How to Get a Head Start on a Thermal Energy Network

Whether or not you're ready to launch a project now, you can lay the groundwork for an effective process and a successful project.

To get a head start on a Thermal Energy Network (TEN), it helps to know your buildings and local thermal energy resources, to be aware of upcoming local developments, to add TENs to local and regional plans, and to upgrade systems in need of replacement with a TEN in mind.

1. Inventory thermal energy resources.

What thermal energy is already generated in your community? What facilities or spaces could provide heat to nearby buildings and/or receive excess heat or cooling?

Identify local thermal energy resources such as:

- Grocery stores and large refrigeration centers,
- Ice arenas,
- Wastewater treatment facilities,
- Data processing centers, including buildings that house telephone or internet facilities,
- Breweries, distilleries, bakeries, factories,
- Ponds or reservoirs,
- Office buildings with central cooling systems and year-round cooling loads, or
- Other industrial facilities.

Thermal Energy Resources

A *thermal energy resource* can add heat to a TEN or receive excess heating or cooling, helping to balance thermal loads among buildings. Thus, a thermal energy resource can be a thermal *source* or a thermal *sink*. Generally, a promising thermal energy resource is approximately ¼ mile away from buildings that can use the heating or cooling it provides.

- **Waste heat from buildings:** Excess heat vented from large buildings can be harvested and recirculated in a Thermal Energy Network.
- **Waste heat from wastewater:** Wastewater treatment plants and sewer lines are reliable sources of heat and can also accept excess thermal energy to cool other buildings.
- **Thermal energy resources and TEN customers:** As heating and cooling needs shift from one season to another, an owner of thermal energy resources can both provide heat to other buildings and also be a customer in a network, helping to balance thermal loads among buildings.

This resource was developed by Vermont Community Thermal Networks in consultation with and including valuable contributions from the Thermal Energy Network Team supported by Energy Action Network.

- **Geothermal is a thermal energy resource:** As you look for thermal energy resources in your community, include spaces that could host a geothermal borefield or loop field—a place that could be used for laying pipe and/or drilling shallow boreholes and could later be replanted or repaved and returned to its original purpose. A geothermal borefield or loop field can benefit a TEN by diversifying sources of thermal energy and adding thermal storage underground. Geothermal systems can be developed in a variety of ways using various technologies.
- **Surface water can be a thermal energy resource**: Heat exchanging plates or coils can be sunk into lakes, ponds, and other bodies of water. Surface water can be an effective thermal source and sink at different times of year. Environmental review is needed to ensure that any fluctuations in water temperatures do no harm to local species and ecological balance.
- **Other thermal energy resources:** Additional thermal energy resources such as thermal energy storage, solar thermal, or other technologies may be considered depending on local building or community opportunities.

One example of surface water as a thermal energy resource:

WaterFurnace, a leading heat pump manufacturer, has been heating and cooling its 115,000 square foot headquarters for over 34 years using an adjacent three-acre pond.

Their heat exchange loop consists of 12 zones on the bottom of the eight-foot-deep pond. Each zone is constructed from 15 300-foot-long coils of three-quarter-inch pipe connected to the building by two-inch supply and return lines.

In the winter, the underwater pipes capture and move the moderate temperature from the bottom of the pond to heat pumps inside the building, which amplify it for space heating and hot water. In the summer, the heat pumps remove heat from the building to create cooling, returning that heat to the pond or venting it.

During the summer, the pond loop doubles the efficiency of conventional cooling. In the winter when the pond's surface is frozen, the loop is four times more efficient than electric resistance heating and provides considerable savings when compared to the highest-efficiency gas systems.

▶ *For an overview and examples of how a TEN can use existing heat watch this short Thermal Energy Networks video: tiny.cc/tens-video.*

For an introduction to waste heat and thermal energy resources, see:

- Moving Heat*: How Thermal Energy Networks repurpose existing heat*
- Energy from Wastewater*: Capturing and reusing thermal energy from wastewater*

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2. Inventory potential TEN buildings.

Which buildings are most TEN-ready and could be prioritized to connect to local thermal energy resources?

- Identify a large municipal, institutional, or privately-owned building that could be an anchor customer (and potentially a thermal energy resource) for a TEN.
- List buildings, then group them in clusters that could form the first node of a TEN, a route or corridor for a TEN, and areas for future network expansion.
- Consider whether a building contains available space to host equipment, such as a mechanical room or basement.
- Note building improvements needed such as weatherization and electric capacity upgrades like electric panels, meters, and utility service upgrades.[1]
- Identify existing buildings that contain TEN-ready distribution systems (*see item 5 below for more detail*) such as ducted heating and cooling, low temperature hydronic distribution, or other systems that need less complex retrofits to connect to a TEN.
- Prioritize buildings, including affordable housing developments, with oil or propane systems that could greatly benefit from lower-cost, non-emitting thermal energy.

3. Create a simple map.

- Locate potential thermal energy resources.
- Note distances between those resources and large buildings and residential or commercial areas. What is within ¼ mile?
- Mark open land, such as a green space or parking area, that could host a geothermal borefield.

4. Identify upcoming development projects.

Good timing for a TEN can be informed by upcoming local improvements and developments. Knowing what's already being planned or permitted can inform where and when to start. As long as complementary projects are in the early stages, there can be time to plan for a TEN.

Consult local leaders:

- City council or selectboard,
- Town commissions or committees such as a planning commission, energy committee and/or coordinators, housing or recreation committee,
- Municipal staff: planners, manager, clerk,
- Regional planning commission staff,
- Economic development agencies or organizations,
- Schools and higher education leadership, or
- Others such as housing organizations and community institutions or businesses.

1. The level of electrical upgrades needed for a TEN varies case by case. When a project is outlined, electric capacity needed can be estimated, but is different for every building and project.

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Ask:

- Where are infrastructure plans in the works, such as replacing water or wastewater pipes, roadwork, etc?
- Where are new housing, commercial, industrial, or mixed-use developments being planned?
- Are any of these developers considering all-electric construction, including a geothermal system or a TEN?

If you started with Where and When a Thermal Energy Network Makes Sense, you may already have compiled much of this information.

5. Add TENs to local and regional plans.

Using steps 1-4 above, you can further support TEN development by explicitly adding TENs to local and regional planning documents. Specific language about TENs included in these plans can provide ways to meet existing infrastructure, energy, and community resilience goals.

Work with your local or regional planners to add wording on TENs that:

- **Identifies thermal energy resources in your plan's infrastructure section (see 1 above).**
  - Describe how and where waste heat can be captured and reused in existing or future buildings.
  - Note how including TENs also supports energy efficiency and conservation goals.
- **Includes a brief description of TENs.**
  - Highlight how using TENs to electrify buildings significantly reduces the amount of energy consumed to heat and cool homes, community spaces, and businesses.
  - Describe local opportunities to incorporate TENs in your plan's energy element/ enhanced energy plan (see 2-4 above).
- **Factors TENs into planning discussions and processes.**
  - Look for opportunities to bring TENs into local planning for smart growth, zoning (e.g. considerations of density and mixed-uses), housing, etc.
  - Include how TENs can play an important role in reducing both greenhouse gas emissions and demands on electric infrastructure capacity.

In addition, you can ask your municipality to add two ways to encourage TEN development:

- **Create incentives for TEN-ready buildings.**[2]
  - Zoning bonuses or incentives can help real estate developers create more housing units or less parking if the project is all-electric or is TEN-ready. Local real estate developers can be engaged in the TEN planning process in the same way they cooperate with municipalities on other infrastructure planning. Aligning their interests with TEN development can accelerate TEN deployment and reduce overall costs.

2. See Climate Change and Land Use (ccrpcvt.org/wp-content/uploads/2022/05/Climate-Change-and-Land-Use_Standard-Resolution_20220524.pdf) for a variety of other strategies that could be expanded to include TENs and considered at the local and regional levels.

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- **Tie TEN-ready work into building or infrastructure capital plans.**
  - A municipality or local government can coordinate TEN plans as it advances other infrastructure work like stormwater drainage or roadway work. Any planned infrastructure work affecting rights of way should consider potential TENs to reduce project costs and timelines.

6. Retrofit buildings along a potential TEN route.

Preparing buildings to connect to a TEN can be accomplished at any time and will benefit whatever heating and cooling systems are in place until a TEN can be built.

If the terms below are new to you, consult a heating and cooling expert such as an HVAC installer or engineer.

Three Ways to Make a Building TEN-ready:

- **Weatherize and improve the building envelope.**
  - Many older buildings need insulation, air sealing, or new windows and doors to take advantage of the efficiencies a TEN provides. This work is beneficial whenever it can be performed, as it reduces the need for oversized heating and cooling equipment and lowers customer bills.
- **Upgrade electric capacity.**
  - While TENs are highly efficient and use significantly less electricity to heat and cool, it is important to ensure a building's electric capacity is sufficient to connect to a TEN. Gather information on current electric systems in potential buildings to share with a TEN developer or designer.
- **Retrofit existing thermal distribution systems.**
  - When replacing an aging heating system, choose a replacement system that accepts low temperature heat and is ready to connect to a TEN. Low temperature water-based systems and low velocity air ductwork systems are easily retrofitted to work for a TEN.

TEN-ready Indoor Heating and Cooling Systems

Planning for a TEN includes identifying the heating, ventilation, and air conditioning (HVAC) systems that already exist in buildings. Some indoor systems are easy to connect to a TEN, some will require adjustments, and others will need to be replaced.

For details on indoor systems for TENs, see vctn.org/s/Compatible-HVAC-Systems.pdf.

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