NOTICE CONCERNING COPYRIGHT RESTRICTIONS

Utility Geothermal Working Group 2011 Update

Guy Nelson

Utility Geothermal Working Group Team Lead

Keywords

Utility, power generation, geothermal heat pumps, energy efficiency, costs

ABSTRACT

This paper summarizes the Utility Geothermal Working Group (UGWG) activities since the October 2010 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.

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 supported by the US Department of Energy's (DOE) Geothermal Technologies Program.

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, Western Area Power Administration, and GRC staff to shape utility training sessions at the 2006 - 11 GRC meetings.

The training sessions provided an opportunity for more utilities to attend the high quality technology transfer meetings. In the past, other activities have focused on topics such as Power Generation, Geothermal Heat Pumps (GHP), Transmission Issues, and Renewable Energy Credits. Very little additional activities have been accomplished in the past year due to lack of DOE support. At press time for this paper, DOE has agreed to provide support in 2011 for UGWG and is going to give the group direction.

Introduction

The Utility Geothermal Working Group (UGWG) was formed in September 2005 at the GRC's annual meeting in Reno, NV. It has been providing annual update reports at the 2006-9 annual meetings. UGWG is a group of utilities and ancillary associations supported by the US Department of Energy's (DOE) Geothermal Technologies Program. UGWG is also supported by five other organizations:

American Public Power Association (APPA)
Bonneville Power Administration (BPA)
Geothermal Resources Council (GRC)
National Rural Electric Cooperative Association (NRECA)

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:

Pacific Gas & Electric
NV Energy
Sandia National Lab
Idaho National Lab
Ormat International, Inc.
South San Joaquin Irrigation District
Salt River Project
Delta Montrose Electric Assn
Oklahoma Municipal Power Authority
Western Farmers Electric Coop

The Group encourages additional utilities and other interested parties to become members. Membership currently carries no annual dues. The Group asks its current and new members to express their needs in and experiences from geothermal technologies.

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, Western Area Power Administration, and GRC staff to shape utility training sessions at the 2006 – 2010 GRC annual meetings. The training sessions provided an opportunity for more utilities to attend the high quality technology transfer meetings. Other workshops and webcasts have focused on topics such as Power Generation, Geothermal Heat Pumps (GHP), Transmission Issues, and Renewable Energy Credits.

Major Findings

Direct Use and Power Generation 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. Geothermal direct use is not addressed in the IRPs and the UGWG utility membership is not interested in exploring the application as an energy services option. However, the UGWG will continue to discuss opportunities for direct use with its members, because hundreds of cities and countries have case histories of its applications and its energy benefits to the end user.

On the other hand, geothermal power generation is of great 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, and contingencies)	12
Total Cost	$ 80

A major impact to 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 financing costs are $ 104/mWh. The financing costs assume that the plant is on-line 90% each year. At an annual factor of 0.15, reflecting an interest rate of 13-15%, the capital financing costs are $ 76/mWh.

Typical O&M cost for a plant is about $ 15/mWh. The O&M costs include reservoir management and 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 efficiency 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. A December 2008 Oak Ridge National Laboratory Report (Geothermal (Ground Source) Heat Pumps, ORNL/TM 2008/232) described the barriers to GHP system adoption and methods to overcome them. The barriers include (1) High installation costs, (2) Consumer's and Regulator's lack of Awareness of the Technologies, (3) Lack of Business Models that Support Long Term Adoption, (4) Lack of Infrastructure to Install and Maintain Systems, and (5) Lack of New Technologies and Methods of Installation

The report describes that utilities, individually and collectively, can push through the barriers by adopting large, pilot scale GHP installation programs for new and retrofit sites. Programs could start with a goal of several hundred tons of GHP systems installed in the first year, and then scale up to thousands of tons per year based on the results of the earlier years.

The program can consist of four segments, some of which follow one another, while others can be done at the same time: (1) providing education that maintains and enhances customer, installer, and other stakeholder awareness and skill levels, (2) selecting GHP installation sites, (3) installing and commissioning GHP equipment, and (4) evaluating retrofit performance and revising project implementation.

Success Stories and 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 GHP systems to be put into service.

The UGWG assisted the Oklahoma Municipal Power Authority (OMPA) and its members in implementing the first year of the Oklahoma Comfort Program. The program includes a rebate of $1000 per ton for up to 2340 tons of GHP installed by OMPA members by March 31, 2012. This rebate is in addition to the $800 per ton that OMPA and its members offer their customers. OMPA is presenting a paper on the program at this meeting.

The OMPA members have conducted studies showing that GHP systems provide a ½ kW per ton reduction in summer peaks. Over a 25 year period and a 5% discount rate, using current capacity costs of $100 per kW yr, the savings represent a net present value of $1400 per ton. The GHP systems also reduce the building's carbon footprint by 17 million Btu/ton annually.

In an effort to take the OMPA model nationally, the UGWG has formed a "GEO HERO" Working Group. The GEO HERO Working Group has six objectives:

1. Enhance communications between and among utilities that have geothermal heat pump (GHP) programs or are considering such programs,
2. Use the combined group purchasing power to reduce the cost of GHP installations by taking advantages of marketing efficiencies,
3. Quantify the cost and benefits of GHP programs, including carbon footprints and the "non-energy" benefits such as jobs, comfort, safety, and extended equipment life,
4. Transform the market of installing, operating, maintaining, evaluating, and improving GHP systems in homes and businesses in the US,
5. Work with utility oversight organizations to describe the benefits of GHP in meeting the requirements of renewable energy and energy efficiency portfolios, and
6. Work with State utility regulatory commissions to gain approval for utility investments in GHP systems to be included in the rate base.

GHP systems appear to be promising because of the ARRA funding that is available to help them move to the market place. The DOE's Geothermal Program no longer has responsibility for promoting cost-effective GHP applications. Therefore future GHP activities by the UGWG are uncertain at this time.

The DOE's Geothermal Program is very interested in promoting geothermal power production and direct use (other than GHP). To that end, as of press time for this paper, the UGWG is working with DOE staff on educational activities such as identifying the more promising sites to drill exploration wells and conducting training on remote sensing technologies to aid in geothermal reservoir exploration and identification.

As a final note, the Working Group estimates that nationwide there is 10 GW of available recoverable heat from industrial applications. Utilities can take a leadership role in encouraging its beneficial use as a fuel source to produce electric power. The waste heat can be converted to electricity without any additional fossil fuel. The conversion uses the field proven ORC commercial technology discussed above. ORC plants have a track record of producing reliable geothermal power for over 20 years and are being applied for waste heat recovery in gas pipeline compressor stations. The ORC design applies to other waste heat recovery opportunities such as industrial applications. It can be considered a renewable fuel-free resource resulting from human activity.

---

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