HELPING UTILITIES AND CUSTOMERS QUANTIFY THE BENEFITS OF GEOTHERMAL HEAT PUMPS

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Abstract: GHPs installations have been making strong gains as a viable alternative heating and cooling system, both in the United States and around the world. Although this technology has been in existence since the 1940s, it still has not realized its full market potential.

To help promote GHP installations, the Western Area Power Administration (Western), the National Rural Electric Cooperative Association (NRECA) and the American Public Power Association (APPA) commissioned a report featuring the "Best Practices" used by 12 utilities and 17 trade allies to promote GHPs. This paper summarizes the ways in which these utilities have blended marketing, financing, and infrastructure support to increase GHP installations in their service areas.

The last section of this paper displays two very simple calculators. These tools were developed to assist utility program planners estimate the value of GHP installations from both the customer and utility perspectives. These calculators, which leverage existing materials, provide a quick way that utilities can determine if the benefits of promoting a GHP program outweigh the costs associated with lost revenues and program administration.

Key Words: ***residential, electric utilities, marketing, cost-benefit analysis, "best in class"***

1 INTRODUCTION

Geothermal heat pumps (GHP) installations are increasing again, as electric utilities and their customers discover the benefits of this energy efficient technology. As the demand for energy continues to increase, more electric utilities are showing a renewed interest in this technology. This paper provides a summary of the "Best Practices" implemented by 12 electric utilities. The selected utilities have found the right combination of financing, marketing, and contractor outreach to create innovative and successful, GHP programs. The 12 utilities featured in this paper are a mix of mix of investor-owned, municipal, and rural electric cooperatives (RECs):

Table 1: Utility Programs Profiled

Investor-owned	Municipal	Rural Electric Cooperatives
First Energy	Bonneville Power Administration	Delta-Montrose Electric Association
Gulf Power	City of Tallahassee	Palmetto Rural Electric Cooperative
Northeast Utilities	Muscatine Power and Water	Plumas-Sierra Electric Cooperative
Otter Tail Power	Tennessee Valley Authority	Yellowstone Valley Electric Cooperative

The full report, available through the Western Area Power Administration (Western) also features 17 profiles of trade allies that have been active in the geothermal heat pump industry. These trade allies or strategic partners include geothermal heat pump manufacturers, architects, engineers, and non-profit associations dedicated to promoting this technology. This is not designed to be a comprehensive list, but rather an indication of the types of companies that have committed resources to promoting this technology.

Table 2: Trade Allies Profiled

Manufacturers		Engineering Firms	Trade Associations
Addison Products/Heat Controllers	Maritime Geothermal Ltd.	Alderson Engineering, Inc.	GEO-NII
Climatemaster	McQuay International	Geo-Enterprises, Inc.	IGSHPA
EarthSource Energy Solutions	Millbrook Industries-Hydronic Division	LoopMaster International	GHPC
Econar	Trane		
FHP	WaterFurnace International		
Hydro Delta			

2 SUMMARY OF UTILITY PROGRAMS

This paper summarizes the best practices these 12 utilities have developed and deployed, in conjunction with their trade allies, to develop successful geothermal heat pump (GHP) programs. This is not an exhaustive list, but rather serves as examples of the ways that these utilities have been able to create successful self-sustaining market. These practices focus on the ways in which these utilities have been able to identify, encourage, train, and support the drillers, dealers, and installers who actually deliver geothermal heat pumps to the end users. By nurturing these contractors, the utilities have been able to create a marketplace that results a more favorable pricing structure, a more knowledgeable infrastructure, and a true competition. The ways in which these utilities achieved these goals are summarized next.

2.1 Experience in Geothermal Heat Pump Installations

The first critical element to developing long-term success in GHP programs is to gain experience. Geothermal heat pump installations are inherently complex, requiring the expertise of different skills sets and contractor groups. However, as these profiles demonstrate, successful utilities have been able to tap into the experience and knowledge of contractors, rather than having to cultivate it internally. For example, *Muscatine Power and Water,* an Iowa municipal utility, has only been running its GHP program a few years. But they have been successful because they were able to rely on advice and guidance from geothermal experts, such the Iowa Heat Pump Contractors Association and the International Ground Source Heat Pump Association. The most successful geothermal programs have been those where the program developers gained experience and then leveraged this experience to further build the market. *Otter Tail Power*, with its strong word-of-mouth and customer referrals, illustrates the benefits that gaining and building experience offers.

2.2 Patience to Develop a Market

Patience is a virtue, especially in this market. It takes time to develop a contractor infrastructure, to identify the best applications for geothermal, and to actually install the units. Patience is also necessary on the part of the customers, since the paybacks for geothermal heat pumps can be longer compared to conventional systems. However, as the customers soon learn, patience can be rewarding. Utilities, such as *Otter Tail Power*, have demonstrated the patience necessary to foster a geothermal heat pump program, despite occasional setbacks, also benefit from an enhanced load profile, and satisfied customers. The patience demonstrated by these electric utilities are displayed in Figure 1

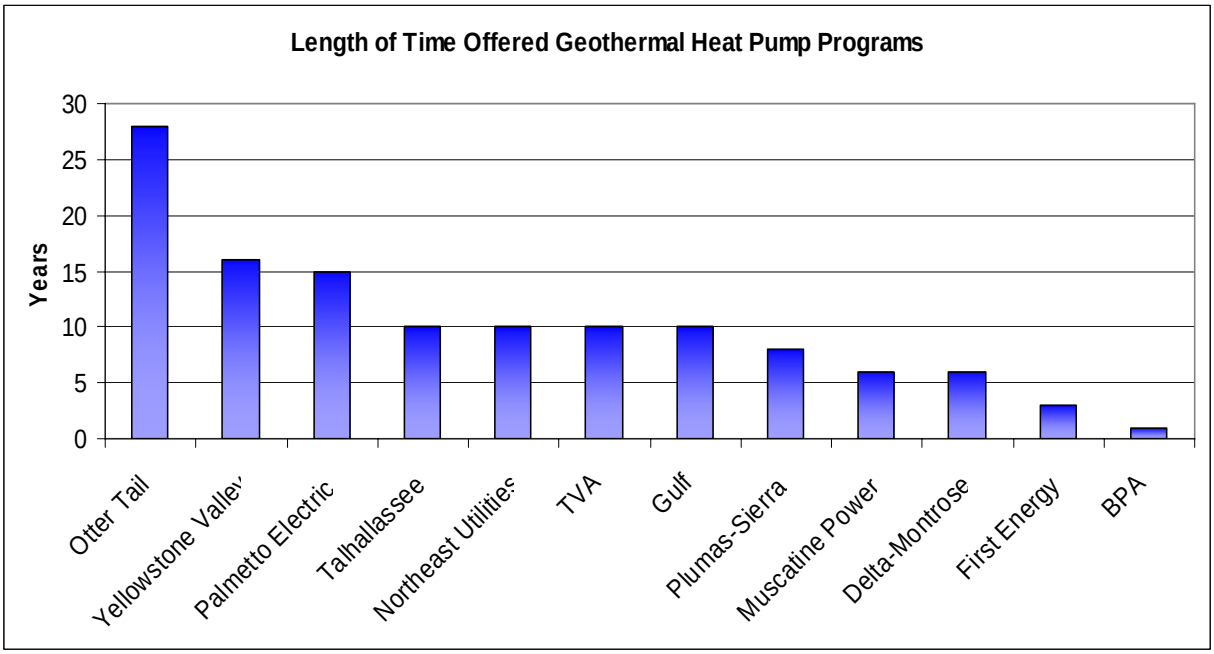

Figure 1: Length of Time Utilities Offered GHP Programs

2.3 Vision

Developing a successful geothermal heat pump program also requires looking beyond the short term and envisioning a new and better market. *Muscatine Power and Water* is among the most forward thinking utilities involved in geothermal programs. While it recognizes the shortcomings in the current situation, the utility thinks out of the box to create the infrastructure and environment necessary to make its vision a reality.

3. MARKETING BEST PRACTICES

This paper also summarizes the most successful ways in which these utilities have marketed their geothermal heat pump programs to both customers and trade allies.

Reduce the First Cost Barrier

These utilities demonstrated great creativity in developing strategies to lower or eliminate the biggest barrier to geothermal installations: the higher incremental first cost beyond traditional

rebates. Rather these utilities developed a range of financial incentives from providing design assistance, to developing specialized geothermal loop leases or GHP rates. Other innovative financing strategies included having the utilities actually pay for the GHP loop and then recouping the investment through a monthly billing payment. Most importantly, however, many utilities offered a variety of programs to best meet the needs of their customers, as illustrated in Table 3.

Table 3: Strategies to Reduce First Costs

Utility	Design Assistance	Tax Credits	Loop Leases/ Financing	Low Interest Loans	Rebates	Special Geo Rates	Pay for Loop
BPA	√				√		
City of Tallahassee				√			
Delta-Montrose					√		
First Energy							√
Gulf Power					√		√
Muscatine Power & Water	√			√	√		
Northeast Utilities		√					
Otter Tail					√	√	√
Palmetto Electric					√		√
Plumas- Sierra			√				
TVA		√			√		
Yellowstone Valley	√				√		

3.2 Nurturing Contractor Development

These utility profiles also illustrate some of the more successful strategies that have been used to develop a sustainable contractor infrastructure. These strategies include investing in new tools and technologies to assist in the geothermal installation process, holding design and training sessions for architects and engineers to educate them about geothermal heat pumps, developing a contractor referral network to support the local drillers, installers, and dealers, and developing a partnership in that all parties work together to help the ultimate customer. Table 4 shows these strategies

Table 4: Strategies to Nurture Contractors

Utility	Offer Training	Invest in New Tools	Contractor Referrals	Develop Partnerships
BPA	√		√	√
City of Tallahassee			√	
Delta-Montrose	√		√	√
First Energy	√			√
Gulf Power	√	√	√	√
Muscatine Power & Water			√	√
Northeast Utilities	√	√		√
Otter Tail	√	√	√	√
Palmetto Electric	√	√		√
Plumas- Sierra	√	√	√	√
TVA			√	√
Yellowstone Valley	√	√	√	√

As Table 4 illustrates, *Gulf Power, BPA,* and *Otter Tail* have had the most success in developing a strong contractor infrastructure by offering all four strategies to cultivate and support local contractors. Other utilities tend to rely more heavily on developing partnerships with local contractors and building a strong contractor referral network.

3.3 Creating/Generating Enthusiasm at All Levels

Perhaps the most overlooked part of developing a successful geothermal heat pump program is creating a sense of enthusiasm for geothermal heat pumps. Yet, this is a necessary element to long-term program success. This enthusiasm is developed in several ways. For example, "walking the walk," that is installing geothermal installations at utility headquarters and in employees' homes. This is a powerful testimonial to potential buyers that the utility sincerely believes in this technology. (See Table 5)

This strategy has been used most effectively at a number of utilities, including *Plumas-Sierra, Palmetto Electric*, and *Gulf Power*. Each of these utilities has numerous staff members with geothermal systems installed in their homes. Moreover, *Palmetto Electric* and *Yellowstone Valley* have also installed geothermal heat pump installations at their headquarters buildings. Another technique for creating enthusiasm for geothermal heat pump installations is to foster a "geo culture," that is creating a sense of pride in ownership among geothermal customers. This is also a successful strategy for building word-of-mouth among potential customers. This leads to further installations and a broadening of the "geo" mindset. This strategy has been most effectively demonstrated in *Delta-Montrose's* "geo customer dinners," and through the customer tours and demonstrations offered by *Otter Tail Power*.

A third element necessary to creating enthusiasm for geothermal heat pumps is to showcase high profile installations in new and compelling ways. For example, *First Energy* often holds its dealer training seminars at Richard Stockton College, home to one of the largest geothermal heat pump installations in the world. This technique demonstrates the utility's belief in the system, and reinforces the versatility and overall superiority of geothermal heat pumps to potential customers.

Table 5: Strategies to Generate Enthusiasm for GHPs

Utility	"Walk the Talk"	Create a "Geo' Culture	Showcase High Profile Installations
BPA			√
City of Tallahassee			√
Delta-Montrose	√	√	√
First Energy	√		√
Gulf Power		√	√
Muscatine Power & Water	√		
Northeast Utilities			√
Otter Tail	√		√
Palmetto Electric	√		√
Plumas- Sierra	√	√	√
TVA		√	√
Yellowstone Valley	√		√

4. COMMUNICATING THE VALUE OF GEOTHERMAL HEAT PUMPS

In order to be truly successful, these electric utilities also developed ways to convey the benefits of geothermal heat pumps both internally, to justify the program, and externally to the customer. As a way to assist other electric utilities, this project funded the development of two simple calculators, which are available to Western customers for now charge through its GeoPowering the West Program (www1.eere.energy.gov/geothermal/gpw) or by contacting the authors directly. Both calculators leverage existing tools currently available to the public, but are designed to be quite user-friendly. So they convey the costs and benefits to customers and utilities in laymen's terms.

4.1 The Residential Geothermal Heat Pump Calculator

This simple calculator, based in MS Excel leverages information available from a variety of sources to help customers see the costs and benefits associated with installing a GHP system in their home in two simple steps. First the customer needs to provide the following information, which may be obtained through the hyperlinks provided in the calculator, if necessary:

- System size for the geothermal heat pump
- Annual heating costs for both systems
- Annual cooling costs for both systems

4.1.1 Step 1: Installation Cost Comparison

This information is fairly straightforward and the customer can also include rebates, loop leases, or any other financing that may be available as a way to quickly compare costs.

RESIDENTIAL GEOTHERMAL HEAT PUMP COMPARISON CALCULATOR- CUSTOMER PERSPECTIVE

Input data in the green shaded cells; the other fields are automatically calculated		
STEP 1.	**INSTALLATION COST COMPARISON**	
	Alternative	**Geothermal Heat Pump**
Number of Tons	3	3
System Installation Cost	$3,498.00	$5,459.60
Lifetime Loop Lease Costs (if any)	$0.00	$0.00
Total Costs	$3,498.00	$5,459.60
Installation Benefits		
Tax Credits (if any)	$0.00	$0.00
Rebates (if any)	$0.00	$0.00
Net Installation Costs	**$3,498.00**	**$5,459.60**
System Cost Premium	**$1,961.60**	

Figure 2: Screen Shot of Residential GHP Calculator to Compare Installation Costs

4.1.2 Step 2: Energy Cost Comparison

Once the customer has determined the annual energy costs for both heating and cooling, the calculator provides a simple comparison. The default calculators are based on the following links to Washington State University's website, which houses a comprehensive heating and cooling equipment library. This information is illustrated in the following screen shot, in Figure 6.

STEP 2.	ENERGY COST COMPARISON
Click on following link for heating calculator	http://www.energyexperts.org/fuelcalc/default.asp
Click on following link for cooling calculator	http://www.energyexperts.org/ac_calc/default.asp
Follow instructions and copy the heating and cooling costs in the shaded green cells	

Annual Energy Costs

Type	Alternative	Geothermal Heat Pump	Difference
Annual Heating Costs	$1,142.02	$546.80	$595.22
Annual Cooling Costs	$635.03	$230.14	$404.89
Total Annual Heating and Cooling Costs	$1,777.05	$776.94	$1,000.11

	Alternative	Geothermal Heat Pump	Difference
Net Present Value of Lifetime Heating and Cooling Costs	$22,145.97	$9,682.39	$12,463.58

Figure 3: Screen Shot of Residential GHP Calculator's Energy Cost Comparison

4.1.3 Summary of Benefits

The summary of costs and benefits are then summarized simply for the customer based on these inputs. (See Figure 7). These benefits are displayed in easy to understand terms to help customers understand that paying the higher up-front cost of a geothermal heat pump will be recouped the annual energy savings.

SUMMARY OF BENEFITS FOR GEOTHERMAL HEAT PUMP SYSTEMS	
Initial cost difference	$1,961.60
Life cycle savings	$12,463.58
Net life cycle savings (life cycle savings - additional cost)	$10,501.98
Simple payback of additional cost (years)	1.96

Figure 4: Screen Shot of Summary of GHP Benefits

4.2 The Utility GHP Calculator

However, electric utility staff also grapple with the issue of determining if creating a geothermal heat pump program "makes sense" from both an economic and financial viewpoint. To help answer this question, a separate calculator was developed to help utilities calculate the effects of residential geothermal heat pump installations in their service territories.

This calculator, also based in MS Excel, is based on a simple engineering analysis which compares GHPs to standard heating and cooling equipment. These assumptions may be modified as needed to reflect the utilities specific climates and baseline installations. The purpose of this calculator was to help non-engineers determine if pursuing a geothermal program could be cost justified. This is accomplished in a few simple steps which are described next.

4.2.1 Step 1: Determine Costs

This calculator is designed to capture all the costs associated with implementing a geothermal heat pump program, including rebates, wholesale generation costs, and program

administration. These costs may be modified as a way to help program designers determine the appropriate budget for a geothermal heat pump program. (See Figure 8)

Residential Geothermal Heat Pump Calculator Savings Based on Engineering Assumptions			
Step 1: Determine Costs			
Electric Costs		**Program Costs/Installation**	
Customer cost per kWh	$0.06	Administration	$0.00
Utility Costs		Loop Lease	$0.00
Wholesale power per kWh	0.02	Rebates/ton	$100.00
Coincident Peak Demand per KW	$10.00	#Tons Installed	50

Figure 5: Screen Shot of Utility GHP Calculator to Determine Costs

4.2.2 Step 2: Determine Number of Installations

The second step is to determine the effects based on the total number of installations. This can be modified to determine the likely effects of a program over time.

4.3 Net Effects from Geothermal Heat Pump Installations

The calculator then summarizes the net effects based on both the increased revenue from the year-round base load for the geothermal heat pump less the lost revenues associated with installing more efficient cooling technologies. Figure 9 summarizes the screen shot that illustrates this cost-benefit analysis.

Net Effects from Geothermal Heat Pump Installations	
"Net Revenue" from Customers	$26,575.04
Increased kWh sales cost	($8,858.35)
Avoided kWh Cost	$780.00
"Net Effect"	$18,496.69

Net Revenue Effects	
Net Revenue Effects	$18,496.69
Administration	$0.00
Loop Lease	$0.00
Rebates	$5,000.00
Total Program Costs	$5,000.00
TOTAL REVENUE	**$18,496.69**
TOTAL COSTS	**$5,000.00**
NET GAIN/LOSS	**$13,496.69**

Figure 6: Screen Shot of the Summary of Net Revenue Effects

5. CONCLUSION

The purpose of this paper was two fold. It was first designed to provide a summary of the best practices used by electric utilities to promote the installation of geothermal heat pumps. It also provided a brief overview of the ways in which utilities can determine the value of a geothermal heat pump program. In order for geothermal heat pump programs to truly gain traction in the market place, utility staff must be able to explain the costs and benefits simply and clearly. These resources, which are available free of charge, to Western customers, APPA and NRECA members, demonstrate that the most successful geothermal heat pump programs start by understanding the value of this technology and communicating it effectively to customers, trade allies, and utility staff.

6. FOR MORE INFORMATION

The following websites provide additional information on ways to communicate the value of geothermal heat pumps:

The following organizations are able to provide more detailed information about both the costs and benefits of purchasing and installing a GHP system:

- DOE Geothermal Technologies Program
- Geo-Heat Center
- Geothermal Heat Pump Consortium
- International Ground Source Heat Pump Association (IGHSHPA)
- U.S. Department of Energy – *Energy Efficiency and Renewable Energy, How To Buy and Efficient Ground Source Heat Pump*
- GeoPowering the West
- ENERGY STAR®, *Geothermal Heat Pump Systems*
- American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE)
- Air-conditioning and Refrigeration Institute (AHRI)

Carbon Emissions Calculator

- http://www.epa.gov/cleanenergy/energy-resources/calculator.html