



EXISTING BUILDING COMMISSIONING

PRACTICAL GUIDE FOR BUILDING OWNERS AND MANAGERS

Existing building commissioning is an optimization process that includes inspection, diagnosis and repair for existing buildings. This ensures that a building's equipment and systems are operating optimally to meet current facility requirements.

Existing building commissioning (EBCx) is a cost-effective process to improve energy performance and profitability in buildings with three or more years of service.

This guide provides building owners and managers with the practical knowledge that will help them get the most value from the EBCx process to reduce both costs and carbon emissions.

This guide covers the following key areas:

- What to expect from the EBCx process
- How to prepare for it
- The actions that will get you the most value from EBCx



WHAT ARE THE BENEFITS OF THE EBCx PROCESS?

- Improves building energy performance
- Reduces utility costs by 7% on average
- Reduces maintenance costs
- Extends equipment life
- Improves occupant comfort and productivity
- Helps address complaints from occupants
- Verifies proper operation of equipment
- Increases the knowledge and capacity of operations staff
- Ensures proper documentation for ongoing operations and maintenance



CASE STUDY

MULTI-UNIT RESIDENTIAL

CityHousing Hamilton (CHH) conducted a EBCx project on a large, multi-unit residential building with the goals of addressing complaints about domestic hot water, improving performance of solar walls and improving energy performance. Isolated capital and maintenance repairs over the years had inadvertently led to systems issues and complaints that couldn't be easily diagnosed or resolved.

The EBCx investigation phase found that the building's original hot water design involved separate pressure zones, but these had been connected during a previous

repair. The project also found that ductwork for make-up air units was undersized, resulting in insufficient air flow and complaints about odours. In addition, the solar wall balancing dampers had been labeled backwards, and were set in the closed position (labeled open).

Based on these findings, CHH made minor piping and ductwork improvements that addressed persistent resident complaints related to hot water and odours. It adjusted the solar wall dampers to better use free heating energy, improving heating system performance.

DID YOU KNOW?

EBCx is a collaborative process involving the EBCx provider and building ownership, management and operations staff. The more an owner and their team is involved in the EBCx process providing direction and hands-on experience, the lower the costs to implement, the larger the benefits and the longer-lasting the impacts.

GOOD CANDIDATES FOR EBCx ARE:

BUILDINGS

- Commercial or institutional building 50,000 ft² 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 system 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 its useful life

ENERGY SAVINGS OPPORTUNITIES COMMONLY IDENTIFIED BY EBCx:

- Reduced HVAC equipment operating hours
- Setpoint optimization (fresh air intake, supply air temperature, water supply temperature)
- Readjustment of static pressure
- Recalibration of sensors
- 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

DO YOU NEED AN ENERGY AUDIT OR EBCx?

Energy audits and EBCx projects are two different processes and are compared below.

	ENERGY AUDIT	EBCx
Service definition	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
Purpose	To replace existing equipment	To improve the operation of existing equipment
Level of investment	Long-term capital investment plan	Low-cost, short-term investment
Payback period	Greater than 3 years	Less than 2 years
External party involvement	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

¹ Non-energy savings refer to benefits beyond energy savings, such as improved comfort and indoor air quality, reduced equipment operation and maintenance cost, improved property value, reduced tenant turnover, etc.

EBCx BY THE NUMBERS

ENERGY SAVINGS

2% to 14%

Average 7%

Source: BC Hydro Continuous Optimization Program Results

ANNUAL UTILITY COST SAVINGS

\$0.51 to \$2.91/m²

\$0.05 to \$0.27/ft²

Median \$2.58/m² or \$0.24/ft²

Source: BC Hydro Continuous Optimization Program Results

NON-ENERGY SAVINGS¹

\$1.08 to \$4.84/m²

\$0.10 to \$0.45/ft²

Median \$1.94/m² or \$0.18/ft²

Source: Lawrence Berkley National Laboratory

COST OF EBCx

\$0.86 to \$4.95/m²

\$0.08 to \$0.46/ft²

Average \$2.58/m² or \$0.24/ft²

Source: BC Hydro Power Smart

PAYBACK PERIOD

1.4 to 2.6 years

Average 1.7 years

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

OVERVIEW OF THE EBCx PROCESS

DELIVERABLES

1

PLANNING

- Owner selects a building and generates benchmarking score¹
- Owner selects EBCx provider and identifies team
- Owner and provider define project objectives
- Provider conducts interviews and performs walk through

EBCx Plan

2

INVESTIGATION

- Provider reviews facility documentation
- Provider performs diagnostic monitoring and testing
- Provider and owner prioritize and select EBCx improvements

Findings Log

Investigation Report

3

IMPLEMENTATION

- Provider, building staff, or contractors implement selected operational improvements
- Provider verifies results

Implementation Plan

Implementation Report

4

HAND-OFF

- Provider recommends persistence strategies
- Provider conducts staff training
- Provider holds hand-off meeting

EBCx Final Report



CASE STUDY

TORONTO AREA OFFICE TOWER

During the investigation phase of a EBCx project in an office tower in the Greater Toronto Area, the EBCx provider and building operators found two building pumps operating in parallel. The system was designed for one pump to supply the load, with the other serving as a back-up. Both pumps were equipped with variable frequency drives, but the VFDs were in an override condition and the two pumps were operating simultaneously. The operators shut down the back-up pump, re-engaged the VFD on the primary pump, and returned the system to its design condition. This no-cost, operational change led to \$2,900 in annual electricity savings.

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

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

DOCUMENTATION

Accessible, up-to-date building documentation saves money and solves problems!

WHAT DOCUMENTATION WILL YOUR EBCx PROVIDER NEED?

- Utility data (at least 36 months)
- Complete plans and specifications (as-built drawings and updates)
- Operations/systems manuals
- Maintenance logs
- Control system documentation
- Equipment lists, with nameplate information
- Reports for testing, adjusting and balancing
- Shop drawings
- Previous energy studies

HOW WILL THE INFORMATION BE USED?

- To understand the designer's intent
- To detect integration issues
- To identify known issues
- To spot major energy consumers
- To target investigation activities

Good documentation



Less effort



Lower cost

THE EBCx PROCESS: ELEMENTS AND SUCCESS FACTORS



PHASE 1 - PLANNING

EBCx PLAN

The EBCx plan is prepared by the EBCx provider over the course of the planning phase. It 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 for the EBCx process.

The EBCx plan should include:

- General building information and owner contact information
- Goals and scope of the project
- Brief building and system descriptions, including a list of systems that will be investigated
- Energy balance (summary by energy source)
- Description of energy systems and observations
- List of systems and equipment targeted
- Investigation scope and methods
- List of team members and division of tasks
- List of deliverables
- Implementation phase requirements
- Project hand-off
- Description of the communication, reporting and management protocols
- Timeline and cost of investigation
- Schedule (for primary tasks)
- Documentation requests
- Current facility requirements (CFR)
 - e.g., comfort, temperature and humidity, air quality and operational requirements (such as schedules)

PHASE 1 SUCCESS FACTORS

1. Identify the building's current operational requirements. These will provide the baseline for all EBCx work.
2. Clearly indicate in the EBCx plan the owner's project objectives, including non-energy objectives such as addressing complaints, reducing maintenance calls, or improving air quality.
3. The EBCx plan should use the same system and equipment nomenclature/tags as those used in the building and in the BAS/BMS (if applicable).
4. Include operational staff in walk throughs and other investigation activities.

The CFR document is central to the EBCx process. It is typically prepared by the EBCx provider and approved by the building owner.

PHASE 2 - INVESTIGATION

FINDINGS LOG

Scope of document: The findings log summarizes all the measures identified during the investigation

It should contain:

- Unique identifier for each measure
- Observation that led to the measure and references to all related documents (e.g., functional tests)
- Description of proposed measure/solution
- Recommendation for implementation (and by whom)
- Planned energy savings
- Impact on power
- Annual cost savings
- Estimated implementation cost and payback period

INVESTIGATION REPORT

Scope of document: The investigation report describes the observations, measurements and tests conducted during the investigation

It should contain:

- Presentation of site and facilities
- Building documentation review
- Current facility requirements
- Energy analysis
- Findings log
- Summary of the investigation:
 - List of pre-functional checks
 - List of monitoring plans
 - List of functional tests
 - Summary of on-site observations
 - List of measures already implemented

The owner should request that the savings calculations be included in the Findings Log.

PHASE 2 SUCCESS FACTORS

1. The investigation phase often spans one heating season (winter), one shoulder season, and one cooling season, depending on analyses to be conducted (e.g., heating, air conditioning).
2. If the documentation is poor or incomplete, especially in terms of mechanical and control systems, EBCx costs may increase. The provider must take the time to gather and/or re-create this crucial information to evaluate system performance.
3. Easy-to-use documentation is essential for savings persistence in an EBCx project.

The investigation report should focus on meeting the CFR, as well as on cost and energy savings and payback period.

PHASE 3 - IMPLEMENTATION

IMPLEMENTATION PLAN

Scope: The implementation plan details how the work will be performed.

It should contain:

- Detailed description of measures
 - Scope of work
 - Implementation method
- Expected results
- Verification method
- Implementation sequence
- Estimated implementation cost and payback period

PHASE 3 SUCCESS FACTORS

Communication and collaboration between operations staff, contractors or installers and the EBCx provider are important to ensure that new measures and equipment are tuned and operated to support the CFR.

The implementation plan can be incorporated into the investigation report.

IMPLEMENTATION REPORT

Scope of document: The Implementation report details how the work was performed

It should contain:

- Detailed description of measures
 - Scope of work
 - Implementation method
 - Expected results
 - Verification method
- Implementation sequences
- Implementation status
- Implementation summary
- Verification of results
- Future recommendations

The scope of work should be detailed enough to go to tender. In the case of implementation by the owner, it should enable staff to adequately undertake the work.

The implementation report may be integrated into the final EBCx report.

PHASE 4 - HAND OFF

FINAL EBCx REPORT

Scope of document: To ensure that the basic knowledge acquired during the EBCx project is preserved to inform O&M staff and maintain the improvements

It should contain:

- Executive summary
- Current facility requirements
- Implementation report/findings log
 - Brief description of each measure
 - Description of findings
 - Implementation status
 - Implementation summary
 - Verification results
 - Updated estimates of expected savings and costs
- Operations and maintenance plan and persistence strategies
- List of additional measures, subject to further investigation
- Staff training
 - Verify understanding of measures and control sequences
 - Confirm roles and responsibilities
 - Improve ongoing operations and maintenance procedures
- Other documentation, including all functional tests and results, complete documentation of new or modified control sequences for the HVAC and electrical systems

PHASE 4 SUCCESS FACTORS

Project documentation should be accessible and understandable.

Make sure you receive the following:

1. Up-to-date list of building equipment and control-monitoring devices
2. Operation and maintenance (O&M)/systems manuals
3. Control systems data, drawings and HVAC system sequences of operations
4. As-built plans, if modified

Training for operations staff is critical to maintaining performance improvements over time.

Clear, well-documented roles and responsibilities for building managers and staff ensure that savings persist through staffing changes.



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