Thermal Energy Networks in the United States

Emerging Opportunities, Challenges, and Needs

EXECUTIVE SUMMARY

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Transformative Strategies

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Executive Summary

Background

The growing reliance on fossil fuels, rising energy costs, and the need for energy security are significant concerns in the United States. Fossil fuels, especially natural gas,[1] oil, and propane, dominate space heating and cooling and water heating, driving up energy costs and contributing significantly to greenhouse gas (GHG) emissions, which are destabilizing the climate and posing threats to public health. Methane emissions, which account for 20% of global GHGs, and leaks from gas pipelines and other aging fossil fuel infrastructure, cause significant health and safety risks. As energy costs rise and the environmental impacts of fossil fuels become more urgent, the need for solutions that provide affordable, reliable, and sustainable energy becomes critical.

There is a growing opportunity in neighborhood-scale solutions, such as thermal energy networks, which have the potential to advance widescale decarbonization and improve quality of life in our communities. A thermal energy network (TEN) uses a system of water pipes and heat pumps to provide space heating, cooling, and hot water by capturing waste heat from surrounding sources like the ground, water, or air. By leveraging "waste" heat and renewable sources, TENs provide fossil fuel-free heating and cooling with unmatched efficiency.

TENs offer a number of potential benefits over fossil fuel-based heating and cooling systems, including climate benefits; health and safety benefits; facilitating a just transition for oil and gas workers; decreased energy costs; the ability to transition entire neighborhoods off fossil fuels; localized energy sources; resilience from oil and gas supply interruptions; easing strains on the electric grid; water savings; and new business models for utilities to transition from fossil fuels to clean heating and cooling technologies.

Like any emerging solution, TENs face several challenges that must be addressed to ensure thoughtful and intentional deployment in order to avoid the environmental injustices that conventional energy systems have historically caused in low-income and marginalized communities, and enable greater local control and meaningful community participation in energy decision-making.

This report draws on research and 40 interviews with a diverse range of stakeholders — including government agencies, environmental justice organizations, energy democracy groups, TENs advocates, labor organizations, legal advisors, and industry representatives — in order to

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[1] Many decarbonization advocates have begun using the terms "methane gas" or "fossil gas" instead of "natural gas" in response to the natural gas industry's efforts to rebrand the fuel in a way that makes it more appealing to Americans. However, because these terms have not yet been widely adopted by the general public and for clarity's sake, this paper will use the term "natural gas."

explore the following questions: 1) What is the scale and breadth of policy action around TENs in the United States; 2) What are the various ownership models we're seeing with TENs development; 3) What are the equity and environmental justice perspectives on TENs; and 4) What is the potential of TENs to advance energy democracy. The goal is to inform stakeholders about strategies for scaling this technology in a way that advances equity, environmental justice, and energy democracy.

Policy Landscape and TENs Ownership Models

An increasing number of states are granting permission for the ownership and operation of TENs by a range of entities, including private developers, investor-owned utilities, municipalities, cooperatives, nonprofit organizations, and community-based organizations. As of March 2025, eight states have passed TENs-specific legislation and four additional states have passed or introduced legislation to study or fund TENs pilot projects. A number of others have passed or introduced complementary policies such as clean heat standards, obligation to serve reform, and methane pollution protections or have begun "future of gas" proceedings to integrate GHG emission targets into gas system planning.

The choice of TEN ownership structure plays a critical role in financing, cost recovery, and eligibility for federal and state incentive programs—often shaping which model is ultimately pursued. This decision is heavily influenced by stakeholder priorities, legal mandates, and the availability of financing options. Ownership—whether private, public, or community-based—determines who bears the financial risks and benefits: a private entity, shareholders, the public, or the community. It also influences how the TEN is funded—through private investment, public financing, ratepayer contributions, or taxpayer dollars—and who oversees the project, whether it be the community, cooperative members, a public utilities commission, or a city council.

This paper explores the ownership structures currently being implemented for TENs (Table 1) and provides case studies of different models from across the country.

Table 1: Types of TENs Ownership Models Discussed in this Paper[2]

Privately Owned	– Private Developers – Investor-Owned Utilities (IOUs)

Publicly Owned	– Publicly Owned Utilities (POUs)
	   ○ Traditional POUs
	   ○ Municipally-Owned Gas Utilities
	   ○ Sustainable Energy Utilities (SEUs)*
	   ○ Public Heating & Cooling Utilities

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[2] This paper does not offer a comprehensive analysis of each model, nor are the categorizations based on peer-reviewed, industry-accepted standards, which, to the authors' knowledge, have not yet been established. In the absence of such standards, the authors have made editorial decisions to classify these models as clearly as possible based on our best understanding.

	○ Collaborative Public Ownership Structures – Public-Nonprofit Partnerships (PNPs) – Untapped Public Ownership Structures ○ Rural Energy Cooperatives (Co-ops) ○ Community Choice Aggregators (CCAs)
Community Owned	– Community Based Organizations (CBOs) – Tribal Nations – Nonprofit Organizations (NGOs)

*SEUs can be established as either publicly sponsored non-profits or municipally owned entities. For this paper, the authors have chosen to categorize SEUs under POUs because the case study presented follows this structure.

The field remains in its early stages, and new structures are likely to emerge as interest in TENs grows and regulatory frameworks evolve.

Equity and Environmental Justice Perspectives on TENs

Energy infrastructure has historically harmed marginalized communities, exposing them to pollution, safety risks, and economic disinvestment, while clean energy advancements often benefit wealthier populations. The transition to clean energy must prioritize environmental justice (EJ) communities, ensuring that solutions like TENs address inequities and create opportunities for sustainable progress. This includes ensuring community input, addressing concerns like displacement and affordability, and implementing inclusive policies that offer job training for workers in fossil fuel industries. Achieving an equitable transition requires deep collaboration between utilities, policymakers, and EJ advocates, emphasizing community leadership and shared decision-making to ensure that TENs provide long-term social, economic, and environmental benefits.

Interviewees highlighted several challenges in realizing the potential of TENs, including exclusion of meaningful community input due to complex processes and rigid engagement structures, as well as misrepresentation of rural communities in official EJ maps. Technical challenges like spatial constraints, labor shortages, and high retrofit costs also pose obstacles, alongside workforce limitations that require collaboration with unions and diverse hiring practices to ensure EJ communities access clean energy jobs. Additionally, community distrust and cost issues remain significant barriers, as EJ communities have historically been burdened by energy infrastructure with little benefit. Overcoming these challenges requires transparent, community-centered decision-making, strong policy design, and financial mechanisms to ensure equitable access to TENs.

Energy Democracy Perspectives on TENs

There is increasing momentum toward advancing locally controlled, community-driven energy systems, shifting power from private ownership to more localized, community-led models. While

local governments and community groups are pioneering innovative ownership models for TENs, they often encounter significant obstacles. TENs present a unique opportunity to transform the energy landscape by empowering communities to control, govern, and benefit from their energy systems, but realizing this potential requires overcoming substantial policy, financial, and governance challenges.

Interviewees identified several challenges to developing and implementing TENs, including policy and regulatory barriers that favor IOUs and restrict community or municipal ownership models. Financial obstacles, such as high upfront costs, limited financing for community-driven projects, and distorted energy pricing due to outdated rate structures, hinder adoption. Additionally, reforms are needed in utilities' "obligation to serve" and thermal energy decarbonization planning. Local governments face resource gaps in staffing and political power, while trusted entities often lack the resources to navigate the complexities of TENs. Legacy gas infrastructure also complicates the transition to non-IOU-owned systems. Successful TENs development requires robust policy, community-driven decision-making, and financial strategies to support inclusive implementation.

Summary of Recommendations

Based on these identified opportunities and barriers, the authors recommend the following actions for effectively deploying TENs as an equitable and democratic decarbonization strategy.

Advancing TENs that Prioritize Equity and Environmental Justice

1. Support Communities in Determining their Own Energy Future — TENs should only proceed with clear community support, especially in Environmental Justice (EJ) communities, ensuring local input through advisory boards and transparent processes.
2. Include and Resource Equitable Processes in Policy Design — Legislation should guarantee inclusive participation, supporting marginalized groups with technical, legal, and financial resources, while ensuring EJ communities can make decisions to avoid displacement and burdens.
3. Build Community Trust through Meaningful Engagement — Building trust in EJ communities requires sustained engagement, early involvement, and addressing concerns like displacement and affordability through informed dialogue.
4. Expand Workforce Training and Development for Local Jobs — Strong labor standards in the TENs industry should prioritize local workforce development through training programs, partnerships with unions, and career pathways for EJ communities.
5. Reduce Consumer Costs with Public and Innovative Financing — To reduce consumer costs, TENs should utilize public-private partnerships and community-led funding to lower upfront costs and promote affordability and collective ownership.

6. <u>Remove Risk to Communities in Project Design and Implementation</u> — TENs projects should be well-researched, cost-effective, and considerate of EJ communities' needs, minimizing disruptions and ensuring energy access during development.

7. <u>Pursue Comprehensive Energy Upgrades</u> — TENs should be integrated with energy efficiency upgrades, weatherization, and energy storage to enhance resilience, sustainability, and overall community benefits.

Advancing TENs that Prioritize Energy Democracy

8. <u>Implement Policy Reforms and Clarify Regulatory Frameworks</u> — Legislative and regulatory reforms should create pathways for local ownership of TENs, empowering communities and municipalities to lead the transition to sustainable energy.

9. <u>Support the Development of Locally Owned Pilot Projects</u> — Financial and technical support for locally-owned pilot projects will help communities test and refine ownership models and establish best practices for TENs.

10. <u>Expand Funding and Financing Support</u> — Increase access to grants and financial mechanisms to support the early stages of locally-owned TENs, including feasibility studies and planning efforts.

11. <u>Resource Deep Community Engagement</u> — Strengthen CBOs by providing resources to engage local communities in inclusive decision-making for TENs development.

12. <u>Support or Mandate Thermal Energy Planning and Waste Heat Mapping</u> — Policies should encourage or require thermal energy planning and waste heat mapping to reduce fossil fuel use and support holistic energy planning.

13. <u>Mandate Safe Decommissioning of Legacy Gas Pipelines</u> — Policies should mandate the safe decommissioning of legacy gas pipelines when installing new non-IOU TEN systems, with incentives or cost-sharing to support this process.

14. <u>Evaluate Fossil Fuel Infrastructure Maintenance Costs When Doing TEN Financial Assessments</u> — Financial evaluations of TENs should account for the full costs of maintaining aging fossil fuel infrastructure to provide a clearer long-term financial picture.

15. <u>Reform Electric Rates</u> — Electric rates should be reformed to reflect the true costs of fossil fuel use, supporting the transition to clean thermal energy and reducing emissions.

16. <u>Reform Utilities' "Obligation to Serve"</u> — Update utilities' "obligation to serve" to include clean thermal energy options, enabling the transition to more efficient and sustainable energy sources.

17. <u>Deploy a Suite of Technical, Financial, Legal, and Governance Resources</u> — Provide local governments and communities with comprehensive technical, financial, legal, and governance resources to support TENs development, fostering collaboration and innovation

Unlocking TENs' Full Potential

TENs offer a transformative opportunity to advance clean energy, equity, and environmental justice by decarbonizing buildings and promoting local ownership and decision-making. They can democratize energy, support local economies, and address disparities in access to clean energy. However, as a relatively new concept, TENs require continuous learning and adaptation for effective design, scalability, and long-term success. Diverse ownership models and community-led engagement are essential, and by resourcing communities to shape their own energy future, enacting reforms that prioritize energy democracy, and ensuring transparency and accountability in project development, TENs can become a cornerstone of a clean, resilient, and community-centered energy future.