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THE FEDERAL ROLE IN GEOTHERMAL RESOURCE DEVELOPMENT†

*Randall C. Stephens**

The geothermal resources of this nation constitute an enormous physical potential, theoretically almost inexhaustible. With foreseeable technical advances within the next few decades, a substantial fraction of our energy needs could be provided from geothermal resources on an economically competitive basis.

High-temperature hydrothermal resources at accessible depths are estimated to have the potential of providing more than 150,000 megawatts of electric generating capacity. Dry steam hydrothermal resources are already a proven energy source in this country. Liquid-dominated resources are being exploited in seven countries and are on the threshold of commercial utilization in the United States. The longer-term prospects, for later in this century or early in the next century, include utilization of moderate-temperature hydrothermal resources (less than 150°C), geopressured, and hot dry rock resources. The potential electric generating capacity for energy recoverable from those resources with technology of the next few decades could be as high as 1,000,000 megawatts. Direct application of these resources for space heating, industrial

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processing, aquaculture, agriculture, and other uses could be even more significant. The extent to which this potential will be tapped depends on a number of economic, institutional, and technological factors.

The private sector will ultimately determine the extent of geothermal energy use, but its decisions will be strongly influenced by the actions, inactions, and policies of the federal government in a number of areas. Federal research and development and incentive programs such as loan guaranties play an obvious role, but policies in such areas as taxation, land management and environmental standards may be even more significant.

It was in recognition of this fact that Congress enacted the Geothermal Energy Research, Development, and Demonstration Act of 1974¹ [P.L. 93-410]. This Act called for a vigorous national program to bring to commercial application the technologies for utilization of geothermal resources. The Act provided for establishment of an interagency Geothermal Coordination and Management Project to develop and carry out a comprehensive federal program, coordinating research and development, resource assessment, technology demonstration, and establishment of policies conducive to development. When the Energy Research and Development Administration (ERDA) was created in 1975, the research and development functions of the Project were transferred to ERDA.

Because there remained a need to ensure sound policies as well as to coordinate research and development, the Project agencies formed a group now known as the Interagency Geothermal Coordinating Council. ERDA's Assistant Administrator for Solar, Geothermal, and Advanced Energy Systems chairs the group, which is made up of Assistant Secretary level officials from eight federal agencies. Besides ERDA, the Council includes the Federal Energy Administration, the Interior, Agriculture, and Treasury Departments, the National Science Foundation, the Environmental Protection Agency, and NASA. The Council has underway a continuing review of federal policies which serve to expedite or impede commer-

¹ 30 U.S.C. § 1101 *et seq.* (Supp. 1975).
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cial development. This will be a long-term task, because federal policies impinge in various ways on every step in the commercial development process. The Council is also coordinating the program responsibilities of the various agencies, so that all the programs are working toward common goals on common schedules.

The components of the federal program mandated by PL 93-410 include specifically: (1) Resource Inventory and Assessment, (2) Research and Development, (3) Demonstration, (4) Scientific and Technical Education, and (5) Loan Guaranties.² Included in the goals of the research and development effort were social, legal, and economic studies for the development of policy conducive to commercial geothermal development. This aspect of the program has developed into one of the most critical. ERDA has taken the lead role in policy development, through the Council and with the blessing of the other agencies on the Council. This aspect will be discussed later in some detail, following a brief description of the program areas.

PROGRAM STRATEGY

The strategy of the federal program is based upon an interesting relationship between the various resource types. Dry steam hydrothermal resources, already commercial, are quite limited in extent. The near-commercial liquid-dominated hydrothermal resources are more extensive, but limited to an estimated potential of about 150,000 megawatts of recoverable electric potential. Geopressured and hot dry rock resources have substantially greater potential, but will require development of new technology that may take anywhere from ten to twenty years. Near-normal gradient resources are almost limitless, but would require technological breakthroughs to become economically producible.

The strategy, in its simplest formulation, is to nurture a geothermal industry on hydrothermal resources, while simultaneously improving our knowledge of the extent and characteristics of the various resource types, and beginning the

2. 30 U.S.C. §§ 1101 *et seq.* (Supp. 1975).

development of technology for the utilization of the more extensive resources. The first element might be termed "institutional development," the second, "identifying the resource," and the third, "technology development."

The objectives of the effort have been expressed in quantitative goals for utilization of geothermal energy. The October 1975 Program Definition Report for the federal program (ERDA-86) sets a goal of 6,000 megawatts of geothermal electric capacity by 1985, and 39,000 megawatts by the year 2000.³ Similar goals are established for direct thermal utilization. The establishment of the common goals has provided a framework for scheduling the various federal programs, including the federal leasing program, development of environmental standards, the ERDA research and development program, and other critical components.

These quantitative goals were developed in a generic manner, based on assumptions about potential industry response times, identified resources, and economic factors. ERDA is initiating a series of more detailed regional analyses to determine on a realistic basis what might actually be achieved. These regional studies will be joint efforts with the state governments involved, and will result in the development of coordinated goals for geothermal development agreed upon by industry, federal, state, and local government agencies and public groups. They will also identify in detail the actions that must be taken by each entity and the schedules for such actions.

This is an ambitious objective, but if it is achieved, it will establish a framework for decisions by the private and public sector which should lead to consistent decisions. It will also serve to identify areas of conflict early enough to permit efforts at resolution of disagreements before they become roadblocks.

IDENTIFYING THE RESOURCE

The estimates given above for the potential geothermal resources are based on the present limited knowledge of the

3. U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION, DEFINITION REPORT, GEOTHERMAL ENERGY RESEARCH DEVELOPMENT AND DEMONSTRATION PROGRAM (October 1975).

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national resource base. They are in a primitive phase comparable to estimates of oil and gas resources of perhaps fifty years ago. Part of the federal program involves improving our knowledge of the extent and location of geothermal resources. Improved resource information is vital to government policy-makers and to industry decision-makers, for determining the appropriate level of effort for geothermal energy development.

The United States Geological Survey has the lead role in this effort. The program includes regional and national surveys, and development of better methods for finding and assessing specific reservoirs. The USGS published an initial assessment of the national resource in USGS Circular 726, "Assessment of Geothermal Resources of the United States—1975."⁴ An improved assessment is planned for 1978, based on the studies underway now.

Detailed information including maps, reports, and other data, on identified geothermal reservoirs is also available to the public through two data banks, one at ERDA's Lawrence Berkeley Laboratory and the other at USGS's Reston, Virginia facility.

Resource assessment by the private geothermal industry is not yet accelerating in response to the federal program. We believe that economic and institutional limitations are largely impeding industry from moving forward. However, the assessment of the national potential of geothermal resources will remain a federal government function even when industry exploration efforts begin to pick up. Private resource data is to a great extent proprietary for at least a limited time period after it is generated, but aggregated estimates can be derived from data required for various regulatory purposes supplemented by USGS and State Geologist data from their own surveys.

TECHNOLOGY DEVELOPMENT

ERDA has the lead role for the federal research and development program. This program includes efforts to improve

4. U.S. DEPT OF THE INTERIOR, ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES — 1975 (Geological Survey Circular 726, 1975).

the technology for exploration, drilling, reservoir assessment, reservoir management and stimulation, conversion technology, and environmental control, as well as the policy studies already mentioned. The technology program has been growing at a rapid pace for the past three years, and has now reached a size sufficient to encompass the full scope of the technical problems facing the industry.

The emphasis of the pre-ERDA programs was on research by national laboratories and universities. ERDA has successfully reoriented the program into a cooperative effort with industry. The difficulty of technology transfer will be lessened considerably by this approach, although it is still by no means a trivial task to stimulate commercial adoption of a new technique. Some of the longer-range efforts, such as hot dry rock utilization, are still being conducted at national laboratories, but industry involvement will be sought as early as possible.

Our best estimates are that the technology efforts underway under private industry sponsorship are minimal at present. Where the private sector perceives a market for new technology, this situation should change, but it appears that for the next ten to fifteen years, the federal research and development effort will be the bulk of the national effort.

The emphasis at present is on the near-commercial hydrothermal resources and the mid-term geopressured resources. If the overall program meets our goals, this technological head start should lead to a viable industry by 1985 to 1990, and the federal program will turn to long-range efforts to develop technology for hot dry rock, magma, and near-normal gradient geothermal resources.

The technology program also includes establishment of test facilities where new ideas and components from industry can be tested under simulated operating conditions. Industry has expressed great interest in this concept. A Geothermal Component Test Facility has already been constructed at East Mesa in California to test conversion equipment for high temperature low-to-moderate salinity resources.

An important phase in the development of liquid-dominated hydrothermal resources will be the first electric genera-

tion demonstration plant. Although such plants have been in operation in other countries since 1970, the foreign installations do not meet the stringent environmental standards of the United States. Furthermore, since they were for the most part government projects, little or no information has been developed on the economics of these plants. Utilities, financial institutions, and regulatory agencies are reluctant to make decisions about such facilities in the absence of United States operating experience.

ERDA plans to enter into a cooperative demonstration plant effort with a selected utility during fiscal year 1978 to break the ice. Additional demonstrations for alternative technologies or resource types may be needed later on, and demonstration projects for non-electric utilization will likely also be planned. These first-of-a-kind demonstrations are the last phase of the technical effort for each resource type, and government involvement through cost-sharing will be proposed whenever it is considered essential to accelerate commercial development. Our first preference would be to see industry demonstrate on its own or backed by a federal loan guaranty.

INSTITUTIONAL DEVELOPMENT

By "institutional development" is meant the stimulation of the interrelated structure of industry sectors and public agencies that are required for the orderly but rapid development of geothermal energy resources. This requires the creation of an institutional and economic environment, founded on federal, state, and local government policies, that both permits and encourages large and small developers, utilities, industrial energy consumers, homeowners, financial institutions, service and component industries, and other essential factors to participate in a thriving geothermal marketplace.

The tools for this undertaking are the establishment of desirable federal government policies (and the modification of undesirable policies), the encouragement of desirable state and local government policies, incentive programs (such as the Geothermal Loan Guaranty Program), and widespread dissemination of information. The first step is, of course, the

determination of what policies are needed. This is the purpose of ERDA's Policy Studies Program, consisting of legal, socio-economic, and economic studies, and the critically important regional studies described above. Federal policies are promoted and implemented through the Interagency Geothermal Coordination Council and its Institutional Barrier Panel. Policies at the state and local government level will be encouraged in a number of ways, and ERDA is already actively working with state and local bodies on a number of efforts.

FEDERAL LAND MANAGEMENT

An estimated sixty percent of the nation's geothermal resources underlie federal lands. Thus, the Federal Land Management Program is a critical component of the national program. The Geothermal Steam Act of 1970⁵ provides the authority for the leasing of rights to these geothermal resources. The leasing program became operational in January 1974. As of October 31, 1976, 1,435,096 acres of federal lands were under federal geothermal leases.

Despite the magnitude of this figure, the leasing program has had some difficulties. Environmental reviews, for the leasing program as a whole and for specific regions to be leased, have been the major source of delay. There remains a backlog of 1,858 non-competitive lease applications awaiting action, in contrast to 751 non-competitive leases issued. Very few wells have been drilled on federal land, largely because most of the leases were issued in the past eighteen months.

The leasing backlog is expected to be cleared up by the end of this year, at least for lands supervised by BLM. However, the United States Forest Service will not be adequately funded for pre-leasing environmental reviews until fiscal year 1978. To alleviate this problem, the Institutional Barrier Panel has recommended that leases be issued without environmental review, stipulating that no activity may take place which would disturb the surface until an environmental review has been made.⁶

5. Pub. L. No. 91-581, 84 Stat. 1566 *et seq.*

6. INSTITUTIONAL BARRIER PANEL OF GEOTHERMAL ADVISORY COUNCIL, INSTITUTIONAL BARRIERS TO GEOTHERMAL ENERGY DEVELOPMENT (1976).

The Panel has also recommended a number of other changes to the leasing program. The law presently limits the acreage leased to any company or individual to no more than 20,480 acres in any state. A legislative change, increasing the limit to 51,200 acres, is being proposed. Furthermore, a proposed change in the Steam Act regulations will exempt developed acreage from the limitations. Other changes are also being developed to make leasing policy more amenable to early development of geothermal resources.

The requirements for post-leasing activity are also under review. A task force has been set up to examine ways to reduce the burdensome regulatory requirements for exploratory and development activity. Regulations allowing siting on geothermal power plants or other utilization facilities on federal land have been drafted. These regulations would allow such facilities on federal land even in cases where the geothermal resource to be tapped is not on federal land.

The Interior Department and the United States Forest Service have been pointed to as major impediments to geothermal development. These agencies are clearly bullish on geothermal energy, but have been constrained by regulatory and especially environmental requirements from moving forward more expeditiously. Federal Land Policy and its administration should no longer be viewed as an impediment. Where problems still exist, solutions are being sought aggressively and will be implemented as quickly as possible.

FEDERAL TAXATION

Geothermal resource development is not a favored energy investment under current federal tax treatment. The developments at the Geysers field in California have won the intangible drilling cost deduction and percentage depletion in the courts, to reach tax parity with oil and gas, coal mining, and uranium mining, which are allowed similar writeoffs. However, it is not likely that liquid-dominated hydrothermal resources will be allowed these advantages under present law. At any rate, the present uncertainty is a major deterrent to investment in geothermal development.

During the past year, Congress considered the extension of IDC's and percentage depletion to geothermal resources, in Senate-passed amendments to the Tax Reform Act of 1976. These and other energy provisions were dropped from the bill in conference on the insistence of the House of Representatives conferees, who had passed a different energy bill earlier in the session. The apparent reason for this decision was a desire by the House to consider their own bill in conference with the Senate measures. Time ran out on the Ninety-Fourth Congress before that bill could be acted upon by the Senate. The subject can be expected to arise again in Congress this year.

The Interagency Council has recommended an amendment to the tax code providing specific tax treatment for geothermal resources. The recommended legislation would amend Section 174 of the Internal Revenue Code to permit, for a ten-year period, research and development expensing of the costs associated with exploration for geothermal resources prior to the commercial development phase. ERDA and the Treasury Department are working on the drafting of legislation to effectuate this change. This would allow for treatment of geothermal exploratory wells essentially equivalent to that for oil and gas wells, albeit under a different section of the code.

THE GEOTHERMAL LOAN GUARANTY PROGRAM

The Federal leasing program provides access to geological resources. The Federal Geothermal Loan Guaranty Program is intended to provide access to capital for geothermal projects. This program was authorized by PL 93-410 as a major part of the federal effort.

It allows ERDA to provide guaranties for up to seventy-five percent of the cost of projects for "the purposes of: (1) the determination and evaluation of the resource base; (2) research and development with respect to extraction and utilization technologies; (3) acquiring rights in geothermal resources; or (4) development, construction, and operation of facilities for the demonstration or commercial production of

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energy from geothermal resources"⁷ The program has been open for business since June of this year. Three applications have been submitted, and are under consideration. About eight more are expected early in 1977.

The purpose of the loan guaranty program is to stimulate the flow of private capital into geothermal projects. It is a ten-year program, extending until September 1984. It is hoped by that time lenders will have developed sufficient experience and confidence in geothermal energy investments so that Federal guaranties will no longer be needed.

The program is administered by ERDA's San Francisco Operations Office, located in Oakland, California. The staff there are ready and anxious to talk to potential borrowers or lenders. This program is a prototype for similar programs proposed on a larger scale (so far unsuccessfully) for other technologies, such as synthetic fuels. The experience gained from the Geothermal Loan Guaranty program will help in assessing the need for and feasibility of such proposed programs.

FEDERAL REGULATION

Increasing federal regulation is a fact of life for American business in general. Geothermal development faces perhaps more extensive and burdensome regulation than any existing industry had to deal with in its infancy. Environmental regulation may be the major contributor to the delays and expenses.

The history of nuclear power shows decreasing costs as technology advances were made for the first two decades of that industry's existence. But for the past ten years, the costs of nuclear power have been increasing rapidly even when inflation is discounted, because of escalating environmental and safety requirements. Geothermal energy is not being accorded a similar grace period to establish itself. The factors which are bloating nuclear costs are present at the outset. One wonders if the major firms who became heavily involved in nu-

7. 30 U.S.C. § 1141 (Supp. 1977). The regulations can be found at 10 C.F.R. § § 790 *et seq.* (1977).

clear energy in the early years, and are now trapped in a hostile regulatory environment by massive sunken investments, would have shied away entirely had they been faced with the present requirements. One also wonders to what extent the so-called "hassle factor" is keeping industry out of geothermal.

Environmental reviews are conducted at every step of the process on federal land. Prior to the ultimate production of energy from a geothermal project on federal land, at least five separate environmental reviews, and probably one or more environmental impact statements will have occurred. At each stage—the generic environmental impact statement for the federal leasing program, the pre-lease environmental assessment, the environmental assessment for the plan of exploration, the environmental assessment for the plan of development, and the environmental assessment for the plan of production—the consequences of development and production will have been considered, with more specificity and detail at each succeeding stage. The pre-lease environmental assessment alone may take as long as thirty to forty months. In California, even developments on private or state lands face similar delays.

The technical basis for sound environmental standards has not been developed for geothermal effluents. Thus, each individual regulatory jurisdiction is free to adopt its own best estimate. In many cases, conservative standards are being set because of uncertainty. Even where liberal standards exist, fear of future requirements for modifications is a deterrent to industry.

It may be that not much can be done to expedite matters. But there are at least some options. Elimination of pre-lease environmental review will help considerably, if it can be done consistent with NEPA. It would allow land packages to be completed and drilling to begin on lands adjacent to tracts on which non-competitive applications have been filed, without fear of creating a KGRA, requiring competitive bidding. It would also allow limited federal agency funds for environmental reviews to be more efficiently directed to areas where preliminary exploration indicates sufficient promise for deep

drilling. Millions of dollars are now being expended on reviews for tracts where no environmentally disturbing activity will ever take place.

Efforts are planned to examine the permitting process in detail to reduce redundancies and improve the efficiency as well as the speed with which necessary reviews take place. This will be a grueling task, and implementation of resulting changes will take time. But it is an essential effort.

The permitting and environmental review process is not the only federal regulatory impact on industrial geothermal development. Electricity rate regulation and antitrust and securities regulation also affect these activities. These areas have not yet been identified as barriers, at least at the federal level, but they will be examined for potential problems.

The Federal Power Commission has yet to be required to decide on rate treatment of expenses related to geothermal development, but they have agreed to develop and issue prospective guidelines for the voluntary use of state utility commissions, and to assist utilities in their planning.

STATE AND LOCAL GOVERNMENTS

Policies at the state and local level are an important part of the institutional framework for geothermal development. ERDA is cooperating with state governments in a number of ways, including the regional planning studies, cooperative resource assessment efforts, and workshops and seminars on regulatory problems. We are working with such groups as the Interstate Oil Compact Commission, National Conference of State Legislatures, National Governors Conference, and Western States Water Council, on policy questions. Among the plans for this year is a study of state policies on such matters as taxation, land leasing, securities regulation, resource definition, and rate regulation to provide guidance and recommendations, and perhaps alternative model code sections.

At the local level, ERDA has funded studies for county and city governments for planning for geothermal resource

utilization. We do not propose a general program of geothermal planning grants, but a series of well-documented prototypical planning efforts should provide a sound basis for other communities to emulate, perhaps with some technical assistance from ERDA. Our regional planning studies will also be of assistance to local government bodies in identifying likely development scenarios.

FEDERAL INCENTIVES

The loan guaranty program and the proposed tax amendment should provide substantial incentives for certain elements of the private sector. We will be watching closely how effectively they work. In the meantime, studies are underway to assess the need for additional or alternative incentive mechanisms. For instance, the need for and feasibility of a Federal reservoir insurance program, to provide for losses in the event of premature reservoir depletion or failure, is being examined. Such other options as price supports or guaranteed markets will be assessed. Any such incentive would be cautiously applied and temporary, because the objective is to bring about a healthy private sector involvement, rather than continuing support of economically unsound business activity.

We are also opening up contacts with existing sources of Federal support, such as HUD's programs, the Commerce Department's Economic Development Administration, the Small Business Administration, Farmer's Home Administration, and the Rural Electrification Administration. The objective is to assure that the policies and programs of these agencies are not biased, inadvertently or advisedly, against geothermal energy projects. Indeed, in some cases preferential treatment for projects involving geothermal energy may be proposed.

SUMMARY

If all of the above sounds ambitious, it is. Little or nothing could be achieved in the policy development area without the active cooperation of the myriad responsible agencies. So far the response has been encouraging and gratifying. The

substantial achievements to date are an important index of the interest in geothermal energy throughout federal and state governments. ERDA's contribution has been largely to act as a catalyst, a coordinator, and a cheerleader.

The federal program is designed to deal with the entire scope of commercialization. This is a role at which the federal government has historically not been successful. The lack of proven precedents makes the task doubly difficult, and doubly exciting. Whether geothermal energy, if it is ever widely developed, will be developed because of or in spite of our efforts, remains to be seen.