THE ECONOMIC RESULT OF GEOTHERMAL HEAT FOR TWO LARGE GREENHOUSES

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ABSTRACT

Two large commercial greenhouses in metropolitan Salt Lake City have been placed on geothermal heat within the last three years. Economic results and comparisons with conventional gas heat show the advantages of geothermal in a very competitive market, where natural gas prices are only 60% of the national average. The 190°F resource proved very attractive, with a simple payback period less than a year. The much deeper, low temperature resource showed the need to squeeze the maximum heat from the water, using economical equipment that would not be suitable for the higher temperatures. The impact of the current tax incentives are discussed.

INTRODUCTION AND SUMMARY

Utah Roses is a large commercial greenhouse growing and wholesale operation in metropolitan Salt Lake City. It has been operating from a 6-acre greenhouse facility for the last 14 years, growing approximately 10,000 roses per day, and shipping nationwide by air freight. This facility is in Sandy, a suburb of Salt Lake City, 10 miles south of the metropolitan airport. See Figure 1.

In 1978 the company sought a means of reducing its fuel costs, which were then approximately 15% of the gross costs of operation. Geothermal energy was considered a possibility, even though the location of the facility was five miles from the Wasatch Fault. Application was made to the US Dept. of Energy to participate in the cost-shared grant program to develop pilot projects for direct heat applications of geothermal energy. The award was made in early 1979, the conditions calling for the D.O.E. to contribute most of the cost of drilling the exploratory deep well (3000 to 5000 ft), and Utah Roses to provide all the remaining costs for utilizing the geothermal water should the well be successful.

The well was drilled in December 1979, but was only marginally successful, with 123°F water at the well head. The retrofitting of the heating system to geothermal warm water was completed in the fall of 1981. The facility has now seen two heating seasons of experience on geothermal, with the well producing 45% of the annual heating needs for the facility.

During the period that the company was awaiting a decision from the D.O.E. on the grant application, Utah Roses saw need to expand its production facilities to accommodate the demand. Energy Services was asked to assist in selecting a new site that had the potential of developing geothermal energy, and yet was accessible to markets (the airport), labor, and preferably the existing (Sandy) facility. Expansion at the original facility was considered economically impractical because of the $125,000 per acre price tag for any nearby undeveloped land in this heavily industrial/commercial area.

A site was selected at a known geothermal area, Crystal Hot Springs, with temperatures of 135°F. This location is 10 miles south of the Sandy facility, but in a nominally rural area adjacent to the Utah State Prison and near the town of Bluffdale, where land costs were reasonable. There the plan was to first drill a geothermal well, and depending on the result, then proceed to build a new greenhouse facility. A successful 190°F well was drilled in Sept. 1979, and the greenhouses were then built and went into production in the summer of 1980. Geothermal energy supplies 100% of the heating needs of this 3-acre greenhouse facility. Expansion to up to 10 acres of greenhouse is planned, all capable of being heated by the original production well.

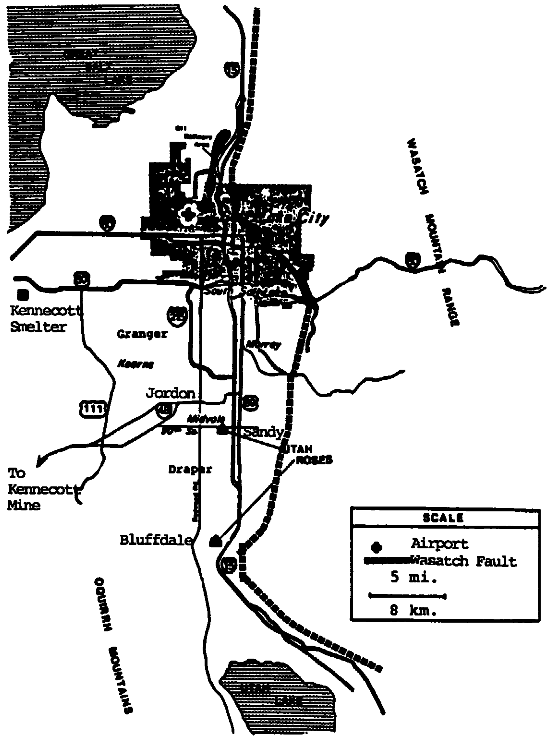

Figure 1, Location Map

WELL DRILLING AND UTILIZATION

BLUFFDALE PRODUCTION WELL:
Though it seemed reasonably certain that a well would be successful if drilled among the many pools and springs of the Crystal Hot Springs area, there was still concern. The State had attempted a geothermal well only 150 yards away, in 1978, and the well was non-productive. There was concern that Crystal Hot Springs resource was a very shallow, near-surface, perched aquifer, fed through faults from a more distant main reservoir.

The well was drilled in September 1979, to a depth of 410 ft. Water hotter than the Crystal Hot Springs temperatures of 135°F was encountered from below 175 ft. Production casing (8" I.D.) was set to the 190 ft depth. The entire drilling operation was done without bentonite-based mud, using essentially pure water as the drilling fluid.

The well was pump tested to 400 gpm, with a measured drawdown of 75 ft. Shut-in pressure is 5 psig, and the well free flows about 60 gpm. Quality of the water is good, approximately 1100 ppm dissolved solids. Because of this free-flow capability, it was decided to rely entirely on the geothermal well for greenhouse heat, i.e. no back-up heating. The 190°F well head temperatures provided much more energy than was needed for the originally planned 3-acres of greenhouse. Therefore these were fitted with the least expensive form of heating system, primarily convection finned tube heating pipes, most at ground level, and a few overhead around the periphery of the greenhouse. A 30 HP submersible pump was installed, and delivers 400 gpm.

BLUFFDALE INJECTION WELL:
Discharge water temperature from the greenhouse is 160°F. Because of the uncertain nature of this resource, the water-use permit from the State required that all geothermal water withdrawn from the production well be returned to the aquifer system. Consequently an injection well was drilled about half a mile to the north west, in the summer of 1980, just before the heating system was to be placed into operation. This well was very difficult to make successful. Permeable and stable formations were not encountered until a depth of 800 ft. The well was drilled to a total depth of 950 ft. The well developed into an excellent production well approximately three days after the drill rig was dismissed. However, the requirement for re-injection had to be followed, and this well has been used only as a re-injection well. Injection of 400 gpm of the 160°F discharge water requires approximately 100 psig well head pressure.

SANDY PRODUCTION WELL:
There was less than a fourth of an acre available behind the greenhouse on which to set up a large, double-stand drill rig, and all the auxiliary equipment. The rig needed to have a 5000 ft capability, though it was hoped that 3000 ft might be adequate to reach the desired reservoir. Temperatures at the 3000 ft level were anticipated to be at least the minimum targeted 120°F, based on average geothermal gradients for the Basin and Range regions.

Drilling began in late November 1979, and was completed in two weeks, to a depth of 5000 ft. The well had a very small free flow (about 5 gpm) and a shut-in pressure of 7 psig. A workover rig subsequently had to be brought in to clean out a bridge at the 2850 ft level and to drop in a liner to prevent further bridging.

Initial pump testing showed the well to have very poor permeability. The subsequent well-development effort spanned a period of six months, and included high pressure iar lifting (during which a 2000 ft head was taken off of the well), and shot perforating of the liner. Despite these efforts, the productivity of the well was not noticeably altered, and it remains a poorly producing well. Though the bottom-hole temperature is 165°F, it appears that most of the production is from the 2800 to 3500 ft levels, and well head temperatures are only 123°F.

A 100 HP submersible pump was set at the 1250 ft depth, and has been pumping for most of the last two years. The well draws down to about 1000 ft after long term pumping at 180 gpm, the rate at which fluid is being supplied to the greenhouse facility.

Efforts have been made to extract the most heat from this low temperature water. Fan-forced, finned-tube heat exchangers are used, mounted at the eight foot height. The design calls for 57 of these, but only 43 have been placed in service to date. Discharge temperature is 90°F with the present complement of heat exchangers, and should drop to about 82°F with the full 57 units.

Water quality is moderately good, about 2800 ppm dissolved solids. Consequently, permission was obtained to discharge the used and cooled geothermal water directly to the Jordan River, which typically flows about 300 cfs, and whose quality varies from 1200 to 2200 ppm. The Jordan empties into the Great Salt Lake 10 miles down stream. However, the State has restricted such discharging to the critical heating months of September through May.

ECONOMICS

BLUFFDALE FACILITY:
This facility, newly built, would require approximately $100,000 (32,000 million Btu) of natural gas per year if that were the source of heat. These Utah prices (31 cents per therm) are well below the national average. The cost of the geothermal heating system, including the wells, was approximately $90,000. Thus the simple payback period has been less than a year, without any consideration for the investment tax credits and intangible drilling costs write-offs for geothermal. Furthermore, there is considerable thermal heating potential remaining in the discharged water, enough to heat a greenhouse three times the size of the present 3-acre facility. Future expansion is planned.

SANDY FACILITY
This six acre greenhouse would require $230,000 of natural gas each year for heat, at present Utah prices. (At national average prices, the cost would be $375,000 per year.) The geothermal well has restricted production capability, compared to what had been anticipated, and can only supply 45% of the total greenhouse annual heat requirements. Thus, present <u>net</u> annual savings are only $83,000, giving a simple payback period of 7.5 years for the $640,000 project. Of this investment, the US D.O.E. contributed 66%, Utah Roses 34%.

In terms of competitive investments, this project would not have been attractive if undertaken entirely on private capital. Even with the investment tax credit and the intangible drilling cost write-off, the simple payback period would have been 4.9 years, still unattractive in the competitive investment market place. However, if the competitive natural gas price was not the low Utah price, but the national average price, the project would show a 3 year simple payback, an attractive figure.

Comparisons between these two projects, both undertaken by the same user-company, are instructive with regard to the risk and incentive for undertaking geothermal energy development. In the high temperature case (the Bluffdale Facility), the project was an outstanding economic success, and even more so if one considers the tax incentives, which applied without question.

However, in the case of the Sandy facility, the low temperature and poor production of the well made this only marginally successful, though, in the long term its success may become more apparent as natural gas prices in Utah increase. The critical aspect is that this project nearly fell short of the 122°F limit established by the IRS to qualify for the alternative energy tax incentives. Ironically, the unfortunate project, with the high risk, could have been ineligible for the incentives, while the fortunate, low risk project was unquestionably eligible. This effect is obviously the reverse of what is needed to stimulate risk investments into geothermal energy. Table 1 summarizes these economic results.

TABLE I - ECONOMICS

Project	Temp. °F	Eligible for tax incentives	Geoth. install. cost	% of Annual heating by geothermal	Annual fuel cost savings*
BLUFFDALE	190	Yes	$90,000	100	$100,000
SANDY	123	Barely	640,000	45	83,000

*These are net cost savings, equal to the natural gas cost saved less the cost of electricity to operate the geothermal pumps.

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