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THE GEOTHERMAL PROGRESS MONITOR

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ABSTRACT

The Geothermal Progress Monitor is sponsored by the Division of Geothermal Energy/Resource Applications, DOE, to assemble the important facts about geothermal development activities in the United States in order to assess the pace of the development of this alternative energy source.

The initial emphasis for the monitoring effort has been placed on the detection and analysis of important and simple indicators of what the main participants in geothermal energy utilization - field developers, energy users, and governments - are doing to foster the discovery, confirmation, and especially the use of this resource. The major indicators currently considered to be both important and measurable, are leasing activities, drilling effort, feasibility studies, construction plans and progress, costs of installations, levels of investment, environmental study and regulatory and legislative status of events, and government monetary investments in projects and activities. Additional indicators may be pursued in the future, depending on specific needs for or opportunities to capture relevant data and facts.

INTRODUCTION

The Department of Energy (DOE) program for geothermal hydrothermal energy development was selected in 1978 as one of the priority areas for rapid energy technology commercialization. In October of 1978, the Division of Geothermal Resource Management (DGRM) was established within DOE to promote geothermal energy technology and development throughout the nation. In February 1980, DGRM was merged into the Division of Geothermal Energy (DGE) to form DGE/Resource Applications (DGE/RA) which continues the mandate of DGRM; with respect to the commercialization of geothermal resources in the United States.

To measure progress in developing geothermal energy in the marketplace, a system for monitoring resource development has been designed, and is being implemented. The system, called the Geothermal Progress Monitor (GPM), tracks and reports significant trends and events in the

U.S. geothermal industry and the DGE program. The effort to establish the GPM began in 1975, when MITRE was tasked by DGE to develop system concepts for monitoring the development and utilization of geothermal energy in the U.S. (Cohen, 1977). Further action was taken in February 1979, when a panel of the DGRM Commercialization Workshop evaluated a number of concepts for a progress monitoring system. The panel further developed the rationale for a progress monitoring system, and described a preferred approach for developing a system. Initial objectives and contents for a operative GPM were established at a meeting of geothermal database managers convened by DGRM in McLean, Virginia in August 1979. The results of this meeting served as a basis, for developing an initial GPM design and a proposed first report of the GPM. These were revised at a meeting of DGRM field elements in San Francisco in November 1979, and a consensus was reached to produce the GPM report on a trial basis for three issues. GPM Report No. 1 was issued in January 1980 (Lopez and Neham, 1979). A description of the GPM was published in June 1980 (Lopez, et al., 1980).

PURPOSE AND ROLE

This monitoring capability is required by DGE and other members of the Interagency Geothermal Coordinating Council (IGCC) for three major purposes: to support effective management of the federal program for the commercialization of geothermal energy, to identify and quantify trends in the development and utilization of geothermal energy resources, and to provide information required for executive, legislative, statutory, and public needs. Figure 1 illustrates the approach toward fulfilling this purpose, with the top row of boxes showing the sources of information, the next row showing the conversion of this information into status indicators and trends, and the remainder showing users of the information.

The basic objective is to provide a guide-response centralized geothermal information collection, storage, analysis, and reporting system that (a) tracks the development of geothermal energy in the U.S. and the world, to (b) assist the Director, Division of Geothermal Energy, in reporting (c) geothermal energy activities.

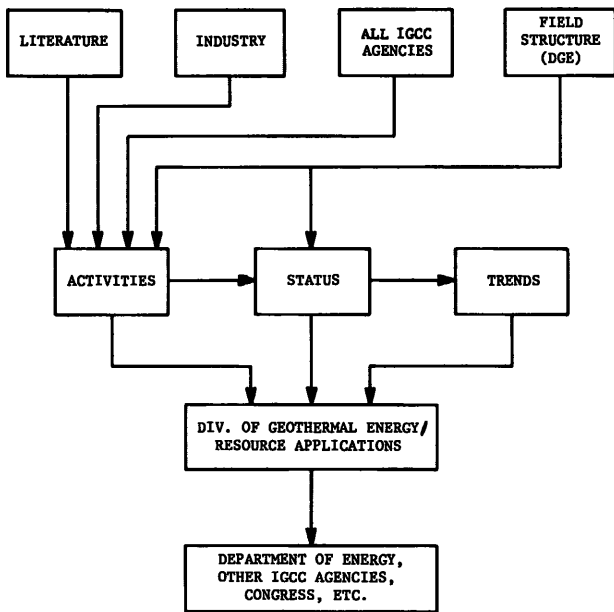


Fig. 1 Schematic of information flow in the geothermal progress monitor

status and trends to (d) other officials in the government, (e) field members of the DGE geothermal commercialization team, and (f) other interested parties in the geothermal industry. The emphasis is on collecting and analyzing a complex set of progress indicators from a wide variety of sources to produce an understandable, timely, and usefully accurate picture of the status and rate of geothermal energy development. The principal emphasis is on developments within the U.S. of the geothermal resource and the geothermal industry. The principal policy-oriented aim is to detect the degree to which the U.S. geothermal energy program is accelerating the growth of geothermal energy use. The principal commercialization oriented aim is to inform all interested parties of the wheres, whats, and whens of the geothermal industry.

STRUCTURE

The GPM is configured as an operation of DGE Headquarters, managed by DGE while developed and implemented by MITRE. However, the Headquarters and MITRE operations of the GPM represent only a small part of the overall system, the point where information is assembled and processed. Most of the data collection is done by DGE field teams. Figure 2 illustrates the overall institutional scheme of the GPM system, including the executive levels served by the GPM and the field elements where the information originates. The

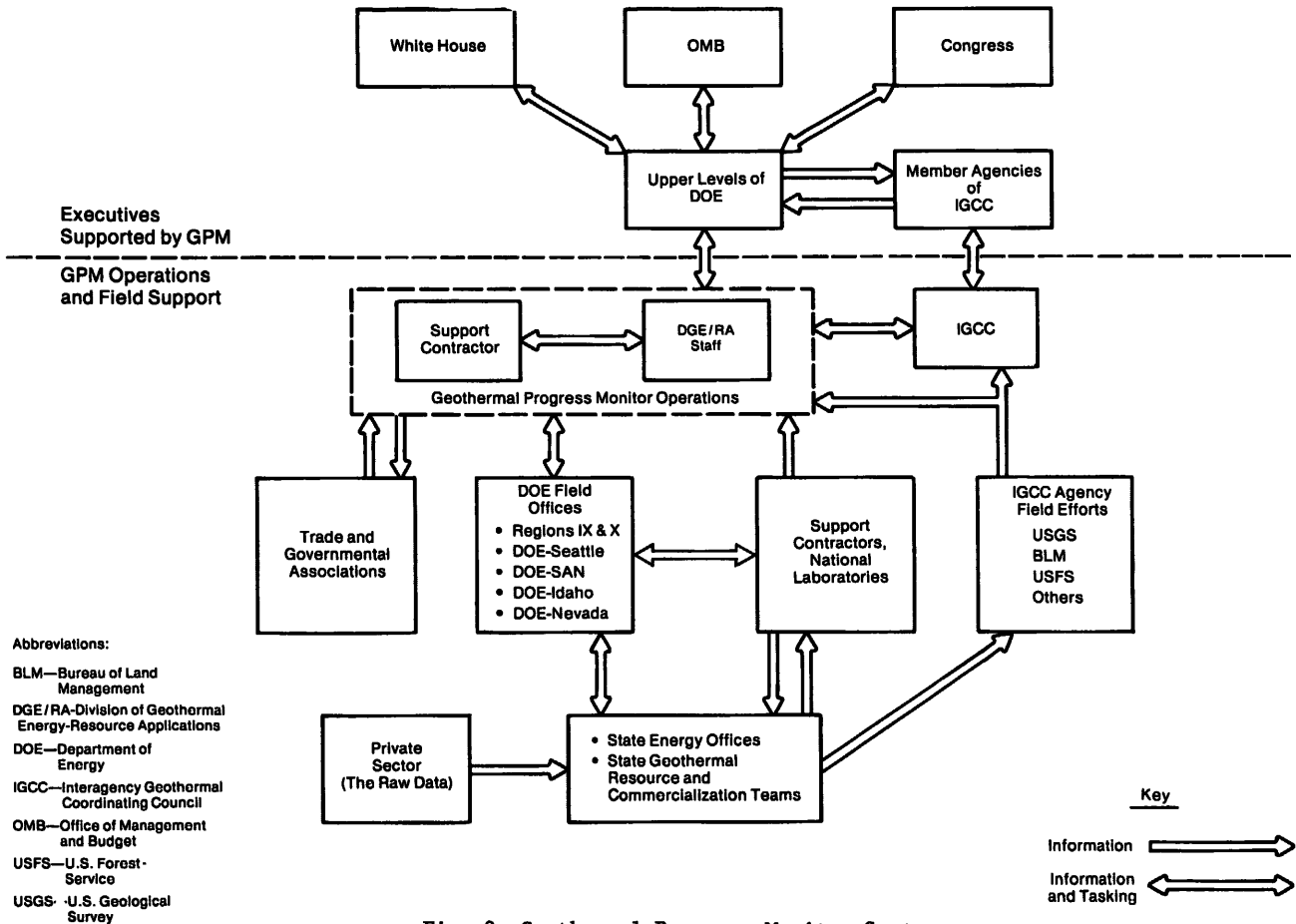


Fig. 2 Geothermal Progress Monitor System

actual configurations of the field elements is considerably more complex than depicted here, with a lot of information flowing among the participants in more or less informal ways.

The primary formal source of information for the GPM is the DGE field organization. This organization is comprised of the geothermal staff of DOE Regional and Operations Offices and their designated contractors and State Teams. Each of these offices serves as a funnel to DOE Headquarters for information developed or collected by their contractors and State Resource Teams and State Commercialization Teams.

Other participants in the GPM include the member agencies of the Interagency Geothermal Coordinating Council (IGCC). Of particular note is the U.S. Geological Survey (USGS), which maintains automated files on the geothermal resources, the leasing activities on Federal land (data is from the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS)), and on drilling activities on Federal land. The USGS issues reports from these files periodically, which are a significant input to the GPM.

A number of the important information collection and evaluation efforts of the GPM system, and databases to support those efforts, are conducted by contractors to DGE. These include the Applied Physics Laboratory of Johns Hopkins University, the Idaho National Engineering Laboratory, the Lawrence Berkeley Laboratory, the New Mexico Energy Institute, the Oregon Institute of Technology, and the University of Utah Research Institute.

CURRENT FILES

The GPM reports principally on three types of information: activities, status, and trends. Activity reports are news items of general interest to the GPM audience which have been reported to DGE, but which may not have received the wider circulation that the information deserves. The GPM will not compete with commercial geothermal information services by attempting to report comprehensively, but rather provide its audience with announcements to stimulate further inquiry where appropriate.

Status information is maintained in site-specific soft (paper) files in order to handle the large amounts of information that must be maintained on particular sites or installations. Soft files have been established for electric power sites, direct heat sites, lease sales, drilling data and R&D programs. From these files the information is abstracted to form the simple hard (computer) files. The hard files are maintained on a computer text editing system for rapid editing and production of reports in tabular form.

The computer generated reports are used to circulate information to field teams for updating and validation, and are presented in the form of lists that appear quarterly or semi-annually, updated as appropriate, but retaining the same format (for a given report) through each revision.

The hard files also serve to provide quick summaries of information and rapid access to sources of the data.

The trend reports arise from periodic review of status indicators. These reviews will highlight changes in time intervals, quantities, and costs, and provide the basis for more detailed investigation and analysis. Other trend analyses might be suggested by DGE or other interested parties, and would be performed by MITRE as resources permit.

RESULTS

A number of target-analyses were specified at the outset of the GPM effort in August 1979. Targeted subject areas include: plans for and construction of electrical plants and direct heat installation, drilling of deep and thermal gradient wells, leasing of federal and private land for geothermal use, activities of governments to stimulate development and demonstration at specific sites, environmental assessment activities, legal and regulatory changes, and cost and investment statistics.

It was recognized at the start that achievement of these analyses would depend on the ability to capture data economically and accurately. Moreover, it was clear that certain baseline statistics and trends need to be compiled very quickly, since they were needed as inputs to DGE managers.

The existence of the DGE State Commercialization Teams and State Resource Assessment Teams as well as a number of structured commercial and governmental data sources, made it possible to start the GPM effort based on initial timeliness and later establishment of accuracy. Redundancy of sources allowed a rapid establishment of estimates for electric plants (installation and plans), direct heat installations, and deep geothermal wells. Feedback from a variety of sources, has allowed establishment of a fair degree of confidence in the initial estimates.

Currently, sufficient data has been collected to establish status and trends for: (1) electric power plants, (2) direct heat installations, (3) deep geothermal wells, and (4) leases on Federal lands. Other trends will be established as the data collection and analysis efforts become more mature. Some of the major findings in these areas as of May 1980 are:

- (1) Electric Power Plants - operating plant capacities are currently 802 MWe, with an additional 2771 MWe planned by 1990:

TIME PERIOD	CAPACITY (Mw)		
	GEYSERS	OTHER	TOTAL
TD 5/80	792	10	802
6/80 - 12/90	1753	1018	2771
TOTALS	2545	1028	3573

If the planned plant schedule is maintained, the resulting total capacity of 3573 MWe (0.71 Quad/year) by 1990 will exceed DGE's 1990 utilization goal of 0.6 Quad/year:

- (2) Direct Heat - major operating installations total 1.48×10^{12} BTU/year and planned installations by 1990 total 7.71×10^{12} BTU/year for an estimated total capacity of 9.19×10^{12} BTU/year by 1990. This figure is certain to increase as more information on these applications, which are "less visible" than electric plants, is obtained from the field, and more installations are planned over the next few years.
- (3) Deep Wells - in the 1973-1979 period, the average annual increase in the drilling rate in The Geysers and Imperial Valley areas is one well per year, and in other areas this average increase is 4 wells per year. However, in the last two years, the average annual drilling rate increase in the other areas has exceeded 10 additional deep wells per year.

LOCATION	DEEP WELLS DRILLED		CHANGE IN ANNUAL RATE 1973 - 1979
	TO 12/79	1979 ONLY	
The Geysers	307	29	+1
Imperial Valley	119	15	+1
All Others	291	55	+4
TOTALS	717	99	+6

- (4) Leasing - Federal lands leased in the 1974-1979 period totalled 2,255,559 acres of which 534,493 acres (24 percent) were based on competitive bids (KGRA land) and 1,691,066 acres (76 percent) were based on non-competitive bids:

TYPE OF BID	FEDERAL LAND LEASED (acres)						TOTAL
	1974	1975	1976	1977	1978	1979	
Competitive	35,666	162,361	135,280	101,045	59,350	40,791	534,493
Non-Competitive	0	160,833	956,241	133,359	245,164	195,429	1,691,066
TOTALS	35,666	323,194	1,091,521	234,404	304,220	236,220	2,225,557

The most complex undertaking in this effort is the establishment and tracking of accurate information about the status of development at specific geothermal sites. Site status is most easily determined when inputs on activities at or concerning a site come from many sources. In most cases where many sources report frequently, the site is either well into development (e.g., construction will begin within one to two years), or the site is the focus of a government-funded project (e.g., frequent reports flow directly to DGE headquarters or the DGE field teams). This will leave many sites where the owner/developer must be queried directly to assess site status. Achieving accurate site status assessments will require increasingly closer coordination between MITRE and the DGE field teams.

Inasmuch as the information and analyses contained in the GPM is wholly derived from

activities and status reported from the field, it is obviously to the advantage of all participants in the geothermal industry to ensure that this information is timely and accurate. If you wish to report new information or correct apparent errors or misinterpretations, or if you would like to suggest further analytic studies, contact the GPM staff in writing or by telephone at:

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