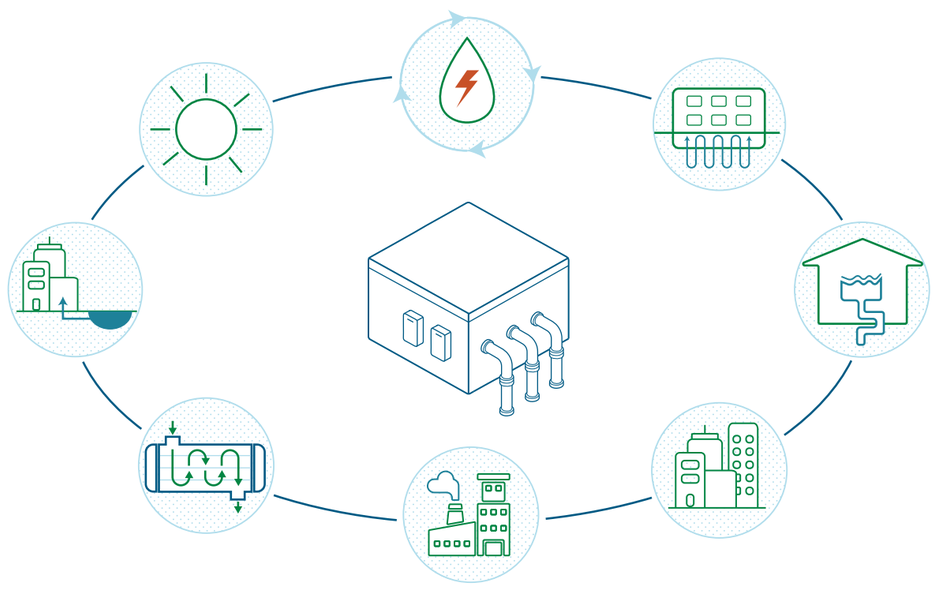
Net Zero Building Retrofit Guides

Low Carbon District Energy

Technology Companion Guide



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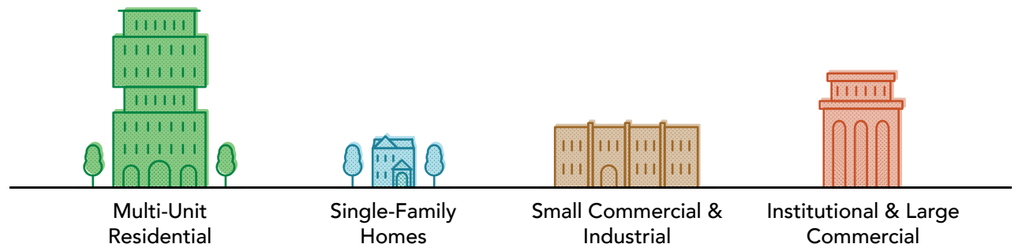

Co-benefits

Resilience	Indoor Air Quality	Occupant Comfort	Property Value
■■■□	□□□□	□□□□	■■■□

Impacts

Emissions Reduction	Utility Savings	Capital Cost	Maintenance Requirements
■■■■	■□□□	■■■□	■□□□

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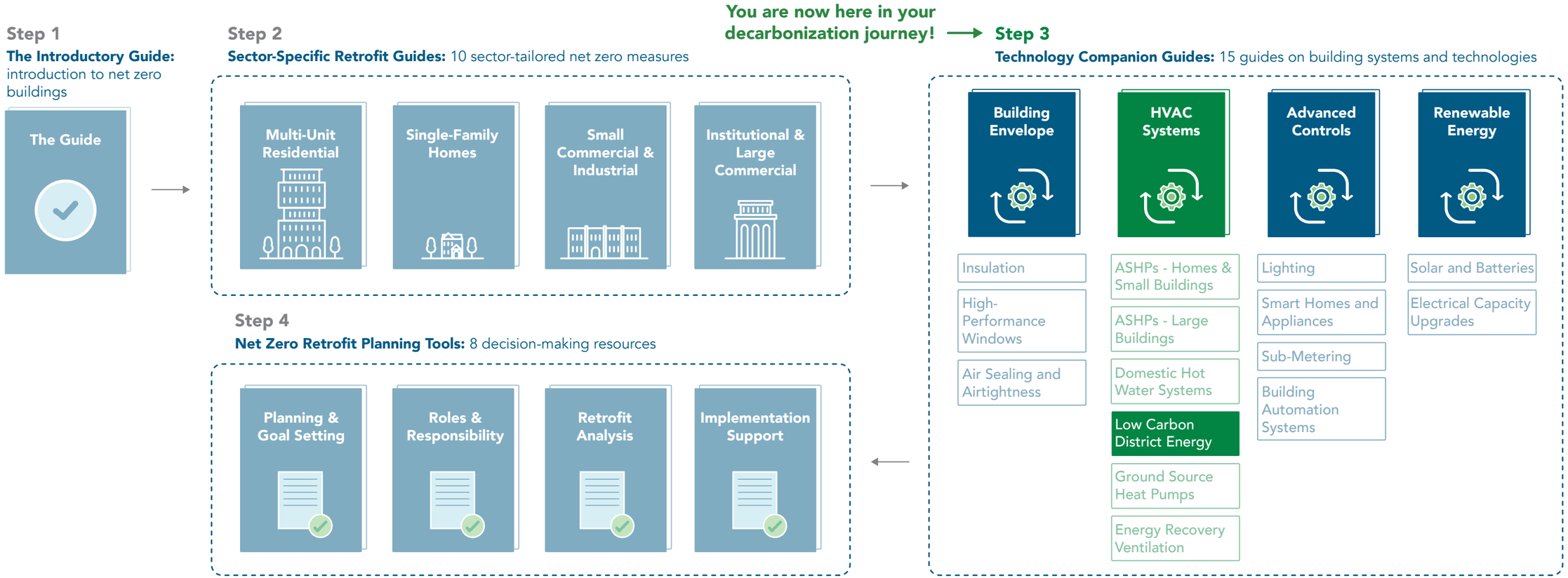
Navigating the Net Zero Building Retrofit Guides

Reducing Greenhouse Gas (GHG) emissions is a journey. It's also an opportunity to make your building more comfortable, healthier, valuable, and resilient to extreme weather events. Successfully arriving at your net zero destination requires careful planning and the right travel companions to ensure a smooth trip.

The City of Toronto's **Net Zero Building Retrofit Guides** include a range of documents designed to support home and building owners reduce GHG emissions from their buildings.

1. **The Introductory Guide** introduces the topic of "net zero buildings." The guide's goal is to familiarize all home and building owners with Toronto's net zero goals and concepts.
2. **The Sector-Specific Retrofit Guides** highlight net zero measures tailored to each building sector and type. These guides provide direction to plan and implement retrofit projects specific to your building.
3. **The Technology Companion Guides** provide technical information about building systems and technologies related to net zero measures and retrofits.
4. **The Net Zero Retrofit Planning Tools** provide decision-making resources to help home and building owners prioritize their retrofit projects. The tools include needs assessments, checklists, and support for contractor selection.



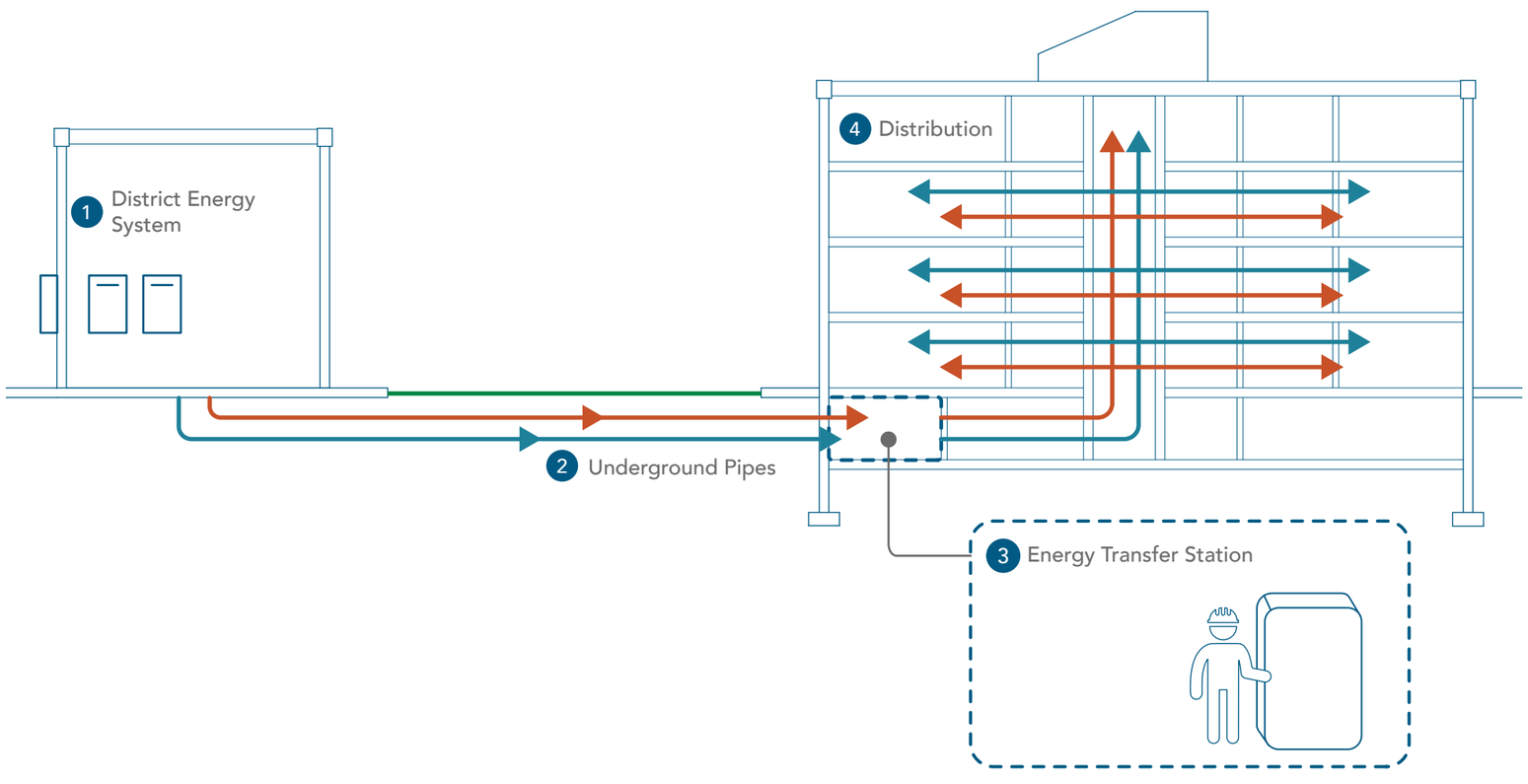
Net Zero Building Retrofit Guides Document Navigation

Low Carbon District Energy

What Is This Technology

District energy systems are large, interconnected heating and cooling systems that serve several buildings within a small geographical area. In Toronto, energy sources can include deep lake water cooling, wastewater recovery, geo-exchange systems, thermal networks, and solar thermal.

District energy systems are sometimes owned and operated by a third party, and building owners pay for these heating and cooling services similar to how they pay for water or electricity. Your building can connect to existing district energy systems, if they are available, or you can create a low carbon district energy system by collaborating with other neighbouring building owners.



Retrofit technology explained

How Low Carbon District Energy Works

Low carbon district energy systems work by distributing thermal energy (heating and cooling) to multiple buildings through an interconnected network of pipes. The key components of low carbon district energy are:

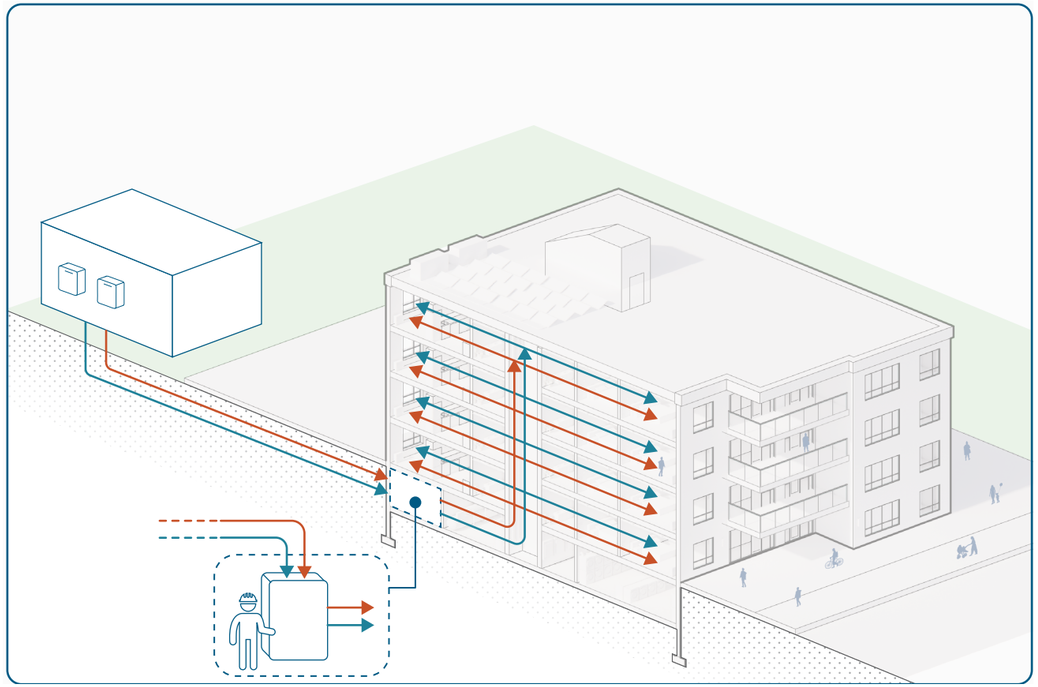
1. A central district energy system, which produces hot water for heating or chilled water for cooling.
2. Large underground pipes, which deliver hot and chilled water underground to buildings to supply their heating and cooling needs.
3. An energy transfer station located in the basement of your building, which consists of piping, pumps, and heat exchangers. It is the connection point between your building and the district energy system.
4. Energy distribution through your building, which integrates with your existing heating, ventilation, and cooling systems.

When to Retrofit This System

Major renovations or planned upgrades to HVAC systems may prompt building owners to consider connecting to or developing a new district energy system. District energy systems can even be considered for as few as two buildings with balanced heating and cooling needs.

Why Retrofit This System

Low carbon district energy provides energy with reduced emissions, costs, and maintenance, making it more efficient and potentially cost effective for building owners. They tap into local, low carbon energy sources and can recover and redistribute energy that is rejected from building processes. By reducing energy consumption, you can decrease reliance on utilities and protect yourself from rising energy costs, all while lowering GHG emissions.



Typical locations in a building associated with this technology.

Below are co-benefits and impacts to help you better understand this technology.

Co-benefits

Resilience:
Connecting to a district energy network provides built in redundancy, reducing the likelihood of equipment failure and increasing resilience of connected buildings.

Indoor Air Quality:
Low carbon district energy does not impact indoor air quality.

Occupant Comfort:
Low carbon district energy does not impact occupant comfort.

Property Value:
The simplified operation and reduced maintenance, and higher energy efficiency for buildings connected to low carbon district energy systems may enhance the building's marketability and long-term value.

Impacts

Emissions Reduction:
District energy systems are often able to operate more efficiently by sharing excess heating or cooling between buildings. This results in emission reductions across all connected buildings.

Utility Savings:
The efficiencies associated with district energy systems may result in net energy savings. However, the building's heating and cooling will now be considered a utility, which you will continue to pay for.

Capital Cost:
Depending on the type, size, and provider of the low carbon district energy system, capital costs can vary. It is typically a major upgrade to install the infrastructure required connect to district energy systems, but perhaps less costly than installing your own heating and cooling plant.

Maintenance Requirements:
District energy systems share heating and cooling plant equipment to serve the many buildings that connect to the system. This results in lower maintenance for individual buildings as the central equipment is maintained by the district energy provider, or costs are shared across all buildings involved.

Types of Systems and Retrofit Solutions

District energy systems centralize heating and cooling equipment, so local buildings can benefit from the efficiencies of an interconnected energy system. District energy systems deliver heat (or cooling) to an energy transfer station in your building, where you tap into and transfer the energy to your building's hot water or chilled water system.

District energy systems are often owned and operated by a district energy provider. Similar to a utility company, building owners enter into a contract with the district energy provider where they supply energy which is metered and paid for by the building owner.

Here are some available solutions for a low carbon district energy system:

Deep Lake Water Cooling

A large pipe reaches deep into Lake Ontario to bring cold water to buildings as a source of cooling.

Wastewater Recovery

Energy is captured from the wastewater flowing through the city's large sewer pipes underground.

Geo-Exchange

A network of pipes in the ground transfers heat energy between the building and the ground to be used for building heating and cooling.

Thermal Networks

Heat is recovered from buildings and industrial processes. Heat pumps are used to extract heat without burning fossil fuels.

Solar Thermal

A network of pipes absorb the sun's heat. The temperature of the water flowing through these pipes rises before travelling through the system to provide heating.

Here are some options for buildings without low carbon district energy systems in their area:

Partner with an Energy Provider

If there are no district energy system in your area, discuss options with district energy providers about expanding their services to reach your building. This option will likely only be feasible if there are neighboring buildings in your area with large heating and cooling that wish to connect to district energy.

Start a Local District Energy Collective

Collaborate with neighboring building owners to identify and look for opportunities to share energy. For example, if you are planning on installing a large geothermal energy system, consider partnering with your neighbors to share costs and optimize benefits.

How to Implement

Before starting, refer to the **seven-step roadmap to net zero** in the **Introductory Guide** and in your **Sector-Specific Retrofit Guide**, to ensure your retrofit aligns with your overall strategy and goals. Here are a few steps to get you started with a district energy retrofit:

1. Understand your current building heating and cooling needs.
    - o What is the total amount of heat your building requires at peak time?
    - o What is the total amount of cooling your building requires at peak time?
2. Research and contact district energy providers in your area to understand if connection is possible. District energy providers will tell you what retrofits or equipment upgrades are required to connect to their system.
3. Hire experts, like mechanical engineers and contractors, to collaborate with the district energy provider and advise and support you in applying this retrofit to your building. Consider the costs associated with this work. Your experts will also help you with the following steps.
    - o Negotiate and sign a contract with a district energy provider confirming that you agree with the energy supply and associated operational costs.
    - o Hire a contractor with district energy expertise to complete the work. Carefully plan the construction schedule to align with any additional construction required by the district energy provider. Consider this when scheduling your own construction work.

Will District Energy Pay Back?

Every building is unique with its own heating and cooling needs and associated challenges with connecting to a given district energy system. The savings due to increased efficiency, simplified operation, and reduced maintenance should ideally "pay back" the cost of the piping and equipment required to connect your building to a district energy system.

You can use payback calculations to decide if connecting to a district energy system is appropriate for your building.

Opportunities

Evaluate how this retrofit can be integrated with the following building systems to maximize potential synergies and optimize overall performance.

Gas Appliances

HVAC systems must be compatible with district energy, so if you are pursuing district energy, HVAC modifications or system changes may be required.

Building Controls and Automation Systems

Controls integration is necessary for district energy to work well with building systems.

Heating Systems

Domestic Hot Water

Connecting to district energy systems can help your building to reduce GHG emissions related to heating and domestic hot water systems.

Challenges and Solutions

Integrating your building with a district energy system can be challenging. Below are some common challenges you may face and how to solve them.

Challenge 1: Availability

Solution: Check whether you are within the range of an existing district energy piping connection. They are not always locally available.

Challenge 2: Integration Complexity

Solution: Even if a district energy system is within range, integration with existing building infrastructure can be complex and may take many years.

Challenge 3: Balancing Energy Needs

Solution: Ensure that heating and cooling needs are similar and balanced, so you can share excess energy between buildings.

Challenge 4: Space and Clearance

Solution: Leave enough space to house the heat exchanging equipment that connects your building to the district energy system piping. This is often in a dedicated room, known as an energy transfer station, in the basement.

Toronto's Climate Considerations

Due to Toronto's cold, dry winters, there are a few things to consider before connecting to a district energy system. Your service provider will ensure the system is designed correctly for Toronto's cold climate.

Backup Heat

Some building owners keep their original heating equipment as a backup in case district heating fails in winter. Although district energy systems are usually very reliable and have their own backups, having backup heat improves building resilience. Depending on the needs of your building occupants, you may consider maintaining your own heating system for backup heat. To move to net zero, consider using electric resistance heating for backup in place of aging natural gas boilers.

Pipe Insulation

District energy pipes that bring heating and cooling to your building are located below the frost line and must be insulated to minimize heat loss.

Timing of Construction

The cold climate makes it challenging to connect underground piping for district energy. It is recommended to plan construction carefully so that there are no disruptions to heating and risks of freezing for your building.

Ready!

You should now have a better idea of what **Low Carbon District Energy** is, its co-benefits and impacts, and how to implement it in your building given potential synergies and challenges!

Also check your building **Sector-Specific Retrofit Guide** for steps to achieve net zero and visit the other **Technology Companion Guides** to learn more about retrofit measures.

Other guides in the HVAC Systems Technology Companion Guides:

- Air Source Heat Pumps for Homes and Small Buildings
- Air Source Heat Pumps for Large Buildings
- Domestic Hot Water Systems
- Energy Recovery Ventilation
- Ground Source Heat Pumps

Other resources in the Net Zero Building Retrofit Guides:

- The Introductory Guide
- Sector-Specific Retrofit Guides
- Net Zero Retrofit Planning Tools

For more information, please refer to these other City of Toronto resources:

- Net Zero Existing Building Strategy
- Transform TO Net Zero Strategy
- Toronto Green Standard
- Better Buildings Partnership
- Better Homes: Green Resources for Residents
- Energy & Water Reporting for Buildings

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