DIRECT APPLICATIONS OF GEOTHERMAL ENERGY MARKET PENETRATION ANALYSES AND INFRASTRUCTURE REQUIREMENTS

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ABSTRACT

EG&G Idaho, under contract with the Idaho Operations Office of the Department of Energy, is performing geothermal market penetration analyses, and investigating infrastructure requirements. This paper provides a brief summary of some of the analyses being conducted to serve as a guide in the preparation of comprehensive plans for the accelerated commercialization of geothermal energy.

INTRODUCTION

Market penetration analyses have been performed for ten states: Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, the Dakotas, Utah, and Wyoming. The size of current and potential future markets for these states has been assessed for direct heat applications using a basis of colocation of geothermal resources with potential users.

Exploration and development activities are minimal in these states. A very large increase in activity is needed, along with improvements in exploration and confirmation technologies. Financial incentives; simplified leasing, siting, permitting, and licensing practices; development of appropriate codes and standards; and promotional activities are all needed for the early commercialization of geothermal energy.

The infrastructure to effect early commercialization of geothermal energy is just beginning to emerge. Certain assumptions were made, and a preliminary effort is underway to describe the scope of the infrastructure, in dollars and manpower, needed through the year 1987 for the early commercialization of this energy source on a national basis.

AREA DIRECT HEAT APPLICATIONS

Each of the ten states have been analyzed for potential uses of geothermal energy for direct applications. Resource areas (identified by the U.S. Geological Survey[1], and through work performed by the Earth Science Laboratory of the University of Utah) have been evaluated for potential matching with users. Industrial processes, that could use geothermal energy in the temperature ranges possibly available in the area, have been identified from listings in state manufacturing directories, and energy use projections, using data developed by the Intertechnology Corporation[2] in 1977, were made. Some of the best matched industries considered are dehydrated and frozen fruits and vegetables, concrete blocks, poultry dressing, meat packing, prepared foods, plastic materials, and the dairy industry. The most promising counties in the ten states (191 out of 399) have been evaluated for residential, commercial, and industrial energy use and resource colocation. Starting with this basic information, market growth and capture assumptions were made to estimate potential geothermal use. These assumptions are listed below:

- Apply national industrial growth rates by Standard Industrial Classification Codes.
- Assume 3% annual increase per capita consumption.
- Assume 5% annual new industry spin off for 1985 and beyond.
- Assume 4% per year regional population growth.
- Apply factors for potential new resource discoveries by the year 2020 and beyond.
- Apply factors for new industries relocating to the region.
- Assume a retrofit of the baseline market of 1% per year for 1980 and beyond, to a 25% maximum.
- Assume a lineal increase in the percent capture of the new growth market from 1980 to 1985.
- Assume 80% of new industrial growth will be captured in 1985 and beyond.
- Assume 40% of relocated industry will be captured in 1990 and beyond.

DISCLAIMER

- Assume 75% of new residential and commercial growth will be captured in 1985 and beyond.

These analyses of present and future markets present an attractive profile. The summary of the findings[3] of this effort are listed below.

- All ten states have potentially economical geothermal resources with temperatures suited to many process applications and to space conditioning.
- Most industrial and population concentrations are colocated with geothermal resources.
- The geothermal water quality is often potable, but a wide range of scale and corrosion problems may be encountered.
- The major direct heat markets are currently residential and commercial space conditioning, and industrial process heat applications. The industrial market sector has the greater potential for near term penetration.
- The current hydrothermal market potential for direct applications within these states is about 0.4 quads. The market potential and the possible capture of that market for direct heat use is shown in Figure 1.
- Current technologies are adequate for initiating commercial use of geothermal energy in the area, but new technologies are needed for full market penetrations.
- A reservoir confirmation program is required.
- Transportation costs may be a signficant economic factor.
- A major barrier to the direct heat market penetration is the lack of an infrastructure to develop geothermal energy applications. A discussion on this follows.

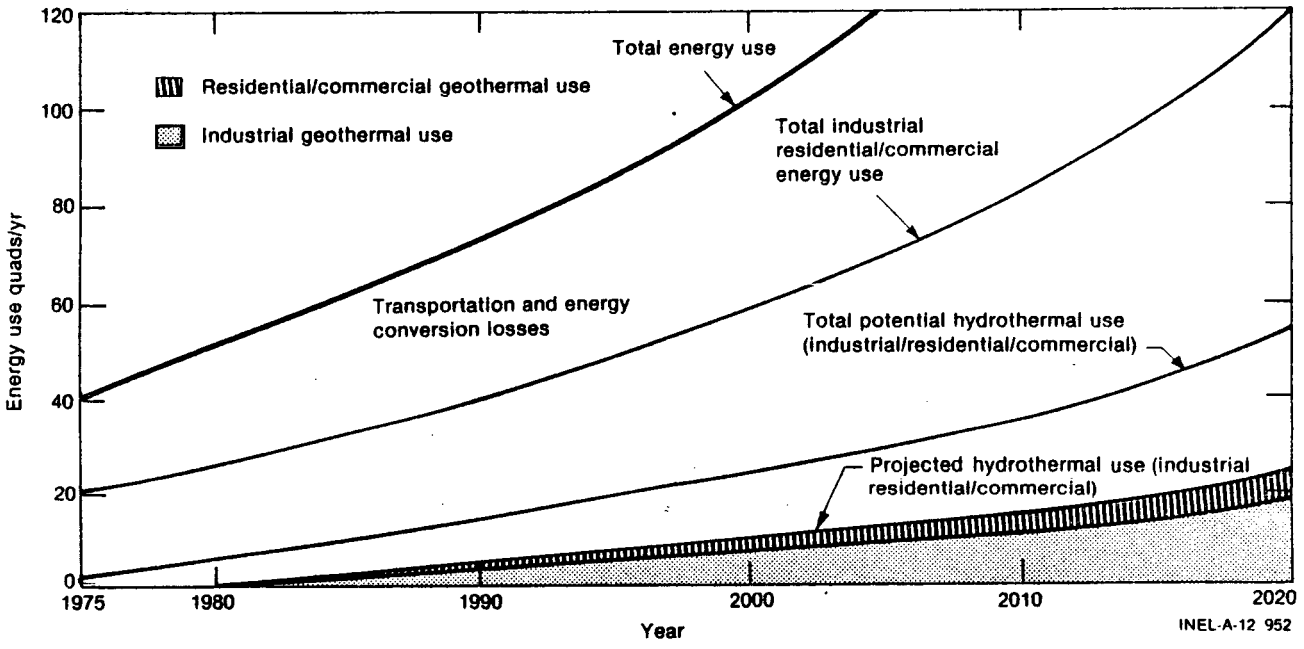

Figure 1. Energy consumption and projections for the Rocky Mountain ten state area[4].

NATIONAL INFRASTRUCTURE REQUIREMENTS

Commercialization of geothermal energy requires the development of an extensive new industry consisting of an infrastructure of developers, financiers, designers, builders, and operators. An analysis has been made of the capital and manpower needed through 1987, to place 5000 MW of direct applications development on line. The number and sizes of projects have been estimated, success ratios assumed, project types identified, and average development costs assigned to obtain an overview of cost and manpower needs. Following is a brief discussion of this activity.

Average costs per kW and development times were assumed for three generic systems: district heating, industrial parks, and single industry, and are shown in Table I.

TABLE I

ASSUMED PROJECT COST AND TIME VALUES

Item	Average Development Time (years)	Average Cost ($/kW)
Resource Development	1 to 2	
District Heating	3[a]	700
Industrial Parks	3[a]	500
Single Industry > 25 MWt	3[a]	300
Single Industry 5 to 25 MWt	2[a]	300

[a] After the first well is proven.

The systems are sized from 100 MWt to 5 MWt or less. Depending on the time required for resource development, design, and construction, these were evaluated to determine the year in which they are most likely to be operational. Average costs for each system have been applied, and labor and material costs were apportioned. Starting in 1980, it is expected that expenditures in the order of $85 million will grow to $775 million in 1987 and continue to increase thereafter. Converting these amounts to equivalent manpower needs shows that design, construction, administration, and other support personnel will grow in number to equal over 11,120 man-years in 1987, as shown in Figure 2. These evaluations considered only the cost of the geothermal systems needed to operate plants. To obtain an indication of the national expenditure that will be required for geothermal systems, plus the plants in which the systems operate, an average value of $2,000 per kW can be applied. On this basis, it is expected that industry will have invested over $20 billion through the year 1987.

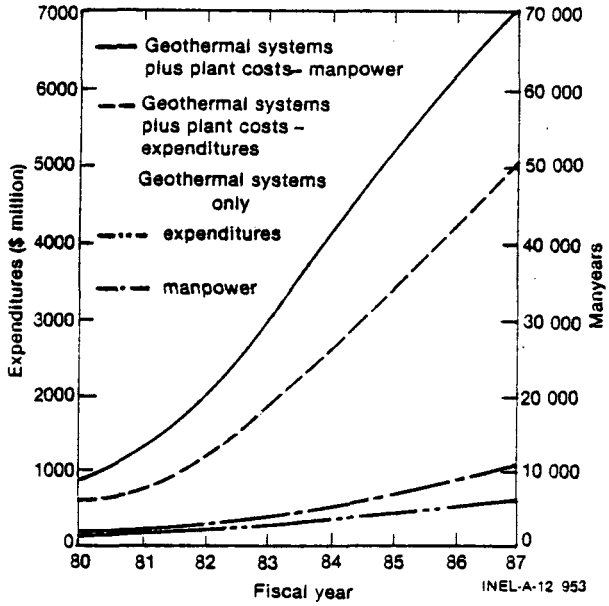

Figure 2. Projected national expenditures and manpower needs through FY 1987 for facility development.

ACKNOWLEDGMENTS

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REFERENCES

[1] United States Department of the Interior, Geological Survey, Assessment of Geothermal Resources of the United States - 1978, Geological Survey Circular 790 (and 726).

[2] Intertechnology Corporation, Analysis of the Economic Potential of Solar Thermal Energy to Provide Industrial Process Heat, Volume III (February 1977).

[3] EG&G Idaho and University of Utah Research Institute Earth Science Laboratory, Draft Regional Hydrothermal Market Penetration Analysis, (October 31, 1978).

[4] Department of Energy, Division of Geothermal Energy and the Idaho Operations Office; EG&G Idaho, and the University of Utah Research Institute Earth Science Laboratory, Regional Hydrothermal Commercialization Plan, (July 14, 1978).