BRIEF

Building Decarbonization Meets Water Conservation

The Potential of Thermal Energy Networks to Cool Buildings & Save Water

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The Building Decarbonization Coalition (BDC) aligns critical stakeholders on a path to transform the nation's buildings through clean energy, using policy, research, market development, and public engagement. The BDC and its members are charting the course to eliminate fossil fuels in buildings to improve people's health, cut climate and air pollution, prioritize high-road jobs, and ensure that our communities are more resilient to the impacts of climate change.

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Introduction

The United States faces multiple sustainability challenges, including adapting to rising temperatures, reducing emissions, and conserving water.[1] Cooling buildings to safe, comfortable interior temperatures is associated with each of these challenges. Many commercial and institutional buildings use a system of chillers and cooling towers that remove heat through evaporation. This process consumes vast amounts of water, making these systems unsustainable in water-scarce areas. There is a need and opportunity for solutions that integrate climate adaptation, building decarbonization, *and* water usage in a warming climate.

One promising solution may be under our feet. For decades, universities and commercial institutions have installed thermal energy networks (TENs) to replace conventional heating and cooling systems. These institutions have published data on their systems' energy efficiency, cost savings, and emissions reductions—with water savings *sometimes* included as a secondary benefit. Yet because TENs recycle and recirculate heat instead of releasing it through evaporation, it stands to reason that they may produce significant water savings. To that end, we asked: Does publicly available data show evidence that these systems save water?

We reviewed self-reported data from ten thermal energy systems across the United States and Canada, assessing their potential to save water in commercial and institutional buildings. The initial results are promising. When replacing conventional heating and cooling systems, TENs show potential to significantly reduce large buildings' water consumption:

- Eight of the ten sites included in this review produced a collective annual water savings of approximately 337 million gallons, equivalent to the average annual water use of 3,000 U.S. households. [2]
- While water savings vary depending on system design and the number of connected buildings, these sites show annual savings between 18% to 46%, or 3,000 and 18,000 gallons per cooling or heating ton.
- These systems save water in varied, diverse climate zones and geographic areas.

This review also reveals important data gaps, and makes recommendations for building industry professionals, developers, policymakers, and sustainability advocates:

- There is a lack of standardized, publicly available data on water usage in large buildings, and existing data is inconsistent in tracking and measuring water savings.
- More research is needed to explore and optimize the water-saving potential of TENs, especially as these systems proliferate.

This report offers an initial step toward understanding how TENs can improve water conservation in heating and cooling large buildings. It is timely for two reasons: first, water scarcity is likely to increase due to drought and rising cooling demand, making it crucial to understand how buildings can begin saving water *now*. Second, TENs are poised to expand significantly in coming years, driven by new federal funding, legislation in multiple states, and highly-anticipated utility pilot projects in Massachusetts and New York.[3] Now is the perfect moment to make water savings an explicit component of TENs design, installation, data collection, and decarbonization policy.

Installing a geothermal pipe loop.
Image credit: Ania Camargo

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[1] National Integrated Drought Information System, "National Current Conditions," Drought.gov, accessed July 3, 2024, https://www.drought.gov/current-conditions.

[2] U.S. Environmental Protection Agency, "How We Use Water," Overviews and Factsheets, January 16, 2017, https://www.epa.gov/watersense/how-we-use-water.

[3] Building Decarbonization Coalition, "A Legislative Heatwave: Thermal Energy Network Legislation Updates (June 2024)," BDC, June 4, 2024, https://buildingdecarb.org/tens-legislation-june-2024.

The Problem: Rising Temperatures and Thirsty Buildings

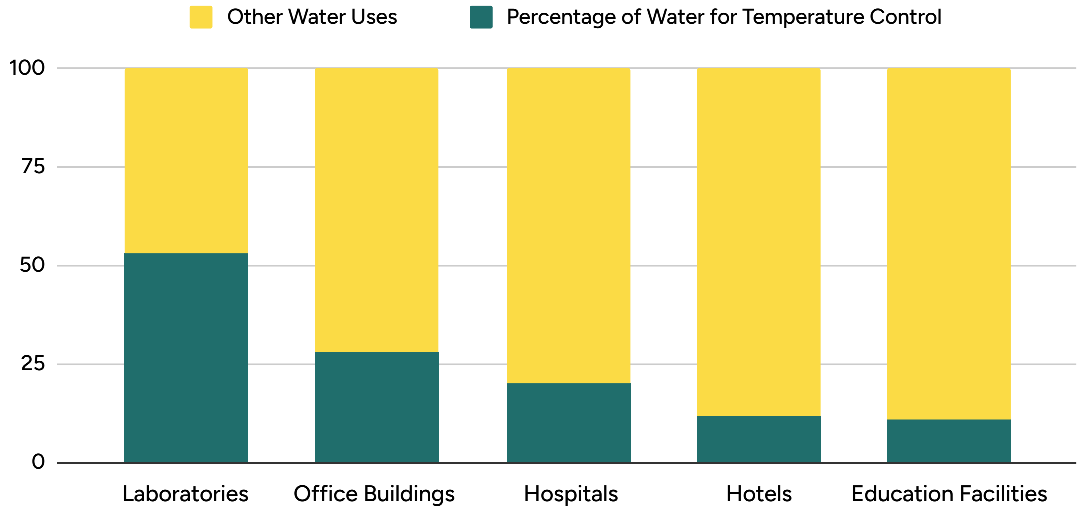
Heat waves in the U.S. are increasing in intensity, duration, and frequency. Data from 50 U.S. cities shows that the heat wave season is now 46 days longer than it was in the 1960s, and occurrences have tripled from two per year in the 1960s to six per year in the 2010s and 2020s.[4] This extreme weather makes interior cooling a necessity.

However, cooling large buildings is water-intensive. Figure 1 shows the percentage of water used for indoor temperature control (heating and cooling) in various types of commercial and institutional buildings in the U.S.[5] Overall, there are an estimated 81 billion square feet of commercial space in the U.S. requiring 300 million tons of cooling capacity, which consumes between 5 and 15 billion gallons of fresh water daily: equivalent to the daily freshwater consumption of 50 million U.S. residents, and at a cost of $20 billion for delivery and treatment of water and waste.[6]

These numbers will only grow as heat waves increase and we construct more buildings that require cooling. Data centers associated with cloud computing and A.I., for example, are one of the most water intensive commercial buildings and are expected to proliferate in the near future; the data center industry as a whole "directly or indirectly draws water from 90% of U.S. watersheds." [7]

These estimates and predictions are particularly alarming in areas experiencing drought, which, as of mid-June 2024, includes roughly 10% of the U.S. and Puerto Rico and 12% of the lower 48 states.[8] Evaporative cooling towers have become a target for water conservation in arid areas. In 2018, the mayor of Los Angeles encouraged building owners to upgrade their cooling towers; across Los Angeles County, these systems were estimated to consume over 2.5 billion gallons of water annually, an amount that could supply approximately 15,000 households.[9] And in 2023, the Southern Nevada Water Authority Board of Directors voted to support a moratorium on installing evaporative cooling towers in new buildings in the Las Vegas Valley.[10]

Figure 1: *Percentage of Water End Use for Temperature Control in Commercial and Institutional Buildings*



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[4] U.S. Environmental Protection Agency, "Climate Change Indicators: Heat Waves," Reports and Assessments, February 4, 2021, https://www.epa.gov/climate-indicators/climate-change-indicators-heat-waves.

[5] U.S. Environmental Protection Agency, "Types of Facilities," Overviews and Factsheets, Types of Facilities, January 16, 2017, https://www.epa.gov/watersense/types-facilities.

[6] Jay Egg, "How Can We Save 2-Trillion Gallons of Water?," Geothermal Rising (blog), July 29, 2021, https://geothermal.org/our-impact/blog/how-can-we-save-2-trillion-gallons-water.

[7] Ahmad, Rasheed. 2024. "Engineers often need a lot of water to keep data centers cool." ASCE. https://www.asce.org/publications-and-news/civil-engineering-source/civil-engineering-magazine/issues/magazine-issue/article/2024/03/engineers-often-need-a-lot-of-water-to-keep-data-centers-cool.

[8] National Integrated Drought Information System, "National Current Conditions."

[9] Murphy, Katy. 2016. "Amid drought, Los Angeles looks to upgrade "swamp coolers."" Times Herald Online. https://www.timesheraldonline.com/2016/01/02/amid-drought-los-angeles-looks-to-upgrade-swamp-coolers/.

[10] Rhiannon Saegert, "Water Authority Moves to Conserve on Cooling Systems in Southern Nevada," Las Vegas Sun, September 25, 2023, https://lasvegassun.com/news/2023/sep/25/new-barrier-to-keep-cool/.

Water-Cooled Chillers: How Conventional Cooling Works

In many buildings, chillers and cooling towers work in tandem. Chillers are refrigeration systems designed to cool fluids for air conditioning or *process cooling*: the cooling of equipment or products during manufacturing.[11] Chillers circulate a refrigerant that absorbs heat from a fluid, and then releases it through a condenser, which separates the absorbed heat from the refrigerant. [12]

Chillers often rely on cooling towers to dissipate that heat. Cooling towers are heat rejection devices that circulate water over a fill material—such as plastic, wood, or ceramic—which increases the surface area for evaporation. As the water flows over or through the fill material, a portion evaporates, carrying heat away with it. The remaining water is then recirculated into the chiller. In the majority of cooling towers, water is also chemically treated to prevent scaling (mineral buildup) and the growth of algae, legionella, and other pathogens.[13]

Cooling towers lose water in multiple ways. The first is through evaporation, which is the desired outcome to remove heat. Another is through periodic discharge of the residual water left behind after evaporation; this concentrated water contains higher levels of dissolved minerals, chemical treatments, and impurities, and must be discharged to prevent unwanted scaling.[14] Finally, cooling towers can also lose water due to drift, *or* the escape of water droplets. These combined losses mean cooling towers require water replenishment throughout their lifetime.

*Abundant cooling towers in L.A. County, highlighted here in yellow, use an **estimated 2.5 billion gallons** annually.*

Sets of cooling towers in data center building. Image credit: Adobe

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[11] U.S. Environmental Protection Agency, "Industrial Process Cooling Towers: National Emission Standards for Hazardous Air Pollutants," Other Policies and Guidance, June 30, 2015, https://www.epa.gov/stationary-sources-air-pollution/industrial-process-cooling-towers-national-emission-standards.

[12] IQS Directory, "Chiller: What Is It? How Does It Work? Types & Uses," Chiller: What is it? How Does It Work? Types & Uses, accessed July 3, 2024, https://www.iqsdirectory.com/articles/chillers.html.

[13] U.S. Centers for Disease Control and Prevention, "Controlling Legionella in Cooling Towers," Controlling Legionella, April 2, 2024, https://www.cdc.gov/control-legionella/php/toolkit/cooling-towers-module.html.

[14] U.S. Department of Energy, "Cooling Towers: Understanding Key Components of Cooling Towers and How to Improve Water Efficiency," February 2011.

A Solution: Thermal Energy Networks

TENs is an umbrella term for neighborhood-scale systems that use a network of underground, water-filled pipes for heat exchange between buildings and energy sources. These sources can include lakes and rivers, energy-intensive structures, wastewater systems, or even the stable temperature of the earth.[15]

There are many design approaches. *District energy systems* use a central plant to generate heat, which is distributed to customers through a shared pipe system. Early district energy systems relied on combustion to generate heat, but geothermal is increasingly preferred for clean heating or cooling.[16] *Geothermal networks* use boreholes to access the ambient temperature of the earth for thermal energy capture and storage. These are distributed systems, meaning they transfer thermal energy to ground-source heat pumps (GSHPs) in every building. Heat pumps do not use evaporation to cool. Instead, they move thermal energy through a compressor to remove heat, exactly like a refrigerator.

Figure 2 shows a geothermal network that heats and cools buildings by transferring thermal energy through a single loop of water-filled pipe connected to GSHPs in every building. By redistributing thermal energy instead of rejecting it as waste, it can replace cooling towers.[13]

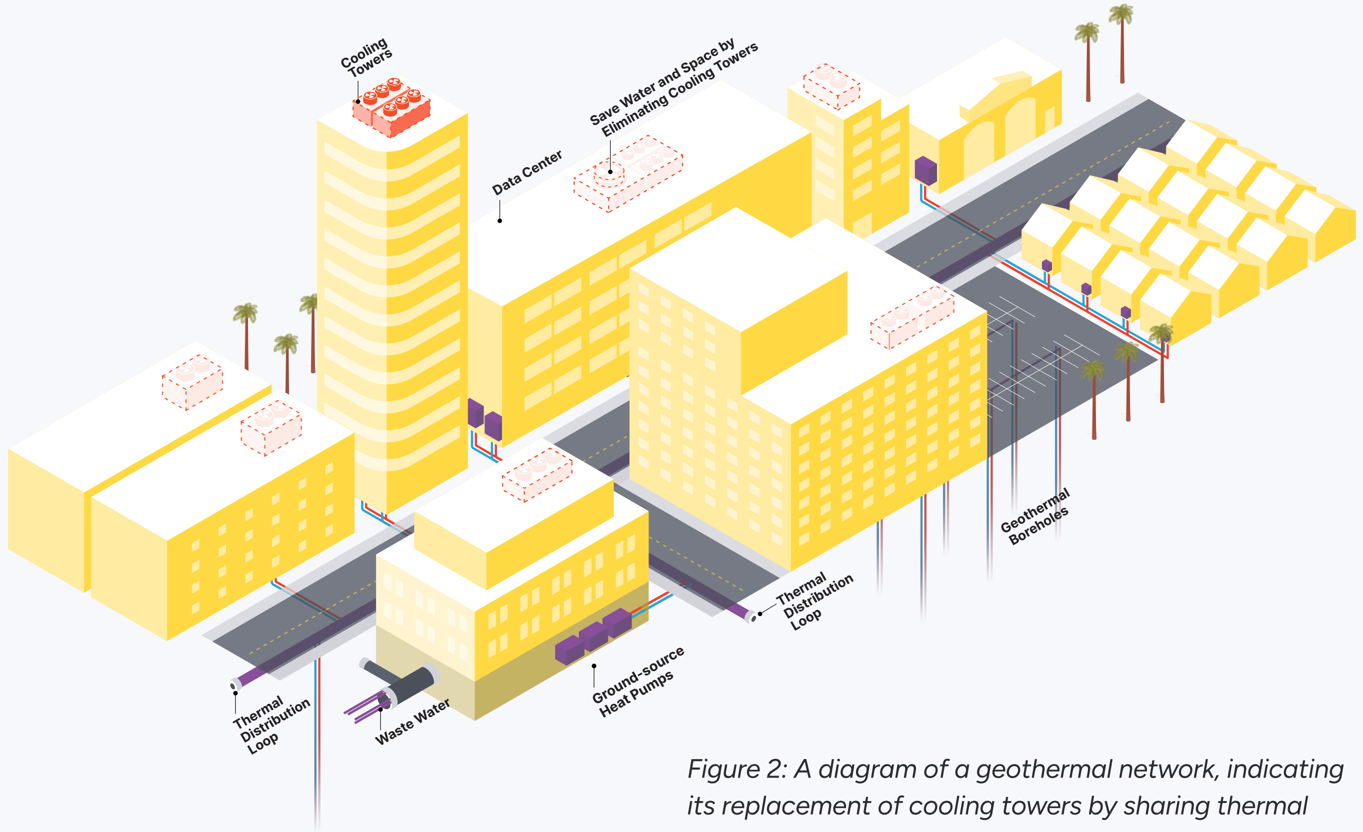

Figure 2: A diagram of a geothermal network, indicating its replacement of cooling towers by sharing thermal energy through a network of water-filled pipes.

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[15] HEET, "Geothermal Networks 2019 Feasibility Study," 2019, https://assets-global.website-files.com/649aeb5aaa8188e00cea66bb/656f8ad67bbc7df081e3fe17_Buro-Happold-Geothermal-Network-Feasibility-Study.pdf.

[16] Building Decarbonization Coalition, "Thermal Energy Networks (Definitions)," BDC, accessed July 3, 2024, https://buildingdecarb.org/resource-library/ten-definitions.

What Early Water Savings Data Shows Us

Table 1 summarizes and standardizes water savings data from ten existing TENs. The data here is self-reported by institutions and was gathered through publicly available sources like websites or reports and through personal correspondence with building managers or owners. An engineer with experience designing TENs reviewed the table. There are important caveats and limitations to its ability to apply generally—these are discussed in "About the Data" below.

The table includes information on the site's location, IECC climate zone, general system design, size and capacity, and annual water savings. Total annual water savings are represented in gallons, *except* when sites share water savings as a percentage. The majority of these systems are district energy systems that use geothermal resources as an energy source; one is a geothermal network. Most sites saved water by replacing their conventional cooling systems, but Oberlin College and Missouri S&T share data on water savings associated with converting their heating *and* cooling systems to geothermal. Other sites are new and are proposing their projected savings relative to conventional options.

Table 1: Summary Description, Performance, IECC Climate Zone, and Water Usage Data for 10 Thermal Energy Networks

Site / Operation Year	Location	System Design	# of Connected Buildings	System Capacity (tons)	Annual Water Savings (gallons)
Ball State University[17][18][19][20] 2012	Muncie, Indiana Zone: 5	District energy system using geothermal	Heats & cools: 47	Heating & cooling: 2,500	45 million
Colorado Mesa University[21][20] 2008	Grand Junction, Colorado Zone: 5	Geothermal network with ambient temperature loop	Heats & cools: 16	Heating: 2728 Cooling: 3113	10 million
Cornell University[22][23][20] 2000	Ithaca, New York Zone: 6	Lake source cooling system	Heats & cools: 75	Cooling: 3,000	4 million
Enwave Energy Corporation[24][25][26][20] Commissioned 2004	Toronto, Canada Zone: 6a	Lake source cooling system	Heats & cools: 180	Cooling: 75,000	220 million

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[17] Ball State University, "Geothermal Energy System," accessed July 3, 2024, https://www.bsu.edu/about/geothermal.

[18] Ball State University, "Ground Source Geothermal District Heating and Cooling System," January 27, 2019, https://doi.org/10.2172/1329477.

[19] Indiana University, "Ball State University Geothermal Case Study," accessed July 3, 2024, https://eri.iu.edu/erit/case-studies/ball-state-university-geothermal.html.

[20] International Code Council. 2020. "2021 International Energy Conservation Code (IECC)." International Code Council Codes. https://codes.iccsafe.org/content/IEC-C2021P1/chapter-3-ce-general-requirements#IECC2021P1_CE_Ch03_SecC301.

[21] Hyunjun Oh and Koenraad Beckers, "Cost and Performance Analysis for Five Existing Geothermal Heat Pump-Based District Energy Systems in the United States," July 1, 2023, https://doi.org/10.2172/1992646.

[22] Cornell University, "How Lake Source Cooling Works | Facilities and Campus Services," accessed July 3, 2024, https://fcs.cornell.edu/departments/energy-sustainability/utilities/cooling-home/cooling-production-home/lake-source-cooling-home/how-lake-source-cooling-works.

[23] CHA Solutions, "Cornell University Lake Source Cooling," accessed July 3, 2024, https://www.chasolutions.com/projects/cornell-university-lake-source-cooling/.

[24] Rob Thorton, "District Energy Conserves Water, Cuts Emissions on Both Sides of the Great Lakes," The Energy Mix (blog), October 27, 2023, https://www.theenergymix.com/district-energy-conserves-water-cuts-emissions-on-both-sides-of-the-great-lakes/.

[25] H.H. Angus and Associates Ltd., "Enwave Energy Corporation District Energy System," H.H. Angus and Associates Ltd. (blog), accessed July 3, 2024, https://hhangus.com/projects/enwave-energy-corporation-district-energy-system/.

[26] Enwave, "Enwave and Toronto Water Tap into Innovative Energy Source - Enwave Energy Corporation," accessed July 3, 2024, https://www.enwave.com/case-studies/enwave-and-toronto-water-tap-into-innovative-energy-source/

Site / Operation Year	Location	System Design	# of Connected Buildings	System Capacity (tons)	Annual Water Savings (gallons)
Miami University [27] [20] Phase 1: 2014 Phase 2: 2028	Oxford, Ohio Zone: 5	District energy system using geothermal	Heats & cools: 39 (10 in Phase 1)	Heating: 1833 tons Cooling: 2,300	43% (relative to installing chiller)
Microsoft Redmond Campus [28] [20] 2022	Seattle, Washington Zone: 4	District energy system using geothermal, plus chilled and hot water tanks	Heats & cools: 12 (will be 16 when completed)		8 million
Missouri S&T [29] [30] [20] 2014	Rolla, Missouri Zone: 4	District energy system using geothermal	Heats & cools: 17	Heating & cooling: 1,500	15.3 million (46%)
Nashville Airport [31] [20] 2016	Nashville, Tennessee Zone: 4	Lake source cooling system	Heats & cools: 2	Heating & cooling: 3,600	30 million
Oberlin College [32] [20] Fall 2024	Oberlin, Ohio Zone: 5	District energy system using geothermal	Heats 50, cools 24	Heating & cooling: 2,400	5 million (14%)
Stanford University [33] [34] [35] [20] 2015	Stanford, California Zone: 3	District energy system using chilled and hot water tanks	Heats & cools: ~1,000	Heating & cooling: 770,000 tons per hr Cooling: 2,500	18%

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[27] Miami University, Data provided by Olivia Herron, Director of Sustainability, Physical Facilities Department for Miami University., n.d.

[28] GLY Construction, "Microsoft Thermal Energy Center," GLY, accessed July 3, 2024, https://www.gly.com/projects/microsoft-thermal-energy-center.

[29] Missouri University of Science and Technology, "Geothermal Energy," Missouri S&T, accessed July 8, 2024, https://facilitiesoperations.mst.edu/geothermal/.

[30] Missouri University of Science and Technology, "Geothermal Energy System – Facilities Operations," Missouri S&T, accessed July 3, 2024, https://facilitiesoperations.mst.edu/geothermal/.

[31] Jay Egg, Data provided by Jay Egg, President of Egg Geo., n.d.

[32] Ever-Green Energy, Data provided by Ever-Green Energy, the Owner's Representative and consulting engineering firm for Oberlin College's Sustainable Infrastructure Program., n.d.

[33] Stanford University, "SESI General Overview." https://sesi.stanford.edu/sites/g/files/sbiybj29541/files/media/file/sesi-general-overview.pdf.

[34] Stanford University, "Stanford Energy Systems Innovations (SESI)," accessed July 3, 2024, https://sesi.stanford.edu/.

[35] Stanford University, "Central Energy Facility | Stanford Energy Systems Innovations (SESI)," accessed July 3, 2024, https://sesi.stanford.edu/energy-systems/central-energy-facility.

This initial analysis, although limited in scope, suggests significant water savings and justifies future research and data collection on water savings:

- **These sites collectively save approximately 337 million gallons of water each year, equivalent to the average annual water use of 3,000 U.S. households.**[36] This excludes Miami and Stanford Universities, which did not track direct water savings in gallons in their conversion projects—which means that the total savings for all ten sites would be even *greater* than 337 million gallons. Extrapolating from these case studies, we can infer that widespread adoption of TENs would result in potentially significant water savings.
- **While water savings vary depending on system design and the number of connected buildings, these sites show annual savings between 18% to 46%, or 3,000 and 18,000 gallons per cooling or heating ton.** While these initial numbers are impressive, maximizing future water savings requires more reporting and a better understanding of system components and specifications, as well as more consistent reporting.
- Future data collection should explore exactly how these savings are achieved by asking:
  - What was the site's total water consumption for heating and cooling before installing a TEN or geothermal system?
  - Do these institutions distinguish between the water used for cooling and other purposes, such as sanitation, irrigation, or drinking?
  - Did any cooling towers remain after the geothermal system was installed, or was the cooling infrastructure completely replaced? (See "About the Data" for a full list of potential questions.)
- **These sites save water in diverse climatic and geographic settings.** Table 1 highlights the potential of TENs to save water *and* heat and cool buildings in locations that are very different in terms of climate, altitude, and moisture.[37]
  - This is significant for two reasons: first, temperatures are rising throughout the U.S., requiring sustainable cooling solutions everywhere. Second, water scarcity is driven not only by climate and aridity but also by human consumption patterns (for example, the need for water to cool data centers); any region can be vulnerable to water shortages.

Saving Water, Saving Money

In addition to saving costs associated with saving water, TENs can reduce costs by avoiding the need for wastewater treatment. Cooling towers discharge millions of gallons of chemically treated and mineral-laden water, requiring expensive wastewater treatment and infrastructure. The treatment of this wastewater requires increasing investments in treatment facilities and infrastructure, increasing rates for all customers within a class, not only for the owners of these buildings.

High costs of installation are sometimes cited as a reason to avoid installing TENs, but federal tax credits may ease the financial transition to geothermal heating and cooling. By converting a water-cooled chiller or any building using water-source air conditioners to ground-source heat pumps, the entire HVAC system qualifies as geothermal, making it eligible for federal tax credits. The Inflation Reduction Act of 2022 (IRA) significantly enhances federal tax incentives for ground-source heat pumps (GSHP) energy installations in commercial buildings, including a new direct payment option for non-taxable entities. Key benefits include an investment tax credit (ITC) up to 30%, an additional bonus for domestic content and energy communities, and new provisions for carrybacks and credit transfers.[38] The federal Modified Accelerated Cost Recovery System (MACRS) offers a 10% tax credit and five-year depreciation for commercial geothermal systems, with a 50% bonus depreciation in the first year.[39] For example, a $1 million upgrade to a geothermal system can yield federal tax incentives totaling 48% of the cost, or $480,000.

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[36] U.S. Environmental Protection Agency, "How We Use Water."

[37] International Code Council. 2020. "2021 International Energy Conservation Code (IECC)." International Code Council Codes. https://codes.iccsafe.org/content/IEC-C2021P1/chapter-3-ce-general-requirements#IECC2021P1_CE_Ch03_SecC301.

[38] Geo-Enterprises, "Geothermal Tax Credits," 2024, https://geo-enterprises.com/tax-credits/; Internal Revenue Service. 2024. "Domestic content Bonus Credit." IRS. https://www.irs.gov/credits-deductions/domestic-content-bonus-credit; Internal Revenue Service. 2022. "IRS Issues Guidance for Energy Communities and the Bonus Credit Program Under the Inflation Reduction Act." IRS. https://www.irs.gov/pub/irs-drop/n-24-30.pdf.

[39] Cornell University School of Law, "MACRS," LII / Legal Information Institute, July 2021, https://www.law.cornell.edu/wex/macrs.

Eligible properties must be in the U.S. and commence construction by January 1, 2035.[40] The ITC can be used to offset both regular and alternative minimum tax (AMT) taxes, with specific eligibility criteria for bonuses and depreciation detailed by the IRS.[41]

Next Steps: TENs and Water in a Warming World

Investment in sustainable, efficient, water-smart cooling technologies is urgently needed to solve for multiple sustainability challenges. TENs and geothermal cooling systems present a potential paradigm shift in cooling buildings in a warming and water-stressed world, but more data is required to accelerate their adoption.

This initial analysis of self-reported data shows that TENs have the potential to reduce buildings' dependence on cooling towers—saving millions of gallons of water annually and reducing costs associated with chemical wastewater management.

Our analysis also highlights the need for additional research on the water savings potential of building decarbonization. The limited data from TENs indicates insufficient tracking and monitoring of systems' water usage, particularly when compared to the standards for tracking energy savings and emissions reductions in buildings. To fully understand the water-saving potential of TENs, researchers, system designers and engineers, facilities managers, building owners, environmentalists, and sustainability advocates require more—and more standardized—data. This could include collecting baseline and comparative data on water usage in buildings, assessing existing heating and cooling infrastructure, and consistently monitoring water usage. This will provide a more comprehensive understanding of the components that contribute to water conservation in buildings, and guide the appropriate adoption of different TEN designs.

These questions are particularly relevant as utility-owned TENs take off in states across the country.[42] Understanding the advantages of different system designs is essential to installing systems that optimize efficiency, emissions reductions, and water savings. Site owners, facilities managers, and future system operators should also consider the potential for their institution or system's future connection to a broader utility-owned system: for example, although only one site in Table 1 is a geothermal network, gas utilities piloting TENs have shown a preference for this design because it allows for expansion and scale as they evolve their business model.[43]

Investing in sustainable, water-smart cooling technologies is crucial for addressing both water conservation and climate change. With further research and data, TENs can lead the way in reducing water usage while efficiently cooling buildings.

A geothermal borehole drilling rig.

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[40] Geo-Enterprises, "Geothermal Tax Credits."

[41] Geo-Enterprises.

[42] Building Decarbonization Coalition, "A Legislative Heatwave."

[43] Building Decarbonization Coalition, "BDC Celebrates Utility Geothermal Network Launch - BDC," June 4, 2024, https://buildingdecarb.org/bdc-celebrates-geothermal-network-launch.

Appendix

About the Data

Data origins and review: The data is self-reported by the owners of these systems and was gathered through publicly available sources, such as institutional websites or reports, and mostly confirmed through personal correspondence with building managers or owners. The data was reviewed by thermal energy experts and engineers.

System designs and size: System design descriptions are simplified, but serve as a starting point from which we can begin to analyze the advantages (if any) of different design specifications or components that result in water savings. The number of connected buildings and system capacity provide perspective on each site's size.

Total annual water savings: This is represented in gallons, except when sites share their water savings as a percentage; for example, when facilities managers at Miami University considered installing chillers or a geothermal system, system designers proposed that the geothermal system would save 43% of water relative to chillers.[44] If sites share savings in both gallons and by percentage, both figures are included in the table.

Heating and cooling tons: The majority of sites in Table 1 saved water by replacing their conventional cooling systems. However, Oberlin College and Missouri S&T report on water savings associated with converting their heating *and* cooling systems to geothermal. Future data collection should analyze these conversions separately for a precise understanding of water conservation potential in building retrofits.

Recommendations for future data collection: Rigorous data collection is needed so future system designers can understand exactly how water savings are achieved:

- Are water savings achieved from replacing heating infrastructure, cooling towers, or both?
- Did any cooling towers remain after the geothermal system was installed, or was the cooling infrastructure completely replaced? How often are the cooling towers used when they remain in place, and what conditions merit their use?
- What was the site's total water consumption, in gallons, before installing a TEN or geothermal cooling system?
- Do these institutions distinguish between the water used for cooling and other purposes, such as sanitation, irrigation, or drinking?

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[44] Miami University, Data provided by Olivia Herron, Director of Sustainability, Physical Facilities Department for Miami University.

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