U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Clean Heat Policies and Thermal Energy Networks: Tools for Efficiency and Emission Reduction

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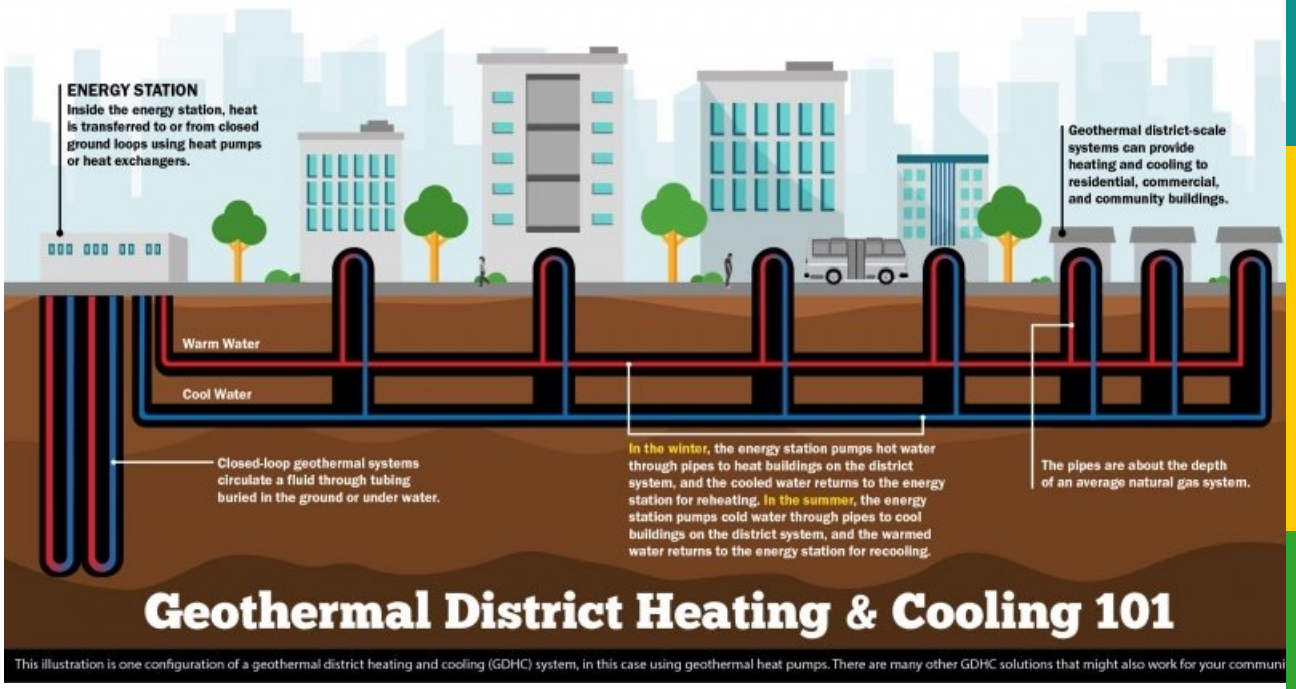
Origins: Geothermal District Heating and Cooling Systems

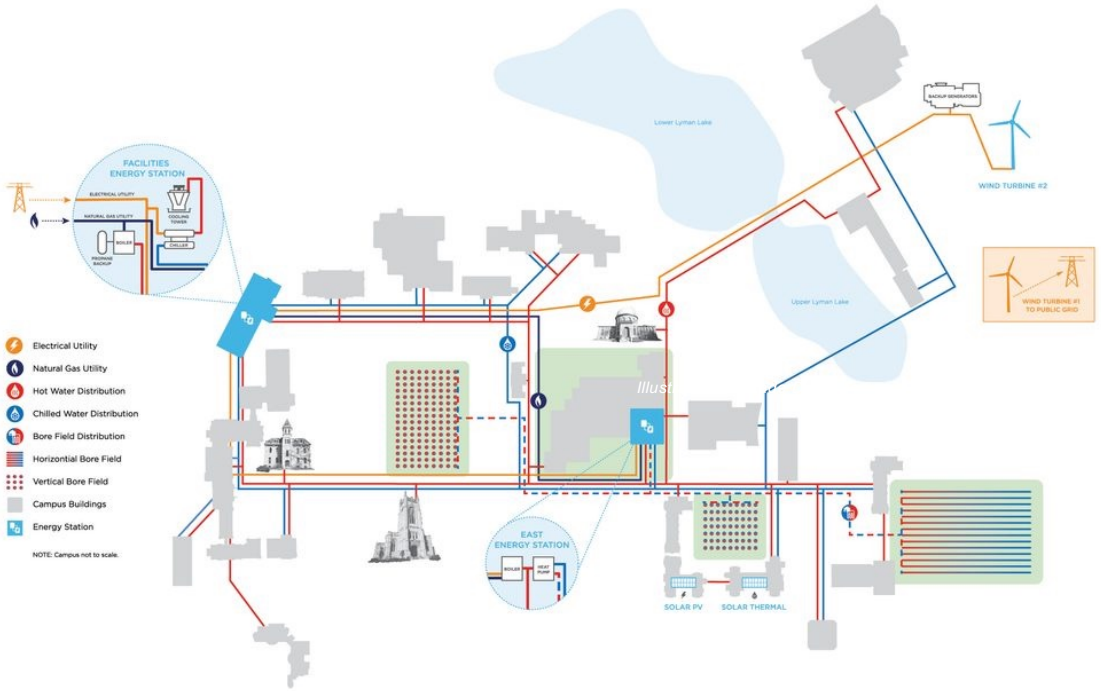
- Low-temperature, shallow systems
- Hundreds to thousands of boreholes connected to district energy stations
- Central loops distribute hot and cold water to buildings
- Major trends:
  - Replace existing district systems
  - Often hybrid systems
  - Buildings slowly retrofitted and added to system
  - Interest in shifting towards utility-scale



Icons via Flaticon.com

Evolution: Thermal Energy Networks

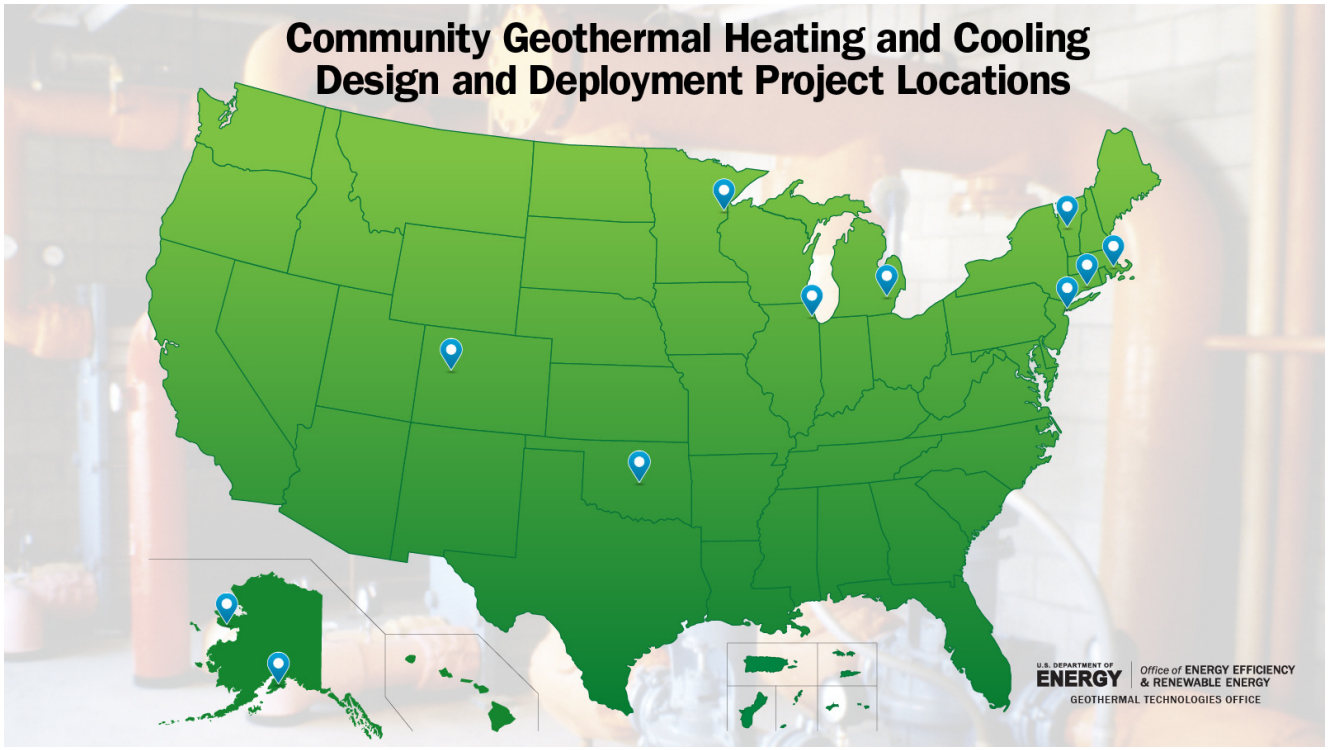
- Different stakeholders may have different conceptual structures for “district energy” or "thermal energy networks."
- Thermal Energy Networks have many variations, including:
  - Stand-alone or coupled with other energy systems or stranded thermal assets (e.g., wastewater or sewer heat)
  - Systems with an underground thermal loop connecting the system
  - System using geothermal heat pumps (GHPs), direct use of geothermal heat, or both
  - Systems that provide heating only, and systems that provide both heating and cooling



Campus energy system including borefields and hot and chilled water distribution at Carlton College in Northfield, Minnesota, completed in 2021

Icons via Flaticon.com

Community Geothermal



energy.gov/eere/geothermal/community-geothermal-heating-and-cooling-design-and-deployment

Selected 11 communities in 10 states to assess and design community-scale geothermal heating and cooling systems

Urban/Suburban

- Ann Arbor, MI
- Chicago, IL
- Duluth, MN
- Framingham, MA
- New York City, NY
- Wallingford, CT

Rural

- Carbondale, CO
- Middlebury, VT
- Seward, AK
- Shawnee, OK

Remote

- Nome, AK

Icons via Flaticon.com

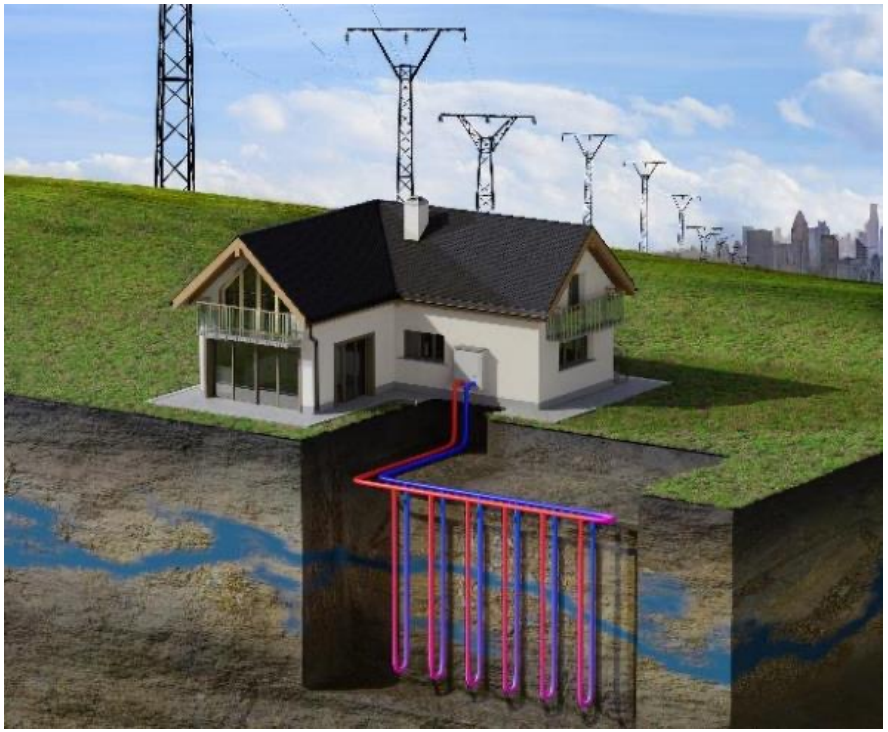
GHP Impacts Analysis

GTO-funded analysis by Oak Ridge National Laboratory and National Renewable Energy Laboratory to assess how mass deployment of geothermal heat pumps (GHPs) can provide cost and carbon reductions at the grid.

Aimed to quantify:

- Effects on building electricity use and emissions resulting from mass deployment of GHPs
- Impacts to the bulk power system under various carbon policy, electrification, and sensitivity scenarios

Assessment considered GHPs at the individual building level, so networked deployment in community-scale systems could likely provide **even greater benefits**.



https://www.osti.gov/biblio/2224191

GHP Impacts Analysis

Eliminate the need for up to **43,600 miles** of new interregional transmission infrastructure – equivalent of up to 44 SunZia transmission projects

Reduce up to **410 GW** of nationwide generation capacity requirements – bolstering seasonal U.S. grid resilience

Eliminate more than **7 gigatons** of carbon – equivalent to all U.S. emissions produced in 2022

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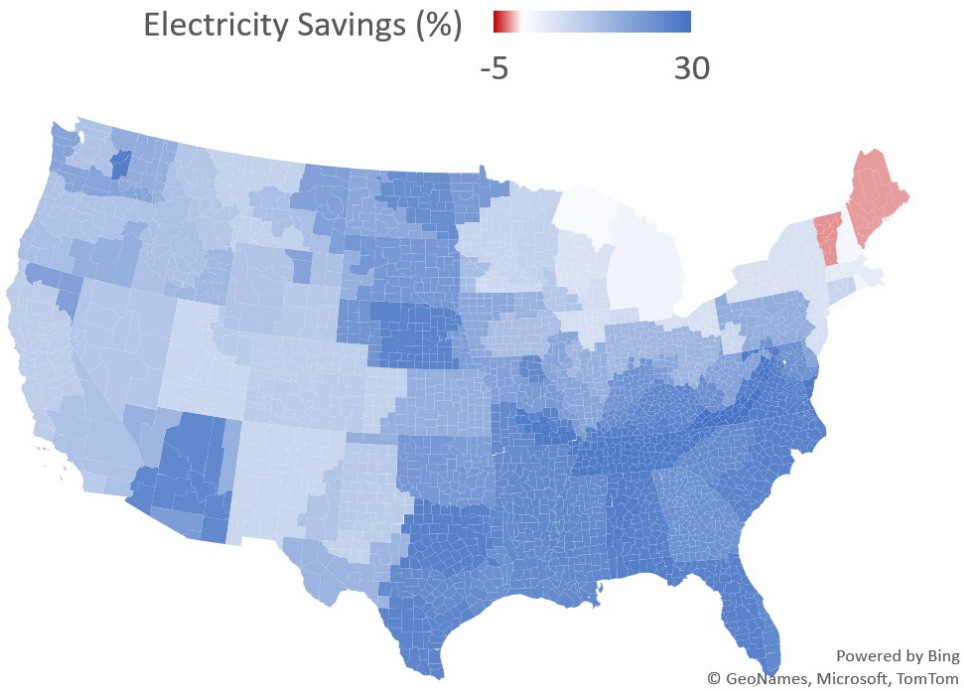
GHP Impacts Analysis



Based on the analysis, **mass GHP deployment**:

- Electrifies heating in all climate zones at high efficiency
  - Electrification increases grid winter electrical demand; HOWEVER, in aggregate, increases are offset by summer cooling savings
- In combination with building envelope improvements, reduces annual electric consumption in 132 of the 134 Balancing Authority Areas
- By 2050, reduces national generation requirements by 11% and 13% for Decarb and Electrification Future scenarios
- Can reduce the cost of grid power and provide environmental benefit even to those who do *not* have GHPs installed

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Pathways to Commercial Liftoff: Geothermal Heating and Cooling

- Cross-office collaborative DOE report
- All DOE Liftoff Reports take a technology or suite of technologies and build a common understanding with the private sector and broader ecosystem around the current state, pathways to commercial liftoff, and challenges and solutions to unlock scale
- Anticipated late 2024 release of Liftoff Report focused on geothermal heating and cooling technologies

Geothermal heating and cooling system at the University of Utah. Photo courtesy University of Utah.

energy.gov/lpo/pathways-commercial-liftoff-reports

Incentives and Resources

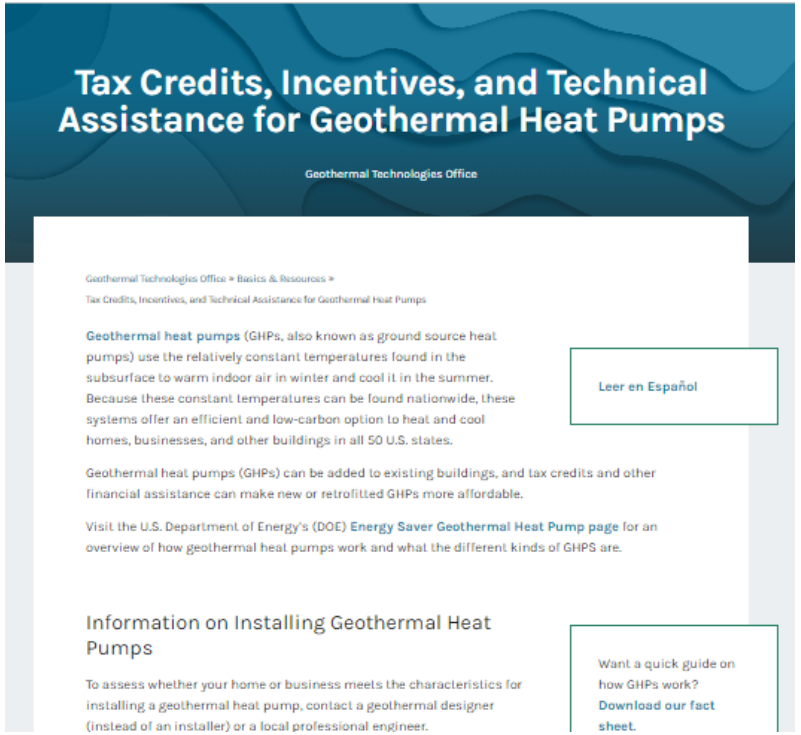
GHPs in the Inflation Reduction Act

- **Residential:** 30% tax credit for ENERGY STAR-rated GHPs through 2032

- **Commercial:** Investment Tax Credit (ITC) for renewable energy projects beginning construction before 1/1/25. For geothermal, base ITC is 6% for the first 10 years; credit increases for projects meeting labor, content, and locations parameters

Building Decarbonization Coalition

Maintains a web page of states that have implemented legislation advancing or promoting thermal energy networks
buildingdecarb.org/resource-library/tens-state-leg



GTO's website features numerous resources, including a tax credits, incentives, and technical assistance web page with more information!

energy.gov/eere/geothermal/tax-credits-incentives-and-technical-assistance-geothermal-heat-pumps

Better Climate Challenge Working Groups

Better Climate Challenge: organizations that have committed to a **50% reduction in emissions in 10 years**

- Part of DOE Better Buildings, Better Plants
- Better Climate Challenge Partners can participate in working groups to understand challenges, discuss strategies, and share best practices
- Working groups just started and will run for 6–8 months
- Central Plants – focused on large heating and cooling systems looking to decarbonize including thermal networks
- Refrigerants – focused on impacts of refrigerants and ways to reduce this impact including large plants with heat pumps

Better Buildings and ASHRAE Decarbonizing Thermal Systems Guide

Decarbonizing Building Thermal Systems: A How-to Guide for Heat Pump Systems and Beyond

- Design guidance for heat pumps (which includes air-source, ground source, and hot water heating)
- Based on input from ASHRAE experts, NREL analysis, Better Buildings Design and Construction Allies and Better Climate Challenge Partner experiences
- Expanded content coming in FY2025

https://www.nrel.gov/docs/fy24osti/87812.pdf

More Resources and Thank You!

GTO has additional tools and resources available to learn about geothermal energy, find funding opportunities, and more.

- Funding Opportunities
- Fact Sheets
- The Drill Down Newsletter
- Stakeholder Toolkits
- Infographics
- Project Postcards

Get the hottest geothermal news from ***The Drill Down***, GTO's monthly newsletter!

Sign up today: geothermal.energy.gov