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PRICING AND MARKETING GEOTHERMAL ENERGIES
FOR SPACE HEATING IN BOISE, IDAHO

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ABSTRACT

The Boise Geothermal System will begin delivering geothermal water for space heating in the fall of 1982. Boise Geothermal represents one of the first district heating systems to become operational from the ERDA and DOE programs to stimulate geothermal development. This paper discusses the economic aspects of the project. The pricing policy and operating cost structure are compared, along with the role of a drilling partnership from the private sector. Also described are Boise Geothermal's marketing activities to date and the obstacles that have been encountered in trying to convince building owners to convert their heating system to use geothermal water. The paper presents actual financial data and describes actual marketing experiences. Although the literature contains many feasibility studies, Boise Geothermal is the first of the new heating districts for which actual data are available.

INTRODUCTION

In October 1975, when the initial grant application was made to the Energy Research and Development Agency (ERDA), the Boise Geothermal System represented a "pie-in-the-sky" system concept; by fall 1982 it will have evolved into a fully operational district heating system which supplies geothermal energy for space heating to downtown Boise. Early feasibility studies indicated that the project made economic sense, i.e., that geothermal energy could be sold at a price that would cover operating costs but that was below the prices of alternative energy sources. All costs are now either known or can be estimated with considerable accuracy. A pricing policy has been established. Contracts are being negotiated with end-use customers. The actual financial data becoming available indicates that Boise Geothermal should achieve its goal of being financially self-supporting if the current marketing obstacles can be overcome.

SYSTEM HEATING CAPACITY

When it is completed in the fall of 1982, the Boise Geothermal System will consist of four production wells and distribution and disposal pipelines. Pump draw down tests which were completed in May, 1982 indicate a peak capacity

in May, 1982 indicate a peak capacity of about 4,000 gallons per minute (GPM) at a temperature slightly above 170 degrees F. The distribution pipeline is 9,750 feet long and varies in diameter from 14 inches at the well heads down to 8 inches at end of the pipeline in downtown Boise. The pipeline has a nominal design capacity of 4000 GPM.

with 5,833 average degree days per year in Boise, and a minimum design temperature of 0 degrees F, the system will operate with a 25 percent average load factor. The number of degree-days occurring in a local area indicates the demand that the outside weather temperature places upon a building's heating system. When the outside air temperature drops below 65 degrees F, customers turn on their heating systems. If the outside air temperature stayed at 0 degrees F for a 24 hour period, 1 day, then a heat load of 65 degrees days would result. The theoretical maximum heat load would be 23,725 degree-days which would occur if the outside air temperature remained at 0 degrees F all year. With 5,833 average degree days, Boise's average annual load factor will be 25 percent (5,833 degree-days divided by 23,725 degree-days).

The load factor means that only 25 percent of the available energy will be sold each year. Customers will be added to the system until the aggregate customer demand reaches 4000 GPM when the outside air temperature drops to 0 degrees F. Below 0 degrees F, customers must depend on their backup heating system. In a typical year, however, the outside air temperature in Boise remains at or below 0 degrees F for only several hours. Therefore, the system's peak delivery rate will rarely be reached.

The amount of heat extracted from geothermal water depends upon the temperature drop achieved by the building's heating system. All of Boise Geothermal's cost and pricing analyses assume a 50 temperature drop, or "delta T."

Boise Geothermal's heating capacity, then, depends upon three system parameters:

- 1) A peak flow rate of 4000 GPM.
- 2) An overall system load factor of 25 percent per year.
- 3) A temperature drop of 50 degrees F in

building's heating system which then extracts 417 BTUs from each gallon of geothermal water.

From these system parameters, the heating capacity of the Boise Geothermal System was calculated at 2.2 million therms per year. Pricing analyses assumed that this amount of heat would be sold each year.

PRICING POLICY

Early economic analyses indicated that Boise Geothermal should be able to deliver geothermal energy at a price which could be below alternative energy sources but which could still cover all costs. The Project Board of Control recognized that a significant price incentive would have to be present to motivate building owners to retrofit their existing heating systems for geothermal use. The Board also desired to operate the system at a profit which could be used to finance future growth. After considering preliminary cost estimates and comparing these cost estimates with the price of natural gas, the Board somewhat arbitrarily established the policy that Boise Geothermal would supply energy at least 30 percent below the price of natural gas.

In the Boise area, the Intermountain Gas Company (IGC) a privately owned utility, supplies natural gas. The average price per therm varies with: 1) the type of customer, 2) the quantity of gas consumed and 3) the season of the year, either heating or non-heating. The average prices in effect at June 1982 and expected to remain in effect until November 1982 are:

<u>Customer Type</u>	<u>Average Price Per Therm</u>
Residential	\$0.64
Commercial	\$0.56

Since a significant percent of the therms of natural gas which a customer purchases escape in the combustion process, the number of useful therms is less than the purchased therms. Therefore, the price of natural gas was adjusted for the relative efficiencies of natural gas and geothermal heating before applying the 30 percent price reduction for geothermal energy. Average heating efficiencies expressed as the percent of useful heating therms to total therms purchased were estimated at 75 percent for natural gas and 100 percent for geothermal. Adjusting the purchase prices of natural gas for these efficiencies and applying the 30 percent price reduction set as Boise Geothermal's policy results in the following maximum prices which Boise Geothermal may charge:

MAXIMUM PRICES FOR GEOTHERMAL ENERGY SET AT 70 PERCENT OF NATURAL GAS PRICES BASED ON INTERMOUNTAIN GAS COMPANY'S RATE SCHEDULES EFFECTIVE AT JUNE 1982

<u>Type of Customer</u>	<u>Price Per Therm</u>
Residential	\$.60
Commercial	\$.52

The minimum prices which Boise Geothermal might charge depend upon the costs to produce and distribute geothermal water. Boise Geothermal's costs are heavily influenced by an agreement with a drilling partnership formed to produce and sell water to Boise Geothermal.

ENTER THE PRIVATE SECTOR

When it became apparent that the Department of Energy (DOE) grants to Boise Geothermal would not be large enough to construct the desired geothermal system, participation was sought from the private sector. After almost two years of discussion and negotiations with a number of entrepreneurs and companies in the private sector, Boise formed an agreement in August 1980 with a limited partnership which agreed to drill the production wells. Boise's agreement with the partnership (subsequently referred to as the "drilling partnership") contained the following main provisions.

MAIN PROVISIONS WITH DRILLING PARTNERSHIP

- 1) Boise granted the drilling partnership a 30 year lease to the mineral rights to extract geothermal water from the property believed to encompass the geothermal resource.
- 2) The drilling partnership agreed to drill sufficient wells to produce 2000 GPM. The first well had to be drilled and tested within one year.
- 3) Boise agreed to obtain contracts for the use of 2000 GPM of geothermal water and up to 4000 GPM.
- 4) Boise agreed to purchase the water from the drilling partnership at a 46 percent discount from the price of natural gas in effect when the water was purchased. This provision tied the price of geothermal energy to natural gas prices.

The terms of this agreement were negotiated and agreed to with the specific intent of compensating the drilling partnership for incurring the risks inherent in drilling wells to search for an unproven resource.

By June 1982, the drilling partnership had drilled four wells with a combined peak production capacity of about 4,000 GPM. Since it is a private entity, the drilling partnership's investment in the project is not public information. The drilling partnership's total investment has been estimated, however, at about \$2.1 million.

BOISE GEOTHERMAL'S COST STRUCTURE

Boise Geothermal will purchase water from the drilling partnership, distribute and sell the water to end-user customers and collect and dispose of the spent water. The total costs incurred by Boise Geothermal will include four cost elements.

- 1) Purchase From Drilling Partnership - At the price of natural gas in effect at June 1982

and expected to be in effect through November 1982, Boise Geothermal will pay the drilling partnership \$.30 per therm equal to 54 percent of the natural gas price to commercial customers of \$.56 per therm.

2) Depreciation - The total investment in the distribution and collection pipelines of slightly over \$2 million will be amortized over 50 years with straight line depreciation of \$40,000 per year.

3) Boise Geothermal's expenses for billing and administration are estimated at \$35,000 per year comprised of \$25,000 labor and \$10,000 materials.

Cost items 2, 3 and 4 are considered fixed costs in that the total dollar amount of these costs will not vary with the amount of energy delivered by the system. The per therm cost of these items will depend upon the total therms delivered. The total per therm cost of geothermal energy is summarized in the table below for peak flow rates of 2000 GPM and 4000 GPM.

BOISE GEOTHERMAL'S COSTS
FOR PEAK FLOWS OF 2000 AND 4000 GPM
DOLLARS PER THERM

	2000 GPM Peak	4000 GPM Peak
To Drilling Partnership	\$.302	\$.302
Depreciation	.036	.018
Billing & Administration	.014	.007
Maintenance	.032	.016
Totals	\$.384	\$.343

As discussed above, the \$.041 per therm difference results from spreading the fixed costs of depreciation, billing, administration and maintenance over a different number of total therms delivered.

PRICE - COST RELATIONSHIP

The upper and lower bounds of the price that Boise Geothermal will charge its customers for geothermal have been established. In order to motivate building owners to connect to geothermal energy, the Project Board of Control established a policy that geothermal energy should be at least 30 percent below the price of natural gas. This sets an upper limit on Boise Geothermal's prices at \$.52 and \$.60 respectively for commercial and residential users.

Boise Geothermal also established a policy that the geothermal system should be self-supporting, i.e., revenues from the sale of energy should cover all costs. The lower limits on prices that must be charged are the costs that Boise Geothermal will incur to purchase water from the drilling partnership and distribute it to end-users. This cost was estimated above at \$.38 or \$.34 per therm depending upon the volume of water sold. The following table summarizes the

range within which Boise Geothermal will set its final price.

PRICE RANGE WITHIN WHICH
BOISE GEOTHERMAL WILL SET
FINAL PRICES TO CUSTOMERS

	Per Therm
MAXIMUM PRICE - set at 30 percent below natural gas prices.....	\$.52
MINIMUM PRICE - to cover all costs to purchase and distribute water.....	\$.34

Comparison of these maximum and minimum prices indicates that Boise Geothermal should not have much difficulty in setting prices which will cover all costs and which will still offer a significant incentive for building owners to convert to geothermal energy.

MARKETING STRATEGY

Concurrently with the technical and economic analyses, Boise Geothermal initiated a comprehensive marketing program. The purpose of this effort was to ensure that end user contracts to purchase geothermal energy would be finalized by the 1982-83 heating season when the system was ready to begin delivering hot water. This marketing program included the following activities.

1) Publicity - In order to make the general public aware of Boise's geothermal program, a large number of press releases, radio and television presentations, and speeches to various local groups were made.

2) Building Surveys - Each building in the downtown core area was carefully surveyed to determine if conversion to geothermal energy appeared practicable. The owners of about 150 buildings for which retrofit appeared feasible received a letter which asked if the owner wished to be included in the plans for a geothermal heating district. Almost all of these owners expressed an interest by signing and returning the letter. To a great extent, the pipeline route was designed to serve these buildings.

3) Letter-Of-Intent - A letter-of-intent was signed with interested building owners. Boise Geothermal guaranteed to deliver water at 170 degrees F at a price at least 30 percent below the price of natural gas. The building owner indicated his or her intent to convert to geothermal energy, if conversion turned out to be technically and economically feasible. At June 1982, 45 downtown buildings have signed letters-of-intent out of a total of 142 buildings for which conversion may be feasible. The letters-of-intent which do not constitute a legal obligation, promise that Boise Geothermal will notify building owners six months before completion of the pipeline.

4) Free Consultation - A few hours of free engineering consulting were provided to some building owners to determine if conversion was technically feasible.

5) Site Specific Study - For a few, very large buildings, a comprehensive technical and economic feasibility study was completed. In addition to a preliminary design, this study showed: (1) the investment required to convert, (2) the annual savings in the building's heating bill, and (3) the rate of return on the investment under various financing alternatives.

By June 1982, many discussions had been held with the owners of many different types of buildings. With respect to potential use of geothermal energy, buildings seem to fall into several different categories.

BUILDING CATEGORIES

Each building presents a unique combination of characteristics which influences the potential for retrofit. Four dominant categories emerged from the many discussions and analyses.

1) Conversion not technically feasible - many buildings have heating systems, such as electric baseboard heaters, which cannot be retrofitted for geothermal energy.

2) Good existing system - some buildings have heating systems which could be converted, but their owners are not interested because the existing systems operate satisfactorily.

3) Already improved efficiency - some buildings have achieved significant improvements in heating efficiency over the last several years and the additional savings possible with geothermal energy does not warrant the required investment. For example, one large office building in Boise with over 200,000 square feet of floor space has achieved a 50 percent reduction in the number of therms of natural gas used per degree day between 1978 and 1981. Also, many of the public schools in Boise have achieved dramatic improvements in heating efficiency by making a large number of minor operating improvements. It is difficult to convince a building owner to invest \$100,000 to save 30 percent on his or her heating bill after the same owner has just reduced the heating bill by 50 percent with practically no investment.

4) Conversion or replacement mandatory - some older buildings with inefficient heating systems have experienced such large increases in their heating bills over the past several years that the owners feel compelled to convert to geothermal energy or completely replace the existing system. Conversion to geothermal energy also appears desirable for many of the commercial and residential buildings which are being renovated near Boise's downtown core area.

Having several of the large, downtown commercial buildings convert to geothermal was a high priority for Boise Geothermal. The large buildings would be very cost-effective customers because they would use a relatively high volume of water compared to the required investment to

bring the pipeline to the building. In addition, high public visibility would result from having a large, prominent building convert. Discussions with owners of large buildings, however, revealed several obstacles to conversion to geothermal.

MARKETING OBSTACLES

The most serious marketing obstacle which must be overcome appears to be the perceived risk in converting to geothermal energy. Building owners believe that electricity and natural gas will be available into the foreseeable future. The building owners are not certain that geothermal energy will be available forever. How long will the wells continue to produce? How do we know that the temperature won't drop over the years? Who will pay for and drill new wells if the existing wells fail? What about the bad odor from the hot water? Won't the water corrode our heating system? Will the city have enough money to keep the pipeline repaired? These are the types of questions asked by building owners. Some of the perceived risks appear mostly emotional and cannot be effectively addressed with purely rational answers. An important technical risk is whether a geothermal heating system in a large building will achieve the predicted operating efficiency. If the heating system extracts only 40 degrees F from the geothermal water rather than the assumed 50 degrees F, then 20 percent of the purchased therms will remain in the discharge water. No actual experience with geothermal conversions in large buildings appears available to prove that the projected efficiencies will occur.

Financial risk is also an important obstacle to conversion to geothermal energy by the large buildings. With the current high interest rates, achieving a satisfactory Internal Rate of Return (IRR) and a fast enough payback becomes difficult. For example, an IRR of about 18 percent and a payback period of five years were predicted for one large building. These were after the Geothermal Investment Tax Credit and the Economic Recovery Tax Act of 1981 provisions for accelerated depreciation. Compared to other investment alternatives, such financial performance is hardly spectacular and the building owners ask questions like, "what if your operating costs are higher or what guarantee do I have that the price won't increase faster than expected?" These marketing obstacles pertain mostly to large, commercial buildings. A number of residences in the Warm Springs Water District have converted to geothermal energy in the last few years. Most of the owners of these residences have experienced favorable results and they are quite enthusiastic about use of geothermal energy.

SUMMARY

At June 1982, Boise Geothermal is about to begin construction of a pipeline to distribute geothermal water to downtown Boise. Pricing and cost analysis indicate that geothermal water can be sold to customers for considerably less than natural gas. For a number of reasons, however, many building owners are reluctant to convert their existing space heating systems to use geothermal energy.