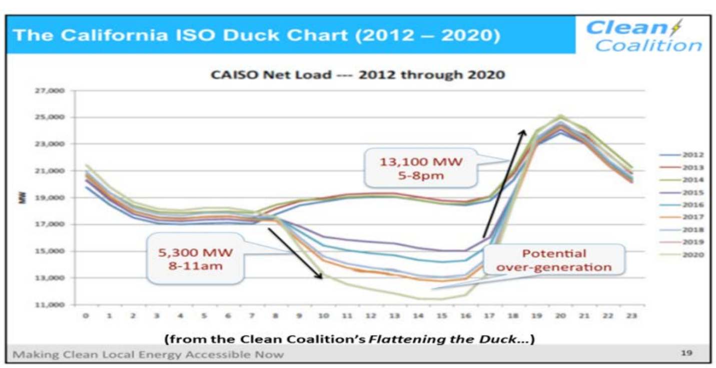
Action Plan to Expand the Market for Ground Source Heat Pumps in North America

IGSHPA Advocacy Committee

This document summarizes the action plan developed by the IGSHPA Advocacy Committee to expand the markets for ground source heat pumps in the U.S. This plan is designed to accomplish three mutually supporting goals designed to grow the GHP market by positioning GHPS as an ideal technology supporting the objectives of climate, renewable energy and utility stakeholders. Creating a favorable policy and regulatory environment through education and advocacy will enable utilities (electric, gas and water) to participate in the GHP industry through Beneficial Electrification (BE) and or thermal revenue up to third party ownership of loops and/or equipment. This paper was developed to promote Ground Source (GS) space conditioning and water heating by providing the industry with the talking points and resources necessary to:

1. Educate and engage federal, state and local governments to develop policies and regulations that support the beneficial electrification of space conditioning and water heating, in a cooperative effort with other beneficial electrification partners like the electric vehicle industry. This would encompass the promotion of Thermal Renewable Energy Certificates (TRECs) issued under expanded Renewable Portfolio Standards. In appropriate markets, primarily where opposition is building against natural gas, a more aggressive approach would focus on the adoption of Renewable Thermal Standards (RTS) for fossil fuel end uses, in partnership with other renewable thermal industries (biomass, solar thermal). In all target markets this legislative effort would also champion the removal of barriers to beneficial electrification, including fuel switching restrictions, unfair Standard Practice Test restrictions, and restrictions against utility load building programs.
2. Engage electric utility regulators and the governing boards of public utilities and electric co-ops to adopt beneficial electrification through marketing and program implementation efforts that bring economic value to their respective utilities.
3. Engage utility regulators (public utility commissions) to obtain fair electric rates that recognize and support the value of beneficial electrification to the electric grid.

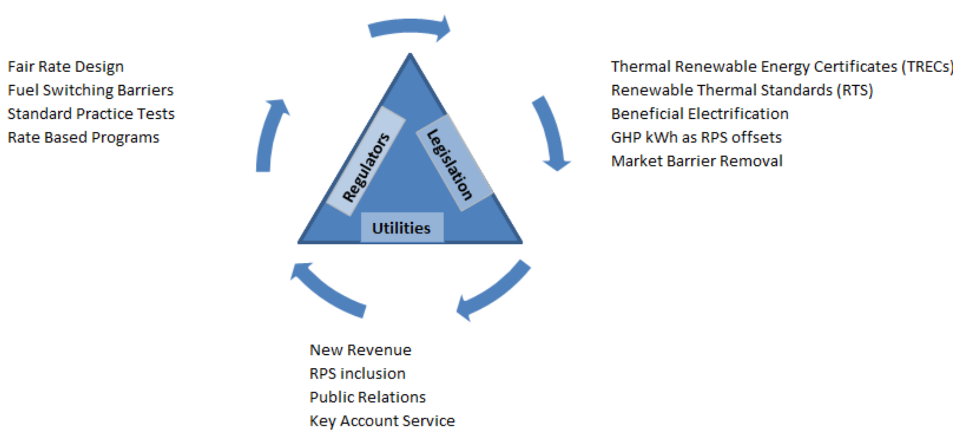


Step one will be the development of a white paper that outlines the talking points, value proposition(s), and implementation plan(s) for these three focus points. This will be used as the "pitch" for step two.

Step two will be the Identification of outside associations, foundations, organizations and agencies that support the goals of beneficial electrification, renewable energy adoption and the advancement of a low carbon economy. Once developed, this target list will be approached for financial and other support in advancing the three target areas.

Step three will begin after adequate funding is in place. This will be a focused outreach effort initially targeting states and utilities with high probabilities for early success. Early successes will be leverage for greater adoption across the U.S. This will require the development of template legislation, technical information and rate structure proposals for utility regulators, and utility focused economic analysis tools and program design and implementation templates. State chapters and industry players will be included in the engagement effort. A sub-set of this outreach could include a grass-roots industry education effort to position participants to engage their respective utilities, regulators and government officials. This can be a collaborative effort with active participation and support from both IGSHPA and GEO.

When a final outline is approved by the committee, work can begin on fleshing out the talking points and action items for the three target area outlined above and shown in the following graphic.

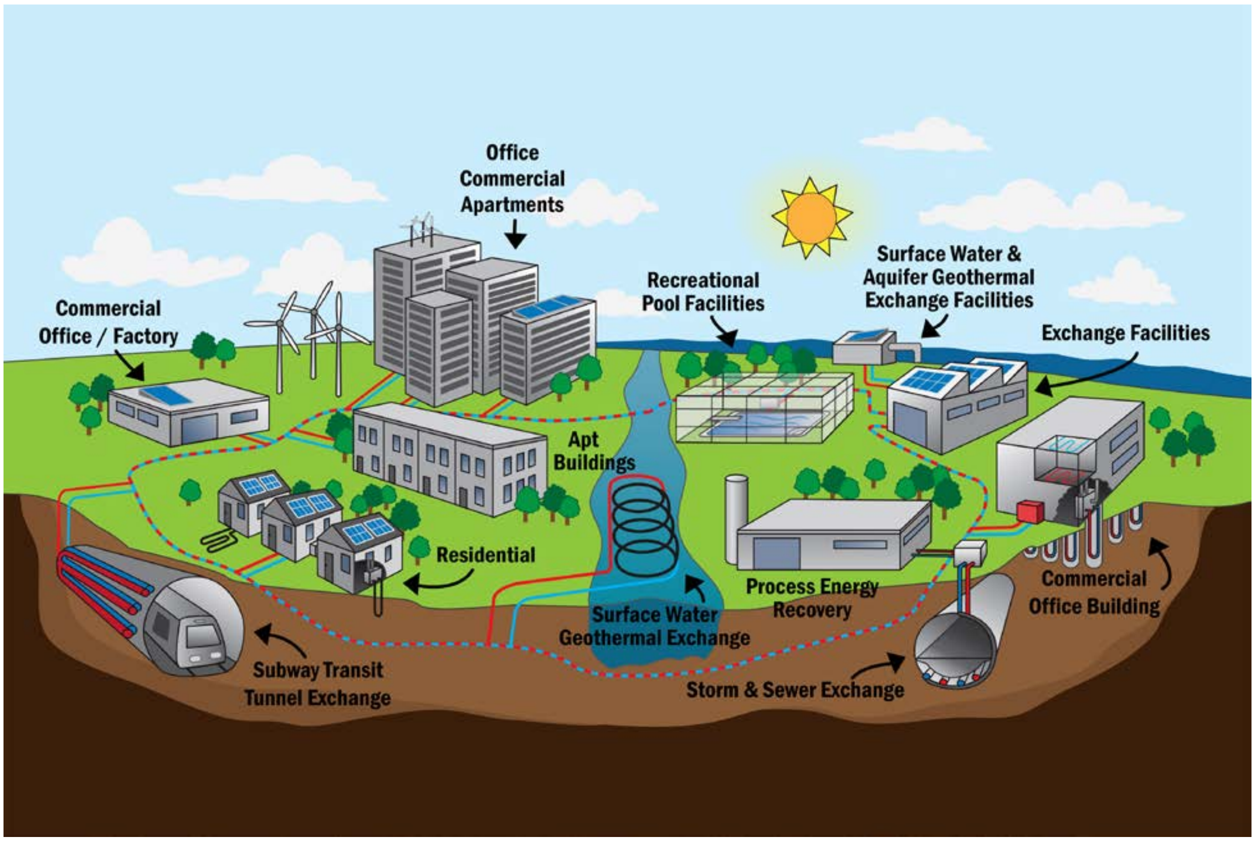


Adopted Policy Committee 3-13-17
Adopted by IGSHPA Board of Directors

The three goals outlined above will promote Beneficial electrification, reduce carbon emissions and support an increase in beneficial use kWh sales leading to a decarbonization or reduced carbonization of electric generation, the adoption of Geothermal Heat Pumps for space and water heating and cooling, and the adoption of other beneficial electrification end uses including electric vehicles.

The Role of Ground Source Heat Pumps in Beneficial Electrification:

Opportunities, Barriers and Discussion



Educational graphic ©EggGeothermal Consulting 2017

"We want energy that is made in America, that is good for America and good for American jobs," Energy Secretary Rick Perry - in his address to more than 2,100 co-op leaders gathered for NRECA's Legislative Conference in Washington, D.C., 2017

"We believe stored electricity, increasingly derived from renewable sources, will entirely replace fossil fuels as the preferred method to power everything in our lives" Andrew Beebe, a managing director at Obvious Ventures, December 10, 2015.

"We learned there's no sucker's choice here. You can have a healthy economy and have a healthy environment at the same time." Gerry Anderson, DTE Energy CEO

"It's really quite simple. We've overloaded the atmosphere with heat-trapping gas and the rest are just details." – Professor Jason Box, Geological survey of Denmark and Greenland

Introduction

This paper was written to provide geothermal industry contractors, distribution partners, manufacturers, customers and friends a short overview of the important role the geothermal heat pump industry can play in supporting a rapid transformation from a fossil fuel powered world to a clean, productive and prosperous low carbon economy. The GHP industry can use the information provided in this paper to develop a dialog with environmental and policy groups, local and state officials and congressional representatives to promote discussions on beneficial electrification and the supporting role of GHPs. The information provided is targeted at 3 primary audiences, utilities, policy makers and utility regulators. By design this paper discusses topics at a high level. IGSHPA will continue to advance this effort through the collection of a library of in-depth papers, studies and policy documents.

Beneficial Electrification – and the Case for GHPs

Beneficial Electrification (BE), also called "Environmentally Beneficial Electrification", is a rapidly developing concept that promotes the aggressive 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. GHX or GS can play a key role in this transformation.

Increasing concerns about climate change risks, game changing improvements 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 massive wave of conversions from fossil fuels to electric end uses. The two primary technologies capable of converting significant carbon emitting fossil fuel end uses to carbon free electric consumption are electric vehicles and electric compressors for space and water heating. Converting our economy to these low/no carbon electric end uses will also provide electric utility companies a huge opportunity to reverse their current low/no growth business while providing a platform for continuing the robust growth of carbon free electric generation. This becomes a utility win while reaching the deep economy-wide decarbonization needed to minimize the risk of catastrophic climate change. The rapid electrification of transportation, space heating and water heating can eliminate as much as 45 percent of current U.S. greenhouse gas (GHG) emissions, using existing American manufactured technology.

In addition to reducing carbon emissions, GHP's also provide other electric utility benefits including improved load factor from reducing peak demand and increasing off-peak kWh sales. While this paper focuses on beneficial electrification, all utilities, electric, gas, water and sewer, can expand their revenue by rate basing (investing capital) GHP loops and/or equipment to provide renewable thermal energy services to their customers. This 3d party ownership model is also available to non-utility operators and investors.

Electric vehicles (EVs) also represent a large potential market for increasing utility kWh sales through beneficial electrification. Unlike GHPs, EVs have a very high potential to negatively impact utility peak loads (perhaps by creating peaks at new times). Avoiding "charging" peaks will require investments in new or expanded utility load management tools. Even with these tools, EVs will have a lower load factor than GHP's and will not provide as large of an opportunity for utility companies to expand their rate base. Today, EVs have more market (and media) attention than GHPs. The GHP industry needs to educate the utility industry on the parallels between EVs and GHPs and the beneficial electrification and decarbonization benefits that will result from an increased use of GHPs for space heating and water heating. While every home does not have a car, every car has a home.

According to 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 could also offset the need to build 91 to 105 GW of electricity generation capacity, or 42 to 48 percent of the 218 GW of net new capacity additions projected to be needed nationwide by 2030. In addition, DOE's recent study shows $49.8 Billion annually (at 2014 rates) in reduced utility bills could be achieved through aggressive deployment of GHPs. Considering residential and commercial building markets, both new construction and retrofits, it is estimated that GHPs have the potential to reduce non-renewable primary energy consumption in buildings by 3.4 to 3.9 quads 4.5 quads in site energy and 5.7 quads in source energy annually by the year 2030. Since buildings currently consume about 40 quads of non-renewable primary energy annually, and are projected to consume 49.5 quads in 2030, GHPs have the potential to offset about 35 to 40 percent of the projected growth in 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. The greening of the electric grid is happening at an ever increasing pace. On April 30, 2017 Germany established a new national record for renewable energy use with 85% of all the electricity consumed being produced from renewables such as wind, solar, biomass, and hydroelectric power. As the carbon footprint of electric generation drops, the percentage of total carbon emissions from fossil fuel space and water heating will become bigger.

While an increased adoption of GHPs will bring many benefits to society, there are major barriers standing in the way of GHPs becoming a major component of beneficial electrification. After first cost, these barriers fall primarily under two interrelated categories, legislation and regulation. Combined, these public policy arenas are blocking many utilities from embracing GHPs as a beneficial electrification tool. The first cost barrier will fall with greater market adoption.

Education and Advocacy Supporting Favorable GHP Policy and Regulation

The policy goal of reducing electric end uses through efficiency and the conversion of electric loads to fossil fuel end uses was founded in the late 1970's and early 1980's on a few core assumptions. First, for the first time in the history of electric production, the incremental cost of producing the next kWh had become higher than the cost of producing the previous kWh. New, bigger plants had higher construction and operating costs than legacy plants. Second, it was recognized that there was a lot of inefficiency in the electric sector that could be cost effectively reduced by using efficiency to extend the coverage of the existing generation fleet while reducing customers' electric energy bills. This thought process started the era of Demand Side Management (DSM) where efficiency was placed into utility Integrated Resource Plans as a competing alternative to building new generation.

A decade or so later, beginning in the 1990's governments began to recognize the value of renewable electric generation as a tool to promote environmental improvements. Legislation supporting the adoption of Renewable Portfolio Standards (RPS) requiring electric utilities to obtain a fixed percentage of their generation measured in megawatt or megawatt-hours from renewable energy sources began to sweep the country.

Both the DSM and RPS efforts have been highly successful and the importance of efficiency will continue. However, this legacy legislation and the resulting legacy regulatory mindset that requires (primarily electric) utilities to reduce peak electric demand and energy sales is now in conflict with the urgent societal goal of reducing total carbon emissions. As an example, Colorado in early 2017 passed legislation renewing the mandate that the state's Public Utilities Commission create electric efficiency goals for the state's two investor-owned electricity providers, requiring them to reduce peak demand and energy sales by 5% of their 2018 base year by 2028. While GHPs could play a key role in reducing peak demand, they cannot support a reduction in annual kWh sales in Colorado's heating dominated climate. Consequently, there is no incentive for the electric utilities to invest in carbon reducing, demand clipping and energy sales increasing GHP's. The only way GHP systems can be supported by a utility under this legislation would be if environmentally beneficial electrification was exempted from the mandated kWh reduction goals. Colorado's electricity has a high carbon content, but the amount of the state's electricity generated using coal has dropped over 20% from 2001 to 2017. Even with

Colorado's relatively high carbon electricity, an average residential GHP retrofit from natural gas (4 tons) will save approximately 1 metric ton of CO_2 per year. The societal goal to decarbonize energy is in direct conflict with this legacy DSM legislation to reduce electric consumption. Colorado is not alone in this regulation paradox.

The mainstream regulatory belief that electric efficiency 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 CO_2 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)

To position GHPs as a beneficial electrification technology the GHP industry needs to change this embedded legislative mindset that an increased use of electricity is always undesirable. Decades of electric energy efficiency mandates, programs and regulatory goals have created an institutional bias against GHPs in heating dominated markets where they increase annual electric consumption while reducing carbon emissions. An active effort on the part of the GHP industry with support from the environmental community will be required to change this mindset and eliminate the failure to recognize the value of replacing carbon heavy fossil fuel consumption with super-efficient low-carbon electric replacements. The following is a list of legislative platforms that can be used to support the GHP industry and the vision of beneficial electrification.

Beneficial Electrification as an expansion of the Renewable Portfolio Standard Movement:

Concern over emissions and climate change has led over half of the states to enact "renewable portfolio standard" (RPS) legislation requiring regulated electric utilities to obtain some portion of their power requirements from sources defined as renewable. After a start in the early 1990's, RPS policies are now in place in 29 States and the District of Columbia, and apply to utilities responsible for 55% of total U.S. retail electricity sales. More than half of all growth in renewable electricity generation (60%) and capacity (57%) since 2000 is associated with state RPS requirements. Existing RPS requirements could require an additional 60 GW of renewable electricity (RE) capacity by 2030, roughly a 50% increase from current non-hydro renewable energy capacity (114 GW through 2015). So far, utilities have been successful in achieving their RPS requirements with states collectively meeting roughly 95% of their interim RPS targets in recent years. With states revisiting and revising their RPS requirements, the timing is right to expand this legislative tool to include a new focus on reducing the carbon emissions from burning fossil fuels through beneficial electrification.

GHP kWh as RPS offsets through RPS inclusion

A rapid path to incorporating Beneficial Electrification into the RPS frame work can come from the inclusion of GHP fossil fuel thermal offsets into existing (or new) RPS requirements. The States of Maryland, New Mexico and New Hampshire have already made GHPs an accepted technology available for Renewable Energy Credits (REC's) under their Renewable Portfolio Standard (RPS) mandates. This legislative path requires a modification to existing RPS legislation, which is often easier to accomplish than writing new regulation. Allowing electric utilities to include renewable thermal energy into their RPS mandates provides financial benefits to the participating electric utilities while recognizing the environmental purpose of the RPS legislation. Because RPS requirements are stated in kW and/or kWh reduction goals, there needs to be a conversion to fit renewable thermal energy (which increases electric use) into the RPS regulation. There are several paths to convert GHP thermal energy savings into an acceptable conversion of renewable thermal energy equivalents, with the calculation of thermal Btu equivalent savings one of the easiest to calculate. In its simplest form, converting the fossil fuel Btus saved into equivalent kWh on a Btu basis (1 kWh equaling 3,413 Btus) can meet the intent of the RPS and be easily tracked and reported, especially when incorporated into a "deemed savings" process.

Thermal Renewable Energy Certificates (TRECs)

Renewable Energy Certificates (RECs), also known as Green tags, Renewable Energy Credits, Renewable Electricity Certificates, or Tradable Renewable Certificates (TRCs), are tradable, non-tangible energy commodities in the United States that represent proof that 1 megawatt-hour (mWh) of electricity was generated from an eligible renewable energy resource (renewable electricity) and was fed into the shared system of power lines which transport energy. Renewable Energy Certificates provide a mechanism for the purchase of renewable energy that is added to and pulled from the electrical grid. REC's were developed to allow utilities (or other entities) to meet their RPS requirements without directly developing renewable energy generating assets as the RECs can be purchased from developers, funding the construction of the renewable energy source. These REC certificates can be sold and traded or bartered, and the owner of the REC can claim to have purchased renewable energy. According to the U.S. Department of Energy's Green Power Network, RECs represent the environmental attributes of the power produced from renewable energy projects and are sold separately from commodity electricity. While traditional carbon emissions trading programs use penalties and incentives to achieve established emissions targets, RECs simply incentivize carbon-neutral renewable energy by providing a production subsidy to electricity generated from renewable sources. Legislation allowing renewable thermal energy into the RPS platform should include an allowance for renewable thermal RECS to be included in the REC market.

Renewable Thermal Standards (RTS)

Another powerful GHP supporting public policy tool would be to expand the electric focused RPS legislation to include carbon emitting fossil fuels through the enacting of Renewable Thermal Standards (RTS) focused on growing the market for renewable thermal or renewable heating & cooling (RH&C) mandates. This new legislative effort would place an obligation on fossil fuel providers to off-set a certain portion of their historic (base year) fossil fuel sales (measured in Btus) with new renewable thermal resources. The concept of RH&C has been identified as an emerging market in New York State (with constraints on the extent to which mandates are a viable policy option at this stage). However, there is also an opportunity to legislatively integrate RH&C into building and energy mandates for public buildings, new construction, and renovation.

In 2013 the Colorado Geothermal Association worked in partnership with several environmental organizations and the Solar Thermal Industry to advance a Renewable Thermal Standard (RTS). While unsuccessful, this effort laid the foundation to pursue RTS legislation across the U.S. The proposed RTS would have created a 2% renewable thermal standard by 2025, with the goals of stabilizing energy costs, strengthening the local economy, creating local jobs, and protecting the environment. This proposed Renewable Thermal Standard (RTS) would have integrated proven renewable thermal technologies into a diverse energy portfolio by collecting a 1¢/therm surcharge on natural gas and propane retail sales in the residential, commercial and industrial sectors. Based on energy use, the surcharge collected would vary but the amount per Btu collected would not change with energy prices. The funds raised would then be spent on the advancement of renewable thermal technologies through programs and incentives targeting the adoption of renewable thermal energy technologies. The legislation was intended to encourage fossil fuel energy conservation and provide a stable fund for renewable thermal energy market development by accumulating about $30 million annually for solar thermal, geothermal and biomass thermal systems that addressed point-of-use heating and cooling needs through the production or transfer of heat. In addition, 10% of the proposed funding was to be allocated to support renewable thermal innovation with oversight by the Colorado Office of Economic Development and International Trade (OEDIT).

Community Involvement in Beneficial Electrification

Over 27 U.S. cities have made a pledge to power their communities entirely with clean energy sources by 2035 and more communities are making this pledge every month (Smart Cities research, Dr. Lantz Holtzhower/OSU, Dr. Amanda Smith/U of U). Communities making the pledge include Atlanta, GA; Portland, OR (pledged to go 100 percent renewable by 2050); the county surrounding Portland, Multnomah County; South Lake Tahoe, CA (committed to go renewable by 2032); Madison, WI which became the biggest city in the Midwest to pledge to a community-wide switch to 100 percent renewable energy (it hasn't set a target date) and the tiny town of Abita Springs, LA which committed to transition to clean energy by 2030. The GHP industry needs to leverage this local community and government enthusiasm for clean power to expand to clean **energy** to include the beneficial electrification of space conditioning and water heating. "We know that moving to clean energy will create good jobs, clean up our air and water, and lower our residents' utility bills," said Kwanza Hall, an Atlanta City Council member and mayoral candidate, in a statement. "We have to set an ambitious goal or we're never going to get there." On a macro scale, In early June of 2017 The California Senate passed a measure to mandate 60% renewable electric energy by 2045 (Senate Bill 100) and this bill is now in the state Assembly. Unfortunately for California, this electric mandate neglects the fact that California is the 2nd largest consumer of natural gas in the U.S., consuming 2,417.50 trillion Btus annually, while consuming only 895.9 trillion Btus of low carbon electricity (.942 pounds per kWh).

The GHP industry needs to work with State, regional and local community leaders to educate them on the carbon impact of their continued reliance on fossil fuel heating and water heating.

Other Market Barrier Removal

Legislation or Regulatory intervention may also be required to fix other market barriers beyond those discussed above that impede the greater adoption of GHPs. These barriers may have been put into place by accident or design. Examples of legislative fixes include (and may go beyond):

Favorable Tax Treatment (Reference Federal Taxation Issues for Third-Party Owners of GHP Assets – a work in progress by non-attorney Bob Wyman (bob@wyman.us)

Fuel switching

Poorly designed Standard Practice Tests

Bans on utility ownership of GHP loops or equipment (3d party ownership)

Building Codes (Ex. Title 24 in California that favors natural gas space and water heating)

Inspection, licensing and construction barriers

Water/aquifer issues

US Regulations

The U.S. Department of Energy (DOE) released its findings in September 2015, "A Common Definition for Zero Energy Buildings," which states that a Zero Energy Building is "an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy." The report has no measurement criteria for greenhouse gas (GHG) emissions, and in the report, it states that it "… does not tell the whole story of impacts from resource consumption and emissions associated with the *energy* use." There is no further mention of GHG emissions, so in a Net-Zero building, combustion heating, a source of GHG emissions, may be employed. The following link has an excellent illustration of the increasingly renewable grid as produced by the IEA. (http://www.renewableenergyworld.com/articles/2016/09/a-primer-on-zero-energy-vs-zero-emissions.html)

UTILITY REGULATION

Utility regulation is the implementation arm of utility/energy legislation. While legislative bodies set goals and mandates, it is up to the utility regulators to set the rules and approve the utility plans necessary to meet the legislative goals. Electric utilities currently face many regulatory obstacles to embracing GHPs as a beneficial electrification platform. For decades natural gas has been favored by utility regulators and efficiency policy makers driven by the outdated but deeply embedded belief that electricity is bad and natural gas is good. This regulatory foundation made sense in an era of rising electric rates driven by the increasing construction costs of large thermal electric generating plants that could be avoided by electric energy conservation. However, that battle is mostly over. The goal of reducing the carbon dioxide emissions of the electric grid as a driving policy objective has resulted in low cost renewable energy generation rapidly becoming a major component of the electric supply. We now live in a world where electricity is green and getting greener while more and more natural gas is being produced from fracking resulting in a large and growing negative impact on the environment.

On the gas side of utility regulation, the natural gas industry has a solid track record of promoting and obtaining natural gas friendly regulation. In April of this year the National Association of Regulatory Utility Commissioners (NARUC) President and its Executive Committee established a new Presidential Natural Gas Access and Expansion Task Force charged with developing best practices and recommendations regarding the expansion of natural gas service for underserved and unserved areas of the country, including, but not limited to rural communities. A similar group has not been established to promote beneficial electrification.

Utility regulators need to recognize that several fundamental changes have come to the electric utility industry. First, the RPS process has obtained its goal of delivering low-cost renewable energy. Wind and solar electric generation can now be installed and operated for nearly the same, or less than, the cost per kW and cost per lifecycle kWh produced from natural gas powered electric generation. Using a levelized cost of electricity (LCOE) metric (a convenient summary measure of the overall competiveness of different generating technologies representing the per-kilowatt-hour cost in discounted real dollars of building and operating a generating plant over an assumed financial life), on-shore wind and solar PV are now competitive with the lowest cost combustion technology, combined cycle gas generation. In 2017 utility scale solar plant additions are continuing to reach even lower construction costs, with reported price-per-watt costs falling below $1.00 per watt for the first time, according to the Solar Energy Industries Association's (SEIA) latest U.S. Solar Market Insight Report (June 2017). Higher than forecast natural gas prices will easily push renewable generation into the lowest kWh production cost lead. This is entirely possible as the U.S., driven by new liquefied natural gas (LNG) export capacity, is forecast by the EIA to be a net exporter of natural gas by mid-2017 at the same time natural gas is now exceeding coal as the nation's primary fuel for electricity generation on an annual basis. According to the EIA, the U.S. currently exports approximately 2 Bcf/day of natural gas but by 2021 five fully operational LNG export plants are expected to have an export capacity of at least 9.2 Bcf per day. In 2016, the United States consumed about 27.28 Bcf per day of natural gas for electric generation. Connecting the dots, it is easy to see the possibility that a rapid increase in natural gas exports combined with a continuing increase in natural gas generation will put greater than expected upward pressure on natural gas prices.

The continuing shift to a focus on carbon emissions, the forecast ending of historically low natural gas prices, and the increasing awareness of the negative externalities of natural gas production through fracking will place increasing pressure on utility regulators to incorporate some new beneficial electrification platforms into the utility regulatory framework. Regulatory platforms that support beneficial electrification and the expanded use of GHPs are include the following:

Targeted Focus on Electric Savings (DSM)

Regulators are focusing on reducing kWh consumption based on the old framework of Demand Side Management to reduce expensive kWh generation. With the closure of coal powered base load plants, an expanded use of flexible gas generation and an abundance of clean wind, solar, and other renewable generation the time has come for regulators to focus on the new problem, climate change and total carbon emissions. The simple regulatory fix is to exempt beneficial electrification programs from DSM electric savings goals. An increased focus on fossil fuel energy savings will also increase the use of beneficial electrification technologies. Efficiency needs to continue to be a social goal under utility regulation, but beneficial electrification also needs to be given a dedicated regulatory focus. Regulators can establish separate metrics and policies for both efficiency and beneficial electrification.

Fair Rate Design

With GHP's providing both peak demand reduction (.55kW to .88kW summer peak reduction per ton of installed GHP) modest winter peak increases and annual kWh increases, standard "postage stamp" rates do not recognize the benefits GHP users bring to the grid. In states with politically designed increasing block rates (California) GHPs owners are further dis-incentivized to participate in beneficial electrification. Fair rate design would recognize the load factor improvements provided by GHP owners over traditional gas furnace and AC customers through lower electric rates or other favorable rate designs. There is a strong argument that the increased kWh consumption of homes and buildings using GHPs versus homes with fossil fueled furnaces and water heaters 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 users. In fairness to GHP customers, who bring incremental high load factor kWh sales to the utility while lowering peal load demands 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.

Fuel Switching Barriers

In a low carbon economy powered by renewable energy the need for heat pump technology is obvious. Unfortunately, policy and politics are standing in the way. One of the biggest regulatory and political restrictions is the regulatory barrier against "fuel switching" as defined by not allowing electric companies to engage in program efforts that involve moving from natural gas to electric end uses, including heating and water heating. This fuel switching argument has been used to prevent widespread adoption of heat pumps. Politically, this regulatory barrier probably has its roots in the fact that gas utilities don't want to give up customers to an electrical provider. This is a one-sided argument in the face of gas replacing coal for electric generation (also called fuel-switching) for environmental purposes.

While arguments against fuel switching and denying customers choice in their energy systems seem out of place in a market moving to renewable energy, on site generation and rapidly evolving energy alternatives, simple language such as the following adopted by Oklahoma can remove the fuel switching barrier for beneficial electrification products including GHPs: “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.”

Standard Practice Tests

Utility regulators have developed a series of “tests” to measure or compare the benefits of an efficiency investment against the costs of the investment. Originally developed in California and outlined in the California Standard Practice Manual, five key cost-effectiveness tests have been used for over 20 years as the principal benchmarks for energy efficiency program evaluation. These five cost-effectiveness tests are the participant cost test (PCT), the utility/program administrator cost test (PACT), the ratepayer impact measure test (RIM), the total resource cost test (TRC), and the societal cost test (SCT). The most common primary measurement of energy efficiency cost-effectiveness is the TRC, followed closely by the SCT. A positive TRC result indicates that the program will produce a net reduction in energy costs in the utility service territory over the lifetime of the program (or measure).

The question of how to define the cost-effectiveness of energy efficiency investments is a critical issue to address when advancing energy efficiency as a key resource in meeting future energy needs. How cost-effectiveness is defined substantially affects how much of our nation’s efficiency potential will be accessed and whether consumers will benefit from the lower energy costs and environmental impacts that would result. The decisions on how to define cost effectiveness or which tests to use are largely made by state utility commissions and their utilities, hopefully with input from consumers and other stakeholders.

Because the California Standard Practice Manual doesn't offer specific instructions about how to implement the TRC and other four tests, each state implements the tests in a different way. Some of their methods are neither supportive of beneficial electrification nor consistent with the underlying rational of the tests. Most programs attempt to conduct a net-to-gross analysis that captures the difference between total savings and the savings that should be attributed to the program (savings that occurred only as a result of the program's existence). These calculations typically reduce the benefit of a program by assessing the extent to which free riders take advantage of program subsidies. But they often don't take into account spillover – in which non-participants install the efficiency measures after seeing participants do so – or market transformation, in which the program drives a large-scale change in pricing and consumer behavior.

GHPs often face a disadvantage under the standard practice test process. For example, total energy bill savings is usually the most important reason why customers upgrade their homes and businesses to GHPs. But, in many states, the TRC test only looks at electric savings and does not capture the fossil fuel savings "benefit". However, the TRC does count the full (or incremental) cost of the GHP system. This is because, by historic adoption, the TRC does not account for reductions in the consumption of energy that is not provided by the GHP program sponsoring (electric) utility. Consequently, the replacement of an expensive to use propane furnace and water heater with an electric water heater connected to a GHP under an electric utility program, the propane savings cannot be recognized by the TRC but the cost of the new electric water heater, the cost of the GHP system and the cost of any additional kWh used by the GHP system are counted as measure costs! In heating dominated climates (without electric heating and electric water heating) no electric utility program can pass the TRC even though the participating customer is saving on their annual energy bill!

There is a movement to eliminate the TRC as the calculation to determine the efficacy of energy efficient technologies but at the moment the standard tests are still the benchmark regulatory tools for utility program measurement. Fortunately, there have been successful efforts to change the TRC to recognize GHPs. The GEO spent time and money to change the definition of TRC energy efficiency in the Illinois statute. They were able to get GHPs approved as an electric utility efficiency program 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. This language needs to be adopted by other states using the TRC as the benchmark for approving efficiency programs or GHPs will continue to fail the TRC and consequently be kept out of electric utility efficiency program offerings.

Technical Reference Manuals

Utility regulators often use Technical Resource Manuals (TRMs) to support their standard practice test process by developing test inputs including the useful life of a measure, expected energy savings, customer costs and measure costs. Sometimes the TRMs that drive the standard practice tests in the states can be purposely complicated by the gas industry resulting in a bias against GHPs. These barriers can be overcome, as was done by the GEO in Illinois where they were successful is changing the useful life of a GHP from an ASHP life of 15 years to 25 years (a useful life for a GHP system could be argued to be 30 plus years.) ComEd was able to pass the TRC for their GHP program after these changes to the TRM. Another issue that could be changed to benefit GHPs would be to use a source calculation for the cost and environmental impact of natural gas versus electricity as natural gas impacts usually only goes back to the distribution source and not the production source, unlike the source of electricity which goes back to the power plant.

Rate Based Programs

GHPs offer utilities an opportunity to increase their rate base by offering renewable energy services. Utility ownership of GHP loops, often call 3d party ownership can provide electric utilities with increased loads, improved load factors and a return on invested capital. In addition to infrastructure ownership, GHPs allow electric utilities an opportunity to manage GHP loads, especially GHP units with inverter driven compressors. The ability to float loads with system demands opens the door to a new era of actively managing customers use and bills 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 source can be classified as a Renewable Thermal Revenue Resource. 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 asset that can earn an authorizer rate of return for the utility.

Public Health

Amory Lovins has pointed out that the emissions leaked through incomplete combustion of methane gas create an existential threat for natural gas companies. "The methane slip — that is, total release end to end — has to be drastically and urgently reduced otherwise even natural gas is worse than coal, possibly by several fold, in its climate impact," he said adding "and if that turns out to be the case, as the evidence is starting to show, these companies won't be allowed to operate for long." Through the societal Test, utility regulators have the ability to recognize the benefits (as measured in financial value) of program measures. Recognizing the upstream costs of developing and delivering natural gas would greatly improve the societal value of utility GHP programs.

Legionella Dangers

Aside from the loss of life and related medical expenses, how much is it collectively costing us to keep chasing this epidemic of cooling towers infections? If you Google *Legionella Outbreaks in Cooling Towers* and click on the "News" tab, you're going to find thousands of hits; most of them recent. Exactly when is the "right time" for government to say "enough," and at least list cooling towers as a product that is a risk to public safety? Lead-based paint and water pipes have been outlawed, as has the use of asbestos for insulation. We now have safe alternatives for these products, just as we have alternatives for cooling towers. According to Victoria, Australia's government health website, alternative No. 2 is to see if it is possible to eliminate the risk altogether — that is, have the cooling tower be removed altogether. (From REW: http://www.renewableenergyworld.com/articles/2016/12/a-solution-for-legionella-outbreaks-in-cooling-towers-eliminate-them.html)

Energy Independence and Security

Destruction of power systems is a combat strategy as old as modern warfare. As reported in the Clean Energy Group's paper Distributed Power Generation for Homeland Security: Proposal for a New Federal and State Partnership (written by Lewis Milford), There is little doubt that overhead transmission lines and the pipelines that carry electricity and fuel in this country are vulnerable to terrorist attack, particularly the switching centers and aboveground valves. They are essentially unguarded, vulnerable to a variety of weapons, and difficult to repair." The Clean Energy Groups message is that locally produced renewable energy and energy conservation can reduce society's vulnerability to terrorist attacks while also addressing global climate change and other environmental concerns. By eliminating dependence on long distance gas production and distribution, GHPs can also support these security and environmental objectives.

GHP's PROVIDE UTILITY OPPORTUNITIES

Electric utilities are facing unprecedented threats to their economic model. Reduced consumer demand, driven by increasingly efficient energy products and end uses, coupled with a growing market for distributed (non-utility owned) generation is driving utilities into a high 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).

Beneficial electrification and 3d party ownership are opportunities for utilities to break the 'death spiral". Utilities can and should be involved in the expansion of GHPs as part of a beneficial electrification effort. The GHP industry needs to become an active partner to help shape the relevant policies, regulations, and standards for the future. Utilities have a central role to play as a nexus for stakeholders in the expanded implementation of GHPs. With their 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 renewable generation, reduce grid stress and maintain grid stability by minimizing peak demand across all seasons, reduce the need for new peak generation and distribution capacity. These benefits can be leveraged with load management tools and low cost water based thermal energy storage.

New Utility Revenue and Peak Cost Reduction

Electric companies have been focused on selling a product (electrons) instead of a service (comfort). Making the transition to selling a service instead of a product demands a large cultural mind-shift but GHPs can help electric utilities make the transition. A robust GHP program effort can position them to provide both. If utilities realize that their customers are becoming wiser to how to use energy more efficiently, they can stop loosing revenue to conservation and distributed generation by embracing beneficial electrification. The utilities will need GHP industry support to remove regulatory barriers that are, in many cases, standing in the way of this beneficial electrification.

GHPs are one of two major opportunities for the electric utility industry to provide beneficial electrification as a service. The other major candidate is electric transportation. EVs are being touted as the largest electric utility strategic opportunity, but there are significant utility risks associated with EV's. The downside is mostly associated with load impacts including peak load increases that could cause expensive generation, distribution, transformer and substation impacts driven by both unmanaged customer use and "timer peaks" caused by unmanaged EV friendly time-of-use rates. In a study commissioned by the Sacramento Municipal Utility District, an estimated 17 percent (12,000) of the utility's transformers may need to be replaced due to EV-related overloads, at an average estimated cost of $7,400 per transformer. The potential for EV's to impact utility peaks will continue to grow. As of February 2017, more than 580,000 EVs were sold in the United States, representing approximately one terawatt-hour (TWh) of annual consumption. According to Bloomberg New Energy Finance (BNEF), EV electricity consumption is projected to increase to approximately 33 TWh annually by 2025, and 551 TWh by 2040 (BNEF, EV sales forecast in the US 2010–2040, May 2016). Depending on the electric vehicle type (plug-in hybrid electric or battery electric) a single EV represents between 1.4 kilowatt (kW) and 20 kW of load, and 500 to 4,350 kilowatt hours per year (kWh/year) of electric energy consumption. This will create an uncertain load profile for utilities. At .335 kWh per mile an electric vehicle charge rate in demand (kW) will depend on the miles driven, the storage capacity of the battery, and the charge time available. A fully discharged Tesla with a 100kWh battery (335 mile range) will require 10kW of charging capacity to recharge in 10 hours. A daily drive of 60 miles will require approximately 9 hours of charge time at 2 kW.

GHPs reduce peak air conditioning 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. Homes with fossil fuel heating will see a small increase in peak winter demand with a GHP retrofit. 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 heating, GHPs will also increase a utility's annual kWh sales, again at a high annual load factor. Depending on climate, this annual kWh increase per average home can match or exceed those from an electric vehicle.

Key Account Services

Electric utilities are eager to serve large commercial and industrial customers that use substantial amounts of electricity at higher load factors. These customers are identified as “Key Accounts.” Key Accounts often have the ability to choose their locations, fuels, and power suppliers (as permitted by law). These customers also have their own competitive forces to meet, requiring them to minimize their energy costs to maximize their profitability. GHPs can provide an excellent opportunity for electric utilities to offer their key accounts, especially schools, hotels, corporate headquarters, ag production facilities, and other conditioned space and low temperature thermal energy users a beneficial electrification service through GHPs. This beneficial electrification service can be greatly enhanced if the utility offers some form of third party ownership. Key account programs use designated utility representatives to manage the accounts. The GHP industry can expanded the market for GHPs by educating these key account representatives on the identification of good GHP retrofit (and new construction) opportunities, as they meet with their accounts on a regular basis.

Public Relations

In 1995 a study conducted by the Oregon Institute of Technology identified that a total of 57 utilities out of 178 investigated reported having DSM programs involving GSHPs. These utilities were using GHP marketing techniques including utility publications and seminars (36%), newspaper and radio/TV advertising (16%), test/demonstrations (10%), education (6%), home shows (6%) and other (26%). In short, GHPs give utilities an opportunity to provide a positive public relations message to their customers. GHPs position the utility as a customer focused, environmentally sensitive organization focused on helping customers manage their energy bills and environmental footprints.

Natural Gas – Losing the Green Halo

The natural gas industry is well funded, politically active and riding on decades of a well implemented public education campaign to develop the perception that natural gas is “clean”. Recent studies out of Harvard and other universities, based on satellite data and ground observations, have concluded that our expanding natural-gas infrastructure has been bleeding methane into the atmosphere in record quantities. Molecule for molecule, this unburned methane is much, much more efficient at trapping heat than carbon dioxide. These leaks are big enough to wipe out a large share of the gains from the Obama administration’s work on climate change—all those closed coal mines and fuel-efficient cars. In fact, it’s even possible that America’s contribution to global warming increased during the Obama years. The methane story is utterly at odds with what we’ve been telling ourselves, not to mention what we’ve been telling the rest of the planet. It undercuts the promises we made at the climate talks in Paris. It’s a disaster—and one that seems set to spread. The Obama administration, to its credit, began to recognize this problem and the EPA began to revise its methane calculations. In early March, 2016 the United States reached an agreement with Canada to begin the arduous task of stanching the leaks from the natural gas infrastructure. But none of this gets to the core problem, which is the rapid spread of fracking. Carbon dioxide is driving the great warming of the planet, but CO2 isn't doing it alone. It's time to take methane seriously as a major contributor to climate change.

What About Gas and Other Utilities

It is entirely possible for natural gas and other (water, sewer) utilities to participate in the GHP industry. As communities and governments adopt no carbon policies and goals, the natural gas industry will need to pivot to thermal energy service delivery. As reported in Renewable Energy World (http://www.renewableenergyworld.com/articles/2017/04/cana…ss=tedmills@groundswellgeo.ca&eid=291127824&bid=1731374) Enbridge Gas Distribution is interested in developing geothermal heating and cooling solutions in Ontario and offering those solutions to homeowners. This interest is being driven by Ontario's aggressive carbon-reduction goals that aim to eliminate the use of fossil fuel heating in the province. Enbridge is considering "rate-basing" the up-front cost of installing the geothermal loops, spreading that cost over a much longer period than property owners could do on their own.

CLOSING COMMENTS

The board of directors fully supports this document and will work towards the industry wide use of the paper. The board charge to the IGSHPA advocacy committee to develop and deliver this white paper will be highly used as the new guideline for ground source heat exchangers as the basis for beneficial electrification to deliver grid stability and CO2e reductions. The board thanks the advocacy committee and its co-chairs, Paul Bony and David Thomison for their guidance and efforts.

GHP and Beneficial Electrification Quick Facts:

- 2016 was the warmest year globally on record, and global temperatures continue to rise because of climate change. Each of the sixteen years of this century have been among the hottest 17 years on record. By 2050, greenhouse gas emissions must be reduced by 40 to 70 percent below the levels they were at in 2010 to limit global warming by two degrees Celsius according to the United Nations Intergovernmental Panel on Climate Change (IPCC).
- The Department of Energy states building lighting, appliances, space conditioning and water heating account for 36% of primary energy in the United States. Forty percent (40%) of the total energy used, in those buildings, is for space conditioning (heating & cooling) and water heating! (From Jack D)
- A recent NREL estimate of DG solar technical potential indicates that the individual customer-level total electricity demand (as the sum of current electric demand and new electric demand

for heating and transport) significantly exceeds the ability to generate enough electricity in a distributed fashion. Put simply, even with significant increases in solar PV efficiency and deployment of distributed storage systems, the amount of power the typical residential roof can generate will not be sufficient to power all uses of electricity in the home.

- The U.S. Environmental Protection Agency (EPA) estimates that coal-based generation will decline 20–22 percent in 2020 and 25–27 percent in 2030.
- Major corporations such as Walmart, Costco, IKEA, and Apple are increasingly "going solar." According to the World Wildlife Fund's Power Forward report, nearly 60% of Fortune 100 and Global 100 companies have renewable energy targets, greenhouse gas emissions goals, or both. These commitments are driving increased investment in renewable energy.
- Robert Howarth and Anthony Ingraffea, researchers at Cornell University, began producing a series of papers claiming that if even a small percentage of methane produced from fracking leaks (as little as 3 percent), then fracked gas burned to make electricity would do more climate damage than coal. Their preliminary data showed that leak rates were at least that high, with possibly 3.6 to 7.9 percent of methane gas from shale-drilling operations actually escaping into the atmosphere.
- A study conducted by the Rockefeller Foundation and DB Climate Change Advisors points out that upgrading and replacing energy consuming equipment, in buildings, offers an important capital investment opportunity with the potential for significant, economic, climate and employment benefits. They go on to state that "an investment, in this type of initiative, could yield more than $1 Trillion of energy savings over 10 years, equivalent to saving approximately 30% of the annual electricity use in the US." (From Jack D)
- The US Environmental Protection Agency (EPA) has stated that GHPs reduce Greenhouse Gas emissions by up to 40% over conventional HVAC systems. (From Jack D)

The National Renewable Energy Laboratory (NREL), in a report entitled "The Energy under Our Feet", stated that, there are more than one million geothermal heat pump systems in use nationwide. Since then we estimate that number has grown to approximately 1.5 million. These units have had a significant effect on energy savings and environmental issues including the conservation of over 31 million barrels of crude annually and the annual reduction of approximately 9 million tons of CO2 which is equivalent to taking 2 million cars off the road or

Potential Beneficiation Allies

Energy and Environmental Economics (E3)

Lawrence Berkeley National Lab (LBNL)

The Natural Resources Defense Council

The Sierra Club

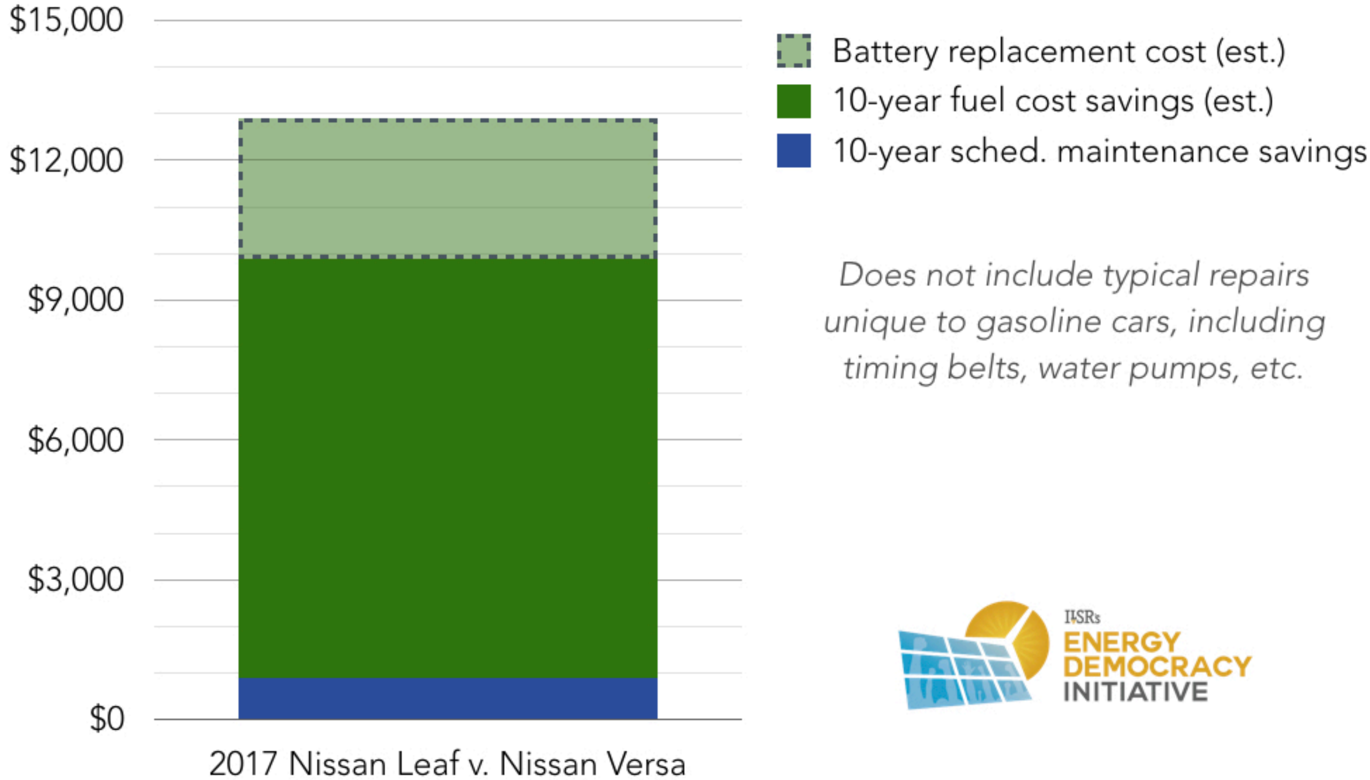
NRECA

APPA

EEI

The Clean Energy Group

ELECTRIC VEHICLE OWNERSHIP 10-YEAR SAVINGS



Other Items and suggestions

Again, just to identify that we're talking about ground heat exchanger systems of any kind. Perhaps we should identify in a glossary or right up front that GHP implies this?

Reference Ontario: http://www.renewableenergyworld.com/articles/2017/07/the-tale-of-two-sisters-natural-gas-and-electricity-in-new-york-and-ontario.html

New legionella federal madates: http://www.plumbingengineer.com/content/federal-agency-mandates-legionella-prevention-policies?eid=277266734&bid=1811867