Geothermal Resources Council, TRANSACTIONS, Vol. 3 September 1979

GL02620

GEOTHERMAL ALTERNATIVES FOR THE IDAHO CAPITAL MALL

William B. Eastlake

Idaho Office of Energy
Boise, Idaho 83720

ABSTRACT

Working as staff for the State Geothermal Task Force, the Idaho Office of Energy has prepared a preliminary analysis of the economic feasibility of retrofitting and heating seven state buildings in the Capital Mall. The two basic choices for the state are: (1) to buy geothermal water, or (2) to construct its own geothermal system. The analysis that follows indicates that each of the six alternatives considered is preferable to continued use of natural gas and concludes that, on the basis of available data, the best of these alternatives is for the state to buy water at the proposed Boise Geothermal public rate.

INTRODUCTION

Although Boise has had some geothermal space heating since 1890, recent exploration and resource assessment by Boise City, the State of Idaho, and Warm Springs Water District have progressed to the point where geothermal space heat could be on line as early as September of 1980.

In February, 1979, Governor John Evans created a State Geothermal Task Force to analyze the future role of geothermal energy in the Capital Mall area and to advise as to appropriate actions to be taken. The Idaho Office of Energy provides technical staff and acts in an advisory capacity on the economic feasibility of using geothermal water in the Capital Mall area.

METHOD

In applying geothermal resources to space heating, two alternatives appear. Either the State of Idaho could buy water or it could establish its own system. Within each alternative several sub-alternatives appear. The state could buy water from Warm Springs Water District or from the City of Boise. In establishing its own system the state could drill for and/or dispose of the spent water in several ways. The analysis that follows explores the costs associated with each sub-alternative and then compares each with the cost of the present natural gas heating system.

The Capital Mall area under consideration is comprised of seven buildings ranging from the old Capitol to the Twin Towers, still under construction. The basic data on heat rating and geothermal water requirements are based on a minimum design temperature of -10°F. Retrofit of these buildings has been studied extensively. The Capitol itself is already fitted with insulated pipe and ready for geothermal water when it becomes available.

The geothermal water requirement in Table I is a peak requirement. Adjusted for the average number of degree days in Boise, the average water requirement is 346 GPM (.77 CFS).

TABLE I
Capitol Mall Area

Building	Estimated Conversion Cost	Heat Rating at Minimum Design Temperature (10^6BTU/hr)	Geothermal Water Required at Max. Heating Capacity (GPM)	Average Natural Gas Cost Per Season
1. Idaho State Capitol	$ 16,990	2.25	227	$ 18,285
2. State Veteran's Home	35,703	4.34	438	34,026
3. LBJ Office Bldg.	33,118	6.37	255	49,131
4. Idaho Supreme Court	28,563	3.72	149	29,097
5. Idaho State Library	19,329	5.10	170	39,750
6. "Hall of Mirrors" Office Bldg.	19,452	1.80	120	14,949
7. Twin Towers Office Bldg.	43,303	5.24	250	26,665
TOTALS	$196,458	28.82	1609	$211,900

Notes:

Data on buildings 1 through 6 from Table I, p. viii,"Feasibility/Conceptual Design Study for Boise Geothermal Space Heating Demonstration Project Building Modification", Donovan & Richardson, September, 1975.

Data on building 7 from State Department of Administration and Lombard, Conrad, Architects.

Conversion cost estimates have been expanded by the implicit price deflator to reflect 1979 price levels.

Fuel costs have been expanded to reflect 1979 commercial gas rates.

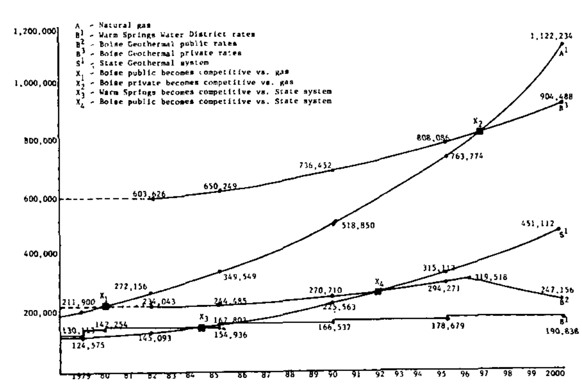
The average natural gas cost was estimated for each building based on average heat load factor and average number of degree days for Boise. The total natural gas cost for seven buildings at 1979 commercial gas rates was then projected over time at rates given in the Dames and Moore report. This projection, line A in Figure 1, is the benchmark against which geothermal savings are measured and rises at slightly over 8% yearly.

ANALYSIS OF GEOTHERMAL WATER PURCHASE
(See FIGURE 1)

The simplest alternative for geothermal use in the Capital Mall area is for the state to retrofit existing buildings and purchase geothermal water from another party. Geothermal cost is made up of two parts: retrofit cost and cost of water purchased. The retrofit cost of $196,458 (see TABLE I) is amortized over 30 years at 10%, which gives a yearly amortization cost of $20,841. This is added to the cost of water purchase to give a total cost for each alternative.

FIGURE I

Yearly Heating Cost
Natural Gas vs. Geothermal Water Purchase



Three possible rates were used for water purchase. The cheapest alternative would be for the state to purchase water at the rate obtaining in the contract with Warm Springs Water District for use in the Agricultural and Health Laboratory demonstration project. This contract specifies 45¢ per 100 ft.^{3} until 1980, 50¢ to 1984 and 55¢ starting in 1985. This same pattern of increase was extrapolated to 2000, giving line B^1.

The Boise Geothermal Energy Systems Plan suggests rates needed to cover costs of their system based on its projected usage. One rate is suggested for a publicly-owned system, high enough to cover operating cost, depreciation, and debt service. The other rate is for a privately-owned system, which must also cover taxes and a profit (10% return on capital). The public rate starts at 87.8¢ per 100 ft.^{3}, rising to a peak of $1.23 in 1996, and falling after debt service is paid off to 93.2¢ in 2000. This water purchase alternative appears as line B^2. The private rate starts at $2.40 per 100 ft.^{3} and ascends continuously to $3.63 in 2000. This private rate results in the cost shown as line B^3.

From FIGURE I, it is obvious that purchase at the Warm Springs rate is already competitive with use of natural gas. However, that rate was negotiated several years ago in a different economic climate and is probably unrealistically low. Point X_1 indicates the option of water purchase at Boise public rates will be competitive with gas as soon as that water is actually available for use. Point X_2 indicates that it will be a long while before purchase at Boise private rates will be competitive with present natural gas heating.

ANALYSIS OF STATE GEOTHERMAL SYSTEM
(See FIGURE 1)

If the State of Idaho cannot or does not wish to purchase geothermal water from other sources, the obvious alternative is to establish a state geothermal system. The cost of the system will be made up of individual cost components for drilling, pumping, and constructing a distribution system for production and in some cases for injection, plus the cost for retrofit of the seven Capital Mall buildings under consideration.

Three alternatives were considered. The differences between them were based on disposal of used water. The first two alternatives differ only in the distance from the production well at which injection is accomplished. The third alternative involves payment of a disposal fee.

The production and distribution set-up is identical for all three alternatives. A 1500-foot production well, fully cased and tapering from 18" to 8", is to be drilled on state property near the Veterans Administration Hospital. The well will be equipped with a 275 hp. pump and hooked up to 3000 feet of 10" pipe which will carry geothermal water (about 170°F.) to the central heating plant in the Capital Mall. The total cost of these systems is $267,482. Table II presents a comprehensive cost breakdown for all three alternatives.

TABLE II

Costs of State Geothermal System

		Capital Well Injection (S^1)		Hull's Gulch Injection (S^2)		Disposal Fee (S^1)
PRODUCTION:		$141,540		$141,540		$141,540
Drill and case well	$104,540					
Pump and fixtures	37,000					
DISTRIBUTION:		125,942		125,942		125,942
Pipe	90,000					
Power cost	35,942					
DISPOSAL:		106,950		313,470		92,395
Drill and case well	34,008		$ 60,528			
Pump and fixtures	37,000		37,000			
Power cost	35,942		35,942			
Return pipe	minimal		180,000			
Disposal fee					$ 92,395	
Total cost		$374,432		$580,952		$359,877
- Variable		-71,884		-71,884		-128,337
Capital cost		302,548		509,068		231,540
Amortized over 30 yrs. at 10%		31,850		53,591		24,375

Costs assembled from a variety of sources, including Boise Geothermal Energy Systems Plan, Geothermal Energy for Agri-Business, in consultation with CH2M Hill.

The first alternative consists in drilling a shallow (600 ft.) injection well, either right next to the central heating plant or just across the street. This will require a minimal amount of pipe to get the spent fluids to the disposal well. Lacking more specific well test data it was assumed that injection would require the same pump and power as the production well.

The second alternative is to pipe the spent fluid to the Hull's Gulch area and drill a 1,000 foot injection well there. This will require 6,000 ft. of 10" pipe to carry spent water to Hull's Gulch. Again, pump and power costs are assumed to be the same as for the production well.

The last alternative is to have the State pay a disposal fee rather than constructing its own disposal system. Disposal of State water in the

Boise City-Warm Springs Water District lines would be feasible since one of their disposal lines is planned to go right past the central heat plant but at this time we can hazard no guess on what sort of fee they might charge for disposal. As a high-side estimate of what a disposal fee might be we have used the minimum city sewer charge of 38¢ per 100 ft.[3], which gives a total cost of $92,395 for disposal of state geothermal water.

Various state geothermal system alternatives (S^1, S^2, S^3) are derived by adding pump power costs (escalating at rates given by Dames and Moore) to amortized capital costs for each system. All three alternatives for a state geothermal system are, and will continue to be, competitive with use of natural gas for heating. The best alternative is disposal at the Capital Mall, shown as S^1 in FIGURE 1.

CONCLUSIONS

Data on all alternatives available to the State are cumulated and converted to dollars per therm in Table III. In Table III all three alternatives for a state geothermal system are projected to be competitive (lower-priced) with natural gas beginning as soon as wells can be drilled and the new system put on line. As for water purchase, the Warm Springs rate seems unbelievably low. The Boise private rate results in higher prices per therm than natural gas until sometime in the late 1990s. Water purchase at the Boise public rate results in lower heating cost than natural gas by 1982.

TABLE III

COMPARISON OF FUEL ALTERNATIVES FOR CAPITAL MALL, in $/therm

Reference to Figs. 1 and 2	1979	1982	1985	1990	1995	2000	
A - Gas	$.274	$.352	$.452	$.671	$.988	$1.451	
B^1 - WSWD	.172	.188	.204	.220	.236	.252	
B^2 - B. Pub.	.309	.309	.323	.357	.409	.326	
B^3 - B. Pvt.	.797	.797	.858	.972	1.067	1.194	
S^1 - Dispose Capital	.164	.192	.221	.298	.416	.596	
S^2 - Dispose Hull's Gulch	.193	.220	.250	.327	.445	.624	
S^3 - Pay Fee	.227	.244	.259	.298	.358	.449	Disposal fee fixed
	Hypothetical prices since systems are not on line	.263	.300	.384	.502	.666	Disposal fee rises 5%

A - 1979 commercial gas rate increased by Dames and Moore projections (8.7% - 1986) (8.1% 1987-1992) (8.0% 1993-2000)

B's - Dollars for geothermal water purchased plus amortized conversion cost divided by 757,621 therms (24,282,720 ft.[3]) average usage for system

S's - Electric power purchased plus amortized capital cost of system (pump, distribution and injection) divided by average usage

The two best alternatives are a state geothermal system with injection near the Capitol (S^1) and purchase of geothermal water at the Boise public rate (B^2). Alternative S^2 was excluded from this final choice because its savings were identical to S^1 while its initial capital investment was much higher due to injection at considerable distance from the Capitol.

Savings were calculated from the two final alternatives and discounted at a 20% rate to generate the present value of those savings flows. In each case, yearly savings represent the difference between yearly operating costs for the present gas system and yearly operating costs for the geothermal alternative. In the case of alternative B^2, the operating cost is the cost of water purchased at Boise public rates. In the case of alternative S^1, operating cost is the cost of electric power required for pumps to lift and later inject the geothermal water from state wells.

Maintenance costs have been omitted from specific inclusion since we feel there will be little marginal change in the expense of maintaining a geothermal system as opposed to the existing state gas-fired system.

Yearly present values were combined to give a net present value figure. While the net present value of the savings stream from alternative B^2 ($890,475) is less than that for alternative S^1 ($1,086,492), when we take into account the total capital investment required, we find that savings streams from B^2 will pay back the original investment in only 3.55 years versus 5.22 years for alternative S^1.

Finally, we calculated an internal rate of return, which is a rate of interest which would make the value of the discounted yearly savings just equal to the original capital investment. Higher internal rates of return indicate higher yield investment opportunities. This internal rate of return was considerably higher for B^2 (53%) than for S^1 (37%). To explore quickly the sensitivity of our analysis to higher or lower savings than projected, we cut the projected gas costs by 10% while raising the cost of the two geothermal alternatives by 10%. This considerably worsens the yearly savings from each alternative, yet it leaves the ranking unchanged, 36% for B^2 and 31% for S^1.

To summarize neatly the reasons for our choice of water purchase at Boise public rates, alternative B^2, as the best alternative for utilizing geothermal heat in the Capital Mall: this water purchase option generates a significant amount of yearly cash savings from a rather small initial investment in retrofit of seven state buildings; the payback period, even in terms of present value savings flows, is short; and the internal rate of return is very high.

The State of Idaho would use its funds wisely in pursuing the transition to geothermal heat in the Capital Mall by purchasing water.

REFERENCES

Agribusiness Geothermal Energy Utilization Potential of Klamath and Western Snake River Basins, Oregon.

"Drilling for Geothermal Resources. Rules & Regs.". Idaho Dept. of Water Resources, June, 1978.

"Feasibility/Conceptual Design Study for Boise Geothermal Space Heating Demonstration Project Building Modifications." L.E. Donovan & A.S. Richardson, Aerojet Nuclear, September, 1975.

"Feasibility Review for Geothermal Conversion of Existing H & V Systems on the Boise Geothermal Space Heating Project." L.D. Torgerson, A.S. Richardson, Aerojet Nuclear Co., September, 1975.

Geothermal Energy. H. Christopher, H. Armstead, E. & F.N. Spon Ltd., London, 1978.

"Geothermal Energy Systems Plan for Boise City". Energy Office, Boise City, January, 1979.

"Geothermal Space Heating Project Involving Idaho State Owned Buildings in Boise, Idaho." Aerojet Nuclear Co., March 10, 1975.

"Natural Gas Supply Requirements for the State of Idaho". Dames & Moore, San Francisco, November, 1977.

"Preliminary Plan for Boise Geothermal Energy System". City of Boise Energy Task Force, April, 1977.

"Report to the Idaho Governor - Project Summary for the Boise Space Heating Project". R.C. Schmitt, L.E. Donovan, S.G. Spencer, J.G. Kelly, R.C. Stoker, April, 1976.

"Well Construction Standards Rules & Regs., Idaho Dept. of Water Resources", June, 1978.