



GeoBridge: Connecting Communities to Geothermal Information and Opportunities

Preprint

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2 U.S. Department of Energy

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ABSTRACT

The geothermal community is well established with long-standing events, organizations, and tools that are known across the geothermal community. But many of these tools and resources are located behind pay walls, require memberships, or are otherwise difficult to find, especially for people looking to join the geothermal community. These barriers to access can prevent outsiders from discovering valuable geothermal resources, limiting the geothermal community's potential for collaboration with other communities, such as clean energy entrepreneurs looking to expand into geothermal energy. The Department of Energy's (DOE) GeoBridge serves to bring these communities together by acting as a single, publicly accessible, searchable portal that facilitates easy access to available geothermal knowledge and information. It works to expand and diversify the pool of geothermal stakeholders by providing in-roads to geothermal information and community resources. It helps build a stronger geothermal community; one inclusive of individuals and groups from a variety of different backgrounds, including potential investors and start-up companies looking to accelerate innovation in geothermal technologies.

By linking communities to geothermal information, analysis and expertise, GeoBridge serves as a launch point, directing interested parties to existing data and tools, events, educational resources, STEM programs, permitting and regulatory information, and other resources that can be used to evaluate, promote, and discover geothermal opportunities.

1. Introduction

Geothermal technologies such as Enhanced Geothermal Systems (EGS) and Ground Source Heat Pumps (GSHPs) have been gaining national attention over the last several years, boosted in part by high-profile projects like Google’s project with Fervo Energy (McDermott 2023). As more people become interested in geothermal, many of them, especially those in professions adjacent to geothermal technologies or in other industries, are finding it challenging to get connected to the resources they need to join the geothermal community.

The National Renewable Energy Laboratory (NREL), working with the Department of Energy (DOE) and an advisory board comprised of geothermal experts from many different segments of the geothermal community, have identified the need for an aggregate information portal to address gaps in information that are making it difficult for some communities to get started in geothermal. A cursory analysis identified 9 user communities facing notable information gaps. In some cases, the information they seek is simply not available, while in others, it is hidden behind membership or pay walls, invisible to search engines, or otherwise undiscoverable.

DOE’s [GeoBridge](#) facilitates easier access to geothermal knowledge and information by making it universally accessible to all, and by bridging knowledge gaps that exist between the established geothermal community and the 9 user communities identified below. (GeoBridge 2024).

GeoBridge works to expand and diversify the pool of geothermal stakeholders to help build a stronger geothermal community; one inclusive of individuals and groups not traditionally linked to geothermal research and analysis, including potential investors, municipalities interested in geothermal and start-up companies looking to accelerate innovation in geothermal technologies.

2. Origins of GeoBridge

An early example of the need for GeoBridge came from the DOE Geothermal Data Repository (GDR), which provides free, universal access to geothermal data. Each dataset on the GDR has a primary Point of Contact (POC) listed to allow users to ask detailed questions about the data contained with the dataset, such as the conditions and methods used to acquire the data, any assumptions made, or other questions critical to understanding the data. The GDR also has links that allow users to “Contact GDR Help” to ask questions about the GDR platform itself or request technical assistance with data submission (Weers et al 2022). However, recent inquiries to both these communication channels have illuminated potential gaps in information that could be making it challenging for outsiders to join the geothermal community. The GDR Help team along with numerous dataset POCs and other geothermal subject matter experts have reported fielding a growing number of questions unrelated to their established communication channels.

GDR Help, for example, has recently been receiving questions such as, “*What colleges or universities should I be considering if I want to have a career in geothermal energy?*” and “*What events should I attend to meet geothermal professionals or learn more about emerging geothermal technologies?*”

While the answers may seem obvious to many, it’s important to recognize that the geothermal community is well established with long-standing events that require little-to-no advertisement to garner participation. Events like the Geothermal Rising Conference (GRC) and the Stanford Geothermal Workshop are well known to those already in the community. Their cadence and

locations are stable, predictable, and familiar to those that have been before. However, these events and others are not easily discoverable through conventional means, including internet searches. This is but one example of an information gap identified by the GeoBridge team. Additional gaps are listed in *Section 3: Identified Information Gaps*.

2.1 Information Accessibility and Discoverability

It is important to fully recognize and appreciate the likely journey an information seeker has undertaken prior to emailing the GDR Help team. On the road to answers, people asking questions like those above do not start with an email to the GDR Help team. More likely, they begin their journey at a search engine or by asking their question to an Artificially Intelligent (AI) chat bot; in both cases expecting an instant response. Yet, at some point in their search, these information seekers are arriving at the GDR, finding the GDR Help email (located under the Help menu or in the footer of each page), opening an email program, typing their question in an email to an unfamiliar recipient and then awaiting a response. This is not an efficient way to get information in the modern world. Sending an email to GDR Help is often a last resort, the (presumably) final attempt of a desperate information seeker.

The questions above, and many more like them, are indicative of larger gaps in the availability of relevant geothermal information. Whatever the answers may be, we can assume that they are not easily discoverable through conventional means.

2.2 Community Engagement

The GeoBridge team reached out to geothermal subject matter experts across the geothermal community to identify information gaps. Many of the experts had recently fielded similar queries from students, job seekers, startup companies, regulators, utilities and more. The people in these communities were clearly struggling to find answers to their questions and were otherwise unable to engage the geothermal community.

The primary objective of GeoBridge is to bring these communities together to improve diversity in geothermal energy and bridge the gap between established geothermal communities, emerging startups, and the next generation of the geothermal workforce. To fulfill that objective, the GeoBridge team established an Advisory Group consisting of experts and representatives of many different aspects of the geothermal community.

2.2.1 Formation of the GeoBridge Advisory Group

The GeoBridge Advisory Group was formed in early 2024 and contains members from industry, non-profit organizations, universities, DOE, national labs, international associations, installers, state energy offices, and the Women In Geothermal (WING) network. The group is also representative of the many aspects of geothermal technologies, with experts in EGS, GSHPs, direct use, low temp, analysis, policy, and development. The GeoBridge Advisory Group was selected to be representative of the geothermal community at large and tasked with assisting the GeoBridge team with the identification information gaps and the prioritization of efforts to address those gaps.

3. Identified Information Gaps

The following information gaps have been identified and prioritized by the GeoBridge team through conversations with the GeoBridge Advisory Group and interviews with industry professionals, geothermal experts, and other stakeholders. These gaps are organized by community along with examples of their respective needs and described in the sections below:

Section	Community
3.1	Entrepreneurs looking to introduce their technology into the geothermal space
3.2	Professionals looking to find and build a career in geothermal including work force development and training for the next generation of geothermal workers
3.3	Homeowners and Businesses interested in learning how heat pumps can save them money
3.4	Students looking for studies programs that will set them up for a career in geothermal
3.5	Organizations looking to generate more interest in geothermal projects and job openings
3.6	Teachers looking to integrate geothermal learning into their lesson plans
3.7	Policy Makers looking to introduce geothermal into their communities and educate their constituents
3.8	Utilities looking for guidance on how to incorporate geothermal energy into their future plans
3.9	Regulators looking for assistance and best practices for approving and monitoring geothermal systems

Table 1. Identified information gaps organized by communities and their respective needs.

3.1 Entrepreneurs looking to introduce their technology into the geothermal space.

DOE initiatives such as GEODE (DOE GTO 2024) are helping to address technology and knowledge gaps in geothermal through the transfer of technology, expertise, and best practices from the oil and gas industry. Many other efforts already bridge the gap between geothermal and oil and gas, however there are numerous other industries, both established and emerging, with geothermally relevant technologies that are struggling to make a connection. The GDR Help email has received inquiries from startup companies specializing in high temperature electronics, special cements, and advanced sensing technologies such as Distributed Acoustic Sensing (DAS), each looking to expand into geothermal energy, but unsure of who to talk to, what events to attend, or how to get connected with geothermal experts.

3.2 Professionals looking to find and build a career in geothermal

It is difficult for outsiders with geothermal-relevant skills to discover opportunities in the geothermal industry. This is especially relevant to GSHP companies who are struggling to find certified installers and technicians (IGSHPA 2024). Many people aren't aware that their existing skills are applicable to geothermal technologies while others are searching for ways to advance their careers in geothermal. Increasing awareness of training and certification programs can help with workforce development. Additionally, links to prominent geothermal employers and their job boards can provide additional pathways for others to advance their geothermal careers.

3.3 Homeowners and Businesses interested in learning how heat pumps can save them money

Interest in GSHPs has grown considerably in recent months. Searches for GSHP incentive programs, average costs and the feasibility of installation by region have increased by as much as 1,200% in the last two years (Google Trends 2024). However, an in-depth analysis of the search terms used and the resources available indicated that homeowners and businesses alike were failing to find the unbiased information they need to make informed decisions. The GeoBridge team found that members of these communities are often turning to Reddit forums, friends, neighbors, and other unvetted sources to find answers to their questions. Furthermore, incentive programs for GSHPs can be difficult to find as they often toe the line between energy efficiency and green building programs and will appear inconsistently in lists of one or the other depending on region and funding source.

3.4 Students looking for studies programs that will set them up for a career in geothermal

Many of the inquiries received by the GDR Help team were from high school students and undergraduates interested in a career in geothermal, wanting to know which schools are the most involved in the geothermal community and which degree programs are most likely to be valued by hiring organizations.

3.5 Organizations looking to generate more interest in geothermal projects and job openings

Geothermal organizations frequently share their progress, project updates, and job openings during popular geothermal events, but these announcements often do not reach beyond the established geothermal community. GeoBridge is built upon OpenEI's wiki making it easy for others to contribute to topics and provide additional information. Users can leverage this structure to advertise their projects and successes to a broader network and connect with new audiences and communities to help fill open positions.

3.6 Teachers and educators looking to integrate geothermal learning into their lesson plans

Energy education is critical for the adoption and acceptance of new and innovative technologies. However, geothermal is typically only a small piece of renewable energy education. While geothermal energy appears to be easily understood within the confines of a textbook, it is difficult to illustrate in hands-on activities. GeoBridge includes a variety of resources for teachers and educators such as hands-on activities and lesson plans broken down by appropriate grade level, with examples of standards and corresponding materials (e.g., Next Generation Science Standards).

3.7 Policy Makers looking to introduce geothermal into their communities and educate their constituents

Policy makers, including state and local energy offices, are struggling to find the information they need to affect long term changes in their energy grid, including the adoption of geothermal technologies. Even in communities where there is considerable motivation to adopt geothermal technologies, community leaders still need assistance crafting effective policies and regulations, and educating their constituents on the benefits, economics, and potential job opportunities of geothermal technologies.

3.8 Utilities looking for guidance on how to incorporate geothermal energy into their future plans

Utilities interested in geothermal energy are struggling to find the information they need to make informed decisions. They are finding it difficult to sort through the multitude of tools and resources available, to identify information that is current and relevant to their service territories.

3.9 Regulators looking for assistance and best practices for approving geothermal systems

The classification of GSHPs varies from state to state, with some states classifying them as water wells, requiring additional permits and restricting proposed locations. The approval of new geothermal projects in these areas often depends on the limitations of outdated or potentially unrelated regulations, and in some areas can prevent GSHP wells from existing beneath residential structures (Gergely et al 2023). The regulations, best practices and lessons learned from communities with high GSHP adoption rates could help expedite the adoption of geothermal technologies in other areas.

Similarly, as EGS technologies begin to expand to other regions across the country, states less familiar with regulating geothermal technologies are seeking technical assistance and information on regulatory best practices.

4. Bridging the Gaps

GeoBridge is working to bring these communities together by acting as a single, publicly accessible, searchable portal that facilitates easy access to available geothermal knowledge and information.

Connecting people to geothermal communities, information, and opportunities

GeoBridge provides answers to some of the most pressing questions in geothermal, covering everything from home heat pump installation to careers in geothermal, educational tools, and cost savings opportunities for businesses.

What is Geothermal?

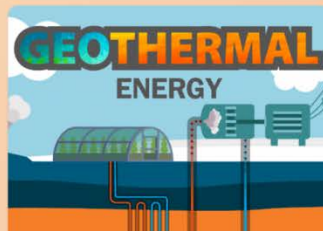
Geothermal for Home and Business



Get Connected

Find partners, communities, and opportunities to get involved in geothermal

Connect



Geothermal 101

Learn the basics about geothermal and find helpful educational resources

Learn about Geothermal



Explore Careers

Learn about types of geothermal careers, who's hiring, and where.

Explore Employers

Figure 1 GeoBridge home page and main site navigation.

The GeoBridge site has been organized around the needs of the communities and information gaps identified in Table 1. The collective needs of these communities were clustered into common themes, which formed the basis for the main navigation. Additional pathways to information are featured in tiles on the homepage (Figure 1), which have been designed to align with common questions about geothermal pulled from recent inquiries to the GDR team and an analysis of search terms being used on major search engines.

In addition to the homepage and main navigation, GeoBridge features focus pages tailored to information from each of the common themes identified across the target communities. For example, a page on how to get connected within the geothermal industry (Figure 2) helps entrepreneurs, businesses, students, and aspiring professionals find the events, resources and connections they need. These content pages were prioritized by the GeoBridge team and the Advisory Group based on community engagement and outreach efforts and are designed to maximize the impact of GeoBridge's efforts to bridge the information gaps identified above.




GeoBridge Basic Geothermal **Get Connected** Work in Geothermal Heat Pumps STEM


Get Connected

Connecting entrepreneurs, businesses, and individuals to the geothermal industry

Get in touch with the people, events, and news you'll need to build a network in the geothermal community.

Meet Key Participants in Geothermal Find Events

 <p>+25bn New investment in geothermal by 2030</p>	 <p>+9% Annual growth rate in geothermal for heating and cooling</p>	 <p>20x Increase in geothermal power by 2050</p>
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Sources:

- Pathway to Commercial Liftoff Report, U.S. Department of Energy
- Global Geothermal Market and Technology Assessment, International Renewable Energy Agency

- Get Started
- Join a Regional Interest Group
 - Events
 - Newsletters
 - Social Feeds
- Get Noticed
- Share Research
 - Publish Research in a Journal
 - Present Research at an Event
 - Geothermal Organizations

Make Connections in Geothermal

Geothermal is both an old and rapidly evolving industry, meaning that there is a large community of state, national, and international developers, events, and communities dedicated to the advancement of geothermal you can tap into network, get involved, or learn more about geothermal technologies, news, and events. Whether you're an entrepreneur, a student interested in pursuing a career in geothermal, or a utility looking to add geothermal to your energy portfolio, knowing what communities are out there and how to get in touch is the best way to get connected in geothermal.

Get Started

The easiest ways to get involved in Geothermal include joining Regional Interest Groups (RIGs), attending events, and following key newsletters, blogs, and social media feeds.

Figure 2 GeoBridge focus page for entrepreneurs, businesses, students, and aspiring professionals looking to make connections in the geothermal industry.

4.1 Content Roadmap

Content development and organization activities included in the initial launch of GeoBridge were outlined in a Content Roadmap developed from the gap analysis and prioritization efforts of the GeoBridge team, DOE, and the Advisory Group. The Content Roadmap also outlines future development efforts planned for Federal Fiscal Year 2025 (FY25), which include providing additional information and resources for:

- 1) Entrepreneurs looking to accelerate the development of their technologies, seek additional funding, or collaborate on new projects with existing geothermal teams.
- 2) Homeowners and businesses interested in GSHPs looking for an impartial, reliable source for information on the cost and feasibility of GSHPs in their local area.
- 3) Professionals seeking careers in geothermal or looking to apply their skills toward geothermal ventures.

- 4) Students interested in geothermal-relevant graduate programs.
- 5) Teachers looking for resources and experiences outside of the classroom such as geothermal field trips.
- 6) Work force development resources and additional information on training and certifications needed to become GSHP installers, technicians, and other supporting trades.

4.2 Built on OpenEI: Open Energy Information

GeoBridge has been developed in the OpenEI wiki, enabling quick and easy content updates and allowing the geothermal community to assist in keeping resources and links up to date. OpenEI uses a Semantic Mediawiki hosted in a secure cloud environment to provide universal access to energy information. Launched in 2009 as part of the White House Open Government Initiative (Brodt-Giles 2009), information on OpenEI is freely available and is accessible online through web browsers and numerous Application Programming Interfaces (APIs), making it a powerful and effective information dissemination engine. It is currently home to over 50,000 content pages and more than a dozen energy-related data and analysis applications.

By leveraging the OpenEI platform, GeoBridge content is easily discovered by search engines and is automatically disseminated to dozens of other sites.

4.3 Avoiding Duplication of Effort

GeoBridge helps users find the information they need without generating duplicative content. In cases where pertinent information already exists online, GeoBridge points to the best sources for that information. For resources with difficult to discover information, such as information behind membership or pay walls, GeoBridge acts as a guide providing users with the additional context needed to access the information they seek.

The GeoBridge team coordinates closely with the GeoBridge Advisory Group, which includes operators of other geothermal information portals, who help ensure that GeoBridge efforts are complimentary to the ongoing and future efforts of other sites. The GeoBridge team is working closely with Geothermal Rising, IGSHPA, and state energy offices to address these gaps across the geothermal information space and to serve the needs of the communities identified above without being duplicative.

5. Conclusion

Users of GeoBridge are able to answer their questions, make connections, and find useful inroads into the established geothermal community through links to existing knowledge hubs, databases, and websites from a variety of sources, including other national labs, energy.gov, Geothermal Rising, the International Geothermal Association (IGA), state and local geothermal hubs, and more.

GeoBridge creates pathways to information not currently available or easily discoverable and makes it easier for outsiders to find information and opportunities within the geothermal industry. It helps to expand and diversify the larger geothermal community by bridging gaps to geothermal information and community resources. As a result, it helps build a stronger geothermal community; one inclusive of individuals and groups from a variety of different backgrounds,

including potential investors, clients interested in geothermal and start-up companies looking to accelerate innovation in geothermal technologies.

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