Thermal Energy Networks: Considerations from Environmental Justice and Energy Democracy Perspectives

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Acknowledgements

Common Spark Consulting is a for-profit business working with community-based organizations, state agencies, utilities, and environmental advocates to facilitate conversation, unpack energy policy, and build collaborative pathways to a clean energy future. Transformative Strategies Consulting is a consulting practice that works with leaders in the climate and sustainability sectors to foster impactful, just, and equitable deep decarbonization solutions. We accept editorial responsibility for this document.

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Interviewees were offered honoraria for their time and expertise, however, we acknowledge that these one-time payments do not sufficiently represent the value of a community's lived experience nor the central role that lived experience can and should play in better policymaking. Long-term investment provided directly to frontline communities and community-based organizations can better support inclusive policymaking and implementation of community-driven solutions.

Introduction

Thermal energy networks (TENs) are gaining momentum in the clean energy transition as a heating and cooling resource that can provide health, economic, and environmental benefits compared to natural gas, fuel oil, and electricity. Decision-makers are increasingly directing fossil fuel gas utilities to consider TENs as an alternative to conventional heating and cooling, and eight states have adopted legislation to implement pilot projects.[1] At the same time, community-based organizations are learning more about the potential of TENs as a neighborhood-scale solution that can be developed in partnership with local governments, labor unions, and other partners.

The Project Team sought to better understand how development of thermal energy networks could advance the goals of environmental justice (EJ) and energy democracy (ED) advocates. We did this through interviews with 13 environmental justice and energy democracy organizations, complemented by secondary research. Findings from interviews and secondary research informed the development of *Thermal Energy Networks in the United States: Emerging Opportunities, Challenges, and Needs* and this "companion piece" that aims to take a closer look at the potential for and risks to environmental justice and energy democracy related to the policies for and development of TENs. Further, findings also informed a private report to philanthropic funders with recommendations on funding needs. We hope this “companion piece” and the perspectives shared within it, serve as a resource to inform energy justice and energy democracy advocates on what has been learned, and what is still left to understand, about TENs.

We include here a note about the nature of this work in an effort to exercise accountability for how consulting fits into the greater context of the energy industry. We acknowledge that, as paid consultants gathering information from frontline community-based organizations to elevate priorities to funders, we are perpetuating a common industry practice that can be extractive and unjust because, after the interview, resources are not always allocated to those frontline organizations, but our consultant fees have been paid. While our intent is to honestly represent what we heard in interviews, this is not the same as funding frontline organizations to elevate their priorities directly with funders. Offering honoraria is an important step to compensate frontline organizations, but it does not substitute for long-term investment and funding to build capacity within frontline organizations, advance their respective missions, and lead and fund their own research.

[1] Building Decarbonization Coalition, Thermal Energy Networks (TENs) State Legislation website, accessed March 18, 2025.

Methodology

The project was conducted from September 2024 through March 2025.

We conducted a literature review from secondary sources to establish a foundation for research. The review helped us identify gaps in the literature to refine interview questions.

Each interview was conducted virtually and lasted approximately one hour. We selected interviewees by researching several organizations, and reaching out to those with experience or interest overlapping with TENs or related clean energy approaches. Some of the individuals and organizations we reached out to did not have the capacity or interest to meet with us. Ultimately, we held 13 interviews.

To support interviews, we developed a short presentation to provide context on the technology and policy landscape to-date and shared interview questions tailored to the organization (see Appendix B). Interviews were intended to be conversational and open to what interviewees wanted to share, rather than scripted.

Of the 13 EJ and ED organizations interviewed, three were actively engaged in feasibility studies to develop a thermal energy network in their community. Others were in different stages of engagement on TENs, ranging from community-based organizations just beginning to learn about TENs to regional advocacy organizations with a history supporting district heating policies and programs, but not directly representing communities pursuing clean energy resources.

Given the nascence of the TEN approach, perspectives are expected to evolve as more experience is gained with TENs research, policies, and pilots. As such, this document represents a point-in-time synthesis of perspectives captured through the generous time and knowledge sharing of experienced environmental justice and energy democracy advocates.

An initial draft of this document was reviewed by an energy democracy organization. That review provided productive insight that helped re-shape this document.

Key Equity Concepts

While we recognize important nuances and perspectives in approaching environmental justice and energy democracy work, we use the following definitions for the purposes of this paper:

- **Procedural justice** is about the fairness of the process of decision-making.[2] Under the umbrella of environmental justice, procedural justice calls for meaningful community engagement in clean energy decision-making processes, ensuring that frontline communities have a voice in shaping the future of energy infrastructure in their neighborhoods. In order for meaningful engagement to occur, decision-making must include complete transparency of energy and environmental information, unbiased sharing of technical context, and deeply inclusive and accessible participation of stakeholders at every level.[3]
- **Distributive justice** relates to distribution according to needs, based on the principle that every human being has the right to fulfill basic needs.[4] Distributive justice demands equitable access to the benefits of clean energy, such as affordable solar power or energy efficiency programs, while rectifying the historical inequities that have excluded these communities from such opportunities.
- **Environmental justice** means that everyone—regardless of race, color, national origin, or income—has the right to the same environmental protections and benefits, as well as meaningful involvement in the policies that shape their communities.[5] The current inequitable distribution of energy services and cost burden is due to imbalanced dynamics between stakeholders in the energy sector and society.[6] Environmental Justice Communities include, but are not limited to, low-income communities, communities of color, frontline communities, and Indigenous communities. Each community will have unique considerations that deserve specific attention.
- **Energy democracy** is the process of democratizing the production and management of energy resources, including the social ownership of energy infrastructure, decentralization of energy systems, and meaningful public participation in energy-related policymaking. Through the course of this project, we received feedback on this definition and now specify that energy democracy does not necessarily need to emphasize energy, as energy is not the "golden ticket" solution to the climate crisis. Rather, energy democracy relates to the relationships between people and the planet. Further, the "social ownership of

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[2] Svarstad, H., *et. al.*, (2011), Three types of environmental justice: From concepts to empirical studies of social impacts of policy instruments for conservation of biodiversity, POLICYMIX Vol. 1.

[3] Prehoda, Emily, (2016), Energy Justice and U.S. Energy Policy: Case Study Applications Exploring U.S. Energy Policy Through an Energy Justice Framework.

[4] Svarstad, H., *et. al.*, (2011), Three types of environmental justice: From concepts to empirical studies of social impacts of policy instruments for conservation of biodiversity, POLICYMIX Vol. 1.

[5] Natural Resources Defense Council, (2023), Explainer: The Environmental Justice Movement, accessed March 17, 2025.

[6] Edem Lawrencia Anku, N., University of Energy and Natural Resources, Sunyani, Ghana, (2023), The Power of Procedural Justice in the Planning of Energy Projects, The Power of Energy Justice & the Social Contract, Just Transitions.

energy infrastructure" as used in the initial definition of energy democracy could reference wide distribution of energy generation, and "meaningful public participation" could be specified as democratic and equitable participation. We are grateful for the feedback received on the initial definition of energy democracy.

Thermal Energy Network Function and Types

A thermal energy network uses a network of water pipes to interconnect buildings and thermal energy sources to provide space heating, cooling and domestic hot water. The network can harness otherwise wasted thermal energy from buildings, sewage systems, underground transit stations and other "waste" heat sources. Additional baseload thermal sources can include shallow geothermal boreholes, bodies of water, and data centers. When installed, these networks can provide efficient, fossil fuel-free heating and cooling to commercial and residential buildings.

TENs can be supported by different thermal sources to provide heating and cooling for the network but some key features include:

- They connect multiple buildings with different owners within a shared heating and cooling network.
- They are "bidirectional," meaning they both supply and receive thermal energy from connected buildings. This enables the management of heating or cooling energy distribution to ensure that demand is met efficiently across all connected buildings or systems, a process known as "load balancing."
- They transfer renewable, passive, or waste heat from sources to sinks, rather than generating new heat or cooling.

In recent years, advocacy groups including the Building Decarbonization Coalition[7] and Home Energy Efficiency Team (HEET)[8] have defined a set of terms to describe TENs. In interviews, we found some consistency in the use of the term "thermal energy network" but not all interviewees used the same terminology. The different types of TENs discussed with interviewees included:

- Networked Geothermal projects (also known as geothermal energy networks), which use relatively shallow geothermal boreholes (200-700 feet) and a system of

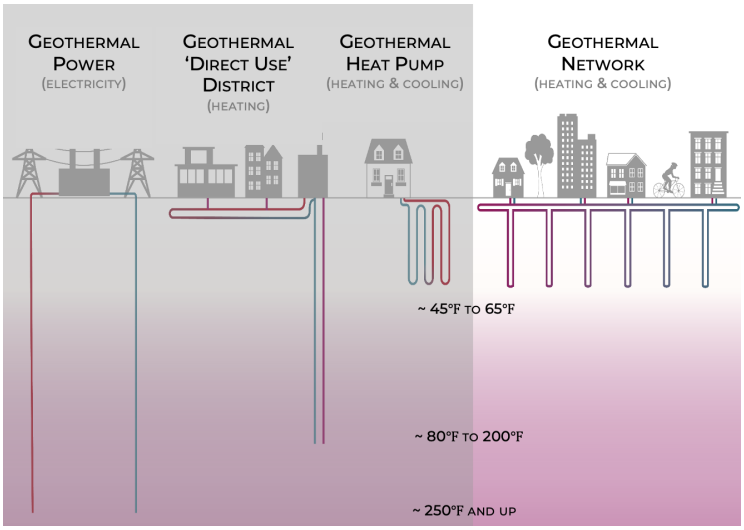
[7] Building Decarbonization Coalition, Thermal Energy Networks (TENs) Terminology website, accessed March 18, 2025.

[8] Magavi, Z., Alberto-Escobar, A., Varela, I., HEET, (2024), A Definitional Taxonomy for (Geo)Thermal Energy Networks, GRC Transactions, Vol. 48.

networked ground source heat pumps to deliver heating and cooling to connected buildings.[9]

- District Heating or Campus Geothermal Systems, which distribute heat generated from one centralized location through a system of pipes. Historically, the heat has typically been generated from fossil fuels, biomass or cogeneration, but in a clean energy context waste heat, geothermal or other non-emitting sources can be used. Typically, boreholes are installed to a depth of 400-500 feet.[10]
- Wastewater or Sewer Heat Recovery Systems, which harness heat from wastewater or sewer pipes to supply space and water heating in surrounding buildings.[11]
- Waterbodies Thermal Energy-Based Systems, which harness the thermal energy of oceans, seas, lakes, or rivers to extract heating and or cooling.[12]
- Waste Heat Networks (without geothermal boreholes), which use heat exchange to share heating and cooling between multiple buildings.[13]

Of the three environmental justice interviewees conducting feasibility studies, one was examining a networked geothermal project, one a district geothermal loop system, and the third was studying a wastewater heat recovery system.



[9] Magavi, Z., Alberto-Escobar, A., Varela, I., HEET, (2024), A Definitional Taxonomy for (Geo)Thermal Energy Networks, GRC Transactions, Vol. 48.

[10] Ibid.

[11] Sewer Thermal Energy Network Objectives and Focus website, accessed March 12, 2025.

[12] Bordbar, A. *et. al.* (2023), Waterbodies thermal energy based systems interactions with marine environment - A review, Energy Reports, Vol. 9, pages 5269-5286.

[13] Building Decarbonization Coalition, Thermal Energy Networks (TENs) Examples website, accessed March 12, 2025.

Figure 1. Types of Geothermal Technologies and Approaches (Source: HEET)

Environmental Justice and Energy Democracy Goals

For the interviewees representing community-based organizations, the pursuit of and/or interest in TENs stemmed from a holistic vision of sustainability and affordability for their communities, including clean, affordable, and reliable energy; job opportunities; and community well-being. A TEN was not the only solution to advancing an organization's mission or goals. Environmental justice interest and engagement on TENs was more about whether TENs could be a good fit to achieve their broader vision, as opposed to whether their community might be a good fit for TENs.

Interviewees consistently raised that even if a TEN *would* be an appropriate resource for their community, additional interventions are needed to ensure that communities have equitable access to holistic home upgrades and affordable and reliable clean energy. Interviewees highlighted the need for electrification, energy efficiency upgrades, and weatherization interventions in their communities to complement clean heating and cooling resources. Additionally, building decarbonization efforts must address broader equity issues, including meaningful engagement, community education, tenant protections, and workforce development.[14]

Community residents and the organizations that represent them are local experts and have deep knowledge of their needs.[15] They already have clear ideas about the solutions needed for their communities and should be empowered to shape the future of energy infrastructure in their neighborhoods. While some communities may be more open to try innovative approaches, they should not be test cases for approaches that could introduce significant financial, technological, or social risk. As a baseline, communities need accessible and inclusive processes and culturally-competent outreach and education materials so that they can determine whether TENs would be a fit for their respective goals. Appendix A aims to offer a starting point for community engagement.

[14] Building Energy, Equity, and Power (BEEP) Coalition, (2022), BEEP Preliminary Report: Community Priorities for Equitable Building Decarbonization.

[15] Radtke, J., Renn, O. (2024), Participation in Energy Transitions: A Comparison of Policy Styles, Energy Research & Social Science, Vol. 118.

Conditional Opportunities for Thermal Energy Networks

It is critical that any thermal energy network development is coupled closely with a deep understanding of the environmental injustice context that surrounds energy provision. The potential opportunities for TENs remain true only to the extent TENs developers and policymakers learn from and respond to past environmental injustices and build community trust through meaningful engagement. Communities want and should be afforded the ability to define the terms of achieving their broader visions of sustainability and community well-being. This section describes some of the opportunities related to TENs, and the conditions that should be met to support equitable TEN development.

Waste Heat Use

A thermal energy network can leverage an existing waste heat source, such as a wastewater treatment plant, data center, power plant, and/or industrial process. For example, the City of Duluth designed a TEN to address waste heat discharged as effluent from a wastewater treatment plant.[16] By employing a system of water pipes, heat exchangers, and heat pumps, the thermal energy from effluent can be harnessed to heat water. This hot water can then be circulated through a network of buildings, providing for their heating needs through thermal exchange while helping to decarbonize its heat source.

Ideally, a TEN creates a use for a waste heat source from a necessary service, such as a wastewater treatment plant or other service needed by and serving the community. This adds value to the community asset, and adds new efficiency to the community. However, development of a TEN could also justify an undesirable waste heat source, such as an industrial process or other service, making it more difficult for the community to advocate for its shutdown in an already disproportionately-burdened area.

To address these potential concerns, utilities, TENs developers, and policymakers must conduct meaningful engagement where TENs are proposed. **Meaningful engagement begins with *asking* community members if they believe a TEN would be a good fit for their community and their broader vision of sustainability and justice, rather than *assuming* that any technical potential equates to community value.** TENs developers and policymakers should work with community representatives to consider whether

[16] City of Duluth, Community Geothermal website, accessed March 18, 2025.

development of a Community Benefits Agreement[17] would help to ensure that TENs development does not introduce new nor exacerbate existing environmental burdens, and can secure certain benefits for the community.

There are many ways for TENs advocates/stakeholders/developers to approach communities in a respectful manner; **it is not the responsibility of communities to educate developers and TENs advocates on how to engage respectfully and knowledgeably.** However, developers can include funding in their project development budgets to resource community leaders to conduct effective engagement. Appendix A of this document includes resources intended to support community engagement processes.

Localized Ownership

To date, legislation requiring TENs pilots has primarily directed utility ownership of the installed systems. However, TENs are inherently localized systems, which may make ownership by a community and/or municipality feasible.

- **Community-owned:** Blacks in Green (BIG) is leading a coalition of community groups, government, and universities to design and implement a community geothermal system, the Sustainable Chicago Geothermal Project, in the West Woodlawn neighborhood on the South Side of Chicago. BIG's TEN will be developed in the public rights-of-way that residents and businesses can opt into, which will position neighbors as owners/managers of an innovative clean energy technology. BIG's community-centered and values-based approach ensures that the local communities have trust and personal buy-in to TENs. BIG provided their community with education on the technology so that community members could make informed decisions. BIG was selected for Phase 2 of the Department of Energy's (DOE's) Community Geothermal Heating and Cooling initiative, moving their proposal forward to construction.
- **Publicly-owned:** The City of Ann Arbor authorized a Sustainable Energy Utility (SEU), an opt-in, city-owned energy utility that provides 100% renewable energy from solar, battery storage, and networked geothermal systems at participating homes and businesses. Creation of the SEU helps ensure that local energy initiatives will be prioritized and benefits will be brought directly to the community. This form of ownership can shift energy from being viewed as a commodity to being viewed as a service. Further, local governments can exercise substantial

[17] For more information, please refer to the Initiative for Energy Justice's post, Energy Justice in Community Benefits Agreements and Plans, dated June 26, 2024.

control over underground pipes that deliver fossil or non-fossil fuels through a combination of legal authorities, regulatory powers, and practical oversight. An SEU means that the owner of TENs has a strong relationship and familiarity with much of the bureaucratic processes surrounding development, and also a public-serving charge, giving community priorities greater influence in its governance and operations.

Most TENs legislation passed today mandates or anticipates investor-owned utility ownership. While this does not preclude the opportunity for equitable development, IOUs have not demonstrated a consistent track record of meaningful community engagement, building trust with community residents and businesses, nor prioritizing the needs of environmental justice communities. Performative engagement processes extract from communities without elevating their needs and desires, serving only to help IOUs meet regulatory requirements. EJ and ED communities have expressed concerns that IOUs will maintain control through the TENs transition, and the development process will not be managed equitably, leaving them and their community needs and priorities, and subsequent benefits, at risk.

Due to the unique opportunity for community and local ownership models, policymakers, utilities, and philanthropic funders should engage a broad range of stakeholders to understand the opportunities for and barriers to community and local ownership of TENs. This could include broad visioning and reimagination of what the provision of energy and clean heating and cooling services can look like, as well as what legal authorities and organizational and financial resources may be necessary. Ultimately, communities should be engaged in a collaborative and democratic process to determine the ownership model that best suits their needs. Appendix A of this document includes resources intended to support community engagement processes.

The Eversource Energy TEN pilot in Framingham, MA, exemplifies how an IOU can prioritize effective community engagement by collaborating with and providing resources to local community-based organizations and working closely with community members. As a result of conversations about community priorities and concerns, the pilot covers the cost of weatherization, asbestos and mold abatement, HVAC and electrical upgrades, furnace replacements, and heat pump installations. If customers are dissatisfied after the pilot phase, Eversource will cover the cost of removing the equipment and will either reinstall gas units or provide alternative agreed-upon equipment, such as an air-source heat pump.

Neighborhood-scale Solution

TENs, by definition, connect multiple buildings within a neighborhood and enable decarbonization at scale as these buildings decarbonize and connect to the system at the same time. This can be an effective approach to wide-scale emission reductions compared to building-by-building approaches, where building owners might only upgrade heating and cooling systems at failure and without coordinating with neighboring buildings. Additionally, building-by-building approaches can exacerbate distributive injustices, with higher income households having means to electrify and improve their homes' energy efficiency, while lower income households continue to use older, less efficient infrastructure and may not be able to afford to electrify. Given these challenges of building-by-building decarbonization, the concept of neighborhood-scale decarbonization is particularly alluring to interviewees.

Interviewees, however, also raised concerns around community consent to energy infrastructure development. TENs presents unique nuances around participation threshold, as TENs implementation is, in theory, most cost effective when more buildings of different types are connected to the network. Community members may be hesitant to connect to TENs given that this is a novel approach in the U.S., and if 100% consensus is not achievable, the neighborhood may not pursue a TEN.

This is yet another reason why meaningful community engagement and community education are necessities for TENs design, development, and implementation (See Appendix A).

Other Potential Benefits

Interviewees also expressed interest in several other benefits, some specific to TENs, but others more general to clean energy infrastructure. Like many of the benefits of any clean energy project, the actual benefits are in the details. As TENs continue to develop as an approach, more information about these benefits can increase confidence among communities exploring TENs:

- Cost savings from efficient TEN or TEN-supported heat pump and other efficient heating and cooling appliances
- Air quality and health benefits from removing gas infrastructure and associated leaks
- Resilience from being part of a network and perhaps not as dependent on fossil fuels for all energy services

Potential Risks of Thermal Energy Networks

It should be emphasized that environmental justice groups are speaking directly from experience and their community's experience when speaking about risks; risks often are not framed as "potential" or hypothetical, but as present and real.

For TENs advocates and developers, these risks should be seen as a challenge to solve the whole problem of climate change and its unjust impacts, and that by addressing these risks in full, in partnership with communities and their solutions, more of the potential benefits of TENs can be realized.

Complex Engineering + Novel Approach

Though the technology used in a TEN is not new, the approach of networking multiple buildings to share thermal energy is newer to the U.S. Thus, it remains unclear how TENs development will fit into established energy development processes, policies, and physical infrastructure.

The intersecting nature of TENs, providing energy, using existing right of way, and potentially adding or replacing infrastructure raises the bar on what might be considered in-scope to create a truly and comprehensively beneficial project in the end. At the same time, the complexity of overlapping jurisdictions, technologies, and infrastructure, mean that each project will have specific needs and challenges. All this adds up to uncertainty and risk for all involved, despite the possible benefits. It ought to be emphasized that while some stakeholders may be willing to tolerate some level of uncertainty, it should not be assumed that communities, and especially communities harmed in the past, will be willing to do the same.

At a minimum, time delays and project cost exceedances are very likely. For example, New York's TENs pilots are experiencing barriers from state law that prevent utilities from connecting multiple independently-owned buildings to a thermal energy network.[18] Additionally, in 2024 reports by ConEdison, a New York utility developing TENs, shared that all three of its pilots are delayed in completing the final engineering design "due to

[18] Public News Service, October 10, 2024, *NYS moves ahead with thermal energy network pilot programs*, accessed March 31, 2025.

unanticipated activities associated with the novel nature of the [Chelsea/Mount Vernon/Rockefeller Center] project."[19, 20]

EJ and ED organizations emphasized the importance of "digging once," urging developers to recognize the significant disruption that excavation causes for communities. Other upgrades beneficial to the community should be made at the same time as TENs installation, such as broadband, sewer, or gas repair. This “digging once” concept demands advanced and detailed coordination between various stakeholders, jurisdictions, and municipal departments.

Developing a TEN project demands a coalescence of political willpower, resources, infrastructure, and community-based intelligence. While frontline communities must be prioritized in the clean energy transition, they should not be offered promises that cannot be kept.

Uncertain Costs and Rates

A second critical risk is around uncertain costs and who and how a TEN would be paid for. This section, pulls from *Thermal Energy Networks in the United States: Emerging Opportunities, Challenges, and Needs*, which outlines what data is available about costs.

There is very limited data on the costs of implementing TENs, due to the emerging nature of the technology and the limited number of projects currently being implemented or under development. In interviews, the authors encountered estimated total installed costs ranging from $2 million for a relatively small project to $80 million for much larger projects. The all-in cost of a TENs project is highly dependent on local conditions and requirements and remains an important question to understand more fully as more projects are developed and implemented. HEET is developing an open-source database of geothermal energy network projects in the U.S. to provide cost and other data.[21]

While not exhaustive, the following key cost categories highlight the many factors influencing overall expenses:

- Feasibility Study: Each TEN project requires an assessment of financial, technical, and political feasibility, given variations in layout, assets, and ownership models.

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[19] ConEdison, December 16, 2024, RE: Case 22-M-0429 - Proceeding to Implement the Requirements of the Utility Thermal Energy Network and Jobs Act, Monthly Progress and Expenditure Report - through November 30, 2024, Item No. 214, available at: https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=22-m-0429.

[20] ConEdison, December 24, 2024, CECONY Extension Requests for UTEN Stage 2 Filing for the Rockefeller Center, Mount Vernon, and Chelsea Pilots, filed as Items 220, 221, and 222 (respectively) in Case 22-M-0429, available at: https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=22-m-0429.

[21] The First Open-Source Database for Geothermal Networks

The U.S. Department of Energy (U.S. DOE) has funded several such studies nationwide.

- Community Engagement and Partnerships: As a relatively new energy approach, TENs require extensive outreach efforts. Funding for community-based organizations involved in outreach will be essential, particularly for locally driven projects.
- Access and Right of Way: Depending on ownership, projects may need to purchase or negotiate access to land or right of way for pipeline infrastructure.
- Energy Source Infrastructure: If using geothermal, boreholes and equipment must be installed. If integrating waste heat or another existing source, infrastructure modifications will be necessary.
- Piping Network: While new pipelines may follow existing gas pipeline rights of way, they will likely need to be newly constructed to meet TEN-specific requirements.
- Inside-the-Building Equipment: If using geothermal, buildings must upgrade to geothermal or ground-source heat pumps in order to connect to the TEN. Depending on the building's existing heating and cooling system, some buildings can use existing ducts and others may need to install new ductwork, while others might replace hot water or steam heating systems with a ductless system.[22] Many states and utilities offer additional incentives for heat pump installations.[23]

Developing a better set of data and certainty around costs and cost-share modeling will be important. It should also be noted that modeled costs unfortunately have not always come to fruition, and communities are often reluctant to trust modeling, since any departures from modeled results (which are often averages) can outweigh economic and financial impact on their community members and, therefore, a decision to pursue a project like a TEN in the first place.

It is especially important to avoid placing the financial burden of energy systems on communities before their cost-competitiveness has been established. Instead, government and private sector investment should absorb these risks at this early stage, ensuring that technology matures and becomes a stable, cost-effective option before transitioning to widespread community ownership.

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[22] What happens when a Thermal Energy Network is installed?

[23] DSIRE

Limited Workforce and Developers

As TENs is a relatively new approach in the U.S., there is not yet a sufficient workforce with the specialized skillset required for drilling the boreholes needed for TENs using geothermal, at least on a widespread basis.

Utility oil and gas workers likely have transferable skills to support TENs especially for the laying, fitting, and maintaining pipes, but there is no guarantee that 100% of current fossil fuel jobs will transfer to TENs, or that fossil fuel workers will want to transition to clean energy work.[24]

TENs can offer opportunities for local job creation, but advocacy efforts may be needed to ensure that jobs are accessible to local community members and provide family-sustaining wages. As seen with other clean energy development, the installation of new technology does not always provide permanent local employment; for example, while a dedicated workforce may be needed to install solar panels or lay new pipes for TENs, the workforce needed to maintain it often looks different. TENs development efforts should collaborate with local workforce development organizations to design training programs to leverage skill transfer and identify opportunities to create permanent local jobs.

Other Risks

Interviewees shared additional questions and concerns regarding TENs, but also about clean energy projects more broadly. While we don't go into detail on each in this section, enough of these risks are so prevalent among other energy and clean energy infrastructure projects, that information on them is generally accessible and can also be learned through a meaningful engagement process with communities exploring TENs.

- Most vulnerable communities being left behind and not benefiting from the solution, but bearing the cost in some way.
- Temporary displacement or living disruption that becomes long-term and becomes permanent.
- Damages from new equipment installation, or lack of technical support if new equipment isn't working as expected.
- Cost recovery and rate design have yet to be explored but it is expected that both will differ from existing structures because of the two-way flow of thermal energy

[24] Penrod, E., Utility Dive, (2021) Unlocking the Transition: Politicians tout renewable energy jobs for ex-fossil fuel workers, but it's not so simple

that fluctuates across seasons. Because TENs require significant upfront capital, it's not clear how rates would compare with fossil fuel and electricity rates.

Moving Forward

This report explores the potential for and risks to environmental justice and energy democracy as we develop TENs policies and implement TENs projects. This exploration is just the start–there are many questions that are worth exploring more deeply.

Questions for Future Consideration

We've included a selection of the many questions environmental justice advocates raised in our discussions with them. These questions demonstrate the detailed and thoughtful care that community-based advocates are giving to opportunities like TENs and the role something like TENs might play in their climate justice efforts.

- The ownership model is critical. What efforts are there to enable community-owned or locally-owned projects?
    - In addition, what if TENs were owned and operated by the local municipal water company, which often enjoys greater trust by some communities?
- How can we measure and ensure social and economic impacts of thermal energy on frontline and EJ communities?
    - How do TENs advocates think about more mild climates where TENs aren't as cost-effective? How should communities think about where needs are better met by retrofitting homes and apartments but without TENs?
    - There's a concern about TENs being promoted where the economics and climate don't make sense. Has there been any effort to pre-screen to avoid regions where the economics are not likely to be encouraging?
- How can we ensure that thermal energy does not exacerbate issues of displacement or gentrification in areas? How do we ensure that this doesn't happen when implementing new technologies?
    - How might TENs affect renters? Renters are some of the most vulnerable members of frontline communities.

- What are financial mechanisms that can support equitable access to clean energy? How are we going to make clean energy technologies accessible for low-income and rural communities?
    - Especially in light of the present uncertainty of federal funding, what other financing approaches are there for these capital-intensive projects?
- How can existing energy policies be adjusted to make thermal energy and existing tech more equitable? How can we ensure that policies are inclusive in the sense of language when we are implementing these policies?
- How can we responsibly approach the conversation of cost? How can communities lead on TENs development and bear the risk of unknown costs? How can we protect consumers from bearing that risk?
- What are the documented (if any) economic benefits or impacts of TENs in a community? Are their numbers around job development and the types of jobs TENs would support?
    - What have unions said about TENs?
- Is it actually economically and technically feasible to retrofit existing pipelines? Replacing the lines could be costly, but it does offer opportunities for workers – how would this work?
- What are the key barriers to workforce development and training in clean energy for underserved communities, and how can these barriers be overcome?
- What role does digital infrastructure and smart grid technology play in ensuring the equitable distribution of energy across different communities?
- How does TENs impact the local environment? How can TENs contribute to advancing environmental justice in regions already burdened by pollution and climate change impacts?
- How long does the infrastructure last, what is the lifespan?

As with any other clean energy project, climate justice solutions require aligning with the priorities, needs, questions, and resources of the specific community involved. The best way to accomplish that is to put community leaders front and center in any exploration of TENs.

EJ/ED Community-Based Requests

Community-based organizations highlighted specific requests to ensure their ability to engage in equitable TENs development.

- **Funding:** EJs and EDs request funding in order to designate staff or reserve staff capacity to TENs technical research, robust development, and meaningful outreach. EJs and EDs also mentioned support with grantwriting is needed in order to secure future funding.
- **Education:** EJs and EDs request support developing accessible educational materials for their community. Organizations mentioned the need to demystify the new technology to community members and local municipalities, which might include funding tours to existing TENs projects. Ultimately, educational materials work to make energy infrastructure less abstract.
- **Advocacy Support:** EJs and EDs request support in navigating the complex bureaucracy that comes with new technological development, such as the various jurisdictions, agencies, and nascent regulatory processes that accompany new energy infrastructure development.
- **Coalition:** EJs and EDs are navigating a new space, and would appreciate a means to connect with other community-based organizations involved in TENs. Organizations could use a coalition to resource share and problem solve together.

Conclusion

While interviewees expressed interest in exploring TENs as an opportunity for community-scale decarbonization, the overriding theme heard was that implementation requires intentional policymaking, equitable ownership models, and deep and meaningful community engagement to ensure frontline communities truly benefit.

With the right conditions and by comprehensively addressing concerns, removing and mitigating risks, and giving power and influence over projects to those that know their community best, TENs have the potential to advance environmental justice and energy democracy.

However, considerable work remains to more deeply understand the risks related to cost recovery, workforce development, and inequitable ownership models, and to develop concrete solutions to address those risks. Only then, are the conditions available for communities to realize the benefits of TENs.

As communities, advocates, and policymakers navigate these challenges, procedural and distributive justice must be prioritized to ensure that TENs fulfill their potential to support a just and sustainable energy transition.

Appendices

Appendix A: Resources to Support Community Engagement

Clean energy policy is essential for reducing greenhouse gas emissions and working toward a sustainable future and. However, without community engagement, policy fails to be truly effective and reflective of the needs of the communities that it aims to serve. Logically, if communities are not engaged from the ideation of a policy, they will not readily accept or support its development. **Thus, deeply respectful community-centered community engagement must be a cornerstone of TENs development.**

The resources shared in this section are intended as a starting point for community-based organizations considering TENs. We recognize that every community has unique needs, so these resources are meant to be refined as necessary to best support each community's specific context and priorities.

This section includes the following resources:

- TENs Primer for Community Discussions: a prime overview of TENs technology. This resource is meant to support EJ and ED conversations with their communities about TENs.
- Recommended TENs Policy Development Process: a draft policy development process, informed by EJ and ED interviews and secondary research. This overview is meant to serve as a resource for EJs and EDs to share with TENs advocates, policymakers, developers, and other stakeholders who approach EJs and EDs about TENs.

Recommended TENs Policy Development Process

This overview is meant to serve as a resource for EJs and EDs to share with TENs advocates, policymakers, developers, and other stakeholders who approach EJs and EDs about TENs. As mentioned earlier in this report, **it is not the responsibility of communities to educate developers and TENs advocates on how to engage respectfully and knowledgeably.** It is the responsibility of stakeholders–policymakers, advocates, and developers–to conduct preliminary research on the historic inequities that have existed in prospective TENs neighborhoods.

EJs and ED organizations shared that community engagement materials on TENs must come from trusted spokespersons with long-standing connections in the community and understand long-term implications of past failed or successful projects. EJ and ED communities are rightfully wary of new stakeholders, particularly developers and IOUs, sharing information about a technology that would advance their profits.

New stakeholders must work to meet community members where they are, so as to not approach communities from a place of ignorance, entitlement, or paternalism. Stakeholders must work to understand how community lived experiences have shaped their perceptions of what is being communicated throughout the community engagement process. Communities that have developed warranted distrust for the energy industry might approach all interactions with energy developers from a defensive position. Relationships and trust must be earned.

This high-level overview of opportunities for community engagement is informed by EJ and ED interviews and secondary research. The development process uses Jemez Principles for Democratic Organizing[25] to further scaffold the process design. In 1996, forty people of color and European-American representatives met in Jemez, New Mexico, for the "Working Group Meeting on Globalization and Trade." The Jemez meeting was with the intention of hammering out common understandings between participants from different cultures, politics and organizations. The "Jemez Principles" for democratic organizing were adopted by the participants.

In an ideal world, aspects of the TENs policy development process would ensure a more equitable, inclusive, and accessible implementation of TENs. This draft policy development process prioritizes robust community engagement in the design and development of TENs. Of course, each community has different approaches to community engagement and policy development – this framework is meant to serve as a starting point to discuss the processes.

EJ principles like the Jemez Principles are available to guide engagement so that project proponents do not repeat past harms like transaction-based relationships, inaccessible public meetings, and the paternalism of prescribed solutions. The Jemez Principles include:

1. Be Inclusive
2. Emphasis on Bottom-Up Organizing
3. Let People Speak for Themselves
4. Work Together in Solidarity and Mutuality

[25] https://www.ejnet.org/ej/jemez.pdf

5. Build Just Relationships Among Ourselves
6. Commitment to Self-Transformation

These principles are crucial in ensuring a just transition. The adoption of these principles in decision-making processes may support the pursuit of procedural and distributive justice in energy.

Recommended TENs Policy Development Process

Centered in Community[26]

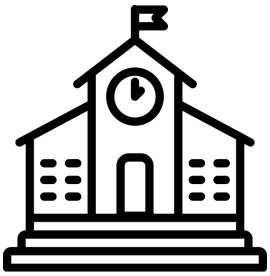
- Relevant Jemez Principles: 1, 2, 3
- Description: Individuals build community by connecting with folks who share environmental goals. As folks connect and create community, they account for differing perspectives and lived experiences. Community develops shared values and environmental goals together.
- Consideration: TENs development must be rooted in community values and goals.

Community-Based Coalitions

- Relevant Jemez Principles: 2, 3, 4, 5
- Description: Community organizations respond to community interests by identifying resources and coalition-building opportunities for community members. Community organizers are aware of their power as organizers and ensure that there are resources and equitable processes for individuals to provide input to goal development. Community organizations work together to develop solidarity around key issues and identify resources or opportunities. Organizations advocate for and develop culturally appropriate and multilingual resources around TENs.
- Consideration: Community organizations can form coalitions built upon values and goals. Coalitions must willingly identify TENs as an appropriate technology for their community values and goals.

[26] All icons from https://thenounproject.com/

Relationships with Local Governments



- Relevant Jemez Principles: 2, 3, 4
- Description: Coalitions share TENs to local governments and seek buy-in and support. Local government should be receptive to community values and work alongside coalitions to uplift community desires of TENs to legislators. Local governments should identify ways that TENs might align with the City's initiatives, infrastructure, and funding to reinforce discussions with legislators.
- Consideration: TENs implementation demands a coalescence of political willpower, resources, infrastructure, and community-based organizations

Receptive Legislators

- Relevant Jemez Principles: 2, 3, 4
- Description: Legislators are receptive to community voices and local government priorities. Legislators include accessible ways for communities to engage in TENs design, such as language around TENs development "scorecards" to be required in pilot projects. Scorecards should be community-centered and collaboratively developed, including components like equity metrics and data.[27] Legislators identify potential policy barriers that might affect TENs development in communities. Further, environmental justice should be addressed as a component policy, instead of as a separate consideration / committee.
- Consideration: TENs policy needs to be written to explicitly provide protections and opportunities to EJ communities. Policymakers must do their due diligence of identifying potential barriers. At present, most legislation excludes equity-related language. Some pilots have already experienced delays due to delayed policymaking.

Inclusive Regulatory Processes

- Relevant Jemez Principles: 1, 2, 3
- Description: Regulators ensure that community organizations are involved and compensated in TENs design and

[27] https://gdr.openei.org/files/1672/Framingham%20Geothermal%20Network%20Environmental%20Justice%20Considerations.pdf

implementation processes. Regulators create means for community organizations and coalitions to identify trusted partners to work on a rate and cost recovery proposals. Regulators accept various modes of community engagement to increase accessibility and honor lived experiences of communities.

- Consideration: TENs development must be inclusively implemented. Regulators have the means to create accessible processes and ensure that EJ voices are heard.

Deeply Collaborative Design

- Relevant Jemez Principles: 2, 3, 4
- Description: Local government is deeply engaged with community organizations and coalitions. Local government provides technical support. Together, with community, design research to achieve multiple purposes: explore TENs workforce development potential, priority communities to serve, and other ways research might be conducted to inform development, while also benefiting other local initiatives.
- Consideration: TENs might not be a good technical fit for every community. However, research to assess TENs' viability can be used for other purposes to benefit the community and better understand workforce and clean energy technology needs.

Relationship with TENs Developers

- Jemez Principles: 1, 4

- Description: Legislative and regulatory policymakers must build collaborative opportunity into TENs policy. Additionally, policymakers and local governments should hold potential TENs developers accountable for conducting prework and research to understand the historical context of the community. Developers are receptive to community-developed equity scorecards and consider equity metrics when making decisions.
- Consideration: It is the responsibility of developers to meet community members where they are. Communities want developers to bring TENs from a place of "continued curiosity" of how community contexts shaped the perception of engagement processes.

Questions for TENs Advocates, Developers, Policymakers, and IOUs

Stakeholders should reflect on the following questions before engaging with community-based organizations. While this is not an exhaustive list, these questions provide a starting point for external stakeholders to consider before approaching an EJ or ED community.

Stakeholder Reflections on Purpose of Outreach

- Why am I reaching out to this community?
- Have I asked this community if they are even interested in TENs, or have I made an assumption that TENs would be a good fit for them?
- Have I made an earnest effort to learn about this community's past experience with energy infrastructure development?

Stakeholder Reflections on Readiness to Engage

- Am I interested in learning more about this community's lived experiences? How do I plan to acknowledge, account for, and honor what they share with me?
- Do I have the resources to adequately compensate community members for their time and efforts in TENs development? If not, am I willing to do the work to seek funding?
- Is my organization prepared to structure engagement efforts in a transparent, accountable, and accessible manner? Have I learned what the community needs in order to attend community events? Have I considered any of the following:
    - Translation
    - Transportation
    - Compensation
    - Childcare/Family care
    - Food
    - Accessible before or after work hours
    - Accessible modes of engagement
    - Multiple modes of engagement

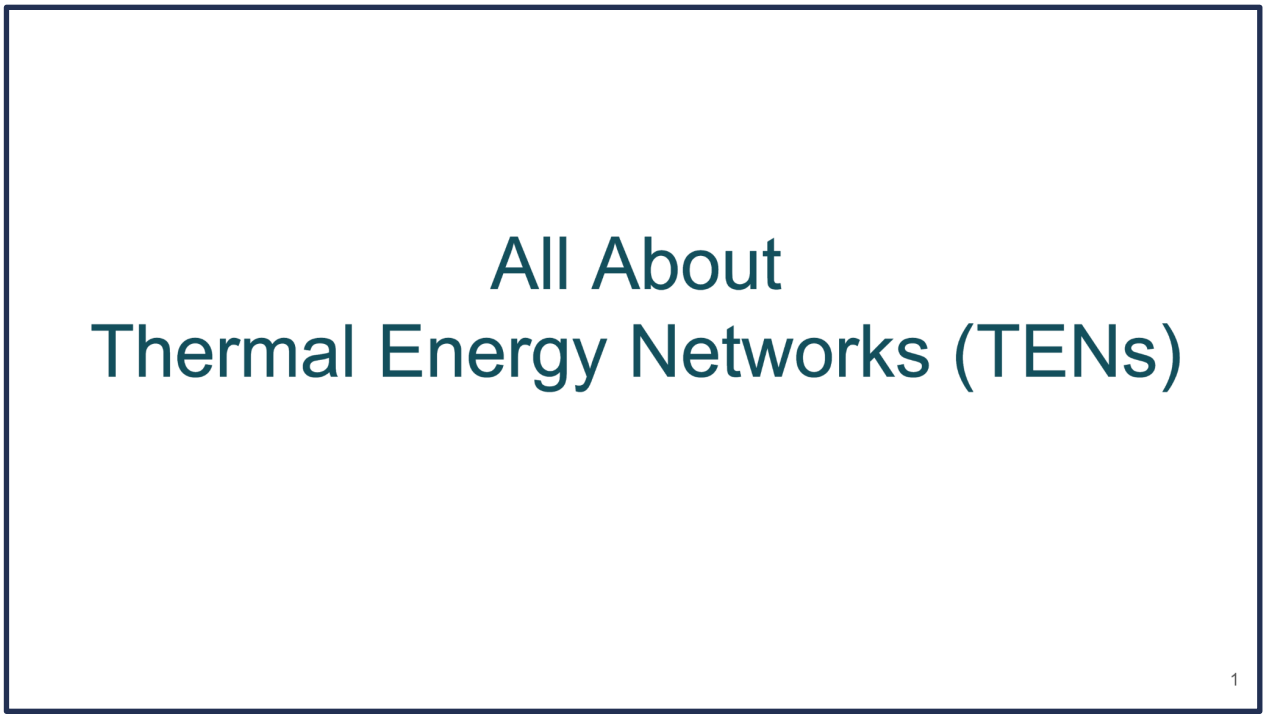
Stakeholder Reflections on Power

- Do I have the power to amplify the community's thoughts? If not, which avenues might I use to elevate the community's engagement?
- How will I attribute / give credit to the community if this development endeavor is successful?
- What protections can I guarantee for the community if we are not able to proceed with development?
- What level of transparency can I provide the community about financing options?
- Have I considered how the current political climate and effects of federal administration might affect how receptive community-based organizations are to collaborating with my organization?

TENs Primer for Community Discussions

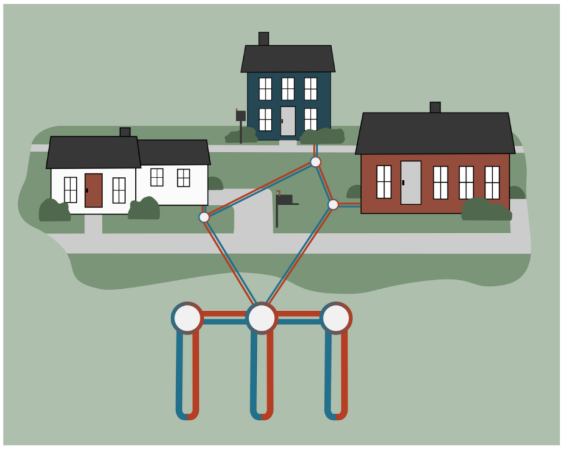
These slides are intended to support engagement with folks who have some level of familiarity with clean energy, but perhaps not geothermal energy or thermal energy networks, specifically. The primer can be used to show community members the potential of TENs in your area. There are placeholder slides in the primer in acknowledgement that in order for discussions around TENs to be equity- and community-centered, exploration should be a community-initiated endeavor, rooted in community values, mission, and goals. The slides also include a list of additional

technical resources to aid in addressing community questions and concerns surrounding geothermal and TENs.



What is a Thermal Energy Network (TEN)?

- A TEN uses a web system of pipes to **connect buildings and thermal energy** sources **to one another.**
- TENs provide space heating, cooling and domestic hot water.
- The network can use otherwise wasted energy from buildings, sewage systems, and/or underground transit stations.
- When waste heat is not available, other thermal sources can provide a “baseload” source of heat, like shallow geothermal boreholes, bodies of water, and data centers.



A TEN that uses shallow geothermal boreholes, like in this picture, is called a “geothermal network”!

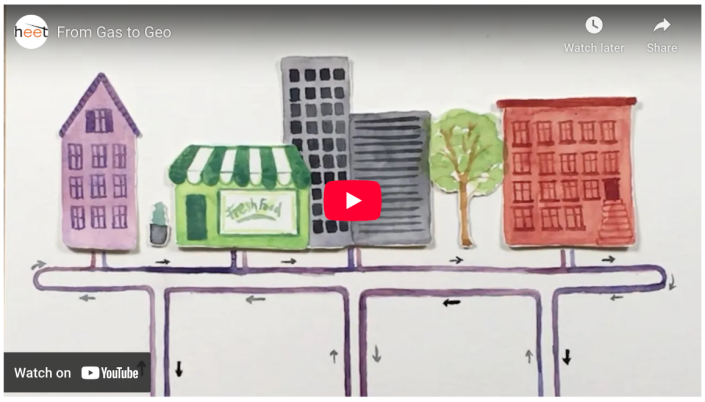
3

What are Geothermal Networks?!

*A TEN that uses shallow geothermal boreholes is called a **geothermal network**.*

- The ground stays at a steady temperature of around 55°F all year, making it a reliable heat source for geothermal systems. This helps heat pumps work more efficiently than using outside air, allowing thermal energy networks to be 500-600% more efficient.
- Geothermal networks can work in both hot and cold weather climates, but the economics are better when the heating and cooling loads are relatively balanced, like places with extreme temperatures.

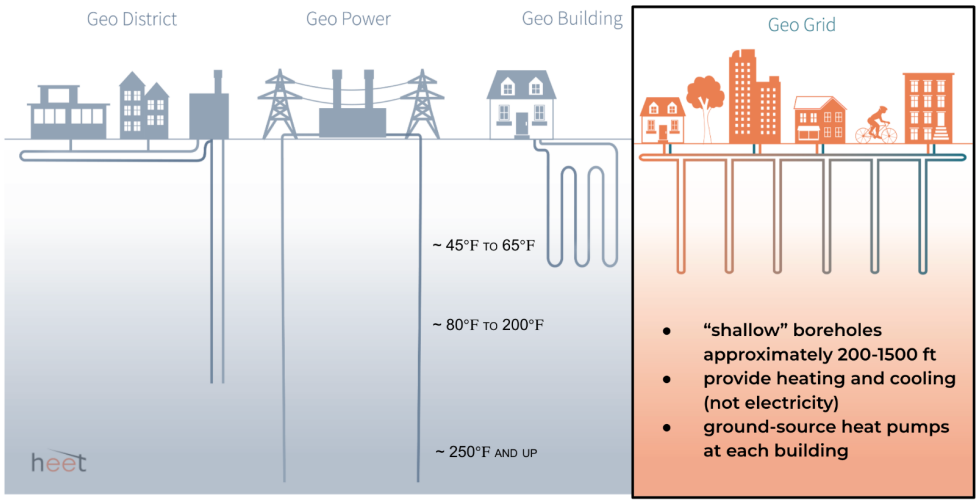
How it works



From Gas to Geo - HEET

4

What's the Difference Between a Geothermal Network & Other Types of Geothermal Energy?



Source: HEET

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Why Are TENs Needed?

Thermal energy networks (TENs) is a clean energy technology that could help us decarbonize.

Natural gas is a polluting, dangerous & expensive fossil fuel:

- More than 60% of US households use natural gas for at least one energy end use.
- More than 1/3 of methane emissions comes from gas leaks from oil and natural gas wells, storage tanks, pipelines, and processing plants, causing serious health & safety risks.

Building-by-building decarbonization approaches aren't always the right fit:

- "Conventional" building-by-building electrification approaches might mean that higher income households exit the gas system, creating higher costs for households still relying on the gas system.
- Geothermal heat pumps used in TENs require less electricity than air source heat pumps.

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Why Are TENs Needed?

Thermal energy networks (TENs) present an opportunity to change this game entirely, if done right.

TENs is new to the U.S., but not a new technology

- The United States needs to improve reliability and resiliency by investing in a wider range of clean energy technologies
- Countries like Germany have proven TENs efficiency and effectiveness

Gas utilities & workers have strongly opposed "conventional" building decarbonization:

- TENs are similar to gas company operations, including maintaining pipes and charging regulated rates to recover costs.
- Gas companies and utilities have are against decarbonization policies across the country, instead proposing replacing methane with hydrogen or biogas, which can both worsen environmental justice concerns and harm to communities.

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How Could TENs Benefit Me?

Resilience

TENs rely on local sources of energy which allows them to run independently during power outages.

Energy Costs

TENs have low operating costs. Using TENs also means that you are no longer subject to the volatility of gas prices. This can significantly lower the cost of providing heating and cooling to households.

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How Could TENs Benefit My Community?

Equitable Access to Clean Energy

TENs allow entire neighborhoods to transition off gas together, spreading decarbonization costs and benefits.

Burden on the Electric Grid

Air heating and cooling plus water heating accounts for about half of the country's total energy consumption. Moving these functions off the electric grid to TENs can free up electricity for other uses.

Just Transition for Fossil Fuel Workers

TENs drilling uses similar skill sets as oil and gas drilling, and installing thermal energy network pipes requires virtually identical skills as installing gas pipes.

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Has This Been Done Before? Who Else is Exploring TENs?

DOE Pilots
The DOE has sponsored five pilots:

- Ann Arbor, MI — Lead: City of Ann Arbor
- Chicago, IL — Lead: Blacks in Green™
- Framingham, MA — Lead: Home Energy Efficiency Team [HEET]
- Hinesburg, VT — Lead: GTI Energy
- Shawnee, OK — Lead: University of Oklahoma

Legislation
As of February 2025, a few states are considering TENs and have authorized utilities to propose TENs pilots:

- Colorado
- Massachusetts
- Minnesota
- New York
- Washington
- Maryland
- Vermont
- California

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Why TENs?

Here are a few reasons why we have identified TENs as a potential resource:

- *[Placeholder slide]*

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What Are Other Communities Concerned About?

Distributive justice

- Because they are a new technology, TENs roll-out might first go to wealthier neighborhoods. This might mean folks still using gas will experience higher rates as neighborhoods shift to TENs and fewer rely on gas.

Impacts on workforce

- Existing natural gas workforce folks might be able to transition to TENs clean energy jobs, but this is not guaranteed.
- The number, quality, and scope of TENs jobs is not guaranteed.

Ownership models

- TENs might create opportunities for local ownership, or it might also be another way for investor owned utilities to generate profit.

Inclusive policy processes

- Like all regulatory processes, there is no guarantee that the utility commission, utilities, or other stakeholders will have accessible ways for us to share our thoughts on TENs design or development

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What Concerns Does Our Community Have About TENs?

Here are some reasons why we are considered about TENs:

- *[Placeholder slide]*

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Why Might Our Community Want TENs?

Here are a few reasons why other folks in our community are considering TENs:

- *[Placeholder slide]*

What are your thoughts / feelings about TENs so far? What questions come up for you?

- *[Placeholder slide]*

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Why Would TENs Work for Our Community?

Our community values [do/do] not align with TENs

- *[Placeholder slide]*
- *[Specific CBO value]*
- *"Municipal goals would support TENs adoption…"*

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Why Would TENs Work for Our Community? cont'd

Technical considerations that would make TENs possible for our community:

- *[Placeholder slide]*
- *"We have the physical space for a TENs installation…"*
- *"We face experience extreme temperatures…"*

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Where Can I Find More Information?

TENs video explainers:

- From Gas to Geo
- What is Thermal Energy?
- Geothermal for Vermont: A Proven Solution to Accelerate Our Energy Transition

Resources:

- There's a battery underneath your feet, and utilities want to use it
- 'Every building sits on a thermal asset': how networked geothermal power could change cities
- New York will replace gas pipelines to pump clean heat into buildings
- In this Massachusetts neighborhood, nearly every home is switching to geothermal energy
- The secret to decarbonizing buildings might be right beneath your feet
- Community Clean Heat Infrastructure
- Underground Thermal Energy Networks May Be About to Have Their Moment
- HEET Gas to Geo wiki
- BDC TENs page

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Appendix B: Interview Materials

TENs Primer for Interviewees

At the beginning of this project, we developed a short presentation to provide context on TENs technology and policy landscape to-date for interviewees. The primer can be viewed at this link. Please note that some of the contents in the Primer may be out of date, given the evolving nature of TENs policy and pilots.

EJ Interview Questions

1. In general, what clean energy technologies and projects is your organization/community interested in developing and siting in your community? What benefits do you think these projects offer your community?
2. What concerns does [organization] have about continuing or expanding the use of natural gas and gas infrastructure (e.g., pipelines, gas plants) in EJ communities? Do you have any concerns about reducing demand for natural gas and gas infrastructure in EJ communities?
3. In your view/in your project, what are the benefits that TENs can provide to communities? Do any other clean energy technologies offer these benefits?
4. In your view, how can TENs be developed to ensure that they directly benefit environmental justice communities?
    a. Based on prior experiences with the clean energy transition and new technologies, can you share any best practices for ensuring that community priorities are addressed throughout the planning for and development of TENs?
5. What types of infrastructure investments and policies do you see as most critical to ensure that TENs are equitable and don't reinforce existing inequalities?
6. In your view, what are some concerns that you have around how TENs might be planned and developed? Which entities are responsible for addressing these concerns and how would you recommend they do so?
7. Are there any clean energy project funding models that you've seen work well for communities? What about funding models that have worked poorly and should not be replicated?

8. What questions do you have about TENs that you suggest for further research?

ED Interview Questions

1. [If relevant, after overview]: What's rising to the surface for you?
2. [If relevant, mention org's previous work/research on TENs]: Has your org done any additional work/analysis related to TENs since then?
3. TENs are unique from other types of geothermal energy because of the connections (or networking) between different buildings, allowing independent buildings to be linked for heating and cooling exchange. In some regions this requires the system owner to be a utility, but not necessarily an investor-owned utility. What are your initial thoughts on ownership given the unique interconnected nature of TENs?
4. At present, only a handful of local governments are working on exercising their authority to advance TENs, including [list below]...Do you have any reactions to the ways cities are approaching TENs so far?
    a. The city of Framingham, MA, worked with the nonprofit HEET and Eversource Energy to install the first utility-owned underground thermal energy network.
    b. The city of Ann Arbor, MI, is creating a Sustainable Energy Utility (SEU) to advance TENs around the Bryant Elementary School, 262 homes, and a community center.
    c. The city of Troy, NY, is working with the Troy Local Development Corporation to develop a geothermal borefield and sell thermal energy to the utility for resale to thermal energy customers.
    d. A number of small towns in VT have been exploring community-owned TENs approaches, inspiring the state's recently passed legislation allowing municipalities to form thermal energy utilities without PUC approval (as they do for water and sewer utilities).
    e. Boston Mayor Michelle Wu and National Grid recently announced plans for the city's first-ever utility-owned TENs system, which will serve 346 families in Dorchester's Franklin Field affordable housing community.
    f. Philadelphia's municipal utility PGW is exploring TENs as a way for the gas utility to transition toward renewable energy and to get the union workforce

on board with new clean energy jobs. (This work seems to be stalled at the moment.)

5. In your experience, what broad conditions are most successful in empowering local decision-making authority in energy?
6. In your view, what are some concerns that you have around how TENs might be planned and developed? Which entities are responsible for addressing these concerns and how would you recommend they do so?
7. In an ideal world, what would the TENs' development process look like in your community to support energy democracy? Who would be involved? What resources are needed?
8. At this point, for the purposes of this project, we define 'energy democracy' as democratizing the production and management of energy resources, including the social ownership of energy infrastructure, decentralization of energy systems, and meaningful public participation in energy-related policymaking. Do you have any edits to this definition?
    a. [Org's energy democracy definition:]
9. What are outstanding questions that you have about TENs' energy democracy and local ownership?