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POTENTIAL FOR GEOTHERMAL DIRECT USE  
IN THE GREENHOUSE, LUMBER, CHEMICAL, AND POTATO AND ONION PROCESSING INDUSTRIES

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ABSTRACT

It has generally been assumed that rising energy costs in industries with high energy needs for low-temperature process heat will induce increasingly widespread geothermal direct use, so long as technical feasibility and cost advantage can be demonstrated. However, few systematic attempts have been made to determine how industry management and technical personnel within these industries view this possibility in light of factors they deem important to their own firms' energy supply choices.

This paper discusses that subject in relation to potential commercial geothermal use in the greenhouse, lumber, chemical, and potato and onion processing industries. It is based upon extensive interviews with decision-makers in over 50 firms representing various segments of these industries and is a selected synthesis of material compiled into reports on each industry.

INTRODUCTION

Present fuel patterns and practices and anticipated responses to perceived fuel problems vary by industry. Some industries are seriously affected by rising energy costs and are thus more interested in a broader range of alternative energy sources; but some can pass on cost increases, utilize internal energy resources or take conservation measures which diminish energy concerns.

Knowledge of geothermal energy potential for low temperature process or space heating also varies greatly by industry and by geographic location. Technical information networks differ among industries such that dissemination of information needs to be tailored to each industry. Virtually all industry members anticipate some difficulties with using geothermal energy in their particular businesses. Not surprisingly, the most prominent concern is finding resources near sites suitable for plant location. Geothermal cost information is generally lacking and financing capabilities vary widely.

For commercialization planning, knowledge of these industry patterns and preferences are likely to be critical for policy makers in designing programs to encourage geothermal use and to developers in designing projects likely to attract users.

I. CURRENT FUEL PATTERNS AND CONCERNS

Based on preliminary engineering analysis, it appears geothermal energy could substitute for fuels used for space heat in greenhousing, for steam heat in lumber drying and veneer and plywood processing, for some process heat in ammonia, chlorine/caustic soda and salt production, for blanching and peeling potatoes and in dehydrating onions. Our survey shows that the primary fuel currently used for these processes is natural gas, except in the lumber industry, which is rapidly converting from oil and natural gas to the use of wood waste for most energy needs.

It is commonly assumed that the ratio of fuel cost to total cost of operations is an important indicator of potential interest in geothermal use. Among the industries surveyed, the ratio varies from one to another and also within some industries depending on the product mix. The range is from 5 to 85% of total costs. The highest energy consumers among chemical firms sampled are the chlorine/caustic soda and nitrogen fertilizer producers, and among vegetable processors, producers of potato flakes and dehydrated potatoes and onions.

However, these circumstances do not necessarily correlate with interest in geothermal energy. For example, in the production of nitrogen fertilizer, 50% of the energy cost is for feed stock for which geothermal energy cannot substitute. And while chlorine/caustic soda producers have high energy costs in relation to total costs, part of this reflects the cost of supplying high temperatures needed for a variety of chemicals produced in a complex chemical plant, and these firms' primary interest is in resources for electricity generation. On the other hand, greenhouse growers sampled have a much lower energy/total cost ratio but show more interest in geothermal because it is more compatible with their basic energy needs. Thus, it appears that while high energy consumption influences fuel choices, other factors need to be considered.

Tolerance of fuel supply interruptions is one such factor. This also varies from one industry to another and within industries. In most of the industries surveyed, the consequences of fuel supply interruptions are considered serious enough to induce almost all firms to provide back-up systems.

Precise temperature control is critical to product survival in greenhouse and potato flake production. Among most chemical firms surveyed, start-up time is usually so lengthy as to make unscheduled shut-downs very costly. On the other hand, providing steam heat for lumber drying and veneer processing is a fairly simple operation; because wood waste is a plentiful fuel for these processes and because interruption would not destroy the product, no back-up is considered necessary.

In spite of provisions for fuel interruptions, these firms generally do not expect serious supply curtailments. Back-up systems are considered necessary because of fuel supply interruptions which occur periodically in most areas, but few consider the interruptions as ominous. Most respondents indicated that an inadequate fuel supply more than any other factor would force them to look for alternative energy sources, but also felt that, while natural gas may become increasingly expensive, supplies will be adequate in the near future.

Almost all the firms in all industries did express serious immediate concern about rising fuel costs. The responses to price escalation were consistent within each industry but differed significantly from one industry to another. Lumber producers have an immediately available alternative in wood waste which is particularly attractive because it is internally produced. Currently these firms are almost universally shifting from the use of natural gas and other fuels to wood waste for steam heat needs. This trend is limited in the short run only by the inability of some firms to meet expensive pollution control requirements and by the reluctance of utilities to purchase electricity from companies seeking to co-generate and sell excess power to make burning waste economic.

In the chemical industry increased fuel costs also have induced some firms to seek alternatives. However, the search is primarily for energy sources with high-temperature potential. At the same time many chemical processes produce sufficient waste heat to make heat recycling an obvious and attractive alternative for serving lower temperature needs.

The greenhouse industry invokes two responses to rising fuel costs. Most firms recently began converting to polyethylene thermal blankets as greenhouse cover to conserve heat and thus reduce fuel consumption. Secondly, some indicated that they can pass on increased costs to their customers, and several indicated they could accommodate doubling or even trebling of fuel costs in this way before considering alternative energy choices.

Potato and onion processors appear to be in the least satisfactory position to deal with energy cost increases. Unlike other industries, they have no internal energy resource, little conservation potential and an inelastic product demand which makes it difficult to pass on cost increases. For these reasons, they are very interested in alternative energy generally, and because potatoes grow

well near good resource potential, they have given substantial consideration to geothermal use.

## II. PLANT SITING REQUIREMENTS

Resource location was considered by all utilities to be the primary inhibiting factor for geothermal use, because the large majority of firms surveyed would not relocate simply to take advantage of a geothermal resource even if it offered some cost savings. While some would consider locating new plants to take advantage of an available resource, over all, other considerations have priority. Lumber firms, potato and onion processors and some chemical sectors are heavily dependent upon the location of raw materials for plant siting, while greenhouse growers are more concerned about transportation, product markets, labor and water supply.

### Factors Influencing Plant Location\*

Factor	MI	VI	I	TOTAL	NI
Raw Material Supply	19	9	4	32	3
Close to Product Market or Transportation	4	20	7	31	1
Energy Supply	2	21	2	25	2
Water Supply	2	9	6	17	-
Labor Supply	3	6	8	17	-
Climate	1	-	3	4	1
Waste Disposal	-	2	1	3	-
Air Quality	-	1	-	1	-

\* MI = Most Important; VI = Very Important; I = Important; NI = Not Important

While most people in all industries see available energy supply as very important to plant siting, the picture is more complicated than just comparing energy costs among locations. Energy supply needs can be met in many locations, and plant location plans will focus first on requirements for which there is no substitute. Therefore, geothermal will be attractive only where it can offer lower energy costs at a site where the other basic requirements are met.

## III. COMMERCIALIZATION POTENTIAL

Knowledge of potential for the direct use of geothermal energy varied widely from one industry to another in the survey. At one extreme, over half of the potato and onion processors had considered using geothermal energy. At the other, only those few lumber companies located near commercially exploited geothermal resources were even aware of direct use potential. Chemical producers were for the most part aware only of geothermal electric potential. Almost all greenhouse operators knew that geothermal is used for space heating in their industry, but like lumber producers, only those near commercially exploited resources had more specific information. Although there was also little awareness of actual costs for geothermal development and use, except among potato processors, there was a general skepticism in all industries about its cost competitiveness with conventional fuels.

Assuming adequate cost information, however, it does not appear that the high capital investment associated with geothermal use is necessarily the barrier one might expect. Given a choice between investments with high initial costs and low operating costs or ones with low capital requirements and higher operating costs, many companies would prefer initial high capital costs for a variety of reasons: tax advantages, long-range cost certainty and inflation protection. Furthermore, a significant number of firms are indifferent to cost distribution as long as annualized costs are the same. The firms which would prefer low capital costs do so because of cash flow problems, because they need greater investment flexibility or because the company has a policy of minimizing debt. However, in some industries, such as greenhousing, a general undercapitalization limits choice, and for these firms high initial capital costs may indeed pose a barrier to geothermal use.

Another common assumption has been that possible unreliability of geothermal resources poses a significant barrier to commercial use. There is evidence in the survey that this factor may in many instances be less important than imagined. While reliable energy supply is extremely important, particularly in greenhousing, potato flake and some chemical production, in many instances reliability does not present new problems. As noted earlier, most firms in all industries surveyed already follow a convention of providing back-up for primary fuels.

A different sort of barrier did, however, emerge in the survey. There appear to be dominant trends in some industries which distract from consideration of other energy alternatives. The lumber industry, for example, is focusing almost exclusively on wood waste, even though geothermal energy might well suit some of its energy needs. Similarly in greenhousing conservation by insulation is the prevailing idea. In the chemical industry heat recycling and electric quality resources dominate energy thinking. Geothermal promoters are therefore confronted not only with the problems associated with introducing an unfamiliar energy source, but also with the problem of obtaining a hearing where other energy strategies have taken hold.

Perhaps a more significant barrier to commercial use of geothermal energy surfaced in the survey for those who focus upon user development of resources. Among the industries studied, there is a general and overwhelming lack of interest in exploring for low temperature resources, a strong reluctance to participate in development and an overwhelming preference to purchase energy of any sort through a distribution system. The few companies willing to explore for geothermal tend to be large chemical companies who are already in the energy business or potato or lumber companies near known resources which have already been exploited. There is no more venturesome attitude among those who might consider field development activity. They generally require that the resource be well established, that there be very little risk of

drilling a dry hole, and that the resource be near their existing plants. Otherwise, companies are most likely to consider using geothermal energy when someone can offer it to them through a distribution system in much the same way they receive other existing energy supplies.

#### REFERENCES

The material summarized here appears in more complete form in four reports prepared by the Earl Warren Legal Institute under contract with the U.S. Department of Energy. See: "Prospects for Geothermal Commercialization in the Greenhouse Industry" (March 1980); "Prospects for Geothermal Commercialization in the Chemical Industry" (March 1980); "Prospects for Geothermal Commercialization in the Lumber Industry" (March 1980); "Prospects for Geothermal Commercialization in the Potato and Onion Industry" (March 1980).