermal resources by the industrial and public sectors will be assessed. Incentives deemed necessary to accelerate the pace of commercialization will be proposed and promoted through appropriate administrative channels.

o Define Requirements for Supporting RD&D

The requirements for supporting research and technology development will be defined in order to (a) improve the comparative cost and commercial viability of hydrothermal resources in the marketplace; (b) increase the resource base to assure adequate reserves to meet national goals; and (c) minimize adverse environmental impacts.

B. Program Effectiveness Measures

The ultimate test of the hydrothermal program's effectiveness will be the extent to which the various elements of the program can cause geothermal energy utilization to come on-line at an accelerated pace in the realization of the goals and objectives set forth. However, a basis for earlier evaluation of progress is needed for timely revisions of program efforts, priorities and objectives to maximize progress. For this purpose a national progress monitoring activity will examine and analyze selected indicators or criteria for measuring program effectiveness.

(1) Evaluation Criteria

The most important indicators for judging program effectiveness concern those factors that explicitly express commercialization progress or that have an identifiable impact in achieving near-term goals, such as those on the critical path for commercial development. Important criteria include:

- o Rate of exploration for and establishment of new reserves and investment cost trends.
- o Number of plants, total MWe capacity and trends represented by electric generating plants under construction or plants on-line, built with and without Government support.
- o Number of plants, total MWt capacity and trends of direct heat projects under construction or projects on-line, built with or without Government support.

- o Number of new companies involved in the hydrothermal market.
- o Trends in proportion of hydrothermal projects with Government financial support versus all hydrothermal projects.
- o Trends for geographic distribution and end-use diversity of hydrothermal applications.
- o Rate of change of industrial, and other participation in geothermal development following passage of NEA and the Geothermal Omnibus Bill.

(2) Activity Measures

In addition to evaluation of nation-wide success in realizing an increased rate of commercialization of hydrothermal resources from all causes, an evaluation will be made of progress resulting from specific Federal program activities. Measures for this purpose include:

- o Decrease in time to process a geothermal loan guaranty application.
- o Progress on completing lease sales for high priority hydrothermal resource.
- o Status of DOE's R&D effort to make reliable reservoir performance predictions.
- o Reduction in average permitting time as a result of streamlining the permitting process.
- o Status of DOE's R&D effort to mitigate adverse environmental impacts.
- o Passage of the Geothermal Omnibus Bill.
- o Progress on technology development programs to establish feasibility, reduce costs and improve efficiencies of various aspects of the geothermal energy recovery and utilization cycle.
- o Lowest temperature at which hydrothermal electric applications are economic.
- o Number and degree of detail on site-specific and state geothermal development plans.



### III. MANAGEMENT APPROACH

The basic characteristic of the management approach for the hydrothermal commercialization program is the participation of all DOE entities and other Federal agencies having responsibilities for hydrothermal development in matrix organizations under the direction or cognizance of the RA Geothermal Resource Manager. Management matrices are established at three principle levels: Federal, DOE Headquarters, and DOE Field Offices.

Leadership and coordination of the Federal hydrothermal development program is accomplished through the IGCC and its organizational components, the Staff Committee, Budget and Planning Working Group, three Panels for Institutional Barriers, Research and Technology, and Resources. The Chairman of the IGCC who has the statutory responsibility for the total Federal program, is the Assistant Secretary for Energy Technology; the Chairman of the Staff Committee is the Geothermal Resource Manager. At the DOE Headquarters level support to the hydrothermal development program is provided by various Assistant Secretaries and Heads of Offices as described in Addendum 2 entitled Resource Manager Matrix Support. Designated representatives of the other DOE offices participate in the activities of the activities of the Budget and Planning Working Group and the Panels of the IGCC as appropriate.

Management of the commercialization program at the Field level is assigned to matrix management teams comprised typically of members of the staff of Operations Offices and the Offices of the Regional Representatives. These teams are delegated responsibility for implementation of the outlay program of the Resource Manager and generally to represent the Resource Manager's interests in the teams' assigned geographical jurisdictions. The Field teams will be directly responsible for cooperative state commercial development planning programs, Field experiments in direct heat applications, outreach activities, and other aspects of the program elements identified under Paragraph I above that relate to local, state, or region specific initiatives. The Field teams are responsible programmatically to the Resource Manager for accomplishment of specific goals and objectives assigned to their areas of jurisdiction. Advice on development needs and on the development program is provided to the Resource Manager from the geothermal community at large and special interest groups by the Advisory Committee on Geothermal Energy (ACGE).

### IV. MANAGEMENT PLAN

The management plan and schedules for implementation of the activities outlined above to accomplish the goals and objective are shown in Figure 1.







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ACTIVITIES AND EVENTS  
LEGEND FOR FIGURE 1

1. Complete
2. Annual Update
3. Issue Initial Report
4. Issue Program Research and Development Announcement (PRDA)
5. Technical Review of the PRDA
6. PRDA Selection
7. PRDA Award
8. Begin Cost-Sharing with County
9. Issue Initial Report
10. Report to IGCC for Approval
11. Report to Congress
12. First Workshop
13. Regulations Issued
14. Draft Plan
15. Final Plan
16. Workshop
17. Report Legislative Recommendation
18. Public Hearing
19. Project Review - Decision on Continuation
20. Draft Legislation
21. Draft Regulation Recommendations
22. Conduct Legislative Hearings
23. Outline Specific Policy
24. Policy Review
25. Final Review and Editing
26. Westmoreland Electric Plant Decision
27. CU-1 Agribusiness (Onion Plant) Decision
28. Honeylake Farms, Agribusiness (Space Heat) Decision
29. O'Brien Reservoir Decision
30. RGI Decision
31. NCPA Decision
32. Geysers (Binary) Electric Plants Decision
33. O'Brien (Flash) Electric Plant (Decision)
34. Commercial Hybrid Electricity Generating Plant Decision
35. Commercial District Heating Plant Decision
36. Develop Plan
37. Revise Regulations
38. Food Processing
39. Chemicals
40. Additional

## V. RESOURCE PLAN

Table I is a summary of project costs for RA-controlled outlay projects. For comparison the project costs for ET-controlled outlay projects which support hydrothermal commercialization are shown in Table II.

## VI. ISSUES

The primary issues (and plan for their resolution) faciling large-scale commercial development of geothermal/hydrothermal resources at this time are:

- o Will resource reservoirs sustain operation over the economic life of facilities constructed to exploit the resource?
  - Successful operating histories of plants and facilities supported by GLGP or incentives
  - Confirmation of reservoir performance models
  - Cost-shared reservoir performance testing
- o Can the mismatch between potential users and identified resource location for direct heat applications be overcome?
  - Encourage formation of direct-use entrepreneurs to identify and market resources for thermal applications
  - Support user-oriented resource definition at market sites
  - Conduct cooperative planning studies for specific applications with user market sector companies
- o What form will Federal and state environmental standards take which pertain specifically to geothermal activities?
  - Identify health and societal impacts of environmental effects
  - Coordinate with EPA in establishing guidelines and standards
  - Improve H<sub>2</sub>S control technology
  - Develop subsidence control techniques
  - Prove injection technique to provide for protection of potable aquifers
- o Can the expensive and time-consuming regulatory process resulting from the overlapping, conflicting and duplicative regulations for leasing and permitting geothermal development be improved?

- Streamlining of Federal leasing program
- State Law Project to encourage favorable state legislation
- Cooperative planning with Federal, state, and local agencies
- Selective participation in regulatory process to encourage favorable decisions
- Develop formalized interagency coordination in regulatory process
- o Can substantial exploration for and development of geothermal resources be conducted in undeveloped areas of potential high interest to preservationists for recreational and wilderness values?
  - Establish policies allowing exploration in areas under study for classification
  - Work with DOI and U.S. Forest Service to assure incorporation of geothermal resource data in land use planning

VII. CONTROLLED ITEMS

Table III contains a list of significant milestones which can serve to indicate status and progress during Fiscal Year 1979.

TABLE III  
SIGNIFICANT PROGRAM MILESTONES

PLANNING AND ANALYSIS

- |  |                |
|--|----------------|
| 1. Issue initial report on site-specific development for direct heat applications.                   | September 1979 |
| 2. Review project results on state barriers and incentives study and reach decision on continuation. | March 1979     |
| 3. Complete Interagency Geothermal Coordinating Council (IGCC) Annual Report to Congress.            | January 1979   |
| 4. National progress monitoring system established.  | September 1979 |
| 5. Report to IGCC concerning leasing streamlining recommendations.                                   | September 1979 |
| 6. Issue report to Congress on Geothermal Omnibus Bill.  | March 1979     |
| 7. Complete revision of Geothermal Loan Guaranty Program.  | July 1979      |

MARKETING

- |  |  |
|--|--|
| 1. Award contracts for engineering and economic studies for direct heat applications.              | July 1979  |
| 2. Begin cost-sharing project to update Imperial County, California, environmental baseline study. | March 1979   |
| 3. Initiate food processing and chemicals industry product teams projects.                         | March 1979<br>June 1979                                  |
| 4. Reach decision on loan guaranty applications for four applications.                             | February 1979<br>May 1979<br>July 1979<br>September 1979 |
| 5. Complete draft of plan for marketing U.S. geothermal technology.                                | July 1979  |



ADDENDA

1. PROGRAM ELEMENTS

## ADDENDUM 1

### PROGRAM ELEMENTS

The approach adopted for accomplishing the geothermal commercialization program objective involves collective planning, implementation, and monitoring of the time-phased, interrelated activities (both technical and non-technical) that are needed to produce electricity and to utilize direct heat in commercial quantities from specific geothermal resources.

The program is comprised of two major elements: (1) Planning and Analysis and (2) Marketing.

#### A. Planning and Analysis Activity

Cooperative development planning with participation by Federal, state, and local governments and the private sector is underway to provide regional and site-specific development plans for all known and potential geothermal resources in each of the three regions of the U.S. Regional planning will include analyses of the economics, environmental, legal, and technical framework within which regional development of geothermal energy must take place and will identify initiatives required by Federal, state, and private sectors to further development.

The success of the Federal activities will ultimately be measured by the magnitude (and schedule) of the commercial geothermal contribution to the national energy supply.

The subdivision of work under the following subactivities is designed to cover the various planning, implementation, progress monitoring, coordination and management activities necessary to accomplish the program objectives:

##### 1. Site-Specific Development Plan

For each major geothermal energy prospect (i.e., potentially large reservoirs with a demand market within reasonable distance from the resources), an achievable development plan is formulated with direct participation by Federal, state, and local government agencies, local industry and community interest groups. These development plans are in the form of activity networks delineating explicitly the public and private initiatives that need to be undertaken to bring power-on-line at an ambitious pace. The time phasing and interdependence between the activities various entities that need be involved are included in each plan.

##### 2. State and Local Planning Support

Planning grants will be issued for establishing and updating (a) master development plans at selected prospects, (b) data

base for county permitting and land and water use decisions, and (c) an institutional framework for exploiting electric and direct heat applications at selected prospects.

3. Interagency Coordination

Analysis support will be provided for the work of the Budget and Planning Working Group and the Staff Committee of the Interagency Geothermal Coordinating Council and its Resource, Research and Technology and Institutional Barrier Panels. The working groups and panels of the IGCC provide forums for addressing issues concerning Federal incentives and barriers affecting the development scenarios created as a product of regional planning activities and for establishing the priorities for Federal initiatives.

4. National Progress Monitoring

Progress made within the Federal program is being monitored, along with the success of non-Federal entities in achieving national targets for geothermal energy utilization. A computerized program management system is being developed to fulfill the need to enter, update, retrieve, manipulate, and display information contained in the development plans. The system will aid in program planning, coordinating, evaluation, as well as monitoring activities. A data collection and handling procedure will be established to support the computer and monitoring activity.

Progress monitoring will be conducted in a manner so as to enable interpretations of early development indicators, thereby allowing enough time for corrective measures and Federal program redirection.

5. National and Federal Program Analysis

Development plans formulated for various regions of the U.S. for both electric and direct heat applications will be aggregated and analyses performed to (1) evaluate magnitude are scheduled for achievable utilization estimates and potential benefits in terms of substitution of conventional energy sources, (2) evaluate total costs of achieving goals, (3) assess total resource requirements, (4) determine net energy balance estimates, and (3) determine national benefit/cost and cost-effective estimates.

## 6. Federal Policy Analysis

Work under this subactivity is based on the recognition of the critical importance of institutional factors (as opposed to technical factors) with respect to the timing by which geothermal development can proceed. As the regional planning and implementation processes progress, the delineation of potential barriers to the development schedules will become more definitive, as will the evaluations of alternative corrective measures. The effort will address the need for policy initiatives as well as administrative procedures in solving the institutional barriers problems.

A continuing review of newly proposed legislation and regulations affecting geothermal energy will be established. Environmental, tax, land policy, and other potentially limiting policies will be monitored and DOE positions proposed as appropriate.

Input to a comprehensive Geothermal Omnibus Bill will be completed leading to the introduction of this Bill in the 96th Congress. The Bill is intended to resolve regulatory barriers and remove limitations preventing use of existing Federal subsidy programs for geothermal projects and provide positive incentives as well. Supporting legal, economic, and benefit cost analyses will be conducted in the preparation of the Bill and in the course of Congressional consideration.

### B. Marketing

The principal barriers to commercial acceptance of geothermal energy for generating electricity in the marketplace are uncertainties over long-term reservoir performance and non-competitiveness of generating costs. The principal barriers to increase direct heat applications are resource unknowns, the lack of low temperature resource development companies, the mismatch between potential users and resource locations, the site-specific variability of reservoirs and its associated direct applications potential, and the lack of potential user familiarity with the use of geothermal energy. The time, cost, and uncertainties involved in leasing and permitting are also currently impeding geothermal development, particularly for electric generation.

The subdivision of work under the following subactivities covers a set of Federal actions, driving in many cases non-

Federal Government and private sector actions, which together deal with key barriers that inhibit a rapid development in the market:

1. User Commitment Initiatives

Demographic and energy market information will be acquired and analyzed. In particular, the market for direct heat applications will be determined on a state-by-state basis in terms of current and projected industrial, agribusiness, and district heat potential. The market penetration potential will be determined for known geothermal resources colocated with potential users. Site-specific application studies will be directed toward broadening the scope of involvement of various nonelectric industry sectors in the direct use of geothermal heat by matching potential users with appropriate geothermal prospects. In addition, industry product team studies, focusing in specific market sectors, will be conducted in coordination with the private sector, to stimulate early and vigorous commercial utilization. These studies will actively involve corporate energy decision-makers in analyses to evaluate geothermal resource use in their plants, and to identify technical and policy measures to make such use more attractive. Industrial process users, developers of electric power generating systems and community users will be the main targets for user commitment initiatives.

2. Support Infrastructure Development

Lack of infrastructure to bring together complementary teams of developers, users, and financial institutions delays development. Infrastructure needs are the greatest for development at the many remote geothermal resources when manpower, and communication, transportation, and electric transmission systems may be nonexistent. Case study analyses of existing and planned geothermal projects will be conducted to produce data on the cost-effectiveness of geothermal applications for funding organizations and on other aspects of the projects' institutional structures. The potential benefits to geothermal development to be derived from the operation of Interim Risk Absorbing Companies (IRAC's) will also be investigated.

3. Outreach Activities

Increased public awareness is essential for accelerating geothermal energy development in the U.S., particularly for direct thermal applications. The paucity of public

education and information dissemination efforts has resulted in few industries, organizations, communities, and other potential market participants being made aware of geothermal opportunities and potential benefits. A public education campaign will be designed and implemented to provide a basis for decision-makers to judge the merits of utilizing geothermal energy. Such an effort will include conferences, news, and television releases on geothermal energy, exhibits, design of educational curricula for high school and college usage, and general brochures for a wide spectrum of readers.

#### 4. Incentives

The geothermal loan guaranty program allows DOE to insure lenders against financial risks associated with commercial geothermal development projects. By reducing or eliminating financial risks borne by lenders to geothermal borrowers, the flow of capital into the industry can be stimulated. This program is well underway and is expected to continue through FY 1984. The active solicitation of loan applications is being pursued by interested lenders, and the program will be administered to expedite processing of these applications. The DOE geothermal 50 MWe demonstration plant and direct heat application field experiments are considered major incentives to stimulate the commercialization of geothermal/hydrothermal resources.

#### 5. International Marketing

International cooperation in the area of geothermal energy development can play an important part in the commercialization of U.S. hydrothermal resources. Such cooperative efforts provide opportunities to acquire operating experience technical and economic data from other countries which have geothermal power plants and installations utilizing industrial processing, space heating applications; and provide market opportunities for the U.S. geothermal industry, particularly in the lesser developed countries (LDC's). Efforts will include the monitoring of progress with current multi-lateral and bilateral cooperative agreements and active participation in international trade fairs and conferences.