AMERICAN MADE
U.S. DEPARTMENT OF ENERGY

Geothermal Collegiate Competition

2024 Fall Semester Rules

Initial release date: July 23, 2024
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Acronyms and Abbreviations

ACH	Automated Clearing House
DOE	U.S. Department of Energy
GDHC	Geothermal district heating and cooling
GHP	Geothermal heat pump
GTO	Geothermal Technologies Office
NREL	National Renewable Energy Laboratory

Summary of Changes in January 2025 Release

Sections 1 and 2 were updated for wording; no changes that impact the competition deliverables were made.

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1. COMPETITION SUMMARY

Welcome to the U.S. Department of Energy (DOE) Geothermal Collegiate Competition (GCC)! The GCC is part of DOE's **American-Made** collection of prizes and competitions.

The Geothermal Collegiate Competition engages student teams to develop and analyze forward-thinking geothermal heating and cooling concepts for a community or campus to inspire students and professionals alike.

The DOE Geothermal Technologies Office (GTO) encourages students to propose innovative geothermal heating and cooling solutions while building skills that may be applied in the energy workforce. By engaging with students and stakeholders that may not yet be aware of geothermal technologies, or not be traditionally involved with geothermal research, GTO aims to raise awareness of geothermal energy, its applications, and its benefits to broaden the geothermal stakeholder base.

The competition seeks to engage students across geosciences, engineering, finance, regional planning, sustainability, policy, design, communications, and other disciplines to reimagine how to heat and cool their communities and campuses. Students will assume the role of a developer of a geothermal heating and cooling system for a *district-scale application*. There are two types of proposals, and teams will choose only one:

Technical Track teams present a qualitative justification for deploying a geothermal district heating and cooling (GDHC) system in the proposed district (community or campus) and a conceptual design of a geothermal system based upon community needs, available resources, and prospective benefits to that community.

Policy Track teams present a qualitative justification for deploying a GDHC system in the proposed district (community or campus), an analysis of the regulatory environment, financial incentives and economic assessment, including workforce development analysis.

For both tracks, the Geothermal Collegiate Competition is designed for students to consider community-driven change as the fundamental requirement of any proposal. What are the challenges, needs, and desires of the community or campus? Examples might include quantification of job opportunities, expanding geothermal awareness, addressing health concerns, or honoring the community's previous experience with energy development and impacts. The perspectives gained during the competition will prepare the students to lead the next generation of geothermal energy development. As competitors, students will also:

- Gain experience with innovative renewable energy applications
- Develop real-world concepts that shape the future of geothermal energy
- Compete to earn a cash prize and national recognition.

The Geothermal Collegiate Competition invites participation by teams of at least three students enrolled in accredited U.S.-based collegiate institutions or U.S. citizens enrolled at non-U.S.-based collegiate institutions. In this case, "collegiate institution" refers to any school of postsecondary or higher education, including but not limited to community colleges, technical colleges, and traditional four-year and graduate-level universities. See "Who Can Enter" for more information on eligibility. There is no cost to register or participate.

The National Renewable Energy Laboratory (NREL) is the Geothermal Collegiate Competition administrator and supports student team efforts through educational webinars and informational references. Learn more at https://www.energy.gov/eere/geothermal/geothermal-collegiate-competition. Questions on these rules or the program overall can be directed to Geo.Competition@nrel.gov.

Register to compete at www.herox.com/geothermalcollegiatecompetition2024

Summary Timeline and Deadlines

The Geothermal Collegiate Competition is a semester-long project, opening in August and ending in December 2024. Important program dates are listed below.

- June 13, 2024 – Competition announced
- July 23, 2024 – Competition Rules released
- July 23, 2024 – Informational webinar
- August 12, 2024 – Competition opens and registration begins
- September 12, 2024 – Informational webinar
- September 16, 2024 – Registration deadline for mentor assignments
- October 7, 2024 – Final registration deadline
- October 28, 2024 – Progress Submission deadline (optional)
- November 12, 2024 – Feedback provided on Progress Submission
- December 20, 2024 – Final Submission deadline
- February 2025 – Winners announced
- Prior to July 2025 – First Place Winners must conduct a stakeholder event, funded by DOE.

Background

Geothermal energy is a firm and flexible renewable energy resource derived from the Earth's heat. It is used for a wide spectrum of applications including heating, cooling, and electricity generation. This competition focuses on *geothermal heating and cooling technologies.*

Many geothermal heating and cooling systems take advantage of naturally heated hot water from deep underground, which is pumped to the surface and through a heat exchanger for heating and cooling buildings, defined as direct use. *Direct use,* as the name implies, involves using the heat in the water for such things as heating districts, buildings, industrial processes, greenhouses, aquaculture (fish farming), and resorts. Direct use projects generally use resource temperatures between 38°C (100°F) and 149°C (300°F). Current U.S. installed capacity of direct-use systems totals 470 MW, or enough energy to heat 40,000 average-sized houses.[1] Direct use of geothermal energy can help districts decarbonize their heating and cooling systems, which is of increasing value in today's energy market.

Other heating and cooling systems use the naturally occurring temperature difference between the above-ground air temperature and the shallow subsurface soil temperature to create a heat sink in warmer temperatures and a heat source in cooler temperatures. These are called geothermal heat pumps (GHPs). GHPs can heat and cool single homes, or can be networked to service a district with a GDHC system. *GHPs* use the natural insulating properties of the Earth to heat and cool spaces, offering a unique and highly efficient renewable energy technology for heating and cooling. In a GHP-based system, an above-ground electric-powered heat pump moves water or another fluid through a series of buried pipes or ground loops located in the shallow subsurface. Heat is taken from the district and transferred to the ground in the summer. The system is reversible, and heat is taken from the ground and used in the buildings in the winter. The system only moves heat, which is much more efficient than using fuel or electricity to create heat. GHPs can support space heating and cooling needs in almost any part of the country.

[1] Geo_101.pdf (mygeoenergynow.org)

For the purposes of this competition, teams identify a community or campus use case location and propose a *district direct use or GHP-based application of geothermal heating and cooling*. A further description of some public case studies on installed GDHC systems in the U.S. is available in Appendix B. Additionally, is recommended, but not required, that teams incorporate added components or heating processes to the GDHC systems (e.g., Heat Recovery Process, Thermal Storage Systems, Waste Heat), as a means of augmenting the overall efficiency, capabilities and economical purposes of the system.

DOE has a history of supporting education and workforce development through competitions focused on project-based learning (e.g., Solar Decathlon®, Collegiate Wind Competition, EcoCAR Mobility Challenge, Cleantech University Prize, EnergyTech University Prize, and more). Student competitors in the Geothermal Collegiate Competition gain experience working with communities to solve energy challenges that prepare them for careers in geothermal and related energy fields, while benefiting from mentorship, training, and collaboration. This competition supports DOE's ongoing work to help grow the domestic geothermal industry and address employment gaps through experiential learning that inspires innovation.

2. COMPETITION PROCESS

Introduction

The Geothermal Collegiate Competition engages collegiate student teams to analyze a community or campus and its resources for geothermal heating and cooling system deployment. The strongest teams are multidisciplinary, including students from geosciences; mechanical, chemical, or civil engineering; social sciences; business or finance; regional planning; construction management; resource management; communications; sustainability; environmental science; energy policy; political science; and other degree programs.

As noted in Section 1, students will choose to compete in one of two tracks for this prize:

1. The **Technical Track** encourages teams to propose the development of a GDHC system leveraging direct use or GHP-based technologies.

   GDHC systems can be defined as the use of geothermal energy to heat and/or cool multiple buildings through a single distribution network. GDHC systems leverage commercially available components, such as heat exchangers and GHP technologies.

   The proposal for the competition's Technical Track must be for a community or campus located in the United States or a U.S. territory. The use case must consist of two or more commercial or multifamily buildings, or an industrial or agricultural process use with property access rights to the geothermal resources. Each team will propose a GDHC concept for their chosen community. Furthermore, is recommended, but not mandated, that teams think of innovative ways to incorporate added components or heating processes to the GDHC system (e.g., Heat Recovery Process, Thermal Storage Systems, Waste Heat, etc.), as a means of augmenting the overall efficiency, capabilities, and economical purposes of the system.

   Students will work with real-world parameters including actual energy load, utility rates, and subsurface data while designing their project. Input from community stakeholders will inform real-world project constraints and considerations. The concepts the teams develop will provide insights that could inform community stakeholders for future development of an actual GDHC at their chosen location. The proposal must include an assessment using geotechnical data, cost data, and energy consumption metrics for that community.

2. The **Policy Track** challenges students to consider the permitting requirements and incentive opportunities available to geothermal developers.

   Geothermal projects face a myriad of regulatory requirements at the federal, state, county, and local level as they move from the conceptual stage to construction. This overlapping and patchwork regulatory regime can impose barriers to promising projects.

   Financial incentive programs available to geothermal developers are also of importance. There may be federal, state, or local incentive programs (tax rebates, utility rebates, grant programs, etc.) available to developers of geothermal resources in given jurisdictions that can defray some of the costs. Some incentive programs may have other factors which limit eligibility, such as cash on hand requirements. A clearer picture of how these programs overlap and interrelate with each other should be considered.

   Socio-economic benefits, such as workforce development, related to design, construct, operate and maintain GDHC systems could be substantial for a local community. Workforce analysis could include forecasting new jobs required, training and upskilling needs, integration of current community members (i.e. sustainable degrees students and faculty) and incentives for prevailing wages, among others.

   Deliverables for policy track submissions should take the form of a flow chart and narrative detailing how they would pursue the necessary permits, incentives, and financing of a geothermal project from inception to operation at their proposed site.

   As in the case of the technical track submissions, the district use case or cases being considered must be located in the United States or a U.S. territory. The use case(s) must consist of two or more commercial or multifamily buildings, or an industrial or agricultural process use with property access rights to the geothermal resources.

Final Submission Summary

Final Submissions contain the following elements:

1. **Overview Presentations –** Completed by all teams
   a. One PowerPoint slide summarizing your project (template available in HeroX resources).
   b. Video (10-minute maximum) presenting your work, targeted at a high school audience.
   c. Simple resumes of all student team members. No specific format required.
2. **Core Submission –** Completed by all teams
   a. Site Identification: Each team will present a qualitative justification for deploying a geothermal heating and cooling system in their proposed district (community or campus).
   b. Stakeholder Engagement Report and Event Plan: The report should include a description of the stakeholder engagement strategy and a stakeholder map (see Appendix C), including a description of stakeholder roles in the development process, how they were engaged in the project, and their feedback. If stakeholders necessary to project development were not engaged over the course of the competition, that should also be detailed, including an explanation for why they were not included. A plan for a stakeholder engagement event should also be submitted; first-place teams in each track

will be required to host a community stakeholder event and will be given funding to do so.

3. In addition, CHOOSE ONE of the following two Tracks:
    a. **Technical Track:** The team will propose a GDHC conceptual design for their chosen community in PowerPoint or preferred design software. GDHC design will be based on the actual energy demand of the community or campus, available resources (e.g., land and subsurface data), and will factor in current conditions when discussing advantages of the current system (e.g., utility rates, energy sources, etc.). Input from community stakeholders will serve as real-world project constraints and considerations.
    b. **Policy Track:** The team will propose how a community could construct a GDHC. The proposal should include a flow chart and narrative detailing how their proposed site would pursue the necessary permits, economic incentives, financing, and workforce analysis of a GDHC project from inception to operation.

Prizes to Win

Prizes for the Geothermal Collegiate Competition are as follows:

Technical Track:

First Place – $10,000 cash prize + $9,000 stakeholder event budget

Second Place – $6,000 cash prize

Third Place – $2,000 cash prize

Policy Track:

First Place – $10,000 cash prize + $9,000 stakeholder event budget

Second Place – $6,000 cash prize

Third Place – $2,000 cash prize

Bonus Prize:

Outstanding Submission from a Tribal College or Community College – $2,000 cash prize

Honorable Mention:

Best Video

Best Informative Graphic

First, second, and third place prizes will be awarded in each track. In addition to the $10,000 cash prize, each first-place winning team will receive $9,000 for the express purpose of planning and executing a stakeholder event in the proposed community (in the United States or U.S. territories). NREL staff will travel to the two stakeholder events, and a photographer will be provided. The stakeholder event should include a showcase of geothermal technologies and their potential within the community, local speakers and attendees, and GDHC informational materials.

Cash prizes will be paid to the team captain upon receipt of proof of school enrollment, Internal Revenue Service Form W-9, and Automated Clearing House (ACH) banking information. Stakeholder event funding will be paid either to the team captain or the university, whichever the team selects.

Second and third place winners will be awarded cash prizes, though will not receive funding nor be required to host a stakeholder engagement event. New to the competition this year, a bonus prize of $2,000 may be awarded to an outstanding submission from a team comprised exclusively of tribal college or community college students. Honorable Mention awards will also be announced for submissions with the Best Video and Best Informative Graphic; these deliverables will be spotlighted in NREL and DOE social media and announcements. Cash prizes will not be awarded for these Honorable Mentions.

How to Enter

1. Go to the Challenge page at www.herox.com/geothermalcollegiatecompetition2024
2. Create a HeroX account if you do not already have one or sign in and then choose "Solve this Challenge" once registration opens in August. This indicates your interest in competing; it is not yet a commitment.
3. The team captain must click "Begin Entry" and then complete the Team Registration Form no later than September 16, 2024, in order to guarantee being assigned an industry mentor for the competition. The final registration deadline to be eligible for the competition is October 7, 2024, though teams registering by this date are not guaranteed an industry mentor to guide their work. All teams that complete the Team Registration Form and meet the competition eligibility requirements are deemed eligible to participate in the remainder of the competition.
4. Only the team captain may submit a Team Registration Form entry. Other members join that captain's team via HeroX. Team members may be added or removed from a team at any time. Once a captain has created a team, they can invite additional members using HeroX. All participating student team members are expected to have HeroX accounts and be joined in a team.

Who Can Enter

The Geothermal Collegiate Competition invites teams consisting of at least three collegiate students who meet the following criteria:

- All participating students must be enrolled in an accredited collegiate institution. Students must be enrolled in at least one class and be pursuing a degree throughout the duration of the competition.
    - For the purposes of this competition, "collegiate institution" refers to a school of post-secondary or higher education, including but not limited to community colleges, colleges, and universities. Collegiate students of any level are eligible to compete. Teams with students from multiple universities are allowed, and multiple teams from the same university are allowed. Individual students may be members of only one team.
- The team captain and HeroX account holder for the team submission must be a U.S. citizen or permanent resident.
    - Teams may represent U.S.-based or non-U.S.-based accredited collegiate institutions, provided the team captain is a U.S. citizen or permanent resident.
    - **For teams representing non-U.S.-based accredited collegiate institutions, the team captain and all team members must be U.S. citizens.**
- Members of the expert reviewer panels, competition administrator staff, and DOE and national laboratory employees are ineligible to compete.

- Individuals participating in a foreign government talent recruitment program[2] sponsored by a country of risk[3] and teams that include such individuals are not eligible to compete.
- To be eligible, an individual authorized to represent the competitor must agree to and sign the following statement upon registration with HeroX:

  I am providing this submission package as part of my participation in this prize. I understand that the information contained in this submission will be relied on by the federal government to determine whether to issue a prize to the named competitor. I certify under penalty of perjury that the named competitor meets the eligibility requirements for this prize competition and complies with all other rules contained in the Official Rules document. I further represent that the information contained in the submission is true and contains no misrepresentations. I understand false statements or misrepresentations to the federal government may result in civil and/or criminal penalties under 18 U.S.C. § 1001 and § 287, and 31 U.S.C. §§ 3729-3733 and 3801-3812.

In keeping with the goal of growing a community of innovators, competitors are encouraged to form multidisciplinary teams while developing their concept. The HeroX platform provides a space where parties interested in collaboration can post information about themselves and learn about others who are also interested in competing in this contest.

- Multiple teams from a single academic institution may participate. However, each student is only eligible to be a member on a single team.
- Teams can consist of students from multiple institutions.
- Teams are encouraged to have at least one faculty advisor, but this is not required for participation. The faculty advisor is not an official team member and does not count toward the minimum requirement of three participating students per team.
- Teams are encouraged to build a team that is multidisciplinary so that the team consists of students from all disciplines needed to produce the final submission package.
- By uploading a submission package, a team self-certifies that it is in compliance with the eligibility requirements. If the competition administrator becomes aware that a team or individual is not eligible, that team may be disqualified from competition.

How to Compete

The Geothermal Collegiate Competition consists of the following steps:

1. **Preparation –** Students identify their multidisciplinary team members, become familiar with the competition rules, and register their team on HeroX filling in the Team Registration Form. The rules are available July 23 and registration opens on August 12. Teams must register by September 16 to be assigned a mentor; final registration closes on October 7. Teams will select either the Technical or Policy track upon registration.

[2] Foreign Government-Sponsored Talent Recruitment Program is defined as an effort directly or indirectly organized, managed, or funded by a foreign government, or a foreign government instrumentality or entity, to recruit science and technology professionals or students (regardless of citizenship or national origin, or whether having a full-time or part-time position). Some foreign government-sponsored talent recruitment programs operate with the intent to import or otherwise acquire from abroad, sometimes through illicit means, proprietary technology or software, unpublished data and methods, and intellectual property to further the military modernization goals and/or economic goals of a foreign government. Many, but not all, programs aim to incentivize the targeted individual to relocate physically to the foreign state for the above purpose. Some programs allow for or encourage continued employment at United States research facilities or receipt of federal research funds while concurrently working at and/or receiving compensation from a foreign institution, and some direct participants not to disclose their participation to U.S. entities. Compensation could take many forms including cash, research funding, complimentary foreign travel, honorific titles, career advancement opportunities, promised future compensation, or other types of remuneration or consideration, including in-kind compensation.

[3] DOE has designated the following countries as foreign countries of risk: Iran, North Korea, Russia, and China. This list is subject to change.

2. **Optional Progress Submission –** Teams can submit an optional Progress Submission by October 28 to receive feedback on their deliverables. This submission includes:
    a. Qualitative site identification/justification.
    b. Initial stakeholder engagement strategy.
    c. CHOOSE ONE of the following two track submissions:
        - Technical Track: Preliminary geothermal resource assessment.
        - Policy Track: Preliminary permitting assessment.

    Throughout the Progress Submission process, the competition administrator may host virtual educational opportunities and will recommend resources to help teams complete their submission. These are announced through the HeroX platform. Teams submitting a Progress Submission must do so in HeroX by the deadline.
3. **Progress Submission Feedback –** The competition administrator evaluates each Progress Submission for eligibility and relevance. Each team that submits their Progress Submission by the deadline will be provided with comments by November 12, 2024.
4. **Final Submission –** Teams complete all required sections for their Final Submission and submit them in HeroX by December 20, 2024.
5. **Assessment and Winner Selection –** The competition administrator screens all entered Final Submissions and assigns expert reviewers to independently score the content of each submission. DOE then makes a determination of the first, second, and third place teams of each track.
6. **Winner Announcements –** The competition administrator publicly announces the competition results by February 2025. After the public announcement, all teams are individually notified of their status and receive the expert reviewer comments on their respective Final Submissions. Winning teams will receive the associated prize funding.
7. **Stakeholder Engagement Events –** The first-place teams implement their plans for an in-person Stakeholder Engagement Event. The local in-person events will be funded by DOE, but it is expected that the university will support the winning teams with event logistics. Stakeholder Engagement Events may be held within the United States or U.S. territories any time between March and July of 2025.

Assigned Mentors

Teams who register for the challenge by the September 16, 2024, deadline will be assigned a mentor for support throughout the semester-long competition. These hand-selected industry mentors will play a critical role throughout the competition, providing teams with real-world experience, technical insight, and other important support.

3. WHAT TO SUBMIT

Teams submit deliverables in two phases: a Progress Submission (optional), and a Final Submission (required). For both the Policy Track and Technical Track, the Final Submission is composed of four scored sections and four unscored sections. The Progress Submission contains a subset of these scored sections.

Table 1. Overall Deliverable Details

		Section	Included in Optional Progress Submission	Included in Final Submission
	Overview Presentation	Team Information (unscored)	x	X
		Summary Slide (unscored)		x
		Presentation Video (unscored but recognized by a "best video" honorable mention)		x
		Student Team Member Resumes (unscored)		x
	Core Submission	Site Identification	x	x
		Stakeholder Engagement Strategy, Report, and Event Plan	x	x
CHOOSE ONE	Technical Track	Geothermal Resource Assessment	x	x
		Engineering and System Design Assessment		x
	Policy Track	Permitting Assessment	x	x
		Economic and Financial Incentives Assessment		x

Overview Presentation

Table 2. All Teams: Team Information

Team Information (not scored)
These questions are answered directly on the HeroX platform. They are used to determine eligibility and for reference by competition administrators.
Content: • Name, collegiate affiliation, and degree program of each team member • Team photo

Table 3. All Teams: Summary Slide

Summary Slide (may be made public, not scored)
Applicants are required to provide a single slide summarizing the proposed project. [Single PowerPoint slide; template available on HeroX under "Resources"]
Content: • A project summary • A description of the proposed project's impact • Proposed project goals • Any key graphics (illustrations, charts, and/or tables) • The proposed project's key idea/takeaway • Project title, team name, names and email addresses of all team members and faculty advisor (if applicable).

Table 4. All Teams: Presentation Video

Presentation Video	
Online public video targeted at a high school audience (up to 10 minutes). Ensure that your video is posted publicly online (YouTube, Vimeo, etc.) and that all images and visuals can be publicly used free of copyright restrictions.	
Content: • Background information on geothermal technology and the problem space that a high school student would need to know to understand your project. • The real-world problem you are solving, presented to a general high school-level audience. • Your solution, why it is transformational, and the impacts it will have for the target community • Graphics, diagrams, photos, and animations that clearly illustrate your solution.	Evaluation Statements: • The video clearly and concisely explains relevant background of the technology, a compelling real-world problem, and your solution in a way that is accessible to a high-school audience. • Unique and creative graphics, diagrams, and photos are included that effectively illustrate the concepts presented. • The video clearly explains what makes your solution innovative, transformational, and the extent of the impact to the community. • The video describes a unique innovation that will benefit the proposed community. • The video is engaging and tells a compelling story that a high school

	student with no prior knowledge of geothermal could understand.
Additional details: The video is a non-scored required deliverable. However, the video will be evaluated separately and the winner of the "best video" award will be spotlighted in NREL and DOE social media and announcements.	

Table 5. All Teams: Student Team Member Resumes

Student Team Member Resumes (not scored)	
Single PDF document containing all team resumes. [No specific format or length requirement].	
Content: • A single PDF document containing combined resumes of all student team members. • Resumes should include student name, contact information, work and research experience, and education experience.	Evaluation Statements: • All student team members are represented by the resumes in the document.

Core Submission

Table 6. All Teams: Site Identification

PROGRESS SUBMISSION AND FINAL SUBMISSION: Site Identification	
Map showing identified site and 2-page written narrative [Single PDF, 11pt Calibri font, double spaced, 1-inch margins] 2-page limit does not include map of site.	
Content: • Aerial map clearly identifying (1) the location of proposed community or campus site, (2) the geothermal resource and any existing infrastructure, and (3) buildings connected to the GDHC. • Description of the community or campus site. • Justification of the site's selection.	Evaluation Statements: • The community or campus site is clearly identified. • The site is appropriate for a GDHC system.
Additional description and requirements: The selected site must be within the United States or within U.S. territories. The site must be clearly identified and appropriate for the selected use case. The use case must consist of two or more commercial or multifamily buildings, or industrial or agricultural process use, with property access rights to the geothermal resources.	

Table 7. All Teams: Stakeholder Engagement Strategy, Report, and Event Plan

<table>
<tr><th colspan="2"><u>PROGRESS SUBMISSION</u>: Stakeholder Engagement Strategy</th></tr>
<tr><td colspan="2">5-slide PowerPoint presentation [saved as a PDF]</td></tr>
<tr><td>Content:
Draft stakeholder map (see Appendix C for example) identifying site-specific stakeholder group(s) and description of their role in the development process.
Discussion of how the groups have or will be engaged during the competition, and a summary of messaging.
Feedback or key findings to date.</td><td>Evaluation Statements:
Stakeholder map lays out a comprehensive path of engagement from GDHC inception to operation.
Preliminary messaging and engagement type is specific to the needs of the stakeholder group and the project.</td></tr>
<tr><th colspan="2"><u>FINAL SUBMISSION</u>: Stakeholder Engagement Strategy, Report, and Event Plan</th></tr>
<tr><td colspan="2">10-slide PowerPoint presentation [saved as a PDF]</td></tr>
<tr><td>Content:
Complete stakeholder map (see Appendix C for example) identifying all stakeholders relevant to the design, construction, and operation of the GDHC.
Discussion of each stakeholder and their relevance in the process.
Summary of engagements, including descriptions, attendees, topics, questions, findings.
Develop an informative graphic to raise awareness of your project and GDHC benefits to the community or campus. This should be incorporated inside the 10-slide PowerPoint length.
Description of the possible community engagement event if awarded (e.g. location, objectives, outcomes, needed resources, attendees, timing).
Letter of commitment from the prospective host of the community engagement event committing to supporting the event if awarded.</td><td>Evaluation Statements:
Stakeholder map lays out a comprehensive path of engagement from GDHC inception to operation.
Community engagement embodies principles of community-driven change and honoring the challenges and desires of the community above external forces.
Educational graphic is innovative with a unique and compelling story.
The team presents a well-thought-out community engagement event and displays a commitment to hosting it.</td></tr>
<tr><td colspan="2">Additional description and requirements:

The stakeholder event must be within the United States or U.S. territories. The informative graphic will be evaluated separately and the winner of the “best informative graphic” award will be spotlighted in NREL and DOE social media and announcements.</td></tr>
</table>

Technical Track

Table 8. Technical Track Teams: Geothermal Resource Assessment

PROGRESS SUBMISSION: Geothermal Resource Assessment	
3- to 5-page document [Single PDF, 11pt Calibri font, double spaced, 1-inch margins] Pages are inclusive of all text and figures. References cited are not included in the page total.	
Content: • Preliminary map of the proposed community or campus, including geography, topography, and geologic description of the proposed site. • Overview of the current energy and general infrastructure for the site. • General description of why the site is capable of conversion to a GDHC system.	Evaluation Statements: • The team used data to conduct their initial assessment. • The team demonstrated competency in creating a map or other visualization of the site and its features.
FINAL SUBMISSION: Geothermal Resource Assessment	
5-page document [Single PDF, 11pt Calibri font, double spaced, 1-inch margins] Pages are inclusive of all text and figures. References cited are not included in the page total.	
Content: • Map of the proposed community or campus, including geography, topography, and geologic description of the proposed site. • Overview of the current energy and general infrastructure for the site. • Description of infrastructure needed for a GDHC system and how the resource can be accessed. • Description of why the site is capable of conversion to a GDHC system.	Evaluation Statements: • There is the space and/or infrastructure necessary to install a GDHC. • The team used data to conduct their initial assessment. • The team demonstrated competency in creating a map or other visualization of the site and its features. • The team clearly articulates why the resource is adequate for the selected site and end use (temperature, required flow rate, available/required infrastructure, etc.)
Additional description and requirements: This is intended to be a literature review and analysis of available data at the proposed location. Teams are not expected to conduct surveys or collect their own data. The resource assessment should demonstrate that the geothermal resources at the site are adequate for the selected use case. Teams must use relevant and reputable data to conduct the assessment.	

Table 9. Technical Track Team: Engineering and System Design Assessment

FINAL SUBMISSION: Engineering and System Design Assessment	
5-page document [PDF, 11pt Calibri font, double spaced, 1-inch margins] Pages are inclusive of all text and figures. References cited are not included in the page total.	
Content: • Visual aid (chart or graph) showing annual energy end usage for the community or campus. • Qualitative description of system design, including details on selected technology and necessary components/equipment. • Quantitative analysis of system design, including but not limited to discussion of required system size (e.g., MWh), required temperatures, well design (e.g., depth, diameter, count), required distribution network, and any other design components specific to the proposed project. • Conclusions drawn from available data.	Evaluation Statements: • The chart or graph clearly demonstrates the community or campus energy usage. • The system uses appropriate equipment required for a GDHC. • The entire GDHC uses sound engineering design to distribute thermal energy. • The team clearly articulates accurate conclusions from the available data.

Policy Track

Table 10. Policy Track Teams: Permitting Assessment

<table>
<tr><th colspan="2"><u>PROGRESS SUBMISSION</u>: Preliminary Permitting Assessment</th></tr>
<tr><td colspan="2">3- to 5-page document [PDF, 11pt Calibri font, double spaced, 1-inch margins]
References cited are not included in the page total.</td></tr>
<tr><td>Content:
Discussion of a conceptual understanding of the lands and resources needed to develop a GDHC on in the community or campus.
A preliminary outline of the permitting steps necessary to construct a GDHC system.
A preliminary outline of the contractors and vendors necessary to construct a GDHC system.
An itemized cost breakdown of installing a GDHC system, along with incentives.</td><td>Evaluation Statements:
A high-level technical understanding of the project’s technical needs and district’s available resources is demonstrated.
Clear identification of the components needed for GDHC (e.g. permits, funding, vendors) is demonstrated.</td></tr>
<tr><th colspan="2"><u>FINAL SUBMISSION</u>: Permitting Assessment</th></tr>
<tr><td colspan="2">5-page document [PDF, 11pt Calibri font, double spaced, 1-inch margins]
References cited are not included in the page total.</td></tr>
<tr><td>Content:
Qualitative description of federal, state, and local permitting requirements, along with how they apply to the project, at what point during the project the permits are needed, how to obtain the permits, and any barriers to obtaining them.
Qualitative description of potential environmental impacts (e.g., biological resources, cultural resources, other environmental sensitives) applicable to the selected site.
Flow chart and narrative detailing the permitting and construction steps between project inception and operation.
A table summarizing applicable federal, state, and local permits/approvals for the selected site.</td><td>Evaluation Statements:
All possible federal, state, and local permits/approvals are clearly identified.
Each permit or regulatory requirement is appropriately applied to the project, demonstrating a thorough understanding of the process.
An appreciation of the approval timelines has been worked into the flow chart and narrative of the project development.</td></tr>
<tr><td colspan="2">Additional details and requirements:

The Permitting Assessment is intended to be a literature review and analysis based on available data at the proposed location and a review of applicable permits/approvals issued by federal, state, and local authorities. Teams are not expected to conduct surveys or collect their own data. The analysis should include full consideration of the permits/approvals required to develop a geothermal project at the site.</td></tr>
</table>

Table 11. Policy Track Teams: Economic and Financial Incentives Assessment

<table>
<tr><th colspan="2"><u>FINAL SUBMISSION</u>: Economic and Financial Incentives Assessment</th></tr>
<tr><td colspan="2">7-page document [PDF, 11pt Calibri font, double spaced, 1-inch margins]
References cited are not included in the page total.</td></tr>
<tr><td>Content:
General understanding of the GDHC system specifications necessary for the community or campus is presented.
Itemized costs for the GDHC system design, construction, and maintenance are presented.
Cost breakdown of the current energy system, and thus cost savings over time, is presented.
Options for funding and financing to cover the full cost of the project are tabulated. Should include additional grant funding or investment if necessary.
Financial incentives available within given jurisdiction, and potential limitations on those incentives, are thoroughly presented.
Workforce assessment analysis, jobs creation, training required, upskilling opportunities and incentives.</td><td>Evaluation Statements:
The team has used appropriate costs and consulted appropriate experts for GDHC cost estimates.
Thorough list of potential incentive opportunities (federal and state tax incentives, grants, energy programs, etc.) including probability and level of funding for each incentive.
The submission demonstrates a full financial plan to realize the deployment of a GDHC system.
Detailed analysis of workforce economic benefits and opportunities for the community.</td></tr>
<tr><td colspan="2">Additional details and requirements:

Possible Resources: GeoRePORT Socio-Economic Assessment Tool (SEAT) and associated protocol documents, available at https://openei.org/wiki/GeoRePORT/Protocol;

GeoVision Analysis Supporting Task Force Report: Barriers, available at https://www.nrel.gov/docs/fy19osti/71641.pdf;

the Regulatory and Permitting Information Desktop (RAPID) Toolkit, available at https://openei.org/wiki/RAPID;

Bureau of Land Management E-Planning National NEPA Register (access to Bureau of Land Management Geothermal NEPA Documents), available at https://eplanning.blm.gov/eplanning-ui/home.

Details on GEOPHIRES, NREL’s economic simulator tool, can be found in Appendix B.</td></tr>
</table>

4. SUBMISSION SCORING

Only one entry is accepted from each team. Competition submissions are considered to be on time if they are received by the respective due date and time as indicated on HeroX. Late submissions may be considered on a case-by-case basis but are marked as such with notice given accordingly to the competition administrator and/or expert reviewers.

The competition administrator evaluates the submissions using the statements given previously in Table 2 through Table 11. Progress Submissions and Final Submissions are scored on a scale of 1 (strongly disagree) to 6 (strongly agree) as shown in Table 12.

Table 12. Scoring Scale

1	2	3	4	5	6
Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree

Final Submissions are screened by the competition administrator for compliance and completeness. Eligible submissions will be reviewed, scored, and commented on by a panel of expert reviewers. Each evaluation statement is of equal weight. The individual reviewer scores for each submission will be averaged for a total score for each submission. The final scores for each submission will provide the basis for DOE to determine the winners. A first, second, and third place prize will be awarded for both the Technical Track and for the Policy Track, and the bonus prize for the outstanding submission from a Tribal College or Community College. DOE makes the final determination of the winners.

5. ADDITIONAL TERMS AND CONDITIONS

Universal Contest Requirements

Your submission for the Geothermal Collegiate Competition is subject to the following terms and conditions:

- You must include all the required submission elements, including those marked as “unscored”. The competition administrator may disqualify your submission after an initial screening if you fail to provide all required submission elements. Competitors may be given an opportunity to rectify submission errors due to technical challenges.
- Your submission must be in English and in a format readable by Adobe Acrobat Reader. Scanned hand-written submissions will be disqualified.
- Submissions and competitors will be disqualified if any engagement with the Geothermal Collegiate Competition—including but not limited to the submission, the HeroX forum, or emails to the competition administrator—contains any matter that, in the sole discretion of DOE or NREL, is indecent, obscene, defamatory, libelous, lacking in professionalism, or demonstrates a lack of respect for people or life on this planet.
- If you click “Accept” on the HeroX platform and proceed to register for the competition described in this document, these rules will form a valid and binding agreement between you and DOE and are in addition to the existing HeroX Terms of Use for all purposes relating to this contest. You

should print and keep a copy of these rules. These provisions only apply to the contests described here and no other contests on the HeroX platform or anywhere else. To the extent that these rules conflict with the HeroX Terms of Use, these rules shall govern.

- The competition administrator, when feasible, may give competitors an opportunity to fix nonsubstantive mistakes or errors in their submission packages.
- Reviewers will review submissions according to the evaluation criteria described in this document. Expert reviewers may not (a) have personal or financial interests in, or be an employee, officer, director, or agent of any entity that is a registered competitor in the prize; or (b) have a familial or financial relationship with an individual who is a registered competitor. These judge requirements apply to all reviews across all regions.
- As part of your submission to this prize, you will be required to sign the following statement:

> I am providing this submission package as part of my participation in this prize. I understand that the information contained in this submission will be relied on by the federal government to determine whether to issue a prize to the named competitor. I certify under penalty of perjury that the named competitor meets the eligibility requirements for this prize competition and complies with all other rules contained in the Official Rules document. I further represent that the information contained in the submission is true and contains no misrepresentations. I understand false statements or misrepresentations to the federal government may result in civil and/or criminal penalties under 18 U.S.C. § 1001 and § 287, and 31 U.S.C. §§ 3729-3733 and 3801-3812.

Verification for Payments

The competition administrator will verify the identity and the role of a participant potentially qualified to receive the prizes. Receipt of a prize payment is contingent upon fulfilling all requirements contained herein. The competition administrator will notify winning competitors using the provided email contact information after the date that results are announced. Each competitor (or parent/guardian if under 18 years of age), will be required to sign and return to the competition administrator, within 30 days of the date the notice is sent, a completed NREL Request for ACH Banking Information form and a completed W-9 form (https://www.irs.gov/pub/irs-pdf/fw9.pdf). In the sole discretion of the competition administrator, a winning competitor will be disqualified from the competition and receive no prize funds if: (i) the person/entity cannot be contacted; (ii) the person/entity fails to sign and return the required documentation within the required time period; (iii) the notification is returned as undeliverable; (iv) the submission or person/entity is disqualified for any other reason.

Teams and Single-Entity Awards

The competition administrator will award a single dollar amount to the designated primary submitter, whether consisting of a single entity or multiple entities. The primary submitter is solely responsible for allocating any prize funds among its member competitors as they deem appropriate. The competition administrator will not arbitrate, intervene, advise on, or resolve any matters between team members or between teams.

Submission Rights

By making a submission, and thereby consenting to the rules of the contest as described in this document, a competitor is granting to DOE, the competition administrator, and any other third parties supporting DOE in the contest a license to display publicly and use all parts of any submission for any other government purpose. This license includes posting or linking to the portions of the submission on the competition administrator or HeroX applications, including the contest website, DOE websites, and

partner websites, and the inclusion of the submission in any other media, worldwide. The submission may be viewed by the DOE, competition administrator, and reviewers for purposes of the contests, including but not limited to screening and evaluation purposes. The competition administrator and any third parties acting on their behalf will also have the right to publicize the competitor's name and, as applicable, the names of the competitor's team members and organizations which participated in the submission on the contest website indefinitely.

By entering, the competitor represents and warrants that:

1. Competitor's entire submission is an original work by competitor and competitor has not included third-party content (such as writing, text, graphics, artwork, logos, photographs, dialogue from plays, likeness of any third party, musical recordings, clips of videos, television programs or motion pictures) in or in connection with the submission, unless (i) otherwise requested by the competition administrator and/or disclosed by competitor in the submission, and (ii) competitor has either obtained the rights to use such third-party content or the content of the submission is considered to be in the public domain without any limitations on use;

2. Unless otherwise disclosed in the submission, the use thereof by competition administrator, or the exercise by competition administrator of any of the rights granted by competitor under these rules, does not and will not infringe or violate any rights of any third party or entity, including without limitation patent, copyright, trademark, trade secret, defamation, privacy, publicity, false light, misappropriation, intentional or negligent infliction of emotional distress, confidentiality, or any contractual or other rights;

3. All persons who were engaged by the competitor to work on the submission or who appear in the submission in any manner have:

    a. Given competitor their express written consent to submit the submission for exhibition and other exploitation in any manner and in any and all media, whether now existing or hereafter discovered, throughout the world;

    b. Provided written permission to include their name, image, or pictures in or with the submission (or if a minor who is not competitor's child, competitor must have the permission of their parent or legal guardian) and competitor may be asked by competition administrator to provide permission in writing;

    c. Not been and are not currently under any union or guild agreement that results in any ongoing obligations resulting from the use, exhibition, or other exploitation of the submission.

Copyright

Each competitor represents and warrants that the competitor is the sole author and copyright owner of the submission; that the submission is an original work of the applicant or that the applicant has acquired sufficient rights to use and to authorize others, including DOE, to use the submission, as specified throughout the rules; that the submission does not infringe upon any copyright or upon any other third party rights of which the applicant is aware; and that the submission is free of malware.

Use of Artificial Intelligence in Competition Deliverables

The following are requirements regarding the use of artificial intelligence in competition deliverables:

• Teams must indicate if generative artificial intelligence (AI) was used in any part of their deliverables, including which tool and prompts.

• Teams are not allowed to use verbatim text from a generative AI chatbot as part of their competition deliverables. Chatbots may reuse text from other sources, causing inadvertent plagiarism.

• All human authors of a deliverable are responsible for all of its content. ChatGPT and similar tools cannot be held accountable.

• Citations recommended by any generative AI chatbot must be verified with the original literature because chatbots are known to generate citations that are inaccurate and/or don't exist.

• AI-generated images and/or multimedia used in competition deliverables will not be accepted.

• The organizers may decline to move a deliverable forward in the competition if AI is used inappropriately according to the requirements outlined above

Contest Subject to Applicable Law

All contests are subject to all applicable federal laws and regulations. Participation constitutes each participant's full and unconditional agreement to these contest rules and administrative decisions, which are final and binding in all matters related to the contest. This notice is not an obligation of funds; the final awards are contingent upon the availability of appropriations.

Resolution of Disputes

DOE is solely responsible for administrative decisions, which are final and binding in all matters related to the contest.

Neither DOE nor the prize administrator will arbitrate, intervene, advise on, or resolve any matters between team members or among competitors.

Publicity

The winners of these prizes (collectively, "winners") will be featured on the DOE and NREL websites.

Except where prohibited, participation in the contest constitutes each winner's consent to DOE's and its agents' use of each winner's name, likeness, photograph, voice, opinions, and/or hometown and state information for promotional purposes through any form of media, worldwide, without further permission, payment, or consideration.

Liability

Upon registration, all participants agree to assume and, thereby, have assumed any and all risks of injury or loss in connection with or in any way arising from participation in this contest, or development of any submission. Upon registration, except in the case of willful misconduct, all participants agree to and, thereby, do waive and release any and all claims or causes of action against the federal government and its officers, employees, and agents for any and all injury and damage of any nature whatsoever (whether existing or thereafter arising, whether direct, indirect, or consequential and whether foreseeable or not), arising from their participation in the contest, whether the claim or cause of action arises under contract or tort.

Records Retention and the Freedom of Information Act

All materials submitted to DOE as part of a submission become DOE records and are subject to the Freedom of Information Act. The following applies only to portions of the submission not designated as public information in the instructions for submission. If a submission includes trade secrets or

information that is commercial or financial, or information that is confidential or privileged, it is furnished to the Government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the application. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, DOE will seek to limit disclosure of such information to its employees and to outside reviewers when necessary for review of the application or as otherwise authorized by law. This restriction does not limit the Government's right to use the information if it is obtained from another source.

Submissions containing confidential, proprietary, or privileged information must be marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Government is not liable for the disclosure or use of unmarked information and may use or disclose such information for any purpose.

The submission must be marked as follows and identify the specific pages containing trade secrets, confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets, confidential, proprietary, or privileged information that is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes. [End of Notice]

The header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: "Contains Trade Secrets, Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure." In addition, each line or paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets.

Competitors will be notified of any Freedom of Information Act requests for their submissions in accordance with 29 C.F.R. § 70.26. Competitors may then have the opportunity to review materials and work with a Freedom of Information Act representative prior to the release of materials.

Privacy

If you choose to provide HeroX with personal information by registering or completing the submission package through the contest website, you understand that such information will be transmitted to DOE and may be kept in a system of records. Such information will be used only to respond to you in matters regarding your submission and/or the contest unless you choose to receive updates or notifications about other contests or programs from DOE on an opt-in basis. DOE and NREL do not collect any information for commercial marketing.

General Conditions

DOE reserves the right to cancel, suspend, and/or modify the contest, or any part of it, at any time. If any fraud, technical failures, or any other factor beyond DOE's reasonable control impairs the integrity or proper functioning of the contests, as determined by DOE in its sole discretion, DOE may cancel the contest.

Although DOE indicates that it will select up to several winners for each contest, DOE reserves the right to only select competitors that are likely to achieve the goals of the program. If, in DOE's determination, no competitors are likely to achieve the goals of the program, DOE will select no competitors to be winners and will award no prize money.

DOE may conduct a risk review, using Government resources, of the competitor and project personnel for potential risks of foreign interference. The outcomes of the risk review may result in the submission

being eliminated from the prize competition. This risk review, and potential elimination, can occur at any time during the prize competition. An elimination based on a risk review is not appealable.

ALL DECISIONS BY DOE ARE FINAL AND BINDING IN ALL MATTERS RELATED TO THE CONTEST.

Competition Authority and Administration

The Geothermal Collegiate Competition is organized by DOE and NREL, which is managed and operated by the Alliance for Sustainable Energy, LLC, for DOE. Funding is provided by DOE GTO. The views expressed herein do not necessarily represent the views of DOE or the U.S. government.

The Geothermal Collegiate Competition is governed and adjudicated by this rules document, which is intended to establish fair contest rules and requirements. The competition is designed and administered by a team consisting primarily of DOE and NREL staff. In the case of a discrepancy with other competition materials or communication, this document takes precedence. The latest release of these rules takes precedence over any prior release. The competition administrator reserves the right to change contest criteria, rules, and outcomes as needed. Additionally, competitors are encouraged to bring to the organizers' attention rules that are unclear, misguided, or in need of improvement. For the purposes of competition evaluation, a violation of the intent of a rule will be considered a violation of the rule itself. Questions on these rules or the program overall can be directed to Geo.Competition@nrel.gov

Expert reviewers may not have personal or financial interests in; be an employee, officer, coordinator, or agent of any entity that is a registered participant in; or have a familial or financial relationship with an individual who is a registered competitor in this contest.

By making a submission and consenting to the rules of this competition, each team member grants the Government permission to use and make publicly available any entry provided or disclosed to DOE in connection with the competition. In addition, each team grants to the Government, and others acting on its behalf, a paid-up, nonexclusive, irrevocable, worldwide license to reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, by or on behalf of the U.S. Government, for any and all copyrighted works that are or make up any submission.

Geothermal Collegiate Competition and any associated nicknames and logos ("Competition Marks") are trademarks owned by DOE. The trademark license granted to contestants is below. Non-contestants can request individualized trademark licenses (for the purpose of engaging with contestants and/or expressing interest in the competition); the decision to grant such licenses is under the sole discretion of DOE.

1. Contestants are granted, for the duration of the competition, a revocable, non-exclusive, royalty-free license to use the Competition Marks for the purposes of producing materials for the competition and other approved competition-related activities as long as the use does not suggest or imply endorsement of the contestant by DOE, and the use of the Competition Marks by a contestant does not imply the endorsement, recommendation, or favoring of the contestant by DOE.
2. Contestants may not use the Competition Marks for any other purpose. Contestants may not sublicense the Competition Marks.
3. All contestants can request individualized trademark licenses; the decision to grant such requests is under the sole discretion of DOE.

Further, from the Competes Act:
(j) Intellectual property
    (1) Prohibition on the government acquiring intellectual property rights

The Federal Government may not gain an interest in intellectual property developed by a participant in a prize competition without the written consent of the participant.
(2) Licenses
As appropriate and to further the goals of a prize competition, the Federal Government may negotiate a license for the use of intellectual property developed by a registered participant in a prize competition.

National Environmental Policy Act (NEPA) Compliance

DOE's administration of this prize is subject to NEPA (42 USC 4321, et seq.). NEPA requires federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at http://nepa.energy.gov/.
While NEPA compliance is a federal agency responsibility and the ultimate decisions remain with the federal agency, all participants in this prize will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their participation in the prize competition. Participants may be asked to provide DOE with information on their planned activities such that DOE can conduct a meaningful evaluation of the potential environmental impacts.

Return of Funds

As a condition of receiving a prize, competitors agree that if the prize was awarded based on fraudulent or inaccurate information provided by the competitor to DOE, DOE has the right to demand that any prize funds or the value of other non-cash prizes be returned to the government.

Appendix A. Geothermal Educational References

The following references are relevant to geothermal resources, including geothermal direct heating and cooling systems, as well as other geothermal applications, data, and tools.

Geothermal Basics

DOE Geothermal Educational Resources
https://www.energy.gov/eere/geothermal/educational-resources
GeoVision: Harnessing the Heat Beneath Our Feet
https://www.energy.gov/eere/geothermal/geovision
2021 U.S. Geothermal Power Production and District Heating Market Report
Market Report | Department of Energy
NREL Energy Basics: Geothermal
https://www.youtube.com/watch?v=rpgJWYp2OLA
NREL Advancing Geothermal Research with Impact Analysis
https://www.youtube.com/watch?v=l4oKi2spRPE
NREL, "Geothermal Research"
https://www.nrel.gov/geothermal/
Geothermal Rising, "What is Geothermal?"
https://geothermal.org/resources/geothermal-basics
U.S. Geological Survey Geothermal Resources Investigations Project
https://www.usgs.gov/centers/gmeg/science/geothermal-resource-investigations-project

NREL Learning Playlist - Geothermal Collegiate Competition

Geothermal Collegiate Competition - YouTube

- Geothermal 101
- Ethical and Responsible Stakeholder Engagement
- How to Create a Geothermal Direct Use System
- GeoRePORT Socioeconomic Assessment Tool for Geothermal
- Overview of Environmental Regulations and Permitting for Geothermal
- Geothermal Direct Use System Design
- Leapfrog Geothermal 3D Modeling
- GEOPHIRES – Geothermal Techno-Economic Simulation Tool

Geothermal and Buildings

Better Buildings Solution Center Geothermal Case Studies
https://betterbuildingssolutioncenter.energy.gov/search?f%5B0%5D=field_technology%3A433

Geothermal Energy Permitting

Bureau of Land Management, "Geothermal Energy"
https://www.blm.gov/programs/energy-and-minerals/renewable-energy/geothermal-energy

Bureau of Land Management E-Planning National NEPA Register (access to BLM Geothermal NEPA Documents)
https://eplanning.blm.gov/eplanning-ui/home.

Regulatory and Permitting Information Desktop (RAPID) Toolkit
https://openei.org/wiki/RAPID

Geothermal Data

Geothermal Data Repository
https://gdr.openei.org/

NREL Geothermal Prospector
https://maps.nrel.gov/geothermal-prospector/

Southern Methodist University, "Geothermal Lab Data and Maps"
https://www.smu.edu/Dedman/Academics/Departments/Earth-Sciences/Research/GeothermalLab/DataMaps

Economics

GEOPHIRES Techno-economic tool.
https://github.com/NREL/GEOPHIRES-X

OpenEI Transparent Cost Database
https://apps.openei.org/TCDB/

GeoRePORT and protocol documents
https://openei.org/wiki/GeoRePORT/Protocol

Conference Publications

International Geothermal Association Geothermal Paper Database
https://www.geothermal-energy.org/explore/our-databases/conference-paper-database/

Stanford Earth
https://pangea.stanford.edu/ERE/db/IGAstandard/search.php

Appendix B. Fundamentals and Case Studies of GDHC

Geothermal district heating and cooling systems take advantage of naturally heated hot water from deep underground, which is pumped to the surface and through a heat exchanger for heating and cooling buildings, defined as direct use. Other district heating and cooling systems use the naturally occurring temperature difference between the above-ground air temperature and the shallow subsurface soil temperature to create a heat sink in warmer temperatures and a heat source in cooler temperatures. For geothermal district heating and cooling systems, shallow (10-500 ft) boreholes are usually drilled to provide interconnected buildings with constant temperatures that are used to both heat and cool buildings via geothermal heat pumps. Geothermal heating and cooling technologies such as district heating offer green, efficient temperature control solutions for buildings, campuses, and entire communities, helping to decarbonize the building and electricity sectors[4].

Geothermal District Heating and Cooling Systems (Direct Use)

Geothermal energy refers to the thermal energy stored in subsurface rocks and fluids. Using injection and production wells, which may go several kilometers deep, a geothermal reservoir can be developed and exploited to transfer heat to the surface. The produced geothermal fluid can be used directly as heat (direct use) in various applications such as heating for buildings (stand-alone or in a district), greenhouses, fish farming, food drying, snow melting, and industrial processes. With absorption chillers, the geothermal heat can also provide cooling, refrigeration, and freezing[5].

Direct use, as the name implies, involves using the heat in the water for such things as heating districts, buildings, industrial processes, greenhouses, aquaculture (fish farming), and resorts. Direct (nonelectric) use of geothermal energy refers to the use of energy for both heating and cooling applications. Fluids with temperatures adequate for geothermal direct use are available throughout much of the United States. While accessing those fluids typically requires costly well drilling, the relatively low operations and maintenance costs (including zero fuel costs) of direct use systems can be economically competitive under certain market conditions. Direct use of geothermal energy can help districts decarbonize their heating and cooling systems, which is of increasing value in today's energy market.

Furthermore, direct-use applications such as aquaculture, greenhouses, microbreweries, fruit and vegetable drying, spas, pulp and paper processing, and lumber drying offer attractive, low-carbon opportunities for local businesses and entrepreneurs.

4 Geothermal District Heating & Cooling | Department of Energy

5 Evaluating the feasibility of geothermal deep direct-use in the United States - ScienceDirect

Case Studies Direct Use

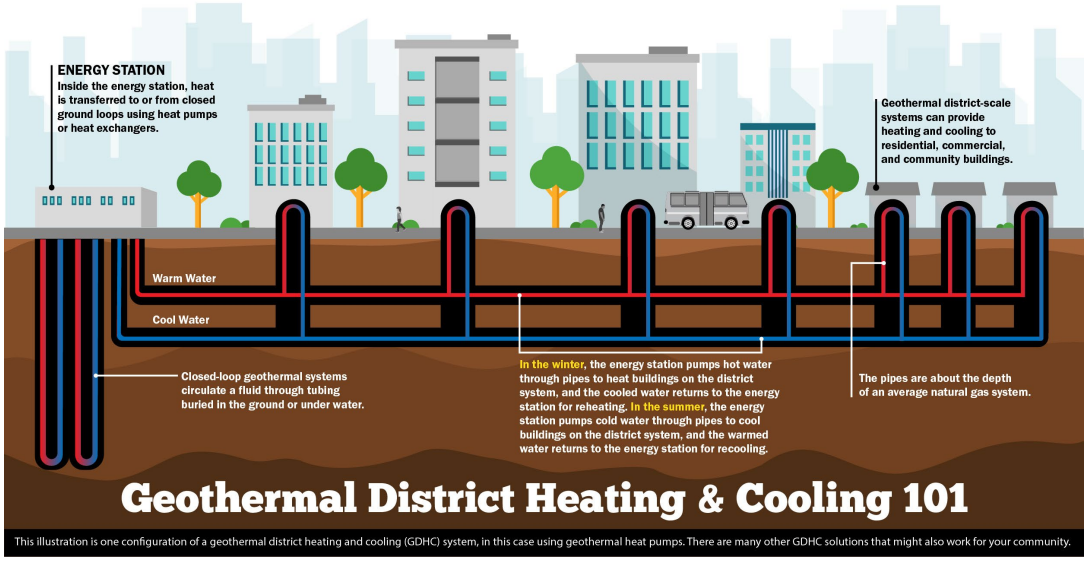
The 2021 U.S. Geothermal Power Production and District Heating Market Report listed 23 locations with Geothermal District Heating Systems from direct use geothermal technology, table below.

States	Geothermal District Heating (GDH) System	Year Commissioned	Capacity (MW_{th})	Energy Use ($GW_{th}h/yr$)
California	Susanville	1982	5.6	3.4
	San Bernardino	1984	12.8	22.0
	Canby / I'SOT	2003	No data	1.2
	Mocdoc Schools / Alturas	2017	0.4	No data
Colorado	Pagosa Springs	1982	5.1	4.8
Idaho	Warm Springs Water District	1892	3.6	8.8
	Ketchum District Heating	1929	0.9	1.9
	College of Southern Idaho	1980	6.3	14
	Idaho Capitol Mall	1982	3.3	18.7
	Boise City District Heating	1983	20.6	42.3
	Fort Boise Veteran's Hospital	1988	1.8	3.5
	Kanaka Rapids Ranch	1989	1.1	2.4
New Mexico	Gila Hot Springs Ranch	1987	0.3	0.9
Nevada	Elko District Heat	1982	3.8	6.5
	Warren Estates	1983	1.1	2.3
	Elko County School District	1986	4.3	4.6
	Manzanita Estates	1986	3.6	21.2
Oregon	Oregon Institute of Technology	1964	6.2	13.7
	City of Klamath Falls District Heating	1984	4.7	10.3
	Lakeview Prison	2005	No data	No data
	Lakeview District Hospitals and Schools	2014	1.6	4.4
South Dakota	Midland	1969	0.1	0.2
	Philip	1980	2.5	5.2

Geothermal District Heating and Cooling Systems (GHP-based)

For geothermal district heating and cooling systems, shallow (10-500 ft) boreholes are usually drilled to provide interconnected buildings with constant temperatures that are used to both heat and cool buildings via geothermal heat pumps. The district uses pipes so water can circulate between buildings. Heat is taken from the district and transferred to the ground in the summer. The system is reversible, and heat is taken from the ground and used in the building in the winter. The system only moves heat, which is much more efficient than using fuel or electricity to create heat. Geothermal heat pumps can support space heating and cooling needs in almost any part of the country.[6]

[6] https://www.energy.gov/eere/geothermal/geothermal-heat-pumps



Case Studies GHP-based

A recent data compilation and cost analysis of five existing GHP-based district energy systems in the U.S.: Ball State University in Indiana, Colorado Mesa University in Colorado, Miami University in Ohio, West Union in Iowa, and Whisper Valley in Texas. These five systems consist of geothermal borehole field(s) and ground loop(s) connected to a central loop. The GHPs were in central plants at Ball State University and Miami University, whereas the central loops at Colorado Mesa University, West Union, and Whisper Valley were connected through service lines to individual heat pumps in each building. https://www.nrel.gov/docs/fy23osti/86678.pdf

Other examples[7]:
Antioch College, OH
Carleton College[8], MN
Epic Healthcare Corporate Campus, WI
Lake Land College, IL
Missouri University of Science and Technology, MO
Monroe County Community College, MI
Notre Dame University, IN
Rogers State University, OK
Roosevelt School Condos, IA
Skidmore College, NY
Southeastern Louisiana University, LA
West Chester University, PA

[7] Taken from: Hughes, H.J. 2022. "Geothermal Heat Pump-Based District Heating and Cooling Throughout the United States." Geothermal Resources Council Transactions, Vol. 46, Reno, NV.
[8] https://betterbuildingssolutioncenter.energy.gov/solutions-at-a-glance/carleton-college-steam-hot-water-district-energy-transition

Appendix C. Stakeholder Analysis and Map

The goal of the stakeholder analysis is to identify and map the important stakeholders across several policy sectors, assess their potential effect on the geothermal project's decision-making framework, and show the interdependencies across them.

Figure 1. Stakeholder analysis

Modified from Acheilas et al. (2020)

The following steps (Figure 1) are recommended by Acheilas et al. (2020):

1. The main internal and external stakeholder groups of the district heating sector should be compiled into a detailed list.
2. Create a stakeholder map to show the multi-level overview (Figure 2).
3. Stakeholder prioritization (Figure 3) to identify the interest and interrelation between different groups on urban energy planning and make sure that resources are managed effectively.
4. A stakeholder engagement network (Figure 4) should be designed to distinguish the necessary activities by the involved players and the common actions between them.

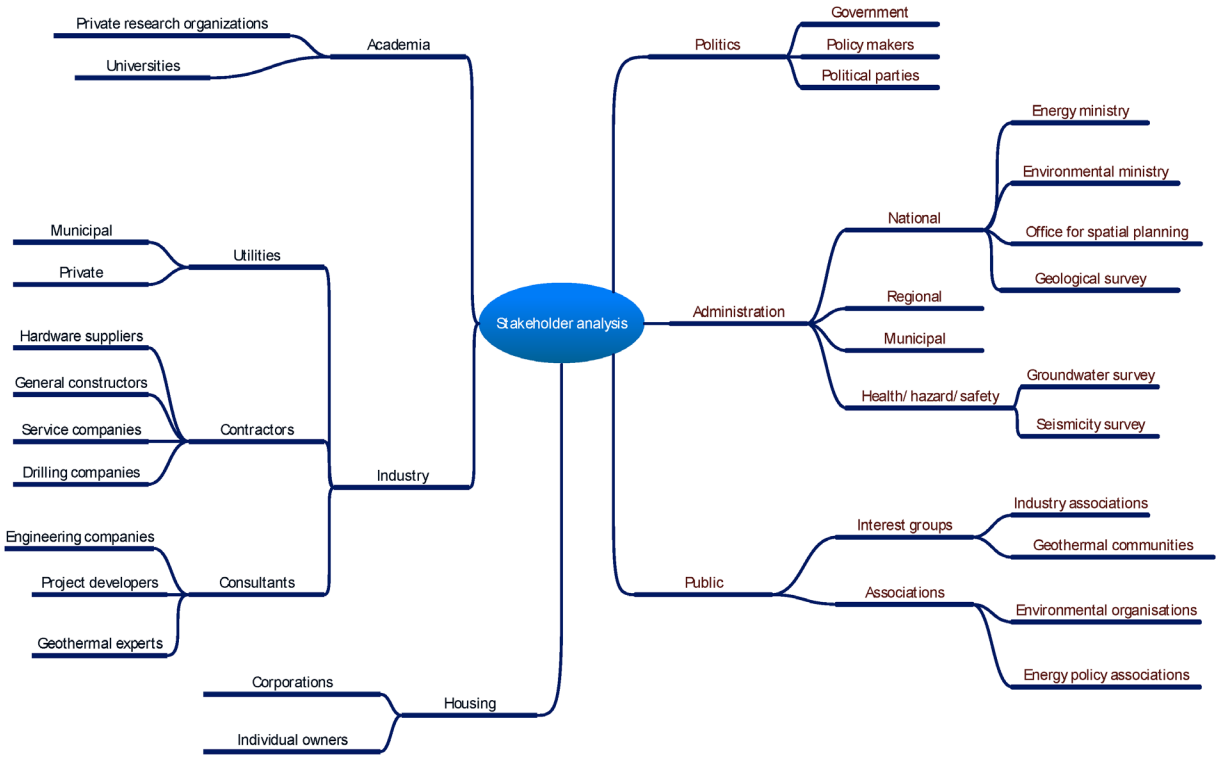


Figure 2. Stakeholder map from Acheilas et al. (2020)

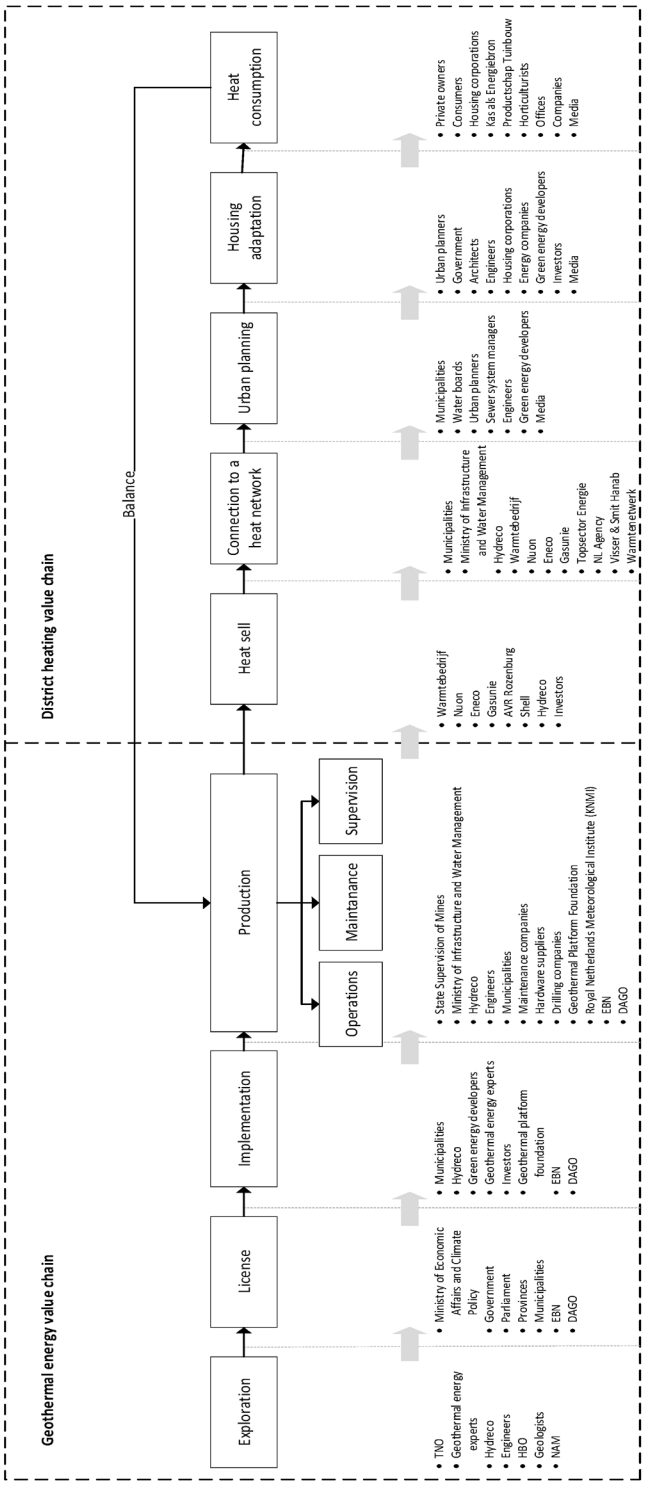


Figure 3. District heating and geothermal energy prioritization from Acheilas et al. (2020).

Reference

Acheilas, Ioannis, Fransje Hooimeijer, and Aksel Ersoy. 2020. A Decision Support Tool for Implementing District Heating in Existing Cities, Focusing on Using a Geothermal Source. Energies 13, no. 11: 2750.