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A Detailed Review of Retail Pricing Strategies, Marketing Efforts and Performance of the Boise City District Heating System 1983-1985

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ABSTRACT
The Boise City District Heating system serving the downtown area of Boise, Idaho became operational in 1983. The project has the capability of delivering 4,000 gallons per minute under peak load conditions, or an equivalent of 2.2 million therms in a heating season. Retail prices are discounted from natural gas rates and financing of the project was through a combination of public and private funds. System growth has been steady since the project became operational.

HISTORY OF PROJECT
Geothermal space heating has been in existence since the 1890's in Boise, Idaho. The natural resource was first evidenced by hot springs on the north side of the city near the base of the foothills. Two wells were drilled in 1890 to a depth of 400 feet and this venture eventually became the Boise Warm Springs Hot Water District. In the 1930's hot water was provided to approximately 400 residences, small commercial businesses, and the world famous Natatorium (a swimming and health facility). The use of the geothermal heat from this system began to decline in the late 1930's when low cost natural gas and electricity became readily available. In 1974 the State of Idaho initiated a study for heating ten State office buildings in downtown Boise. Shortly after that, the City of Boise in cooperation with the United States Department of Energy, the Economic Development Administration and a private partnership, Boise Geothermal Limited (BGL). BGL was formed in order to augment available public agency funds in the development of the project. BGL secured funds for well drilling, testing, and completing three production wells.

SUMMARY OF RESOURCE & PROJECT DETAILS
a. Resource temperature - 170°F.
b. Quality of water - meets drinking water standards with exception of fluoride at 17 ppm, generally aggressive towards brasses and bronzes.
c. Total Dissolved Solids - 290 ppm.
d. Well depths 880' - 2,010' with three equipped wells.
e. Pumping details:
   Well #2, 125 hp, 1,500 gpm
   Well #3, 200 hp, 2,000 gpm
   Well #4, 50 hp, 750 gpm
   In Line Booster Pump, 25 hp, 450 gpm
   (used during summer low flow periods)
f. System design - closed loop, no direct use.
g. Piping - insulated supply, 18,000 feet (6"-14")
   Uninsulated collection, 23,000 feet, (6"-12")
h. Disposal - to Boise River. To be supplemented with injection wells in future.
i. Piping and pumping system designed to deliver 4,000 gpm.
j. System operations - pumping facilities - Boise City Public Works through contract with BGL.
k. System pressure - remote control sensors maintain 70 psi at delivery system midpoint.
TABLE 1

<table>
<thead>
<tr>
<th>Temp Drop thru System</th>
<th>Therms per Gallon</th>
<th>Gallons Req'd to Deliver 750 Therms</th>
<th>Monthly Bill $,22792/100 Gallons</th>
<th>Monthly Savings Geothermal vs. Natural Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>35°F</td>
<td>.00285</td>
<td>750</td>
<td>263,158</td>
<td>$600</td>
</tr>
<tr>
<td>50°F</td>
<td>.00407</td>
<td>750</td>
<td>184,275</td>
<td>$180</td>
</tr>
<tr>
<td>65°F</td>
<td>.00529</td>
<td>750</td>
<td>141,171</td>
<td></td>
</tr>
</tbody>
</table>

Heating system efficiency - 75%
Gas bill: 1000 therms x $.60 = $600/month

The owner contemplates converting to geothermal. Three options are evaluated with respect to geothermal retrofit. They are based upon a temperature drop of:

a. 35°F
b. 50°F
c. 65°F

What will monthly geothermal bill be after conversion, given the above assumptions?

Geothermal rate = $.56/therm
Geothermal heating requirements: (1000 therms of natural gas)(.75) = 750 geothermal therms. (See Table 1, above)

The conclusion to be drawn from this analysis is:
The greater the temperature drop from a gallon of geothermal water, the greater the savings.

If an existing heating system is less than 75% efficient, the percent and dollar savings will increase proportionately as shown in the following example.

Natural gas consumption = 1000 therms
Monthly bill = $600
Efficiency = 60%

Geothermal required heat
1000 x .6 = 600 therms
Temperature Drop = 50°F
Gallons required = 147,420
.00407

Monthly bill: 147,420 x $,22792 = $336
Monthly savings $600 - $336 = $264

Engineers analyzing a building for potential conversion need to clearly understand the pricing issues and the efficiencies of existing building heating systems in order to fairly evaluate the potential for retrofit to geothermal. Buildings where domestic water use

PRICING STRATEGIES

In 1980 the City and BGL negotiated a contract for water to be wholesaled at the wells to the City. Water would be metered by volume and the City would ultimately be charged for therms delivered by the partnership, assuming a water temperature drop of 50°F. This provision was renegotiated in 1983 to provide that 90% of retail revenue goes to BGL. In return, BGL agreed to pump the necessary water to keep the pipelines hot during non-peak periods in order to satisfy customer needs. The City sells the water to end-use customers through volumetric measurements. Retail rates are set in accordance with the following basic assumptions:

a. Geothermal price discount: thirty percent (30%) below the Intermountain Gas Company natural gas schedule GS-1 (general service.)
b. Efficiencies:
   Natural gas - 75%
   Geothermal - 100%
c. Temperature utilization: building customer needs to drop water temperature 50°F in order to save 30% of natural gas bill.

Example:

a. Natural gas retail price $.60/therm.
b. Existing furnace/boiler 75% efficient.
c. Geothermal 100% efficient.

What is effective geothermal rate per therm?

Geothermal rate = $.60/therm x (1-0.3)
               = $.42/therm
               = $.56/therm

This would be the published rate converted to $/100 gallons of geothermal water. One hundred gallons of geothermal water @ 50°F drop contains .407 therms, therefore rate per 100 gallons, $.56 x .407 = $.22792/100 gallons.

Customers’ costs per month are determined by the volume of water utilized.

Example:

Assume a commercial building utilized and paid for 1000 natural gas therms in a month.
Natural gas price - $.60/therm

The owner contemplates converting to geothermal. Three options are evaluated with respect to geothermal retrofit. They are based upon a temperature drop of:

a. 35°F
b. 50°F
c. 65°F

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Temperature Drop = 50°F
Gallons required

Monthly bill:
147,420 x $.22792 = $336
Monthly savings $600 - $336 = $264

Engineers analyzing a building for potential conversion need to clearly understand the pricing issues and the efficiencies of existing building heating systems in order to fairly evaluate the potential for retrofit to geothermal. Buildings where domestic water use
is high are excellent candidates for geothermal conversion. Initially heat is extracted for space heating and then waste water is used for preheating of domestic water.

Many older hot water systems have been designed to only take a 20-30°F temperature drop. Since Boise's retail price structure requires a customer to take 50°F temperature out of the water in order to save 30%, some retrofits may not be financially attractive if building owners can only achieve a 30°F drop. The break-even point with natural gas in terms of geothermal temperature drop is 35°F. However, Boise has no limitation on the temperature drop that a customer may take out. In order to encourage extensive utilization of the resource, Boise encourages customers to take as much temperature out as possible. If a customer is able to take 70°F temperature drop out of the system, then savings will exceed 50% of the cost of natural gas.

The geothermal system is operated by Boise City as an enterprise fund. Ordinance provisions provide that maintenance expenses, capital expansion and replacement of facilities be provided from user funds. A connection fee was established to recapture local tax dollars originally dedicated to the project. The connection fee is set at $40 per gallon of peak demand, or $60 per 1,000 square feet of building space.

MARKETING EFFORTS

The general marketing strategy utilized to secure retail customers follows:

a. An initial survey of buildings was done to determine heat loads and location of appropriate service areas.

b. A letter was transmitted to all potential building owners indicating to them that they had an opportunity to be included in system planning.

c. After evaluation of preliminary data a second letter was sent to all building owners indicating to them that plans had been completed and that connection agreements were being requested.

d. Upon completion of the distribution system, application forms were transmitted along with various sales material to obtain specific commitments for connection to the system.

e. Contracts for service were prepared and transmitted for those buildings located reasonably close to the service line but of sufficiently great distance away to merit the expenditure of separate funds.

f. Supplemental grant funds were obtained for retrofit to augment the existing project funds. The Boise project did not include any funding to retrofit buildings.

Approximately 60 signed connection agreements (item e) were returned during the early phases of the project, and these signed connection agreements were then used to establish a layout for the overall pipeline system within the constraints of the budget monies available. Initially, a fairly high commitment of public and institutional buildings were secured. Thus, many of those buildings began retrofitting in anticipation of an operational date for the Boise City pipeline system. No budget amount was allocated in the Boise project for detailed building retrofit analyses. As the project progressed, it became more and more apparent that a greater commitment of resources was required for marketing.

There were several factors affecting the lack of committed connections from building owners in the early stages of the project, such as exact retail price, unknown retrofit costs for accurate financial analyses, and a period of stable - even declining - energy prices.

Eventually, the City, through the use of consulting engineers, offered to do a brief engineering analysis for any of the building owners who appeared to be interested in utilizing geothermal and who had not yet committed. These analyses and letter reports varied from two (2) to 30 (thirty) hours of engineering time, depending on the size of the facility and the complexity and/or the likelihood of that building eventually being converted to geothermal. These reports were very helpful in detailing the existing heating systems and the potential for retrofit. Unfortunately the engineering estimates for retrofitting were overstated at times because no good historical costs were available. This overstatement of costs increased the simple payback periods and discouraged some building owners from pursuing the conversion. As the project engineers and vendors gained more experience in retrofitting, more detailed studies were made and more time was spent in obtaining accurate cost estimates for building owners.

After an engineering study was done for a particular building, a summary of the data was extracted from the reports in the following format (see Table 2, next page).

This matrix format was used to establish priorities for marketing purposes. Staff and marketing efforts are applied to those buildings where the annual geothermal revenue potential is the greatest and the offsite costs the least. Major potential users are a local hospital, university, and large office complexes.

One must be prepared to be flexible in pricing of the retail water in that the larger commercial and institutional users such as the
hospital are on a large-volume natural gas rate which is substantially less than the general service rate to which the Boise rates have been tied. In order to induce certain large customers to use geothermal heat, price concessions over a fixed period of time may be necessary. Negotiations are taking the form of guaranteeing a certain payback to the customer and subsequent to having achieved the payback, then the customer will be guaranteed by contract a 30% discount from the prevailing price of natural gas which the geothermal has displaced.

SYSTEM PERFORMANCE

The Boise City system became totally operational in October 1983 with six (6) retail customers. Twenty-one buildings were connected by March, 1985. These buildings represent 830,000 square feet. Connected square footage is represented in Figure 1. The 21 buildings are comprised of offices, a library, a hospital, several public buildings, a veteran's home, and a commercial laundry. The current customer mix is nine public buildings and 12 private buildings. The system has the capacity to service four to five times the connected square footage. The system is also operated during the summer. Year-round users include a laundry, a hospital, a veteran's home and a recreational facility.

Retail billings are summarized below:

<table>
<thead>
<tr>
<th>Date</th>
<th>Billings</th>
<th>Equivalent (50^\circ F) drop</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1/83-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/30/84(Actual)</td>
<td>$102,821</td>
<td>195,990</td>
</tr>
<tr>
<td>10/1/84-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/30/85(Projected)</td>
<td>$143,000</td>
<td>282,000</td>
</tr>
<tr>
<td>10/1/85-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/30/86(Projected)</td>
<td>$150,000-</td>
<td>296,000-$250,000</td>
</tr>
</tbody>
</table>

OTHER USES

Much of the sewer system in Boise constructed prior to 1930 has seen massive tree root intrusion due to deterioration of the pipeline joints. Through experimentation we have found that complete submergence of the root mass with 160\(^\circ F\) geothermal water for a period of 45 minutes to one hour will kill the living tissue. In one to two months the roots will become soft at which time they can be easily removed with hydraulic cleaning equipment. This treatment does not have any apparent effect on the trees and is effective for three to five years. Several hundred-thousand feet of sewer pipe have been treated in this fashion.

During the winter of 1983-84 extremely cold weather coupled with snow blocked the street inlets. Underground drainage culverts became frozen. Our local highway district used geothermal water for about a month to clear inlets and drains. Water was loaded into conventional flusher trucks and as drivers approached frozen or blocked inlets the hot water was used to melt the snow and ice. This was extremely effective in solving a potentially serious flooding problem. Geothermal water was also used to melt ice at stream undercrossings. Water is loaded into trucks from a conventional fire hydrant which was installed on the geothermal pipeline.

CONCLUSION

The Boise project is clearly a technical success having completed two (2) heating seasons. Buildings formerly heated with oil, natural gas and electricity have been converted to geothermal. This renewable resource has a tremendous future in the City of Boise.
ACKNOWLEDGEMENTS

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Boise Geothermal Limited