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# Introduction to Existing Building Commissioning (EBCx) for Ontario Municipalities

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# Agenda

- The Save on Energy Existing Building Commissioning (EBCx) Program
- What is EBCx?
- Typical measures and examples
- EBCx vs. energy audit
- Costs and benefits
- Good candidates for EBCx
- Roles and responsibilities
- Technical skills required
- EBCx process, roles and deliverables



# Save on Energy Capability Building – EBCx resources

- Designed to enhance knowledge and develop skills in organizations and communities to increase awareness and participation in energy-efficiency opportunities across Ontario, including Save on Energy programs
- Our dedicated EBCx resources include:
  - Webinars (*EBCx in a Nutshell*, *Key Measures*)
  - practical guide for building owners and managers
  - information sheets: condos, medical buildings, office buildings and warehouses
  - incentives for ~20 training courses

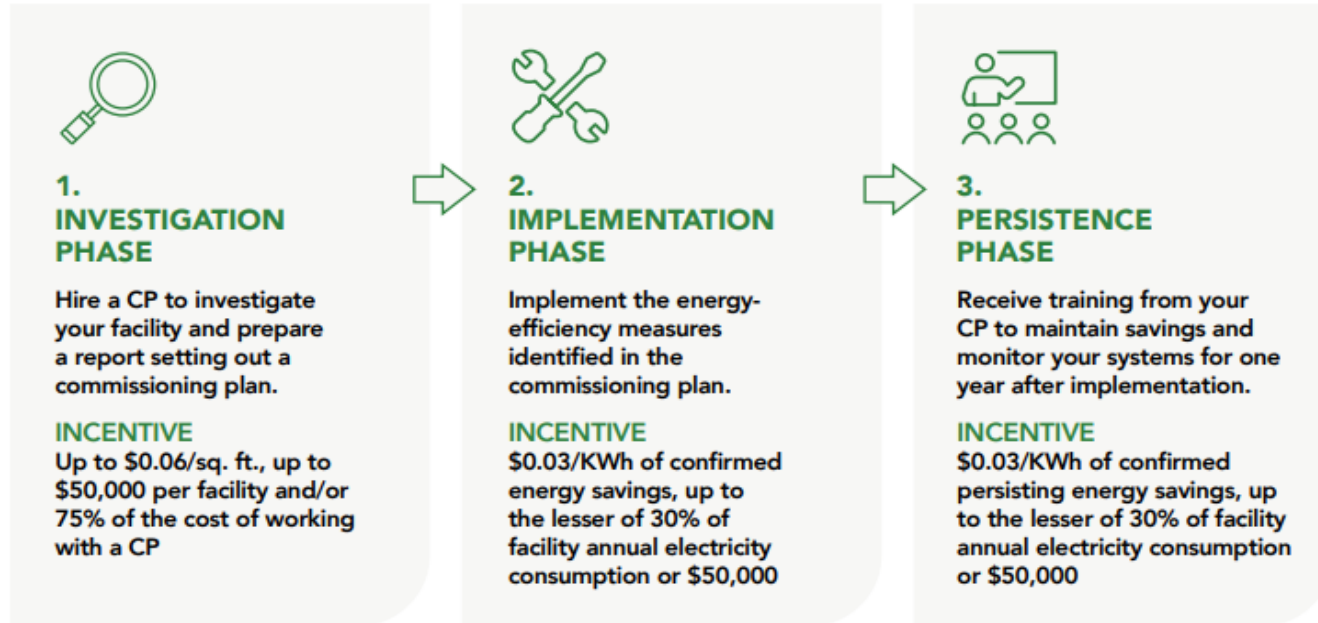


[EBCx resources](#) on Save on Energy website

# Save on Energy - EBCx Program

## HOW DOES THE PROGRAM WORK?

The EBCx program has three phases with incentives for participants who complete each one.



# What is Existing Building Commissioning?

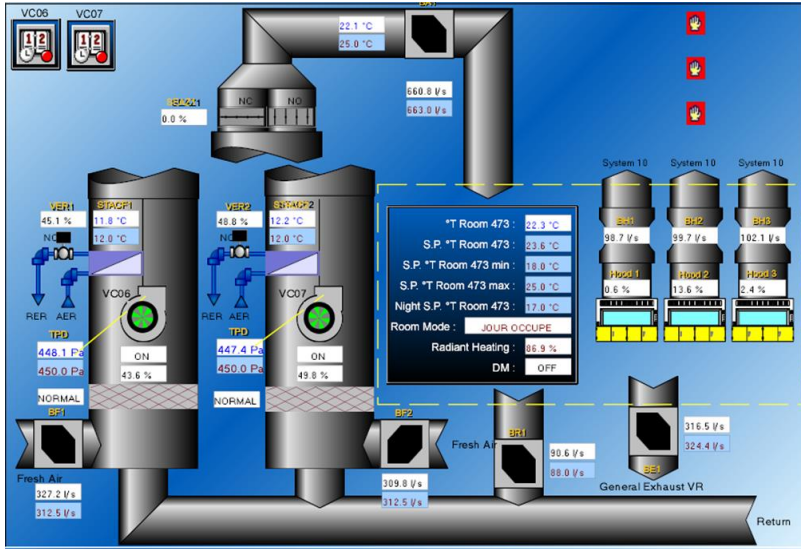


- An optimization process that includes: inspection, diagnosis and repair for existing buildings and systems
- Objective: energy-optimized operation of the building to meet current facility requirements
- Cost-effective: low-cost actions, generally short payback period

# Typical EBCx Measures

- Reduced HVAC/lighting/other equipment operating hours
- Setpoint optimization (fresh air intake, supply air temperature, humidity levels airflow setpoints, etc.)
- Readjustment of static pressure
- Recalibration of sensors
- Repair of faulty equipment
- Elimination of simultaneous heating and cooling
- Verification of terminal units, adjustment and calibration of valves and dampers
- Operating sequence update for chillers and boilers
- Controls updates for HVAC equipment and economizers
- Cleaning fouled heat transfer elements

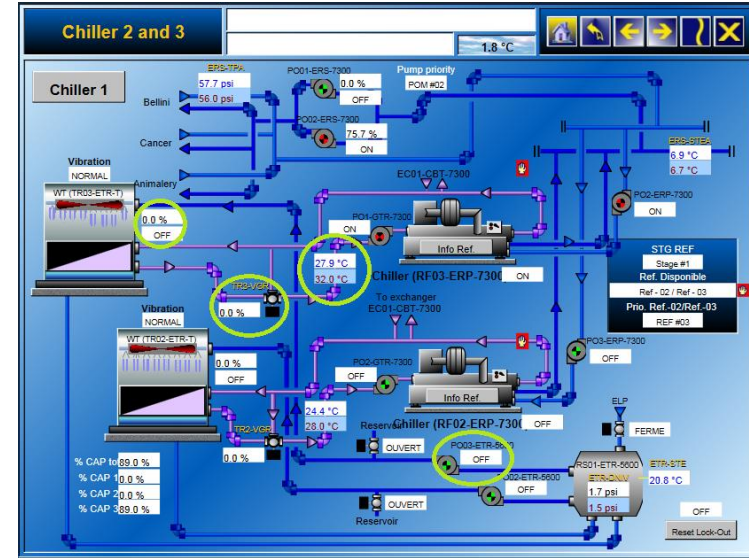
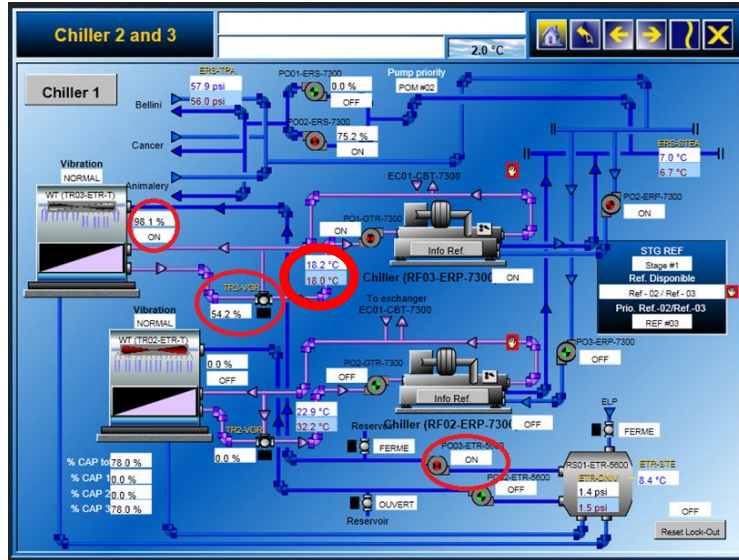
# Example 1: Reduce HVAC and Lighting Operating Hours



**University research building:** variable air flow fan-coils serving each lab; occupancy detection to control lighting levels and total air change per hour.

Photo taken at 10:30 p.m. on a Tuesday: over 60% of occupancy detection is non-functional or incorrectly configured! Obvious EBCx measure!

# Example 2: Cooling Plant Setpoint Optimization

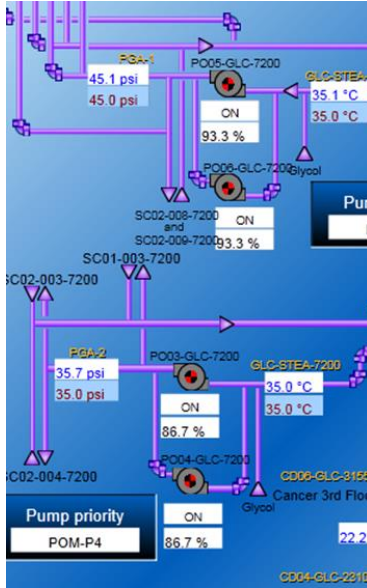


RF-02 and RF-03 are heat-recovery chillers. The operator has reduced the condenser return water temperature setpoint to 18°C: too cold to be used for heating...

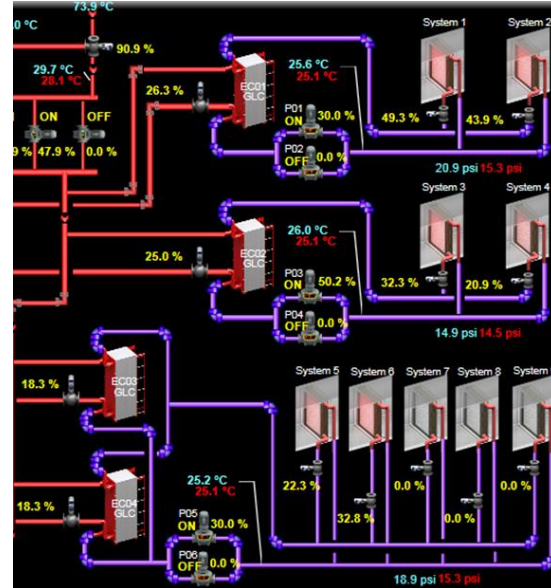
After setpoint optimization: the cooling tower no longer operates and the heat is recovered!



# Example 3: Control Sequence Improvement



**Before EBCx:** Pump speed was controlled to maintain a static pressure of 35 to 45 PSI (depending on the system). This forced the operation of two pumps most of the time, at high speed.



**After EBCx:** the setpoint pressure varies according to the opening of the valves on the heating coils. The new pressure is usually much lower, allowing a single pump to operate at lower speed.

# Energy Audit vs. EBCx

	ENERGY AUDIT	EBCx
<b>Service definition</b>	Provides a snapshot of the building and mechanical equipment and proposes measures to improve energy efficiency	Provides an understanding of how the building operates under different conditions e.g., heating/cooling seasons
<b>Purpose</b>	To replace existing equipment	To improve the operation of existing equipment
<b>Level of investment</b>	Long-term capital investment plan	Low-cost, short-term investment
<b>Payback period</b>	Greater than 3 years	Less than 2 years
<b>External party involvement</b>	Engineering consultant investigates the building, develops the energy-efficiency improvement plan  External vendors replace key equipment	EBCx provider investigates the building, develops EBCx plan and supports operator to implement it, and trains building staff in energy-efficient operations  External contractors perform EBCx work

# Typical EBCx Costs

## COST OF EBCx

\$0.86 to \$4.95/m<sup>2</sup>

\$0.08 to \$0.46/ft<sup>2</sup>

Average \$2.58/m<sup>2</sup> or \$0.24/ft<sup>2</sup>

Source: BC Hydro Power Smart

## TYPICAL COST ALLOCATION

Planning and investigation	70%
Implementation	25%
Hand-off and persistence	5%

Source: Lawrence Berkley National Laboratory

## EBCx PROVIDER'S FEES

35% to 75% of total project cost

Source: Lawrence Berkley National Laboratory

## Factors that influence costs:

- Availability of existing building documentation
- Control system features: ease of access to programming, possibility of implementing trend curves
- Building area: generally, the cost per sq. ft. decreases as the building gets larger
- Number and complexity of HVAC systems
- Level of involvement of in-house personnel

# EBCx Benefits

## ENERGY SAVINGS

2% to 14%

Average 7%

Source: BC Hydro Continuous Optimization Program Results

## ANNUAL UTILITY COST SAVINGS

\$0.51 to \$2.91/m<sup>2</sup>

\$0.05 to \$0.27/ft<sup>2</sup>

Median \$2.58/m<sup>2</sup> or \$0.24/ft<sup>2</sup>

Source: BC Hydro Continuous Optimization Program Results

## NON-ENERGY SAVINGS<sup>1</sup>

\$1.08 to \$4.84/m<sup>2</sup>

\$0.10 to \$0.45/ft<sup>2</sup>

Median \$1.94/m<sup>2</sup> or \$0.18/ft<sup>2</sup>

Source: Lawrence Berkley National Laboratory

## Factors that influence savings:

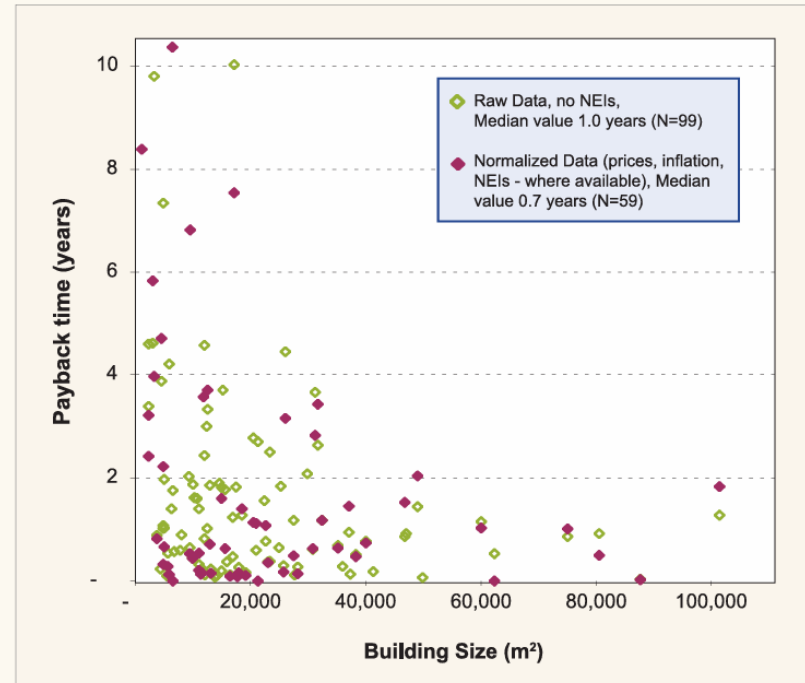
- Depth of investigation by EBCx provider
- Optimized operation in all modes: summer, winter, shoulder season
- Building performance before EBCx
- Building complexity: more complex buildings often offer greater potential
- Quality of operation and maintenance

# EBCx Payback

PAYBACK PERIOD
1.4 to 2.6 years
Average 1.7 years

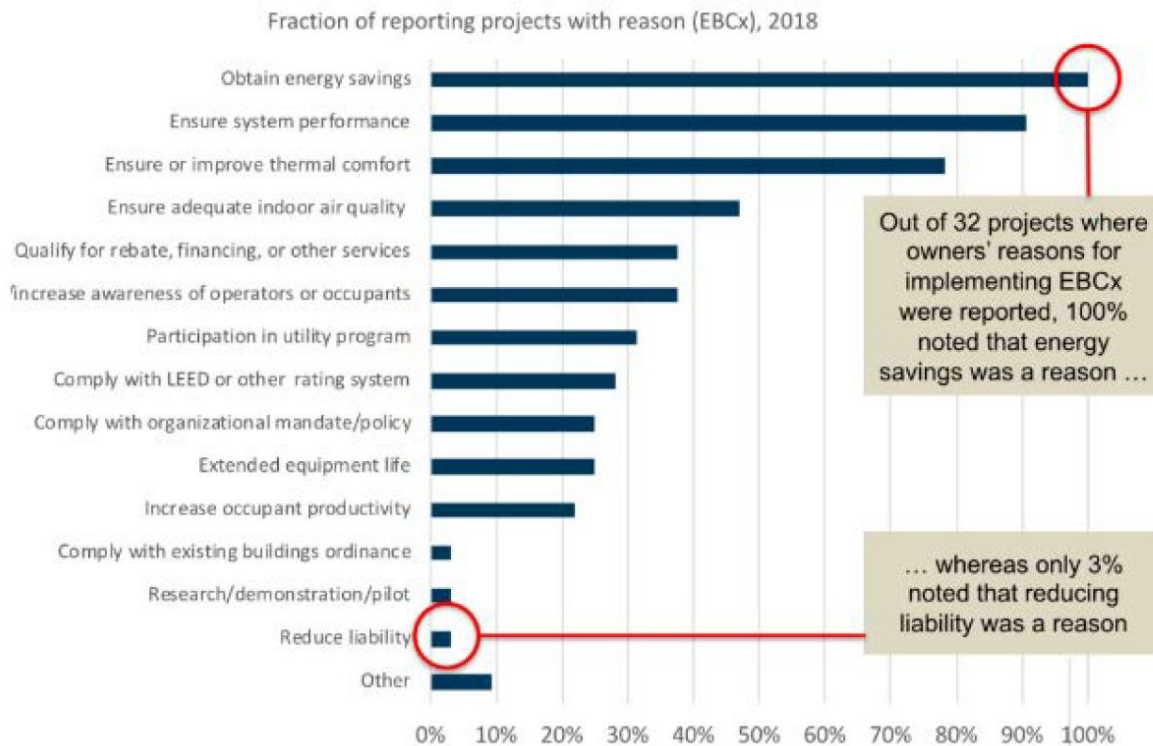
Source: BC Hydro Power Smart

Figure 2: Commissioning payback time vs. building size (existing buildings)



NEIs = Non-Energy Impacts  
Adapted from: Lawrence Berkeley National Laboratory, "The Cost Effectiveness of Commercial-Buildings Commissioning," December 2004.

# EBCx – Other Benefits



Source : "VALUE OF COMMISSIONING - 2018 MARKET SURVEY".

# Good Candidates for EBCx

## Buildings

- Commercial or institutional building 50,000 ft<sup>2</sup> or larger
- Changed function without any major renovations
- Occupancy rate > 75%
- No major renovations are planned in the next five years
- Energy use has increased over time, or is higher than similar buildings

## Equipment

- Has complex direct digital control or an energy management control down to the zone level
- Has complex HVAC equipment (e.g., laboratories)
- Mechanical equipment is in good condition and is not at the end of useful life

# Roles and Responsibilities

## OWNER

- Creates and supports team
- Provides information and documentation
- Clearly communicates goals
- Coordinates EBCx work
- Commits financial resources
- Commits human resources  
(minimum 20 hours over the EBCx process)

## FACILITY MANAGER

- Provides documentation
- Prepares a list of known problems and opportunities
- Works with EBCx provider to perform testing and to verify system operation

## EBCx PROVIDER

- Supports development of scope of work
- Performs investigation and carries out assessment of building (energy analysis, documentation review, functional testing)
- Establishes the current facility requirements
- Identifies EBCx measures and prepares EBCx plan
- Works with facility management to perform tests and to verify system operation
- Supports client in developing scope of work for contractors implementing the measures

## CONTRACTORS

- Assist the EBCx provider with investigation and functional testing
- Implement upgrades and measures identified in the investigation phase for the operation and maintenance (O&M) of HVAC, controls and electrical systems



# Skills of the EBCx Agent or Team

## Technical skills

- Experience in building mechanical design: an asset
- Knowledge of the limits of mechanical equipment
- Understanding of building controls
- Ability to perform energy savings calculations
- Knowledge of applicable building standards – ASHRAE 55, ASHRAE 62.1, market standard (e.g., CSA Z317 for healthcare buildings), etc.



# Skills of the EBCx Agent or Team cont'd

## Essential non-technical skills

- Good communicator: ability to talk to operators and people to understand issues, ability to explain proposed changes
- Curiosity and interest in challenging established practices
- Negotiation skills

# EBCx Process and Deliverables Overview

<b>1</b>	<b>PLANNING</b> <ul style="list-style-type: none"><li>• Owner selects a building and generates benchmarking score<sup>1</sup></li><li>• Owner selects EBCx provider and identifies team</li><li>• Owner and provider define project objectives</li><li>• Provider conducts interviews and performs walk through</li></ul>	EBCx Plan
<b>2</b>	<b>INVESTIGATION</b> <ul style="list-style-type: none"><li>• Provider reviews facility documentation</li><li>• Provider performs diagnostic monitoring and testing</li><li>• Provider and owner prioritize and select EBCx improvements</li></ul>	Findings Log Investigation Report
<b>3</b>	<b>IMPLEMENTATION</b> <ul style="list-style-type: none"><li>• Provider, building staff, or contractors implement selected operational improvements</li><li>• Provider verifies results</li></ul>	Implementation Plan Implementation Report
<b>4</b>	<b>HAND-OFF</b> <ul style="list-style-type: none"><li>• Provider recommends persistence strategies</li><li>• Provider conducts staff training</li><li>• Provider holds hand-off meeting</li></ul>	EBCx Final Report

<sup>1</sup> The EnergyStar Portfolio Manager Program is a free benchmarking tool: <https://portfoliomanager.energystar.gov/pm/login.html>



# Navigating The EBCx Process

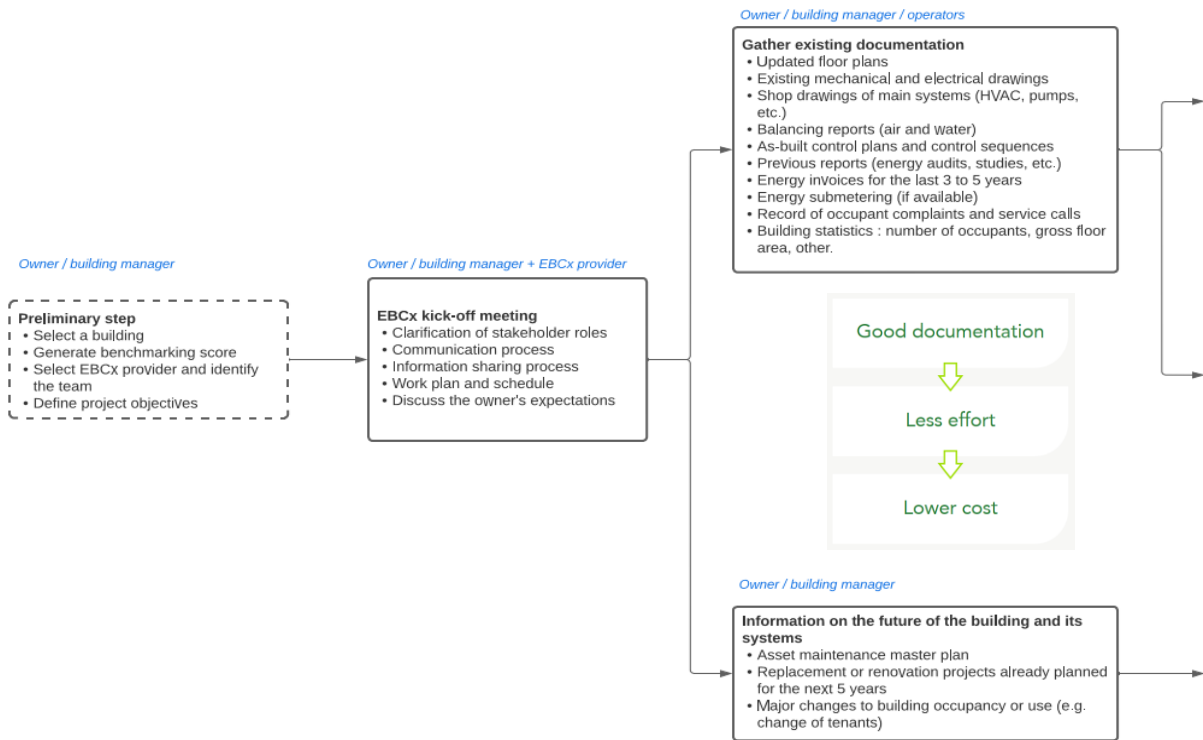
# Phase 1: Planning

This phase defines the project objectives, scope and process, as well as the current facility requirements (CFR) that inform all subsequent EBCx activities.

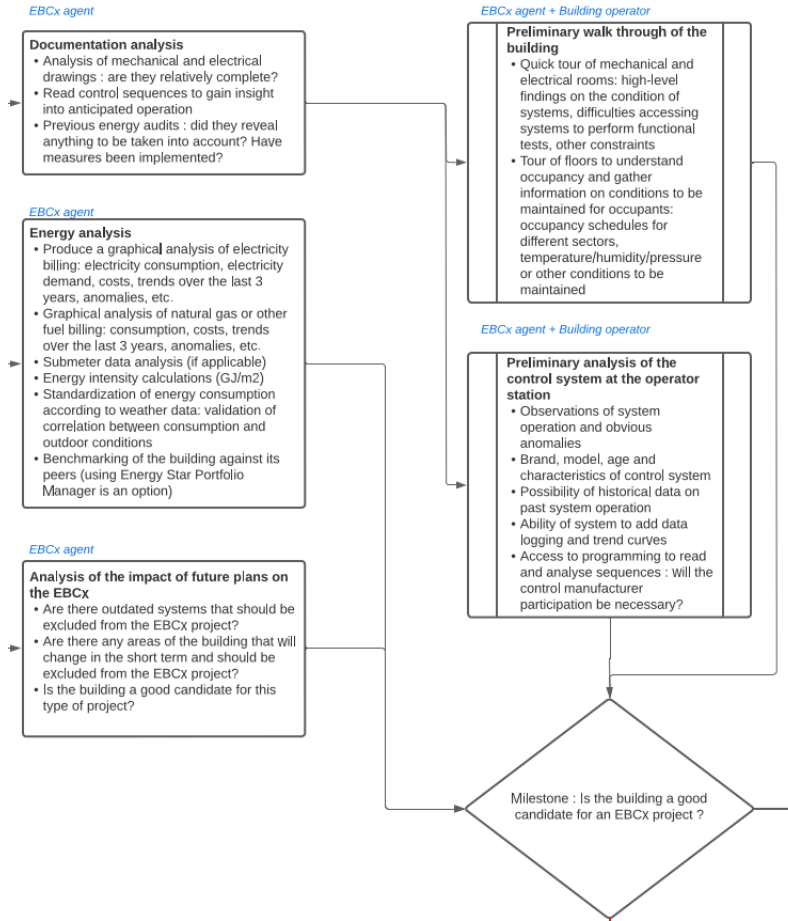
For the building owner, the EBCx plan supports the decision process to proceed with the EBCx project or not and provides a roadmap of the entire process.



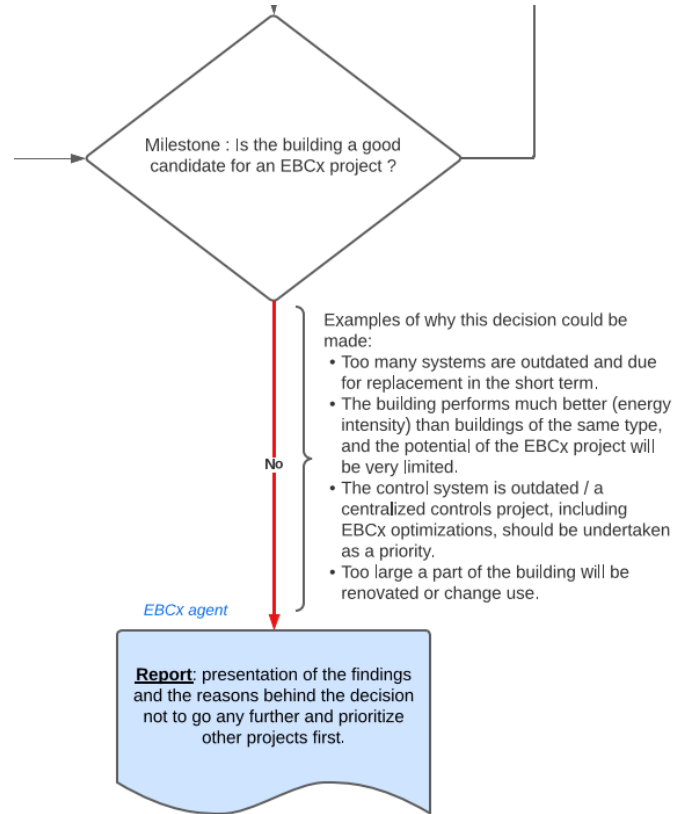
# Phase 1: Planning Activities (1 of 4)



# Phase 1: Planning Activities (2 of 4)

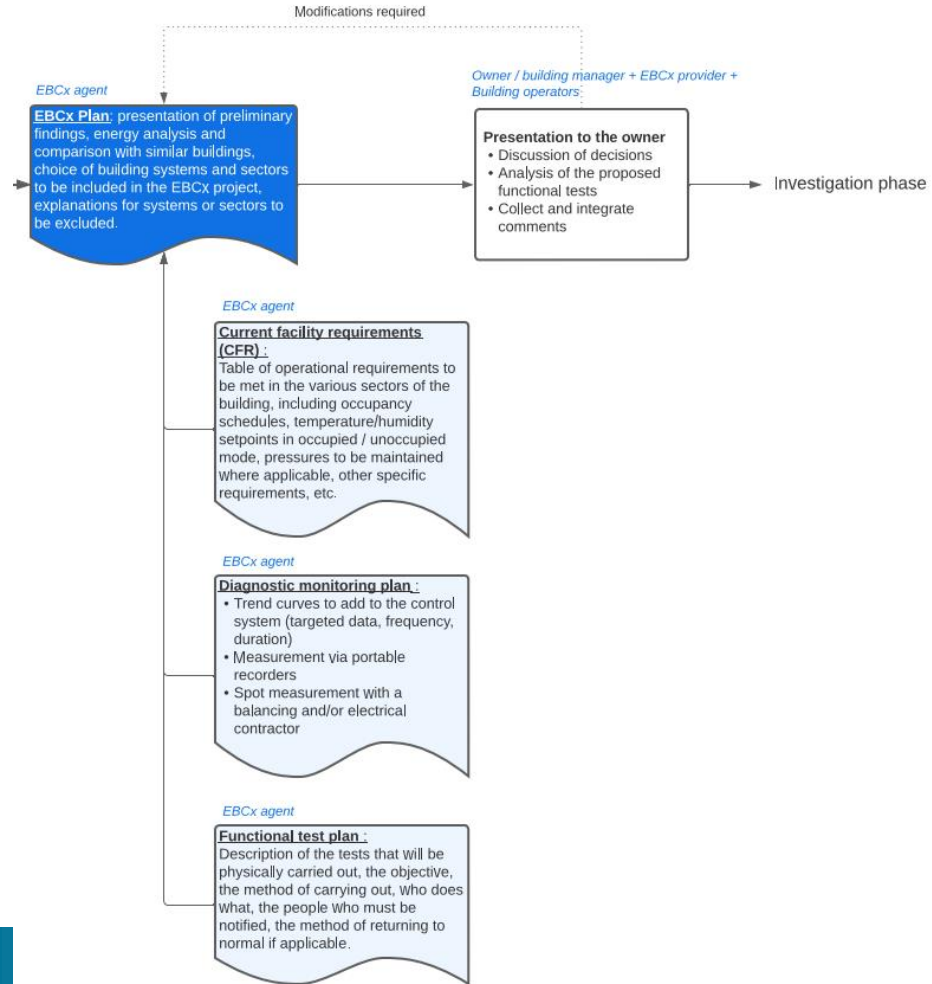


# Phase 1: Planning Activities (3 of 4): Poor Candidate for EBCx





# Phase 1: Planning Activities (4 of 4) : Good Candidate for EBCx

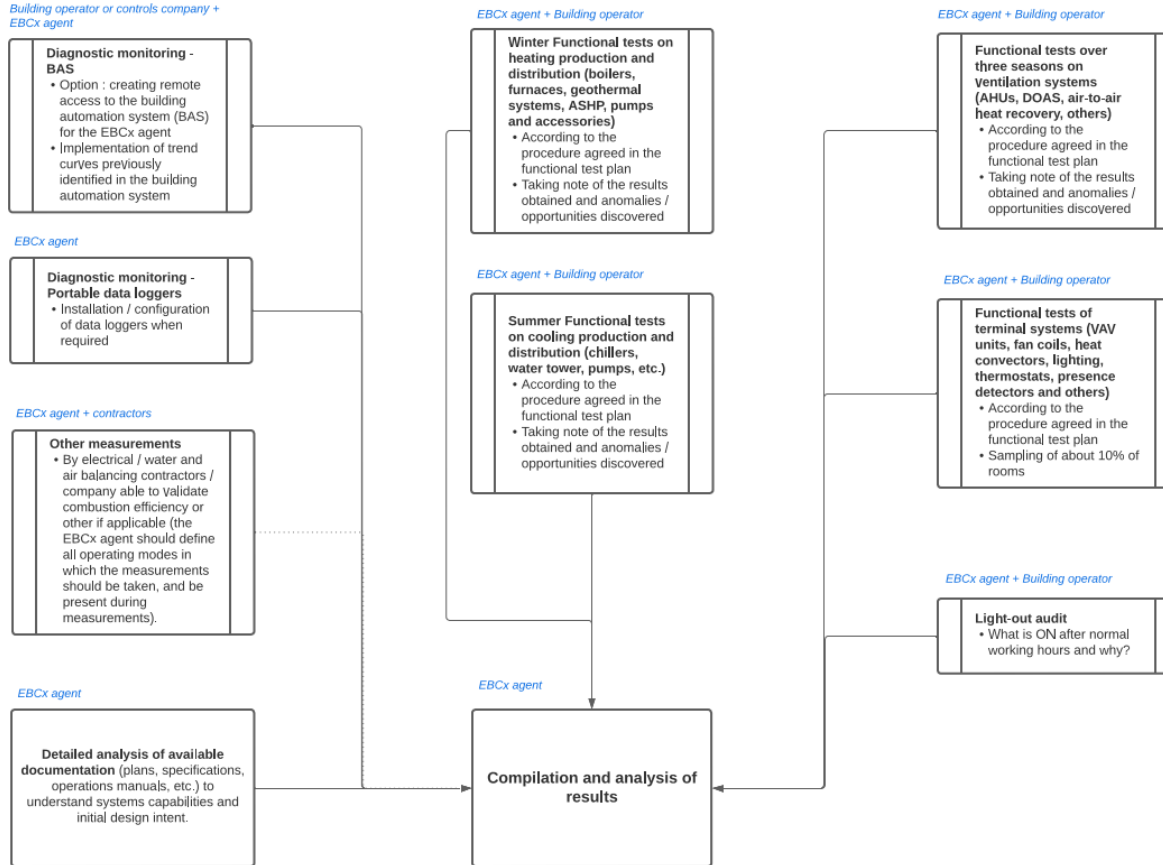


## Phase 2: Investigation

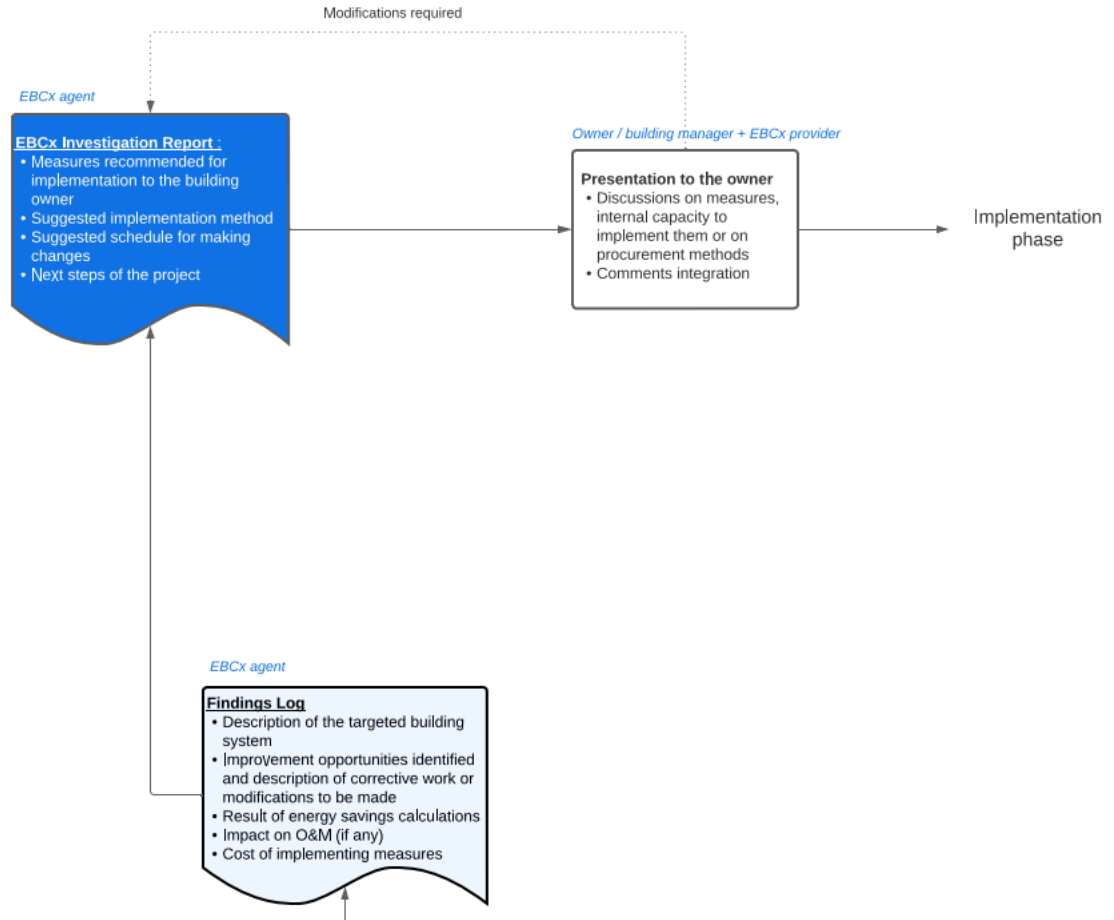
The investigation phase enables the EBCx team to analyse system operation in detail, carry out diagnostic tests and propose measures to optimize system operation. These measures are presented in the Findings Log, an integral part of the Investigation report.



# Phase 2: Investigation Activities (1 of 2)

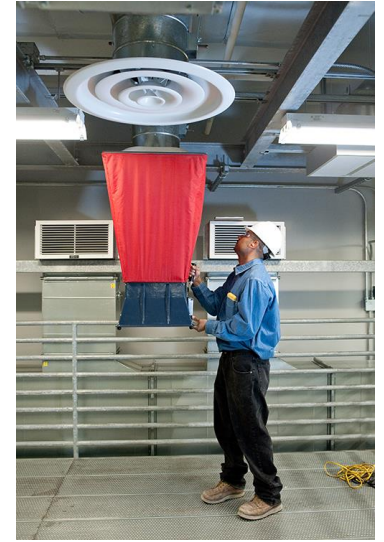


# Phase 2: Investigation Activities (2 of 2)

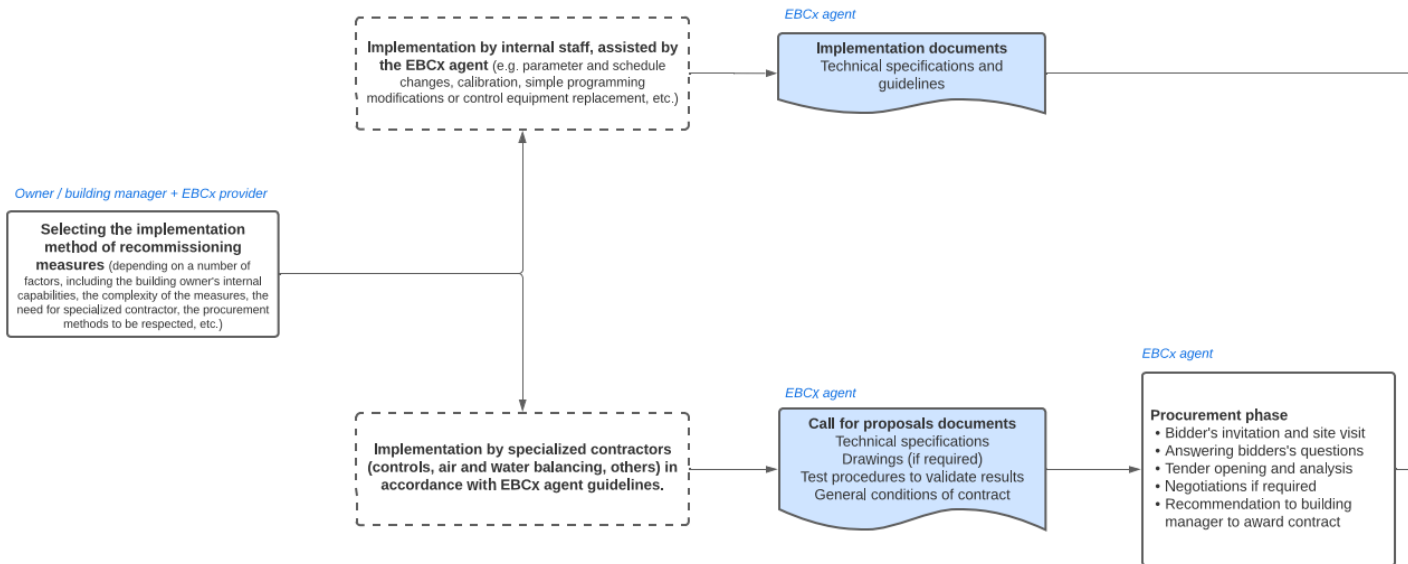


## Phase 3: Implementation

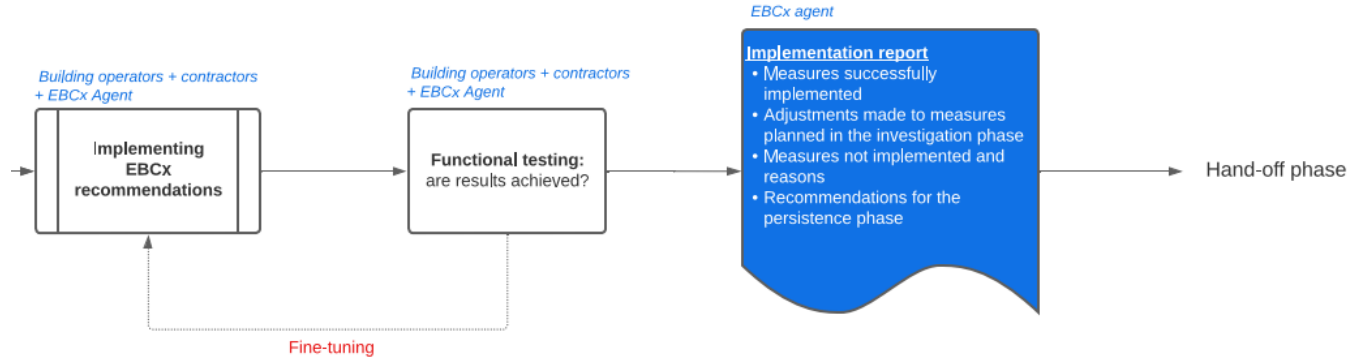
The implementation phase consists of choosing the best method for carrying out the system optimizations, then supervising their implementation by in-house staff or specialized contractors.



# Phase 3: Implementation Activities (1 of 2)



# Phase 3: Implementation Activities (2 of 2)



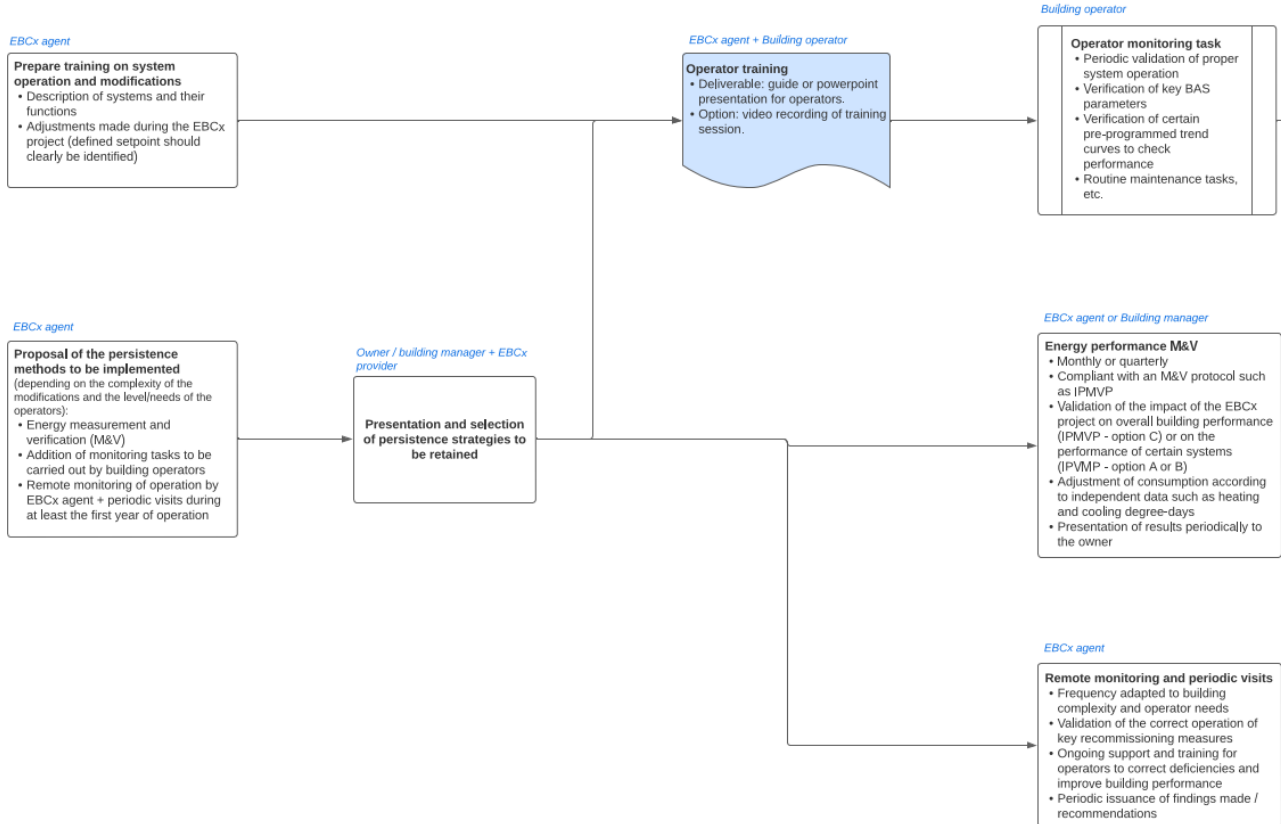
## Phase 4: Hand-Off Phase

The objective of the hand-off phase is to ensure that the knowledge acquired during the EBCx project is preserved to inform O&M staff and maintain improvements.

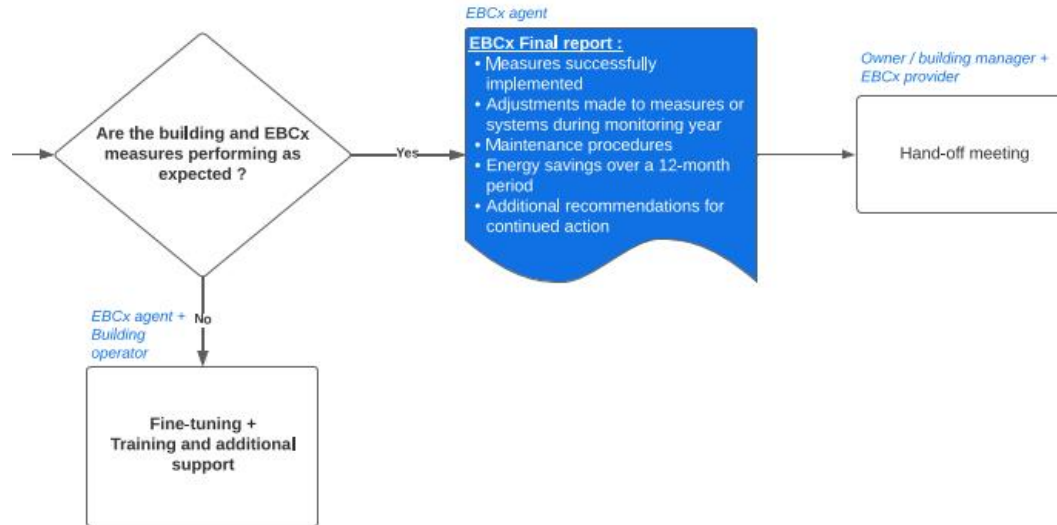




# Phase 4: Hand-Off Activities (1 of 2)



# Phase 4: Hand-Off Activities (2 of 2)





# Questions and Answers



Thank you for participating!

Questions: [trainingandsupport@ieso.ca](mailto:trainingandsupport@ieso.ca)

Information, events, courses: <https://saveonenergy.ca/For-Business-and-Industry/Training-and-support>

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# Thank you!

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