How IRA Can Take Ground-Source Heat Pumps Mainstream

Incentives in the Inflation Reduction Act help GSHPs pay for themselves faster than conventional HVAC systems—with far better performance.

by Elizabeth Waters

Photo: CMTA

The fabrication of ground-source heat pump mains for Louisville International Airport. Commercial projects are eligible for significant tax credits through the expanded Investment Tax Credit.

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Since the late 1940s, the United States has used ground-source heat pumps (GSHPs) to heat and cool residential and commercial buildings. And though the technology is reliable and offers good performance, GSHPs have not become popular due, in large part, to the upfront cost of installation. A few tax provisions in the Inflation Reduction Act (IRA)—notably the expanded and extended Investment Tax Credit—are making ground-source systems affordable even in tough markets.

(Editor's note: The analysis below focuses on GSHPs, for which the ITC offers a unique timeline. Technologies that do not fall under the "geothermal heat property" umbrella, such as energy storage and onsite solar, will qualify for a

shorter period of time. In 2025, these other types of systems will fall instead under a new program, The Clean Electricity Investment Tax Credit, while owners of GSHP systems will continue to qualify for the ITC.)

The difference between geothermal energy and ground-source heat pumps

We use Earth's heat for energy in two ways: electricity generation and heating and cooling. We generate electricity by harnessing heat from Earth's core (called geothermal energy) through deep wells drilled into hot-water reservoirs. Utilities use steam from these reservoirs to generate power at scale, which provides constant electricity and can be very reliable. Geothermal energy can also be used for direct heating (think a hot spring).

Ground-source heat pumps are different. As the name suggests, instead of drawing geothermal energy from Earth's core, they use heat from the sun's energy stored in the ground much closer to the surface. At the depth of a few feet, the ground stays at a relatively constanttemperature (between 45°F and 75°F, depending on latitude) all year. GSHP systems act as heat exchangers, using the temperate subsurface as a heat source in the winter and a heat sink in the summer.

Though the IRA uses the term "geothermal" to describe both geothermal energy and ground-source heat pumps, the two are very different. This article will focus on the IRA incentives for ground-source heat pumps only, which are a promising decarbonization strategy for residential and commercial buildings.

Ground-source heat pumps are versatile and efficient

The configuration of GSHPs varies, but they always have three components: a set of pipes in the ground or in a surface water body that acts as a heat exchanger, a distribution system for heating or cooling a building (such as ducts for air or pipes for hydronic systems), and an electricity-powered heat pump. Most ground-source heat exchangers in the U.S. are closed-loop systems set horizontally or vertically in the ground, usually filled with water and antifreeze. A smaller number of systems are immersed in a surface water body or use groundwater to exchange heat in an open- or closed-loop system. These configuration options allow GSHP systems to be flexible based on the physical constraints of a site.

For even greater flexibility, GSHPs can be operated in conjunction with conventional technology like a boiler or cooling tower, which can kick in during peak heating or cooling times. Hybrid systems lower the installation costs of ground-source heat exchangers by requiring smaller systems (or well fields) to deliver the same thermal capacity. They are typically more efficient than conventional HVAC systems but less efficient than those run entirely by GSHPs.

Brian Turner, zero energy engineer and partner at CMTA, Inc., elaborated: "If you're supplementing [a GSHP] with a dry cooler to help radiate heat, we can selectively run it when the ambient air temperature is particularly cool to prevent the well field from overheating." He explained that, although this adds complexity to a system, it dramatically reduces the required size of the well field and is likely worthwhile for buildings 50,000 square feet or larger.

According to Turner, "A GSHP really shines when it's serving more than just a single building. One of the biggest advantages to any sort of neutral-temperature water loop is that it has a heat-recovery ability, so you can trade heat around the building." Schools, he says, are a good example of this: "You might have an intense food service component but empty gymnasiums." In such cas-

Photo: CMTA

The excavation required for ground-source heat pumps contributes to the technology's high upfront costs, which provisions in the IRA aim to reduce.

es, he told BuildingGreen, "You can just trade heat, and it never actually sees the well field or plant."

GSHPs can also achieve high efficiencies at a community scale, where multiple commercial and residential buildings are on a single GSHP loop. As explained in an article by Joe Demell of the Minnesota-based nonprofit Fresh Energy, this model is called a "networked geothermal system." Such systems can achieve 500% to 600% efficiency and improve local air quality by replacing combustion equipment.

So why aren't GSHPs more widely used?

In a 2019 report, *GeoVision: Harnessing the Heat Beneath Our Feet*, the U.S. Department of Energy's (DOE) Geothermal Technologies Office (GTO) explains that, although ground-source heat pumps could reduce the costs and increase the reliability of energy for consumers, the technology is currently underused. The report noted that GSHPs are more common in residential than commercial buildings—specifically in new construction—but make up only about 1% of the HVAC market in the U.S. As of 2016, the capacity of installed heat pumps was 16.8 gigawatts-thermal, the equivalent of 4.8 million tons of cooling capacity, or the installation of pumps in about two million homes.

The report highlights three barriers to consumer uptake of the technology:

- high upfront costs and long payback periods
- a lack of attractive project financing models
- insufficient consumer awareness and outreach

The incentives in the IRA address the first two barriers.

Photo: Melissa Haertsch

This well-drilling rig was used for a 2022 ground-source heat pump installation at a home in northeastern Pennsylvania. Even relatively small projects like this three-well system can run up high costs due to their complexity. But because GSHPs are so efficient, the Inflation Reduction Act was designed to make them pay off financially in a very short time. Funding for GSHP design and installation is available for homeowners as well as organizations.

Up to 50% in tax credits for GSHPs

Under the expanded and extended Investment Tax Credit (ITC), sometimes referred to as Section 48, GSHP projects are eligible for a base credit amount of 6% until 2032, 5.2% in 2033, and 4.4% in 2034. The credit ends in 2035. Projects under one megawatt are automatically eligible for five times that base credit, currently 30%, while those greater than one megawatt must meet prevailing wage and apprenticeship requirements—for five years of construction, alter-

ation, and repair—to receive the multiplier. Hybrid GSHP systems must send at least 75% of BTUs to and from the ground wells to be eligible for the credit.

One megawatt equals about 284 tons of thermal output, or the heat needed for roughly 150,000 square feet, explained Turner. But he also noted ambiguity within the guidance about whether the one-megawatt threshold triggering extra workforce requirements would apply to the thermal capacity of the pump or to the electricity used to run it.

On top of the 30% credit, the ITC offers two 10% bonuses for projects that meet domestic-content requirements or are in an "energy community" (a justice designation). Turner notes that the content requirements, for which the IRS released initial guidance in May, are easily accessible for GSHP projects: "If you were to do a PV [photovoltaic] system today, it'd cost a lot more than 10% to ensure that components were sourced domestically," he explained. "But [GSHPs] are a different story. Almost everything in the system is already domestic. … Operationally, we're assuming that GSHPs will be eligible for the 40%, not just the 30%."

The Internal Revenue Service (IRS) released guidance in June 2023 to help project teams determine eligibility for the energy-community bonus. The notice defines three categories of energy community:

- Brownfield Category
- Statistical Area Category (an area that meets certain thresholds for fossil-fuel employment or tax revenue and unemployment rate)
- Coal Closure Category

DOE has released a mapping tool with the locations of qualifying communities.

Direct pay opens more doors

Another significant change to the ITC is that tax-exempt organizations are now eligible for direct pay. This will enable nonprofit organizations, states, political subdivisions, Indian Tribal governments, Alaska Native Corporations, the Tennessee Valley Authority, and rural electricity cooperatives to benefit from the credit. The IRS released proposed rules in June 2023 for how this process will work (for which public comment is open until August 10).

The ITC is also transferable, meaning that tax-paying entities can sell the credits to a third party for their value in cash.

Accelerated depreciation adds icing on the cake

And finally, ground-source heat pumps are classified as a five-year property under Section 168 of the Internal Revenue Code. As such, they are eligible for accelerated depreciation of energy property, for which the cost basis must be reduced by half of the credit, and a one-time bonus depreciation of 80% of their cost in 2023, reduced to 60% in 2024, and eventually to 0% by 2027.

Turner emphasizes that, according to guidance his firm has receieved, the ITC applies to more than just the wells and heat pumps; it also includes ductwork, controls, and many soft costs, such as the mechanical-system design process. It therefore has the potential to significantly reduce the project budget.

Another option: tax deduction 179D for AEC firms

The IRA increased and expanded provision 179D, the Energy-Efficient Commercial Buildings Deduction—a potential tax boon for AEC firms as well as commercial building owners.

179D now offers up to $5 per square foot (for qualifying energy-efficiency measures) to new or existing commercial properties that achieve 25% to 50% reductions in energy use compared to

models of the same building constructed according to minimum requirements of the ASHRAE 90.1 standard. The version of the ASHRAE standard used will be determined by the year the building was placed into service. Both owners and renters are eligible for this deduction, but AEC firms can claim it as well.

System designers and builders, who before the IRA could only get this deduction for government-owned property, can now do so for projects owned by other tax-exempt entities, including religious organizations, Tribal organizations, and nonprofits—so most private K–12 schools and higher-ed institutions would now qualify. Projects must meet apprenticeship and prevailing-wage requirements to maximize the deduction.

This deduction is not eligible for direct payments (unlike a credit, a deduction doesn' t come straight out of your tax liability), and 179D must be claimed for the year the property is (or was) put into service. It can even be applied retroactively to past projects, going back to the very beginning of 179D—but there are certain risks and caveats associated with that.

Many tax-preparation companies are aggressively touting their services online to help commercial building owners

Photo: CMTA

A mechanical room with multiple 10 ton-plus ground-source heat pumps. A single GSHP loop can efficiently serve multiple buildings on a campus or community scale.

and AEC firms claim this tax deduction for all eligible projects completed after January 1, 2006. But before taking this step, firms should recognize that retroactive claims will require amending past-year returns, so it's important to consider the costs (and potential audit risk) associated with re-filing up to 17 years' worth of taxes. Especially since claims relating to buildings put into service before 2023 are not eligible for the higher per-square-foot deduction established by the IRA, according to IRS guidance. IRS also notes that pre-2023 buildings must have achieved at least a 50% energy improvement to qualify—not the lower 25% threshold now in force.

For these reasons, BuildingGreen strongly recommends consulting with a trusted tax advisor before considering retroactive claims.

On the residential side, the IRA also modified and extended provision 25D, the Residential Clean Energy tax credit, through 2034. It offers a 30% tax credit for qualified residential energy-efficiency improvements, including installing GSHPs, to homeowners and renters in existing or new homes. The credit drops to 26% for systems placed into service in 2033 and 22% in 2034. It comes to an end after December 31, 2034.

GSHPs suddenly make the most financial sense

"We've been doing [GSHPs] for 30 years," recalls Turner, "and it's rare that it achieves cost parity with alternatives." But, he says, given the IRA incentives, the technology is increasingly a good fit almost everywhere.

Turner referenced an ongoing project in the Midwest, which began before the passage of the IRA, as an example. Based on preliminary designs, installing a GSHP system without any incentives would have had a six-year payback period. After Congress passed the IRA, the newly available incentives transformed the project economics by halving the mechanical system (MasterSpec Division 23) costs. The payback period disappeared—with more than $4 million in savings on day one, he said.

Turner explained that the IRA incentives are making GSHPs economically attractive even in regions of the country (primarily west of the Rockies) where the technology has not been particularly viable. High drilling costs, hard clay in the subsurface, and less groundwater can reduce conductivity and lower the system's performance. Projects in these areas often require more wells—thus increasing upfront costs.

But, Turner said, "Post-IRA is a different world. We're looking at it a lot more now on the West Coast than we would otherwise." He continued that, barring other feasibility issues, IRA incentives will make the cost of GSHPs equivalent to that of other system options—with better performance.

He provided an example of a project he is working on in California. To supply the project heating and cooling needs entirely with a GSHP system would require the installation of 220 wells. A hybrid system, however, would need only 90, and the project could still receive the ITC tax credit for its mechanical system at least 75% of the heating and cooling energy in the system come from the GSHPs). Combining the cost savings of a hybrid system with the IRA incentives reduced the payback period for this project from 30 years (for a 100% GSHP system with no incentives) to two.

Who will benefit from GSHPs?

Public awareness and understanding of GSHPs remain a barrier to widespread adoption. BuildingGreen asked Turner if he expected the technology to be adopted in affordable housing developments or low-income communities to help reduce utility burdens. He explained that "because of some of the moving pieces

and some of the complexity [of the ITC], I think there will be a barrier to entry for a lot of groups out there. Even though there could be a strong business model for it, I don't see a lot of developers going for it." Hopefully, he muses, they will begin to adopt it over time as they see it modeled.

To help with this modeling, the DOE's Geothermal Technologies Office announced the Community Geothermal Heating and Cooling Design and Deployment Funding Opportunity in July 2022. The program will award $13 million to support the design and deployment of community-scale geothermal heating and cooling and GSHP projects, create workforce training programs, and address environmental justice concerns. The program aims to develop case studies and share data and other information to help communities replicate successful models. In April, the program selected 11 projects for phase one.

Looking forward

Turner stresses that a good understanding of IRA incentives is necessary for practitioners to capitalize on opportunities: "I can't emphasize enough how complicated the [IRA] is and how many moving pieces you need to be familiar with," he said. "We've invested a lot of time and effort in understanding it because we know how transformative it will be for projects and owners." Turner and his team keep a tax advisor on retainer to help them navigate the evolving rules.

Turner advises that proficiency with the rules, including the tax code, can help teams assuage the reservations owners may have about installing GSHPs. "The more uncertainty you communicate to owners, the less they're interested in pursuing it," Turner noted. The timelines of the incentives, which extend until the mid-2030s, provide some policy certainty that may also help owners feel more comfortable investing in the technology.

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