The Case for Expanding Electrification with Ground Source Heat Pumps

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

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Introduction
The geothermal heat pump industry is poised to play a significant role in the rapid electrification of space and water heating that provides peak load reduction, improved load factors and opportunities for new electric utility revenue.

Beneficial Electrification – and the Case for GHPs
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/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 (GHPs) can play a key role in this transformation.

GHP’s provide other electric utility benefits including improved load factor from reducing peak demand and increasing off-peak kWh sales. Electric utilities can expand their revenue by rate basing GHP loops and/or equipment or providing other renewable thermal energy services to their customers.

As outlined in the ORNL report - Geothermal (Ground-Source) Heat Pumps: Market Status, Barriers to Adoption, and Actions to Overcome Barriers December 2008, if the U.S. buildings sector set a goal to use the same amount of nonrenewable primary energy in 2030 than 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 GHPs. GHPs 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 million Mt. As electricity becomes greener the environmental benefits of GHPs will increase.

Unlike electric vehicle charging that can negatively impact utility peaks, GHPs reduce peak demand in the summer by approximately 2 kW per home. For cooling dominated commercial buildings GHPs reduce peak demand across all seasons. GHPs also decrease peak winter demand in homes heated with air source heat pumps or electric resistance heating. In general, properly sized GHP systems will reduce peak utility loads, allowing “room” for EV charging capacity while
providing an improved annual load factor for the utility. By replacing fossil fuel space and water heating, GHPs 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 GHP Industry Can Provided Education and Advocacy Supporting Favorable GHP Policy**

There are barriers to GHPs 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 GHPs as a beneficial electrification platform, the GHP industry has been successful in working with electric utilities to effect needed changes in support of the 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 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 CO2 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 GHP 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 GHP industry with support from the environmental community can change this mindset and gain support for efficient low-carbon electrification. The GHP 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
- GHP 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 GHP loops and equipment (3rd party ownership)
• Favorable Tax Treatment for Utility/Third-Party Owners of GHP 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 GHPs. 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 GHP industry has developed advocacy and educational efforts that support beneficial electrification and the expanded use of GHPs 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 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 GHP industry has advocated for the exemption of beneficial electrification programs from DSM electric savings goals. Our 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 with regulators establishing separate metrics and policies for efficiency and beneficial electrification.
**Fair Rate Design**
GHP’s provide peak demand reduction (.55kW to .88kW summer peak reduction per ton of installed GHP) and significant annual kWh increases. Standard rates do not recognize the benefits GHPs bring to the grid. Fair rate design recognizes the load factor improvements provided by GHP systems over traditional gas furnace and AC installations. There is a strong argument that the increased kWh consumption and load factor of GHP buildings vs. 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, the same should apply to GHP systems. Utilities can and should provide GHP rates that reflect these benefits. This approach serves the dual purposes of allowing all customers to reduce their overall energy use (and costs) while 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 GHP 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**

GHPs often face a disadvantage under the standard practice tests. Total energy bill savings are the most important reason customers upgrade to GHPs. However, the TRC test often looks only at electric savings and ignores the fossil fuel savings benefits while counting the full (or incremental) cost of the GHP system. In heating dominated climates electric utility GHP programs cannot pass the TRC even though customers have cost effective total energy bill savings. The GHP industry has been successful in changing the TRC to recognize GHPs. Illinois statutes were modified to include GHPs 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 GHPs to get credit for heating and hot water production efficiencies against fossil fuels.

**Revised Technical Reference Manuals**

Technical Resource 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 GHPs. The GHP industry corrected the TRM in Illinois by changing the useful life of a GHP from 15 years to 25 years. ComEd was then able to pass the TRC for their GHP program. Recognizing the non-energy benefits of GHPs 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 GHPs as part of beneficial electrification.

**GHP’s 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 an NREL study, the potential for rooftop solar PV 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).
GHPs offer utilities an opportunity to increase their revenue by offering renewable energy services. Utility ownership of GHP loops can provide electric utilities with increased kWh sales, improved load factors and a return on new capital (GHP loop) assets. GHPs also provide electric utilities an opportunity to manage inverter driven compressor 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 2 way communications will make GHPs an integral part of the smart grid. This service can be accelerated by allowing utilities to put investments into GHP 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.

Beneficial electrification and utility renewable thermal revenue provides a new opportunities for utilities to break out of the “death spiral”. Utilities can and should include GHPs in their beneficial electrification efforts. Utilities have a central role to play as a nexus for stakeholders in the expanded implementation of GHPs. With deep connections to their customers utilities can effectively communicate the economic and environmental value of GHPs. GHP installers, equipment distributors and manufacturers can support the electric utilities with quality installations connected to load control and performance monitoring tools. GHPs are positioned to be an integral, efficient part of the “internet of things” 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 GHPs 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 GHP programs also provide opportunities for Key Account Services eager to provide new value propositions to commercial and industrial customers. The GHP industry is prepared to become an active partner to help shape the relevant policies, regulations, and standards for this electrification future.

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This paper was prepared for IGSHPA by the Advocacy Committee under the direction of Board Member Paul Bony.

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