THE CASE FOR EXPANDING BENEFICIAL ELECTRIFICATION WITH GROUND SOURCE HEAT PUMPS
INTRODUCTION

Ground source heat pumps (GSHPs) are a well-established electrification technology that provides high value to all electric utility stakeholders. The GSHP industry stands ready to assist electric utilities in increasing the adoption GSHPs by providing education and advocacy efforts. It is focused on developing a favorable policy and regulatory environment for the Beneficial Electrification (BE) of thermal space conditioning and water heating, which in turn provides new electric utility renewable energy revenue opportunities.

BENEFICIAL ELECTRIFICATION AND THE CASE FOR GSHPS

Concerns about climate change, rapid reductions in the cost of renewable electric generation, the battery storage revolution and the increasing desire of customers to participate in their energy production and consumption, all point to a wave of conversions from fossil fuels to electric end uses. This electrification will provide electric utility companies a huge opportunity to obtain cost-effective load growth and new revenue opportunities.

Beneficial Electrification (BE), also called “Environmentally Beneficial Electrification,” promotes the electrification of energy end uses currently powered by fossil fuels (natural gas, propane, gasoline, diesel and fuel oil) including transportation, space conditioning and water heating with low or no carbon electricity. As the U.S. electric supply becomes less carbon intensive, beneficial electrification is the quickest and best path for the United States to reach meaningful reductions in carbon dioxide and other greenhouse gas emissions. Ground source heat pumps can play a key role in this transformation. GSHPs provide other electric utility benefits including improved load factor by reducing peak demand and increasing off-peak kWh sales. Electric utilities can expand their revenue by rate basing GSHP loops and/or equipment or providing other renewable thermal energy services to their customers.

As outlined in the Oak Ridge National Laboratory report, “Geothermal (Ground-Source) Heat Pumps: Market Status, Barriers to Adoption, and Actions to Overcome Barriers December 2008,” if the U.S. buildings sector sets a goal to use the same amount of nonrenewable primary energy in 2030 that it did in 2008, it is estimated that 35 to 40 percent of this goal, or
a savings of 3.4 to 3.9 quads annually, could be achieved through aggressive deployment of GSHPs. GSHPs have the potential to offset about 35 to 40 percent of the projected growth in total building energy consumption between now and 2030. This would equate to an estimated annual carbon emissions reduction of 356 metric tons. As electricity becomes greener, the environmental benefits of GSHPs will increase.

Unlike electric vehicle charging that can negatively impact utility peaks, GSHPs reduce peak demand in the summer by approximately 2 kW per home. For cooling dominated commercial buildings, GSHPs reduce peak demand across all seasons. GSHPs also decrease peak winter demand in homes heated with air source heat pumps or electric resistance heating. In general, properly sized GSHP systems will reduce peak utility loads, allowing “room” for electric car charging capacity while providing an improved annual load factor for the utility. By replacing fossil fuel space and water heating, GSHPs will also increase a utility’s annual kWh sales at a high annual load factor. This annual kWh increase per average home can easily exceed the kWh gained from an electric vehicle at a higher load factor.

THE GSHP INDUSTRY CAN PROVIDE EDUCATION AND ADVOCACY

There are barriers to GSHPs becoming a major component of beneficial electrification. After first cost (which will fall with greater market adoption) these barriers fall into two interrelated categories, legislation and regulation. While these public policy arenas are currently blocking many utilities from embracing GSHPs as a beneficial electrification platform, the GSHP
industry has been successful in working with electric utilities to affect changes in support of beneficial electrification. The conventional regulatory belief that electric efficiency and renewable electricity can make a significant impact on climate goals is just wrong. Even if the electric power sector aggressively pursues full decarbonization by 2050, removing 36 percent of future energy-related greenhouse gas (GHG) emissions, the U.S. will still be well above its long-term GHG goals as originally included in the Paris Agreement. A linear electric power decarbonization trend between 2015 and 2050 still leaves the U.S. 2,400 million metric tons short of reaching the goal of an 80 percent carbon dioxide reduction from 1990 emissions by 2050. To achieve 80 percent reductions relative to 1990 emissions, carbon savings have to come from the non-electric sectors (Electrification Emerging Opportunities for Utility Growth - Brattle Group Jan. 2017).

The GSHP industry stands ready to support electric utilities in changing this regulatory mindset that an increased use of electricity is undesirable. An active effort on the part of the GSHP industry with support from the environmental community can change this mindset and gain support for efficient low-carbon electrification. The GSHP industry has already succeeded in bringing a favorable regulatory focus to the following policy topics:

- Beneficial Electrification as an expansion of the Renewable Portfolio Standards (RPS)
- GSHP net thermal savings (in Btus) as RPS offsets
- Thermal Renewable Energy Certificates (TRECs)
- Renewable Thermal Standards (RTS)
- Fuel switching restrictions
- Poorly designed Standard Practice Tests
- Utility ownership of GSHP loops and equipment (third party ownership)
- Tax treatment for utility/third-party owners of GSHP assets
- Building codes (Ex. Title 24 in California) that favor natural gas space and water heating
- Inspection, licensing and construction barriers

FAVORABLE UTILITY REGULATION

Electric utilities have faced many regulatory obstacles to embracing GSHPs. This environment is rapidly changing as the carbon footprint of electricity is getting smaller while more and more natural gas is being produced from fracking. The increasing focus on total (system) carbon emissions, the forecast ending of historically low natural gas prices and the growing awareness of negative externalities related to natural gas production through fracking, will place increasing pressure on policy makers to incorporate beneficial electrification into the electric utility regulatory framework. The GSHP industry has developed advocacy and educational efforts that support beneficial electrification and the expanded use of GSHPs in the following areas:

Exemption of Beneficial Electrification End Uses from Targeted (DSM) Electric Savings

Regulators have focused on reducing kWh consumption based on the old framework of Demand Side Management (DSM) to reduce expensive kWh generation. With an expanded use of flexible gas generation and an abundance of low-cost wind, solar and other renewable generation, the time has come for
regulators to focus on total carbon emissions. The GSHP industry has advocated for the exemption of beneficial electrification programs from DSM electric savings goals. The industry has also advocated for an increased focus on fossil fuel energy savings mandates to spur the growth of beneficial electrification technologies. While efficiency will continue to be a goal of utility regulation, beneficial electrification needs to be given a dedicated regulatory focus of its own with regulators establishing separate metrics and policies for efficiency and beneficial electrification.

**Fair Rate Design**

GSHPs provide peak demand reduction (.55 kW to .88 kW summer peak reduction per ton of installed GSHP) and significant annual kWh increases. Standard rates do not recognize the benefits GSHPs bring to the grid. Fair rate design recognizes the load factor improvements provided by GSHP systems over traditional gas furnace and air conditioning installations. There is a strong argument that the increased kWh consumption and load factor of GSHP buildings versus conventional HVAC and water heating systems generates more net revenue for the electric utility for the same fixed cost of electric delivery. These increased revenue contributions should be equalized to the baseline fossil fuel buildings via lower rates. If electric vehicles are given favorable (lower) rates, then the same should apply to GSHP systems. Utilities can and should provide GSHP rates that reflect these benefits. This approach serves the dual purposes of allowing customers to reduce their overall energy use (and costs) and encouraging beneficial electrification.

**Removing Fuel Switching Barriers**

In a low carbon economy powered by renewable energy the value of heat pump technology is obvious. However, heat pumps face a regulatory barrier against “fuel switching” that prevents electric companies from engaging in program efforts that involve moving from natural gas to efficient electric end uses. The fuel switching argument has prevented widespread adoption of heat pumps. Fuel switching prohibitions deny customers a choice in their energy systems and are out of place in a market moving to renewable energy, on-site electric storage and rapidly evolving energy management. Simple language successfully promoted by the GSHP industry in Oklahoma can remove the fuel switching barrier for beneficial electrification:

> “Fuel switching means changing from natural gas to electricity or from electricity to natural gas for a particular end use service or installing electric heating devices in new construction where natural gas service is available or can be economically made available. It does not include installation of any device that relies primarily on on-site renewable energy, such as, but not limited to, a solar water heater, geothermal heat pump, or biomass gas-powered furnace. For new construction, an electric utility shall not offer customer or builder incentives for the use of specific electric equipment or appliances with the exception of programs or measures that promote renewable technologies such as geothermal, solar and other renewable resources.”
Improved Standard Practice Tests

GSHPs often face a disadvantage under the standard practice tests. Total energy bill savings are the most important reason customers upgrade to GSHPs. However, the total resource cost (TRC) test often looks only at electric savings and ignores the fossil fuel savings benefits while counting the full (or incremental) cost of the GSHP system. In heating dominated climates, electric utility GSHP programs cannot pass the TRC even though customers have cost effective total energy bill savings. The GSHP industry has been successful in changing the TRC to recognize GSHPs. Illinois statutes were modified to include GSHPs by changing the statutory definition of energy efficiency to be expressed as “the reduction of energy consumed expressed in Btus for an end use.” This modification to express program efficiency results in Btus allowed GSHPs to get credit for heating and hot water production efficiencies against fossil fuels.

Revised Technical Reference Manuals

Technical Reference Manuals (TRMs) developed to support the standard practice test process with metrics including the useful life of a measure, expected energy savings, customer costs and measure costs can be poorly written in regards to GSHPs. The GSHP industry corrected the TRM in Illinois by changing the useful life of a GSHP from 15 years to 25 years. Commonwealth Edison Company, the largest electric utility in Illinois, was then able to pass the TRC for its GSHP program. Recognizing the non-energy benefits of GSHPs, including source calculations for the cost and environmental impact of the fossil fuel savings versus electricity back to the production source for both fuels, will also support greater adoption of GSHPs as part of beneficial electrification. If the nation’s regulatory policies increase the inclusion of all the social and environmental costs tied to carbon, those electric utilities with plans and processes to embrace BE and refrigerant-compression technology will experience greater rate stability by avoiding carbon penalties charges. GSHPs boost gains because underground thermal resources lower summer peak demand of a resource that is becoming cheaper and more carbon-free, every year.

GSHPs Provide New Utility Opportunities

Electric utilities are facing unprecedented threats to their economic model. Reduced consumer demand driven by increasingly efficient energy products, coupled with a growing market for distributed (non-utility owned) generation is driving utilities into a higher cost, lower margin business. According to a National Renewable Energy Laboratory study, the potential for rooftop solar photovoltaic could easily erase any currently forecasted utility sales growth and possibly even lead to non-trivial reductions in utility sales over the coming decades (Brattle – Electrification Emerging Opportunities for Utility Growth – January 2017).

GSHPs offer utilities an opportunity to increase their revenue by offering renewable energy services. Utility ownership of GSHP loops can provide electric utilities with increased kWh sales, improved load factors and a return on new capital (GSHP loop) assets. GSHPs also provide electric utilities an opportunity to manage inverter driven compressors, providing...
the ability to float loads with grid demands. This opens the door to a new era of actively managing customers’ energy use as a service. New, innovative load management tools powered by two-way communications will make GSHPs an integral part of the smart grid. This service can be accelerated by allowing utilities to put investments into GSHP loops and/or equipment into their rate base. This new revenue opportunity can be classified as a Renewable Thermal Revenue. In simple terms, utility loop ownership will open new revenue sources by monetizing the value of moving heat to desired end uses, capturing the zero marginal cost to move energy to and from the ground via the utility owned system, earning revenue from a new 100 year asset class, earning a new “clean fuel” income stream and increasing capital investment that can earn an authorized rate of return.

BE and utility renewable thermal revenue provide new opportunities for utilities to break out of the “death spiral.” Utilities can and should include GSHPs in their beneficial electrification efforts. Utilities have a central role to play as a nexus for stakeholders in the expanded implementation of GSHPs. With deep connections to their customers’ utilities, they can effectively communicate the economic and environmental value of GSHPs. GSHP installers, equipment distributors and manufacturers can support electric utilities with quality installations connected to load control and performance monitoring tools. GSHPs are positioned to be an integral, efficient part of the “internet of things” by providing cost-effective energy and energy management strategies for the renewable energy powered grid. Utilities can develop a range of customer outreach and engagement strategies to leverage their customers’ space conditioning needs, comfort, health and environmental values.

The conversion of fossil fuel heating and water heating to GSHPs will improve grid economics by achieving higher load factors, reduce emissions by aligning space conditioning and water heating with low carbon generation, reduce grid stress and maintain grid stability by minimizing peak demand across all seasons and reduce the need for new peak generation and distribution capacity. These benefits can be leveraged with load management tools. Utility GSHP programs also provide opportunities for key account services eager to provide new value propositions to commercial and industrial customers. The GSHP industry is prepared to become an active partner to help shape the relevant policies, regulations and standards for this electrification future.