NOTICE CONCERNING COPYRIGHT RESTRICTIONS

Utility Leadership Roles in Promoting More Cost-Effective Energy Efficiency Programs

Paul Bony

Residential Marketing Manager, ClimateMaster, Int'l

Keywords

Carbon footprint, energy efficiency, geothermal heat pumps, loop lease, renewable energy

ABSTRACT

A utility, in addition to providing many other services, is in the business of delivering energy services that provide affordable comfort to its customers. The customers want to have their homes and offices at a comfortable temperature and humidity throughout the year … and they want that service delivered at an affordable price.

This paper describes how a utility can enhance its bottom line and its customer relationships by deploying an aggressive geothermal heat pump (GHP) program that meets the residential and commercial heating, ventilation, and air conditioning (HVAC) needs of its customers. Also, a GHP program can provide additional value to the utility because it can be melded into existing residential and commercial energy efficiency programs, such as a Residential Air Conditioning Load Management Program.

In new construction, the program consists of installing the GHP systems while the structure is being built. In existing commercial and residential facilities, the program consists of removing the HVAC systems and replacing them with GHP systems. GHP technology is a proven method of delivering comfort. GHP technology has been applied in the US for over 50 years. Despite the technology's track record of proving affordable comfort in a cost effective and energy efficient manner, its market penetration has not significantly improved. Historically, barriers – such as inexpensive natural gas, lack of knowledge, high first costs, and inadequate infrastructure support – have prevented the technology from taking hold.

This paper describes ways for the utility to implement GHP programs which will:

1. Push through the barriers,
2. Meet regulatory goals to put more energy efficiency into place,
3. Enhance customer relationships, and
4. Improve the utility's bottom line.

Introduction

GHP Technology has been providing affordable heating and cooling to homes and businesses for over 60 years. The technology has proven to be robust and has reduced energy use by 30-50% over conventional HVAC systems. In addition, because the equipment used is less exposed to weather and vandalism, its life cycle is longer than other heating and cooling options.

The technology is embraced by some utilities – particularly those in rural areas where homes and offices are heated with propane furnaces. The utilities offer rebates of $300 – $800 per ton to their customers to install them because the systems improve the utilities' load factor. Despite the proven track record, the market penetration of GHP systems remains below 2%. What conditions in the marketplace exist that prevent the technology from taking hold?

A December 2008 Oak Ridge National Laboratory Report described the barriers to GHP system adoption and methods to overcome them. The barriers include

1. High first costs in installation,
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

Pushing Through the Barriers

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.

Education

The utility can conduct timely educational workshops and training programs to maintain and enhance energy awareness and skill levels for all stakeholders. The curriculum will address the needs of the audience. For example, customer workshops focus on home energy use, ways to control energy use, the cost and benefits of energy efficiency improvements, and how they can participate in the pilot project. In another example, installer workshops focus on site analysis, GHP design considerations, and installation techniques.

Site Selection

In parallel with Step One, utilities can select customers' buildings for willingness and adequacy for GHP system installs. Willingness can come from a variety of sources. For example, utilities can solicit interest from low income customers, housing authorities, or a pool of customers developed by their residential energy services staff. Another option is the use of one or more of a combination of bill stuffers, media ads, and public meetings to announce the pilot program and solicit interest from a broad range of customers.

Once willing customers are identified, utilities can perform the energy audit and building shell tests. The audit and tests include review of historic energy use and site conditions, equipment and building inspections, and blower door and duct tests. The personnel conducting the audit and tests can generate a report on the findings. The report provides energy efficiency and demand response recommendations and permission from the homeowner, property manager, or landlord for contractors and equipment access.

Installation and Commissioning

Utility selected contractors install the recommended energy efficiency improvements. With GHP systems, retrofit installations require a light weight drilling rig and excavation equipment to enter onto the property and drill a series of holes and trenches, typically in either the front or back yard. The equipment is designed to fit through a section of fence. The equipment can cause temporary damage to landscape such as trees, lawns, and shrubbery. Landscape repair can be included in the installation costs. After installation, Utility or contract staff can commission the GHP system to validate that it was installed properly and works as performed. The HVAC commissioning includes duct temperature measurements in both the heating and cooling cycles.

Program Evaluation and Revision

Utility or contract staff can evaluate the long term GHP system performances and compare them with projected energy usage and savings. Based on the evaluation, the utility may alter the program design and implementation. The alterations could include adjusting incentives and ancillary services.

For example, drilling and loop installation represent a significant first cost investment with GHP systems. Program evaluation is likely to show that drilling costs drop if the equipment and workforce were used more effectively in an area wide retrofit program – moving from house to house down a street rather than across the town doing single installs in one residential area after another. The first costs could also be mitigated with funding mechanisms such as rebates, tax credits, conservation bonds, and loans so that the customer's check to pay the loan amount is substantially less than the savings achieved by reduce energy use.

The utility can also evaluate the acceptance and benefits of loop leasing. Loop leasing eliminates the first cost barrier and allows the participant to achieve an immediate positive cash flow, because the utility bill reduction is more than the payment on the loop lease.

The program evaluation process could show "non-energy" benefits such as improved health and safety, quieter operation, and reduced exposure of equipment to weather and vandalism. The evaluation process could also identify ways to break down the barriers to implementing similar GHP programs across the country.

Meeting Regulatory Goals

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 source energy savings of GHP vs. conventional HVAC equipment. The report tracks energy usage in a Habitat for Humanity Project near Oklahoma City, OK. The project uses 2 ton CM Heat Pumps to space condition small homes in Oklahoma Gas and Electric's service territory. 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.

Enhancing Customer Relationships

The customers who install GHP systems will benefit in the pocket book. The same Habitat for Humanity report cited above estimates that customers will save $250 annually per ton on their utility bill. The customer's share of the GHP system cost (the costs of installation over and above the rebates, tax credits, and other incentives) is $150 annually per ton. The net savings is $100 annually per ton. Escalating energy prices will drive this net savings higher in the future. Avoiding the meter charge of natural gas delivery will also put money in their pockets.

GHP programs can dovetail into Community Action Agency activities. These activities target auditing and weatherization upgrades to average to below average income housing. Coordination with the agencies will result in even more energy savings. When using GHP systems, customers will discover that they

are sustainable. Current GHP efficiencies of 400% are typical benchmarks. This efficiency level means that the systems provide 4 units of energy for every unit consumed by the heat pump. Heat pumps outlast conventional HVAC systems because most of the equipment is indoors and not subject to weather damage or vandalism. The ground loops are even more sustainable. Once installed, they can operate efficiently for 50 years or more. GHP systems are kinder on the environment, too. Based on Habitat for Humanity report cited above, annual CO2 emissions are reduced by one ton for each ton of GHP installed. Customers who use GHP in their homes and businesses will realize the benefits and appreciate the utility's leadership in bringing a good program to their doorstep.

Improving the Utility's Bottom Line

The Oklahoma Municipal Power Authority (OMPA) has determined the extent that GHP systems improve its bottom line. OMPA serves 36 communities in Oklahoma, ranging in size from less than 300 people to almost 80,000. OMPA mainly serves residential loads. OMPA has a summer peak of almost 700 MW, dropping to less than 300 MW during the winter. OMPA has a diversified fuel mix with renewable energy (wind and hydro) ranging from 20% in an average year up to 30% in a wet or windy year. The large percentage of renewable energy, coupled with the low winter usage, creates an environment where optimum usage of OMPA's renewable energy is difficult. Further development of off-peak consumption, such as GHP program implementation, will improve OMPA's ability to optimize the renewable portfolio. Likewise, high-efficiency GHP air conditioning will reduce summer peak demand and defer the requirement for additional development of thermal power plants.

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.