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GEOTHERMAL DIRECT USE PRICING SURVEY

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OREGON DEPARTMENT OF ENERGY
SALEM, OREGON

Abstract

An updated survey of pricing terms in direct use projects in the western United States is presented. The survey was undertaken to determine the character of pricing strategies which are currently in place or proposed for direct-use projects. A majority of projects are shown to base their geothermal price on a discounted natural gas rate. The average discounted rate for non-profit projects is calculated to be 60% of current gas rates; for profit projects the average is 70% of gas rates. The average delivered geothermal price for all projects basing rates on gas and oil was $4.64 per million British thermal units (MBtu) as of March 1985.

Introduction

Within the states of California, Colorado, Idaho, Nevada, and Oregon, many geothermal direct-use projects involve contractual agreements between the resource supplier and user. Such projects were surveyed for the heat prices and terms which are currently in place or proposed. Unlike previous surveys, proposed projects are not included in this year's survey. One of the projects is under construction and will depend on wellhead generation for its supply source. And one of the projects is constructed but not operating; hence it is listed as "operative." A majority of the projects (14) are operating; 1 is operative; and 1 is under construction.

Factors which are examined in the projects include resource and load data, developer type, funding sources, contractual terms, and delivered prices (generally exclusive of system efficiency). In addition, as this survey is updated, trends are now beginning to emerge, and are discussed. The survey is summarized in Table 1, detailed by state and project in Table 2, and characterized in Table 3.

Table 1

<table>
<thead>
<tr>
<th>Project Status</th>
<th>No of Projects</th>
<th>% of Survey Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating</td>
<td>14</td>
<td>88</td>
</tr>
<tr>
<td>Operative</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Construction</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Wellhead Developer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal/Non-profit</td>
</tr>
<tr>
<td>Private/Profit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Government Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects with partial federal or state funding</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Basis of Geothermal Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on percentage of oil cost</td>
</tr>
<tr>
<td>Based on percentage of gas cost</td>
</tr>
<tr>
<td>Based otherwise, e.g., costs or flat rate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource/Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource temperatures range from 87°F to 230°F, with most projects using resources in the 160°F range. Loads frequently consist of public agency and private office buildings. However, loads now also include a gas station, jail, laundry, prison, shopping mall, schools, greenhouses, motels, casinos, a sewage treatment plant, and more than 300 homes.</td>
</tr>
</tbody>
</table>
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Developer/Funding

Risk distribution is ascertained by examining the number of projects involving private resource developers. In the previous survey 52 percent of all projects had private wellhead developers. In the 1985 survey, 62 percent of the projects involved private resource developers.

Boise Geothermal is an example of a hybrid private developer-municipal distributor project, a structure equitably allocating risk and function.

Not coincidentally, almost all of the municipal developer projects had partial federal or state funding, frequently from the US Department of Energy.

Heat Measurement

The geothermal heat to be priced is measured in some manner, e.g., Btus or gallons per minute at a constant temperature. In nearly all projects, resource are not actually consumed; only heat is extracted. The majority (64%) of projects use standard flow meters to measure a constant temperature flow of the resource as it enters the point of use and as it departs. The reason generally given is cost, both to the individual and to the system. Capital costs are higher for Btu meters. Also, more pumping is apparently required to meet pressure drops of the sophisticated Btu meters. Thus, systems are being designed based on minimum assumed temperature drops, e.g., 30-40°F in Elko, and measuring only flow. Users are encouraged to achieve large temperature drops in their systems with flow meters.

A minority of projects, typically older operations, charge either a flat rate or include the price of the heat in a larger sum, e.g., a building rental or land lease payment. The flat rate being charged in Klamath Falls’ downtown system is temporary until operating costs are determined.

System Efficiency

In measuring the heat to be sold, system efficiencies are generally considered in the price; thus prices shown in Table 2 are for usable heat. To clarify, fossil-fuel systems usually have a maximum efficiency of 80% in converting delivered heat into usable heat. In contrast, direct-use geothermal systems measure heat used across the customer’s system, so efficiency is generally not a factor. Therefore, a new geothermal customer will likely use only 80 MBtu of geothermal heat for every 100 MBtu of fossil fuel which was historically consumed. The result of neglecting to consider this difference in efficiency in computing heat prices is a revenue stream significantly lower than anticipated.

Geothermal system efficiency is an excellent marketing tool in negotiating contracts with potential users. The average price for geothermal energy is only 20% less than gas or oil. But the average savings are approximately 40% of the competing fuels.

Referring to the Boise geothermal example, the city encourages users to draw over 50°F delta T although it assumes for billing purposes that only 50°F is being consumed. Thus, users are rewarded for increasing system efficiency. In fact, some heat pumps using geothermal water in Boise appear to be drawing temperature drops of greater than 80°F.

Alternate Fuels

As in other areas of economics, the prices of alternatives directly influence the price of the commodity in question. In this case, the "alternatives" are fossil fuels such as oil and natural gas. (As opposed to geothermal being the alternative energy source.) The majority of projects offer a discount sufficient enough to make conversion to geothermal energy financially attractive. The majority of pricing formulas are either tied to a percentage of natural gas costs, or marketed using them as a reference. Natural gas is selected in many projects because it is generally the least cost alternative fuel in an area. Also, it is similar to geothermal production and distribution practices.

Discount Rates

Discount rates range from 15 to 100 percent of current alternate fuel prices. Those projects offering free heat do so for a set period of time prior to converting to a 15-35 percent discount basis. One system, Elko, has a two-tier price structure whereby a customer may purchase heat from the system return line at a substantially reduced price. Some projects offer a flat fee (per MBtu) at frozen fossil fuel rates. Others start with a base price equivalent to some percentage of current fossil fuel rates, but with an annual escalation factor not connected to fossil-fuel prices. Still others offer the geothermal heat at a floating rate with a maximum price ceiling or limit.

It should be noted that some risk exists in indexing geothermal heat to alternate fossil fuels. Should these fuels drop in price, as oil and gas both have recently, revenue problems may develop for geothermal producers. In Boise, frequent gas price
### Table 2.  
**PROJECT DETAILS BY STATE**

<table>
<thead>
<tr>
<th>Project (Status)</th>
<th>Resource</th>
<th>End-Use Load</th>
<th>Contract Terms</th>
<th>Price/MBtu$^1$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CALIFORNIA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*SUSANVILLE MAIN</td>
<td>160-170°F, 600 gpm</td>
<td>7 high school bldgs., plus veterans bldg. &amp; jail. 21 x (10^9) Btu/yr; 50% load factor. 17 total bldgs. planned &amp; permitted for discharge. New pricing ordinance suggests base price of 66¢/therm. Old formula @ 67% of oil price, included 20% efficiency savings. Escalation maximum of 5%/yr.</td>
<td>6.60</td>
<td></td>
</tr>
<tr>
<td>Division or Uptown (Operating)</td>
<td>2 wells, 900 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*SUSANVILLE SOUTH</td>
<td>150°F, 300 gpm</td>
<td>23 homes &amp; greenhouse park.</td>
<td>Same as above</td>
<td>6.60</td>
</tr>
<tr>
<td>Division (Operating)</td>
<td>1 well, 500 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*LITCHFIELD PROJECT</td>
<td>180°F, 2500 gpm</td>
<td>State prison &amp; greenhouse industrial complex. 60 x (10^9) Btu/yr.</td>
<td>Curve starting @ 67% then drops to 50% of oil after equipment is amortized.</td>
<td>6.60</td>
</tr>
<tr>
<td>(Operating)</td>
<td>2 wells, 1500 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*HONEY LAKE HYDROPONICS</td>
<td>174-205°F, 6 wells</td>
<td>30 greenhouses</td>
<td>Resource developed by single user landowner receives royalty of flat rate per greenhouse</td>
<td>NA</td>
</tr>
<tr>
<td>(Operating)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*SAN BERNADINO</td>
<td>130-138°F, 2500-3500 gpm</td>
<td>7 buildings now, 38 public bldgs &amp; 24 private bldgs eventually</td>
<td>Price = 75% of gas, but 50% savings including efficiency. For 10 years, then increased.</td>
<td>5.40</td>
</tr>
<tr>
<td>(Operating)</td>
<td>1 well, 975 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*BRIDGEPORT</td>
<td>158-230°F, 1 well</td>
<td>15-18 public bldgs planned</td>
<td>Will start from 1986 fuel price level, but tied to power generation costs.</td>
<td></td>
</tr>
<tr>
<td>(construction)</td>
<td>unknown large flow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*ALAMOSA (Operating)</td>
<td>116°F, 700-1000 gpm</td>
<td>36,000 ft.₂ shopping mall</td>
<td>60% of gas rate</td>
<td>3.15</td>
</tr>
<tr>
<td>*PAGOSA SPRINGS</td>
<td>131-148°F, 1800 gpm</td>
<td>5 public bldgs; 4 businesses</td>
<td>80% of gas rate, 43% savings.</td>
<td>4.20</td>
</tr>
<tr>
<td>(Operating)</td>
<td>2 wells, 300 ft.</td>
<td>29 x (10^9) Btu/yr.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>COLORADO</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*BOISE GEOTHERMAL</td>
<td>160-170°F, 700 gpm</td>
<td>9 public &amp; 12 private bldgs; 81 x (10^9) Btu/yr. 100+ residences and businesses eventually.</td>
<td>Wellhead developer sells to City; City redistributes to consumers at approximately 90% of gas rate, but 30% savings. Customer charge of $4.00/mo.</td>
<td>5.10</td>
</tr>
<tr>
<td>(Operating)</td>
<td>artesian, 6 local &amp; state wells, 400-2000 ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*BOISE WARM SPRINGS</td>
<td>170°F, 900 gpm artesian, 2 wells, 800 ft.</td>
<td>Approximately 250 homes, condos, and 2 state offices.</td>
<td>Water district sells both heat and domestic water based on actual consumption according to pipe diameter.</td>
<td>NA</td>
</tr>
<tr>
<td>Water District (Operating)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*KETCHUM (Operating)</td>
<td>159°F artesian springs, estimated 1000 gpm</td>
<td>Approximately 60 homes &amp; businesses</td>
<td>Only written agreements between resource/owner &amp; 2 customers; motel and pool purchase resource temperature and flow under same terms; both flat fees; other customers purchasing by oral agreements which vary widely.</td>
<td>$200 yr flat rate estimate</td>
</tr>
</tbody>
</table>

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$^1$Price/MBtu: MBtu stands for million Btu (British Thermal Units), which is a unit of energy measurement. It is used to quantify the amount of energy consumed by a system. A Btu is a measure of heat energy, where 1 Btu is the amount of energy required to heat one pound of water by one degree Fahrenheit. The price/MBtu is the cost of energy measured in millions of Btu. This is a common unit of energy pricing, especially in the context of natural gas or electricity, where the cost is often quoted per million Btu.
Table 2. (cont'd)

**NEVADA**

<table>
<thead>
<tr>
<th>Operator</th>
<th>Temperature</th>
<th>GPM</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>ELKO HEAT CO.</em> (Operating)</td>
<td>180°F, 485 gpm</td>
<td>2 banks, laundry, 2 hotel/casinos, &amp; sewage treatment plant</td>
<td>First users receive heat at 5 yr. flat rate approx. 50% of gas. Metered rate approximately 80% of gas price, 50% savings. return line heat 13% of gas.</td>
</tr>
<tr>
<td><em>WARREN ESTATES</em> (Operating)</td>
<td>205°F, 833 ft.</td>
<td>16 homes on-line</td>
<td>Heat is free until 1988, then tied to 85% of gas rate. Experimenting with equipment and pricing policy.</td>
</tr>
</tbody>
</table>

**OREGON**

<table>
<thead>
<tr>
<th>Operator</th>
<th>Temperature</th>
<th>GPM</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>KLAMATH FALLS DOWNTOWN</em> (Operating)</td>
<td>219°F, 728 gpm</td>
<td>11 public bldgs; total equals 51 x 10^9 Btu/yr</td>
<td>Flat rate for startup. Initial rate and demand charge to be roughly equal to 30-40% of gas.</td>
</tr>
<tr>
<td><em>KLAMATH FALLS COLLEGE</em> Industrial Park (Operative)</td>
<td>104°F, 70 gpm</td>
<td>effluent from OIT</td>
<td>First one or two years free if employment is created in industrial park, then roughly 30-40% of gas plus demand charge.</td>
</tr>
<tr>
<td><em>RAIN FOREST NURSERY</em> (Operating)</td>
<td>87°F, 100 gpm</td>
<td>Waste water to greenhouses</td>
<td>Flat rate for land and resource combined, resource portion estimated to be $150 per month.</td>
</tr>
</tbody>
</table>

1Prices are for delivered heat as of March, 1985, except where noted.

fluctuations have generally resulted in slightly less cost for geothermal heat than offered one year ago. Conversely, any rate of increase in fossil fuel prices is hard to predict, and thus could possibly exceed allowable escalation increases of price agreements.

**Economic Development**

In two of the surveyed projects, economic growth and diversification for the community, rather than energy savings, is the driving force behind the project. In Klamath Falls and Susanville, incentives to businesses which locate in "geothermal industrial parks" may include free heat for a certain period, or heat at even greater discounts than offered elsewhere in the community.

**Trends**

Three trends emerged in this year's survey. First, pricing policies seem to be moving away from directly tying heat to competing fuels. The recently adopted Susanville Pricing Ordinance is the most overt example of this direction. Price advantages over competing fuels, expressed as a percentage, are obviously important selling points. But maintaining heat as a direct percentage of fossil fuel prices may not necessarily be best for all parties. The fear of rapid escalation, even though discounted, is perhaps a marketing barrier. And while geothermal heat is not free, marketing based on a cost-plus basis may prove more effective to a skeptical public.

This leads to another emerging trend: marketing. With falling fossil fuel costs and increased conservation, this would appear to be excellent timing. For example, there is now a willingness of some heat suppliers to assist in retrofit costs. Retrofit cost payback to consumers is increasingly important.

Finally, the past trend of using standard flow meters as opposed to Btu meters continues in 1985. Again, costs to both the individual and to the system are the main reasons given.
### Table 3
DIRECT USE PROJECT CHARACTERISTIC SUMMARY

<table>
<thead>
<tr>
<th>Project</th>
<th>Status</th>
<th>Developer</th>
<th>Fed or Operative</th>
<th>State $</th>
<th>Btu Meters</th>
<th>Price Basis</th>
<th>Cost %</th>
<th>Cost $</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUSANVILLE MAIN</td>
<td>On</td>
<td>M</td>
<td>F</td>
<td>Y</td>
<td>Oil/Ord.</td>
<td>67</td>
<td>6.60</td>
<td></td>
</tr>
<tr>
<td>SUSANVILLE SOUTH</td>
<td>On</td>
<td>M</td>
<td>F</td>
<td>Y</td>
<td>Oil/Ord.</td>
<td>67</td>
<td>6.60</td>
<td></td>
</tr>
<tr>
<td>LITCHFIELD PROJECT</td>
<td>On</td>
<td>P</td>
<td>S</td>
<td>N</td>
<td>Oil</td>
<td>67</td>
<td>6.60</td>
<td></td>
</tr>
<tr>
<td>HONEY LAKE HYDROPONICS</td>
<td>On</td>
<td>P</td>
<td>-</td>
<td>N</td>
<td>Flat</td>
<td>-</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>SAN BERNADINO</td>
<td>On</td>
<td>M</td>
<td>S</td>
<td>Y</td>
<td>Gas</td>
<td>75</td>
<td>5.40</td>
<td></td>
</tr>
<tr>
<td>BRIDGEPORI</td>
<td>C</td>
<td>P</td>
<td>S</td>
<td>-</td>
<td>Gas/Costs</td>
<td>-</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>ALAMOSA</td>
<td>On</td>
<td>P</td>
<td>-</td>
<td>N</td>
<td>Gas</td>
<td>60</td>
<td>3.15</td>
<td></td>
</tr>
<tr>
<td>PAGOSA SPRINGS</td>
<td>On</td>
<td>M</td>
<td>F</td>
<td>Y</td>
<td>Gas</td>
<td>80</td>
<td>4.20</td>
<td></td>
</tr>
<tr>
<td>BOISE GEOTHERMAL</td>
<td>On</td>
<td>P</td>
<td>-</td>
<td>N</td>
<td>Flat Rate</td>
<td>-</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>BOISE WARM SPRINGS</td>
<td>On</td>
<td>P</td>
<td>-</td>
<td>N</td>
<td>Flat Rate</td>
<td>-</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>KETCHUM</td>
<td>On</td>
<td>P</td>
<td>-</td>
<td>N</td>
<td>Flat Rate</td>
<td>-</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>ELKO HEAT Co.</td>
<td>On</td>
<td>P</td>
<td>F</td>
<td>N</td>
<td>Gas</td>
<td>13-80</td>
<td>4.30</td>
<td></td>
</tr>
<tr>
<td>WARREN ESTATES</td>
<td>On</td>
<td>P</td>
<td>-</td>
<td>N</td>
<td>Gas</td>
<td>0-85</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Klamath Falls Downtown</td>
<td>On</td>
<td>M</td>
<td>F</td>
<td>Y</td>
<td>Flat/Gas</td>
<td>(35)</td>
<td>750/mb</td>
<td></td>
</tr>
<tr>
<td>Klamath Falls CIP</td>
<td>Onv</td>
<td>M</td>
<td>-</td>
<td>N</td>
<td>Flat/Gas</td>
<td>(35)</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td>Rain Forest Nursery</td>
<td>On</td>
<td>P</td>
<td>-</td>
<td>N</td>
<td>Flat</td>
<td>-</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

1. On = operating, Ov = operative, C = Construction
2. M = municipal, P = private
3. In $/MBtu

**Summary**

The results of the survey are as follows:

- The average price of delivered geothermal energy for all operating projects with prices based on gas and oil rates is $4.64/MBtu as of March 1985.

- 37% of the projects base their geothermal price on some discounted rate of natural gas because it is usually the least costly alternative fossil fuel and because of its similarity to geothermal production and distribution operations.

- The average price for geothermal energy is only 20% less than gas or oil. But the average savings are approximately 40% of the competing fuels. Thus, efficiency is a large part of the savings actually realized by consumers.

- The difference in average savings for non-profit projects and for profit projects is approximately 10 percent.

- A majority of the projects previously escalated their geothermal price annually with corresponding increases in fossil-fuel prices. Now the minority of the projects utilizing other escalation factors is increasing. Examples of such factors include the Consumer Price Index.

- Only two projects includes a fixed-demand charge in addition to the price rate for heat consumed.

- The prices in place or proposed for 56% of these projects have been affected by various federal and state grants, e.g., DOE, EDA, HUD.

- Individual geothermal system efficiency is increasing in importance both as a marketing tool and as a design tool for construction. Minimum temperature drops per user are frequently assumed in order to encourage system efficiency and conservation of the resource.

- Nearly all of the private-developer projects are structured such that the de-
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veloper "wholesales" the geothermal heat to another distribution entity, usually a local governmental unit. This allows the private developer to avoid public-utility regulation, reinforcing the division of risk and rate of return between resource developers and utility supplier.

References

Colahan, K., City of Klamath Falls, personal communication, March 1985.


Latton, M., Chilton Engineering, personal communication, March 1985.


Martinez, O., City of Pagosa Springs, personal communication, March 1984.
