Building Decarbonization Alliance pour la décarbonation des bâtiments

dunsky Energy + Climate

THERMAL ENERGY NETWORKS IN CANADA:

UNLOCKING IMPACT POTENTIAL AND ADVANCING ENABLING POLICY

WHITE PAPER

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Thermal Energy Networks in Canada: Unlocking Impact Potential and Adva ncing Enabling Policy

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Prepared by

The Building Decarbonization Alliance and Dunsky Energy + Climate Advisors

About the Building Decarbonization Alliance

The Building Decarbonization Alliance is a non-partisan and cross-sector coalition working to change the narrative on building heat, inspire and inform industry and government leadership, and accelerate market transformation. We reach beyond rhetoric to engage with evidence and science, helping put in place the conditions for effective policy, change the narrative, and increase awareness of the benefits of decarbonized all-electric buildings.

We've convened over 300 partner organizations and are working hard to expand the reach of our Alliance and proposing an exciting slate of research and initiatives to advance our mission and vision. If you are interested in supporting our work, visit **our website** or reach out to us at **info@buildingdecarbonization.ca** to find out how you can help accelerate building electrification.

About Dunsky Energy + Climate Advisors

Dunsky supports leading governments, utilities, corporations and others across North America in their efforts to accelerate the clean energy transition, effectively and responsibly. With deep expertise across the Buildings, Mobility, Industry and Energy sectors, we support our clients in two ways: through rigorous Analysis (of technical, economic and market opportunities) and by designing or assessing Strategies (plans, programs and policies) to achieve success.

Project Funders

BC Hydro

Edmonton

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TAF

Toronto

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Glossary of Terms and Acronyms

Anchor load	Buildings with a large, predictable, and long-term demand for heating or cooling (e.g., hospital, university, data centre), often with a stable and constant use profile, helping stabilize and support the economics of TENs
AUC	Alberta Utilities Commission
BCUC	British Columbia Utilities Commission
BPS or BEPS	Building (emissions) performance standards: Regulations that set energy or emissions performance requirements for existing buildings
CIB	Canada Infrastructure Bank
Clean Heat Planning	A strategic process to identify the most efficient, low-carbon pathways to determine the best heating and cooling solutions at the community or utility scale. Integrated Community Energy Planning refers to a similar concept that goes beyond heat.
COP	Coefficient of performance
Generation (TENs)	A way to classify TENs based on several factors, especially energy source, system temperatures, and technology
Geoexchange	Systems using shallow wells to provide heat and cooling to buildings
GHG	Greenhouse gas
GTHA	Greater Toronto and Hamilton Area
HVAC	Heating, ventilation, and air conditioning
IERMP	Integrated energy resource management plan
IRP	Utility integrated resource planning
NRC	National Research Council
NRCan	Natural Resources Canada
RNG	Renewable natural gas
TENs	Thermal energy networks: the distribution of thermal energy (heating, cooling and/or water use) from one or more sources of production to multiple buildings through a network of pipes.
Waste heat recovery	Capturing unused heat from sources like sewage, data centres, or industrial processes and reusing it to heat buildings through a TEN or other system.

Executive Summary

When deployed strategically, Thermal Energy Networks (TENs) can offer a versatile and scalable platform to support heating decarbonization in Canadian communities. While TENs are not inherently low carbon, they can enable significant emissions reductions over time when paired with clean energy sources. Removing existing barriers and coordinating planning efforts will be key to unlocking their full potential.

What are they? TENs are energy infrastructure for delivering heating and cooling to multiple buildings through shared underground piping. In the right context, they may offer a complementary alternative to traditional heating and cooling approaches. While they may not always reduce energy costs compared to the current fossil-fired status quo, they often provide cost advantages relative to other low-carbon pathways, as well as other benefits (e.g. local energy security, resilience, economic development).

Why do TENs matter now? TENs are gaining momentum in Canada, with over 250 systems already in place, particularly in urban centers and northern communities. While still a small share of the market, these systems reflect growing exploration of alternatives to conventional heating and cooling. Unlike existing distributed heating systems, TENs enable the sharing of clean energy sources such as waste heat, geoexchange, or renewables across buildings and neighborhoods. Their ability to reduce emissions, cut energy costs, and support resilient infrastructure may in some contexts complement grid decarbonization by diversifying heating strategies and helping manage peak demand. Additionally, TENs provide efficient and flexible infrastructure to create the conditions for future emissions reductions by allowing the system to evolve over time. In many jurisdictions, particularly in Europe, their local and economic benefits have proven to be a more immediate driver of adoption than carbon reductions.

Who is this white paper for? This white paper is intended for policymakers, regulators, utilities, municipalities, developers, and TENs proponents. Each of these actors has a role to play in enabling the scaling of TENs and ensuring they contribute meaningfully to Canada's decarbonization goals.

Key Findings

- **Broad Benefits:** Modern TENs (i.e. 4^{th} and 5^{th}-generation systems) can offer significant advantages over incumbent heating solutions. They reduce greenhouse gas emissions, can lower heating and cooling costs when compared to other low-carbon heating pathways, improve energy resilience, and create local economic opportunities. They are especially effective in dense, mixed-use developments; their advantages are therefore highly site-specific and depend on building density, energy demand diversity, and proximity and access to clean thermal sources.

- **Deployment Gaps:** Despite their promise, TENs currently serve just three per cent of Canada's heating demand. Compelling business cases are not always enough to offset the uncertainties and challenges associated with these projects; without intervention, the market will struggle to deploy TENs at scale. Key barriers include regulatory uncertainty (around decarbonization at large and around thermal energy), lack of planning tools, gaps in awareness, the complexity of coordinating multiple stakeholders, uneven municipal capacity, and fundamental distinctions in the current scale and state of evolution compared to business-as-usual approaches.

- **Ownership and Regulation:** While there is growing development of large-scale private systems, particularly in dense urban areas, most new low-carbon TENs in Canada tend to be publicly owned, serving institutional campuses, or following public-private partnership models. Scaling deployment will require a broader mix of ownership models and foster public/private cooperation. There is also increasing interest in more supportive regulation, balancing consumer protection with the need to encourage investment and innovation in the public interest. Some provinces, municipalities, and utilities are beginning to explore planning frameworks to prioritize clean thermal infrastructure.
- **Global Momentum:** Other jurisdictions are moving faster than Canada. European countries mandate local heat planning, which, while not solely focused on TENs, can help identify the most effective decarbonization strategies. Additionally, several U.S. states have passed legislation to support utility-led deployment of TENs as regulated energy services. Canada's current policy environment remains fragmented by comparison. Without more coordinated action, Canada risks missing out on significant opportunities as global demand for low-carbon heating solutions accelerates.

The Path Forward

Three enabling strategies are essential to catalyzing TENs deployment across Canada:

1. **Level the TENs playing field**: Implement clear policies and mandates to accelerate building decarbonization and modernize regulations and financing tools to ensure TENs can compete on equal footing with conventional heating and cooling systems.
2. **Let strategic TENs opportunities emerge**: Use clean heat planning strategies to target high-impact zones and require large new developments to assess TENs feasibility. Align these efforts with housing expansion goals to leverage growth as a driver of clean thermal infrastructure.
3. **Unlock TENs delivery at scale**: Equip municipalities, utilities, real estate developers, and other key stakeholders with the policy tools, incentives, and training needed to act.

Introduction: What Are Thermal Energy Networks?

Most Thermal Energy Networks (TENs) share a similar purpose: to deliver heating, cooling, and/or domestic hot water to multiple buildings through shared piping infrastructure. Technologically, TENs are similar to individual building systems. The main difference is scale: TENs can serve anything from a few buildings on a small campus to entire neighbourhoods. TENs use a range of thermal energy sources, including ground-source heat pumps, waste heat (from sewage or industrial processes), surface water, biomass, and fossil fuels. Like other utility services (e.g., water, sewage, or natural gas), TENs infrastructure typically runs underground within public rights-of-way.

Today, the terms **Thermal Energy Networks** and **District Energy Systems** are often used interchangeably in Canada to describe shared heating and cooling infrastructure. TENs encompass a variety of system configurations and technology mixes. As research and practice have advanced, additional terms have emerged, including networked geothermal (geoexchange) and heat-sharing networks.

A generation-based taxonomy is often used to classify TENs in Canada, Europe, and the U.S. This method is increasingly recognized across the building industry, energy sector, and academia. It offers a clearer, more consistent framework for understanding system types and technological evolution at the national and international level. The framework is structured into five generations reflecting the transition to lower carbon, lower temperature, and more efficient TEN systems.

Key Features of the Generation-Based TENs Taxonomy

- **Technology-Focused:** Each generation reflects the evolution of heating and cooling technologies in thermal networks.
- **Legacy Systems (1st to 3rd Gen)**: Early generations rely on centralized and high-temperature distribution, often using fossil fuels. They are mainly found in existing infrastructure and rarely used in new developments.
- **Modern Generations (4th and 5th Gen):** Designed for energy efficiency and decarbonization, these operate at lower temperatures and support renewables and waste heat recovery. Figure 1 provides an overview of the main characteristics of these systems. Fifth-generation systems use ambient-temperature distribution loops that allow buildings to inject and extract thermal energy. These systems rely on decentralized energy exchange and often incorporate building-level heat pumps to provide heating and cooling as needed.

Rather than being considered as an upgrade over fourth-generation systems, fifth-generation networks can be considered as a subclass of fourth-generation systems.[1] Although fifth-generation TENs are often perceived as

1 IEA DHC (2024). District heating network generation definitions.

a step forward, they may not necessarily be more efficient than fourth-generation systems. This misconception stems from the generation-based naming convention, which can falsely imply a linear improvement over time.

However, many TENs are hybrids, combining features of different so-called generations into application-specific and context-driven designs, reflecting local energy sources, building types, and community needs.

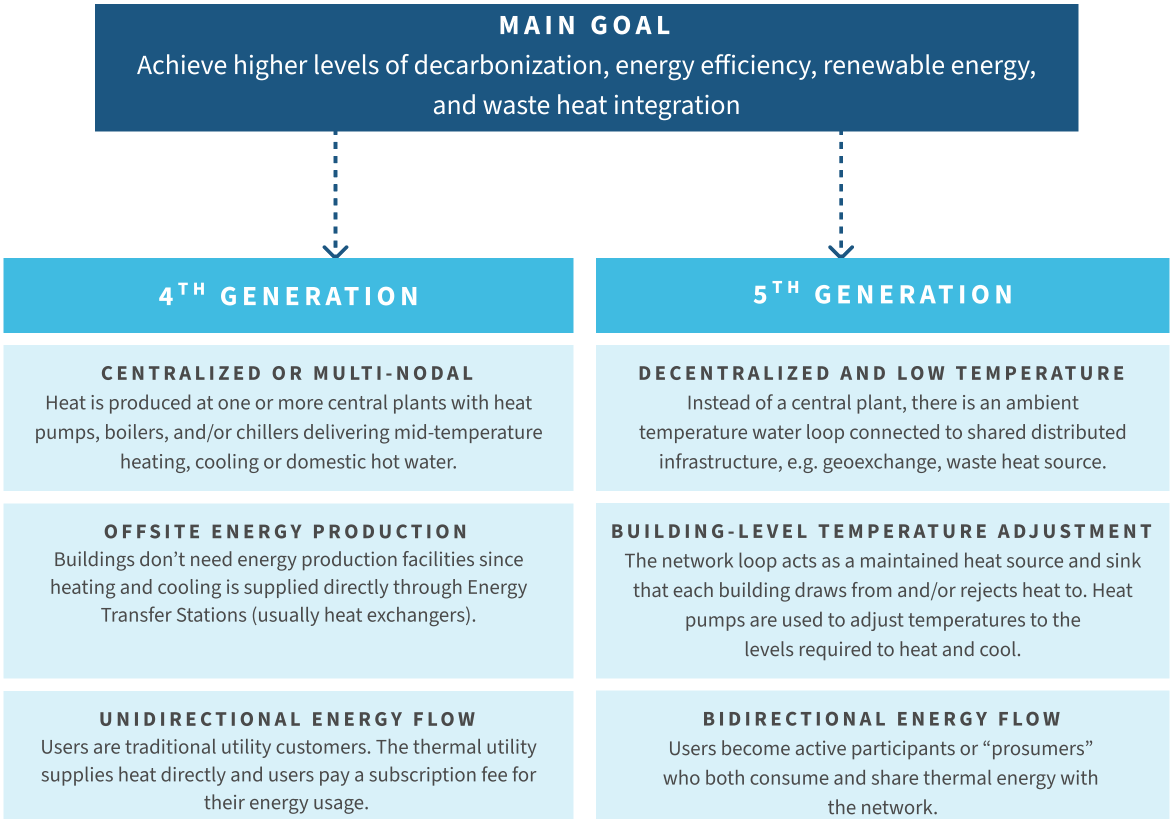

Figure 1 *– 4th vs 5th Generation Thermal Energy Network Overview*

In this paper, the focus is on the development of fourth and fifth-generation Thermal Energy Networks. They represent the current standard for new TENs developments due to their lower temperatures and higher integration potential with renewable and waste heat sources, although mixed network models are increasingly common. Retrofitting existing high-temperature networks is technically challenging but generally avoids many of the hurdles facing new TEN deployments. This paper therefore concentrates on new installations, where the greatest opportunities exist for growth, innovation, and impact at scale.

Market Outlook: Energy Sources and Technologies

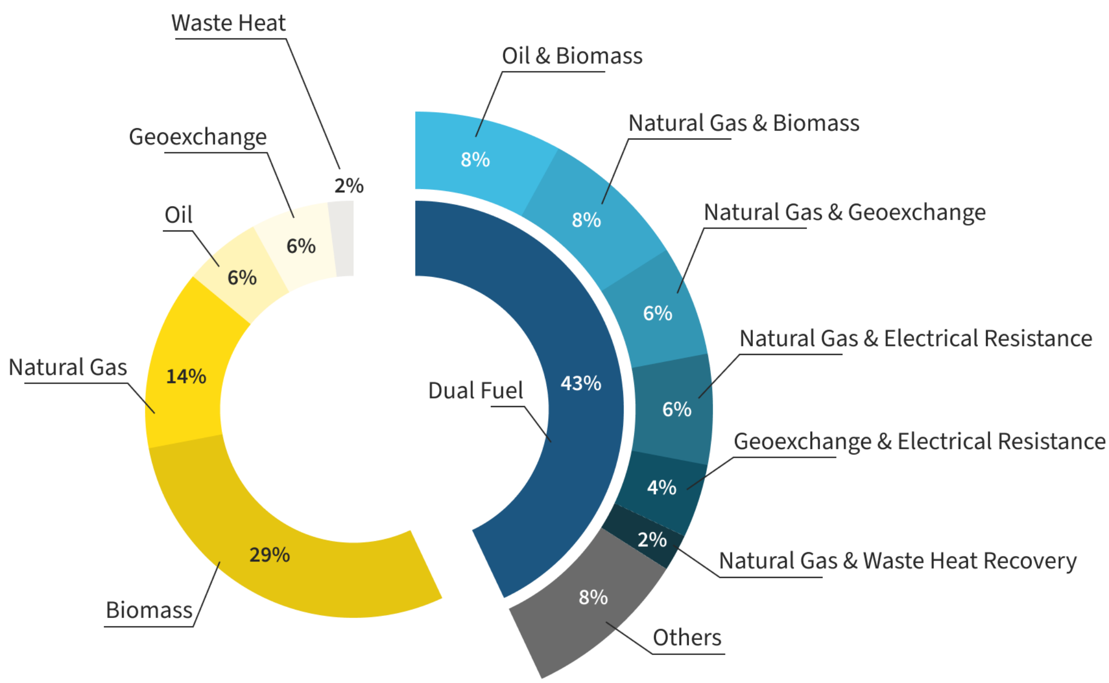

***Figure 2** – TENs Energy Sources Since 2010*

Most recent TENs projects are fourth generation, with a high proportion of systems using fossil fuels alongside renewables, as illustrated in Figure 2. Several fifth-generation TENs are either under construction, planned, or recently built; these include the Humano District, a private thermal waste recovery project in Sherbrooke, QC, and Blatchford, a publicly owned net-zero thermal utility designed for a new mixed-use community in Edmonton, AB.

However, it is important to clarify that the use of hybrid energy sources is not the result of technical limitations. It rather reflects the regulatory and economic conditions in which TENs operate. Most buildings served by TENs are not required to meet net-zero or zero-carbon performance standards. In the absence of mandatory decarbonization or connection requirements, developers are unlikely to voluntarily choose higher-cost low-carbon energy sources.

Why Is There Growing Interest in TENs?

There are about 250 TENs across Canada, together meeting about three per cent of the country's total heat demand. Given the challenge of rapidly decarbonizing buildings in line with Canada's emissions targets, there is increasing focus on TENs from governments, regulators, utilities, developers, investors, and other stakeholders as a complementary solution to individual building decarbonization approaches, given their potential to reduce emissions and improve efficiency by diversifying heating strategies and minimizing electricity grid impacts.

TENs can offer flexible, future-ready platforms capable of enabling deeper, faster, and more affordable decarbonization, so long as building and energy policies evolve to support their deployment. This shift is already evident in municipal planning trends across Europe and is on the rise in the U.S. as traditional utility mandates are expanding to include thermal energy delivery. And importantly, TENs offer natural gas utilities a potential avenue to diversify their business models as fossil fuels are phased out, allowing them to invest in network-based thermal infrastructure.

At the community level, TENs offer benefits beyond emissions reductions and energy savings. They can support economic development and job creation, reduce the cost of new high-performance buildings, improve air quality and energy affordability, and provide greater resilience during peak demand periods and power outages.

Municipalities: Support local climate goals, local economic development, energy security, and energy system resilience during extreme weather.

Electric Utilities: Reduce upgrade costs and stress on local and regional electricity grids.

Gas Utilities: Diversify investment in alignment with climate objectives, and offer broader range of service to customers.

Real Estate Developers: Support local climate goals, local economic development, energy security, energy system resilience during extreme weather.

Customers and Users: Offer more reliable, resilient, affordable, and expanded levels of service.

***Figure 3** – Value Proposition for Key TENs Stakeholders*

> *"If we look at TENs only through the lens of decarbonization, we risk overlooking their broader value. Heat is a powerful energy carrier—it enables local use of waste energy, strengthens energy resilience, supports local economic development, and enhances energy security. The benefits go well beyond carbon."*
> *— **Karen Farbridge**, Urban Connector, Karen Farbridge & ASSOCIATES*

Despite the benefits of TENs, the true potential and the boundaries of their applicability have yet to be fully valued in Canada; for example, in community energy planning frameworks, or in their role in supporting integrated grid planning and optimizing energy system performance.

The remainder of this white paper provides an overview of the current state of the TENs sector in Canada, shedding light on the typical opportunities and challenges associated with TENs deployment, and identifying pathways to accelerate their adoption in high-potential applications.

TENs in Canada: State of Play

History: 1900s to Early 2000s

Canada has a long history with TENs, tracing back to the early 20th century when institutional campuses across the country began deploying centralized steam distribution systems. These early networks laid the foundation for what we now recognize as TENs, with the oldest known examples—such as the Cliff heating and cooling plant that supplies Ottawa's Parliament Hill buildings—still operating today.

A second wave emerged in North America around the time of the 1970s energy crisis, marked by a shift in clientele toward commercial buildings in dense urban areas. These networks featured both cooling and high-temperature heating, and marked an emerging focus on energy efficiency. Concurrently, campuses continued to expand their facilities with TEN systems, incorporating the latest available technologies into new developments.

	Customer Profile	Energy Consumption	Fossil Fuel Dependency	Difficulty to Retrofit
Early 20th Century	**Institutional Campuses:** Healthcare, universities, prisons, military, parliaments.	High	High	High
Mid-Century	**Downtowns:** Mainly office buildings	Mid to High	Mid to High	Mid

***Figure 4** – Historical TENs Customers & Characteristics*

Many of these legacy systems continue to operate. Data from Simon Fraser University show more than 250 TENs in operation across Canada, with nearly 50 per cent serving institutions and campuses. Although these systems are not the focus of this report, there is a need and opportunity to decarbonize and expand them to connect neighboring buildings.

The Cliff heating and cooling plant in 1920

50% of TENs across Canada are serving institutional campuses

Current Market Overview: 2010 to Today[2]

Many consider the modern era of TENs in Canada to begin with the launch of Vancouver's False Creek Neighbourhood Energy Utility in 2010. This landmark project introduced innovative technologies, including low-temperature heating and waste heat recovery, and prioritized partial electrification. It also marked a shift toward a previously untapped market segment: mixed-use developments.

Since 2010, about 80 new TENs projects have been developed, out of these, approximately 15 are campus projects. Some regions have been more active than others in deploying such systems: British Columbia, Ontario and Northwest Territories stand out with a higher proportion of TEN systems, ranging from urban networks to systems serving rural and remote communities (see the *TENs: Clean Fuel Alternatives for Remote Communities* call out box that follows). This momentum continues today, with several municipalities—including Montréal, Edmonton, Vancouver, and the Greater Toronto and Hamilton Area (GTHA)—planning for and deploying new TENs projects.

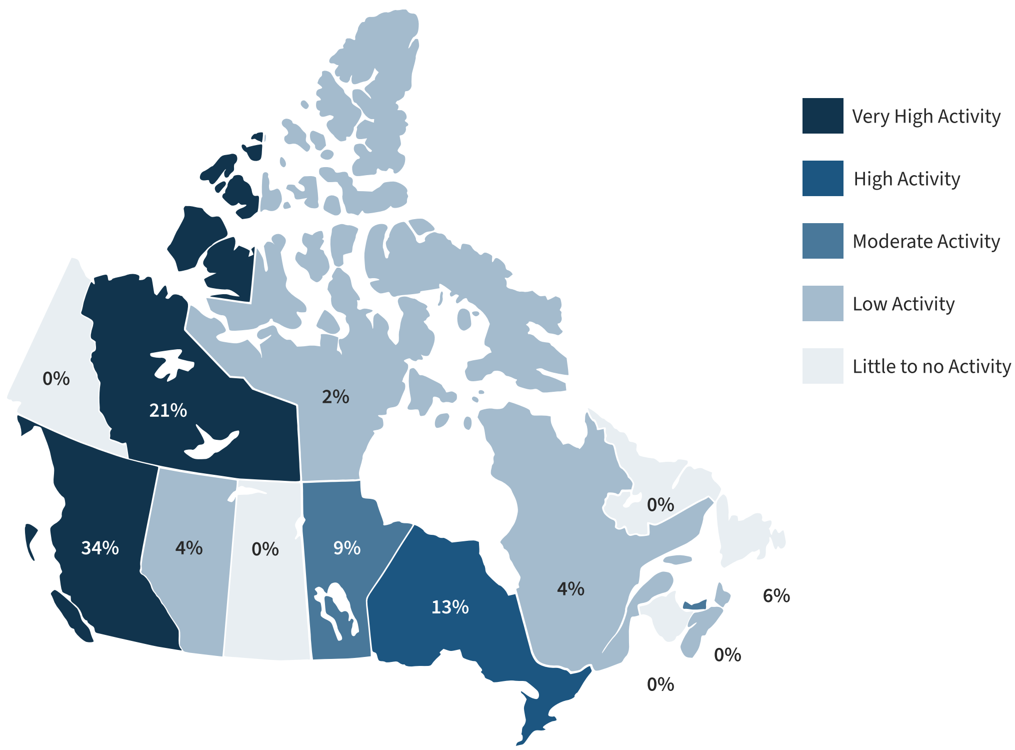

Figure 5 *– Completed TENs Projects (% of National Total) per Province Since 2010*

2. The data highlighted in this section are not exhaustive; they represent a compilation from multiple sources, including the Simon Fraser Database. While not capturing every TEN in Canada, they provide a solid foundation for discussion and help identify key trends in the Canadian market. The data exclude TEN systems located on institutional campuses. In other words, any TEN that serves only a single public entity on its own grounds, such as universities, hospitals, parliaments, prisons, or military bases, is not included. However, if these systems share infrastructure with other public or private actors outside their premises, they are counted under the mixed-use categories.

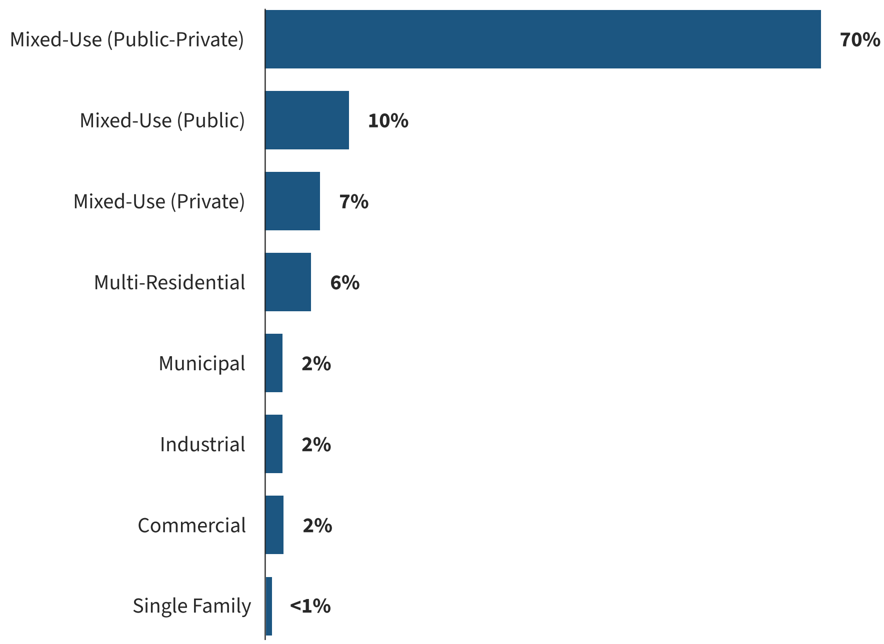

***Figure 6** – TENs Users Across Canada Since 2010*

TENs in Canada serve a wide variety of users. Since 2010, most networks have catered to a mix of public and private buildings, with 80 per cent of TENs serving one or more institutional customer.

This trend reinforces the importance of "anchor loads": large institutional buildings such as hospitals and universities, and energy-intensive facilities like data centres, that provide stable, continuous demand for heating or cooling to maintain a reliable baseline for the network, enhancing its efficiency and viability.

By contrast, just 20 per cent of recent systems serve a single customer type (e.g. residential, commercial, industrial). Multi-residential projects have outpaced other types of private users, which correlates with broader construction market trends.

TENs: Clean Fuel Alternatives for Remote Communities

Halfway between modern TENs and historic systems, a distinct trend has emerged among northern communities. Since the 1990s, several TENs have been developed to support the transition from heating oil to biomass in these communities, with the goal of reducing fossil fuel dependence while increasing community resilience and self-sufficiency.

Despite the low population density of these regions, these TENs account for more than 20 per cent of recently installed networks across Canada. The types of connected buildings and the nature of the projects differ significantly from what is typically observed in southern regions, with retrofit projects for community and institutional buildings, and in some cases, even the connection of single-family homes. This trend demonstrates the potential for TENs to support northern communities in their pursuit of decarbonization and energy independence. Some systems are already modernizing by integrating more renewable energy sources and even combining with electric microgrids.

TENs in Canada have emerged under a range of ownership models, each with distinct strengths and trade-offs. Ownership structures generally fall into these three main categories: public, private, or hybrid. Hybrid models exist along a spectrum, with varying degrees of public and private involvement depending on the specific context.

Public Ownership Models: The system is owned and operated by a local government or another publicly owned entity. This structure allows public authorities to align energy infrastructure with policy goals, such as affordability and reducing emissions. These models are common where energy systems are viewed as essential public infrastructure serving long-term community interests.

Private Ownership Models: Systems are owned and operated by private entities, or by organizations that manage their own infrastructure (e.g. post-secondary institutions, health campuses). These systems may rely on long-term demand from anchor clients and may be supported by incentives. These models are more common where market conditions are strong. The local authority might have initiated the project, helped secure grants or financing, and supported energy efficiency, low-carbon and social initiatives that might otherwise be unviable under typical private firms' standards.

Hybrid Models: These systems often combine public oversight and private investment in varying forms, though the degree of balance between the two can differ significantly across models. They may include joint ventures and concession agreements, with varying degrees of control and risk-sharing between public and private partners. In a hybrid model, the public sector may retain control over key decisions or infrastructure components while leveraging private capital and expertise and sharing financial risk.

Newly built low-carbon TENs tend to be municipally owned or follow hybrid public-private models, though prominent private systems also exist. Importantly, ownership structures can evolve over the lifecycle of a system—what works in early development may shift as systems scale and mature. The table below reflects a synthesis and is based on perspectives shared in stakeholder interviews.

Ownership Model	Examples	Typical Features	Key Considerations
Public	• False Creek (Vancouver, BC) • Lulu Island Energy Company (Richmond, BC) • Blatchford Energy Utility (Edmonton, AB)	• Municipal ownership and oversight • Alignment with public policy goals (e.g. affordability, decarbonization)	• Needs internal expertise and resources • Requires sustained political will • May be exposed to shifting priorities or budget constraints
Private	• Humano District (Sherbrooke, QC)	• Access to private capital and operational expertise • Can move quickly and scale across jurisdictions	• Public influence limited unless regulated or coordinated • May prioritize returns unless guided by policy or agreements
Hybrid	• Enwave–City of Toronto Joint Development Agreements	• Combines public oversight with private delivery capacity and expertise • Enables risk sharing and innovative financing • Aligns municipal goals with private innovation	• Requires clear governance • Complex to structure and manage over time

Exploring the Role of Existing Utilities

While municipalities and private actors have led most Canadian TENs projects, utilities could play a larger role to support the scale-up of TENs (e.g., through coordinated planning and incentives, contributions under demand-side management/non-pipe or non-wire alternatives, or even direct TENs deployment).

However, provincial regulators often prevent existing utilities from developing or funding TENs, restrict how electric and gas utilities can jointly plan ongoing activities, and limit the meaningful participation of other players in the development of TENs. Additionally, including TENs in the gas or electric rate base—as has been the recent trend in U.S. TENs pilots—has pros and cons in terms of rate impacts in the short and long term, and may create a misalignment if costs are shared with other ratepayers while benefits are not.

That is why the BDA recently launched another initiative on TENs, with two objectives:

1. To reduce deployment risks for TENs through regulatory innovation and targeted reform for all ownership models; and

2. To define when, where, and how existing utilities could play a larger role.

This three-year project will provide the opportunity to explore and address these aspects in greater depth.

Thermal Energy Regulation: Building on the different ownership models observed across jurisdictions, it is important to consider how thermal energy networks are—or could be—regulated. Industry players had a range of perspectives on the need for economic regulation of TENs akin to how gas and electric utilities are regulated. While some highlighted the potential benefits of a more regulated approach, such as greater standardization, transparency and consumer protection, others felt this would risk stifling innovation and limiting utility profits. Under any approach, effective de-risking is critical to securing long-term customer confidence in TENs and enabling promoters to access the financing needed for scale.

The table below summarizes the role of regulation in scaling TENs gathered from the interviews:

Why Regulation Matters	Implications
Investor confidence	Enables utilities and private partners to recover costs through approved rates, reducing investment risk and making projects more attractive to investors
Transparency and customer protection	Ensures oversight of pricing, with transparency for customers regarding rates and billing structures, and stability over the long term
Service quality and safety	Provides stable and reliable services, fostering customer trust
Flexibility within regulatory oversight	Varied models (e.g., public, private, hybrid) can operate under the same regulatory framework

Policy and Regulatory Landscape Across Canada

In Canada, provincial and municipal governments together possess the most effective policy tools to facilitate the growth of TENs. While municipalities currently exert the most influence over TENs deployment, their authority is delegated by provincial governments, which means provincial action is often necessary to establish the enabling conditions that support municipal initiatives.

Until now, provincial leadership has not kept pace with TENs' potential impact. This has led to fragmented progress across the country: while some municipalities, utilities, and developers are advancing ambitious TENs projects, others remain constrained by policy gaps or lack of coordination.

As for the federal government, it has limited direct jurisdiction over TENs but plays an important role in setting national direction, harmonizing standards, and offering financial support.

Municipal TEN Policy Levers

Municipalities have several policy tools to support TENs, including land-use planning, municipal bylaws, fees, and rights of way. These tools can also be shaped and reinforced by provincial and federal policy levers, which are described in more detail in the sections below.

Land-Use Planning is a fundamental responsibility of municipalities. It encompasses a range of planning instruments, from high-level, municipality-wide Official Plans to detailed, site-specific plans. These tools are primarily intended to guide new development and redevelopment projects. While land-use planning can also influence the existing built environment, this ability is often limited by grandfathering provisions. Some steps in the land-use planning process are mandated by legislation and therefore statutory, while others are considered best practices that support sound urban planning and decision-making.

Municipal land-use planning can facilitate TENs expansion in several ways: Master Community Plans (Official Plans) can set long-term policy direction and guidance to encourage the growth of TENs and other low-carbon energy solutions; local energy planning such as Community Energy Plans can identify opportunities to integrate TENs at a neighbourhood scale; while neighbourhood/secondary and subdivision plans can provide more detailed TENs requirements at a community or site-specific level. The table below summarizes the features and limitations of these planning tools.

Land-Use Planning Tool	Purpose & Role in TENs	Key Features	Limitations / Notes
Master Community Plans (Official Plans)	Provide the overarching policy framework for all land uses; set high-level support for TEN	Can include goals like emissions reduction, energy security, and climate resilience; reviewed every ~5 years	Slow to update; in some provinces only lower-tier municipalities can implement them
Neighborhood Plans (Secondary Plans)	Guide detailed development in specific areas; can mandate TEN connections or emissions standards	Statutory; can require new buildings to meet higher standards, connect to TEN as condition for approval, or include TENs-ready HVAC designs to help future-proof	Can be appealed easily, which may delay or increase costs
Subdivision Plans	Address infrastructure placement (e.g., TEN nodes, piping); enforce TEN-related requirements at site level	May require an Integrated Energy Strategy from developers	Focused on infrastructure and land division; late-stage planning
Community Energy Plans	Identify energy demand; guide TEN feasibility and planning	Often inform Official Plans or Secondary Plans; may include thermal load mapping	Typically, don't assess thermal supply scenarios unless expanded into Clean Heat Planning

Clean Heat Planning: Municipal clean heat plans typically involve assessing local heating needs and identifying optimal options to reduce emissions, according to many factors including forecasted grid constraints, fossil phaseout requirements and gas system right-sizing, availability of waste heat sources, and equity concerns. Solutions include energy efficiency, heating electrification, renewable gases and TENs. By shifting away from building-by-building decision making, municipalities can exercise greater control over the pace and trajectory of decarbonization, while improving speed, equity, and efficiency of implementation.

Municipal Bylaws: Municipalities have the authority to define and enforce bylaws. These bylaws can play a key role in supporting the development of TENs through:

- **Mandatory TEN connections:** Municipalities can require certain buildings to connect to TENs infrastructure. This is typically enforced through site plan approvals, rezoning conditions, or standalone bylaws.
- **Green building/development standards:** Some municipalities have the authority to enforce stricter requirements than provincial building codes and set emissions and energy performance targets based on building characteristics. Green development standards can encourage connections to low-carbon TEN systems and may also require developers to evaluate TENs feasibility for new developments above a certain size.
- **Building (emissions) performance standard (BPS or BEPS):** Some Canadian municipalities are introducing energy and/or emissions minimum performance requirements for existing large buildings. Unlike green standards, which guide new building design, building performance standards apply to existing buildings and focus on measured outcomes, with phased increases in performance thresholds. Vancouver has the only active BEPS, while Montréal (soon all of Québec) and Toronto require disclosure and are considering performance thresholds.

Fees & Rights of Ways: Municipalities can levy service fees, such as development charges, and determine permissible uses of public land and rights-of-way through land leasing and land sales. Municipalities could partly use these fees to fund TENs infrastructure.

Mandatory Heating & Cooling Planning in Europe

In Europe, municipalities are playing a leading role in local heating and cooling transitions. But crucially, this leadership is supported by strong mandates and frameworks from higher levels of government. In 2023, the European Union introduced a requirement for member states to require and facilitate local heating and cooling plans in cities with more than 45,000 residents. These plans must outline optimal transition pathways at the neighbourhood level and support coordinated planning of local energy infrastructure. Key elements include spatially targeted policies for building retrofits, active citizen engagement, and strong leadership from local governments.

This mandate also creates an opportunity to provide clarity on where TENs could be developed, where gas grids might be phased out or studied further, and where upgrades to the electric system may be needed to support decarbonization efforts.

In Europe, TENs are increasingly seen as a key part of the solution to decarbonize heating in dense urban areas. The graphic below shows national targets for several European countries, highlighting the significant scale-up planned over the coming decades.

Current Market Penetration	Target Penetration
14%	30% (2030)
5%	25% (2050)
3.5%	15% (2035)
2%	20% (2050)

Figure 7 *- Sample European TENs Penetration Targets*

In Denmark, 100 per cent of the country is covered by clean heat planning for TENs, driven by municipal heat planning laws and regulations. Since 1979, the Danish Heat Supply Act has required municipalities to map, analyze, and designate specific zones for TENs, natural gas, or individual heating solutions. These zoning decisions are guided by socio-economic, technical, and energy efficiency criteria, ensuring that energy infrastructure is planned in a coordinated and optimized manner across the country.

Municipalities play a vital role in advancing TENs, but scaling deployment also requires provincial leadership through clear mandates, support for utility participation, and a stable regulatory framework.

Provincial Policy Levers

Provincial governments have a unique opportunity to take a direct, hands-on role in advancing the thermal energy sector. Yet across Canada, most provinces have not established the essential enabling regulatory frameworks to support the development of TENs. Provinces can help shape the role of energy utilities, the construction industry, consumers, and municipalities (e.g., by supporting capacity building, supporting building and carbon policies and regulation, funding capital and development costs, and promoting integrated energy infrastructure planning). Provinces also play a critical role in defining the future of the gas industry.

Based on our interviews, TENs industry stakeholders expressed a desire to see provincial governments assume a more active role in TENs development. This should at minimum include establishing a favourable regulatory environment to support their growth where they deliver value-added benefits.

	Energy Code Adoption (Part 3)	Municipal Code Adoption Authority	Carbon Pricing And Gas Transition Policies	Thermal Energy Regulation	Mandatory Clean Heat Planning
Yukon	-	✓			
British Columbia	Tier 2/3 Tier 5 - Net Zero (2030)	✓		✓	
Northwest Territories	-	✓			
Alberta	Tier 1	Tier 1		✓	
Saskatchewan	Tier 1	✓			
Manitoba	Tier 1	Tier 1			
Nunavut	-	-			
Ontario	Tier 1	Tier 1			
Quebec	Tier 1	✓	✓	⧗	
New Brunswick	Tier 2 Tier 4 (2030)	-			
Newfoundland & Labrador	-	✓			-
Prince Edward Island	Tier 1	✓			
Nova Scotia	Tier 1 Tier 3 (2029)	-		Tier 1 Tier 3 (2029)	

Effect on TENs Adoption: Negative | Neutral | Positive

Legend: ✓ Implemented | ⧗ Pending

__Figure 8__ – Overview of TENs-Enabling Provincial Policies Across Canada

The U.S. experience reinforces this point (see the *TEN Regulation & Pilots in the U.S.* call out box that follows): in every case where thermal energy legislation has advanced meaningfully, it has been through state-level action.

Energy Code Adoption: According to industry stakeholders, one of the most powerful tools for advancing TENs adoption is the implementation of stringent energy and carbon building codes. Without clear requirements for buildings to be low-carbon, TENs struggle to compete with conventional, often cheaper, high-emission systems. Moreover, many energy codes do not adequately account for shared thermal systems and may disadvantage TENs if compliance metrics don't value their efficiency and carbon benefits. This was a key criticism of BC's original Energy Step Code, which led to the introduction of a separate Carbon Step Code, and there are issues with purchased energy's assumptions in the model code, as highlighted in the Federal policy levers below.

Thermal Energy Regulation: Provinces can regulate the production, distribution, and sale of thermal energy. As of May 2025, only one provincial energy regulator—the BC Utilities Commission (BCUC)—has developed a regulatory framework for thermal utilities. Otherwise, Québec, Ontario, and Manitoba have seen some early developments regarding thermal regulation. The shortage of provincial regulatory initiatives is in stark contrast to the growing number of U.S. states (15 as of May 2025) that have passed or are developing legislation to support the growth of thermal energy networks.[3]

TEN Regulation & Pilots in the U.S.

In the United States, TENs development is primarily driven by a shift in state-level utility mandates to diversify from natural gas and include thermal energy, positioning existing gas and electric utilities as central actors in the transition. TEN regulation is evolving rapidly; as of now, eight states have passed legislation, and 11 states have introduced TENs-enabling bills in state legislatures. At their core, most of these laws authorize (and in some cases require) energy utilities and municipalities to pilot, own, and operate TENs. They also consider a broader set of policies for successful TEN deployment, such as:

Utility Clean Heat Planning: Clean Heat Planning is a policy tool used by governments to require key market actors—including utilities and heating equipment manufacturers—to transition new and existing buildings to low-carbon heating sources. The main goal of clean heat planning is to reduce greenhouse gas emissions from space and water heating to help achieve climate change targets.

Several states have introduced mandatory clean heat planning. Colorado, for example, requires natural gas utilities to submit plans to reduce natural gas consumption and cut emissions 22 per cent by 2030 from a 2015 baseline. The state also allows local governments to explore neighbourhood-scale clean heat projects, such as TENs, to reduce natural gas use in new or existing developments.

Non-Pipeline Alternatives: In Massachusetts, a modification to the "obligation-to-serve" allows a utility to provide non-combusting thermal energy to a customer instead of gas.

Encourage Waste Heat Recovery: In Minnesota, the state Pollution Control Agency has the authority to promote practices that support the recovery and use of waste heat from wastewater treatment operations.

3 Building Decarbonization Coalition (2025). Thermal Energy Networks (TENs) State Legislation.

Municipal Building Code / Green Standard Adoption: Some provinces grant municipalities the authority to adopt stricter energy and carbon requirements within their jurisdictions. This flexibility has proven valuable, as many large Canadian cities are recognized for their energy transition leadership. Allowing municipalities to go beyond provincial minimum standards creates fertile ground for TENs adoption, especially in dense urban areas where these systems are often most viable. The ability to set such bylaws was rolled back in Alberta in 2023, and the Ontario government's recent enactment of Bill 17 introduces changes that may similarly constrain municipal authority, though to what extent remains unclear.

Carbon Pricing and Gas Transition Policies: Consumer carbon taxes can significantly shift heating economics by increasing the price of fossil fuel heating, thus making low-carbon TENs more competitive. In April 2025, the federal government repealed the consumer carbon price, effectively removing it in most provinces. BC followed shortly after, eliminating the consumer portion of its carbon tax while retaining the industrial component. Provinces retain the authority to establish their own carbon pricing systems. Québec remains an exception, continuing to operate its cap-and-trade program, also called the carbon market. This system sets a price on carbon based on supply and demand of carbon "permits", thereby requiring large businesses to reduce their GHG emissions and/or pay for the pollution generated.

Provinces also have other policy tools to level the playing field between fossil fuel energy sources and low-carbon alternatives. These include introducing renewable gas retail targets or carbon caps on gas distributors, setting clear rules for gas system expansion (e.g. extension policies), or adjusting depreciation rates, amortization periods and revenue horizon timeframes to guide the future role of gas in a low-carbon future.

Federal Policy Levers

The federal government plays an influential role in decarbonizing the building sector by setting a consistent national direction and acting as a unifying force from coast to coast to coast. The federal government's overarching strategy for net-zero buildings—the Canada Green Buildings Strategy—includes a major focus on electrification and demand-side management but has little to say on thermal energy networks.[4]

Beyond setting strategic direction, the federal government has several other levers that can directly or indirectly support the adoption of TENs.

Funding and Financing: Through grants, low-interest loans, or public-private partnerships, the federal government can deploy capital to de-risk and close the investment gap for TENs. The Canada Infrastructure Bank (CIB) has made major investments in low-carbon TENs, leveraging additional private financing. The Federal government also funded the Federation of Canadian Municipalities' Green Municipal Fund, which provides financing and funding for community energy systems such as TENs.[5]

4 Natural Resources Canada (2025). The Canada Green Buildings Strategy: Transforming Canada's buildings sector for a net-zero and resilient future

5 Canada Infrastructure Bank (2023). Underground Thermal Networks Key To Net-Zero Emissions Goal.

Model Building & Energy Codes: The federal government plays a key role in shaping national energy policy through the development of model codes. While the authority to adopt and enforce these codes ultimately rests with the provinces, national codes can provide a harmonized framework that supports energy efficiency and building decarbonization. This coordinated approach creates favourable conditions for the broader adoption of TENs, while still allowing provinces the flexibility to adopt the codes directly or adapt them to suit regional priorities.

> The model code's treatment of system boundaries poses challenges for TENs. For example, the code classifies thermal energy from a TEN as purchased energy, applying an assumed coefficient of performance (COP) of only 1.0 — which puts networked heat pumps at a disadvantage compared to those installed directly at the building level.

Leading By Example: The federal government owns and operates a substantial portfolio of buildings nationwide, encompassing military bases, correctional institutions, and other federal facilities. As one of the largest owners and operators of TENs, it is well-positioned to lead by example. A forward-looking strategy could ensure that all new federal buildings are connected to a TEN or ready for future connection. Moreover, existing federal TENs could be extended beyond the boundaries of federal properties to help support nearby networks. These systems could act as anchor loads or serve as the foundation for new TENs in surrounding communities.

The federal Greening Government Strategy[6] ets strong emissions reduction targets for new construction and major retrofits, and recent initiatives include the Centre Block Rehabilitation Project, which includes connection to the Cliff district energy plant and a network of geoexchange boreholes to store excess heat energy.[7]

Research & Innovation: In addition to its policy role, the federal government supports the advancement of sustainable energy pathways, including TENs, through research and innovation led by departments and agencies such as Natural Resources Canada (NRCan) and the National Research Council (NRC).

6 Treasury Board of Canada Secretariat (2025). Greening Government Strategy: A Government of Canada Directive

7 Public Services and Procurement Canada (2025). About the Centre Block project.

Why TENs Aren't Scaling (Yet)

Despite their strong potential to support decarbonization, TENs face a range of barriers that limit broader adoption. Some of these challenges are common to all low-carbon heating solutions, while others are specific to TENs. These challenges are not solely technical in nature; they stem largely from unclear governance, uneven market conditions, and gaps in awareness, regulation, and capacity. This section explores the main barriers and uncertainties surrounding TENs adoption.

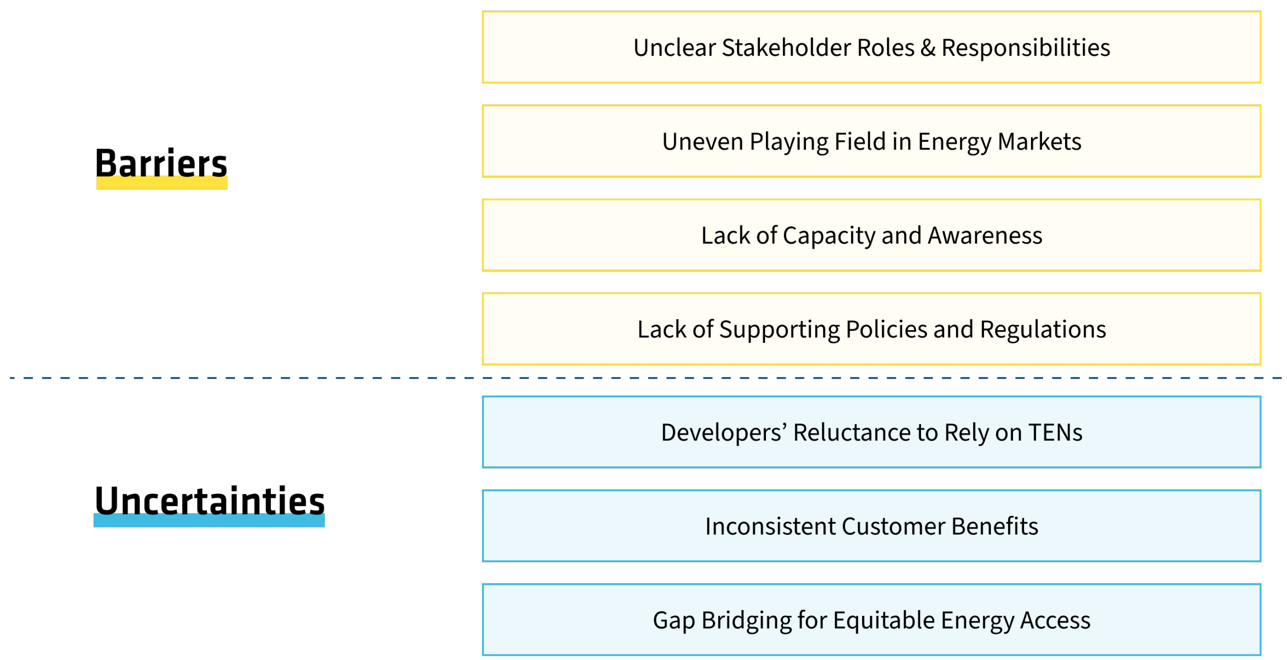

Figure 9 *– TENs Face Several Barriers and Uncertainties Restricting Their Uptake*

Unclear Stakeholder Roles & Responsibilities: Many TENs projects lack clear leadership, with defined responsibilities and a designated entity responsible for championing and coordinating the project development. This gap results in fragmented project development, where a single actor often identifies the opportunity and takes on both the developer and champion roles. While other stakeholders may participate, their involvement varies widely depending on capacity, expertise, and priorities. The absence of a structured process makes it difficult for each party to understand their role and collaborate effectively. By contrast, connecting a project to electricity or gas follows a well-defined, consistent process with few variations.

Uneven Playing Field in the Energy Market: TENs face major structural disadvantages compared to gas. At the utility level, gas utilities benefit from a long-standing regulatory framework that allows them to recover infrastructure costs through rates, often amortized over decades and spread across a large customer base. In contrast, new TENs typically lack this financial structure and must recover infrastructure costs directly from the limited set of customers they serve through long-term contracts. Gas remains a strong default in new developments, often seen as essential for marketability, especially for cooking. Without clear decarbonization or electrification mandates or cost-sharing mechanisms, low-carbon options struggle to compete.

The figure below provides an overview of typical differences between gas infrastructures and TENs, although these comparisons may not apply in every situation, as conditions can vary significantly by jurisdiction, ownership model, and project context.

Gas Piping Infrastructures		Themal Energy Networks
Franchise Agreement Have streamlined access to rights-of-way through established legislation and regulatory frameworks, allowing them to install infrastructure efficiently with municipal coordination.	**Access to Rights of Ways**	**No Special Agreement** Lack statutory rights, requiring case-by-case negotiations that often lead to longer timelines, higher costs, and more uncertainty.
Fixed and Regulated Gas utilities in Canada typically offer regulated returns in the range of 6–9%, backed by stable, long-term cost recovery mechanisms.	**Return On Investment**	**Variable and Uncertain** Generally TENs target higher returns (10–15% or more) to compensate for greater market, policy, and demand risks.
40 – 50 years Benefits from regulatory certainty, ensuring cost recovery through stable rates. Their durable assets, like underground pipelines, require minimal maintenance and serve consistent demand from heating.	**Amortization Period**	**15 - 30 Years** Even with comparable life spans, TENs are subject to shorter amortization periods and higher annual cost recovery requirements, since there is no regulatory protection and revenue streams are more variable.
Discounted to Customers Connections are generally low-cost for customers, often subsidized or included in regulated rates. Utilities recover these costs over time through their broad customer base.	**Customer Connection**	**No Financial Relief** TENs often requires higher upfront investment from the customer. Without standardized regulatory treatment, TEN projects typically recover connection costs through direct contributions without subsidy.

Figure 10 *– Overview of the Differences Between Gas Infrastructures and TENs.*

Lack of Capacity and Awareness: Municipalities often play a key role in the development of TENs, yet with limited budgets, competing operational priorities, and a lack of in-house energy or TENs expertise, cities often miss opportunities simply because they cannot identify or act on them. Electric utilities and developers also face similar challenges. This is compounded by the absence of infrastructure and waste heat mapping at the local and provincial level, making it even harder to plan or prioritize energy networks. Financial constraints also lead to a cautious approach, discouraging investment in unfamiliar infrastructure like TENs.

Lack of Supporting Policies and Regulations: Municipalities are not required to engage in energy planning or consider TENs, leading to uneven progress across the country. While some cities show leadership and use every available tool, others remain passive, waiting for provincial direction. Yet provinces themselves, despite having climate targets, have introduced few policies to support TENs or building decarbonization. Weak energy codes, limited oversight of thermal energy, lack of funding (for study or development), and the absence of mandates for local integrated energy planning all reflect a broader lack of supporting TEN policies and regulations. Moreover, without early planning, particularly for long lead-time public infrastructure like hospitals or campuses, TENs opportunities are often missed. Utilities and municipalities need to coordinate at the distribution level and align with public-sector capital cycles, where the best time to plan for a future TEN is years before construction begins. So, until strong policies are in place, such as mandatory connections or existing building performance standards, TENs cannot be expected to decarbonize beyond the current requirements for buildings they would serve.

Developers' Reluctance to Rely on TENs: A frequently cited barrier to TEN adoption is the reluctance of developers to rely on these systems during building construction. Developers tend to prioritize supply-side logistics—such as project timelines, construction coordination, and cost control, over long-term energy infrastructure considerations. As a result, they may hesitate to commit to connecting to a TEN unless they can be assured the network will be operational by the time the building is commissioned. This uncertainty around the timing and availability of TEN infrastructure makes developers more likely to default to conventional, self-contained HVAC (heating, ventilation, and air conditioning) systems. Additionally, another major challenge is the issue of split incentives: real-estate developers often have little motivation to invest in higher-cost, lower-carbon infrastructure, because they do not directly benefit from those savings.

Inconsistent Customer Benefits: While it is clear that most stakeholders stand to benefit from the strategic deployment of TENs, it is crucial to reinforce and ensure that users will also benefit from the infrastructure. Recent surveys on the operations and consumer experience of TENs in the United Kingdom highlight a mix of progress and persistent challenges (see the *UK TEN Customer National Survey Results* call out box that follows). While consumer satisfaction has improved since 2017 and heating costs remain relatively low, heat networks still face reliability, communication, and regulatory consistency issues. Operators vary widely in their practices and priorities, and consumers and providers alike show low engagement with the system's environmental potential.

Although comparable surveys do not exist for Canadian TENs, the City of Vancouver—which operates the False Creek Neighbourhood Utility—has reported no significant service interruptions to heating and hot water, and stable energy rates for customers since 2010.[8]

8 City of Vancouver (2025). False Creek Neighbourhood Energy Utility (NEU). Utility customers

UK TEN Customer National Survey Results

The 2022 survey compared heat network users and non-users to assess heating system impacts. It included 2,244 consumer responses and 1,733 matched non-user responses. Interview data came from 130 network operators.

1. **Uneven Consumer Costs and Experiences:** Although the average annual bill for heat network users is lower (£600 vs. £960), cost variation is high, with 1 in 10 consumers reporting paying £2,000 or more*. Heat network users also experience more outages (50% vs. 29%**) and are more likely to file complaints. Only 39 per cent*** of those who complain are satisfied with how their complaint is handled, and many face barriers to doing so, such as unclear contacts or fear of landlord retaliation.

2. **Low Consumer Engagement and Transparency:** While more consumers receive bills and contracts than in 2017, many still find the information unclear—especially households with vulnerable members. Clear billing is linked to perceptions of fairness, yet nearly one in three say their bill lacks sufficient detail.

3. **Limited Environmental Commitment:** Most consumers (79%) support low-carbon heating in principle, but only 40 per cent are willing to pay more for it. On the operator side, 44 per cent still use no low-carbon heat sources, though many of those express willingness to switch. Environmental strategies are more common among operators with a broader sustainability focus.

* One key reason for cost variability is that gas and electricity network charges are averaged across large ratepayer pools, while heat networks are more localized and reflect actual system costs.

** Structural characteristics like centralized systems, planned maintenance, and network ownership variations inherently increase outage frequency and severity for heat network users.

*** Complaints largely stem from outages, unpredictable high bills, and inadequate information either pre- or post-installation.

Gap Bridging for Equitable Energy Access: Effective engagement with communities, especially those that are historically under-prioritized, requires a fundamental shift in how energy projects like TENs are approached. Many of these communities face urgent challenges, such as housing, affordability, and overcrowding, making discussions about new energy technologies feel out of touch. Past infrastructure efforts have often excluded them entirely, leaving little awareness or understanding of systems like TENs. Assuming readiness or interest without first investing in relationships and co-creating solutions risks repeating past mistakes.

The Opportunity: Why TENs Matter

In certain contexts, TENs can offer a compelling pathway to deliver clean, efficient heating and cooling at scale. This section explores key success factors for TENs deployment and highlights potential energy and economic opportunities unlocked by TENs.

Key Success Factors for TENs

From our interviews with more than 30 stakeholders in the energy and building sectors, we heard broad agreement on the typical demographic and technical conditions for successful implementation. Most importantly, stakeholders identified a clear preference for greenfield TENs developments alongside new construction, especially when they meet the following criteria:

1. **Medium to High-Density New Developments:** Areas with sufficient building concentration to support network efficiency and infrastructure investment. A recent study by McMaster University found that 70 per cent of Canadians live in areas where home heating needs could be met by TENs.[9] To

2. **Mixed-Use Projects with Diverse Thermal Loads:** Developments that combine residential, commercial, and institutional buildings, creating complementary heating and cooling demand profiles.

3. **Availability of Waste Heat and Anchor Loads:** Opportunities to recover waste heat from sources like sewers, data centers, or industrial facilities, alongside stable, high-demand users such as hospitals or university campuses. However, reliance on waste heat can introduce a risk, as these loads may fluctuate or disappear in the long-term due to economic or policy changes.

Conversely, non-networked, distributed heating equipment approaches may be more appropriate to decarbonize existing buildings in certain contexts, such as low-density new developments and zones with little thermal load diversity and/or no anchor loads. Nevertheless, networked systems can still benefit from economies of scale, even in the absence of load diversity, and may enable access to cost-effective resources like waste heat that individual buildings cannot leverage. In Europe, much of the expansion of heat networks is focused on existing buildings. Coordinating heat planning and long-term community energy strategies can help minimize system-wide costs and lay the groundwork for future integration.

9 McMaster University (2024). New publication outlines promising role of Thermal Networks in supporting low-carbon heating for Canadian buildings.

Energy Opportunities

1. **Capturing Untapped Waste Heat Potential:** Canada has significant waste heat energy potential. One study estimated that Québec could meet ~40 per cent of its residential heating demand (64–81 petajoules) by recovering waste heat from large-scale sources.[10] o understand why TENs can unlock this potential, it's important to grasp the basics of heat recovery.

> **Heat Recovery in Buildings 101**
>
> Many buildings release valuable thermal energy through exhaust air, boiler flues, or warm wastewater. Recovering this energy and redirecting it—such as to preheat ventilation air or domestic hot water—can significantly increase energy efficiency and reduce GHG emissions. Effective heat recovery requires consideration of several factors:
>
> - *Source Quality:* Higher, more stable temperatures and flow rates improve recovery potential.
> - *Heat Demand:* Recovered heat must match a real and consistent thermal need.
> - *Timing:* Heat supply and demand must align, or storage will be needed.
> - *Proximity:* Locating heat sources and sinks close together improves efficiency.
> - *Site Specifics:* Risks like air contamination, condensation, corrosion, or flow mismatches must be addressed.

While various technologies can recover waste heat, TENs are especially effective at capturing and distributing it across multiple buildings. Unlike standalone HVAC systems, which often miss opportunities due to isolated demand profiles, TENs pool diverse waste heat sources and user profiles, turning waste heat into a shared energy resource. This networked approach greatly improves the chances of aligning waste heat availability with real-time demand.

Local governments can identify and support waste heat recovery opportunities. For example, the City of Toronto's Wastewater Energy Map highlights sites with potential for thermal energy recovery from sewer systems. Québec's Waste Heat Map serves a similar purpose, supplemented by targeted provincial incentives to support waste heat feasibility studies and TENs implementation.

2. **Increase Clean Energy Access—Efficient and Decarbonized Heating and Cooling at Scale:** Most building owners, particularly in the residential sector, place little importance on the type of heating system as long as it works reliably and keeps operating costs reasonable. Convincing each individual owner to adopt cleaner, more efficient systems like geoexchange or heat pumps can be slow, resource-intensive, and ultimately limit the pace of decarbonization. In addition, HVAC choices are often driven by upfront cost, with developers and contractors lacking long-term incentives to bridge the gap between the

10 Marcotte, B., & Kummert, M. (2024). Évaluation du potentiel technico-économique de valorisation des rejets thermiques au Québec.

cost of low-carbon energy and conventional energy sources when buildings have no formal requirements to lower GHG emissions.

TENs offer a scalable and effective alternative. By centralizing clean thermal infrastructure and shifting investment from individual buildings to networked systems, TENs may improve access to high-performance technologies such as geoexchange systems, air-source heat pumps, and other renewables. This approach makes advanced systems viable in settings where they would otherwise be financially out of reach, helping accelerate the transition without relying solely on individual consumer decisions.

> *"By investing in infrastructure to move thermal energy—regardless of whether it's sourced from carbon-intensive or carbon-free systems—you create flexibility. You can decarbonize what's feasible today and phase out the rest of the carbon sources over time, as it becomes practical, just like Scandinavia has done."*
>
> *— **John Rathbone**, CEO & Co-Founder, Rathco ENG*

3. **Centralize to Optimize Efficiency, Equipment Reduction and Long-Term Performance:** Centralization may allow for a reduction in total installed capacity by balancing diversified and offsetting thermal demands across multiple buildings, which can lead to cost reductions. It also enables greater diversification of heat sources and allows for cost-effective integration of thermal storage, which is often more challenging at the building scale. Additionally, when combined with technologies like geoexchange or other renewable sources, fewer resources, such as boreholes or wells, are needed to deliver the same output and benefits at scale, resulting in additional cost savings. Moreover, TENs usually enable better monitoring and optimization of system performance, ensuring long-term efficiency, better financial performance, and reliability.

Economic Opportunities

1. **Electric Grid Infrastructure Savings:** TENs can serve as a complementary pathway, particularly in high-density areas or where infrastructure timelines, costs, or local constraints pose challenges to full electrification in the near term. Moreover, they can represent a promising pathway to delay or eliminate infrastructure investments at some saturated nodes, as well as overall power generation. This is particularly important as heating electrification drives increased winter peak demand in many regions.

2. **Gas Utility Transition:** TENs offer natural gas utilities a promising avenue to diversify their business models. In Canada, several utilities have experience developing TENs projects either as part of their unregulated business (Énergir in Québec) or through standalone entities (FortisBC Alternative Energy Services). As these utilities navigate the energy transition, their experience with pipeline infrastructure, existing rights of way, and established customer relationships position them as key players in the deployment of TENs. Their existing assets and workforce can be leveraged and repurposed to support this emerging thermal energy solution, facilitating a smoother and more coordinated transition.

3. **Integrated Resource Planning and TENs:** Some jurisdictions in Canada are moving towards integrated planning of the electric and gas systems. Historically these systems have been planned and overseen separately, but due to several factors—including the transition to net zero, a greater focus on fuel-switching and electrification, and challenges potentially encountered by full electrification in the near term—there is now a move to more closely coordinate the two. Integrated planning at the distribution level (local clean heat planning) could be encouraged, where utilities engage with local governments, developers, and communities on shared energy solutions like TENs. The BC Utilities Commission (BCUC) recognized in 2020 that "business-as-usual" integrated resource planning (IRP) was no longer an option and asked its major gas and electric utilities to work more closely to share forecasts and assumptions when developing their plans.[11] Ontario and Québec have followed BC's lead by taking steps to integrate electric and gas IRP planning. In June 2025, Ontario released its first "Integrated Energy Resource Plan", considering all sources of energy and taking a long-term view to support growth in demand while maintaining reliability and affordability.[12]eanwhile, Québec's Bill 69, enacted in June 2025, mandated the creation of a 25-year integrated energy resource management plan (IERMP) with targets for electricity, gas, and other energy sources.[13]

Catalysing Growth: Solutions to Help Scale TENs

Unlocking the full potential of TENs requires more than recognizing their benefits—it demands removing the barriers and uncertainties that currently hold them back. While TENs can offer compelling advantages in specific contexts, their success depends on key players' involvement.

This section explores who the key players are in making TENs happen and what roles they can play to move projects forward. It also presents a practical three-step framework with concrete actions to help scale up TENs in a way that complements existing solutions.

11 Energy Regulation Quarterly (2025). The future of integrated resource planning: How integrated should it be?

12 Ontario Ministry of Energy and Mines (2025). Energy for Generations.

13 Assemblée nationale du Québec (2025). Bill 69, An Act to ensure the responsible governance of energy resources and to amend various legislative provisions.

Key TENs Players Roles and Responsibilities

By clarifying responsibilities and creating the right conditions for success amongst key stakeholders, TENs can become one of several tools in Canada's broader effort to transition toward low-carbon, resilient communities.

KEY TEN STAKEHOLDER	POTENTIAL ROLE
Municipal Government	Ensure the decarbonization of new and existing developments through area-based planning, permitting, and support for TEN deployment.
Provincial Government	Create favourable market conditions for decarbonization of buildings, and develop a clear policy and regulatory framework for thermal energy, coordinated with gas and electric sectors as well as building regulations. Clarify the vision on gas grid transition.
Federal Government	Provide funding (grants, loans, insurance) and support provinces through the creation of a robust model energy code that goes beyond energy efficiency to include carbon.
Gas Utilities	Leverage their skilled workforce for TEN deployment and bridge provincial gaps like leading pilot projects and shaping thermal utilities approach.
Electric Utilities	Optimize grid investment and ensure the availability of clean power to achieve high-scale electrification, support non-wires alternatives, and align rate design and incentives with local decarbonization strategies.
Builders & Developers	Lead innovation in construction practices and bring valuable operational skills.
Energy Regulators	Protect TEN customers and ensure they have access to transparency, reliability, and energy price stability, once thermal energy is within regulatory scope.

Proposed Framework

Several actions can be developed to help scale TENs in a way that complements existing non-networked heating systems. They are described in this section and detailed further in the Appendix.

1. **Level the TENs playing field:** Due to competition with conventional gas and electric systems, very few TENs projects are launched each year in Canada, even when key conditions are met. To rebalance the market, it is essential to tilt the playing field towards decarbonization by establishing a supportive ecosystem for decarbonization and leveling the playing field to ensure that TENs receive the same regulatory and financial treatment as electricity and gas infrastructure.

   Favorable decarbonization policies would benefit not only TENs but also a wide range of efficient, low-carbon energy solutions. Stronger building codes and green standards are a key part of this ecosystem. Raising minimum performance requirements helps prevent efficient systems from being undercut by outdated, low-upfront cost fossil fuel options.

   Clear mandates for building decarbonization are also essential. Voluntary action is not enough: there must be accountability for delivering results. Progress would be achieved by requiring municipalities to use clean heat planning for new buildings and by using utility-driven strategies for existing buildings.

Field of Application	Actions
Priority Actions	
Policy & Regulatory	Build and announce a clear code adoption roadmap toward net-zero emissions, establishing targets for TENs deployment.
	Impose mandatory clean heat planning for utilities and mid- to large-size municipalities.
	Support longer amortization periods for TENs piping infrastructure, where appropriate.
Supporting Actions	
Policy & Regulatory	Adapt NECB to account for TENs energy efficiency and decarbonization potential.
	Implement TENs regulatory mechanisms to set a policy framework, which could include items such as mandatory TENs pilots, implementing a thermal utility, and modernizing a gas utility's obligation to serve.
	Allow municipalities to adopt tailored regulatory frameworks that reflect local conditions and priorities, including mandatory building performance standards and green standards.

2. **Let strategic TENs opportunities emerge:** Once TENs can compete fairly with other decarbonization and energy supply approaches, jurisdictions and utilities can use innovative planning tools such as local clean heat planning (commonly used in European cities) to prioritize how and where to deploy TENs and other decarbonization solutions to provide the most value to communities. This approach involves identifying areas where key demographic and technical conditions align, such as population density, load diversity, access to waste heat, or suitability for new developments (where network integration can be planned up front and costs effectively managed), local grid constraints, and potential avoided gas and electricity infrastructure costs, while prioritizing low- or zero-carbon energy sources where possible.

Field of Application	Actions
Priority Actions	
Planning	Create and share detailed geospatial maps of TENs and waste heat sources.
Planning	Commit to a TENs penetration target.
Policy & Regulatory	Implement clean heat planning with clear identification of decentralized vs community energy approach through TENs and microgrids.
Supporting Actions	
Stakeholder Engagement	Ensure underrepresented groups can voice their needs and help them create their own custom TENs approach.
Policy & Regulatory	Enforce disclosure of thermal waste to enhance resource mapping.
Planning	Establish a coordinating entity to support territorial planning at the regional or multi-municipality scale, helping to ease the burden on small and mid-sized municipalities.

3. **Unlock TENs delivery at scale:** In neighborhoods where TENs represent the most promising decarbonization option, targeted enabling strategies and policies should be applied to support their deployment. These may include TEN-ready building design standards, mandatory connection bylaws for new developments, and other policy and regulatory tools that facilitate network build-out. Additionally, de-risking mechanisms for municipalities, developers, and building owners, such as financial support, transparency, technical support, or streamlined permitting, can play a critical role in accelerating adoption and ensuring successful implementation.

Field of Application	Actions
Priority Actions	
Economic & Financial	Reduce financial barriers with subsidies, tax credits, low-cost financing, and/or insurance schemes. Share TENs economics benefits (such as avoided capacity and infrastructure costs) with developers and users.
Economic & Financial	Develop business case archetypes with detailed ownership structures, clear demographics, energy rates, and other facilitating conditions and regulations.
Planning	Ensure industry readiness by mapping and developing skills at every level (e.g., university programs, trades, municipalities, and utilities).
Planning	Implement strong customer protection mechanisms to ensure fairness, resiliency, and affordability.
Stakeholder Engagement	Raise awareness among developers on TENs benefits and provide tangible evidence of their reliability.
Stakeholder Engagement	Develop legislative tools and clear guidelines for municipalities to support TENs adoption.
Supporting Actions	
Policy & Regulatory	Assess whether and how thermal energy should be regulated to reflect the unique characteristics of TENs and public policy objectives for TENs related to decarbonization.
Stakeholder Engagement	Develop and promote a clear, compelling, accessible narrative for TENs to build public understanding and familiarity, similar to that of electricity and natural gas.
Planning	Demonstrate feasibility and benefits through pilot projects.
Planning	Enable non-governmental buildings to connect to federally owned TENs, and vice versa. Establish clear connection guidelines

Overall, a more coherent theory of change is needed, rather than opportunity-driven approaches. Clear roles must be defined for the various key players, to help move toward a structured framework. The enabling strategies identified in the previous tables illustrate the range of interventions needed to scale TENs, going through regulatory and policy actions, financing, planning, and stakeholder engagement.

Unlocking the Potential of TENs: Key Lessons Learned

TENs are not a one-size-fits-all solution, but they may offer a valuable tool in the broader effort to decarbonize heating, particularly when deployed in the right contexts. As governments, utilities, and developers explore strategies to reduce building emissions and improve infrastructure resilience, TENs present a potential pathway worth evaluating alongside other low-carbon options.

TENs can provide advantages, such as improved efficiency, lower peak electricity demand, and access to clean non-electric heat sources, but only where enabling conditions exist.

However, most Canadian TENs remain small-scale and publicly owned, and significant barriers remain around regulatory clarity, municipal capacity, utility involvement, equitable costs, and investments de-risking. Without policy and regulatory changes, the sector is unlikely to grow beyond niche applications.

In the end, the decision to advance TENs should be grounded in local realities, rigorous analysis, and a clear understanding of trade-offs. Where those align, TENs may offer a scalable contribution to Canada's transition to low-carbon future.

Coming Soon from the BDA: TENs Policy Framework and Decision Support Toolkit
Following the research findings and this white paper, and incorporating our modeling results, the next stage of this project will focus on developing a policy framework and decision support toolkit to guide the deployment of TENs across Canada. Key actions will include:

1. **Modeling of Techno-Economic Benefits of TENs:** This analysis will quantify the technical, economic, and achievable potential of different TENs archetypes to reduce energy consumption, emissions and peak loads across Canada, comparing them to alternative decarbonization pathways (e.g., air-source heat pumps, business-as-usual scenarios).

2. **Development of a Decision Support Toolkit:** Key components of the toolkit will be identified and stakeholder inputs will be gathered to initiate this phase. Based on this, the toolkit will be developed to help government and other key TENs players in their decision-making processes about TENs implementation.

3. **Draft a Policy Framework:** Using findings from this research and modeling, a policy brief will be drafted to outline regulatory conditions needed for enabling TENs. This brief will explore several mechanisms and will likely include prototype by-laws and/or policy templates.

4. **Stakeholder Engagement:** A series of workshops will be organized to present the results of the toolkit and policy framework to collect feedback. Final tools and materials will be shared with stakeholders and published for broader use, equipping decision-makers with additional resources to support TENs at scale.

Building Decarbonization Alliance pour la décarbonation des bâtiments

Appendix – Detailed Proposed Framework

1. Level the TENs Playing Field

Field of Application	Actions	Roles & Impact: Municipalities	Provincial	Federal	Gas Utilities	Electric Utilities	Developers	Operators	Initiatives to Monitor
Priority Actions									
Policy & Regulatory	Build and announce a clear code adoption roadmap toward net zero emissions, establishing targets for TENs deployment.		P	C			C		BC Zero Carbon Step Code adoption
Policy & Regulatory	Impose mandatory clean heat planning for utilities and mid- to large-size municipalities.	C	P		C	C			Europe mandatory heat & Cooling Planning Colorado Clean-Heat planning
Policy & Regulatory	Support longer amortization periods for TENs piping infrastructure where appropriate.		P						-
Supporting Actions									
Policy & Regulatory	Adapt NECB to account for TENs energy efficiency and decarbonization potential.		C	P					-
Policy & Regulatory	Implement TENs regulatory mechanisms to set a policy framework, which could include items such as mandatory TENs pilots, implementing a thermal utility, and modernizing a gas utility's obligation to serve.		P		C				Monitor U.S. TEN regulation adoption QC Bill 69
Policy & Regulatory	Allow municipalities to adopt tailored regulatory frameworks that reflect local conditions and priorities including mandatory building performance standards and green standards.	C	P				C		Vancouver MBPS New York MBPS Lessons-learned from Toronto Green Standard

P: Primary lead C: Collaborator Impacted by the action

2. Drive TENs Growth Where It Creates the Most Benefit

Field of Application	Actions	Roles & Impact: Municipalities	Provincial	Federal	Gas Utilities	Electric Utilities	Developers	Operators	Initiatives to Monitor
Priority Actions									
Planning	Create and share detailed geospatial maps of TENs and waste heat sources.	**P**	**C**	**C**					QC waste heat map Open TO Sewer map
Planning	Commit to a TENs penetration target.	**C**	**P**	**C**					EU TENs Targets
Policy & Regulatory	Implement clean heat planning with clear identification of decentralized vs community energy approach through TENs and microgrids.	**P**			**C**	**C**	**C**		-
Supporting Actions									
Stakeholder Engagement	Allow underrepresented groups to voice their needs and help them create their own custom TENs approach.	**P**					**C**		Montréal, Eco-Quartier Louvain-Est Northwest Territories.
Policy & Regulatory	Enforce disclosure of thermal waste to enhance resource mapping.	**C**	**P**						-
Planning	Establish a coordinating entity to support territorial planning at the regional or multi-municipality scale, helping to ease the burden on small and mid-sized municipalities.	**P**	**C**						CCET: Centre for Community Energy Transformation European centers of excellence for heat planning

P: Primary lead C: Collaborator Impacted by the action

3. Enabling Strategies to Scale TENs

Field of Application	Actions	Roles & Impact: Municipalities	Provincial	Federal	Gas Utilities	Electric Utilities	Developers	Operators	Initiatives to Monitor
Priority Actions									
Economic & Financial	Reduce financial barriers with subsidies, tax credits, low-cost financing, and/or insurance schemes. Share TENs economics benefits (such as avoided capacity and infrastructure costs) with developers and users.	C	P	P	P	P			QC Environment Ministry Waste Heat grants
Economic & Financial	Develop business case archetypes with detailed ownership structures, clear demographics, energy rates, and other facilitating conditions & regulations.	C	C		C	C	C	P	BDA work
Planning	Ensure industry readiness by mapping and developing skills at every level (e.g., university programs, trades, municipalities & utilities).		P	C			C	C	-
Planning	Implement strong customer protection mechanisms to ensure fairness, resiliency and affordability.		P						Alberta Rate of Last Resort (RoLR)
Stakeholder Engagement	Raise awareness among developers on TENs benefits and provide tangible evidence of their reliability.	P	C			C			
Stakeholder Engagement	Develop legislative tools and clear guidelines for municipalities to support TENs adoption.	P	C	C					FCM CES Accelerate program
Supporting Actions									
Policy & Regulatory	Assess whether and how thermal energy should be regulated to reflect the unique characteristics of TENs and public policy objectives for TENs related to decarbonization.	C	P		C		C		BCUC thermal regulation
Stakeholder Engagement	Develop and promote a clear, compelling, accessible narrative for TENs to build public understanding and familiarity, similar to that of electricity and natural gas.	C	P	C	C	C			Blatchford Energy Utility's rate structure and messaging.
Planning	Demonstrate feasibility and benefits through pilot projects.	C	C		P	C			Canada: See case studies US: Framingham, MA
Planning	Enable non-governmental buildings to connect to federally owned TENs, and vice versa. Establish clear connection guidelines			P					-

P: Primary lead C: Collaborator Impacted by the action