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MARKET SURVEY FOR INDUSTRIAL AND COMMERCIAL USES OF GEOTHERMAL ENERGY IN CALIFORNIA

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ABSTRACT

A market survey was conducted to determine the demand for the direct use of geothermal energy in California. Information was gathered using a mailed survey questionnaire and by personal interviews. The following are some of the major findings:

- The potential industrial direct use market in 1980 totals 41 trillion BTUs by the year 2000. The commercial market for 1980 totals 21 trillion BTUs and could grow to 35 trillion BTUs by 2000.
- The "best estimate" geothermal direct use market penetration projections for commercial and industrial BTUs on-line are as follows:

Year	Industrial Trillion BTUs	Commercial Trillion BTUs	Total Trillion BTUs
1980	0.0	0.05	0.05
1985	3.0	1.5	4.5
1990	12.0	4.0	16.0
1995	26.0	9.0	35.0
2000	38.0	15.0	53.0

- The projections of the annual quantity of fuels that can be displaced by the direct use of geothermal resources in 1980 are as follows:

	Trillions of BTUs		
Fuel	Industrial	Commercial	Total
Electricity	2.5	5.0	7.5
Natural Gas	34.0	15.0	54.0
Oil	3.6	.5	4.1
LPG & Other	.8	.5	1.3
TOTAL	41.0	21.0	62.0

- At the present time, most industrial decisionmakers are unaware of the potential for geothermal direct utilization.

INTRODUCTION

The California Energy Commission (CEC) is required by law to assess the potential of alternative energy sources, (including geothermal energy), develop and coordinate a research and development program in energy supply, explore and support the accelerated development of alternative sources of energy, and improve methods of forecasting energy demand. To support accomplishing the preceding legal requirements, CEC's Geothermal Office initiated a study to establish the projected usage levels of direct applications of geothermal energy for California. Geothermal energy, when utilized in direct applications, can replace electricity, oil or natural gas normally used as fuel. In order to plan for future energy supply facilities, the amount of the projected replacement of fossil fuels by geothermal energy must be known.

Accordingly, Science Applications, Inc. was contracted by CEC to perform a market survey which:

1. identified potential users of geothermal energy;
2. defined user/resource matches;
3. projected market penetration rates;
4. determined the amount of fossil fuel and electricity displacement possible from geothermal resources;
5. determined the present attitudes of industrial decisionmakers about the feasibility of geothermal energy development; and
6. recommended future courses of action.

This paper summarizes the findings of the market survey and highlights several aspects of the project.

Data for the market survey was collected by a mail survey and personal interviews. Two

groups of industries were surveyed. Industries in Group 1 were selected according to the type of industry or product produced. Group 2 companies were selected on a geographic basis.

Group 1 industries included the following standard industrial classifications:

- Food & Kindred Products (SIC 20)
- Lumber & Wood (SIC 24)
- Paper & Allied Products (SIC 26)
- Chemicals & Allied Products (SIC 28)

Process heat is essential to the companies in the categories listed above. These industries make substantial monthly expenditures for natural gas, electricity and fuel oil, which could be reallocated to expenditures for using geothermal direct heat applications.

The four SIC categories identified as major targets for the direct use of geothermal energy account for 35% of the purchased fuels and electric energy used for industrial heat and power in California.

CALIFORNIA DIRECT HEAT MARKET

California leads the nation in the production of over fifty crops and accounts for over 50% of the U.S. production of thirty-six crops. This high volume of agri-business makes food processing a very important target industry for geothermal direct uses. Virtually every county in Northern California produces lumber, wood and paper. The paper and paper-board industry is the fourth largest industry in the country, with the fifth fastest rate of real growth. The chemical industry is the State's most energy intensive industry, with energy accounting for the highest percentage of product cost of any industrial classification.

Commercial activity also represents a substantial market and generally takes place around the population centers of the State. Potential commercial users of geothermal energy include laundries, hotels, hospitals, schools and universities, shopping malls and retail outlets, and office buildings.

Space heating is the primary commercial usage, in addition to space cooling and water heating. The most common fuels that would be displaced by using geothermal resources are natural gas and electricity. Space heating and hot water are excellent applications for geothermal energy utilization since the temperature requirement for these end-uses corresponds with the temperature range of the majority of the State's geothermal resources.

In 1978, Californians used a total of 5,086 trillion BTUs of energy, of which 21 percent was consumed in the industrial sector and 9 percent in the commercial sector. These two sectors account for thirty percent of the State's energy demand. Figure 1 is a graphical representation of energy consumption in California for 1978.

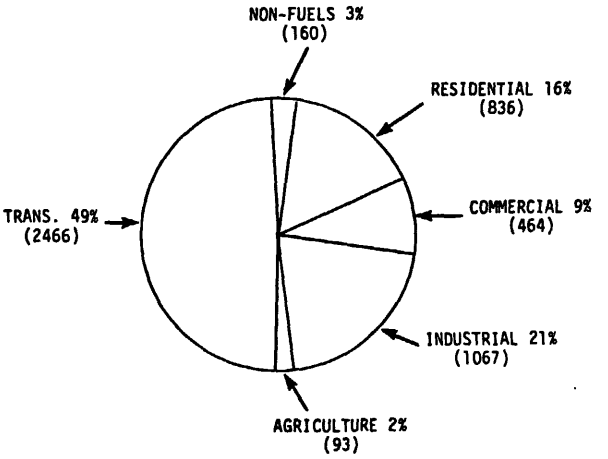

Figure 1 Energy Consumption in California -- 1978

Source: Carasso, Meir and Oilver, Steve, 1979.

Table 2 displays energy consumption in California by fuel type:

Table 2

Energy Consumption in California by Fuel Type, (Trillions of BTUs)

Fuel Type	Energy Consumption (TBTU)
Gasoline	1,460
Aviation Fuel	385
Distillates	437
Other Petroleum Products	780
Still gas --175	
Nonfuel---160	
Other (Residual, crude)---445	
Natural Gas	1,331
Electricity	549
Biomass	72
Coal	60
Geothermal Steam or Hot Water	12
TOTAL	5,086

Source: Carasso, Meir and Oliver, Steve, 1979.

DATA ANALYSIS

The breakdown of energy usage in the commercial and industrial sectors for the State of California, shown in Table 3, indicates reliance primarily on natural gas and electricity. Survey responses also showed the primary geothermal targets for replacement to be natural gas and electricity. The respondents answering the energy usage questions (both Group 1 and Group 2) accounted for about 6.2 trillion BTUs, or about .4 percent of the total commercial and industrial energy usage of 1978.

Table 3

Breakdown of Energy Usage for Commercial and Industrial Sectors, 1978

	Industrial Sector (Trillions BTUs)	Commercial Sector (Trillions BTUs)
Electricity	133	199
Natural Gas	515	225
Distillate	50	15
LPG	15	15
Residual Oil	40	10
Biomass	42	0
Coal	42	0
Crude Oil	60	0
Still Gas	175	0
Cog Steam	12	0
TOTAL	1,067	464

Source: Carasso, Meir and Oliver, Steve, 1979.

A review of the survey responses indicated that the industry representatives who answered the end-use energy questions showed good judgement in determining what percentage of their energy could be displaced by the use of geothermal energy. Table 4 displays the survey responses concerning end-use consumption of energy. For Group 1 it was determined that between 35.6% and 70.1% of the BTUs used could be displaced by geothermal energy, while in Group 2 between 18.7% and 36% of their energy could be displaced. This highlights the point that Group 1 is an important target group for geothermal development.

Table 5 shows the breakdown of fuel use by type and end-use, as well as the percentage of fuel supplies that are interruptible. By taking the estimates of the amount of energy that could be displaced by geothermal energy for each end-use along with the fuel usage information in Table 5, it was determined that the energy displaced by geothermal direct use will be 83% gas, 6% electric and 11% other fuels for the respondents in this survey. a large percentage of the respondents were on interruptible energy supplies, particularly with regard to boilers, dryers and pressure vessels.

Table 4

Energy End Use for Responding Companies (Group I and 2 and Total)

End Use	Energy Use Millions of BTUs Total	Group I	Group 2
Space Heating	732,720	20,920	711,800
Space Cooling	115,075	39,875	75,200
Hot Water	50,092	40,625	9,467
Refrigeration	43,900	2,100	41,800
Drying, Dehydration	1,221,100	1,011,100	210,000
Boilers	3,975,120	2,213,920	1,761,200
Pressure Vessel	92,600	92,600	-------
Other	54,640	2,840	51,800
TOTAL	6,285,247	3,423,980	2,861,267

Table 5
Percentage of Respondents that Use Gas, Electricity and Other Fuels, Companies that Have Interruptible Energy Supplies By End Use

	% Gas	% Electric	% Other	% Interruptible Yes	% Interruptible No
Space Heating	84%	20%	11%	55%	45%
Space Cooling	8%	94%	2%	35%	65%
Hot Water	82%	13%	13%	66%	34%
Refrigeration	3%	97%	--	33%	67%
Drying Dehydration	88%	4%	8%	70%	30%
Boilers	87%	--	13%	88%	12%
Pressure Vessels	57%	14%	28%	80%	20%
Other	83%	8%	8%	78%	12%

(Percentages do not add up to 100% because some companies use more than one fuel for an end use category)

Table 6
Annual Costs of Energy by Fuel Type for Survey Respondents (Groups 1 and 2 and Total)

$ Millions 1979

Fuel	Total Cost	Group 1	Group 2
Electricity	22.1	12.7	9.4
Natural Gas	27.6	19.2	8.4
Oil	2.5	1.7	.8
LPG	.1	.0	.1
Other	1.6	.1	1.5
TOTAL	54.7	33.8	20.3

ATTITUDE ANALYSIS

Results of the questionnaire revealed that few industries are aware of the potential for employing direct uses of geothermal energy. Ninety percent of the companies had never considered using geothermal energy, 60% did not know if appropriate technology existed, and only 6% believed that the technology was proven. These projections are low, considering the many direct use applications currently using conventional technology. Fifty percent of the respondents did not know if a geothermal system could be cost-competitive and only 14% thought geothermal could be cost-competitive with alternative fuels.

Most of the companies are openminded about geothermal energy. When asked if geothermal energy could be a viable fuel for their industry, 78% responded "yes" or "maybe." When asked if Federal, State and local institutions could help their company arrive at a decision to use geothermal energy, 78% responded "yes" or "perhaps." Representatives of 26 companies believed that Federal and State institutions could help them arrive at a decision to use geothermal energy, but only twelve answered that it was viable at this time. [Government assistance appears to be important in influencing the decisionmakers.]

The companies were generally noncommittal about their intentions to pursue and develop geothermal energy. If it can be demonstrated that a reliable system can be economically implemented, the respondents will readily adopt it. As more information about successful demonstrations becomes available, industrial decisionmakers will be more convinced of the viability of geothermal energy. The reliability of the resource is also critical. The cost of downtime for the intensive energy users is very expensive. Many companies, operative 24 hours a day, lose thousands of dollars for each hour that the plant is not in production. Consistent reliable geothermal productivity is very important in order to maintain production at an economically feasible level.

One point that should be emphasized is that very little exploration and resource assessment has been conducted for those resources which are in proximity to the larger urban markets. Although there is little information available regarding the geothermal potential for non-traditional, urban areas such as San Diego, San Jose, or San Bernardino, the potential for utilization, if confirmed, is very high. Because of this high utilization potential, it is very important to consider these non-traditional prospects, when planning for full market saturation and use.

A pattern emerges from responses to the question "What should State and Federal governmental agencies do to help expedite geothermal direct use by your company?". The three most common actions chosen were: "provide tax incentives", "provide technical information" and "demonstrate reliability of the resource". A second group of actions, receiving less frequent but still significant response rates included: "funding more demonstration plants" and "providing direct subsidies". Loan guarantees were chosen markedly less than the above-mentioned actions.

CONCLUSION

Since there is such a wide range of geothermal potential, optimistic and pessimistic estimates of the projections for the BTU's on line from 1980 to 2000 were made. Tables 7 and 8 display the optimistic, pessimistic, and "best estimate" projections for industrial and commercial energy on line.

Table 7
Projections of Industrial BTUs On-Line
(Trillions of BTUs)

	1980	1985	1990	1995	2000
Optimistic	0.0	4.0	24.0	44.0	65.0
Best Estimate	0.0	3.0	12.0	26.0	38.0
Pessimistic	0.0	1.0	6.0	12.0	14.0

Table 8
Projections of Commercial BTUs On-Line
(Trillions of BTUs)

	1980	1985	1990	1995	2000
Optimistic	0.05	2.0	9.0	21.0	30.0
Best Estimate	0.05	1.5	4.0	9.0	15.0
Pessimistic	0.05	1.0	2.0	5.0	8.0

The above projections are useful in developing a strategy to maximize the direct utilization of geothermal energy in California; however, it is important to understand the shortcomings of such projections in order to avoid over-reliance on the numbers. The important concept to note is that while current direct use of geothermal energy in California is miniscule, the potential market available for displacement of conventional fuels is large. Government actions to provide technical information, assist in resource confirmation, and to provide appropriate economic and tax incentives will result in increased levels of geothermal utilization in the State, which in turn will result in decreased reliance on increasingly expensive and unreliable conventional fuels.

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