# 10 on TEN: Collective Solutions to Scale Thermal Energy Networks

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## ABSTRACT

Thermal Energy Networks (TENs), also referred to as district energy or shared thermal infrastructure, offer a systems-level pathway to decarbonize heating and cooling by pooling loads, recovering waste heat, and leveraging ambient resources across multiple buildings. This report examines how municipalities can catalyze TEN deployment and why coordinated action between municipalities, utilities, developers, building owners, financiers and senior governments is essential.

We identify the principal barriers - load risk and first-mover challenges, misaligned incentives, lack of capacity, and multi-actor coordination issues - and outline practical tools to address them, including thermal planning, decision-support scorecards, standardized agreements, and transparent rate design. We also detail the roles municipalities can play as planners, long-term visionaries, anchor customers, public utilities, and connection authorities, while acknowledging constraints related to financing, staffing, and regulatory alignment. Policy pathways highlighted include mandatory connection policies, integration of thermal planning with land-use and grid planning, TENs-ready building codes, and expanded access to grants and other de-risking finance. Ultimately, TENs are not just a technology choice, they are a governance and infrastructure model that can improve affordability, resilience, and emissions outcomes when implemented through clear policy frameworks and disciplined, area-based planning.

This report introduces several new tools to help municipalities and other proponents advance their knowledge and impact to scale up of TENs solutions, including: a Thermal Energy Network Guidebook for Municipalities, a Development Toolkit with a Stakeholder Map and a Scoring Matrix, and a Policy Toolkit (FCM 2026; BDA 2026a; BDA 2026b).

## Why Thermal Energy Networks are Important

Thermal energy networks (TENs) offer a scalable pathway to decarbonization by reducing emissions, optimizing energy infrastructure, improving affordability, supporting local economic development, and enhancing community health and resilience. TENs distribute heating and cooling through underground piping to serve multiple buildings, neighbourhoods, or campuses. They can operate as centralized low-temperature systems or ambient bidirectional networks with distributed heat pumps, depending on context and thermal resources. The value proposition of TENs in the energy transition is multifaceted, as explained below. Opportunities for TENs are more apparent and streamlined in the context of a new construction application, though they also present opportunities for coordinated fuel switching for existing buildings.

### Decarbonization at Scale

TENs enable electrification of thermal demand and system-level optimization, reducing reliance on fossil fuel-based, building-level systems. By pooling loads and leveraging waste heat or geoexchange, TENs can deliver greenhouse gas (GHG) reductions aligned with climate targets. They can be particularly relevant to campuses and dense urban neighbourhoods, especially new developments, those close to sources of recoverable thermal energy, or those with motivations to reduce emissions (NYSERDA 2024).

**Infrastructure Optimization and Grid Resilience**

Networked thermal systems improve peak demand management via pooling load diversity and heat storage capabilities, which reduces stress on the electricity infrastructure during the transition towards electrification (Fry, Adebayo, Tian, et al. 2024). By centralizing and coordinating heating and cooling infrastructure, TENs can also reduce capital expenditures for individual existing building service entry electrification upgrades. Low-temperature district energy also increases the usefulness of heat pumps, geothermal, renewables, and recovered heat (Averfalk H et al. 2021).

**Long-Term Affordability and Asset Management**

Compared to business-as-usual (BAU) systems, TENs in appropriate locations (often new, dense developments) can reduce lifecycle costs and space for mechanical systems at the building level (e.g., boilers, cooling towers). The project economics typically have a front-end loaded investment, which can be offset by reductions in long-term operations and maintenance costs and risks. Also, given that distribution piping and TENs infrastructure typically have long life expectancies, these costs can be spread over longer amortization periods, improving lifecycle economics.

**Economic Development and Local Value Creation**

Local benefits of TENs include job creation and economic development. When the enabling conditions (such as connection policies and access to public land for infrastructure) are put in place, TENs can anchor clean energy supply chains, support local trades via a “pipes-to-pipes” workforce transition, and attract private capital. TENs shift heating and cooling from a building-by-building paradigm, which is typically dependent on fossil fuels, to an integrated infrastructure model that leverages local energy sources. TENs can also enable buildings to increase the value of their thermal resources such as waste heat capture or on-site thermal storage, by selling excess back to the network. Developing. In many cases, these models provide valuable new revenue streams to the local municipality such as access agreements, land leases, interest payments, and increased tax revenue, while also creating local jobs and economic development activity.

**Health and Resiliency Benefits**

The health benefits of TENs are three-fold: first, the reduction of fossil fuel combustion equipment inside buildings improves air quality; second, providing cooling to buildings that may not have previously had cooling reduces the health risk of extreme heat on occupants; and third, TENs can increase resiliency because they can be paired with relatively modest backup power sources for pumps and controls to keep thermal energy supplied to buildings.

## TENs Requires Coordination Between Many Actors

TEN development requires coordinated action among all levels of government, thermal, gas and electric utilities, developers and building owners, and financiers. The Stakeholder Map in the Development Toolkit, shown in Figure 1, highlights the distinct roles of each throughout the enabling, screening, developing, and executing phases (BDA 2026a). Misalignment across these actors, such as conflicting policies or timelines that do not dovetail, can stall progress and increase costs. The roles of the most relevant stakeholders are summarized below, except for municipalities which are discussed in more detail in the next section of the report.

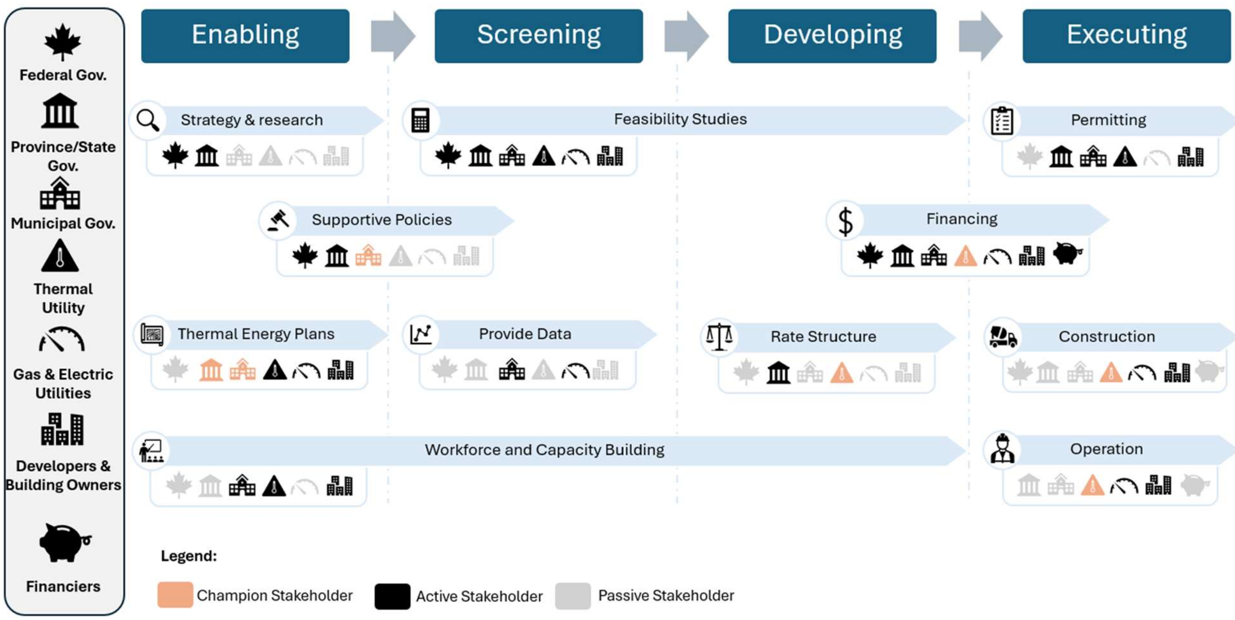


Figure 1 Stakeholder map of actors and their roles throughout a TENs development

**Federal Government.** Provides strategy, research, supportive policies (e.g., carbon pricing, model codes), and financial support.

**Provincial/State Governments and Regulators.** Set building codes, approve and enforce rate structures (where regulated), and may mandate municipalities and/or energy utilities to develop Thermal Energy Plans.

**Gas and Electric Utilities.** Provide load data, participate in planning, and must align TEN deployments with integrated resource planning. Their mandates for reliability and affordability shape engagement strategies.

**Developers and Building Owners.** Provide thermal demand, capital participation, and long-term customer commitments. Their engagement is essential to overcome early-stage risk.

**Financiers**. Provide long term financing for the construction and operational phases of TENs projects.

## Barriers to TENs Development

Despite strong system-level benefits, TENs face significant challenges related to knowledge gaps associated with the less common technology. Some of the most common barriers are detailed below.

### Load Risk and First-Mover Problem

The economic viability of a TEN depends on sufficient thermal density to justify the investment in infrastructure, committed long-term anchor loads to enable the TEN to launch and operate through perpetuity, while predictable customer acquisitions enable the TEN to scale. Because they are long term assets, TENs are less nimble to changes in thermal loads, and particularly vulnerable to changes in load of the anchor and large customers. Also, when geoexchange energy sources are included, shifts in the ratio between heating and cooling demand can cause balancing of thermal fields.

### Inaccurate Lifecycle Accounting

When comparing the costs of in-building systems and TENs, building owners typically overlook the capital, operations and maintenance cost savings associated with TENs and therefore do not accurately assess lifecycle costs. In addition, prospective participants may face unforeseen costs related to building retrofits, particularly in older building stock where envelope upgrades may be required to improve energy efficiency, refine load forecasts, and support the optimal sizing and deployment of boreholes. Proponents of TENs need to provide transparent, comprehensive and accurate cost comparisons for each prospective client.

### Institutional Friction

Gas utilities may present institutional friction to TEN developments because thermal networks can reduce natural gas demand, creating concerns around cost recovery, stranded assets, and regulated cost recovery authorities. While TENs can be integrated relatively easily into new developments during the planning stage, deployment in existing buildings results in less gas sales, potentially increasing utility resistance and concerns regarding cost burdens for buildings that remain on the gas network. On the other side, TENs can be a valuable part of a coordinated approach to reducing the gas network at a neighbourhood level, since they can provide a single solution for all buildings in a geographic area, allowing gas utilities to reduce their infrastructure burden.

### Information and Capacity Gaps

In jurisdictions without existing TENs, municipalities, utilities, and building owners require support to understand technical, regulatory, and financial dimensions. This creates a high degree of uncertainty, inability to understand and communicate benefits to decision-makers and potential for risk aversion to set in, which slows development timelines and increases transaction costs. The tools outlined in this report are designed to expedite the capacity-building process so all interested parties can buy into a collective vision and feel confident about investment decisions.

**Challenges Faced Specifically by Municipalities**

While municipalities are central actors, they face structural constraints, outlined below.

**Determining an Ownership Model.** Municipalities need to determine their appetite for taking various ownership stakes in a TENs project, with options outlined in Figure 2 and further detailed in the TENs Guidebook (FCM 2026). Understanding the various ownership options and navigating the risk management decisions is often a barrier faced by municipalities. They often are limited by staff capacity to engage with TEN proponents, navigate procurement processes, and coordinate across multiple departments.

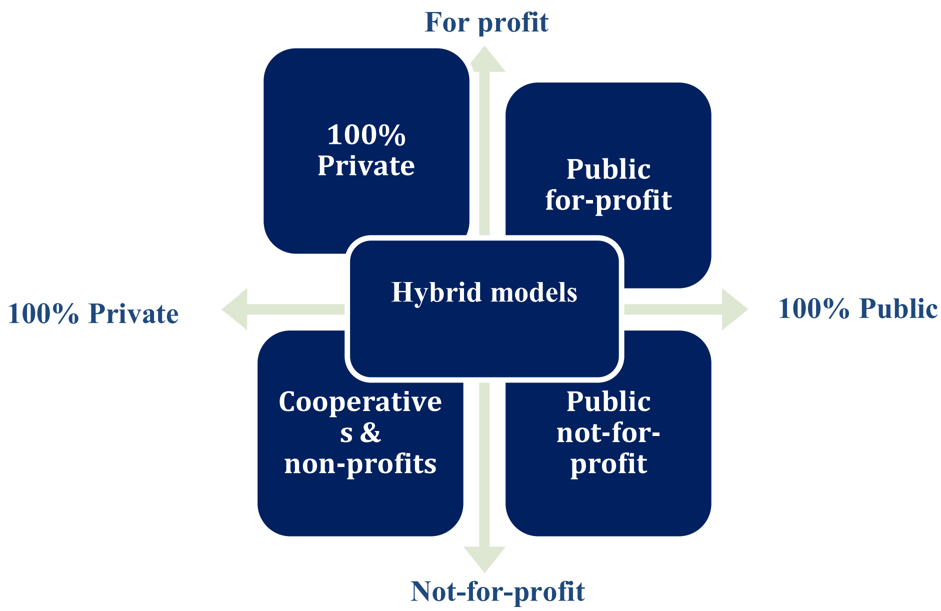


Figure 2 Matrix of ownership models for TENs

**Competing Priorities.** Municipalities are often juggling numerous priorities, including housing affordability, transit, public infrastructure renewal, climate action, among others. Developing TENs competes with these other priorities, resulting in uncertainty for developers, as municipal processes and timelines may not align with TEN infrastructure deployment.

**Revenue and Financing Constraints**. Upfront capital requirements for TENs infrastructure can be substantial. Although municipalities can leverage tools such as green bonds, debentures, loan guarantees, or grants, debt limits and risk exposure remain barriers.

**Misalignment with Senior Governments**. Model building and energy codes are developed federally and typically adopted (as is or with amendments) provincially/statewide, with delays between model updates, adoption and enforcement. For new developments, if building and energy codes do not properly account for network efficiency (e.g., measuring energy only at the building supply point), they may inadvertently disadvantage TEN-connected buildings. In addition, where they apply, regulatory approval for rate structures can constrain design flexibility.

## Municipalities Solutions to Enable TENs

Because of their land use planning and public utilities authority, their significant building footprint, and their connection to local businesses and economic activity, municipalities are uniquely positioned to play a leadership role in catalyzing TENs.

### Incorporate TENs into Long-Term Plans

Municipalities control land use planning, zoning, subdivision approvals, and right-of-way access. TENs can be embedded within Master Community Plans, Community Energy Plans, and Thermal Energy Plans. The hierarchy of municipal planning documents and how they relate to thermal energy plans is depicted in Figure 3 Thermal plans typically intersect with community plans, neighbourhood plans, and subdivision plans. Key steps in developing a Thermal Energy Plan include mapping loads and waste heat sources, aligning with utility planning, and translating plans into policy instruments. The Policy Toolkit highlights that Thermal Energy Plans align zoning, utilities, and community expectations with net-zero pathways and enable smarter sequencing of investments (BDA 2026b).

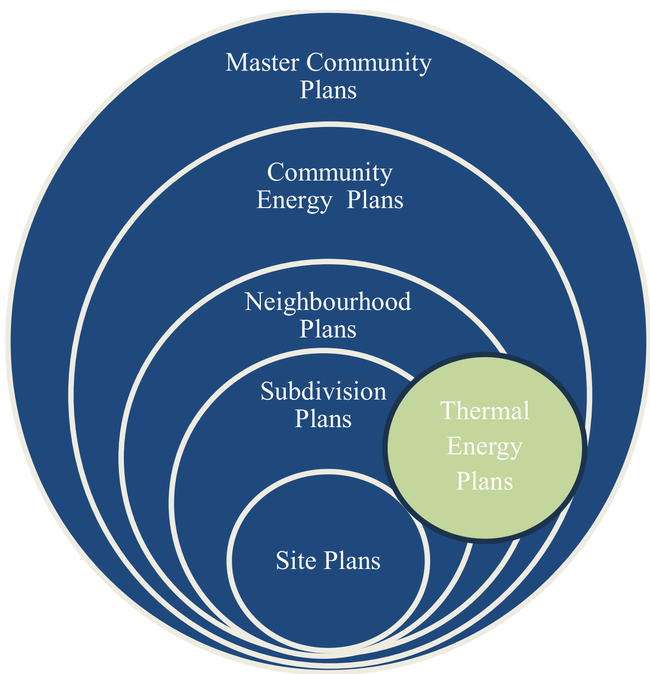


Figure 3 Planning tools of municipalities that affect TENs

The Development Toolkit includes a Decision Tree (shown in Figure 4) and Opportunity Scorecard to help screen high-potential sites based on load density and diversity, peak demand, waste heat availability, and other characteristics (BDA 2026a). These tools direct scarce municipal resources toward viable zones to help overcome the competing priorities challenge faced by municipalities.

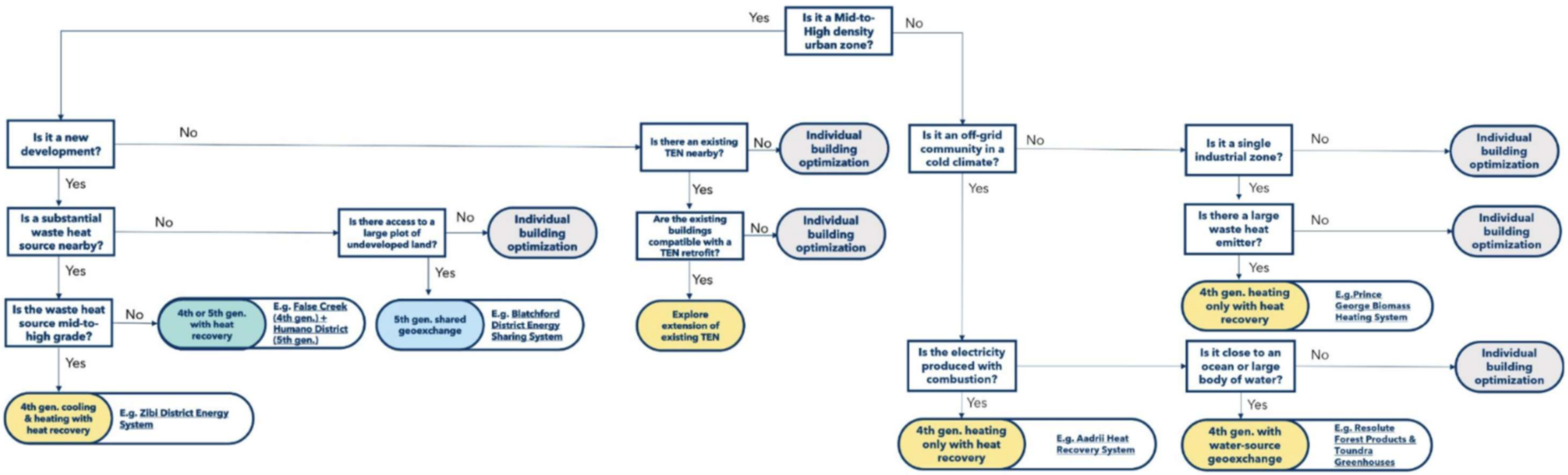


Figure 4 Decision tree for screening for viable sites for TENs

**Provide Anchor Customers, Demonstration Sites, and Land Access**

Municipal buildings (e.g., recreation centres, libraries, office buildings, etc.) can serve as anchor loads, reducing load risk and first mover challenges. Also, having long-term, trustworthy customers helps strengthen project bankability. These public facilities can then be used as demonstration sites to help increase awareness of the technology and understanding of the business case. Municipalities can also enable access to public land for energy hubs, geoexchange fields, pumping stations, and distribution pipes. Access to land in dense urban areas is often a key element to making a TENs project possible. The municipality can generate revenue from these land access agreements.

**Develop a Thermal Utility**

Municipalities can own and operate public utilities as they often do with water and wastewater utilities. By owning and/or operating a thermal utility, they gain control over system design, affordability, and climate outcomes. Public ownership can also reduce the cost of connection by aligning infrastructure with planning tools and connection policies.

**Support Workforce Capacity**

Municipalities can support TENs workforce development by partnering with utilities, educational institutions, and industry associations to create targeted training, apprenticeship, and certification programs for the design, installation, and operations. They can also help facilitate a "pipes-to-pipes" workforce transition by supporting the retraining of workers from the natural gas sector and incorporating local workforce development requirements into TEN procurement and development processes.

**Policies to Encourage Connection**

To overcome the load risk/first mover challenge, municipalities may implement various programs or policies from incentives to connection bylaws to encourage buildings to connect to a TEN, which are outlined in the TENs Guidebook (FCM 2026). These options are outlined below.

**1. Financial Support.**
Municipalities can offer grants, tax credits, affordable access to public land, or other support to strengthen business cases and attract private investment into TENs.

**2. Mandatory Connection Bylaws.**
Connection bylaws can require all (typically new) buildings in a specific area to connect to the TEN, which reduces the load risk and provides certainty for infrastructure investment. Such bylaws may only be applicable when the TEN is municipally owned. They can be associated with incentives to reduce cost burdens if that is a concern.

**3. High Performance Development Standards.**
High performance development standards for new developments can include a compliance pathway that involves connecting to a TEN. Senior governments can support by incorporating TENs into building codes and energy codes.

4. **Building Emissions Performance Standards.**

Building Emissions Performance Standards are bylaws requiring existing buildings to meet emissions reduction targets in line with municipal timelines. These bylaws can include a compliance pathway that recognizes connection to a TEN.

### Manage Cohorts and Learning Networks

Cross-sector working groups are recommended to build capacity and align stakeholders over time, as outlined in the TENs Guidebook and shown in Figure 5 (FCM 2026). Additionally, peer learning among municipalities, especially those with operating TENs, can accelerate learning.

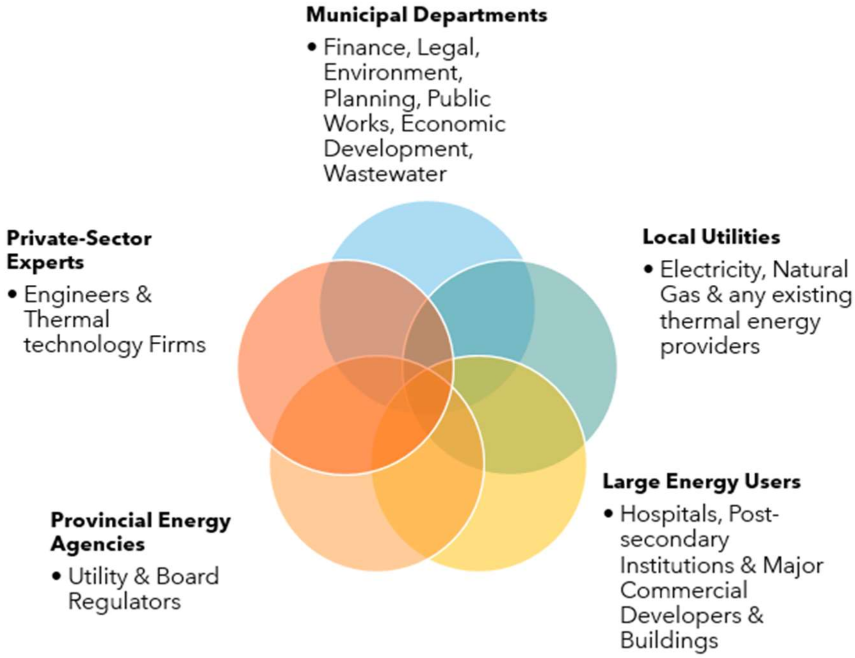


Figure 5 Multi-stakeholder working group

### Provide Templates and Standardization

Clear and standard templates for feasibility assessments and planning processes are critical. Standardized thermal energy supply agreements and rate design frameworks reduce transaction costs and investor uncertainty. Examples of both are provided in the Development Toolkit (BDA 2026a).

## Conclusion

Thermal energy networks represent a structural shift in how buildings are decarbonized, from disjointed building-by-building decisions to coordinated, neighbourhood-wide solutions. Municipalities are central to this transition as planners, infrastructure owners, regulators, conveners, and long-term stewards; yet they require clearer policy alignment, standardized tools, and financial support from senior governments and utilities. Some of the main barriers faced by

TENs and their associated solutions, which are further details in the Guidebook and Toolkits referenced in this paper, are listed in Table 1.

Table 1. Barriers and associated Solutions to Thermal Energy Networks

| **Barrier** | **Solution** |
|---|---|
| Load risk / First mover problem | Anchor customers<br>Connection policies |
| Inaccurate lifecycle accounting | Demonstration sites<br>Standardized Template |
| Information and capacity gaps | Cohorts and learning networks |
| Municipal challenges | Guidebooks and Toolkits |

The path forward lies in coordinated planning, tools to focus effort, risk-sharing ownership models, and policy frameworks that reduce load risk while ensuring affordability, transparency, and resilience. TENs are not simply an energy technology; they are a governance and infrastructure model for delivering decarbonized thermal energy at scale.

## Disclosure

AI-assisted tools used: ChatGPT
Used for: synthesizing documents, research
Extent: drafting sections
Human review: The authors reviewed and verified all content.

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