Utility Geothermal Working Group Update

Guy Nelson, Team Leader

Utility Geothermal Working Group

Keywords

Power production, economics, utility issues, heat pumps

ABSTRACT

This paper summarizes the Utility Geothermal Working Group (UGWG) activities since the October 2007 Annual Meeting of the Geothermal Resources Council (GRC). The activities support the UGWG's mission . . . to accelerate the appropriate integration of three geothermal technologies into mainstream utility applications: Power Generation, Direct Use, and Geothermal Heat Pumps.

Introduction

The Utility Geothermal Working Group (UGWG) was formed in September 2005 at the GRC's annual meeting in Reno, NV. It is a group of utilities and ancillary associations formed under the US Department of Energy's (DOE) Geothermal Technologies Program. UGWG is supported by six organizations:

American Public Power Association (APPA)
Bonneville Power Administration (BPA)
Geothermal Resources Council (GRC)
National Rural Electric Cooperative Association (NRECA)
US Department of Energy (DOE)
Western Area Power Administration (Western)

The Working Group's mission is to accelerate the appropriate integration of three geothermal technologies into mainstream applications: Power Generation, Direct Use, and Geothermal Heat Pumps (GHP). In addition to the six support organizations listed above, the UGWG members include

Arizona Public Service	State Working Groups
Sandia National Lab	Idaho National Lab
Ormat Technologies, Inc	South San Joaquin Irrigation Dist.
Palo Alto Utilities	Salt River Project
Redding Electric Utility	Seattle City Light
Springfield Utility Board	

Webcasts and Workshops

To help accomplish its mission, the Group conducts periodic training events in the form of webcasts and workshops. The events focus on geothermal and other renewable applications, technologies, and issues. Since its formation, the Group worked with its members and GRC staff to shape utility training sessions at the 2006 and 2007 GRC meetings. The training sessions provided an opportunity for more utilities to attend the high quality meetings. Other workshops and webcasts have focused on topics such as

Power Generation	Renewable Energy Credits
Transmission Issues	Coal Fired Power Plants
Public Participation	Geothermal Heat Pumps
Project 25x25	Geothermal Heat Pump Economics
Direct Use	Clean Renewable Energy Bonds

Power Generation and Direct Use Findings

Utilities are continuing on the path of integrated resource planning (IRP) to provide energy services to their customers. IRP demonstrates that energy efficiency remains the first choice in a utility resource portfolio and that direct use is an application that utilities continue to avoid. On the other hand, geothermal power generation is of interest to the utilities – even though they regard them as risky because of the need for success on the first wells drilled into a reservoir. Geothermal power plants are also capital-intensive, requiring most of the funding up front before the project produces any revenue. The utilities are more confident in the plants and are willing to negotiate a financeable power purchase agreement (PPA) with a developer, if the following five conditions are met:

- A delineated geothermal resource, with a bankable report that defines probable long term performance,
- A defined permitting path without pitfalls,
- A credible developer with a proven project management track record

- The control of entire geothermal resource to preclude competing interests for same fluid/steam supply, and
- The use of proven technologies.

The utilities are willing to enter into PPAs if the output compares favorably with the "default power plant", which currently is a gas-fired combined cycle plant. The utilities estimate purchasing power from the default choice in the range of 65 to 90 $/MWh. The price includes capital, O&M, and fuel costs.

The price that a geothermal power plant developer can offer to a utility in a PPA largely depends on (1) the exploration, drilling, and development costs of getting the project on line and (2) the financing charges associated with the costs. The costs for a typical 20 MW power plant are

Development Stage	**Cost (Millions of $)**
Exploration & resource assessment	$ 8
Well field drilling and development	20
Power plant, surface facilities, and transmission	40
Other costs (fees, operating reserves, contingencies)	12
Total Cost	$ 80

A major impact development cost is the local, regional, national, and global competition for commodities such as steel, cement, and construction equipment. Geothermal power is competing against other renewable and non-renewable power development, building construction, road and infrastructure improvements, and all other projects that use the same commodities and services. Until equipment and plant inventories rise to meet the increase in demand for these commodities and services, project developers can expect the costs of them to rise.

Using the above costs as a basis, a typical geothermal power plant has a capital cost of 4000/kW. This capital cost is translated to a MWh cost by applying an annual factor reflecting interests rates for financing the total capital cost.

At an annual factor of 0.2, reflecting an interest rate of 18-20%, the capital costs are $ 104/MWh.

At an annual factor of 0.15, reflecting an interest rate of 13-15%, the capital costs are $ 76/MWh.

There are no fuel costs and the typical O&M cost for a plant is about $ 15/MWh. The O&M costs assume that the power plant uses Organic Rankine Cycle (ORC) technology for energy conversion with air to air cooling towers. ORC technology uses a moderately high molecular mass organic fluid such as butane or pentane to absorb the heat from the geothermal fluid and drive the turbine. The technology has the benefits of high cycle and turbine efficiencies, low turbine mechanical stress of the turbine, reduced turbine blade erosion, and the lack of the need for full time operators to be present.

If the power plant uses a different technology or water to air cooling towers, the O&M costs are likely to be higher. Using these two annual factors and adding the O&M cost to the annualized capital costs, the developer may be able to offer a utility output in the range of $ 91 to 119/MWh. This price could be lowered if the utility were to finance the power plant construction.

Geothermal Heat Pump Findings

Geothermal heat pumps (GHP) represent an energy efficient technology that is making strong gains as a viable alternative heating and cooling system, both in the United States and around the world[1]. Although this technology has been in existence since the 1940s, it still has not realized its full market potential. But the technology is gaining ground. The UGWG and one of its four major support organizations, Western, developed a report that describes the reasons why geothermal heat pump technology appeals to both electric utilities and end users, and also explains why this appeal has not been enough to sustain a national market.

Western also developed two worksheets that provide the economics of GHP vs other HVAC options from the customer and utility perspective. This report and the spreadsheets help readers to:

- Understand the benefits that geothermal heat pumps offer customers and electric utility providers
- Describe the market potential and appeal of geothermal heat pumps
- Document the tactics and strategies that some electric utilities have used to develop sustainable and effective geothermal heat pump programs

Twelve utility programs were selected to be included in this report describing successful geothermal heat pump installations. These are not all the utilities currently offering geothermal heat pump programs. Nor are they some of the geothermal "pioneers" that first established utility programs. Rather, these are the utilities still committed to selling and promoting this technology. They still believe the possibilities that geothermal systems offer. The selected utilities featured in this report have found the right alchemy of program elements to create innovative and successful geothermal programs

The report identifies one major barrier to expanding GHP applications – first costs that the customer must incur without utility financing. The GHP typically has a 20% premium when compared to traditional air-source heat pump system installations.[2] Cost premiums are associated with designing and installing ground loop systems that operate year-round without auxiliary back-up units. According to one EIA report, these systems have a payback period of two to ten years when one accounts for energy and maintenance costs.[3] Other reports have indicated simple paybacks of five to eight years.[4] The large variance in payback discourages implementing these systems. Typically, businesses and individuals look for a return on an investment within a two

[1]Johnson, Katherine "Geothermal Heat Pump Guidebook, 3rd Addition" May 2007 pg.3

[2]Sacramento Municipal Utility District "Geothermal Heat Pumps," January 2007

[3]Holihan, Peter "Analysis of Geothermal Heat Pump Manufacturers Survey Data," U.S. DOE January 2007

[4]Kavavaugh, Steve "Ground-Coupling With Water Source Heat Pumps," April 2004 pg 10.

to three year payback, and a longer payback is highly unattractive for consumers and businesses alike.

If the utility were to step in and finance all or a portion of the GHP system for customers, the customers may likely enjoy a positive cash flow from the start of the system operation. The utility could place a lien on the customers' properties and charge an interest rate, in the form of a loop lease, which is digestible for the customer and financially prudent for the utility.

To illustrate a typical residential application, the following assumptions are used and compare a GHP system with a conventional HVAC system that uses a natural furnace for heating and electrically served air conditioning for cooling. Sources for assumptions are USDOE and USEIA. If the conventional source is propane, oil, or electric resistance for heating, GHP economics are better.

Electric Rate = 10¢ per kWh	Gas Rate = $1.50 per therm
Electric AC Use = 1660 kWh per year	Gas Heating Use = 900 therms per year,
GHP System Cost = $ 10,000	

Conventional HVAC costs (gas heating and electric cooling) are $1350 (heating) + $166 (cooling) = $1516/year. The GHP costs (all electric) are $ 1061 + loop lease. For the customer, GHP makes sense if the loop lease is less the difference between the costs of the conventional HVAC system and the cost of providing electricity to the GHP system or $1516 - $1061 = $455/yr. Loop leases vary due to loan terms. If the utility offer 6% financing and 30 year terms, the loop lease is $332/yr.

Does it make sense for a utility to offer a GHP program that includes loop leases to the customer? Utility economics are less straight forward than customer economics. The utility needs to assess how the program make impact its peak period (Summer vs. Winter), including the impact of the default heating option (electric resistance vs. other fuel sources such as natural gas or propane.

If the GHP system is replacing electric resistance heating, the utility saves about 40% in peak demand in the summer and winter and loses about 70% of revenues from kWh sales. GHP makes sense if the peak demand savings and interest revenues from the loop leases more than offset the revenue losses and any other losses resulting from implementing the program. The other revenue losses include actions such as rebates, rate reductions, or lower interest rates.

Conclusions

The UGWG finds that the utility members are interested in two of the three geothermal technologies – power generation and geothermal heat pumps. The third technology, direct use, does not appear on their radar screen. Direct use appears to be too far afield from their core business to pursue at this time. Based on the results of training and interaction with the members over the past year, the UGWG plans to continue promoting the two geothermal technologies of interest to its members. The focus will be on workshops, training programs, and field assessments that cause more geothermal power plants to be developed and more geothermal heat pumps to be put into the ground.