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Utility Geothermal Working Group 2009 Update

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Utility Geothermal Working Group

Keywords

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

ABSTRACT

This paper summarizes the Utility Geothermal Working Group (UGWG) activities since the September 2008 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 - 09 GRC 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	Direct Use
Geothermal Heat Pumps	Transmission Issues
Project 25x25	Renewable Energy Credits
Coal Fired Power Plants	Public Participation
Renewable Energy Bonds	

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 supported by the US Department of Energy's (DOE) Geothermal Technologies Program. UGWG is also supported by four 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 five support organizations above, the UGWG members include:

State Working Groups	Springfield Utility Board
Sandia National Lab	Idaho National Lab
Ormat International, Inc.	South San Joaquin Irrigation District
Palo Alto Utilities	Salt River Project
Oklahoma Municipal Power Authority	
Seattle City Light	

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.

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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 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 major support organizations, Western, funded the third update to a report, "Geothermal Heat Pump Guidebook". The update 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 is now funding the fourth update.

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:

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

In a related effort, a December 2008 Oak Ridge National Laboratory Report described the barriers to GHP system adoption and methods to overcome them. The barriers include

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

(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 pilot programs.

The pilot program consists 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.

Once the utilities gain confidence in GHP Technology, they can launch full scale programs that help them meet energy efficiency goals and improve their bottom line. Utilities across the country are required to set and meet energy efficiency goals. Source energy reduction is a standard method of determining the energy efficiency of systems, including GHP equipment. Source energy traces back and accounts not only for the energy use on site, but also the system losses in generating and transmitting the energy to the site.

A recent ClimateMaster report, *Field Experience with Ground-Source Heat Pumps in Affordable Low Energy Housing*, documents the site energy and utility bill savings and the source energy savings of GHP vs. conventional HVAC equipment. The report tracks energy usage in a Habitat for Humanity Project near Oklahoma City, OK. Tables One and Two show the utility bill savings and the source energy reduction of GHP systems. The project, coordinated with Habitat for Humanity, uses 2 ton CM Heat Pumps to space condition small homes in Oklahoma Gas and Electric's service territory. GHP homes save $530 per year. Source energy use in these homes is 140 MM Btus/year. Source energy use in homes using conventional HVAC systems (gas furnace and packaged air conditioners), is 174 MM Btus/year. In this climate zone, GHP systems annually save 17 MM Btus of source energy per ton installed.

GHP systems also improve the utility's bottom line. The Oklahoma Municipal Power Authority (OMPA) system largely serves residential load throughout the State of Oklahoma. OMPA members have provided GHP rebates and other energy efficiency incentives to their customers in the past. The members have conducted studies showing that GHP systems offer 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. Also, if the utility provides a loop leasing option, the option provides another cash flow stream for the utility. Furthermore, if the utility may be able to get a rate of return on the portion of the GHP system (including the loop) that it owns.

Conclusions and Success Stories

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.

GHP systems appear to be promising because of the ARRA funding that is available to help them move to the market place. Also, 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, as opposed to letting it escape to the atmosphere as a source of environmentally polluting emissions.

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.

Finally, the UGWG has helped successfully move geothermal technologies further into the marketplace. Snohomish County

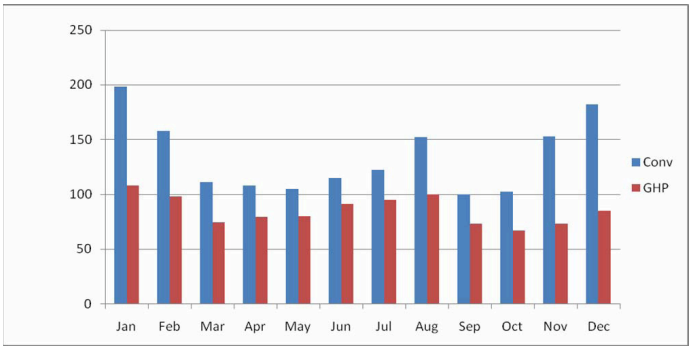

Table 1. Home Utility Bill Comparison.

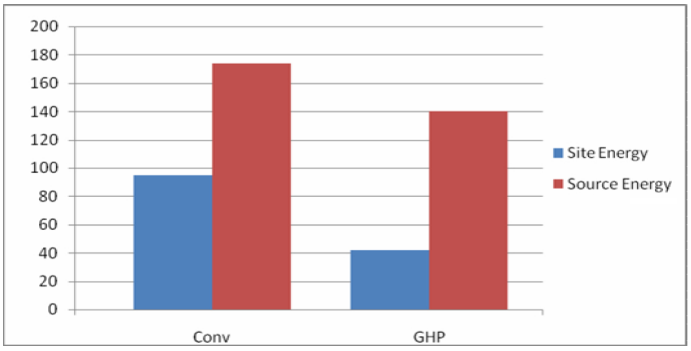

Table 2. Site and Source Energy Comparison.

PUD hosted a UGWG workshop on geothermal technologies. As a result of the workshop, the utility is now pursuing geothermal power production sites in the Pacific Northwest and evaluating residential geothermal heat pump retrofits in a portion of its service territory that has all electric resistance heating.

In another example, PacifiCorp has participated in three UGWG workshops by giving presentations on geothermal power plant O&M and has offered the group its services in the future. The presentations help utilities get more comfortable with the reliability of geothermal power. Also, PacifiCorp has become interested in developing its own geothermal heat pump program.

In yet another example, after participating in a GHP webinar, Oklahoma Municipal Power Authority worked with UGWG and applied for a State Energy Program Grant funded by DOE's portion of the ARRA stimulus package. The application was accepted by the State, subject to approval by the DOE.