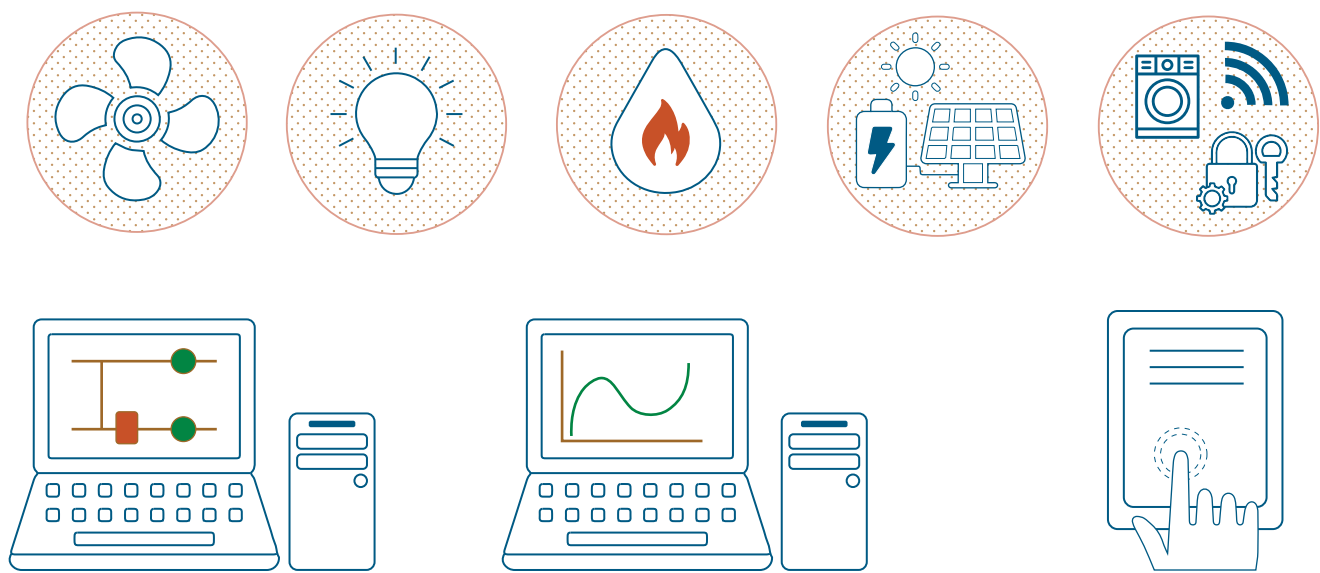


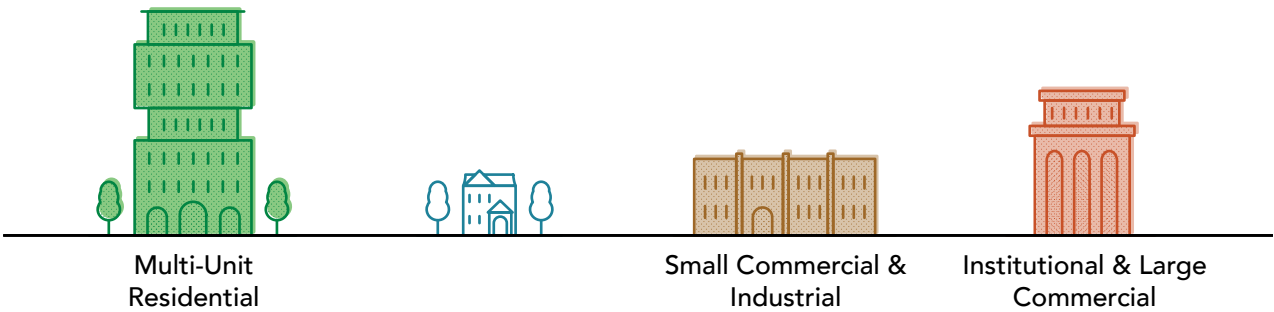
Net Zero Building Retrofit Guides

Building Automation Systems

Technology Companion Guide



Applicable to:



Co-benefits

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

Impacts

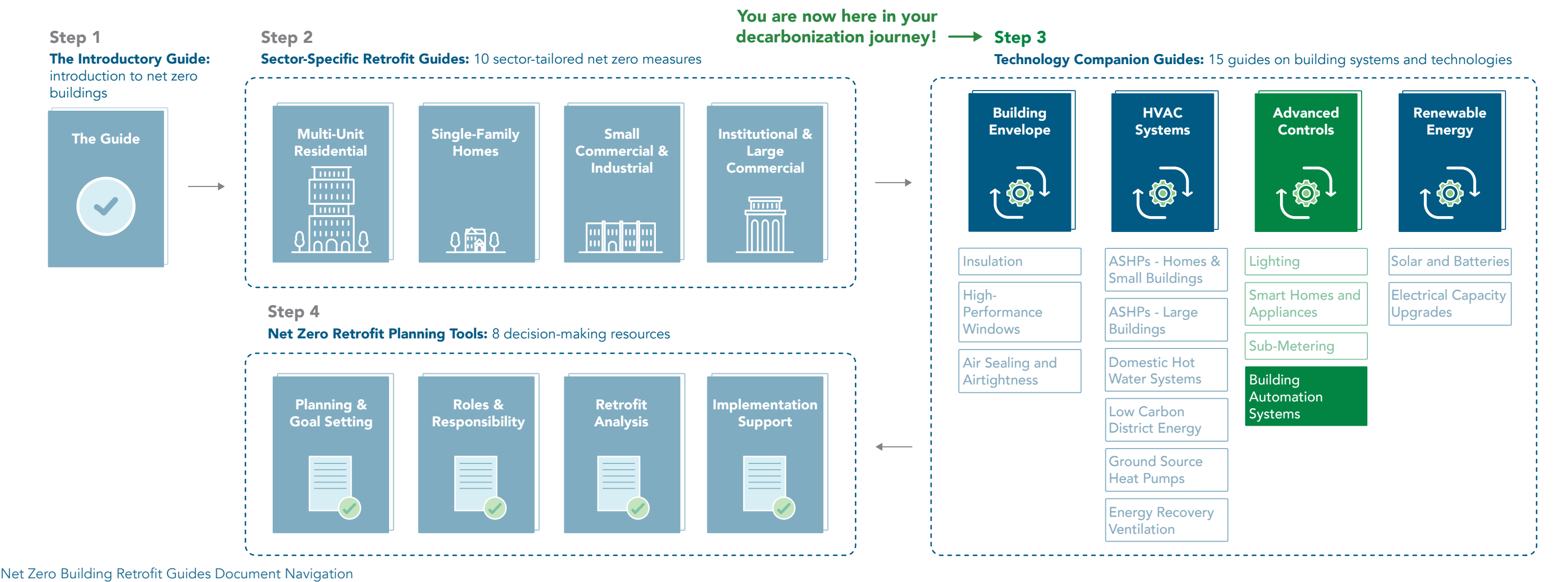
Emissions Reduction	Utility Savings	Capital Cost	Maintenance Requirements
■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■

# 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.

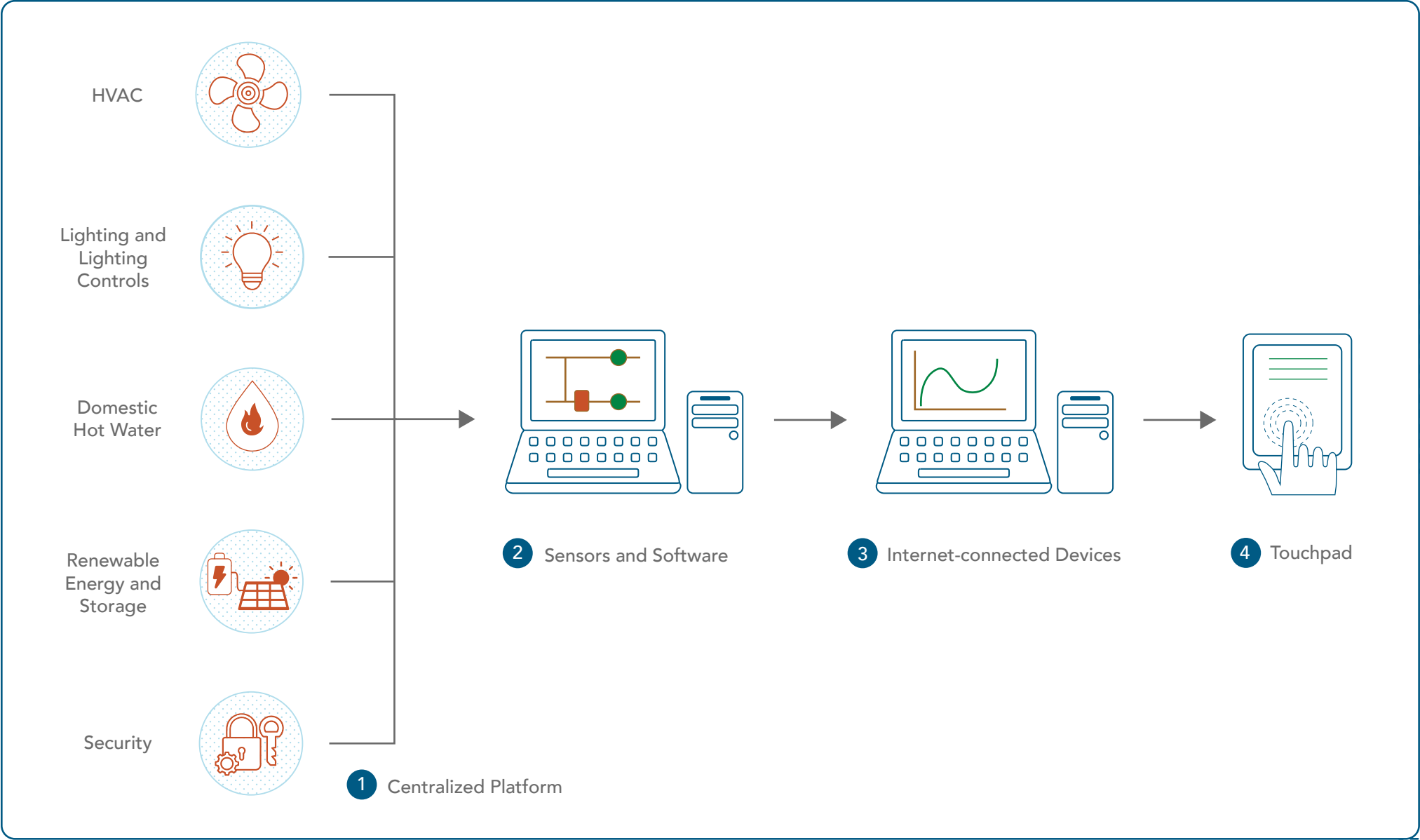
- 1. **The Introductory Guide** introduces the topic of "net zero buildings." The guide's goal is to familiarize all home and building owners with Toronto's net zero goals and concepts.
- 2. **The Sector-Specific Retrofit Guides** highlight net zero measures tailored to each building sector and type. 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.



# Building Automation Systems

## What Is This Technology

Building Automation Systems (BAS) are integrated systems that centralize the control and monitoring of a building’s mechanical, electrical, and plumbing systems, such as HVAC, lighting, and security. A BAS uses sensors and software to automate system operations, ensuring efficient and streamlined building management. By integrating these different building systems, BAS enhance operational efficiency, reduce energy consumption, and improves overall building performance.



## How This Technology Works

BAS offer a comprehensive solution for managing multiple systems within a building, enhancing both efficiency and convenience. Through the use of sensors, software, and intuitive controls, it simplifies operations and improves data collection for better decision-making. The key features of BAS are:

- 1 A centralized platform, which combines various systems (HVAC, lighting, security).
- 2 Sensors and software, which automate building operations and gather data on occupancy, environmental conditions, and energy usage.
- 3 Internet-connected devices, which provide remote management and real-time monitoring of BAS.
- 4 A touchpad, which displays and provides a control panel for quick adjustments and easy access to system information directly within the building.

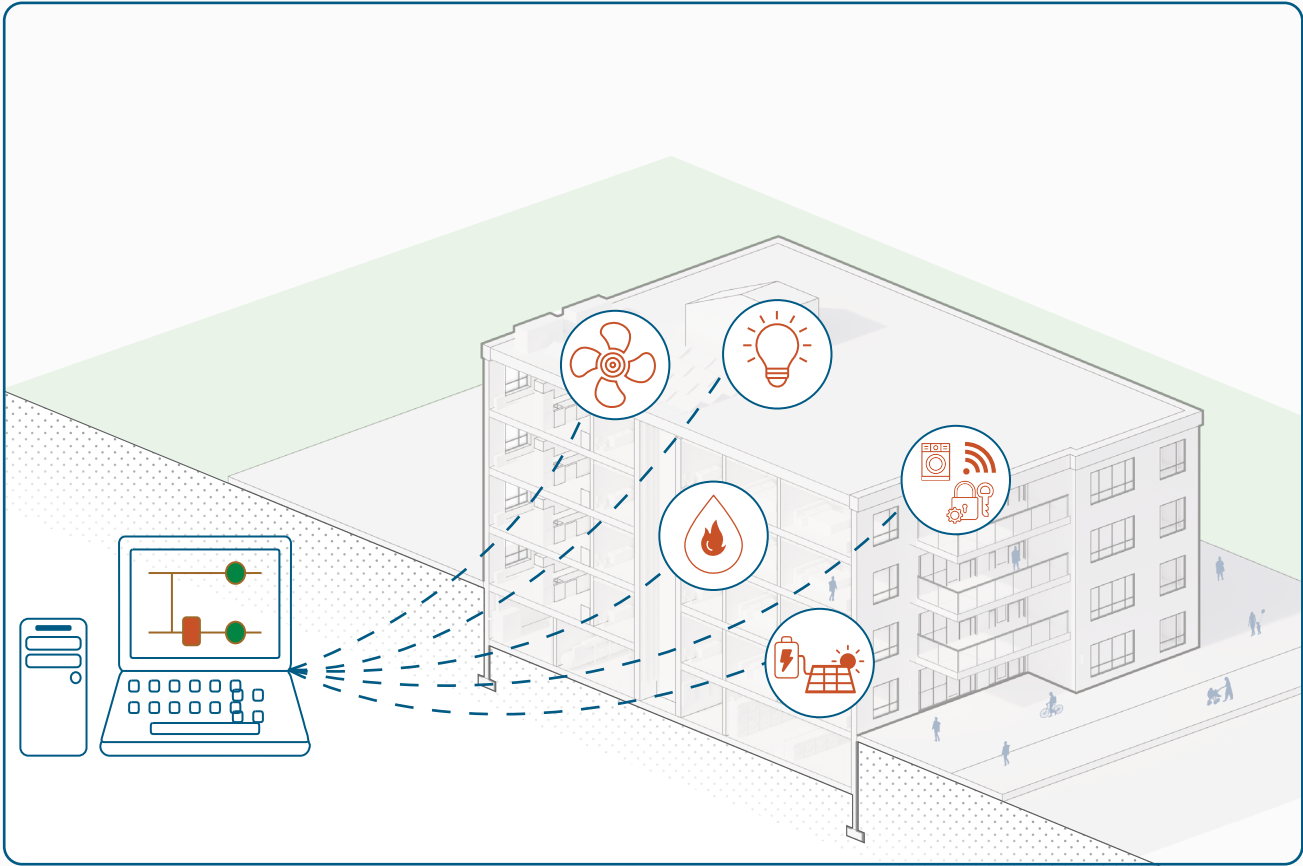
Retrofit technology explained

## When to Retrofit This System

BAS integration should be planned early in the planning stages of a retrofit, ideally during the design phase of system upgrades. Early integration into the design phase can yield significant system performance improvements. This retrofit should be considered by default when your existing equipment reaches end of life.

## Why Retrofit This System

BAS are crucial for net zero retrofits because it optimizes energy use and GHG emissions reduction, reduces operational costs, and enhances indoor environmental quality. It can also provide valuable data analytics for making informed decisions and helping building owners achieve long-term sustainability goals. 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:** BAS increase resilience by quickly addressing system failures or inefficiencies. It also helps systems adapt during extreme conditions and disruptions to maintain operations and reduce risks.
- Indoor Air Quality:** BAS improve air quality by adjusting ventilation rates to reduce pollutants and maintain humidity levels.
- Occupant Comfort:** BAS maintains consistent and comfortable temperature and humidity levels and can adjust lighting based on natural light availability and occupancy.
- Property Value:** Buildings equipped with BAS are more attractive to buyers or tenants who value efficient building operations and use of energy. This can lead to higher property value in the real estate market.

### Impacts

- Emissions Reduction:** BAS help to reduce energy waste, leading to lower GHG emissions.
- Utility Savings:** By automating building operations, BAS reduce energy consumption, resulting in utility cost savings.
- Capital Cost:** Installing a BAS can require high upfront capital expenses, but significant savings will quickly repay the investment.
- Maintenance Requirements:** BAS reduce manual maintenance needs but requires regular monitoring and occasional updates.

# Types of Systems and Retrofit Solutions

Existing buildings often lack BAS, relying on manual control for heating, ventilation, lighting, and security. Multiple solutions are available to automate controls, enhance efficiency and comfort, and modernize building operations.

Here are some BAS retrofit solutions for different existing building systems:

## Basic Building Control Systems

These basic systems typically involve manual controls for HVAC and lighting. They include basic thermostats and on/off switches.

**Retrofit:** Upgrade manual controls with smart thermostats, lighting controls, and occupancy sensors. These systems enable automated adjustments based on occupancy and time-of-day schedules, optimizing energy use without relying on manual intervention.

## Centralized Building Management System

A centralized system manages HVAC, lighting, and energy from a single control point with a graphical interface but may be less advanced compared to newer systems.

**Retrofit:** Install an advanced BAS for enhanced data analytics, automation capabilities, and real-time monitoring. This allows for predictive maintenance, energy management, and insights into building performance.

## Security and Safety Systems

Basic security and life safety systems have manual controls and limited integration.

**Retrofit:** Install smart security systems, such as automated access controls, surveillance cameras, and life safety systems like fire alarms and smart smoke detectors. These systems provide real-time monitoring and remote access, enhancing building security and safety.

## Energy and Utility Management

This includes basic meters with limited energy monitoring.

**Retrofit:** Implement smart meters and energy analytics tools that provide real-time data on energy consumption, allowing for detailed monitoring and analysis of utility use across the building. These tools enable proactive energy management and detection of inefficiencies.

## 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 BAS retrofit:



1. Evaluate your current building and its system.
  - o Does your building have existing HVAC, lighting, or security systems?
  - o Are these systems centralized or decentralized?
  - o What kind of controls and monitoring systems are currently in place?
2. Hire experts, like mechanical engineers, BAS specialists and contractors, to advise and support you on how to apply this retrofit to your building and to conduct a system audit. Your experts will help you with the following steps.
  - o Integrate the BAS with your existing systems, considering potential challenges and solutions. This may require upgrading controls, installing sensors, and configuring system settings.
  - o Test and balance to make sure everything works.
3. Maintain your BAS with regular software updates, system checks, and quick issue fixes to keep it running efficiently.

## What is a System Audit?

A BAS audit checks how well the system manages building systems like HVAC (for ventilation and cooling) and lighting. Experts like energy auditors or BAS technicians conduct the audit to find inefficiencies, outdated parts, and integration problems, and suggest ways to improve energy use and system performance.



# Opportunities

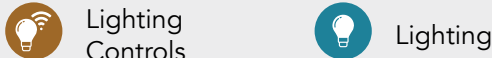
Evaluate how this retrofit can be integrated with the following building systems to maximize potential synergies and optimize overall performance.



BAS optimize HVAC operation by adjusting heating, cooling, and ventilation based on occupancy and outdoor conditions, preventing unnecessary energy use.



Enhancing your domestic hot water (DHW) system with advanced controls will enable your BAS to monitor real-time hot water demand and actively optimize efficiency.



BAS adjust lighting based on occupancy and daylight, leading to energy savings. Combined with motion sensors and dimming systems, they lower lighting costs while ensuring comfort.



BAS optimize the use of renewable energy by scheduling usage of energy storage during peak generation periods. This will reduce peak demand charges and GHG emissions.

# Challenges and Solutions

Adding a BAS retrofit to 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:** Check for compatibility issues with older equipment. Work with experts to complete a detailed compatibility assessment and ensure a smooth integration.

## Challenge 2: Cost Overruns

**Solution:** Create a detailed budget and backup plan to handle unexpected installation costs and any potential cost overruns.

## Challenge 3: Data Security

**Solution:** Protect system data from cyber threats by using strong cybersecurity measures and regularly updating security protocols.

## Challenge 4: System Complexity

**Solution:** Provide staff with comprehensive training and support to effectively manage complex systems and controls.



## Toronto's Climate Considerations

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

### Control System Calibration

Calibration of the control system is required for accurate performance in fluctuating temperatures.

### Lighting Control Adjustments

Adjustments to the lighting control system are necessary to accommodate shorter daylight hours and varying external temperatures.

### Outdoor Weather Integration

Monitor outdoor temperature to automate HVAC operation based on real time, such as adjusting HVAC operation based on real-time temperature and humidity changes.

## Ready!

You should now have a better idea of what **Building Automation 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 Advanced Controls Technology Companion Guides:**

- Lighting
- Smart Homes and Appliances
- Sub-Metering

**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

Prepared for:



Prepared by:



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