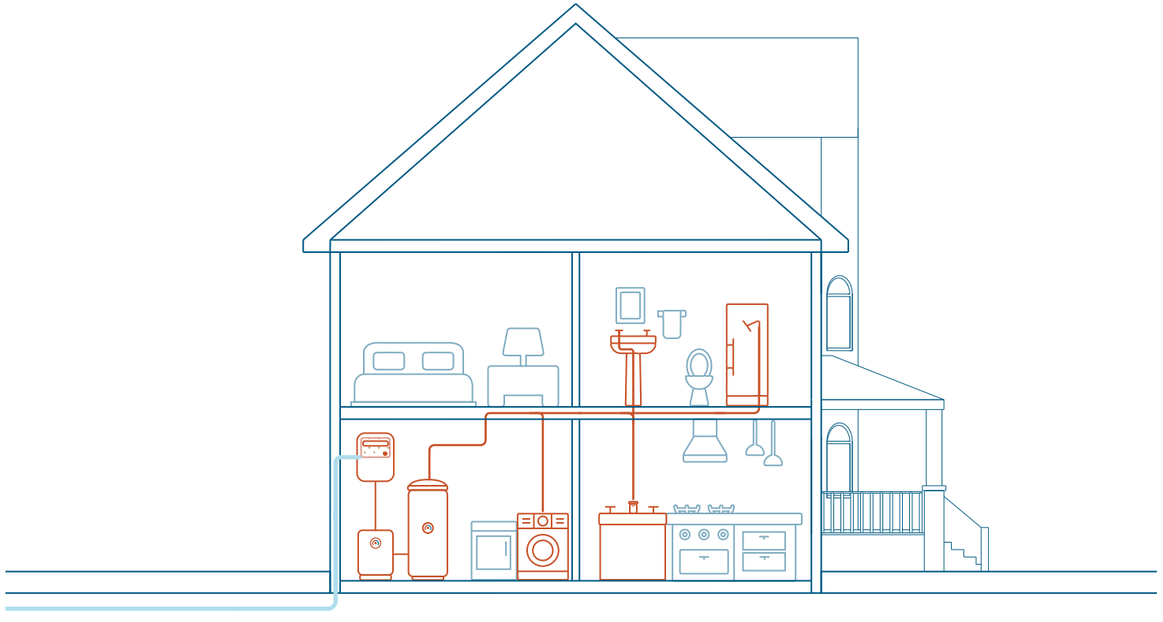
Net Zero Building Retrofit Guides

Domestic Hot Water Systems

Technology Companion Guide



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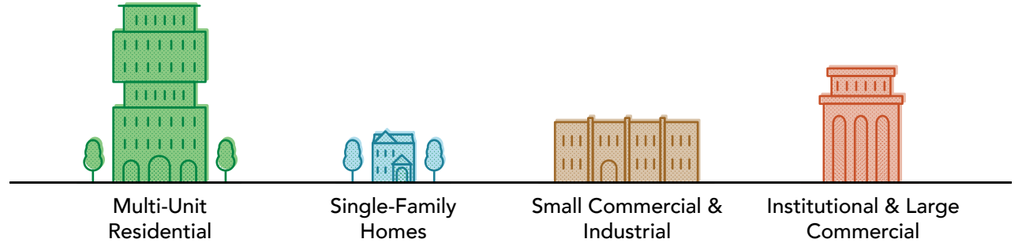

Co-benefits

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

Impacts

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

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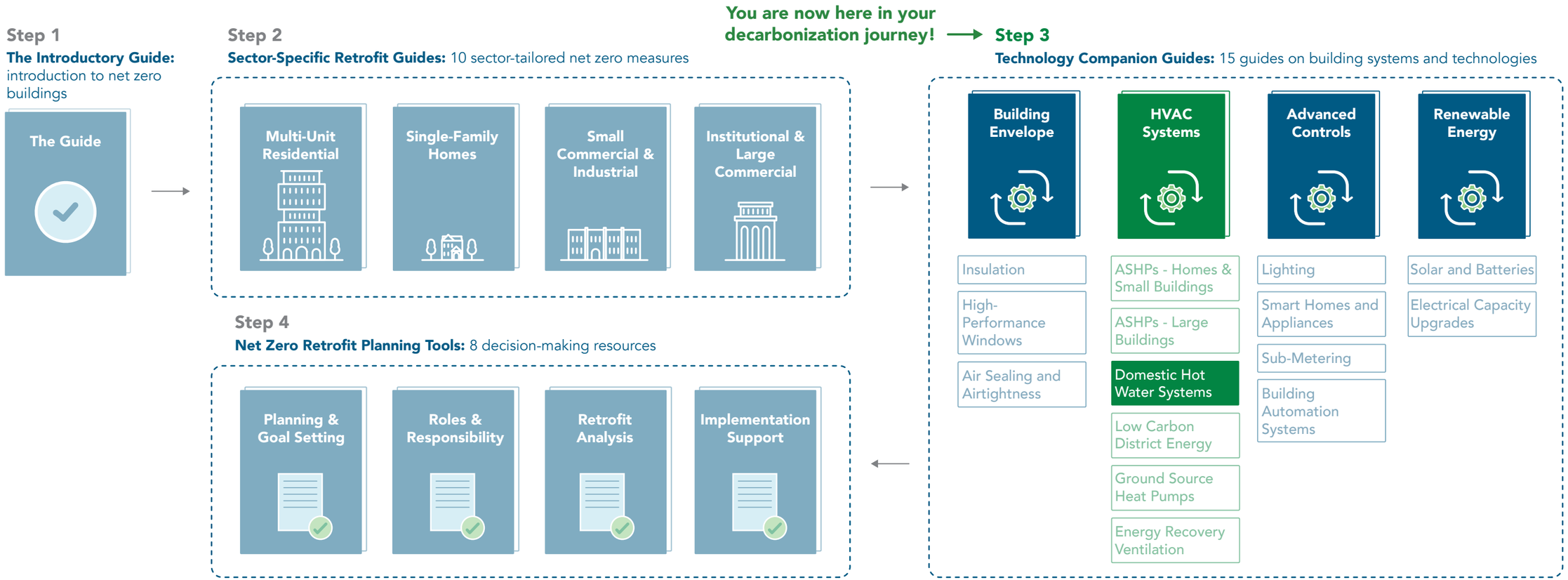
Navigating the Net Zero Building Retrofit Guides

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.

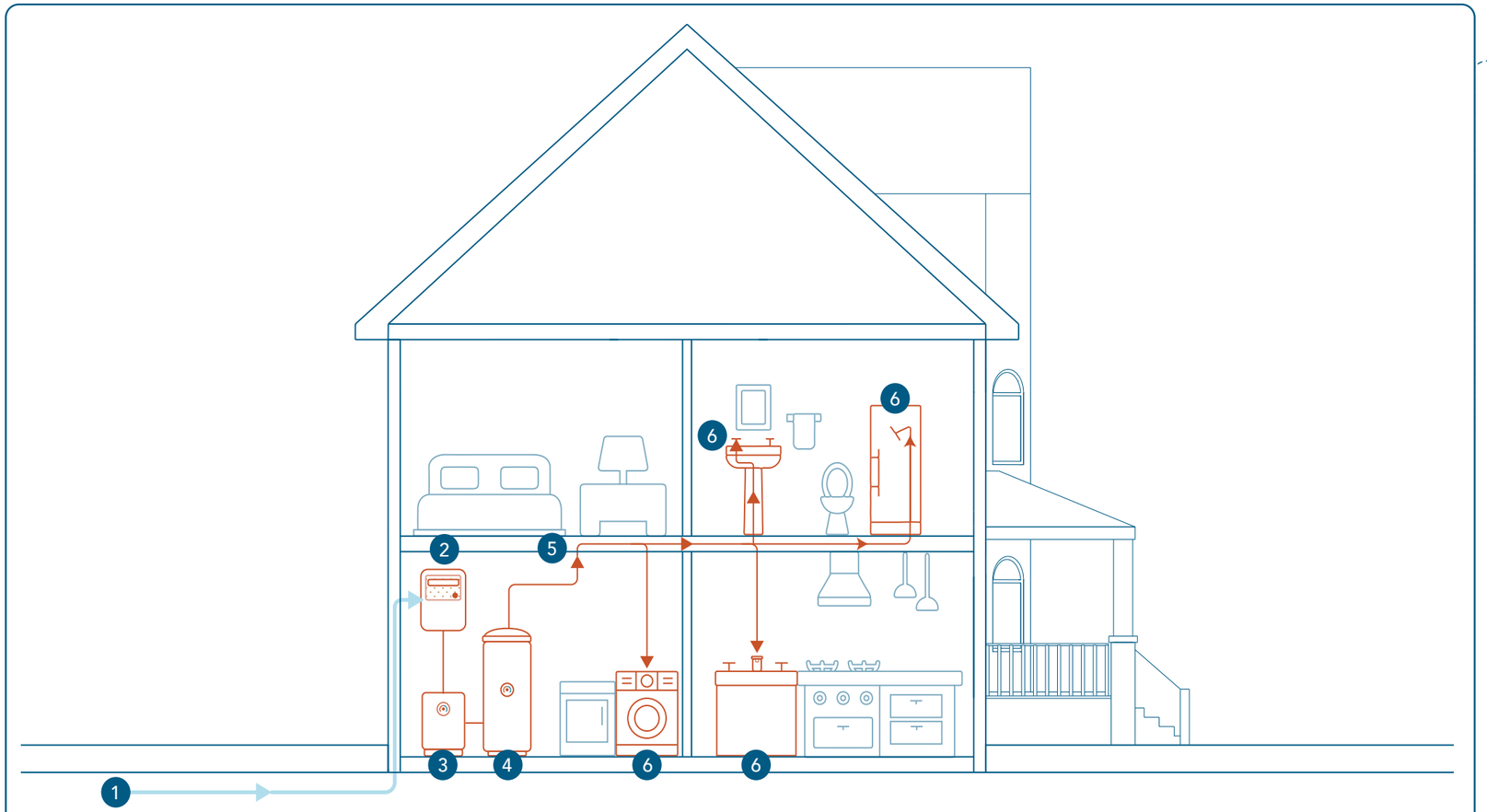


Net Zero Building Retrofit Guides Document Navigation

Domestic Hot Water Systems

What Is This Technology

Domestic Hot Water (DHW) systems supply hot water for uses, such as bathing, cooking, and cleaning. These systems usually include a water meter, water heaters and tanks, pipes, and controls to manage water temperature and flow. Improving these systems involves electrification, high-efficiency water heaters, low-flow fixtures and appliances, and enhanced controls. Electrification significantly reduces GHG emissions due to fuel-switching, while the other improvements reduce energy and water consumption, all while supplying water at the desired temperature.



Retrofit technology explained

How DHW Systems Works

Upgrading a building's hot water system plays a crucial role in improving energy and water efficiency and reducing carbon impact. Here are the key components of an efficient hot water system:

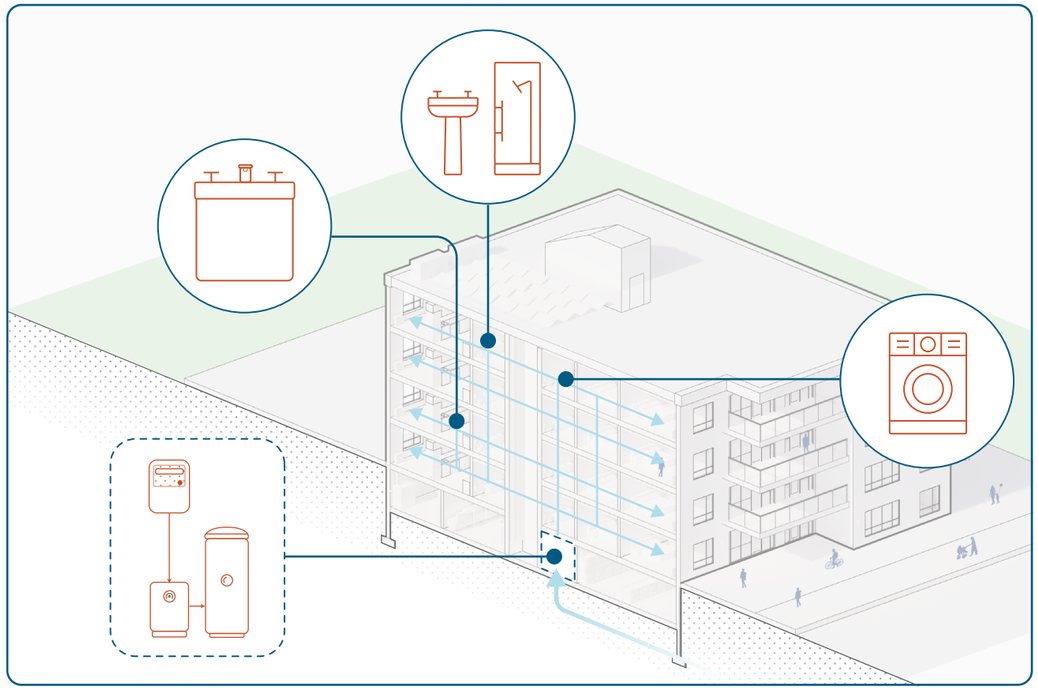
1. Main water line and pipes, which bring water to your building.
2. Water meter, which measures the quantity of water entering your building.
3. Water heaters, including heat pumps and electric water heaters, which heat the water to the desired temperature for end uses like showers, faucets and washing machines.
4. Hot water tanks, which store hot water.
5. Pipes, which bring the water to fixtures (faucets and showerheads) and appliances, (dishwashers and clothes washers).
6. Water fixtures and appliances, which deliver hot water for your needs. Their controls help you choose the water temperature and flow.

When to Retrofit This System

Retrofit for domestic hot water systems are most beneficial when the existing system is old and inefficient. Such retrofits are often undertaken during major building renovations, when replacing fixtures and appliances, or when the current system is approaching the end of its service life.

Why Retrofit This System

Improving domestic hot water systems not only enhances energy efficiency but also contributes to water conservation by integrating efficient fixtures and appliances. These upgrades reduce operational costs and lower GHG emissions by optimizing heat use, minimizing heat loss, and decreasing reliance on high-emission energy sources like natural gas. Given that domestic hot water use is a significant contributor to GHG emissions in buildings, reducing energy and water consumption can decrease reliance on utilities and protect yourself from rising energy cost, 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:
Improved domestic hot water systems can make a building more resilient. For example, super insulated tanks retain heat during power outages, allowing for some hot water use without power.

Indoor Air Quality:
Replacing gas-fired DHW systems with electric ones can improve indoor air quality by eliminating the emission of combustion-related pollutants, such as carbon monoxide and nitrogen dioxide.

Occupant Comfort:
Retrofits to DHW systems do not directly impact occupant comfort.

Property Value:
Upgrading to energy-efficient systems, including fuel switching, can increase property value by reducing operating costs and modernizing infrastructure.

Impacts

Emissions Reduction:
Switching to more efficient DHW systems powered by electricity, rather than natural gas, reduces GHG emissions.

Utility Savings:
Fuel switching to more efficient or renewable energy sources can lower overall energy consumption, resulting in reduced utility bills.

Capital Cost:
There is moderate to high initial investment, depending on the technology selected.

Maintenance Requirements:
Maintenance requirements can vary, but high-efficiency systems often require regular servicing to maintain optimal performance.

Types of Systems and Retrofit Solutions

Existing buildings typically rely on conventional DHW systems that are energy and water intensive, and which rely on fossil fuels. These traditional systems often have high energy demands and limited control of the water heating processes.

Here are some typical DHW systems for existing buildings and how to retrofit them:

Traditional DHW Systems

Traditional DHW systems discharge warm wastewater into the drain without any energy recovery.

Retrofit: Install a drain water heat recovery system, which uses a heat exchanger to transfer heat from the outgoing wastewater to the incoming cold water. This process preheats the cold water entering the water heater, reducing the energy required to heat it to the desired temperature and improving overall energy efficiency.

Traditional Tank-Style Water Heaters

Older buildings often use traditional tank-style water heaters that store a lot of hot water, leading to higher energy use and water waste.

Retrofit: Replace the existing system with tankless systems which heat water only when required. This type of system saves energy and reduces water waste. This upgrade can lower energy bills and improve efficiency by eliminating the need for a bulky storage tank.

Traditional Insulated Water Tanks

Traditional water heaters with standard insulated tanks often lose a lot of heat, which require more energy to keep the water hot.

Retrofit: Upgrade to super insulated tanks, which have enhanced insulation to reduce heat loss and maintain the water temperature more effectively. This reduces the energy required to keep the water hot, improving overall efficiency and lowering energy costs. Additionally, consider installing a timer or smart control to optimize the heater's operation based on actual hot water usage patterns.

Point-of-use Heaters

Point-of-use heaters are small water heaters installed near the location where hot water is needed.

Retrofit: Replace point-of-use heaters with more energy-efficient alternatives such as heat pump water heaters or tankless electric water heaters. These options not only reduce energy consumption but also eliminate standby heat loss. Additionally, ensure that the systems are properly sized to meet the building's demand, and upgrade insulation or piping where needed to further reduce heat loss and improve overall efficiency.

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 help you to get you started with a DHW retrofit:

1. Determine your building's hot water demand and existing energy consumption.
2. Consult experts, like mechanical engineers and plumbers, as needed, to guide you through designing, planning, and integrating the new DHW system with your existing systems. Make sure the new system is compatible with the existing one. The experts will assist with the following critical steps:
    - o Evaluate the current DHW system and identify areas for improvement.
    - o Install new system with minimal disruption to occupants and ensure that it is properly commissioned.
    - o Implement a monitoring system to track performance and ensure correct operation.
    - o Develop a maintenance plan with regular checks and servicing to maintain system performance.

Heat Pumps for Heating, Cooling, and DHW

A heat pump can heat or cool the air of your building, working like an air conditioner in summer and a heater in winter. A DHW heat pump heats water for shower, appliances, faucets and other water related needs. Some heat pumps can do both, providing climate control and hot water.

Opportunities

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

Gas Appliances

Switching from gas-fired water heaters to electric heat pump water heaters reduces reliance on fossil fuels. This transition can lower GHG emissions and improve energy efficiency by using electricity to transfer heat rather than burning gas.

Building Controls and Automation Systems

Building automation systems can optimize your DHW usage by scheduling heating cycles based on occupancy and demand patterns.

Energy Generation

Energy Storage

Pairing your DHW systems with renewable energy sources like solar panels allows for sustainable hot water generation. Adding thermal storage tanks helps to have extra heat for later use, ensuring a continuous supply, maximizing renewable energy use, and reducing emissions and grid reliance.

Challenges and Solutions

Retrofitting the DHW system of your building can be challenging. Below are some common challenges you may face and how to solve them.

Challenge 1: Compatibility with Existing Systems

Solution: Integrating DHW technologies with existing systems can be complex. Existing infrastructure may not easily accommodate upgrades, requiring custom solutions. Conduct thorough assessments and consult specialists to ensure compatibility.

Challenge 2: Electrical Capacity

Solution: Electric DHW can increase electricity demand in a building and require additional energy capacity. Consider integrating DHW controls to manage demand and or consider an electrical service upgrade.

Challenge 3: Disruption to Occupants

Solution: Installing new DHW systems, such as high-efficiency water heaters or heat pump systems may require water shut-offs. Plan the retrofit in phases and communicate with occupants about the schedule to minimize disruption.

Challenge 4: System Complexity

Solution: New DHW systems, especially those involving advanced technologies like heat pump water heaters or drain water heat recovery systems, can be complex to install and maintain. Involve experienced professionals in the design, installation, and maintenance processes.

Toronto's Climate Considerations

Due to Toronto's climate, there are a few things to consider before implementing a DHW systems retrofit.

Backup Heat

Consider integrating a backup heating system, such as an electric resistance boiler, to ensure consistent hot water supply during extreme cold weather.

Performance

Heat pump water heaters may experience reduced efficiency in very cold climates. Consider selecting models specifically designed for low-temperature operation.

Pipe Insulation

Insulate pipes to prevent heat loss in unconditioned spaces, ensuring the DHW system operates efficiently in cold temperatures.

System Location

Place the DHW system in a location that minimizes exposure to cold drafts, which can impact performance.

Ready!

You should now have a better idea of what **Domestic Hot Water Systems** are, their co-benefits and impacts, and how to implement them 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
- Energy Recovery Ventilator
- Low Carbon District Energy
- 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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